

SEPTEMBER 26, 2022
PROJECT NO: 1807-5430
SENT VIA: EMAIL

City of Pickering
1 The Esplanade South
City of Pickering, ON, L1V 6K7

Attention: Richard Holborn
Director, Engineering Services, City of Pickering

RE: TRANSPORTATION UPDATE LETTER
FILE NO. A05/20 OPA 20-001/P D-5100
2055 BROCK ROAD
CITY OF PICKERING, DURHAM REGION

Dear Richard,

C.F. Crozier & Associates Inc. (Crozier) was retained by Brock Road Duffins Forest Inc. to undertake a Traffic Impact Study (TIS) in support of a Zoning By-Law Amendment (ZBA) and an Official Plan Amendment (OPA) for a residential development located at 2055 Brock Road, in the City of Pickering, Regional Municipality of Durham.

The following submissions were previously prepared in support of the development:

- Traffic Impact Study (Crozier, April 2020)
- Traffic Impact Study Addendum (Crozier, September 2021)

The Transportation Update Letter herein, accompanies the previously submitted TIS Addendum, dated September 2021, summarizes the changes in the most recent Site Plan, as well as addresses the City's most recent comments.

The most recent Site Plan dated September 2022 is attached as **Attachment 1**. The City's most recent comments, including associated responses, is included in **Attachment 2**.

1.0 Development Proposal

The most recent Site Plan prepared by Kohn Partnership Architects Inc. proposes a residential development consisting of a 20-storey tower with 328 residential units, 10 street townhouses and 34 back-to-back townhouses. The development also proposes 514 parking spaces and a full moves site access at Usman Road (south).

The most recent Site Plan dated September 2022 is attached as **Attachment 1**.

Table 1 below outlines the breakdown of the development proposal, as well as changes in the site statistics when compared to the previously submitted studies.

**Table 1
Proposed Development Breakdown (Comparison)**

| Block | April 2020 | September 2021 | September 2022 |
|---|-------------------|-------------------|-------------------|
| Block A Residential Tower High Rise with 4 storey podium | 307 units | 328 units | 328 units |
| Block B Street Townhouse 3 storeys | 9 units | 10 units | 10 units |
| Block C & D Back-to-Back Townhouses 3 storeys | 64 units | 34 units | 34 units |
| Total | 380 units | 372 units | 372 units |
| Parking Spaces | 502 spaces | 513 spaces | 514 spaces |

As shown in **Table 1**, the most recent Site Plan proposes 372 residential units and 514 parking spaces. In comparison to the previous submission, the development proposes an **unchanged** number of residential units and an increase of one (1) parking space.

2.0 Sensitivity Analysis

As mentioned in **Section 4.5** of the previously submitted TIS Addendum (Crozier, September 2021), prior to road widening, significant delays and capacity issues are expected for the southbound left-turn movement at Brock Road and Usman Road (south). As such, it is expected that a portion of residents and regular commuters who are familiar with the area will alternatively choose to make the southbound left-turn at the signalized intersection of Brock Road and Major Oaks Road/Usman Road (north).

2.1 Brock Road at Major Oaks Road/Usman Road (North) – 50% SBL

In the previous TIS Addendum, a sensitivity analysis was prepared to review the operations of Brock Road at Major Oaks Road/Usman Road (north), and Brock Road at Usman Road (south), if 50% of the southbound left-turn traffic at Brock Road and Usman Road (south), did so at Brock Road and Major

Oaks Road/Usman Road (north) instead. These results are outlined in **Table 2** below.

As road widening is recommended by 2029 and the intersection of Brock Road and Usman Road (south) operates acceptably post-road widening, the analysis is reviewed only for 2024 future background and future total volumes **without road widening**. The analysis has been conservatively conducted for the Friday Mid-day peak hour as this peak period yielded the highest delays and the highest theoretical volume-to-capacity ratio based on the 2024 future background and future total operations outlined in the previously submitted TIS Addendum (Crozier, September 2021).

Table 2
2024 Future Total Level of Service: 50% SBL at Major Oaks Road/Usman Road (North)

| Intersection | Control | Peak Hour | Level of Service ¹ | Control Delay | Maximum V/C Ratios ² |
|--|---------------------------------------|----------------|-------------------------------|---------------|---------------------------------|
| Brock Road (RR1) at Major Oaks Road/Usman Road (north) | Signalized (Reconfigured & Optimized) | Friday Mid-day | E | 67.4 s | 1.15 (NBT) |
| Brock Road (RR1) at Usman Road (south) | One-Way Stop Controlled | Friday Mid-day | B | 14.9 s | 0.86 (SBL) |

Note 1: The Level of Service of a signalized intersection is based on the average control delay per vehicle. The level of Service of a stop-controlled intersection is based on the minor (stopped) approach control delay per vehicle.

Note 2: The critical v/c ratio is considered to be the maximum v/c ratio at the intersection. All v/c ratios greater than 0.90 are outlined and highlighted.

As shown above in **Table 2**, the intersection of Brock Road at Major Oaks/Usman Road (north) is expected to continue to operate at an unchanged level of service (LOS) "E" during the Friday Mid-day peak hour despite the expected additional southbound left-turning vehicles. When compared to the future total operations outlined in **Table 13** of the previous TIS Addendum (September 2021), the intersection is expected to operate with a minor, but acceptable, increase in control delay of 11.5 seconds and a minor increase in maximum theoretical volume-to-capacity ratio of 0.05.

The intersection of Brock Road and Usman Road (south) is expected to continue to operate at an unchanged LOS "B" with an unchanged control delay of 14.9 seconds during the Friday Mid-day peak hour. The intersection is expected to operate with a maximum volume-to-capacity ratio of 0.86, a material improvement from 1.72 as previously shown in **Table 13** of the previous TIS Addendum.

As such, if regular commuters of the area choose to avoid the unsignalized intersection of Brock Road and Usman Road (south) by making the southbound left-turn at the signalized intersection of Brock Road and Major Oaks Road/Usman Road (north), the intersection is expected to continue to operate acceptably with no additional improvements required prior to Brock Road widening.

2.2 Brock Road at Major Oaks Road/Usman Road (North) – 100% SBL

Per the City of Pickering comments dated July 2022, the above sensitivity analysis was updated for the scenario in which 100% of the southbound left-turning traffic at Brock Road and Usman Road (south), did so at Brock Road and Major Oaks Road/Usman Road (north) instead.

Based on observed site conditions in September 2022, the intersection of Brock Road (RR1) and Usman

Road (south) is still configured as left-in right-in right-out. As such, this analysis can be considered conservative as it is unlikely that all southbound left-turn maneuvers would take place at the intersection of Brock Road (RR1) and Major Oaks Road/Usman Road (north). Instead, it is anticipated that a portion of southbound left-turns will continue to be made at the unsignalized intersection of Brock Road (RR1) and Usman Road (south), as shown above in **Section 2.1**.

The revised sensitivity analysis is outlined in **Table 3** below.

Table 3
2024 Future Level of Service: 100% SBL at Major Oaks Road/Usman Road (north)

| Intersection | Control | Peak Hour | Level of Service ¹ | Control Delay | Maximum V/C Ratios ² |
|--|---------------------------------------|----------------|-------------------------------|---------------|---------------------------------|
| Future Background | | | | | |
| Brock Road (RR1) at Major Oaks Road/Usman Road (north) | Signalized (Reconfigured & Optimized) | Friday Mid-day | E | 75.1 s | 1.19 (NBT) |
| Brock Road (RR1) at Usman Road (south) | One-Way Stop Controlled | Friday Mid-day | B | 14.4 s | 0.63 (NBT) |
| Future Total | | | | | |
| Brock Road (RR1) at Major Oaks Road/Usman Road (north) | Signalized (Reconfigured & Optimized) | Friday Mid-day | F | 87.2 s | 1.23 (NBT) |
| Brock Road (RR1) at Usman Road (south) | One-Way Stop Controlled | Friday Mid-day | B | 14.9 s | 0.63 (NBT) |

Note 1: The Level of Service of a signalized intersection is based on the average control delay per vehicle. The level of Service of a stop-controlled intersection is based on the minor (stopped) approach control delay per vehicle.

Note 2: The critical v/c ratio is considered to be the maximum v/c ratio at the intersection. All v/c ratios greater than 0.90 are outlined and highlighted.

Note 3: Lost time adjustments and/or left-turns during intergreen were not accounted for.

As shown above in **Table 3**, the intersection of Brock Road at Major Oaks/Usman Road (north) is expected to operate at a level of service "F" during the Friday Mid-day peak hour under future total sensitivity conditions. The intersection is expected to operate with a maximum control delay of 87.2 seconds or less, and maximum theoretical volume-to-capacity ratio of 1.23 or less. When compared to the future background sensitivity conditions, the intersection is expected to experience an increase in control delay of 12.1 seconds and a minor increase of maximum volume-to-control ratio of 0.04.

The intersection of Brock Road and Usman Road (south) is expected to continue to operate at an unchanged level of service "B" with a control delay of 14.9 seconds during the Friday Mid-day peak hour under future total sensitivity conditions. The intersection is expected to operate with a reduced maximum volume-to-capacity ratio of 0.63, a material improvement from 1.72 under future total conditions as outlined in the previous submission.

Detailed capacity analyses are included in **Attachment 3**.

2.3 Conservative Assumptions

As the southbound left-turn movement at Brock Road and Usman Road (south) is not proposed to be removed, the analysis above is considered conservative. The analysis represents the upper bound scenario, where all southbound left-turn traffic is to be conducted at Brock Road and Major Oaks Road/Usman Road (north). Nonetheless, based on **Table 3** operations outlined above, both intersections are expected to continue to operate comparably to the boundary road network's existing and future background traffic conditions.

The above analysis in **Section 2.2** and **2.3** can also be considered conservative as existing Peak Hour Factors (PHF) of 0.84 and 0.90 were applied to the intersections of Brock Road and Major Oaks Road/Usman Road (north), and Brock Road and Usman Road (south), respectively, for all future analysis per previous Region staff request. As peak hour traffic flow typically becomes more uniformly distributed as traffic approaches capacity, the above analysis may also be considered conservative from this perspective.

Furthermore, it is noted that left-turns during intergreen (or lost time adjustments) were not accounted for in the analysis above. Based on typical peak hour traffic conditions, an average of 1 to 2 left-turning vehicles may proceed during the amber and all red phases, representing an increase in left-turn capacity of approximately 32-65 vehicles per peak hour. Thus, once again, the analysis above may be considered conservative. Similar to the previously submitted TIS, an analysis considering a lost time adjustment of 3.0 seconds is outlined in **Section 2.4** below.

Lastly, the traffic conditions herein, are based on the Friday Mid-day peak hour volumes. As Friday Mid-day is not typically associated with peak hour trip generation for residential developments, the above analysis can once again be considered conservative.

As the operations outlined herein are considered conservative, typical for urban arterial roadways, and are consistent with existing and future background operations of other intersections in the boundary road network, additional background warranted interim improvements (prior to Brock Road widening) are not required.

2.4 Sensitivity Analysis with Lost Time Adjustments

Table 4 below outlines the 2024 Future Total Level of Service of Brock Road and Major Oaks Road/Usman Road (north) with 100% southbound left-turns and lost time adjustments applied to account for left-turns during the intergreen period.

Table 4
2024 Future Total Level of Service: 100% SBL at Major Oaks Road/Usman Road (north)
With Lost Time Adjustments

| Intersection | Control | Peak Hour | Level of Service ¹ | Control Delay | Maximum V/C Ratios ² |
|--|--|----------------|-------------------------------|---------------|---------------------------------|
| Brock Road (RR1) at Major Oaks Road/Usman Road (north) | Signalized (Reconfigured & Optimized with Lost Time) | Friday Mid-day | E | 77.3 s | 1.18 (NBT) |

Note 1: The Level of Service of a signalized intersection is based on the average control delay per vehicle. The level of Service of a stop-controlled intersection is based on the minor (stopped) approach control delay per vehicle.

Note 2: The critical v/c ratio is considered to be the maximum v/c ratio at the intersection. All v/c ratios greater than 0.90 are outlined and highlighted.

With lost time adjustments applied, the intersection is expected to operate at a level of service “E” during the Friday Mid-day peak hour under future total sensitivity conditions. The intersection is expected to operate with a reduced maximum control delay of 77.3 seconds or less, and maximum theoretical volume-to-capacity ratio of 1.18 or less. These peak hour operations are typical for an urban arterial roadway and are consistent with other intersection operations in the boundary road network, thus, once again, additional background warranted interim improvements (prior to Brock Road widening) are not required.

3.0 Vehicle Turning Diagrams

As required by Durham Region Waste Management Services, a 13-metre centerline radius has been provided along the drive aisle, where waste collection vehicles are expected. Per discussion with the proponent, waste collection for the development will exclusively take place at the Block A loading spaces.

Based on the updated Vehicle Turning Diagrams, no operational issues are expected for waste collection vehicles, delivery vehicles (i.e., MSU), and fire trucks.

The updated Vehicle Turning Diagrams are included in **Attachment 4**.

4.0 Pavement Marking and Signage Plan

A Pavement Marking and Signage Plan will be prepared at the Site Plan Application stage.

5.0 Comment Response

Comment responses are included as **Attachment 2** of this letter. It is noted that Region of Durham comments are still outstanding and will be addressed at a later date.

Per City staff request, the previous Trip Distribution and Assignment traffic volume figures have been included as **Attachment 5**. It is noted that these figures are associated with the base trip assignment reviewed in **Section 5.0** of the previously submitted TIS Addendum (Crozier, September 2021).

6.0 Conclusions

The revised Site Plan proposes a residential development with 372 units, unchanged in comparison to the previous submission. Thus, the previous traffic operational analysis remains valid and is not updated herein.

The City of Pickering's comments as of July 20, 2022, are addressed herein. The Region of Durham comments are still outstanding and will be addressed at a later date.

We trust that this review addresses any transportation related concerns with the project. Should you have any questions or require any further information, please do not hesitate to contact the undersigned.

Respectfully submitted by,

C.F. CROZIER & ASSOCIATES INC.



Martin Chan, P.Eng.
Project Engineer, Transportation

C.F. CROZIER & ASSOCIATES INC.



My-Linh Yee, BEng.
Engineering Intern, Transportation

Enclosed

Attachment 1: Site Plan

Attachment 2: Comment Response Matrix

Attachment 3: Detailed Capacity Analyses

Attachment 4: Vehicle Turning Diagrams

Attachment 5: Trip Distribution & Assignment Figures

/MY/KH

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ATTACHMENT 1

Site Plan

| SITE STATISTICS | |
|--|----------------------------------|
| BUILDING & SITE INFORMATION: | |
| ZONING DESIGNATION | RH/MUJ_3_OS-HL |
| LOT AREA | 13,115.2sqm (3.24 AC) (1.3 ha) |
| LOT FRONTAGE | 72.2m |
| LOT DEPTH | 209.79m |
| PROPOSED GFA | 30,389sqm (325,812sf) |
| PERMITTED DENSITY (units per hectare) | 140 (182) |
| PROPOSED DENSITY (units per hectare) | 286 |
| POPS AREA MIN (5% SITE AREA) | 660.7m |
| COVERAGE | |
| BUILDING COVERAGE | ...sm (...% of lot area) |
| PAVING (HARDSCAPING) | ...sm (...% of lot area) |
| LANDSCAPING (SOFTSCAPING) | ...sm (...% of lot area) |
| No. OF STOREYS (TOWER): 20 STOREYS | |
| HEIGHT (TOWER): 62m | |
| GROSS FLOOR AREA | |
| BACK TO BACK TH | 2,160sqm (23,250sf) |
| BLOCK C | 3,059sqm (33,034sf) |
| TOWNHOUSES | 1,849sqm (19,902sf) |
| TOWER | 23,121sqm (249,625sf) |
| TOTAL: | 372 |
| AMENITY SPACES (INDOOR/OUTDOOR) FOR APARTMENT DWELLINGS | |
| INDOOR AMENITY AREA = 2sqm/UNIT | OUTDOOR AMENITY AREA = 2sqm/UNIT |
| INDOOR REQUIRED: 744 sqm | OUTDOOR REQUIRED: 744 sqm |
| INDOOR PROPOSED: 830 sqm | OUTDOOR PROPOSED: 1193 sqm |
| LEVEL 1 LOBBY: 234sqm (2517sf) | POPS: 660.7sqm (7112sf) |
| LEVEL 1 AMENITY: 121sqm (1301sf) | LEVEL 5 AMENITY: 473sqm (5094sf) |
| LEVEL 5 MIDRISE AMENITY: 211sqm (2271sf) | TERRACE: 265sqm (2835sf) |
| LEVEL 5 TOWER AMENITY: 265sqm (2835sf) | |
| NOTE: POPS IS INCLUDED IN OUTDOOR AMENITY SPACE | |

| PARKING SPACE RATES: AS PER OLD ZONING BY-LAW 7065-10 | | | |
|---|-------------|-------------|-------------|
| MULTIPLE DWELLING VERTICAL USES TENANT - 1 SPACE PER UNIT | | | |
| MULTIPLE DWELLING VERTICAL USES VISITOR - 0.25 SPACE PER UNIT | | | |
| MULTIPLE DWELLING HORIZONTAL USES TENANT - 2 SPACES PER UNIT | | | |
| MULTIPLE DWELLING HORIZONTAL USES VISITOR - 0.25 SPACE PER UNIT | | | |
| PARKING SPACES: | | REQUIRED | PROPOSED |
| STALL DIMENSION | 2.6m x 5.3m | 2.6m x 5.3m | 2.6m x 5.3m |
| DRIVE AISLE WIDTH | 6.5m | 6.5m | 6.5m |
| MULTIPLE DWELLING VERTICAL USES (TENANT+VISITOR) 410 SPACES 410 SPACES | | | |
| MULTIPLE DWELLING HORIZONTAL USES (TENANT+VISITOR) 99 SPACES 99 SPACES | | | |
| SUBTOTAL 509 SPACES 514 SPACES | | | |
| BICYCLE PARKING SPACE RATES | | | |
| APARTMENT DWELLING PARKING RATES | | | |
| BICYCLE PARKING NOT REQUIRED | | | |
| NOTE: WHERE THE NUMBER OF BICYCLE PARKING SPACES EXCEEDS 50 SPACES, A MIN OF 25% OF THE TOTAL REQUIRED MUST BE WITHIN AN ENCLOSED AREA | | | |
| BICYCLE PARKING SPACES: | | REQUIRED | PROPOSED |
| APARTMENT DWELLINGS | 0 | 366 | 366 |
| TOTAL SPACES | 0 | 366 | 366 |
| INDOOR STORAGE (25% MIN) | 366 | | |
| OUTDOOR STORAGE | 0 | | |
| NOTE: ALL INDOOR BICYCLE PARKING WILL BE LOCATED IN THE UNDERGROUND PARKING GARAGE | | | |

| RESIDENTIAL STORAGE LOCKERS | |
|---|------------------------|
| TOTAL LOCKERS: | 290 |
| LOADING SPACE RATES (BASED ON ZONING BY-LAW 7553/17) | |
| RESIDENTIAL LOADING SPACE IS 3.5m x 12m x 4.2m | |
| LOADING SPACES: | |
| REQUIRED | PROPOSED |
| RESIDENTIAL: | 2 |
| SURVEY INFORMATION | |
| PLAN SURVEY OF PART OF LOT 18, CONCESSION 2 | |
| REGISTERED PLAN 29297 | |
| CITY OF PICKERING | |
| PREPARED BY: VERMADEN STUBBSFIELD HARTLEY BREWER BEZARE INC. 944 OTTAWA STREET WINDSOR ON T: 519-258-1772 | |
| LEGEND | |
| --- | COMPLETE OWNERSHIP |
| --- | EXTENTS OF DEVELOPMENT |



Kohn
Kohn Partnership Architects Inc.
116 Spadina Avenue, Suite 501, Toronto ON M5V 2K6
Tel 416.703.6700 www.kohnarchitects.com

ALL DIMENSIONS ARE GIVEN IN METRES UNLESS OTHERWISE INDICATED.
DO NOT SCALE DRAWINGS.
CONTRACTOR SHALL VERIFY AND CHECK ALL DIMENSIONS AND CONDITIONS ON SITE PRIOR TO STARTING ANY OF THE WORK AND REPORT ANY DISCREPANCY TO THE ARCHITECT AND CORRECT THEM BEFORE PROCEEDING. CONSTRUCTION MUST CONFORM TO ALL APPLICABLE CODES AND REQUIREMENTS OF AUTHORITIES HAVING JURISDICTION PERTAINING TO THIS APPLICATION.
THE ARCHITECT BEARS NO RESPONSIBILITY FOR THE INTERPRETATION OF THESE DOCUMENTS BY THE CONTRACTOR. UPON WRITTEN APPLICATION THE ARCHITECT WILL PROVIDE WRITTEN OR GRAPHIC CLARIFICATION AS SUPPLEMENTARY INFORMATION REGARDING THE INTENT OF THE CONTRACT DOCUMENTS.
LOCATIONS OF EXPOSED MECHANICAL OR ELECTRICAL DEVICES, FITTINGS AND FIXTURES ARE INDICATED ON ARCHITECTURAL DRAWINGS WHICH SHALL GOVERN OVER THE MECHANICAL AND ELECTRICAL DRAWINGS. THOSE ITEMS NOT CLEARLY LOCATED TO BE LOCATED AS DIRECTED BY THE ARCHITECT.
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ISSUE DATES AND DISTRIBUTION

| No. | Date | Note |
|-----|------------|-----------------------------|
| 1 | 2019-08-28 | ISSUED FOR COORDINATION |
| 2 | 2019-10-30 | ISSUED FOR COORDINATION |
| 3 | 2019-11-21 | ISSUED FOR COORDINATION |
| 4 | 2020-02-20 | ISSUED FOR COORDINATION |
| 5 | 2020-03-03 | ISSUED FOR COORDINATION |
| 6 | 2020-03-10 | ISSUED FOR COORDINATION |
| 7 | 2020-04-03 | ISSUED FOR ZBA #1 |
| 8 | 2021-04-02 | ISSUED FOR COORDINATION |
| 9 | 2022-02-07 | ISSUED FOR ZBA RESUBMISSION |

SITE PLAN SYMBOL AND SIGN LEGEND:

| | |
|---|---|
| ▲ | PRINCIPLE ENTRANCE (FOR FIRE FIGHTING) |
| ▲ | ENTRANCE TO RETAIL OR GRADE RELATED RES. UNIT |
| ▲ | CATCH BASIN (REFER TO CIVIL DWGS.) |
| ▲ | AREA DRAIN (REFER TO CIVIL DWGS.) |
| ▲ | TRENCH DRAIN (REFER TO CIVIL DWGS.) |
| ▲ | MANHOLE (REFER TO CIVIL DWGS.) |
| ▲ | FIRE HYDRANT |
| ▲ | SIAMSESE (STANDPIPE) CONNECTION |
| ▲ | ACCESSIBLE PARKING SIGNAGE |
| ▲ | FIRE ROUTE SIGNAGE |
| ▲ | LIGHT STANDARD (EXTERIOR POLE FIXTURE) |
| ▲ | WALL MOUNTED EXTERIOR LIGHT FIXTURE |
| ▲ | ACCESSIBLE CURB CUT |
| ▲ | BARRIER FREE PARKING SPACE |

PROJECT NORTH TRUE NORTH SEA

2055 BROCK ROAD
BROCK RD DUFFINS FOREST INC.

PICKERING ON

Drawing Title:
ENLARGED SITE PLAN & STATISTICS

Project Manager Team: ES
Date Plotted: 2022-09-22 6:36:31 PM
Building No.:

Project No.: 17-119
Scale: As indicated
Drawing No.:

A1 01

SITE PLAN
SCALE: 1 : 250
1
A1 01

ATTACHMENT 2

Comment Response Matrix

| Department/Agency | Comment | Crozier Response |
|---|--|--|
| <p>City of Pickering – Engineering Services</p> <p>Traffic Comments dated June 23, 2022</p> <p>Richard Holborn Director, Engineering Services</p> | <p>Table 2 of the Transportation Impact Study (TIS) Addendum dated September 2021 shows that the posted speed limit for Major Oaks Road is 50 km/hour. Revise this to 40 km/hr.</p> | <p>Noted. This a typo and does not affect the conclusions of the report.</p> |
| | <p>Section 12 of the TIS recommends a list of interim improvements for 2024, regarding the signal timing. The Region of Durham has recently added an advance green signal timing for the southbound left traffic on the Major Oaks Road and Usman Road intersection. Please contact the Region and update the traffic report accordingly.</p> | <p>Noted. The ‘existing’ condition is not updated as the report reflects the ‘existing’ traffic operations at the time of the initial report.</p> <p>The future conditions are also not updated as the TIS reflects the optimal signal timing plan for the projected volumes in the future horizon year. The Region’s recently revised signal timing plan would have to be further optimized to the signal timings outlined in the TIS, in the future horizon year.</p> <p>It is also noted that based on a site visit on September 24th, 2022, no advanced green signal was observed for the southbound left traffic at the Major Oaks Road and Usman Road intersection.</p> <p>Finally, as concluded in the TIS, the site generated traffic does not materially change future traffic operations. Thus, regardless of the recently revised Region’s signal timing plan, the conclusions of the TIS do not change.</p> |
| | <p>As per Section 12 of the TIS, a traffic signal is recommended at the Brock Road and Usman Road intersection for the to provide pedestrian and cyclist crossing opportunity across Brock Road. The city is supportive of adding a signal at this location due to the high volume of pedestrian crossing the road. However, the signalization of this intersection is under the jurisdiction of the Region of Durham.</p> | <p>Per discussion with Durham Region staff, an internal meeting will be held to discuss the signalization of Brock Road and Usman Road (south). Correspondence with the Region has been included following this matrix.</p> |

| Department/Agency | Comment | Crozier Response |
|--|---|---|
| | Provide an Autoturn diagram for all the proposed design vehicles including a fire truck. | Vehicle Turning Diagrams were previously provided as part of the TIS. Nevertheless, updated Vehicle Turning Diagrams were prepared per the latest Site Plan. The Vehicle Turning Diagrams are included as Attachment 4 . |
| | Show the proposed road widths, radiuses and the access width on the proposed plans. | Noted. |
| | Shows the proposed signage on the proposed plans. | A Pavement Marking and Signage Plan will be provided during the Site Plan Application process. |
| | A sightline review should be provided at the proposed access. | A sight distance assessment was provided in Section 8.0 of the previously submitted TIS Addendum (Crozier, September 2021). |
| City of Pickering City Development Department – Transportation Impact Study Comments as of July 20, 2022 | <p>Several area residents expressed concerns that existing traffic levels along Usman Road are already high and the proposal will only worsen the existing traffic issues experienced along this roadway.</p> <p>Additionally on February 22, 2021 City Council adopted a motion requesting:</p> <ol style="list-style-type: none"> 1. That the Region of Durham consider the expedited approval and installation of full traffic and pedestrian signals at the intersection of Brock Road (RR#1) and the southern leg of Usman Road in place of the existing left in, right in and right out only access; 2. That the installation of signals be completed prior to the beginning of construction of the new development in order to address construction traffic from having to drive through the existing neighbourhood. | <p>The previous submissions concluded that the site generated traffic is not expected to materially change future traffic operations.</p> <p>Per discussion with the Durham Region staff, an internal meeting will be held to discuss the signalization of Brock Road and Usman Road (south). Correspondence with the Region has been included following this matrix.</p> |

| Department/Agency | Comment | Crozier Response |
|-------------------|---|---|
| | <p>A Transportation Impact Study (TIS) Addendum, prepared by Crozier Consulting Engineers, dated September 2021, was submitted in support of the proposed development. The study undertook a signal warrant analysis for the signalization of the Brock Road/Usman Road intersection, which determined that a signal is not warranted under 2029 future total conditions based on the OTM Book 12 guidelines. Although not warranted under OTM Book 12 conditions, the TIS outlined that signalization could provide benefits, such as pedestrian and cycling crossing opportunity across Brock Road.</p> | <p>Noted.</p> |
| | <p>The City's Engineering Services Department has reviewed the submitted TIS Addendum and have outlined the City is supportive of the signalization of the Brock Road/Usman Road (south) intersection due to high pedestrian volume crossing the road. However, Engineering Services identified signalization of this intersection is under the jurisdiction of the Region of Durham.</p> | <p>Per discussion with the Durham Region staff, an internal meeting will be held to discuss the signalization of Brock Road and Usman Road (south). Correspondence with the Region has been included following this matrix.</p> |

| Department/Agency | Comment | Crozier Response |
|-------------------|--|---|
| | <p>The TIS also noted that it is expected that regular commuters will choose to make a southbound left turn at the signalized intersection of Brock Road at Major Oaks/Usman Road (north) rather than Brock Road at Usman Road (south) to avoid delays. A sensitivity analysis confirms that in the case that 50% of the southbound left-turning traffic at Brock Road and Usman Road (south) turns at Brock Road and Major Oaks/Usman Road (north) instead, the intersection still operates acceptably with no additional improvements required. Please revise the TIS to recognize all (100%) of vehicles making a southbound left turn will utilize the Brock Road at Major Oaks/Usman Road (north), given the Brock Road and Usman Road (south) is limited to a northbound right turn only.</p> <p>Please also provide a summary as a part of the Trip Generation/Distribution section of the report which provides a summary on how many outbound trips during the AM/PM/Friday Mid-Day Peak hours are anticipated to travel north on Usman Road to the Brock Road and Major Oaks/Usman Road (north) and west to the Brock Road and Usman Road (south) from the subjects lands.</p> <hr/> <p>Comments have not yet been received by the Region of Durham, however, in light of Council’s motion, the findings of the TIS and comments received from the City’s Engineering Services Department, City staff request the applicant engage the Region of Durham regarding the feasibility of the signalization of the Brock Road/Usman Road intersection.</p> | <p>The sensitivity analysis was updated to reflect 100% of vehicles making a southbound left turn will utilize Brock Road at Major Oaks/Usman Road (north) and is included in Section 2.0 of the Transportation Update Letter.</p> <p>It is unclear whether the City/Region intends to remove the southbound left-in from Brock Road to Usman Road (south). Based on a site visit on September 24th, 2022, the intersection of Brock Road and Usman Road (south) is configured as a left-in-right-in-right-out. Nevertheless, we have provided analysis of 100% of southbound left-turns occurring at Brock Road and Major Oaks/Usman Road (north). This analysis is considered conservative, as it is not expected that 100% of trips will make the southbound left-turn at Brock Road and Major Oaks/Usman Road (north).</p> <p>The previously submitted TIS (Crozier, September 2021) included trip distribution and trip assignment figures. The trip distribution and trip assignment figures are attached in Attachment 5.</p> <hr/> <p>Per discussion with the Durham Region staff, an internal meeting will be held to discuss the signalization of Brock Road and Usman Road (south). Correspondence with the Region has been included following this matrix.</p> |

Kierra Harper

From: Amanda Spencer <Amanda.Spencer@Durham.ca>
Sent: Thursday, September 8, 2022 8:42 AM
To: Kierra Harper
Cc: Steven Kemp; Lynda Motschenbacher; Joel Walker
Subject: FW: 2055 Brock Road - Brock and Usman Signalization

Hi Kierra,

A letter will be sent today to the City of Pickering responding to their Council resolution to install a traffic control signal at the subject intersection. We would like to give the City of Pickering an opportunity to comment and discuss these plans prior to giving any direction on proposed traffic control at Brock/Usman South.

I apologize for the delay.

Regards,
Amanda

From: Lynda Motschenbacher <Lynda.Motschenbacher@Durham.ca>
Sent: September 7, 2022 4:07 PM
To: Amanda Spencer <Amanda.Spencer@Durham.ca>
Subject: FW: 2055 Brock Road - Brock and Usman Signalization

Hi Amanda,

I hope that you had a great summer and great vacation! Would you be able to contact Kierra, she's been trying to contact someone in Traffic the last few weeks.

Thanks

Lynda

From: Kierra Harper <kharper@cfcrozier.ca>
Sent: September 7, 2022 2:35 PM
To: Lynda Motschenbacher <Lynda.Motschenbacher@Durham.ca>
Cc: Michael Linton <mlinton@cfcrozier.ca>; Martin Chan <mchan@cfcrozier.ca>; My-Linh Yee <myee@cfcrozier.ca>
Subject: RE: 2055 Brock Road - Brock and Usman Signalization

Hi Lynda,

I hope you are doing well and enjoyed the long weekend.

Have you had any luck reaching anyone to help us with our inquiry regarding the Region's position on signalization at Brock Road and Usman Road?

Feel free to give me a call if that is easier.

Thanks,
Kierra

Kierra Harper, EIT | Engineering Intern
211 Yonge Street, Suite 600 | Toronto, ON M5B 1M4
T: 416.477.3392



Crozier Connections: [f](#) [t](#) [in](#) [i](#)

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From: Kierra Harper
Sent: Wednesday, August 31, 2022 2:37 PM
To: Lynda Motschenbacher <Lynda.Motschenbacher@Durham.ca>
Cc: Michael Linton <mlinton@cfcrozier.ca>; Martin Chan <mchan@cfcrozier.ca>; My-Linh Yee <myee@cfcrozier.ca>
Subject: RE: 2055 Brock Road - Brock and Usman Signalization

Thanks Lynda, really appreciate your help on this!

Kierra

From: Lynda Motschenbacher <Lynda.Motschenbacher@Durham.ca>
Sent: Wednesday, August 31, 2022 1:57 PM
To: Kierra Harper <kharper@cfcrozier.ca>
Subject: RE: 2055 Brock Road - Brock and Usman Signalization

Hi Kierra,

Sorry it has been so crazy busy this summer and then vacations on top of that. I'll try to reach someone for you.

Thanks for your patience.

Lynda

From: Kierra Harper <kharper@cfcrozier.ca>
Sent: August 31, 2022 1:51 PM
To: Lynda Motschenbacher <Lynda.Motschenbacher@Durham.ca>
Cc: Michael Linton <mlinton@cfcrozier.ca>; Martin Chan <mchan@cfcrozier.ca>; My-Linh Yee <myee@cfcrozier.ca>
Subject: FW: 2055 Brock Road - Brock and Usman Signalization

Hi Lynda,

I hope you are doing well.

I was wondering if you could reach out to Amanda or Joel on my behalf or refer me to someone else in the Traffic and Operations Division to proceed with this inquiry. I tried reaching out to Amanda and Joel by email and voicemail and have not heard back.

Any help to get this moving along would be greatly appreciated!

Thanks,
Kierra

Kierra Harper, EIT | Engineering Intern
211 Yonge Street, Suite 600 | Toronto, ON M5B 1M4
T: 416.477.3392



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From: Kierra Harper
Sent: Tuesday, August 30, 2022 2:16 PM
To: 'Amanda Spencer' <Amanda.Spencer@Durham.ca>; 'Joel Walker' <Joel.Walker@Durham.ca>
Cc: Michael Linton <mlinton@cfcrozier.ca>; Martin Chan <mchan@cfcrozier.ca>; My-Linh Yee <myee@cfcrozier.ca>
Subject: RE: 2055 Brock Road - Brock and Usman Signalization

Hi Amanda, Joel,

Just called you both and left voicemails. I am just following up on the emails below regarding the Region's position on the signalization of Brock Road and Usman Road.

Feel free to call me back or respond here.

Thanks,
Kierra

From: Kierra Harper
Sent: Monday, August 22, 2022 10:42 AM
To: Amanda Spencer <Amanda.Spencer@Durham.ca>; Joel Walker <Joel.Walker@Durham.ca>
Cc: Michael Linton <mlinton@cfcrozier.ca>; Martin Chan <mchan@cfcrozier.ca>; My-Linh Yee <myee@cfcrozier.ca>
Subject: RE: 2055 Brock Road - Brock and Usman Signalization

Hi Amanda, Joel,

Just following up on my emails below.

Thanks,
Kierra

From: Kierra Harper
Sent: Friday, August 19, 2022 8:47 AM
To: Amanda Spencer <Amanda.Spencer@Durham.ca>; Joel Walker <Joel.Walker@Durham.ca>
Cc: Michael Linton <mlinton@cfcrozier.ca>; Martin Chan <mchan@cfcrozier.ca>; My-Linh Yee <myee@cfcrozier.ca>
Subject: RE: 2055 Brock Road - Brock and Usman Signalization

Hi Amanda, Joel,

I hope you are doing well.

I have been referred to you regarding my email below (also attached). We are inquiring about the Region's position on the signalization of Brock Road and Usman Road.

Could you advise on the Region's stance on this signalization issue?

Thanks,
Kierra

From: Lynda Motschenbacher <Lynda.Motschenbacher@Durham.ca>
Sent: Thursday, August 18, 2022 3:30 PM
To: Kierra Harper <kharp@cfcrozier.ca>
Cc: Amanda Spencer <Amanda.Spencer@Durham.ca>; Joel Walker <Joel.Walker@Durham.ca>
Subject: RE: 2055 Brock Road - Brock and Usman Signalization

Hi Keirra,

You can contact Amanda Spencer or Joel Walker in the Traffic and Operations division.

Regards,

Lynda

From: Kierra Harper <kharp@cfcrozier.ca>
Sent: August 18, 2022 3:12 PM
To: Lynda Motschenbacher <Lynda.Motschenbacher@Durham.ca>
Cc: Glyn Reedman <Glyn.Reedman@Durham.ca>; Michael Linton <mlinton@cfcrozier.ca>; Martin Chan <mchan@cfcrozier.ca>; My-Linh Yee <myee@cfcrozier.ca>
Subject: RE: 2055 Brock Road - Brock and Usman Signalization

Hi Lynda,

Just following up on the below emails. Is there someone in the Traffic and Operations Division I can follow up with about this?

Thanks,
Kierra

Kierra Harper, EIT | Engineering Intern
211 Yonge Street, Suite 600 | Toronto, ON M5B 1M4
T: 416.477.3392



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From: Lynda Motschenbacher <Lynda.Motschenbacher@Durham.ca>
Sent: Thursday, August 11, 2022 1:57 PM
To: Kierra Harper <kharper@cfcrozier.ca>; Glyn Reedman <Glyn.Reedman@Durham.ca>
Cc: Michael Linton <mlinton@cfcrozier.ca>; Martin Chan <mchan@cfcrozier.ca>; My-Linh Yee <myee@cfcrozier.ca>
Subject: RE: 2055 Brock Road - Brock and Usman Signalization

Hi Kierra,

The Region's Traffic and Operations Division has been involved with the request for signalization at this intersection, I'll reach out to staff there and have someone contact you.

Regards,

Lynda

From: Kierra Harper <kharper@cfcrozier.ca>
Sent: August 11, 2022 1:45 PM
To: Glyn Reedman <Glyn.Reedman@Durham.ca>; Lynda Motschenbacher <Lynda.Motschenbacher@Durham.ca>
Cc: Michael Linton <mlinton@cfcrozier.ca>; Martin Chan <mchan@cfcrozier.ca>; My-Linh Yee <myee@cfcrozier.ca>
Subject: FW: 2055 Brock Road - Brock and Usman Signalization

Hi Glyn,

Just forwarding the below message to you as I got your contact from Doug's out of office email. Would you be able to respond to our inquiry below?

Thanks,
Kierra

Kierra Harper, EIT | Engineering Intern
211 Yonge Street, Suite 600 | Toronto, ON M5B 1M4
T: 416.477.3392



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From: Kierra Harper

Sent: Wednesday, August 10, 2022 3:39 PM

To: Doug Robertson <Doug.Robertson@Durham.ca>; Lynda.Motschenbacher@Durham.ca

Cc: Michael Linton <mlinton@cfcrozier.ca>; Martin Chan <mchan@cfcrozier.ca>; My-Linh Yee <myee@cfcrozier.ca>

Subject: 2055 Brock Road - Brock and Usman Signalization

Hi Doug, Lynda,

I hope you are both doing well.

I am working on the Transportation Impact Study for the proposed development at 2055 Brock Road and would like to clarify something with you.

You are probably aware that the City of Pickering is supportive of installing a signal at the intersection of Brock Road (RR#1) and the southern leg of Usman Road in place of the existing left in, right in and right out only access. We understand this request would provide an additional pedestrian crossing opportunity between Major Oaks and Finch Ave (particularly with the Brock Ridge Community Park west of Brock Road) and generally improve operations along Major Oaks and Usman. However, the signalization of this intersection is under the jurisdiction of the Region.

Considering the City Council motion requesting that Region of Durham consider the expedited approval and installation of full traffic and pedestrian signals at the intersection of Brock Road and Usman Road, the City has requested that we engage with the Region regarding the feasibility of the signalization. I'm not sure if your team has had further discussion with City staff on this. We understand that the Region has previously had concerns with the installation of a signal at this location given the ultimate 6-lane configuration and possible spacing concerns.

As such, we are looking for a definitive answer from the Region with their position on the signalization of Brock and Usman if possible. You may recall that our TIS did not consider a signal in our primary analysis and would technically not be reliant on it.

Are you able confirm the Region's stance on this signalization issue? Our concern would be having this item in limbo with respect to the current application so any clarification we can provide in response to the City's request would be helpful.

Thank you,
Kierra

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ATTACHMENT 3

Detailed Capacity Analyses



| Movement | WBL | WBR | NBT | NBR | SBL | SBT | |
|-----------------------------------|------|------|-------|------|----------------------|------|------|
| Lane Configurations | | ↗ | ↕ | ↘ | ↙ | ↕ | |
| Traffic Volume (veh/h) | 0 | 85 | 1935 | 282 | 0 | 1139 | |
| Future Volume (Veh/h) | 0 | 85 | 1935 | 282 | 0 | 1139 | |
| Sign Control | Stop | | Free | | | Free | |
| Grade | 0% | | 0% | | | 0% | |
| Peak Hour Factor | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | |
| Hourly flow rate (vph) | 0 | 94 | 2150 | 313 | 0 | 1266 | |
| Pedestrians | 55 | | 7 | | | 1 | |
| Lane Width (m) | 4.5 | | 3.4 | | | 3.4 | |
| Walking Speed (m/s) | 1.2 | | 1.2 | | | 1.2 | |
| Percent Blockage | 6 | | 1 | | | 0 | |
| Right turn flare (veh) | | | | | | | |
| Median type | | | None | | | None | |
| Median storage veh | | | | | | | |
| Upstream signal (m) | | | 367 | | | 225 | |
| pX, platoon unblocked | 0.59 | 0.47 | | | 0.47 | | |
| vC, conflicting volume | 2845 | 1131 | | | 2518 | | |
| vC1, stage 1 conf vol | | | | | | | |
| vC2, stage 2 conf vol | | | | | | | |
| vCu, unblocked vol | 803 | 0 | | | 1964 | | |
| tC, single (s) | 6.8 | 6.9 | | | 4.1 | | |
| tC, 2 stage (s) | | | | | | | |
| tF (s) | 3.5 | 3.3 | | | 2.2 | | |
| p0 queue free % | 100 | 80 | | | 100 | | |
| cM capacity (veh/h) | 181 | 477 | | | 128 | | |
| Direction, Lane # | WB 1 | NB 1 | NB 2 | NB 3 | SB 1 | SB 2 | SB 3 |
| Volume Total | 94 | 1075 | 1075 | 313 | 0 | 633 | 633 |
| Volume Left | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Volume Right | 94 | 0 | 0 | 313 | 0 | 0 | 0 |
| cSH | 477 | 1700 | 1700 | 1700 | 1700 | 1700 | 1700 |
| Volume to Capacity | 0.20 | 0.63 | 0.63 | 0.18 | 0.00 | 0.37 | 0.37 |
| Queue Length 95th (m) | 5.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Control Delay (s) | 14.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Lane LOS | B | | | | | | |
| Approach Delay (s) | 14.4 | 0.0 | | | 0.0 | | |
| Approach LOS | B | | | | | | |
| Intersection Summary | | | | | | | |
| Average Delay | | | 0.4 | | | | |
| Intersection Capacity Utilization | | | 65.8% | | ICU Level of Service | | C |
| Analysis Period (min) | | | 15 | | | | |

Lanes, Volumes, Timings
3: Brock Road & Major Oaks Road/Usman Road

2024 FB Mid-day OPT Interim

09-22-2022

| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBU | NBL | NBT | NBR | SBL | SBT |
|----------------------------|-------|-------|-------|-------|-------|-------|--------|-------|-------|-------|-------|-------|
| Lane Configurations | | | | | | | | | | | | |
| Traffic Volume (vph) | 33 | 12 | 249 | 159 | 25 | 47 | 2 | 280 | 1817 | 24 | 233 | 1010 |
| Future Volume (vph) | 33 | 12 | 249 | 159 | 25 | 47 | 2 | 280 | 1817 | 24 | 233 | 1010 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Lane Width (m) | 3.5 | 3.5 | 3.5 | 3.5 | 3.7 | 3.7 | 3.6 | 3.0 | 3.5 | 3.5 | 3.0 | 3.5 |
| Storage Length (m) | 0.0 | | 30.0 | 20.0 | | 0.0 | | 72.0 | | 70.0 | 60.0 | |
| Storage Lanes | 0 | | 1 | 1 | | 0 | | 1 | | 1 | 1 | |
| Taper Length (m) | 7.5 | | | 48.0 | | | | 72.0 | | | 92.0 | |
| Lane Util. Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.95 | 1.00 | 0.95 | 1.00 | 1.00 | 0.95 |
| Ped Bike Factor | | 0.99 | 0.94 | 0.95 | 0.98 | | | | | 0.95 | | 1.00 |
| Frt | | | 0.850 | | 0.902 | | | | | 0.850 | | 0.997 |
| Flt Protected | | 0.965 | | 0.950 | | | | 0.950 | | | 0.950 | |
| Satd. Flow (prot) | 0 | 1689 | 1566 | 1733 | 1654 | 0 | 0 | 1652 | 3400 | 1597 | 1685 | 3294 |
| Flt Permitted | | 0.741 | | 0.722 | | | | 0.113 | | | 0.075 | |
| Satd. Flow (perm) | 0 | 1286 | 1472 | 1257 | 1654 | 0 | 0 | 196 | 3400 | 1512 | 133 | 3294 |
| Right Turn on Red | | | Yes | | | Yes | | | | Yes | | |
| Satd. Flow (RTOR) | | | 277 | | 56 | | | | | 69 | | 2 |
| Link Speed (k/h) | | 50 | | | 40 | | | | 60 | | | 60 |
| Link Distance (m) | | 292.9 | | | 123.2 | | | | 224.5 | | | 180.3 |
| Travel Time (s) | | 21.1 | | | 11.1 | | | | 13.5 | | | 10.8 |
| Confl. Peds. (#/hr) | 10 | | 37 | 37 | | 10 | | 10 | | 13 | 13 | |
| Peak Hour Factor | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 |
| Heavy Vehicles (%) | 10% | 0% | 2% | 3% | 5% | 2% | 0% | 2% | 5% | 0% | 0% | 8% |
| Adj. Flow (vph) | 39 | 14 | 296 | 189 | 30 | 56 | 2 | 333 | 2163 | 29 | 277 | 1202 |
| Shared Lane Traffic (%) | | | | | | | | | | | | |
| Lane Group Flow (vph) | 0 | 53 | 296 | 189 | 86 | 0 | 0 | 335 | 2163 | 29 | 277 | 1226 |
| Enter Blocked Intersection | No | No | No | No | No | No | No | No | No | No | No | No |
| Lane Alignment | Left | Left | Right | Left | Left | Right | R NA | Left | Left | Right | Left | Left |
| Median Width(m) | | 3.5 | | | 3.5 | | | | 3.3 | | | 3.3 |
| Link Offset(m) | | 0.0 | | | 0.0 | | | | 0.0 | | | 0.0 |
| Crosswalk Width(m) | | 4.8 | | | 4.8 | | | | 4.8 | | | 4.8 |
| Two way Left Turn Lane | | | | | | | | | | | | |
| Headway Factor | 1.01 | 1.01 | 1.01 | 1.01 | 0.99 | 0.99 | 1.00 | 1.09 | 1.01 | 1.01 | 1.09 | 1.01 |
| Turning Speed (k/h) | 25 | | 15 | 25 | | 15 | 15 | 25 | | 15 | 25 | |
| Number of Detectors | 1 | 1 | 1 | 1 | 1 | | 1 | 1 | 0 | 0 | 1 | 0 |
| Detector Template | Left | | | | | | Left | | | | | |
| Leading Detector (m) | 2.0 | 12.0 | 12.0 | 12.0 | 12.0 | | 2.0 | 24.0 | 0.0 | 0.0 | 24.0 | 0.0 |
| Trailing Detector (m) | 0.0 | -3.0 | -3.0 | -3.0 | -3.0 | | 0.0 | 14.0 | 0.0 | 0.0 | 14.0 | 0.0 |
| Detector 1 Position(m) | 0.0 | -3.0 | -3.0 | -3.0 | -3.0 | | 0.0 | 14.0 | 0.0 | 0.0 | 14.0 | 0.0 |
| Detector 1 Size(m) | 2.0 | 15.0 | 15.0 | 15.0 | 15.0 | | 2.0 | 10.0 | 0.6 | 2.0 | 10.0 | 0.6 |
| Detector 1 Type | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex |
| Detector 1 Channel | | | | | | | | | | | | |
| Detector 1 Extend (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Queue (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Delay (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Turn Type | Perm | NA | Perm | Perm | NA | | custom | pm+pt | NA | Perm | pm+pt | NA |
| Protected Phases | | 4 | | | 8 | | | 5 | 2 | | 1 | 6 |
| Permitted Phases | 4 | | 4 | 8 | | | 5 | 2 | | 2 | 6 | |
| Detector Phase | 4 | 4 | 4 | 8 | 8 | | 5 | 5 | 2 | 2 | 1 | 6 |

| Lane Group | SBR |
|----------------------------|-------|
| Lane Configurations | |
| Traffic Volume (vph) | 20 |
| Future Volume (vph) | 20 |
| Ideal Flow (vphpl) | 1900 |
| Lane Width (m) | 3.5 |
| Storage Length (m) | 0.0 |
| Storage Lanes | 0 |
| Taper Length (m) | |
| Lane Util. Factor | 0.95 |
| Ped Bike Factor | |
| Flt | |
| Flt Protected | |
| Satd. Flow (prot) | 0 |
| Flt Permitted | |
| Satd. Flow (perm) | 0 |
| Right Turn on Red | Yes |
| Satd. Flow (RTOR) | |
| Link Speed (k/h) | |
| Link Distance (m) | |
| Travel Time (s) | |
| Confl. Peds. (#/hr) | 10 |
| Peak Hour Factor | 0.84 |
| Heavy Vehicles (%) | 6% |
| Adj. Flow (vph) | 24 |
| Shared Lane Traffic (%) | |
| Lane Group Flow (vph) | 0 |
| Enter Blocked Intersection | No |
| Lane Alignment | Right |
| Median Width(m) | |
| Link Offset(m) | |
| Crosswalk Width(m) | |
| Two way Left Turn Lane | |
| Headway Factor | 1.01 |
| Turning Speed (k/h) | 15 |
| Number of Detectors | |
| Detector Template | |
| Leading Detector (m) | |
| Trailing Detector (m) | |
| Detector 1 Position(m) | |
| Detector 1 Size(m) | |
| Detector 1 Type | |
| Detector 1 Channel | |
| Detector 1 Extend (s) | |
| Detector 1 Queue (s) | |
| Detector 1 Delay (s) | |
| Turn Type | |
| Protected Phases | |
| Permitted Phases | |
| Detector Phase | |

Lanes, Volumes, Timings
 3: Brock Road & Major Oaks Road/Usman Road

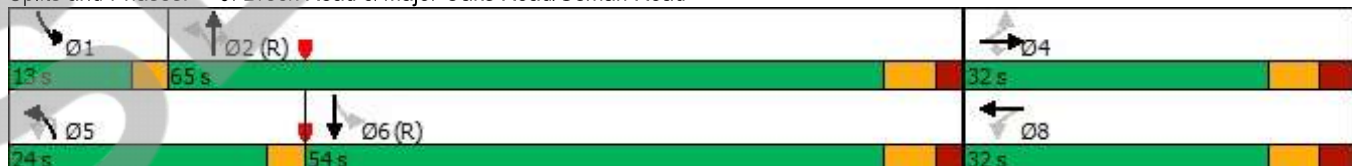


| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBU | NBL | NBT | NBR | SBL | SBT |
|---------------------------|-------|-------|-------|-------|-------|-----|-------|-------|-------|-------|-------|-------|
| Switch Phase | | | | | | | | | | | | |
| Minimum Initial (s) | 8.0 | 8.0 | 8.0 | 4.0 | 4.0 | | 5.0 | 5.0 | 20.0 | 20.0 | 5.0 | 20.0 |
| Minimum Split (s) | 32.0 | 32.0 | 32.0 | 32.0 | 32.0 | | 8.0 | 8.0 | 29.0 | 29.0 | 9.5 | 29.0 |
| Total Split (s) | 32.0 | 32.0 | 32.0 | 32.0 | 32.0 | | 24.0 | 24.0 | 65.0 | 65.0 | 13.0 | 54.0 |
| Total Split (%) | 29.1% | 29.1% | 29.1% | 29.1% | 29.1% | | 21.8% | 21.8% | 59.1% | 59.1% | 11.8% | 49.1% |
| Maximum Green (s) | 25.0 | 25.0 | 25.0 | 25.0 | 25.0 | | 21.0 | 21.0 | 58.6 | 58.6 | 10.0 | 47.6 |
| Yellow Time (s) | 4.1 | 4.1 | 4.1 | 4.1 | 4.1 | | 3.0 | 3.0 | 4.2 | 4.2 | 3.0 | 4.2 |
| All-Red Time (s) | 2.9 | 2.9 | 2.9 | 2.9 | 2.9 | | 0.0 | 0.0 | 2.2 | 2.2 | 0.0 | 2.2 |
| Lost Time Adjust (s) | | 0.0 | 0.0 | 0.0 | 0.0 | | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Lost Time (s) | | 7.0 | 7.0 | 7.0 | 7.0 | | | 3.0 | 6.4 | 6.4 | 3.0 | 6.4 |
| Lead/Lag | | | | | | | Lead | Lead | Lag | Lag | Lead | Lag |
| Lead-Lag Optimize? | | | | | | | Yes | Yes | Yes | Yes | Yes | Yes |
| Vehicle Extension (s) | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |
| Recall Mode | None | None | None | None | None | | None | None | C-Max | C-Max | None | C-Max |
| Walk Time (s) | 7.0 | 7.0 | 7.0 | 7.0 | 7.0 | | | | 7.0 | 7.0 | | 7.0 |
| Flash Dont Walk (s) | 18.0 | 18.0 | 18.0 | 18.0 | 18.0 | | | | 14.0 | 14.0 | | 14.0 |
| Pedestrian Calls (#/hr) | 0 | 0 | 0 | 0 | 0 | | | | 0 | 0 | | 0 |
| Act Effct Green (s) | | 20.8 | 20.8 | 20.8 | 20.8 | | | 77.1 | 58.6 | 58.6 | 69.9 | 53.1 |
| Actuated g/C Ratio | | 0.19 | 0.19 | 0.19 | 0.19 | | | 0.70 | 0.53 | 0.53 | 0.64 | 0.48 |
| v/c Ratio | | 0.22 | 0.59 | 0.80 | 0.24 | | | 0.84 | 1.19 | 0.03 | 0.98 | 0.77 |
| Control Delay | | 38.1 | 10.8 | 65.9 | 16.8 | | | 42.4 | 119.4 | 0.1 | 81.3 | 29.0 |
| Queue Delay | | 0.0 | 0.0 | 0.0 | 0.0 | | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Delay | | 38.1 | 10.8 | 65.9 | 16.8 | | | 42.4 | 119.4 | 0.1 | 81.3 | 29.0 |
| LOS | | D | B | E | B | | | D | F | A | F | C |
| Approach Delay | | 15.0 | | | 50.6 | | | | 107.8 | | | 38.6 |
| Approach LOS | | B | | | D | | | | F | | | D |

Intersection Summary

Area Type: Other
 Cycle Length: 110
 Actuated Cycle Length: 110
 Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
 Natural Cycle: 150
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 1.19
 Intersection Signal Delay: 75.1
 Intersection Capacity Utilization 96.9%
 Analysis Period (min) 15
 Intersection LOS: E
 ICU Level of Service F

















Splits and Phases: 3: Brock Road & Major Oaks Road/Usman Road



| | |
|-------------------------|-----|
| Lane Group | SBR |
| Switch Phase | |
| Minimum Initial (s) | |
| Minimum Split (s) | |
| Total Split (s) | |
| Total Split (%) | |
| Maximum Green (s) | |
| Yellow Time (s) | |
| All-Red Time (s) | |
| Lost Time Adjust (s) | |
| Total Lost Time (s) | |
| Lead/Lag | |
| Lead-Lag Optimize? | |
| Vehicle Extension (s) | |
| Recall Mode | |
| Walk Time (s) | |
| Flash Dont Walk (s) | |
| Pedestrian Calls (#/hr) | |
| Act Effct Green (s) | |
| Actuated g/C Ratio | |
| v/c Ratio | |
| Control Delay | |
| Queue Delay | |
| Total Delay | |
| LOS | |
| Approach Delay | |
| Approach LOS | |
| Intersection Summary | |






















HCM Unsignalized Intersection Capacity Analysis
2: Brock Road & Usman Road

2024 FT Mid-day OPT
09-22-2022

| |  |  |  |  |  |  |  |
|-----------------------------------|---|---|--|---|---|--|--|
| Movement | WBL | WBR | NBT | NBR | SBL | SBT | |
| Lane Configurations | |  |   |  |  |   |   |
| Traffic Volume (veh/h) | 0 | 101 | 1935 | 342 | 0 | 1177 | |
| Future Volume (Veh/h) | 0 | 101 | 1935 | 342 | 0 | 1177 | |
| Sign Control | Stop | | Free | | | Free | |
| Grade | 0% | | 0% | | | 0% | |
| Peak Hour Factor | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | |
| Hourly flow rate (vph) | 0 | 112 | 2150 | 380 | 0 | 1308 | |
| Pedestrians | 55 | | 7 | | | 1 | |
| Lane Width (m) | 4.5 | | 3.4 | | | 3.4 | |
| Walking Speed (m/s) | 1.2 | | 1.2 | | | 1.2 | |
| Percent Blockage | 6 | | 1 | | | 0 | |
| Right turn flare (veh) | | | | | | | |
| Median type | | | None | | | None | |
| Median storage veh | | | | | | | |
| Upstream signal (m) | | | 367 | | | 225 | |
| pX, platoon unblocked | 0.60 | 0.47 | | | 0.47 | | |
| vC, conflicting volume | 2866 | 1131 | | | 2585 | | |
| vC1, stage 1 conf vol | | | | | | | |
| vC2, stage 2 conf vol | | | | | | | |
| vCu, unblocked vol | 737 | 0 | | | 2108 | | |
| tC, single (s) | 6.8 | 6.9 | | | 4.1 | | |
| tC, 2 stage (s) | | | | | | | |
| tF (s) | 3.5 | 3.3 | | | 2.2 | | |
| p0 queue free % | 100 | 77 | | | 100 | | |
| cM capacity (veh/h) | 202 | 477 | | | 113 | | |
| Direction, Lane # | WB 1 | NB 1 | NB 2 | NB 3 | SB 1 | SB 2 | SB 3 |
| Volume Total | 112 | 1075 | 1075 | 380 | 0 | 654 | 654 |
| Volume Left | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Volume Right | 112 | 0 | 0 | 380 | 0 | 0 | 0 |
| cSH | 477 | 1700 | 1700 | 1700 | 1700 | 1700 | 1700 |
| Volume to Capacity | 0.23 | 0.63 | 0.63 | 0.22 | 0.00 | 0.38 | 0.38 |
| Queue Length 95th (m) | 7.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Control Delay (s) | 14.9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Lane LOS | B | | | | | | |
| Approach Delay (s) | 14.9 | 0.0 | | | 0.0 | | |
| Approach LOS | B | | | | | | |
| Intersection Summary | | | | | | | |
| Average Delay | | | 0.4 | | | | |
| Intersection Capacity Utilization | | | 66.7% | | ICU Level of Service | | C |
| Analysis Period (min) | | | 15 | | | | |

Lanes, Volumes, Timings
3: Brock Road & Major Oaks Road/Usman Road

2024 FT Mid-day OPT
09-22-2022

| |  |  |  |  |  |  |  |  |  |  |  |  |
|----------------------------|---|---|---|---|---|---|--|---|---|---|---|---|
| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBU | NBL | NBT | NBR | SBL | SBT |
| Lane Configurations | |  |  |  |  | | |  |  |  |  |  |
| Traffic Volume (vph) | 33 | 12 | 249 | 197 | 25 | 47 | 2 | 280 | 1833 | 24 | 259 | 1036 |
| Future Volume (vph) | 33 | 12 | 249 | 197 | 25 | 47 | 2 | 280 | 1833 | 24 | 259 | 1036 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Lane Width (m) | 3.5 | 3.5 | 3.5 | 3.5 | 3.7 | 3.7 | 3.6 | 3.0 | 3.5 | 3.5 | 3.0 | 3.5 |
| Storage Length (m) | 0.0 | | 30.0 | 20.0 | | 0.0 | | 72.0 | | 70.0 | 60.0 | |
| Storage Lanes | 0 | | 1 | 1 | | 0 | | 1 | | 1 | 1 | |
| Taper Length (m) | 7.5 | | | 48.0 | | | | 72.0 | | | 92.0 | |
| Lane Util. Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.95 | 1.00 | 0.95 | 1.00 | 1.00 | 0.95 |
| Ped Bike Factor | | 0.99 | 0.94 | 0.95 | 0.98 | | | | | 0.95 | | 1.00 |
| Frt | | | 0.850 | | 0.902 | | | | | 0.850 | | 0.997 |
| Flt Protected | | 0.965 | | 0.950 | | | | 0.950 | | | 0.950 | |
| Satd. Flow (prot) | 0 | 1689 | 1566 | 1733 | 1654 | 0 | 0 | 1652 | 3400 | 1597 | 1685 | 3294 |
| Flt Permitted | | 0.751 | | 0.722 | | | | 0.098 | | | 0.077 | |
| Satd. Flow (perm) | 0 | 1303 | 1472 | 1257 | 1654 | 0 | 0 | 170 | 3400 | 1512 | 137 | 3294 |
| Right Turn on Red | | | Yes | | | Yes | | | | Yes | | |
| Satd. Flow (RTOR) | | | 246 | | 56 | | | | | 69 | | 2 |
| Link Speed (k/h) | | 50 | | | 40 | | | | 60 | | | 60 |
| Link Distance (m) | | 292.9 | | | 123.2 | | | | 224.5 | | | 180.3 |
| Travel Time (s) | | 21.1 | | | 11.1 | | | | 13.5 | | | 10.8 |
| Confl. Peds. (#/hr) | 10 | | 37 | 37 | | 10 | | 10 | | 13 | 13 | |
| Peak Hour Factor | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 |
| Heavy Vehicles (%) | 10% | 0% | 2% | 3% | 5% | 2% | 0% | 2% | 5% | 0% | 0% | 8% |
| Adj. Flow (vph) | 39 | 14 | 296 | 235 | 30 | 56 | 2 | 333 | 2182 | 29 | 308 | 1233 |
| Shared Lane Traffic (%) | | | | | | | | | | | | |
| Lane Group Flow (vph) | 0 | 53 | 296 | 235 | 86 | 0 | 0 | 335 | 2182 | 29 | 308 | 1257 |
| Enter Blocked Intersection | No | No | No | No | No | No | No | No | No | No | No | No |
| Lane Alignment | Left | Left | Right | Left | Left | Right | R NA | Left | Left | Right | Left | Left |
| Median Width(m) | | 3.5 | | | 3.5 | | | | 3.3 | | | 3.3 |
| Link Offset(m) | | 0.0 | | | 0.0 | | | | 0.0 | | | 0.0 |
| Crosswalk Width(m) | | 4.8 | | | 4.8 | | | | 4.8 | | | 4.8 |
| Two way Left Turn Lane | | | | | | | | | | | | |
| Headway Factor | 1.01 | 1.01 | 1.01 | 1.01 | 0.99 | 0.99 | 1.00 | 1.09 | 1.01 | 1.01 | 1.09 | 1.01 |
| Turning Speed (k/h) | 25 | | 15 | 25 | | 15 | 15 | 25 | | 15 | 25 | |
| Number of Detectors | 1 | 1 | 1 | 1 | 1 | | 1 | 1 | 0 | 0 | 1 | 0 |
| Detector Template | Left | | | | | | Left | | | | | |
| Leading Detector (m) | 2.0 | 12.0 | 12.0 | 12.0 | 12.0 | | 2.0 | 24.0 | 0.0 | 0.0 | 24.0 | 0.0 |
| Trailing Detector (m) | 0.0 | -3.0 | -3.0 | -3.0 | -3.0 | | 0.0 | 14.0 | 0.0 | 0.0 | 14.0 | 0.0 |
| Detector 1 Position(m) | 0.0 | -3.0 | -3.0 | -3.0 | -3.0 | | 0.0 | 14.0 | 0.0 | 0.0 | 14.0 | 0.0 |
| Detector 1 Size(m) | 2.0 | 15.0 | 15.0 | 15.0 | 15.0 | | 2.0 | 10.0 | 0.6 | 2.0 | 10.0 | 0.6 |
| Detector 1 Type | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex |
| Detector 1 Channel | | | | | | | | | | | | |
| Detector 1 Extend (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Queue (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Delay (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Turn Type | Perm | NA | Perm | Perm | NA | | custom | pm+pt | NA | Perm | pm+pt | NA |
| Protected Phases | | 4 | | | 8 | | | 5 | 2 | | 1 | 6 |
| Permitted Phases | 4 | | 4 | 8 | | | 5 | 2 | | 2 | 6 | |
| Detector Phase | 4 | 4 | 4 | 8 | 8 | | 5 | 5 | 2 | 2 | 1 | 6 |

| Lane Group | SBR |
|----------------------------|-------|
| Lane Configurations | |
| Traffic Volume (vph) | 20 |
| Future Volume (vph) | 20 |
| Ideal Flow (vphpl) | 1900 |
| Lane Width (m) | 3.5 |
| Storage Length (m) | 0.0 |
| Storage Lanes | 0 |
| Taper Length (m) | |
| Lane Util. Factor | 0.95 |
| Ped Bike Factor | |
| Frt | |
| Flt Protected | |
| Satd. Flow (prot) | 0 |
| Flt Permitted | |
| Satd. Flow (perm) | 0 |
| Right Turn on Red | Yes |
| Satd. Flow (RTOR) | |
| Link Speed (k/h) | |
| Link Distance (m) | |
| Travel Time (s) | |
| Confl. Peds. (#/hr) | 10 |
| Peak Hour Factor | 0.84 |
| Heavy Vehicles (%) | 6% |
| Adj. Flow (vph) | 24 |
| Shared Lane Traffic (%) | |
| Lane Group Flow (vph) | 0 |
| Enter Blocked Intersection | No |
| Lane Alignment | Right |
| Median Width(m) | |
| Link Offset(m) | |
| Crosswalk Width(m) | |
| Two way Left Turn Lane | |
| Headway Factor | 1.01 |
| Turning Speed (k/h) | 15 |
| Number of Detectors | |
| Detector Template | |
| Leading Detector (m) | |
| Trailing Detector (m) | |
| Detector 1 Position(m) | |
| Detector 1 Size(m) | |
| Detector 1 Type | |
| Detector 1 Channel | |
| Detector 1 Extend (s) | |
| Detector 1 Queue (s) | |
| Detector 1 Delay (s) | |
| Turn Type | |
| Protected Phases | |
| Permitted Phases | |
| Detector Phase | |

Lanes, Volumes, Timings
3: Brock Road & Major Oaks Road/Usman Road

2024 FT Mid-day OPT
09-22-2022



| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBU | NBL | NBT | NBR | SBL | SBT |
|---------------------------|-------|-------|-------|-------|-------|-----|-------|-------|-------|-------|-------|-------|
| Switch Phase | | | | | | | | | | | | |
| Minimum Initial (s) | 8.0 | 8.0 | 8.0 | 4.0 | 4.0 | | 5.0 | 5.0 | 20.0 | 20.0 | 5.0 | 20.0 |
| Minimum Split (s) | 32.0 | 32.0 | 32.0 | 32.0 | 32.0 | | 8.0 | 8.0 | 29.0 | 29.0 | 9.5 | 29.0 |
| Total Split (s) | 32.0 | 32.0 | 32.0 | 32.0 | 32.0 | | 22.0 | 22.0 | 64.0 | 64.0 | 14.0 | 56.0 |
| Total Split (%) | 29.1% | 29.1% | 29.1% | 29.1% | 29.1% | | 20.0% | 20.0% | 58.2% | 58.2% | 12.7% | 50.9% |
| Maximum Green (s) | 25.0 | 25.0 | 25.0 | 25.0 | 25.0 | | 19.0 | 19.0 | 57.6 | 57.6 | 11.0 | 49.6 |
| Yellow Time (s) | 4.1 | 4.1 | 4.1 | 4.1 | 4.1 | | 3.0 | 3.0 | 4.2 | 4.2 | 3.0 | 4.2 |
| All-Red Time (s) | 2.9 | 2.9 | 2.9 | 2.9 | 2.9 | | 0.0 | 0.0 | 2.2 | 2.2 | 0.0 | 2.2 |
| Lost Time Adjust (s) | | 0.0 | 0.0 | 0.0 | 0.0 | | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Lost Time (s) | | 7.0 | 7.0 | 7.0 | 7.0 | | | 3.0 | 6.4 | 6.4 | 3.0 | 6.4 |
| Lead/Lag | | | | | | | Lead | Lead | Lag | Lag | Lead | Lag |
| Lead-Lag Optimize? | | | | | | | Yes | Yes | Yes | Yes | Yes | Yes |
| Vehicle Extension (s) | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |
| Recall Mode | None | None | None | None | None | | None | None | C-Max | C-Max | None | C-Max |
| Walk Time (s) | 7.0 | 7.0 | 7.0 | 7.0 | 7.0 | | | | 7.0 | 7.0 | | 7.0 |
| Flash Dont Walk (s) | 18.0 | 18.0 | 18.0 | 18.0 | 18.0 | | | | 14.0 | 14.0 | | 14.0 |
| Pedestrian Calls (#/hr) | 0 | 0 | 0 | 0 | 0 | | | | 0 | 0 | | 0 |
| Act Effct Green (s) | | 23.3 | 23.3 | 23.3 | 23.3 | | | 75.6 | 57.6 | 57.6 | 67.8 | 51.7 |
| Actuated g/C Ratio | | 0.21 | 0.21 | 0.21 | 0.21 | | | 0.69 | 0.52 | 0.52 | 0.62 | 0.47 |
| v/c Ratio | | 0.19 | 0.59 | 0.88 | 0.22 | | | 0.91 | 1.23 | 0.04 | 1.17 | 0.81 |
| Control Delay | | 36.6 | 13.1 | 74.7 | 16.3 | | | 56.3 | 133.3 | 0.1 | 141.6 | 30.9 |
| Queue Delay | | 0.0 | 0.0 | 0.0 | 0.0 | | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Delay | | 36.6 | 13.1 | 74.7 | 16.3 | | | 56.3 | 133.3 | 0.1 | 141.6 | 30.9 |
| LOS | | D | B | E | B | | | E | F | A | F | C |
| Approach Delay | | 16.7 | | | 59.0 | | | | 121.6 | | | 52.7 |
| Approach LOS | | B | | | E | | | | F | | | D |

Intersection Summary

Area Type: Other
 Cycle Length: 110
 Actuated Cycle Length: 110
 Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
 Natural Cycle: 150
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 1.23
 Intersection Signal Delay: 87.2
 Intersection Capacity Utilization 99.2%
 Analysis Period (min) 15
 Intersection LOS: F
 ICU Level of Service F

Splits and Phases: 3: Brock Road & Major Oaks Road/Usman Road



| | |
|-------------------------|-----|
| Lane Group | SBR |
| Switch Phase | |
| Minimum Initial (s) | |
| Minimum Split (s) | |
| Total Split (s) | |
| Total Split (%) | |
| Maximum Green (s) | |
| Yellow Time (s) | |
| All-Red Time (s) | |
| Lost Time Adjust (s) | |
| Total Lost Time (s) | |
| Lead/Lag | |
| Lead-Lag Optimize? | |
| Vehicle Extension (s) | |
| Recall Mode | |
| Walk Time (s) | |
| Flash Dont Walk (s) | |
| Pedestrian Calls (#/hr) | |
| Act Effct Green (s) | |
| Actuated g/C Ratio | |
| v/c Ratio | |
| Control Delay | |
| Queue Delay | |
| Total Delay | |
| LOS | |
| Approach Delay | |
| Approach LOS | |
| Intersection Summary | |

Lanes, Volumes, Timings
3: Brock Road & Major Oaks Road/Usman Road

2024 FT Mid-day OPT, w/ Lost Time
09-26-2022

| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBU | NBL | NBT | NBR | SBL | SBT |
|----------------------------|-------|-------|-------|-------|-------|-------|--------|-------|-------|-------|-------|-------|
| Lane Configurations | | | | | | | | | | | | |
| Traffic Volume (vph) | 33 | 12 | 249 | 197 | 25 | 47 | 2 | 280 | 1833 | 24 | 259 | 1036 |
| Future Volume (vph) | 33 | 12 | 249 | 197 | 25 | 47 | 2 | 280 | 1833 | 24 | 259 | 1036 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Lane Width (m) | 3.5 | 3.5 | 3.5 | 3.5 | 3.7 | 3.7 | 3.6 | 3.0 | 3.5 | 3.5 | 3.0 | 3.5 |
| Storage Length (m) | 0.0 | | 30.0 | 20.0 | | 0.0 | | 72.0 | | 70.0 | 60.0 | |
| Storage Lanes | 0 | | 1 | 1 | | 0 | | 1 | | 1 | 1 | |
| Taper Length (m) | 7.5 | | | 48.0 | | | | 72.0 | | | 92.0 | |
| Lane Util. Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.95 | 1.00 | 0.95 | 1.00 | 1.00 | 0.95 |
| Ped Bike Factor | | 0.99 | 0.94 | 0.95 | 0.98 | | | | | 0.95 | | 1.00 |
| Frt | | | 0.850 | | 0.902 | | | | | 0.850 | | 0.997 |
| Flt Protected | | 0.965 | | 0.950 | | | | 0.950 | | | 0.950 | |
| Satd. Flow (prot) | 0 | 1689 | 1566 | 1733 | 1654 | 0 | 0 | 1652 | 3400 | 1597 | 1685 | 3294 |
| Flt Permitted | | 0.751 | | 0.722 | | | | 0.098 | | | 0.073 | |
| Satd. Flow (perm) | 0 | 1303 | 1472 | 1257 | 1654 | 0 | 0 | 170 | 3400 | 1512 | 129 | 3294 |
| Right Turn on Red | | | Yes | | | Yes | | | | Yes | | |
| Satd. Flow (RTOR) | | | 246 | | 56 | | | | | 69 | | 2 |
| Link Speed (k/h) | | 50 | | | 40 | | | | 60 | | | 60 |
| Link Distance (m) | | 292.9 | | | 123.2 | | | | 224.5 | | | 180.3 |
| Travel Time (s) | | 21.1 | | | 11.1 | | | | 13.5 | | | 10.8 |
| Confl. Peds. (#/hr) | 10 | | 37 | 37 | | 10 | | 10 | | 13 | 13 | |
| Peak Hour Factor | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 |
| Heavy Vehicles (%) | 10% | 0% | 2% | 3% | 5% | 2% | 0% | 2% | 5% | 0% | 0% | 8% |
| Adj. Flow (vph) | 39 | 14 | 296 | 235 | 30 | 56 | 2 | 333 | 2182 | 29 | 308 | 1233 |
| Shared Lane Traffic (%) | | | | | | | | | | | | |
| Lane Group Flow (vph) | 0 | 53 | 296 | 235 | 86 | 0 | 0 | 335 | 2182 | 29 | 308 | 1257 |
| Enter Blocked Intersection | No | No | No | No | No | No | No | No | No | No | No | No |
| Lane Alignment | Left | Left | Right | Left | Left | Right | R NA | Left | Left | Right | Left | Left |
| Median Width(m) | | 3.5 | | | 3.5 | | | | 3.3 | | | 3.3 |
| Link Offset(m) | | 0.0 | | | 0.0 | | | | 0.0 | | | 0.0 |
| Crosswalk Width(m) | | 4.8 | | | 4.8 | | | | 4.8 | | | 4.8 |
| Two way Left Turn Lane | | | | | | | | | | | | |
| Headway Factor | 1.01 | 1.01 | 1.01 | 1.01 | 0.99 | 0.99 | 1.00 | 1.09 | 1.01 | 1.01 | 1.09 | 1.01 |
| Turning Speed (k/h) | 25 | | 15 | 25 | | 15 | 15 | 25 | | 15 | 25 | |
| Number of Detectors | 1 | 1 | 1 | 1 | 1 | | 1 | 1 | 0 | 0 | 1 | 0 |
| Detector Template | Left | | | | | | Left | | | | | |
| Leading Detector (m) | 2.0 | 12.0 | 12.0 | 12.0 | 12.0 | | 2.0 | 24.0 | 0.0 | 0.0 | 24.0 | 0.0 |
| Trailing Detector (m) | 0.0 | -3.0 | -3.0 | -3.0 | -3.0 | | 0.0 | 14.0 | 0.0 | 0.0 | 14.0 | 0.0 |
| Detector 1 Position(m) | 0.0 | -3.0 | -3.0 | -3.0 | -3.0 | | 0.0 | 14.0 | 0.0 | 0.0 | 14.0 | 0.0 |
| Detector 1 Size(m) | 2.0 | 15.0 | 15.0 | 15.0 | 15.0 | | 2.0 | 10.0 | 0.6 | 2.0 | 10.0 | 0.6 |
| Detector 1 Type | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex |
| Detector 1 Channel | | | | | | | | | | | | |
| Detector 1 Extend (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Queue (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Delay (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Turn Type | Perm | NA | Perm | Perm | NA | | custom | pm+pt | NA | Perm | pm+pt | NA |
| Protected Phases | | 4 | | | 8 | | | 5 | 2 | | 1 | 6 |
| Permitted Phases | 4 | | 4 | 8 | | | 5 | 2 | | 2 | 6 | |
| Detector Phase | 4 | 4 | 4 | 8 | 8 | | 5 | 5 | 2 | 2 | 1 | 6 |

| Lane Group | SBR |
|----------------------------|-------|
| Lane Configurations | |
| Traffic Volume (vph) | 20 |
| Future Volume (vph) | 20 |
| Ideal Flow (vphpl) | 1900 |
| Lane Width (m) | 3.5 |
| Storage Length (m) | 0.0 |
| Storage Lanes | 0 |
| Taper Length (m) | |
| Lane Util. Factor | 0.95 |
| Ped Bike Factor | |
| Flt | |
| Flt Protected | |
| Satd. Flow (prot) | 0 |
| Flt Permitted | |
| Satd. Flow (perm) | 0 |
| Right Turn on Red | Yes |
| Satd. Flow (RTOR) | |
| Link Speed (k/h) | |
| Link Distance (m) | |
| Travel Time (s) | |
| Confl. Peds. (#/hr) | 10 |
| Peak Hour Factor | 0.84 |
| Heavy Vehicles (%) | 6% |
| Adj. Flow (vph) | 24 |
| Shared Lane Traffic (%) | |
| Lane Group Flow (vph) | 0 |
| Enter Blocked Intersection | No |
| Lane Alignment | Right |
| Median Width(m) | |
| Link Offset(m) | |
| Crosswalk Width(m) | |
| Two way Left Turn Lane | |
| Headway Factor | 1.01 |
| Turning Speed (k/h) | 15 |
| Number of Detectors | |
| Detector Template | |
| Leading Detector (m) | |
| Trailing Detector (m) | |
| Detector 1 Position(m) | |
| Detector 1 Size(m) | |
| Detector 1 Type | |
| Detector 1 Channel | |
| Detector 1 Extend (s) | |
| Detector 1 Queue (s) | |
| Detector 1 Delay (s) | |
| Turn Type | |
| Protected Phases | |
| Permitted Phases | |
| Detector Phase | |

Lanes, Volumes, Timings
 3: Brock Road & Major Oaks Road/Usman Road

2024 FT Mid-day OPT, w/ Lost Time
 09-26-2022

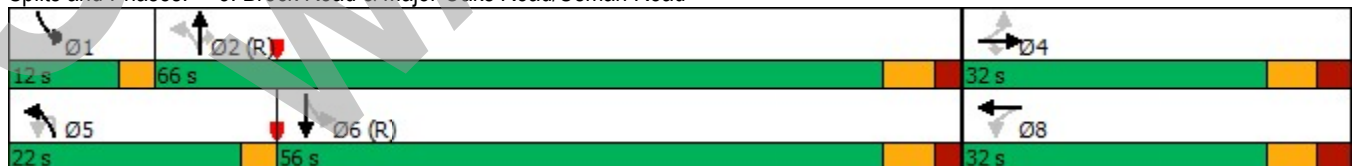
| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBU | NBL | NBT | NBR | SBL | SBT |
|---------------------------|-------|-------|-------|-------|-------|-----|-------|-------|-------|-------|-------|-------|
| Switch Phase | | | | | | | | | | | | |
| Minimum Initial (s) | 8.0 | 8.0 | 8.0 | 4.0 | 4.0 | | 5.0 | 5.0 | 20.0 | 20.0 | 5.0 | 20.0 |
| Minimum Split (s) | 32.0 | 32.0 | 32.0 | 32.0 | 32.0 | | 8.0 | 8.0 | 29.0 | 29.0 | 9.5 | 29.0 |
| Total Split (s) | 32.0 | 32.0 | 32.0 | 32.0 | 32.0 | | 22.0 | 22.0 | 66.0 | 66.0 | 12.0 | 56.0 |
| Total Split (%) | 29.1% | 29.1% | 29.1% | 29.1% | 29.1% | | 20.0% | 20.0% | 60.0% | 60.0% | 10.9% | 50.9% |
| Maximum Green (s) | 25.0 | 25.0 | 25.0 | 25.0 | 25.0 | | 19.0 | 19.0 | 59.6 | 59.6 | 9.0 | 49.6 |
| Yellow Time (s) | 4.1 | 4.1 | 4.1 | 4.1 | 4.1 | | 3.0 | 3.0 | 4.2 | 4.2 | 3.0 | 4.2 |
| All-Red Time (s) | 2.9 | 2.9 | 2.9 | 2.9 | 2.9 | | 0.0 | 0.0 | 2.2 | 2.2 | 0.0 | 2.2 |
| Lost Time Adjust (s) | | 0.0 | 0.0 | 0.0 | 0.0 | | | 0.0 | 0.0 | 0.0 | -3.0 | 0.0 |
| Total Lost Time (s) | | 7.0 | 7.0 | 7.0 | 7.0 | | | 3.0 | 6.4 | 6.4 | 0.0 | 6.4 |
| Lead/Lag | | | | | | | Lead | Lead | Lag | Lag | Lead | Lag |
| Lead-Lag Optimize? | | | | | | | Yes | Yes | Yes | Yes | Yes | Yes |
| Vehicle Extension (s) | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |
| Recall Mode | None | None | None | None | None | | None | None | C-Max | C-Max | None | C-Max |
| Walk Time (s) | 7.0 | 7.0 | 7.0 | 7.0 | 7.0 | | | | 7.0 | 7.0 | | 7.0 |
| Flash Dont Walk (s) | 18.0 | 18.0 | 18.0 | 18.0 | 18.0 | | | | 14.0 | 14.0 | | 14.0 |
| Pedestrian Calls (#/hr) | 0 | 0 | 0 | 0 | 0 | | | | 0 | 0 | | 0 |
| Act Effct Green (s) | | 23.3 | 23.3 | 23.3 | 23.3 | | | 76.0 | 59.6 | 59.6 | 71.7 | 51.7 |
| Actuated g/C Ratio | | 0.21 | 0.21 | 0.21 | 0.21 | | | 0.69 | 0.54 | 0.54 | 0.65 | 0.47 |
| v/c Ratio | | 0.19 | 0.59 | 0.88 | 0.22 | | | 0.91 | 1.18 | 0.03 | 1.11 | 0.81 |
| Control Delay | | 36.6 | 13.1 | 74.7 | 16.3 | | | 56.1 | 114.8 | 0.1 | 119.4 | 30.8 |
| Queue Delay | | 0.0 | 0.0 | 0.0 | 0.0 | | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Delay | | 36.6 | 13.1 | 74.7 | 16.3 | | | 56.1 | 114.8 | 0.1 | 119.4 | 30.8 |
| LOS | | D | B | E | B | | | E | F | A | F | C |
| Approach Delay | | 16.7 | | | 59.0 | | | | 105.7 | | | 48.3 |
| Approach LOS | | B | | | E | | | | F | | | D |

Intersection Summary

Area Type: Other
 Cycle Length: 110
 Actuated Cycle Length: 110
 Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
 Natural Cycle: 150
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 1.18
 Intersection Signal Delay: 77.3
 Intersection Capacity Utilization 99.2%
 Analysis Period (min) 15

Intersection LOS: E
 ICU Level of Service F

Splits and Phases: 3: Brock Road & Major Oaks Road/Usman Road

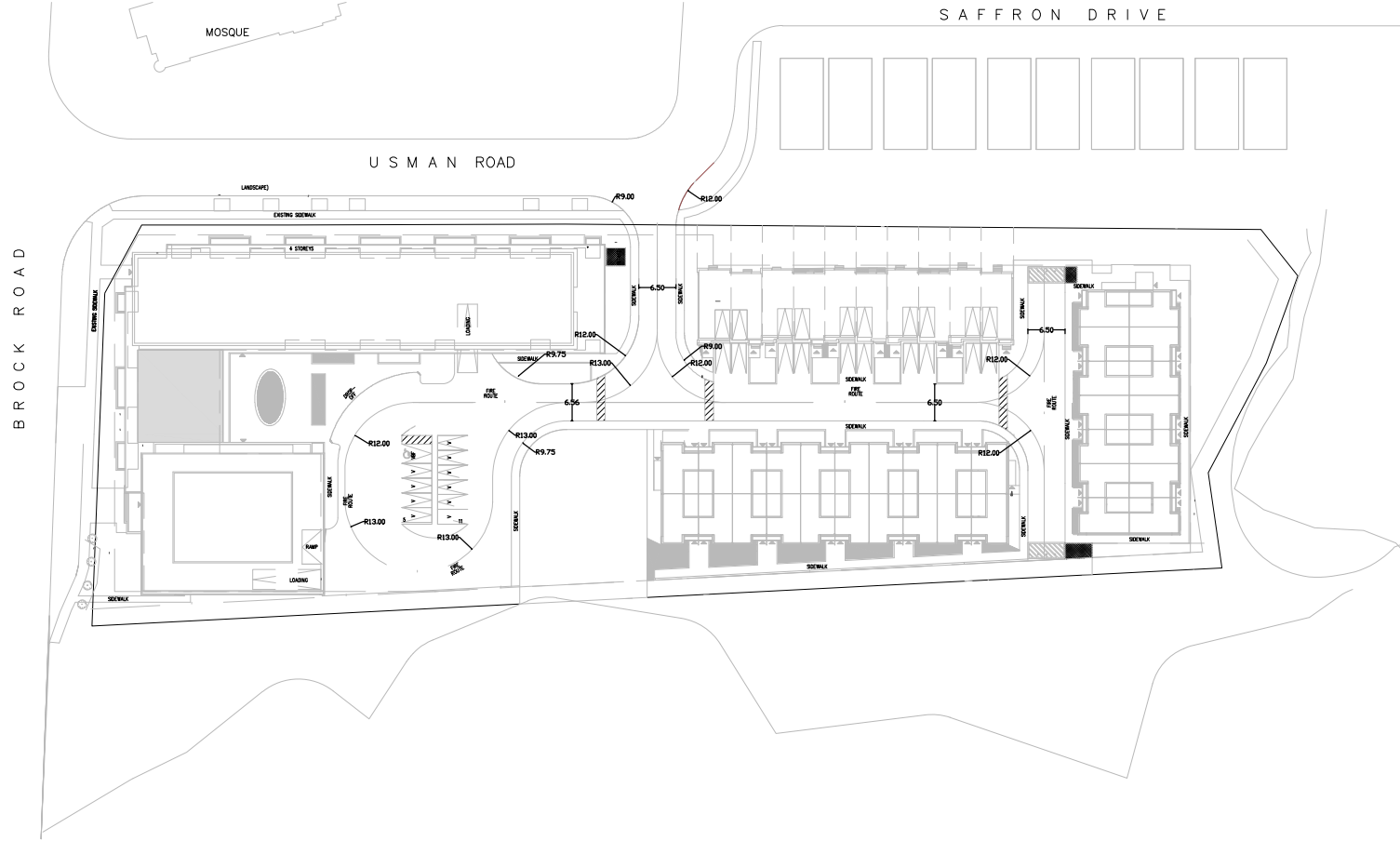


| | |
|-------------------------|-----|
| Lane Group | SBR |
| Switch Phase | |
| Minimum Initial (s) | |
| Minimum Split (s) | |
| Total Split (s) | |
| Total Split (%) | |
| Maximum Green (s) | |
| Yellow Time (s) | |
| All-Red Time (s) | |
| Lost Time Adjust (s) | |
| Total Lost Time (s) | |
| Lead/Lag | |
| Lead-Lag Optimize? | |
| Vehicle Extension (s) | |
| Recall Mode | |
| Walk Time (s) | |
| Flash Dont Walk (s) | |
| Pedestrian Calls (#/hr) | |
| Act Effct Green (s) | |
| Actuated g/C Ratio | |
| v/c Ratio | |
| Control Delay | |
| Queue Delay | |
| Total Delay | |
| LOS | |
| Approach Delay | |
| Approach LOS | |
| Intersection Summary | |

SENSITIVE
W/ LOST TIME

ATTACHMENT 4

Vehicle Turning Diagrams



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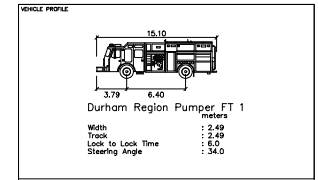
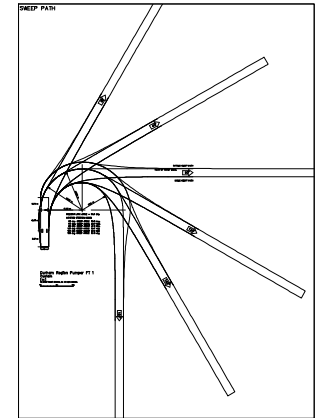
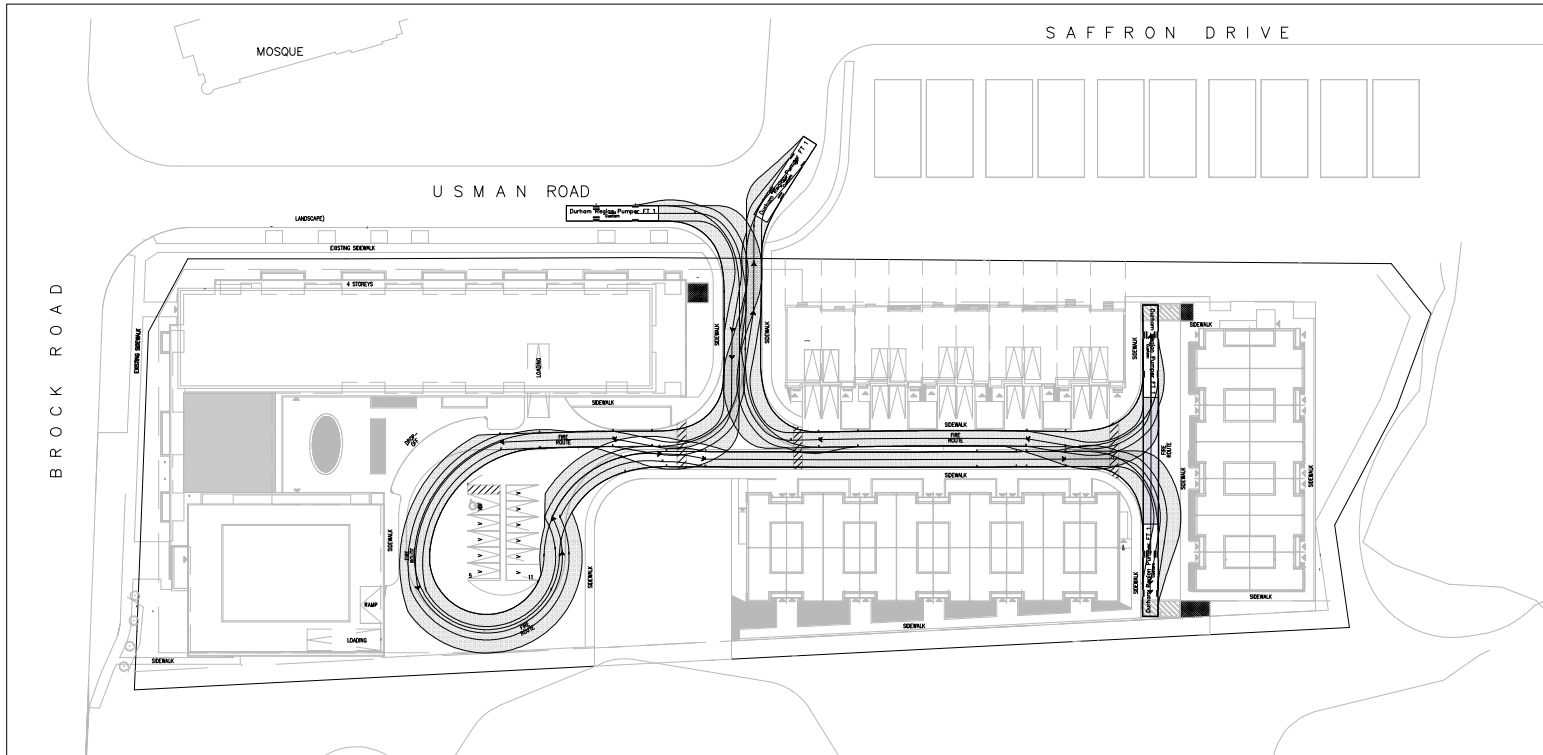
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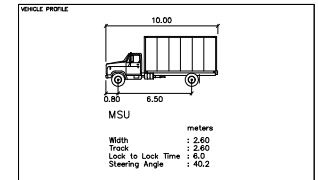
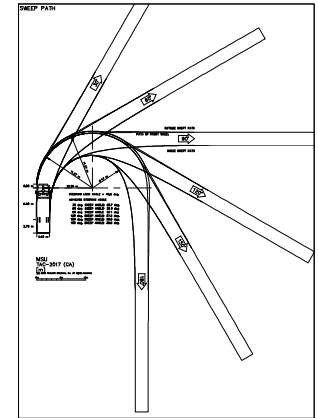
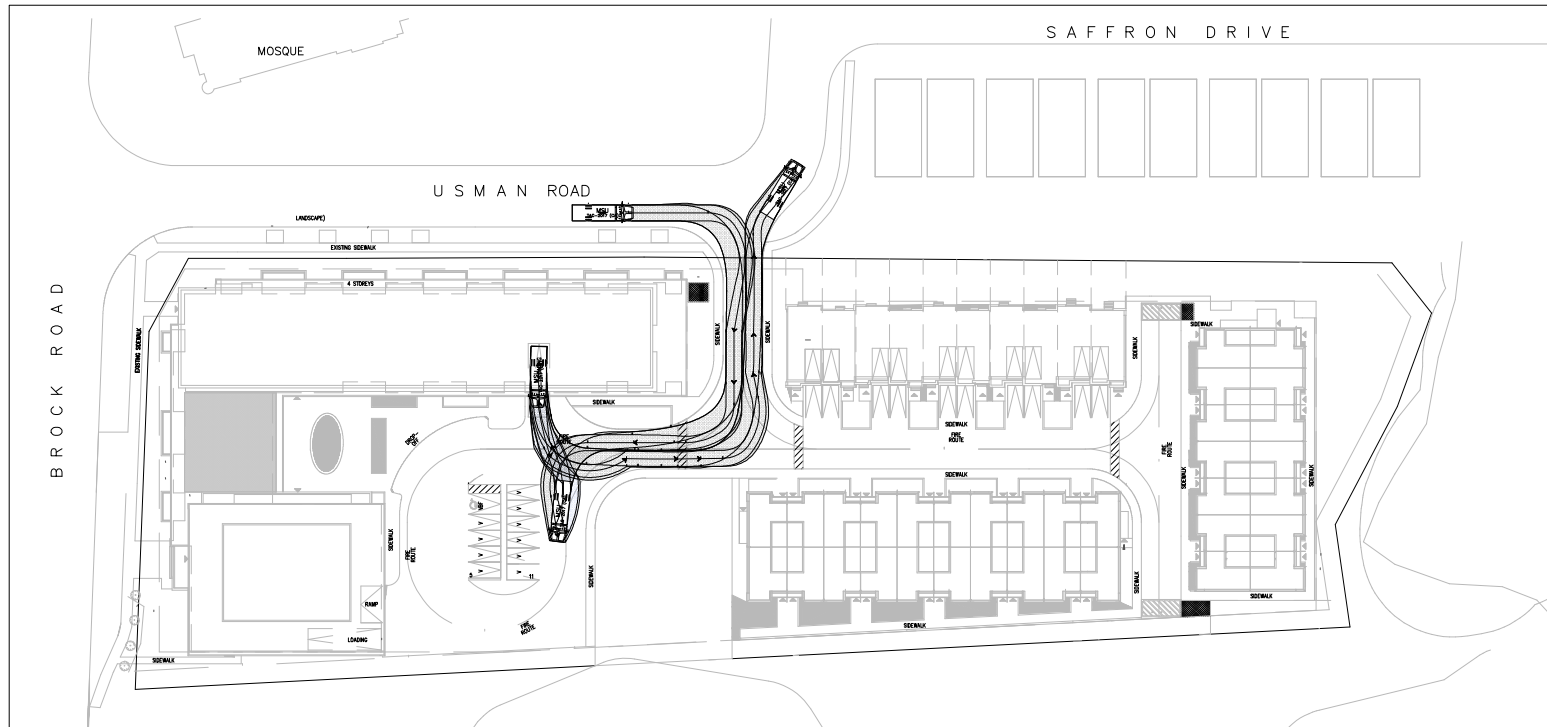


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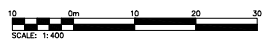
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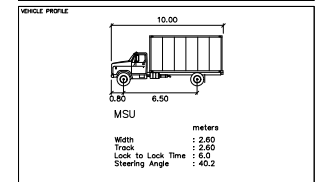
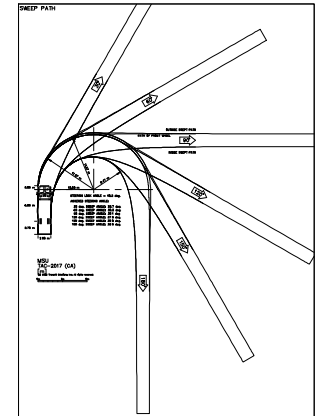
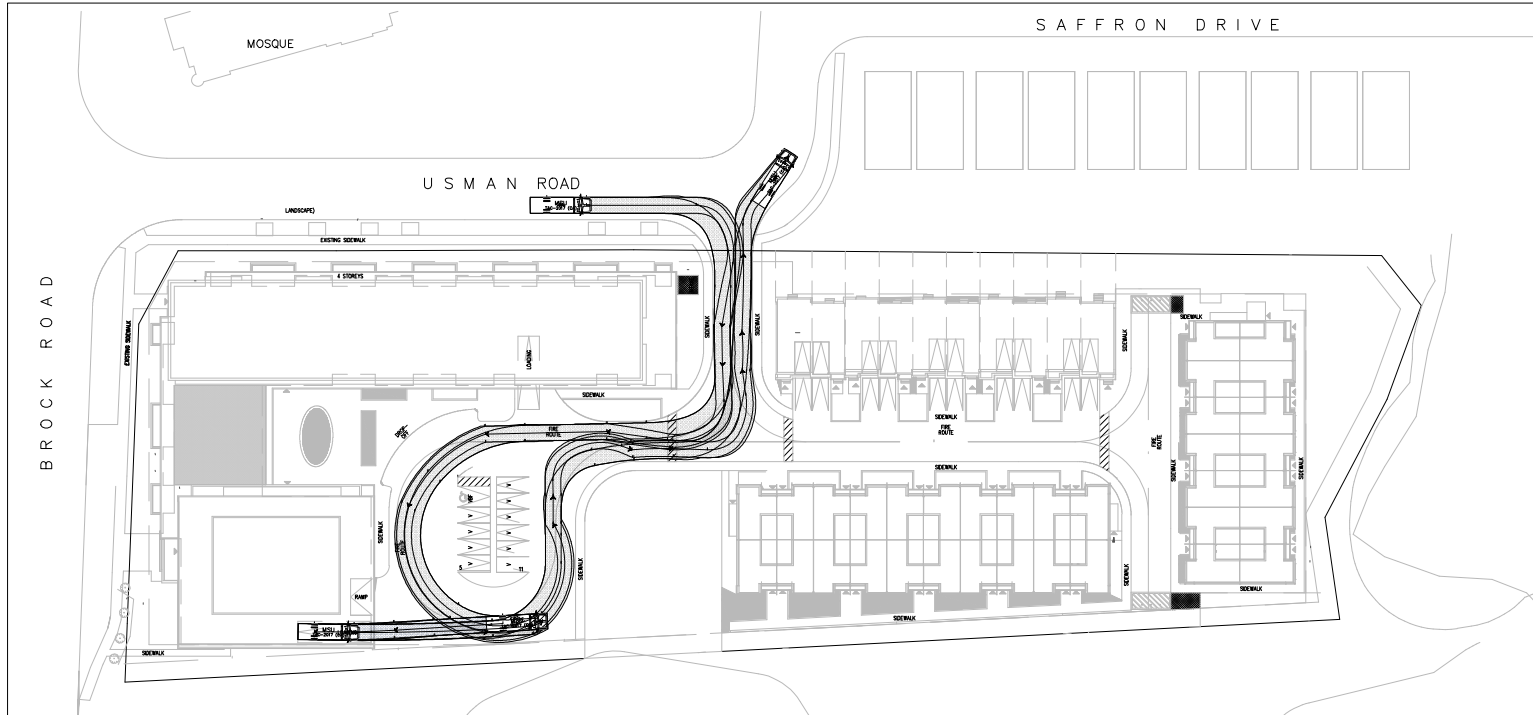
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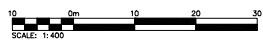
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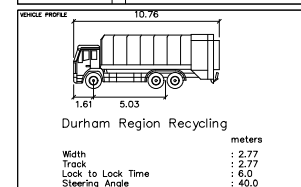
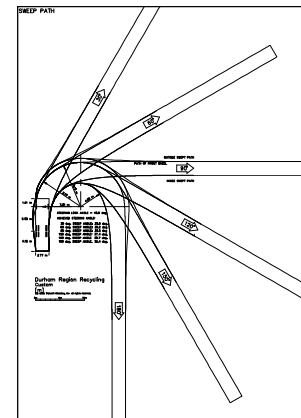
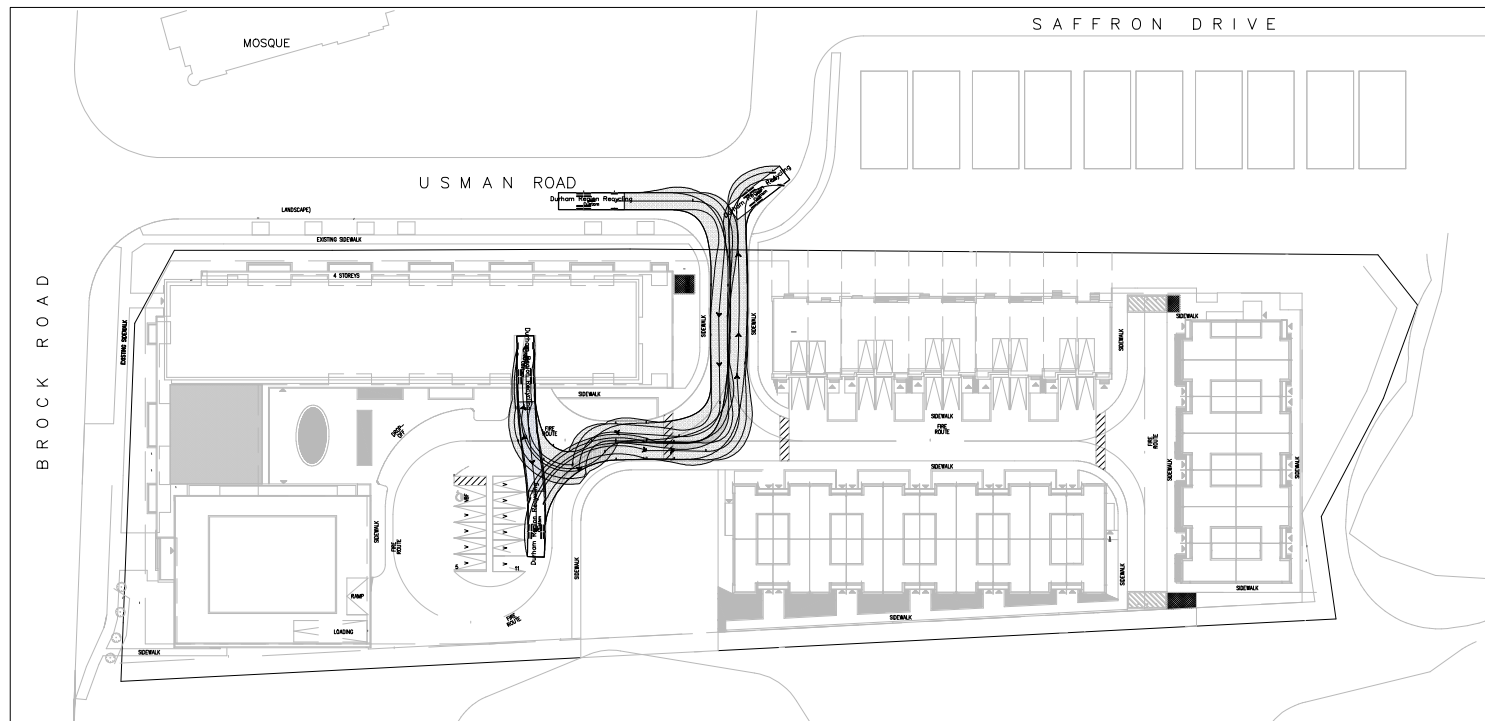
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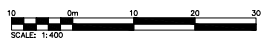
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VEHICLE MANEUVERING ANALYSIS
RECYCLING TRUCK

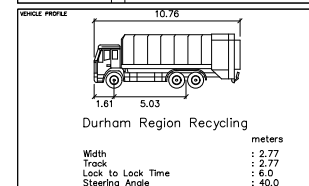
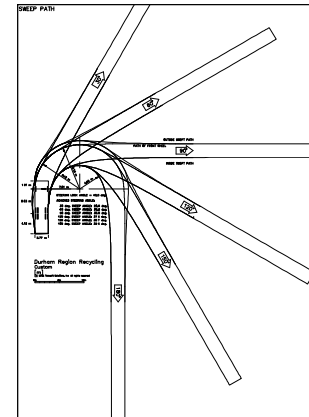
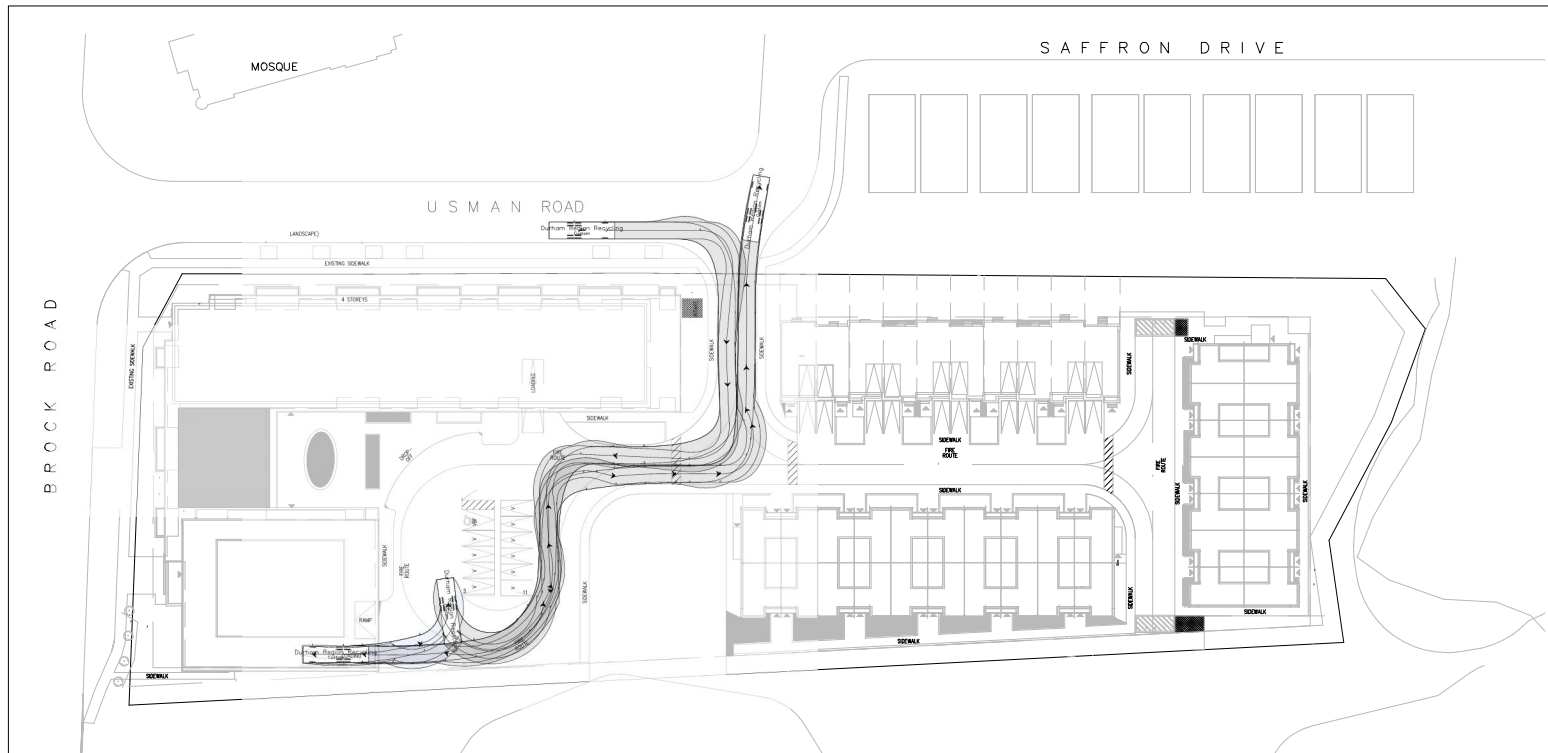


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RECYCLING TRUCK



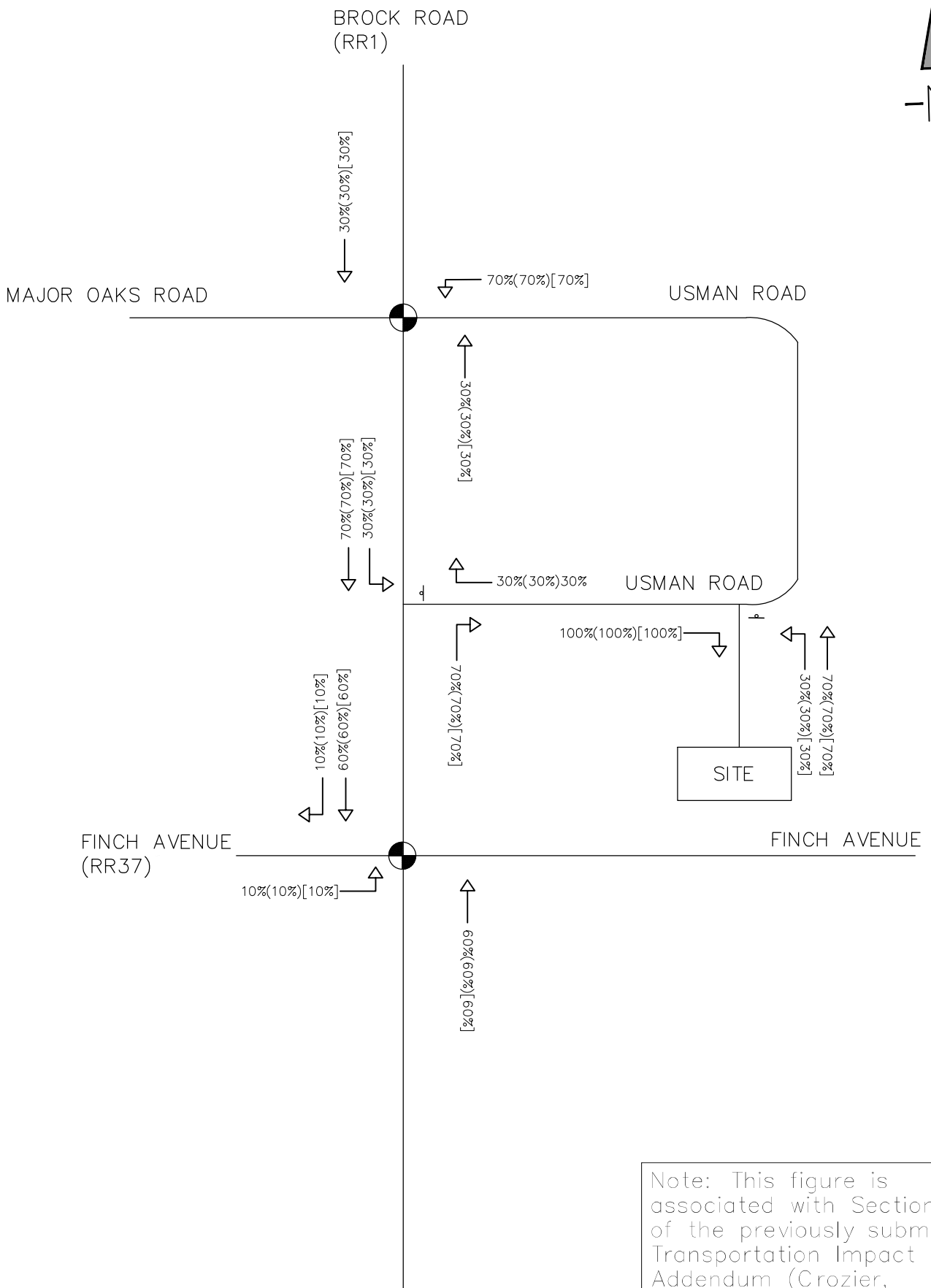
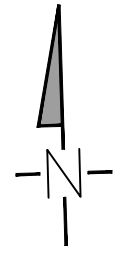
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| Check By | K.R. | Check By | Scale | 1:400 |
| | | M.C. | Drawing | T306 |



ATTACHMENT 5

Trip Distribution & Assignment Figures



NOTE: THIS FIGURE IS FOR SCHEMATIC PURPOSES ONLY & IS NOT TO BE SCALED.

Note: This figure is associated with Section 5.0 of the previously submitted Transportation Impact Study Addendum (Crozier, September 2021).

| | |
|--------|--|
| | SIGNAL CONTROL |
| | STOP CONTROL |
| XX(YY) | A.M. (P.M.) [FRIDAY] PEAK HOUR TRAFFIC VOLUMES |

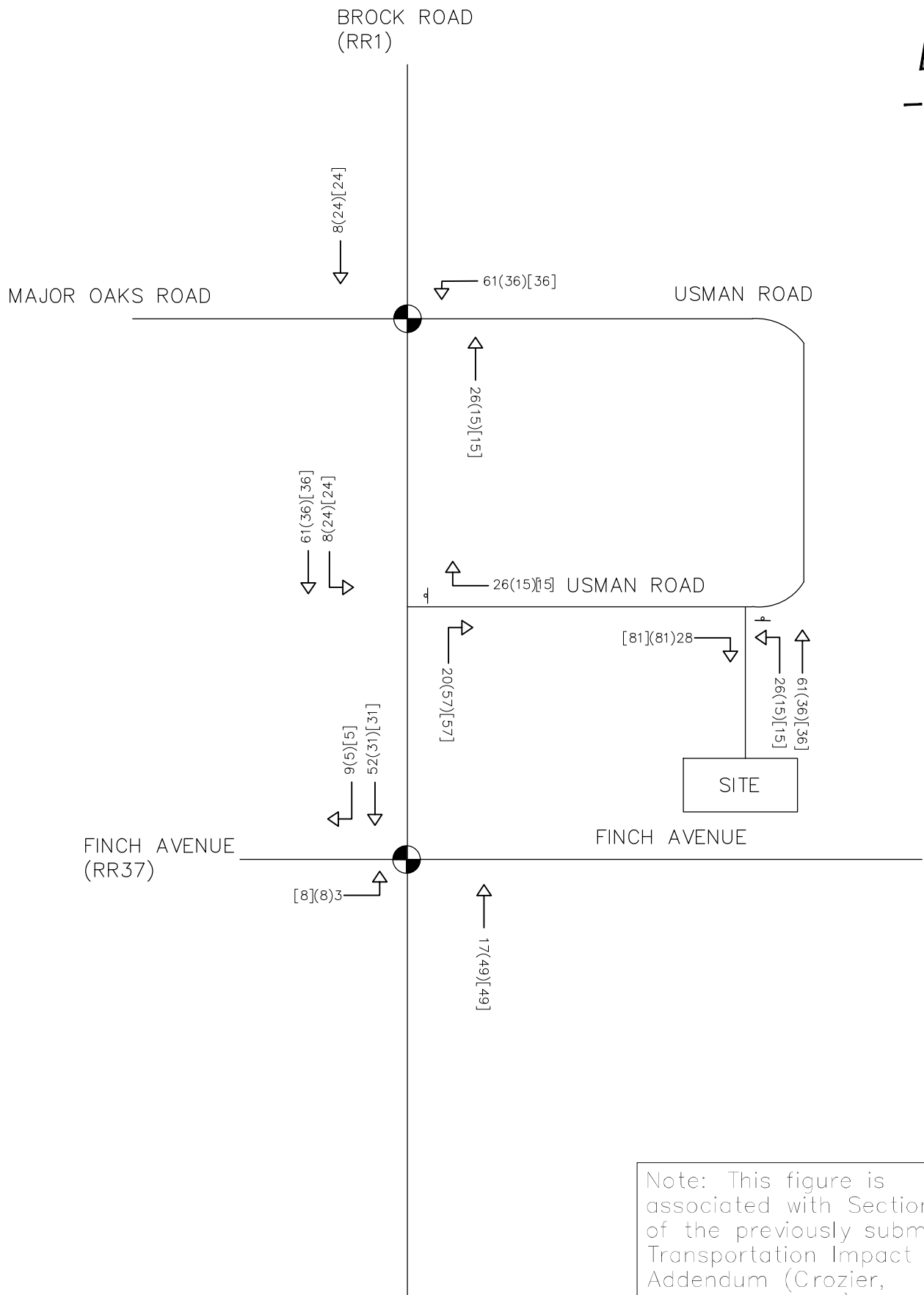
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| Project | 2055 Brock Road Duffins Forest Inc. 2055 Brock Road | |
| Drawing | Trip Distribution | |

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THE HARBOUREDGE BUILDING,
40 HURON STREET, SUITE 301,
COLLINGWOOD, ON L9Y 4R3
705 446-3510 T
705 446-3520 F
WWW.CROZIER.CA
INFO@CROZIER.CA

| | | | | | |
|----------|--------|-----------|-------------|----------|-----------|
| Drawn By | S.A. | Design By | M.J. | Project | 1807-5430 |
| Scale | N.T.S. | Date | OCT 4, 2019 | Check By | M.C. |

FIG. 8



Note: This figure is associated with Section 5.0 of the previously submitted Transportation Impact Study Addendum (Crozier, September 2021).

NOTE: THIS FIGURE IS FOR SCHEMATIC PURPOSES ONLY & IS NOT TO BE SCALED.

| | | | | | | | | | | | | | |
|--|--|--|---|----------|-----------|-----------|------|---------|-----------|-------|--------|------|------------|
| Legend  SIGNAL CONTROL  STOP CONTROL XX(YY) A.M. (P.M.) [FRIDAY] PEAK HOUR TRAFFIC VOLUMES | Project 2055 Brock Road Duffins Forest Inc. 2055 Brock Road |  CROZIER & ASSOCIATES Consulting Engineers <small>THE HARBOUREDGE BUILDING, 40 HURON STREET, SUITE 301, COLLINGWOOD, ON L9Y 4R3 705 446-3510 T 705 446-3520 F WWW.CROZIER.CA INFO@CROZIER.CA</small> | | | | | | | | | | | |
| | Drawing Trip Assignment | | <table border="1"> <tr> <td>Drawn By</td> <td>T.D.S.</td> <td>Design By</td> <td>K.H.</td> <td>Project</td> <td>1807-5430</td> </tr> <tr> <td>Scale</td> <td>N.T.S.</td> <td>Date</td> <td>2021/08/10</td> <td>Check By</td> <td>K.H.</td> </tr> </table> | Drawn By | T.D.S. | Design By | K.H. | Project | 1807-5430 | Scale | N.T.S. | Date | 2021/08/10 |
| Drawn By | T.D.S. | Design By | K.H. | Project | 1807-5430 | | | | | | | | |
| Scale | N.T.S. | Date | 2021/08/10 | Check By | K.H. | | | | | | | | |