Andover Trails
3480 Morgan Avenue, London
Transportation Impact Assessment

Paradigm Transportation Solutions Limited

May 2022
220050

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Project Summary

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Andover Trails
3480 Morgan Avenue, London
Transportation Impact Assessment

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Executive Summary

Content

Paradigm Transportation Solutions Limited (Paradigm) has been retained to conduct this Transportation Impact Assessment (TIA) for the proposed Andover Trails residential development located at 3480 Morgan Avenue in the City of London.

This Transportation Impact Assessment (TIA) includes an analysis of existing traffic conditions, a description of the proposed development, traffic forecasts for partial development completion (2027), development completion (2030) and a five-year horizon from development completion (2035) and assessment of traffic impacts with recommendations to accommodate the proposed development as appropriate.

Background

The subject site is the triangular parcel of land bounded by Wharncliffe Road, Bradley Avenue and Morgan Avenue.

In June 2019, Paradigm prepared a TIA for a mixed-use development on the subject site including the following access points:

- One all-moves access and one Right-In Right-Out (RIRO) access on Morgan Avenue;
- Two RIRO access points on Bradley Avenue; and
- Two all-moves access points on Wharncliffe Road.

Following a review of the June 2019 TIA, the City of London indicated that only one access on Morgan Avenue could operate as all-moves, and the remaining access points should be RIRO.

Proposed Development

Since the June 2019 TIA, the development proposal has been changed from mixed-use based on a Site Plan to primarily residential uses based on a new Subdivision Plan. The new plan includes approximately 300 stacked townhouse units and 700 apartment units for a total of up to 1,000 units, and 600 m^2 (6,458 ft^2) GFA of commercial uses.

The development is to be completed in two stages involving five phases. Stage 1 will include Phase 1 and Phase 2 accommodating 240 townhouses, and Phase 3 accommodating 164 apartment units, to be

completed by 2027. Stage 2 will include Phase 4 and Phase 5 comprising 60 townhouses, 536 apartment units and 600 m^2 (6,458 ft^2) GFA of commercial uses, to be completed by 2030.

The stacked townhouse block (Phase 1) with access to Morgan Avenue is being developed separately from the remaining development and will accommodate 144 units.

Six access points are proposed, three on Morgan Avenue, two on Bradley Avenue, and one on Wharncliffe Road. The access arrangement is based on an internal road system consisting of a north-south road (Street A) connecting Morgan Avenue and Wharncliffe Road, and an east-west road (Street B) connecting Street A to Bradley Avenue, all connections being tee intersections.

Three additional driveways are also proposed: Driveway B as all-moves access at Morgan Avenue in Phase 1; Driveway C as RIRO access at Morgan Avenue in Phase 4; and Driveway A as RIRO access at Bradley Avenue in Phase 5 of the development.

At full development, Street A, Street B and the three driveways will provide internal connections between all five phases and the six access points on the three abutting roadways.

TIA Scope

The scope of the Transportation Impact Assessment for the proposed development includes:

- **Study Area intersections:**
  - Wharncliffe Road and Morgan Avenue/Middleton Avenue (unsignalized);
  - Wharncliffe Road and Bradley Avenue (unsignalized);
  - Bradley Avenue and Morgan Avenue (unsignalized);
  - Future Street A all-moves connection to Morgan Avenue;
  - One all-moves (Driveway B) and one RIRO (Driveway C) connection to Morgan Avenue;
  - Two RIRO connections to Bradley Avenue, one being Street B; and
  - Future Street A RIRO connection to Wharncliffe Road.
- **Analysis Periods:** Weekday AM and PM peak hours.

- **Background Developments:**
  - 3433 Morgan Avenue;
  - 146 Exeter Road;
  - Goldfield Subdivision;
  - 284 Exeter Road; and
  - 1789 Wharncliffe Road South.
- **Traffic Conditions:** Base Year (2022), partial completion (2027), full build-out (2030) and five-years from development completion (2035).

Conclusions

Based on the investigations carried out, it is concluded that:

- **Existing Traffic Conditions:** The study area intersections are operating within acceptable levels of service. Although not considered critical under City of London TIA guidelines, the following movements are operating with poor LOS:
  - Wharncliffe Road and Middleton Avenue/Morgan Avenue: The northbound and southbound left-turn movements are operating with LOS E during the PM peak hour.
  - Wharncliffe Road and Bradley Avenue: The southbound left-turn movement is operating with LOS F and the southbound through movement is operating with LOS E during the PM peak hour.

  It is noted that both intersections are currently operating under two-way stop control and will potentially be converted to traffic signal control under future traffic conditions.
- **Development Trip Generation:** The subdivision is forecast to generate a total of 427 AM peak hour trips and 466 PM peak hour trips:
  - Stage 1: 158 AM peak hour trips and 188 PM peak hour trips; and
  - Stage 2: 269 AM peak hour trips and 278 PM peak hour trips.
- **2027 Background Traffic Conditions:** The study area intersections are forecast to operate with the same critical movements as under existing traffic conditions, and the addition of the following movements at the intersection of Wharncliffe Road and Middleton Avenue/Morgan Avenue:

- The northbound and southbound left-turn movements are forecast to operate with LOS E during the AM peak hour; and
- The northbound shared through/right-turn movement is forecast to operate with LOS E during the PM peak hour.

Existing two-way stop control is assumed for the intersection of Wharncliffe Road and Middleton Avenue/Morgan Avenue, while traffic signal control is assumed at the Bradley Avenue and Wharncliffe Road intersection along with the easterly extension of Bradley Avenue.

- **2027 Total Traffic Conditions:** The study area intersections are forecast to operate with the same critical movements as under 2027 background traffic conditions.
- **2030 Background Traffic Conditions:** The study area intersections are forecast to operate with the same critical movements as under 2027 background traffic conditions, with the addition of the southbound shared through/right-turn movement at Wharncliffe Road and Middleton Avenue/Morgan Avenue which is forecast to operate with LOS E during the PM peak hour.
- **2030 Total Traffic Conditions:** The study area intersections are forecast to operate with the same critical movements as under 2030 background traffic conditions, with the addition of the following movements:
  - Wharncliffe Road and Middleton Avenue/Morgan Avenue: The northbound and southbound left-turn movements are forecast to operate with LOS F and a v/c ratio greater than 0.90 during the PM peak hour.
  - Wharncliffe Road and Bradley Avenue: The southbound left-turn movement is forecast to operate with 95th percentile queues exceeding the available storage of 80 metres during the PM peak hour.
- **2035 Background Traffic Conditions:** The study area intersections are forecast to operate with the same critical movements as under 2030 background traffic conditions.
- **2035 Total Traffic Conditions:** The study area intersections forecast to operate with the same critical movements as under 2030 total traffic conditions, with the addition of the northbound shared through/right-turn movement at Wharncliffe Road and Middleton Avenue/Morgan Avenue which is forecast to operate with LOS F and a v/c ratio greater than 0.90 during the PM peak hour.

- **Remedial Measures:**
  - Wharncliffe Road and Bradley Avenue: Signal timings should be monitored for potential coordination with surrounding signalized intersections. If the forecast queueing issues continue to occur for the southbound left-turn movement, the existing left-turn lane storage of 80 metres should be increased to 95 metres by 2035.
  - Wharncliffe Road and Morgan Avenue: Although traffic signal control is not warranted under 2035 total traffic conditions, the critical movements at this intersection can be resolved with signalization of the intersection. The intersection operations should be monitored in the future to identify appropriate traffic control.
- **Summary of Traffic Impact Assessment:** The development benefits from the three abutting roads and multiple access points, which contributes to an efficient distribution of development traffic without overloading any of the roadway or access intersections. Capacity constraints and critical turning movements are mostly pre-existing and/or independent of the subject development. Also, the identified issues could be addressed through operational adjustments without requiring roadway modifications.
- **Site Access:** All access intersections are projected to operate satisfactorily under future traffic conditions. Driveway B at Morgan Avenue was analyzed both as all-moves and as an RIRO access, and it is appropriate to be implemented as an all-moves access.
- **Transportation Demand Management:** The following TDM measures can be implemented to support the use of alternative modes within the surrounding area:
  - Internal sidewalks with connections to the existing municipal sidewalk network, and cycle track/bike lanes nearby.
  - Bicycle parking in accordance with the City's Zoning By-Law requirements for both residential and non-residential developments.
  - Access to frequent transit that provides good connectivity to the broader network and major destinations.
  - Parking unbundled from the sale/rent agreement of apartment units.
  - Carshare space/vehicle(s) in a premium location.

- Transit, carshare and active transportation information provided in a welcome package to new residents and/or posted in central locations on-site.

Recommendations

Based on the findings and conclusions of this study, it is recommended that the proposed development be considered for approval.

Contents

Appendices

Figures

Tables

1 Introduction

1.1 Overview

Paradigm Transportation Solutions Limited (Paradigm) has been retained to conduct this Transportation Impact Assessment (TIA) for the proposed Andover Trails residential development located at 3480 Morgan Avenue in the City of London. **Figure 1.1** details the subject development location.

The subject site is the triangular parcel of land bounded by Wharncliffe Road, Bradley Avenue and Morgan Avenue.

The development proposal includes approximately 300 stacked townhouse units and 700 apartment units for a total of up to 1,000 units, and 600 m^2 (6,458 ft^2) GFA of commercial uses.

The development is to be completed in two stages involving five phases. Stage 1 will include Phase 1 and Phase 2 accommodating 240 townhouses, and Phase 3 accommodating 164 apartment units, to be completed by 2027. Stage 2 will include Phase 4 and Phase 5 comprising 60 townhouse units, 536 apartment units and 600 m^2 (6,458 ft^2) GFA of commercial uses, to be completed by 2030.

The stacked townhouse block (Phase 1) with access to Morgan Avenue is being developed separately from the remaining development and will accommodate 144 units.

Six access points are proposed, three on Morgan Avenue, two on Bradley Avenue, and one on Wharncliffe Road. The access arrangement is based on an internal road system consisting of a north-south road (Street A) connecting Morgan Avenue and Wharncliffe Road, and an east-west road (Street B) connecting Street A to Bradley Avenue, all connections being tee intersections.

Three additional driveways are also proposed: Driveway B as all-moves access at Morgan Avenue in Phase 1; Driveway C as RIRO access at Morgan Avenue in Phase 4; and Driveway A as RIRO access at Bradley Avenue in Phase 5 of the development.

At full development, Street A, Street B and the three driveways will provide internal connections between all five phases and the six access points on the three abutting roadways.

1.2 Purpose and Scope

The purpose of this report is to identify and assess the potential traffic impact resulting from the proposed development. The scope of the study, developed in consultation with City of London staff via e-mail in January 2022, includes:

- Assessment of the current traffic and site conditions within the study area;
- Estimates of background traffic growth for partial completion (2027), full build-out (2030) and five-years from development completion (2035);
- Estimates of additional traffic generated by the subject site;
- Analyses of the impact of the future traffic on the surrounding road network, including the following study area intersections:
  - Wharncliffe Road and Morgan Avenue/Middleton Avenue (unsignalized);
  - Wharncliffe Road and Bradley Avenue (unsignalized);
  - Bradley Avenue and Morgan Avenue (unsignalized);
  - Future Street A all-moves connection to Morgan Avenue;
  - One all-moves and one RIRO connection to Morgan Avenue;
  - Two RIRO connections to Bradley Avenue, one being Street B; and
  - Future Street A RIRO connection to Wharncliffe Road.
- Recommendations necessary to mitigate the site generated traffic in a satisfactory manner; and
- Transportation Demand Management (TDM) measures appropriate to the site.

Appendix A contains the pre-study consultation material and responses from the City of London.

This study has been prepared in accordance with the requirements detailed by the City of London Transportation Impact Assessment Guidelines[1].

[1] Transportation Impact Assessment Guidelines, City of London, April 2012.

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Location of Subject Lands

2 Existing Conditions

2.1 Existing Roadways

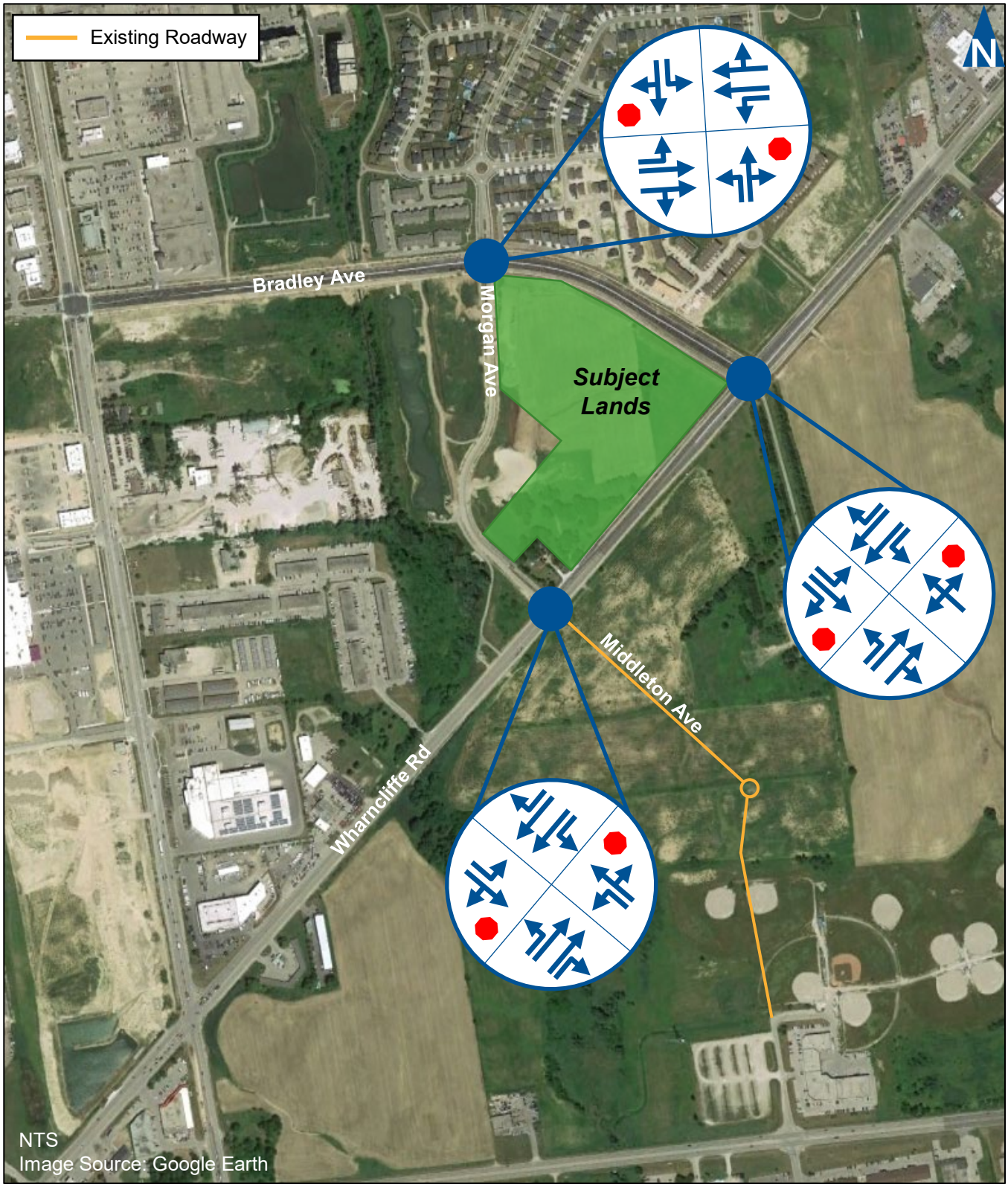
The main roadways near the subject site considered in assessing the traffic impacts of the development include:

- **Wharncliffe Road** is a north-south roadway, classified as a civic boulevard under the City's Official Plan (OP)[2], for the purpose of this study, this road runs east-west. The roadway has a four-lane cross section and a posted speed limit of 80 km/h west of Bradley Avenue and 60 km/h to the east. Sidewalks are provided on both sides of the roadway east of Bradley Avenue and on the north side between Bradley Avenue and Morgan Avenue.
- **Bradley Avenue** is an east-west urban thoroughfare with a four-lane cross section and a posted speed limit of 60 km/h. Sidewalks are provided on both sides of the roadway and a cycle track is located on the south side of the roadway between Wharncliffe Road and Wonderland Road.

  Bradley Avenue is to be extended between Wharncliffe Road South and White Oak Road by 2023. The extension is anticipated to have a four-lane cross section and a speed limit of 60 km/h. Sidewalks are to be provided on both sides of the extension and the cycle track is to be extended on the south side of the roadway.
- **Morgan Avenue** and **Middleton Avenue** are classified as neighbourhood connectors. Both roadways have a two-lane cross section and an assumed speed limit of 40 km/h. Sidewalks will be provided on both sides of the roadway.

Figure 2.1 illustrates the existing lane configuration and traffic control at the study area intersections.

[2] The London Plan, May 2019.



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Existing Lane Configuration and Traffic Control

2.2 Transit Service

London Transit Route 12 (Downtown – Wharncliffe at Wonderland) which operates along Wharncliffe Road and Wonderland Road with major stops in Downtown London and southwest London. This route operates Monday to Saturday (6:00AM – 12:30AM) with 30-minute headways and Sunday/Holiday (8:30AM – 9:45PM) with 60-minute headways. **Figure 2.2** illustrates the existing transit service.

2.3 Traffic Volumes

Turning movement counts were collected by Paradigm on 22 January 2019 and 02 March 2022. **Table 2.1** summarizes the count date and peak hour start times for each study area intersection.

TABLE 2.1: TURNING MOVEMENT COUNT SUMMARY

Intersection	Count Date	AM Peak Hour	PM Peak Hour
Morgan Ave/Middleton Ave & Wharncliffe Rd	2 March 2022	7:30 AM	4:15 PM
Bradley Ave & Wharncliffe Rd	22 January 2019	7:30 AM	4:30 PM
Morgan Ave & Bradley Ave	22 January 2019	7:45 AM	4:30 PM

The 2019 traffic counts were increased to 2022 using a growth rate of 1.5% as confirmed with the City during pre-study consultation. Traffic volumes on Wharncliffe Road have been balanced between Morgan Avenue and Bradley Avenue.

Figure 2.3a and **Figure 2.3b** illustrate the 2022 base year AM and PM weekday peak hour traffic volumes, respectively.

Appendix B contains the detailed traffic counts for the study area intersections.

Existing Transit Network

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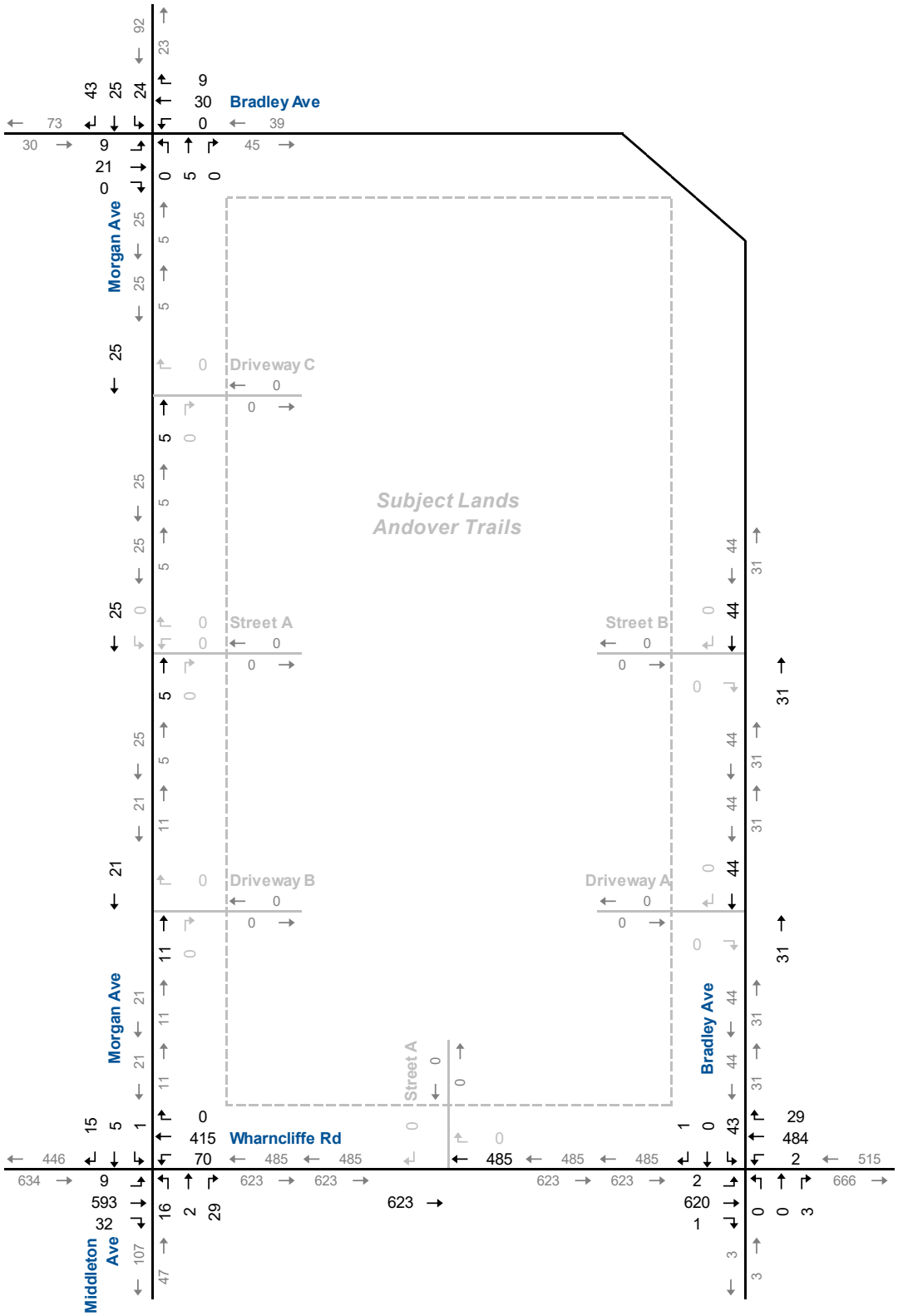
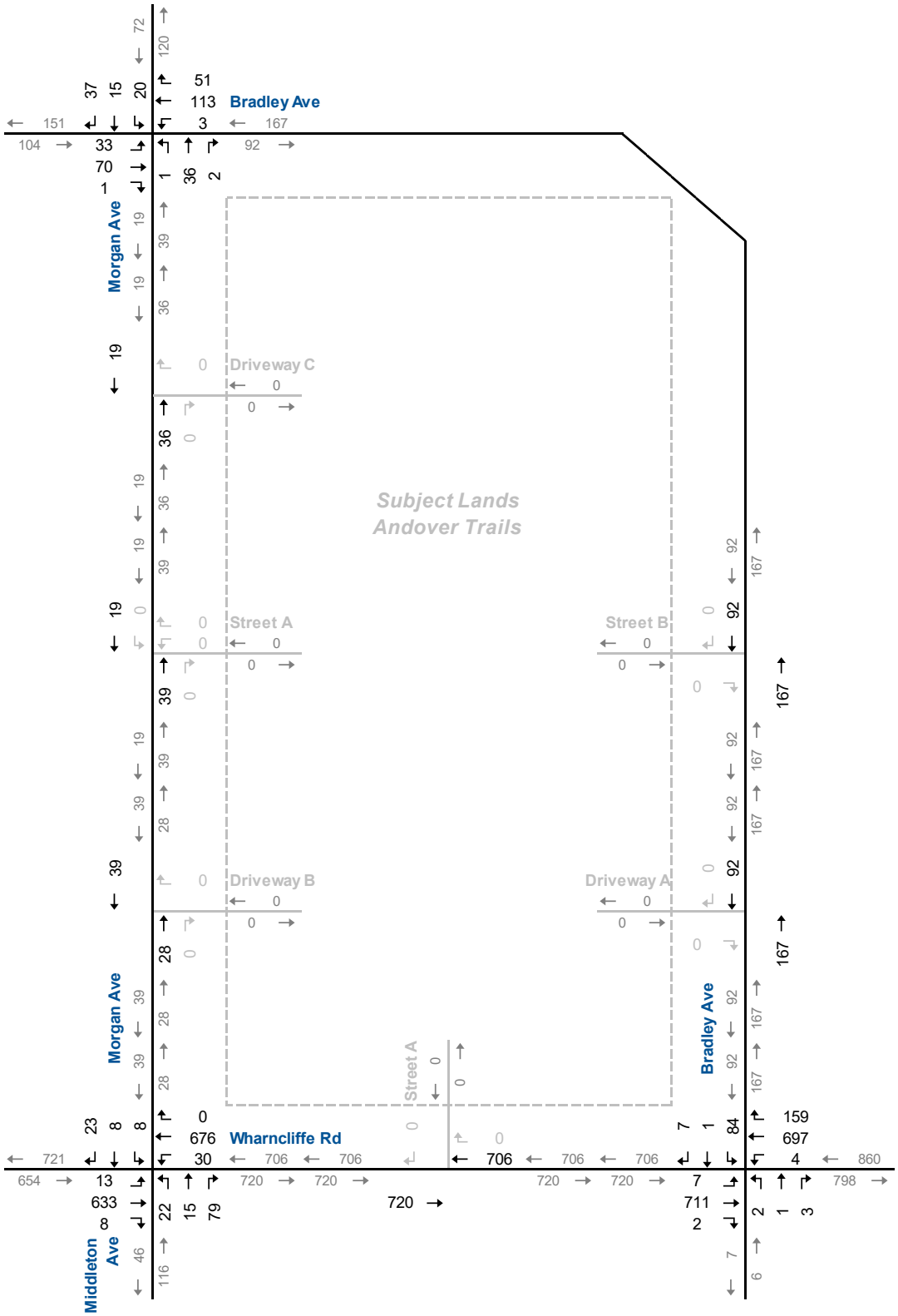
Figure 2.2



NTS

Base Year (2022) Traffic Volumes AM Peak Hour



NTS

Base Year (2022) Traffic Volumes PM Peak Hour

2.4 Traffic Operations

The level of service conditions at the study area intersections have been assessed using Synchro 10. Movements are considered critical under the following conditions:

- Volume/capacity (v/c) ratios for overall intersection operations, through movements or shared through/turning movements increased to 0.90 or above and Level of Service (LOS) 'E' or worse;
- v/c ratios for dedicated turning movements increased to 0.90 or above and LOS 'E' or worse;
- 95th percentile queue lengths for individual movements exceeds available lane storage.

Intersection LOS is a recognized method of quantifying the average delay experienced by drivers at intersections. It is based on the delay experienced by individual vehicles executing various movements. The delay is related to the number of vehicles intending to make a particular movement, compared to the estimated capacity for that movement. The capacity is based on a number of criteria related to the opposing traffic flows and intersection geometry.

The highest possible rating is LOS A, under which the average total delay is equal to or less than 10.0 seconds per vehicle. When the average delay exceeds 80 seconds for signalized intersections, 50 seconds for unsignalized intersections or when the volume to capacity ratio is greater than 1.0, the movement is classed as LOS F and remedial measures are usually implemented if they are feasible. LOS E is usually used as a guideline for the determination of road improvement needs on through lanes, while LOS F may be acceptable for left-turn movements at peak times, depending on delays.

Table 2.2 summarizes the results of the intersection operational analysis under existing conditions, including the AM and PM peak hour LOS, v/c ratios and 95th percentile queues.

The results indicate that the study area intersections are operating with acceptable levels of service. Although not considered critical under City of London TIA guidelines, the following movements are operating with poor LOS:

Wharncliffe Road and Middleton Avenue/Morgan Avenue

- The northbound and southbound left-turn movements are operating with LOS E during the PM peak hour.

Wharncliffe Road and Bradley Avenue

- The southbound left-turn movement is operating with LOS F during the PM peak hour; and
- The southbound through movement is operating with LOS E during the PM peak hour.

The low to moderate v/c ratios for the above movements indicates the delay is likely due to the high volume of through traffic on Wharncliffe Road which limits the number of available gaps for side street traffic.

Appendix C contains the detailed Synchro 10 reports.

TABLE 2.2: EXISTING TRAFFIC OPERATIONS

Analysis Period	Intersection	Control Type	MOE	Direction/Movement/Approach																Overall
				Eastbound				Westbound				Northbound				Southbound				
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
AM Peak Hour	Middleton Avenue/Morgan Avenue & Wharncliffe Road South	TWSC	LOS	A	A	A	A	A	A	A	A	D	B	>	C	C	C	>	C	
			Delay	9	0	0	0	10	0	0	1	31	13	>	19	24	15	>	16	
			V/C	0.01	0.00	0.00		0.09	0.00	0.00		0.11	0.07	>		0.01	0.06	>		
			Q	0	0	0		2	0	0		3	2	>		0	2	>		
			Stor.	90	-	60		85	-	60		45	-	>		50	-	>		
			Avail.	90	-	60		83	-	60		42	-	>		50	-	>		
	Wharncliffe Road South & Bradley Avenue	TWSC	LOS	A	A	>	A	A	A	A	A	<	B	>	B	C	A	A	C	
			Delay	8	0	>	0	9	0	0	0	<	10	>	10	23	0	10	23	
			V/C	0.00	0.00	>		0.00	0.00	0.00		<	0.01	>		0.19	0.00	0.00		
			Q	0	0	>		0	0	0		<	0	>		5	0	0		
			Stor.	110	-	>		110	-	45		<	-	>		80	-	-		
			Avail.	110	-	>		110	-	45		<	-	>		75	-	-		
	Morgan Avenue & Bradley Avenue	TWSC	LOS	A	A	>	A	A	A	>	A	A	A	>	A	A	A	>	A	
			Delay	7	0	>	2	0	0	>	0	0	10	>	10	9	9	>	9	
			V/C	0.01	0.00	>		0.00	0.00	>		0.00	0.01	>		0.03	0.08	>		
			Q	0	0	>		0	0	>		0	0	>		1	2	>		
			Stor.	45	-	>		45	-	>		45	-	>		45	-	>		
			Avail.	45	-	>		45	-	>		45	-	>		44	-	>		
PM Peak Hour	Middleton Avenue/Morgan Avenue & Wharncliffe Road South	TWSC	LOS	A	A	A	A	A	A	A	A	E	C	>	C	E	C	>	C	
			Delay	9	0	0	0	9	0	0	0	38	19	>	22	41	19	>	24	
			V/C	0.02	0.00	0.00		0.04	0.00	0.00		0.18	0.28	>		0.08	0.12	>		
			Q	1	0	0		1	0	0		4	8	>		2	3	>		
			Stor.	90	-	60		85	-	60		45	-	>		50	-	>		
			Avail.	89	-	60		84	-	60		41	-	>		48	-	>		
	Wharncliffe Road South & Bradley Avenue	TWSC	LOS	A	A	>	A	A	A	A	A	<	C	>	C	F	E	B	F	
			Delay	10	0	>	0	9	0	0	0	<	24	>	24	63	38	11	59	
			V/C	0.01	0.00	>		0.01	0.00	0.00		<	0.03	>		0.62	0.01	0.01		
			Q	0	0	>		0	0	0		<	1	>		25	0	0		
			Stor.	110	-	>		110	-	45		<	-	>		80	-	-		
			Avail.	110	-	>		110	-	45		<	-	>		55	-	-		
	Morgan Avenue & Bradley Avenue	TWSC	LOS	A	A	>	A	A	A	>	A	B	B	>	B	B	A	>	B	
			Delay	8	0	>	2	7	0	>	0	10	12	>	12	11	10	>	10	
			V/C	0.03	0.00	>		0.00	0.00	>		0.00	0.07	>		0.04	0.07	>		
			Q	1	0	>		0	0	>		0	2	>		1	2	>		
			Stor.	45	-	>		45	-	>		45	-	>		45	-	>		
			Avail.	44	-	>		45	-	>		45	-	>		44	-	>		

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds
V/C - Volume to Capacity Ratio
Q - 95th Percentile Queue Length (m)
Stor. - Existing Storage (m)
Avail. - Available Storage (m)
TWSC - Two-Way Stop Control
< / > - Shared with through movement

3 Development Concept

3.1 Development Description

The subject site is the triangular parcel of land bounded by Wharncliffe Road, Bradley Avenue and Morgan Avenue.

The development proposal includes approximately 300 stacked townhouse units and 700 apartment units for a total of up to 1,000 units, and 600 m^2 (6,458 ft^2) GFA of commercial uses.

The development is to be completed in two stages involving five phases. Stage 1 will include Phase 1 and Phase 2 accommodating 240 townhouses, and Phase 3 accommodating 164 apartment units, to be completed by 2027. Stage 2 will include Phase 4 and Phase 5 comprising 60 townhouse units, 536 apartment units and 600 m^2 (6,458 ft^2) GFA of commercial uses, to be completed by 2030.

The stacked townhouse block (Phase 1) with access to Morgan Avenue is being developed separately from the remaining development and will accommodate 144 units.

Figure 3.1a illustrates the development concept including access arrangements, and **Figure 3.1b** illustrates the phasing plan.

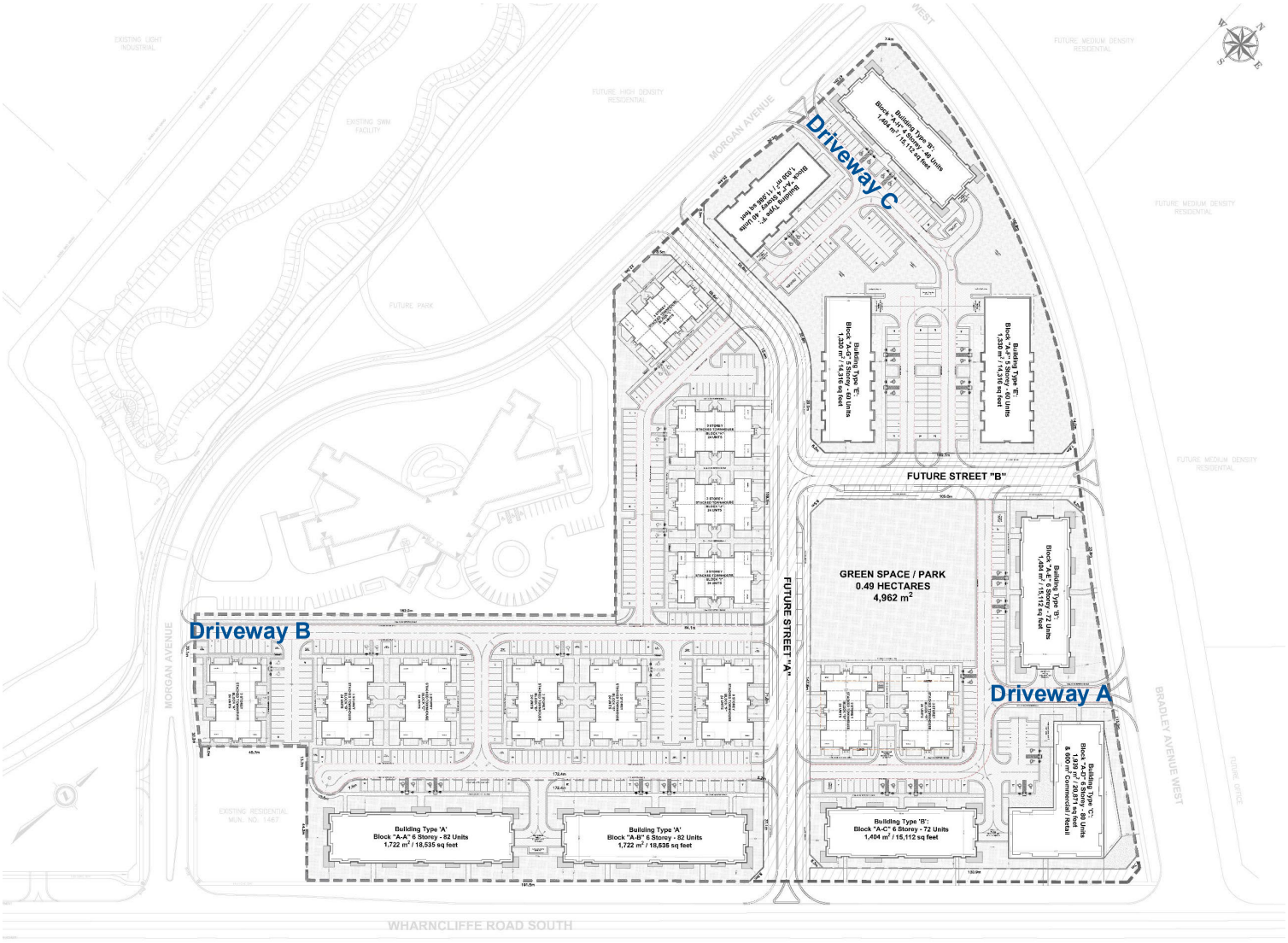
Six access points are proposed, three on Morgan Avenue, two on Bradley Avenue, and one on Wharncliffe Road. The access arrangement is based on an internal road system consisting of a north-south road (Street A) connecting Morgan Avenue and Wharncliffe Road, and an east-west road (Street B) connecting Street A to Bradley Avenue, all connections being tee intersections.

Street A at Morgan Avenue will provide all-moves access to the development; the intersections at Wharncliffe Road (Street A) and at Bradley Avenue (Street B) will be restricted to RIRO movements.

Three additional driveways are also proposed: Driveway B as all-moves access at Morgan Avenue in Phase 1; Driveway C as RIRO access at Morgan Avenue in Phase 4; and Driveway A as RIRO access at Bradley Avenue in Phase 5 of the development.

It is noted that Driveway B at Morgan Avenue is analyzed in this study both as a restricted RIRO access and as an all-moves access. Traffic operational analysis (**Section 4**) indicates that Driveway B is operationally feasible either as a restricted or as an all-moves access. However, as Phase 1 is to be developed in advance of the rest of the site, Driveway B should be implemented as an all-moves access.

At full development, Street A, Street B and the three driveways will provide internal connections between all five phases and the six access points on the three abutting roadways.



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Development Concept Plan

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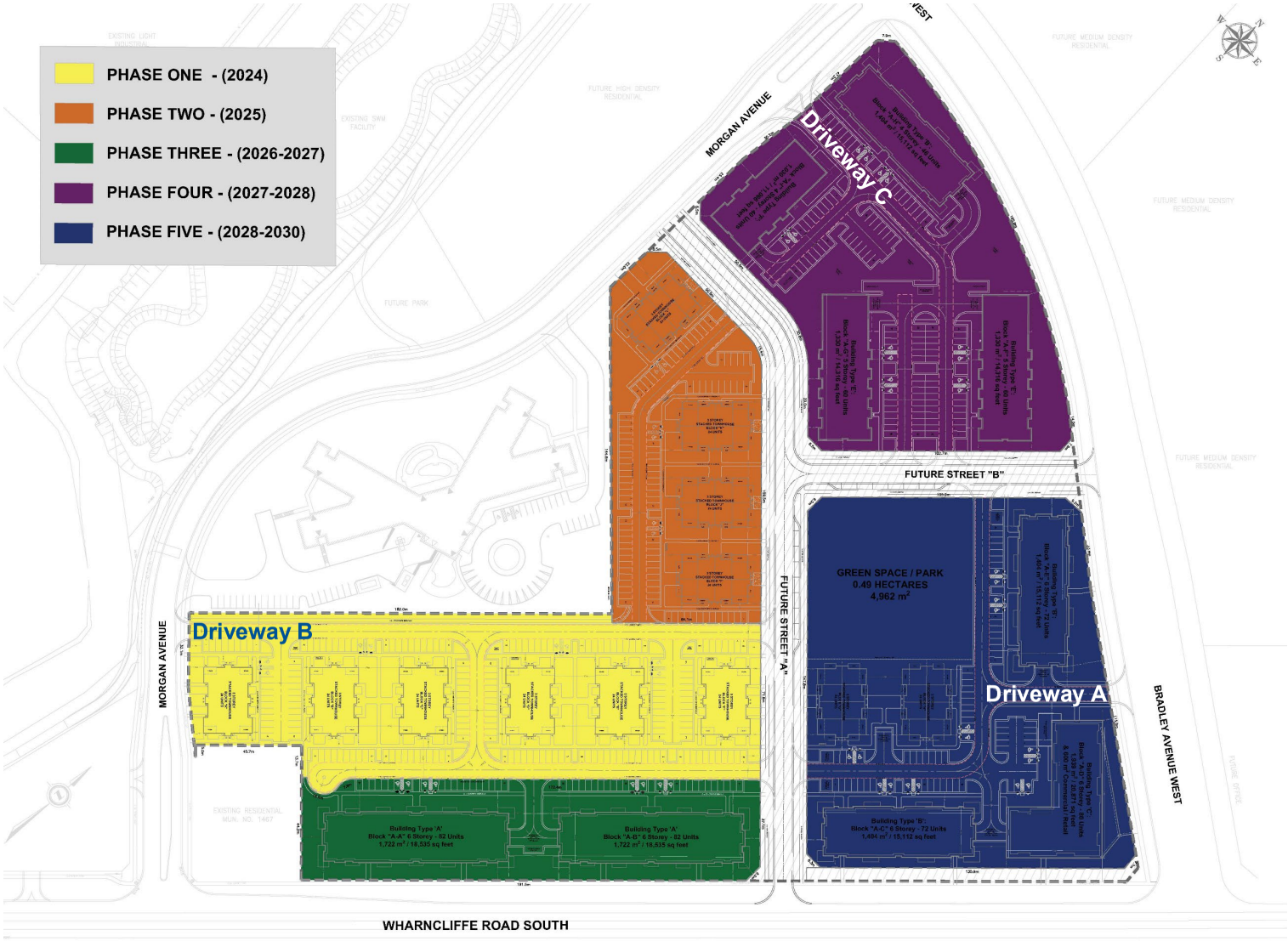
Figure 3.1a



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Phasing Plan

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Figure 3.1b

3.2 Development Trip Generation

The Institute of Transportation Engineers (ITE) Trip Generation Manual[3] rates and equations are used to estimate the peak hour traffic volumes generated by the Land Use Codes (LUC) of this development:

- LUC 220 (Multifamily Housing, Low Rise);
- LUC 221 (Multifamily Housing, Mid Rise); and
- LUC 822 (Strip Retail Plaza <40k).

The ITE provides information on average pass-by rates for different land use codes, however, pass-by rates are not provided for LUC 822. As the commercial use within the subject development is minimal and located within a residential building, pass-by on Wharncliffe Road is anticipated to be minimal. Therefore, reductions due to pass-by have not been applied to the commercial use. In addition, reductions for internal trips are estimated to be minimal and have not been included in the trip generation.

Table 3.1 summarizes the forecast number of net new trips generated by Stage 1 of the proposed development.

TABLE 3.1: TRIP GENERATION – STAGE 1

Land Use	Number of Units	AM Peak Hour				PM Peak Hour			
		Rate	In	Out	Total	Rate	In	Out	Total
LUC 220 - Multifamily Housing (Low-Rise)	240	Eq	23	74	**97**	Eq	78	46	**124**
LUC 221 - Multifamily Housing (Mid-Rise)	164	Eq	14	47	**61**	Eq	39	25	**64**
Total Trip Generation			**37**	**121**	**158**		**117**	**71**	**188**

LUC 220 - AM: T = 0.31(X) + 22.85 | PM: T = 0.43(X) + 20.55

LUC 221 - AM: T = 0.44(X) - 11.61 | PM: T = 0.39(X) + 0.34

Table 3.2 summarizes the forecast number of net new trips generated by full build-out of the proposed development.

TABLE 3.2: TRIP GENERATION – FULL BUILD-OUT

Land Use	Number of Units	AM Peak Hour				PM Peak Hour			
		Rate	In	Out	Total	Rate	In	Out	Total
LUC 220 - Multifamily Housing (Low-Rise)	300	Eq	28	88	**116**	Eq	94	56	**150**
LUC 221 - Multifamily Housing (Mid-Rise)	700	Eq	68	228	**296**	Eq	167	106	**273**
LUC 822 - Strip Retail Plaza (<40k) 1,000 ft^2 GFA	6.46	2.36	9	6	**15**	6.59	21	22	**43**
Total Trip Generation			**105**	**322**	**427**		**282**	**184**	**466**

LUC 220 - AM: T = 0.31(X) + 22.85 | PM: T = 0.43(X) + 20.55

LUC 221 - AM: T = 0.44(X) - 11.61 | PM: T = 0.39(X) + 0.34

[3] Institute of Transportation Engineers Trip Generation Manual 11th Edition, 2021.

3.3 Development Trip Distribution and Assignment

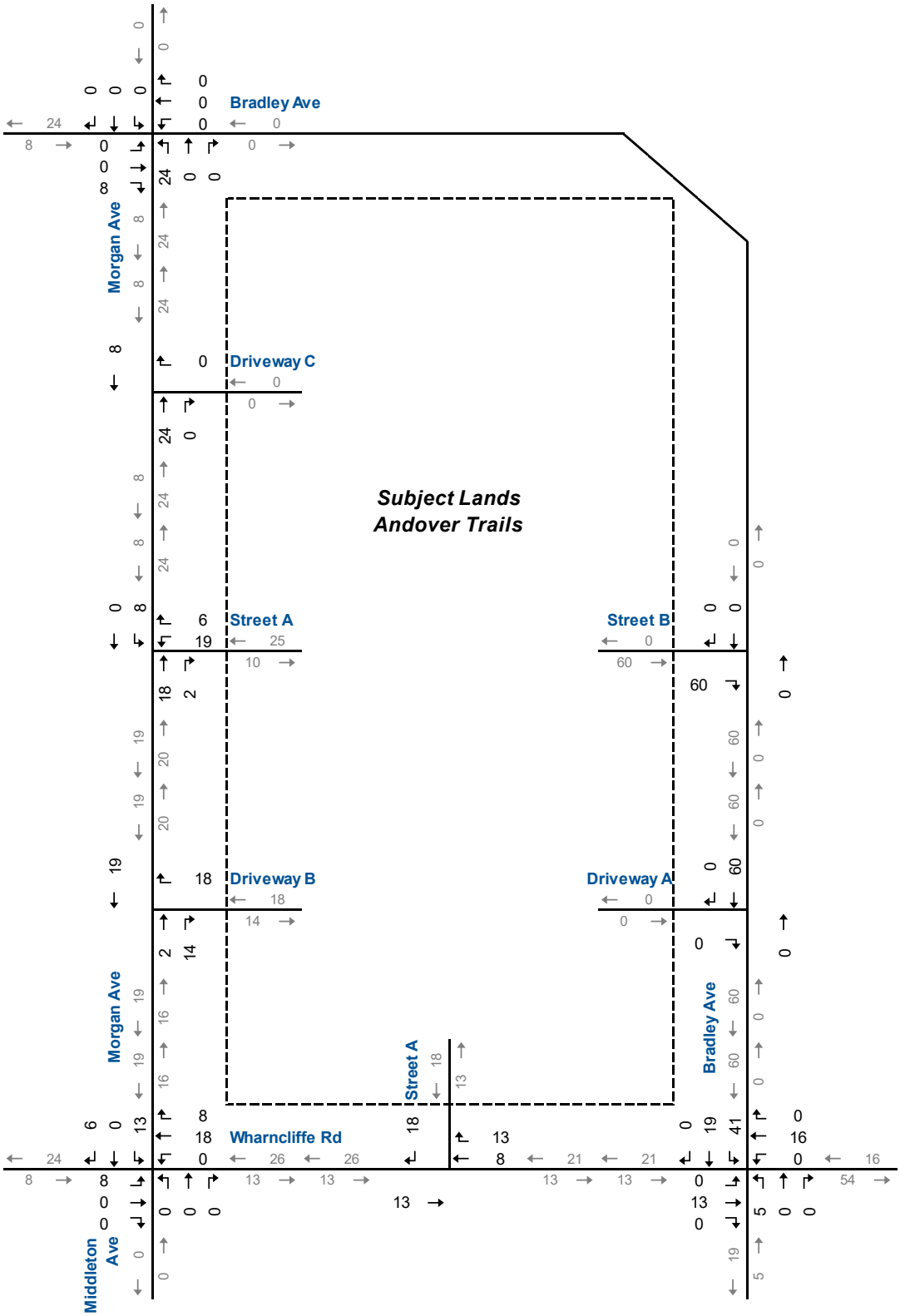
The trip distribution was determined based on existing traffic volumes at the study area intersections. **Table 3.3** displays the breakdown of trip distributions used in this study.

TABLE 3.3: ESTIMATED TRIP DISTRIBUTION

Origin/Destination	Percentage
North via Wharncliffe Rd	45%
South via Wharncliffe Rd	20%
East via Bradley Ave	15%
West via Bradley Ave	20%
Total	**100%**

Figure 3.2a and **Figure 3.2b** illustrate the 2027 (Stage 1) site-generated traffic volumes for the AM and PM peak hours, respectively.

Figure 3.3a and **Figure 3.3b** illustrate the 2030 (full build-out) site-generated traffic volumes for the AM and PM peak hours, respectively.

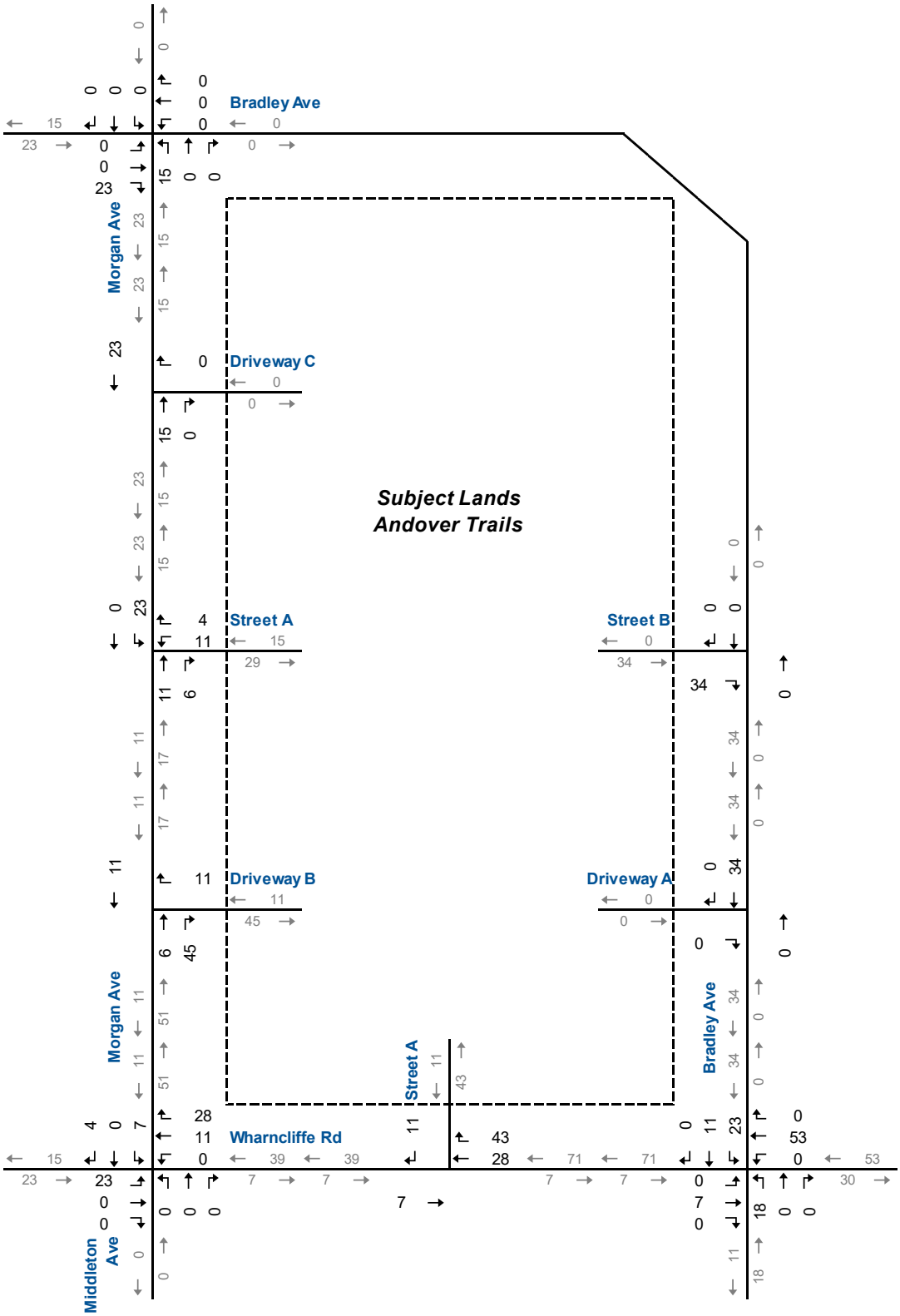


NTS

2027 Site Generated Traffic Volumes AM Peak Hour

Andover Trails, 3480 Morgan Avenue, London | TIA
220050

Figure 3.2a



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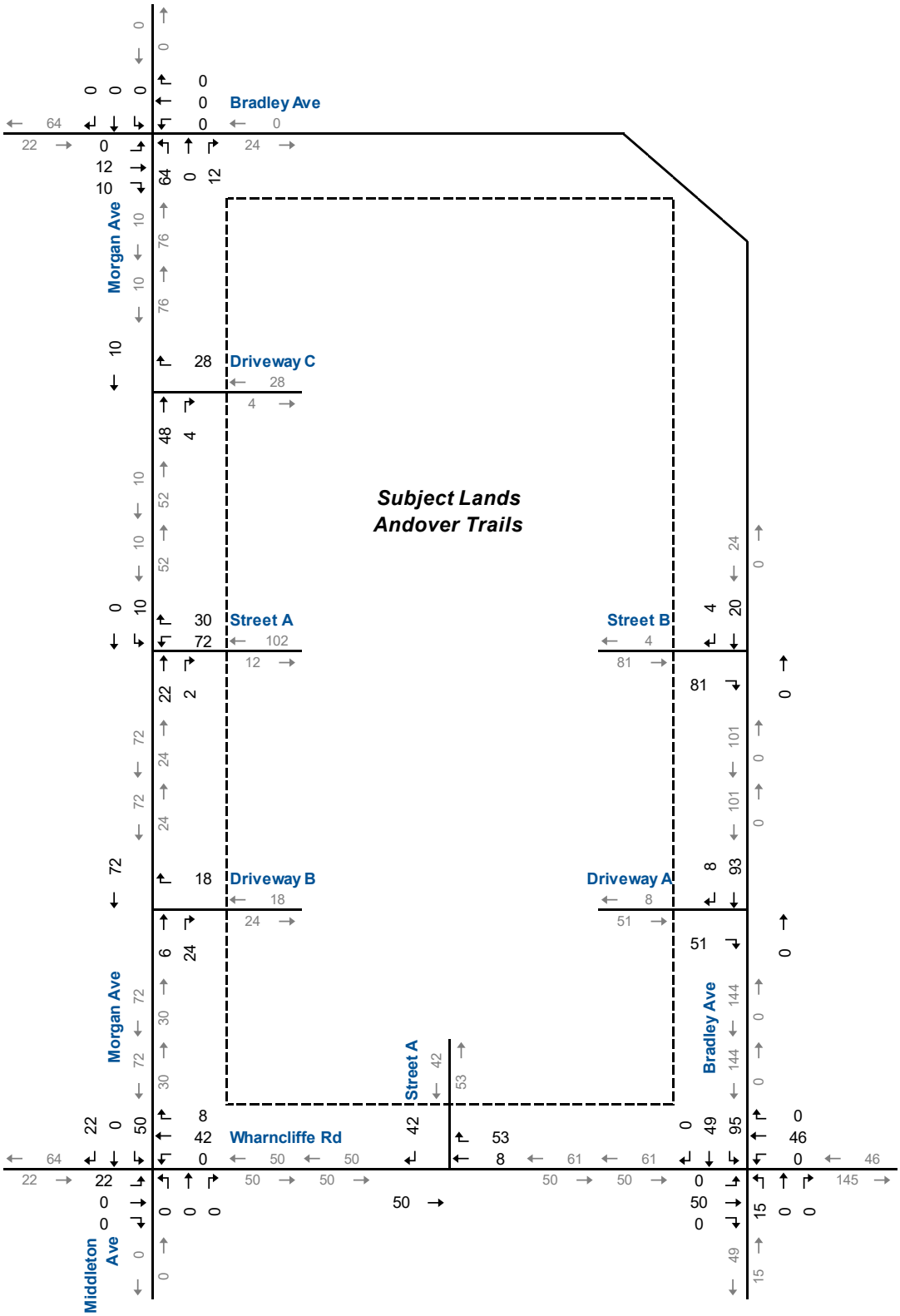
2027 Site Generated Traffic Volumes PM Peak Hour



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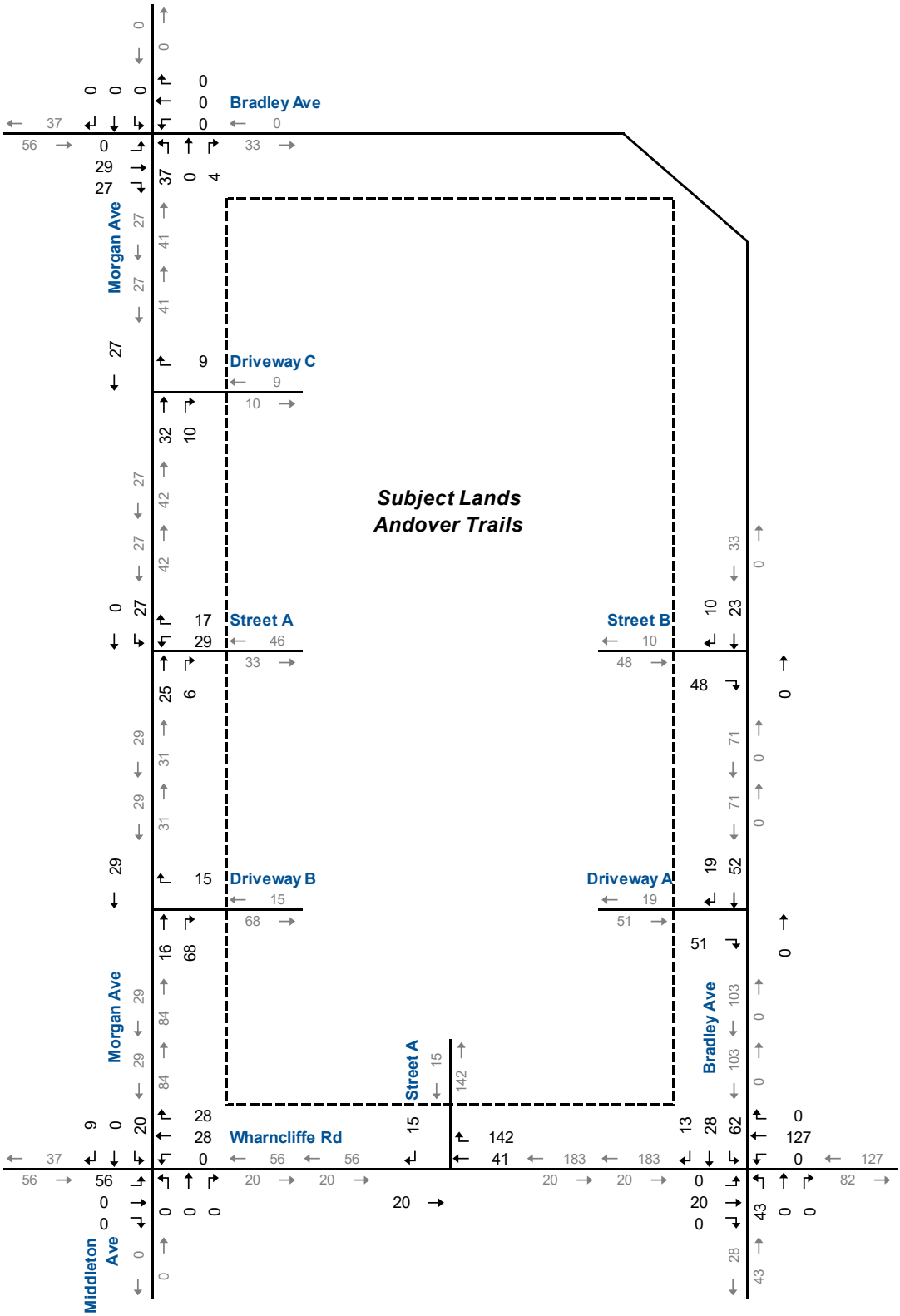
2030 Site Generated Traffic Volumes AM Peak Hour

Andover Trails, 3480 Morgan Avenue, London | TIA
220050

Figure 3.3a



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2030 Site Generated Traffic Volumes PM Peak Hour

Andover Trails, 3480 Morgan Avenue, London | TIA
220050

Figure 3.3b

4 Evaluation of Future Traffic Conditions

The assessment of future traffic conditions in this section includes estimates of future background and total traffic volumes, and the analyses for the 2027, 2030 and 2035 horizon years.

As noted, Driveway B at Morgan Avenue is analyzed both as a restricted RIRO access (**Sections 4.2** to **4.7**) and as an all-moves access (**Section 4.8**).

4.1 Background Traffic Forecasts

To derive the 2027, 2030 and 2035 generalized background traffic volumes, a growth rate of 1.5% was applied to the existing roadway traffic volumes. This growth rate was confirmed with the City during the pre-study consultation.

4.1.1 Other Area Developments

In consultation with City staff, the following developments have been included in estimating background traffic volumes:

- 3433 Morgan Avenue: Residential development comprising 12-storey and 14-storey residential towers, and eight townhouses. A total of 300 residential units are proposed within the residential towers. Based on ITE rates, the development is forecast to generate 100 AM peak hour trips and 117 PM peak hour trips.
- 146 Exeter Road (North-East): Residential subdivision with a commercial component located in the north-east portion of the Richardson North lands. The development consists of 366 single-family units, 326 townhouse units and 93,108 square feet (8,650 square metres) GFA of commercial uses. The development is forecast to generate 500 AM peak hour trips and 757 PM peak hour trips[4].
- Goldfield Subdivision: Residential subdivision located immediately east of 146 Exeter Road and consists of 78 single-family units and 254 townhouse units. The development is forecast to generate 176 AM peak hour trips and 215 PM peak hour trips[5].

[4] *146 Exeter Road (North-East), London, Transportation Impact Assessment*, Prepared by Paradigm Transportation Solutions Limited. September 2021.
[5] *Goldfield Subdivision, London Transportation Impact Assessment*, Prepared by Paradigm Transportation Solutions Limited. September 2021.

- 284 Exeter Road: Residential subdivision located immediately east of Goldfield Subdivision and consists of 8.249 ha of low density residential (247 units) and 6.367 ha of medium density residential (477 units). Based on ITE rates, the development is forecast to generate 390 AM peak hour trips and 479 PM peak hour trips.
- 1789 Wharncliffe Road South: Commercial development located in the northwest corner of Wharncliffe Road South and Wonderland Road South and consists of approximately 640,000 square feet of retail commercial GFA amongst 32 buildings. The development is forecast to generate 443 AM peak hour trips and 1,550 PM peak hour trips[6].

All developments are assumed to be completed by 2027.

Figure 4.1 illustrates the location of the other area developments.

Appendix D contains the other area development traffic volumes.

4.1.2 Network Improvements

Bradley Avenue is to be extended between Wharncliffe Road South and White Oak Road by 2023.

Due to the high volumes forecast at the intersection of Wharncliffe Road South and Bradley Avenue, traffic control signals have been assumed under future traffic conditions.

[6] *Proposed Commercial Development Wonderland Road and Wharncliffe Road, City of London Final Traffic Impact Study*, Prepared by Dillon Consulting Group. July 2015.

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Other Area Development Locations

4.2 2027 Background Traffic Operations

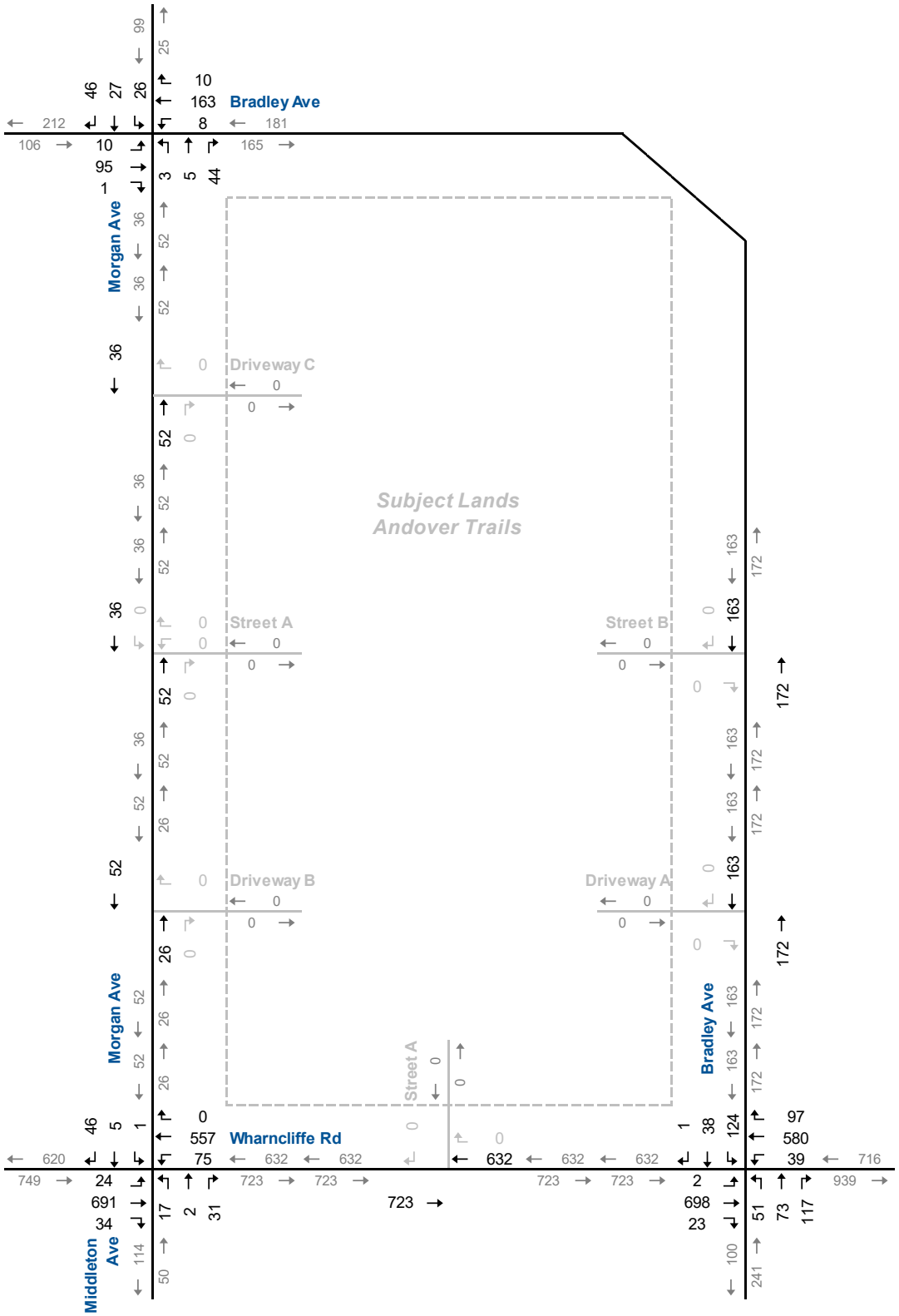
Figure 4.2a and **Figure 4.2b** illustrate the 2027 background traffic volumes, including road traffic growth and other area development traffic.

The 2027 background traffic volumes have been analyzed using the same methodology as under existing traffic conditions. The Bradley Avenue extension and signal traffic control at Wharncliffe Road is assumed to be in place.

Table 4.1 summarizes the results of the 2027 background traffic operations. The results indicate that the study area intersections are forecast to operate with the same critical movements as under existing traffic conditions, with the addition of the following movements at the intersection of Wharncliffe Road and Middleton Avenue/Morgan Avenue:

- The northbound and southbound left-turn movements are forecast to operate with LOS E during the AM peak hour; and
- The northbound shared through/right-turn movement is forecast to operate with LOS E during the PM peak hour.

Appendix E contains the supporting detailed Synchro 10 reports.



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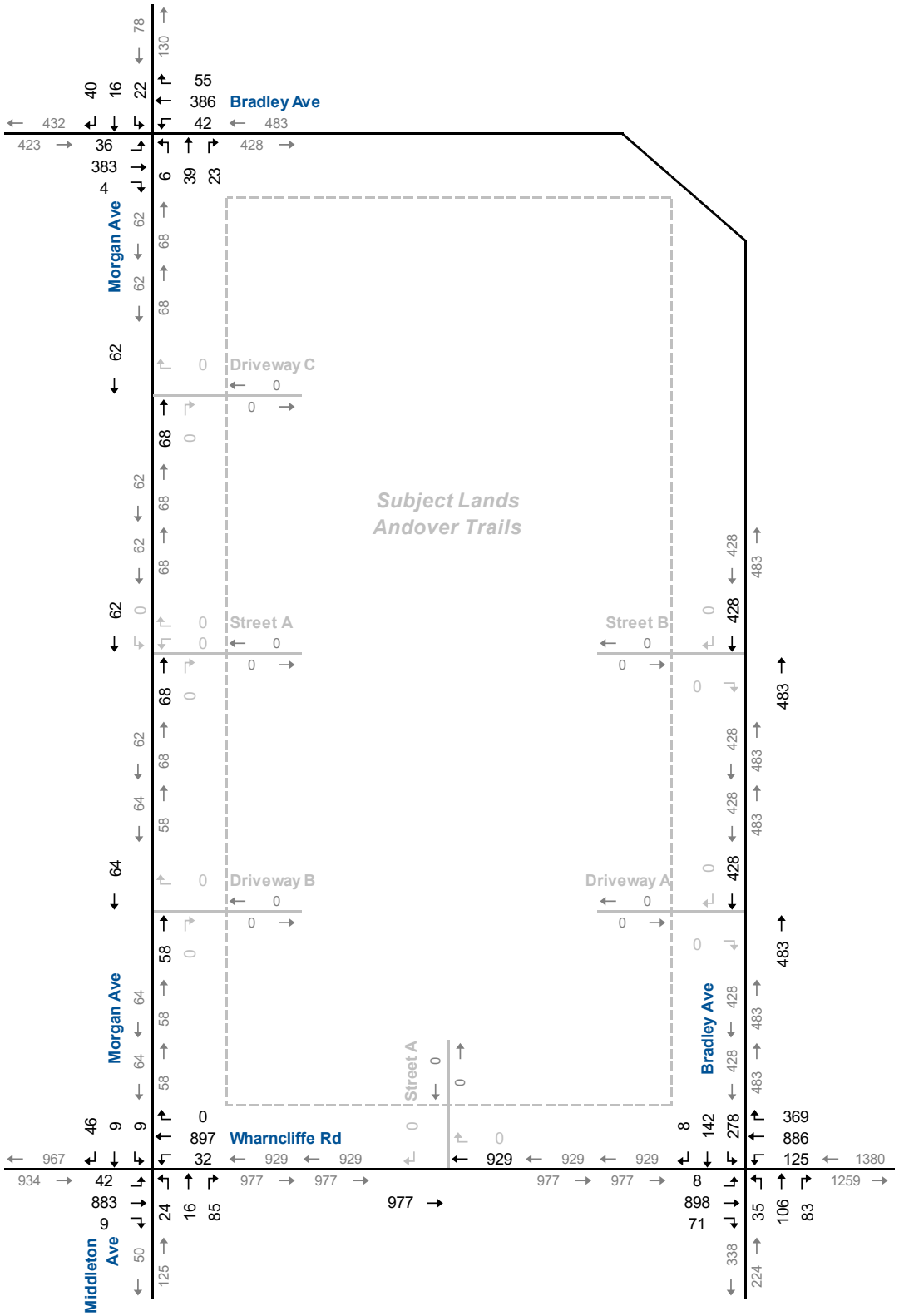
2027 Background Traffic Volumes AM Peak Hour



NTS

2027 Background Traffic Volumes PM Peak Hour

TABLE 4.1: 2027 BACKGROUND TRAFFIC OPERATIONS

Analysis Period	Intersection	Control Type	MOE	Direction/Movement/Approach																
				Eastbound				Westbound				Northbound				Southbound				Overall
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
AM Peak Hour	Middleton Avenue/Morgan Avenue & Wharncliffe Road South	TWSC	LOS	A	A	A	**A**	A	A	A	**A**	F	C	>	**D**	E	B	>	**C**	
			Delay	9	0	0	**0**	10	0	0	**1**	51	16	>	**28**	36	15	>	**15**	
			V/C	0.03	0.00	0.00		0.10	0.00	0.00		0.19	0.10	>		0.01	0.13	>		
			Q	1	0	0		2	0	0		5	2	>		0	4	>		
			Stor.	90	-	60		85	-	60		45	-	>		50	-	>		
			Avail.	89	-	60		83	-	60		40	-	>		50	-	>		
	Wharncliffe Road South & Bradley Avenue	TCS	LOS	B	B	>	**B**	A	B	A	**B**	C	B	>	**B**	B	B	>	**B**	**B**
			Delay	16	20	>	**20**	10	12	3	**11**	30	14	>	**17**	16	14	>	**15**	**16**
			V/C	0.01	0.65	>		0.13	0.43	0.14		0.26	0.34	>		0.29	0.04	>		
			Q	2	66	>		8	41	7		17	14	>		24	5	>		
			Stor.	110	-	>		110	-	45		80	-	>		80	-	>		
			Avail.	108	-	>		102	-	38		63	-	>		56	-	>		
	Morgan Avenue & Bradley Avenue	TWSC	LOS	A	A	>	**A**	A	A	>	**A**	B	A	>	**A**	B	B	>	**B**	
			Delay	8	0	>	**1**	7	0	>	**0**	11	9	>	**9**	11	10	>	**10**	
			V/C	0.01	0.00	>		0.01	0.00	>		0.01	0.06	>		0.05	0.10	>		
			Q	0	0	>		0	0	>		0	2	>		1	2	>		
			Stor.	45	-	>		45	-	>		45	-	>		45	-	>		
			Avail.	45	-	>		45	-	>		45	-	>		44	-	>		
PM Peak Hour	Middleton Avenue/Morgan Avenue & Wharncliffe Road South	TWSC	LOS	B	A	A	**A**	B	A	A	**A**	F	E	>	**F**	F	D	>	**E**	
			Delay	11	0	0	**0**	10	0	0	**0**	147	48	>	**68**	144	32	>	**48**	
			V/C	0.07	0.00	0.00		0.05	0.00	0.00		0.54	0.59	>		0.28	0.31	>		
			Q	2	0	0		2	0	0		15	24	>		7	10	>		
			Stor.	90	-	60		85	-	60		45	-	>		50	-	>		
			Avail.	88	-	60		83	-	60		30	-	>		43	-	>		
	Wharncliffe Road South & Bradley Avenue	TCS	LOS	B	C	>	**C**	B	B	A	**B**	D	C	>	**C**	C	B	>	**C**	**B**
			Delay	15	25	>	**25**	19	14	3	**11**	37	22	>	**24**	29	18	>	**25**	**18**
			V/C	0.04	0.79	>		0.57	0.54	0.41		0.28	0.45	>		0.68	0.14	>		
			Q	4	91	>		19	64	16		14	19	>		65	16	>		
			Stor.	110	-	>		110	-	45		80	-	>		80	-	>		
			Avail.	106	-	>		91	-	29		66	-	>		15	-	>		
	Morgan Avenue & Bradley Avenue	TWSC	LOS	A	A	>	**A**	A	A	>	**A**	C	C	>	**C**	D	B	>	**C**	
			Delay	8	0	>	**1**	8	0	>	**1**	21	22	>	**22**	26	15	>	**18**	
			V/C	0.04	0.00	>		0.04	0.00	>		0.03	0.24	>		0.12	0.14	>		
			Q	1	0	>		1	0	>		1	7	>		3	4	>		
			Stor.	45	-	>		45	-	>		45	-	>		45	-	>		
			Avail.	44	-	>		44	-	>		44	-	>		42	-	>		

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds
V/C - Volume to Capacity Ratio
Q - 95th Percentile Queue Length (m)
Stor. - Existing Storage (m)
Avail. - Available Storage (m)
TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
< / > - Shared with through movement

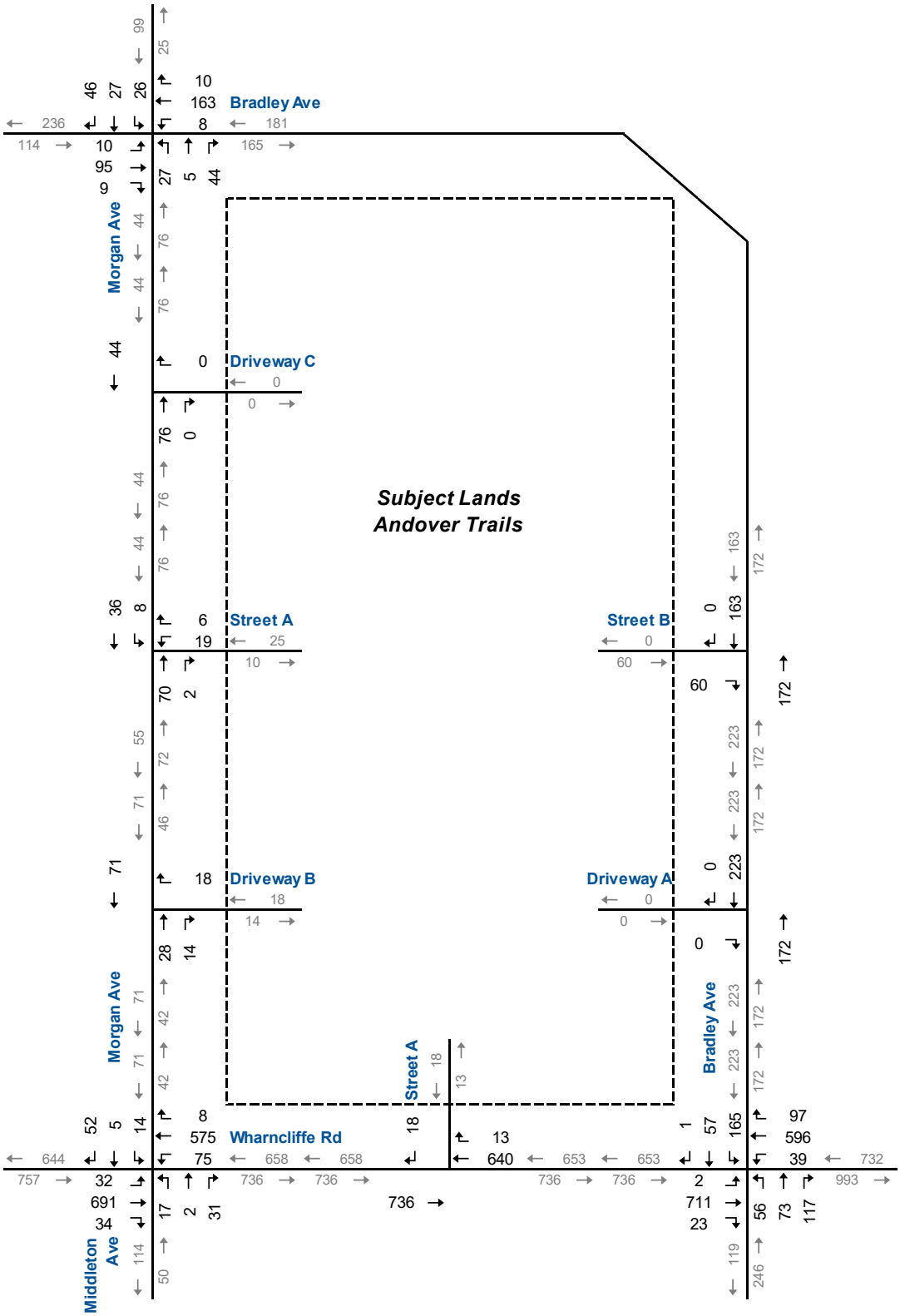
4.3 2027 Total Traffic Operations

Figure 4.3a and **Figure 4.3b** illustrate the 2027 total traffic volumes, including trips generated by Stage 1 of the proposed development.

The 2027 total traffic volumes have been analyzed using the same methodology as under existing and background traffic conditions. Signal timings at Bradley Avenue and Wharncliffe Road have not been optimized.

Table 4.2a and **Table 4.2b** summarize the results of the 2027 total traffic operations. The results indicate that the study area intersections are forecast to operate with the same critical movements as under 2027 background traffic conditions.

Appendix F contains the supporting detailed Synchro 10 reports.



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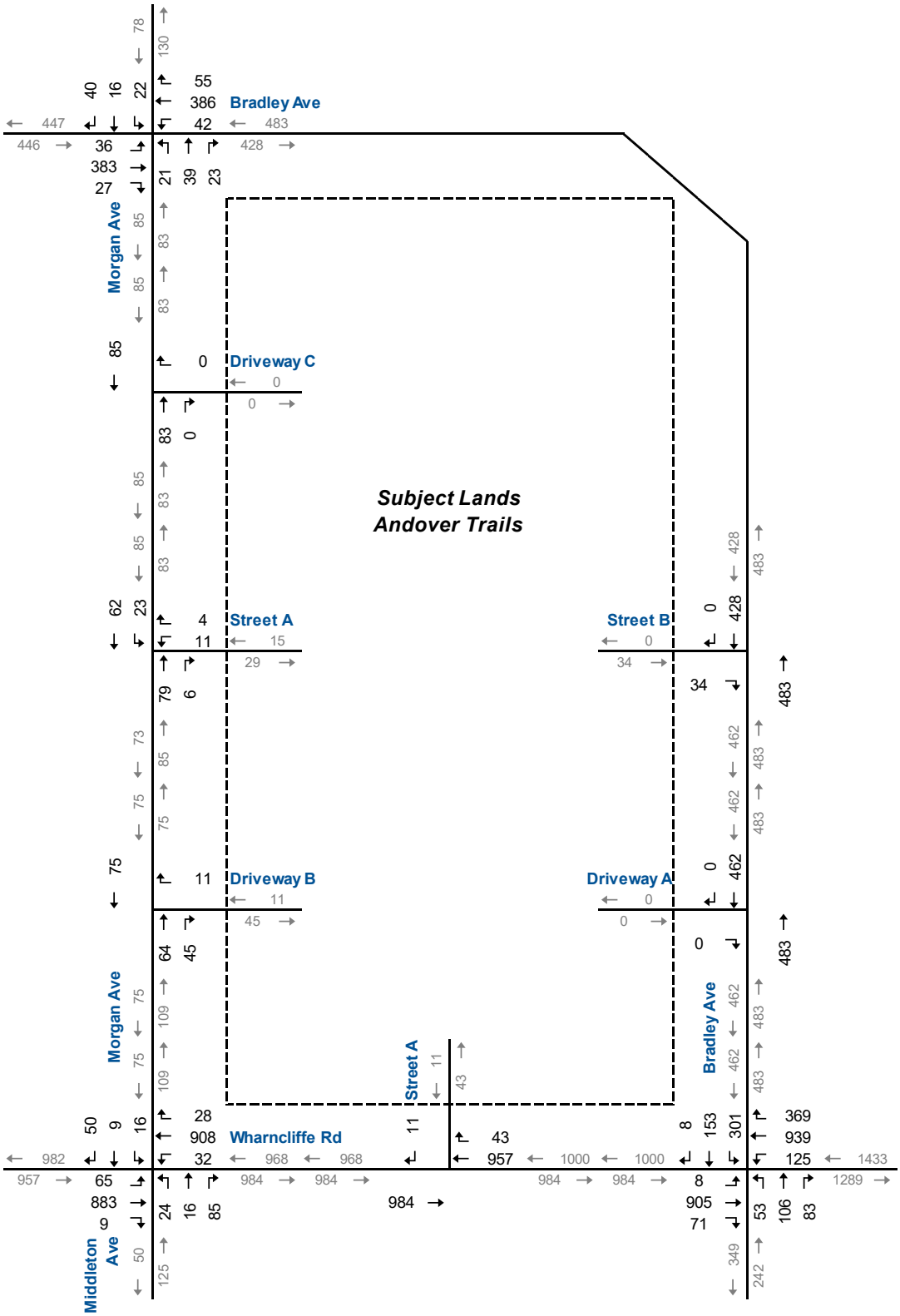
2027 Total Traffic Volumes AM Peak Hour

Andover Trails, 3480 Morgan Avenue, London | TIA
220050

Figure 4.3a



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2027 Total Traffic Volumes PM Peak Hour

Andover Trails, 3480 Morgan Avenue, London | TIA
220050

Figure 4.3b

TABLE 4.2A: 2027 TOTAL TRAFFIC OPERATIONS – AM PEAK HOUR

Analysis Period	Intersection	Control Type	MOE	Direction/Movement/Approach																
				Eastbound				Westbound				Northbound				Southbound				Overall
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
AM Peak Hour	Middleton Avenue/Morgan Avenue & Wharncliffe Road South	TWSC	LOS	A	A	A	**A**	A	A	A	**A**	F	C	>	**D**	E	C	>	**C**	
			Delay	10	0	0	**0**	10	0	0	**1**	56	16	>	**30**	43	15	>	**21**	
			V/C	0.04	0.00	0.00		0.10	0.00	0.00		0.21	0.10	>		0.14	0.15	>		
			Q	1	0	0		2	0	0		5	2	>		4	4	>		
			Stor.	90	-	60		85	-	60		45	-	>		50	-	>		
			Avail.	89	-	60		83	-	60		40	-	>		46	-	>		
	Wharncliffe Road South & Bradley Avenue	TCS	LOS	B	C	>	**C**	B	B	A	**B**	C	B	>	**B**	B	B	>	**B**	**B**
			Delay	16	22	>	**22**	11	14	3	**12**	32	14	>	**18**	16	14	>	**16**	**17**
			V/C	0.01	0.70	>		0.14	0.47	0.15		0.31	0.35	>		0.36	0.05	>		
			Q	2	68	>		8	43	7		19	14	>		31	7	>		
			Stor.	110	-	>		110	-	45		80	-	>		80	-	>		
			Avail.	108	-	>		102	-	38		61	-	>		49	-	>		
	Morgan Avenue & Bradley Avenue	TWSC	LOS	A	A	>	**A**	A	A	>	**A**	B	A	>	**A**	B	B	>	**B**	
			Delay	8	0	>	**1**	7	0	>	**0**	11	9	>	**10**	11	10	>	**10**	
			V/C	0.01	0.00	>		0.01	0.00	>		0.05	0.06	>		0.05	0.10	>		
			Q	0	0	>		0	0	>		1	2	>		1	2	>		
			Stor.	45	-	>		45	-	>		45	-	>		45	-	>		
			Avail.	45	-	>		45	-	>		44	-	>		44	-	>		
	Wharncliffe Road South & Street A	TWSC	LOS		A		**A**		A	>	**A**					B			**B**	
			Delay		0		**0**		0	>	**0**					11			**11**	
			V/C		0.00				0.00	>						0.03				
			Q		0				0	>						1				
	Bradley Avenue & Street B	TWSC	LOS			A	**A**						A		**A**		A	>	**A**	
			Delay			9	**9**						0		**0**		0	>	**0**	
			V/C			0.07							0.00				0.00	>		
			Q			2							0				0	>		
	Morgan Avenue & Driveway B	TWSC	LOS					A			**A**		A	>	**A**		A		**A**	
			Delay					8			**8**		0	>	**0**		0		**0**	
			V/C					0.02					0.00	>			0.00			
			Q					1					0	>			0			
	Morgan Avenue & Street A	TWSC	LOS					A		>	**A**		A	>	**A**	<	A		**A**	
			Delay					9		>	**9**		0	>	**0**	<	7		**1**	
			V/C					0.03		>			0.00	>		<	0.01			
			Q					1		>			0	>		<	0			

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds
V/C - Volume to Capacity Ratio
Q - 95th Percentile Queue Length (m)
Stor. - Existing Storage (m)
Avail. - Available Storage (m)
TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
< / > - Shared with through movement

TABLE 4.2B: 2027 TOTAL TRAFFIC OPERATIONS – PM PEAK HOUR

Analysis Period	Intersection	Control Type	MOE	Direction/Movement/Approach																
				Eastbound				Westbound				Northbound				Southbound				Overall
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
PM Peak Hour	Middleton Avenue/Morgan Avenue & Wharncliffe Road South	TWSC	LOS	B	A	A	**A**	B	A	A	**A**	F	F	>	**F**	F	D	>	**F**	
			Delay	11	0	0	**1**	10	0	0	**0**	189	63	>	**87**	256	35	>	**82**	
			V/C	0.11	0.00	0.00		0.05	0.00	0.00		0.64	0.67	>		0.62	0.35	>		
			Q	3	0	0		2	0	0		17	29	>		15	11	>		
			Stor.	90	-	60		85	-	60		45	-	>		50	-	>		
			Avail.	87	-	60		83	-	60		28	-	>		35	-	>		
	Wharncliffe Road South & Bradley Avenue	TCS	LOS	B	C	>	**C**	C	B	A	**B**	D	C	>	**C**	C	B	>	**C**	**B**
			Delay	16	26	>	**26**	21	15	4	**12**	40	21	>	**25**	30	18	>	**26**	**20**
			V/C	0.05	0.80	>		0.59	0.58	0.41		0.39	0.42	>		0.72	0.14	>		
			Q	4	97	>		22	74	19		20	18	>		72	17	>		
			Stor.	110	-	>		110	-	45		80	-	>		80	-	>		
			Avail.	106	-	>		88	-	26		60	-	>		8	-	>		
	Morgan Avenue & Bradley Avenue	TWSC	LOS	A	A	>	**A**	A	A	>	**A**	C	C	>	**C**	D	B	>	**C**	
			Delay	8	0	>	**1**	8	0	>	**1**	23	22	>	**22**	26	15	>	**18**	
			V/C	0.04	0.00	>		0.04	0.00	>		0.10	0.24	>		0.12	0.14	>		
			Q	1	0	>		1	0	>		2	7	>		3	4	>		
			Stor.	45	-	>		45	-	>		45	-	>		45	-	>		
			Avail.	44	-	>		44	-	>		43	-	>		42	-	>		
	Wharncliffe Road South & Street A	TWSC	LOS		A		**A**		A	>	**A**					B			**B**	
			Delay		0		**0**		0	>	**0**					13			**13**	
			V/C		0.00				0.00	>						0.03				
			Q		0				0	>						1				
	Bradley Avenue & Street B	TWSC	LOS			A	**A**						A		**A**		A	>	**A**	
			Delay			10	**10**						0		**0**		0	>	**0**	
			V/C			0.05							0.00				0.00	>		
			Q			1							0				0	>		
	Morgan Avenue & Driveway B	TWSC	LOS					A			**A**		A	>	**A**		A		**A**	
			Delay					9			**9**		0	>	**0**		0		**0**	
			V/C					0.01					0.00	>			0.00			
			Q					0					0	>			0			
	Morgan Avenue & Street A	TWSC	LOS					A		>	**A**		A	>	**A**	<	A		**A**	
			Delay					10		>	**10**		0	>	**0**	<	7		**2**	
			V/C					0.02		>			0.00	>		<	0.02			
			Q					1		>			0	>		<	1			

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds
V/C - Volume to Capacity Ratio
Q - 95th Percentile Queue Length (m)
Stor. - Existing Storage (m)
Avail. - Available Storage (m)
TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
< / > - Shared with through movement

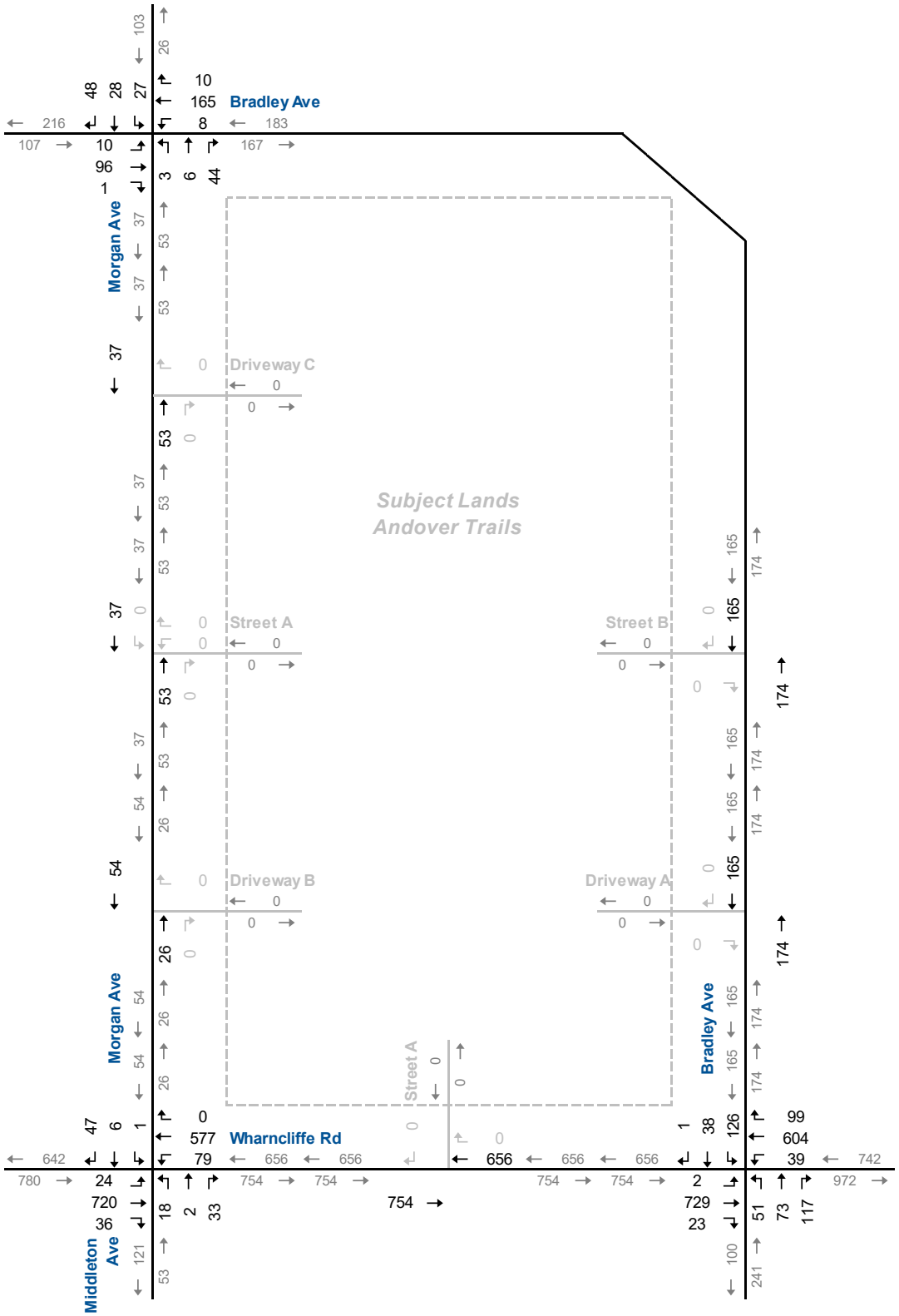
4.4 2030 Background Traffic Operations

Figure 4.4a and **Figure 4.4b** illustrate the 2030 background traffic volumes, including road traffic growth and other area development traffic.

The 2030 background traffic volumes have been analyzed using the same methodology as under existing traffic conditions. Signal timings at Bradley Avenue and Wharncliffe Road have not been optimized.

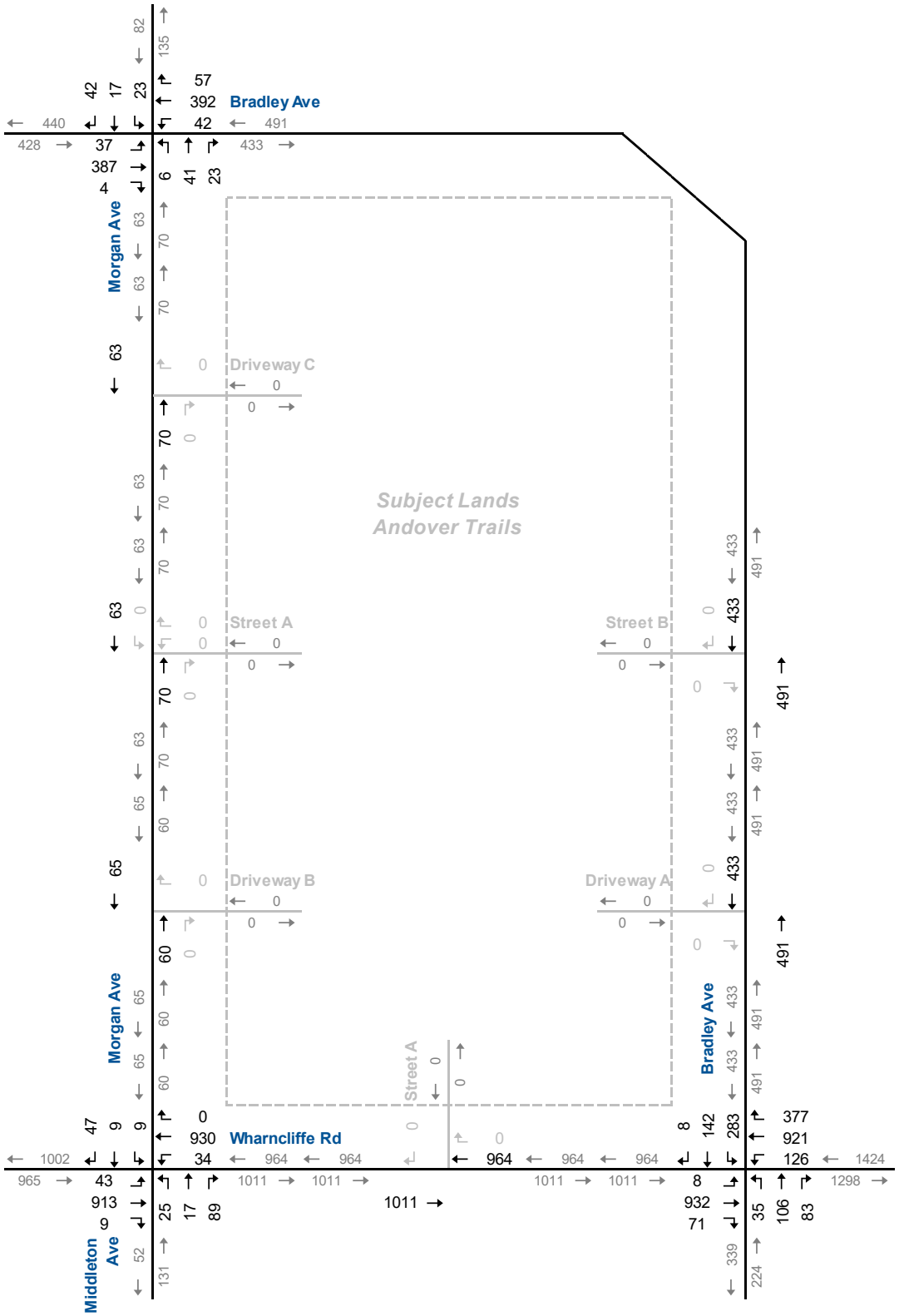
Table 4.3 summarizes the results of the 2030 background traffic operations. The results indicate that the study area intersections are forecast to operate with the same critical movements as under 2027 background traffic conditions, with the addition of the southbound shared through/right-turn movement at Wharncliffe Road and Middleton Avenue/Morgan Avenue which is forecast to operate with LOS E during the PM peak hour.

Appendix G contains the supporting detailed Synchro 10 reports.



NTS

2030 Background Traffic Volumes AM Peak Hour



NTS

2030 Background Traffic Volumes PM Peak Hour

TABLE 4.3: 2030 BACKGROUND TRAFFIC OPERATIONS

Analysis Period	Intersection	Control Type	MOE	Direction/Movement/Approach																
				Eastbound				Westbound				Northbound				Southbound				Overall
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
AM Peak Hour	Middleton Avenue/Morgan Avenue & Wharncliffe Road South	TWSC	LOS	A	A	A	**A**	B	A	A	**A**	F	C	>	**D**	E	C	>	**C**	
			Delay	10	0	0	**0**	10	0	0	**1**	60	16	>	**31**	39	16	>	**17**	
			V/C	0.03	0.00	0.00		0.11	0.00	0.00		0.23	0.11	>		0.01	0.15	>		
			Q	1	0	0		3	0	0		6	3	>		0	4	>		
			Stor.	90	-	60		85	-	60		45	-	>		50	-	>		
			Avail.	89	-	60		82	-	60		39	-	>		50	-	>		
	Wharncliffe Road South & Bradley Avenue	TCS	LOS	B	B	>	**B**	A	B	A	**B**	C	B	>	**B**	B	B	>	**B**	**B**
			Delay	16	20	>	**20**	10	12	3	**11**	31	14	>	**17**	16	15	>	**16**	**16**
			V/C	0.01	0.66	>		0.13	0.44	0.14		0.26	0.34	>		0.30	0.04	>		
			Q	2	69	>		7	43	7		17	14	>		25	5	>		
			Stor.	110	-	>		110	-	45		80	-	>		80	-	>		
			Avail.	108	-	>		103	-	38		63	-	>		55	-	>		
	Morgan Avenue & Bradley Avenue	TWSC	LOS	A	A	>	**A**	A	A	>	**A**	B	A	>	**A**	B	B	>	**B**	
			Delay	8	0	>	**1**	7	0	>	**0**	11	9	>	**9**	11	10	>	**10**	
			V/C	0.01	0.00	>		0.01	0.00	>		0.01	0.06	>		0.05	0.11	>		
			Q	0	0	>		0	0	>		0	2	>		2	3	>		
			Stor.	45	-	>		45	-	>		45	-	>		45	-	>		
			Avail.	45	-	>		45	-	>		45	-	>		43	-	>		
PM Peak Hour	Middleton Avenue/Morgan Avenue & Wharncliffe Road South	TWSC	LOS	B	A	A	**A**	B	A	A	**A**	F	F	>	**F**	F	E	>	**F**	
			Delay	11	0	0	**0**	11	0	0	**0**	181	60	>	**83**	183	35	>	**56**	
			V/C	0.07	0.00	0.00		0.05	0.00	0.00		0.63	0.67	>		0.34	0.34	>		
			Q	2	0	0		2	0	0		18	29	>		8	10	>		
			Stor.	90	-	60		85	-	60		45	-	>		50	-	>		
			Avail.	88	-	60		83	-	60		27	-	>		42	-	>		
	Wharncliffe Road South & Bradley Avenue	TCS	LOS	B	C	>	**C**	C	B	A	**B**	D	C	>	**C**	C	B	>	**C**	**B**
			Delay	15	25	>	**25**	20	14	3	**12**	38	22	>	**24**	31	18	>	**26**	**19**
			V/C	0.04	0.79	>		0.59	0.55	0.41		0.28	0.46	>		0.70	0.14	>		
			Q	4	96	>		20	67	17		14	19	>		68	16	>		
			Stor.	110	-	>		110	-	45		80	-	>		80	-	>		
			Avail.	106	-	>		90	-	28		66	-	>		12	-	>		
	Morgan Avenue & Bradley Avenue	TWSC	LOS	A	A	>	**A**	A	A	>	**A**	C	C	>	**C**	D	C	>	**C**	
			Delay	8	0	>	**1**	8	0	>	**1**	22	22	>	**22**	27	15	>	**18**	
			V/C	0.04	0.00	>		0.04	0.00	>		0.03	0.25	>		0.13	0.15	>		
			Q	1	0	>		1	0	>		1	8	>		3	4	>		
			Stor.	45	-	>		45	-	>		45	-	>		45	-	>		
			Avail.	44	-	>		44	-	>		44	-	>		42	-	>		

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds
V/C - Volume to Capacity Ratio
Q - 95th Percentile Queue Length (m)
Stor. - Existing Storage (m)
Avail. - Available Storage (m)
TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
< / > - Shared with through movement

4.5 2030 Total Traffic Operations

Figure 4.5a and **Figure 4.5b** illustrate the 2030 total traffic volumes, including trips generated by full build-out of the proposed development.

The 2030 total traffic volumes have been analyzed using the same methodology as under existing and background traffic conditions. Signal timings at Bradley Avenue and Wharncliffe Road have not been optimized.

Table 4.4a and **Table 4.4b** summarize the results of the 2030 total traffic operations. The results indicate that the study area intersections are forecast to operate with the same critical movements as under 2030 background traffic conditions, with the addition of the following movements:

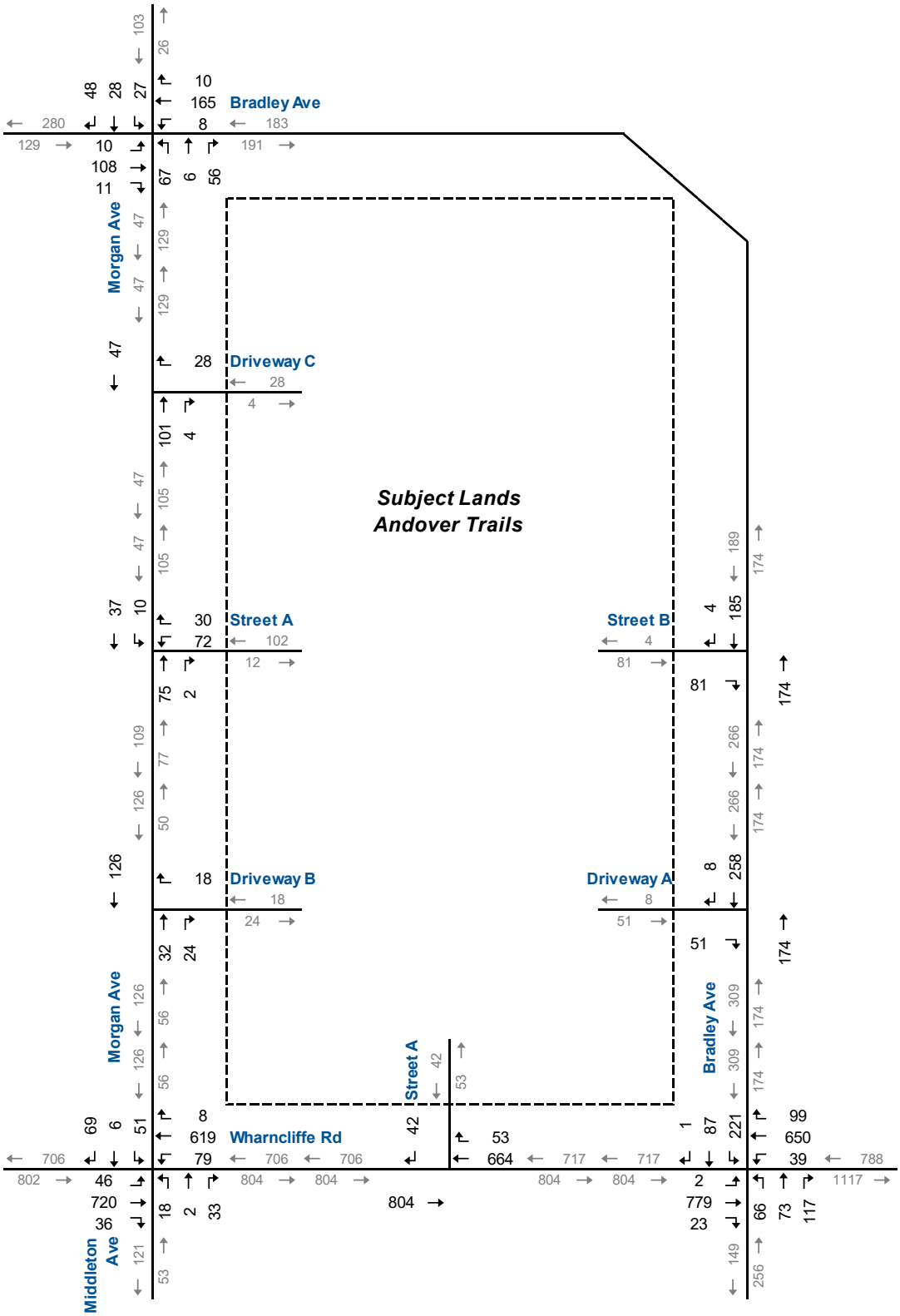
Wharncliffe Road and Middleton Avenue/Morgan Avenue

- The northbound and southbound left-turn movements are forecast to operate with LOS F and a v/c ratio greater than 0.90 during the PM peak hour.

Wharncliffe Road and Bradley Avenue

- The southbound left-turn movement is forecast to operate with 95th percentile queues exceeding the available storage of 80 metres during the PM peak hour.

Appendix H contains the supporting detailed Synchro 10 reports.

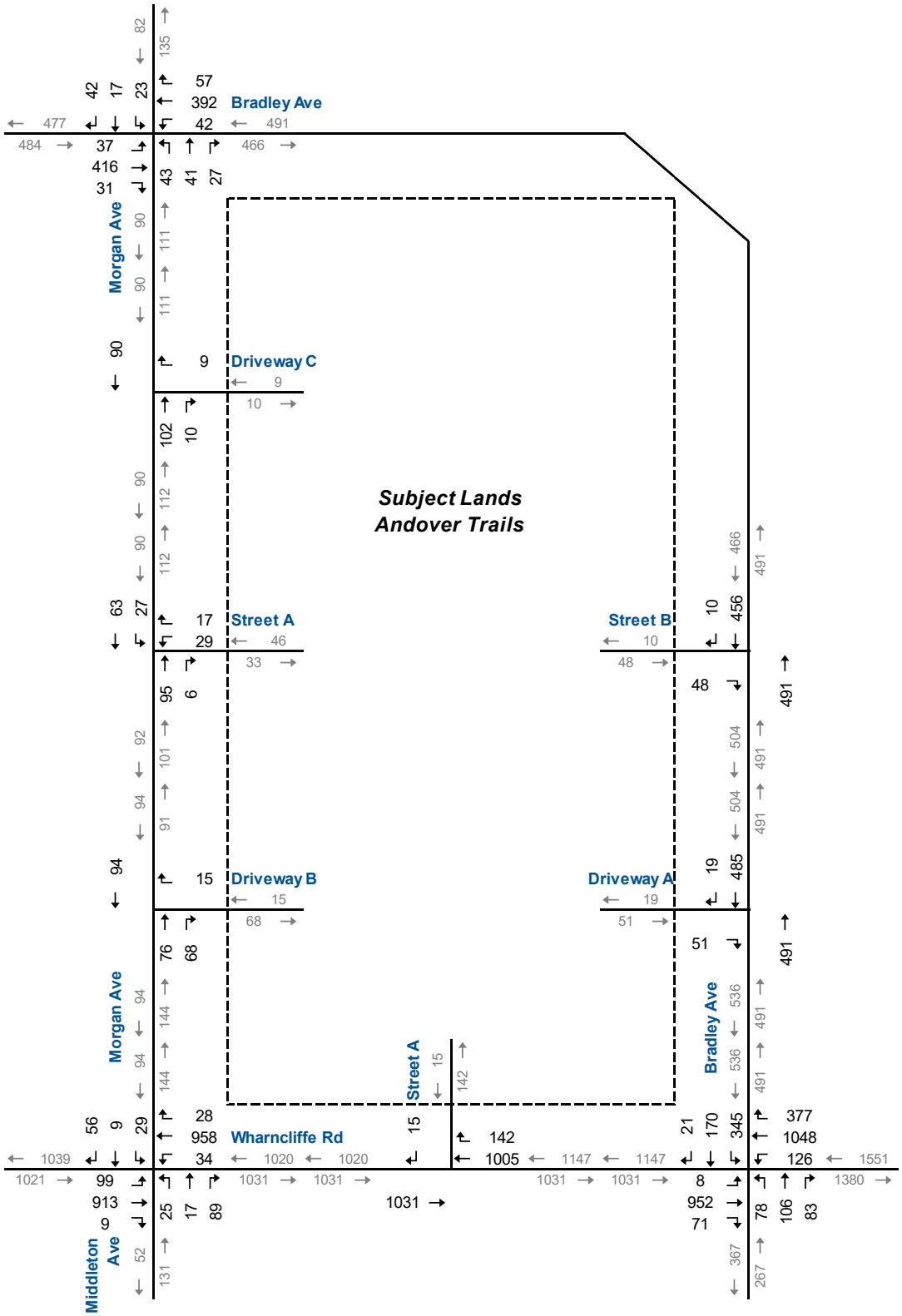


NTS

2030 Total Traffic Volumes AM Peak Hour

Andover Trails, 3480 Morgan Avenue, London | TIA
220050

Figure 4.5a



NTS

2030 Total Traffic Volumes PM Peak Hour

Andover Trails, 3480 Morgan Avenue, London | TIA
220050

Figure 4.5b

TABLE 4.4A: 2030 TOTAL TRAFFIC OPERATIONS – AM PEAK HOUR

Analysis Period	Intersection	Control Type	MOE	Direction/Movement/Approach																
				Eastbound				Westbound				Northbound				Southbound				Overall
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
AM Peak Hour	Middleton Avenue/Morgan Avenue & Wharncliffe Road South	TWSC	LOS	A	A	A	**A**	B	A	A	**A**	F	C	>	**E**	F	C	>	**E**	
			Delay	10	0	0	**1**	10	0	0	**1**	75	17	>	**37**	97	17	>	**49**	
			V/C	0.06	0.00	0.00		0.11	0.00	0.00		0.28	0.12	>		0.62	0.21	>		
			Q	2	0	0		3	0	0		8	3	>		22	6	>		
			Stor.	90	-	60		85	-	60		45	-	>		50	-	>		
			Avail.	88	-	60		82	-	60		37	-	>		28	-	>		
	Wharncliffe Road South & Bradley Avenue	TCS	LOS	B	C	>	**C**	B	B	A	**B**	C	B	>	**B**	B	B	>	**B**	**B**
			Delay	16	23	>	**23**	11	14	3	**13**	35	14	>	**20**	18	15	>	**18**	**18**
			V/C	0.01	0.73	>		0.16	0.49	0.15		0.38	0.35	>		0.47	0.07	>		
			Q	2	77	>		8	48	7		22	15	>		44	10	>		
			Stor.	110	-	>		110	-	45		80	-	>		80	-	>		
			Avail.	108	-	>		102	-	38		58	-	>		36	-	>		
	Morgan Avenue & Bradley Avenue	TWSC	LOS	A	A	>	**A**	A	A	>	**A**	B	A	>	**B**	B	B	>	**B**	
			Delay	8	0	>	**1**	8	0	>	**0**	12	9	>	**11**	12	10	>	**11**	
			V/C	0.01	0.00	>		0.01	0.00	>		0.12	0.07	>		0.05	0.11	>		
			Q	0	0	>		0	0	>		3	2	>		2	3	>		
			Stor.	45	-	>		45	-	>		45	-	>		45	-	>		
			Avail.	45	-	>		45	-	>		42	-	>		43	-	>		
	Wharncliffe Road South & Street A	TWSC	LOS		A		**A**		A	>	**A**					B			**B**	
			Delay		0		**0**		0	>	**0**					11			**11**	
			V/C		0.00				0.00	>						0.07				
			Q		0				0	>						2				
	Bradley Avenue & Driveway A	TWSC	LOS			A	**A**						A		**A**		A	>	**A**	
			Delay			9	**9**						0		**0**		0	>	**0**	
			V/C			0.06							0.00				0.00	>		
			Q			2							0				0	>		
	Bradley Avenue & Street B	TWSC	LOS			A	**A**						A		**A**		A	>	**A**	
			Delay			9	**9**						0		**0**		0	>	**0**	
			V/C			0.09							0.00				0.00	>		
			Q			2							0				0	>		
	Morgan Avenue & Driveway B	TWSC	LOS					A			**A**		A	>	**A**		A		**A**	
			Delay					9			**9**		0	>	**0**		0		**0**	
			V/C					0.02					0.00	>			0.00			
			Q					1					0	>			0			
	Morgan Avenue & Street A	TWSC	LOS					A		>	**A**		A	>	**A**	<	A		**A**	
			Delay					10		>	**10**		0	>	**0**	<	7		**2**	
			V/C					0.13		>			0.00	>		<	0.01			
			Q					3		>			0	>		<	0			
	Morgan Avenue & Driveway C	TWSC	LOS					A			**A**		A	>	**A**		A		**A**	
			Delay					9			**9**		0	>	**0**		0		**0**	
			V/C					0.03					0.00	>			0.00			
			Q					1					0	>			0			

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds
V/C - Volume to Capacity Ratio
Q - 95th Percentile Queue Length (m)
Stor. - Existing Storage (m)
Avail. - Available Storage (m)
TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
< / > - Shared with through movement

TABLE 4.4B: 2030 TOTAL TRAFFIC OPERATIONS – PM PEAK HOUR

Analysis Period	Intersection	Control Type	MOE	Direction/Movement/Approach																	
				Eastbound				Westbound				Northbound				Southbound				Overall
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
PM Peak Hour	Middleton Avenue/Morgan Avenue & Wharncliffe Road South	TWSC	LOS	B	A	A	A	B	A	A	A	F	F	>	F	F	E	>	F	
			Delay	12	0	0	1	11	0	0	0	386	118	>	169	1127	47	>	380	
			V/C	0.18	0.00	0.00		0.05	0.00	0.00		1.01	0.89	>		2.25	0.46	>		
			Q	4	0	0		2	0	0		24	44	>		35	16	>		
			Stor.	90	-	60		85	-	60		45	-	>		50	-	>		
			Avail.	86	-	60		83	-	60		21	-	>		15	-	>		
	Wharncliffe Road South & Bradley Avenue	TCS	LOS	B	C	>	C	C	B	A	B	D	B	>	C	D	B	>	C	C
			Delay	17	28	>	27	25	17	5	14	45	20	>	27	37	18	>	30	22
			V/C	0.06	0.82	>		0.63	0.64	0.43		0.52	0.38	>		0.81	0.17	>		
			Q	4	110	>		26	92	25		27	18	>		89	19	>		
			Stor.	110	-	>		110	-	45		80	-	>		80	-	>		
			Avail.	106	-	>		84	-	20		53	-	>		-9	-	>		
	Morgan Avenue & Bradley Avenue	TWSC	LOS	A	A	>	A	A	A	>	A	D	C	>	D	D	C	>	C	
			Delay	8	0	>	1	8	0	>	1	28	23	>	25	28	16	>	19	
			V/C	0.04	0.00	>		0.04	0.00	>		0.23	0.28	>		0.14	0.16	>		
			Q	1	0	>		1	0	>		6	8	>		4	4	>		
			Stor.	45	-	>		45	-	>		45	-	>		45	-	>		
			Avail.	44	-	>		44	-	>		39	-	>		41	-	>		
	Wharncliffe Road South & Street A	TWSC	LOS		A		A		A	>	A					B			B	
			Delay		0		0		0	>	0					14			14	
			V/C		0.00				0.00	>						0.04				
			Q		0				0	>						1				
	Bradley Avenue & Driveway A	TWSC	LOS			B	B						A		A		A	>	A	
			Delay			10	10						0		0		0	>	0	
			V/C			0.08							0.00				0.00	>		
			Q			2							0				0	>		
	Bradley Avenue & Street B	TWSC	LOS			B	B						A		A		A	>	A	
			Delay			10	10						0		0		0	>	0	
			V/C			0.07							0.00				0.00	>		
			Q			2							0				0	>		
	Morgan Avenue & Driveway B	TWSC	LOS					A			A		A	>	A		A		A	
			Delay					9			9		0	>	0		0		0	
			V/C					0.02					0.00	>			0.00			
			Q					1					0	>			0			
	Morgan Avenue & Street A	TWSC	LOS					A		>	A		A	>	A	<	A		A	
			Delay					10		>	10		0	>	0	<	8		2	
			V/C					0.06		>			0.00	>		<	0.02			
			Q					2		>			0	>		<	1			
	Morgan Avenue & Driveway C	TWSC	LOS					A			A		A	>	A		A		A	
			Delay					9			9		0	>	0		0		0	
			V/C					0.01					0.00	>			0.00			
			Q					0					0	>			0			

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds
V/C - Volume to Capacity Ratio
Q - 95th Percentile Queue Length (m)
Stor. - Existing Storage (m)
Avail. - Available Storage (m)
TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
< / > - Shared with through movement

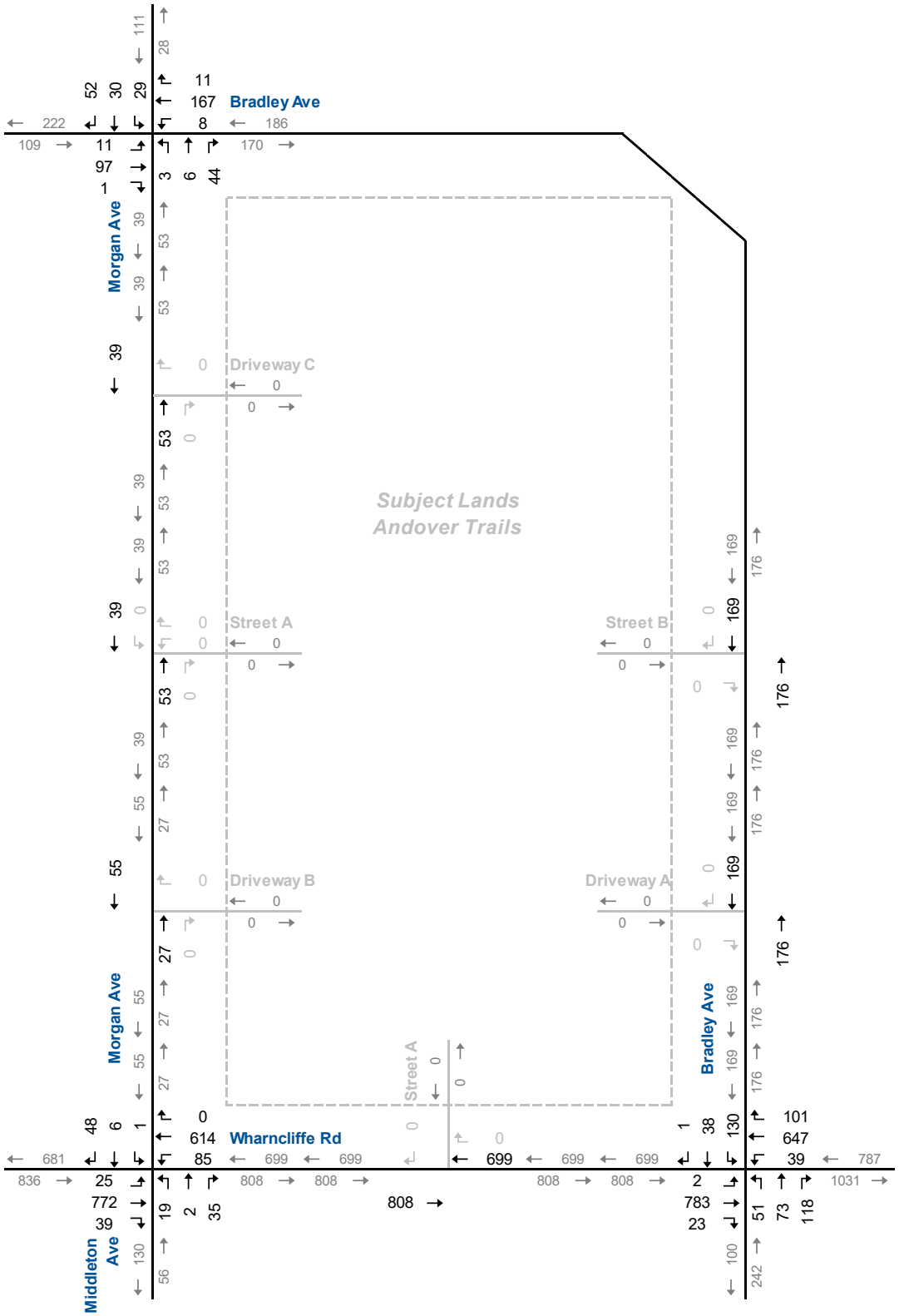
4.6 2035 Background Traffic Operations

Figure 4.6a and **Figure 4.6b** illustrate the 2035 background traffic volumes, including road traffic growth and other area development traffic.

The 2035 background traffic volumes have been analyzed using the same methodology as under existing traffic conditions. Signal timings at Bradley Avenue and Wharncliffe Road have not been optimized.

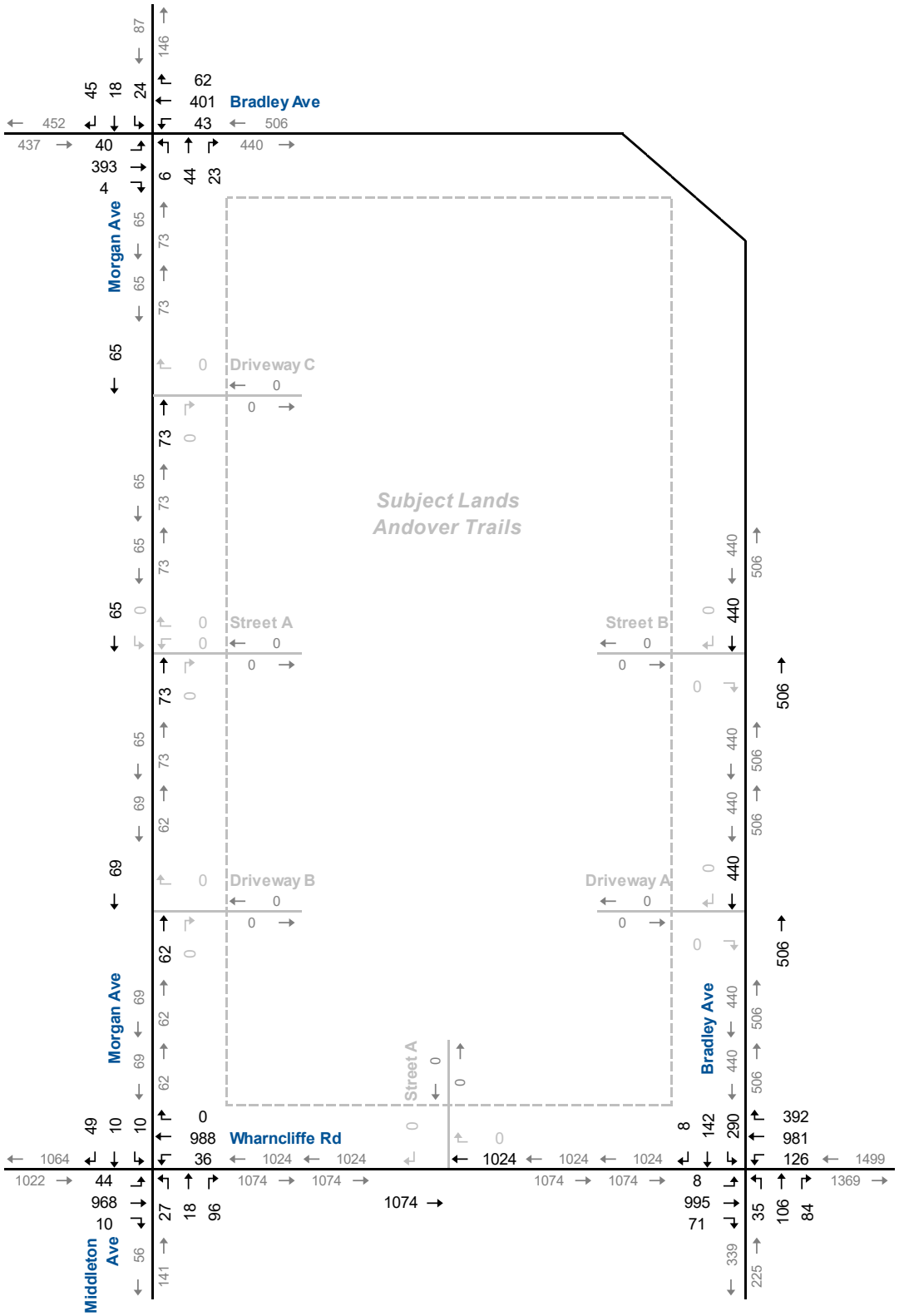
Table 4.5 summarizes the results of the 2035 background traffic operations. The results indicate that the study area intersections are forecast to operate with the same critical movements as under 2030 background traffic conditions.

Appendix I contains the supporting detailed Synchro 10 reports.



NTS

2035 Background Traffic Volumes AM Peak Hour



NTS

2035 Background Traffic Volumes PM Peak Hour

TABLE 4.5: 2035 BACKGROUND TRAFFIC OPERATIONS

Analysis Period	Intersection	Control Type	MOE	Direction/Movement/Approach																
				Eastbound				Westbound				Northbound				Southbound				Overall
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
AM Peak Hour	Middleton Avenue/Morgan Avenue & Wharncliffe Road South	TWSC	LOS	A	A	A	A	B	A	A	A	F	C	>	E	E	C	>	C	
			Delay	10	0	0	0	11	0	0	1	75	17	>	37	45	18	>	18	
			V/C	0.03	0.00	0.00		0.12	0.00	0.00		0.29	0.12	>		0.01	0.17	>		
			Q	1	0	0		3	0	0		8	3	>		0	4	>		
			Stor.	90	-	60		85	-	60		45	-	>		50	-	>		
			Avail.	89	-	60		82	-	60		37	-	>		50	-	>		
	Wharncliffe Road South & Bradley Avenue	TCS	LOS	B	C	>	C	A	B	A	B	C	B	>	B	B	B	>	B	B
			Delay	15	20	>	20	10	13	3	11	32	14	>	18	17	16	>	17	16
			V/C	0.01	0.68	>		0.14	0.46	0.14		0.27	0.35	>		0.31	0.04	>		
			Q	2	75	>		7	46	7		18	15	>		27	5	>		
			Stor.	110	-	>		110	-	45		80	-	>		80	-	>		
			Avail.	108	-	>		103	-	38		62	-	>		53	-	>		
	Morgan Avenue & Bradley Avenue	TWSC	LOS	A	A	>	A	A	A	>	A	B	A	>	A	B	B	>	B	
			Delay	8	0	>	1	7	0	>	0	11	9	>	9	11	10	>	11	
			V/C	0.01	0.00	>		0.01	0.00	>		0.01	0.06	>		0.05	0.12	>		
			Q	0	0	>		0	0	>		0	2	>		2	3	>		
			Stor.	45	-	>		45	-	>		45	-	>		45	-	>		
			Avail.	45	-	>		45	-	>		45	-	>		43	-	>		
PM Peak Hour	Middleton Avenue/Morgan Avenue & Wharncliffe Road South	TWSC	LOS	B	A	A	A	B	A	A	A	F	F	>	F	F	E	>	F	
			Delay	11	0	0	0	11	0	0	0	300	95	>	134	339	46	>	89	
			V/C	0.08	0.00	0.00		0.06	0.00	0.00		0.89	0.84	>		0.57	0.43	>		
			Q	2	0	0		2	0	0		23	41	>		12	14	>		
			Stor.	90	-	60		85	-	60		45	-	>		50	-	>		
			Avail.	88	-	60		83	-	60		22	-	>		38	-	>		
	Wharncliffe Road South & Bradley Avenue	TCS	LOS	B	C	>	C	C	B	A	B	D	C	>	C	C	B	>	C	B
			Delay	15	25	>	25	22	14	4	12	39	23	>	25	34	19	>	29	19
			V/C	0.05	0.80	>		0.61	0.57	0.42		0.29	0.47	>		0.74	0.14	>		
			Q	4	105	>		22	73	20		14	19	>		71	16	>		
			Stor.	110	-	>		110	-	45		80	-	>		80	-	>		
			Avail.	106	-	>		88	-	25		66	-	>		9	-	>		
	Morgan Avenue & Bradley Avenue	TWSC	LOS	A	A	>	A	A	A	>	A	C	C	>	C	D	C	>	C	
			Delay	8	0	>	1	8	0	>	1	22	24	>	24	29	16	>	19	
			V/C	0.04	0.00	>		0.04	0.00	>		0.03	0.28	>		0.15	0.17	>		
			Q	1	0	>		1	0	>		1	8	>		4	4	>		
			Stor.	45	-	>		45	-	>		45	-	>		45	-	>		
			Avail.	44	-	>		44	-	>		44	-	>		41	-	>		

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds
V/C - Volume to Capacity Ratio
Q - 95th Percentile Queue Length (m)
Stor. - Existing Storage (m)
Avail. - Available Storage (m)
TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
< / > - Shared with through movement

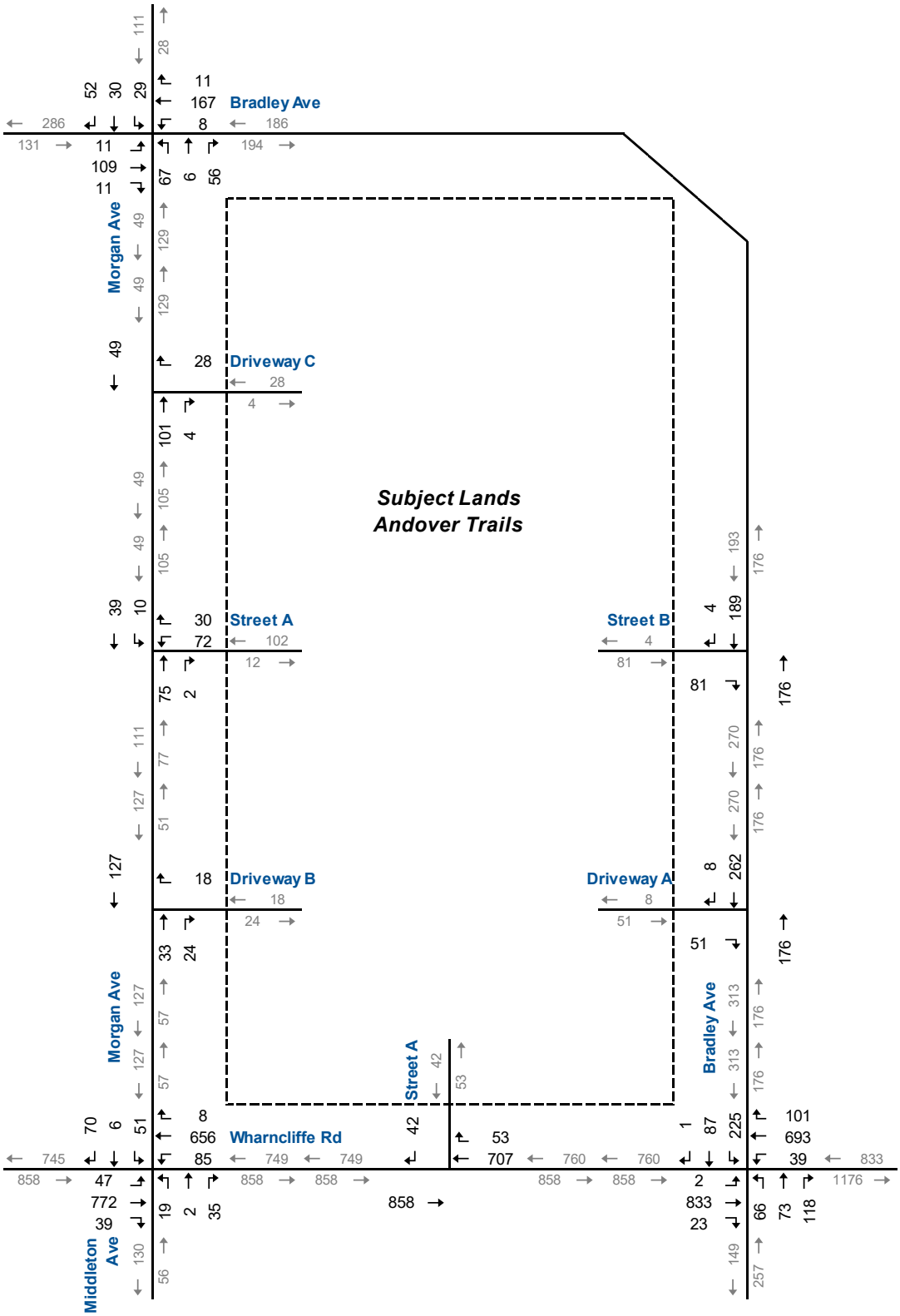
4.7 2035 Total Traffic Operations

Figure 4.7 a and **Figure 4.7b** illustrate the 2035 total traffic volumes, including trips generated by the proposed development.

The 2035 total traffic volumes have been analyzed using the same methodology as under existing and background traffic conditions. Signal timings at Bradley Avenue and Wharncliffe Road have not been optimized.

Table 4.6a and **Table 4.6b** summarize the results of the 2035 total traffic operations. The results indicate that the study area intersections are forecast to operate with the same critical movements as under 2030 total traffic conditions, with the addition of the northbound shared through/right-turn movement at Wharncliffe Road and Middleton Avenue/Morgan Avenue which is forecast to operate with LOS F and a v/c ratio greater than 0.90 during the PM peak hour.

Appendix J contains the supporting detailed Synchro 10 reports.

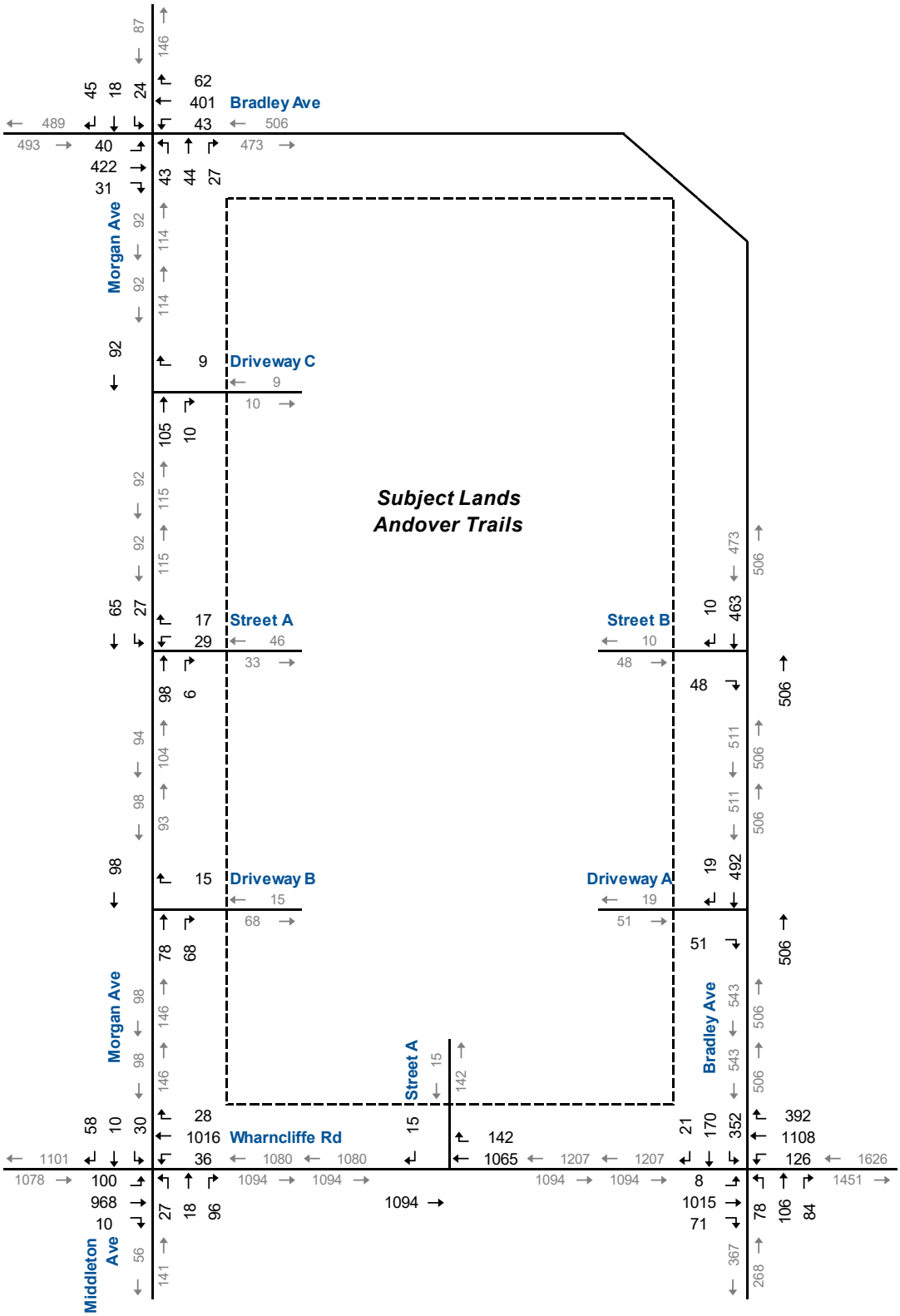


NTS

2035 Total Traffic Volumes AM Peak Hour

Andover Trails, 3480 Morgan Avenue, London | TIA
220050

Figure 4.7a



NTS

2035 Total Traffic Volumes PM Peak Hour

TABLE 4.6A: 2035 TOTAL TRAFFIC OPERATIONS – AM PEAK HOUR

Analysis Period	Intersection	Control Type	MOE	Direction/Movement/Approach																
				Eastbound				Westbound				Northbound				Southbound				Overall
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
AM Peak Hour	Middleton Avenue/Morgan Avenue & Wharncliffe Road South	TWSC	LOS	B	A	A	**A**	B	A	A	**A**	F	C	>	**E**	F	C	>	**F**	
			Delay	10	0	0	**1**	11	0	0	**1**	100	19	>	**46**	134	18	>	**64**	
			V/C	0.07	0.00	0.00		0.12	0.00	0.00		0.36	0.13	>		0.74	0.23	>		
			Q	2	0	0		3	0	0		10	4	>		26	7	>		
			Stor.	90	-	60		85	-	60		45	-	>		50	-	>		
			Avail.	88	-	60		82	-	60		35	-	>		24	-	>		
	Wharncliffe Road South & Bradley Avenue	TCS	LOS	B	C	>	**C**	B	B	A	**B**	D	B	>	**C**	B	B	>	**B**	**B**
			Delay	16	23	>	**23**	11	14	3	**13**	36	15	>	**20**	20	16	>	**19**	**18**
			V/C	0.01	0.75	>		0.17	0.51	0.15		0.38	0.36	>		0.49	0.07	>		
			Q	2	84	>		8	52	7		23	15	>		47	10	>		
			Stor.	110	-	>		110	-	45		80	-	>		80	-	>		
			Avail.	108	-	>		102	-	38		57	-	>		33	-	>		
	Morgan Avenue & Bradley Avenue	TWSC	LOS	A	A	>	**A**	A	A	>	**A**	B	A	>	**B**	B	B	>	**B**	
			Delay	8	0	>	**1**	8	0	>	**0**	12	9	>	**11**	12	10	>	**11**	
			V/C	0.01	0.00	>		0.01	0.00	>		0.12	0.07	>		0.05	0.12	>		
			Q	0	0	>		0	0	>		3	2	>		2	3	>		
			Stor.	45	-	>		45	-	>		45	-	>		45	-	>		
			Avail.	45	-	>		45	-	>		42	-	>		43	-	>		
	Wharncliffe Road South & Street A	TWSC	LOS		A		**A**		A	>	**A**					B			**B**	
			Delay		0		**0**		0	>	**0**					12			**12**	
			V/C		0.00				0.00	>						0.08				
			Q		0				0	>						2				
	Bradley Avenue & Driveway A	TWSC	LOS			A	**A**						A		**A**		A	>	**A**	
			Delay			9	**9**						0		**0**		0	>	**0**	
			V/C			0.06							0.00				0.00	>		
			Q			2							0				0	>		
	Bradley Avenue & Street B	TWSC	LOS			A	**A**						A		**A**		A	>	**A**	
			Delay			9	**9**						0		**0**		0	>	**0**	
			V/C			0.09							0.00				0.00	>		
			Q			2							0				0	>		
	Morgan Avenue & Driveway B	TWSC	LOS					A			**A**		A	>	**A**		A		**A**	
			Delay					9			**9**		0	>	**0**		0		**0**	
			V/C					0.02					0.00	>			0.00			
			Q					1					0	>			0			
	Morgan Avenue & Street A	TWSC	LOS					A		>	**A**		A	>	**A**	<	A		**A**	
			Delay					10		>	**10**		0	>	**0**	<	7		**2**	
			V/C					0.13		>			0.00	>		<	0.01			
			Q					3		>			0	>		<	0			
	Morgan Avenue & Driveway C	TWSC	LOS					A			**A**		A	>	**A**		A		**A**	
			Delay					9			**9**		0	>	**0**		0		**0**	
			V/C					0.03					0.00	>			0.00			
			Q					1					0	>			0			

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds
V/C - Volume to Capacity Ratio
Q - 95th Percentile Queue Length (m)
Stor. - Existing Storage (m)
Avail. - Available Storage (m)
TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
< / > - Shared with through movement

TABLE 4.6B: 2035 TOTAL TRAFFIC OPERATIONS – PM PEAK HOUR

Analysis Period	Intersection	Control Type	MOE	Direction/Movement/Approach																	
				Eastbound				Westbound				Northbound				Southbound				Overall
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
PM Peak Hour	Middleton Avenue/Morgan Avenue & Wharncliffe Road South	TWSC	LOS	B	A	A	**A**	B	A	A	**A**	F	F	>	**F**	F	F	>	**F**	
			Delay	13	0	0	**1**	11	0	0	**0**	700	202	>	**298**	3880	68	>	**1235**	
			V/C	0.19	0.00	0.00		0.06	0.00	0.00		1.54	1.14	>		6.52	0.59	>		
			Q	5	0	0		2	0	0		30	58	>		42	22	>		
			Stor.	90	-	60		85	-	60		45	-	>		50	-	>		
			Avail.	85	-	60		83	-	60		15	-	>		8	-	>		
	Wharncliffe Road South & Bradley Avenue	TCS	LOS	B	C	>	**C**	C	B	A	**B**	D	C	>	**C**	D	B	>	**C**	**C**
			Delay	18	28	>	**28**	27	17	5	**15**	45	20	>	**28**	41	18	>	**33**	**23**
			V/C	0.06	0.83	>		0.65	0.66	0.44		0.52	0.38	>		0.84	0.17	>		
			Q	4	121	>		28	101	29		27	18	>		93	19	>		
			Stor.	110	-	>		110	-	45		80	-	>		80	-	>		
			Avail.	106	-	>		82	-	16		53	-	>		-13	-	>		
	Morgan Avenue & Bradley Avenue	TWSC	LOS	A	A	>	**D**	A	A	>	**D**	D	D	>	**D**	D	C	>	**C**	
			Delay	8	0	>	**27**	8	0	>	**27**	29	25	>	**27**	30	16	>	**20**	
			V/C	0.04	0.00	>		0.04	0.00	>		0.24	0.30	>		0.15	0.18	>		
			Q	1	0	>		1	0	>		7	9	>		4	4	>		
			Stor.	45	-	>		45	-	>		45	-	>		45	-	>		
			Avail.	44	-	>		44	-	>		38	-	>		41	-	>		
	Wharncliffe Road South & Street A	TWSC	LOS		A		**A**		A	>	**A**					B			**B**	
			Delay		0		**0**		0	>	**0**					14			**14**	
			V/C		0.00				0.00	>						0.04				
			Q		0				0	>						1				
	Bradley Avenue & Driveway A	TWSC	LOS			B	**B**						A		**A**		A	>	**A**	
			Delay			10	**10**						0		**0**		0	>	**0**	
			V/C			0.08							0.00				0.00	>		
			Q			2							0				0	>		
	Bradley Avenue & Street B	TWSC	LOS			B	**B**						A		**A**		A	>	**A**	
			Delay			10	**10**						0		**0**		0	>	**0**	
			V/C			0.07							0.00				0.00	>		
			Q			2							0				0	>		
	Morgan Avenue & Driveway B	TWSC	LOS					A			**A**		A	>	**A**		A		**A**	
			Delay					9			**9**		0	>	**0**		0		**0**	
			V/C					0.02					0.00	>			0.00			
			Q					1					0	>			0			
	Morgan Avenue & Street A	TWSC	LOS					A		>	**A**		A	>	**A**	<	A		**A**	
			Delay					10		>	**10**		0	>	**0**	<	8		**2**	
			V/C					0.06		>			0.00	>		<	0.02			
			Q					2		>			0	>		<	1			
	Morgan Avenue & Driveway C	TWSC	LOS					A			**A**		A	>	**A**		A		**A**	
			Delay					9			**9**		0	>	**0**		0		**0**	
			V/C					0.01					0.00	>			0.00			
			Q					0					0	>			0			

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds
V/C - Volume to Capacity Ratio
Q - 95th Percentile Queue Length (m)
Stor. - Existing Storage (m)
Avail. - Available Storage (m)
TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
< / > - Shared with through movement

4.8 Morgan Avenue and Driveway B

The operation of the intersection of Driveway B and Morgan Avenue as an all-moves access is analyzed under 2035 total traffic conditions, representing the largest roadway and driveway traffic volumes.

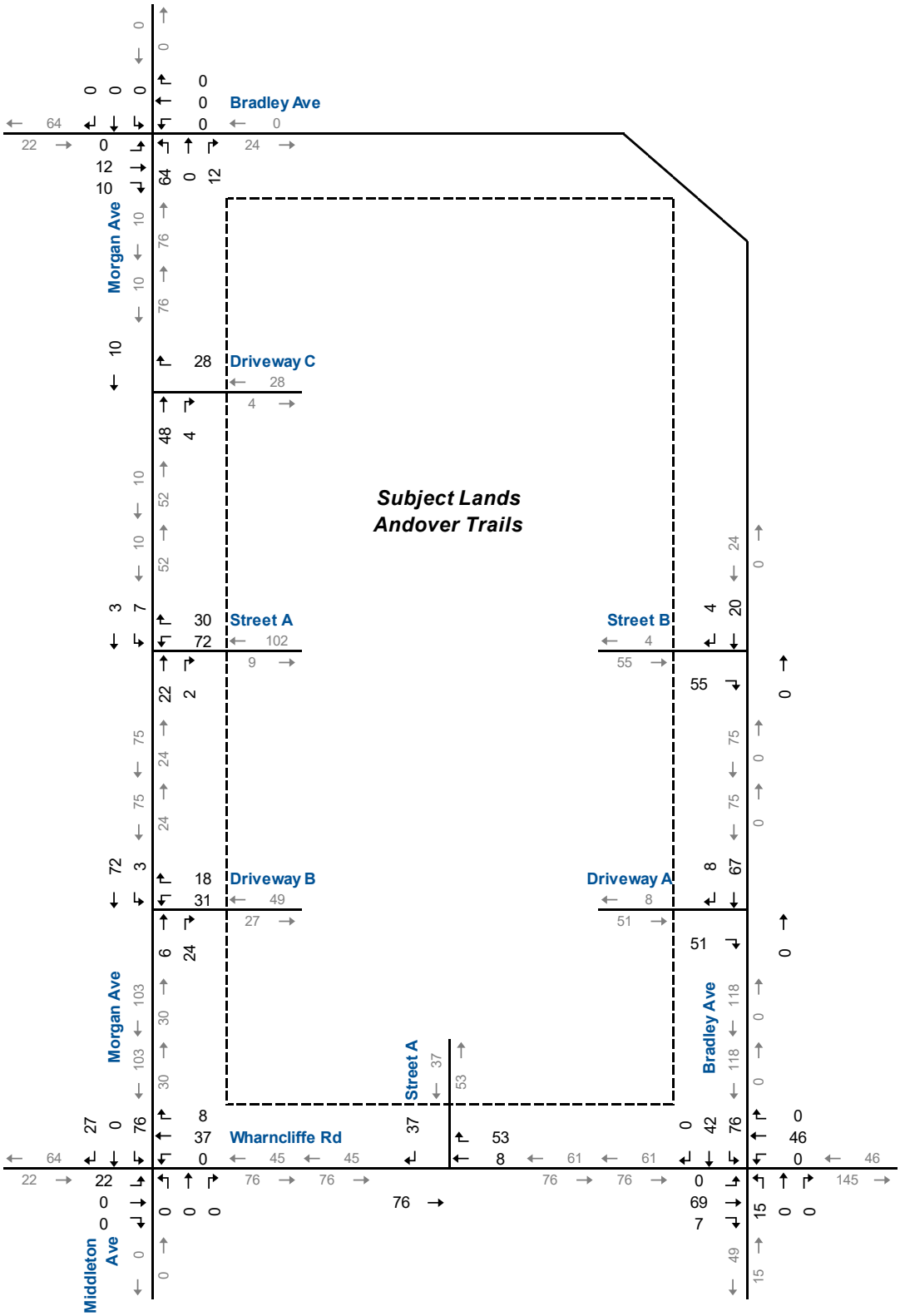
Figure 4.8a and **Figure 4.8b** illustrate the site generated traffic volumes with Driveway B as full moves.

Figure 4.9a and **Figure 4.9b** illustrate the 2035 total traffic volumes.

Table 4.7a and **Table 4.7b** summarize the results of the 2035 total traffic operations with Driveway B operating as a full-moves access. The results indicate that the study area intersections are forecast to operate with similar operations as under 2035 total traffic conditions with Driveway B as RIRO.

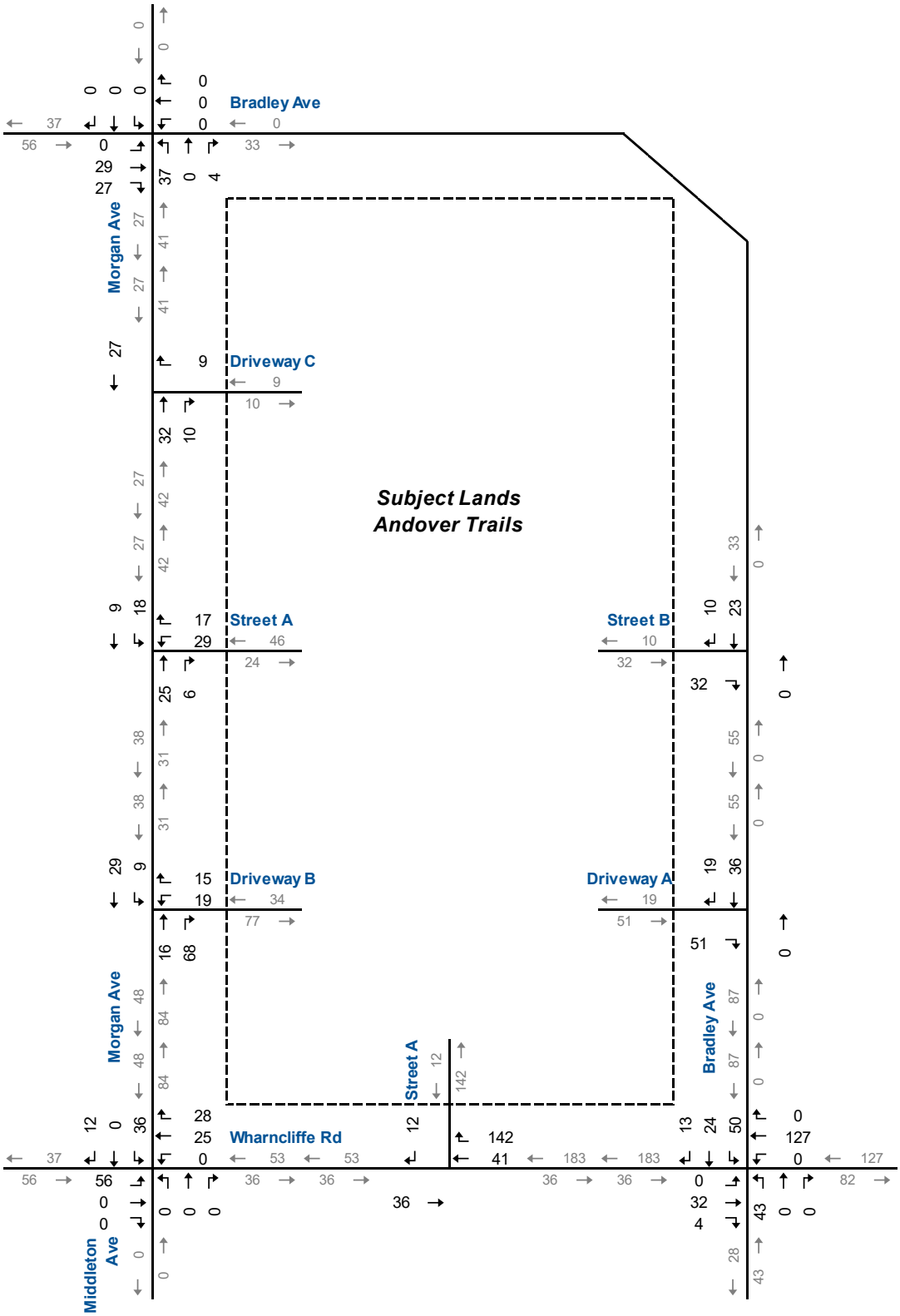
Appendix K contains the supporting detailed Synchro 10 reports.

Based on the above results and given the location and timing of Phase 1 development, it is appropriate to implement Driveway B as an all-moves access on Morgan Avenue. The geometry and the operations of the Driveway B intersection are also consistent with the location of the existing driveway to north of Driveway B, and its distance (approximately 110 metres) from Wharncliffe Road.



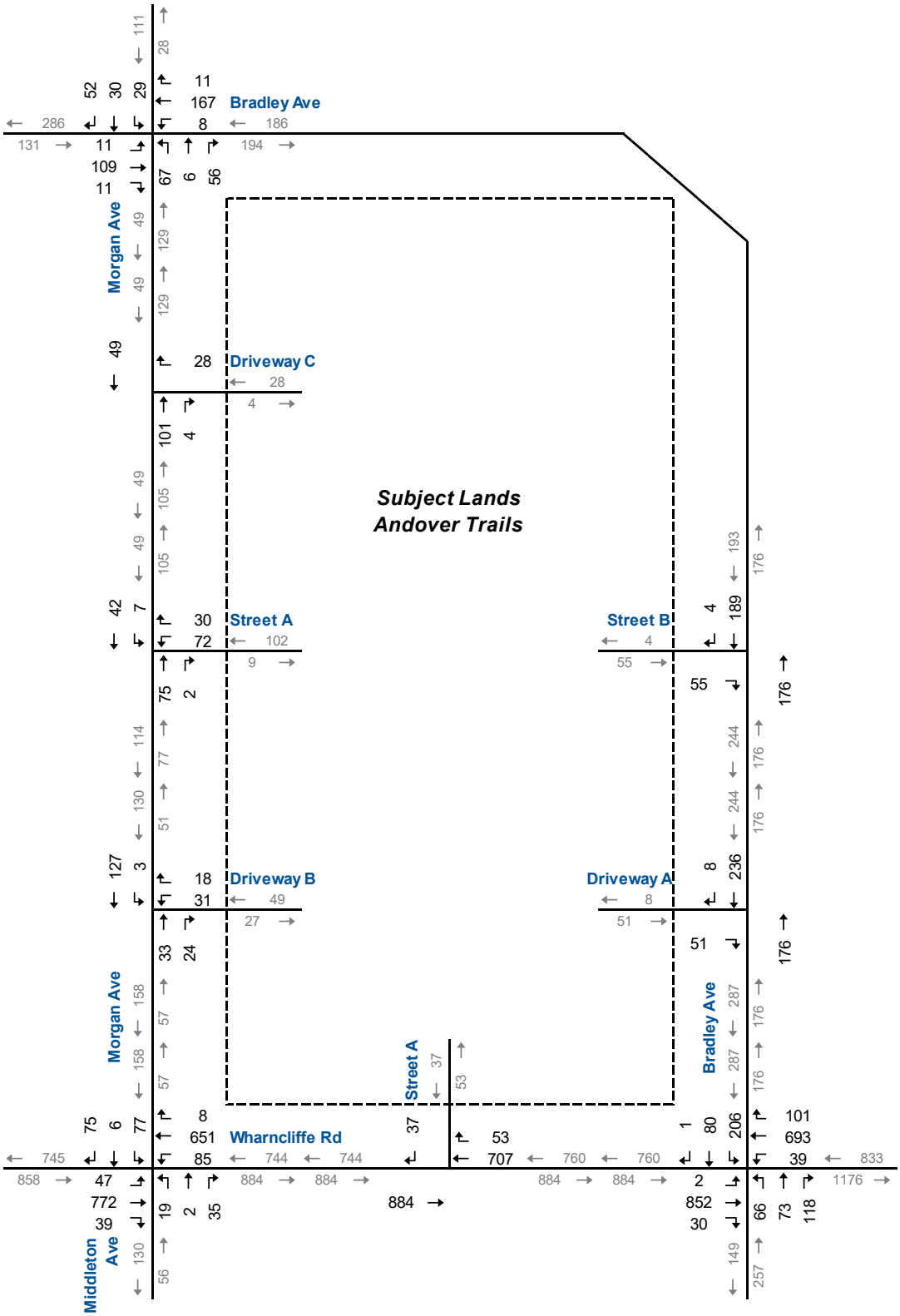
NTS

Site Generated Traffic Volumes (Full Moves Driveway B) AM Peak Hour



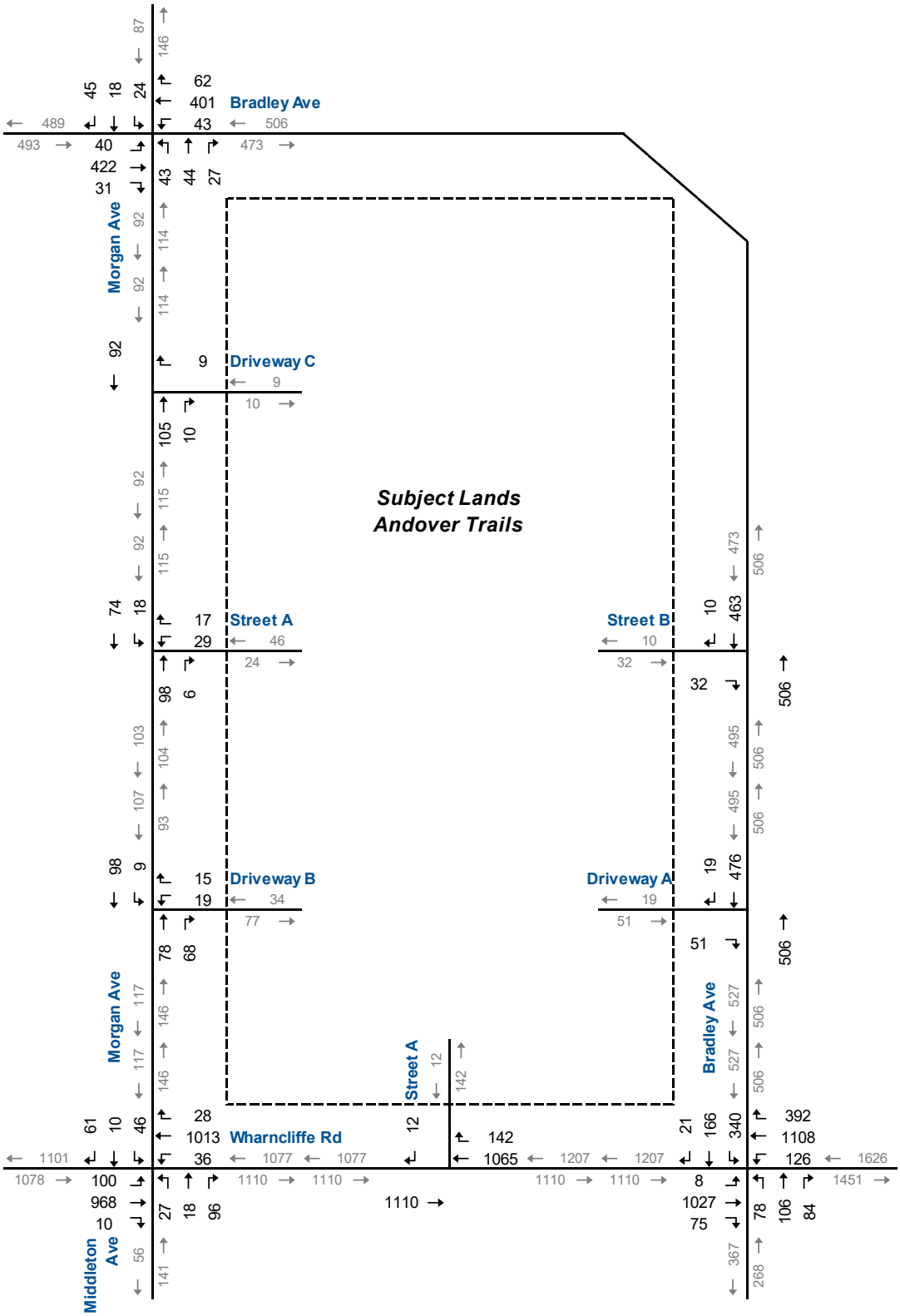
NTS

Site Generated Traffic Volumes (Full Moves Driveway B) PM Peak Hour



NTS

2035 Total Traffic Volumes (Full Moves Driveway B) AM Peak Hour



NTS

2035 Total Traffic Volumes (Full Moves Driveway B) PM Peak Hour

TABLE 4.7A: 2035 TOTAL TRAFFIC OPERATIONS (FULL MOVES DRIVEWAY B) – AM PEAK HOUR

Analysis Period	Intersection	Control Type	MOE	Direction/Movement/Approach																	
				Eastbound				Westbound				Northbound				Southbound				Overall
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
AM Peak Hour	Middleton Avenue/Morgan Avenue & Wharncliffe Road South	TWSC	LOS	B	A	A	**A**	B	A	A	**A**	F	C	>	**E**	F	C	>	**F**	
			Delay	10	0	0	**1**	11	0	0	**1**	100	19	>	**46**	236	18	>	**124**	
			V/C	0.07	0.00	0.00		0.12	0.00	0.00		0.36	0.13	>		1.12	0.24	>		
			Q	2	0	0		3	0	0		10	4	>		46	7	>		
			Stor.	90	-	60		85	-	60		45	-	>		50	-	>		
			Avail.	88	-	60		82	-	60		35	-	>		4	-	>		
	Wharncliffe Road South & Bradley Avenue	TCS	LOS	B	C	>	**C**	B	B	A	**B**	D	B	>	**C**	B	B	>	**B**	**B**
			Delay	16	23	>	**23**	11	14	3	**13**	36	15	>	**20**	20	17	>	**19**	**18**
			V/C	0.01	0.75	>		0.17	0.50	0.14		0.38	0.36	>		0.45	0.07	>		
			Q	2	87	>		8	52	7		23	15	>		44	10	>		
			Stor.	110	-	>		110	-	45		80	-	>		80	-	>		
			Avail.	108	-	>		102	-	38		57	-	>		36	-	>		
	Morgan Avenue & Bradley Avenue	TWSC	LOS	A	A	>	**A**	A	A	>	**A**	B	A	>	**B**	B	B	>	**B**	
			Delay	8	0	>	**1**	8	0	>	**0**	12	9	>	**11**	12	10	>	**11**	
			V/C	0.01	0.00	>		0.01	0.00	>		0.12	0.07	>		0.05	0.12	>		
			Q	0	0	>		0	0	>		3	2	>		2	3	>		
			Stor.	45	-	>		45	-	>		45	-	>		45	-	>		
			Avail.	45	-	>		45	-	>		42	-	>		43	-	>		
	Wharncliffe Road South & Street A	TWSC	LOS		A		**A**		A	>	**A**					B			**B**	
			Delay		0		**0**		0	>	**0**					12			**12**	
			V/C		0.00				0.00	>						0.07				
			Q		0				0	>						2				
	Bradley Avenue & Driveway A	TWSC	LOS			A	**A**						A		**A**		A	>	**A**	
			Delay			9	**9**						0		**0**		0	>	**0**	
			V/C			0.06							0.00				0.00	>		
			Q			2							0				0	>		
	Bradley Avenue & Street B	TWSC	LOS			A	**A**						A		**A**		A	>	**A**	
			Delay			9	**9**						0		**0**		0	>	**0**	
			V/C			0.06							0.00				0.00	>		
			Q			2							0				0	>		
	Morgan Avenue & Driveway B	TWSC	LOS					A		>	**A**		A	>	**A**	<	A		**A**	
			Delay					9		>	**9**		0	>	**0**	<	7		**0**	
			V/C					0.06		>			0.00	>		<	0.00			
			Q					2		>			0	>		<	0			
	Morgan Avenue & Street A	TWSC	LOS					A		>	**A**		A	>	**A**	<	A		**A**	
			Delay					10		>	**10**		0	>	**0**	<	7		**1**	
			V/C					0.13		>			0.00	>		<	0.01			
			Q					3		>			0	>		<	0			
	Morgan Avenue & Driveway C	TWSC	LOS					A			**A**		A	>	**A**		A		**A**	
			Delay					9			**9**		0	>	**0**		0		**0**	
			V/C					0.03					0.00	>			0.00			
			Q					1					0	>			0			

MOE - Measure of Effectiveness
LOS - Level of Service
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V/C - Volume to Capacity Ratio
Q - 95th Percentile Queue Length (m)
Stor. - Existing Storage (m)
Avail. - Available Storage (m)
TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
< / > - Shared with through movement

TABLE 4.7B: 2035 TOTAL TRAFFIC OPERATIONS (FULL MOVES DRIVEWAY B) – PM PEAK HOUR

Analysis Period	Intersection	Control Type	MOE	Direction/Movement/Approach																	
				Eastbound				Westbound				Northbound				Southbound				Overall
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
PM Peak Hour	Middleton Avenue/Morgan Avenue & Wharncliffe Road South	TWSC	LOS	B	A	A	**A**	B	A	A	**A**	F	F	>	**F**	F	F	>	**F**	
			Delay	13	0	0	**1**	11	0	0	**0**	651	202	>	**288**	5459	67	>	**2187**	
			V/C	0.19	0.00	0.00		0.06	0.00	0.00		1.47	1.14	>		10.00	0.59	>		
			Q	5	0	0		2	0	0		30	58	>		60	22	>		
			Stor.	90	-	60		85	-	60		45	-	>		50	-	>		
			Avail.	85	-	60		83	-	60		15	-	>		-10	-	>		
	Wharncliffe Road South & Bradley Avenue	TCS	LOS	B	C	>	**C**	C	B	A	**B**	D	C	>	**C**	D	B	>	**C**	**C**
			Delay	17	28	>	**28**	28	17	5	**15**	45	20	>	**28**	39	18	>	**32**	**23**
			V/C	0.06	0.84	>		0.66	0.66	0.44		0.52	0.38	>		0.82	0.17	>		
			Q	4	124	>		28	101	29		27	18	>		86	18	>		
			Stor.	110	-	>		110	-	45		80	-	>		80	-	>		
			Avail.	106	-	>		82	-	16		53	-	>		-6	-	>		
	Morgan Avenue & Bradley Avenue	TWSC	LOS	A	A	>	**A**	A	A	>	**A**	D	D	>	**D**	D	C	>	**C**	
			Delay	8	0	>	**1**	8	0	>	**1**	29	25	>	**27**	30	16	>	**20**	
			V/C	0.04	0.00	>		0.04	0.00	>		0.24	0.30	>		0.15	0.18	>		
			Q	1	0	>		1	0	>		7	9	>		4	4	>		
			Stor.	45	-	>		45	-	>		45	-	>		45	-	>		
			Avail.	44	-	>		44	-	>		38	-	>		41	-	>		
	Wharncliffe Road South & Street A	TWSC	LOS		A		**A**		A	>	**A**					B			**B**	
			Delay		0		**0**		0	>	**0**					14			**14**	
			V/C		0.00				0.00	>						0.03				
			Q		0				0	>						1				
	Bradley Avenue & Driveway A	TWSC	LOS			B	**B**						A		**A**		A	>	**A**	
			Delay			10	**10**						0		**0**		0	>	**0**	
			V/C			0.07							0.00				0.00	>		
			Q			2							0				0	>		
	Bradley Avenue & Street B	TWSC	LOS			A	**A**						A		**A**		A	>	**A**	
			Delay			10	**10**						0		**0**		0	>	**0**	
			V/C			0.05							0.00				0.00	>		
			Q			1							0				0	>		
	Morgan Avenue & Driveway B	TWSC	LOS					A		>	**A**		A	>	**A**	<	A		**A**	
			Delay					10		>	**10**		0	>	**0**	<	8		**1**	
			V/C					0.04		>			0.00	>		<	0.01			
			Q					1		>			0	>		<	0			
	Morgan Avenue & Street A	TWSC	LOS					A		>	**A**		A	>	**A**	<	A		**A**	
			Delay					10		>	**10**		0	>	**0**	<	8		**2**	
			V/C					0.06		>			0.00	>		<	0.01			
			Q					2		>			0	>		<	0			
	Morgan Avenue & Driveway C	TWSC	LOS					A			**A**		A	>	**A**		A		**A**	
			Delay					9			**9**		0	>	**0**		0		**0**	
			V/C					0.01					0.00	>			0.00			
			Q					0					0	>			0			

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds
V/C - Volume to Capacity Ratio
Q - 95th Percentile Queue Length (m)
Stor. - Existing Storage (m)
Avail. - Available Storage (m)
TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
< / > - Shared with through movement

5 Remedial Measures

The following section reviews the need for left-turn lanes on Morgan Avenue at Street A and at Driveway B, and potential improvements on Wharncliffe Road at Bradley Avenue and Middleton Avenue/Morgan Avenue. Each assessment has been completed with Driveway B operating as a RIRO and as a full-moves access.

5.1 Left-Turn Lanes

5.1.1 Morgan Avenue and Future Street A

The Ministry of Transportation Design Supplement for the Transportation Association of Canada (TAC) Geometric Design Guide for Canadian Roads[7] provides guidance on the assessment and/or need for auxiliary left-turn lanes.

Warrants have been calculated for southbound left-turns at Morgan Avenue and Street A. The warrant was calculated using the nomographs for left-turn lanes on a two-lane undivided highway at an unsignalized intersection with a design speed of 50 km/h (10 kilometres per hour over the posted speed limit). Based on this criterion, a southbound left-turn lane is not warranted under 2035 total traffic conditions.

Appendix L contains the warrant nomographs.

5.1.2 Morgan Avenue and Driveway B

Based on the same methodology as above, warrants have been reviewed for southbound left-turns at Morgan Avenue and full moves Driveway B. A southbound left-turn lane is not warranted under 2035 total traffic conditions.

Appendix L contains the warrant nomographs.

5.2 Wharncliffe Road and Bradley Avenue

With the signal timing plan used at the future traffic control signals, the southbound left-turn movement at Wharncliffe Road and Bradley Avenue is forecast to operate with 95th percentile queues exceeding the available storage of 80 metres by 13 metres during the PM peak

[7] *MTO Design Supplement for TAC Geometric Design Guide for Canadian Roads*, June 2017.

hour. It is recommended that the signal timing plan be reviewed by the City for potential coordination with surrounding signalized intersections.

5.3 Wharncliffe Road and Middleton Avenue/Morgan Avenue

The intersection of Wharncliffe Road and Middleton Avenue/Morgan Avenue has been assessed using the Ontario Traffic Manual (OTM) signal warrant guidelines[8] to determine if a change in traffic control is warranted.

Based on the warrant analysis, traffic control signals are not warranted under 2035 total traffic conditions.

Appendix M contains the warrant analysis worksheets.

Although traffic signal control is not warranted, **Table 5.1** summarizes the operational results of the intersection of Wharncliffe Road and Middleton Avenue/Morgan Avenue under traffic signal control. The results indicate that the intersection is forecast to operate with acceptable levels of service. It is recommended that the City monitor the operation of the intersection to ensure an appropriate from of traffic control is provided in the future.

Appendix N contains the supporting detailed Synchro 10 reports

[8] Ontario Traffic Manual Book 12 – Traffic Signals

TABLE 5.1: 2035 TOTAL TRAFFIC CONDITIONS WITH INTERSECTION IMPROVEMENTS

Analysis Period	Intersection	Control Type	MOE	Direction/Movement/Approach																	
				Eastbound				Westbound				Northbound				Southbound				Overall
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
AM Peak Hour	Middleton Avenue/Morgan Avenue & Wharncliffe Road South	TCS	LOS	A	A	A	A	B	A	A	A	B	A	>	A	B	A	>	A	A
			Delay	8	9	3	9	12	8	0	9	13	7	>	9	14	6	>	9	9
			V/C	0.20	0.57	0.06		0.37	0.49	0.01		0.08	0.13	>		0.19	0.22	>		
			Q	6	30	3		11	25	0		5	5	>		10	8	>		
			Stor.	90	-	60		85	-	60		45	-	>		50	-	>		
			Avail.	84	-	57		74	-	60		40	-	>		40	-	>		
	Middleton Avenue/Morgan Avenue & Wharncliffe Road South (Full Moves DW B)	TCS	LOS	A	A	A	A	B	A	A	A	B	A	>	A	B	A	>	B	A
			Delay	9	10	3	9	12	9	0	9	13	7	>	9	15	6	>	10	9
			V/C	0.21	0.57	0.07		0.38	0.49	0.01		0.07	0.12	>		0.26	0.22	>		
			Q	7	33	3		12	27	0		5	5	>		14	8	>		
			Stor.	90	-	60		85	-	60		45	-	>		50	-	>		
			Avail.	83	-	57		73	-	60		40	-	>		36	-	>		
PM Peak Hour	Middleton Avenue/Morgan Avenue & Wharncliffe Road South	TCS	LOS	B	A	A	A	A	A	A	A	C	B	>	B	C	B	>	B	A
			Delay	14	7	0	8	6	7	2	7	22	18	>	18	23	13	>	16	8
			V/C	0.47	0.51	0.01		0.15	0.54	0.03		0.13	0.40	>		0.16	0.25	>		
			Q	18	41	0		5	44	2		9	19	>		10	12	>		
			Stor.	90	-	60		85	-	60		45	-	>		50	-	>		
			Avail.	72	-	60		80	-	58		36	-	>		40	-	>		
	Middleton Avenue/Morgan Avenue & Wharncliffe Road South (Full Moves DW B)	TCS	LOS	B	A	A	A	A	A	A	A	C	B	>	B	C	B	>	B	A
			Delay	14	7	0	8	6	7	2	7	22	17	>	18	24	14	>	18	8
			V/C	0.47	0.51	0.01		0.15	0.54	0.03		0.13	0.40	>		0.24	0.26	>		
			Q	18	41	0		5	44	2		9	19	>		13	12	>		
			Stor.	90	-	60		85	-	60		45	-	>		50	-	>		
			Avail.	72	-	60		80	-	58		36	-	>		37	-	>		

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds
V/C - Volume to Capacity Ratio
Q - 95th Percentile Queue Length (m)
Stor. - Existing Storage (m)
Avail. - Available Storage (m)
TCS - Traffic Control Signal
< / > - Shared with through movement

6 Transportation Demand Management

Transportation Demand Management (TDM) refers to ways of making the capacity of roads more efficient by reducing vehicle demand. TDM approaches consider how people's choices of travel mode are affected by land use patterns, development design, parking availability, parking cost, and the relative cost, convenience, and availability of alternative modes of travel. Various TDM strategies are used to influence those factors so that the alternatives are more competitive with single-occupancy travel and potentially reduce reliance on motor vehicles.

The City of London requires TIA submissions to include a suitable travel demand management plan with reasonable measures to facilitate reduced automobile reliance and promote transit, cycling and walking for trips to and from the site. This requirement is consistent with the goal established by the 2030 Transportation Master Plan to achieve a mode share target of 35% by 2030[9].

Potential TDM measures appropriate for the proposed development include the following.

6.1 Walking

The pedestrian accessibility of a development is essential in helping to ensure that those that can walk, have access to accessible pedestrian connections.

Sidewalks are provided on both sides of Bradley Avenue and on at least one side of Wharncliffe Road. As part of the subject development and surrounding future developments, sidewalks will be provided on both sides of Morgan Avenue.

Proper pedestrian connections from the surrounding community to the development should be available to ensure safety and to enhance the experience of those that choose to walk. The development concept indicates that sidewalks are proposed on both sides of Street A and Street B, with connections to each building and surrounding municipal sidewalks.

The subject lands are located within 400 metres (5-minute walk) from commercial uses along Wharncliffe Road, and 600 metres (8-minute walk) from the commercial plazas on Wonderland Road north and south of Bradley Avenue.

[9] City of London 2030 Transportation Master Plan: Smart Moves, January 2013.

6.2 Cycling

A separated cycle track is provided on the south side of Bradley Avenue between Wharncliffe Road and Wonderland Road, with bike lanes continuing north and south on Wonderland Road.

To promote cycling to/from the development, the City's Zoning By-Law requires 0.75 long-term bicycle parking spaces per residential unit.

The commercial component in Block A-D should consider providing short-term bicycle parking spaces at a rate of 7% of the required number of automobile parking spaces.

6.3 Transit

As discussed in **Section 2.2**, London Transit currently operates Route 12 within the study area. The closest bus stops are located on the north side of Wharncliffe Road, Stop #2751 is located 140 metres north of Bradley Avenue and Stop #2595 at 230 metres south of Morgan Avenue.

The nearby Route 12 bus stops are easily accessible from the subject development via the existing sidewalks along Bradley Avenue and Wharncliffe Road. This route provides good connectivity to the broader network and key destinations within the City.

6.4 Parking Management

To further encourage residents of the development to utilize sustainable travel modes, parking spaces should be sold separately from the cost to rent/purchase a unit. This practice of 'unbundling' parking from the unit is also more equitable and efficient since occupants are not forced to pay for parking they do not need.

6.5 Carshare

Carsharing refers to automobile rental services intended to substitute for private vehicle ownership. It makes occasional use of a vehicle affordable while providing an incentive to minimize driving and rely on alternative travel options as much as possible.

Communauto (VRTUCAR) currently has five locations in the City of London. The closest vehicle is located over 4.4 kilometres from the subject development.

Given the size of the development and distance to the nearest carshare location, a car share vehicle/space in a convenient location

on-site would allow residents from the development and surrounding area who normally would not need a vehicle for their daily activities to be comfortable with the decision to not own a vehicle.

6.6 Travel Planning and Wayfinding Resources

Increasing awareness of sustainable transportation opportunities for residents and visitors of the development should be considered.

Providing a welcome package that outlines the available transit routes and active transportation options can be helpful to encourage new residents to educate themselves on the support for alternative modes near the subject site. Posting real-time transit and active transportation information in common areas can further support this education.

7 Conclusions and Recommendations

7.1 Conclusions

Based on the investigations carried out, it is concluded that:

- **Existing Traffic Conditions:** The study area intersections are operating within acceptable levels of service. Although not considered critical under City of London TIA guidelines, the following movements are operating with poor LOS:
  - Wharncliffe Road and Middleton Avenue/Morgan Avenue: The northbound and southbound left-turn movements are operating with LOS E during the PM peak hour.
  - Wharncliffe Road and Bradley Avenue: The southbound left-turn movement is operating with LOS F and the southbound through movement is operating with LOS E during the PM peak hour.

  It is noted that both intersections are currently operating under two-way stop control and will potentially be converted to traffic signal control under future traffic conditions.
- **Development Trip Generation:** The subdivision is forecast to generate a total of 427 AM peak hour trips and 466 PM peak hour trips:
  - Stage 1: 158 AM peak hour trips and 188 PM peak hour trips; and
  - Stage 2: 269 AM peak hour trips and 278 PM peak hour trips.
- **2027 Background Traffic Conditions:** The study area intersections are forecast to operate with the same critical movements as under existing traffic conditions, and the addition of the following movements at the intersection of Wharncliffe Road and Middleton Avenue/Morgan Avenue:
  - The northbound and southbound left-turn movements are forecast to operate with LOS E during the AM peak hour; and
  - The northbound shared through/right-turn movement is forecast to operate with LOS E during the PM peak hour.

  Existing two-way stop control is assumed for the intersection of Wharncliffe Road and Middleton Avenue/Morgan Avenue, while traffic signal control is assumed at the Bradley Avenue and

Wharncliffe Road intersection along with the easterly extension of Bradley Avenue.

- **2027 Total Traffic Conditions:** The study area intersections are forecast to operate with the same critical movements as under 2027 background traffic conditions.
- **2030 Background Traffic Conditions:** The study area intersections are forecast to operate with the same critical movements as under 2027 background traffic conditions, with the addition of the southbound shared through/right-turn movement at Wharncliffe Road and Middleton Avenue/Morgan Avenue which is forecast to operate with LOS E during the PM peak hour.
- **2030 Total Traffic Conditions:** The study area intersections are forecast to operate with the same critical movements as under 2030 background traffic conditions, with the addition of the following movements:
  - Wharncliffe Road and Middleton Avenue/Morgan Avenue: The northbound and southbound left-turn movements are forecast to operate with LOS F and a v/c ratio greater than 0.90 during the PM peak hour.
  - Wharncliffe Road and Bradley Avenue: The southbound left-turn movement is forecast to operate with 95th percentile queues exceeding the available storage of 80 metres during the PM peak hour.
- **2035 Background Traffic Conditions:** The study area intersections are forecast to operate with the same critical movements as under 2030 background traffic conditions.
- **2035 Total Traffic Conditions:** The study area intersections forecast to operate with the same critical movements as under 2030 total traffic conditions, with the addition of the northbound shared through/right-turn movement at Wharncliffe Road and Middleton Avenue/Morgan Avenue which is forecast to operate with LOS F and a v/c ratio greater than 0.90 during the PM peak hour.
- **Remedial Measures:**
  - Wharncliffe Road and Bradley Avenue: Signal timings should be monitored for potential coordination with surrounding signalized intersections. If the forecast queueing issues continue to occur for the southbound left-turn movement, the existing left-turn lane storage of 80 metres should be increased to 95 metres by 2035.

- Wharncliffe Road and Morgan Avenue: Although traffic signal control is not warranted under 2035 total traffic conditions, the critical movements at this intersection can be resolved with signalization of the intersection. The intersection operations should be monitored in the future to identify appropriate traffic control.

- **Summary of Traffic Impact Assessment:** The development benefits from the three abutting roads and multiple access points, which contributes to an efficient distribution of development traffic without overloading any of the roadway or access intersections. Capacity constraints and critical turning movements are mostly pre-existing and/or independent of the subject development. Also, the identified issues could be addressed through operational adjustments without requiring roadway modifications.
- **Site Access:** All access intersections are projected to operate satisfactorily under future traffic conditions. Driveway B at Morgan Avenue was analyzed both as all-moves and as an RIRO access, and it is appropriate to be implemented as an all-moves access.
- **Transportation Demand Management:** The following TDM measures can be implemented to support the use of alternative modes within the surrounding area:
  - Internal sidewalks with connections to the existing municipal sidewalk network, and cycle track/bike lanes nearby.
  - Bicycle parking in accordance with the City's Zoning By-Law requirements for both residential and non-residential developments.
  - Access to frequent transit that provides good connectivity to the broader network and major destinations.
  - Parking unbundled from the sale/rent agreement of apartment units.
  - Carshare space/vehicle(s) in a premium location.
  - Transit, carshare and active transportation information provided in a welcome package to new residents and/or posted in central locations on-site.

7.2 Recommendations

Based on the findings and conclusions of this study, it is recommended that the proposed development be considered for approval.

Appendix A

Pre-Study Consultation

Appendix B

Existing Traffic Data

Appendix C

Existing Traffic Operations Reports

Appendix D

Background Development Traffic Volumes

Appendix E

2027 Background Traffic Operations Reports

Appendix F

2027 Total Traffic Operations Reports

Appendix G

2030 Background Traffic Operations Reports

Appendix H

2030 Total Traffic Operations Reports

Appendix I

2035 Background Traffic Operations Reports

Appendix J

2035 Total Traffic Operations Reports

Appendix K

2035 Total Traffic Operations Reports – Full Moves Driveway B

Appendix L

Left-Turn Lane Warrants

Appendix M

Signal Warrants

Appendix N

2035 Total Traffic Operations Reports with Improvements