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TRANSPORTATION SOLUTIONS LIMITED

Residential Subdivision, Cork Street, Mount Forest
Transportation Impact Study

Paradigm Transportation Solutions Limited

July 2020
200219

ptsl.com

Project Summary

Project Number
200219

July 2020

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Version 1.0.0

Residential Subdivision, Cork Street, Mount Forest
Transportation Impact Study

Signing Licencee/Engineer, P.Eng.

Disclaimer

Executive Summary

Content

Paradigm Transportation Solutions Limited (Paradigm) was retained to conduct this Transportation Impct Study for a proposed residential development located on Cork Street in the community of Mount Forest, Township of Wellington North, Ontario.

This Transportation Impact Study (TIS) includes an analysis of existing traffic conditions, a description of the proposed development, traffic forecasts for assumed full build-out (Year 2023) and five year horizon from the full build-out (Year 2028), and any recommendations required to improve future traffic conditions.

Development Concept

The subject site is located on the west side of Cork Street between Melissa Crescent and Martin Street. A total of 138 residential untis are proposed consisting of 57 single detached and 81 townhome units.

Vehicle access is proposed via two new municipal intersections on Cork Street: opposite of Melissa Crescent, and between Melissa Crescent and Martin Street. Just south of the second access is a private driveway with access to Cork Street for approximately 15 townhome units.

Conclusions

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

- **Existing Traffic Conditions:** All study area intersections are currently operating within acceptable levels of service;
- **Development Trip Generation:** The development is forecast to generate approximately 84 and 108 trips during the AM and PM peak hours, respectively;
- **2023 Background Traffic Conditions:** All study area intersections are forecast to continue to operate within acceptable levels of service;
- **2028 Background Traffic Conditions:** All study area intersections are forecast to continue to operate within acceptable levels of service;
- **2023 Total Traffic Conditions:** All study area intersections are forecast to continue to operate within acceptable levels of service;

- **2028 Total Traffic Conditions:** All study area intersections are forecast to continue to operate within acceptable levels of service;
- **Remedial Measures:** auxiliary lanes are not warranted at either proposed municipal road intersections with Cork Street nor the private driveway connection with Cork Street.
- A westbound left-turn lane on Queen Street West at Cork Street is warranted for 15m of storage under 2028 Background traffic conditions.
- A northbound left-turn lane on Main Street South at North Water Street is warranted for 15m of storage under 2028 Background traffic conditions.

Recommendations

Based on the findings of this study, it is recommended that the Township of Wellington North monitor the future traffic volumes at the Queen Street West at Cork Street and Main Street South at North Water Street intersections to determine the need for auxiliary turn lanes.

It is further recommended that the development be approved with no additional requirement for off-site transportation improvements

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Appendices

Figures

Tables

1 Introduction

1.1 Overview

Paradigm Transportation Solutions Limited (Paradigm) was retained to conduct this Transportation Impact Study for a proposed residential development located on Cork Street in the community of Mount Forest in the Township of Wellingotn North, Ontario. **Figure 1.1** illustrates the subject development location.

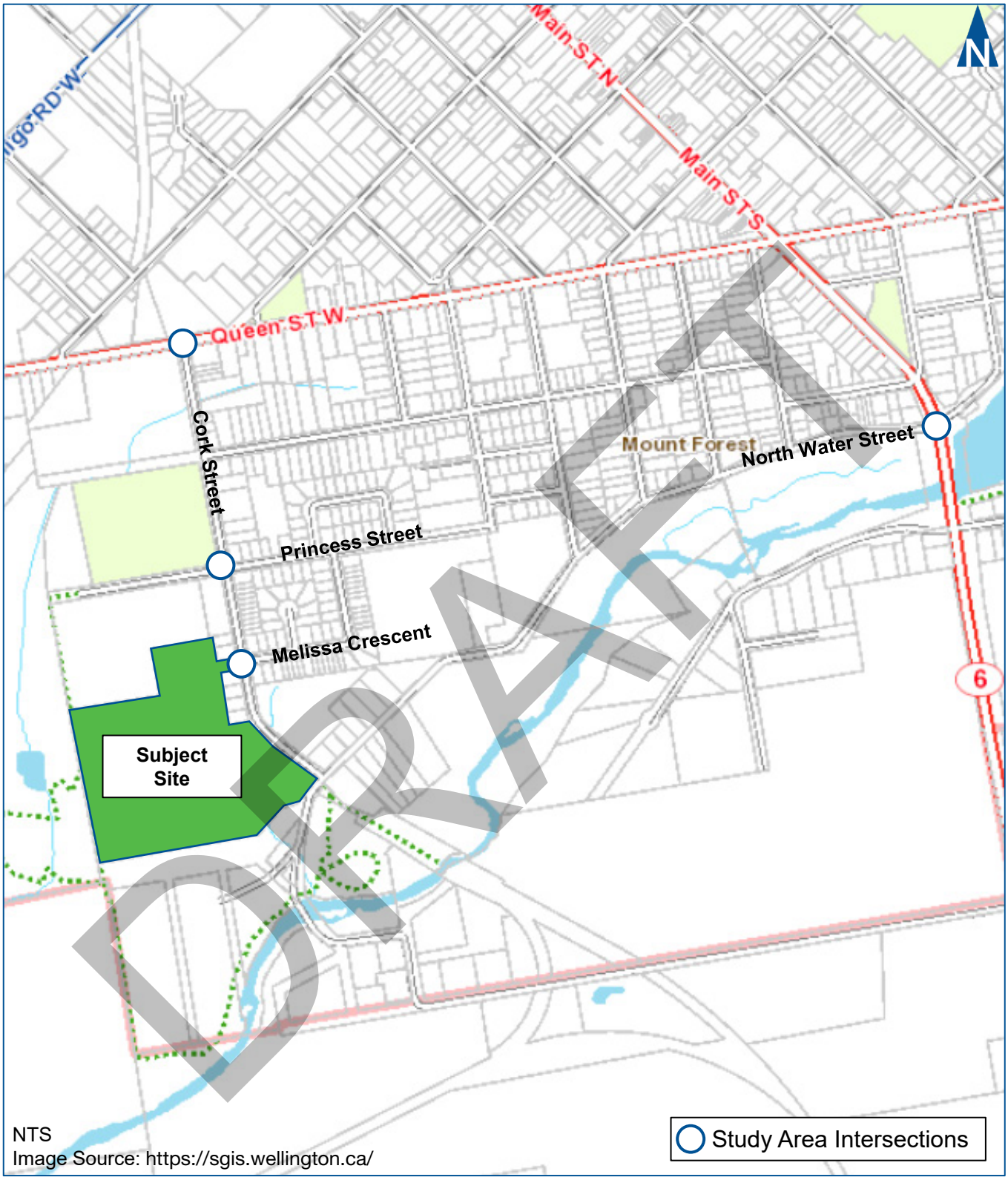
1.2 Purpose and Scope

The purpose of this report is to identify and assess the potential traffic impact resulting from the proposed development. The scope included:

- Assessment of the current traffic and site conditions within the study area;
- Estimates of background traffic growth for full build-out (2023) and five years beyond full build-out (2028);
- Estimates of additional traffic generated by the subject site;
- Analyses of the impact of the future traffic on the surrounding road network; and
- Recommendations necessary to mitigate the site generated traffic in a satisfactory manner.

The scope was reviewed and confirmed with the Township of Wellington North via email in June 2020. Based on the pre-study consultation, the following intersections were identified for investigation in this study:

- Queen Street West and Cork Street (unsignalized);
- Cork Street and Princess Street (unsignalized);
- Cork Street and Melissa Crescent (unsignalized);
- Main Street South and North Water Street (unsignalized); and
- Cork Street and the proposed development accesses (proposed).



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Site Location and Study Area

Residential Subdivision, Cork Street, Mount Forest TIS
200219

Figure 1.1

2 Existing Conditions

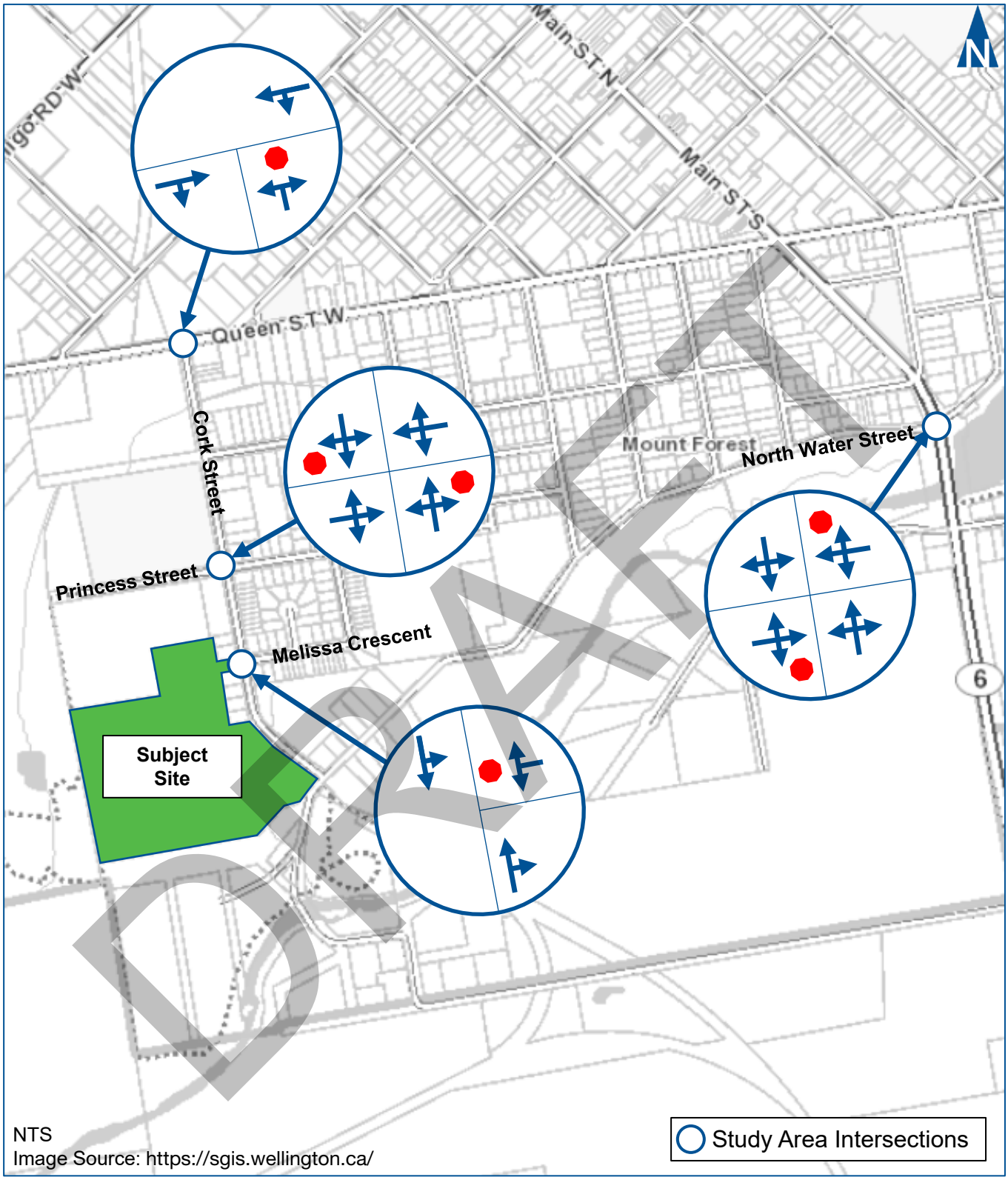
This section documents current traffic conditions, operational deficiencies, and constraints experienced by the public travelling at the intersections within the study area. The operational deficiencies and constraints identified at this stage will be fundamental to the process of defining the required remedial measures.

2.1 Existing Roadways

The main roadways (all under the jurisdiction of the Township of Wellington North) in the study area include:

- **Cork Street** is a north-south road with a two-lane cross-section and 50 km/h speed limit. A sidewalk is present on the east side of Cork Street from Queen Street West to Waterloo Street. The Township has indicated that Cork Street between Waterloo Street and Princess Street will be urbanized to include sidewalk, curb and gutter in the future.
- **Melissa Street** is a two-lane local road with a 50 km/h speed limit that connects Princess Street and Cork Street. There are currently no sidewalks on either side of the roadway.
- **Princess Street** is an east-west road with a two-lane cross-section and 50 km/y speed limit. There is a sidewalk on the south side of the roadway west of Cork Street.

Figure 2.1 details the existing traffic control and intersection lane configurations.



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Existing Lane Configuration & Traffic Control

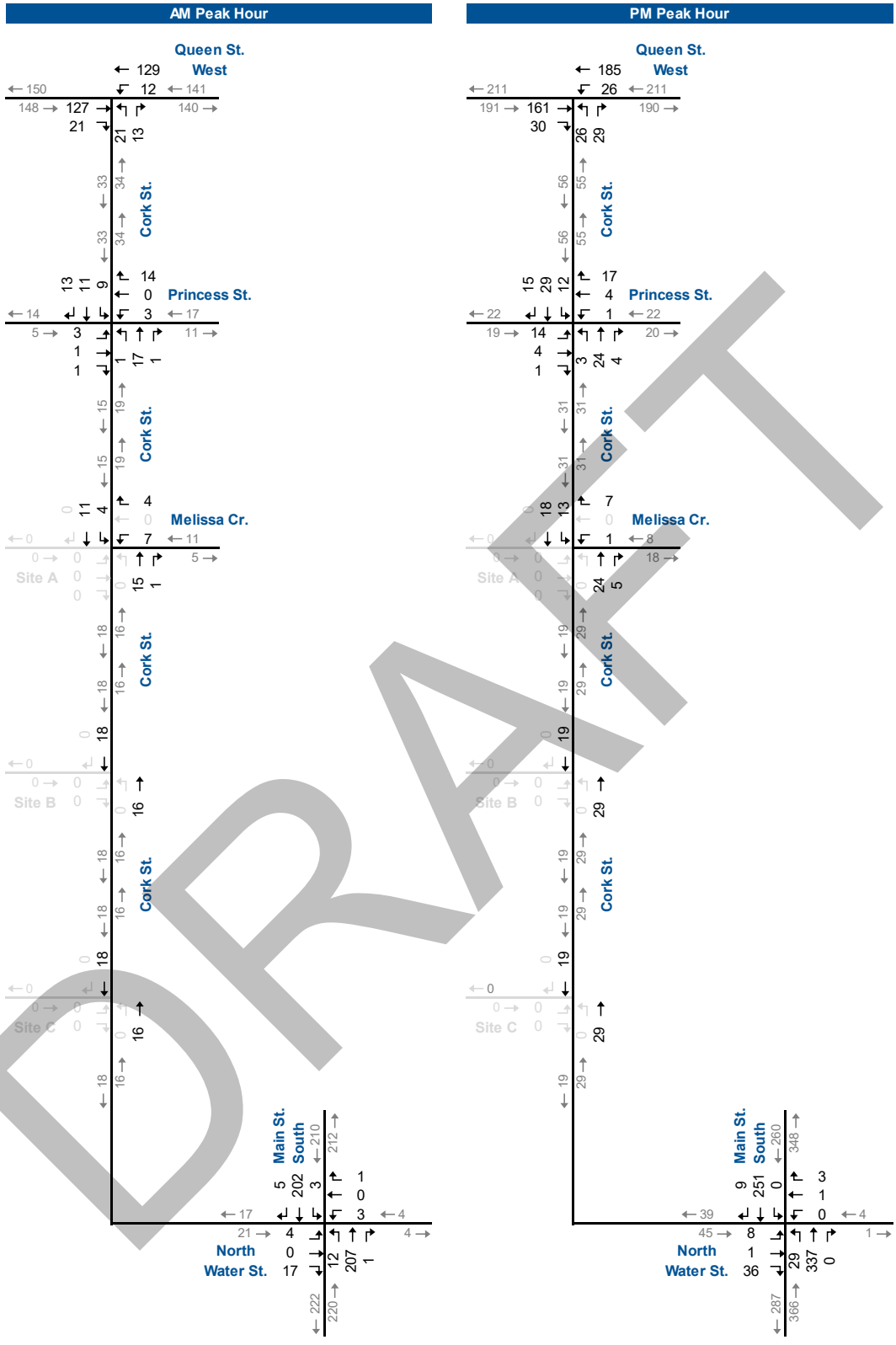
2.2 Traffic Volumes

Paradigm collected weekday, eight-hour turning movement counts for all intersections within the study area in June 2020. Due to the 2020 Covid-19 pandemic and the actions of the Federal and Provincial governments enacting such measures as school closures, travel bans and implementing many other social distancing strategies, there has been a significant impact on travel demands and typical travel patterns.

To account for any descepancy due to the Covid-19 pandemic, the turning movements were increased by 30% and balanced to ensure all traffic is accounted for through the study area intersections.

Figure 2.2 displays the factored base year weekday AM and PM peak hour traffic volumes.

Appendix A contains the detailed turning movement counts for the study area intersections



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Existing Traffic Volumes

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Figure 2.2

2.3 Traffic Operations

Intersection level of service (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 the 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 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.

The operations of the study intersections were evaluated using the existing lane configurations, traffic controls and the existing traffic peak volumes.

The level of service conditions on the existing road network have been assessed using Synchro 9. 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; and
- 95th percentile queue lengths for individual movements exceeds available lane storage.

Table 2.1 summarizes the existing intersection operations. The entries in the table indicating the AM and PM peak hour level of service (LOS), volume to capacity ratios (V/C), and 95th percentile queues experienced.

All intersections operate within acceptable levels, with no specific problem movements under existing traffic conditions.

Appendix B contains the detailed Synchro 9 reports

TABLE 2.1: EXISTING 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	Queen Street West & Cork Street	TWSC	LOS		A	>	A	<	A		A	B		>	B					A
			Delay		0	>	0	<	1		1	10		>	10					1
			V/C		0.09	>		<	0.01			0.05		>						
			Q		0	>		<	0			1		>						
	Cork Street & Princess Street	TWSC	LOS	<	A	>	A	<	A	>	A	<	A	>	A	<	A	>	A	A
			Delay	<	9	>	9	<	9	>	9	<	0	>	0	<	2	>	2	4
			V/C	<	0.01	>		<	0.02	>		<	0.00	>		<	0.01	>		
			Q	<	0	>		<	0	>		<	0	>		<	0	>		
	Cork Street & Melissa Crescent	TWSC	LOS					A		>	A		A	>	A	<	A		A	A
			Delay					9		>	9		0	>	0	<	2		2	3
			V/C					0.01		>			0.01	>		<	0.00			
			Q					0		>			0	>		<	0			
	Main Street South & North Water Street	TWSC	LOS	<	B	>	B	<	B	>	B	<	A	>	A	<	A	>	A	A
			Delay	<	10	>	10	<	12	>	12	<	1	>	1	<	0	>	0	1
			V/C	<	0.03	>		<	0.01	>		<	0.01	>		<	0.00	>		
			Q	<	1	>		<	0	>		<	0	>		<	0	>		
PM Peak Hour	Queen Street West & Cork Street	TWSC	LOS		A	>	A	<	A		A	B		>	B					A
			Delay		0	>	0	<	1		1	11		>	11					2
			V/C		0.12	>		<	0.02			0.09		>						
			Q		0	>		<	1			2		>						
	Cork Street & Princess Street	TWSC	LOS	<	A	>	A	<	A	>	A	<	A	>	A	<	A	>	A	A
			Delay	<	10	>	10	<	9	>	9	<	1	>	1	<	2	>	2	4
			V/C	<	0.02	>		<	0.02	>		<	0.00	>		<	0.01	>		
			Q	<	1	>		<	1	>		<	0	>		<	0	>		
	Cork Street & Melissa Crescent	TWSC	LOS					A		>	A		A	>	A	<	A		A	A
			Delay					9		>	9		0	>	0	<	3		3	2
			V/C					0.01		>			0.02	>		<	0.01			
			Q					0		>			0	>		<	0			
	Main Street South & North Water Street	TWSC	LOS	<	B	>	B	<	B	>	B	<	A	>	A	<	A	>	A	A
			Delay	<	12	>	12	<	12	>	12	<	1	>	1	<	0	>	0	1
			V/C	<	0.08	>		<	0.01	>		<	0.03	>		<	0.00	>		
			Q	<	2	>		<	0	>		<	1	>		<	0	>		

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds
Q - 95th Percentile Queue Length (m)
Ex. - Existing Available Storage (m)
Avail. - Available Storage (m)
TCS - Traffic Control Signal
< - Shared Left-Turn
> - Shared Right-Turn

3 Development Concept

3.1 Development Description

The subject site is located on the west side of Cork Street between Melissa Crescent and Martin Street. A total of 138 residential untis are proposed consisting of 57 single detached and 81 townhome units.

Vehicle access is proposed via two new municipal intersections on Cork Street: opposite of Melissa Crescent, and between Melissa Crescent and Martin Street. Just south of the second access is a private driveway with access to Cork Street for approximately 15 townhome units.

Figure 3.1 shows the proposed development concept.

3.2 Sight Distance

Cork Street has a speed limit of 50 km/h. Using a design speed of 60km/h the following sight distance requirements are noted:

- Minimum stopping sight distance – 85 m[1]; and
- Intersection sight distance:
  - Left-turn from stop – 130 m[2];
  - Right-turn from stop – 110 m[3].

Cork Street is considered flat with a slight horizontal curve south of Melissa Crescent. As the curve on Cork Street bends away from the proposed road intersections, sight distance to the north and south is not obstructed. With over 135 meters of sight distance available at the proposed municiapal roadway intersections, no sight distance issues are anticipated to occur.

[1] TAC Table 2.5.2. Stopping Sight Distance on level roadways for Automobiles
[2] TAC Table 9.9.4. Design Intersection Sight Distance – Case B1, Left-Turn from Stop
[3] TAC Table 9.9.6. Design Intersection Sight Distance – Case B2, Right-Turn from Stop

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Proposed Concept Plan

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Figure 3.1

3.3 Site Trip Generation

The Institute of Transportation Engineers (ITE) Trip Generation[4] methods predict the site trip generation. The following Land Use Codes (LUC) were used to estimate the site trip generation:

- LUC 210 (Single-Family Detached Housing); and
- LUC 220 (Multifamily Housing, Low Rise).

Regression equation rates were used to calculate the trips generated by the residential use. No reductions for mode split or alternate modes of transportation was calculated.

Table 3.1 summarizes the estimated trip generation. The site's base trip generation is estimated to be approximately 84 AM peak hour trips and 108 PM peak hour trips.

TABLE 3.1: TRIP GENERATION

ITE Land Use	Units	AM Peak Hour			PM Peak Hour		
		In	Out	Total	In	Out	Total
210 - Single Family Detached Housing	57	11	34	45	37	22	59
220 - Multifamily Housing (Low-Rise)	81	9	30	39	31	18	49
Total Trip Generation	**138**	**20**	**64**	**84**	**68**	**40**	**108**

LUC 210 - AM: T=0.71(X)+4.80 / PM: Ln(T)=0.96Ln(X)+0.20
LUC 220 - AM: Ln(T)=0.95Ln(X)-0.51 / PM: Ln(T)=0.89Ln(X)-0.02

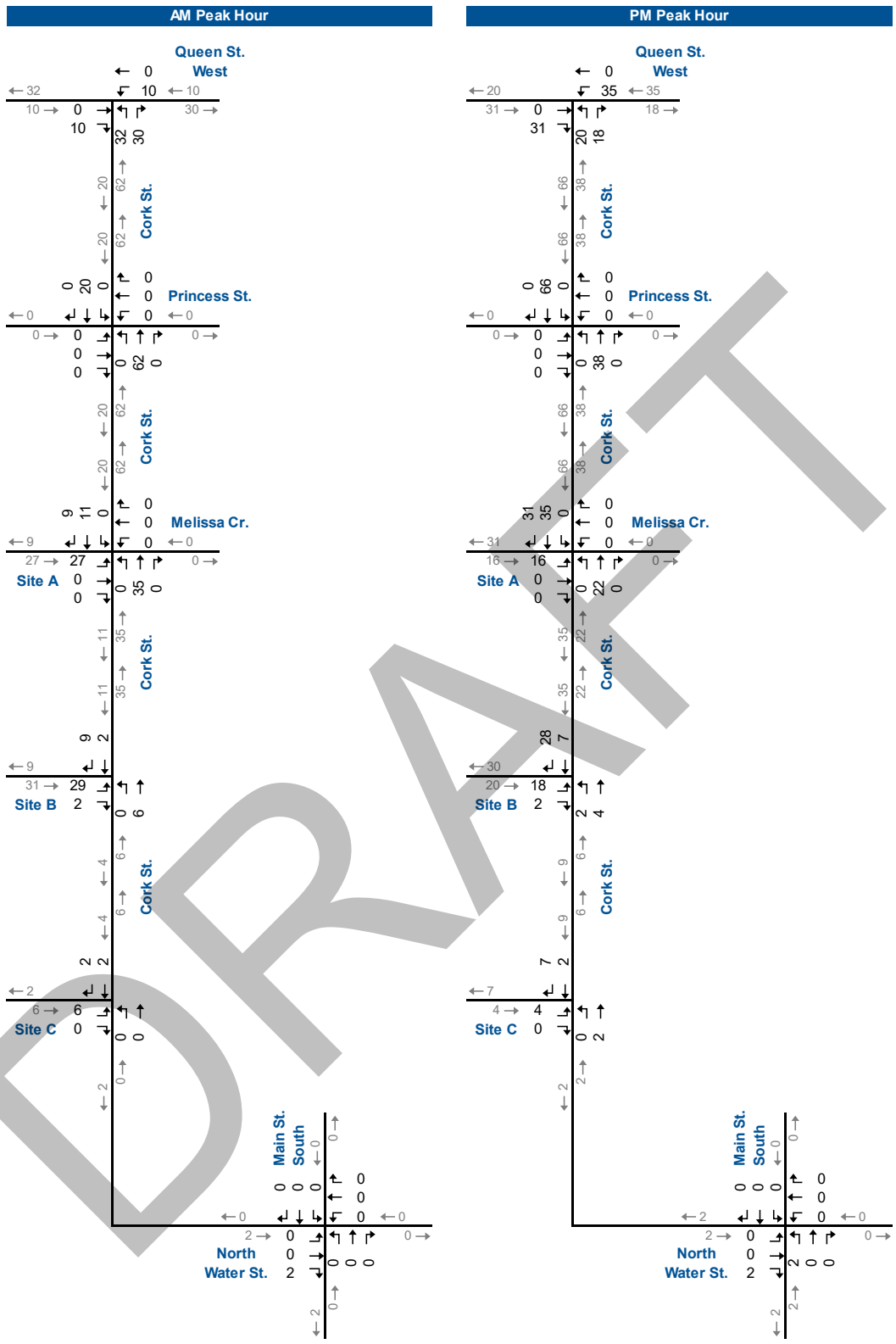
The trip distribution used for this study was based on the existing distribution. The trip distribution is shown in **Table 3.2**.

TABLE 3.2: TRIP DISTRIBUTION

Origin / Destination	AM Peak Hour		PM Peak Hour	
	In	Out	In	Out
East via Queen St. West	48%	46%	50%	45%
West via Queen St. West	50%	49%	45%	49%
South via Main St. South	2%	5%	5%	6%
Total	**100%**	**100%**	**100%**	**100%**

Figure 3.2 contains the AM and PM peak hour trip assignment.

[4] *Trip Generation Tenth Edition*, Institute of Transportation Engineers, Washington D.C., 2017



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Site Generated Traffic Volumes

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Figure 3.2

4 Evaluation of Future Traffic Conditions

The assessment of the future traffic conditions contained in this section includes the future traffic forecasts as well as the level of service analysis.

4.1 Background Traffic Volumes

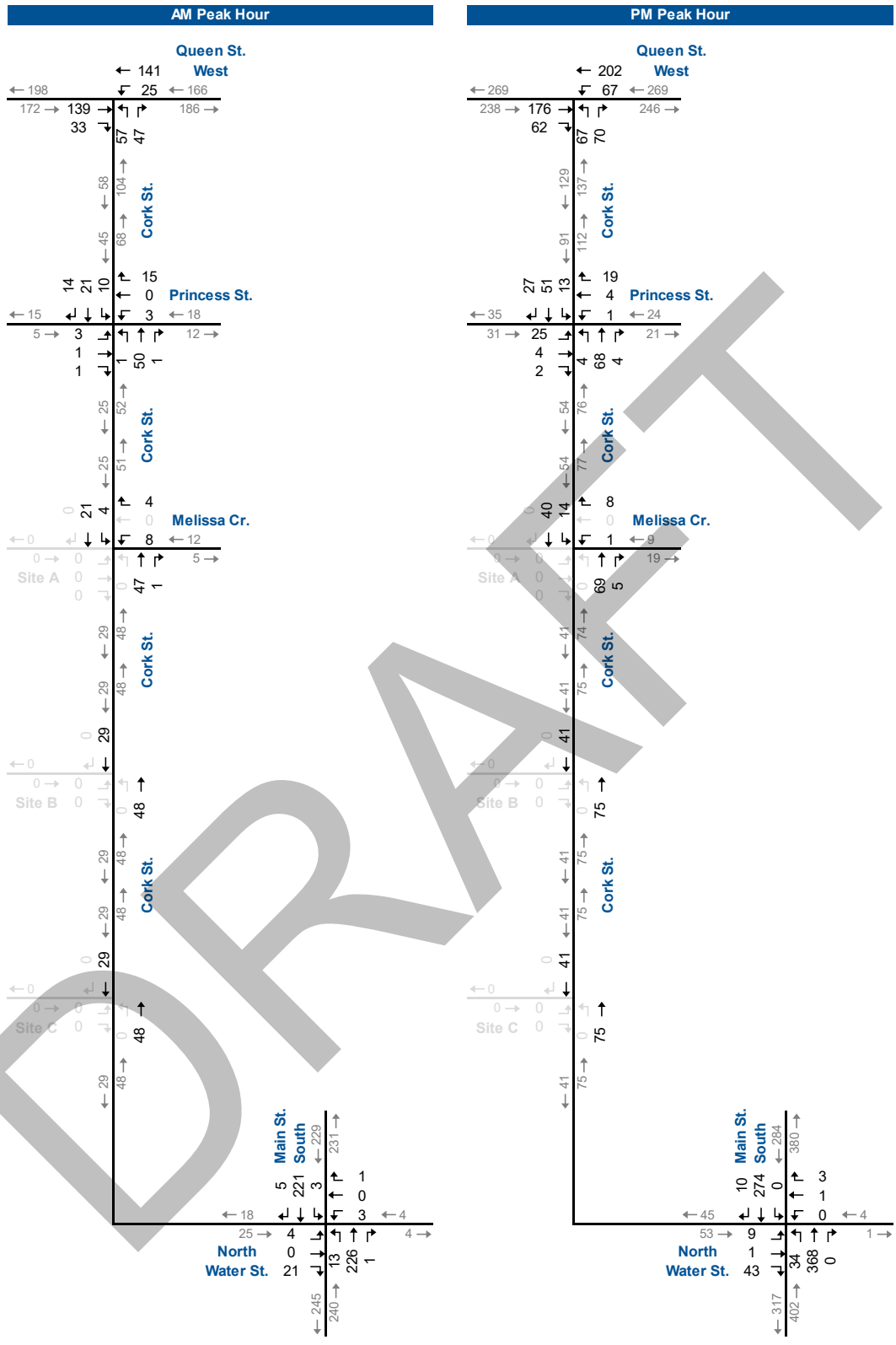
The future background traffic volumes reflect an assumed annual growth rate of 3.0% per annum applied to the existing traffic volumes as well as several adjacent development applications identified by the Township. The growth rate was provided by the Township of Wellington North through their Community Growth Plan[5]. The following background developments provided by the Township were included in the background forecasts:

- **Residential Development** east side of Cork Street between Martin Street and Melissa Crescent. Trip generation determined using ITE equations rates and existing distribution;
- **Outdoor Pool Facility** to be located in the southwest corner of Cork Street and Princess Street. Trip generation determined using ITE rates and existing distribution;
- **590 Queen Street West** is a higher density residential development in the southwest corner of Queen Street West and Cork Street. Trip generation determined using ITE equation rates and existing distribution.

All other background development generated trips are assumed to be captured by the background growth rate. Detailed trip assignments for the background developments are provided in **Appendix C**.

Figure 4.1 illustrates the 2023 background traffic volume forecasts.
Figure 4.2 illustrates the 2028 background traffic volume forecasts.

[5] Wellington North Community Growth Plan, Final Report, GSP Group, Curtis Planning, February 2018



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2023 Background Traffic Volumes

Residential Subdivision, Cork Street, Mount Forest TIS
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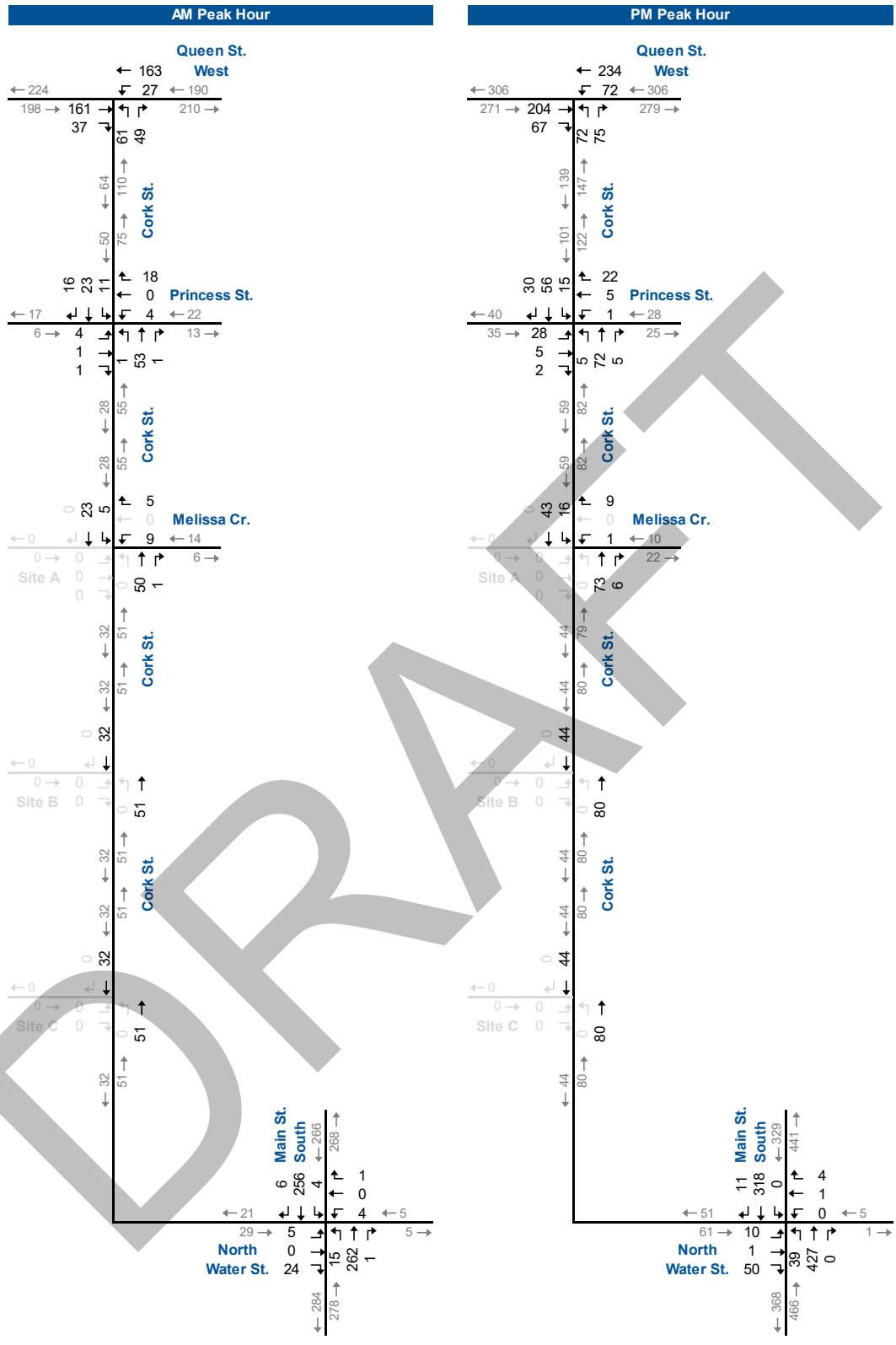
Figure 4.1



2028 Background Traffic Volumes

Residential Subdivision, Cork Street, Mount Forest TIS
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Figure 4.2

4.2 Background Traffic Operations

4.2.1 Background Traffic Operations – Year 2023

The study area intersection operational analyses followed the same methodology used for existing conditions. No changes to the existing lane configuration or traffic control are assumed.

Table 4.1 summarizes the level of service conditions. The results indicate that the study area intersections are forecast to operate at acceptable levels of service during the AM and PM peak hours.

Appendix D1 contains the detailed Synchro output.

TABLE 4.1: BACKROUND TRAFFIC OPERATIONS – YEAR 2023

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	Queen Street West & Cork Street	TWSC	LOS		A	>	A	<	A		A	B		>	B					A
			Delay		0	>	0	<	1		1	11		>	11					3
			V/C		0.11	>		<	0.02			0.16		>						
			Q		0	>		<	1			5		>						
	Cork Street & Princess Street	TWSC	LOS	<	A	>	A	<	A	>	A	<	A	>	A	<	A	>	A	A
			Delay	<	9	>	9	<	9	>	9	<	0	>	0	<	2	>	2	2
			V/C	<	0.01	>		<	0.02	>		<	0.00	>		<	0.01	>		
			Q	<	0	>		<	1	>		<	0	>		<	0	>		
	Cork Street & Melissa Crescent	TWSC	LOS					A		>	A		A	>	A	<	A		A	A
			Delay					9		>	9		0	>	0	<	1		1	2
			V/C					0.01		>			0.03	>		<	0.00			
			Q					0		>			0	>		<	0			
	Main Street South & North Water Street	TWSC	LOS	<	B	>	B	<	B	>	B	<	A	>	A	<	A	>	A	A
			Delay	<	10	>	10	<	12	>	12	<	1	>	1	<	0	>	0	1
			V/C	<	0.04	>		<	0.01	>		<	0.01	>		<	0.00	>		
			Q	<	1	>		<	0	>		<	0	>		<	0	>		
PM Peak Hour	Queen Street West & Cork Street	TWSC	LOS		A	>	A	<	A		A	B		>	B					A
			Delay		0	>	0	<	2		2	14		>	14					4
			V/C		0.15	>		<	0.06			0.26		>						
			Q		0	>		<	1			8		>						
	Cork Street & Princess Street	TWSC	LOS	<	B	>	B	<	A	>	A	<	A	>	A	<	A	>	A	A
			Delay	<	10	>	10	<	9	>	9	<	0	>	0	<	1	>	1	3
			V/C	<	0.05	>		<	0.03	>		<	0.00	>		<	0.01	>		
			Q	<	1	>		<	1	>		<	0	>		<	0	>		
	Cork Street & Melissa Crescent	TWSC	LOS					A		>	A		A	>	A	<	A		A	A
			Delay					9		>	9		0	>	0	<	2		2	1
			V/C					0.01		>			0.05	>		<	0.01			
			Q					0		>			0	>		<	0			
	Main Street South & North Water Street	TWSC	LOS	<	B	>	B	<	B	>	B	<	A	>	A	<	A	>	A	A
			Delay	<	12	>	12	<	12	>	12	<	1	>	1	<	0	>	0	2
			V/C	<	0.10	>		<	0.01	>		<	0.03	>		<	0.00	>		
			Q	<	3	>		<	0	>		<	1	>		<	0	>		

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds
Q - 95th Percentile Queue Length (m)
Ex. - Existing Available Storage (m)
Avail. - Available Storage (m)
TCS - Traffic Control Signal
< - Shared Left-Turn
> - Shared Right-Turn

4.2.2 Background Traffic Operations – Year 2028

The study area intersection operational analyses followed the same methodology used for existing conditions. No changes to the existing lane configuration or traffic control are assumed.

Table 4.2 summarizes the level of service conditions. The results indicate that the study area intersections are forecast to operate at acceptable levels of service during the AM and PM peak hours.

Appendix D2 contains the detailed Synchro output.

TABLE 4.2: BACKROUND TRAFFIC OPERATIONS – YEAR 2028

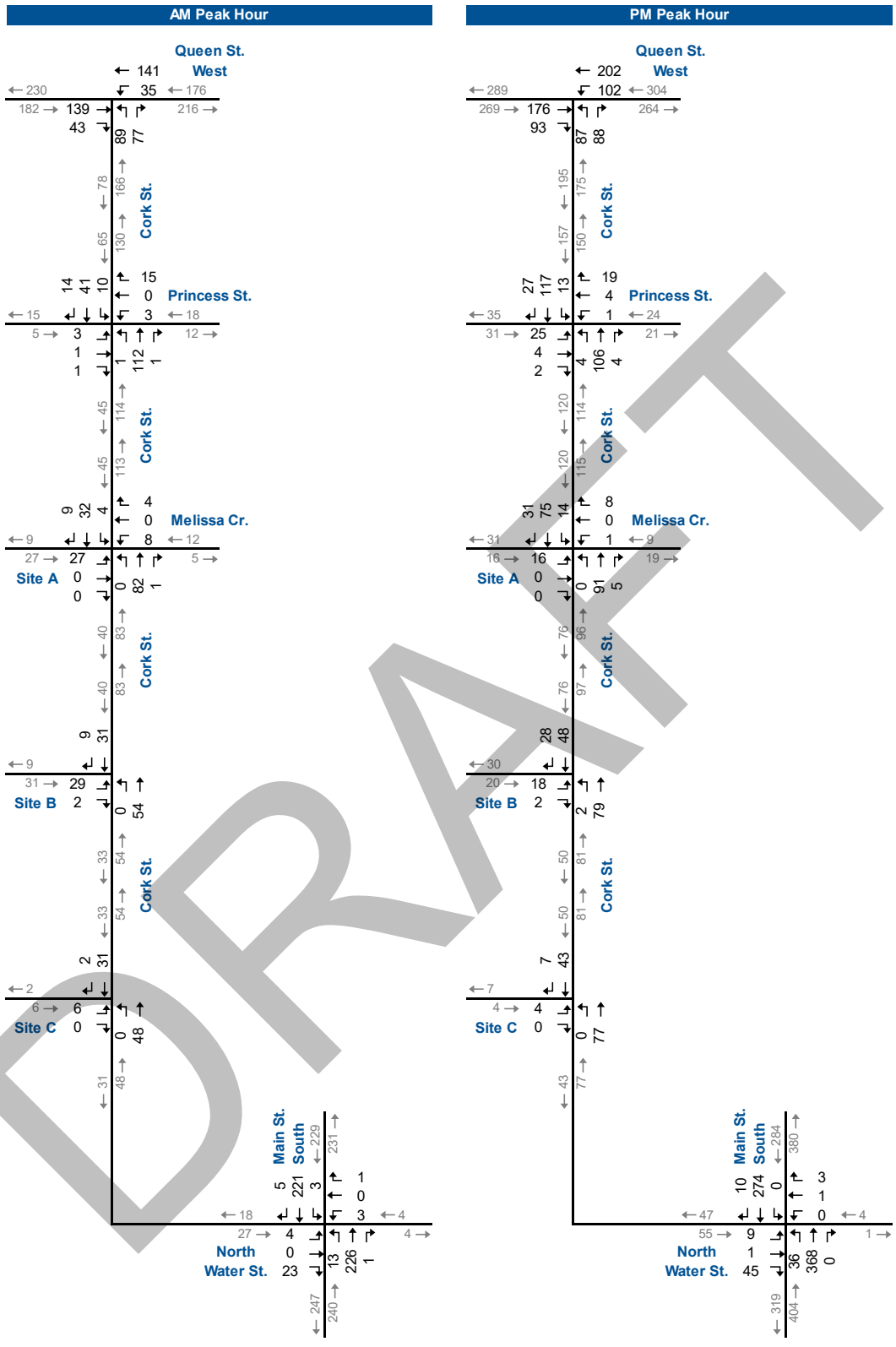
Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																
				Eastbound				Westbound				Northbound				Southbound				Overall
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
AM Peak Hour	Queen Street West & Cork Street	TWSC	LOS		A	>	A	<	A		A	B		>	B					A
			Delay		0	>	0	<	1		1	12		>	12					3
			V/C		0.13	>		<	0.02			0.18		>						
			Q		0	>		<	1			5		>						
	Cork Street & Princess Street	TWSC	LOS	<	A	>	A	<	A	>	A	<	A	>	A	<	A	>	A	A
			Delay	<	9	>	9	<	9	>	9	<	0	>	0	<	2	>	2	3
			V/C	<	0.01	>		<	0.02	>		<	0.00	>		<	0.01	>		
			Q	<	0	>		<	1	>		<	0	>		<	0	>		
	Cork Street & Melissa Crescent	TWSC	LOS					A		>	A		A	>	A	<	A		A	A
			Delay					9		>	9		0	>	0	<	1		1	2
			V/C					0.02		>			0.03	>		<	0.00			
			Q					0		>			0	>		<	0			
	Main Street South & North Water Street	TWSC	LOS	<	B	>	B	<	B	>	B	<	A	>	A	<	A	>	A	A
			Delay	<	11	>	11	<	14	>	14	<	1	>	1	<	0	>	0	1
			V/C	<	0.05	>		<	0.01	>		<	0.01	>		<	0.00	>		
			Q	<	1	>		<	0	>		<	0	>		<	0	>		
PM Peak Hour	Queen Street West & Cork Street	TWSC	LOS		A	>	A	<	A		A	B		>	B					A
			Delay		0	>	0	<	2		2	15		>	15					4
			V/C		0.17	>		<	0.06			0.30		>						
			Q		0	>		<	2			10		>						
	Cork Street & Princess Street	TWSC	LOS	<	B	>	B	<	A	>	A	<	A	>	A	<	A	>	A	A
			Delay	<	10	>	10	<	9	>	9	<	1	>	1	<	1	>	1	3
			V/C	<	0.05	>		<	0.03	>		<	0.00	>		<	0.01	>		
			Q	<	1	>		<	1	>		<	0	>		<	0	>		
	Cork Street & Melissa Crescent	TWSC	LOS					A		>	A		A	>	A	<	A		A	A
			Delay					9		>	9		0	>	0	<	2		2	1
			V/C					0.01		>			0.05	>		<	0.01			
			Q					0		>			0	>		<	0			
	Main Street South & North Water Street	TWSC	LOS	<	B	>	B	<	B	>	B	<	A	>	A	<	A	>	A	A
			Delay	<	13	>	13	<	13	>	13	<	1	>	1	<	0	>	0	2
			V/C	<	0.13	>		<	0.01	>		<	0.04	>		<	0.00	>		
			Q	<	4	>		<	0	>		<	1	>		<	0	>		

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds
Q - 95th Percentile Queue Length (m)
Ex. - Existing Available Storage (m)
Avail. - Available Storage (m)
TCS - Traffic Control Signal
< - Shared Left-Turn
> - Shared Right-Turn

4.3 Total Traffic Forecast

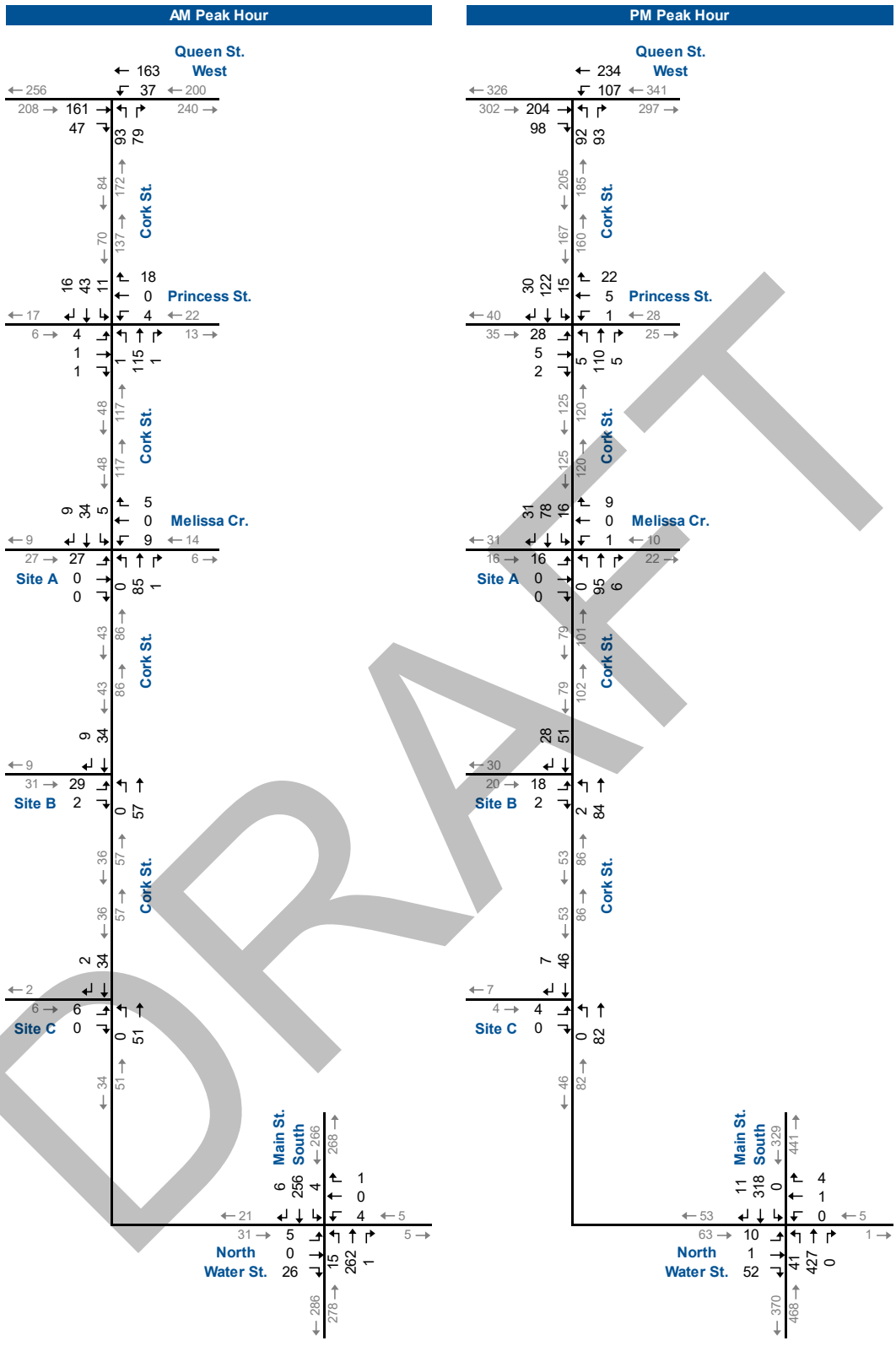
The future total traffic volumes forecast to occur includes the future background traffic volumes and the site generated traffic volumes for each horizon year.

Figure 4.3 illustrates the forecast year 2023 total traffic volumes.
Figure 4.4 illustrates the forecast year 2028 total traffic volumes.



paradigm TRANSPORTATION SOLUTIONS LIMITED

2023 Total Traffic Volumes



2028 Total Traffic Volumes

Residential Subdivision, Cork Street, Mount Forest TIS
200219

Figure 4.4

4.4 Total Traffic Operations

4.4.1 Total Traffic Operations – Year 2023

The study area intersection operational analyses followed the same methodology used for background traffic conditions. The proposed new accesses to Cork Street are assumed to operate as stop-controled with shared left/right-turn lanes. **Table 4.3** summarizes the level of service conditions for the AM and PM peak hours. The results indicate that the study area intersections are forecast to operate at acceptable levels of service during the AM and PM peak hours.

Appendix E1 contains the detailed Synchro output.

TABLE 4.3: TOTAL TRAFFIC OPERATIONS – YEAR 2023

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	Queen Street West & Cork Street	TWSC	LOS		A	>	A	<	A		A	B		>	B					A
			Delay		0	>	0	<	2		2	12		>	12					5
			V/C		0.12	>		<	0.03			0.27		>						
			Q		0	>		<	1			9		>						
	Cork Street & Princess Street	TWSC	LOS	<	A	>	A	<	A	>	A	<	A	>	A	<	A	>	A	A
			Delay	<	10	>	10	<	9	>	9	<	0	>	0	<	1	>	1	1
			V/C	<	0.01	>		<	0.02	>		<	0.00	>		<	0.01	>		
			Q	<	0	>		<	1	>		<	0	>		<	0	>		
	Cork Street & Melissa Crescent / Site A	TWSC	LOS	<	A	>	A	<	A	>	A	<	A	>	A	<	A	>	A	A
			Delay	<	10	>	10	<	9	>	9	<	0	>	0	<	1	>	1	2
			V/C	<	0.04	>		<	0.02	>		<	0.00	>		<	0.00	>		
			Q	<	1	>		<	0	>		<	0	>		<	0	>		
	Main Street South & North Water Street	TWSC	LOS	<	B	>	B	<	B	>	B	<	A	>	A	<	A	>	A	A
			Delay	<	10	>	10	<	13	>	13	<	1	>	1	<	0	>	0	1
			V/C	<	0.04	>		<	0.01	>		<	0.01	>		<	0.00	>		
			Q	<	1	>		<	0	>		<	0	>		<	0	>		
	Cork Street & Site B	TWSC	LOS	A		>	A					<	A		A		A	>	A	A
			Delay	9		>	9					<	0		0		0	>	0	2
			V/C	0.04		>						<	0.00				0.03	>		
			Q	1		>						<	0				0	>		
	Cork Street & Site C	TWSC	LOS	A		>	A					<	A		A		A	>	A	A
			Delay	9		>	9					<	0		0		0	>	0	1
			V/C	0.01		>						<	0.00				0.02	>		
			Q	0		>						<	0				0	>		
PM Peak Hour	Queen Street West & Cork Street	TWSC	LOS		A	>	A	<	A		A	C		>	C					A
			Delay		0	>	0	<	3		3	16		>	16					5
			V/C		0.17	>		<	0.09			0.37		>						
			Q		0	>		<	2			14		>						
	Cork Street & Princess Street	TWSC	LOS	<	B	>	B	<	A	>	A	<	A	>	A	<	A	>	A	A
			Delay	<	11	>	11	<	9	>	9	<	0	>	0	<	1	>	1	2
			V/C	<	0.05	>		<	0.03	>		<	0.00	>		<	0.01	>		
			Q	<	1	>		<	1	>		<	0	>		<	0	>		
	Cork Street & Melissa Crescent / Site A	TWSC	LOS	<	B	>	B	<	A	>	A	<	A	>	A	<	A	>	A	A
			Delay	<	10	>	10	<	9	>	9	<	0	>	0	<	1	>	1	2
			V/C	<	0.02	>		<	0.01	>		<	0.00	>		<	0.01	>		
			Q	<	1	>		<	0	>		<	0	>		<	0	>		
	Main Street South & North Water Street	TWSC	LOS	<	B	>	B	<	B	>	B	<	A	>	A	<	A	>	A	A
			Delay	<	12	>	12	<	12	>	12	<	1	>	1	<	0	>	0	2
			V/C	<	0.10	>		<	0.01	>		<	0.03	>		<	0.00	>		
			Q	<	3	>		<	0	>		<	1	>		<	0	>		
	Cork Street & Site B	TWSC	LOS	A		>	A					<	A		A		A	>	A	A
			Delay	9		>	9					<	0		0		0	>	0	1
			V/C	0.03		>						<	0.00				0.05	>		
			Q	1		>						<	0				0	>		
	Cork Street & Site C	TWSC	LOS	A		>	A					<	A		A		A	>	A	A
			Delay	9		>	9					<	0		0		0	>	0	0
			V/C	0.00		>						<	0.00				0.03	>		
			Q	0		>						<	0				0	>		

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds
Q - 95th Percentile Queue Length (m)
Ex. - Existing Available Storage (m)
Avail. - Available Storage (m)
TCS - Traffic Control Signal
< - Shared Left-Turn
> - Shared Right-Turn

4.4.2 Total Traffic Operations – Year 2028

The study area intersection operational analyses followed the same methodology used for background traffic conditions. **Table 4.4** summarizes the level of service conditions for the AM and PM peak hours. The results indicate that the study area intersections are forecast to operate at acceptable levels of service during the AM and PM peak hours.

Appendix E2 contains the detailed Synchro output.

TABLE 4.4: TOTAL TRAFFIC OPERATIONS – YEAR 2028

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	Queen Street West & Cork Street	TWSC	LOS		A	>	A	<	A		A	B		>	B					A
			Delay		0	>	0	<	2		2	13		>	13					4
			V/C		0.13	>		<	0.03			0.29		>						
			Q		0	>		<	1			10		>						
	Cork Street & Princess Street	TWSC	LOS	<	A	>	A	<	A	>	A	<	A	>	A	<	A	>	A	A
			Delay	<	10	>	10	<	9	>	9	<	0	>	0	<	1	>	1	2
			V/C	<	0.01	>		<	0.03	>		<	0.00	>		<	0.01	>		
			Q	<	0	>		<	1	>		<	0	>		<	0	>		
	Cork Street & Melissa Crescent / Site A	TWSC	LOS	<	A	>	A	<	A	>	A	<	A	>	A	<	A	>	A	A
			Delay	<	10	>	10	<	9	>	9	<	0	>	0	<	1	>	1	2
			V/C	<	0.04	>		<	0.02	>		<	0.00	>		<	0.00	>		
			Q	<	1	>		<	0	>		<	0	>		<	0	>		
	Main Street South & North Water Street	TWSC	LOS	<	B	>	B	<	B	>	B	<	A	>	A	<	A	>	A	A
			Delay	<	11	>	11	<	14	>	14	<	1	>	1	<	0	>	0	1
			V/C	<	0.05	>		<	0.01	>		<	0.01	>		<	0.00	>		
			Q	<	1	>		<	0	>		<	0	>		<	0	>		
	Cork Street & Site B	TWSC	LOS	A		>	A					<	A		A		A	>	A	A
			Delay	9		>	9					<	0		0		0	>	0	2
			V/C	0.04		>						<	0.00				0.03	>		
			Q	1		>						<	0				0	>		
	Cork Street & Site C	TWSC	LOS	A		>	A					<	A		A		A	>	A	A
			Delay	9		>	9					<	0		0		0	>	0	1
			V/C	0.01		>						<	0.00				0.02	>		
			Q	0		>						<	0				0	>		
PM Peak Hour	Queen Street West & Cork Street	TWSC	LOS		A	>	A	<	A		A	C		>	C					A
			Delay		0	>	0	<	3		3	19		>	20					6
			V/C		0.19	>		<	0.10			0.43		>						
			Q		0	>		<	3			17		>						
	Cork Street & Princess Street	TWSC	LOS	<	B	>	B	<	A	>	A	<	A	>	A	<	A	>	A	A
			Delay	<	12	>	12	<	10	>	10	<	0	>	0	<	1	>	1	2
			V/C	<	0.06	>		<	0.04	>		<	0.00	>		<	0.01	>		
			Q	<	2	>		<	1	>		<	0	>		<	0	>		
	Cork Street & Melissa Crescent / Site A	TWSC	LOS	<	B	>	B	<	A	>	A	<	A	>	A	<	A	>	A	A
			Delay	<	10	>	10	<	9	>	9	<	0	>	0	<	1	>	1	2
			V/C	<	0.02	>		<	0.01	>		<	0.00	>		<	0.01	>		
			Q	<	1	>		<	0	>		<	0	>		<	0	>		
	Main Street South & North Water Street	TWSC	LOS	<	B	>	B	<	B	>	B	<	A	>	A	<	A	>	A	A
			Delay	<	13	>	13	<	13	>	13	<	1	>	1	<	0	>	0	2
			V/C	<	0.13	>		<	0.01	>		<	0.04	>		<	0.00	>		
			Q	<	4	>		<	0	>		<	1	>		<	0	>		
	Cork Street & Site B	TWSC	LOS	A		>	A					<	A		A		A	>	A	A
			Delay	9		>	9					<	0		0		0	>	0	1
			V/C	0.03		>						<	0.00				0.05	>		
			Q	1		>						<	0				0	>		
	Cork Street & Site C	TWSC	LOS	A		>	A					<	A		A		A	>	A	A
			Delay	9		>	9					<	0		0		0	>	0	0
			V/C	0.00		>						<	0.00				0.03	>		
			Q	0		>						<	0				0	>		

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds
Q - 95th Percentile Queue Length (m)
Ex. - Existing Available Storage (m)
Avail. - Available Storage (m)
TCS - Traffic Control Signal
< - Shared Left-Turn
> - Shared Right-Turn

5 Remedial Measures

5.1 Auxiliary Turn Lanes

5.1.1 Left-Turn Lanes

The Ministry of Transportation's Design Supplement for the Transportation Association of Canada (TAC) Geometric Design Guide for Canadian Roads[6] provides guidance on the assessment and/or need for auxiliary left-turn lanes

The warrants have been completed for:

- Cork Street at Site A
- Cork Street at Site B;
- Cork Sreet at Site C;
- Queen Street West at Cork Street; and
- Main Street South at North Water Street.

A design speed of 60 km/h (10 km/h over the assumed speed limit) has been used for the analysis purposes. **Table 5.1** summarizes the left-turn lane warrants for the Cork Street intersections.

The warrant analysis suggests that northbound left-turn lanes are not warranted under 2023 and 2028 total traffic conditions.

TABLE 5.1: CORK STREET LEFT-TURN LANE WARRANT SUMMARY

Roadway	Cork Street											
Intersection	Site A				Site B				Site C			
Approach Direction	Northbound				Northbound				Northbound			
Design Speed	60 km/h				60 km/h				60 km/h			
Horizon	Total 2023		Total 2028		Total 2023		Total 2028		Total 2023		Total 2028	
Peak Hour	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Advancing Volume	83	96	86	101	54	81	57	86	48	77	51	82
Opposing Volumes	45	120	48	125	40	76	43	79	33	50	36	53
Left Turning Traffic	0	0	0	0	0	2	0	2	0	0	0	0
% of Left Turning Traffic	0%	0%	0%	0%	0%	2%	0%	2%	0%	0%	0%	0%
Figure Used*	9A-6	9A-6	9A-6	9A-6	9A-6	9A-6	9A-6	9A-6	9A-6	9A-6	9A-6	9A-6
Warranted	No	No	No	No	No	No	No	No	No	No	No	No
Storage Length Required	--	--	--	--	--	--	--	--	--	--	--	--

Based on MTO Design Supplement for TAC Geometric Design Guide for Canadian Roads - June 2017

Table 5.2 summarizes the left-turn lane warrants for the intersection of Queen Street West and Cork Street. The warrant analysis suggests

[6] *MTO Design Supplement for TAC Geometric Design Guide for Canadian Roads, June 2017 Appendix 9 for Chapter 9 Intersections*

that a westbound left-turn lane with 15m of storage is warranted on Queen Street West at Cork Street under 2028 background traffic conditions.

TABLE 5.2: QUEEN STREET WEST LEFT-TURN LANE WARRANT SUMMARY

Roadway	Queen Street West							
Intersection	Cork Street							
Approach Direction	Westbound							
Design Speed	60 km/h							
Horizon	Background 2023		Total 2023		Background 2028		Total 2028	
Peak Hour	AM	PM	AM	PM	AM	PM	AM	PM
Advancing Volume	166	269	176	304	190	306	200	341
Opposing Volumes	172	238	182	269	198	271	208	302
Left Turning Traffic	25	67	35	102	27	72	37	107
% of Left Turning Traffic	15%	25%	20%	34%	14%	24%	19%	31%
Figure Used*	9A-7	9A-7	9A-7	9A-9	9A-7	9A-7	9A-7	9A-8
Warranted	No	No	No	No	No	Yes	No	Yes
Storage Length Required	--	--	--	--	--	15m	--	15m

Based on MTO Design Supplement for TAC Geometric Design Guide for Canadian Roads - June 2017

Table 5.3 summarizes the left-turn lane warrants for the intersection of Main Street South and North Water Street. The warrant analysis suggests that a northbound left-turn lane with 15m of storage is warranted on Main Street South at North Water Street under 2028 background traffic conditions.

TABLE 5.3: MAIN STREET SOUTH LEFT-TURN LANE WARRANT SUMMARY

Roadway	Main Street South							
Intersection	North Water Street							
Approach Direction	Northbound							
Design Speed	60 km/h							
Horizon	Background 2023		Total 2023		Background 2028		Total 2028	
Peak Hour	AM	PM	AM	PM	AM	PM	AM	PM
Advancing Volume	240	402	240	404	278	466	278	468
Opposing Volumes	229	284	229	284	266	329	266	329
Left Turning Traffic	13	34	13	36	15	39	15	41
% of Left Turning Traffic	5%	8%	5%	9%	5%	8%	5%	9%
Figure Used*	9A-6	9A-6	9A-6	9A-6	9A-6	9A-6	9A-6	9A-6
Warranted	No	No	No	No	No	Yes	No	Yes
Storage Length Required	--	--	--	--	--	15m	--	15m

Based on MTO Design Supplement for TAC Geometric Design Guide for Canadian Roads - June 2017

Appendix F contains the left-turn lane warrant nomographs.

5.1.2 Right-Turn Lanes

The proposed new road connections to Cork Street were assessed to determine if the forecasts traffic volumes warrant installation of southbound right-turn lane along Cork Street.

Although right-turns are generally made more efficiently than left-turn movements, exclusive right-turn lanes are often provided for many of the same reasons than left-turn lanes are provided such as safety (reduced chance or rear-end collisions) and reduced delay to through movements.

MTO guidelines (Geometric Design Standards for Ontario Highways) note that right turn lanes or tapers may be considered where right turn volumes exceed 60 vehicles per hour (vph) and where right turning vehicles create a hazard or reduce capacity at the intersection. The forecast right-turn movement at the proposed new road connections are approximately 31 vph during the PM peak hour.

Southbound right-turn lanes on Cork Street at the three new proposed road accesses are not warranted. No geometric improvements are required to accommodate the site generated traffic.

6 Conclusions and Recommendations

6.1 Conclusions

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

- **Existing Traffic Conditions:** All study area intersections are currently operating within acceptable levels of service;
- **Development Trip Generation:** The development is forecast to generate approximately 84 and 108 trips during the AM and PM peak hours, respectively;
- **2023 Background Traffic Conditions:** All study area intersections are forecast to continue to operate within acceptable levels of service;
- **2028 Background Traffic Conditions:** All study area intersections are forecast to continue to operate within acceptable levels of service;
- **2023 Total Traffic Conditions:** All study area intersections are forecast to continue to operate within acceptable levels of service;
- **2028 Total Traffic Conditions:** All study area intersections are forecast to continue to operate within acceptable levels of service;
- **Remedial Measures:** auxiliary lanes are not warranted at either proposed municipal road intersections with Cork Street nor the private driveway connection with Cork Street.
- A westbound left-turn lane on Queen Street West at Cork Street is warranted for 15m of storage under 2028 Background traffic conditions, regardless of whether the subject development is built.
- A northbound left-turn lane on Main Street South at North Water Street is warranted for 15m of storage under 2028 Background traffic conditions, regardless of whether the subject development is built.

6.2 Recommendations

Based on the findings of this study, it is recommended that the Township of Wellington North monitor the future traffic volumes at the Queen Street West at Cork Street and Main Street South at North Water Street intersections to determine the need for auxiliary turn lanes.

It is further recommended that the development be approved with no additional requirement for off-site transportation improvements.

Appendix A

Turning Movement Counts

Appendix B

Existing Operations Reports

Appendix C

Background Development Trip Assignments

Appendix D1

2023 Background Operations Reports

Appendix D2

2028 Background Operations Reports

Appendix E1

2023 Total Operations Reports

Appendix E1

2028 Total Operations Reports

Appendix F

Left-Turn Lane Warrant Nomographs