

# Appendix 3 Traffic Impact Assessment



transport planning  
traffic engineering  
modelling

# Proposed McDonald's Restaurant

Lot 9065 (101) Chateau Avenue,  
Alkimos

**PREPARED FOR:**  
McDonald's Australia Ltd

November 2021

## Document history and status

Author	Revision	Approved by	Date approved	Revision type
Waihin Tun	r01	B Bordbar	14/08/2021	Draft
R White	r01a	B Bordbar	26/11/2021	Final

**File name:** t21.160.wt.r01a.docx

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**Client:** McDonald's Australia Ltd

**Project:** Lot 9062 (2561) Marmion Avenue, Alkimos

**Document revision:** r01a

**Project number:** t21.160

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# TABLE OF CONTENTS

<b>1</b>	<b>SUMMARY .....</b>	<b>1</b>
<b>2</b>	<b>INTRODUCTION.....</b>	<b>2</b>
<b>3</b>	<b>EXISTING SITUATION.....</b>	<b>4</b>
3.1	EXISTING SITE USE, ACCESS AND PARKING.....	4
3.2	EXISTING ROAD NETWORK.....	4
3.3	EXISTING TRAFFIC VOLUMES ON ROADS.....	7
3.4	PUBLIC TRANSPORT ACCESS.....	9
3.5	PEDESTRIAN AND CYCLIST FACILITIES .....	10
3.6	CRASH DATA .....	11
<b>4</b>	<b>DEVELOPMENT PROPOSAL.....</b>	<b>12</b>
4.1	PROPOSED SITE USE.....	12
4.2	PROPOSED ACCESS FOR ALL MODES.....	12
<b>5</b>	<b>CHANGES TO SURROUNDING TRANSPORT NETWORKS.....</b>	<b>14</b>
<b>6</b>	<b>INTEGRATION WITH SURROUNDING AREA .....</b>	<b>15</b>
<b>7</b>	<b>HOURS OF OPERATION .....</b>	<b>16</b>
<b>8</b>	<b>TRAFFIC ASSESSMENT .....</b>	<b>17</b>
8.1	ASSESSMENT PERIOD .....	17
8.2	TRIP GENERATION AND DISTRIBUTION.....	17
8.2.1	EXISTING TRAFFIC GENERATION .....	17
8.2.2	PROPOSED DEVELOPMENT TRAFFIC GENERATION.....	17
8.3	TRAFFIC FLOWS.....	20
8.4	ANALYSIS OF LOCAL INTERSECTION & DEVELOPMENT'S CROSSOVERS.....	23
8.5	IMPACT ON SURROUNDING ROADS.....	26
8.6	IMPACT ON NEIGHBOURING AREAS .....	26
8.7	TRAFFIC NOISE AND VIBRATION.....	26
<b>9</b>	<b>PARKING.....</b>	<b>27</b>
<b>10</b>	<b>PROVISION FOR HEAVY VEHICLES .....</b>	<b>28</b>
<b>11</b>	<b>DRIVE-THROUGH QUEUE ANALYSIS.....</b>	<b>29</b>
<b>12</b>	<b>PUBLIC TRANSPORT ACCESS .....</b>	<b>32</b>
<b>13</b>	<b>PEDESTRIAN AND CYCLIST ACCESS.....</b>	<b>33</b>
<b>14</b>	<b>CONCLUSIONS.....</b>	<b>34</b>

**APPENDIX A: PROPOSED DEVELOPMENT PLAN**

**APPENDIX B: TURN PATH PLANS**

**APPENDIX C: SIDRA RESULTS**



# REPORT FIGURES

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Figure 1: Location of the subject site .....	2
Figure 2. Westbound View along Hawksbill Drive.....	5
Figure 3. Northbound View along Marmion Avenue.....	6
Figure 4. Existing AM peak hour traffic counts at Marmion Avenue/ Hawksbill Drive and Santorini Promenade roundabout intersection .....	7
Figure 5. Existing PM peak hour traffic counts at Marmion Avenue/ Hawksbill Drive and Santorini Promenade roundabout intersection .....	8
Figure 6. Existing bus routes (source: Transperth).....	9
Figure 7. Bike map (source: Department of Transport) .....	10
Figure 8. Proposed access arrangements.....	13
Figure 9. Existing traffic flows at the Marmion Avenue/Hawksbill Drive/Santorini Promenade roundabout – 2021 Weekday AM & PM peak hours .....	20
Figure 10. Post development (proposed McDonald’s development + proposed adjacent service station development) traffic flows – 2022 Weekday AM and PM peak hours .....	21
Figure 11. 10-year post development (proposed McDonald’s development + proposed adjacent service station development) traffic flows – 2032 Weekday AM and PM peak hours .....	22
Figure 12. SIDRA layout – Existing roundabout intersection of Marmion Avenue/ Hawksbill Drive/ Santorini Promenade .....	24
Figure 13. SIDRA Network layout for post development scenario (2022).....	24
Figure 14. SIDRA Network layout for 10-year post development scenario (2032).....	25
Figure 15: Driveway sightline.....	27
Figure 16. Peak restaurant drive-through weekday morning hour queuing analysis .....	30

# REPORT TABLES

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Table 1. Crash history for the Marmion Avenue/ Hawksbill Drive/ Santorini Promenade roundabout intersection .....	11
Table 2. Estimated peak hour trips for the proposed development .....	18
Table 3. Estimated peak hour trips for the service station development.....	19
Table 4. SIDRA results for the roundabout intersection of Marmion Avenue/ Hawksbill Drive/ Santorini Promenade – 2021 Weekday AM peak period (Existing) .....	43
Table 5. SIDRA results for the roundabout intersection of Marmion Avenue/ Hawksbill Drive/ Santorini Promenade – 2021 Weekday PM peak period (Existing) .....	44
Table 6. SIDRA results for full movement crossover (crossover 1) – Weekday AM peak period (Post development – Year 2022) .....	45
Table 7. SIDRA results for full movement crossover (crossover 1) – Weekday PM peak period (Post development – Year 2022) .....	45
Table 8. SIDRA results for left turn exit only crossover (crossover 2) – Weekday AM peak period (Post development – Year 2022) .....	46

<b>Table 9. SIDRA results for left turn exit only crossover (crossover 2) – Weekday PM peak period (Post development – Year 2022) .....</b>	<b>46</b>
<b>Table 10. SIDRA results for the roundabout intersection of Marmion Avenue/ Hawksbill Drive/ Santorini Promenade – Weekday AM peak period (Post development – Year 2022) .....</b>	<b>47</b>
<b>Table 11. SIDRA results for the roundabout intersection of Marmion Avenue/ Hawksbill Drive/ Santorini Promenade – Weekday PM peak period (Post development – Year 2022) .....</b>	<b>48</b>
<b>Table 12. SIDRA results for full movement crossover (crossover 1) – Weekday AM peak period (10-Year Post development – Year 2032) .....</b>	<b>49</b>
<b>Table 13. SIDRA results for full movement crossover (crossover 1) – Weekday PM peak period (10-Year Post development – Year 2032) .....</b>	<b>49</b>
<b>Table 14. SIDRA results for left turn exit only crossover (crossover 2) – Weekday AM peak period (10-Year Post development – Year 2032) .....</b>	<b>50</b>
<b>Table 15. SIDRA results for left turn exit only crossover (crossover 2) – Weekday PM peak period (10-Year Post development – Year 2032) .....</b>	<b>50</b>
<b>Table 16. SIDRA results for the roundabout intersection of Marmion Avenue/ Hawksbill Drive/ Santorini Promenade – Weekday AM peak period (10-Year Post development – Year 2032) .....</b>	<b>51</b>
<b>Table 17. SIDRA results for the roundabout intersection of Marmion Avenue/ Hawksbill Drive/ Santorini Promenade – Weekday PM peak period (10-Year Post development – Year 2032) .....</b>	<b>52</b>
<b>Table 18. SIDRA average queue results for the roundabout intersection of Marmion Avenue/ Hawksbill Drive/ Santorini Promenade – Weekday PM peak period (10-Year Post development – Year 2032) .....</b>	<b>53</b>



# 1 Summary

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This Transport Impact Assessment (TIA) has been prepared by Transcore with respect to the proposed McDonald's restaurant to be located within the western portion of Lot 9065 (101) Chateau Avenue, Alkimos in the City of Wanneroo. The development proposal contemplates a new fast-food restaurant with a dual-lane drive through facility at the subject site.

The subject lot is located at the northwest corner of the Marmion Avenue/ Hawksbill Drive/ Santorini Promenade roundabout intersection. The eastern portion of the site is proposed to be developed as a service station, which does not form part of the McDonald's development application and is subject to a separate development application. The assessment undertaken in this report allows for the traffic generation of both proposed developments.

The subject site is currently vacant. The proposed development for the subject lot entails a full movement crossover on Hawksbill Drive between the proposed McDonald's site and the service station site, a left turn exit only crossover from the service station site onto Hawksbill Drive and an exit only driveway from the McDonald's site to Carlsbad Promenade on the northern side of the site.

In accordance with the WAPC *"Transport Impact Assessment Guidelines, Volume 4 – Individual Developments (2016)"*, a Transport Impact Assessment is required for developments that generate more than 100 vehicle per hour. Accordingly, a *Transport Impact Assessment* is warranted in this case.

The proposed development layout has been assessed with respect to the traffic circulation including the service vehicles. Swept path analysis confirms that the proposed entry and exit arrangements and site layout facilitate satisfactory and efficient vehicle movements including service vehicles.

Accordingly, the aim of this Transport Impact Assessment is to assess the traffic impact of the development proposal by estimating the traffic which will be generated by both developments and establishing the resultant traffic pattern on the surrounding road network. This assessment will include the capacity analysis of the proposed crossovers on Hawksbill Drive and the adjacent roundabout intersection of Marmion Avenue/ Hawksbill Drive/ Santorini Promenade.

## 2 Introduction

This Transport Impact Assessment (TIA) has been prepared by Transcore on behalf of McDonald's Australia Ltd with regards to the proposed McDonald's restaurant at Lot 9065 (101) Chateau Avenue, Alkimos in the City of Wanneroo.

The subject site is vacant land and the proposed development is located within the western portion of the subject site, which is located at the northwest corner of the Marmion Avenue/ Hawksbill Drive/ Santorini Promenade roundabout intersection. The eastern portion of the site is a proposed to be developed as a service station with convenient store, which does not form part of the McDonald's development application. As shown in **Figure 1**, the subject site is bound by Carlsbad Promenade to the north, proposed service station to the east, Hawksbill Drive to the south and Fontana Loop to the west.



**Figure 1: Location of the subject site**

As part of the development, it is proposed to provide a full movement crossover on Hawksbill Drive between the proposed McDonald's site and the service station site, a left turn exit only crossover from the service station site onto Hawksbill Drive and an exit only crossover from the McDonald's site to Carlsbad Promenade on the northern side of the subject site.



This TIA will estimate the trip generation and distribution of the proposed developments and will assess the impact of the proposed developments traffic on the surrounding roads.

The key issues that will be addressed in this report include the traffic generation of the proposed developments, establishing the resultant traffic pattern on the surrounding road network and capacity analysis of the proposed developments' crossovers and the existing roundabout intersection of Marmion Avenue/ Hawksbill Drive/ Santorini Promenade.



## 3 Existing Situation

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### 3.1 Existing Site Use, Access and Parking

The proposed development is located on the western portion of the subject site, which is located at the northwest corner of the Marmion Avenue/ Hawksbill Drive/ Santorini Promenade roundabout intersection. (Refer to **Figure 1**). The subject site is currently a vacant land.

### 3.2 Existing Road Network

**Hawksbill Drive**, in the immediate vicinity of the subject site is constructed as two lanes divided carriageway with a landscaped median. Pedestrian footpaths are provided on both sides of the road in the vicinity of the subject site. Refer to **Figure 2** for more details.

Hawksbill Drive is classified as an *Access Road* in the Main Roads WA Metropolitan Functional Road Hierarchy, but is planned as Neighbourhood Connector A in the Local Structure Plan (Structure Plan No. 60), which is equivalent to a Local Distributor in the Main Roads WA road hierarchy. The default built up area speed limit of 50km/h applies on Hawksbill Drive.

According to Main Roads WA Restricted Access Vehicles (RAV) network mapping, Hawksbill Drive in this vicinity is classified as RAV Network 1 which can accommodate heavy vehicles of up to 20.0m in length with the appropriate RAV permit. (Almost all roads in Western Australia are included in RAV Network 1.) 'As of Right' vehicles including 19m semi-trailers and 12.5m rigid trucks are therefore allowed on Hawksbill Drive without requiring a permit.

There are no formal traffic counts available for this road. However, based on a traffic video survey undertaken at the Marmion Avenue/ Hawksbill Drive/ Santorini Promenade roundabout on 22 July 2021, the traffic volume on this road is estimated as approximately 3,900vpd on a regular weekday with the morning peak of 390vph between 7:45-8:45AM and the afternoon peak of 290vph between 4:30-5:30PM.



**Figure 2. Westbound View along Hawksbill Drive**

**Carlsbad Promenade**, in the vicinity of the subject site is constructed as a single carriageway, two-lane undivided road with pedestrian footpath on the northern side of the road. No classification for Carlsbad Promenade is shown in the Main Roads WA Metropolitan Functional Road Hierarchy as it is a newly built road, but this road will function as an Access Road. It operates under the default speed limit of 50km/h in the vicinity of the subject site.

There are no available traffic counts for this road at present.

**Fontana Loop**, in the vicinity of the subject site is also constructed as single carriageway, two-lanes undivided road with pedestrian footpath on the eastern side of the road. No classification for Fontana Loop is also shown in the Main Roads WA Functional Road Hierarchy as it is a newly built road, but it will function as an Access Road. It operates under the default speed limit of 50km/h in the vicinity of the subject site.

Traffic counts for this road are not available at present.

**Marmion Avenue** in the immediate vicinity of the subject site is constructed as dual carriageway with four traffic lanes with a landscaped median. Pedestrian footpaths are in place on both sides of Marmion Avenue in the vicinity of the subject site. Refer to **Figure 3** for more details. Marmion Avenue is classified as a *Primary Distributor* in the Main Roads WA Functional Road Hierarchy and operates under the sign posted speed limit of 80km/h in the vicinity of the subject site.

According to Main Roads WA Restricted Access Vehicles (RAV) network mapping, Marmion Avenue in this vicinity is classified as RAV Network 1 which can accommodate heavy vehicles of up to 20.0m in length with the appropriate RAV permit. 'As of Right' vehicles including 19m semi-trailers and 12.5m rigid trucks are therefore allowed on Marmion Avenue without requiring a permit.

According to the latest available traffic count data sourced from Main Roads WA, Marmion Avenue (north of Romeo Road) carried approximately 23,100vpd on a regular weekday in 2017/18. The morning peak of 1,950vph was recorded at this location between 8:00-9:00AM while the afternoon peak of 1,940vph was recorded between 3:00-4:00PM. The traffic counts from the video survey on 22 July, 2021 indicate that the morning peak of approximately 2,170vph was recorded between 7:45-8:45AM and the afternoon peak of approximately 2,440vph was recorded between 4:30-5:30PM.

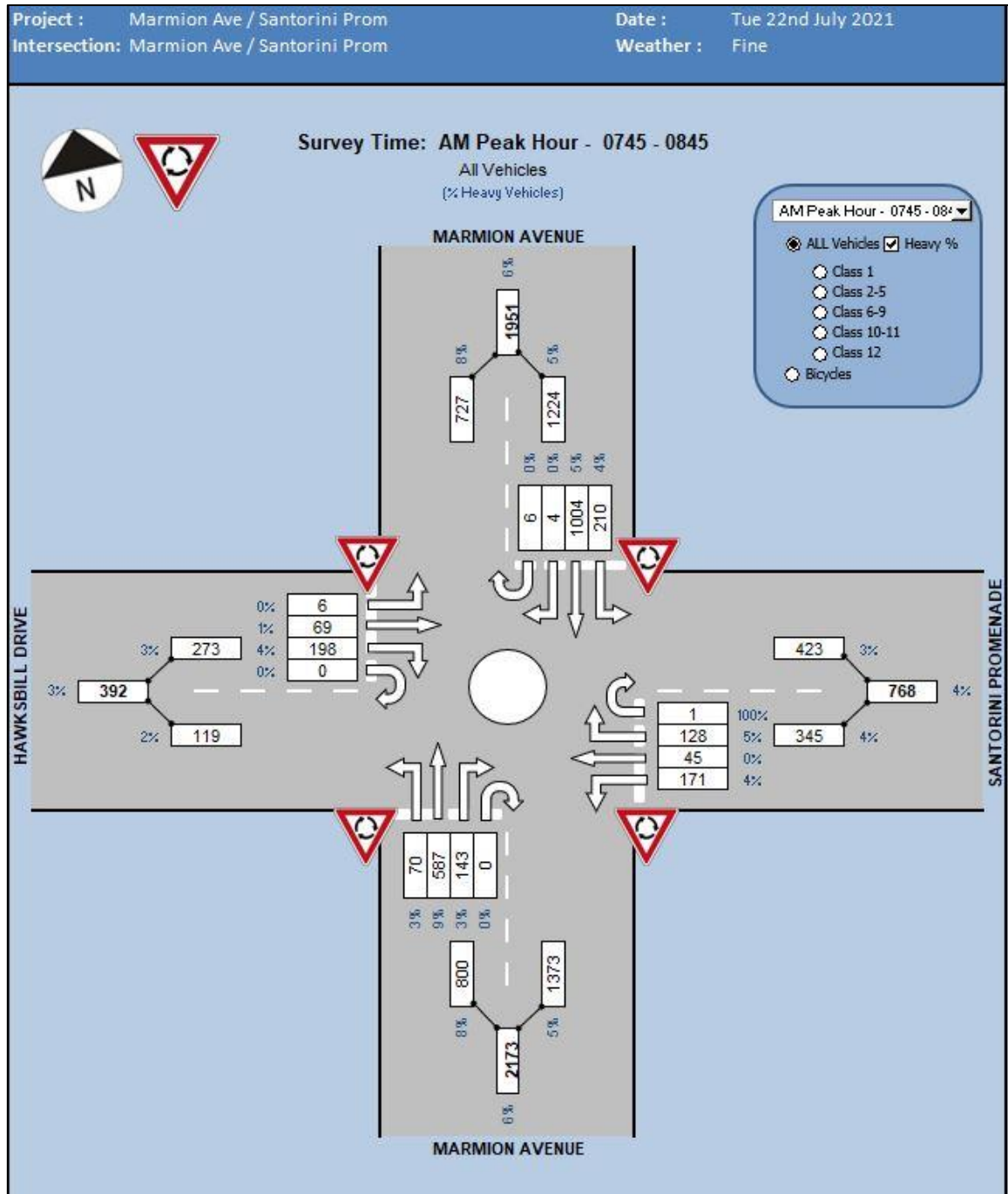
Marmion Avenue forms a four-way roundabout intersection with Hawksbill Drive and Santorini Promenade.



**Figure 3. Northbound View along Marmion Avenue**

### 3.3 Existing Traffic Volumes on Roads

Transcore organised a traffic count video survey at the roundabout intersection of Marmion Avenue/ Hawksbill Drive and Santorini Promenade on 22 July 2021. The AM peak hour and PM peak hour traffic counts at the roundabout intersection of Marmion Avenue/ Hawksbill Drive and Santorini Promenade are shown in **Figure 4** and **Figure 5**.



**Figure 4. Existing AM peak hour traffic counts at Marmion Avenue/ Hawksbill Drive and Santorini Promenade roundabout intersection**

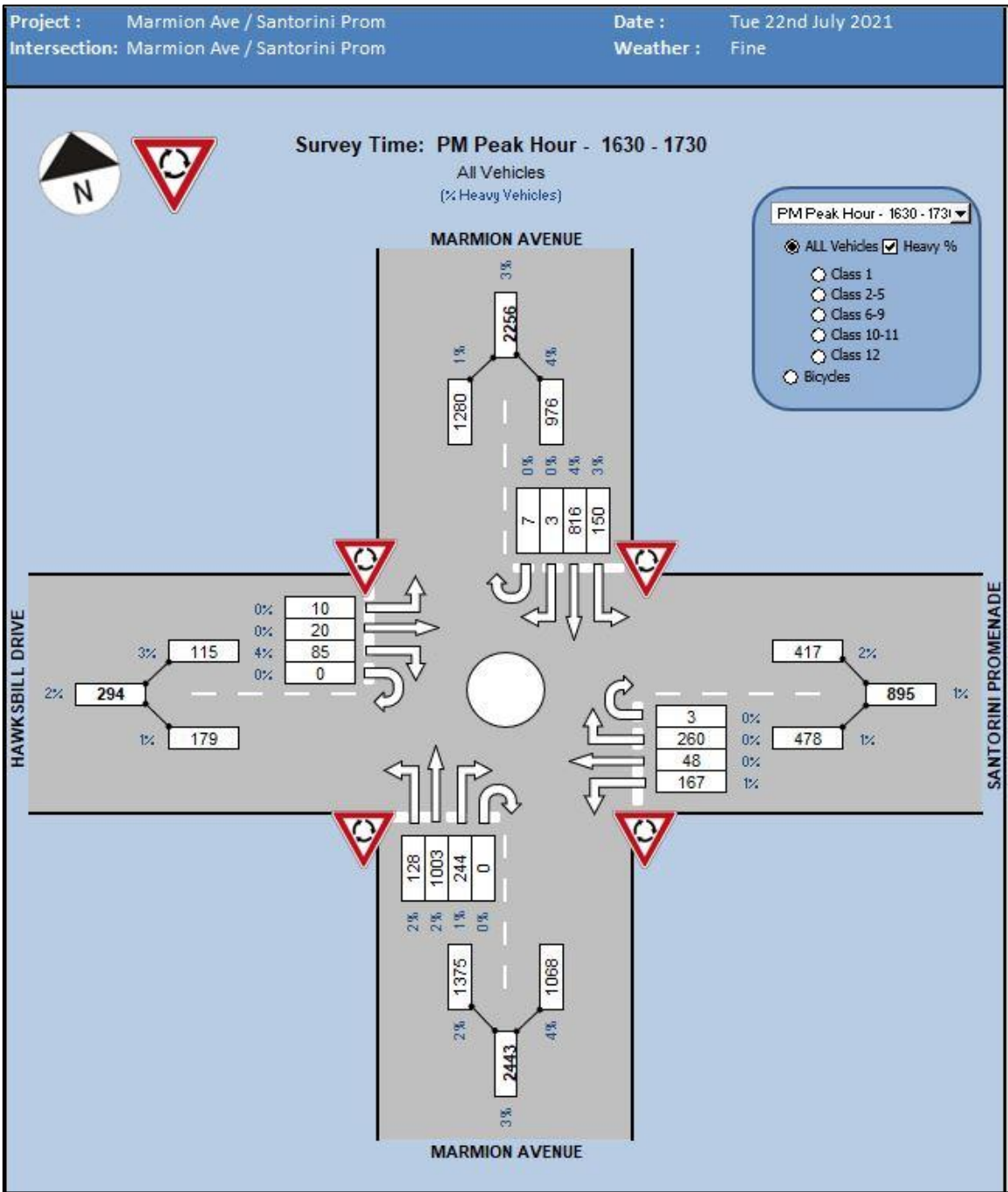


Figure 5. Existing PM peak hour traffic counts at Marmion Avenue/ Hawksbill Drive and Santorini Promenade roundabout intersection

### 3.4 Public Transport Access

Public transport services in the vicinity of the subject site are shown in **Figure 6**. The closest bus service to the subject site are Transperth bus routes 490 and 491, which travel along Marmion Avenue, east of the subject site. The nearest bus stop is located on Marmion Avenue approximately 190m south of the subject site which is accessible from the subject site via the existing footpath network in the locality.

Moreover, the subject site is also served by bus route 483, operating on Santorini Promenade and the nearest bus stop is located on Santorini Promenade, approximately 500m walking distance.

These bus routes provide links to Butler train station.

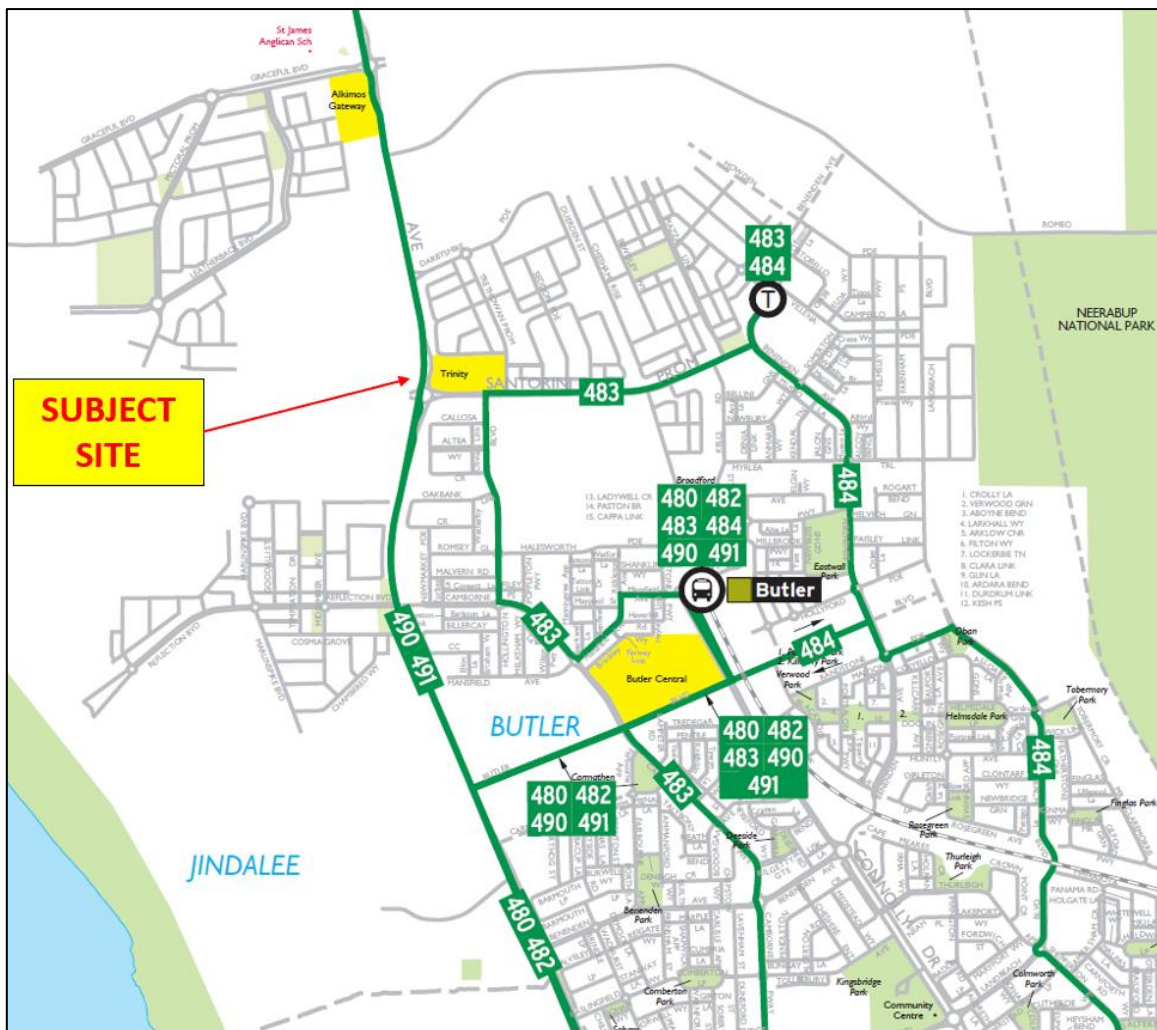


Figure 6. Existing bus routes (source: Transperth)

### 3.5 Pedestrian and Cyclist Facilities

Pedestrian paths in the vicinity of the subject site are provided on both sides of Marmion Avenue and Hawksbill Drive. Pedestrian crossing opportunities with refuge island are available at the Marmion Avenue/ Hawksbill Drive/ Santorini Promenade roundabout intersection.

The Department of Transport’s Perth Bike Map series shows good cyclist connectivity near the subject site as shown in **Figure 7**.

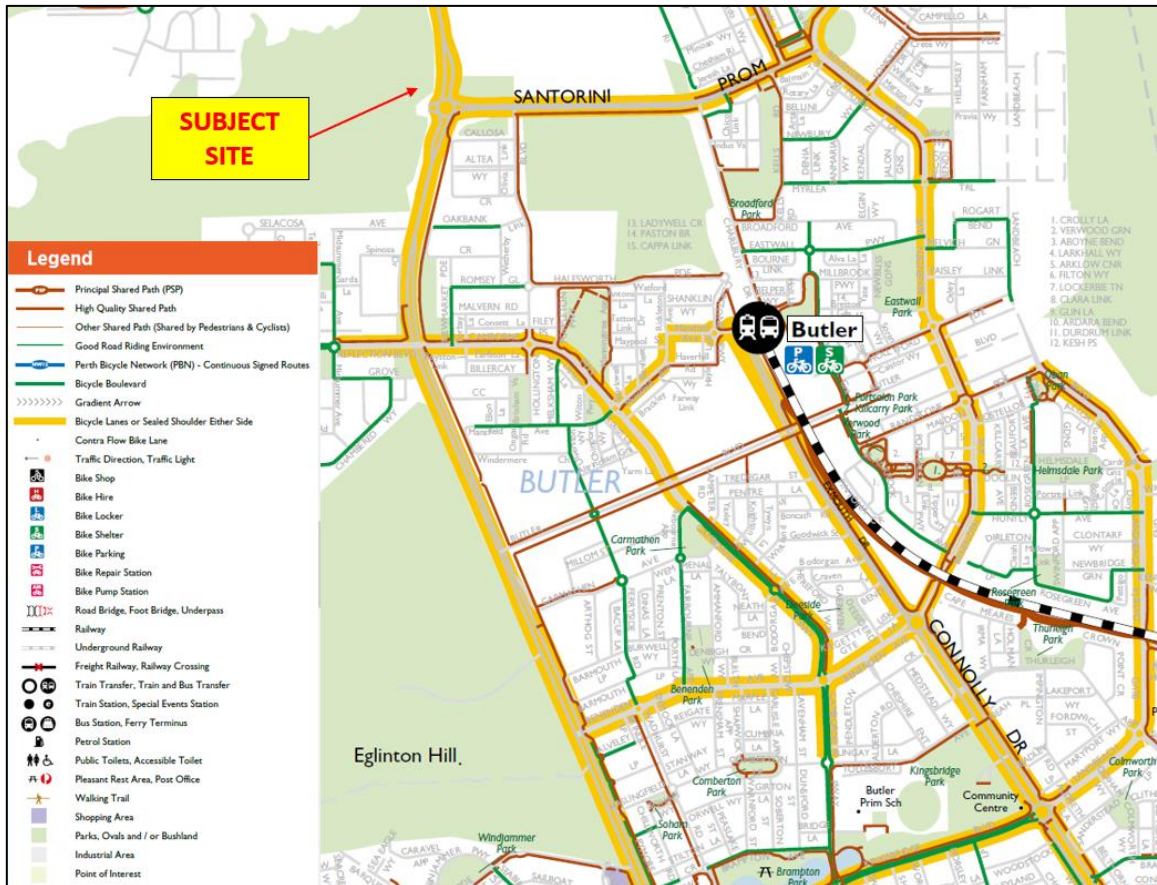


Figure 7. Bike map (source: Department of Transport)



### 3.6 Crash Data

Information available on the Main Roads WA website provides crash statistics for Marmion Avenue/ Hawksbill Drive/ Santorini Promenade roundabout intersection during the five-year period ending December 2020.

The crash records indicate that this intersection recorded a total of 13 road crashes with seven crashes classified as property damage only (PDO) major, four PDO minor crashes and two crashes requiring medical treatment in the last five-year period. More details on the crash records are provided in **Table 1**.

**Table 1. Crash history for the Marmion Avenue/ Hawksbill Drive/ Santorini Promenade roundabout intersection**

Roundabout Intersection						Total Crashes	Casualty
Marmion Avenue/ Hawksbill Drive/ Santorini Promenade						13	2
Right Turn Thru	Rear End	Hit Object	Non-Collision	Same Dir	Right Angle	Wet	Night
1	7	1	1	2	1	5	6

# 4 Development Proposal

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## 4.1 Proposed Site Use

The proposed development is for a McDonald's restaurant with a dual-lane drive through facility. The drive-through lanes merge into a single lane incorporating a cashier and servery facility. The proposed McDonald's building floor area is approximately 420m<sup>2</sup> GFA.

The proposed McDonald's restaurant will provide a total of 21 car parking bays (including one ACROD bay and two drive through waiting bays) for the use of customers and staff. Pedestrian walkaways are provided within the site, linking to the existing footpath network on Hawksbill Drive.

The drive through facility entails a combined stacking length sufficient to accommodate at least 21 standard vehicles.

The layout of the proposed development is shown in the site plan included in **Appendix A**.

## 4.2 Proposed Access for all Modes

The proposed access system for the development comprises one full movement crossover on Hawksbill Drive, between the proposed McDonald's site and the service station site, a left turn exit only crossover from the service station site onto Hawksbill Drive and an exit only crossover from the McDonald's site to Carlsbad Promenade on the northern side of the site. **Figure 8** shows the locations of the proposed crossovers.

The proposed crossover system for the proposed development is in accordance with City of Wanneroo Standard Drawing TS10-5-2, which sets out the required distances from the property boundary of a distributor road to a full movement access or left in / left out access point.

Vehicles entering the site at the main driveway on Hawksbill Drive will need to have a clear path into the site so they can continue north-eastward toward the service station bowlers or turn left towards the McDonald's drive through lanes and car park. A 'Keep Clear' area is marked on the proposed development plan on the McDonald's driveway exit lane to ensure that entry movement is not obstructed. Further refinement of the internal signage and line-marking for both developments in consultation with City of Wanneroo staff is anticipated during the development approval and building licence process to ensure the internal circulation system satisfies the City's requirements.

It has been advised that medium size rigid service vehicle of 12.5m in length would be used for deliveries to the restaurant and waste collection. A turn path assessment has been undertaken confirming the suitability of the internal site layout and service yard designs for the service vehicle. Copy of the turn path plans are provided in **Appendix B**.

Heavy vehicles access, egress and circulation for the proposed development is also discussed in **Section 10** of this report.

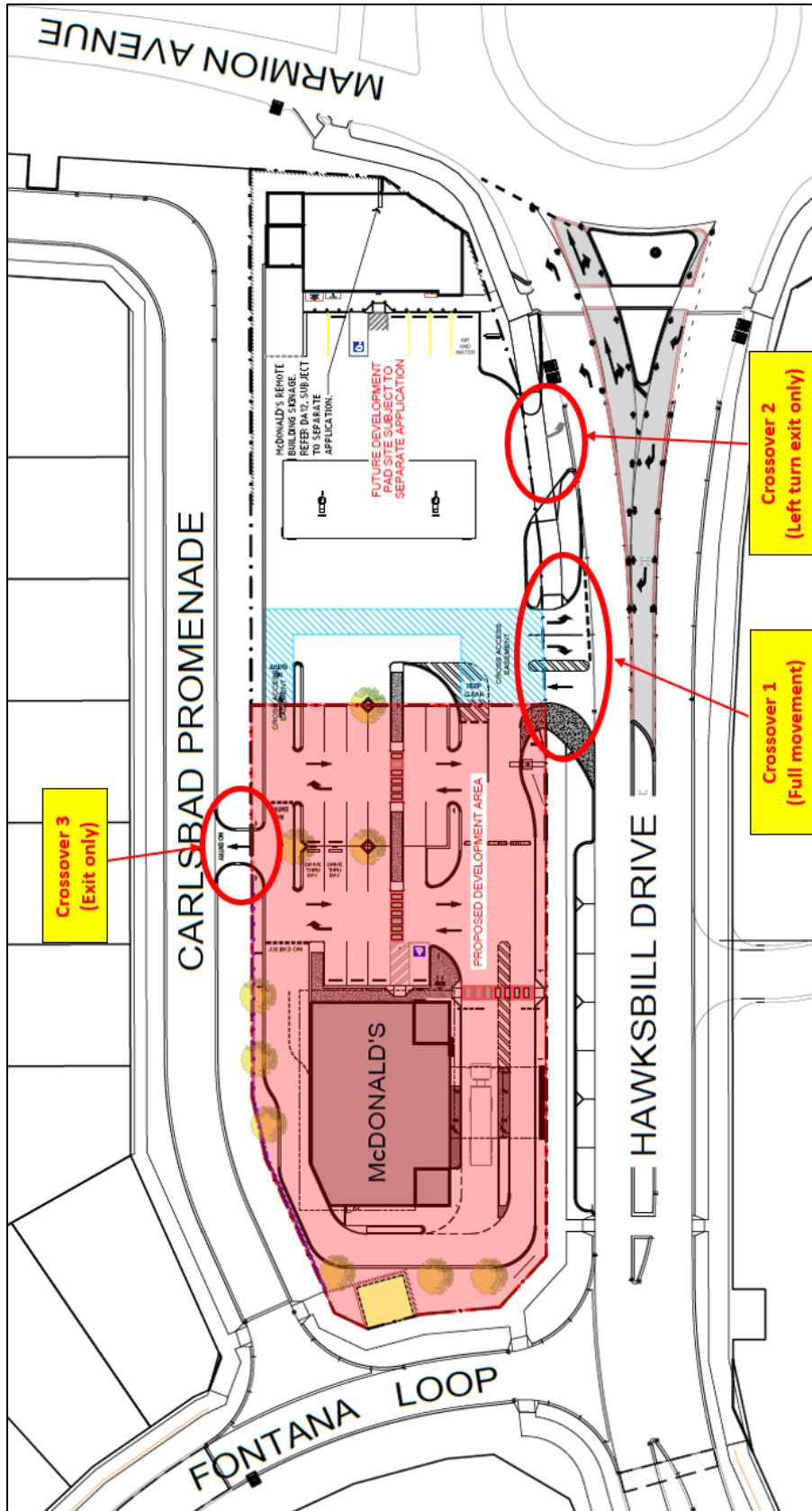


Figure 8. Proposed access arrangements

## 5 Changes to Surrounding Transport Networks

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The traffic analysis undertaken for this proposed development indicates that sometime in the future, the eastbound direction of Hawksbill Drive between the left turn exit only crossover and the roundabout and westbound direction of Santorini Promenade to the roundabout will need to be upgraded to two lanes standard on approach to the roundabout, because of the general traffic growth on Marmion Avenue.

It is anticipated that the timing of these changes to the surrounding road network will be confirmed during the development application approval process.

As part of this development, a total of seven on-street parking bays are also proposed on Hawksbill Drive on the same side as the subject site and to the west of the full movement crossover.

## 6 Integration with Surrounding Area

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The proposed development comprises a McDonald's restaurant with drive through which is in line with the current zoning for the subject site. It is of a commercial/ retail character and is expected to address the existing and future demand for this type of services along Marmion Avenue, Hawksbill Drive and future surrounding land uses in the locality.

# 7 Hours of Operation

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The proposed development is anticipated to operate 24 hours per day and 7 days per week.

# 8 Traffic Assessment

## 8.1 Assessment Period

It is anticipated that the combination of the traffic expected to be generated by the proposed developments and the peak road network traffic periods is likely to result in the greatest demand on the road network during the typical weekday morning and afternoon peak hours between 7:45-8:45AM and afternoon peak hour between 4:30-5:30PM. As such, trip generation is estimated and traffic analysis for the proposed developments is undertaken for these periods.

For the purpose of this assessment, it is assumed that the proposed developments would be fully constructed and activated by 2022. Therefore, the assessment year that has been adopted for this analysis is year 2022 which represents the assumed post-development scenario and 2032 for 10-year post development scenario.

## 8.2 Trip Generation and Distribution

### 8.2.1 Existing Traffic Generation

The subject site is presently vacant and does not generate any traffic.

### 8.2.2 Proposed Development Traffic Generation

Traffic generation rates for the proposed McDonald's restaurant were sourced from the *Institute of Transportation Engineers - Trip Generation Manual 10<sup>th</sup> Edition* (ITE) using "Fast-Food Restaurant with Drive-Through Window (934)" land use as a reference.

The trip rates which were used to estimate the traffic generation for the proposed development are as follows:

#### Fast-Food Restaurant with Drive-Through Window (934) – 1000 Sq. Ft. GFA

- ✚ Weekday daily: 470.95 trips per 1000 Sq. Ft. GFA/ 0.929 = 506.94vpd/ 100m<sup>2</sup> GFA;
- ✚ Weekday AM peak hour: 40.19 trips per 1000 Sq. Ft. GFA/ 0.929 = 43.26vph/ 100m<sup>2</sup> GFA; and,
- ✚ Weekday PM peak hour: 32.67 trips per 1000 Sq. Ft. GFA/ 0.929 = 35.17vph/ 100m<sup>2</sup> GFA.

Accordingly, it is estimated that the traffic generations for the proposed development are:

- ✚ Weekday daily: 506.94 x 4.2 (GFA) = 2,129vpd;
- ✚ Weekday AM: 43.26 x 4.2 (GFA) = 182vph;
- ✚ Weekday PM: 35.17 x 4.2 (GFA) = 148vph.

There is typically a significant amount of cross-trade between the proposed McDonald's restaurant development and the adjacent proposed service station development as they are co-located within the same site, so it has been assumed that 30% of the customers for each component will visit both land uses, so their entry and exit trips only need to be counted

once, not double-counted as traffic generated by both developments. Accordingly, 15% cross trade is applied to each trip generation of McDonald’s restaurant and the service station.

Therefore, the traffic generation for the proposed development with 15% cross trade are:

- ✚ Weekday daily:  $2,129 \times 0.85 = 1,810$ vpd;
- ✚ Weekday AM:  $182 \times 0.85 = 155$ vph; and,
- ✚ Weekday PM:  $148 \times 0.85 = 126$ vph.

Accordingly, it is estimated that the proposed development would generate approximately **1,810** vehicular trips per typical weekday, with about **155** trips during the typical weekday AM and about **126** trips during the typical weekday PM peak hours. These totals include both inbound and outbound vehicle movements.

Fast food outlets and service stations both attract significant proportion of their customers as passing trade from traffic already passing the site on the adjacent road network. Data from the ITE Trip Generation Handbook (3<sup>rd</sup> Edition, 2017) indicates that the passing trade is typically around 50% for fast food outlets with drive through facility. The rest of the traffic attracted to the subject site (referred to as primary trips) will come from the surrounding residential areas. For this analysis, it is anticipated that 25% of primary trips will be from the west via Hawksbill Drive and the rest from east of Marmion Avenue or via Marmion Avenue from other areas to the north and south.

The resultant traffic generation calculations are shown in **Table 2**.

**Table 2. Estimated peak hour trips for the proposed development**

Passing Trade	Daily Trips	AM		PM		Non-passing Trade	Daily Trips	AM		PM	
		IN	OUT	IN	OUT			IN	OUT	IN	OUT
50%	905	39	39	32	31	50%	905	39	39	32	31
	<b>905</b>	<b>39</b>	<b>39</b>	<b>32</b>	<b>31</b>		<b>905</b>	<b>39</b>	<b>39</b>	<b>32</b>	<b>31</b>

Traffic generation rates for the proposed service station development were sourced from the *Institute of Transportation Engineers – Trip Generation Manual 10<sup>th</sup> Edition* (ITE) using “Gasoline/Service Station with Convenient Store (945)” land use as a reference.

The trip rates which were used to estimate the traffic generation for the service station development are as follows:

Gasoline/Service Station with Convenient Store (945) – Regular Fuelling Points

- ✚ Weekday daily: 205.36vpd per bowser;
- ✚ Weekday AM peak hour: 12.47vph per bowser, and,
- ✚ Weekday PM peak hour: 13.99vph per bowser.

Accordingly, it is estimated that the traffic generations for the service station development are:



- ✚ Weekday daily:  $205.36 \times 6 = 1,232\text{vpd}$ ;
- ✚ Weekday AM:  $12.47 \times 6 = 75\text{vph}$ ;
- ✚ Weekday PM:  $13.99 \times 6 = 84\text{vph}$ .

The traffic generation for the service station development with 15% cross trade are:

- ✚ Weekday daily:  $1,232 \times 0.85 = 1,047\text{vpd}$ ;
- ✚ Weekday AM:  $75 \times 0.85 = 64\text{vph}$ ;
- ✚ Weekday PM:  $84 \times 0.85 = 71\text{vph}$ .

Accordingly, it is estimated that the service station development would generate approximately **1,047** vehicular trips per typical weekday, with about **64** trips during the typical weekday AM and about **71** trips during the typical weekday PM peak hours. These totals include both inbound and outbound vehicle movements.

Based on Table E47 and E38 and Figure E18 and E19 of the ITE Guidelines, the weekday AM peak hour passing trade is 62% and PM peak hour passing trade is 56% for land use 945 (service station with convenience store). However, for simplicity of calculation, 60% passing trade was assumed for the analysis for both AM and PM peak hours. Therefore, the net additional traffic when accounting for passing trade is +419vpd (daily), +26vph (AM peak hour) and +28vph (PM peak hour) on the surrounding road network as shown in **Table 3**.

**Table 3. Estimated peak hour trips for the service station development**

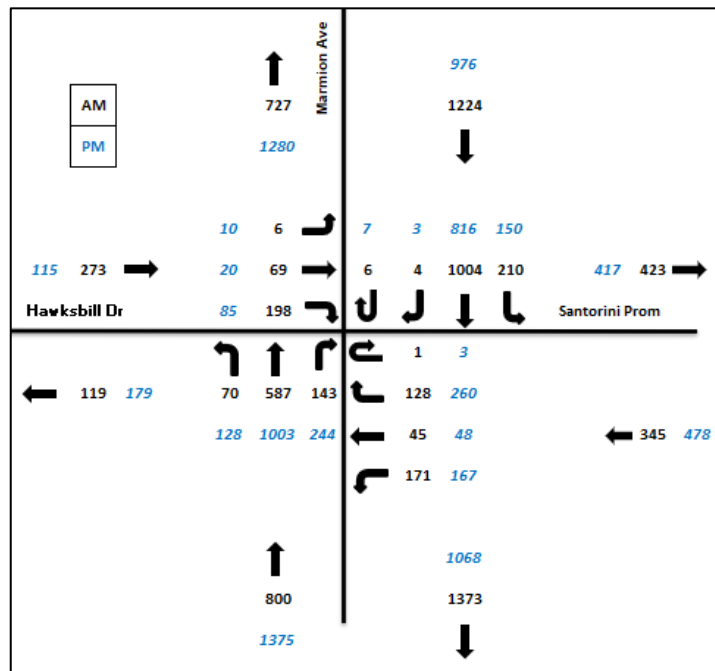
Passing Trade	Daily Trips	AM		PM		Non-passing Trade	Daily Trips	AM		PM	
		IN	OUT	IN	OUT			IN	OUT	IN	OUT
60%	628	19	19	22	21	40%	419	13	13	14	14
	<b>628</b>	<b>19</b>	<b>19</b>	<b>22</b>	<b>21</b>		<b>419</b>	<b>13</b>	<b>13</b>	<b>14</b>	<b>14</b>

The directional split of inbound/outbound trips for the proposed developments is assumed to be about 50/50 for inbound/outbound trips during the peak hours.

Therefore, it is estimated that the proposed developments would generate approximately **2,857** vehicular trips per typical weekday, with about **219** trips during the typical weekday AM and about **197** trips during the typical weekday PM peak hours (allowing for the cross-trade adjustment only). These totals include both inbound and outbound vehicle movements.

## 8.3 Traffic Flows

The existing traffic flows used as the base for traffic assessment are presented in **Figure 9** which is the outcome of the video traffic survey organised by Transcore on 22<sup>nd</sup> July, 2021.

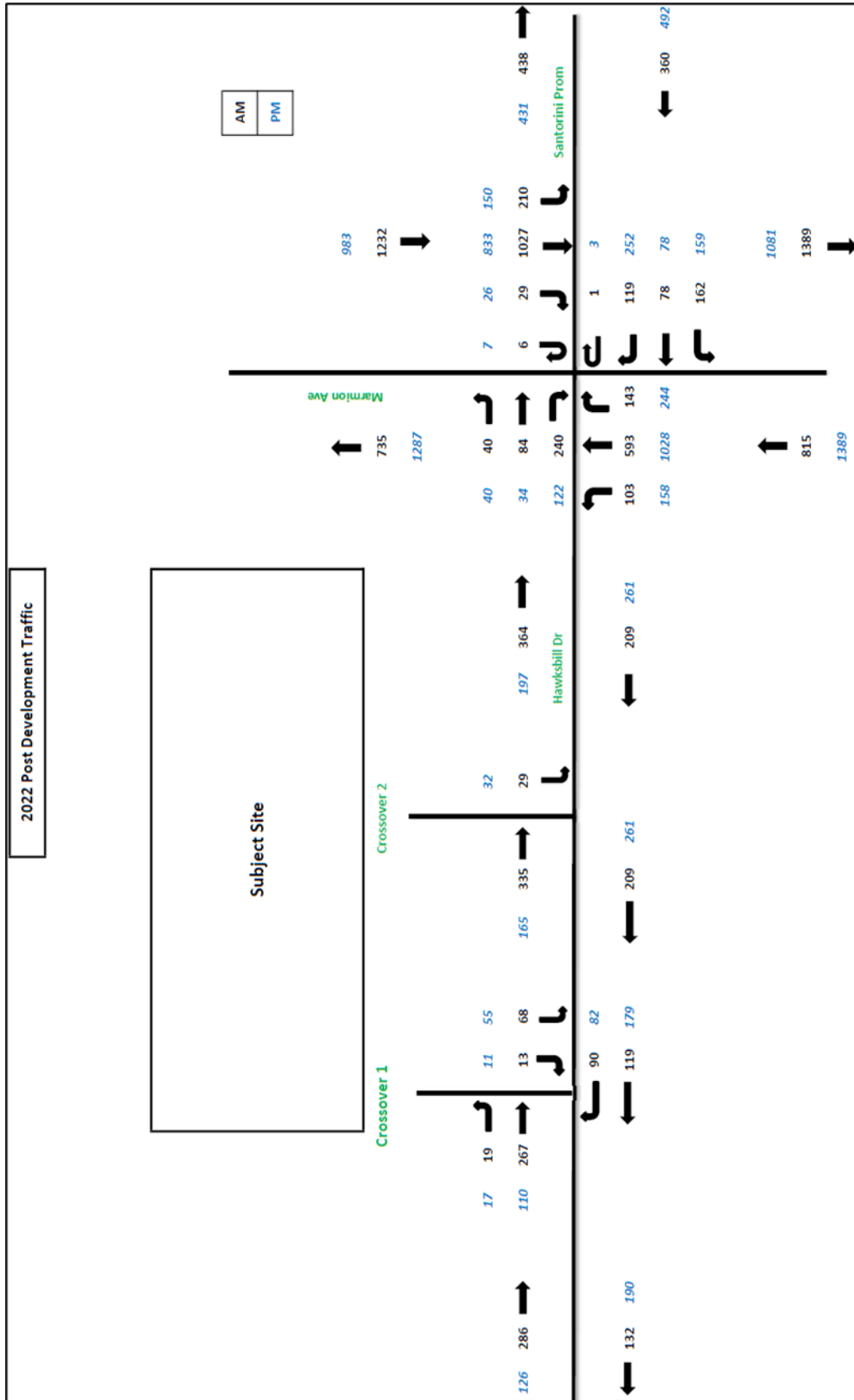


**Figure 9. Existing traffic flows at the Marmion Avenue/Hawksbill Drive/Santorini Promenade roundabout – 2021 Weekday AM & PM peak hours**

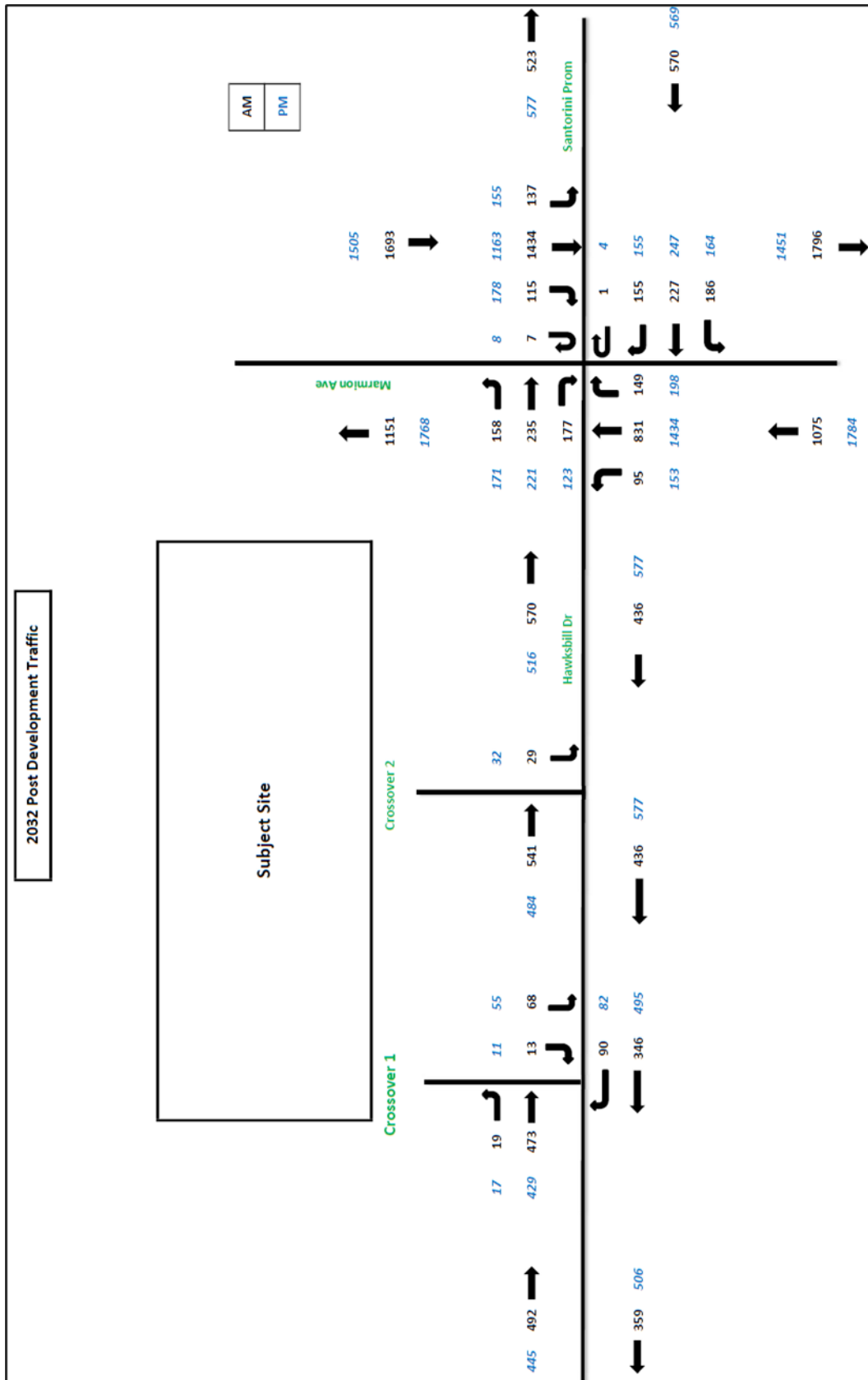
The combined traffic volumes of base, proposed McDonald's restaurant development and the proposed service station for the post development scenario (year 2022) is presented in **Figure 10**.

In accordance with discussions at a pre-lodgement meeting with Main Roads WA (for the adjacent service station development) in September 2021, MRWA provided their latest 2021 and 2031 ROM traffic projections for Marmion Avenue north and south of Santorini Promenade. Taking the average of those modelled traffic flows north and south of this roundabout indicates a 40.5% increase in Marmion Avenue traffic over that 10-year period, which equates to an average growth rate of 4.05% per year. Accordingly, through traffic volumes on Marmion Avenue through this roundabout are calculated based on the observed through traffic flows in **Figure 9** plus growth of 4.05% per year.

The updated traffic model prepared by Transcore in April 2021 for the Trinity Alkimos LSP has been referenced for future background traffic volumes for 10-year post development (the year 2032 scenario) to determine all of the other turn movement traffic flows at this roundabout and the resulting total 10-year post development traffic volumes for the proposed developments are presented in **Figure 11**.



**Figure 10. Post development (proposed McDonald's development + proposed adjacent service station development) traffic flows – 2022 Weekday AM and PM peak hours**



**Figure 11. 10-year post development (proposed McDonald's development + proposed adjacent service station development) traffic flows – 2032 Weekday AM and PM peak hours**

## 8.4 Analysis of Local Intersection & Development's Crossovers

SIDRA 9.0 intersection analysis has been undertaken for the subject site crossovers on Hawksbill Drive and the roundabout intersection of Marmion Avenue/ Hawksbill Drive/ Santorini Promenade in order to assess their operations in the existing and post development scenarios (2022 and 10-year post development 2032) for weekday AM and PM peak hours. It should be noted that SIDRA analysis was undertaken for combined traffic volumes of the proposed McDonald's restaurant development and the proposed adjacent service station development.

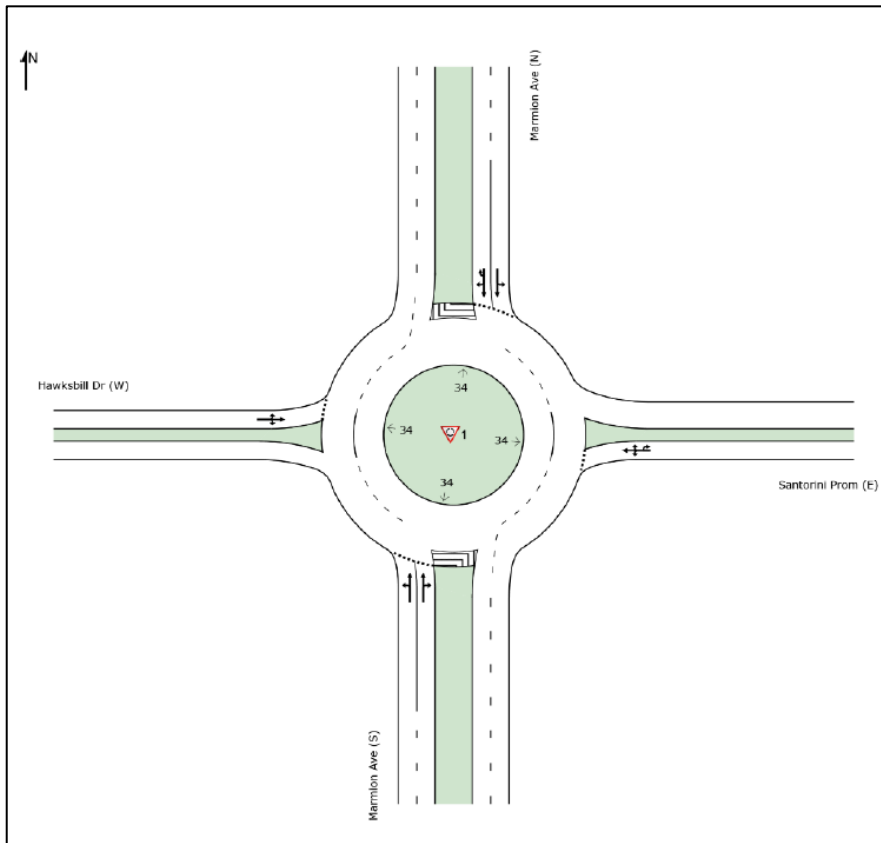
For the purpose of this assessment, relevant heavy vehicle settings and parameters were updated in accordance with Main Roads WA's latest requirements.

The SIDRA package is a commonly used intersection-modelling tool by traffic engineers for all types of intersections. SIDRA outputs are presented in the form of Degree of Saturation, Level of Service, Average Delay and 95% Queue. These items are defined as follows:

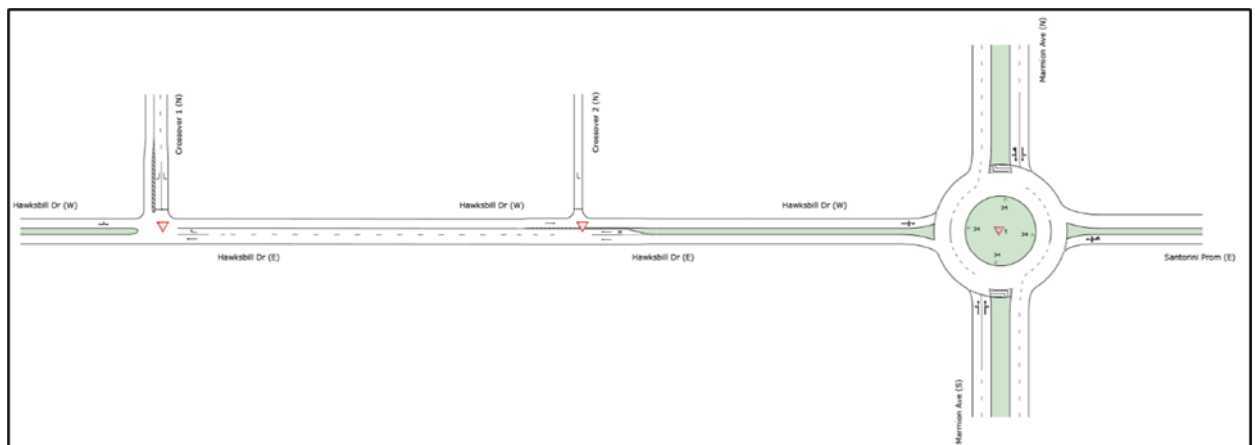
- ✦ **Degree of Saturation:** is the ratio of the arrival traffic flow to the capacity of the approach during the same period. The Degree of Saturation ranges from close to zero for varied traffic flow up to one for saturated flow or capacity.
- ✦ **Level of Service:** is the qualitative measure describing operational conditions within a traffic stream and the perception by motorists and/or passengers. In general, there are 6 levels of service, designated from A to F, with Level of Service A representing the best operating condition (i.e. free flow) and Level of Service F the worst (i.e. forced or breakdown flow).
- ✦ **Average Delay:** is the average of all travel time delays for vehicles through the intersection.
- ✦ **95% Queue:** is the queue length below which 95% of all observed queue lengths fall.

The layout of the existing roundabout intersection is illustrated in **Figure 12** and the layout of the modelled network for the post development scenario and 10-year post development scenario are illustrated in **Figure 13** and **Figure 14**.

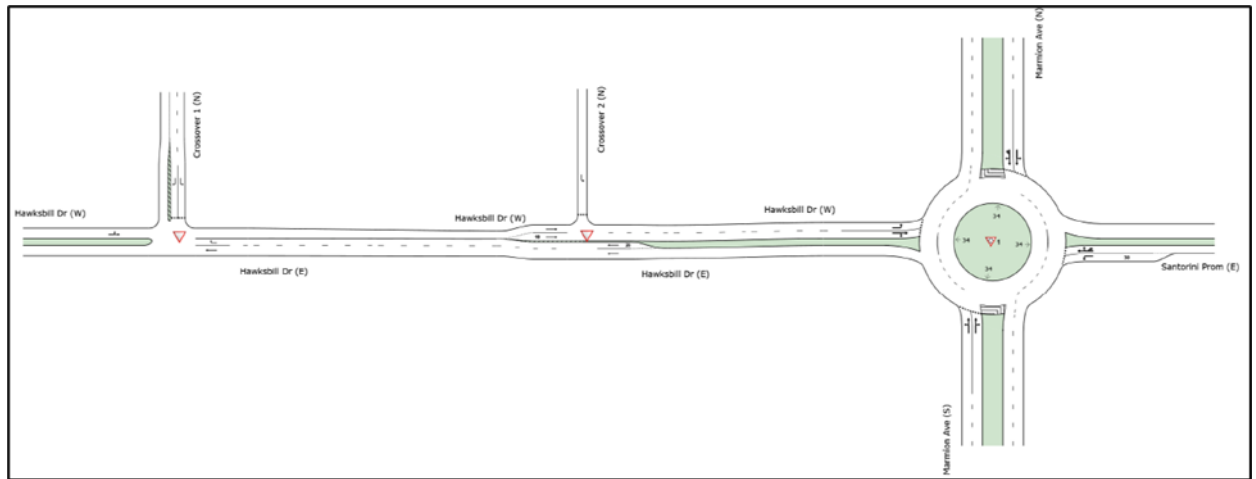
The results of SIDRA analysis of full movement crossover (crossover 1), left turn exit only crossover (crossover 2) on Hawksbill Drive and the roundabout intersection of Marmion Avenue/ Hawksbill Drive/ Santorini Promenade for the post-development scenarios (2022 and 2032) during AM and PM peak traffic periods are reported in **Table 4** to **Table 18** in **Appendix C** and discussed in the following paragraphs.



**Figure 12. SIDRA layout – Existing roundabout intersection of Marmion Avenue/  
Hawksbill Drive/ Santorini Promenade**



**Figure 13. SIDRA Network layout for post development scenario (2022)**



**Figure 14. SIDRA Network layout for 10-year post development scenario (2032)**

**Hawkswill Drive full movement crossover (crossover 1)**

The SIDRA results for the full movement crossover on Hawkswill Drive indicate that this crossover would operate at a very good overall Level of Service (LoS) A during typical AM and PM peak periods in the post development scenarios (both 2022 and 2032).

**Hawkswill Drive left turn exit only crossover (crossover 2)**

The SIDRA results for left turn exit only crossover on Hawkswill Drive indicate that this crossover would also operate with overall Level of Service (LoS) A during typical AM and PM peak periods in the post development scenarios (both 2022 and 2032).

**Roundabout Intersection of Marmion Avenue/ Hawkswill Drive/ Santorini Promenade**

*Existing and post development scenario*

SIDRA results indicate that the roundabout intersection is currently operating with Level of Service A to C with approximately 2 vehicles queue back in AM peak hour and 1 vehicle queue back in PM peak hour on Hawkswill Drive eastbound.

The SIDRA results for the post development scenario confirms that the addition of traffic generated by the proposed developments will not have a material impact on the operation of this roundabout intersection which retains the current level of services and records marginal increases in queues and delays in this scenario. Importantly, the queue back on Hawkswill Drive eastbound does not extend to the development crossovers on Hawkswill Drive.

*Year 2032 – 10 Year post development scenario*

Based on the SIDRA results by 2032 separate left turn approach lanes will need to be provided on Hawkswill Drive eastbound and Santorini Promenade westbound and SIDRA analysis for 2032 scenario was undertaken with these anticipated upgrades. It is important to note that the need for these upgrades is as a result of the assumed traffic growth on Marmion Avenue and not the proposed developments traffic.

SIDRA results for 2032 scenario indicates that, with the assumed upgrades, the roundabout intersection will operate satisfactorily with all movements at level of service A to C except for one right turn and one U-turn at level of services D on Santorini Promenade approach in the 2032 AM peak hour.

It is reported that the 95% queue on Hawksbill Drive eastbound in PM peak hour is 58.9m which only just extends to the centre line of the full movement crossover on Hawksbill Drive. Further, it should be noted that 95% of the time during the PM peak hour, the queue would be less than that reported in SIDRA (58.9m) and therefore this length of queue would occur during 5% of this peak hour which is equivalent to 3 minutes only. The reported average queue length (50% of the peak hour time) on this approach is 23.7m. Please refer to the result of average queue in the year 2032 PM peak hour in **Table 18**.

Therefore, it is considered that the impact of the development traffic on this intersection is not significant and the traffic operations are satisfactory.

## 8.5 Impact on Surrounding Roads

The WAPC Transport Impact Assessment Guidelines (2016) provides guidance on the assessment of traffic impacts:

*“As a general guide, an increase in traffic of less than 10 per cent of capacity would not normally be likely to have a material impact on any particular section of road, but increases over 10 per cent may. All sections of road with an increase greater than 10 per cent of capacity should therefore be included in the analysis. For ease of assessment, an increase of 100 vehicles per hour for any lane can be considered as equating to around 10 per cent of capacity. Therefore, any section of road where the structure plan traffic would increase flows by more than 100 vehicles per hour for any lane should be included in the analysis.”*

The proposed developments will not increase traffic flows near the quoted WAPC threshold to warrant further detailed analysis

## 8.6 Impact on Neighbouring Areas

The traffic generated by the proposed developments will have an insignificant impact on the surrounding areas.

## 8.7 Traffic Noise and Vibration

It generally requires a doubling of traffic volumes on a road to produce a perceptible 3dB increase in road noise. The proposed developments will not increase traffic volumes or noise on surrounding roads anywhere near this level.



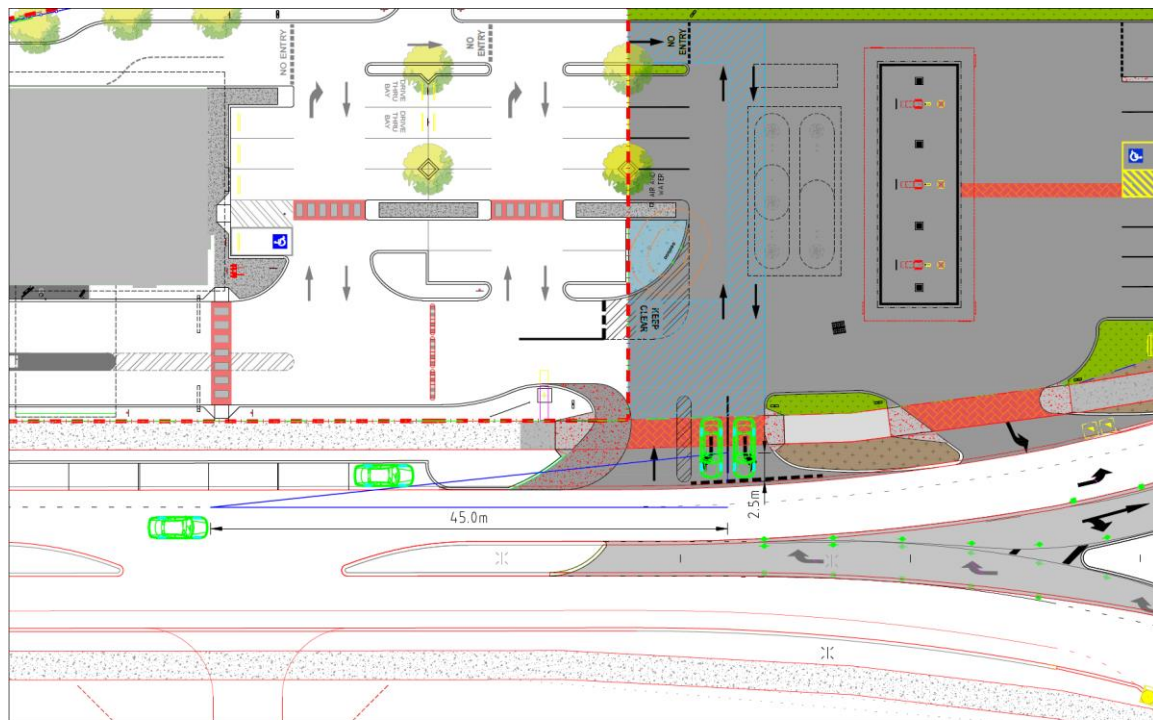
# 9 Parking

The proposed McDonald's restaurant provides a total of 21 car parking bays (including one ACROD bay and two drive through waiting bays) for the use of customers and staff.

The drive through facility entails a combined stacking length sufficient to accommodate at least 21 standard vehicles.

It is Transcore's understanding that sufficient parking supply is provided to address the parking requirements of the proposed development.

The proposed on-street parking bays shown on the site plan are set back from the driveway crossover to allow vehicles exiting from the site to see vehicles approaching from the west on Hawksbill Drive. Sight line assessment from the Hawksbill Drive full movement crossover (crossover 1) is illustrated in **Figure 15**, which demonstrates the 45m driveway sight distance required for a 50km/h road in accordance with the requirements of AS2890.1.



Proposed McDonald's - Marmion Avenue, Alkimos  
Sight distance assessment

t21.160.sk04  
25/11/2021  
Scale: 1:250 @ A3



**Figure 15: Driveway sightline**

## 10 Provision for Heavy Vehicles

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The largest service vehicle which is expected to use the subject site is a 12.5m service vehicle. Delivery and service trucks are anticipated to enter/ exit the subject site via the proposed full movement crossover (crossover 1) on Hawksbill Drive.

It is anticipated that delivery and service trucks will enter the site outside peak operating hours of the proposed development for the safe manoeuvring of the trucks within the site.

Swept path analysis was undertaken for service vehicles to confirm the satisfactory access, egress and circulation within the subject site. The swept path diagrams are included in **Appendix B**.

# 11 Drive-Through Queue Analysis

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## NSW Guidelines:

Section 5.8.1 of the New South Wales *Guide to Traffic Generating Developments*<sup>1</sup> document deals with the parking requirements for the drive-in, take-away food outlets. This clause states that:

*An exclusive area for queuing of cars for a drive through is required (queue length of 5 to 12 cars measured from pick up point). There should also be a minimum of four car spaces for cars queued from the ordering point.*

The proposed McDonald's restaurant proposes a two-lane drive through facility with two Customer Order Booths (COB). This facility merges into a single lane for payment and pickup. The proposed drive through facility entails provision of at least 17 car stacking capacity within the drive through facility with a combined stacking space for at least four cars at the COBs resulting in at least 21 car stacking capacity within the drive through facility.

Accordingly, the proposed drive through facility meets the RTA recommended drive through queuing area provisions.

## Drive-Through queue length analysis model

Based on the peak hour trip generation, the proposed McDonald's restaurant is estimated to generate a total of 182vph (91vph inbound and 91vph outbound) during the critical morning peak hour. It is further estimated that, allowing for walk-in trade dispensation of 5%, and a 60/40 drive-through/park'n'sit ratio typical for such type of restaurants, it is estimated that there could be around 52 drive-through transactions/customers/cars during the weekday morning peak hour period.

According to the advice provided, the average order-taking cycle is estimated at approximately 45 seconds, translating into a service rate of 80 vehicles per hour (maximum capacity of the single COB drive through system). However, in order to provide for a robust assessment, it is assumed that the order-taking cycle would average 1min equating 60 vehicle per hour service rate capacity. It is assumed that two COBs will be in operation during the peak periods, giving a theoretical order taking service rate of 120 vehicles per hour. It is also assumed that cars would enter the COB with the shortest queue, therefore over the peak hour the transactions at each COB would be more or less evenly split.

A queue length analysis was undertaken to assess the provision of storage for vehicles within the drive through lanes. For this purpose, an M/M/1 queuing model was adopted for each COB. The M/M/1 is a single-server queue model that can be used to approximate simple systems.

The queuing model adopts the following assumptions:

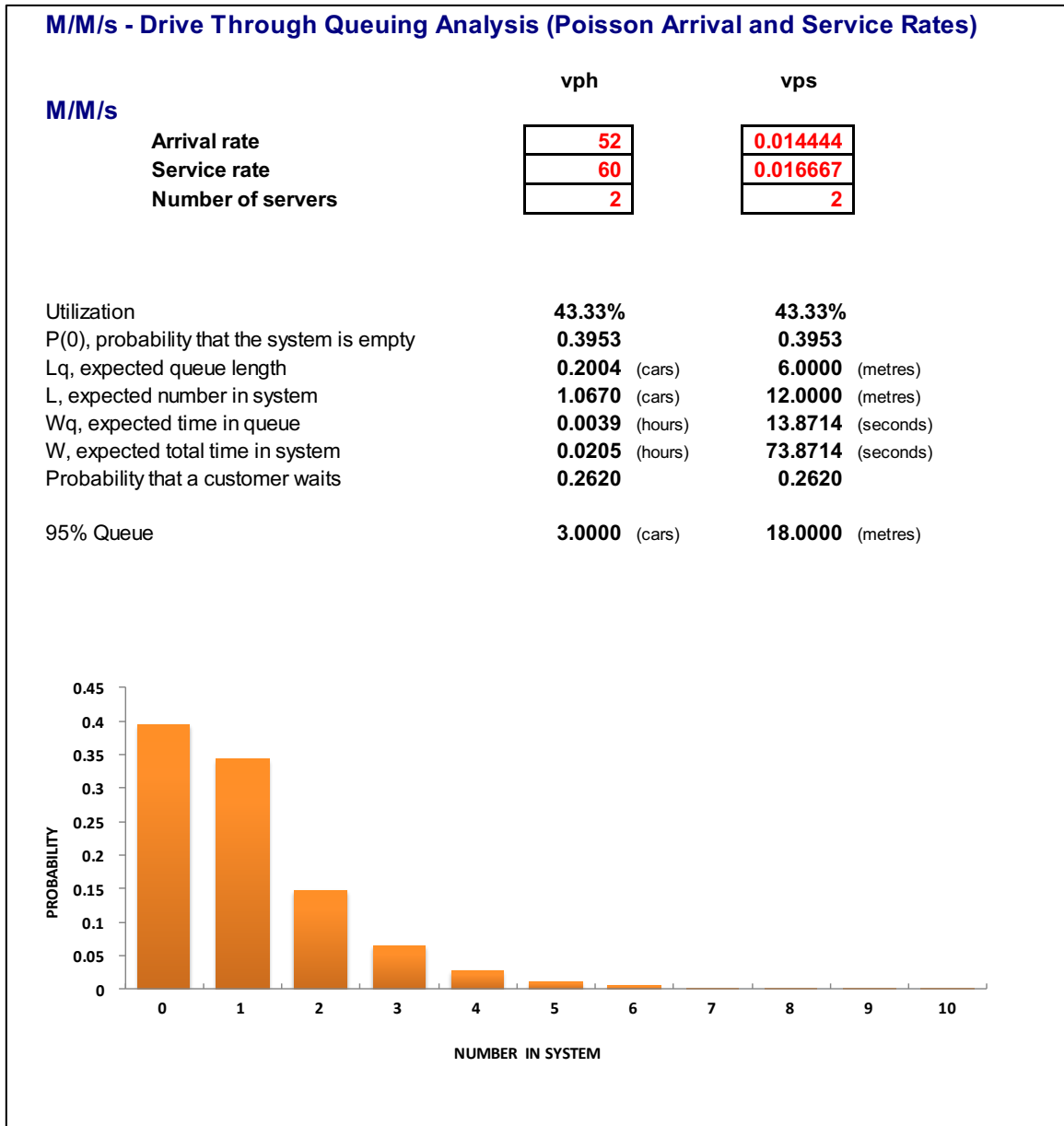
- ✚ Vehicles arrive randomly following Poisson's probability distribution;
- ✚ Service time is exponentially distributed;

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<sup>1</sup> Guide to Traffic Generating Developments, Version 2.2, October 2002.

- ✚ There is one server per queue, i.e., there are two queues, one for each COB, instead of a single queue being served by two COBs;
- ✚ The capacity of the queue in which arriving users wait before being served is infinite (for the purposes of identifying queue space requirements);
- ✚ The population of users (i.e., the pool of users) available to join the system is infinite; and,
- ✚ The queue is serviced on a first come, first served basis.

The results of the queuing analysis are detailed in **Figure 16**.



**Figure 16. Peak restaurant drive-through weekday morning hour queuing analysis**

In summary, critical peak hour queuing analysis of the drive through system established the following for each COB:

- ✚ There is zero queuing 40% of the time;
- ✚ The expected number of vehicles in the system is two;
- ✚ The expected time in the queue is 14 seconds; and,
- ✚ The 95<sup>th</sup> percentile queue is maximum three vehicles at busier COB.

The queue length usually adopted for robust analysis is the 95th percentile queue. This queue length will not be exceeded 95% of the time.

Based on the queue estimation model, it is concluded that under typical peak conditions the queue backing from each COB will be accommodated within the site with no impact on other internal driveways and surrounding road network.

## 12 Public Transport Access

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The existing public transport services in the area are described in **Section 3.4** of this report.

# 13 Pedestrian and Cyclist Access

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Pedestrian and cyclist's facilities are described in **Section 3.5** of this report.

## 14 Conclusions

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This Transport Impact Assessment (TIA) has been prepared by Transcore on behalf of McDonald's Australia Ltd with regards to the proposed McDonald's Family restaurant to be located within the western portion of Lot 9065 (101) Marmion Avenue, Alkimos in the City of Wanneroo. The development proposal contemplates a new fast-food restaurant with a dual-lane drive through facility at the subject site.

The subject lot is located at the northwest corner of the Marmion Avenue/ Hawksbill Drive/ Santorini Promenade roundabout intersection. The eastern portion of the site is proposed to be developed as a service station with a convenient store, which does not form part of the McDonald's development application and is subject to a separate development application. The assessment undertaken in this report allows for the traffic generation of both proposed developments.

The subject site is currently vacant. The proposed development for the subject lot entails a full movement crossover on Hawksbill Drive between the proposed McDonald's site and the service station site, a left turn exit only crossover from the service station site onto Hawksbill Drive and an exit only driveway from the McDonald's site to Carlsbad Promenade on the northern side of the site.

It is Transcore's understanding that sufficient parking supply is provided to address the parking requirement for the proposed developments.

Turn path analysis undertaken for 12.5m service truck confirms satisfactory entry and egress and circulation to/from and within the site.

The results of SIDRA network analysis undertaken for the combined traffic from both developments indicates that the developments crossovers operate satisfactorily with acceptable queues and delays for both post development (2022) and 10-year post development (2032) scenarios. The analysis further demonstrates that the addition of development traffic for post development scenario will have insignificant impact on the traffic operations of the roundabout intersection of Marmion Avenue/ Hawksbill Drive/ Santorini Promenade. Importantly, the queue back on Hawksbill Drive eastbound does not extend to the development crossovers on Hawksbill Drive.

SIDRA analysis for 2032 scenario was undertaken with appropriate traffic growth factor on Marmion Avenue. The SIDRA analysis indicates that by year 2032, the Hawksbill Drive eastbound and Santorini Promenade westbound approaches to the roundabout will need to entail two lanes. These upgrades are a result of the traffic growth on Marmion Avenue and are not related to the proposed developments.

The SIDRA result with the anticipated upgrades confirms that the roundabout intersection will operate satisfactorily with acceptable level of services, queues and delays. The SIDRA result indicates that the reported 95% queue on Hawksbill Drive eastbound in the 2032 PM peak hour is 58.9m which only just extends to the centre line of the full movement crossover on Hawksbill Drive. Further, it should be noted that 95% of time during the PM peak hour, the queue would be less than that reported in SIDRA (58.9m) and therefore this length of queue would occur during 5% of this peak hour which is equivalent to 3 minutes only. The reported average queue length (50% of the peak hour time) on this approach is 23.7m.



Accordingly, it is concluded that the developments traffic will not have a significant impact on the operations of the surrounding roads and intersection.

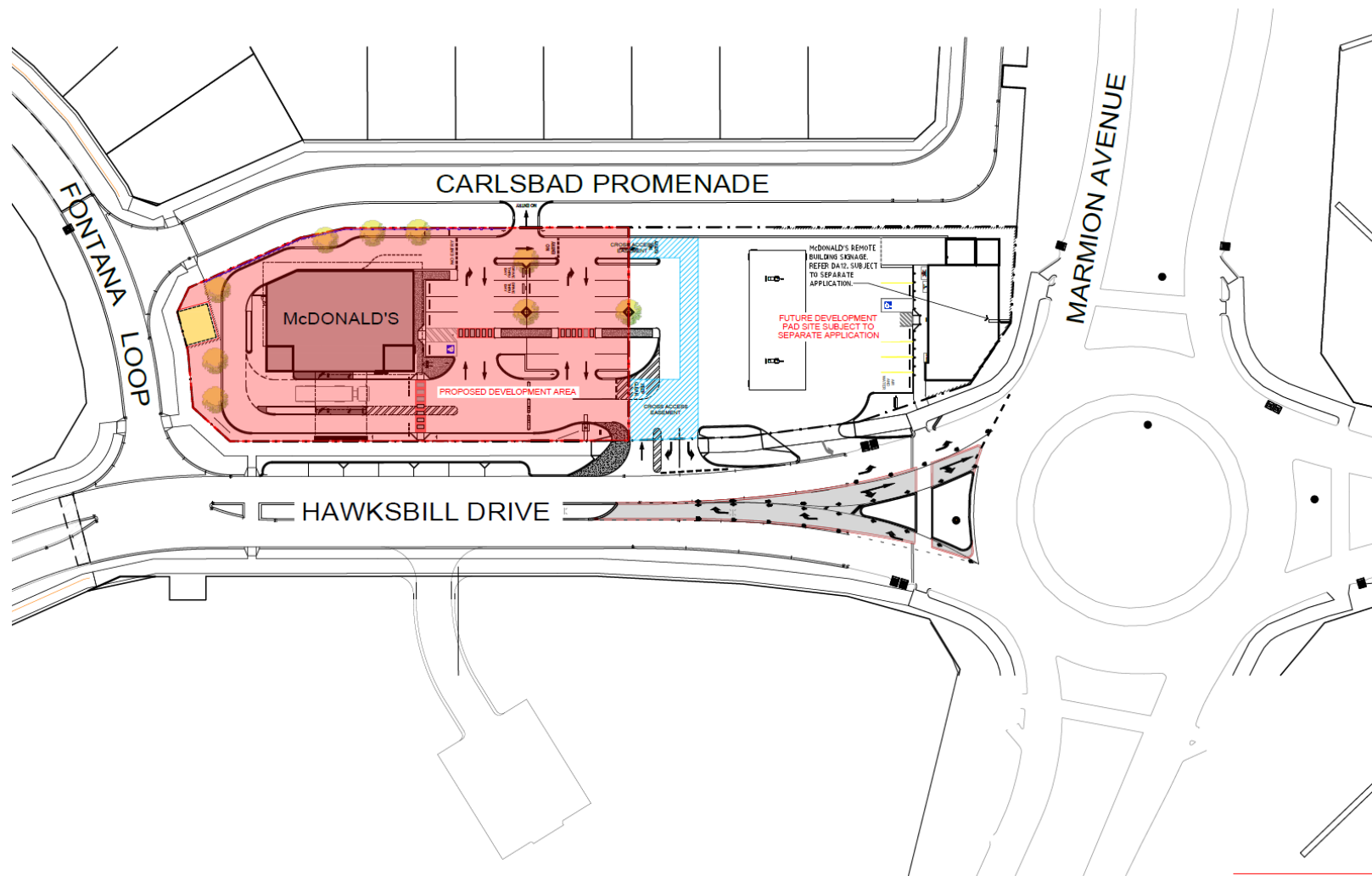
In conclusion, the findings of this Transport Impact Assessment are supportive of the proposed development.



# Appendix A

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## PROPOSED DEVELOPMENT PLAN



**Revisions**

**General Notes**

Do not scale this drawing. The drawing shows design intent only. All dimensions to be checked on site prior to construction or production. Construction details to be confirmed by contractor/manufacturer. This is a computer generated drawing. Do not amend by hand. Figure dimensions are to be used. Contact architect for clarification if dimensions are not clear. All dimensions are in millimetres. All dimensions and annotations on site must be applied to the envelope for their contents or approval prior to commencing work.

**Drawing Notes**



**Client**

McDonald's Australia Limited  
 ABN 43 958 696 928  
 M 02 9875 6666  
 da-group-ecol@au.mcd.com

**Project Manager**

**Architect**

**HIA** Hindley & Associates Pty Ltd  
 Building Designers  
 Unit 4/166 Stirling Highway  
 Nedlands WA 6009  
 PO Box 199 Nedlands WA 6909  
 08 9386 6699  
 www.hindley.com.au

**Project**

PROPOSED McDONALD'S RESTAURANT ALKIMOS

**Location**

LOT 2242 CHW MARMION AVENUE & HAWKSBILL DRIVE, ALKIMOS, WA, 6038

**DEVELOPMENT APPLICATION**

**Scale**

1:600 @ A3

**Drawing**

OVERALL SITE PLAN

**Project Number**

0772

**Drawing Number**

DA01

**Issue**

-

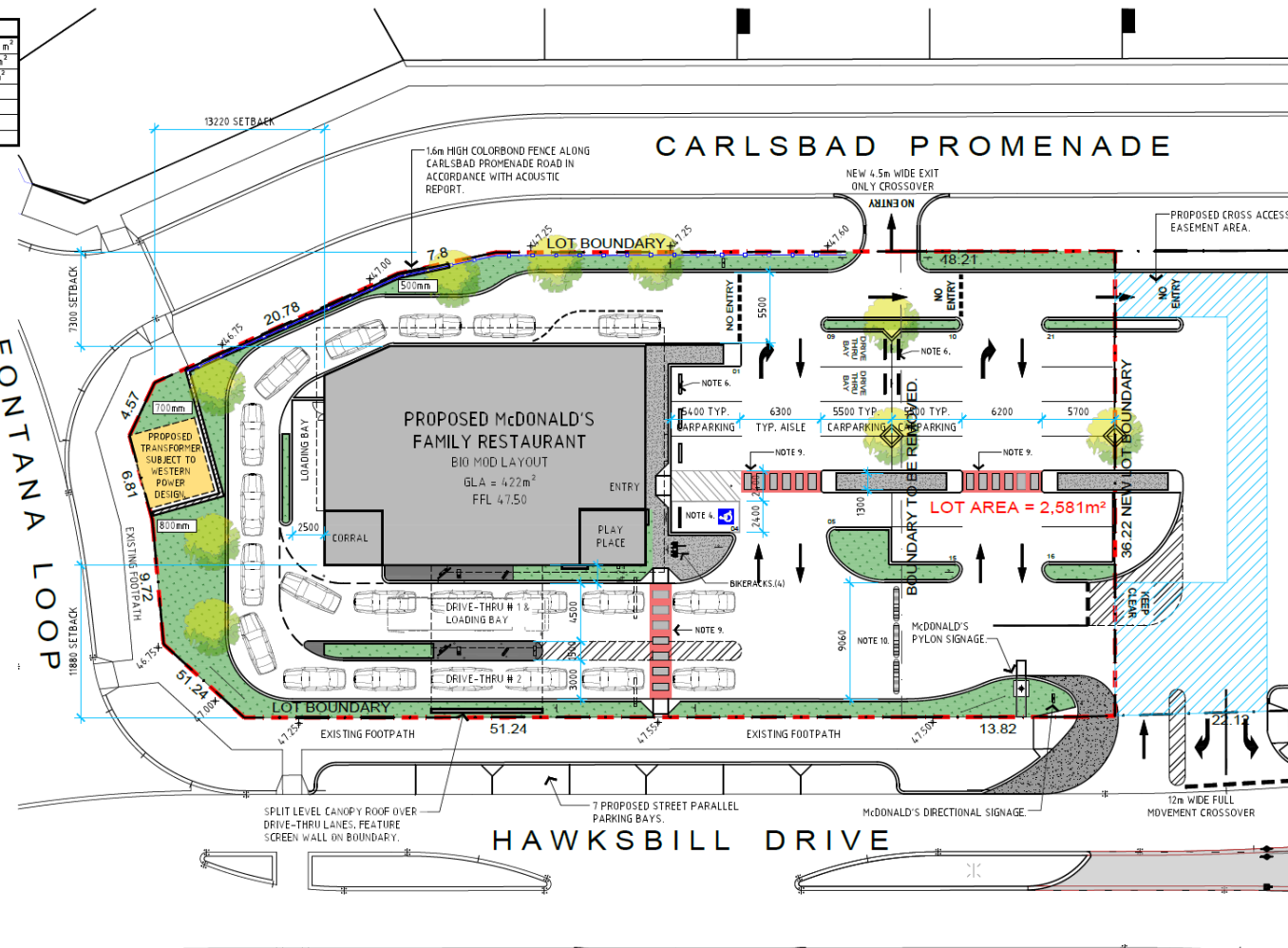
TABLE 1: McDONALD'S ALKIMOS	
PAD SITE AREA	2,581 m <sup>2</sup>
BUILDING AREA	422 m <sup>2</sup>
DINING ROOM AREA	122 m <sup>2</sup>
STANDARD CAR BAYS	18
ACCESSIBLE CAR BAYS	1
DRIVE-THRU WAIT BAYS	2
DINING SEATING NUMBERS	80

**NOTES**

- ALL PAVEMENT LINE-MARKINGS SHALL BE WHITE EXCEPT WHERE NOTED. 200mm PROVIDE A CONTINUOUS BORDER AROUND THE PERIMETER OF CHEVRON MARKING.
- ANGLED LINE-MARKING SHALL BE ADOPTED TO PEDESTRIAN WALKWAYS BETWEEN CAR SPACES AND WHERE SHOWN ON PLAN.
- PERPENDICULAR LINE-MARKING SHALL BE ADOPTED FOR PEDESTRIAN CROSSINGS.
- THE ACCESSIBLE PARKING SPACE SHALL BE DELINEATED WITH A LINE-MARKED PERIMETER AND THE INTERNATIONAL SYMBOL IN ACCORDANCE WITH AS/NZS 1161 AND AS SPECIFIED.
- THE TOP AND VERTICAL FACE OF KERBS SHALL BE PAINTED YELLOW IN ALL AREAS WHICH COULD BE TRAFFICKED BY PEDESTRIANS. THE DRIVE THRU LAINE MAY BE EXCLUDED IF APPROPRIATE SIGNAGE IS PROVIDED. REFER TO SIGNAGE SCHEDULE.
- WHEELSTOPS SHALL BE AVOIDED AND ONLY INSTALLED ON COMPLETION OF A RISK ASSESSMENT AND WHERE ALTERNATIVE PROTECTION DEVICES ARE UNDESIRABLE. WHEELSTOPS SHALL BE PAINTED YELLOW, CENTRED ON THE CAR SPACE AND INSTALLED IN ACCORDANCE WITH AS2499.1.
- WHEELSTOP SPACING SHALL BE 620 FROM FACE OF KERB INCREASE TO 620 AGAINST HIGH KERBS OR WALLS. WHEELSTOPS SHALL BE 950 LONG.
- CAR PARK ENTRY AND EXITS SHALL BE DESIGNED IN ACCORDANCE WITH LOCAL AUTHORITY REQUIREMENTS AND AS2499.1.
- COLORLED PEDESTRIAN CROSSING WITH WHITE LINE-MARKING.
- SPEED HUMP AS SPECIFIED. INSTALL SPEED HUMPS AS FOLLOWS BEFORE PEDESTRIAN WALKWAYS, BEFORE INTERSECTIONS WITH LIMITED SIGHT DISTANCE, AT A MAX. SPACING OF 50 METRES BETWEEN SPEED HUMPS. REFER TO CIVIL DRAWINGS FOR DETAILS.

**LEGEND**

- B - BOLLARD.
- PROPOSED RETAINING WALL.
- SOFT LANDSCAPING BEDS.
- CONCRETE FOOTPATHS.
- EXISTING SPOT LEVEL.
- HEIGHT OF PROPOSED RETAINING WALL ABOVE FOOTPATH LEVEL.



Revisions	General Notes	Drawing Notes
	<p>Do not scale this drawing. The drawing shows design intent only. All dimensions to be checked on site prior to construction or production. Construction details to be confirmed by construction manufacturer. This is a computer generated drawing. Do not amend by hand. Figure dimensions are to be used. Check against the certification dimensions are to be used. All dimensions are in millimeters. All discrepancies and omissions on site must be reported to the architect for their comments or approval prior to commencing work.</p>	



1:300

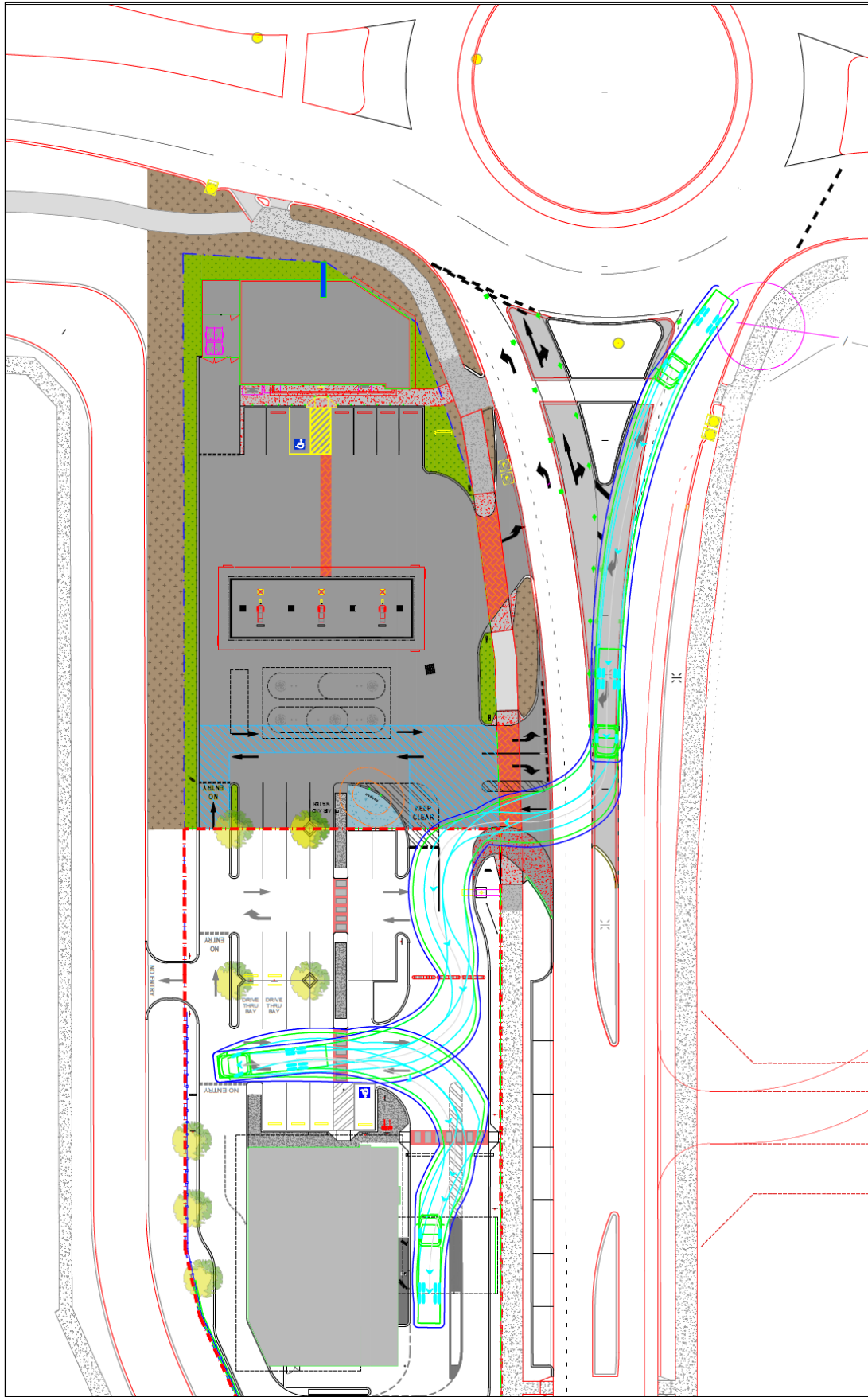


<p>Client McDonald's Australia Limited SBN, 43 008 006 928 02 9575 8665 design@au.mcd.com</p>	<p>Architect Hindley &amp; Associates Pty Ltd Building Designers Unit 4/166 Spring Highway Nedlands WA 6009 PO Box 199 Nedlands WA 6909 08 9386 6699 www.hindley.com.au</p>	<p>Project PROPOSED McDONALD'S RESTAURANT ALKIMOS</p> <p>Location LOT 2242 CHR MARARMON AVENUE &amp; HAWKSBILL DRIVE ALKIMOS, WA 6038</p>	<p>Scale 1:300 @ A3</p> <p>Series MCD_B10</p> <p>Drawing PROPOSED SITE PLAN</p> <p>Project Number 0772</p> <p>Drawing Number DA02</p> <p>Issue -</p>
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# Appendix B

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## TURN PATH PLANS

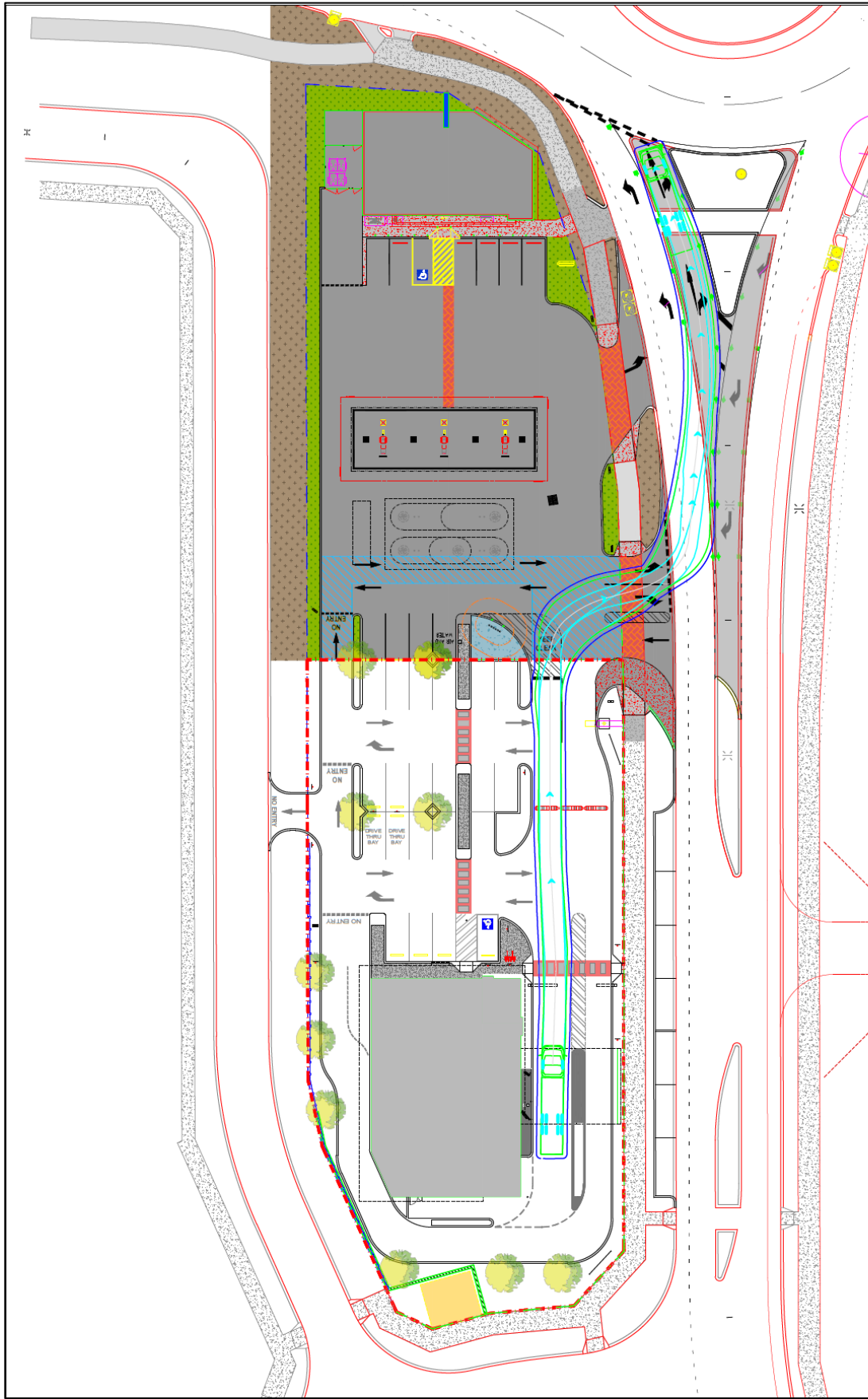


Proposed McDonald's - Marmion Avenue, Alkimos  
 Austrroads 2013: 12.5m SU Truck  
 Service Truck Entry

**LEGEND**  
 Vehicle Body  
 Wheel Path  
 500mm Clearance

t21.160.sk01c  
 25/11/2021  
 Scale: 1:400 @ A3





Proposed McDonald's - Marmion Avenue, Alkimos  
 Austrroads 2013: 12.5m SU Truck  
 Service Truck Exit

**LEGEND**

- Vehicle Body
- Wheel Path
- 500mm Clearance

t21.160.sk02c  
 25/11/2021  
 Scale: 1:400 @ A3



# Appendix C

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SIDRA Results



**Table 4. SIDRA results for the roundabout intersection of Marmion Avenue/  
Hawksbill Drive/ Santorini Promenade – 2021 Weekday AM peak period  
(Existing)**

<b>Vehicle Movement Performance</b>														
Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[ Total veh/h ]	[ HV % ]	[ Total veh/h ]	[ HV % ]				[ Veh. veh ]	[ Dist m ]				
<b>South: Marmion Ave (S)</b>														
1	L2	70	2.9	74	2.9	0.303	6.1	LOS A	2.1	16.6	0.42	0.52	0.42	55.2
2	T1	587	9.2	618	9.2	0.303	6.7	LOS A	2.1	16.6	0.43	0.55	0.43	63.4
3	R2	143	2.8	151	2.8	0.303	13.0	LOS B	2.0	15.5	0.44	0.60	0.44	60.6
Approach		800	7.5	842	7.5	0.303	7.7	LOS A	2.1	16.6	0.43	0.56	0.43	62.0
<b>East: Santorini Prom (E)</b>														
4	L2	171	4.1	180	4.1	0.569	8.1	LOS A	3.5	27.3	0.82	0.98	1.04	50.6
5	T1	45	0.0	47	0.0	0.569	7.5	LOS A	3.5	27.3	0.82	0.98	1.04	44.3
6	R2	128	5.5	135	5.5	0.569	13.5	LOS B	3.5	27.3	0.82	0.98	1.04	48.0
6u	U	1	100.0	1	100.0	0.569	20.2	LOS C	3.5	27.3	0.82	0.98	1.04	22.6
Approach		345	4.4	363	4.4	0.569	10.1	LOS B	3.5	27.3	0.82	0.98	1.04	48.7
<b>North: Marmion Ave (N)</b>														
7	L2	210	3.8	221	3.8	0.527	7.5	LOS A	4.2	32.2	0.67	0.64	0.67	51.7
8	T1	1004	5.4	1057	5.4	0.527	8.4	LOS A	4.2	32.2	0.69	0.68	0.71	62.3
9	R2	4	0.0	4	0.0	0.527	14.9	LOS B	4.1	31.7	0.70	0.71	0.74	54.1
9u	U	6	0.0	6	0.0	0.527	17.9	LOS B	4.1	31.7	0.70	0.71	0.74	63.4
Approach		1224	5.1	1288	5.1	0.527	8.3	LOS A	4.2	32.2	0.69	0.67	0.70	60.9
<b>West: Hawksbill Dr (W)</b>														
10	L2	6	0.0	6	0.0	0.343	4.7	LOS A	1.5	11.3	0.62	0.78	0.63	49.2
11	T1	69	1.5	73	1.5	0.343	4.3	LOS A	1.5	11.3	0.62	0.78	0.63	45.1
12	R2	198	3.5	208	3.5	0.343	10.2	LOS B	1.5	11.3	0.62	0.78	0.63	52.4
Approach		273	2.9	287	2.9	0.343	8.6	LOS A	1.5	11.3	0.62	0.78	0.63	50.8
All Vehicles		2642	5.5	2781	5.5	0.569	8.4	LOS A	4.2	32.2	0.62	0.69	0.66	58.4

**Table 5. SIDRA results for the roundabout intersection of Marmion Avenue/  
Hawksbill Drive/ Santorini Promenade – 2021 Weekday PM peak period  
(Existing)**

Vehicle Movement Performance														
Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
		[ Total veh/h ]	[ HV % ]	[ Total veh/h ]	[ HV % ]				[ Veh. veh ]	[ Dist m ]				
South: Marmion Ave (S)														
1	L2	128	1.6	135	1.6	0.558	7.0	LOS A	4.9	36.6	0.67	0.59	0.67	54.0
2	T1	1003	1.8	1056	1.8	0.558	7.5	LOS A	4.9	36.6	0.68	0.63	0.68	63.3
3	R2	244	1.2	257	1.2	0.558	14.2	LOS B	4.6	34.7	0.69	0.69	0.70	59.0
Approach		1375	1.7	1447	1.7	0.558	8.6	LOS A	4.9	36.6	0.68	0.64	0.68	61.5
East: Santorini Prom (E)														
4	L2	167	1.2	176	1.2	0.627	6.8	LOS A	4.1	30.2	0.77	0.96	0.99	51.8
5	T1	48	0.0	51	0.0	0.627	6.4	LOS A	4.1	30.2	0.77	0.96	0.99	44.5
6	R2	260	0.4	274	0.4	0.627	12.2	LOS B	4.1	30.2	0.77	0.96	0.99	49.8
6u	U	3	0.0	3	0.0	0.627	14.2	LOS B	4.1	30.2	0.77	0.96	0.99	25.6
Approach		478	0.6	503	0.6	0.627	9.7	LOS A	4.1	30.2	0.77	0.96	0.99	49.7
North: Marmion Ave (N)														
7	L2	150	2.7	158	2.7	0.404	6.9	LOS A	2.9	22.2	0.58	0.59	0.58	52.7
8	T1	816	4.3	859	4.3	0.404	7.5	LOS A	2.9	22.2	0.59	0.60	0.59	63.4
9	R2	3	0.0	3	0.0	0.404	13.9	LOS B	2.7	20.8	0.60	0.62	0.60	54.7
9u	U	7	0.0	7	0.0	0.404	16.8	LOS B	2.7	20.8	0.60	0.62	0.60	64.4
Approach		976	4.0	1027	4.0	0.404	7.5	LOS A	2.9	22.2	0.59	0.60	0.59	62.2
West: Hawksbill Dr (W)														
10	L2	10	0.0	11	0.0	0.214	6.3	LOS A	1.0	7.5	0.76	0.87	0.76	48.1
11	T1	20	0.0	21	0.0	0.214	5.9	LOS A	1.0	7.5	0.76	0.87	0.76	44.1
12	R2	85	3.5	89	3.5	0.214	11.8	LOS B	1.0	7.5	0.76	0.87	0.76	51.4
Approach		115	2.6	121	2.6	0.214	10.3	LOS B	1.0	7.5	0.76	0.87	0.76	50.1
All Vehicles		2944	2.3	3099	2.3	0.627	8.5	LOS A	4.9	36.6	0.67	0.69	0.70	59.3

**Table 6. SIDRA results for full movement crossover (crossover 1) – Weekday AM peak period (Post development – Year 2022)**

Vehicle Movement Performance														
Mov ID	Turn	DEMAND FLOWS		ARRIVAL FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[ Total veh/h	HV ] %	[ Total veh/h	HV ] %				[ Veh. veh	Dist ] m				
East: Hawksbill Dr (E)														
5	T1	125	3.0	125	3.0	0.062	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	50.0
6	R2	95	0.0	95	0.0	0.070	4.1	LOS A	0.3	2.3	0.39	0.55	0.39	21.5
Approach		220	1.7	220	1.7	0.070	1.7	NA	0.3	2.3	0.17	0.24	0.17	36.2
North: Crossover 1 (N)														
7	L2	72	0.0	72	0.0	0.057	0.9	LOS A	0.2	1.6	0.35	0.22	0.35	16.4
9	R2	14	0.0	14	0.0	0.021	3.6	LOS A	0.1	0.6	0.51	0.42	0.51	24.9
Approach		85	0.0	85	0.0	0.057	1.4	LOS A	0.2	1.6	0.38	0.25	0.38	18.8
West: Hawksbill Dr (W)														
10	L2	20	0.0	20	0.0	0.150	4.6	LOS A	0.0	0.0	0.00	0.04	0.00	34.1
11	T1	281	3.0	281	3.0	0.150	0.0	LOS A	0.0	0.0	0.00	0.04	0.00	47.7
Approach		301	2.8	301	2.8	0.150	0.3	NA	0.0	0.0	0.00	0.04	0.00	46.3
All Vehicles		606	2.0	606	2.0	0.150	1.0	NA	0.3	2.3	0.11	0.14	0.11	37.9

**Table 7. SIDRA results for full movement crossover (crossover 1) – Weekday PM peak period (Post development – Year 2022)**

Vehicle Movement Performance														
Mov ID	Turn	DEMAND FLOWS		ARRIVAL FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[ Total veh/h	HV ] %	[ Total veh/h	HV ] %				[ Veh. veh	Dist ] m				
East: Hawksbill Dr (E)														
5	T1	188	3.0	188	3.0	0.094	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	50.0
6	R2	86	0.0	86	0.0	0.054	3.2	LOS A	0.2	1.8	0.24	0.48	0.24	21.8
Approach		275	2.1	275	2.1	0.094	1.0	NA	0.2	1.8	0.08	0.15	0.08	40.2
North: Crossover 1 (N)														
7	L2	58	0.0	58	0.0	0.039	0.3	LOS A	0.2	1.1	0.21	0.08	0.21	17.7
9	R2	12	0.0	12	0.0	0.015	2.6	LOS A	0.1	0.4	0.45	0.34	0.45	26.5
Approach		69	0.0	69	0.0	0.039	0.7	LOS A	0.2	1.1	0.25	0.13	0.25	20.3
West: Hawksbill Dr (W)														
10	L2	18	0.0	18	0.0	0.067	4.6	LOS A	0.0	0.0	0.00	0.07	0.00	34.4
11	T1	116	3.0	116	3.0	0.067	0.0	LOS A	0.0	0.0	0.00	0.07	0.00	45.7
Approach		134	2.6	134	2.6	0.067	0.6	NA	0.0	0.0	0.00	0.07	0.00	43.5
All Vehicles		478	1.9	478	1.9	0.094	0.8	NA	0.2	1.8	0.08	0.13	0.08	38.2

**Table 8. SIDRA results for left turn exit only crossover (crossover 2) – Weekday AM peak period (Post development – Year 2022)**

Vehicle Movement Performance														
Mov ID	Turn	DEMAND FLOWS		ARRIVAL FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[ Total veh/h	HV %	[ Total veh/h	HV %				[ Veh. veh	Dist ] m				
East: Hawksbill Dr (E)														
5	T1	220	3.0	220	3.0	0.057	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	50.0
Approach		220	3.0	220	3.0	0.057	0.0	NA	0.0	0.0	0.00	0.00	0.00	50.0
North: Crossover 2 (N)														
7	L2	31	0.0	31	0.0	0.026	1.2	LOS A	0.1	0.7	0.39	0.25	0.39	16.0
Approach		31	0.0	31	0.0	0.026	1.2	LOS A	0.1	0.7	0.39	0.25	0.39	16.0
West: Hawksbill Dr (W)														
11	T1	353	3.0	353	3.0	0.176	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	49.9
Approach		353	3.0	353	3.0	0.176	0.0	NA	0.0	0.0	0.00	0.00	0.00	49.9
All Vehicles		603	2.8	603	2.8	0.176	0.1	NA	0.1	0.7	0.02	0.01	0.02	45.4

**Table 9. SIDRA results for left turn exit only crossover (crossover 2) – Weekday PM peak period (Post development – Year 2022)**

Vehicle Movement Performance														
Mov ID	Turn	DEMAND FLOWS		ARRIVAL FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[ Total veh/h	HV %	[ Total veh/h	HV %				[ Veh. veh	Dist ] m				
East: Hawksbill Dr (E)														
5	T1	275	3.0	275	3.0	0.071	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	50.0
Approach		275	3.0	275	3.0	0.071	0.0	NA	0.0	0.0	0.00	0.00	0.00	50.0
North: Crossover 2 (N)														
7	L2	34	0.0	34	0.0	0.024	0.5	LOS A	0.1	0.7	0.26	0.12	0.26	17.2
Approach		34	0.0	34	0.0	0.024	0.5	LOS A	0.1	0.7	0.26	0.12	0.26	17.2
West: Hawksbill Dr (W)														
11	T1	174	3.0	174	3.0	0.087	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	50.0
Approach		174	3.0	174	3.0	0.087	0.0	NA	0.0	0.0	0.00	0.00	0.00	50.0
All Vehicles		482	2.8	482	2.8	0.087	0.0	NA	0.1	0.7	0.02	0.01	0.02	44.3

**Table 10. SIDRA results for the roundabout intersection of Marmion Avenue/  
Hawksbill Drive/ Santorini Promenade – Weekday AM peak period (Post  
development – Year 2022)**

Vehicle Movement Performance														
Mov ID	Turn	DEMAND FLOWS		ARRIVAL FLOWS		Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
		[ Total veh/h ]	HV %	[ Total veh/h ]	HV %				[ Veh. veh ]	Dist ] m				
South: Marmion Ave (S)														
1	L2	108	2.9	108	2.9	0.330	6.3	LOS A	2.3	18.3	0.48	0.54	0.48	59.0
2	T1	624	9.2	624	9.2	0.330	6.9	LOS A	2.3	18.3	0.48	0.57	0.48	63.0
3	R2	151	2.8	151	2.8	0.330	13.2	LOS B	2.2	17.1	0.50	0.62	0.50	60.3
Approach		883	7.3	883	7.3	0.330	7.9	LOS A	2.3	18.3	0.49	0.57	0.49	62.2
East: Santorini Prom (E)														
4	L2	171	4.1	171	4.1	0.646	9.8	LOS A	4.4	33.6	0.87	1.04	1.18	49.2
5	T1	82	0.0	82	0.0	0.646	9.2	LOS A	4.4	33.6	0.87	1.04	1.18	27.8
6	R2	125	5.5	125	5.5	0.646	15.2	LOS B	4.4	33.6	0.87	1.04	1.18	46.4
6u	U	1	100.0	1	100.0	0.646	22.2	LOS C	4.4	33.6	0.87	1.04	1.18	22.1
Approach		379	3.9	379	3.9	0.646	11.5	LOS B	4.4	33.6	0.87	1.04	1.18	45.4
North: Marmion Ave (N)														
7	L2	221	3.8	221	3.8	0.577	8.4	LOS A	5.3	41.4	0.76	0.73	0.81	51.0
8	T1	1081	5.4	1081	5.4	0.577	9.4	LOS A	5.3	41.4	0.77	0.78	0.85	61.5
9	R2	31	0.0	31	0.0	0.577	16.1	LOS B	5.1	39.8	0.78	0.83	0.88	49.1
9u	U	6	0.0	6	0.0	0.577	19.0	LOS B	5.1	39.8	0.78	0.83	0.88	62.3
Approach		1339	5.0	1339	5.0	0.577	9.4	LOS A	5.3	41.4	0.76	0.77	0.84	60.0
West: Hawksbill Dr (W)														
10	L2	42	0.0	42	0.0	0.464	4.5	LOS A	2.4	18.2	0.67	0.89	0.77	50.2
11	T1	88	1.5	88	1.5	0.464	4.5	LOS A	2.4	18.2	0.67	0.89	0.77	40.0
12	R2	253	3.5	253	3.5	0.464	9.4	LOS A	2.4	18.2	0.67	0.89	0.77	56.3
Approach		383	2.6	383	2.6	0.464	7.8	LOS A	2.4	18.2	0.67	0.89	0.77	53.2
All Vehicles		2984	5.2	2984	5.2	0.646	9.0	LOS A	5.3	41.4	0.68	0.76	0.77	58.3

**Table 11. SIDRA results for the roundabout intersection of Marmion Avenue/  
Hawksbill Drive/ Santorini Promenade – Weekday PM peak period (Post  
development – Year 2022)**

Vehicle Movement Performance														
Mov ID	Turn	DEMAND FLOWS		ARRIVAL FLOWS		Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
		[ Total veh/h ]	HV %	[ Total veh/h ]	HV %				[ Veh. veh ]	[ Dist m ]				
South: Marmion Ave (S)														
1	L2	166	1.6	166	1.6	0.601	7.5	LOS A	5.7	42.7	0.73	0.64	0.75	56.2
2	T1	1082	1.8	1082	1.8	0.601	8.2	LOS A	5.7	42.7	0.74	0.69	0.78	62.7
3	R2	257	1.2	257	1.2	0.601	15.1	LOS B	5.6	42.0	0.76	0.76	0.82	58.3
Approach		1505	1.7	1505	1.7	0.601	9.3	LOS A	5.7	42.7	0.74	0.70	0.78	61.5
East: Santorini Prom (E)														
4	L2	167	1.8	167	1.8	0.682	7.9	LOS A	4.8	35.8	0.82	1.02	1.11	50.8
5	T1	82	0.0	82	0.0	0.682	7.4	LOS A	4.8	35.8	0.82	1.02	1.11	29.3
6	R2	265	0.4	265	0.4	0.682	13.2	LOS B	4.8	35.8	0.82	1.02	1.11	48.9
6u	U	3	0.0	3	0.0	0.682	15.2	LOS B	4.8	35.8	0.82	1.02	1.11	25.2
Approach		518	0.8	518	0.8	0.682	10.6	LOS B	4.8	35.8	0.82	1.02	1.11	47.5
North: Marmion Ave (N)														
7	L2	158	2.7	158	2.7	0.436	7.2	LOS A	3.2	24.8	0.63	0.62	0.63	52.2
8	T1	877	4.3	877	4.3	0.436	7.9	LOS A	3.2	24.8	0.64	0.63	0.64	62.9
9	R2	27	0.0	27	0.0	0.436	14.3	LOS B	3.0	22.9	0.65	0.65	0.65	50.6
9u	U	7	0.0	7	0.0	0.436	17.2	LOS B	3.0	22.9	0.65	0.65	0.65	63.5
Approach		1069	3.9	1069	3.9	0.436	8.0	LOS A	3.2	24.8	0.64	0.63	0.64	61.5
West: Hawksbill Dr (W)														
10	L2	42	0.0	42	0.0	0.380	6.5	LOS A	2.0	15.1	0.81	0.95	0.90	47.5
11	T1	36	0.0	36	0.0	0.380	6.5	LOS A	2.0	15.1	0.81	0.95	0.90	37.0
12	R2	128	3.5	128	3.5	0.380	11.4	LOS B	2.0	15.1	0.81	0.95	0.90	53.8
Approach		206	2.2	206	2.2	0.380	9.6	LOS A	2.0	15.1	0.81	0.95	0.90	50.7
All Vehicles		3299	2.3	3299	2.3	0.682	9.1	LOS A	5.7	42.7	0.72	0.74	0.79	59.0

**Table 12. SIDRA results for full movement crossover (crossover 1) – Weekday AM peak period (10-Year Post development – Year 2032)**

Vehicle Movement Performance														
Mov ID	Turn	DEMAND FLOWS		ARRIVAL FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[ Total veh/h	HV %	[ Total HV veh/h	%				[ Veh. veh	Dist ] m				
East: Hawksbill Dr (E)														
5	T1	364	3.0	364	3.0	0.181	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	49.9
6	R2	95	0.0	95	0.0	0.091	5.2	LOS A	0.4	2.8	0.52	0.67	0.52	19.7
Approach		459	2.4	459	2.4	0.181	1.1	NA	0.4	2.8	0.11	0.14	0.11	42.1
North: Crossover 1 (N)														
7	L2	72	0.0	72	0.0	0.072	2.0	LOS A	0.3	2.0	0.48	0.39	0.48	15.2
9	R2	14	0.0	14	0.0	0.043	10.2	LOS B	0.1	1.1	0.74	0.76	0.74	17.7
Approach		85	0.0	85	0.0	0.072	3.3	LOS A	0.3	2.0	0.52	0.45	0.52	16.1
West: Hawksbill Dr (W)														
10	L2	20	0.0	20	0.0	0.258	4.6	LOS A	0.0	0.0	0.00	0.02	0.00	34.4
11	T1	498	3.0	498	3.0	0.258	0.0	LOS A	0.0	0.0	0.00	0.02	0.00	48.6
Approach		518	2.9	518	2.9	0.258	0.2	NA	0.0	0.0	0.00	0.02	0.00	47.7
All Vehicles		1062	2.4	1062	2.4	0.258	0.8	NA	0.4	2.8	0.09	0.11	0.09	41.7

**Table 13. SIDRA results for full movement crossover (crossover 1) – Weekday PM peak period (10-Year Post development – Year 2032)**

Vehicle Movement Performance														
Mov ID	Turn	DEMAND FLOWS		ARRIVAL FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[ Total veh/h	HV %	[ Total HV veh/h	%				[ Veh. veh	Dist ] m				
East: Hawksbill Dr (E)														
5	T1	521	3.0	521	3.0	0.260	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	49.9
6	R2	86	0.0	86	0.0	0.078	4.9	LOS A	0.3	2.4	0.49	0.63	0.49	20.2
Approach		607	2.6	607	2.6	0.260	0.7	NA	0.3	2.4	0.07	0.09	0.07	44.6
North: Crossover 1 (N)														
7	L2	58	2.0	58	2.0	0.056	1.8	LOS A	0.2	1.6	0.46	0.35	0.46	15.5
9	R2	12	2.0	12	2.0	0.044	12.7	LOS B	0.1	1.1	0.79	0.80	0.79	15.9
Approach		69	2.0	69	2.0	0.056	3.6	LOS A	0.2	1.6	0.51	0.42	0.51	15.7
West: Hawksbill Dr (W)														
10	L2	18	0.0	18	0.0	0.234	4.6	LOS A	0.0	0.0	0.00	0.02	0.00	34.4
11	T1	452	3.0	452	3.0	0.234	0.0	LOS A	0.0	0.0	0.00	0.02	0.00	48.6
Approach		469	2.9	469	2.9	0.234	0.2	NA	0.0	0.0	0.00	0.02	0.00	47.7
All Vehicles		1146	2.7	1146	2.7	0.260	0.7	NA	0.3	2.4	0.07	0.08	0.07	43.4

**Table 14. SIDRA results for left turn exit only crossover (crossover 2) – Weekday AM peak period (10-Year Post development – Year 2032)**

Vehicle Movement Performance														
Mov ID	Turn	DEMAND FLOWS		ARRIVAL FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[ Total veh/h	HV %	[ Total veh/h	HV %				[ Veh. veh	Dist ] m				
East: Hawksbill Dr (E)														
5	T1	459	3.0	459	3.0	0.119	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	50.0
Approach		459	3.0	459	3.0	0.119	0.0	NA	0.0	0.0	0.00	0.00	0.00	50.0
North: Crossover 2 (N)														
7	L2	31	0.0	31	0.0	0.031	1.3	LOS A	0.1	0.8	0.37	0.24	0.37	16.2
Approach		31	0.0	31	0.0	0.031	1.3	LOS A	0.1	0.8	0.37	0.24	0.37	16.2
West: Hawksbill Dr (W)														
11	T1	569	3.0	569	3.0	0.162	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	49.9
Approach		569	3.0	569	3.0	0.162	0.0	NA	0.0	0.0	0.00	0.00	0.00	49.9
All Vehicles		1059	2.9	1059	2.9	0.162	0.0	NA	0.1	0.8	0.01	0.01	0.01	47.3

**Table 15. SIDRA results for left turn exit only crossover (crossover 2) – Weekday PM peak period (10-Year Post development – Year 2032)**

Vehicle Movement Performance														
Mov ID	Turn	DEMAND FLOWS		ARRIVAL FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[ Total veh/h	HV %	[ Total veh/h	HV %				[ Veh. veh	Dist ] m				
East: Hawksbill Dr (E)														
5	T1	607	3.0	607	3.0	0.157	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	49.9
Approach		607	3.0	607	3.0	0.157	0.0	NA	0.0	0.0	0.00	0.00	0.00	49.9
North: Crossover 2 (N)														
7	L2	34	0.0	34	0.0	0.038	1.4	LOS A	0.1	0.9	0.37	0.25	0.37	16.2
Approach		34	0.0	34	0.0	0.038	1.4	LOS A	0.1	0.9	0.37	0.25	0.37	16.2
West: Hawksbill Dr (W)														
11	T1	509	3.0	509	3.0	0.182	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	49.9
Approach		509	3.0	509	3.0	0.182	0.0	NA	0.0	0.0	0.00	0.00	0.00	49.9
All Vehicles		1151	2.9	1151	2.9	0.182	0.0	NA	0.1	0.9	0.01	0.01	0.01	47.2



**Table 16. SIDRA results for the roundabout intersection of Marmion Avenue/  
Hawksbill Drive/ Santorini Promenade – Weekday AM peak period (10-Year Post  
development – Year 2032)**

Vehicle Movement Performance														
Mov ID	Turn	DEMAND FLOWS		ARRIVAL FLOWS		Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
		[ Total veh/h ]	[ HV % ]	[ Total veh/h ]	[ HV % ]				[ Veh. veh ]	[ Dist m ]				
South: Marmion Ave (S)														
1	L2	100	3.1	100	3.1	0.540	8.3	LOS A	5.0	40.1	0.81	0.72	0.85	55.3
2	T1	875	9.3	875	9.3	0.540	9.3	LOS A	5.0	40.1	0.82	0.77	0.87	60.4
3	R2	157	2.8	157	2.8	0.540	16.2	LOS B	4.7	37.3	0.82	0.85	0.91	57.4
Approach		1132	7.8	1132	7.8	0.540	10.2	LOS B	5.0	40.1	0.82	0.77	0.88	59.7
East: Santorini Prom (E)														
4	L2	196	4.1	196	4.1	0.653	19.0	LOS B	4.2	32.2	0.94	1.09	1.30	42.6
5	T1	239	3.0	239	3.0	0.904	33.3	LOS C	10.7	83.0	1.00	1.50	2.25	15.1
6	R2	163	5.5	163	5.5	0.904	39.3	LOS D	10.7	83.0	1.00	1.50	2.25	29.9
6u	U	1	100.0	1	100.0	0.904	48.7	LOS D	10.7	83.0	1.00	1.50	2.25	19.5
Approach		599	4.2	599	4.2	0.904	30.3	LOS C	10.7	83.0	0.98	1.37	1.94	28.7
North: Marmion Ave (N)														
7	L2	144	4.0	144	4.0	0.865	17.3	LOS B	18.1	141.2	1.00	1.14	1.67	43.1
8	T1	1509	5.5	1509	5.5	0.865	19.0	LOS B	18.1	141.2	1.00	1.18	1.72	53.1
9	R2	121	3.0	121	3.0	0.865	27.0	LOS C	16.1	125.7	1.00	1.23	1.78	36.5
9u	U	7	0.0	7	0.0	0.865	29.8	LOS C	16.1	125.7	1.00	1.23	1.78	50.4
Approach		1782	5.2	1782	5.2	0.865	19.5	LOS B	18.1	141.2	1.00	1.18	1.72	51.6
West: Hawksbill Dr (W)														
10	L2	166	3.0	166	3.0	0.343	6.9	LOS A	1.8	13.5	0.81	0.88	0.86	50.5
11	T1	247	1.7	247	1.7	0.611	7.4	LOS A	4.6	35.0	0.90	1.05	1.16	36.8
12	R2	186	3.5	186	3.5	0.611	12.4	LOS B	4.6	35.0	0.90	1.05	1.16	53.8
Approach		600	2.6	600	2.6	0.611	8.8	LOS A	4.6	35.0	0.87	1.01	1.08	47.4
All Vehicles		4113	5.4	4113	5.4	0.904	16.9	LOS B	18.1	141.2	0.93	1.07	1.43	49.8

**Table 17. SIDRA results for the roundabout intersection of Marmion Avenue/  
Hawksbill Drive/ Santorini Promenade – Weekday PM peak period (10-Year Post  
development – Year 2032)**

Vehicle Movement Performance														
Mov ID	Turn	DEMAND FLOWS		ARRIVAL FLOWS		Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
		[ Total veh/h ]	[ HV % ]	[ Total veh/h ]	[ HV % ]				[ Veh. veh ]	[ Dist m ]				
South: Marmion Ave (S)														
1	L2	161	1.8	161	1.8	0.923	23.9	LOS C	25.8	194.3	1.00	1.31	2.13	40.4
2	T1	1509	2.1	1509	2.1	0.923	25.9	LOS C	25.8	194.3	1.00	1.35	2.18	48.3
3	R2	208	1.2	208	1.2	0.923	34.7	LOS C	22.5	169.6	1.00	1.40	2.27	41.6
Approach		1879	2.0	1879	2.0	0.923	26.7	LOS C	25.8	194.3	1.00	1.35	2.19	47.1
East: Santorini Prom (E)														
4	L2	173	1.4	173	1.4	0.459	10.9	LOS B	2.6	19.7	0.89	0.98	1.04	50.5
5	T1	260	3.0	260	3.0	0.781	15.2	LOS B	7.1	53.3	0.99	1.22	1.55	23.4
6	R2	163	0.4	163	0.4	0.781	20.9	LOS C	7.1	53.3	0.99	1.22	1.55	41.9
6u	U	4	0.0	4	0.0	0.781	22.9	LOS C	7.1	53.3	0.99	1.22	1.55	30.1
Approach		600	1.8	600	1.8	0.781	15.6	LOS B	7.1	53.3	0.96	1.15	1.41	38.3
North: Marmion Ave (N)														
7	L2	163	2.9	163	2.9	0.748	12.0	LOS B	10.8	83.4	0.94	0.95	1.24	48.8
8	T1	1224	4.3	1224	4.3	0.748	13.2	LOS B	10.8	83.4	0.95	0.99	1.28	58.7
9	R2	187	3.0	187	3.0	0.748	20.6	LOS C	9.8	75.7	0.96	1.05	1.33	42.7
9u	U	8	0.0	8	0.0	0.748	23.4	LOS C	9.8	75.7	0.96	1.05	1.33	56.3
Approach		1583	4.0	1583	4.0	0.748	14.0	LOS B	10.8	83.4	0.95	0.99	1.28	56.6
West: Hawksbill Dr (W)														
10	L2	180	3.0	180	3.0	0.611	17.0	LOS B	3.8	28.8	0.93	1.07	1.24	37.2
11	T1	233	3.0	233	3.0	0.820	22.7	LOS C	7.8	58.9	1.00	1.30	1.74	22.3
12	R2	129	3.0	129	3.0	0.820	27.5	LOS C	7.8	58.9	1.00	1.30	1.74	39.1
Approach		542	3.0	542	3.0	0.820	21.9	LOS C	7.8	58.9	0.98	1.22	1.58	32.0
All Vehicles		4604	2.8	4604	2.8	0.923	20.3	LOS C	25.8	194.3	0.97	1.19	1.70	47.9

**Table 18. SIDRA average queue results for the roundabout intersection of Marmion Avenue/ Hawksbill Drive/ Santorini Promenade – Weekday PM peak period (10-Year Post development – Year 2032)**

Vehicle Movement Performance														
Mov ID	Turn	DEMAND FLOWS		ARRIVAL FLOWS		Deg. Satn	Aver. Delay	Level of Service	AVERAGE BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[ Total veh/h ]	HV %	[ Total veh/h ]	HV %				[ Veh. veh ]	[ Dist m ]				
South: Marmion Ave (S)														
1	L2	161	1.8	161	1.8	0.923	23.9	LOS C	10.4	78.1	1.00	1.31	2.13	40.4
2	T1	1509	2.1	1509	2.1	0.923	25.9	LOS C	10.4	78.1	1.00	1.35	2.18	48.3
3	R2	208	1.2	208	1.2	0.923	34.7	LOS C	9.1	68.2	1.00	1.40	2.27	41.6
Approach		1879	2.0	1879	2.0	0.923	26.7	LOS C	10.4	78.1	1.00	1.35	2.19	47.1
East: Santorini Prom (E)														
4	L2	173	1.4	173	1.4	0.459	10.9	LOS B	1.1	7.9	0.89	0.98	1.04	50.5
5	T1	260	3.0	260	3.0	0.781	15.2	LOS B	2.9	21.4	0.99	1.22	1.55	23.4
6	R2	163	0.4	163	0.4	0.781	20.9	LOS C	2.9	21.4	0.99	1.22	1.55	41.9
6u	U	4	0.0	4	0.0	0.781	22.9	LOS C	2.9	21.4	0.99	1.22	1.55	30.1
Approach		600	1.8	600	1.8	0.781	15.6	LOS B	2.9	21.4	0.96	1.15	1.41	38.3
North: Marmion Ave (N)														
7	L2	163	2.9	163	2.9	0.748	12.0	LOS B	4.3	33.5	0.94	0.95	1.24	48.8
8	T1	1224	4.3	1224	4.3	0.748	13.2	LOS B	4.3	33.5	0.95	0.99	1.28	58.7
9	R2	187	3.0	187	3.0	0.748	20.6	LOS C	3.9	30.4	0.96	1.05	1.33	42.7
9u	U	8	0.0	8	0.0	0.748	23.4	LOS C	3.9	30.4	0.96	1.05	1.33	56.3
Approach		1583	4.0	1583	4.0	0.748	14.0	LOS B	4.3	33.5	0.95	0.99	1.28	56.6
West: Hawksbill Dr (W)														
10	L2	180	3.0	180	3.0	0.611	17.0	LOS B	1.5	11.6	0.93	1.07	1.24	37.2
11	T1	233	3.0	233	3.0	0.820	22.7	LOS C	3.1	23.7	1.00	1.30	1.74	22.3
12	R2	129	3.0	129	3.0	0.820	27.5	LOS C	3.1	23.7	1.00	1.30	1.74	39.1
Approach		542	3.0	542	3.0	0.820	21.9	LOS C	3.1	23.7	0.98	1.22	1.58	32.0
All Vehicles		4604	2.8	4604	2.8	0.923	20.3	LOS C	10.4	78.1	0.97	1.19	1.70	47.9