



BANKSMEADOW WASTE TRANSFER TERMINAL

Traffic and Transport Impact Assessment

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Prepared for Veolia Environmental Services Pty Ltd
Prepared by Hyder Consulting Pty Limited



VEOLIA

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Author

Damien Chee

A handwritten signature in black ink, appearing to read "Damien Chee".

Approver

Shannon Blackmore

A handwritten signature in black ink, appearing to read "Shannon Blackmore".

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EXECUTIVE SUMMARY

Veolia Environmental Services (Veolia) are submitting an application for State Significant Development for a new Waste Transfer Terminal at Banksmeadow. This is in order to meet the anticipated growth in operational capacity at Woodlawn Eco-Project site in Tarago and the limited spare capacity at the existing transfer terminal at Clyde. At present, Clyde Transfer Terminal receives and processes 500,000 tonnes of waste per annum whilst recent planning approval was granted for Crisps Creek Intermodal Facility (8km from the Woodlawn Eco-Project site) to receive 1.18 million tonnes of waste per annum.

Veolia will be submitting an Application for the construction and operation of the Banksmeadow Transfer Terminal as a State Significant Development under the *Environmental Planning and Assessment Act 1979*. This Traffic and Transport Impact Assessment is required to support the Application. The scope of this study was governed by the relevant Director General Requirements as issued by the NSW Department of Planning and Infrastructure.

The Banksmeadow Transfer Terminal will receive household and commercial waste mainly from surrounding southern Sydney region. Following a five-year ramp up period to 2020, the Transfer Terminal will handle up to a maximum of 500,000 tonnes of waste per year, with 400,000 tonnes of putrescible and 100,000 tonnes of non-putrescible waste.

In assessing traffic impacts associated with the Project, and in response to the relevant DGRs, this study has considered anticipated changes in traffic conditions under several scenarios: These include:

- The *existing* 2013 case which is considered to be a present-day base case acting as a benchmark for comparison for future scenarios.
- The 2020 *build with no other development* scenario which assesses the impacts of the proposed Waste Transfer Terminal in isolation, with no traffic growth due to other land use changes or background traffic growth.
- The 2020 *no build with other development* scenario, which assesses the impacts of other key land use changes on the road network, with no additional traffic from the proposed Waste Transfer Terminal.
- The 2020 *build with other development* scenario, which is a cumulative traffic impact assessment of the proposed Waste Transfer Terminal along with traffic from other key land uses.

Existing traffic conditions

The assessment of existing traffic conditions indicated that the Beauchamp Road/ Perry Street intersection is performing satisfactorily with acceptable delays in the AM and PM peak periods. A key reason for the good modelled performance of this intersection is that, during the traffic survey period, the intersection operated in a similar manner to a signalised T intersection with comparatively less traffic conflicts compared with a four-way cross intersection. Although there is a fourth and western leg to the intersection which feeds into the proposed development site, this road was closed during the traffic survey period and did not carry any traffic.

The existing case traffic models for the Beauchamp Road/ Denison Street intersection indicates that this intersection is failing under existing PM peak period conditions. This is largely due to the high delays experienced by right-turning vehicles from Denison Street to Beauchamp Road. This movement is affected by the high volume of eastbound through vehicles on Beauchamp Road which means that the amount of green signal time given to the Denison Street approach is restricted. Another critical movement is the right-turn from Beauchamp Road North to Denison Street. This is affected by the high volume of (and hence competition from) the eastbound through and left-turning movements from the Beauchamp Road western approach. These

modelling results are critical as they indicate that this intersection is failing under existing conditions before any traffic related to the Project, other land use changes or background traffic growth are added to the road network.

The Botany Road/ Beauchamp Road intersection was also modelled under the existing case traffic conditions. The modelling work indicated that this intersection is performing satisfactorily under AM and PM peak traffic conditions.

Likely impacts of the Project in isolation

The *build with no other development* case was used to assess the likely impacts of the Project in isolation without any traffic impacts from other major land use changes or background traffic growth. The Project is likely to generate 430 truck movements per day for the movement of putrescible waste to the development site, 280 truck movements per day for the movement of non-putrescible waste to the site, and 32 trucks movements per day for the bulk haulage of non-putrescible waste to the Camellia Recycling Centre.

The most significant change in the *build with no other development* case is that the Beauchamp Road/ Perry Street/ Site Access intersection would be a four-way signalised intersection (compared to the previous condition where it operated similar to a T intersection). This has a significant impact as it requires signal phasing adjustments to accommodate the additional traffic emerging from the fourth and western approach – the Site Access Road. As this new traffic and intersection approach demands a portion of the signal cycle, less signal cycle time can be allocated to the other movements (compared with the existing scenario). As such, the reduced capacity would affect the Perry Street and Beauchamp Road South approaches.

The modelling work indicated that some mitigation measures would be required to restore capacity at the Beauchamp Road/ Perry Street/ Site Access Road intersection. As such the following improvements have been recommended and were also confirmed through further traffic modelling work to be effective in addressing the capacity shortfalls:

- Provision of an indented left-turn lane in the Beauchamp Road South approach to the intersection.
- Banning of the through movements from the Perry Street and Site Access Road approaches.

Likely impacts due to other land use changes and background traffic growth

The major land use changes considered in this study included the Port Botany Expansion Project (including the third marine port terminal), the proposed Bunnings Warehouse on Denison Street, and changes to Qenos' hydrogen delivery processes.

As mentioned previously, the Beauchamp Road/ Denison Street intersection is currently failing in the PM peak period. With additional traffic added to the intersection as a result of other major land use changes and background traffic growth, this intersection would experience a further reduction in performance. As these impacts are not due to the Project in isolation, this report has not proposed any mitigation measures for this intersection.

Cumulative traffic impacts

The cumulative traffic impacts were assessed which accounted for traffic growth due to the Project, the predicted growth in background traffic, as well as forecasted traffic from major land use changes

There were no further noted traffic impacts under a cumulative assessment case in addition to those already identified through the other assessments.

Road safety impacts

A road safety inspection was carried out on roads directly associated with the Project. This indicated that the following safety improvement and management measures should be considered.

- Provision of an indented left-turn lane for the northbound direction of Beauchamp Road accessing the development site (at the Perry Street intersection). This would be required to safeguard slow moving left-turning traffic at the intersection from potential *rear-end* crashes. This was also recommended as a traffic mitigation measure and verified through traffic modelling.
- Removal or pruning of the vegetation on the western side of Beauchamp Road to the immediate north of McPherson Street in order to improve entering sight lines from McPherson Street.
- Reviewing and where necessary, implementing more kerbside parking restrictions in the McPherson Street approach to Beauchamp Road, in order to allow egressing trucks to approach at a more perpendicular angle in order to establish better sightlines to oncoming traffic on Beauchamp Road.
- Ensuring that the design of the Site Access Road approach to the signalised intersection with Beauchamp Road/ Perry Street is wide enough to accommodate the queuing and swept path clearances required by entering and egressing trucks. This was also recommended as a traffic mitigation measure and verified through traffic modelling.

Rail network issues

There is likely to be 6 train movements per week per direction generated by the Project during its operational phase. This would consist of 6 outbound trains to Woodlawn, and 6 empty return trains. This would equate to less than one outbound train and one inbound train per day. This would have a marginal impact on the rail network.

Operating on the rail network would attract Access Fees from the relevant Access Providers on the intended network route. Access Fees represent revenue for the Access Providers for provision of access to the network, infrastructure maintenance and upgrades. As such, any impact on the rail network by the Project would be “self-mitigated”.

Discussions between relevant rail asset owners and Pacific National (Veolia’s train operator) have confirmed that there is sufficient ‘Access’ available for purchase to accommodate the Project and these access paths would be purchased on approval of the Proposal by the Department of Planning and Infrastructure.

Examples of major rail infrastructure projects that have been delivered through this process or through alternative funding/ procurement arrangements include the Southern Sydney Freight Line, Enfield ILC and Moorebank Inter-modal Terminal. It is expected that, with ongoing increases to rail volumes across the network, the rail asset managers will continue to prioritise and delivery rail network maintenance and improvement projects.

1 INTRODUCTION

1.1 BACKGROUND

Veolia Environmental Services (Veolia) owns and operates the Woodlawn Eco-Project site in Tarago, NSW. This facility takes in putrescible waste, mainly from Sydney, and then converts it to green electricity using the methane created by the resultant waste. Since 2005, this Bioreactor has taken in more than 2.2 million tonnes of waste to yield 3MWh of electricity (Veolia Environmental Services, 2013a).

The Clyde Transfer Terminal, located in Western Sydney, is also owned and operated by Veolia. This terminal receives and transfers up to 500,000 tonnes of waste per annum. The waste is containerised and transported by rail to the Woodlawn Eco-Project site.

In 2012, Veolia was granted approval to receive 1.18 million tonnes of waste by rail at Crisps Creek Intermodal Facility (8km from Woodlawn Eco-Project site) per annum (Veolia Environmental Services, 2013b). This creates a shortfall of more than 600,000 tonnes of waste at the processing phase of the operations.

In light of this shortfall, and the recent contract to process household waste from some of the Southern Sydney Regional Organisation of Councils (SSROC), Veolia is proposing to develop and operate the Banksmeadow Transfer Terminal located at 14 Beauchamp Road, Banksmeadow, near the Port Botany Precinct (**Figure 1** and **Figure 2**). This transfer facility will process up to 500,000 tonnes of waste including up to 100,000 tonnes per annum of dry waste (non-putrescible) and up to 400,000 tonnes per annum of general domestic and commercial waste (putrescible). All non-putrescible waste would be sorted to remove easily extractable recyclables and residual material would be loaded into semi-trailers for transfer to Veolia's proposed recycling centre in Camellia (Veolia Environmental Services, 2013c)

The Banksmeadow Transfer Terminal will receive waste mainly from the southern Sydney area including waste under a contract with some members of the Southern Sydney Regional Organisation of Councils (SSROC). This contract includes the local government areas of Ashfield, Botany Bay, Burwood, Leichhardt, Kogarah, Rockdale, Waverley and Woollahra, which will be serviced by both the existing Clyde facility and the proposed Banksmeadow Transfer Terminal.

Veolia will be submitting an Application for the construction and operation of the Banksmeadow Transfer Terminal as a State Significant Development under the *Environmental Planning and Assessment Act 1979*. This application (SSD 13_5855) will be supported by an Environmental Impact Statement (EIS). This Traffic and Transport Impact Assessment is a specialist study required as part of the EIS.

1.2 SCOPE OF THE PROPOSED DEVELOPMENT

Application SSD 13_5855 is for the development and operation of the Banksmeadow Transfer Terminal which includes:

- Demolition of existing buildings on Lot 1 in DP435497, Lot A and B in DP 366725 and Part of Lot 2 in DP 1006865 at 14 Beauchamp Road and 34-36 McPherson Street, Banksmeadow.
- Construction and operation of a waste transfer terminal and associated rail infrastructure to receive and process up to 400,000 tonnes of putrescible waste and up to 100,000 tonnes of non-putrescible waste per annum.

- Containerisation of putrescible waste for transfer by rail to Woodlawn for treatment, recycling and energy recovery.
- Receipt of non-putrescible waste for bulk transfer by semi-trailer to resource recovery facilities such as the Camellia Recycling Centre for recovery of recyclables prior to re-processing.

The operation of the waste transfer terminal will rely on nominated truck access routes for the transportation of inbound and outbound waste. These will be based on appropriate routes equipped to accommodate such heavy vehicle movements. This also acknowledges gazetted truck access restrictions based on load, length and vertical clearance, as well as Project-specific restrictions including Veolia's commitment that Perry Street will not be used as a heavy vehicle access or egress route to/from the development site.

This assessment has considered the likely vehicles to be used for the transportation of inbound and outbound waste. Vehicles up to 12.5m in length will be used to transport putrescible and non-putrescible waste to the development site. Standard 19.0m semi-trailers will be used for bulk runs where the non-putrescible waste is transported to Camellia Recycling Centre. All containerised putrescible waste will be transported by rail to Woodlawn.

All incoming waste will be transported to the development site via the intersection of Beauchamp Road/ Perry Street/ Site Access Road. The associated empty outbound trucks will also use this intersection. The semi-trailers associated with the bulk runs (non-putrescible waste) will access and egress from the development site via McPherson Street. This study has examined the potential impacts on the Beauchamp Road/ Perry Street/ Site Access Road intersection with appropriate mitigation measures recommended.

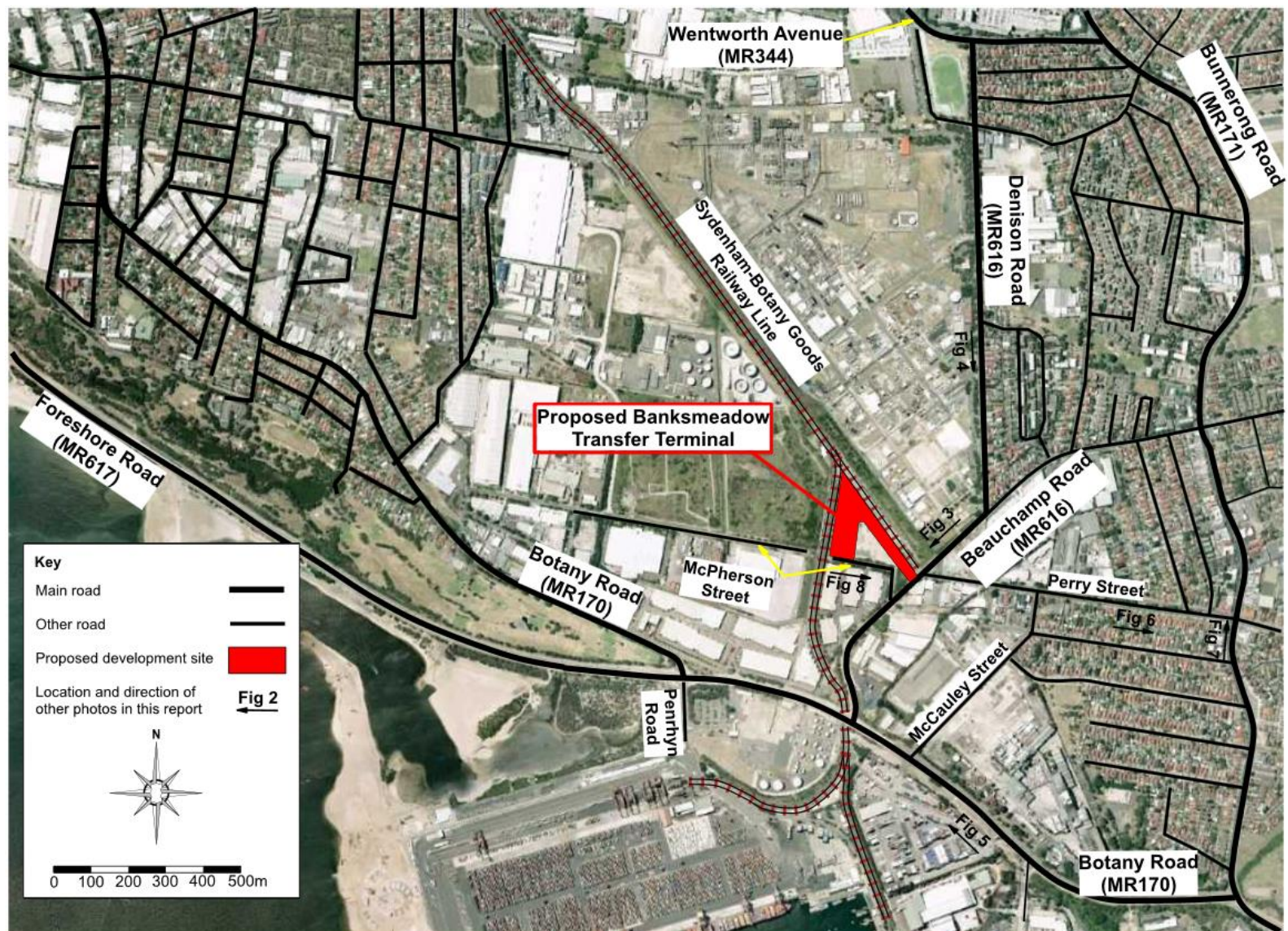


Figure 1 Locality map.

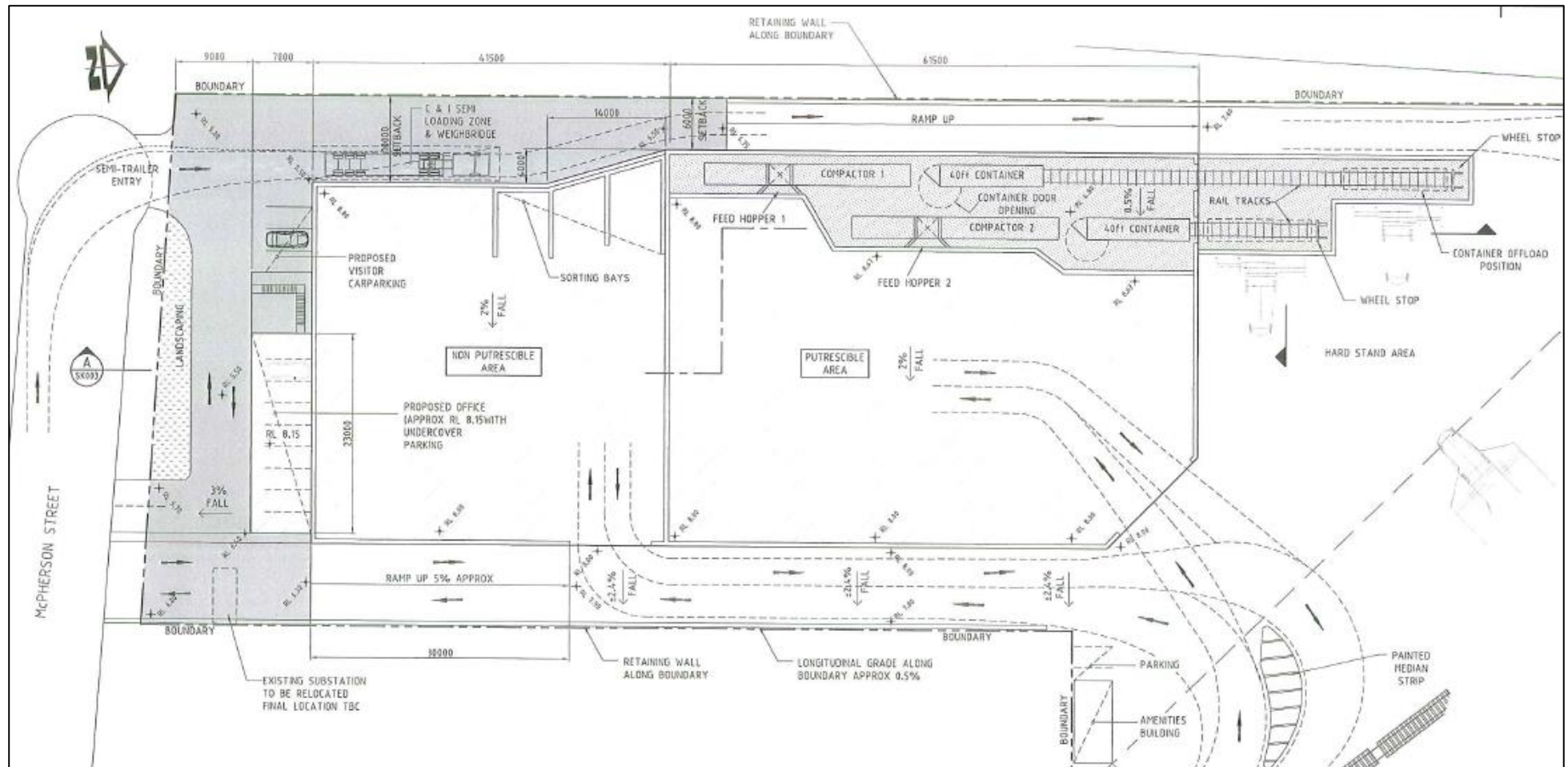


Figure 2 Site layout.

1.3 SCOPE OF THE TRAFFIC AND TRANSPORT IMPACT ASSESSMENT

The scope of this Traffic and Transport Impact Assessment has been governed by the relevant Director General Requirements (DGRs) which are described in **Table 1**. **Table 1** also provides a reference to the relevant section of this report where each DGR is addressed.

Table 1 DGRs relevant to traffic and transport issues.

Item no.	Description	Ref to report section
The EIS must address the following specific matters: Traffic, Transport and Access – including		
1	Details of key transport routes.	3.2
	Vehicle types proposed to access the site.	3.1
	Traffic volumes likely to be generated.	3.1
	The likely arrival and departure times of all traffic generated by the site.	3.1
	Both during construction and ongoing operations.	5.1 and 3.1
2	Assessment of predicted impacts on road safety of the road network to accommodate the Project.	6.0
	Assessment of predicted impacts on capacity of the road network to accommodate the Project.	3.0, 5.0
3	Detailed plans of the proposed layout of the internal road network and parking on site in accordance with the relevant Australian Standards (including swept path diagrams)	Figure 2
	Details to demonstrate that the facility will not result in queuing off-site.	3.5
4	Detailed plans of any proposed road or intersection upgrades, infrastructure works or new roads required for the development (including proposed funding for road improvement works if required).	3.5, 6.0
5	The cumulative impact of traffic generated by other existing or proposed developments.	5.0
6	Details to demonstrate that the proposed operations will not result in adverse impacts on the operations of the main goods rail line.	7.0

Veolia were also provided with individual submissions from key community and organisational stakeholders requesting input to the DGRs. Whilst these are not formal study scope requirements, each issue has been tabled and addressed in Appendix A.

2 EXISTING CONDITIONS

2.1 LAND USES

The proposed site of the Banksmeadow Transfer Terminal is currently occupied by a number of industrial land uses including an engineering manufacturing plant and a railway container yard. Adjacent properties mainly consist of industrial facilities such as a recycling facility for building materials, railway facilities and business parks.

The proposed development site is situated within a SEPP (Port Botany and Port Kembla) 2013 declared *General Industrial* land zone. This zone is mostly situated within the Botany Bay Local Government Area (LGA).

The Site Access Road and the eastern side of Beauchamp Road falls in the Randwick LGA. The length of Perry Street from Beauchamp Road to McCauley Street is zoned as *light industrial* uses. Further east of this point, the land use becomes more residential with a high degree of retail uses along Bunnerong Road in the Matraville Chamber of Commerce.

The land uses immediately surrounding the proposed development site have a strong influence on the traffic that is generated on the surrounding road network. These land uses generate a substantial volume of local trips by trucks and private vehicles.

Furthermore, of critical significance to this proposal from a road and rail transport perspective is the close proximity of the development site to the Port Botany Precinct – the area generally including the two existing marine terminals, the recently constructed third terminal and the surrounding port and container-related land uses. This precinct generates a high volume of trucks associated with the movement of containers to and from the various holding yards and port terminals. In addition to container movements, the precinct, particularly at its south-eastern end, has a number of bulk liquid storage facilities.

The Port Botany Precinct also generates all of the train movements along the Botany Goods Railway Line. These are mostly container movements to and from hinterland and various intermodal terminals.

Further to the west of the development site, is the Sydney Airport precinct. This is a critical traffic generating precinct with road movements generated for air freight and passenger services, as well as the associated aviation industries.

2.2 SURROUNDING ROAD NETWORK

The surrounding road network is shown in **Figure 1** and is described in **Sections 2.2.1 to 2.2.7**.

2.2.1 BEAUCHAMP ROAD

Beauchamp Road is a four lane undivided road (**Figure 3**) extending from Bunnerong Road in the east¹, and Botany Road in the south. The kerbside lane in each direction is designated as a parking lane and footpaths are provided on both sides of the road.

The section of Beauchamp Road to the south-west of Denison Street is classified as Main Road (MR) 616 with Roads and Maritime Services (RMS) having delegated authority to manage and

¹ Beauchamp Road continues to the east and terminates at its intersection with Malabar Road in Malabar. However, the section to the east of Bunnerong Road is not relevant to this Traffic and Transport Impact Assessment.

maintain this portion of the route. The section to the north-east of Denison Street is classified as a regional road (7340) such that the relevant local government is the delegated roads authority. The Randwick/ Botany Bay Local Government Area (LGA) boundary runs along the centre of this road between Bunnerong Road and Perry Street. As such, for the section classified as a regional road, the northern side of the road falls in Botany Bay City Council's jurisdiction, and the southern side falls in Randwick City Council's jurisdiction.



Figure 3 Looking south-west along Beauchamp Road towards Perry Street.

To the north-east of Denison Street, the land surrounding this road is primarily residential. A primary school is located on the north-western corner of the Bunnerong Road/ Beauchamp Road intersection. Retail properties associated with the Matraville Chamber of Commerce are located on the south-western side of this intersection. To the south-west of Denison Street, the surrounding land uses are comprised of light and heavy industries including automobile repair workshops, home and hardware retail/wholesale outlets, and the Orica site.

The section of Beauchamp Road between Denison Street and Botany Road has a major collector road/ sub-arterial road function. It is a critical route providing connectivity between the Port Botany Precinct and Botany Road- Foreshore Road in the south, and the light industrial and residential areas of Pagewood, Hillsdale, Mascot, Matraville and Eastlakes. It is also a critical access route to the proposed development both in providing direct access from the Beauchamp Road/Perry Street signalised intersection, as well as access to the access to the proposed development via McPherson Street.

The route is signposted as a 60km/h speed zone with a 40km/h school zone between Flack Avenue and Bunnerong Road. This road is also part of a public bus route – the 309/ X09 service from the City to Port Botany.

2.2.2 DENISON STREET

Denison Street is a four-lane undivided road (**Figure 4**) linking Wentworth Avenue in the north to Beauchamp Road in the south. It is classified as MR616 and RMS have delegated authority to manage and maintain this route. This road contains a footpath along its eastern side.

This sub-arterial road provides inter-regional connectivity between the Pagewood, Matraville and Sydney Airport precincts with the Port Botany Precinct. It is also a critical access route for the residential and heavy industry land uses adjacent to this road including Qenos and Orica on the western side of this route, and the Hillsdale precinct on the eastern side of the route.

Of relevance to the proposed development, this road will be a critical road access and egress route from the Banksmeadow Transfer Terminal from/to the north.

This route is signposted as a 60km/h speed zone.



Figure 4 Looking south along Denison Street from Grace Campbell Crescent.

2.2.3 BOTANY ROAD - FORESHORE ROAD

Botany Road commences from Bunnerong Road at its eastern end and extends westward towards Botany Bay. This is classified as MR170 and falls under the delegated responsibility of RMS. Between Bunnerong Road and the Penrhyn Road/ Foreshore Road intersection, the route has a six-lane divided road configuration (**Figure 5**) with indented turning lanes at the signalised intersections with Bumborah Point Road, Gate 2 container holding yard, McCauley Street, Beauchamp Road, and Penrhyn Road/Foreshore Road. Footpaths are provided on both sides of this route.

The section of Botany Road between Bunnerong Road and Penrhyn Road/ Foreshore Road is a critical access route for the existing two container terminals (DP World and Patricks) as well as the bulk liquid storage facilities and associated container/ freight handling services in the Port Botany Precinct.



Figure 5 Looking westbound along Botany Road towards McCauley Street.

Although Botany Road continues to the north-west from the Penrhyn Road/ Foreshore Road intersection to Waterloo, this section is less relevant to this Traffic and Transport Impact Assessment.

Foreshore Road is the western extension of Botany Road to the west of Penrhyn Road. This is a controlled access route functioning primarily as a high volume link between the Port Botany Precinct and General Holmes Drive (and hence the Sydney Orbital network). As such, this is a four-lane divided road with a high-speed alignment and very few access points.

The most significant access point along this route is the signalised intersection to the third container terminal which was recently constructed. This will be used by heavy vehicles entering and egressing from the third terminal. There are also other accesses provided along this route for boat ramps and parking areas associated with the Port Botany Expansion Project. The recently completed Hale Street extension also meets Foreshore Road and provides the new means of heavy vehicle access to the Hale Street industrial precinct (in lieu of Botany Road).

Of relevance to the proposed development, this road will be a critical road access and egress route from the Banksmeadow Transfer Terminal from/to the south. This includes access to General Holmes Drive and the Sydney Orbital network.

The entire Botany Road – Foreshore Road route between Bunnerong Road and General Holmes Drive is signposted as a 70km/h speed zone. The portion of the route between Beauchamp Road and Foreshore Road is also part of the 309/X09 public bus route, from City to Port Botany.

2.2.4 PERRY STREET

Perry Street is an east-west local road extending from Bunnerong Road at its eastern end to Beauchamp Road at its western end. The road commences as a divided road configuration (**Figure 6**) at its eastern end, and then transitions to an undivided single carriageway road for the western portion. This road is wholly contained in the Randwick LGA and hence is managed and maintained by Randwick City Council. Footpaths are provided on both sides of the road.



Figure 6 Looking eastbound along Perry Street towards Bunnerong Road.

Perry Street provides access to the residential and light industrial land uses either side of the road and has a signposted speed limit of 60km/h.

In response to concerns identified through ongoing consultation with the community, this route will not be used as a truck route to or from the proposed Banksmeadow Transfer Terminal. In this regard, other roads will be designated for access and egress from the proposed development site.

2.2.5 BUNNERONG ROAD

Bunnerong Road is classified as MR171 and falls under the delegated care and control of RMS. Although this road extends from La Perouse in the south, to Kingsford in the north, the section of relevance to this Traffic and Transport Impact Assessment, is between Botany Road and Beauchamp Road. Within this section, Bunnerong Road has a divided road configuration with two to three travel lanes per direction (**Figure 7**). Parking is allowed in the kerb side lane and indented turning lanes are provided at key intersections. Footpaths are provided on both sides of the road.

The land use surrounding this road includes the Port Botany precinct at the southern end, including the Military Road business park, the Matraville Chamber of Commerce and Primary School, and the Hillsdale residential precinct. The road is signposted as a 60km/h speed zone.



Figure 7 Looking northbound on Bunnerong Road towards Franklin Street and the Matraville Chamber of Commerce (beyond).

A number of public bus services operate along Bunnerong Road including the 392/ 391 City to Little Bay/ Port Botany services.

2.2.6 MCPHERSON STREET

McPherson Street is a local *no-through road* (**Figure 8**) stemming from Beauchamp Road. It provides access to the southern boundary of the proposed development as well as a number of other industrial land uses. These include the business park at 2-12 Beauchamp Road, and a building material recycling facility (Botany Building Recyclers). This road mostly falls under the care and jurisdiction of Botany Bay City Council. This is with the exception of a small portion of land at the eastern end of the road which falls under the Randwick LGA.



Figure 8 Looking eastbound along McPherson Street from the southern gate to the proposed development.

As a *no-through road*, almost all the traffic generated by the land use in this road would enter and egress from the Beauchamp Road/ McPherson Street intersection. The exception is the portion of traffic that may enter the business park at 2-12 Beauchamp Road via the driveways on McPherson Street and then leave the premises via the alternative gates on Beauchamp Road.

This road is not signposted with a speed limit and as such defaults to the general urban speed limit of 50km/h.

2.2.7 WENTWORTH AVENUE

Wentworth Avenue is classified as MR344 and extends from Bunnerong Road at its eastern end, to Botany Road, at its western end. It functions as an arterial road providing a regional link between Maroubra, Pagewood and Eastgardens at its eastern end, and Mascot, the Sydney Airport Precinct, and the Sydney Orbital network at its western end. Of relevance to the proposed development, this route would be a critical road access route from the north and west. It provides connectivity to General Holmes Drive for access to the south-western suburbs of Sydney, as well as access to Southern Cross Drive for access to the northern and inner city suburbs.

This road has a divided road configuration with two to three lanes per direction. The road is signposted as a 70km/h and 60km/h speed zone to the east and west of Dransfield Avenue respectively. Footpaths are provided on both sides of the route.

2.2.8 HEAVY VEHICLE RESTRICTIONS AND ALLOWANCES

Figure 9 shows the heavy vehicle access restrictions across the surrounding road network. This includes the following:

- Many of the streets in the Hillsdale precinct bounded by Wentworth Avenue, Bunnerong Road, Beauchamp Road and Denison Street contain 3 tonne load limits.
- Australia Avenue and Harold Street in Matraville are both signposted with 2 tonne load limits.
- Many of the streets in the Botany precinct bounded by the Botany Goods Railway Line, Stephens Road, Botany Road and Bay Street are signposted with 3 tonne load limits.

This includes Stephens Road and Bay Street which means there is generally no inter-connectivity for vehicles over this limit between Botany and Pagewood.

- Dent Street, Fremlin Street, Anniversary Street, Hanna Street and Waratah Road in the suburb of Botany are all signposted with 3 tonne load limits.
- Vehicles over 12.5m in length are not permitted to use the section of Bunnerong Road between Wentworth Avenue and La Perouse unless they are both over 4.3m high and 19.0m long. Vehicles with local destinations are also excepted.
- Vehicles over 12.5m in length are not permitted use the section of Botany Road between Hill Street and Mill Pond Road unless Foreshore Road is closed.
- Vehicles over 6m in length are not permitted to turn from Perry Street into McCauley Street in Matraville.
- Vehicles over 12.5m in length are not permitted to turn left from Wentworth Avenue to Denison Street unless there is a local destination involved.
- Vehicles over 6m in length are not permitted to turn left from Botany Road to Hale Street. The designated access route is via Foreshore Road.
- Vehicles over 4.4m in height and/or carrying dangerous goods are not permitted in the Airport Tunnel on General Holmes Drive.

Figure 10 shows the Restricted Access Vehicle (RAV) approved routes as gazetted by RMS. These specifically relate to B-doubles up to 26m in length as well as vehicles up to 4.6m high. As shown, the following routes are approved for RAV transit:

- Foreshore Road – Botany Road between Bunnerong Road and General Holmes Drive: Both B-doubles up to 26m as well as vehicles up to 4.6m in height are allowed.
- Denison Street, entire length: Both B-doubles up to 26m as well as vehicles up to 4.6m in height are allowed.
- Beauchamp Road between Denison Street and Botany Road: Both B-doubles up to 26m as well as vehicles up to 4.6m in height are allowed.
- Bunnerong Road between Wentworth Avenue and Botany Road: This route may only be used by 26m B-doubles if there is a local destination in Beauchamp Road.
- Botany Road between Foreshore Road and Hill Street: Both B-doubles up to 26m as well as vehicles up to 4.6m in height are allowed.
- Hale Street: Both B-doubles up to 26m as well as vehicles up to 4.6m in height are allowed. However, these vehicles must enter and egress via Foreshore Road.

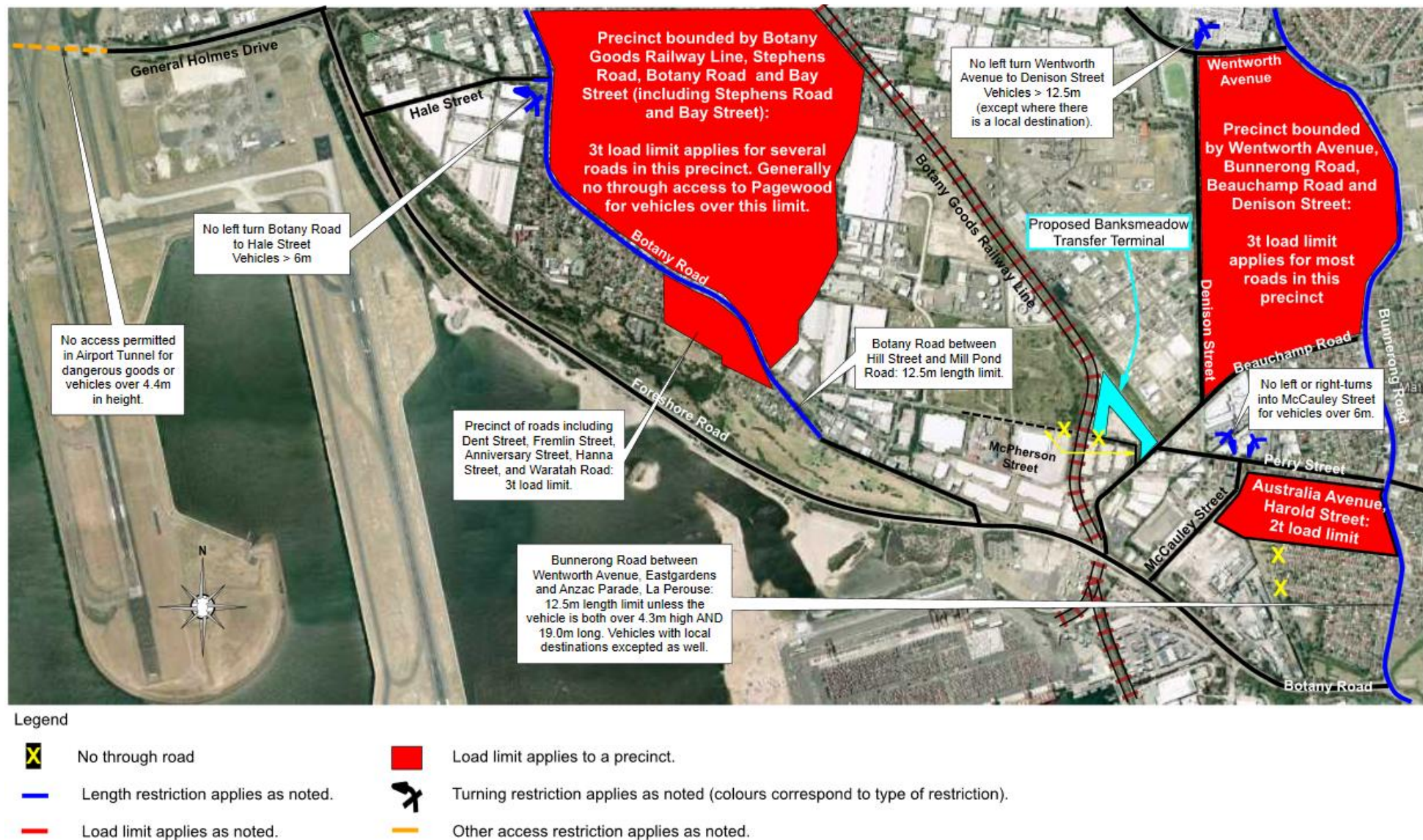


Figure 9 Heavy vehicle access restrictions across the surrounding road network.

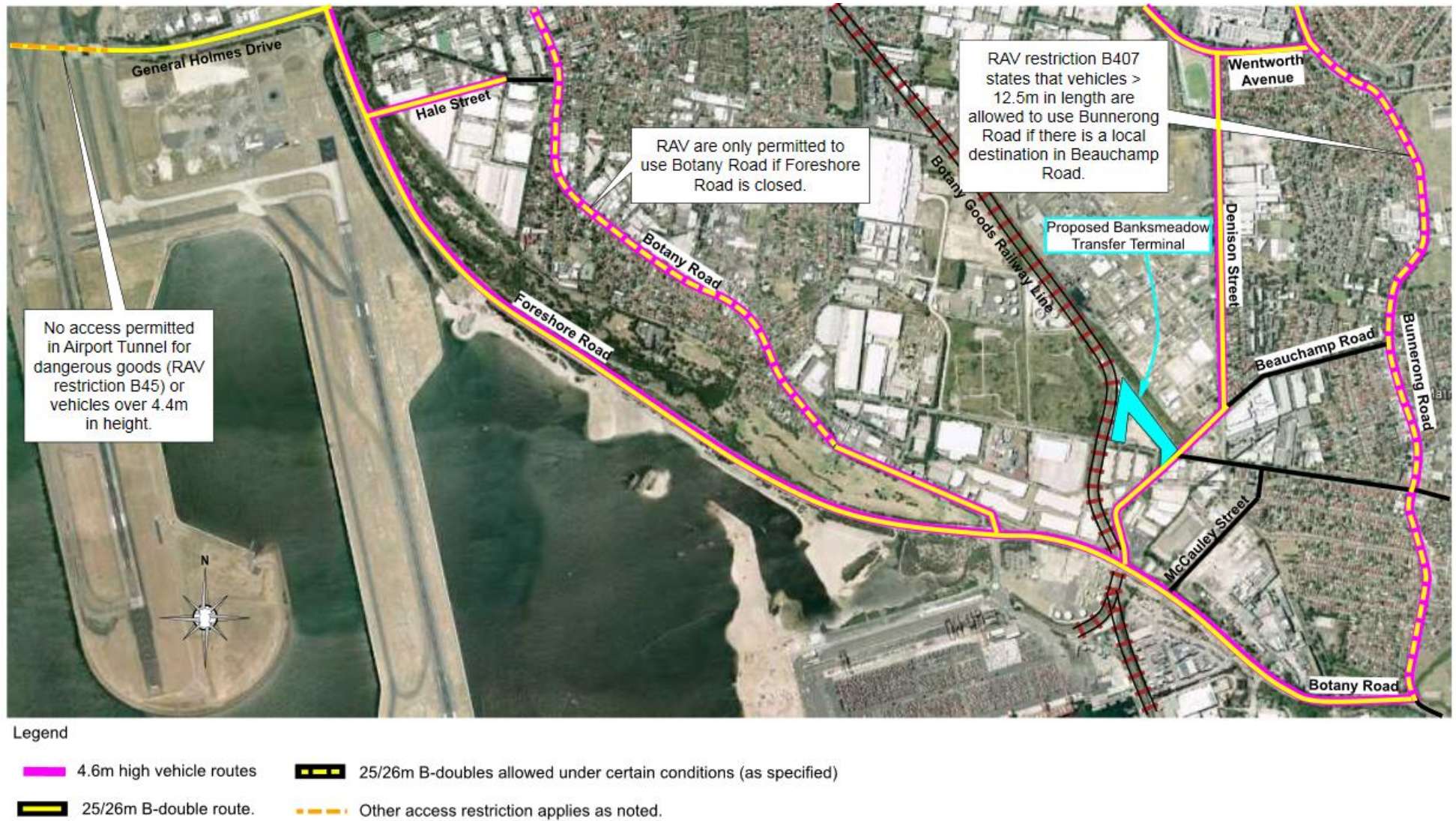


Figure 10 Restricted Access Vehicle (RAV) approved routes (source: RMS, 2011)

2.3 EXISTING TRAFFIC CONDITIONS

2.3.1 RMS SURVEYS

RMS has a number of counting stations in the road network surrounding the Project. These have been summarised in **Table 2**.

Appendix B provides the year-by-year trends in traffic volumes at each of the traffic counting locations. These trends were used to determine the most likely growth scenario up to the 2013 present day case. Assumptions on growth scenarios are also provided in **Appendix B**. The 2013 projected traffic volumes as a result of these trend analyses have also been provided in **Table 2** as well.

Table 2 Traffic volumes recorded and projected from RMS counting stations (RMS, 2005)

Station no.	Location	2005 AADT	2013 projected AADT
16.089	Beauchamp Road, north of Botany Road.	20,848	23,000
16.012	Botany Road, east of Beauchamp Road.	24,266	27,500
16.013	Botany Road, west of Beauchamp Road.	39,342	43,500
16.088*	Foreshore Road, between General Holmes Drive and Botany Road.	33,454	39,000
16.031*	Wentworth Avenue, west of Bunnerong Road	18,862	23,000
16.033	Wentworth Avenue, east of Page Street.	33,054	36,000
13.014	Bunnerong Road, north of Beauchamp Road.	19,153	19,000

Traffic counting sites marked with (*) are measured in vehicles per day. Sites not marked are in axle pairs per day.

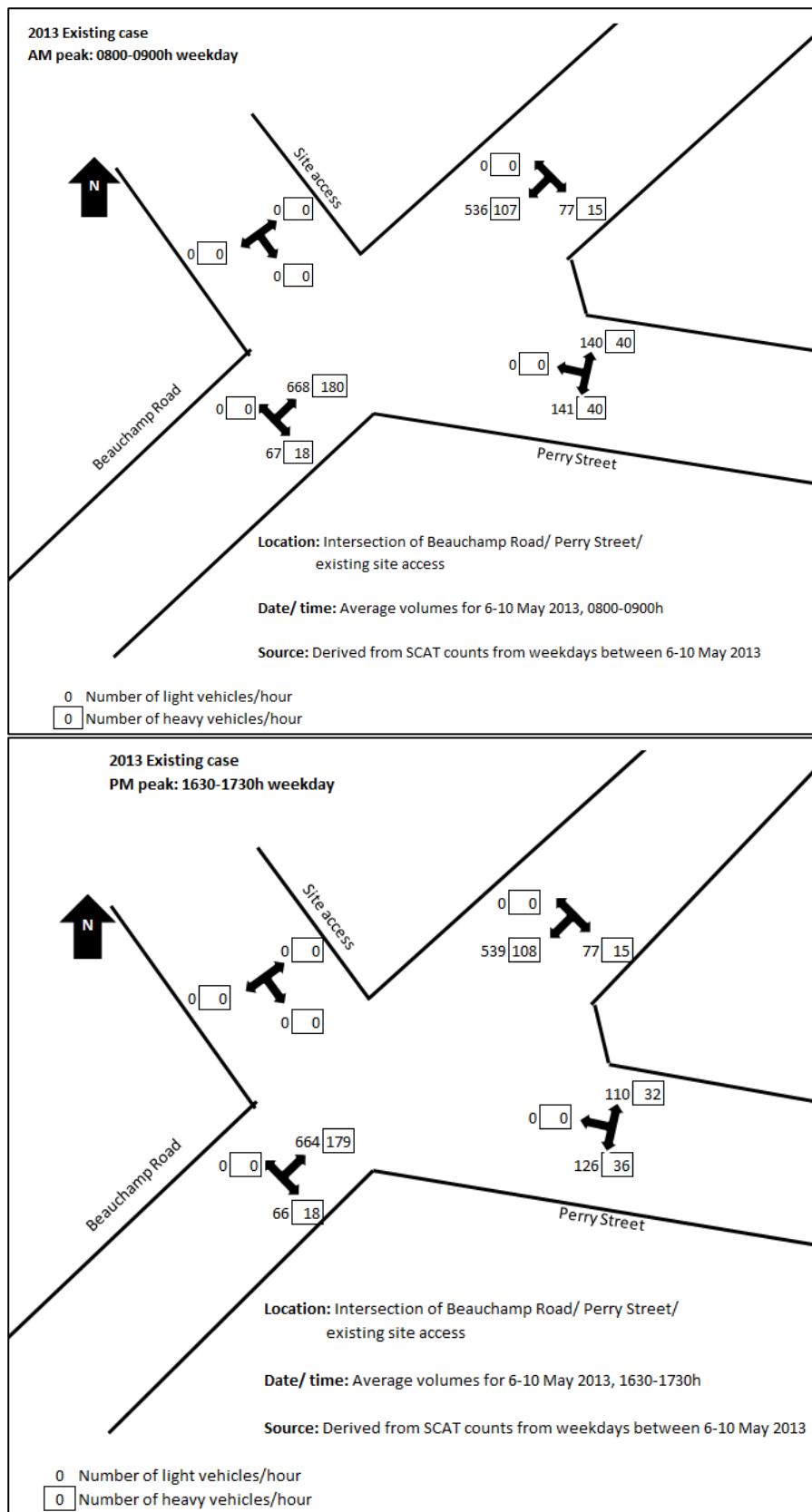
2.3.2 SCATS COUNTS

The vast majority of traffic signal controlled intersections in NSW are managed by RMS through the Sydney Coordinated Adaptive Traffic Signal (SCATS) system. In addition to enabling RMS to coordinate and control signal timings/ phasings at each of these intersections, the system also records the number of vehicles passing over each detector loop associated with these intersections. As such, RMS holds an inventory of traffic data through the SCATS system.

SCATS vehicle detections were provided by RMS for the following signalised intersections:

- TCS 1532: Signalised intersection of Beauchamp Road/ Perry Street/ Site Access Road.
- TCS 1548: Signalised intersection of Beauchamp Road/ Denison Street.
- TCS 1526: Signalised intersection of Botany Road/ Beauchamp Road.

The turning movement counts for the AM and PM peak periods at each of these intersections are depicted in **Figure 11** to **Figure 13**. Relevant notes on the derivation of the turning movement volumes are provided following each figure. Note that these AM and PM peak periods were identified as the highest volume hours for the AM and PM periods respectively. As such, these were adopted as the peak periods for modelling purposes.



Notes for derivation of turning movement counts for Beauchamp Road/ Perry Street:

- (i) AM and PM peak periods were determined by identifying the hour of day (for the average weekday between 6-10 May 2013) which exhibited the highest total volume of traffic entering the intersection.
- (ii) The Perry Street approach contains two approach lanes with detector 5 in the left-hand lane and detector 6 in the right-hand lane. All vehicle actuations on detector 5 were regarded as left-turning vehicles. All vehicle actuations on detector 6 were regarded as right-turning vehicles.
- (iii) The Beauchamp Road North approach contains two approach lanes with detector 1 in the left-hand lane (but which allows both through and left-turn movements) and detector 2 in the right-hand lane. On-site observations indicated that for every 7 vehicles in this approach that proceed straight through the intersection, there is 1 vehicle that turns left into Perry Street.
- (iv) The Beauchamp Road South approach contains two approach lanes with detector 3 in the left-hand lane and detector 4 in the right-hand lane (but which allows both through and right-turn movements). On-site observations indicated that for every 10 vehicles in this approach that proceed straight through the intersection, there is 1 vehicle that turns right into Perry Street.
- (v) On-site observations indicated that in the Perry Street approach, for every 2 heavy vehicles, there are 7 light vehicles.
- (vi) On-site observations indicated that in the Beauchamp Road North approach, for every 1 heavy vehicle, there are 5 light vehicles.
- (vii) On-site observations indicated that in the Beauchamp Road South approach, for every 7 heavy vehicles, there are 26 light vehicles.

Figure 11 Turning movement volumes at the intersection of Beauchamp Road and Perry Street during the AM and PM peak periods. Average for weekdays between 6-10 May 2013 (RMS, 2013a).

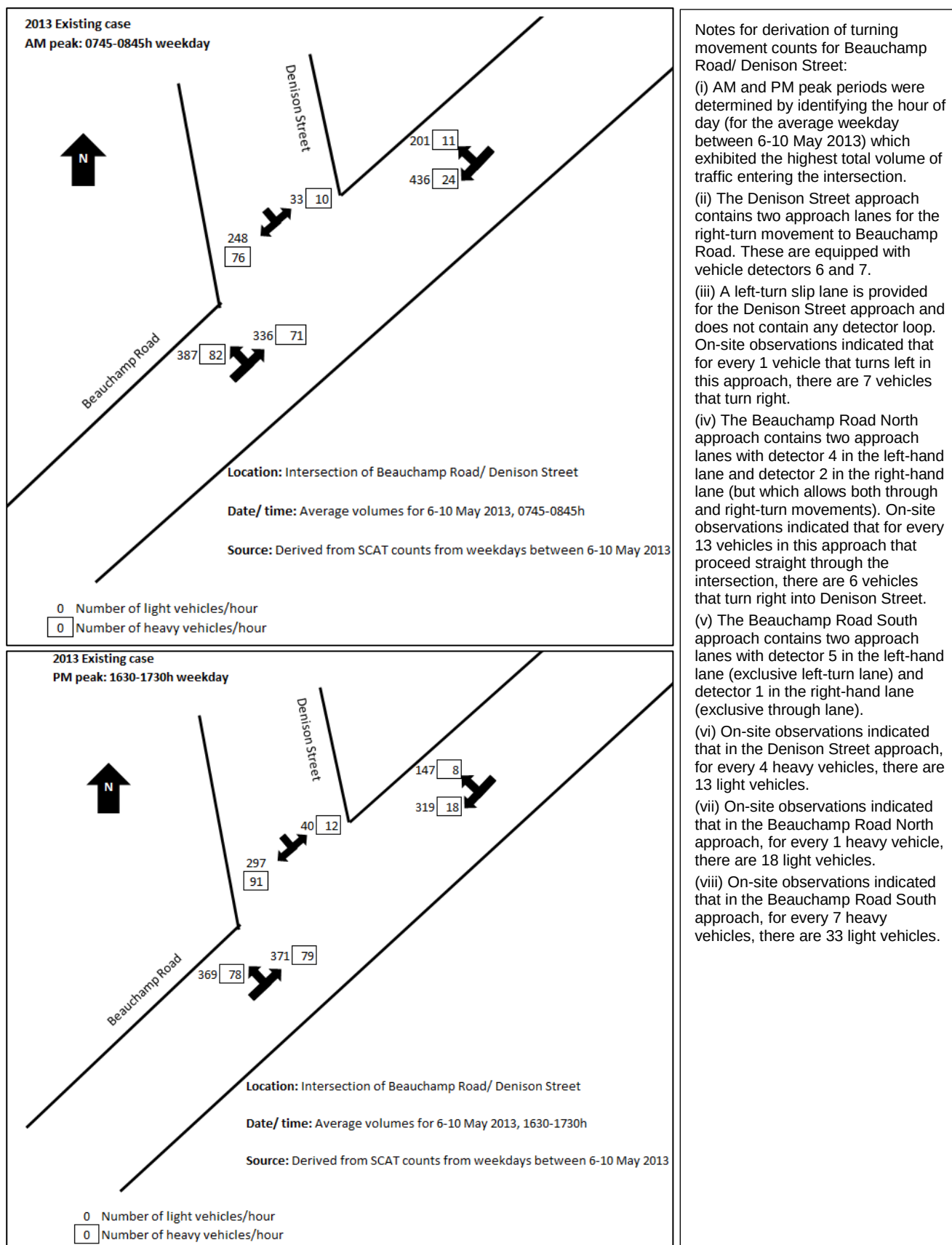


Figure 12 Turning movement volumes at the intersection of Beauchamp Road and Denison Street during the AM and PM peak periods. Average for weekdays between 6-10 May 2013 (RMS, 2013a).

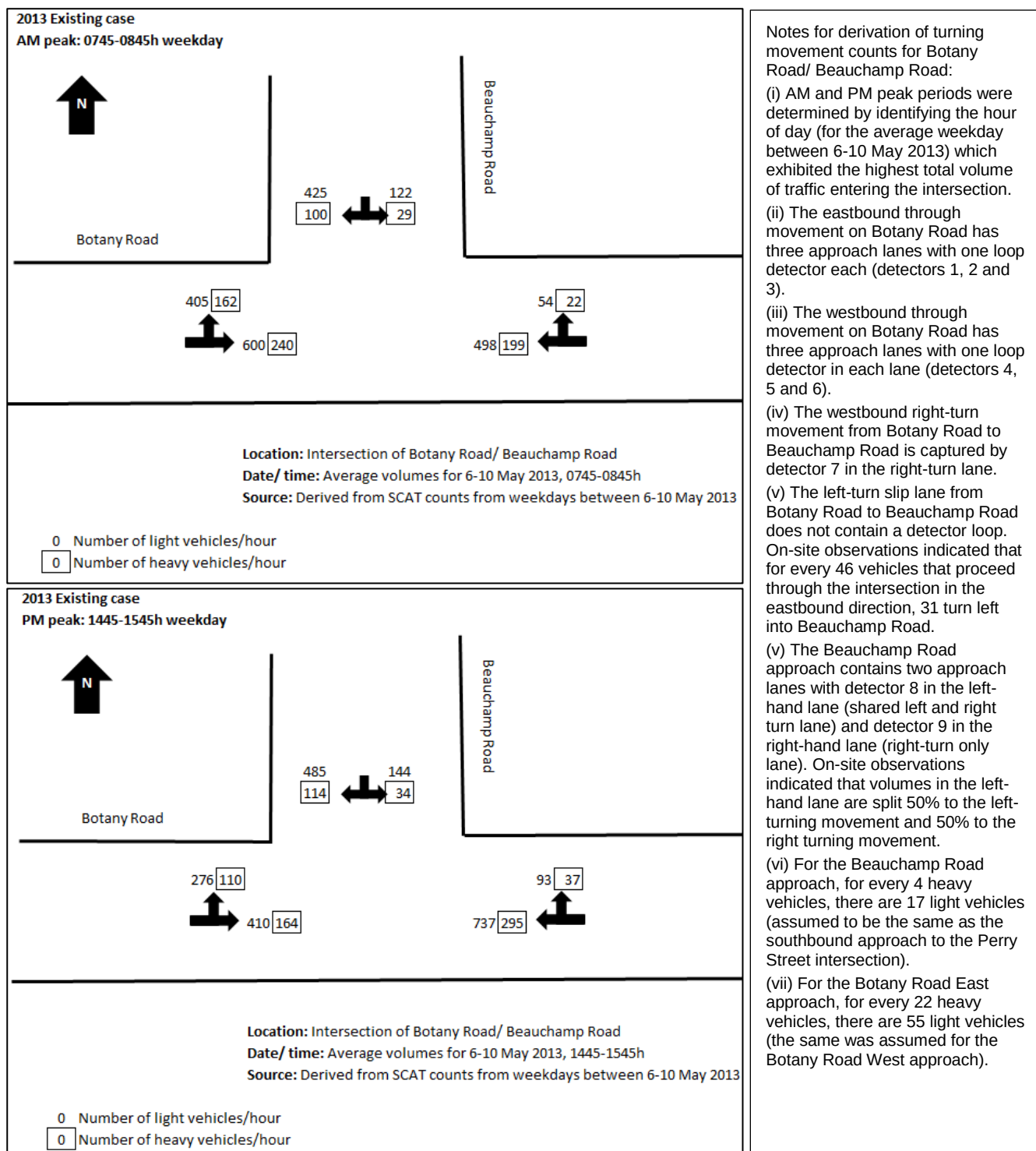


Figure 13 Turning movement volumes at the intersection of Botany Road and Beauchamp Road during the AM and PM peak periods. Average for weekdays between 6-10 May 2013 (RMS, 2013a).

2.3.3 MODEL OUTPUTS FOR EXISTING CONDITIONS

The existing traffic performance as reflected in the AM and PM peak periods (**Figure 11** to **Figure 13**) were simulated using a SIDRA traffic performance modelling software. Separate SIDRA models were prepared for these three study intersections. These models would then serve as the *existing* base case models and a benchmark for comparing the likely future *no build* case and the future *build* case. SIDRA models measure traffic performance via four key traffic parameters – level of service (LoS), degree of saturation (DoS), maximum (95th

percentile) queues, and average delay in seconds per vehicle. These traffic performance indicators are described in more detail in Appendix C.

Beauchamp Road/ Perry Street intersection

The SIDRA model outputs for the Beauchamp Road/ Perry Street intersection are presented in **Table 3**.

Table 3 SIDRA model outputs for the Beauchamp Road/ Perry Street intersection (AM and PM peak) – Existing case.

Beauchamp Road_Perry Street: Existing case 2013 AM peak (0800-0900)

Signals - Fixed Time Cycle Time = 60 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South East: Perry Street (SE)											
21	L	191	22.1	0.722	31.6	LOS C	5.2	42.9	0.86	0.88	16.5
23	R	189	22.2	0.413	28.4	LOS B	4.7	38.9	0.86	0.80	34.1
Approach		380	22.2	0.722	30.0	LOS C	5.2	42.9	0.86	0.84	27.0
North East: Beauchamp Road NE											
24	L	97	16.3	0.483	15.7	LOS B	4.1	32.5	0.44	0.90	27.4
25	T	677	16.6	0.483	7.3	LOS A	6.1	49.0	0.48	0.42	42.7
Approach		774	16.6	0.483	8.4	LOS A	6.1	49.0	0.48	0.48	41.2
South West: Beauchamp Road (SW)											
31	T	893	21.2	0.715	10.4	LOS A	12.0	98.9	0.67	0.62	43.7
32	R	89	21.2	0.715	21.8	LOS B	7.5	62.0	0.71	0.95	38.9
Approach		982	21.2	0.715	11.5	LOS A	12.0	98.9	0.68	0.65	43.2
All Vehicles		2136	19.7	0.722	13.6	LOS A	12.0	98.9	0.64	0.62	39.1

Beauchamp Road_Perry Street: Existing case 2013 PM peak (1630-1730)

Signals - Fixed Time Cycle Time = 65 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South East: Perry Street (SE)											
21	L	171	22.2	0.695	32.5	LOS C	4.9	40.4	0.85	0.86	16.1
23	R	149	22.5	0.334	29.8	LOS C	3.9	32.6	0.84	0.79	33.4
Approach		320	22.4	0.695	31.2	LOS C	4.9	40.4	0.85	0.83	25.9
North East: Beauchamp Road NE											
24	L	97	16.3	0.471	15.3	LOS B	3.9	31.3	0.40	0.90	27.8
25	T	681	16.7	0.471	6.9	LOS A	6.1	49.1	0.44	0.38	43.6
Approach		778	16.6	0.471	7.9	LOS A	6.1	49.1	0.43	0.45	42.0
South West: Beauchamp Road (SW)											
31	T	887	21.2	0.689	9.5	LOS A	11.5	95.1	0.62	0.56	44.7
32	R	88	21.4	0.689	21.2	LOS B	7.3	60.3	0.67	0.93	39.3
Approach		976	21.3	0.689	10.5	LOS A	11.5	95.1	0.62	0.60	44.2
All Vehicles		2074	19.7	0.695	12.8	LOS A	11.5	95.1	0.59	0.58	40.0

As seen in **Table 3**, the SIDRA models indicate that the intersection is currently performing satisfactorily with LoS of C or better for all approaches and an average delay of 12-14 seconds per vehicle.

Beauchamp Road/ Denison Street intersection

The SIDRA model outputs for the Beauchamp Road/ Denison Street intersection are presented in **Table 4**.

Table 4 SIDRA model outputs for the Beauchamp Road/ Denison Street intersection (AM and PM peak) - Existing case.

Beauchamp Road_Denison Street: Existing case 2013 AM peak (0745-0845h)
Signals - Fixed Time Cycle Time = 99 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
North East: Beauchamp Road (NE)											
25	T	484	5.2	0.745	36.2	LOS C	17.8	130.1	0.92	0.84	28.6
26	R	223	5.2	0.745	52.3	LOS D	12.4	90.5	0.95	1.03	25.0
Approach		707	5.2	0.745	41.3	LOS C	17.8	130.1	0.93	0.90	27.4
North: Denison Street											
7	L	45	23.3	0.339	13.7	LOS A	0.6	5.2	0.36	0.67	30.2
9	R	341	23.5	0.841	59.5	LOS E	10.1	84.5	0.99	1.06	22.9
Approach		386	23.4	0.841	54.2	LOS D	10.1	84.5	0.91	1.01	23.1
South West: Beauchamp Road (SW)											
30	L	494	17.5	0.419	9.3	LOS A	2.2	18.0	0.11	0.63	35.1
31	T	428	17.4	0.826	39.6	LOS C	20.4	163.9	0.96	0.92	18.6
Approach		922	17.5	0.826	23.4	LOS B	20.4	163.9	0.51	0.77	23.2
All Vehicles		2016	14.3	0.841	35.6	LOS C	20.4	163.9	0.73	0.86	25.0

Beauchamp Road_Denison Street: Existing case 2013 PM peak (1630-1730h)
Signals - Fixed Time Cycle Time = 80 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
North East: Beauchamp Road (NE)											
25	T	355	5.3	0.566	29.6	LOS C	8.5	62.4	0.88	0.76	31.3
26	R	163	5.2	0.566	38.8	LOS C	7.9	58.0	0.86	0.95	29.7
Approach		518	5.3	0.566	32.5	LOS C	8.5	62.4	0.87	0.82	30.8
North: Denison Street											
7	L	55	23.1	0.377	14.0	LOS A	0.7	5.8	0.42	0.68	29.8
9	R	408	23.5	1.122	190.5	LOS F	32.2	270.8	1.00	1.77	9.6
Approach		463	23.4	1.122	169.6	LOS F	32.2	270.8	0.93	1.64	9.9
South West: Beauchamp Road (SW)											
30	L	471	17.4	0.442	11.4	LOS A	4.4	35.4	0.26	0.68	31.8
31	T	474	17.6	1.128	282.4	LOS F	67.7	545.2	1.00	2.73	3.8
Approach		944	17.5	1.128	147.4	LOS F	67.7	545.2	0.63	1.71	5.7
All Vehicles		1925	15.6	1.128	121.8	LOS F	67.7	545.2	0.77	1.45	10.3

The SIDRA models indicate that the right-turn movement from Denison Street to Beauchamp Road is currently exhibiting a LoS E/F with modelled delays between 60-190 seconds per vehicle. A key factor in this result is the relatively high volume of eastbound through vehicles on Beauchamp Road which has a modelled LoS of C in the AM peak and F in the PM peak. This indicates that any benefit afforded to one of these movements through increased green time, is likely to result in an increase in red time for the other movement and a corresponding reduction in performance. As such, it is difficult to optimise the signal phasing since these two movements are in conflict with each other, and since both movements carry similar volumes of traffic.

Another critical movement is the right-turn from Beauchamp Road North to Denison Street which has a modelled LoS of D in the AM peak. The high through and left-turn volumes from the Beauchamp Road South approach constrain the amount of green time that can be allocated to this right-turn movement. Also, as this movement has a relative smaller demand volume, and has a lower percentage of heavy vehicles, there is little justification in allocating more green time to this movement at the expense of other dominant movements. On-site observations confirmed that the left-turn movement from Beauchamp Road and the opposing right-turn movement from Denison Road are the dominant movements.

Botany Road/ Beauchamp Road intersection

The SIDRA model outputs for the Beauchamp Road/ Perry Street intersection under existing conditions are presented in **Table 5**.

Table 5 SIDRA model outputs for the Botany Road/ Beauchamp Road intersection (AM and PM peak) - Existing case.

Botany Road_Beauchamp Road: Existing case 2013 AM peak (0745-0845h)

Signals - Fixed Time Cycle Time = 50 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Botany Road (E)											
5	T	734	28.6	0.310	7.0	LOS A	2.7	23.9	0.48	0.40	44.9
6	R	80	28.9	0.433	34.1	LOS C	1.9	17.0	0.94	0.76	18.0
Approach		814	28.6	0.433	9.6	LOS A	2.7	23.9	0.52	0.44	40.5
North: Beauchamp Road											
7	L	159	19.2	0.728	27.7	LOS B	8.4	68.7	0.88	0.89	35.9
9	R	553	19.0	0.728	28.4	LOS B	8.4	68.7	0.90	0.88	35.4
Approach		712	19.1	0.728	28.3	LOS B	8.4	68.7	0.90	0.88	35.5
West: Botany Road (W)											
10	L	597	28.6	0.383	11.1	X	X	X	X	0.71	39.8
11	T	884	28.6	0.739	21.7	LOS B	7.2	62.5	0.94	0.86	38.2
Approach		1481	28.6	0.739	17.4	LOS B	7.2	62.5	0.56	0.80	38.5
All Vehicles		3006	26.3	0.739	17.9	LOS B	8.4	68.7	0.63	0.72	37.8

Botany Road_Beauchamp Road: Existing case 2013 PM peak (1445-1545h)

Signals - Fixed Time Cycle Time = 45 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Botany Road (E)											
5	T	1086	28.6	0.522	9.4	LOS A	5.1	44.5	0.66	0.57	39.9
6	R	137	28.5	0.665	32.7	LOS C	3.2	27.8	0.98	0.84	18.5
Approach		1223	28.6	0.665	12.0	LOS A	5.1	44.5	0.69	0.60	36.4
North: Beauchamp Road											
7	L	187	19.1	0.751	25.2	LOS B	8.8	71.7	0.87	0.90	37.4
9	R	631	19.0	0.751	25.9	LOS B	8.8	71.7	0.89	0.90	36.9
Approach		818	19.0	0.751	25.7	LOS B	8.8	71.7	0.89	0.90	37.0
West: Botany Road (W)											
10	L	406	28.5	0.261	11.1	X	X	X	X	0.71	39.9
11	T	604	28.6	0.779	23.6	LOS B	4.9	42.5	0.99	0.91	36.8
Approach		1011	28.5	0.779	18.6	LOS B	4.9	42.5	0.59	0.83	37.4
All Vehicles		3052	26.0	0.779	17.9	LOS B	8.8	71.7	0.71	0.76	37.0

Note: The outputs marked as "X" indicate that performance is not affected. This is because the left-turn movement from Botany Road to Beauchamp Road is a continuous left-turn slip lane with its own downstream lane. As such, this traffic is not in conflict with any other traffic at the intersection.

As seen in **Table 5**, the SIDRA models indicate that the intersection is currently performing satisfactorily with LoS of C or better for all approaches and an average delay less than 20 seconds per vehicle.

3 FUTURE *BUILD WITH NO OTHER DEVELOPMENT CASE*

The *future build with no other development* case is a hypothetical case to test the relative impact of the proposed Banksmeadow Transfer Terminal compared with the *existing* traffic conditions. Details of the traffic volume build-up for this scenario are as follows:

- Existing traffic volumes as presented in **Figure 11**, **Figure 12** and **Figure 13**.
- No background traffic growth. This is in order to test the impact of the Project in isolation.
- Does not include additional traffic due to the Port Botany Expansion Project (including the third marine terminal which was recently constructed but not yet operational). It should be noted that this development and the related traffic growth are certain to occur. However, for the purposes of assessing the relative impact of Banksmeadow Transfer Terminal without the cumulative impact of other developments, this was precluded from the assessment in this Section. As such, this is referred to as a *hypothetical* scenario.
- Does not include additional traffic due to other known land use developments such as Bunnings and Qenos.
- Includes the traffic that would be generated by the proposed Banksmeadow Transfer Terminal operating at peak capacity. Note that this traffic was simply added to the existing traffic volumes. These traffic volumes are described in **Section 3.1**.

3.1 TRAFFIC IMPLICATIONS OF THE OPERATIONAL PHASE OF THE TRANSFER TERMINAL

The putrescible and non-putrescible waste will have differing transport chain logistics. As such, these have been discussed separately in **Sections 3.1.1** and **3.1.2**

3.1.1 PUTRESCIBLE WASTE

When operating at full capacity (by 2020 after a five –year ramp up period), of the total annual 500,000 tonnes of waste to be processed at the proposed development site, 400,000 tonnes would be putrescible waste. This would include waste transported from various local government areas in the SSROC to the Banksmeadow Transfer Terminal, as well as commercial waste collection vehicles. Once the waste has been containerised, the containers would be transported by rail to Woodlawn.

Table 6 provides a summary of the inbound and outbound transport movements for putrescible waste.

Table 6 Traffic and transport generation associated with putrescible waste.

Annual tonnage	400,000 tonnes
Weekly tonnage (t)	7,700 tonnes
Days per week of operation	6.5 days
Truck payload (t)	5.5 tonnes/ truck
Number of inbound loaded trucks per day (various source locations to Banksmeadow)	215
Number of outbound empty trucks/day (Banksmeadow to various destination points)	215
Total truck movements per day	430
Train payload (t) <i>Based on 31.5t/container and an average of 42 containers per train.</i>	1,325 tonnes/ train
Total number of outbound loaded trains per year (to Woodlawn)	300
Total number of inbound (empty container) trains (from Woodlawn)	300
Total number of trains per week (52-week operation)	6 trains/ week/ direction

To understand the hourly distribution of inbound and outbound putrescible waste collection trucks, the 24-hour traffic profile of the Clyde Transfer Terminal was analysed. **Figure 14** shows the hour-by-hour distribution of truck traffic at this terminal during the seven-day period from 30 July to 4 August 2012. As seen, the relative proportion of daily truck movements that occur during the AM and PM periods assessed in this report were 6% and 2.4% respectively².

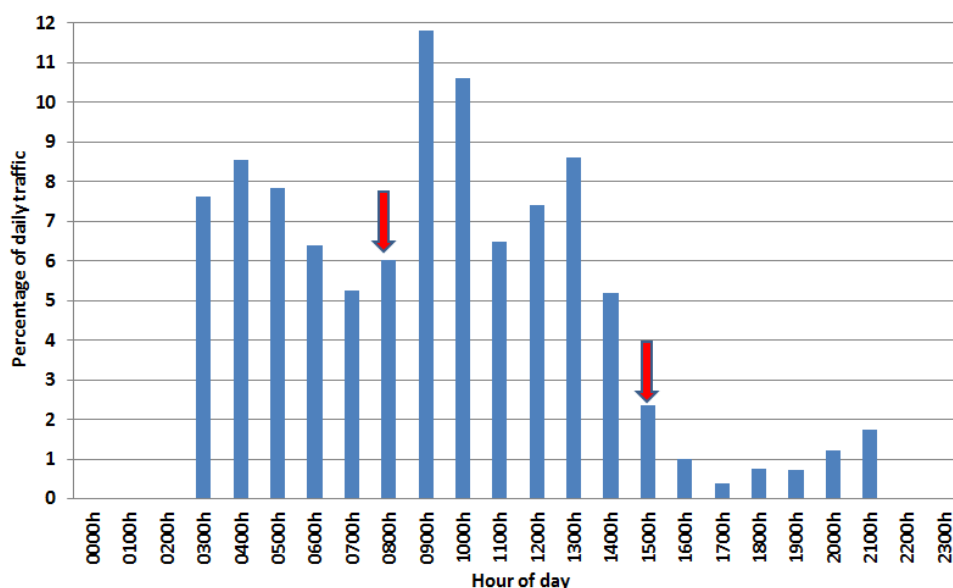


Figure 14 Hourly distribution of truck traffic at Clyde Terminal (30 July to 4 August 2012).

² As shown in Figures 11-13, the AM periods for each site varied between 0745-0900h. However, as the hourly traffic volume from the Clyde Transfer Terminal was only broken down by whole hour periods (and not by 15-minute periods), the 0800-0900h period in Figure 14 was regarded as a good representation of the common AM peak hour period pertaining to all three study intersections. Figures 11-13 also indicated that the PM peaks for each site varied between 1445-1730h. However, as seen in Figure 14, the volumes generated at Clyde for the period beyond 1600h reduce dramatically. As such, for a conservative analysis, the higher volume period of 1500-1600h was adopted.

When applying the hourly distribution data from **Figure 14** to the forecast daily truck trips in **Table 6**, there would be 26 truck movements in the AM assessment period, and 12 truck movements in the PM assessment period. This accounts for inbound and outbound trucks as it is assumed that all trucks leave the facility in the same hour that they arrived. As a conservative analysis, these figures were added to the AM and PM traffic models for all three study intersections. This was irrespective of the individual variations in peak hour as surveyed in the May 2013 SCATS surveys.

It should be noted that although the daily traffic profile (**Figure 14**) peaks at 11.8% between 0900-1000h, this would be when the commuter peak period is over and the road network would no longer be under peak traffic conditions.

3.1.2 NON-PUTRESCIBLE WASTE

When operating at full capacity (by 2020 after a five-year ramp up), of the total annual 500,000 tonnes of waste to be processed at the proposed development site, 100,000 tonnes would be non-putrescible waste. This would include waste transported from various local government areas in the SSROC to the Banksmeadow Transfer Terminal, as well as commercial waste collection vehicles. Once the waste has been sorted, the processed waste would be transported by truck to the Camellia Recycling Centre.

Table 7 provides a summary of the inbound and outbound transport logistics for non-putrescible waste.

Table 7 Traffic and transport generation associated with non-putrescible waste.

	Incoming waste collection	Outgoing bulk haulage
Annual tonnage	100,000 tonnes	100,000 tonnes
Weekly tonnage (t)	1,930 tonnes	1,930 tonnes
Days per week of operation	5.5 days	5.5 days
Truck payload (t)	2.5 tonnes/ truck	22 tonnes/ truck
Number of inbound loaded trucks per day (various source locations to Banksmeadow)	140	-
Number of outbound empty trucks/day (from Banksmeadow to various source/ destination locations)	140	-
Number of inbound unloaded trucks from Camellia Recycling Centre	-	16
Number of outbound loaded trucks to Camellia Recycling Centre	-	16
Total truck movements per day	280	32

Waste collection vehicle movements

To understand the hourly distribution of non-putrescible waste collection trucks, the traffic profile of the Port Botany Resource Recovery Facility was analysed. **Figure 15** shows the hour-by-hour distribution of truck traffic at this facility during the seven-day period from 18-24 February 2013. As seen, the relative proportion of daily truck movements that occur during the AM and PM periods assessed in this report were 7.2% and 5.7% respectively

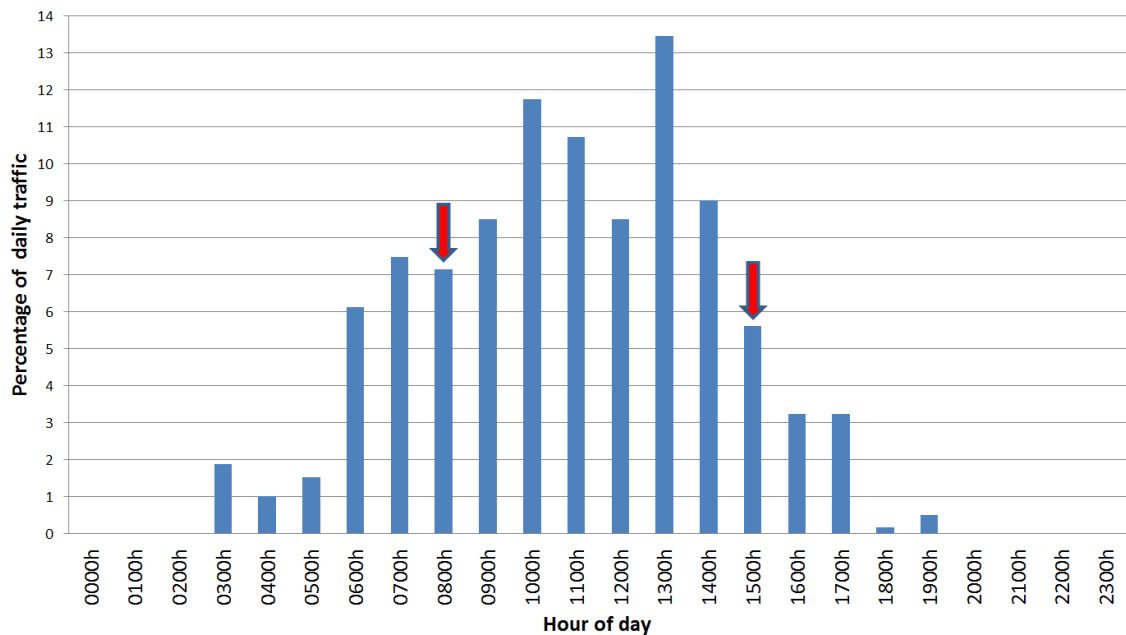


Figure 15 Hourly distribution of truck traffic at Port Botany Resource Recovery Facility (18-24 February 2013).

When applying the hourly distribution data from **Figure 15** to the forecast daily incoming waste collection truck trips in **Table 7**, there would be 22 truck movements in the AM assessment period of 0745-0845h, and 16 truck movements in the PM assessment period of 1445-1545h³. This accounts for inbound and outbound trucks as it is assumed that all trucks leave the facility in the same hour that they arrived.

It should be noted that although the daily traffic profile (**Figure 15**) peaks at 13.5% between 1300-1400h, this does not coincide with any of the commuter peak periods.

For the purposes of the traffic capacity assessment, inbound non-putrescible trucks were assumed to enter and egress from the proposed development site via the Beauchamp Road/ Perry Street/ Site Access intersection.

Bulk haulage movements

The bulk haulage runs are associated with transportation of processed non-putrescible waste to the Camellia Recycling Centre. All truck movements associated with the bulk haulage movements would be via the McPherson Street access to the proposed development site.

Veolia Environmental Services (2012) states that the Camellia Recycling Centre is open 24 hours a day and is able to receive non-putrescible waste all hours of the day. Outgoing bulk haulage of non-putrescible waste would be transported to Camellia in semi-trailers and these movements would be evenly distributed throughout the day. For a conservative analysis, it was assumed that these truck movements would be distributed throughout a 12 hour window. When applying this to the bulk haulage movements in **Table 7**, this equates to an average of 4 truck movements per hour³.

³ Figures have been rounded up to the next even number as it was assumed that each waste collection vehicle would generate an inbound and outbound movement to/from the proposed development site in the same hour. See the previous footnote regarding the explanation for the selected hour of day from the Port Botany Resource Recovery Facility.

Staff movements

The Banksmeadow Transfer Terminal would require up to 21 staff on-site during the day-shift including plant and machinery operators, salaried staff, maintenance personnel, rail operators and workplace health and safety personnel.

The Banksmeadow Transfer Terminal will also require seven staff on-site during the night shift.

This Traffic and Transport Impact Assessment has assumed that all workers will travel to work by private car as drivers (ie. no car pooling). This was to ensure a conservative approach accounting for maximum possible trip generation due to journeys to and from work.

A major advantage from a traffic impact perspective, is the scheduled shift times. Most day-shifts would commence at 0000h or 0300h and would end between 1100-1400h. Most night-shifts would commence 1100-1300h and would end between 1900-2400h. As such, none of the shift changes will occur during the AM and PM assessment periods. Therefore, no trips were added to the *build with no other development* case model in these respects.

3.2 GEOGRAPHICAL DISTRIBUTION OF TRIPS

The available access and egress routes are shown in **Figure 16**.

The following assumptions were made in distributing the trips associated with the operational phase of the Project:

- As stated in **Section 1**, inbound waste will be collected from various locations across the eastern and southern Sydney region, including areas covered by the SSROC. Areas to the east and north of the site (eg. Waverley, Woollahra, Botany, Randwick) are likely to generate truck movements from the north via Denison Street and Beauchamp Road to the north of the site. Areas to the south and west of the site (eg. Kogarah and Rockdale) as well as further to the north (eg. CBD), are likely to generate truck movements from the south via Foreshore Road and Beauchamp Road to the south of the site. Based on potential origins of waste to be received at the facility, an 80%/ 20% directional split has been assumed for south and north respectively from the Site.
- At the Botany Road/ Beauchamp Road intersection, 80% of the truck traffic generated by the Site and using this intersection were assumed to be generated by origins/ destinations to the west. The other 20% would be generated by origins/ destinations to the east.
- Empty trucks on outbound journeys are assumed to return to their origin point and vice versa.
- In the case of bulk haulage of non-putrescible waste, all semi-trailers would be loaded and would head towards Camellia Recycling Centre via Foreshore Road to access the Sydney Orbital network.

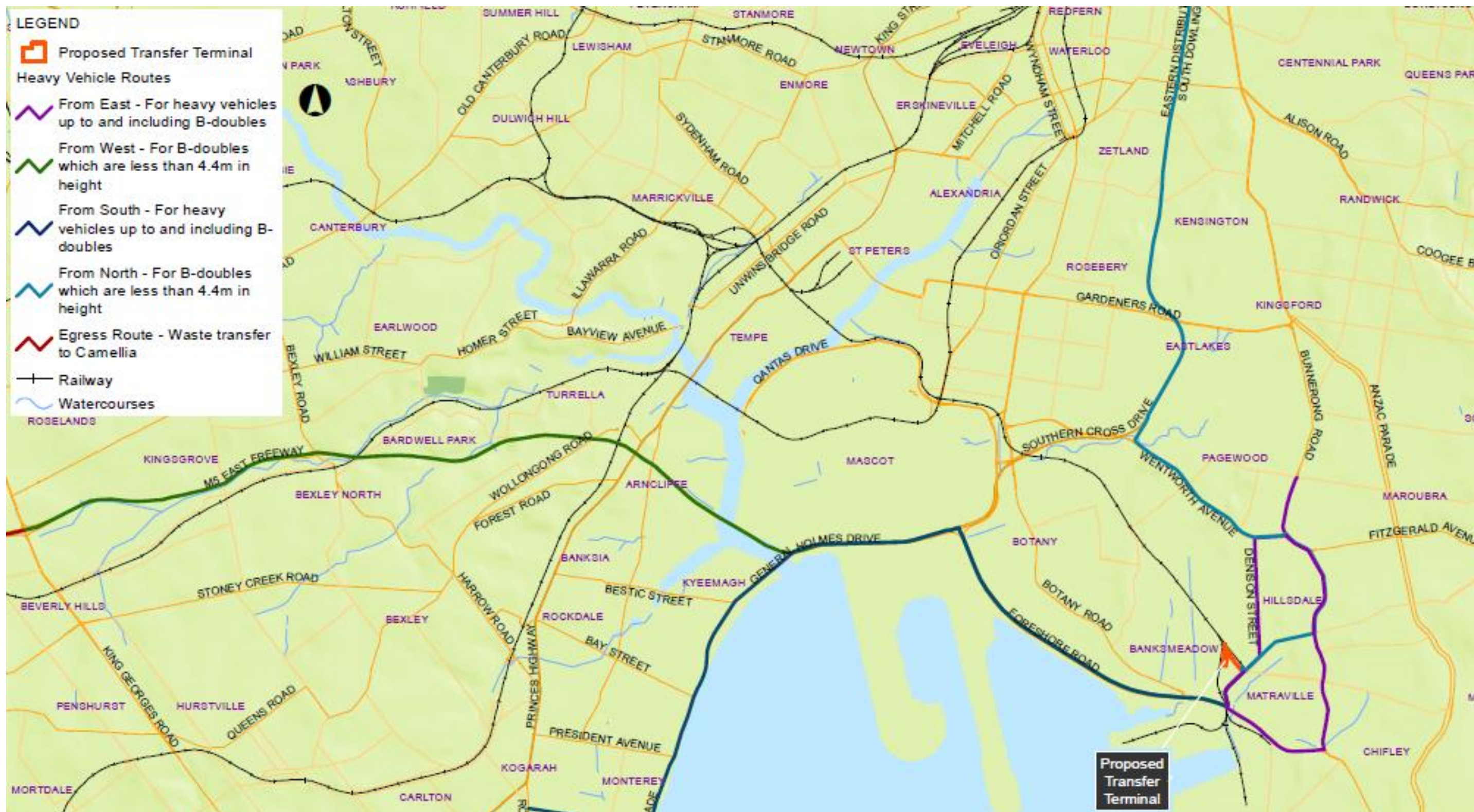


Figure 16 Available access and egress routes showing existing travel restrictions.

3.3 SUMMARY OF FORECAST TRAFFIC VOLUMES FOR FUTURE (2020) *BUILD CASE WITH NO OTHER DEVELOPMENT CASE*

The future traffic volumes for the 2020 *build with no other development* case were forecasted from the information in **Sections 3.1** and **3.2**. This accounts for the forecast traffic volume increases due to background traffic growth and the Project when operating at peak levels. **Figure 17**, **Figure 18** and **Figure 19** provide a summary of the total traffic volumes expected during the AM and PM peak hours at the three study intersections. Similar to the previous cases, SIDRA models were prepared to assess the likely traffic impacts associated with the *build with no other development* case. The total traffic volumes from these three figures were adopted as the input volumes for the models.

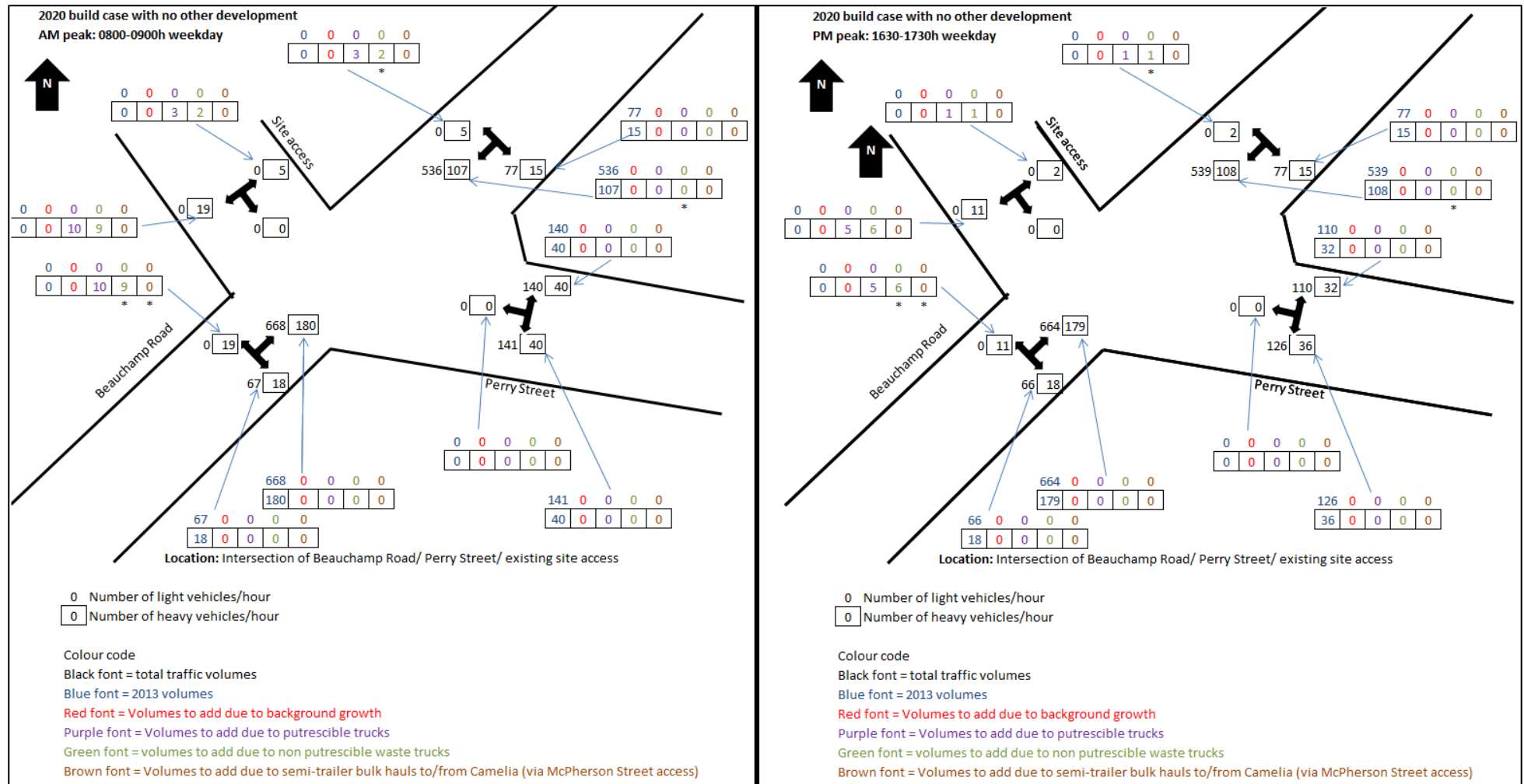


Figure 17 Derived traffic volumes due to *build with no other development* case – Beauchamp Road/ Perry Street/ Site Access intersection.

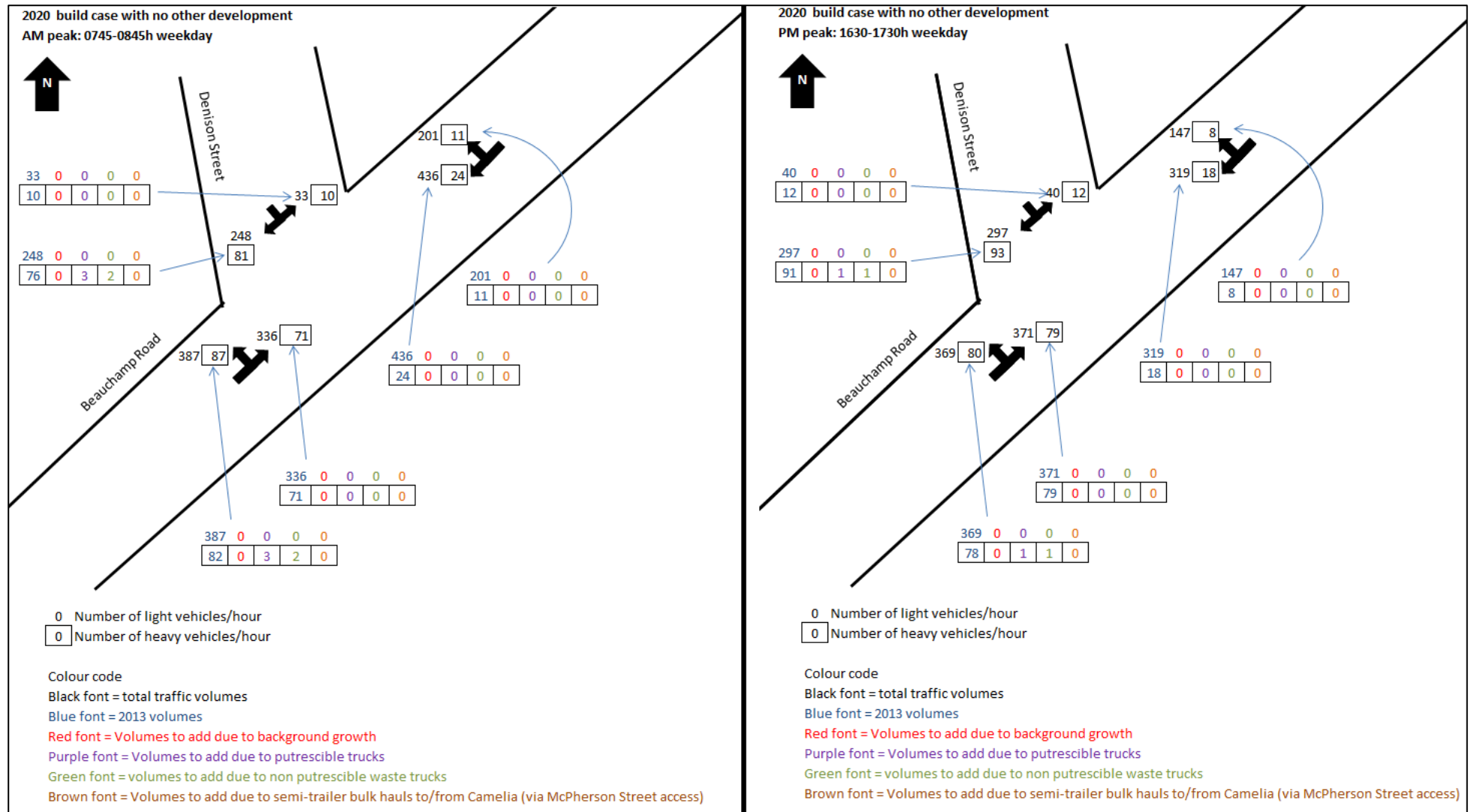


Figure 18 Derived traffic volumes due to *build with no other development* case – Beauchamp Road/ Denison Street intersection.

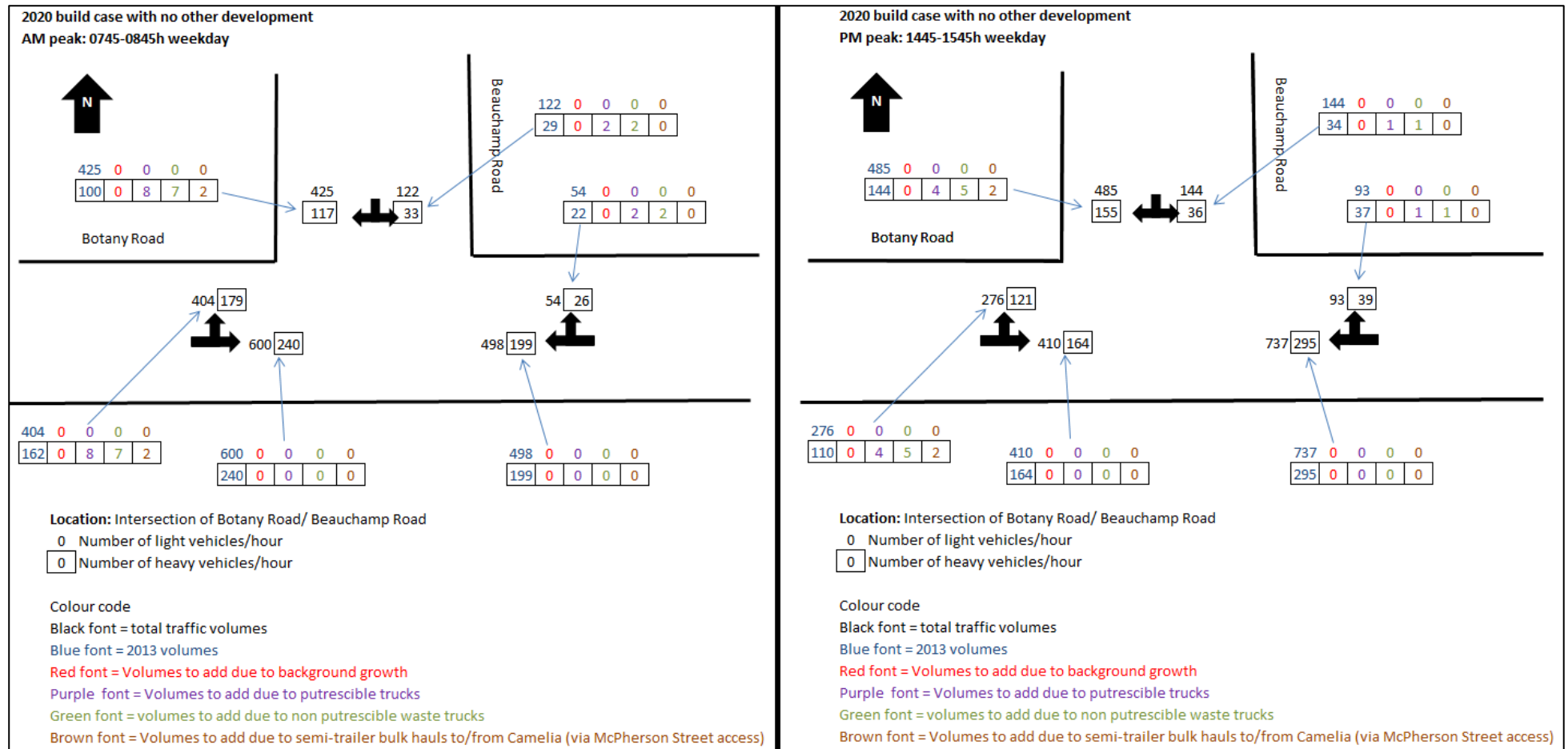


Figure 19 Derived traffic volumes due to *build with no other development* case – Botany Road/ Beauchamp Road intersection.

3.4 MODELLING RESULTS FOR *BUILD WITH NO OTHER DEVELOPMENT CASE*

Beauchamp Road/ Perry Street/ Site Access intersection

The SIDRA model outputs for the Beauchamp Road/ Perry Street/ Site Access intersection are provided in **Table 8**.

Table 8 SIDRA model outputs for the Beauchamp Road/ Perry Street/ Site Access intersection (AM and PM peak) –*build with no other development case*.

Beauchamp Road_Perry Street: 2020 build with no other development case AM peak (0800-0900h)
Signals - Fixed Time Cycle Time = 70 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South East: Perry Street (SE)											
21	L	181	22.1	0.817	42.2	LOS C	6.5	53.7	0.90	0.97	13.2
22	T	1	0.0	0.565	26.3	LOS B	5.7	47.5	0.93	0.77	31.2
23	R	180	22.2	0.565	35.3	LOS C	5.7	47.5	0.93	0.82	30.8
Approach		362	22.1	0.817	38.7	LOS C	6.5	53.7	0.91	0.89	23.2
North East: Beauchamp Road (NE)											
24	L	92	16.3	0.612	19.4	LOS B	1.4	10.8	0.57	0.82	23.5
25	T	643	16.6	0.612	7.1	LOS A	9.2	73.8	0.49	0.43	40.9
26	R	5	100.0	0.612	16.6	LOS B	9.2	73.8	0.48	1.09	33.4
Approach		740	17.2	0.612	8.7	LOS A	9.2	73.8	0.50	0.49	38.6
North West: Site access (NW)											
27	L	5	100.0	0.190	33.2	LOS C	0.7	9.5	0.83	0.73	18.3
28	T	1	0.0	0.190	24.9	LOS B	0.7	9.5	0.83	0.63	15.1
29	R	19	100.0	0.190	33.4	LOS C	0.7	9.5	0.83	0.74	18.3
Approach		25	96.0	0.190	33.0	LOS C	0.7	9.5	0.83	0.73	18.2
South West: Beauchamp Road (SW)											
30	L	19	100.0	0.273	17.2	LOS B	4.5	38.6	0.53	1.02	41.8
31	T	848	21.2	1.012	81.3	LOS F	58.3	482.2	0.86	1.52	17.5
32	R	85	21.2	1.012	120.5	LOS F	58.3	482.2	1.00	1.96	13.8
Approach		952	22.8	1.012	83.5	LOS F	58.3	482.2	0.87	1.55	17.3
All Vehicles		2079	21.5	1.012	48.5	LOS D	58.3	482.2	0.74	1.05	20.9

Beauchamp Road_Perry Street: 2020 build with no other development case PM peak (1630-1730h)
Signals - Fixed Time Cycle Time = 80 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South East: Perry Street (SE)											
21	L	162	22.2	0.842	50.0	LOS D	6.8	57.0	0.92	1.00	11.5
22	T	1	0.0	0.503	31.3	LOS C	5.2	43.0	0.93	0.76	29.1
23	R	142	22.5	0.503	40.3	LOS C	5.2	43.0	0.93	0.81	28.8
Approach		305	22.3	0.842	45.4	LOS D	6.8	57.0	0.93	0.91	20.5
North East: Beauchamp Road (NE)											
24	L	92	16.3	0.535	16.7	LOS B	1.0	8.0	0.49	0.80	25.9
25	T	647	16.7	0.535	4.4	LOS A	6.3	50.6	0.31	0.28	46.3
26	R	2	100.0	0.535	13.8	LOS A	6.3	50.6	0.30	1.16	34.9
Approach		741	16.9	0.535	6.0	LOS A	6.3	50.6	0.34	0.35	43.6
North West: Site access (NW)											
27	L	2	100.0	0.127	38.3	LOS C	0.5	6.1	0.84	0.71	16.7
28	T	1	0.0	0.127	30.0	LOS C	0.5	6.1	0.84	0.62	13.6
29	R	11	100.0	0.127	38.5	LOS C	0.5	6.1	0.84	0.72	16.7
Approach		14	92.9	0.127	37.9	LOS C	0.5	6.1	0.84	0.71	16.5
South West: Beauchamp Road (SW)											
30	L	11	100.0	0.250	16.2	LOS B	4.5	38.2	0.46	1.04	42.3
31	T	843	21.2	0.928	34.8	LOS C	38.6	319.2	0.81	0.99	28.7
32	R	84	21.4	0.928	56.1	LOS D	38.6	319.2	0.97	1.28	24.1
Approach		938	22.2	0.928	36.5	LOS C	38.6	319.2	0.82	1.01	28.3
All Vehicles		1998	20.7	0.928	26.5	LOS B	38.6	319.2	0.66	0.75	29.4

The most significant change between the 2013 *existing* case model (**Table 3**) and the *build with no other development* case (**Table 8**) is that the latter case would have a fourth leg to the intersection – the Site Access. During the traffic survey period (and hence for the *existing* case scenario), this leg was closed to traffic. Recently it was opened to traffic but only used on a limited basis.

The introduction of a fully operational fourth and western leg to the intersection would require permanent signal phasing adjustments. Moreover, the signal phasing previously allowing Perry Street traffic to enter the intersection would now need to accommodate the traffic from the Site Access as well. Under the *existing* scenario, the right-turn movement from Perry Street would be un-opposed and would have substantially higher capacity compared with the *build with no other development* scenario. Under *build with no other development* scenario, this same traffic would need to filter through the left turning traffic from the Site Access. This is a key reason for the modelled drop in performance in the Perry Street approach.

The drop in performance of the Beauchamp Road South approach is a result of the increased delays and hence queuing for the right-turn movement into Perry Street. This then affects the performance of the northbound *through* movement as this traffic shares a common lane with the right-turning traffic.

This modelling indicates that some mitigation measures would be required to restore capacity at this intersection.

Beauchamp Road/ Denison Street intersection

The SIDRA model outputs for the Beauchamp Road/ Denison Street intersection are provided in **Table 9**.

**Table 9 SIDRA model outputs for the Beauchamp Road/ Denison Street intersection (AM and PM peak)
–build with no other development case.**

Beauchamp Road_Denison Street: 2020 build with no other development case AM peak (0745-0845h)
Signals - Fixed Time Cycle Time = 97 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
North East: Beauchamp Road (NE)											
25	T	484	5.2	0.766	37.7	LOS C	17.7	129.5	0.94	0.88	28.0
26	R	223	5.2	0.766	52.8	LOS D	12.7	92.8	0.96	1.04	24.9
Approach		707	5.2	0.766	42.5	LOS C	17.7	129.5	0.95	0.93	27.0
North: Denison Street											
7	L	45	23.3	0.339	13.8	LOS A	0.6	5.2	0.37	0.67	30.1
9	R	346	24.6	0.878	65.8	LOS E	11.0	93.0	1.00	1.11	21.5
Approach		392	24.5	0.878	59.8	LOS E	11.0	93.0	0.93	1.06	21.8
South West: Beauchamp Road (SW)											
30	L	499	18.4	0.429	9.5	LOS A	2.6	20.7	0.13	0.64	34.8
31	T	428	17.4	0.870	44.0	LOS D	21.6	173.8	0.99	1.01	17.3
Approach		927	17.9	0.870	25.5	LOS B	21.6	173.8	0.53	0.81	22.0
All Vehicles		2026	14.8	0.878	38.0	LOS C	21.6	173.8	0.75	0.90	24.1

Beauchamp Road_Denison Street: 2020 build with no other development case PM peak (1630-1730h)
Signals - Fixed Time Cycle Time = 80 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
North East: Beauchamp Road (NE)											
25	T	355	5.3	0.566	29.6	LOS C	8.5	62.4	0.88	0.76	31.3
26	R	163	5.2	0.566	38.8	LOS C	7.9	58.0	0.86	0.95	29.7
Approach		518	5.3	0.566	32.5	LOS C	8.5	62.4	0.87	0.82	30.8
North: Denison Street											
7	L	55	23.1	0.377	14.0	LOS A	0.7	5.8	0.42	0.68	29.8
9	R	411	23.8	1.164	231.0	LOS F	38.1	321.2	1.00	1.93	8.1
Approach		465	23.8	1.164	205.5	LOS F	38.1	321.2	0.93	1.78	8.4
South West: Beauchamp Road (SW)											
30	L	473	17.8	0.445	11.5	LOS A	4.4	35.9	0.26	0.68	31.8
31	T	474	17.6	1.128	282.4	LOS F	67.7	545.2	1.00	2.73	3.8
Approach		946	17.7	1.128	147.1	LOS F	67.7	545.2	0.63	1.70	5.7
All Vehicles		1929	15.8	1.164	130.4	LOS F	67.7	545.2	0.77	1.49	9.8

These model outputs indicated that the Project in isolation will only have marginal impacts to the intersection with very small changes to degree of saturation, average delay, level of service and maximum queue length. The modelled intersection level of service remains at C for the AM peak and F for the PM peak which is the same as the *existing* case scenario. It should be noted that the only two movements that the Project would be contributing to are the left turn movements into and the right turn movement out of Denison Street. Furthermore, as indicated in **Figure 18**, the volumes generated by the Project would be in the order of 10 vehicles per hour. As such, the modelling indicates that this intersection is unlikely to require mitigation measures as a direct result of the Project.

Botany Road/ Beauchamp Road intersection

The SIDRA model outputs for the Botany Road/ Beauchamp Road intersection for the *build with no other development* case are provided in **Table 10**. These models indicate that there would only be marginal changes to the performance of this intersection. This is reflected in the small changes to average delay and queue lengths. Similar to the *existing* (2013) case, the modelled LoS for the intersection would remain at B. In these respects, the Project in isolation (and with no other development) is unlikely to have major impacts on this intersection and no mitigation measures are required as a direct result of the Project.

Table 10 SIDRA model outputs for the Botany Road/ Beauchamp Road intersection (AM and PM peak) – *build with no other development case.*

Botany Road_Beauchamp Road: 2020 Build with no other development case AM peak (0745-0845h)
 Signals - Fixed Time Cycle Time = 50 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Botany Road (E)											
5	T	734	28.6	0.310	7.0	LOS A	2.7	23.9	0.48	0.40	44.9
6	R	84	32.5	0.466	34.3	LOS C	2.1	18.4	0.95	0.76	17.9
Approach		818	29.0	0.466	9.8	LOS A	2.7	23.9	0.52	0.44	40.2
North: Beauchamp Road											
7	L	163	21.3	0.762	28.8	LOS C	9.1	75.4	0.90	0.91	35.4
9	R	571	21.6	0.762	29.5	LOS C	9.1	75.4	0.92	0.91	34.9
Approach		734	21.5	0.762	29.3	LOS C	9.1	75.4	0.92	0.91	35.0
West: Botany Road (W)											
10	L	614	30.7	0.399	11.2	X	X	X	X	0.71	39.8
11	T	884	28.6	0.739	21.7	LOS B	7.2	62.5	0.94	0.86	38.2
Approach		1498	29.4	0.739	17.4	LOS B	7.2	62.5	0.56	0.80	38.5
All Vehicles		3049	27.4	0.762	18.2	LOS B	9.1	75.4	0.63	0.73	37.5

Botany Road_Beauchamp Road: 2020 build with no other development case PM peak (1445-1545h)
 Signals - Fixed Time Cycle Time = 50 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Botany Road (E)											
5	T	1086	28.6	0.524	10.5	LOS A	5.7	49.5	0.66	0.57	38.3
6	R	139	29.5	0.755	37.0	LOS C	3.8	33.0	1.00	0.89	16.9
Approach		1225	28.7	0.755	13.5	LOS A	5.7	49.5	0.70	0.61	34.6
North: Beauchamp Road											
7	L	189	20.0	0.754	25.6	LOS B	9.9	83.0	0.85	0.90	37.2
9	R	674	24.2	0.754	26.5	LOS B	9.9	83.0	0.87	0.89	36.7
Approach		863	23.3	0.754	26.3	LOS B	9.9	83.0	0.87	0.89	36.8
West: Botany Road (W)											
10	L	418	30.5	0.271	11.2	X	X	X	X	0.71	39.9
11	T	604	28.6	0.673	22.9	LOS B	4.9	42.9	0.95	0.82	37.3
Approach		1022	29.4	0.673	18.1	LOS B	4.9	42.9	0.56	0.78	37.9
All Vehicles		3111	27.4	0.755	18.6	LOS B	9.9	83.0	0.70	0.74	36.5

3.5 PROPOSED MITIGATION MEASURES

As indicated in **Section 3.4**, the Project will have a direct impact on the Beauchamp Road/ Perry Street/ Site Access intersection. Furthermore, the provision of the fourth intersection approach/ departure (Site Access) and the traffic generated by this access would be a key contributor to the modelled performance of the intersection. As such, this intersection will require upgrades to address these shortcomings.

To address the identified capacity shortfalls under the *build with no other development* scenario, a modified intersection layout was tested using SIDRA. This intersection included the following capacity upgrades:

- Provision of an indented left-turn lane in the Beauchamp Road South approach to the intersection (nominal length of 60m adopted in the model).
- Banning of the through movements from the Perry Street and Site Access approaches.

The revised intersection layout is provided in **Figure 20** and the corresponding SIDRA model outputs are provided in **Table 11**.

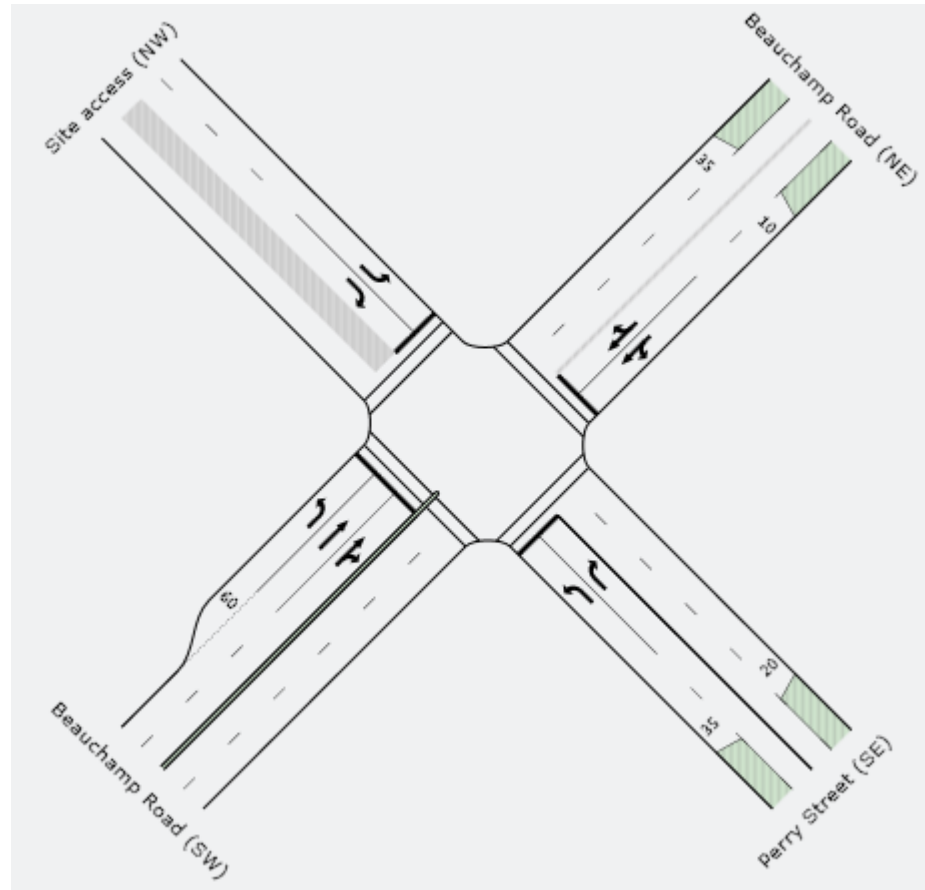
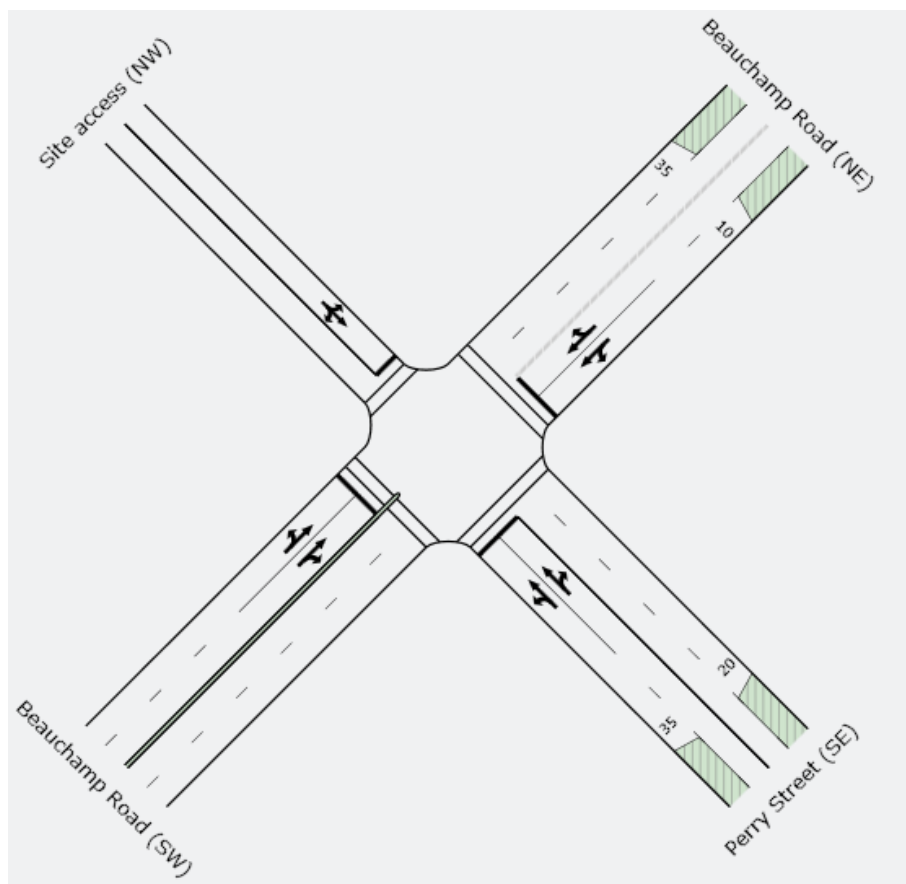


Figure 20 Left - Layout of Beauchamp Road/ Perry Street/ Site Access intersection tested in *build with no other development case* (Section 3.4); Right – Revised layout of intersection as tested in Section 3.5.

Table 11 SIDRA model outputs for the Beauchamp Road/ Perry Street/ Site Access intersection (AM and PM peak) –build with no other development case + mitigation measures.

Beauchamp Road_Perry Street: Future build with no other development case + mitigation 2020 AM peak (0800-0900h)
Signals - Fixed Time Cycle Time = 65 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South East: Perry Street (SE)											
21	L	181	22.1	0.708	31.4	LOS C	5.0	41.9	0.82	0.86	16.5
23	R	180	22.2	0.443	29.2	LOS C	4.8	39.7	0.85	0.81	33.7
Approach		361	22.2	0.708	30.3	LOS C	5.0	41.9	0.84	0.84	26.9
North East: Beauchamp Road (NE)											
24	L	92	16.3	0.716	26.6	LOS B	1.9	15.4	0.68	0.87	18.9
25	T	643	16.6	0.716	11.0	LOS A	12.7	101.7	0.67	0.62	35.3
26	R	5	100.0	0.716	20.0	LOS B	12.7	101.7	0.67	0.99	31.2
Approach		740	17.2	0.716	13.0	LOS A	12.7	101.7	0.68	0.65	33.0
North West: Site access (NW)											
27	L	5	100.0	0.015	25.4	LOS B	0.1	1.5	0.72	0.65	21.4
29	R	19	100.0	0.127	31.2	LOS C	0.5	6.8	0.82	0.71	19.0
Approach		24	100.0	0.127	30.0	LOS C	0.5	6.8	0.80	0.70	19.4
South West: Beauchamp Road (SW)											
30	L	19	100.0	0.057	18.2	LOS B	0.3	4.0	0.52	0.68	37.9
31	T	848	21.2	0.734	16.6	LOS B	16.9	139.6	0.86	0.81	38.2
32	R	85	21.2	0.734	31.6	LOS C	9.0	74.6	0.91	0.96	33.2
Approach		952	22.8	0.734	18.0	LOS B	16.9	139.6	0.86	0.82	37.7
All Vehicles		2077	21.6	0.734	18.5	LOS B	16.9	139.6	0.79	0.76	34.1

Beauchamp Road_Perry Street: Future build with no other development case + mitigation 2020 PM peak (1630-1730h)
Signals - Fixed Time Cycle Time = 70 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South East: Perry Street (SE)											
21	L	162	22.2	0.693	33.5	LOS C	4.9	40.4	0.84	0.85	15.8
23	R	142	22.5	0.374	31.3	LOS C	4.0	33.6	0.84	0.79	32.6
Approach		304	22.4	0.693	32.5	LOS C	4.9	40.4	0.84	0.83	25.3
North East: Beauchamp Road (NE)											
24	L	92	16.3	0.653	22.8	LOS B	1.6	12.6	0.62	0.82	21.0
25	T	644	16.8	0.653	8.8	LOS A	11.1	88.9	0.57	0.51	38.3
26	R	2	100.0	0.653	18.0	LOS B	11.1	88.9	0.56	1.01	32.4
Approach		738	16.9	0.653	10.6	LOS A	11.1	88.9	0.57	0.55	35.9
North West: Site access (NW)											
27	L	2	100.0	0.006	27.7	LOS B	0.0	0.6	0.73	0.63	20.4
29	R	11	100.0	0.077	33.5	LOS C	0.3	4.2	0.83	0.69	18.2
Approach		13	100.0	0.077	32.6	LOS C	0.3	4.2	0.81	0.68	18.5
South West: Beauchamp Road (SW)											
30	L	11	100.0	0.033	17.5	LOS B	0.2	2.3	0.48	0.66	38.5
31	T	843	21.2	0.681	14.1	LOS A	16.0	132.3	0.80	0.72	40.1
32	R	84	21.4	0.681	27.9	LOS B	8.6	70.9	0.85	0.92	35.1
Approach		938	22.2	0.681	15.4	LOS B	16.0	132.3	0.80	0.74	39.6
All Vehicles		1993	20.8	0.693	16.3	LOS B	16.0	132.3	0.72	0.68	35.9

The SIDRA modelling indicates that the proposed improvements would significantly reduce queuing and delays in the Perry Street and Beauchamp Road South approaches to the intersection. The LoS is also restored back to a B. As such, the proposed intersection improvements would be effective in mitigating the traffic impacts of the Project.

The proposed mitigation measures will also provide access for future land use development proposals on the land owned by Asciano Services Pty Ltd (Asciano) to the immediate north of the subject site. Both parties have worked together to ensure that the remaining portion of Asciano's Botany Site is not sterilised for any future use as well as ensuring that the design of

the shared entrance to the site caters for truck movements associated with the Proposal, as well as up to 100 future truck movements per hour on the Asciano Botany Site. Preliminary traffic modelling has indicated that the mitigation measures as discussed above will also allow for the forecast additional traffic from Asciano's operations. Under the combined traffic demands of both operations, the Beauchamp Road/ Perry Street/ Site Access Road intersection will maintain an intersection LoS of C or better and is therefore considered acceptable.

4 FUTURE (2020) NO BUILD WITH OTHER DEVELOPMENT CASE

The purpose of the future *no build with other development* case is to assess the traffic impact of other key land uses without the added traffic generation of the Project. The comparison of these assessments would enable the relative impacts of the Project to be isolated from other key land use changes. The future *no build with other development* case would need to account for traffic volume increases due to the following:

- The growth in background traffic: This would account for the general growth across the road network as a result of general population, employment and demographic changes. This is described in **Section 4.1**.
- Growth in traffic due to specific land use changes surrounding the project: Whilst traffic volumes would continue to change as per the established trends exhibited by historic growth patterns, there are also several “once-off” changes to traffic generation due to proposed land use changes. In particular, the following land use changes are regarded as significant and would lead to substantial changes in traffic generation and distribution:
 - The Port Botany Expansion Project including the recently completely, but not yet operational, third container terminal.
 - The proposed Bunnings Warehouse on Denison Street to the south of Smith Street.
 - Operational changes at Qenos, on Denison Street.

It is important to note that these developments are at a more advanced planning stage compared with the proposed transfer terminal. As such, from a chronological view point, traffic from these sites is likely to be generated before the proposed Transfer Terminal.

4.1 GROWTH IN BACKGROUND TRAFFIC TO 2020

Table 2 provides growth projections based on a traffic volume trends analysis for seven RMS counting stations in the surrounding road network. More detail on these trend analyses is provided in Appendix B.

Using the linear growth rates in the graphs in **Appendix B**, the following growth rates were determined for the background traffic:

- Beauchamp Road, north of Botany Road: Average growth rate of 2.2% per annum.
- Botany Road, east of Beauchamp Road: Average growth rate of 2.9% per annum.
- Botany Road, west of Beauchamp Road: Average growth rate of 3.0% per annum.

As such, the average growth rate across the study area is 2.7% per annum.

It should be acknowledged that traffic growth across the surrounding road network would be based on both (i) growth in *local* traffic as generated by the expansion of existing land uses or the development of new land uses, and (ii) increases in *through* traffic (or background traffic) as a result of land uses and general growth trends in the wider region. To a large extent, the foreseeable traffic growth patterns in the surrounding road network are covered by land use changes described in **Sections 4.2 to 4.4**. This is because the land uses in the Port Botany Precinct (rather than other more distant land uses) tend to be the main generators of traffic in this part of the road network. As such, it would not be appropriate to apply the 2.7% average annual growth rate as this would have included *both* local and regional traffic growth factors. As

such, a growth rate of 0.5% per annum has been adopted for this scenario for the growth in background (through) traffic.

The traffic growth as a result of the 0.5% growth per annum from 2013 to 2020 is equivalent to a multiplication factor of 0.036. As such, to determine the additional traffic volumes as a result of the growth in background traffic, all traffic volumes from **Figure 11** to **Figure 13** were multiplied by 0.036.

4.2 PORT BOTANY EXPANSION PROJECT

The Port Botany Expansion Project will be a major contributor to the growth in traffic in the surrounding road network. It is important to note that in the context of this report, and for the purposes of forecasting cumulative traffic impacts into the future, the Port Botany Expansion Project is not solely related to the recently completed third terminal. Rather, the collective involvement of all three port operators (two existing operators and the third terminal) in meeting future freight targets and demands need to be considered.

The parameters used in the traffic forecasts associated with the Port Botany Expansion Project are outlined below and were sourced by consulting relevant industry experts and references.

Existing conditions

- 2.2 million twenty foot equivalent (TEU) of containerised freight (including empty containers) are handled by the two existing Port Botany stevedores (based on extrapolated forecasts in TEU volumes for 2011 and 2016 from Maunsell (2002)). The number of sea-to-land containers and land-to-sea containers is balanced, although the land-to-sea containers contain more empty containers (since Australia is a net importer).
- From/to the Port Precinct, 14% of the containers are transported by rail and 86% are transported by road. Most rail containers will eventually be transferred to trucks but this is assumed to occur outside the geographic area influencing this study.
- The relative split between imported and exported containers, and full and empty containers is shown in **Table 12**.

Table 12 Relative breakdown in TEUs in 2013.

	Full containers (mill TEU)	Empty containers (mill TEU)	Total
Import	1.1 (0.946 by road)		1.1
Export	0.55 (0.47 by road)	0.55 (0.47 by road)	1.1
Total	1.65	0.55	2.2

- Approximately 60% of the container trade is in forty foot containers (2 TEUs) and 40% is in twenty foot containers (1 TEU). As such, the 0.946 million imported TEUs are made up of approximately 283,800 forty foot containers, and 378,000 twenty foot containers. Assuming that each truck only carries a single container, there would be 661,000 trucks needed to carry 0.946 million TEU. This equates to 1.43 TEU per loaded truck. Note that this does not account for the unloaded trucks (ie. with no container at all).
- All empty containers following delivery to the customer are returned to empty container depots at Botany Road to the west of Bumborah Point Road or Cooks River depot. 0.55 million TEUs of empty containers are exported by ship. The other 0.55 million TEU of empty containers are transported from the empty container depots to domestic exporters.
- The geographic distribution of road-based containers is 75% to locations to the west of Beauchamp Road (including the southern, south-western and western suburbs of Sydney). The other 25% would be distributed to the Beauchamp Road/ Denison Street

corridor to access South Sydney, Sydney CBD and the northern suburbs of Sydney (via Southern Cross Drive).

The existing conditions with regard to freight movements are illustrated in **Figure 21**.

Likely conditions in 2020

- 3.2 million TEU of containerised freight (including empty containers) would be handled by the three Port Botany stevedores (Maunsell (2002). Note that this is the target for 2032, but for conservative reasons and the lack of forecasts for intermediate years, it has been assumed that this will be achieved by 2020. There are proposals to further increase the operating capacity of Port Botany, circa 7 million TEUs. However, this has not been considered in this report as it is highly likely that this will require a suite of network-wide rail improvements including loading facilities, road and rail network capacity and in-land intermodal capacity.
- The number of sea-to-land containers and land-to-sea containers is balanced, although the land-to-sea containers contain more empty containers (since Australia is likely to remain a net importer).
- From/to the Port Precinct, 30% of the containers are transported by rail and 70% are transported by road. Most rail containers will eventually be transferred to trucks but this is assumed to occur outside the geographic area influencing this study.
- The relative split between imported and exported containers, and full and empty containers is shown in **Table 13**.

Table 13 Relative breakdown in TEUs in 2020.

	Full containers (mill TEU)	Empty containers (mill TEU)	Total
Import	1.6 (1.12 by road)		1.6
Export	0.8 (0.56 by road)	0.8 (0.56 by road)	1.6
Total	2.4	0.8	3.2

- The number of TEU per loaded truck would increase to 1.6. Note that this does not account for the unloaded trucks (ie. with no container at all).
- All empty containers following delivery to the customer are returned to empty container depots at Botany Road to the west of Bumborah Point Road or Cooks River depot. 0.8 million TEUs of empty containers are exported by ship. The other 0.8 million TEU of empty containers are transported from the empty container depots to domestic exporters.
- The geographic distribution of road-based containers is 75% to locations to the west of Beauchamp Road (including the southern, south-western and western suburbs of Sydney). The other 25% would be distributed to the Beauchamp Road/ Denison Street corridor to access South Sydney, Sydney CBD and the northern suburbs of Sydney (via Southern Cross Drive).

The likely conditions in 2020 with regard to freight movements are illustrated in **Figure 22**.

The relative difference in forecast traffic volumes in **Figure 21** and **Figure 22** would constitute the likely growth in traffic as a result of the port expansion. **Figure 23** shows the likely changes in traffic volumes entering the three study intersections of Botany Road/ Beauchamp Road, Beauchamp Road/ Perry Street, and Beauchamp Road/ Denison Street. Growth figures have been provided on an annual basis, daily basis, and for the respective peak hour. The following assumptions were used in this analysis:

- It was conservatively assumed that there would be 330 days per year when the port would operate and generate truck movements.

- The 24h traffic profile at the Beauchamp Road intersections with Botany Road, Perry Street and Denison Street was used to inform the percentage of daily traffic that would make up the AM and PM peaks. This analysis indicated that the AM and PM peaks would constitute between 6.6 - 7.8% of the total daily traffic. As such, this study adopted an 8% rate for converting daily traffic to peak hourly movements.

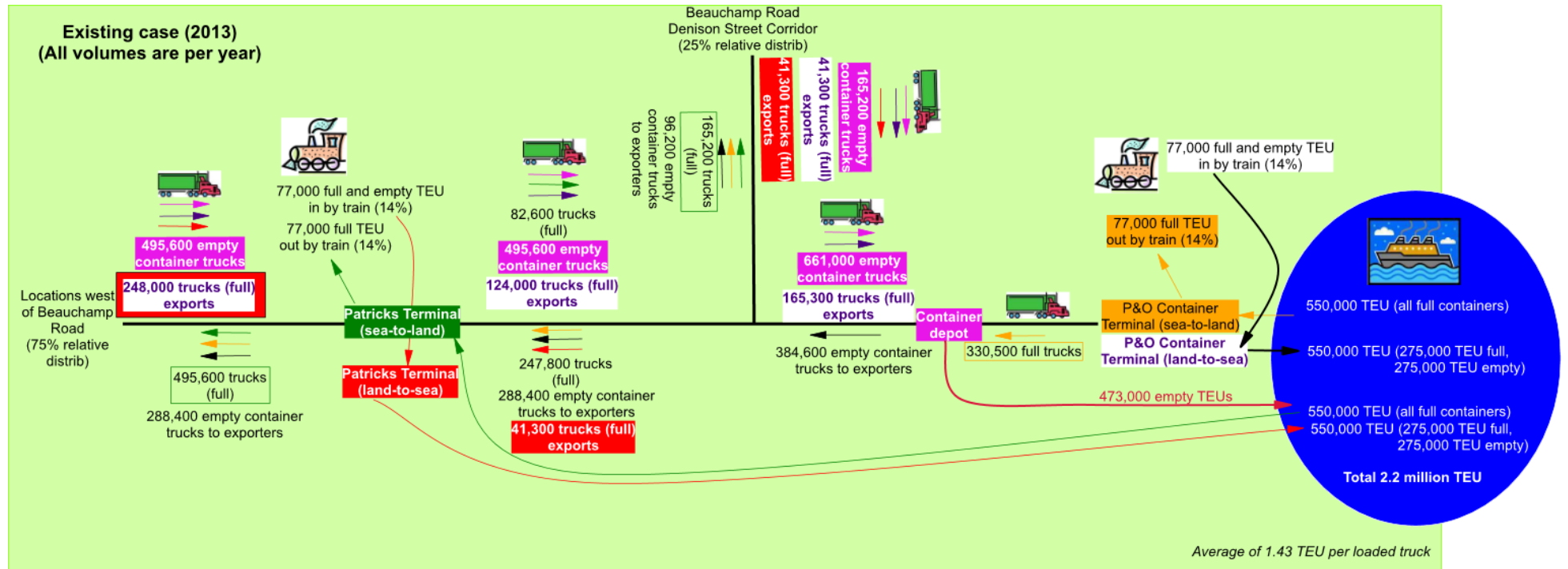


Figure 21 Summary of existing container-related movements (2013).

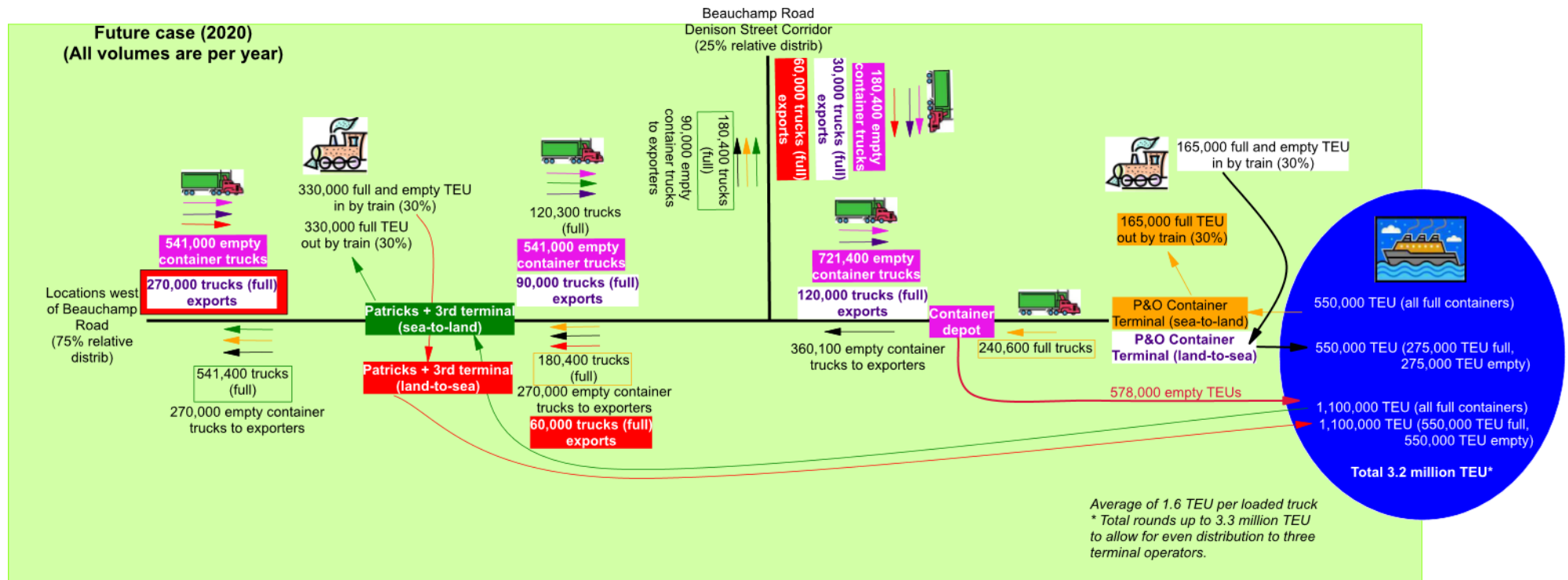


Figure 22 Summary of future container-related movements (2020).

Additional traffic volumes due to Port expansion

(These are volumes to be
added to existing volumes)

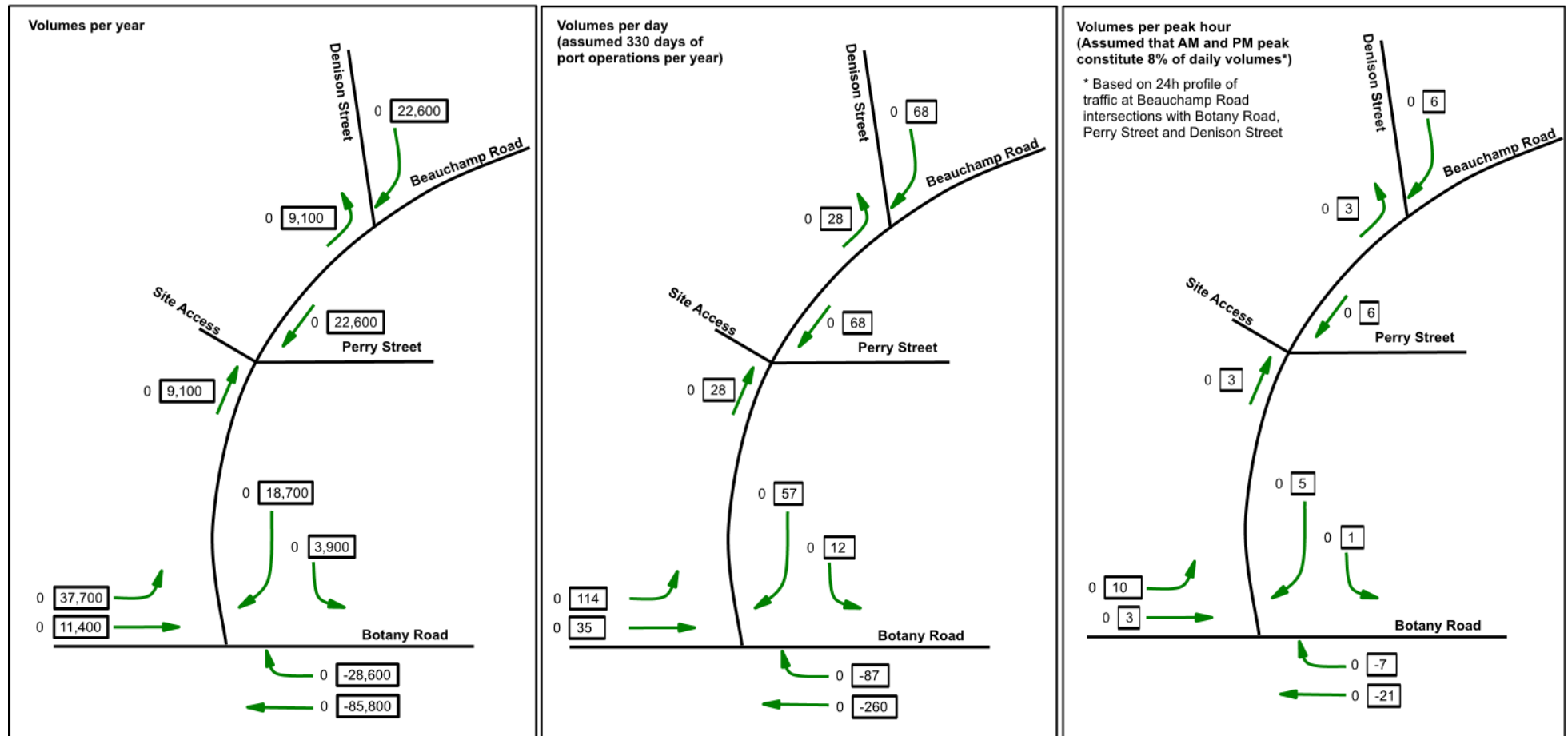


Figure 23 Derivation of additional traffic volumes to add to 2020 models *with other development* as a result of the Port Expansion.

4.3 BUNNINGS WAREHOUSE

A new Bunnings Warehouse is proposed to be developed on the eastern side of Denison Street to the south of Smith Street, Hillsdale. At the time of writing this report, this proposal was at Development Application stage and being reviewed by the Sydney East Joint Regional Planning Panel. *Transport and Traffic Planning Associates* (2012) provided details of the potential traffic generation associated with the warehouse. That report indicated the following:

- During the AM peak, 254 trips would be generated by the development, consisting of 154 inbound trips and 100 outbound trips.
- During the PM peak, 391 trips would be generated by the development, consisting of 171 inbound trips and 220 outbound trips.
- 80% of the trips would be distributed to the north and hence would not use the three study intersections along Beauchamp Road. The other 20% would be distributed to the south of the development. Although not stated in that report, it has been assumed that 15% of the traffic would be distributed to Foreshore Road and beyond, and 5% would be distributed to Beauchamp Road to the east of Denison Street. The assumed low percentage distribution to Beauchamp Road East is supported by *McLaren Traffic Engineering's* report (2012) which indicates that a high proportion of traffic from the east would use local roads in Hillsdale to access Bunnerong Road.

Figure 24 summarises the traffic generation and distribution forecasts from *Transport and Traffic Planning Associates' report*.

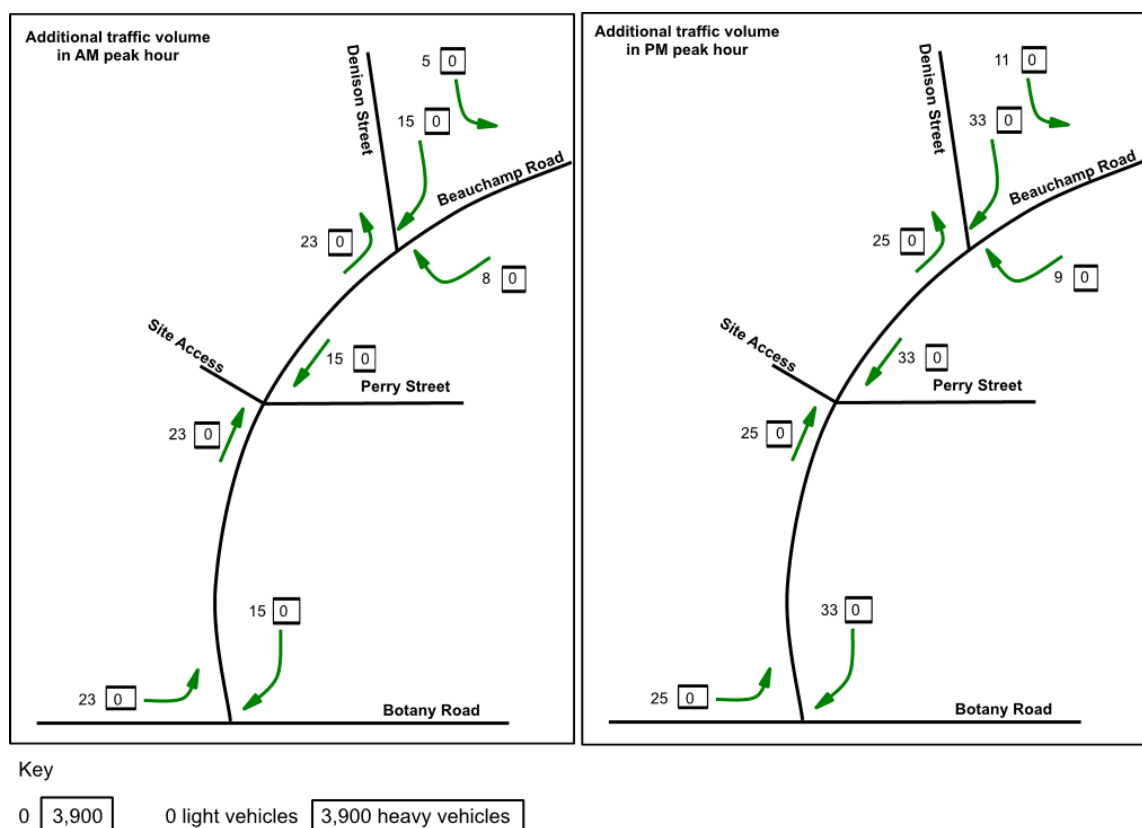


Figure 24 AM and PM traffic generation and distribution due to the proposed Bunnings development.

4.4 QENOS

Qenos is the sole manufacturer and supplier of polyethylene products in Australia with operations in the Botany Industrial Park bounded by Beauchamp Road, Denison Street and Wentworth Avenue. On 28 August 2012, the NSW Government granted approval for DA 35/97 MOD 2, a modification that will involve Qenos:

- Constructing and operating a proposed Hydrogen unloading bay; and
- Contemporising various reporting requirements.

Aecom (2012) stated that the Modification would result in 133 additional truck movements per year associated with the delivery of hydrogen. This equates to less than 0.4 truck movements per day. In these respects, this Traffic and Transport Impact Assessment has not included any additional truck movements associated with Qenos' Modification Request.

4.5 SUMMARY OF FORECAST TRAFFIC VOLUMES FOR FUTURE (2020) *NO BUILD WITH OTHER DEVELOPMENT CASE*

The future traffic volumes for the *2020 no build with other development* case were forecasted from the information in **Sections 4.1 to 4.4**. This accounts for forecast traffic volume increases due to background traffic growth, the Port Botany Expansion Project and Bunnings. **Figure 25**, **Figure 26** and **Figure 27** provide a summary of the total traffic volumes expected during the AM and PM peak hours at the three study intersections.

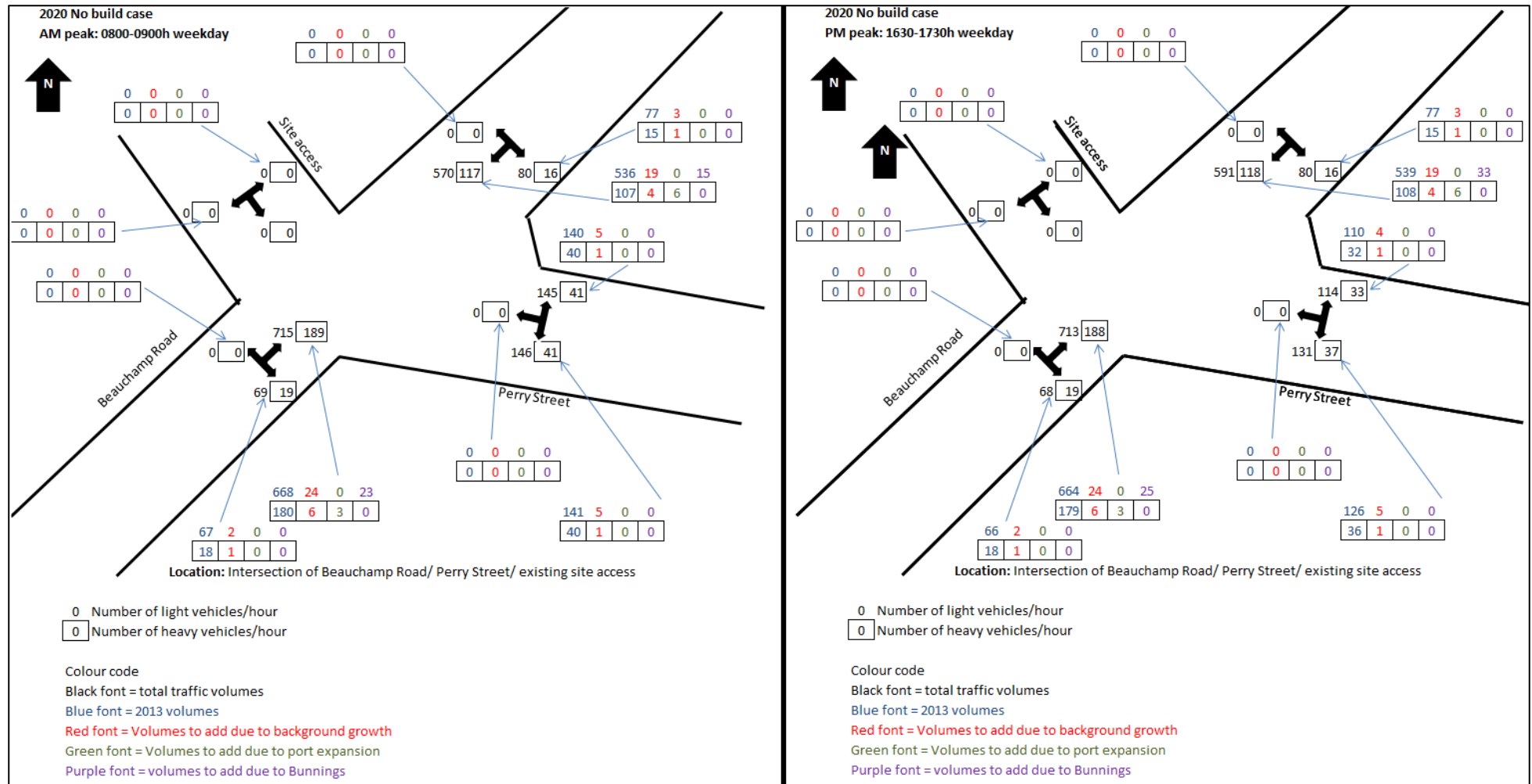


Figure 25 Derived traffic volumes due to future 2020 *no build with other development* case –Beauchamp Road/ Perry Street/ Site Access intersection.

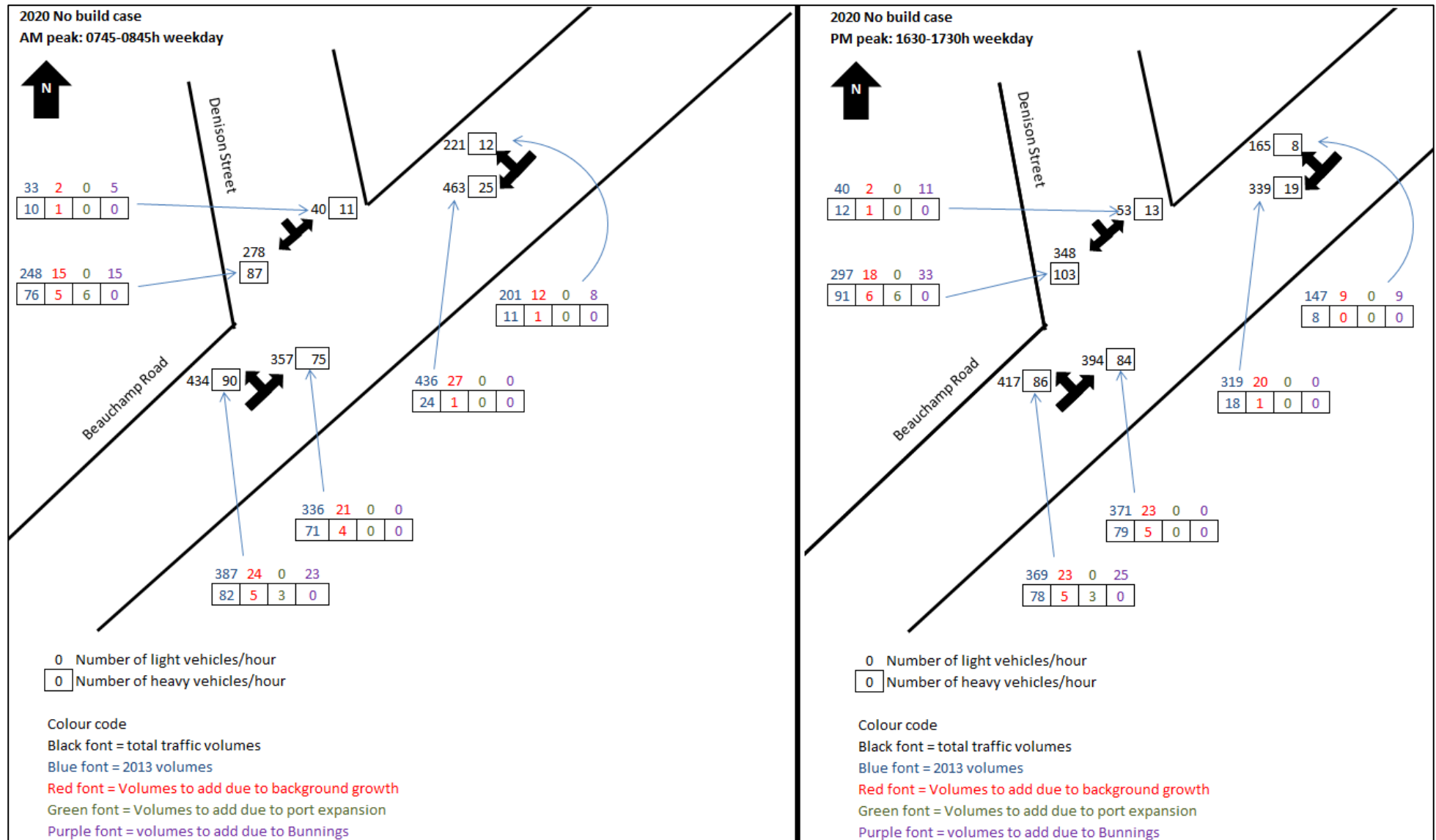


Figure 26 Derived traffic volumes due to future 2020 no build with other development case –Beauchamp Road/ Denison Street intersection.

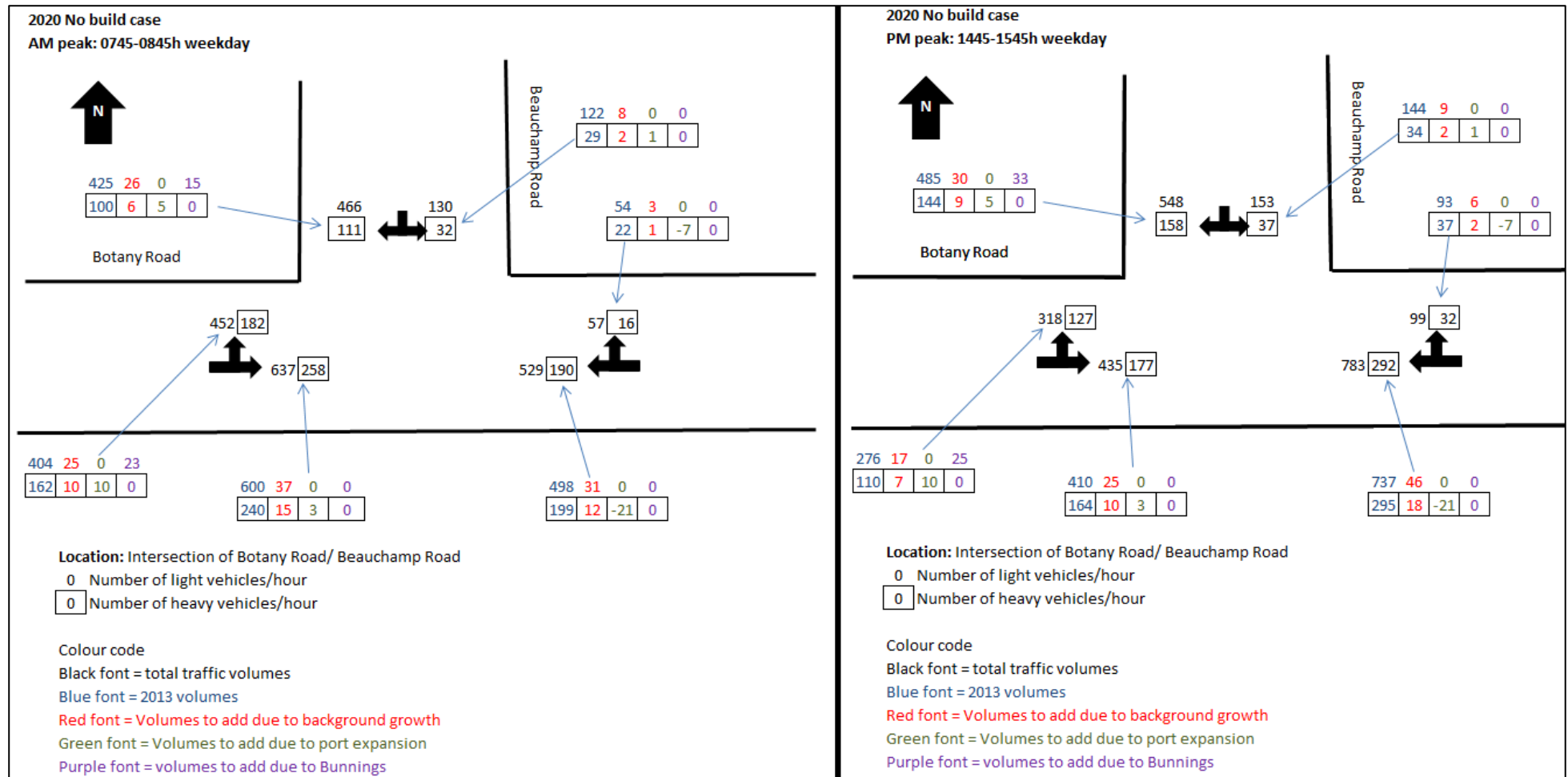


Figure 27 Derived traffic volumes due to future 2020 *no build with other development* case – Botany Road/ Beauchamp Road intersection.

4.6 MODELLING RESULTS FOR FUTURE (2020) NO BUILD WITH OTHER DEVELOPMENT CASE

The forecast traffic volumes due to the no build with other development case as reflected in **Figure 25**, **Figure 26** and **Figure 27** for the AM and PM peak periods were inputted into SIDRA models. The results of the modelling are described below.

Beauchamp Road/ Perry Street intersection

It should be noted that under the *no build with other development* case, this intersection would still operate primarily with three active intersection legs. The fourth leg from the proposed site would not be opened to traffic and only used on a limited basis. As such, the SIDRA models have adopted the same T intersection configuration as the *existing* case models.

The SIDRA model outputs for the Beauchamp Road/ Perry Street intersection for the *no build with other development* case are presented in **Table 14**. The model outputs indicate that under this scenario, this intersection would perform satisfactorily with modelled LoS of A and B and average delays less than 15 seconds/vehicle. This supports the earlier finding (Sections 3.5 and 3.6) that the intersection capacity upgrades required at this intersection are more attributable to the proposed Transfer Terminal rather than other land use developments.

Table 14 SIDRA model outputs for the Beauchamp Road/ Perry Street intersection (AM and PM peak) – Future *no build with other development* case.

Beauchamp Road_Perry Street: 2020 no build with other development AM peak (0800-0900)
Signals - Fixed Time Cycle Time = 60 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South East: Perry Street (SE)											
21	L	197	21.9	0.745	32.5	LOS C	5.5	45.4	0.86	0.90	16.1
23	R	196	22.0	0.426	28.5	LOS C	4.8	40.4	0.86	0.80	34.0
Approach		393	22.0	0.745	30.5	LOS C	5.5	45.4	0.86	0.85	26.8
North East: Beauchamp Road NE											
24	L	101	16.7	0.516	15.9	LOS B	4.4	35.4	0.45	0.90	27.4
25	T	723	17.0	0.516	7.5	LOS A	6.8	54.3	0.50	0.43	42.4
Approach		824	17.0	0.516	8.5	LOS A	6.8	54.3	0.49	0.49	40.9
South West: Beauchamp Road (SW)											
31	T	952	20.9	0.773	12.7	LOS A	14.9	122.9	0.73	0.72	41.5
32	R	93	21.6	0.773	25.3	LOS B	9.0	74.4	0.78	0.99	36.7
Approach		1044	21.0	0.773	13.8	LOS A	14.9	122.9	0.74	0.74	41.0
All Vehicles		2261	19.7	0.773	14.8	LOS B	14.9	122.9	0.67	0.67	38.0

Beauchamp Road_Perry Street: 2020 no build with other development case PM peak (1630-1730)
Signals - Fixed Time Cycle Time = 65 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South East: Perry Street (SE)											
21	L	177	22.0	0.735	34.7	LOS C	5.3	44.1	0.87	0.89	15.3
23	R	155	22.4	0.366	30.8	LOS C	4.1	34.6	0.86	0.79	32.9
Approach		332	22.2	0.735	32.9	LOS C	5.3	44.1	0.87	0.85	25.1
North East: Beauchamp Road NE											
24	L	101	16.7	0.497	14.7	LOS B	4.1	32.9	0.38	0.91	28.4
25	T	746	16.6	0.497	6.3	LOS A	6.4	51.6	0.42	0.37	44.5
Approach		847	16.6	0.497	7.3	LOS A	6.4	51.6	0.42	0.43	42.9
South West: Beauchamp Road (SW)											
31	T	948	20.9	0.736	9.9	LOS A	13.4	110.5	0.64	0.60	44.3
32	R	92	21.8	0.736	22.5	LOS B	7.9	65.4	0.69	0.96	38.4
Approach		1040	21.0	0.736	11.0	LOS A	13.4	110.5	0.64	0.63	43.7
All Vehicles		2219	19.5	0.736	12.9	LOS A	13.4	110.5	0.59	0.59	39.9

Beauchamp Road/ Denison Street intersection

The SIDRA model outputs for the Beauchamp Road/ Denison Street intersection for the *no build with other development* case are presented in **Table 15**.

Table 15 SIDRA model outputs for the Beauchamp Road/ Denison Street intersection (AM and PM peak) – Future *no build with other development* case.

Beauchamp Road_Denison Street: 2020 no build with other development case AM peak (0745-0845h)
Signals - Fixed Time Cycle Time = 90 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
North East: Beauchamp Road (NE)											
25	T	514	5.1	0.884	45.6	LOS D	19.1	139.9	1.00	1.06	25.3
26	R	245	5.2	0.884	57.1	LOS E	15.8	115.8	1.00	1.15	23.9
Approach		759	5.1	0.884	49.3	LOS D	19.1	139.9	1.00	1.09	24.8
North: Denison Street											
7	L	54	21.6	0.393	14.1	LOS A	0.7	6.1	0.40	0.67	29.7
9	R	384	23.8	1.124	197.9	LOS F	32.8	276.2	1.00	1.69	9.3
Approach		438	23.6	1.124	175.3	LOS F	32.8	276.2	0.93	1.56	9.6
South West: Beauchamp Road (SW)											
30	L	552	17.2	0.487	10.5	LOS A	4.1	33.2	0.21	0.66	33.1
31	T	455	17.4	1.101	241.4	LOS F	60.1	483.2	1.00	2.36	4.4
Approach		1006	17.3	1.101	114.8	LOS F	60.1	483.2	0.56	1.43	7.0
All Vehicles		2203	14.3	1.124	104.3	LOS F	60.1	483.2	0.79	1.34	11.9

Beauchamp Road_Denison Street: 2020 no build with other development case PM peak (1630-1730h)
Signals - Fixed Time Cycle Time = 80 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
North East: Beauchamp Road (NE)											
25	T	377	5.3	1.055	161.1	LOS F	36.7	268.4	1.00	1.90	10.9
26	R	182	4.6	1.061	178.4	LOS F	17.6	128.1	0.96	1.51	10.2
Approach		559	5.1	1.061	166.8	LOS F	36.7	268.4	0.99	1.78	10.6
North: Denison Street											
7	L	69	19.7	0.399	12.7	LOS A	0.7	6.1	0.37	0.68	31.3
9	R	475	22.8	1.510	619.7	LOS F	93.6	783.2	1.00	3.15	3.3
Approach		544	22.4	1.510	542.2	LOS F	93.6	783.2	0.92	2.83	3.5
South West: Beauchamp Road (SW)											
30	L	529	17.1	0.497	11.6	LOS A	5.4	43.0	0.28	0.68	31.6
31	T	503	17.6	1.518	978.2	LOS F	162.6	1309.4	1.00	5.33	1.2
Approach		1033	17.3	1.518	482.6	LOS F	162.6	1309.4	0.63	2.95	1.9
All Vehicles		2136	15.4	1.518	415.1	LOS F	162.6	1309.4	0.80	2.61	3.5

The model results in **Table 15** indicate that this intersection is likely to fail in the AM and PM peak periods of this scenario. This is indicated by the modelled LoS of F, and the modelled delays between 100-420 seconds/ vehicle. These impacts would be experienced as a result of traffic volumes generated by background traffic growth and other known developments including the Port Botany Expansion Project and Bunnings. It should also be noted that these developments are at a more advanced planning phase and hence “precede” the proposed Transfer Terminal in those respects.

As these shortcomings are demonstrably more attributable to other land use developments that will precede the proposed Transfer Terminal, no mitigation measures have been proposed.

Botany Road/ Beauchamp Road

The SIDRA model outputs for the Botany Road/ Beauchamp Road intersection for the *no build with other development* case are presented in **Table 16**.

Table 16 SIDRA model outputs for the Botany Road/ Beauchamp Road intersection (AM and PM peak) – Future *no build with other development* case.

Botany Road_Beauchamp Road: 2020 No build with other development case AM peak (0745-0845h)
Signals - Fixed Time Cycle Time = 55 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Botany Road (E)											
5	T	757	26.4	0.321	8.0	LOS A	3.2	27.4	0.49	0.42	43.1
6	R	77	21.9	0.439	36.7	LOS C	2.1	17.2	0.95	0.76	16.9
Approach		834	26.0	0.439	10.6	LOS A	3.2	27.4	0.53	0.45	38.9
North: Beauchamp Road											
7	L	171	19.8	0.730	27.9	LOS B	9.7	79.2	0.87	0.88	35.8
9	R	607	19.2	0.730	28.6	LOS C	9.7	79.2	0.88	0.88	35.3
Approach		778	19.4	0.730	28.5	LOS B	9.7	79.2	0.88	0.88	35.4
West: Botany Road (W)											
10	L	667	28.7	0.429	11.1	X	X	X	X	0.71	39.8
11	T	942	28.8	0.743	23.1	LOS B	8.3	72.2	0.94	0.86	37.3
Approach		1609	28.8	0.743	18.1	LOS B	8.3	72.2	0.55	0.79	37.8
All Vehicles		3221	25.8	0.743	18.7	LOS B	9.7	79.2	0.62	0.72	37.2

Botany Road_Beauchamp Road: 2020 no build with other development case PM peak (1445-1545h)
Signals - Fixed Time Cycle Time = 50 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Botany Road (E)											
5	T	1132	27.2	0.569	11.6	LOS A	6.4	55.1	0.71	0.61	36.6
6	R	138	24.4	0.727	36.2	LOS C	3.7	31.1	1.00	0.87	17.1
Approach		1269	26.9	0.727	14.3	LOS A	6.4	55.1	0.74	0.64	33.5
North: Beauchamp Road											
7	L	200	19.5	0.774	25.4	LOS B	10.9	90.5	0.85	0.91	37.3
9	R	743	22.4	0.774	26.1	LOS B	10.9	90.5	0.87	0.91	36.8
Approach		943	21.8	0.774	26.0	LOS B	10.9	90.5	0.87	0.91	36.9
West: Botany Road (W)											
10	L	468	28.5	0.301	11.1	X	X	X	X	0.71	39.9
11	T	644	28.9	0.809	26.6	LOS B	5.8	51.0	1.00	0.94	34.9
Approach		1113	28.8	0.809	20.1	LOS B	5.8	51.0	0.58	0.84	36.0
All Vehicles		3325	26.1	0.809	19.5	LOS B	10.9	90.5	0.72	0.78	35.7

The modelling results in **Table 16** indicate that this intersection will perform satisfactorily in the AM and PM peak periods of this scenario. There are marginal changes in modelled outputs of this table compared with the *existing* case model in **Table 5** as well as to the future *build with no other development* case in **Table 10**.

5 FUTURE *BUILD WITH OTHER DEVELOPMENT* CASE

The future *build with other development* case considers the cumulative impact of the Project along with background traffic growth and the anticipated growth in traffic due to major land use changes. This assessment includes consideration of the traffic impacts during the construction (**Section 5.1**) and operational (**Section 5.2**) phases of the Project.

5.1 TRAFFIC GENERATION DURING CONSTRUCTION

The construction phase of the Project is likely to generate the following traffic movements (figures include both inbound and outbound movements):

Site preparation

- Site establishment – 10 truck movements/ day over a two-week period.
- Demolition – 60 truck movements/ day over an 18-week period.
- Clearing and grubbing – 60 truck movements/ day over a four-day period.
- Contamination removal – 4 truck movements.

Earthworks, drainage and utilities

- Bulk earthworks - 80 truck movements/ day over a 12-week period.
- Stormwater drainage – 100 truck movements/day over a two-week period.
- Utilities – 16 truck movements/ day over a two-week period.

Pavement and terminal building construction

- Pavement – 60 truck movements/ day over a four-week period.
- Building slab – 40 truck movements/ day over a four-week period.
- Construction of transfer terminal – 14 truck movements/ day over a 12-week period.

Rail construction

- Rail link – 20 truck movements/ day over an eight-week period.

It should be noted that most of these construction items will not occur simultaneously. For example, in the *pavement and terminal building construction* phase, the road pavement would tend to be constructed first as this would then provide a formalised access for the rest of the construction vehicles entering and egressing from the site. The building slab would need to be constructed prior to the transfer terminal. As such, most of the vehicle movements associated with each of these construction items will not coincide.

The items with the most potential overlap would be the *demolition* and *clearing/grubbing* activities. This could generate up to 120 truck movements per day if both activities peak at the same time. As such, this has been adopted as the highest-case traffic generation potential of the site during the construction phase.

Assuming a 10-hour construction window per day, the 120 truck movements would equate to 12 truck movements per hour. This would consist of six inbound trucks and six outbound trucks. If evenly distributed by time, this would equate to one inbound truck and one outbound truck every 10 minutes.

A 50%/50% distributional split was assumed for the construction truck traffic. **Figure 28**, shows the traffic generation potential of the construction phase during the AM and PM assessment periods. The relatively low number of truck movements generated would have a marginal impact on existing traffic volumes and intersection performance. The low numbers of truck movements would be easily absorbed into the existing road network, especially if these were evenly distributed by time. As such, this scenario was not modelled.

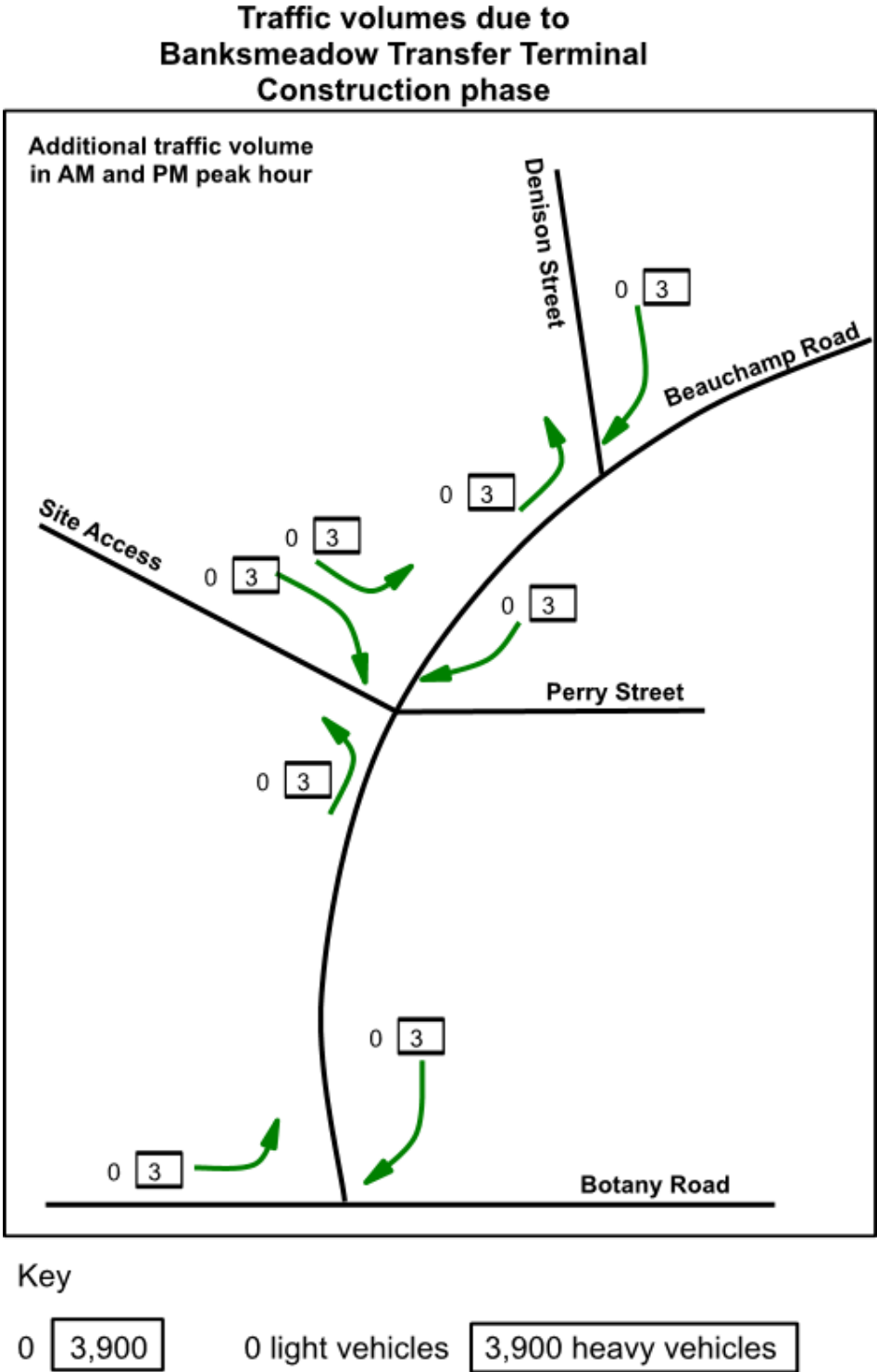


Figure 28 Traffic generation during the construction phase for AM and PM assessment periods (based on an adopted highest-case generation rate of 120 truck movements per day).

5.2 TRAFFIC IMPLICATIONS OF THE *BUILD WITH OTHER DEVELOPMENT CASE*

The traffic generation and distribution effects of the operational phase of the Project were discussed in **Sections 3.1** and **3.2** respectively.

The future *build with other development* case would need to account for traffic volume increases due to the following:

- The growth in background traffic: As discussed in **Section 4.1**, a growth rate of 0.5% per annum was adopted for the purpose of forecasting changes to traffic volumes across the surrounding road network. This equates to a multiplier of 0.036 for the seven-year period between 2013 and 2020.
- Growth in traffic due to major land use changes surrounding the project. These were described in Sections 4.2 to 4.4.
- Traffic generated by the Project as described in **Sections 3.1** and **3.2**.

Figure 29, **Figure 30** and **Figure 31** provide a summary of the traffic volume build ups for this scenario.

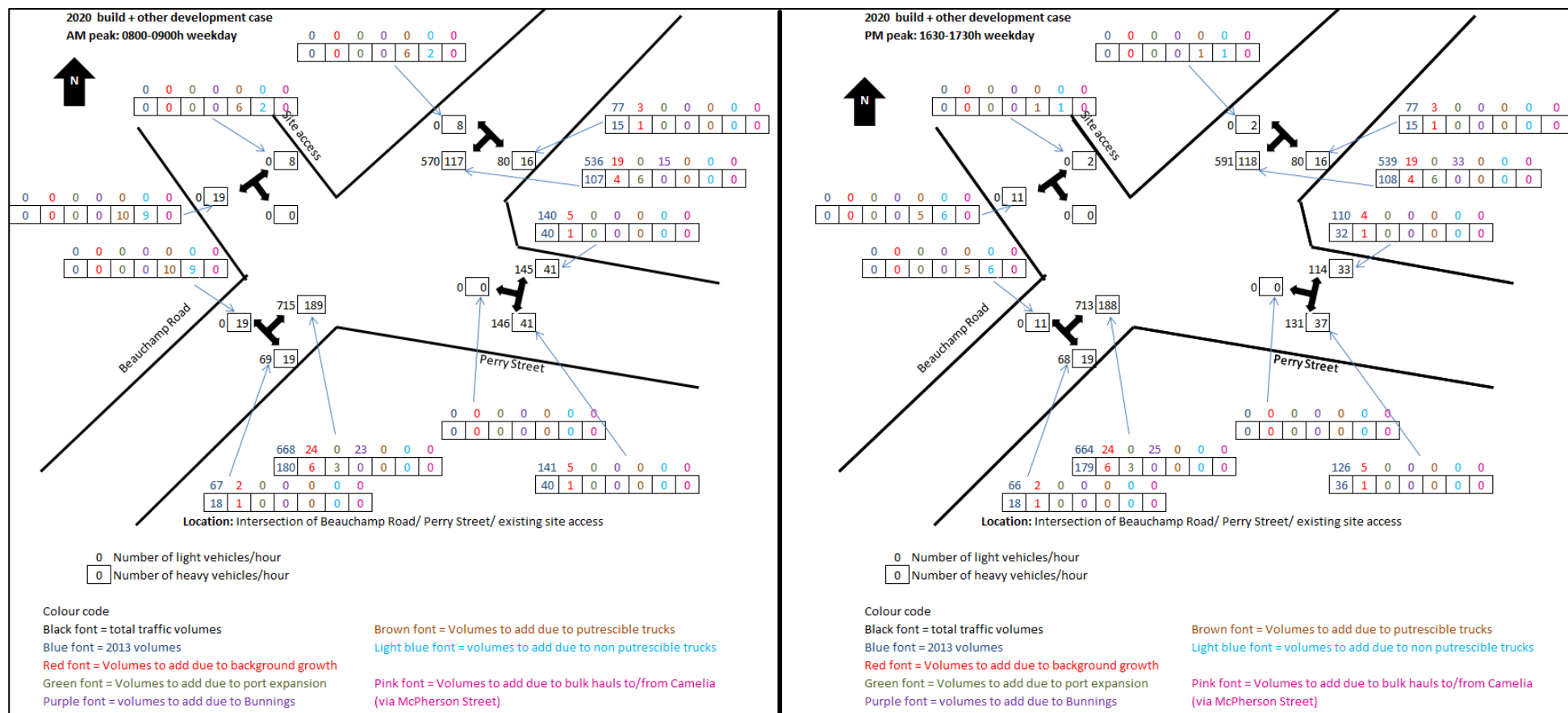


Figure 29 Derived traffic volumes due to future *build with other development case* –Beauchamp Road/ Perry Street/ Site Access intersection.

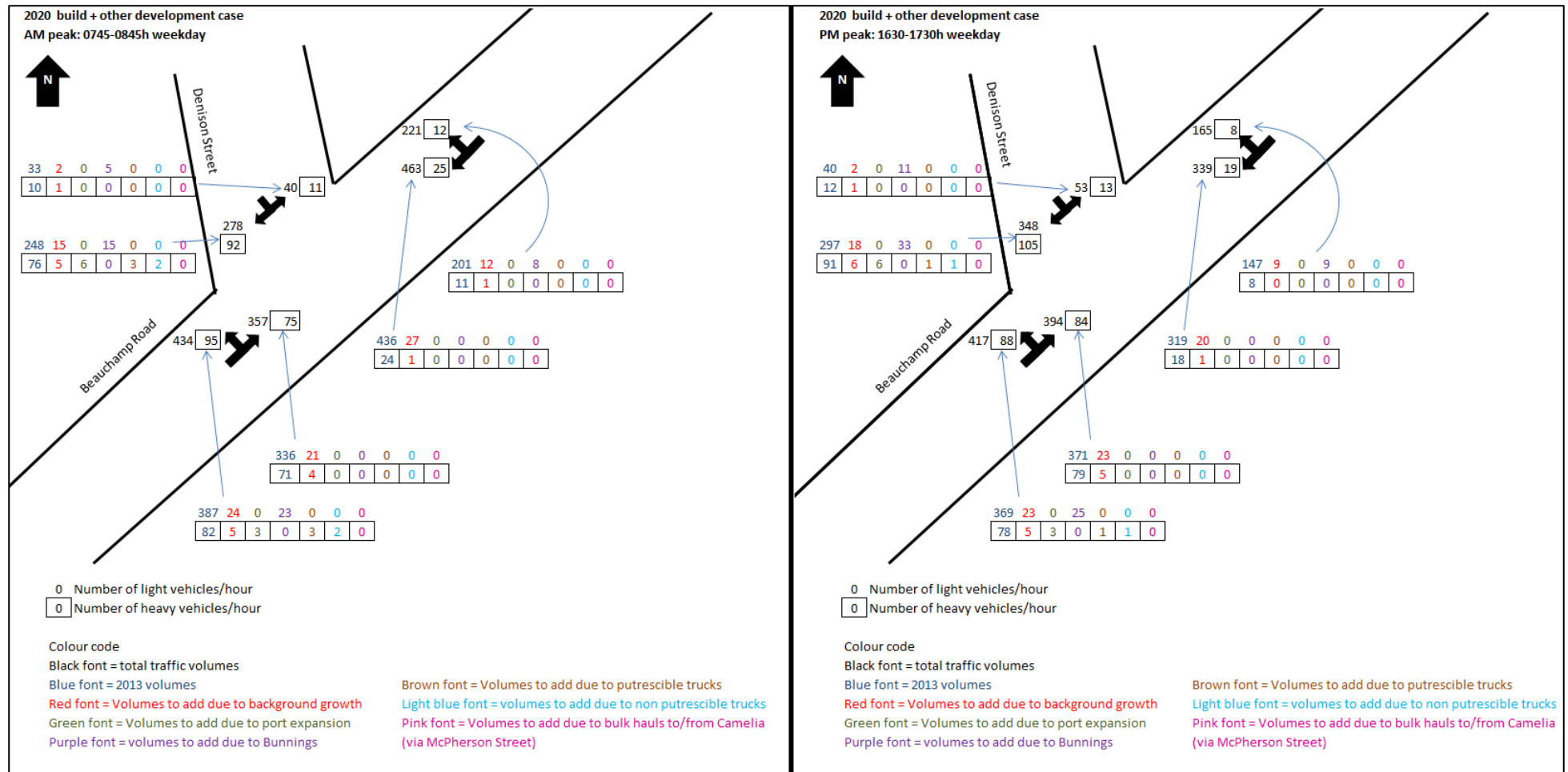


Figure 30 Derived traffic volumes due to future *build with other development* case –Beauchamp Road/ Denison Street intersection.

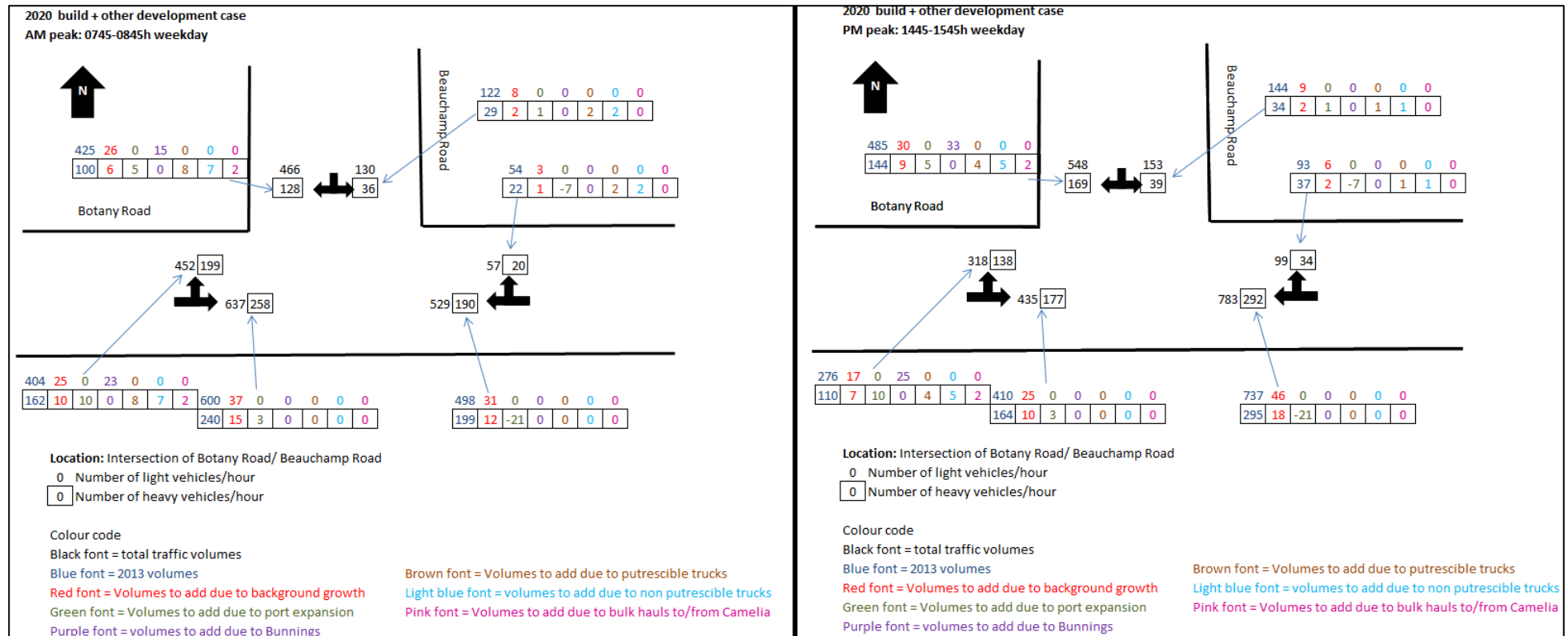


Figure 31 Derived traffic volumes due to future *build with other development* case – Botany Road/ Beauchamp Road intersection.

5.3 TRAFFIC MODELLING RESULTS FOR FUTURE (2020) *BUILD WITH OTHER DEVELOPMENT* CASE– OPERATIONAL PHASE

The forecast traffic volumes due to the build with other development case as reflected in **Figure 29**, **Figure 30** and **Figure 31** for the AM and PM peak periods were inputted into SIDRA models. The results of the modelling are described below.

Beauchamp Road/ Perry Street/ Site Access intersection

Section 3.5 and **Table 11** described the proposed mitigation measures for accommodating the additional traffic generated by the Project. This included the following improvements:

- Provision of an indented left-turn lane in the Beauchamp Road South approach to the intersection (nominal length of 60m adopted in the model).
- Banning of the through movements from the Perry Street and Site Access approaches.

The SIDRA model outputs for the modified Beauchamp Road/ Perry Street/ Site Access intersection for the *build with other development* case are presented in **Table 17**.

These SIDRA results indicate that the proposed mitigation measures would also be effective in accommodating all traffic under the *build with other development* case. This is demonstrated with modelled LoS of B for both AM and PM periods and minor changes to average delays and queue lengths.

Table 17 SIDRA model outputs for the Beauchamp Road/ Perry Street/ Site Access intersection (AM and PM peak) – Future build with other development case.

Beauchamp Road_Perry Street: Future build with other development case + mitigation 2020 AM peak (0800-0900h)
 Signals - Fixed Time Cycle Time = 70 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South East: Perry Street (SE)											
21	L	187	21.9	0.799	38.9	LOS C	6.3	52.4	0.85	0.94	14.0
23	R	186	22.0	0.499	32.3	LOS C	5.5	45.9	0.88	0.81	32.1
Approach		373	22.0	0.799	35.6	LOS C	6.3	52.4	0.87	0.88	24.5
North East: Beauchamp Road (NE)											
24	L	96	16.7	0.738	27.2	LOS B	2.0	16.3	0.70	0.87	18.7
25	T	687	17.0	0.738	11.1	LOS A	14.3	115.4	0.67	0.61	35.1
26	R	8	100.0	0.738	20.1	LOS B	14.3	115.4	0.66	1.01	31.1
Approach		791	17.8	0.738	13.2	LOS A	14.3	115.4	0.67	0.65	32.8
North West: Site access (NW)											
27	L	8	100.0	0.026	28.1	LOS B	0.2	2.6	0.74	0.67	20.2
29	R	19	100.0	0.144	35.1	LOS C	0.6	7.6	0.85	0.72	17.6
Approach		27	100.0	0.144	33.1	LOS C	0.6	7.6	0.82	0.70	18.3
South West: Beauchamp Road (SW)											
30	L	19	100.0	0.057	17.6	LOS B	0.3	3.9	0.48	0.68	38.4
31	T	904	20.9	0.767	17.6	LOS B	20.6	170.0	0.86	0.83	37.5
32	R	88	21.6	0.767	35.5	LOS C	9.6	79.5	0.93	0.99	31.2
Approach		1011	22.5	0.767	19.1	LOS B	20.6	170.0	0.86	0.84	36.9
All Vehicles		2202	21.7	0.799	20.0	LOS B	20.6	170.0	0.79	0.77	33.1

Beauchamp Road_Perry Street: Future build with other development case + mitigation 2020 PM peak (1630-1730h)
 Signals - Fixed Time Cycle Time = 70 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South East: Perry Street (SE)											
21	L	168	22.0	0.717	34.4	LOS C	5.1	42.8	0.84	0.87	15.4
23	R	147	22.4	0.386	31.4	LOS C	4.2	35.0	0.85	0.80	32.6
Approach		315	22.2	0.717	33.0	LOS C	5.1	42.8	0.84	0.84	25.1
North East: Beauchamp Road (NE)											
24	L	96	16.7	0.712	26.5	LOS B	2.0	15.7	0.68	0.87	19.0
25	T	709	16.6	0.712	9.5	LOS A	13.2	106.0	0.62	0.56	37.3
26	R	2	100.0	0.712	18.4	LOS B	13.2	106.0	0.61	1.00	32.4
Approach		807	16.9	0.712	11.5	LOS A	13.2	106.0	0.62	0.60	34.7
North West: Site access (NW)											
27	L	2	100.0	0.006	27.7	LOS B	0.0	0.6	0.73	0.63	20.4
29	R	11	100.0	0.078	33.6	LOS C	0.3	4.2	0.83	0.69	18.2
Approach		13	100.0	0.078	32.7	LOS C	0.3	4.2	0.81	0.68	18.5
South West: Beauchamp Road (SW)											
30	L	11	100.0	0.033	17.5	LOS B	0.2	2.3	0.48	0.66	38.5
31	T	901	20.9	0.757	17.0	LOS B	19.9	164.4	0.85	0.81	37.9
32	R	87	21.8	0.757	34.2	LOS C	9.6	79.2	0.92	0.98	31.8
Approach		999	21.8	0.757	18.5	LOS B	19.9	164.4	0.86	0.82	37.3
All Vehicles		2134	20.5	0.757	18.1	LOS B	19.9	164.4	0.77	0.74	34.4

Beauchamp Road/ Denison Street intersection

The SIDRA model outputs for the Beauchamp Road/ Denison Street intersection for the *build with other development* case are presented in **Table 18**.

Table 18 SIDRA model outputs for the Beauchamp Road/ Denison Street (AM and PM peak) – Future *build with other development* case.

Beauchamp Road_Denison Street: 2020 build with other development case AM peak (0745-0845h)
Signals - Fixed Time Cycle Time = 92 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
North East: Beauchamp Road (NE)											
25	T	514	5.1	0.904	49.5	LOS D	20.3	148.4	1.00	1.09	24.2
26	R	245	5.2	0.904	61.0	LOS E	16.9	123.3	1.00	1.18	22.9
Approach		759	5.1	0.904	53.2	LOS D	20.3	148.4	1.00	1.12	23.8
North: Denison Street											
7	L	54	21.6	0.393	14.0	LOS A	0.7	6.1	0.39	0.67	29.8
9	R	389	24.9	1.174	245.9	LOS F	40.1	340.9	1.00	1.83	7.7
Approach		443	24.5	1.174	217.8	LOS F	40.1	340.9	0.93	1.69	8.0
South West: Beauchamp Road (SW)											
30	L	557	18.0	0.489	10.4	LOS A	3.9	31.5	0.20	0.66	33.4
31	T	455	17.4	1.125	284.2	LOS F	67.2	540.5	1.00	2.55	3.8
Approach		1012	17.7	1.125	133.5	LOS F	67.2	540.5	0.56	1.51	6.1
All Vehicles		2214	14.7	1.174	122.8	LOS F	67.2	540.5	0.78	1.41	10.5

Beauchamp Road_Denison Street: 2020 build with other development case PM peak (1630-1730h)
Signals - Fixed Time Cycle Time = 80 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
North East: Beauchamp Road (NE)											
25	T	377	5.3	1.055	161.1	LOS F	36.7	268.4	1.00	1.90	10.9
26	R	182	4.6	1.061	178.4	LOS F	17.6	128.1	0.96	1.51	10.2
Approach		559	5.1	1.061	166.8	LOS F	36.7	268.4	0.99	1.78	10.6
North: Denison Street											
7	L	69	19.7	0.399	12.7	LOS A	0.7	6.1	0.37	0.68	31.3
9	R	477	23.2	1.557	679.2	LOS F	99.9	837.9	1.00	3.29	3.0
Approach		546	22.7	1.557	594.4	LOS F	99.9	837.9	0.92	2.96	3.2
South West: Beauchamp Road (SW)											
30	L	532	17.4	0.500	11.6	LOS A	5.4	43.5	0.28	0.68	31.5
31	T	503	17.6	1.518	978.2	LOS F	162.6	1309.4	1.00	5.33	1.2
Approach		1035	17.5	1.518	481.7	LOS F	162.6	1309.4	0.63	2.94	1.9
All Vehicles		2140	15.6	1.557	428.2	LOS F	162.6	1309.4	0.80	2.64	3.4

The traffic model results from **Table 18** indicate that this intersection is likely to perform poorly under the *build with other development* case. This is shown by the poor modelled LoS of F for both AM and PM peaks and increased maximum queue lengths and delays.

To better understand the degree to which each of these various traffic volume inputs has contributed to the poor modelled performance of the intersection, the SIDRA results of each of the cases (*existing*, *build with no other development*, *no build with other development*, and *build + other development*) have been shown diagrammatically. **Figure 32** and **Figure 33** illustrate the relative changes with regard to modelled LoS, maximum queue lengths and average delays with each scenario.

As seen in **Figure 32**, the modelled LoS is F for this intersection for the PM peak for all cases. As such, the Project does not make this intersection significantly worse than its existing performance. With regard to the AM peak, the modelled LoS in the *build with no other development* case (ie. a measure of the additional impact due to the proposed waste transfer

terminal in isolation), is the same as the modelled LoS for the *existing* case. The AM LoS deteriorates from C to F in the *no build with other development* case. As such, it can be concluded that the other land use developments and the growth in background traffic are the key drivers for the drop in intersection performance.

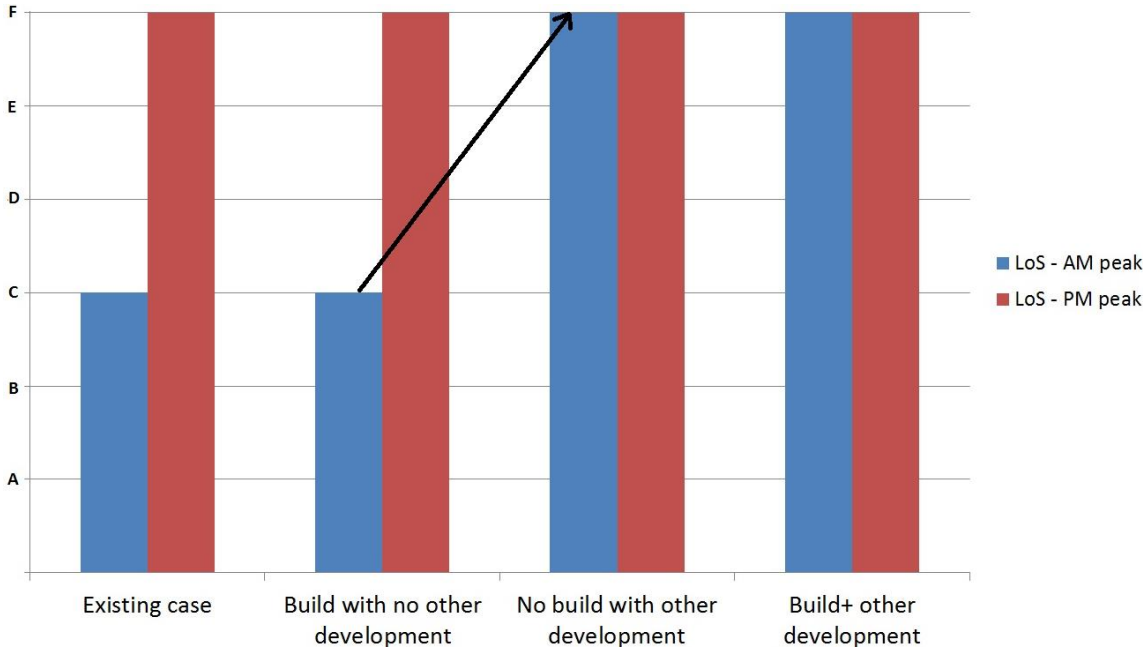


Figure 32 Modelled LoS for the Beauchamp Road/ Denison Street intersection for each case.

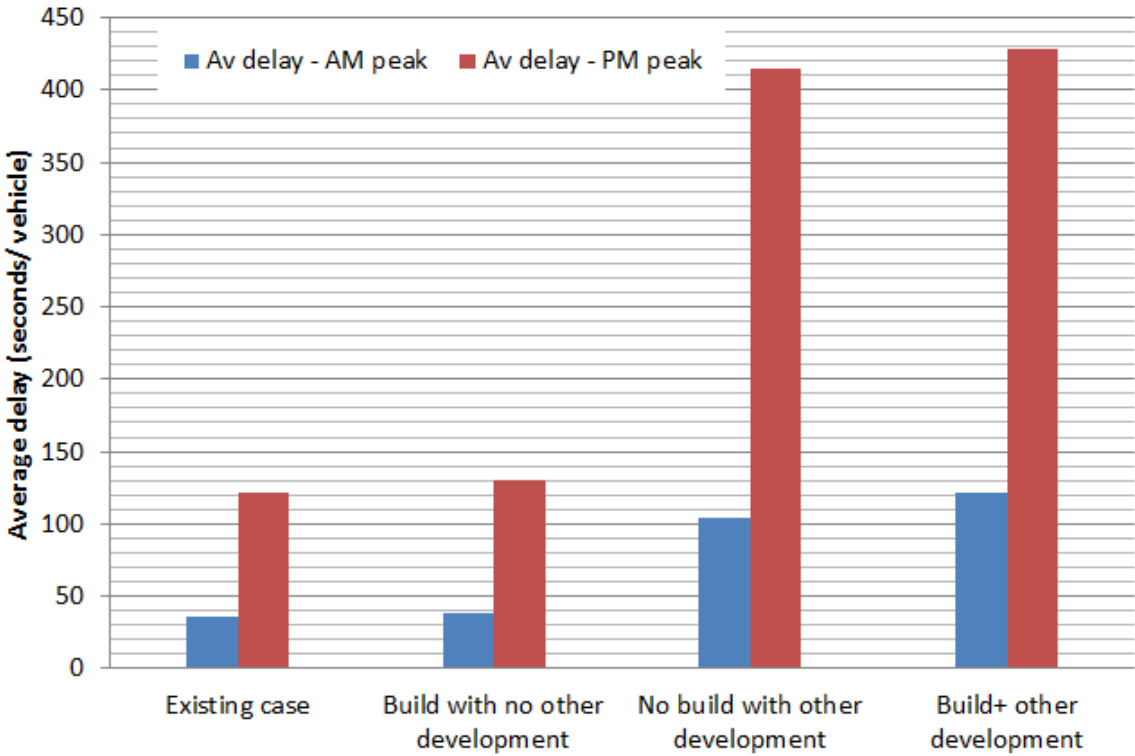


Figure 33 Modelled average delay for the Beauchamp Road/ Denison Street intersection for each case.

As seen in **Figure 33**, there are marginal changes to the modelled average delays at the Beauchamp Road/ Denison Street intersection between the *existing* and *build with no other development* cases. As such, it can be concluded that the proposed Waste Transfer Terminal, in isolation, will not result in a significant change to traffic conditions at this intersection. By

contrast, it can be seen that the modelled delays increase substantially in the *no build with other development* case. This indicates that the other land uses and growth in background traffic are key factors in the poor modelled performance of this intersection.

Based on this assessment, there are no mitigation measures proposed for the Beauchamp Road/ Denison Street intersection due to the marginal impact that the Project traffic, in isolation, will impart on the intersection.

Botany Road/ Beauchamp Road intersection

The SIDRA model outputs for the Botany Road/ Beauchamp Road intersection for the *build with other development* case are presented in Table 19.

Table 19 SIDRA model outputs for the Botany Road/ Beauchamp Road intersection (AM and PM peak) – Future build with other development case.

Botany Road_Beauchamp Road: 2020 Build with other development case AM peak (0745-0845h)
Signals - Fixed Time Cycle Time = 55 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Botany Road (E)											
5	T	757	26.4	0.321	8.0	LOS A	3.2	27.4	0.49	0.42	43.1
6	R	81	26.0	0.474	37.0	LOS C	2.2	18.8	0.96	0.76	16.9
Approach		838	26.4	0.474	10.8	LOS A	3.2	27.4	0.54	0.45	38.7
North: Beauchamp Road											
7	L	175	21.7	0.761	29.0	LOS C	10.4	86.5	0.89	0.90	35.3
9	R	625	21.5	0.761	29.7	LOS C	10.4	86.5	0.90	0.90	34.8
Approach		800	21.6	0.761	29.5	LOS C	10.4	86.5	0.90	0.90	34.9
West: Botany Road (W)											
10	L	685	30.6	0.445	11.2	X	X	X	X	0.71	39.8
11	T	942	28.8	0.743	23.1	LOS B	8.3	72.2	0.94	0.86	37.3
Approach		1627	29.6	0.743	18.1	LOS B	8.3	72.2	0.54	0.79	37.8
All Vehicles		3265	26.8	0.761	19.0	LOS B	10.4	86.5	0.63	0.73	36.9

Botany Road_Beauchamp Road: 2020 build with other development case PM peak (1445-1545h)
Signals - Fixed Time Cycle Time = 50 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Botany Road (E)											
5	T	1132	27.2	0.569	11.6	LOS A	6.4	55.1	0.71	0.61	36.6
6	R	140	25.6	0.743	36.5	LOS C	3.8	32.0	1.00	0.88	17.0
Approach		1272	27.0	0.743	14.4	LOS A	6.4	55.1	0.75	0.64	33.4
North: Beauchamp Road											
7	L	202	20.3	0.791	26.1	LOS B	11.5	95.6	0.86	0.92	36.9
9	R	755	23.6	0.791	26.9	LOS B	11.5	95.6	0.88	0.92	36.4
Approach		957	22.9	0.791	26.7	LOS B	11.5	95.6	0.88	0.92	36.5
West: Botany Road (W)											
10	L	480	30.3	0.311	11.2	X	X	X	X	0.71	39.9
11	T	644	28.9	0.809	26.6	LOS B	5.8	51.0	1.00	0.94	34.9
Approach		1124	29.5	0.809	20.0	LOS B	5.8	51.0	0.57	0.84	36.0
All Vehicles		3353	26.7	0.809	19.8	LOS B	11.5	95.6	0.73	0.79	35.5

The traffic model results in Table 19 indicate that there are likely to be marginal changes to traffic performance in the other scenarios. The intersection's LoS would remain at a B with average delays less than 20 seconds/ vehicle. This indicates that this intersection would have sufficient capacity to absorb the additional traffic generated by the Project, other major land use changes, and the growth in background traffic.

6 ROAD SAFETY ASSESSMENT

6.1 METHODOLOGY

Between 20-22 May 2013, a number of site inspections were carried out on roads surrounding the proposed development. These included:

- Beauchamp Road between and including the intersections of Botany Road and Denison Street.
- Denison Street between Wentworth Avenue and Beauchamp Road.
- Perry Street between Bunnerong Road and Beauchamp Road. It should be noted that this road will not be used by heavy vehicle traffic generated by the Project and hence was not included in the recommended mitigation measures in **Section 6.2**.
- McPherson Street from Beauchamp Road to its cul-de-sac to the east of the Botany Goods Railway Line.

These were considered to be the roads of direct relevance to the Project. The objective of these inspections was to (i) identify existing road safety issues that may affect the operation and transport requirements of the Banksmeadow Transfer Terminal, and (ii) identify potential road safety issues that may arise as a result of the Transfer Terminal and its traffic. It should be noted that this is a high level assessment and not considered to be a formal road safety audit. Also, existing road safety deficiencies which are not affected by the Project were not reported as they are considered to be out of scope.

6.2 IDENTIFIED ROAD SAFETY ISSUES AND RECOMMENDED MITIGATION MEASURES

The identified road safety issues are described in **Table 20**.

Table 20 Road safety issues

Location	Issue	Recommended mitigation/ management measure
Southern approach of Beauchamp Road/ Perry Street/ Site Access.	The lack of formal left-turn facility for vehicles entering the Site Access may lead to either (i) <i>rear-end / side swipe</i> crashes in this approach as well as (ii) truck encroachment into the adjacent northbound lane as required to negotiate the left-turn.	Consider providing an indented left-turn lane. This will separate and shelter left-turning vehicles from other northbound <i>through</i> vehicles. A formal turning lane would also better accommodate the left-turn swept path and reduce the risk of encroachment into adjacent lanes. This was also modelled from a traffic performance perspective and has been discussed in Section 3.5 .
Beauchamp Road/ McPherson Street intersection.	There is poor <i>entering sight distance</i> from the McPherson Street approach towards oncoming traffic on Beauchamp Road from the north (estimated as 5-6 seconds of gap acceptance sight distance). The sight-limiting features include the vegetation and property fence line on the western side of Beauchamp Road (Figure 34). The lack of visibility in these respects may lead to poor gap selection of outbound vehicles and associated crashes with vehicles on Beauchamp Road. Furthermore, the poor angle of the intersection restricts visibility of truck drivers towards the north. The sight line is obstructed due to the lack of inter-cabin visibility. As a result many drivers were observed to approach the intersection at a more perpendicular angle allowing a clearer sight line out of their passenger side window. This resulted in encroachment into the opposing lane of McPherson Street.	The vegetation on the western side of McPherson Street should be cleared or trimmed back to re-instate a safe <i>entering sight distance</i> sight line. Consideration should be given to implementing more kerb side parking restrictions in McPherson Street so that there is more road width to allow vehicles to approach the intersection at a perpendicular angle. Linemarking adjustments should be implemented to accompany this. Consideration should be given to providing inter-connectivity between the McPherson Street gate and the Perry Street gate to the Banksmeadow Transfer Terminal. This will allow egressing right-turning vehicles to use the signalised intersection at Perry Street as a possible alternative to McPherson Street.
McPherson Street.	There is extensive truck queuing within McPherson Street as a result of the neighbouring land uses, particularly trucks associated with the construction recycling facility adjacent to the Project site. The on-street queuing has associated safety risks such as increased risks of <i>rear-end</i> crashes, and <i>side-swipe/ head-on</i> crashes in the event that other vehicles attempt to pass around the queued vehicles.	The proposed site layout includes sufficient layover space for Project-related trucks. As such, there are no further mitigation measures proposed in these respects. Consideration should be given to developing a traffic management plan in collaboration with neighbouring Botany Building Recyclers to address on-street queuing and access issues. Review of kerb side parking restrictions along McPherson Street with a view to removing parking where space is required for layover and queuing.

Location	Issue	Recommended mitigation/ management measure
The existing Site Access approach to the signalised intersection with Beauchamp Road and Perry Street.	There is a risk of <i>side swipe</i> crashes due to lack of turning space in the existing Site Access approach to the signalised intersection at Beauchamp Road and Perry Street.	Ensure that approach is designed to cater for side-by-side stacking of vehicles and the swept path clearances between all vehicles turning into and out of this approach. Also ensure appropriate queuing space provided in this approach and layover areas for staggering dispatch of trucks. This was also modelled from a traffic performance perspective and has been discussed in Section 3.5 .



Figure 34 Poor entering sight distance from the McPherson Street approach to Beauchamp Road traffic from the north.

7 RAIL NETWORK IMPACTS

7.1 RAIL MOVEMENT DEMANDS

As outlined in **Table 6**, there is likely to be 6 train movements per week per direction generated by the Project during its operational phase. This would consist of 6 outbound trains to Woodlawn, and 6 empty return trains. This would equate to less than one outbound train and one inbound train per day. This would have a marginal impact on the rail network.

7.2 RAIL PATH AND OPERATIONS

- Train movements between the Banksmeadow TT site and Crisps Creek would utilise the following routes Botany to Sefton via the Metropolitan Freight Network (MFN)
- Sefton to Macarthur via the Southern Sydney Freight Line (SSFL)
- Macarthur to Joppa Junction via the ARTC main south.
- Joppa Junction to Crisps Creek via the Country Rail Network (CRN)

Preliminary discussions between Pacific National and ARTC and CRN (John Holland) have provided a briefing of the Proposal to enable the inclusion of the proposed train service into ARTC's forecast capacity planning process. Discussions are ongoing between Pacific National and each of the relevant Network Access Providers to secure the appropriate access for the Proposal.

Trains travelling into the Port Botany precinct, including trains accessing the Asciano Botany Site, travel via the main Botany Goods lines, entering the Botany Yard on Arrival Roads #1 and #2. Trains accessing the Asciano Botany Site from this direction currently perform a run-around movement in the Botany Yard, travelling from the Arrival Roads to Departure Road #2. The trains servicing the Banksmeadow Transfer Terminal would need to perform a similar movement to access the Site. The time to complete this movement from the Botany Yard to the Asciano Botany Site is estimated to be in the order of 15 – 20 minutes.

Once in the Asciano Botany Site, Pacific National would shunt the wagons on the two Veolia sidings in order to allow Veolia to undertake container handling operations. These would include unloading of the empty containers from the train using a container handler and loading full containers onto the wagons. Once the wagons have been loaded the train would be assembled ready for transport to the Crisps Creek Intermodal Facility.

The option to operate the train as a haul in service may be constrained by future increases in rail traffic densities in the Port Botany precinct. Mitigation of this issue, should this be the case, would include:

- Change the method of operating to a 'pull-pull' train with a locomotive at the lead and rear of the train in line with other operations in the Port Botany precinct. This would reduce the run-around time but still requires access via Departure Road #2 which is estimated to be in the order of 5 – 10 minutes.
- Develop an additional siding to 'by-pass' the Botany Yard siding to provide direct access to the Asciano Botany Site.

Train operations are proposed to be staged over three phases to align with the ramp up requirements of the Banksmeadow Transfer Terminal. The one train per day would operate up to six days a week with additional wagons to increase capacity.

- Phase 1 – Single Locomotive up to 22 wagons (345 m) train

- Phase 2 – Single Locomotive up to 26 wagons (405 m) train
- Phase 3 – Double Locomotive 31 wagons – 42 wagons (495 – 660 m) train.

Table 21 provides the number of wagons required per train based on operating six trains per week and the expected ramp up in tonnage over the first five years of operation.

Table 21 Wagons required per train correlated to annual throughput

Year	Annual tonnage (tpa)	Number of wagons on the Train	Phase
2016	200,000	22	1
2017	250,000	26	2
2018	300,000	31	3
2019	350,000	36	3
2020	400,000	42	3

Pacific National is also in discussion with ARTC regarding potential pathways for the train in and out of the Banksmeadow Transfer Terminal site. The facility is not expected to be operational until the end of 2015 and therefore potential pathways provided are only indicative at this stage. In addition to train movements in the direct vicinity of the Proposal site, potential constraints along the entire train route, from Banksmeadow to Crisps Creek need to be considered when determining appropriate pathways. This includes current train operations at Crisps Creek and hours of operation and the passenger train schedule at the Crisps Creek end.

7.3 RAIL LOADING/ UNLOADING

Phase 1 and 2

For the initial stage of operations (up to 250,000 tonnes per annum) the train would operate with a single locomotive and be able to be fully assembled completely clear of the main rail line, ie wholly within the Banksmeadow Transfer Terminal site and Asciano's Botany site. During this stage, trains would be likely to occupy the main line for approximately 5 - 10 minutes on departure, to allow the train to be hauled directly out from the Veolia sidings.

Phase 3

To ensure that the train is able to be fully assembled clear of the main line at maximum capacity, ARTC and Pacific National are currently in discussions to identify an appropriate location for a future rail siding off the main Botany Goods line to bypass Botany Yard to access the Asciano Botany site for the Banksmeadow Transfer Terminal requirements. When constructed, this siding would accommodate the predicted additional port freight rail movements by allowing trains to exit the Botany Goods Line direct into the Asciano Site and Banksmeadow Transfer Terminal site and separate these train services from the flow of train movements on the Botany Goods Line using Botany Yard to access the stevedores. The conceptual siding is shown in **Figure 35**.

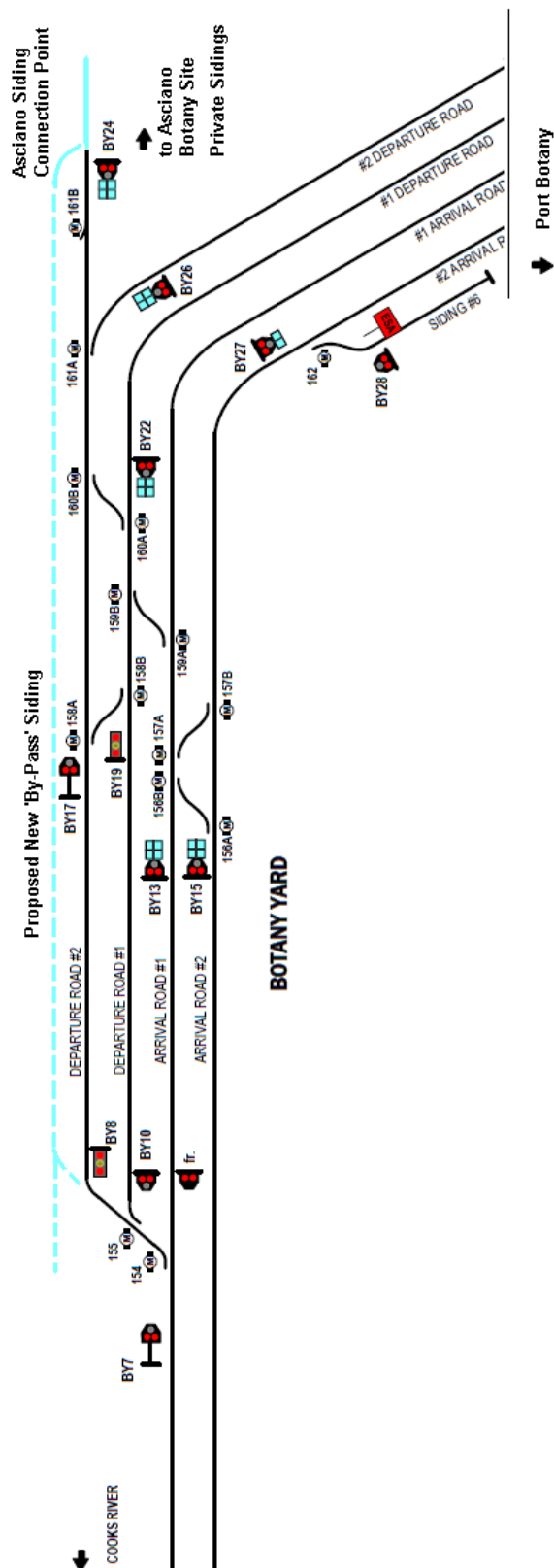


Figure 35 Schematic Layout of the Botany Yard Siding with option for a 'by-pass siding'.

Table 22 provides a conceptual operating plan for the proposed train from the Banksmeadow site.

Table 22 **Indicative train movement schedule**

Train	Indicative Scheduling (24hr)
Departure from Crisps Creek	19:00
Arrival at Banksmeadow	00:30
Departure from Banksmeadow	08:00
Arrival at Crisps Creek	13:00

Based on this scheduling, the process of stripping and re-loading the wagons at Banksmeadow would take approximately seven and a half hours. During the time wagons are on the Site, the provisioning of the locomotive would occur to enable the train to be ready for the outbound journey to Crisps Creek. The provisioning of locomotives would require the locomotive to be taken to another yard, such as Clyde or Cooks River, for re-fuelling.

Alternatively, the locomotive would be exchanged to replace the inbound locomotive with another fully provisioned locomotive. Depending on which yard these locomotives return to, the exchange could occur en-route, or if these exchange movements are required, then travel on the metropolitan passenger network may be required. These movements would be planned to occur while the train is being stripped and re-loaded and would therefore be outside the peak commuter period. In order to avoid additional rail movements for this locomotive exchange, Pacific National would also review opportunities to utilise an existing rail movement into and out of the Port Botany precinct during this time to exchange the locomotives.

The Crisps Creek Intermodal Facility (at the Woodlawn end) has two sidings with a total combined length of 1137m. This allows for a total of 60 containers to be handled per consignment (URS, 2010).

7.4 WIDER NETWORK IMPROVEMENT STRATEGIES

The freight planning needs along this corridor are managed by the respective rail asset owners and in collaboration with the NSW and Federal Governments. With respect to the SSFL and the MFN, the rail asset is operated by the Australian Rail Track Corporation (ARTC) (ARTC, 2013). Across this network, ARTC is responsible for selling access to train operators, capital investment in the rail corridors and management of the network. There is also a portion of the route near Crisps Creek which is owned by John Holland, who operate this portion of the network in a similar manner. These rail asset owners are collectively referred to as *Access Providers*.

Operating on the rail network would attract Access Fees from the relevant Access Providers on the intended network route. Access Fees represent revenue for the Access Providers for provision of access to the network, infrastructure maintenance and upgrades. As such, any rail capacity and safety requirements that arise through increased demand would be to a large extent “self-mitigated” through the sale of train paths. That is, Pacific National will haul the containerised putrescible waste to Woodlawn and will be charged for the access paths, and the payments will add to the Access Providers’ consolidated revenue.

Some of the major rail infrastructure projects that have either received or are likely to receive funding commitment from the Access Providers and/or the respective State and Federal governments include:

- ARTC and Pacific National are currently in discussions to identify an appropriate location for a future rail siding off the main Botany Goods line in the vicinity of the Banksmeadow

Transfer Terminal site. When constructed, this siding would accommodate the predicted additional port freight rail movements by allowing trains to exit the Botany Goods Line to the Asciano and Banksmeadow Transfer Terminal site with minimal disruption to the flow of train movements on the Botany Goods Line.

- **Southern Sydney Freight Line (SSFC):** This is a 36km dedicated freight line between Macarthur and Sefton which is being delivered through an alliance including ARTC and Leightons. This freight line will effectively separate the passenger services of the South and Inner West Lines, from the freight services from Sydney to the south. As such, when completed, this will reduce congestion along this portion of the network and improve safety.
- **Enfield Inter-modal Logistics Centre (ILC):** This is located at the former Enfield Marshalling Yards. This project is being delivered by Sydney Ports and will be handed over to ARTC when completed. The ILC will handle up to 300,000 twenty foot equivalent (TEU) of containers each year which will significantly reduce the demand for road-based freight hauls (Sydney Ports, 2013b). Although the train movements from the Project will not use the ILC directly, there are ancillary benefits in an improved rail network in the approaches and departures to the ILC which will benefit all train movements through this area.
- **Moorebank Intermodal Terminal:** This proposed intermodal facility will be located in Moorebank to the east of the Georges River. When operational, this facility will handle up to 1 million TEU of containers each year which will also reduce the demand for road-based freight hauls. Similar to the Enfield ILC, train movements from the Project will not use the Moorebank terminal directly. However, there are ancillary benefits in an improved rail network in the approaches and departures to the facility which will benefit all train movements through this area.

It is expected that, with ongoing increases to rail volumes across the network, the Access Providers will continue to prioritise and delivery rail network maintenance and improvement projects.

8 CONCLUSIONS

This Traffic and Transport Impact Assessment has been prepared to support the Environmental Application for a new Waste Transfer Terminal at Banksmeadow. After a five-year ramp up period to 2020, the Transfer Terminal will handle up to 500,000 tonnes of waste per year, with 400,000 tonnes of putrescible and 100,000 tonnes of non-putrescible waste.

In assessing traffic impacts associated with the Project, and in response to the relevant DGRs, this study has considered anticipated changes in traffic conditions under several scenarios: These include:

- The *existing* 2013 case.
- The 2020 *build with no other development* scenario which assesses the impacts of the proposed Waste Transfer Terminal in isolation, with no traffic growth due to other land use changes or background traffic growth. The major land uses included the Port Botany Expansion Project with the third container terminal, a Bunnings development and operational changes to Qenos.
- The 2020 *no build with other development* scenario, which assesses the impacts of other key land use changes on the road network, with no additional traffic from the proposed Waste Transfer Terminal.
- The 2020 *build with other development* scenario, which is a cumulative traffic impact assessment.

Existing traffic conditions

The assessment of existing traffic conditions indicated that the Beauchamp Road/ Perry Street intersection is performing satisfactorily with acceptable delays in the AM and PM peak periods.

The *existing* case traffic models for the Beauchamp Road/ Denison Street intersection indicates that this intersection is failing under existing PM peak period conditions. This is largely due to (i) the high delays experienced by right-turning vehicles from Denison Street to Beauchamp Road, and (ii) the right-turn from Beauchamp Road North to Denison Street. These modelling results indicate that this intersection is failing under existing PM conditions before any traffic related to the Project, other land use changes or background traffic growth are added to the road network.

The Botany Road/ Beauchamp Road intersection was also modelled under the *existing* case traffic conditions. The modelling indicated that this intersection is performing satisfactorily under AM and PM peak traffic conditions.

Likely impacts of the Project in isolation

The most significant change in the *build with no other development* case is that the Beauchamp Road/ Perry Street/ Site Access intersection would be a four-way signalised intersection compared to the previous condition where it operated substantially as a T intersection. This has a significant impact as it requires signal phasing adjustments to accommodate the additional traffic emerging from the fourth and western approach – the Site Access. As this new traffic and intersection approach demands a portion of the signal cycle, less signal cycle time can be allocated to the other movements (compared with the existing scenario). As such, the reduced capacity would affect the Perry Street and Beauchamp Road South approaches.

The modelling work indicated that some mitigation measures would be required to restore capacity at the Beauchamp Road/ Perry Street/ Site Access Road intersection. As such the following improvements have been recommended and were also confirmed through further traffic modelling work to be effective in addressing the capacity shortfalls:

- Provision of an indented left-turn lane in the Beauchamp Road South approach to the intersection.
- Banning of the through movements from the Perry Street and Site Access approaches.

The traffic modelling demonstrated that the Project in isolation will not result in significant impacts to the Beauchamp Road intersections with Denison Street and Botany Road.

Likely impacts due to other land use changes and background traffic growth

As mentioned previously, the Beauchamp Road/ Denison Street intersection is currently failing in the PM peak period. With additional traffic added to the intersection as a result of other major land use changes and background traffic growth, this intersection would experience a further reduction in performance. In particular, the modelling shows that the intersection is likely to fail in the AM peak as well. As these impacts are due to other land use changes, rather than as a result of the Project, this report has not proposed any mitigation measures for this intersection.

Cumulative traffic impacts

There were no further (significant) traffic impacts under a cumulative assessment case in addition to those already identified through the other assessments.

Road safety impacts

The assessment of road safety impacts identified the following safety improvement and management measures which should be considered.

- Provision of an indented left-turn lane for the northbound direction of Beauchamp Road accessing the site (at the Perry Street intersection).
- Removal/ pruning of the vegetation on the western side of Beauchamp Road to the north of McPherson Street to improve entering sight lines from McPherson Street.
- Reviewing and where necessary, implementing more kerbside parking restrictions in the McPherson Street approach to Beauchamp Road, to allow egressing trucks to approach at a more perpendicular angle with better sightlines to traffic on Beauchamp Road.
- Ensuring that the design of the Site Access Road has sufficient swept path clearances for entering and egressing trucks.

Rail network issues

There is likely to be 6 outbound loaded trains to Woodlawn, and 6 empty return trains per week. This would equate to less than one outbound train and one inbound train per day. This would have a marginal impact on the rail network.

Discussions between relevant rail asset owners and Pacific National (Veolia's train operator) have confirmed that there is sufficient 'Access' available for purchase to accommodate the Project and these access paths would be purchased on approval of the Proposal by the Department of Planning and Infrastructure. The payments made for the access paths will contribute to consolidated revenue of the rail asset managers. These rail asset managers use this revenue to invest in rail network maintenance and improvement strategies. These are implemented on a priority basis considering the relative needs across the whole network. As such, any impacts to the rail network are "self-mitigated".

Examples of major rail infrastructure projects that have been delivered through this process or through alternative funding/ procurement arrangements include the Southern Sydney Freight Line, Enfield ILC and Moorebank Inter-modal Terminal.

9 REFERENCES

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Veolia Environmental Services (2013c) website on Banksmeadow Transfer Terminal at <https://www.veoliaes.com.au/community-and-environment/banksmeadow-transfer-terminal>

Veolia Environmental Services (2012) *Information on the proposed Camellia Recycling Centre*.

APPENDIX A

INDIVIDUAL SUBMISSIONS FROM KEY COMMUNITY AND ORGANISATIONAL STAKEHOLDERS

Table A1 provides requests from individual stakeholders for DGR scope items related to traffic and transport. This table also provides a response to each of the items or a reference to a section within this report where that issue is addressed.

Table A1 Issues of concern from stakeholders.

Stakeholder	Issue	Response/ reference to report section
RMS (2013b)	RMS would like the following issues to be included in the traffic and transport impact assessment of the proposed development:	
	Daily and peak traffic movements likely to be generated by the proposed development including the impact on nearby intersections and the need/ associated funding for the upgrading or road improvements works (if required).	Section 3.1
	Details of the proposed accesses and the parking provisions associated with the proposed development including compliance with the requirements of the relevant Australian Standards (ie. turn paths, sight distance requirements, aisle widths, etc.)	Figure 2.
	Proposed number of car parking spaces and compliance with the appropriate parking codes.	Section 3.1 addresses the number of employees required on site. The parking provisions will all be provided on site.
	Details of service vehicle movements (including vehicle type and likely arrival and departure times).	Section 3.1
	The EA should address the provision of infrastructure having regard to Council's Section 94 Contributions Plan, and provide details of any Planning Agreement or other legally binding instrument proposed to facilitate development.	Mitigation measures are summarised in Section 8.0
BBCC	The traffic assessment report must incorporate the following information:	
	SIDRA modelling.	Sections 2.3, 3.4, 3.5, 4.6, 5.2.
	Assess the cumulative traffic impact of the locality incorporating nearby landuses (ie. the industrial estate at 2-12 Beauchamp Road and approvals such as Orica and Port Botany Expansion).	Section 5.2.
	Intersection analysis and capacity (ie. Perry Street, Beauchamp Road and McPherson Street).	Sections 2.3, 3.4, 3.5, 4.6, 5.2.
	Identify improvements required.	Mitigation measures are summarised in Section 8.0
	Identify the type of vehicles that will be used during construction and operation of the terminal.	Section 3.1.
	Timing of deliveries	Section 3.1.
	Identify vehicular routes.	Figure 16.
	Beauchamp Road is identified as a classified road and is under the control of RMS. Hence RMS approval may be needed.	Consultation with RMS will continue throughout the EA phase.

Stakeholder	Issue	Response/ reference to report section
BBCC (cont)	Currently, vehicular access to Lot 2 DP 1006865 is serviced by the existing vehicular crossing/ driveway along Beauchamp Road. Veolia proposes to utilise part of Lot 2 in DP 10068/65 as the transfer terminal with the residual of the site to be used as a rail yard by Asciano (ie. owner of Lot 2 DP 1006865). The proponent must demonstrate that the existing vehicular crossing/ driveway can accommodate the existing and proposed uses of the site; works to be undertaken to the existing vehicular crossing/driveway; and vehicular access arrangement between Asciano and Veolia.	Section 3.5.
Randwick Council	Randwick Council raises the following issues to be addressed in the DGRs for this State Significant Development,... A traffic assessment which considers cumulative impacts given recently proposed Bunnings Development on nearby Denison Street and close proximity to the Port Botany. This assessment must include details of the capacity, safety and design of all key haulage routes to and from the site. The assessment should also consider the transport impact of the project in the context of surrounding existing and proposed land use and potential requirements for Perry Street and Beauchamp Road intersection improvements, which is located on the boundaries of Botany and Randwick LGAs.	Sections 4.0 and 5.0
Sydney Ports	Assess the level of service impacts on the intersections of Denison Street and Beauchamp Road; Beauchamp Road and Perry Street; and Beauchamp Road and Botany Road and consider intersection upgrade works to ensure the level of service is not compromised.	Sections 2.3, 3.4, 3.5, 4.6, 5.2.
	How right hand turns from Beauchamp Road into Perry Street and McPherson Street will be managed.	Perry Street will not be used by heavy vehicle traffic generated by the Project. Section 8.0 for mitigation measures regarding McPherson Street.
	The internal layout of the facility to ensure that there is adequate capacity for queuing of trucks and vehicles on site.	Figure 2.
	Undertake a cumulative assessment of known future traffic volumes within the industrial and port precinct area. Developments which have been granted approval but have not commenced operations as yet, which Sydney Ports is aware of, include the Bunnings Development on Denison Street and the operation of the third terminal as part of the Port Botany Expansion project.	Section 5.0

Stakeholder abbreviations:

RMS: Roads and Maritime Services.

BBCC: Botany Bay City Council

APPENDIX B

TRAFFIC PROJECTIONS BASED ON RMS SURVEYS

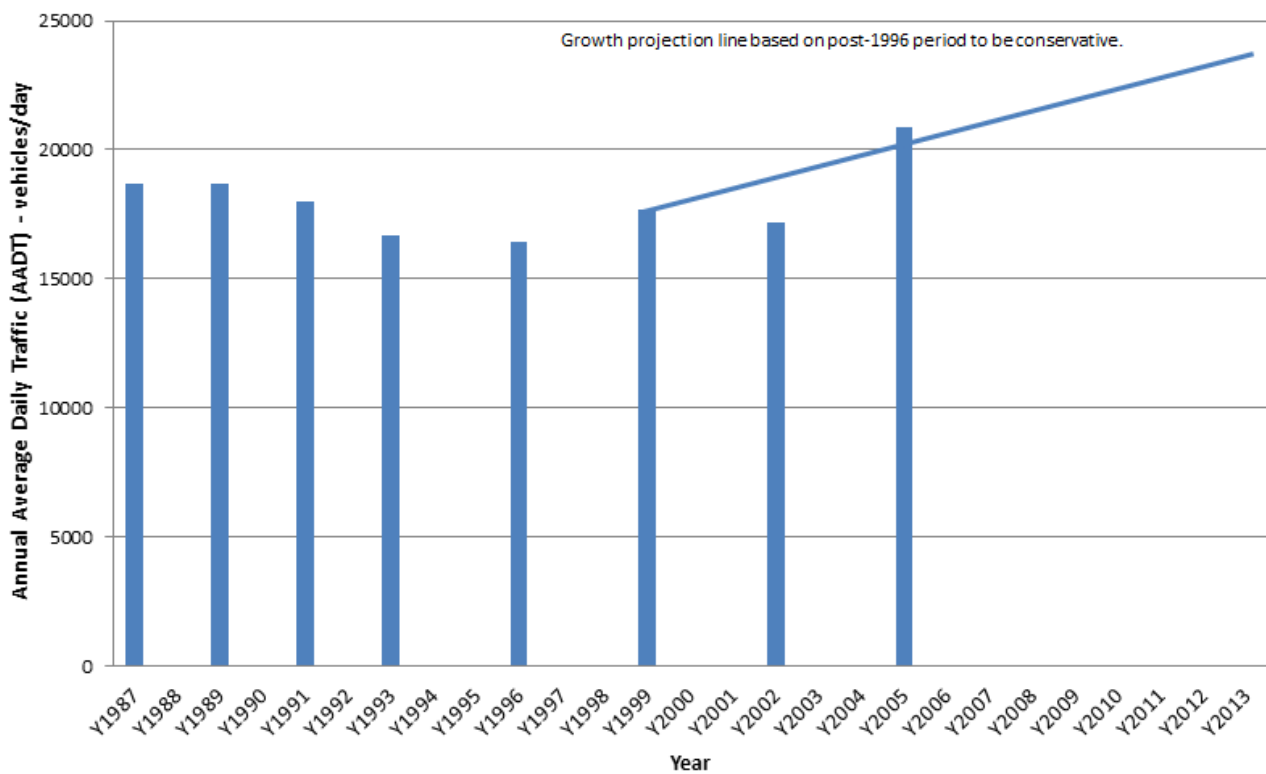


Figure B1 Traffic projections at Station 16.089 – Beauchamp Road, north of Botany Road, Banksmeadow.

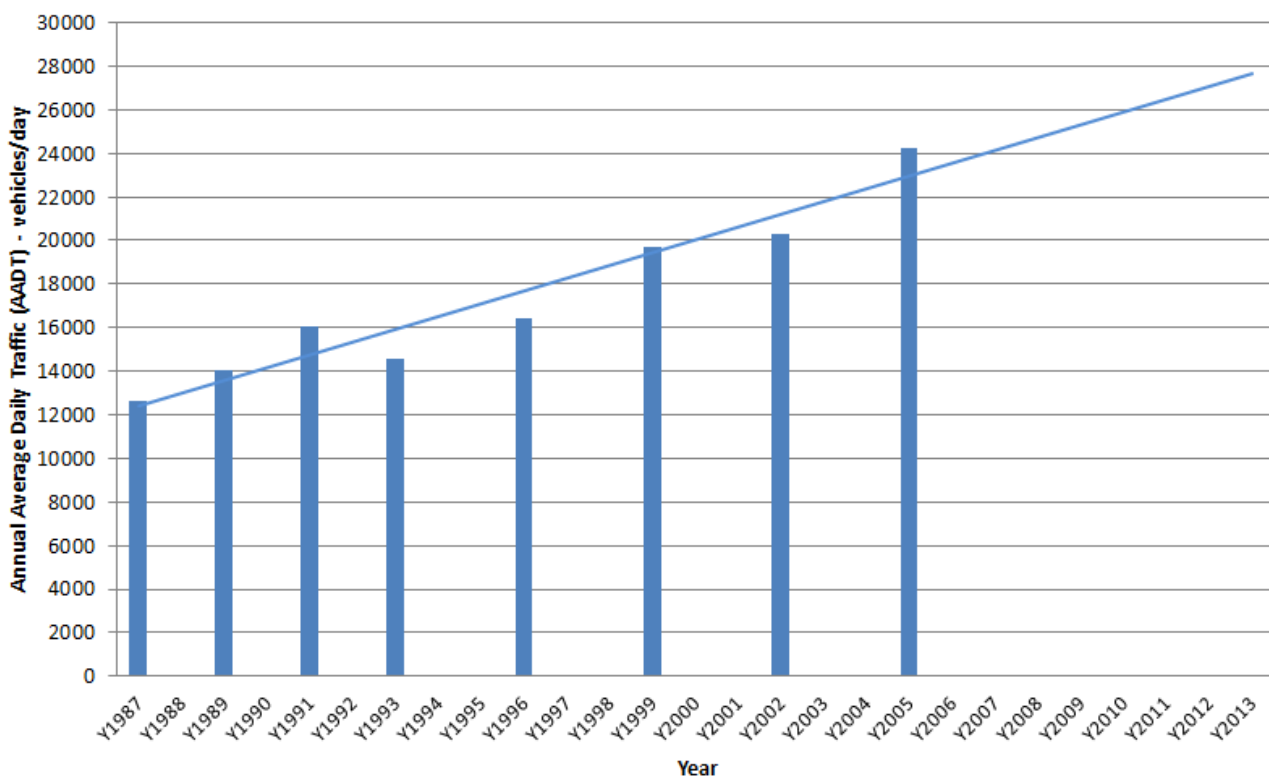


Figure B2 Traffic projections at Station 16.012 – Botany Road, east of Beauchamp Road, Banksmeadow.

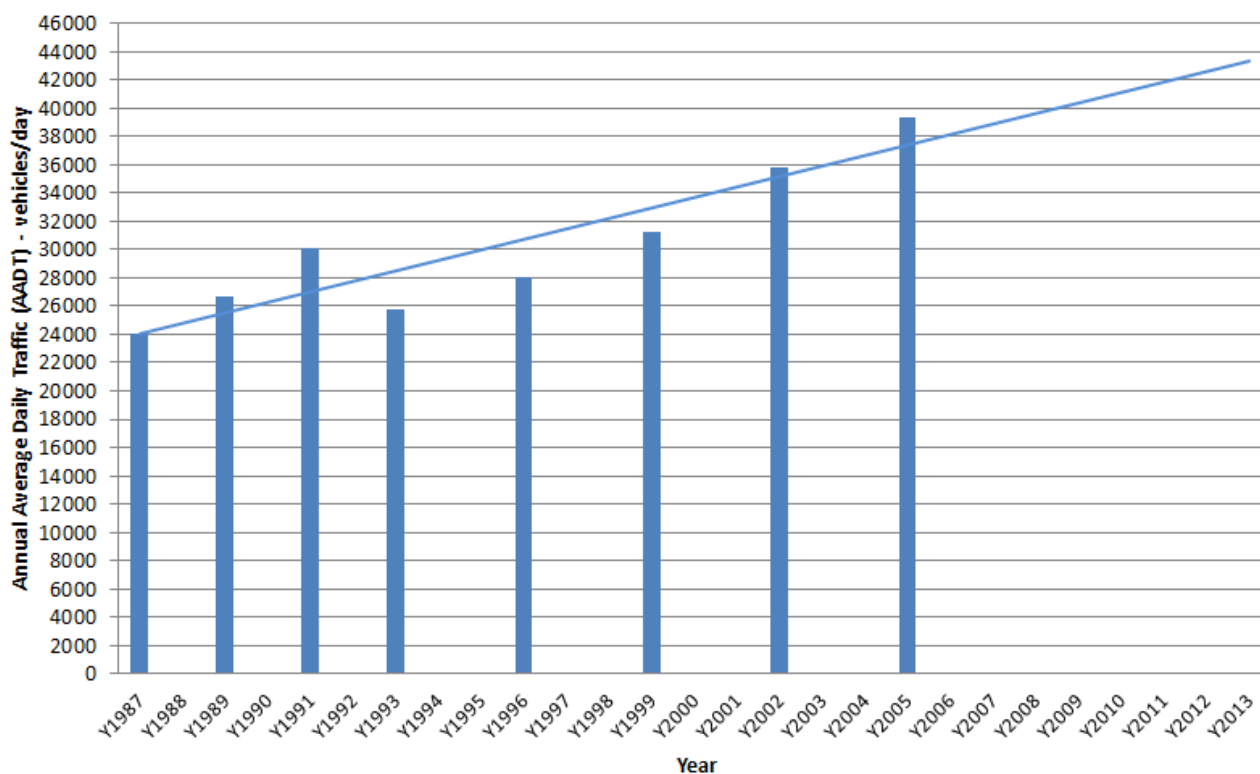


Figure B3 Traffic projections at Station 16.013 – Botany Road, west of Beauchamp Road, Banksmeadow.

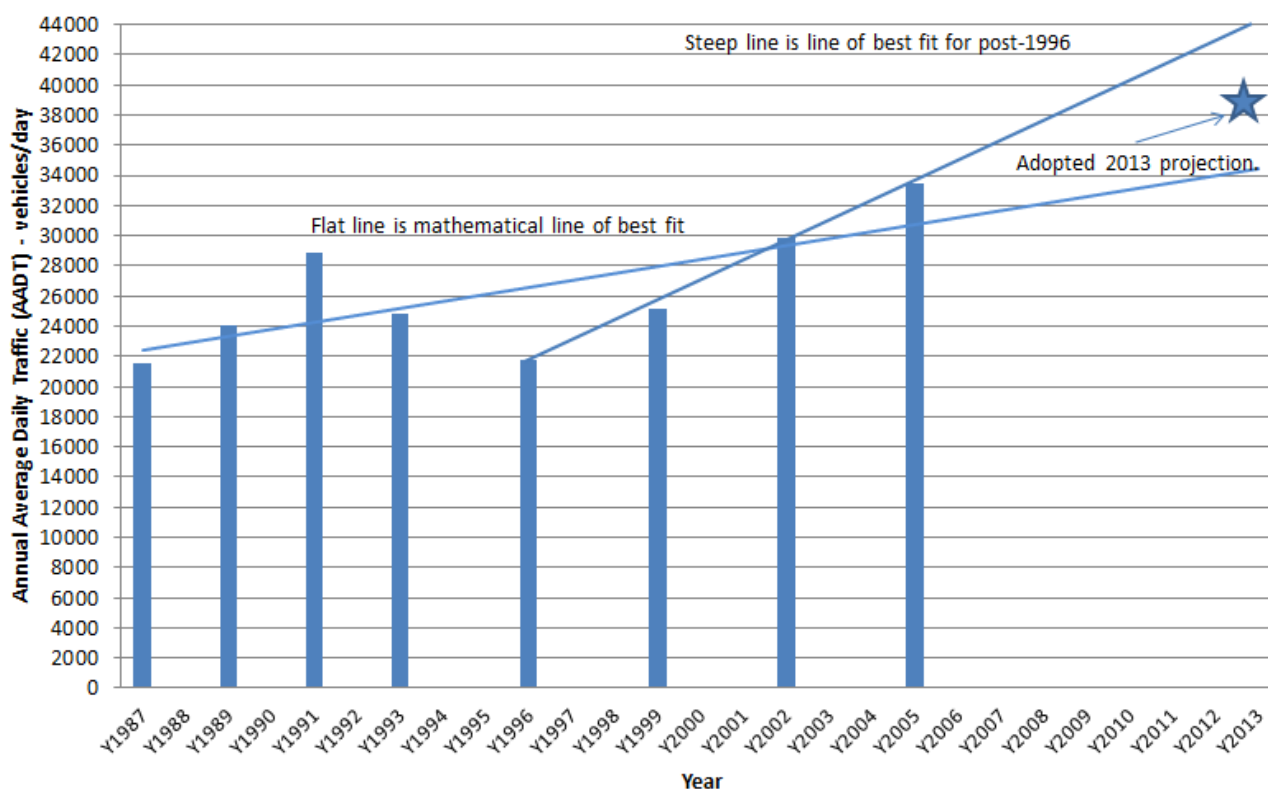


Figure B4 Traffic projections at Station 16.088 – Foreshore Road, 2.1km east of Botany Road, Botany.

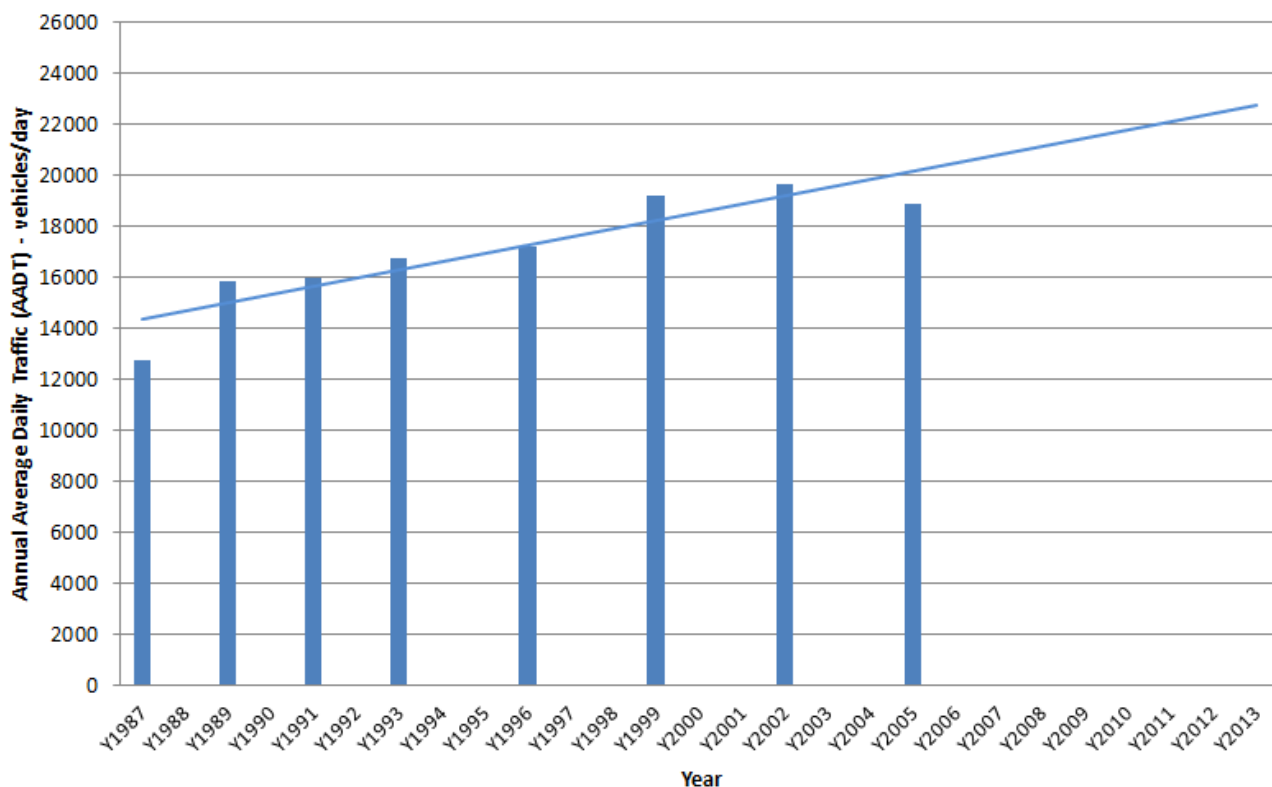


Figure B5 Traffic projections at Station 16.031 – Wentworth Avenue, east of Bunnerong Road, Eastgardens.

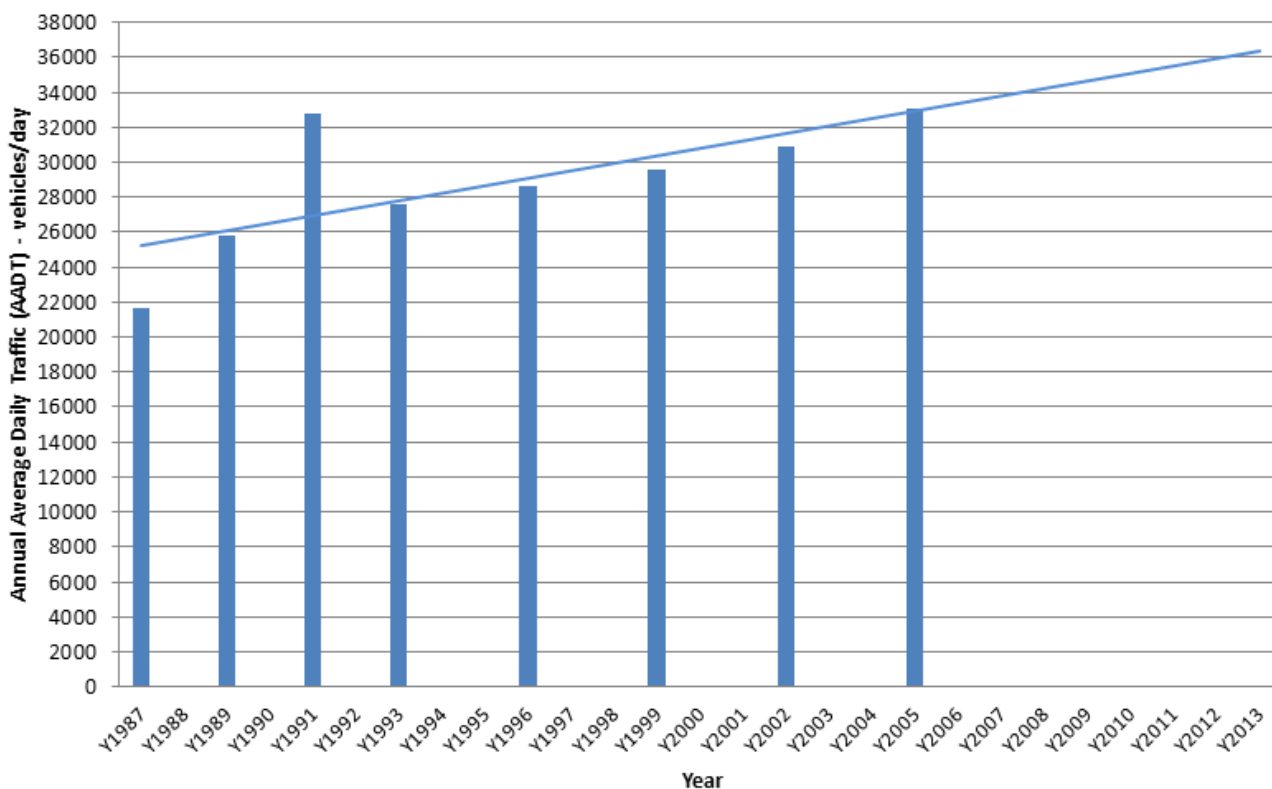


Figure B6 Traffic projections at Station 16.033 – Wentworth Avenue, east of Page Street, Pagewood.

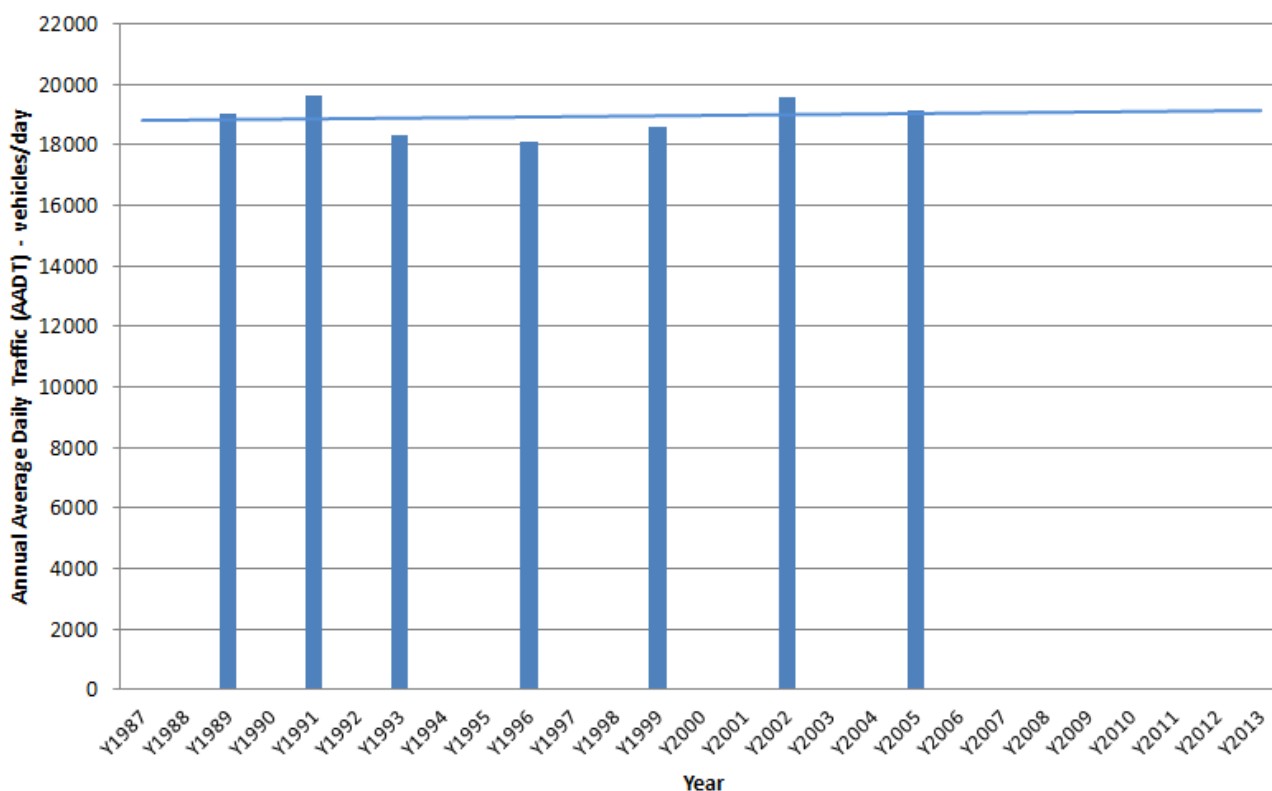


Figure B7 Traffic projections at Station 13.014 – Bunnerong Road, north of Beauchamp Road, Hillsdale.

APPENDIX C

DESCRIPTION OF TRAFFIC PERFORMANCE INDICATORS

The SIDRA intersection simulation software is used to determine the likely traffic performance indicators including level of service (LoS), degree of saturation (DoS), average delay and maximum queue length (represented by 95th percentile queue length). At signalised and roundabout intersections, the LoS criteria are related to average intersection delay (seconds per vehicle). At sign controlled intersections (give way and stop), the LoS is based on the average delay (seconds per vehicle) for the worst movement. The following table summarises the intersection LoS criteria.

Level of Service	Average Delay (seconds per vehicle)	Traffic Signals, Roundabout	Give Way and Stop Signs
A	Less than 14	Good operation	Good operation
B	15 to 28	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Operating near capacity	Near capacity and accident study required
E	57 to 70	At capacity. At signals, incidents will cause excessive delays. Roundabouts require other control mode	At capacity; requires other control mode
F	Greater than 71	Unsatisfactory with excessive queuing	Unsatisfactory with excessive queuing; requires other control mode

Source: RTA Guide to Traffic Generating Developments (2002).

Degree of saturation (DoS)

DoS is defined as the ratio of demand flow to capacity, and therefore has no unit. As it approaches 1.0, extensive queues and delays could be expected. For DoS greater than 1.0, a small increment in traffic volumes would result in an exponential increase in delays and queue length. For a satisfactory situation, the DoS should be less than the nominated practical degree of saturation, usually 0.90. The intersection DoS is based on the movement with the highest ratio.

Average delay

Delay is the difference between interrupted and uninterrupted travel times through the intersection and is measured in seconds per vehicle. The delays include queued vehicles decelerating and accelerating to and/or from stop, as well as delays experienced by all vehicles negotiating the intersection. At signalised and roundabout intersections, the average intersection delay is usually reported and is taken as the weighted average delay by summing the product of the individual movement traffic volumes and their corresponding calculated delays and dividing these by the total number of vehicles entering the intersection. At sign controlled intersections, the average delay for the worst movement is usually reported.

Maximum queue length

Queue length is the number of vehicles waiting at the hold line and is usually quoted as the 95th percentile back of queue, which is the value below which 95 percent of all observed queue lengths fall. For signalised intersections, it is measured as the number of vehicles per traffic lane at the start of the green period, when the traffic starts moving again after a red signal. The intersection queue length is usually taken from the movement with the longest queue length.

Explanation of SIDRA model outputs

An example of a SIDRA model output is provided below. An explanation of the model outputs follows the table.

Kamilaroi Highway/ Mine Access Road intersection 2028 AM peak operational
Giveaway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Kamilaroi Hwy S											
4	L	65	3.2	0.036	14.2	NA ^s	NA ^s	NA ^s	0.00	0.74	73.1
5	T	268	14.1	0.150	0.0	LOS A	0.0	0.0	0.00	0.00	110.0
Approach		334	12.0	0.150	2.8	LOS A	0.0	0.0	0.00	0.14	100.2
North: Kamilaroi Hwy N											
11	T	268	14.1	0.150	0.0	LOS A	0.0	0.0	0.00	0.00	110.0
12	R	97	2.2	0.112	15.8	LOS B	0.5	3.7	0.39	0.78	62.7
Approach		365	11.0	0.150	4.2	LOS B	0.5	3.7	0.10	0.21	95.4
West: Mine Access Road											
1	L	97	2.2	0.234	12.1	LOS A	1.1	8.1	0.50	0.75	54.6
3	R	65	3.2	0.235	12.2	LOS A	1.1	8.1	0.50	0.84	54.6
Approach		162	2.6	0.235	12.2	LOS A	1.1	8.1	0.50	0.79	54.6
All Vehicles		861	9.8	0.235	5.1	NA	1.1	8.1	0.14	0.29	84.8

“South: Kamilaroi Hwy S”: This indicates that the approach in question is the southern approach to the intersection, which is the Kamilaroi Highway South approach.

L, T, R: Refer to the *left-turn*, *through*, and *right-turn* movements in that approach respectively.

Demand flow: is the traffic volume for the corresponding turning movement.

HV%: means the percentage of heavy vehicles in the corresponding traffic stream.

Deg Satn: Refers to the degree of saturation (DoS) for that turning movement. See the explanation for DoS provided in this Appendix.

Average delay (seconds/vehicle): Traffic delay consists of dynamic delay and static delay. Dynamic delay consists of the time taken for a vehicle to slow down, negotiate through the intersection, and then speed up to the target speed of the intersection departure. This is particularly prominent for turning movements as there is significant deceleration and acceleration involved. Static delay is the delay incurred when the vehicle is in a queue and is not moving.

LoS: Refers to Level of Service as explained in this Appendix.

95% back of queue: This is the queue length in vehicles and in metres which is only exceed for 5% of the time. This is regarded as the maximum queue length for design purposes.

Prop queued: This refers to the proportion of traffic in the corresponding traffic stream that is queued.

Effective stop rate per vehicle: This is the average number of stops per vehicle. This considers vehicles in a queue and whether they progress to the front of the queue via series of start-stops (move ups) in which case there would be a high stop rate, or whether the vehicle tends to progress toward the queue head in one go. For priority-controlled intersections (not traffic signals) where queue progression is largely related to the randomness of gap availability and gap acceptance, there tends to be a relatively higher effective stop rate for vehicles in the low priority movements.

Average speed: The average speed of vehicles in the corresponding traffic stream.