CONSULTING CIVIL & TRAFFIC ENGINEERS, RISK MANAGERS.

Project: Transport Assessment and Analysis

MADDINGTON TOWN CENTRE AND CENTRAL MADDINGTON REDEVELOPMENT, MADDINGTON

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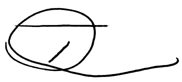

Date: 3rd January 2012

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Document Status

Ver No.	Author	Reviewed by	Date	Issued for	Signature	Date
1	P Yap	Bob Garton	20/08/10	Client review		20/08/10
1.1	P Yap	T Shaw	5/10/10	Revised after PB feedback		6/10/10
1.11	P Yap		21/10/10	Issued for client		
2.0	P Yap	G Miles	7/02/11	Revised after client feedback		08/02/11
3	P Yap, T Shaw		27/06/11			29/6/11
5	T Shaw	G Miles	22/08/11	Issued for client		25/08/11
6	T Shaw	G Miles	22/09/11	Issued for client		25/09/11
7	T Shaw	G Miles	29/09/11	Issued for client		29/09/11
8	T Shaw	G Miles	03/01/12	Issued for client		03/01/12

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1 Executive Summary

The City of Gosnells is undertaking structure planning for the Maddington Town Centre (MTC), an area that is currently characterised by fragmented, low-density residential, commercial and industrial uses, but is proposed to become a high-quality Transit Orientated Development (TOD) accommodating a mix of uses (including medium-high density residential), additional roads and areas of open space.

Transit oriented development promotes the creation of a network of well-designed, human-scale urban communities focused around transit stations that are characterised by:

• A rapid and frequent transit service;

• High accessibility to the transit station;

• A mix of residential, retail, commercial and community uses;

• High quality public spaces and streets, which are pedestrian and cyclist friendly;

• Medium- to high-density development within 800 metres of the transit station (i.e. the TOD precinct);

• Reduced rates of private car parking.

Research[1] has found that Transit-Oriented Developments generate much less (about half) car trips as conventional, car-oriented development. A parking and traffic generation study of Portland, Oregon transit oriented developments recorded 0.73 vehicles per housing unit, about half the 1.3 value in the ITE Parking Generation Handbook, and it recorded 0.15 to 0.29 vehicle trips per dwelling unit in the AM period and 0.16 to 0.24 vehicle trips per dwelling in the PM period, about half the 0.34 AM and 0.38 PM values in the Trip Generation Handbook.

By reducing car dependence and transport-related greenhouse gas emissions, TOD plays an important role in energy conservation, mitigation of climate change and air-quality improvement.

Concurrent with the redevelopment planning for the MTC, the City is also undertaking structure planning of Central Maddington (CM), a precinct to the east of, and adjacent to the MTC.

[1] Arrington, et al. (2008) and Cervero and Arrington (2008)

The key objectives of the transport assessment are:

- to assess the proposed internal transport networks with respect to accessibility, circulation and safety for all modes, ie. vehicle, public transport, pedestrian and cyclist;
- to assess the level of transport integration between the structure plan area and the surrounding land uses;
- to determine the impacts of the traffic generated by the structure plan area on the surrounding land uses; and
- to determine the impacts of the traffic generated by the structure plan area on the surrounding transport networks.

The development of the MTC is governed by planning guidelines while the CM development is guided by an Outline Development Plan (ODP).

The redevelopment of the MTC will commence with the Station Oval Precinct (SOP) and entails the following:

- Relocation of the Council Depot to the northern area of the precinct.
- Realignment of Canning Park Avenue and creation of a 4 way intersection with Kitson Place.
- Kitson Place will be connected to Kelvin Road by a new road.
- Creation of a new boulevard style road connection between Kitson Place and Pratt Street.
- Connection of the existing commuter car park access road to Pratt Street, the new north-south road linking Pratt Street and Kitson Street and a new road at the rear of the LandCorp site.
- Creation of a piazza type town square north of the railway line forming a focal point for the precinct.
- Reconfiguration of the remaining oval area as public open space.

Following development of the rail-bus modal interchange and should the reconstruction of the Maddington Railway Station involving lowering of the railway line proceed, the town square can extended over the railway line.

The balance of redevelopment in the MTC entails the following changes to the road network:

- Blackburn Street will be extended from Albany Highway to the railway line.

- Construction of the access road adjacent to the railway line linking the proposed extension of Blackburn Street to Kelvin Road.
- Construction of a new rail bus modal interchange and associated infrastructure.
- Reconstruction of the railway station.
- Redevelopment of the MCP and MRP precincts area into mixed land use.

The CMNP and CMSP precincts which form CM will be developed into higher density residential land use in accordance with the ODP

Based on research and reference to industry published generation rates, traffic flows associated with both precincts were estimated and formed a basis for determining impacts and necessary infrastructure improvements likely to be required.

Modelling of flows are summarised on Table 1.

Precinct	Sub Precinct	Trips generated under current land use.	Trips generated under proposed land use.
MTC	Station Oval Precinct (SOP).	1,389	7,654
SHP	Station Highway Precinct (SHP). North of Albany Highway, south of the Armadale - Perth rail line.	3,497	9,593
MCP	Maddington Commercial Precinct (MCP). North of Attfield Street.	3,323	9,468
MRP	Maddington Retail Precinct (MRP). South of Attfield Street.	15,393	15,223
CM	The Central Maddington North Precinct (CMNP). North of Albany Hwy.	1,827	2,848
	Central Maddington South Precinct (CMSP).	2,400	3,547
	Total	**27,829**	**48,333**

Table 1. Trips generated

The proposed redevelopment of Maddington using TOD based principles is anticipated to generate an increase of approximately 20,500 additional vehicle trips.

By precinct, increases in traffic can be split as below:

Maddington Town Centre: Additional traffic generation 18,334 vehicles per day

Central Maddington: Additional traffic generation 2,170 vehicles per day

In terms of changes to the network flows, modelling considered changes in development flows superimposed on current external – external network flows and development flows superimposed on 2031 external – external network flows. 2031 flows were sourced from the Main Roads WA ROM model.

A summary of flows is shown on Tables 2 and 3.

Street	Section	Existing ADT	Estimated Existing Internal - External	Estimated Existing External - External	Estimated Future External Internal	Estimated Future ADT
Albany Highway	East of Austin	31,100	7,650	23,450	10,880	34,330
	East of Railway	24,250	4,980	19,270	9,045	28,315
Austin Ave	North of Albany	12,250	680	11,570	2,570	14,140
Burslem Drive	At bridge	22,300	7,520	14,780	13,660	28,440
	South of Albany	12,380	6,040	6,340	7,575	13,915
Olga St	North of Burslem	15,400	4,550	10,850	8,680	19,530
	South of Albany	14,100	8,740	5,360	13,200	18,560
Attfield Street	East of Burslem	7,000	5,240	1,760	5,040	6,800
	West of Olga	7,000	2,450	4,550	3,280	7,830
	East of Olga	1,000	220	780	400	1,180
Kelvin Road	North of Albany	14,800	6,580	8,220	11,980	20,200
	North of Westfield	14,210	4,668	9,542	8,480	18,022
Westfield	East of Kelvin	3,650	800	2,850	520	3,370
Weston	East of Kelvin	1,580	340	1,240	300	1,540
The Crescent	East of Kelvin	3,000	1,430	1,570	2,690	4,260

Table 2. Predicted Future Distribution – Current Base Flows

Street	Section	2031 ROM ADT	Estimated Future External Internal	Estimated Future ADT
Albany Highway	East of Austin	26,990	10,880	37,870
	East of Railway	26,500	9,045	35,545
Burslem Drive	At bridge	15,620	13,660	29,280
	South of Albany	5,505	7,575	13,080
Olga St	North of Burslem	10,100	8,680	18,780
	South of Albany	10,100	13,200	23,300
Attfield Street	West of Olga	4,500	3,280	7,780
	East of Olga	780	400	1,180
Kelvin Road	North of Albany	15,280	11,980	27,260
	North of Westfield	15,280	8,480	23,760
Westfield	East of Kelvin	2,850	520	3,370
Weston	East of Kelvin	1,240	300	1,540
The Crescent	East of Kelvin	1,570	2,690	4,260

Table 3. Predicted Future Distribution – 2031 Base Flows

Impacts will be largely associated with the Maddington Town Centre as this potentially will generate significantly greater volumes of traffic. Generation from Central Maddington is predicted to be low and the changes in traffic volumes are not expected to trigger infrastructure upgrades with the exception of possible improvements to the Kelvin Road – Westfield Street intersection.

As part of that study, impacts on the transport network were considered under two scenarios:

Scenario one considered the Maddington Town Centre Study Area, with the existing road network including the Preliminary Design Proposal for the Station-Oval Precinct.

Scenario two considered the Maddington Town Centre Study Area, as a modified road network with proposed improvements including:

- Streetscape improvements and widening of Albany Highway;
- Extension of the Blackburn Main Street;
- A new bus interchange at the Maddington Train Station;
- Preliminary Design Proposal for the Station-Oval Precinct.

The analysis indicated that little difference in impact on the road network under either scenario was expected and impacts predicted for one would likely apply to the other scenario.

Key impacts identified by the study are summarised on Table 4:

Element	Trigger	Impact
Albany Highway	Once volumes reach 32,000 vpd.	Mid block LOS drops to "E"
Burslem Drive	Once volumes reach 18,000 vpd.	Mid block LOS drops to "E"
Kelvin Road	Increase in rail services / increase in Albany Highway traffic.	Excessive queuing of northbound traffic at the rail crossing impacting on Albany Highway.
Intersection of Burslem Drive – Albany Highway		Degree of saturation reaches 1 and intersection becomes over saturated
Intersection of Kelvin Road – Albany Highway	Current flows.	Degree of saturation currently 1 and intersection over saturated
Kelvin Road – Interchange intersection	Completion of the interchange.	Bus services on Kelvin Road may experience unacceptable delays.
Westfield Road – Kelvin Road intersection	Once Westfield Road volumes reach 4,000 vpd.	Intersection becomes oversaturated.

Table 4. Summary of Impacts

In order to address impacts, strategies summarised on Table 5 are recommended.

Element	Impact	Response
Albany Highway	Mid block LOS drops to "E"	Widen and create central median with turn pockets.
Burslem Drive	Mid block LOS drops to "E"	Widen from 2 lanes to 4.
Kelvin Road	Excessive queuing of northbound traffic at the rail crossing impacting on Albany Highway.	Ideally create a grade separated crossing (not feasible). Coordinate crossing boom gates with Albany Highway signals. Introduce better detection technology. Consider dedicated bus lanes.
Intersection of Burslem Drive – Albany Highway	Degree of saturation reaches 1 and intersection becomes over saturated	Increase capacity by providing double right turn pockets from Albany Highway into Burslem Drive.
Intersection of Kelvin Road – Albany Highway	Degree of saturation currently 1 and intersection over saturated	Increase capacity by providing double right turn pockets from Kelvin Road to Albany Highway (May not be feasible).
Kelvin Road – Interchange intersection	Bus services on Kelvin Road may experience unacceptable delays.	Consider dedicated bus lanes on Kelvin Road.
Westfield Road – Kelvin Road intersection	Intersection becomes oversaturated.	Install traffic signals.

Table 5. Summary of Impacts

The timing of the recommended infrastructure upgrades will not be solely determined by the redevelopment staging as it is anticipated that redevelopment will proceed on a site by site basis. As the study area is a brown field site, the upgrade of transport infrastructure will be triggered by future demand and growth in existing demand.

Existing road cross sections in the MTC and CM are generally adequate with the exceptions detailed above and new roads should have cross sections consistent with Access Roads Types B, C and D as defined by "Liveable Neighbourhoods".

Parking management to support walking, cycling and public transport accessibility is important in the development of TOD precincts. Where there is a high level of parking supply for residents, workers and visitors, the use of public transport may be discouraged.

It is recommended that parking management should incorporate good practice and be governed by a parking management plan that sets maximum parking supply rates rather than minimum rates and provides a future plan for shared parking facilities.

Lower parking generation rates are recommended to ensure that an oversupply of parking does not occur.

As current parking provisions are based on the paradigm that parking is free and car use is encouraged to access a land use, the move to TOD based principles will require a change in mind set by residents and tenants.

For retail and short term visitors, the preference is to direct them to either on-street shared parking or secondary off street shared parking with good pedestrian linkage to the shops and commercial areas.

The parking management plan should outline the strategic vision and philosophy of the new parking management paradigm, as well as outlining in more detail, measures to be deployed in each precinct and governance and review mechanisms to evaluate the effectiveness of the parking management plan.

Parking management measures that are considered to be appropriate to the TOD and should be included in the integrated parking management plan are:

- Establishment of maximum parking levels.
- Establishment of pricing policy to facilitate recoup of the cost of provision of parking and to encourage the use of alternate modes of transportation.
- Define parking zones and parking restrictions that do not inhibit commercial and retail activities but discourage long term private car use.
- Where feasible, provide mechanisms for the unbundling of parking entitlements in buildings to create more choice and lower the cost of renting or buying real estate.
- Establish enforcement framework to encourage compliance and maintain integrity of the parking regulation regime.
- Establish plans to manage occasional peak parking demands in the study area.
- Address parking spill-over issues in adjacent areas using management, enforcement and pricing tools.

The provision of shared parking could be staged with an initial facility provided to service the quantum of commercial / retail floor space initially approved.

As further development progressed, additional bays could be provided to meet increasing demand.

As it is not possible to accurately predict the level of parking demand over time, as this is dependent on development uptake rate and the effectiveness of the combined parking management measures, the integrated parking plan should be coupled with contingency planning such as land banking for future parking supply.

2 Introduction and Background

2.1 Objectives.

The key objectives of this transport assessment are:

- to assess the proposed internal transport networks with respect to accessibility, circulation and safety for all modes, ie. vehicle, public transport, pedestrian and cyclist;
- to assess the level of transport integration between the structure plan area and the surrounding land uses;
- to determine the impacts of the traffic generated by the structure plan area on the surrounding land uses; and
- to determine the impacts of the traffic generated by the structure plan area on the surrounding transport networks.

2.2 Scope of the Study.

The City of Gosnells commissioned Parsons Brinkerhoff to report on the proposed redevelopment of the Maddington Town Centre (MTC), including the sub-area within the MTC designated as the Station Oval Precinct (SOP) into a mixed use precinct based on Transit Oriented Development (TOD) principles

As part of that study, Parsons Brinkerhoff engaged Shawmac to assess the impacts on the transport network under two scenarios:

Scenario one was to consider the Maddington Town Centre Study Area, with the existing road network including the Preliminary Design Proposal for the Station-Oval Precinct.

Scenario two was to consider the Maddington Town Centre Study Area, as a modified road network with proposed improvements including:

- Streetscape improvements and widening of Albany Highway;
- Extension of the Blackburn Main Street;
- A new bus interchange at the Maddington Train Station;
- Preliminary Design Proposal for the Station-Oval Precinct.

Primary outcomes from the Study are:

- Recommendations and modelling of suggested design improvements to the movement network, parking and urban design proposals under both scenarios;
- Recommended parking requirements, traffic and parking management strategies as well as traffic management improvements required to the existing and proposed network;
- Predicted future traffic volumes based on current levels, proposed structure planning and network improvements for critical development years, such as at partial and full development built-out in line with likely development timeframes.

Subsequent to commencement of the Study, the Study Area was extended to include the area to the east designated as Central Maddington (CM) and covered by a separate Outline Development Plan.

2.3 Study Site Characteristics.

Maddington is located approximately 17 kilometres southeast of the Perth CBD, and is a mixed-use suburb comprising residential, retail and industrial land uses as well as some remnant semi-rural areas. Maddington is classified as a "secondary centre" by the Western Australian Planning Commission[2] and as, provides commercial focal points which include a combination of activities such as offices, retail, higher-density housing, entertainment, civic/community, education and medical services.

Maddington was originally an agricultural area servicing the growing City of Perth. In the 1950s and 1960s, Maddington and surrounding areas were subdivided and developed as residential and industrial suburbs.

The general location of Maddington in relation to Perth CBD is shown in Figure 1.

[2] WAPC, Outer Metropolitan Perth and Peel sub-regional strategy, Section 10-South-east sub-region.

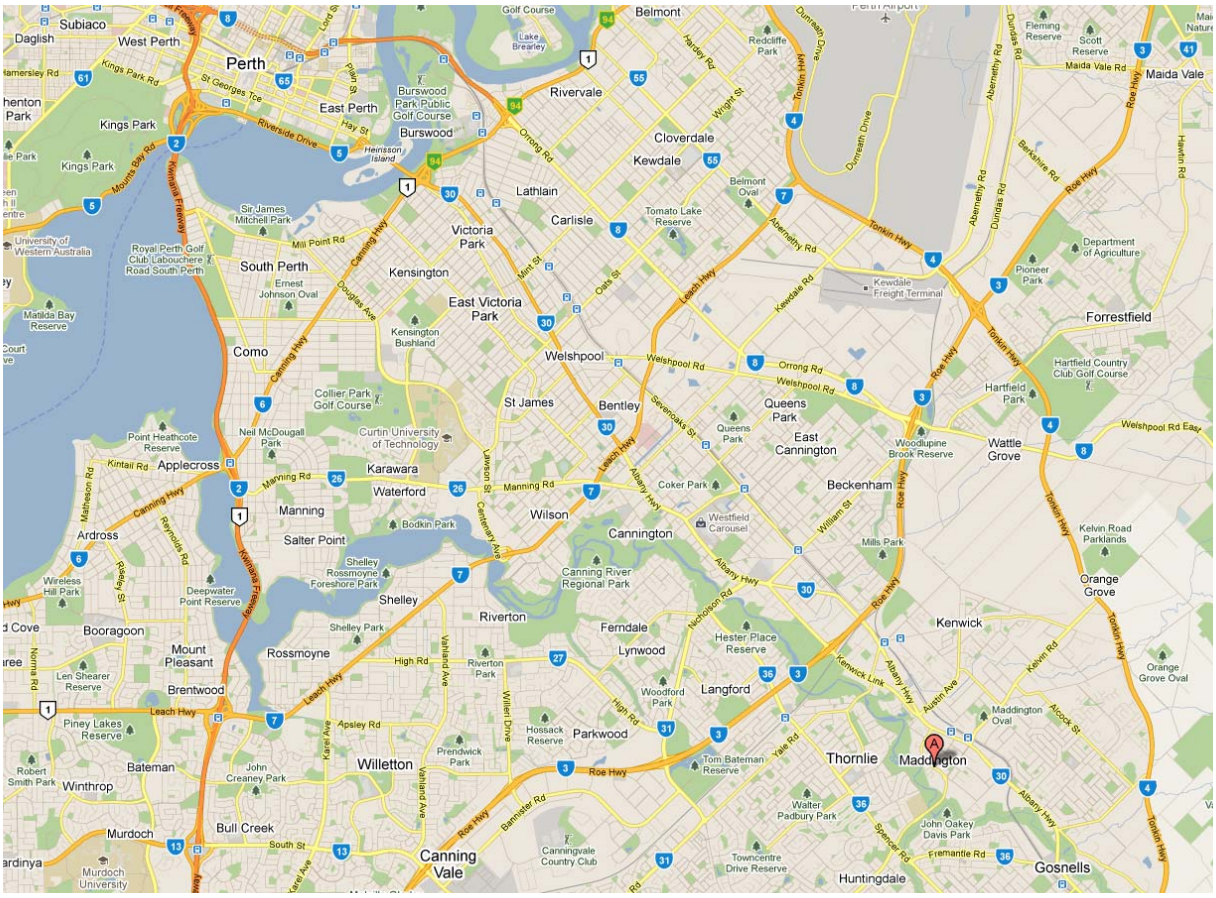


Figure 1. General location of Maddington in relation to the Perth CBD

Within the study area there are a number of distinct cells having differing characteristics.

The Davison industrial estate is situated north-west of the Maddington Town Centre (MTC) and was formerly the Canning Park Race Course. The estate is bounded by Alloa Road, Lower Park Road, Kelvin Road and the Armadale – Perth railway line. The estate lacks strong pedestrian and vehicle connections to the MTC as it is separated by the Armadale-Perth railway line and Albany Highway.

The north east cell bounded by Kelvin Road, Yule Road, Morley Road and Albany Highway forms part of the CM precinct and is predominantly single residential housing and similarly has poor connectivity to the south due to the Armadale – Perth railway line and Albany Highway.

Also forming part of the CM cell is the residential area to the south of the Highway and bounded by Olga Road, Albany Highway, the Armadale – Perth railway line and Canning River.

Adjacent to Albany Highway, land has been developed in a linear fashion and land use consists of light industrial facilities, retail shops and car yards. Albany Highway forms the main thoroughfare through the MTC and the adjoining land use obscures the railway station and other features contributing to the lack of a strong focal point identity for the MTC along its major thoroughfare.

The south west cell of the MTC is largely commercial, the most dominant sites of which is the Centro Shopping Centre. The Cell also contains retail and office uses, petrol station and Tavern. Between Attfield Street and Albany Highway, there is a mix of commercial and residential uses, with a significant amount of vacant or under utilised land.

The MTC also supports an Australian Trades College campus offering automotive training. The Thornlie campus of the Swan TAFE is located outside of the south western boundary of MTC, and provides a major education and employment hub for the area.

As part of the revitalisation of the MTC, the City of Gosnells has developed a master plan based on transit oriented development (TOD) principles. The master plan aims to transform MTC into a vibrant and connected urban centre with a diverse range of housing and employment options that are accessible without heavy reliance on motor vehicles. The MTC and CM are shown in Figure 2, with the study areas being bounded by the following:

- Burslem Drive and Canning River to the south,
- Burslem Drive south of Albany Highway and Alloa Road north of the railway line to the west,
- Lower Park Road and Yule Street to the north,
- Canning River south of Albany Highway and the end of the housing area accessed by Aldington Street, Longfield Road, Kingsdown Road and Barford Street north of Albany Highway to the east.

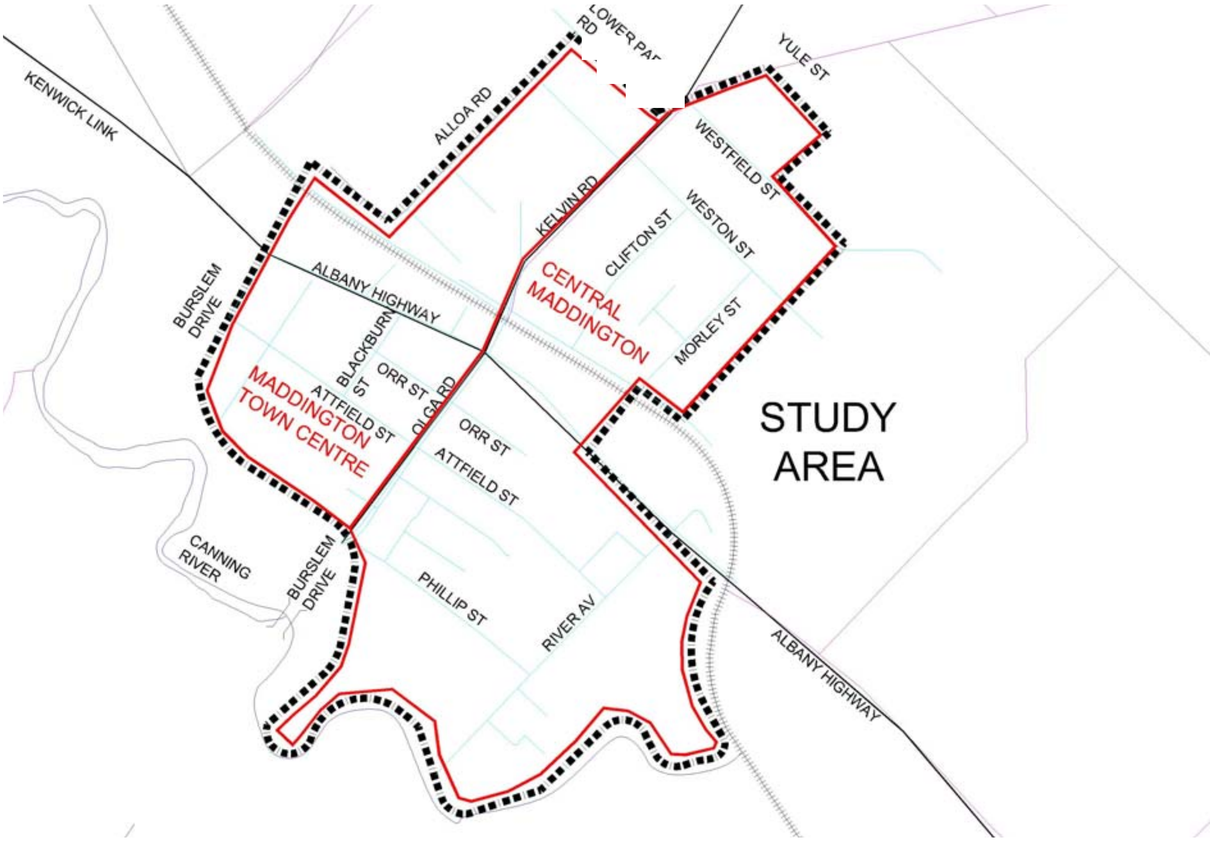


Figure 2. Maddington Town Centre and Central Maddington Study Areas

3 Proposed Structure Plan

3.1 Town Planning Framework

The redevelopment of precincts within and adjacent to the MTC and CM are guided by the following town planning instruments:

- The Central Maddington Outline Development Plan;
- Local Planning Policies – The Maddington Town Centre Development Policy;
- The City of Gosnells Town Planning Scheme No.6;
- The Station Oval Precinct Outline Development Plan.

The objectives of the above are primarily aimed at redeveloping the Station Oval Precinct and its surrounding precincts within MTC as a mixed use commercial and residential land uses based on TOD principles, and the CM precinct as residential land uses, albeit at higher densities.

3.1.1 Transit Oriented Development Principles

The key characteristics of a transit oriented development are:

- a rapid and frequent transit service;
- high accessibility to the transit station;
- a mix of residential, retail, commercial and community uses;
- high-quality public spaces and streets which are pedestrian and cyclist friendly;
- medium to high density development within 800 metres of a transit station;
- reduced rates of private car parking.

To achieve these characteristics, the following elements are incorporated into the planning process:

- Walkable design with pedestrian accessibility is assigned a high priority.
- The public transport node (train station) is to be developed as a prominent feature of the town centre.
- The MTC is designated as a regional activity node containing a mixture of uses in close proximity including office, residential, retail, and civic uses.

- High density, high-quality residential development and public open space are located within a 10-minute (800 metres) walking distance of the public transport node (train station).

- The MTC redevelopment has been designed to encourage the use of bicycles and other non-motorised modes, as part of the transportation system.

- There will be reduced and managed car parking inside a 10 minute walking distance from the town centre and train station.

3.2 Existing MTC and CM Land Use

The existing MTC and CM land use can generally be categorised into the following four broad categories:

- Light Industrial / Warehousing;
- Retail;
- Commercial; and
- Residential.

The MTC and CM have been subdivided into 6 Transport Assessment Zones (TAZ's) designated as:

- The Station Oval Precinct (SOP),
- The Station Highway Precinct (SHP),
- The Maddington Commercial Precinct (MCP),
- The Maddington Retail Precinct (MRP),
- The Central Maddington North Precinct (CMNP), and
- The Central Maddington South Precinct (CMSP).

The six precincts are defined in Table 6, and are shown in Figure 3.

Precinct	Boundary of Precinct			
	North East	North West	South East	South West
SOP	Lower Park Road	Alloa Road	Kelvin Road	Railway Line
SHP	Railway Line	Industrial Land	Kelvin Road	Albany Highway
MCP	Albany Highway	Burslem Drive	Olga Road	Attfield Street
MRP	Attfield Street	Burslem Drive	Olga Road	Burslem Drive
CMNP	Yule Street and Westfield Street	Kelvin Road	East of Morley Street	The Crescent
CMSP	Albany Highway	Olga Road	Railway Line and Canning River	Canning River

Table 6. Boundaries of Precincts in Study Area

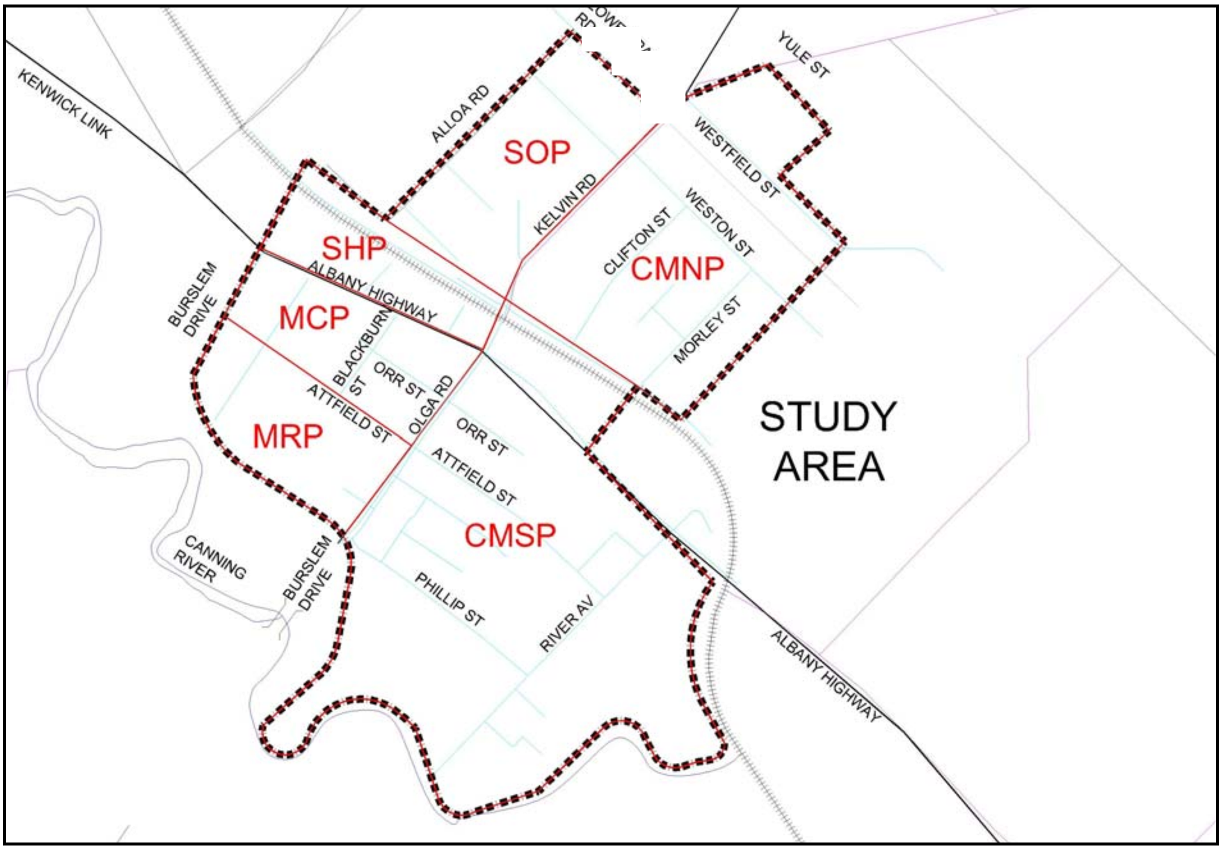


Figure 3. Study Area Precincts

The City of Gosnells advises that the existing land uses within the MTC and CM are distributed as shown in Table 7.

Precinct	Industrial (Square Metres)	Retail (Square Metres)	Commercial / Recreation / Community Uses (Square Metres)	Residential (Units)
SOP	108,596 (Land Area)	0	0	0
SHP	8,215	8,016	3,286	0
MCP	637	5,526	5,534	5
MRP	0	28,380	1,315	0
CMNP	0	0	0	203
CMSP	0	0	0	133

Table 7. Existing Land Use in Study Area

3.3 Proposed MTC and CM Structure Plans

The development of the MTC is governed by planning guidelines while the CM development is guided by an Outline Development Plan (ODP).

The redevelopment of the MTC will commence with the Station Oval Precinct (SOP) and entails the following:

- Relocation of the Council Depot to the northern area of the precinct.
- Realignment of Canning Park Avenue and creation of a 4 way intersection with Kitson Place.
- Kitson Place will be connected to Kelvin Road by a new road.
- Creation of a new boulevard style road connection between Kitson Place and Pratt Street.
- Connection of the existing commuter car park access road to Pratt Street, the new north-south road linking Pratt Street and Kitson Street and a new road at the rear of the LandCorp site.
- Creation of a piazza type town square north of the railway line forming a focal point for the precinct.
- Reconfiguration of the remaining oval area as public open space.

Following development of the rail-bus modal interchange and should the reconstruction of the Maddington Railway Station involving lowering of the railway line proceed, the town square can extended over the railway line.

The balance of redevelopment in the MTC entails the following changes to the road network:

- Blackburn Street will be extended from Albany Highway to the railway line.

- Construction of the access road adjacent to the railway line linking the proposed extension of Blackburn Street to Kelvin Road.
- Construction of a new rail bus modal interchange and associated infrastructure.
- Reconstruction of the railway station.
- Redevelopment of the MCP and MRP precincts area into mixed land use.

The CMNP and CMSP precincts which form CM will be developed into higher density residential land use in accordance with the ODP shown in Figure 4.

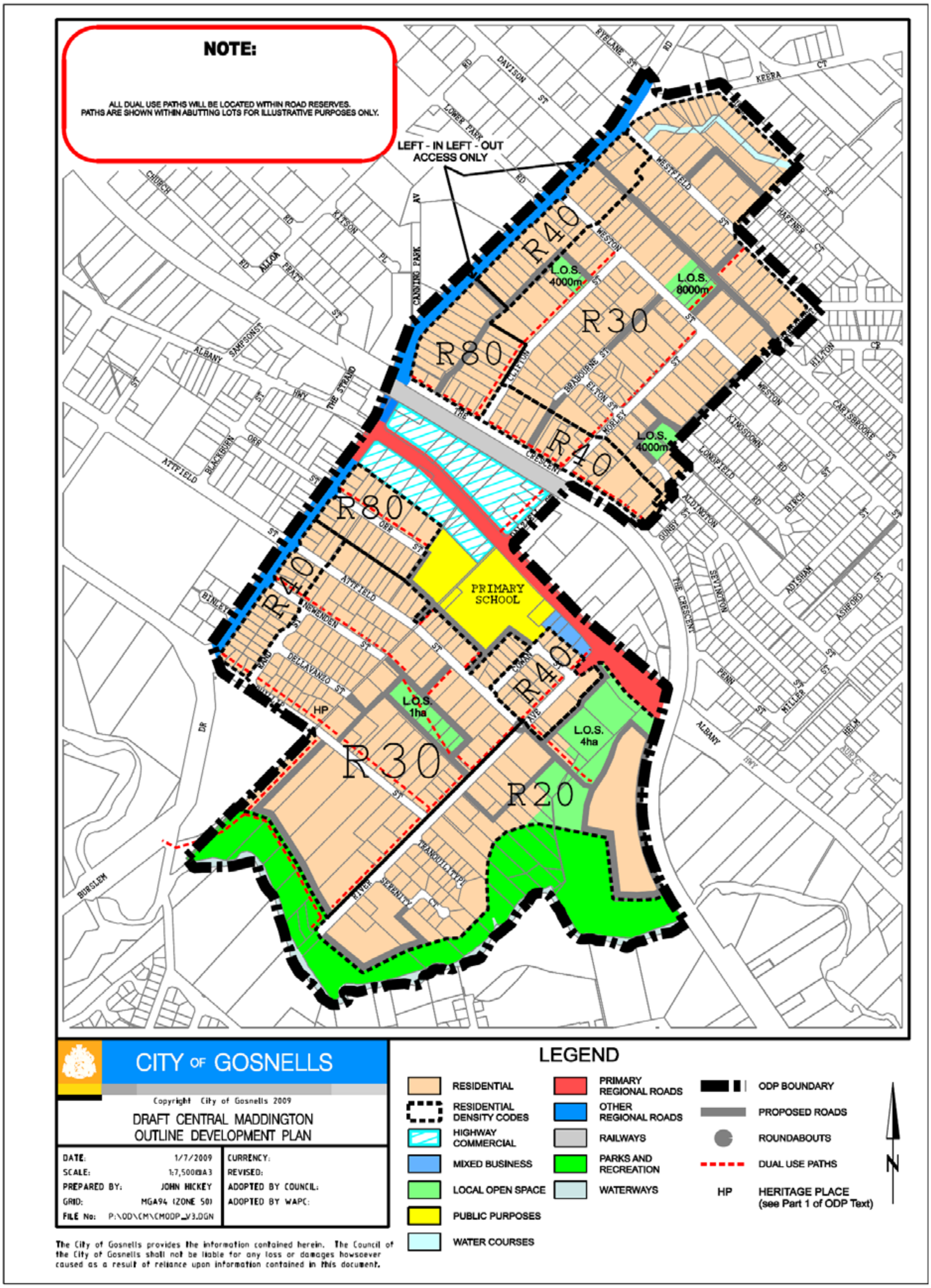


Figure 4. Central Maddington ODP

The breakdown of the proposed land use within the MTC and CM zones is shown in Table 8.

Precinct	Residential Units	Commercial (Square Metres)	Retail (Square Metres)
SOP	1,169	54,680	7,275
SHP	321	37,450	22,700
MCP	483	40,400	20,000
MRP	400	65,000	35,000
CMNP	1,218	0	0
CMSP	1,058	10,000	0
Total	**4649**	**207,530**	**84,975**

Table 8. Proposed Land Use Yields in the Study Area

3.4 Major Attractors and Generators

Specific generators / attractors resulting from the proposed development include a school site and highway commercial zone on Central Maddington and commercial and light industrial zones in the Maddington town Centre.

The proposed bus – rail interchange will function as a major attractor also.

External to the Study site, a number of attractors exist including the Perth CBD, Armadale Regional Centre, Carousel Regional Shopping Centre and the Polytechnic West Thornlie Campus.

4 Existing Situation

4.1 Existing Land Use.

The existing land use is consistent with the current land use zoning which is shown on Figure 5.

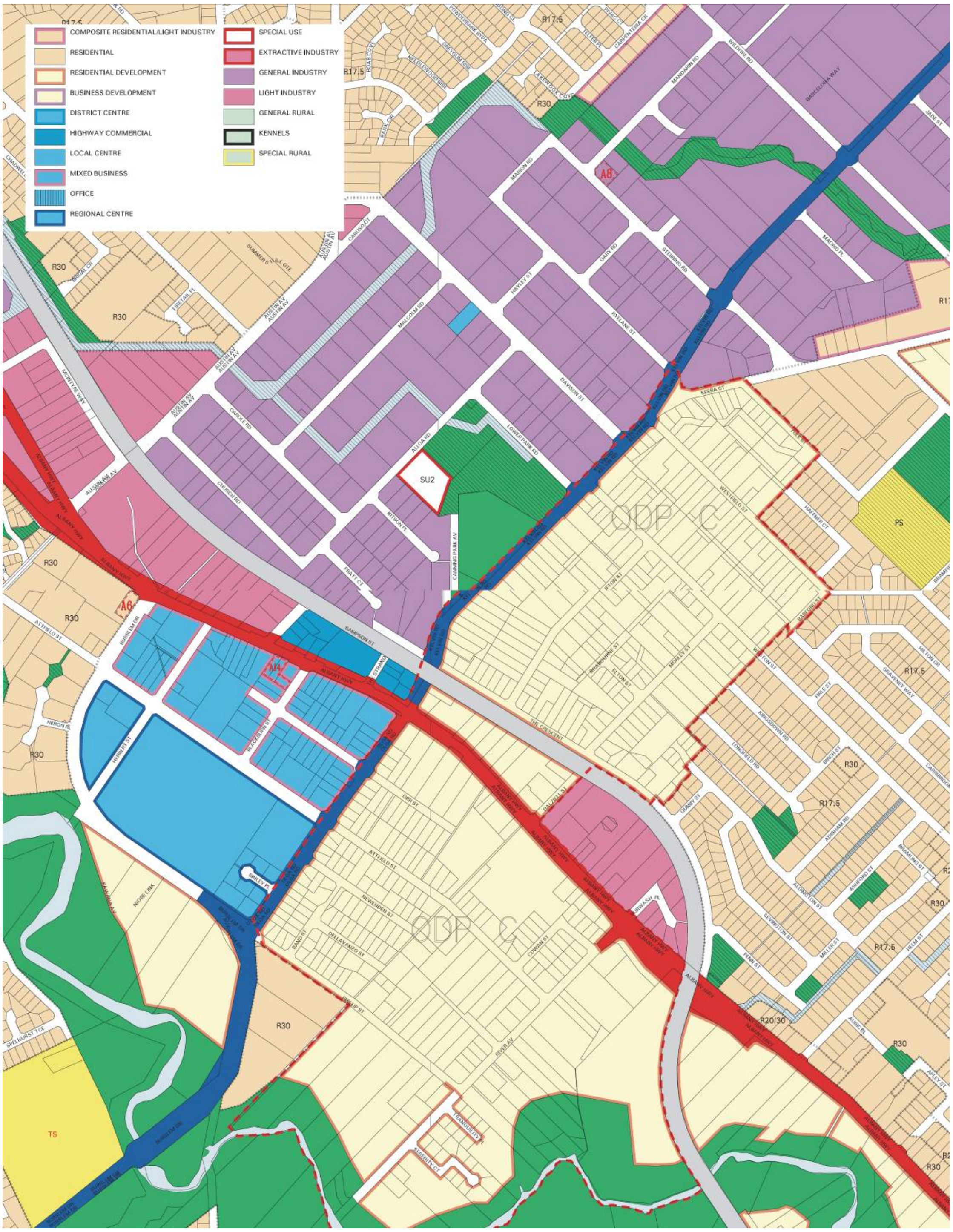


Figure 5. Existing Zoning

4.2 Existing Transport Network

4.2.1 Existing Road Network

The existing road network is defined by the Main Roads WA Functional Road Hierarchy as shown on Figure 6.

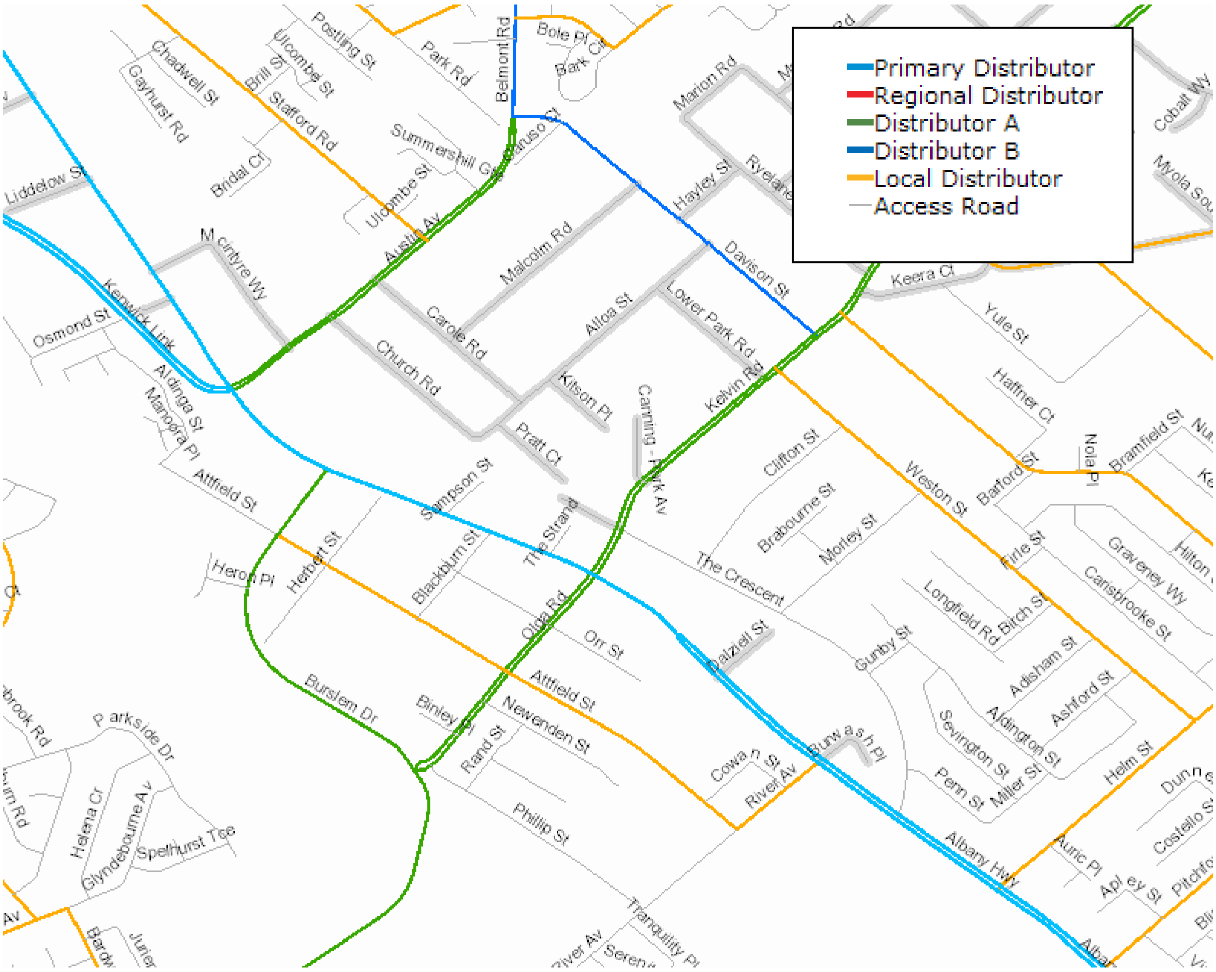


Figure 6. Road Hierarchy

Albany Highway is classified as a Primary Regional Road under the Metropolitan Region Scheme and a Primary Distributor under the Functional Road Hierarchy. It comprises a four lane undivided road with a number of central islands constructed to provide pedestrians with staged road crossings. Based on recent Main Roads Western Australia (MRWA) SCATS traffic counts from the Albany Highway – Burslem Drive signalised intersection, Albany Highway carries approximately 27,000 vehicles per day south of the intersection. Historical counts sourced from Main Roads WA indicated daily volumes of 24,800 north of Kelvin Road (2009) and 24,900 south of Kelvin Road (2003). The speed zone on Albany Highway through MTC is 60 km/hr.

The Albany Highway intersection with Burslem Drive is a 3 way signalised intersection with a protected right turn pocket constructed to provide queuing space for vehicles intending to turn right from Albany Highway into Burslem Drive.

The Albany Highway intersection with Olga Road and Kelvin Road is a 4 way signalised intersection without dedicated right turn pockets on Albany Highway; right turn pockets are provided on Olga Road and Kelvin Road respectively. Right turns from Albany Highway are banned during peak traffic periods. A boom controlled railway crossing is located approximately 70 metres north of the intersection of Albany Highway, Olga Road and Kelvin Road.

Kelvin Road is classified as an Other Regional Road under the Metropolitan Region Scheme and a District Distributor Road A under the MRWA Metropolitan Functional Road Hierarchy (FRH) document. It provides a link to Tonkin Highway which is located approximately 3.5 km to the north. Kelvin Road is a four lane divided road with right turn pockets provided in a central median. Based on MRWA SCATS data, Kelvin Road carries approximately 14,800 vehicles per day. Historical counts sourced from Main Roads WA indicated daily volumes of 13,760 south of Tonkin Highway (2009), 12,800 south of Bickley Road (2009), 14,210 west of Maddington Road and 24,730 at the rail crossing (2007). Kelvin Road provides access to the commuter car park adjacent to the Maddington Railway Station and will provide access to the proposed Station Oval Precinct.

Olga Road is classified as an Other Regional Road the Metropolitan Region Scheme and a District Distributor a road under the MRWA Metropolitan Functional Road Hierarchy. Olga Road provides access into the core retail/ commercial area of the MTC located south west of the Albany Highway intersection. Olga Road is a four lane divided road with a central median. It links Albany Highway in the north and Burslem Drive in the south. Based on MRWA SCATS counts taken in May 2010, approximately 14,100 vehicles per day travel on Olga Drive. Historical counts sourced from MRWA palace daily volumes at 12,450 (2009).

The Olga Road intersection with Orr Street is a 4 way priority controlled intersection with right turn pockets constructed on Olga Road. Orr Street is a local street providing access to the MTC commercial centre in the north-west and a residential area in the south-east.

The Olga Road intersection with Attfield Street is a 4 way signalised intersection with right turn pockets in the median of Olga Road. Attfield Street is classified as a Local Distributor and based on 2010 SCATS traffic counts provided by MRWA Attfield Street north west of Olga Road carries approximately 7,000 vehicles per day. North west of Olga Road Attfield Street is a divided 2 lane carriageway with 3.5 metres lanes separated by a part raised part painted 3.5 metre wide central median. Attfield Road provides access and egress to the Centro Maddington Shopping Centre and at its northwest end links with Burslem Drive. South east of Olga Road, Attfield Street comprises a single 2 lane undivided carriageway 7.4 metres wide.

Burslem Drive is an unclassified road under the Metropolitan Region Scheme, and classified as a District Distributor Road A, under the MRWA Metropolitan Functional Road Hierarchy. Burslem Drive is a 2 lane divided carriageway with 3.5 metre wide lanes separated by a part raised part painted central median 1.8 metres wide. Burslem Drive provides connection between Spencer Road and Albany Highway and south of Spencer Road provides a continuous route along Warton Road MRWA SCATS data indicates that Burslem Drive carries approximately 11,800 vehicles per day south of the intersection with Albany Highway. Other traffic counts sourced from MRWA and taken in 2009 indicate a daily volume of 17,900 vehicles per day at the bridge located south of the Olga Road intersection. The City of Gosnells also undertook counts in 2009 and recorded daily volumes of 22,330 at the Burslem Drive Bridge and 9,490 south of Attfield Street.

Roundabouts are provided at the intersection of Burslem Drive and Olga Road and Burslem Drive and Attfield Street.

Westfield Street and Weston Street are Local Distributor roads that provide east – west connections from Kelvin Road to the CM north east precinct. Westfield Street consists of a two lane carriageway with 3.7 metre lanes separated by a 2.1 metre painted median. Weston Street consists of a 2 lane carriageway 7.4 metres wide. Both streets form channelised priority controlled intersections with Kelvin Road.

The major roads configuration and intersection configurations are shown on Table 9 and Table 10 respectively. The existing road network within the study area is shown in Figure 7.

Road	AADT	Speed Zone (km/h)	MRWA Functional Road Hierarchy
Albany Highway	24,800 – 27,000	60	Primary Distributor
Kelvin Road	14,210 - 14,800	60	District Distributor A
Olga Road	14,100	60	District Distributor A
Burslem Drive	11,800 – 22,330	60	District Distributor A
Attfield Street	7,000	50	Local Distributor
Westfield Street		50	Local Distributor
Weston Street		50	Local Distributor

Table 9. Summary of Major Road Traffic Volumes and Hierarchy

Road	Carriageway configuration	Capacity	Major intersections	Intersection configuration
Albany Highway between Burslem Drive and Kelvin Road	4 lane single carriageway	36,000 vpd	Burslem Drive	T intersection with traffic control signals.
			Kelvin Road and Olga Road	4 way intersection with traffic control signals. No right turns from Albany Highway during peak hours.
Kelvin Road	4 lane dual carriageway	36,000 vpd	Albany Highway and Olga Road	4 way intersection with traffic control signals.
			Rail crossing	Boom and signal controlled crossing.
			Weston Street	3 way channelised priority controlled intersection.
			Westfield Street	3 way channelised priority controlled intersection.
Burslem Drive between Albany Highway and Olga Road	Two way, two lanes painted median	13,500vpd	Albany Highway	T intersection with traffic control signals.
			Olga Road	3 way intersection with roundabout.
			Attfield Street	4 way intersection with roundabout.
Olga Road	4 lane dual carriageway	36,000 vpd	Albany Highway	4 way intersection with signals
			Orr Street	4 way channelised priority controlled intersection.
			Attfield Street	4 way intersection with signals
			Burslem Drive	3-way intersection with roundabout

Table 10. Summary of Major Road Configuration

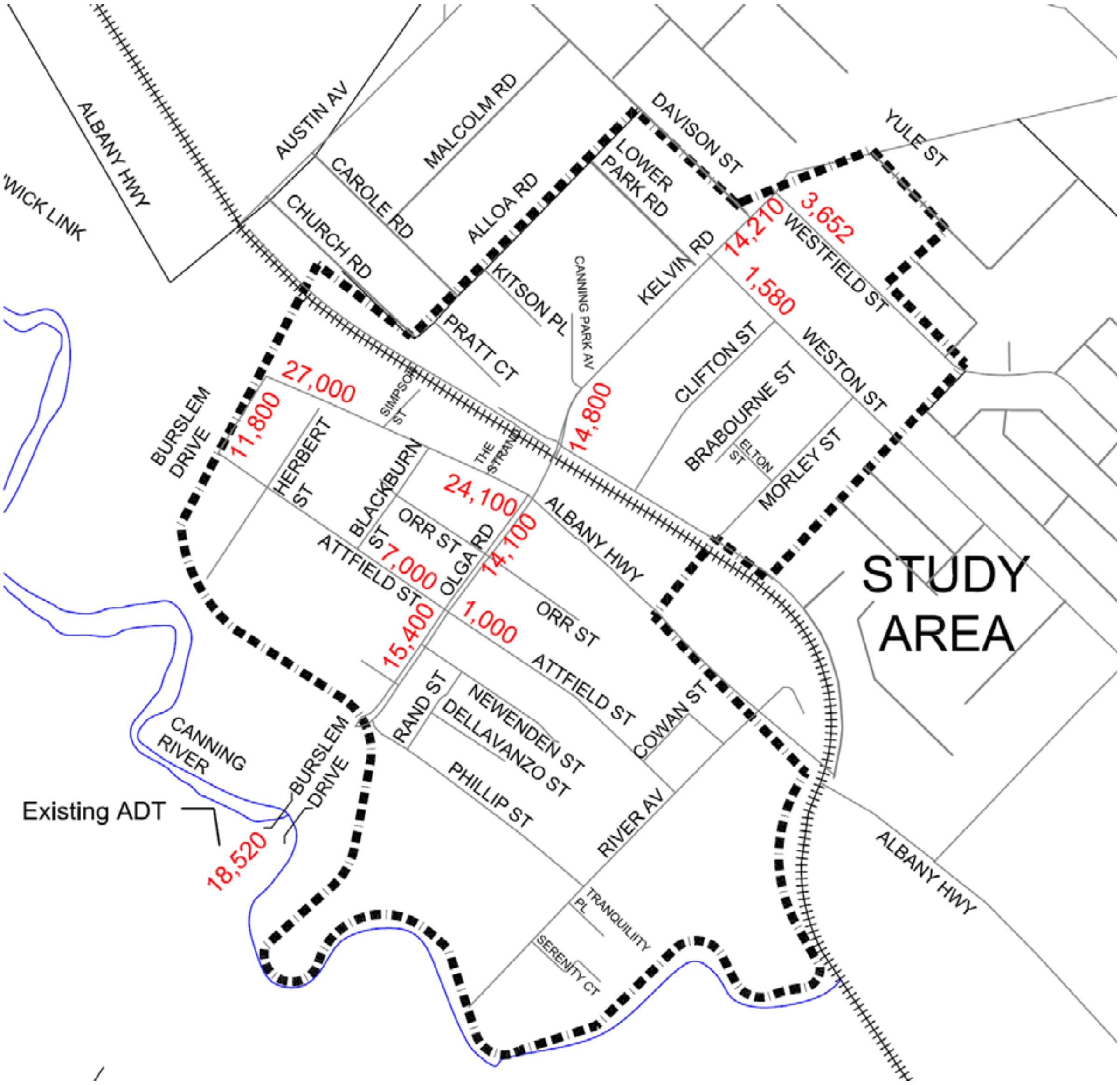


Figure 7. Existing Road Network within the MTC and CM Study Area

Existing traffic flows based on MRWA SCAT counts taken over a 1 week period in May 2010 are summarised below. Flows are reported as AM peak, PM peak and daily flows.

4.2.2 Albany Highway – Burslem Drive.

AM	Albany Hwy SB	Albany Highway NB	Burslem Approach	Burslem Departure
Mon	667	1266	470	419
Tue	720	1342	442	417
Wed	473	1600	510	315
Thu	687	1379	462	440
Fri	734	1295	416	392
Total	**3,281**	**6,882**	**2,330**	**1,983**
Average	**656**	**1,376**	**466**	**397**
Combined	**2,032**		**863**	

PM	Albany Hwy SB	Albany Highway NB	Burslem Approach	Burslem Departure
Mon	1300	825	460	672
Tue	1340	970	480	700
Wed	1359	848	452	667
Thu	1274	913	485	686
Fri	1333	944	464	658
Total	**6,606**	**4,500**	**2,341**	**3,383**
Average	**1,321**	**900**	**468**	**677**
Combined	**2,221**		**1,145**	
Daily	**Albany Hwy SB**	**Albany Highway NB**	**Burslem Approach**	**Burslem Departure**
Mon	12158	13192	5429	5948
Tue	12496	13845	5357	6177
Wed	12643	14160	5388	6228
Thu	13131	14650	5748	6749
Fri	13588	14877	5521	6442
Total	**64,016**	**70,724**	**27,443**	**31,544**
Average	**12,803**	**14,145**	**5,489**	**6,309**
Combined	**26,948**		**11,798**	

Table 11. Albany Highway – Burslem Drive SCATS Summary

4.2.3 Albany Highway - Olga road - Kelvin Road.

AM	Albany Hwy Southbound	Albany Hwy Northbound	Olga approach	Olga departure	Kelvin Approach	Kelvin Departure
Mon	548	1127	508	424	585	482
Tue	573	1126	544	462	617	520
Wed	526	1202	514	481	653	500
Thu	553	1187	521	477	657	513
Fri	578	1117	534	444	623	521
Total	**2,778**	**5,759**	**2,621**	**2,288**	**3,135**	**2,536**
Average	**556**	**1,152**	**524**	**458**	**627**	**507**
Combined	**1,708**		**982**		**1,134**	
PM	**Albany Hwy Southbound**	**Albany Hwy Northbound**	**Olga approach**	**Olga departure**	**Kelvin Approach**	**Kelvin Departure**
Mon	990	709	606	546	669	497
Tue	1145	648	712	629	796	546
Wed	1179	597	689	606	749	536
Thu	1099	704	710	650	786	557
Fri	1143	704	744	598	757	583
Total	**5,556**	**3,362**	**3,461**	**3,029**	**3,757**	**2,719**
Average	**1,111**	**672**	**692**	**606**	**751**	**544**
Combined	**1,847**		**1,342**		**1,340**	
Daily	**Albany Hwy Southbound**	**Albany Hwy Northbound**	**Olga approach**	**Olga departure**	**Kelvin Approach**	**Kelvin Departure**
Mon	10476	10878	7183	5611	7309	6172
Tue	10771	11230	7510	5902	7699	6349
Wed	10934	11617	7704	5904	7774	6463
Thu	11272	12265	8253	6242	8101	6772
Fri	11745	12356	7957	6204	8122	6713
Total	**55,198**	**58,346**	**38,607**	**29,863**	**39,005**	**32,469**
Average	**11,040**	**11,669**	**7,721**	**5,973**	**7,801**	**6,494**
Combined	**24,101**		**14,161**		**14,835**	

Table 12. Albany Highway – Olga Road SCATS Summary

4.2.4 Burslem Drive south of Olga

AM	Burslem Dr Approach	Burslem Dr Departure
Mon	394	1101
Tue	399	1146
Wed	404	1089
Thu	439	1156
Fri	389	1024
Total	**2,025**	**5,516**
Average	**405**	**1103**
Combined	**1,508**	
PM	**Burslem Dr Approach**	**Burslem Dr Departure**
Mon	1020	663
Tue	1012	577
Wed	1050	653
Thu	1059	791
Fri	1011	694
Total	**5,152**	**3,378**
Average	**1,030**	**676**
Combined	**1,706**	
Daily	**Burslem Dr Approach**	**Burslem Dr Departure**
Mon	7831	9748
Tue	8215	9966
Wed	8296	10026
Thu	8944	10869
Fri	8498	10214
Total	**41,784**	**50,823**
Average	**8,357**	**10,165**
Combined	**18,522**	

Table 13. Burslem Drive SCATS Summary

4.2.5 Attfield (West) – Olga

AM	Olga Southbound Approach	Olga Northbound Approach	Attfield Approach	Attfield Departure
Mon	440	638	93	216
Tue	433	634	96	212
Wed	444	651	124	232
Thu	492	664	130	265
Fri	442	518	169	287
Total	**2,251**	**3,105**	**612**	**1,212**
Average	**450**	**621**	**122**	**242**
Combined	**1,071**		**364**	
PM	**Olga Southbound Approach**	**Olga Northbound Approach**	**Attfield Approach**	**Attfield Departure**
Mon	566	696	280	281
Tue	618	705	338	240
Wed	596	683	317	228
Thu	688	741	355	314
Fri	591	797	360	338
Total	**3,059**	**3,622**	**1,650**	**1,401**
Average	**612**	**724**	**330**	**280**
Combined	**1,388**		**698**	

Daily	Olga Southbound Approach	Olga Northbound Approach	Attfield Approach	Attfield Departure
Mon	5660	8065	2907	3004
Tue	5905	8355	3003	3057
Wed	5956	8651	3163	3192
Thu	6579	9444	3865	3851
Fri	6352	9031	3470	3496
Total	**30,452**	**43,546**	**16,408**	**16,600**
Average	**6,090**	**8,709**	**3,282**	**3,320**
Combined	**15,383**		**6,966**	

Table 14. Attfield Street – Olga Street SCATS Summary

4.2.6 Existing Pedestrian and Cycling Infrastructure

The study area is provided with a shared path network and Perth Bicycle Network (PBN) route through the Maddington Station precinct. The shared path network links the study area to Huntingdale in the south, Cannington to the north-west and Maddington to the south east. The PBN route runs alongside the railway corridor and is located adjacent to the railway line at Maddington Station. This network provides a base that can be developed further in order to fulfil the objectives of the TOD based redevelopment of the SOP. An extract from the Perth Bike Plan is shown in Figure 8.

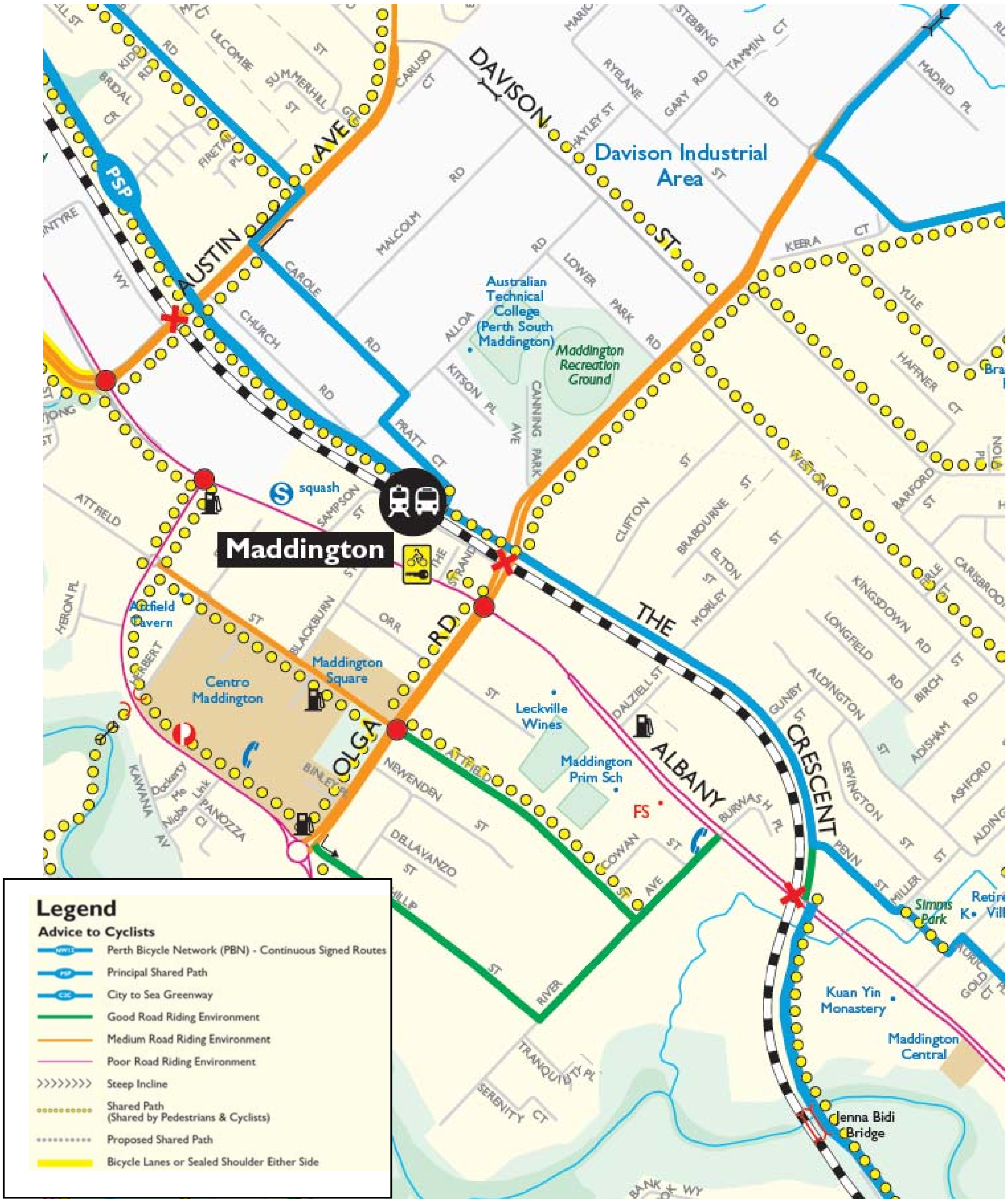


Figure 8. Pedestrian and Bicycle network facilities.

Pedestrians are accommodated on shared paths along Burslem drive, Attfield Street, along the railway PSP, Kelvin Road, Weston Street, Westfield Street and Davison Street. Footpaths are provided on most local access residential streets.

4.2.7 Existing Public Transit Network

The public transit network in the study area provides good bus and train service with connectivity at the Maddington Railway Station. Bus route 220 travels along Albany Highway linking Armadale Station with the Wellington Street bus terminus in Perth. Bus route 228 provides connection between the Thornlie Railway Station, Gosnells Railway Station and Maddington Railway Station. Bus route 229 links the Maddington Railway Station with the Carousel Shopping Centre. These services are typically an hourly service with additional service during commuter peaks. Route 228 runs a reduced service on weekends and route 229 operates a very limited service on weekends.

Bus Routes 850 and 851 link Maddington Station with Murdoch University and Murdoch Railway Station via Warton Road and South Street. This is a high frequency bus route with weekday service running in 10 minute interval during peak periods and 30 minute interval during off peak periods. On weekends the service operates hourly from 7am to 12 midnight. Public transport routes are shown on Figure 9.

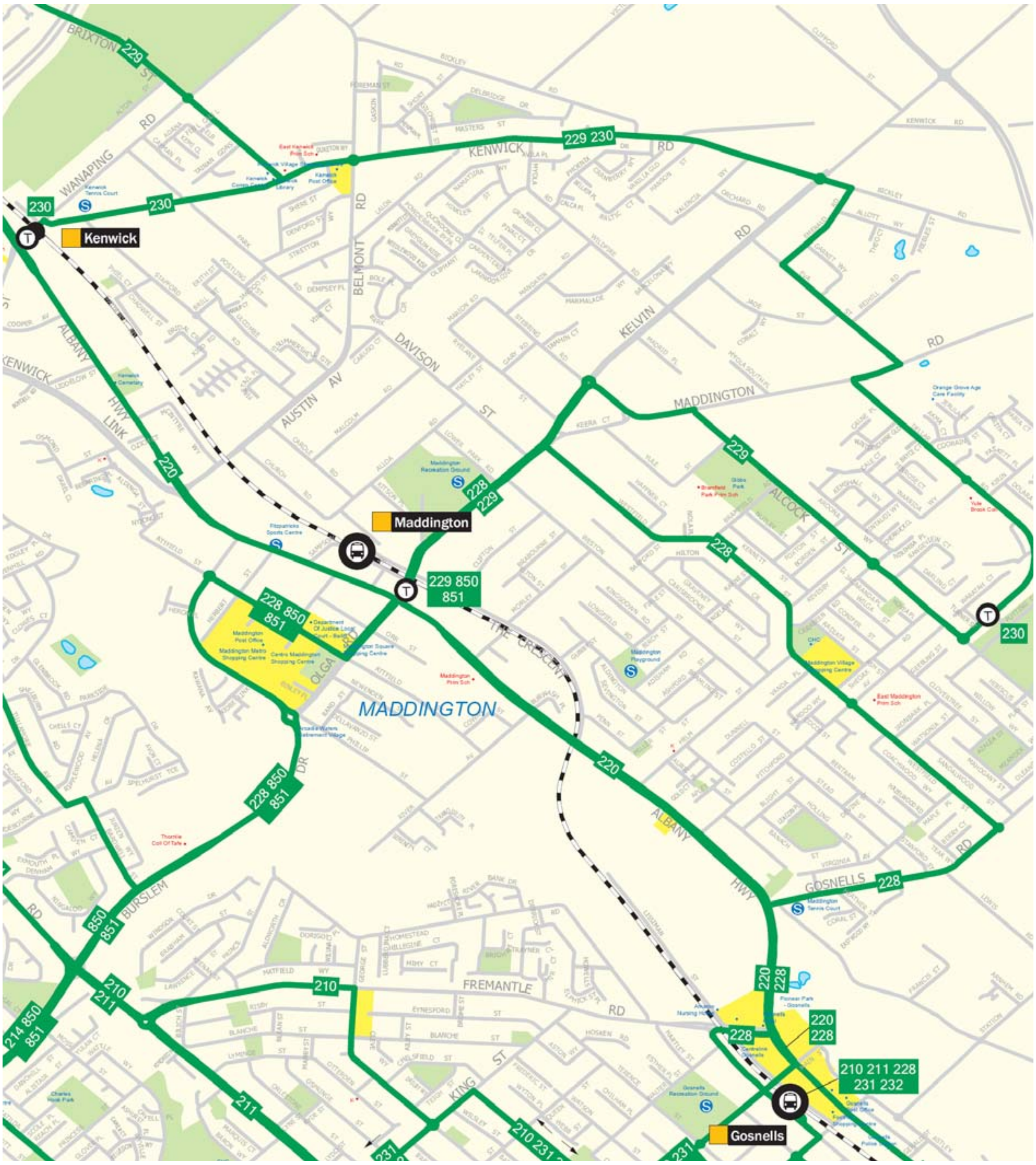


Figure 9. Public Transport Network.

5 Future Planned Transport Environment

5.1 Future Transport Network Modifications

As part of the redevelopment of the MTC the following works are proposed:

- Construction of a rail-bus modal interchange at the railway station adjacent to the intersection of Albany Highway, Olga Road and Kelvin Road.
- Extension of Blackburn Street from Albany Highway to the railway line linking up with the proposed modal interchange.
- Construction of a modified local road network in the redeveloped Station-Oval precinct generally in accordance with that shown on Figure 10.
- Reconstruction of Albany Highway to provide a dual carriageway medians capable of providing turn pockets and staged pedestrian crossings points between the Burslem Drive intersection and the Kelvin Road intersection.

The layout of the proposed road infrastructure within the SOP is shown on Figure 10.

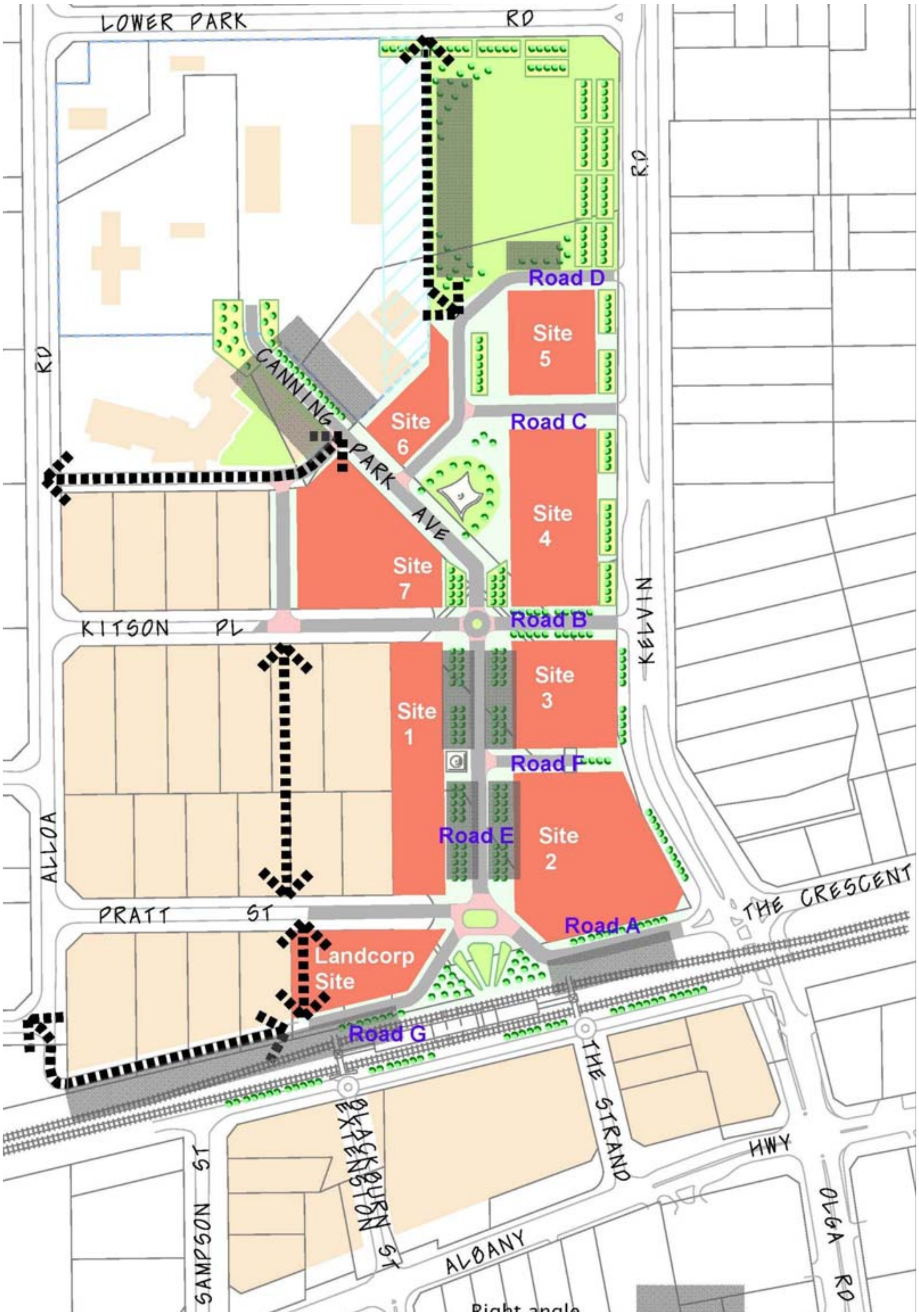


Figure 10. Road Network for Station Oval Precinct

As part of the redevelopment of CM the following works are proposed:

- Extension of Attfield Street to provide access to the proposed new subdivision adjacent to the railway line and the Canning River.
- Extension of Newenden Street to provide access to the proposed new subdivision.

- Extension of Dellavanzo Street to provide access to the proposed new subdivision linking River Avenue.
- Construction of a new road on the southern boundary of the Maddington Primary School to provide access to a proposed new subdivision.
- Construction of a new road to the subdivision located off the middle of Phillip Street to the end of River Avenue.
- Construction of a new road to the subdivision located off River Avenue linking Serenity Court.
- Construction of a new road to the subdivision located off River Avenue linking the proposed extension of Attfield Street.
- The extension of Heffner Court to link up with Westfield Street at the west end effectively forming a loop road.
- Extension of Carisbrooke Street to intersect with Kelvin Road.
- Construction of a local access road network at the rear of blocks fronting Kelvin Road with three access points to be located on Kelvin Road, the Crescent and Clifton Street
- Extension of Brabourne Street from Weston Street to the Crescent.

The future road network layout within CM is shown on Figure 11.

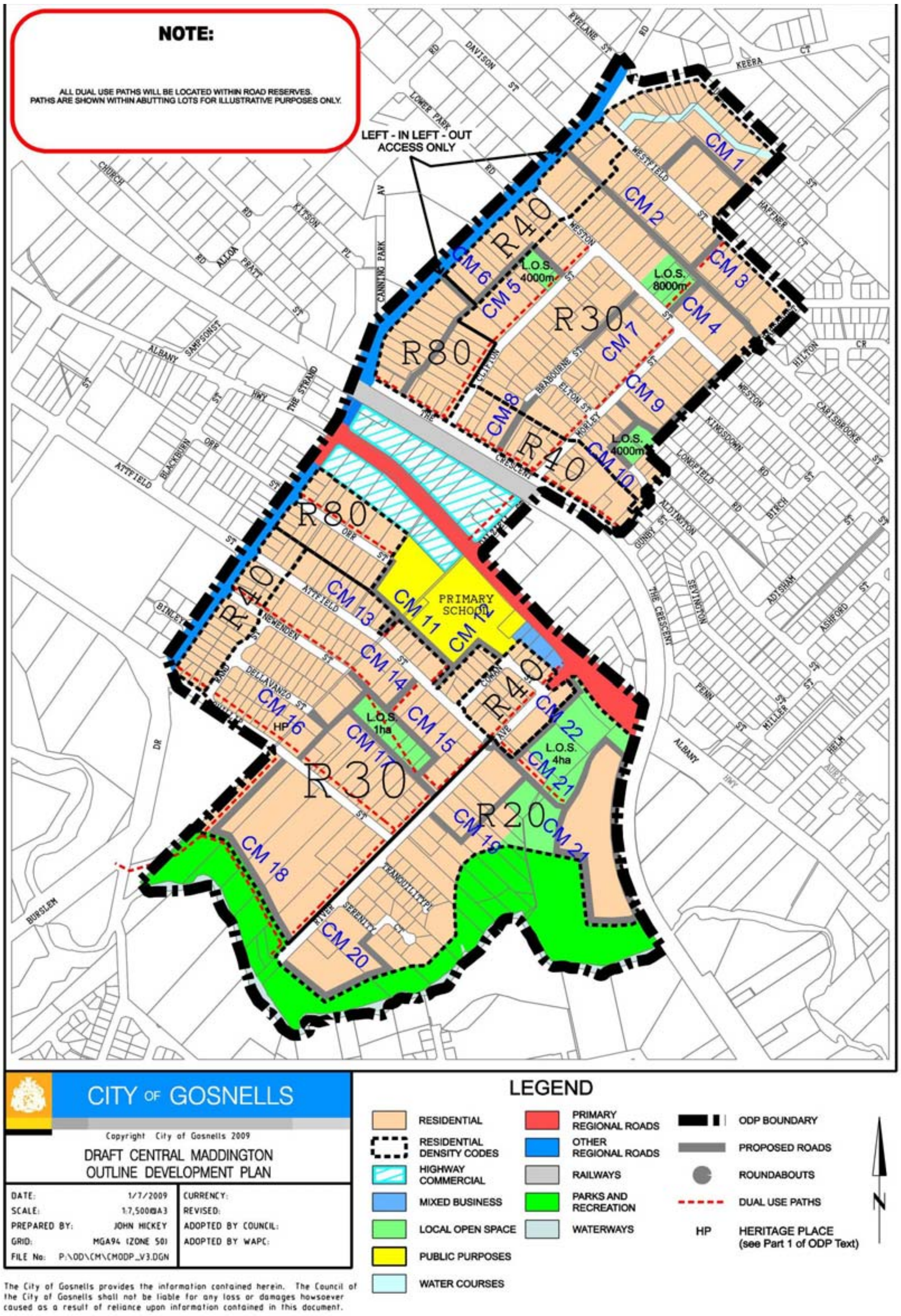


Figure 11. Central Maddington Outline Development Plan

5.2 Future Public Transport Network

The major change proposed to the public transport network in the MTC is the reconstruction of the railway station and the construction of a new modal interchange adjacent to the Maddington Station.

The proposed road network extension is shown in Figure 12.

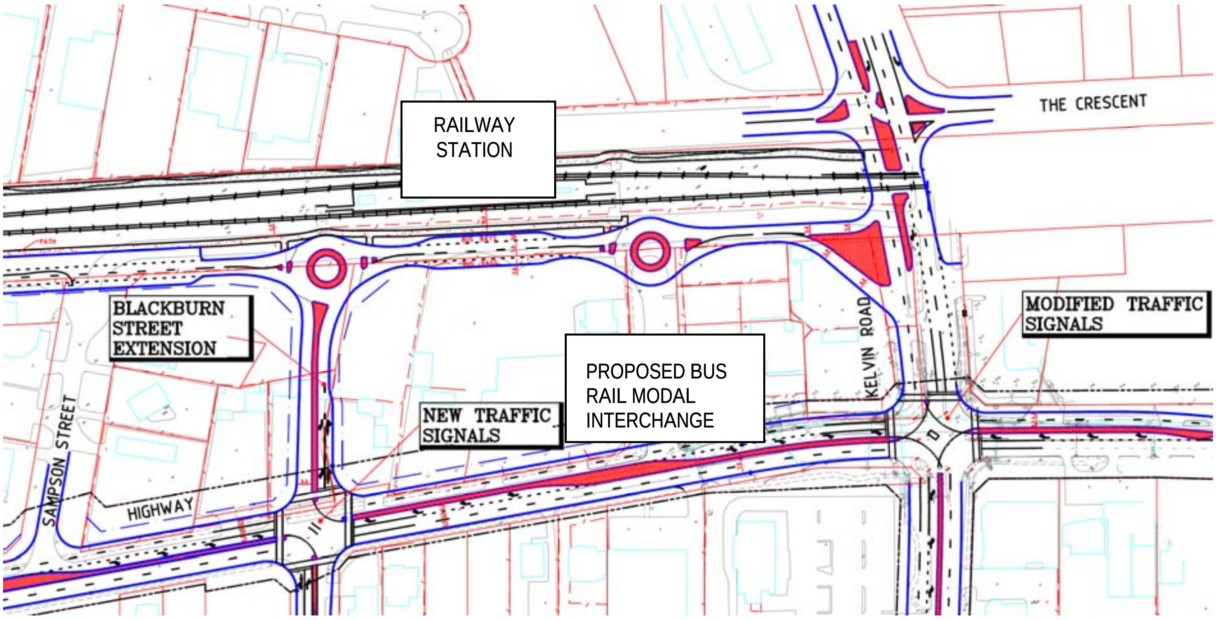


Figure 12. Future Public Transport Improvements Concept Plan[3]

The concept proposal provides for access and egress both via the Blackburn Street extension and from Kelvin Road. Movements at the Kelvin Road intersection and the Blackburn Street – Albany Highway intersection will need to be controlled by traffic signals with the signals at Kelvin Road linked to the railway crossing controller and the signal controller for the Albany Highway - Kelvin Road and Olga Road intersection.

[3] Maunsell Sketch SK_08_003_E Maddington Town Centre Concept Plan, 2004

6 Integration with Surrounding Network

The proposed structure plans integrate well with the surrounding land uses with respect to transport links and accessibility. The transport networks build on the existing road hierarchy and provide access permeability to the surrounding land uses.

Major generators are typically the residential cells external to the study area from which traffic is attracted by the commercial facilities, the industrial facilities, transport hub and school.

Major traffic attractors external to the study site are likely to be the work related destinations including the Perth CBD, Armadale and Cannington, Educational facilities such as the Thornlie Polytechnic, shopping and other commercial nodes such as the Perth CBD, Armadale, Cannington and sporting and recreational sites.

The road network provides a well defined hierarchy with major links from the Albany Highway Primary Distributor to the District Distributors of Olga Road and Kelvin Road. The MTC and CM structure plans should make provision for footpath and cycle networks to support the existing network. Public Transport is provided to a satisfactory level and changes proposed will enhance the service further.

7 Analysis of Transport Network

7.1 Trip Generation

The existing development scenario's trip generation is based on trip generation rates sourced from:

- Institute of Transport Engineers;
- R.T.A.; and,
- Department of Transport – South Australia.

These trip generation rates were derived from the car-based suburban development land-use scenarios and are higher than the rates adopted for the TOD based generation.

The 50-percentile and 100-percentile redevelopment scenario trip generation is based on TOD rates which are lower than rates applied to the current scenario. Comparison of rates is shown on Table 15.

	Residential (Unit)	**Commercial ($100\ M^2$ GFA)**	**Retail ($100\ M^2$ GFA)**	**Notes**
	(Trips per day)			
SOP	2.5	5.75	30	T.O.D based residential and commercial space development.
Balance of MTC	2.5	10	30	T.O.D based residential development. Suburban based commercial and retail to take into account of existing land use patterns.
CM	Refer to appendix 1.	10	-	Density of dwelling varies within the precinct.

Table 15. Summary of Trip Generation Rates for the Redevelopment Scenario.

The trip production rates of the existing land uses in the MTC and CM areas based on the land use quantum for the study area outlined in Table 7 are summarised in Table 16. The estimated trips are derived based on the trip generation rates outlined in the Appendix.

Precinct	Trips
SOP	1,389
SHP	3,497
MCP	3,323
MRP	15,393
CMNP	1,827
CMSP	2,400
Total	**27,829**

Table 16. Trips Generated by Existing Development

A summary of the traffic generation based on the land use quantum outlined in Table 7 in the redeveloped study area is shown in Table 17. This is based on full development of both the MTC and CM precincts.

Land Use	MTC	CM	Daily
Commercial	15,681	850	16,531
Residential	4,589	5,544	10,133
Retail	21,669	0	21,669
Total Study Area	**41,936**	**6,394**	**48,333**

Table 17. Summary of Traffic Generation in the Redeveloped Study Area

Generation by sub-precinct is shown on Table 18.

Precinct	Residential Units	Commercial (Square Metres)	Retail (Square Metres)	Estimated Daily Trips
MTC - SOP	585	27,340	3,638	7,654
MTC - SHP	160	18,725	11,350	9,593
MTC - MCP	242	20,200	10,000	9,468
MTC - MRP	200	32,500	35,000	15,223
Subtotal	1187	98,765	59,988	41,938
CM - CMNP	609	0	0	2,848
CM - CMSP	529	5,000	0	3,547
Subtotal	1138	5,000	0	6,395
Total	**2325**	**103,765**	**59,988**	**48,333**

Table 18. Generation at the 100% Development Potential of the Study Area

Compared to the generation potential of the existing land use zoning, under full redevelopment the MTC and CM precincts are predicted to potentially generate an additional 20,500 trips daily.

7.2 Trip Generation in the 50 percentile Development Scenario

When development in the MTC reaches 50% of TOD potential, and development in CM reaches 50% potential, trip generation is expected to be of the magnitude shown on Table 19. It is assumed that the existing shopping centre land use will remain unchanged.

Land Use	MTC generated trips	CM generated trips	Daily trips generated
Commercial	7,872	425	8,267
Residential	2,413	3,250	5,663
Retail	15,296	0	15,296
Total Study Area	**25,581**	**3,675**	**29,226**

Table 19. Summary of Traffic Generation at the 50% Development Potential

Precinct	Residential Units	Commercial (Square Metres)	Retail (Square Metres)	Estimated Daily Trips
MTC - SOP	585	27,340	3,638	3,886
MTC - SHP	160	18,725	11,350	4,812
MTC - MCP	242	20,200	10,000	4,758
MTC - MRP	200	32,500	35,000	12,095
Subtotal	1187	98,765	59,988	25,551
CM - CMNP	609	0	0	1,663
CM - CMSP	529	5,000	0	2,012
Subtotal	1138	5,000	0	3,675
Total	**2325**	**103,765**	**59,988**	**32,901**

Table 20. Land Use of the 50% Development Potential of the Study Area

7.3 Trip Distribution

The predicted trip distribution is based on judgement supported by a sound understanding of land use distribution in the adjacent areas and the impact of development in surrounding areas on local traffic movements. The trip distributions shown in Table 21 and Table 22 are based on the following assumptions:

- Trips having origin or destination to the north - 20%;
- Trips having origin or destination to the south - 30%;
- Trips having origin or destination to the west - 30% and;
- Trips having origin or destination to the east - 20%.

Given that there are no major road network expansion projects proposed adjacent to the study area in the foreseeable future, car travel patterns are not likely to undergo significant changes by the year 2031.

Direction	Percentage	Theoretical distribution at current land use	Predicted distribution at 50% development (Vehicles per day)	Change (Vehicles per day)
North (via Kelvin Road and Austin Avenue)	20%	5,565	5,860	295
South (via Burslem Drive)	30%	8,350	8,790	440
West (via Albany Highway and Kenwick Link)	30%	8,350	8,790	440
East (via Albany Highway, Weston Street, Westfield Street and The Crescent)	20%	5,565	5,860	295
Total		**27,830**	**29,300**	**1470**

Table 21. Trip Distribution for External Traffic at 50% Development Potential

Direction	Percentage	Theoretical distribution at current land use	Predicted distribution at 100% development (Vehicles per day)	Change (Vehicles per day)
North (via Kelvin Road and Austin Avenue)	20%	5,565	9,665	4,100
South (via Burslem Drive)	30%	8,350	14,500	6,150
West (via Albany Highway and Kenwick Link)	30%	8,350	14,500	6,150
East (via Albany Highway, Weston Street, Westfield Street and The Crescent)	20%	5,565	9,665	4,100
Total		**27,830**	**48,330**	**20,500**

Table 22. Trip Distribution for External Traffic at 100% Development Potential

At the 50% development level no negligible increase in traffic is predicted compared to current land use theoretical generation levels. At the 100% development level, traffic is predicted to increase by approximately 74% over current land use theoretical generation levels.

Assessment of changes in daily flow was based on QRS II modelling (Refer Appendix) of the existing study area generated flows and comparison to predicted study area flows. Table 23 summarises principal roads and expected changes in traffic flows. Existing traffic flows were taken from Main Roads WA average annual daily traffic data rather than the SCATS data as they best represent typical flows, and are in most cases higher than the SCATS flows.

The forecast traffic distributions at the 100% development level is shown on Figure 13.

Street	Section	Exist AADT (vpd)	Current land use generation (vpd	Future land use generation (vpd)	Background flow (vpd)	Predicted future flow (vpd)
Albany Highway	West of Austin	16320	7650	5653	8670	14323
	East of Austin	31100	7650	10880	23450	34330
	West of Olga	31100	4190	3000	26910	29910
	East of Olga	29760	4190	7120	25570	32690
	East of Railway	24250	4980	9045	19270	28315
Kenwick Link	West of Albany	25620	4670	8480	20950	29430
Austin Ave	North Albany	12250	680	2570	11570	14140
	North of Lower Park Road	12250	520	940	11730	12670
Burslem Drive	At bridge	22300	7520	13660	14780	28440
	West of Olga	12380	3720	4000	8660	12660
	South of Albany	12380	6040	7575	6340	13915
Olga St	North of Burslem	15400	4550	8680	10850	19530
	South of Albany	14100	8740	13200	5360	18560
Attfield Street	East of Burslem	7000	5240	5040	1760	6800
	West of Olga	7000	2450	3280	4550	7830
	East of Olga	1000	220	400	780	1180
Kelvin Road	North of Albany	14800	6580	11980	8220	20200
	North of rail	14800	6400	7450	8400	15850
	North of Westfield	14210	4668	8480	9542	18022
Westfield	East of Kelvin	3650	800	520	2850	3370
Weston	East of Kelvin	1580	340	300	1240	1540
The Crescent	East of Kelvin	3000	1430	2690	1570	4260
	West of Kelvin	500	500	1390	0	1390

Table 23. Predicted daily traffic

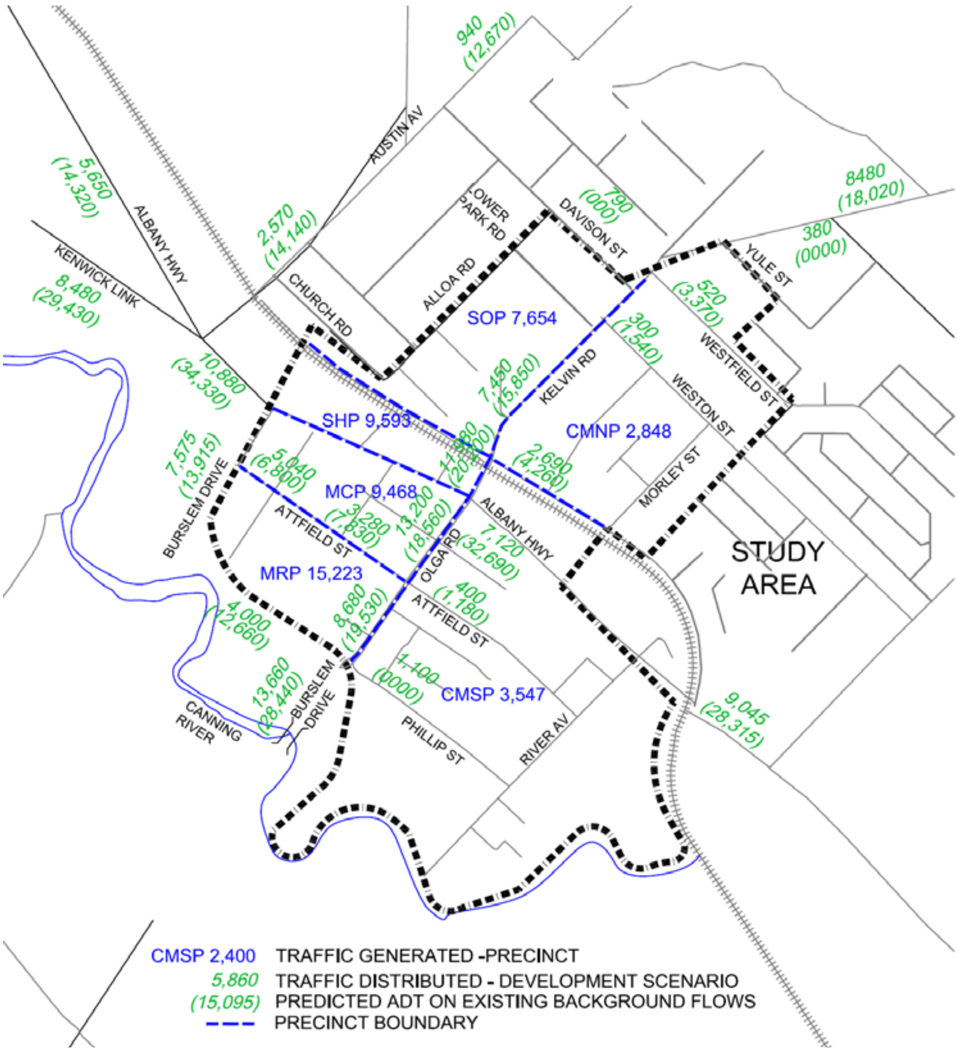


Figure 13. Daily Traffic Distribution onto Adjacent Road Network in the 100% Development Potential Scenario

The issue of internal vehicle traffic circulation of MTC and CM was considered. Given the expected improvement in pedestrian connectivity, abundance of work, shopping and entertainment opportunities; parking constrained by pricing and supply; these internal trips whose average trip length are estimated to be less than 1 km in length can largely be substituted by non-motorised mode.s namely walking or bicycles.

8 Impact on the External Road Network

8.1 Assessment years

Assessment is based on the full development of the study area and is taken as being 2031.

8.2 Time periods for assessment

The assessment is based on analysis of the following peaks:

- PM peak period(s) on the surrounding road network.
- PM peak period(s) for the subdivision.

8.3 Predicted ADT

Predicted ADT based on 100% development flows and current external – external flows have been calculated and are shown on Table 24.

Street	Section	Existing ADT	Estimated Existing Internal - External	Estimated Existing External - External	Estimated Future External Internal	Estimated Future ADT
Albany Highway	East of Austin	31,100	7,650	23,450	10,880	34,330
	East of Railway	24,250	4,980	19,270	9,045	28,315
Austin Ave	North of Albany	12,250	680	11,570	2,570	14,140
Burslem Drive	At bridge	22,300	7,520	14,780	13,660	28,440
	South of Albany	12,380	6,040	6,340	7,575	13,915
Olga St	North of Burslem	15,400	4,550	10,850	8,680	19,530
	South of Albany	14,100	8,740	5,360	13,200	18,560
Attfield Street	East of Burslem	7,000	5,240	1,760	5,040	6,800
	West of Olga	7,000	2,450	4,550	3,280	7,830
	East of Olga	1,000	220	780	400	1,180
Kelvin Road	North of Albany	14,800	6,580	8,220	11,980	20,200
	North of Westfield	14,210	4,668	9,542	8,480	18,022
Westfield	East of Kelvin	3,650	800	2,850	520	3,370
Weston	East of Kelvin	1,580	340	1,240	300	1,540
The Crescent	East of Kelvin	3,000	1,430	1,570	2,690	4,260

Table 24. Predicted Future Distribution – Current Base Flows

Based on 2031 network flows shown on the Regional Operations Model (ROM), a regional traffic model created and maintained by Main Roads Western Australia, future flows are expected to be of a magnitude shown on Table 25.

Street	Section	2031 ROM ADT	Estimated Future External Internal	Estimated Future ADT
Albany Highway	East of Austin	26,990	10,880	37,870
	East of Railway	26,500	9,045	35,545
Burslem Drive	At bridge	15,620	13,660	29,280
	South of Albany	5,505	7,575	13,080
Olga St	North of Burslem	10,100	8,680	18,780
	South of Albany	10,100	13,200	23,300
Attfield Street	West of Olga	4,500	3,280	7,780
	East of Olga	780	400	1,180
Kelvin Road	North of Albany	15,280	11,980	27,260
	North of Westfield	15,280	8,480	23,760
Westfield	East of Kelvin	2,850	520	3,370
Weston	East of Kelvin	1,240	300	1,540
The Crescent	East of Kelvin	1,570	2,690	4,260

Table 25. Predicted Future Distribution – 2031 Base Flows

The ROM model predicts that Kelvin Road external – external traffic volumes will increase to 15,300 vehicles per day by the year 2031. With redevelopment, approximately 8,480 to 11,980 daily trips are expected to be generated from the MTC and CM. On current volumes Kelvin Road background flows, this increase would result in a total daily flow of 18,020 to 20,200 vehicles; on 2031 background flows, the traffic volume on Kelvin Road is predicted to be in the order of 23,760 to 27,260 vehicles per day.

Using LOSPLAN[4] the midblock performance of Kelvin Road is predicted to be as shown on Table 26. Performance is expected to be acceptable at all stages of development and no upgrading will be required.

ADT (Vehicles per day)	lanes	Right turn pockets	Level of Service	LOS Threshold delay (secs)
14,000	4	Yes	B	22.1
17,000	4	Yes	B	22.1
20,000	4	Yes	B	22.1
23,000	4	Yes	C	22.1
26,000	4	Yes	C	22.1

Table 26. Kelvin Road Midblock Performance

The ROM model predicts that Albany Highway external – external traffic volumes west of the study area will be approximately 26,900 vehicles per day in 2031. With the addition of an anticipated 10,880 vehicles from the MTC and CM, Albany Highway west of the study area is predicted to increase to approximately 37,870 vehicles per day. Against current background traffic flows, daily traffic would be in the order of 34,330 vehicles per day. East of the study area, Albany Highway

[4] Florida Department of Transport modeling software “LOSPLAN” was used to model segment performance

traffic is predicted to increase to approximately 35,545 vehicles per day based on the ROM background flows or 28,315 vehicles per day against current background traffic flows

At predicted 2031 levels, traffic would approach or exceed the maximum desirable volume of 36,000 vehicles per day, and congestion, long queue lengths and a poor level of service are anticipated along Albany Highway during peak times. With the existing configuration, performance modelling suggests that the level of service will drop to F. Modelling of various flows and development scenarios is shown on Table 27. Upgrading is likely to be required when traffic volumes reach 33,000 vehicles per day.

ADT (Vehicles per day)	Lanes	Right turn pockets / median	Level of Service	LOS Threshold delay (secs)
27,000	4	No	D	22.1
30,000	4	No	D	22.1
33,000	4	No	E	21.8
36,000	4	No	E	58.6
39,000	4	No	F	125
42,000	4	No	F	125
27,000	4	Yes	C	22.1
30,000	4	Yes	C	22.1
33,000	4	Yes	D	22.1
36,000	4	Yes	D	22.1
39,000	4	Yes	D	22.1
42,000	4	Yes	D	22.1

Table 27. Albany Highway Midblock Performance.

Without upgrading of Albany Highway, as volumes reach the predicted levels the poor level of service and attendant delay would most likely result in transference of through traffic to alternate parallel routes such as the Spencer Road and Corfield Street corridor.

Burslem Drive south of the roundabout at Olga Road is expected to experience an increase in external – internal traffic to 13,660 vehicles per day. Added to the estimated external – external 2031 background traffic of 15,620 vehicles per day gives a predicted future ADT of 29,280. Based on current external-external background flows, future ADT is estimated at 28,440. North of the Olga Road roundabout, Burslem Drive traffic based on 2031 predictions is expected to increase to 13,915. Midblock performance under various traffic flow scenarios is shown on Table 28.

ADT (Vehicles per day)	lanes	Right turn pockets	Level of Service	LOS Threshold delay (secs)
15,000	2	No	D	36.6
18,000	2	No	E	49.4
21,000	2	No	F	66.1
24,000	2	No	F	87.3
27,000	2	No	F	-
30,000	2	No	F	-
15,000	4	Yes	B	22.1
18,000	4	Yes	B	22.1
21,000	4	Yes	B	22.1
24,000	4	Yes	C	22.1
27,000	4	Yes	C	22.1
30,000	4	Yes	C	22.1

Table 28. Burslem Drive Midblock Performance.

The additional traffic on Burslem Drive is likely to trigger the duplication of Burslem Drive between Olga Road and the Canning River crossing when flows exceed 18,000 vehicles per day. Without duplication, the existing bridge crossing over the Canning River will remain a bottleneck.

The ROM model predicts that Olga Road traffic volumes based on current land use zonings will increase to 10,100 vehicles per day by the year 2031. On current volumes Olga Road background flows, this increase would result in a total daily flow of between 18,560 and 19,530 vehicles; on 2031 background flows, the traffic volume on Olga Road is predicted to be in the order of between 18,700 and 23,300 vehicles per day.

Assessment of the Olga Road midblock performance is shown on Table 29.

ADT (Vehicles per day)	lanes	Right turn pockets	Level of Service	LOS Threshold delay (secs)
14,000	4	Yes	B	22.1
17,000	4	Yes	B	22.1
20,000	4	Yes	B	22.1
23,000	4	Yes	C	22.1
26,000	4	Yes	C	22.1

Table 29. Olga Road Midblock Performance.

8.4 Scenario 1 Impacts.

Scenario 1 is based on a fully developed Maddington Town Centre Study Area, with traffic distributed onto the existing road network including the Preliminary Design Proposal for the Station-Oval Precinct. Scenario 1 is shown with both current Central Maddington flows and redeveloped Central Maddington flows on Table 30.

Road	Existing daily flow (inc current CM flows)	Estimated daily flow (inc redeveloped CM flows)	Existing road capacity
Kelvin Road	14,200	18,300	36,000
Albany Highway (west)	27,000	33,150	36,000
Albany Highway (east)	24,990	29,090	36,000
Burslem Drive	17,930	24,080	13,500
Attfield Street (west)	7,000	13,950	15,000
Attfield Street (east)	1,000	2,220	3,000
Olga Street	14,100	20,900	36,000
Weston Street	1,580	2,320	3,000
Westfield Street	3,650	4,200	3,000

Table 30. Traffic flows under Scenario 1

8.5 Scenario 2 Impacts

Scenario two was to consider the Maddington Town Centre Study Area, as a modified road network with proposed improvements including:

- Streetscape improvements and widening of Albany Highway;
- Extension of the Blackburn Main Street;
- A new bus interchange at the Maddington Train Station;
- Preliminary Design Proposal for the Station-Oval Precinct.

Road	Estimated daily flow (inc current CM flows)	Estimated daily flow (inc redeveloped CM flows)	Existing road capacity
Kelvin Road	14,200	18,300	36,000
Albany Highway (west)	27,000	33,150	36,000
Albany Highway (east)	24,990	29,090	36,000
Burslem Drive	17,930	24,080	13,500
Blackburn Street	0	800	9,000
Attfield Street (west)	7,000	13,950	15,000
Attfield Street (east)	1,000	2,220	3,000
Olga Street	14,100	20,400	36,000
Weston Street	1,580	2,320	3,000
Westfield Street	3,650	4,200	3,000

Table 31. Traffic flows under Scenario 2

8.6 Infrastructure Upgrades

As the MTC and CM are "brown field" sites, the triggers for upgrading road infrastructure will largely be influenced by changing traffic volumes, and the need to provide an acceptable level of service to the road user. Notwithstanding this, for a TOD, some congestion and lesser level of service can serve as a policy tool in moderating the level of car use. However the extent of congestion tolerated is somewhat dependent on the level of through traffic that the road network carries and the need to provide a good level of service for regional external – external traffic.

Prediction of the timing of required infrastructure upgrades is difficult given that it is dependent on redevelopment rates which are unknown. Nonetheless, triggers for redevelopment can be set based on when traffic flow reaches a point where segment level of service and / or intersection level of service becomes unacceptable.

8.6.1 Albany Highway

Once traffic volumes reach about 32,000 vehicles per day, midblock level of service is predicted to drop to "E" which is considered to be unacceptable and warranting improvement. Widening of the Highway to provide a central median and protected right turn pockets would increase the level of service to a predicted "D".

8.6.2 Burslem Drive

The current cross section of Burslem Drive restricts the capacity that the road can carry at an acceptable level of service. As a 2 lane road with right turning traffic impacts, the level of service is predicted to be "E" when daily volumes are approximately 18,000. This is less than the level of current traffic flow across the Burslem Drive Bridge.

As such, the upgrading of Burslem Drive south of Olga Road including the duplication of the Burslem Drive Bridge is likely to be required in the near future. The construction of an additional two-lane carriageway on Burslem Drive incorporating a central median would increase capacity, reduce the impact of right turning traffic and provide the opportunity to incorporate landscaping elements and pedestrian crossing facilities into Burslem Drive.

Upgrading of the section of Burslem Drive north of Olga Road would not be required for some time until flows in that section of road reached 18,000 vehicles per day.

8.6.3 Kelvin Road

Kelvin Road is developed as a four lane divided carriageway and the current cross section has a capacity well in excess of the predicted traffic flows. As such, no upgrading is predicted to be required.

8.6.4 Olga Road.

Olga Road is developed as a four lane divided carriageway and the current cross section has a capacity well in excess of the predicted traffic flows. As such, no upgrading is predicted to be required.

8.6.5 Intersection of Albany Highway – Burslem Drive.

The intersection of Albany Highway and Burslem Drive is currently operating at or near the practical degree of saturation. Modelling using SIDRA 5.1 software indicates that the PM peak is the highest demand time where the existing intersection has an overall level of service of C with a degree of saturation of 0.875; which is at the practical limit for a set of traffic signals. A 95-percentile queue length is estimated to be approximately 209 metres. This means that on occasions, the queue for the right turn into Burslem Drive might extend into the through lane of Albany Highway restricting the capacity on the Albany Highway south bound into one lane.

For the intersection to perform satisfactory under increased traffic, double right turn lanes would need to be constructed on Albany Highway for traffic turning right into Burslem Drive. This would entail the realignment the Burslem Drive approach to the intersection, construction of double turn lanes and realignment of the Albany Highway south bound lanes. Ideally improvements should be undertaken in conjunction with the duplication of Albany Highway between Burslem Drive and Kelvin Road.

Should the improvements to the intersection not occur, SIDRA modelling indicates that the degree of saturation would exceed 1, the LOS 'D' and the longest 95 percentile queue length approximately

348 metres long.

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Albany Hwy											
1	L	268	3.0	0.874	23.9	LOS C	23.8	171.1	0.80	0.96	37.5
2	T	1180	3.0	0.874	15.5	LOS B	24.2	173.9	0.80	0.80	39.5
Approach		1448	3.0	0.874	17.1	LOS B	24.2	173.9	0.80	0.83	39.1
North: Albany Hwy											
8	T	675	3.0	0.228	2.6	LOS A	3.5	25.4	0.29	0.25	54.5
9	R	328	3.0	0.850	42.0	LOS D	10.7	76.9	1.00	1.03	27.8
Approach		1003	3.0	0.850	15.5	LOS B	10.7	76.9	0.52	0.51	41.5
West: Burslem Drive											
10	L	469	3.0	0.770	21.3	LOS C	12.8	92.0	0.73	0.85	38.1
12	R	16	3.0	0.116	47.9	LOS D	0.6	4.4	0.96	0.69	25.9
Approach		485	3.0	0.770	22.2	LOS C	12.8	92.0	0.73	0.85	37.5
All Vehicles		2937	3.0	0.874	17.4	LOS B	24.2	173.9	0.70	0.72	39.6

Table 32. Albany Highway – Burslem Drive Existing Intersection Performance – AM Peak

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Albany Hwy											
1	L	179	3.0	0.862	53.2	LOS D	24.9	178.8	1.00	1.00	25.1
2	T	768	3.0	0.862	44.8	LOS D	25.3	181.9	1.00	1.01	25.6
Approach		947	3.0	0.862	46.4	LOS D	25.3	181.9	1.00	1.01	25.5
North: Albany Hwy											
8	T	1367	3.0	0.436	2.7	LOS A	9.2	65.7	0.30	0.28	54.4
9	R	653	3.0	0.875	45.5	LOS D	29.2	209.4	0.99	1.07	26.6
Approach		2020	3.0	0.875	16.5	LOS B	29.2	209.4	0.52	0.53	40.7
West: Burslem Drive											
10	L	469	3.0	0.710	14.5	LOS B	9.8	70.1	0.52	0.74	42.9
12	R	24	3.0	0.222	59.8	LOS E	1.2	8.6	0.98	0.71	22.6
Approach		494	3.0	0.710	16.8	LOS B	9.8	70.1	0.55	0.74	41.2
All Vehicles		3461	3.0	0.875	24.7	LOS C	29.2	209.4	0.66	0.69	35.0

Table 33. Albany Highway – Burslem Drive Existing Intersection Performance – PM Peak

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Albany Hwy											
1	L	271	3.0	0.950	90.0	LOS F	47.3	340.0	1.00	1.06	17.5
2	T	805	3.0	0.950	81.4	LOS F	48.4	347.7	1.00	1.10	17.9
Approach		1076	3.0	0.950	83.6	LOS F	48.4	347.7	1.00	1.09	17.8
North: Alabany Hwy											
8	T	1693	3.0	0.538	4.2	LOS A	18.8	135.3	0.34	0.32	52.0
9	R	601	3.0	1.000 [3]	43.3	LOS D	30.7	220.5	0.89	0.98	27.4
Approach		2294	3.0	1.000	14.5	LOS B	30.7	220.5	0.48	0.49	42.1
West: Burslem Drive											
10	L	493	3.0	1.000 [3]	22.2	LOS C	15.9	114.1	0.63	0.80	37.5
12	R	191	3.0	1.124	215.7	LOS F	25.0	179.7	1.00	1.29	8.6
Approach		684	3.0	1.124	76.1	LOS E	25.0	179.7	0.73	0.94	19.6
All Vehicles		4054	3.0	1.124	43.2	LOS D	48.4	347.7	0.66	0.72	27.0

Table 34. Albany Highway – Burslem Drive Ultimate Intersection based on 2011 Flows PM Peak – No Modifications.

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Albany Hwy											
1	L	295	3.0	0.867	56.2	LOS E	37.1	266.3	0.98	0.91	24.1
2	T	876	3.0	0.867	47.9	LOS D	38.0	273.2	0.98	0.90	24.7
Approach		1171	3.0	0.867	49.9	LOS D	38.0	273.2	0.98	0.90	24.5
North: Albany Hwy											
8	T	1652	3.0	0.570	7.6	LOS A	22.9	164.6	0.45	0.42	47.7
9	R	685	3.0	1.000[3]	67.0	LOS E	34.1	244.8	0.96	1.00	21.1
Approach		2337	3.0	1.000	25.0	LOS C	34.1	244.8	0.60	0.59	34.9
West: Burslem Drive											
10	L	579	3.0	0.932	26.0	LOS C	22.7	163.2	0.62	0.80	35.2
12	R	105	3.0	0.378	67.4	LOS E	6.4	46.1	0.92	0.79	21.0
Approach		684	3.0	0.932	32.4	LOS C	22.7	163.2	0.66	0.80	31.9
All Vehicles		4192	3.0	1.000	33.2	LOS C	38.0	273.2	0.72	0.71	30.8

Table 35. Albany Highway – Burslem Drive Ultimate Intersection Performance based on 2031 Flows – PM Peak Double Right Turn from Albany Hwy.

8.6.6 Intersection of Albany Highway – Kelvin Road – Olga Road.

The intersection of Albany Highway, Kelvin Road and Olga Road is currently operating at or near capacity and is restrictive in as much as peak hour right turn bans on Albany Highway are in place.

Modelling using the SIDRA Intersection 5.1 software of the existing intersection using current PM peak hour flows indicated a level of service of “C”, a degree of saturation of at 0.764 and a maximum queue length on Albany Highway of 123 metres.

Without modification of the intersection, the Level of Service is predicted to be “F” when Maddington is fully developed with the degree of saturation reaching 1.07 and maximum queue length 550 metres.

Modelling further indicates that for the intersection to perform satisfactorily, double right turn lanes would need to be constructed on Kelvin Road for traffic turning into Albany Highway. Further detailed studies would be required to determine land requirements for a modified intersection configuration at Albany Highway, Kelvin Road and Olga Road intersection. Given the restrictions imposed by the existing road corridor and the adjacent development, it may not be feasible in the short to medium term to acquire the necessary land.

Should improvements not occur, increased congestion, delays and attendant driver frustration will occur. It is expected that once delays became significant, some traffic would seek alternative routes and avoid the intersection.

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Olga Rd											
1	L	148	5.0	0.463	34.2	LOS C	5.8	42.6	0.91	0.81	31.3
2	T	243	5.0	0.463	25.9	LOS C	6.1	44.3	0.91	0.75	33.0
3	R	87	5.0	0.260	32.4	LOS C	2.5	18.1	0.85	0.76	31.8
Approach		479	5.0	0.463	29.7	LOS C	6.1	44.3	0.90	0.77	32.2
East: Albany Hwy											
4	L	144	5.0	0.764	32.4	LOS C	16.6	121.4	0.95	0.94	33.1
5	T	879	5.0	0.764	24.0	LOS C	16.8	123.0	0.95	0.89	33.9
Approach		1023	5.0	0.764	25.2	LOS C	16.8	123.0	0.95	0.90	33.8
North: Kelvin Road											
7	L	62	5.0	0.616	39.8	LOS D	6.1	44.3	0.98	0.83	29.7
8	T	300	5.0	0.616	31.5	LOS C	6.2	45.1	0.98	0.81	30.3
9	R	205	5.0	0.728	42.0	LOS D	7.3	53.6	1.00	0.88	27.9
Approach		567	5.0	0.728	36.2	LOS D	7.3	53.6	0.99	0.84	29.3
West: Albany Hwy											
10	L	84	5.0	0.402	26.8	LOS C	6.9	50.6	0.80	0.86	35.9
11	T	454	5.0	0.402	18.4	LOS B	7.0	51.4	0.80	0.67	37.6
Approach		538	5.0	0.402	19.7	LOS B	7.0	51.4	0.80	0.70	37.3
All Vehicles		2607	5.0	0.764	27.3	LOS C	16.8	123.0	0.92	0.82	33.1

Table 36. Albany Highway – Kelvin Road – Olga Road Intersection Performance – Existing Flows AM Peak Current Geometry.

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Olga Rd											
1	L	151	5.0	0.470	34.3	LOS C	5.9	43.4	0.91	0.81	31.3
2	T	247	5.0	0.470	25.9	LOS C	6.2	45.1	0.91	0.75	33.0
3	R	184	5.0	0.552	34.1	LOS C	5.6	40.8	0.91	0.80	31.0
Approach		582	5.0	0.552	30.7	LOS C	6.2	45.1	0.91	0.78	31.9
East: Albany Hwy											
4	L	121	5.0	0.581	28.3	LOS C	10.9	79.3	0.86	0.87	35.1
5	T	656	5.0	0.581	20.0	LOS B	11.0	80.5	0.86	0.75	36.4
Approach		777	5.0	0.581	21.3	LOS C	11.0	80.5	0.86	0.76	36.2
North: Kelvin Road											
7	L	62	5.0	0.745	42.3	LOS D	7.8	57.2	1.00	0.91	28.8
8	T	377	5.0	0.745	34.0	LOS C	7.9	58.0	1.00	0.91	29.3
9	R	187	5.0	0.665	40.6	LOS D	6.5	47.4	0.99	0.85	28.4
Approach		626	5.0	0.745	36.8	LOS D	7.9	58.0	1.00	0.89	29.0
West: Albany Hwy											
10	L	145	5.0	0.764	32.4	LOS C	16.6	121.4	0.95	0.94	33.1
11	T	878	5.0	0.764	24.1	LOS C	16.8	123.0	0.95	0.89	33.9
Approach		1023	5.0	0.764	25.2	LOS C	16.8	123.0	0.95	0.90	33.8
All Vehicles		3008	5.0	0.764	27.7	LOS C	16.8	123.0	0.93	0.84	32.9

Table 37. Albany Highway – Kelvin Road – Olga Road Intersection Performance – Existing Flows PM Peak Current Geometry.

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Olga Road											
1	L	42	0.0	0.182	58.2	LOS E	3.3	23.2	0.84	0.74	23.0
2	T	379	0.0	0.505	54.9	LOS D	12.8	89.7	0.92	0.76	23.1
3	R	84	0.0	0.388	65.6	LOS E	6.6	46.2	0.91	0.76	21.6
Approach		505	0.0	0.505	56.9	LOS E	12.8	89.7	0.91	0.76	22.8
East: Albany Hwy											
4	L	42	0.0	0.145	38.0	LOS D	2.6	18.1	0.65	0.72	29.3
5	T	589	0.0	0.408	34.8	LOS C	15.6	109.0	0.77	0.66	29.5
6	R	84	0.0	0.408	71.7	LOS E	6.9	48.4	0.95	0.77	20.3
Approach		716	0.0	0.408	39.3	LOS D	15.6	109.0	0.78	0.68	28.0
North: Kelvin Rd											
7	L	42	0.0	0.507	63.1	LOS E	12.8	89.4	0.92	0.83	22.6
8	T	337	0.0	0.507	54.9	LOS D	12.9	90.2	0.92	0.76	23.0
9	R	253	0.0	0.510	67.4	LOS E	9.4	66.1	0.94	0.79	21.2
Approach		632	0.0	0.510	60.4	LOS E	12.9	90.2	0.93	0.78	22.2
West: Albany Hwy											
10	L	253	0.0	0.877	49.8	LOS D	14.3	100.1	0.83	0.83	25.3
11	T	1095	0.0	0.758	41.3	LOS D	31.6	221.4	0.92	0.82	27.0
12	R	42	0.0	0.204	69.5	LOS E	3.7	25.8	0.92	0.74	20.8
Approach		1389	0.0	0.877	43.7	LOS D	31.6	221.4	0.90	0.82	26.4
All Vehicles		3242	0.0	0.877	48.1	LOS D	31.6	221.4	0.88	0.77	25.2

Table 38. Albany Highway – Kelvin Road – Olga Road Intersection Performance – Ultimate 2031 Flows PM Peak Double Right Turn from Kelvin Road.

8.6.7 Intersection of Burslem Drive and Olga Road.

The existing double lane roundabout has sufficient capacity to operate satisfactorily at the predicted traffic volumes.

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Burslem Drive											
1	L	529	5.0	0.730	4.9	LOS A	11.2	81.7	0.47	0.40	49.2
3	R	1636	5.0	0.730	10.7	LOS B	11.2	81.7	0.49	0.60	45.7
Approach		2164	5.0	0.730	9.3	LOS A	11.2	81.7	0.49	0.55	46.5
North East: Olga Road											
24	L	1551	5.0	0.883	17.5	LOS B	19.5	142.2	1.00	1.24	40.5
26	R	73	5.0	0.886	25.4	LOS C	18.4	134.1	1.00	1.26	37.8
Approach		1624	5.0	0.883	17.9	LOS B	19.5	142.2	1.00	1.24	40.4
North West: Burslem Drive NW											
27	L	145	5.0	0.319	12.8	LOS B	2.0	14.3	0.81	0.92	44.4
29	R	526	5.0	0.791	24.9	LOS C	9.6	70.2	0.96	1.27	36.5
Approach		671	5.0	0.790	22.3	LOS C	9.6	70.2	0.93	1.19	37.9
All Vehicles		4460	5.0	0.883	14.4	LOS B	19.5	142.2	0.74	0.90	42.7

Table 39. Burslem Drive and Olga Road Intersection Performance – Ultimate 2031 Flows PM Peak Current Geometry.

8.6.8 Intersection of Burslem Drive and Attfield Street.

The existing roundabout has sufficient capacity to operate satisfactorily at the predicted traffic volumes.

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
Movement Performance - Vehicles											
South: Burslem Drive											
1	L	80	5.0	0.800	18.8	LOS B	13.9	101.1	1.00	1.14	39.9
2	T	480	5.0	0.800	18.0	LOS B	13.9	101.1	1.00	1.14	40.0
3	R	80	5.0	0.800	22.5	LOS C	13.9	101.1	1.00	1.14	38.3
Approach		640	5.0	0.800	18.6	LOS B	13.9	101.1	1.00	1.14	39.8
East: Attfield Street											
4	L	160	0.0	0.833	25.4	LOS C	15.2	106.7	1.00	1.31	35.1
5	T	80	0.0	0.833	24.5	LOS C	15.2	106.7	1.00	1.31	35.2
6	R	320	0.0	0.836	29.0	LOS C	15.2	106.7	1.00	1.31	34.0
Approach		560	0.0	0.835	27.3	LOS C	15.2	106.7	1.00	1.31	34.4
North: Burslem Drive											
7	L	320	0.0	0.798	12.6	LOS B	14.4	101.1	0.91	0.82	44.8
8	T	480	0.0	0.799	11.8	LOS B	14.4	101.1	0.91	0.81	44.9
9	R	80	0.0	0.800	16.3	LOS B	14.4	101.1	0.91	0.84	42.5
Approach		880	0.0	0.798	12.5	LOS B	14.4	101.1	0.91	0.82	44.6
West: Attfield Street											
10	L	240	0.0	0.774	29.5	LOS C	11.7	82.2	1.00	1.29	33.0
11	T	80	0.0	0.777	28.7	LOS C	11.7	82.2	1.00	1.29	33.1
12	R	80	0.0	0.777	33.2	LOS C	11.7	82.2	1.00	1.29	32.1
Approach		400	0.0	0.774	30.1	LOS C	11.7	82.2	1.00	1.29	32.8
All Vehicles		2480	1.3	0.835	20.3	LOS C	15.2	106.7	0.97	1.09	38.6

Table 40. Burslem Drive and Olga Road Intersection Performance – Ultimate 2031 Flows PM Peak Current Geometry.

8.6.9 Olga Road – Attfield Street Intersection.

The existing signalised intersection has sufficient capacity to operate satisfactorily at the predicted traffic volumes.

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
Movement Performance - Vehicles											
South: Olga Street											
1	L	64	3.0	0.509	23.0	LOS C	4.3	30.7	0.91	0.83	38.6
2	T	419	3.0	0.509	14.7	LOS B	4.3	31.1	0.91	0.75	39.8
3	R	18	3.0	0.056	23.1	LOS C	0.3	2.1	0.84	0.70	36.7
Approach		501	3.0	0.509	16.1	LOS B	4.3	31.1	0.90	0.75	39.5
East: Attfield Street											
4	L	11	3.0	0.197	25.5	LOS C	1.0	7.2	0.91	0.75	36.1
5	T	22	3.0	0.197	17.3	LOS B	1.0	7.2	0.91	0.68	36.8
6	R	22	3.0	0.197	25.5	LOS C	1.0	7.2	0.91	0.75	36.1
Approach		55	3.0	0.197	22.2	LOS C	1.0	7.2	0.91	0.72	36.4
North: Olga Street											
7	L	21	3.0	0.302	22.1	LOS C	2.4	17.2	0.85	0.83	39.5
8	T	266	3.0	0.302	13.8	LOS B	2.4	17.3	0.85	0.68	40.8
9	R	128	3.0	0.506	26.8	LOS C	2.5	18.2	0.96	0.79	34.5
Approach		416	3.0	0.506	18.2	LOS B	2.5	18.2	0.89	0.72	38.6
West: Attfield Street											
10	L	58	3.0	0.212	25.6	LOS C	1.1	7.7	0.91	0.74	35.2
11	T	2	3.0	0.139	17.1	LOS B	0.7	4.9	0.90	0.66	36.2
12	R	36	3.0	0.139	25.3	LOS C	0.7	4.9	0.90	0.72	35.5
Approach		96	3.0	0.212	25.3	LOS C	1.1	7.7	0.91	0.73	35.3
All Vehicles		1067	3.0	0.509	18.1	LOS B	4.3	31.1	0.90	0.74	38.6

Table 41. Olga Road - Attfield Street Intersection Performance – Current Flows AM Peak - Current Geometry.

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Olga Street											
1	L	53	3.0	0.527	23.9	LOS C	4.1	29.4	0.93	0.83	38.1
2	T	398	3.0	0.527	15.6	LOS B	4.1	29.8	0.93	0.76	39.1
3	R	14	3.0	0.054	25.1	LOS C	0.2	1.8	0.88	0.69	35.5
Approach		464	3.0	0.527	16.9	LOS B	4.1	29.8	0.92	0.76	38.9
East: Attfield Street											
4	L	7	3.0	0.125	25.2	LOS C	0.6	4.5	0.90	0.73	36.3
5	T	14	3.0	0.125	17.0	LOS B	0.6	4.5	0.90	0.65	37.0
6	R	14	3.0	0.125	25.2	LOS C	0.6	4.5	0.90	0.73	36.3
Approach		35	3.0	0.125	22.0	LOS C	0.6	4.5	0.90	0.70	36.6
North: Olga Street											
7	L	31	3.0	0.468	23.7	LOS C	3.6	25.8	0.91	0.83	38.5
8	T	371	3.0	0.468	15.4	LOS B	3.6	26.0	0.91	0.74	39.5
9	R	114	3.0	0.477	27.6	LOS C	2.3	16.3	0.97	0.77	34.1
Approach		515	3.0	0.477	18.6	LOS B	3.6	26.0	0.92	0.75	38.1
West: Attfield Street											
10	L	153	3.0	0.480	25.6	LOS C	2.9	20.9	0.94	0.79	35.2
11	T	62	3.0	0.490	17.3	LOS B	3.0	21.8	0.95	0.75	36.6
12	R	97	3.0	0.490	25.6	LOS C	3.0	21.8	0.95	0.80	36.1
Approach		312	3.0	0.490	23.9	LOS C	3.0	21.8	0.95	0.78	35.8
All Vehicles		1325	3.0	0.527	19.3	LOS B	4.1	29.8	0.93	0.76	37.7

Table 42. Olga Road - Attfield Street Intersection Performance – Current Flows PM Peak - Current Geometry.

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Olga Street											
1	L	154	3.0	0.679	32.6	LOS C	8.4	60.5	0.96	0.88	32.5
2	T	444	3.0	0.679	24.3	LOS C	8.6	62.0	0.96	0.85	33.6
3	R	20	3.0	0.067	28.4	LOS C	0.5	3.4	0.81	0.72	33.6
Approach		618	3.0	0.679	26.5	LOS C	8.6	62.0	0.96	0.85	33.4
East: Attfield Street											
4	L	17	3.0	0.301	37.3	LOS D	1.6	11.7	0.96	0.75	30.2
5	T	22	3.0	0.301	29.1	LOS C	1.6	11.7	0.96	0.72	30.5
6	R	17	3.0	0.301	37.3	LOS D	1.6	11.7	0.96	0.75	30.2
Approach		56	3.0	0.301	34.1	LOS C	1.6	11.7	0.96	0.74	30.3
North: Olga Street											
7	L	33	3.0	0.263	20.1	LOS C	4.1	29.3	0.68	0.88	40.5
8	T	401	3.0	0.263	11.8	LOS B	4.1	29.5	0.68	0.56	42.9
9	R	238	3.0	0.694	25.0	LOS C	5.3	37.7	0.97	0.86	35.6
Approach		672	3.0	0.694	16.9	LOS B	5.3	37.7	0.78	0.68	39.9
West: Attfield Street											
10	L	197	3.0	0.650	35.6	LOS D	5.8	41.9	0.98	0.85	30.3
11	T	16	3.0	0.348	25.1	LOS C	2.9	20.8	0.93	0.73	32.0
12	R	91	3.0	0.348	33.3	LOS C	2.9	20.8	0.93	0.78	31.6
Approach		303	3.0	0.650	34.4	LOS C	5.8	41.9	0.96	0.82	30.8
All Vehicles		1648	3.0	0.694	24.3	LOS C	8.6	62.0	0.89	0.77	35.0

Table 43. Olga Road - Attfield Street Intersection Performance – Ultimate 2031 Flows PM Peak Current Geometry.

8.6.10 Bus Station Access Options – The Crescent

Significant work has been completed by SKM and LL Millar and Associates with respect to the provision of access to the bus station and adjacent intersections with SKM undertaking a review of the three options shown in Figures 14 and 15.

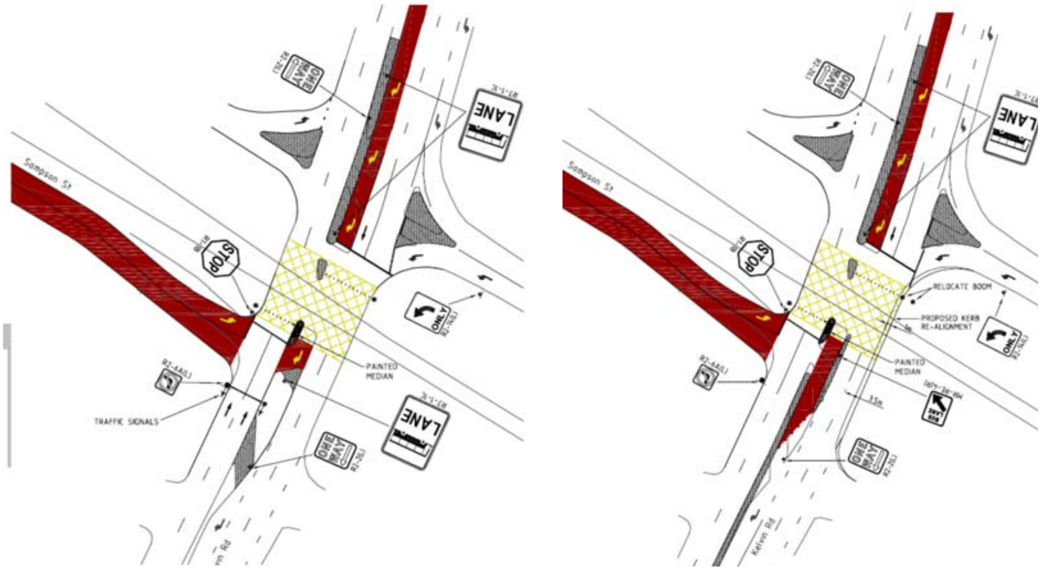


Figure 14. Bus Station Access Option 1- Signalised and Unsignalised Optional Treatments - Source SKM Report

Figure 15. Bus Station Access Main Roads WA Preferred Option.

The Main Roads WA option makes provision for buses to turn right into the bus station from Kelvin Rd using a dedicated southbound bus lane on the approach to the railway level crossing. Bus drivers would be directed to wait prior to the railway level crossing hold line by a dedicated Bus signal. It is assumed that the Bus signals would be coordinated with the active railway crossing control system as well as another set of signals provided for northbound Kelvin Road traffic prior to Sampson Street to facilitate completion of the movement of buses into Sampson Street.

8.6.11 Weston Street – Kelvin Road.

The Weston Street – Kelvin Road intersection currently provides unrestricted movements through a channelised unsignalised intersection. Performance was modelled for staged turns and the results are shown on Tables 41 and 42.

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Weston Street (RT Stage 1)											
1	L	57	3.0	0.142	15.8	LOS C	0.5	3.7	0.61	1.00	43.0
3	R	24	3.0	0.142	18.3	LOS C	0.5	3.7	0.61	0.96	43.9
Approach		81	3.0	0.142	16.5	LOS C	0.5	3.7	0.61	0.99	43.2
East: Kelvin Road											
4	L	19	3.0	0.195	8.3	LOS A	0.0	0.0	0.00	1.06	49.0
5	T	724	3.0	0.195	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		743	3.0	0.195	0.2	NA	0.0	0.0	0.00	0.03	59.7
West: Kelvin Road											
11	T	692	3.0	0.181	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
12	R	52	3.0	0.081	12.4	LOS B	0.3	2.1	0.59	0.82	44.8
Approach		743	3.0	0.181	0.9	NA	0.3	2.1	0.04	0.06	58.6
South West: Median (RT Stage 2)											
32	R	24	3.0	0.021	6.9	LOS A	0.1	0.4	0.42	0.90	24.1
Approach		24	3.0	0.021	6.9	LOS A	0.1	0.4	0.42	0.90	24.1
All Vehicles		1592	3.0	0.195	1.4	NA	0.5	3.7	0.06	0.10	57.8

Table 44. Weston Street – Kelvin Road Intersection Performance – Current Flows PM Peak - Current Geometry.

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Kelvin Road											
11	T	1163	3.0	0.304	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
12	R	87	3.0	0.297	22.2	LOS C	1.1	8.0	0.85	0.98	37.3
Approach		1251	3.0	0.304	1.6	NA	1.1	8.0	0.06	0.07	57.6
South East: Median (RT Stage 2)											
32	R	24	3.0	0.032	8.8	LOS A	0.1	0.6	0.59	0.97	22.1
Approach		24	3.0	0.032	8.8	LOS A	0.1	0.6	0.59	0.97	22.1
East: Weston Street (RT Stage 1)											
1	L	57	3.0	0.317	27.0	LOS D	1.2	8.3	0.86	1.04	35.4
3	R	24	3.0	0.317	29.6	LOS D	1.2	8.3	0.86	1.05	34.9
Approach		81	3.0	0.317	27.8	LOS D	1.2	8.3	0.86	1.04	35.3
North: Kelvin Road											
4	L	32	3.0	0.327	8.3	LOS A	0.0	0.0	0.00	1.06	49.0
5	T	1219	3.0	0.327	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		1251	3.0	0.327	0.2	NA	0.0	0.0	0.00	0.03	59.7
All Vehicles		2606	3.0	0.327	1.8	NA	1.2	8.3	0.06	0.09	57.3

Table 45. Weston Street – Kelvin Road Intersection Performance – Ultimate 2031 Flows PM Peak - Current Geometry.

The intersection is predicted to perform satisfactorily under ultimate 2031flows with movement Level of Service no worse than “D”, a degree of saturation of 0.327 and average delay of 1.8 seconds.

8.6.12 Westfield Street – Kelvin Road.

The Westfield Street – Kelvin Road intersection currently provides unrestricted movements through a channelised unsignalised intersection. Performance was modelled for staged turns and the results are shown on Tables 43 and 44.

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Kelvin Road											
11	T	695	3.0	0.182	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
12	R	112	3.0	0.175	12.7	LOS B	0.7	4.8	0.61	0.86	44.5
Approach		806	3.0	0.182	1.8	NA	0.7	4.8	0.08	0.12	57.2
South East: Median (RT Stage 2)											
32	R	58	3.0	0.051	7.0	LOS A	0.2	1.0	0.42	0.92	24.0
Approach		58	3.0	0.051	7.0	LOS A	0.2	1.0	0.42	0.92	24.0
East: Westfield Street (RT Stage 1)											
1	L	135	3.0	0.333	17.0	LOS C	1.5	10.9	0.66	1.05	42.0
3	R	58	3.0	0.333	19.6	LOS C	1.5	10.9	0.66	1.05	42.8
Approach		193	3.0	0.333	17.8	LOS C	1.5	10.9	0.66	1.05	42.2
North: Kelvin Road											
4	L	59	3.0	0.195	8.3	LOS A	0.0	0.0	0.00	0.99	49.0
5	T	684	3.0	0.195	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		743	3.0	0.195	0.7	NA	0.0	0.0	0.00	0.08	58.9
All Vehicles		1800	3.0	0.333	3.2	NA	1.5	10.9	0.12	0.23	55.4

Table 46. Westfield Street – Kelvin Road Intersection Performance – Current Flows PM Peak - Current Geometry.

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Kelvin Road											
11	T	1063	3.0	0.278	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
12	R	187	3.0	0.636	29.5	LOS D	3.2	22.9	0.91	1.14	33.2
Approach		1251	3.0	0.636	4.4	NA	3.2	22.9	0.14	0.17	53.5
South East: Median (RT Stage 2)											
32	R	54	3.0	0.065	8.4	LOS A	0.2	1.2	0.56	0.99	22.5
Approach		54	3.0	0.065	8.4	LOS A	0.2	1.2	0.56	0.99	22.5
East: Weston Street (RT Stage 1)											
1	L	124	3.0	0.667	35.1	LOS E	3.4	24.1	0.92	1.19	31.4
3	R	54	3.0	0.667	37.6	LOS E	3.4	24.1	0.92	1.21	30.4
Approach		178	3.0	0.667	35.8	LOS E	3.4	24.1	0.92	1.19	31.1
North: Kelvin Road											
4	L	100	3.0	0.328	8.3	LOS A	0.0	0.0	0.00	0.99	49.0
5	T	1151	3.0	0.328	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		1251	3.0	0.328	0.7	NA	0.0	0.0	0.00	0.08	58.9
All Vehicles		2733	3.0	0.667	4.8	NA	3.4	24.1	0.13	0.21	53.1

Table 47. Westfield Street – Kelvin Road Intersection Performance – Ultimate 2031 Flows PM Peak - Current Geometry.

The intersection is predicted to perform satisfactorily under ultimate 2031 flows with movement Level of Service no worse than "E", a degree of saturation of 0.667 and average delay of 4.8 seconds.

8.7 Impacts Associated with the Future Upgraded Road Network

The future upgraded road network in the area will include the following:

- Albany Highway is to be reconstructed as a dual carriageway road with a median capable of providing turn pockets and staged pedestrian crossing of Albany Highway between the Burslem Drive intersection and Kelvin Road intersection.
- A rail-bus modal interchange is proposed to be constructed at the railway station adjacent to the intersection of Albany Highway, Olga Road and Kelvin Road.
- Blackburn Street is to be extended from Albany Highway to the railway line linking up with the proposed modal interchange. A signalised intersection will be provided at the intersection of Blackburn Street and Albany Highway.
- Double right turn pockets from Albany Highway into Burslem Drive.

8.7.1 Albany Highway

The upgrading of Albany Highway between Burslem Drive and Kelvin Road is predicted to improve the mid block level of service to an acceptable level. However, without provision of a double right turn from Kelvin Road onto Albany Highway, that intersection is predicted to perform at Level of Service F when Maddington is fully developed.

Given that the intersection between Albany Highway and Blackburn Street will be newly created, there is no constraint on ensuring the intersection is designed and constructed so as to have adequate capacity.

The intersection of Burslem Drive and Albany Highway currently operates at near capacity.

8.7.2 Kelvin Road – Bus interchange Access Road Intersection.

The proposed entry and egress to the bus interchange adjacent to the Kelvin Road railway crossing has the potential to impact on network performance and contribute to the complexity of traffic management in the precinct. Bus services on Kelvin Road may experience unacceptable delays where increased rail services and an increasingly congested road and intersection network restrict flows.

In the worst case scenario, as the queue space between the railway crossing and Albany Highway is limited, queuing on Kelvin Road may extend back to the Albany Highway intersection further affecting network traffic flows. Should the queues extend onto Albany Highway, through traffic on Albany Highway may be blocked.

Ideally, the rail crossing at Kelvin Road should be constructed as a grade separated facility; however the likelihood of this occurring is remote and not considered to be economically feasible.

Without the grade separated crossing and a modified double right turn from Kelvin Road onto Albany Highway, it is predicted that the operational performance will be severely affected and traffic transference will occur. Options to mitigate impacts include integration of the railway boom gates and the Albany Highway signals as well as the installation of more sophisticated and capable queue detection infrastructure on Kelvin Road and Albany Highway. Additionally, corridor wide bus priority measures should be investigated and wherever possible implemented so as to improve bus services. Reliability of public transport services is paramount to ensuring the success of the TOD as buses play an important role in the transport network supporting connections to and from the railway network.

The intersection of the Bus Access Road and Kelvin Road has been subject to previous consideration by the City of Gosnells, Main Roads WA and the PTA. The current preferred option for the connection is a 3-way intersection with no right turn adjacent to the railway crossing.

8.8 Access and Traffic Management Strategy.

Olga Street and Kelvin Road are classified as District Distributor “A” roads and are expected to carry in excess of 18,000 vehicles per day. As such access considerations apply and the provisions of WAPC Planning Policy 5.1 are relevant in considering future development applications and access arrangements. Consistent with the Policy, when considering applications for access on these roads, the effects of the proposals on traffic flow and road safety should be the primary consideration and a strategy to minimise the creation of new driveways and rationalise existing access arrangements should be developed.

Where alternative access is or could be made available from side or rear streets or from rights of way, no access should be permitted unless special circumstances apply.

9 Internal Roads

9.1 Maddington Town Centre

9.1.1 Proposed Bus Rail Interchange

The proposed layout of the MTC will provide improved bus rail integration with bus services and will enable new services to be provided to the MTC. This, together with improved waiting facilities will make the public transit modes more attractive to users and a higher mode share is expected. While it is not possible to accurately model the movement patterns at Maddington due to the early stage of the proposal, experience based on the operation of railway stations on the Mandurah line and Northern Suburbs line indicates the following:

- Usage of public transport can be enhanced by encouraging patrons to access the station by other modes rather than solely rely on drive and park such as buses, kiss and ride, bicycle and walking.
- Bicycle parking and end of trip facilities should be provided.
- The impact of the implementation of cost recovery options for the provision of "premium" and other long term parking as part of the overall precinct parking management plan should be investigated.

The current layout of the proposed bus-rail interchange includes an entry and left out only at Kelvin Road controlled by a set of signals and a signalised intersection at the Blackburn Street extension with Albany Highway. The volume of traffic on the bus-rail interchange access road is to be restricted to bus only for the left out and right in movements in order to reduce the disruption to the operations on Kelvin Road. An alternate layout would be to use the new extension of Blackburn Street and Albany Highway for bus operations with the proposed roundabout at the western end of The Strand providing a bus turn around area.

Bus priority measures are recommended to be investigated and implemented on a corridor wide basis in order to improve the reliability of route bus operations. This would act to improve the attractiveness of bus transport as a mode choice in its own right or as a feeder to the rail services.

Design of public spaces based on "Crime Prevention Through Environmental Design" (CPTED) principles to increase passive surveillance and improve the perception of safety is important to the success of TOD's, and design principles for the interchange should be based on the City of Gosnells "SafeCity Urban Design Strategy" which incorporates CPTED principles.

9.1.2 Laneways

The design of the MTC parcels of land for redevelopment should consider the need for laneways to provide safe and efficient access for light vehicles to car parks and for service vehicles. Where possible, direct access to car parks from frontage streets should be avoided.

9.1.3 SOP Internal Road Cross Sections

The following provides commentary on the road cross sections required to service the proposed redevelopment of the SOP. Road names are referenced on Figure 9.

- Road A is an access road servicing the southern region and the Landcorp site. It is expected to cater for less than 1,000 vehicles per day with a target speed environment of 40 km/hr.
- Road B (Kitson Place extension) is likely to function as the major access point for SOP and is expected to cater for approximately 2,300 vehicles per day. The recommended classification for the road is Neighbourhood Connector B with a target speed of 50 km/hr.
- Road C and Road D are access roads servicing the Oval sector of the precinct and are expected to cater for less than 1,000 vehicles per day with a target speed of 40 km/hr.
- Road E is a Boulevard style access road servicing the Central sector of the precinct. It is expected to cater for less than 1,500 vehicles per day with a target speed of 40 km/hr.
- Road F is an access road servicing the Central sector of the precinct. It is expected to cater for less than 1,000 vehicles per day.
- Road G is an access road servicing the Landcorp site. It is expected to cater for less than 1,000 vehicles per day.

Road cross sections should be consistent with the recommended profile shown for type B access roads in “Liveable Neighbourhoods” and shown on Figure 16. Road E should be more focussed on pedestrian activities with the provision of road pavement a secondary consideration.

9.2 Central Maddington

Based on the predicted traffic flows and road classification contained in Liveable Neighbourhoods as shown in Table 48, a recommended road hierarchy as shown outlined in Table 49 was developed. Roads are designated according to the convention shown on road Figure 11.

Indicative volume.	Route type / name.	Indicative Reserve Width.	Indicative Carriageway Width.
50,000.	Primary Distributor.		Determined by Main Roads WA
35,000.	Primary Distributor.		Determined by Main Roads WA
15,000 to 35,000.	Integrator Arterial A (District Distributor A).	50.6 – 52.6 metres.	2 X 8.2 metre carriageways including bike lane and 2 X 5.5 metre service roads containing parking.
<25,000	Integrator Arterial A (District Distributor A).	35.6 metres.	2 X 10.7 metre carriageways including combined on street parking and bike lane.
7,000 to 15,000.	Integrator Arterial B (District Distributor B).	29.2 metres.	2 X 7.5 metre carriageways with on street parking and bike lane.
15,000.	Integrator Arterial B (District Distributor B).	25.2 metres.	2 X 7.5 metre carriageways with on street parking.
7,000.	Neighborhood Connector A.	24.4 metres	2 X 7.1 metres including parking, on street bike lane, median plus shared path on one verge.
3,000.	Neighborhood Connector B.	19.4 metres	11.2 metres including parking plus shared path on one verge.
3,000.	Access Street A (Avenue).	20 - 24 metres.	2 x 3.5 metre lanes plus indented parking.
3,000.	Access Street B (Wider street).	16.5 - 18 metres.	9.7 metre lane.
3,000.	Access Street C (Yield or give way street).	15.4 - 16 metres.	7.2 (7.0 – 7.5) metre lane.
1,000.	Access Street D (Narrow yield or give way street).	14.2 metres.	5.5 – 6.0 metre lane.
150	Access Street D (Narrow yield or give way street).	14.2 metres.	3.5 metre lane plus parking indents.
3,000.	Access Street D (Wider street).	16.5 - 18 metres.	9.7 metre lane.

Table 48. Road Hierarchy Criteria.

Road Name	Expected Volume (VPD)	Road Type	Comments
CM 1	< 1,000	Access Street C	R30 zone
CM 2	< 3,000	Access Street B	R30 zone. Extension of Carisbrooke Street.
CM 3	< 1,000	Access Street C	Short Street, R30 zone.
CM 4	< 1,000	Access Street C	Short Street, R30 zone.
CM 5	< 3,000	Access Street B	R40 and R80 zones. Required for on-street parking.
CM 6	< 1,000	Access Street C	Access to CM 5 from Kelvin Road. Limited parking.
CM 7	<1,000	Access Street C	R30 zone. Extension of Brabourne Street.
CM 8	< 1,000	Access Street C	R40 zone. Extension of Brabourne Street. Short length, aims to be same cross-section with CM7.
CM 9	<1,000	Access Street C	R30 zone. Extension of Longfield Road.
CM 10	<1,000	Access Street C	R30 zone. Extension of Aldington Road.
CM 11	<3,000	Access Street B	School parking.
CM 12	<3,000	Access Street B	School parking.
CM 13	<1,000	Access Street B	School parking
CM 14	<1,000	Access Street D	Short Street.
CM 15	<1,000	Access Street C	R30 zone. Extension of Newenden Street.
CM 16	<1,000	Access Street C	R30 zone. New Road
CM 17	<1,000	Access Street C	R 30 zone. New Road
CM 18	<1,000	Access Street C	R 30 zone. New Road. Access to river front public open space.
CM 19	<1,000	Access Street D	R 20 zone.
CM 20	<1,000	Access Street D	R 20 zone.
CM 21	<1,000	Access Street D	R 20 zone.
CM 22	<1,000	Access Street C	R 40 zone. Fronting L.O.S.

Table 49. Recommended Street type Central Maddington

The selection of the type of street is based on the practical consideration for the demand for parking by residents and visitors.

Discussions with the City of Gosnell's officers indicated that at the R30 density in the Central Maddington Precinct, lots would be most likely developed as duplex type group-housing instead of town-house type dwelling unit. Duplex type group-housing would provide visitors parking bays on-site instead of relying on the on-street parking bays and would reduce the anticipated on-street parking demand. It is anticipated the development higher than R40 would rely solely on-street parking as they would be provided with one car bay per residential dwelling. This would be based on the TOD principles.

Given that this is a "brown-field" development site, the transition to a TOD style redeveloped subdivision would be largely driven by demand and interest from developers. There would be a transition period where the existing residents of Central Maddington would expect that the parking privileges that they currently enjoy would not be removed without consultation.

The new road networks within the CMSP and CMNP precincts are created to service the future in-fill development. At present, there is no defined lot layout plan for the precincts and as such the modelling is based on the maximum yield of each residential dwelling density. Based on these assumptions, the analysis of the proposed development plan indicated that most of the new road links would be expected to generate less than 1,000 vehicles per day. The road cross sections within the CMSP and the CMNP should encourage walking and cycling and it is recommended that footpaths are provided on both sides of local roads.

Wider access street type B is recommended for the new subdivisional roads in CM where the proposed density is greater than R40. A typical street cross section is shown in Figure 16. This cross-section can cater for traffic volumes up to 3,000 vehicles per day and makes provision for footpaths on both sides of the street and on road parking.

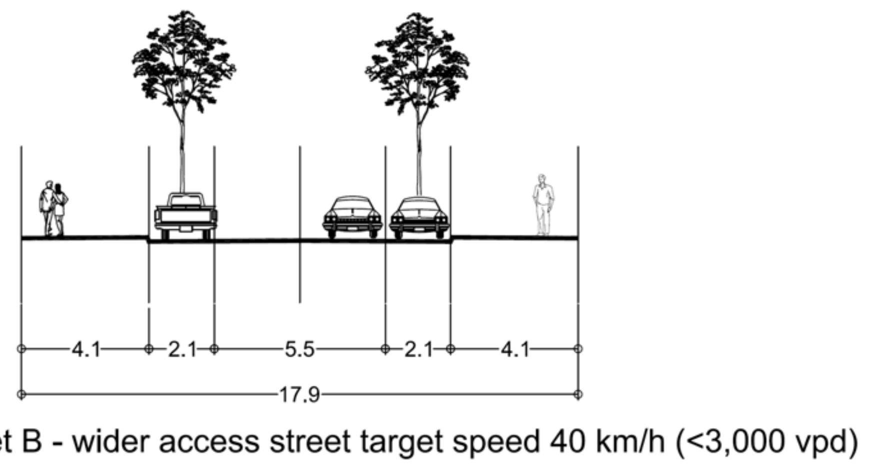
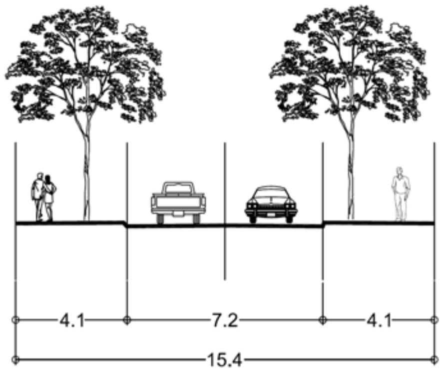


Figure 16. Typical New Access Street B Cross Section.

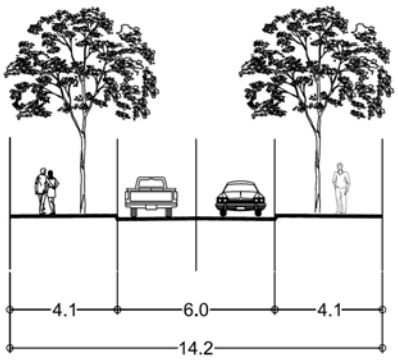
Access Street type C is recommended for roads where the adjacent dwelling density is between R30 and R40. A typical cross section of a type C street is shown in Figure 17. The cross-section can provide ad-hoc on road parking on both sides of the road leaving a single traffic movement. Due to the lateral restrictions posed by parked cars, travel speeds in type C streets are typically low.



Access Street C - yield (or give way) street target speed 40 km/h (<3,000 vpd)

Figure 17. Typical New Access Street C Cross Section.

Access Street type D is recommended for streets servicing proposed R20 developments or where road length is less than 80 metres. A typical cross section of a type D street is shown in Figure 18.



Access Street D - narrow yield (or give way) street target speed 30 km/h (<1,000 vpd)

Figure 18. Typical New Access Street D Cross Section.

9.3 Intersection Controls

9.3.1 SOP Intersections

Intersections within the SOP are designated alphabetically as shown on Figure 10.

A summary of the intersection configurations of Road A, Road B, Road C and Road D with Kelvin Road are shown in Table 50.

Road	Configuration	Control	Lane layout on Minor road	Median
Road A	Left in, Left out	Priority	One lane each direction	No median opening
Road B	Left in, Left out	Priority	One lane each direction	No median opening
Road C	Left in, left out	Priority	One lane each direction	No median opening
Road D	Left in, left out	Priority	One lane each direction	No median opening
Road F	No intersection			

Table 50. Proposed SOP Intersection Configurations with Kelvin Road

Internal intersections within the SOP will be low volume intersections constructed generally as shown on Figure 9.

9.3.2 External Road Intersections – CM

A summary of the recommended intersection configurations for new subdivisional roads where they intersect with Kelvin Road are shown in Table 51.

Road Type	Location	Configuration	Control	Lane layout on Minor road	Median
Access Road.	Between Weston Street and Westfield Street.	Left in, Left out.	Priority.	One lane each direction.	No median opening.
Laneway.	Between Weston Street and The Crescent.	Left in, Left out.	Priority.	6 metre wide roadway no footpath.	No median opening.

Table 51. Proposed Intersection Configurations with Kelvin Road

It is estimated that Weston Street traffic in the post development period may exceed 4,000 vehicles per day at the intersection with Kelvin Road, and warrants for consideration of traffic signals based on traffic demand may be satisfied by 2031 when the area is fully redeveloped. Further investigation on the feasibility and desirability of the installation of traffic signals along Kelvin Road needs to be undertaken at a later date. As a preliminary guide, intersection requirements can be accessed from Figure 19 (Source: Institute of Highway and Transportation (UK) "*Roads and Traffic in Urban Areas*" (1987) publication).

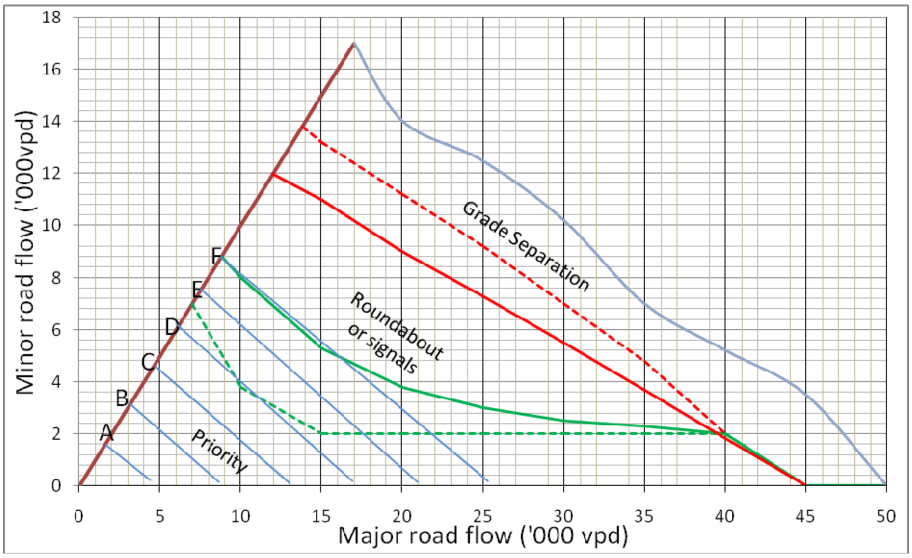


Figure 19. Type of Intersections Appropriate for Different Traffic Flows

9.3.3 Internal Road Intersections – CM

For the internal road network in CM existing intersection configurations are assessed as being adequate post development and intersections channelised and priority controlled will be adequate.

Two new staggered 3-way intersections are shown on Attfield Street approximately 35 metres apart; the separation distance satisfies "Liveable Neighbourhoods" guideline requirements.

A new 4 way intersection will be created by the extension of Attfield Street east of River Avenue and a roundabout is considered desirable to reduce the potential for right angel crashes and to moderate traffic speeds.

Assessment of internal intersection warrants for detailed analysis is shown on Table 52.

Intersection	**Hourly Volume on Major Road** **VPH (two way)**	**Hourly Volume on Minor Road** **VPH (two way)**	**Comment.**
Warrants as per Table 8.1 of Austroads Guide to Engineering Practice Part 2, Roadway Capacity - Two Lane Major Road Cross Road	*400 vph* *500 vph* *650 vph*	*250 vph* *200 vph* *100 vph*	Table details flows that initiate intersection analysis. As major flows increase, there is reduced capacity to accept minor flows.
Westfield Street and CM1	<650	<100	3 Way Intersection – No analysis required
Westfield Street and CM2	<650	<100	3 Way Intersection – No analysis required

Intersection	Hourly Volume on Major Road VPH (two way)	Hourly Volume on Minor Road VPH (two way)	Comment.
Warrants as per Table 8.1 of Austroads Guide to Engineering Practice Part 2, Roadway Capacity - Two Lane Major Road Cross Road	*400 vph* *500 vph* *650 vph*	*250 vph* *200 vph* *100 vph*	Table details flows that initiate intersection analysis. As major flows increase, there is reduced capacity to accept minor flows.
Weston Street and CM4	<500	<200	3 Way Intersection – No analysis required
Weston Street and CM7	<500	<100	3 Way Intersection – No analysis required
Clifton Street and CM5	<400	<250	3 Way Intersection – No analysis required
The Crescent and CM5	<400	<250	3 Way Intersection – No analysis required
CM 5 and CM 6	<400	<250	3 Way Intersection – No analysis required
The Crescent and CM8	<400	<250	3 Way Intersection – No analysis required
Morley Street and CM9	<400	<250	3 Way Intersection – No analysis required
Attfield Street and CM13	<400	<250	3 Way Intersection – No analysis required
Attfield Street and CM12	<400	<250	3 Way Intersection – No analysis required
Cowan Street and CM12	<400	<250	3 Way Intersection – No analysis required
CM14 and CM15	<400	<250	3 Way Intersection – No analysis required
CM15 and CM16	<400	<250	3 Way Intersection – No analysis required
CM 16 and Dellavanzo Street	<400	<250	3 Way Intersection – No analysis required
Philip Street and CM16	<400	<250	3 Way Intersection – No analysis required
Philip Street and CM 18	<400	<250	3 Way Intersection – No analysis required

Intersection	Hourly Volume on Major Road VPH (two way)	Hourly Volume on Minor Road VPH (two way)	Comment.
Warrants as per Table 8.1 of Austroads Guide to Engineering Practice Part 2, Roadway Capacity - Two Lane Major Road Cross Road	*400 vph* *500 vph* *650 vph*	*250 vph* *200 vph* *100 vph*	Table details flows that initiate intersection analysis. As major flows increase, there is reduced capacity to accept minor flows.
River Street and CM18	<400	<250	3 Way Intersection – No analysis required
River Street and CM20	<400	<250	3 Way Intersection – No analysis required
River Street and CM19	<400	<250	3 Way Intersection – No analysis required
River Street and CM17	<400	<250	3 Way Intersection – No analysis required
CM21 and CM22	<400	<250	3 Way Intersection – No analysis required
CM21 and CM19	<400	<250	3 Way Intersection – No analysis required
CM21 and CM23	<400	<250	3 Way Intersection – No analysis required

Table 52. Analysis of Local Street Intersections within CM

9.4 Speed Management

The control of traffic speed is a fundamental component of the principles adopted by "Liveable Neighbourhoods and can be achieved by:

- Provision of road widths appropriate for the traffic volume and parking demand, so traffic is impeded and slowed by parked and opposing vehicles, but capacity is not unduly constrained;
- Creation of short leg lengths between street junctions and /or slow points (tight corners, bends or traffic calming devices) to encourage a speed environment of 30 - 40 km/h or less;
- Creation of visually and physically tight intersections (small kerb radii);
- Planning for short local trips, reducing potential for driver frustration; and,
- Provision of trees planted near the road or in a parking lane so as to narrow visual width but

not obstruct sight lines of drivers.

Application of these initiatives where appropriate within the MTC and CM will help to constrain vehicle speeds and create an environment consistent with the TOD principles.

9.5 Service Vehicle Access

Access by service vehicles and emergency vehicles will need to be provided in both the MTC and CM. The provision of laneways would minimise the interaction between service vehicles and light vehicles and pedestrians, and should be considered in the detailed planning of the MTC and CM. Consideration will also need to be given with respect to larger vehicles such as semi-trailers accessing the development sites, particularly during construction phases.

10 Parking Management

A central principle of TOD with respect to parking is to locate, design, provide and manage car parking to support walking, cycling and public transport accessibility. Where there is a high level of parking supply for residents, workers and visitors, the use of public transport may be discouraged.

Typically parking management in TOD's should incorporate good practice such as:

- Managing demand so that it does not compromise pedestrian movement and local amenity.
- Setting maximum parking standards and encourage low car developments.
- Locating parking in basements, under decks and behind buildings. Surface parking adjacent to active street frontages is not appropriate in TOD precincts.
- Concealing podium parking with active frontages.
- Unbundling car parking from the sale of residential dwellings.
- Providing short-term on-street parking to improve activity and vitality.
- Planning and placing park-and-ride facilities where appropriate for accessing the transit network, preferably not in the core of the precinct.
- Consolidating and sharing parking between developments.
- Introducing car-share schemes and residential-parking permits.
- Pricing parking appropriately to promote sustainable travel behaviour.

The key to the success of a TOD parking management plan is pricing parking services to encourage visitors and workers to use non-car based modes to visit Maddington.

10.1 Parking Requirements

Recommended parking allocation in TOD precincts is shown on Table 53.

Precinct types	Residential (car spaces per unit)		Retail and office (square metres per car space)	
	Base maximum	Preferred maximum	Base maximum	Preferred maximum
City centre	0.75	0.5	400	600
Activity centre	1	0.75	100	200
Specialist activity centre	1.25	0.75	100	150
Urban	1	0.75	200	300
Suburban	1.25	1	75	100
Neighbourhood	1.25	1	50	100

Table 53. Recommended Parking Allocation in TOD precincts[5]

The rate of parking provision for buildings as outlined in the TOD scorecard is recommended with the balance of parking demand to be satisfied by the on street and off street shared parking supply. This would form an efficiency based parking provision which maximises the utilisation of parking infrastructure but has the flexibility to address overall precinct parking demand as redevelopment progresses.

For the proposed TOD in the SOP, the recommended parking rate is 1 car parking space per 100 square metre of gross floor area for commercial development and 1 space per residential dwelling unit. This is consistent with the recommended levels indicated in Table 30 for suburban and neighbourhood precincts.

In the balance of the MTC and CM, recommended parking rates for commercial development is 1 car bay per 100 square metres GFA. For residential developments, where the density is R20 the provisions of the R Codes are recommended, at higher densities the parking rate should be set at between 1 and 1.25 bays per dwelling unit.

As current parking provisions are based on the paradigm that parking is free and car use is encouraged to access a land use, the move to TOD based principles will require a change in mind set by residents and tenants.

For retail and short term visitors, the preference is to direct them to either on-street shared parking or secondary off street shared parking with good pedestrian linkage to the shops and commercial areas.

10.2 Unbundling of Parking

In the TOD based precincts, the ability for residential parking lots to be sold separately (unbundled) from residential units may be an option for parking management; however this would need to be

[5]Growth Management Queensland, Transit oriented development: guide for practitioners in Queensland

further investigated. As a policy initiative, unbundled parking has the potential to improve the affordability of housing for those who choose not to own a car. In addition, parking would not need to be located in the same building or block as the associated land uses. However this approach to parking represents a radical change in paradigm in the Western Australian context, where there is a current expectation that parking is an entitlement provided in suburban development and may be difficult to implement.

10.3 Parking Management

10.3.1 Parking Plan Elements

In developing a parking management plan for the area, the following elements should be considered:

- "Users" should pay directly for parking facilities.
- Parking should be regulated to favour higher priority / value uses and to encourage efficient utilisation of parking resources. For example, on-street parking adjacent to restaurants and shops should be short-term parking. Longer duration parking should be located in parking structures and off street areas. Parking should be rationed by of supply and pricing to encourage desired land use outcomes.
- Funding sources for the provision of parking infrastructure should be identified. Traditional sources typically include developer contribution, Council funded infrastructure repaid from parking levies and car park operations or special rate levies on beneficiaries of the parking infrastructure.
- An integrated parking management and enforcement program should be developed and deployed early in the redevelopment of the MTC and CM to prevent formation of "parking problems".

10.3.2 Parking Management Plan

The parking management plan should outline the strategic vision and philosophy of the new parking management paradigm, as well as outlining in more detail, measures to be deployed in each precinct and governance and review mechanisms to evaluate the effectiveness of the parking management plan.

Parking management measures that are considered to be appropriate to the TOD and should be included in the integrated parking management plan are:

- Establishment of maximum parking levels.

- Establishment of pricing policy to facilitate recoup of the cost of provision of parking and to encourage the use of alternate modes of transportation.
- Define parking zones and parking restrictions that do not inhibit commercial and retail activities but discourage long term private car use.
- Where feasible, provide mechanisms for the unbundling of parking entitlements in buildings to create more choice and lower the cost of renting or buying real estate.
- Establish enforcement framework to encourage compliance and maintain integrity of the parking regulation regime.
- Establish plans to manage occasional peak parking demands in the study area.
- Address parking spill-over issues in adjacent areas using management, enforcement and pricing tools.

10.4 Shared Parking

Shared parking is defined as parking provided in the public domain to support private parking in the TOD precincts. It is typified in activity centres and CBD's by multi level parking structures provided by the Local Authority or private parking operators. With commercial and retail development shared parking is likely to be required for short term visitors. Detailed planning would need to identify land allocation for this function.

10.4.1 Staging of Shared Parking Supply

The provision of shared parking could be staged with an initial facility provided to service the quantum of commercial / retail floor space initially approved.

As further development progressed, additional bays could be provided to meet increasing demand.

As it is not possible to accurately predict the level of parking demand over time, as this is dependent on development uptake rate and the effectiveness of the combined parking management measures, the integrated parking plan should be coupled with contingency planning such as land banking for future parking supply. This will need to be identified in the formulation of the detailed parking management plan. This would give planners the confidence and flexibility to deal with parking related issues that may arise as the centre develops. If the land bank was found to be surplus to the parking requirements, alternate land uses could be considered by Council.

10.5 Dealing with Existing Parking Provisions with MTC

The parking management plan will also need to address how to integrate the legacy parking provision in locations such as Maddington Shopping Centre. At present the shopping centre car parking provision is based on previous planning codes and it is assumed that the shopping centre will stay as it is and not be further developed.

Notwithstanding this, there is potential for the shopping centre to be redeveloped based on TOD principles and the integrated parking management plan should incorporate flexibility to deal with the integration of existing parking supply and manage interface issues between the two parking management philosophies.

11 Pedestrian, Bicycles and Public Transport

11.1 Pedestrian and Bicycle Facilities

A key principle of a TOD is to create an increased mode share for walking, cycling and public transport by providing high levels of accessibility and public amenity within precincts to stations and when residential land use is well integrated with compatible land uses, a strong walk/cycle network can facilitate:

- a reduction of private car dependency for residents;
- increased accessibility to employment and other urban activities for residents;
- a reduction in the adverse environmental impacts of transport;
- an improved level of personal well being and fitness;
- increased resource efficiency in a multi-modal transport system; and,
- a reduction in transport-related crashes.
- surrounding areas for cyclists and pedestrians, with priority for pedestrians.

In order to support a TOD, pedestrian and bicycle facilities should be provided to a higher standard than for a typical development scenario.

It is recommended that footpaths are provided on both sides of roads abutting dwelling densities of R30 or higher in order to encourage walking. Permeability of the pedestrian network could be improved in Central Maddington by the inclusion of pedestrian access walkways (PAW's) linking Brabourne Street to the proposed road CM 6, and Westfield Street to Clifton Street.

Formal pedestrian and cyclist crossing points should be provided on Kelvin Road to link Central Maddington to the Station Oval Precinct and to improve accessibility to the station and bus interchange. Further detailed investigation is required to determine the location and nature of the crossing.

Outside of the SOP, the linkage to the balance of the MTC is vital for the success of the TOD based development as walking and cycling should be promoted as the preferred mode of transport for residents and workers to access the range of goods and services available in the retail core located south of the precinct in the MTC. The provision of traffic signals at the proposed intersection of Albany Highway and Blackburn Street will facilitate the safe pedestrian crossing of Albany

Highway, providing a link between the Shopping Centre and the revamped railway station. The construction of a median on Albany Highway between Olga Road and Burslem Drive would also provide additional informal crossing opportunities for pedestrians, allowing them to stage crossing, improving safety and the north – south pedestrian link in the MTC.

As part of the MTC revitalisation strategy, the river front is proposed to be an active and passive recreation area for residents and visitors. Links from the SOP to the river front are also an important part of the pedestrian strategy for the MTC.

The TAFE campus located south of the MTC and separated by Canning River is a destination suitable to be serviced by either walking or cycling from the SOP. With residential dwelling units suitable to meet the needs of TAFE students, especially international or country students, provision of a strong pedestrian and bicycle link via shared paths and a pedestrian and bicycle only bridge would provide a direct route for pedestrians to the Thornlie TAFE and link to the MTC retail commercial and the transport hub.

Within the MTC and CM, cyclists can be accommodated on shared road pavements and existing cycle infrastructure. Detailed planning of CM should provide formal cycle links from the north and south precincts to the regional bike network.

11.2 Public Transport Provisions

The level of public transport servicing the MTC and SOP is high due to the precinct's proximity to the Maddington Railway Station and major bus routes servicing the region. The construction of the dedicated bus-rail modal interchange will further enhance the attractiveness of public transport in the MTC and allow existing transport options to be expanded.

Discussions with the PTA indicated that there is scope for the introduction of two additional bus routes through Maddington; however, this would be subject to further land development in Kalamunda or Gosnells and a consequent increase in demand.

No alterations to existing bus routes are considered necessary.

12 Conclusions

The expected trip generation for the TOD based MTC and CM is approximately 48,300 trips a day which represents an approximately 20,500 trips increase over the current land use pattern. The trip generation is less than that predicted for a traditional development and was derived from first principles and based on surveys from other Australian TOD's.

Consistent with TOD principles, the internal road network are designed to focus on providing access to and from the development sites and to encourage walking, cycling and for longer trips, public transport.

The redevelopment of Maddington Railway Station with an integrated bus rail modal interchange will complement the proposed TOD and should be a strong driver in changing modal travel patterns. In order to support the bus – rail interchange and the SOP development, a pedestrian friendly link across Albany Highway linking the existing retail and commercial core should be provided. Ultimately, it is desirable for this link to extend across Burslem Drive linking the Canning River foreshore and the Thornlie TAFE campus.

At ultimate development, increase in traffic is likely to trigger the need to widen Albany Highway so as to provide a central median and turn pockets, modify the signals on Albany Highway at the Burslem Drive and Kelvin Road intersections and widen Burslem Drive to 4 lanes. Congestion on Kelvin road associated with queuing back from the rail crossing will also need to be addressed.

Associated with the redevelopment of Central Maddington is the possible need to install traffic signals at the Kelvin Road – Westfield Street intersection when traffic volumes increase.

Some required improvements may not be feasible due to land requirements and cost constraints and the resulting congestion may lead to a transference of traffic to alternative regional routes.

Parking management is a key component to the success of the redevelopment of the MTC and CM and a parking management plan will need to be developed to manage both private and public parking in the MTS and CM.

Appendix 1. Checklist

Item	Refer Section	Comments/Proposals
Summary	1	
Introduction/Background	2	
Structure plan proposal	3	
regional context	3.1	
proposed land uses	3.3	
table of land uses and quantities	3.3	
major attractors/generators	3.4	
specific issues	Various	
Existing situation	4	
existing land uses within structure plan	4.1	
existing land uses within 800 metres of structure plan area	4.1	
existing road network within structure plan area	4.2.1	
existing pedestrian/cycle networks within structure plan area	4.2.6	
existing public transport services within structure plan area	4.2.7	
existing road network within 2 (or 5) km of structure plan area	4.2	
traffic flows on roads within structure plan area (PM and/or AM peak hours)	4.2	
traffic flows on roads within 2 (or 5) km of structure plan area (AM and/or PM peak hours)	4.2	
existing pedestrian/cycle networks within 800m of structure plan area	4.2.6	
existing public transport services within 800m of structure plan area	4.2.7	
Proposed internal transport networks	5.1	
changes/additions to existing road network or proposed new road network	5.1	
road reservation widths	8.1	
road cross-sections & speed limits	8.2	
intersection controls	8.3	
pedestrian/cycle networks and crossing facilities	10.1	
public transport routes	10.2	

Item	Refer Section	Comments/Proposals
Changes to external transport networks	7.4	
road network	7.4.1 – 7.4.4	
intersection controls	7.4.5 – 7.4.12	
pedestrian/cycle networks and crossing facilities	-	
public transport services	-	
Integration with surrounding area		
trip attractors/generators within 800 metres	6	
proposed changes to land uses within 800 metres	6	
travel desire lines from structure plan to these attractors/generators	6	
adequacy of external transport networks	6	
deficiencies in external transport networks	6	
remedial measures to address deficiencies	6	
Analysis of internal transport networks	8	
assessment year(s) and time period(s)	7.1, 7.2	
structure plan generated traffic	7.3	
extraneous (through) traffic	7.3 – 7.5	
design traffic flows (ie. total traffic)	7.3 -7.5	
road cross-sections	8	
intersection controls	8	
access strategy	7.6	
pedestrian / cycle networks	10.1	
safe routes to schools	N/A	
pedestrian permeability & efficiency	10.1	
access to public transport	10.2	
Analysis of external transport networks	6	
extent of analysis	6	
base flows for assessment year(s)	6	
total traffic flows	6	
road cross-sections	7	
intersection layouts & controls	7	
pedestrian/cycle networks	10	
Conclusions	11	

Appendix 2. Trip Generation

12.1 Existing Land Use Trip Generation

The trips rates adopted for the existing traffic generating land uses in the study area from RTA and ITE publications are as follows:

- Recreation area 20 trips per 100 square metres of floor area per day;
- Speciality Retail Stores 33. trips per 100 square metres of floor area per day;
- Commercial 5.1 trips per 100 square metres of floor area per day;
- Supermarket 100 trips per 100 square metres of floor area per day;
- Bulky Goods store 30 trips per 100 square metres of floor area per day;
- Light industrial and warehousing 5 trips per 100 square metres of floor area per day;
- Residential lots 9 trips per day per detached dwelling unit.

The trip production rates of the existing land uses in the MTC and CM areas are as follows:

Precinct	Trip - Vehicles Per Day
SOP	1,389
SHP	3,497
MCP	3,323
MRP	15,393
CMNP	1,827
CMSP	2,400
Total	**27,829**

12.2 Future Trip Generation

Trips are produced by residential land uses, and are attracted to work places, education, shopping and other activities.

A trip production rate of 2.5 motorised trips per dwelling per weekday has been adopted for the MTC. The derivation of these trip production rates is described below.

The key assumptions are:

- An assumed average household size of 2.0 persons per dwelling within the Station Oval Precinct because all residential units are apartment buildings.
- A weekday (all mode) trip rate of 3.4 trips per person per day (based on research by Brog and Erl 2001, the Victorian Activity and Travel Survey and the WA Department of Planning and Infrastructure TravelSmart surveys);
- Total trips (all modes) per dwelling equivalent to 2.0 (people per household) x 3.4 (trips per person) = 6.8;
- Car driver mode share of 36.7 per cent, ("*Transit Oriented Developments: Results from a Travel Survey*" Muley, Bunker and Ferreira 2009) based on a travel survey on a TOD which derived a mode share of 44% assuming a car occupancy of 1.2 and the high level of public transit use and availability of shopping centre and employment opportunities within the MTC and adjacent light industrial areas which can be accessed by either walking or bicycle.
- Weekday car trip rate of 6.8 (all mode trips) x 36.7 per cent (car driver mode share) = 2.5 car driver trips per dwelling. This is lower than that the general industry adopted trip rates for apartment dwellings of 3 to 5 car driver trips per dwelling

Adopting this trip rate would result in 5934 home based residential car trip productions on an average weekday from the MTC. This estimate is based on 100 per cent occupancy of all dwelling units as the main residence. In reality not all apartments are expected to be occupied at the same time and hence the trip estimate outlined above is an upper bound estimate.

For the residential dwellings in the CM study area the following trip generation rates are adopted:

Density	Trips per dwelling per day
R20	8
R30	5
R40	4
R80	3

The number of dwelling is derived by estimation of the area and dividing the available development area by the density. For CM study area, the following yield of dwellings is derived:

Precinct	R20	R30	R40	R80	Total
CMSP	230	400	204	224	1058
CMNP	0	669	271	278	1218

The CMSP precinct can yield up to 1058 dwellings and the CMNP precinct can potentially yield 1218 dwellings.

Using the dwelling yields of CMSP and CMNP precincts and the trip generation rate for various densities of dwellings the gross estimated trip generation of redeveloped CMSP is 5544 and CMNP is 5393 respectively.

The commercial based trip generation rate is based on a base trip rate: 10 trips per day per 100m2 GLA. This rate is derived by RTA based on the following assumptions:

- A car based mode split of 0.62,
- a mean peak hour occupancy of 1.19 i.e. 52% car drivers,
- an employee density of 21 square metre per employee (4.75 employee per 100 square metres)
- A parking provision rate 1 car space per 40 square metres (2.5 car parking bay per 100 square metres of gross floor area).

These parameters outlined above produce a trip generation rate of 2 trips per 100 square metres during the PM peak hour.

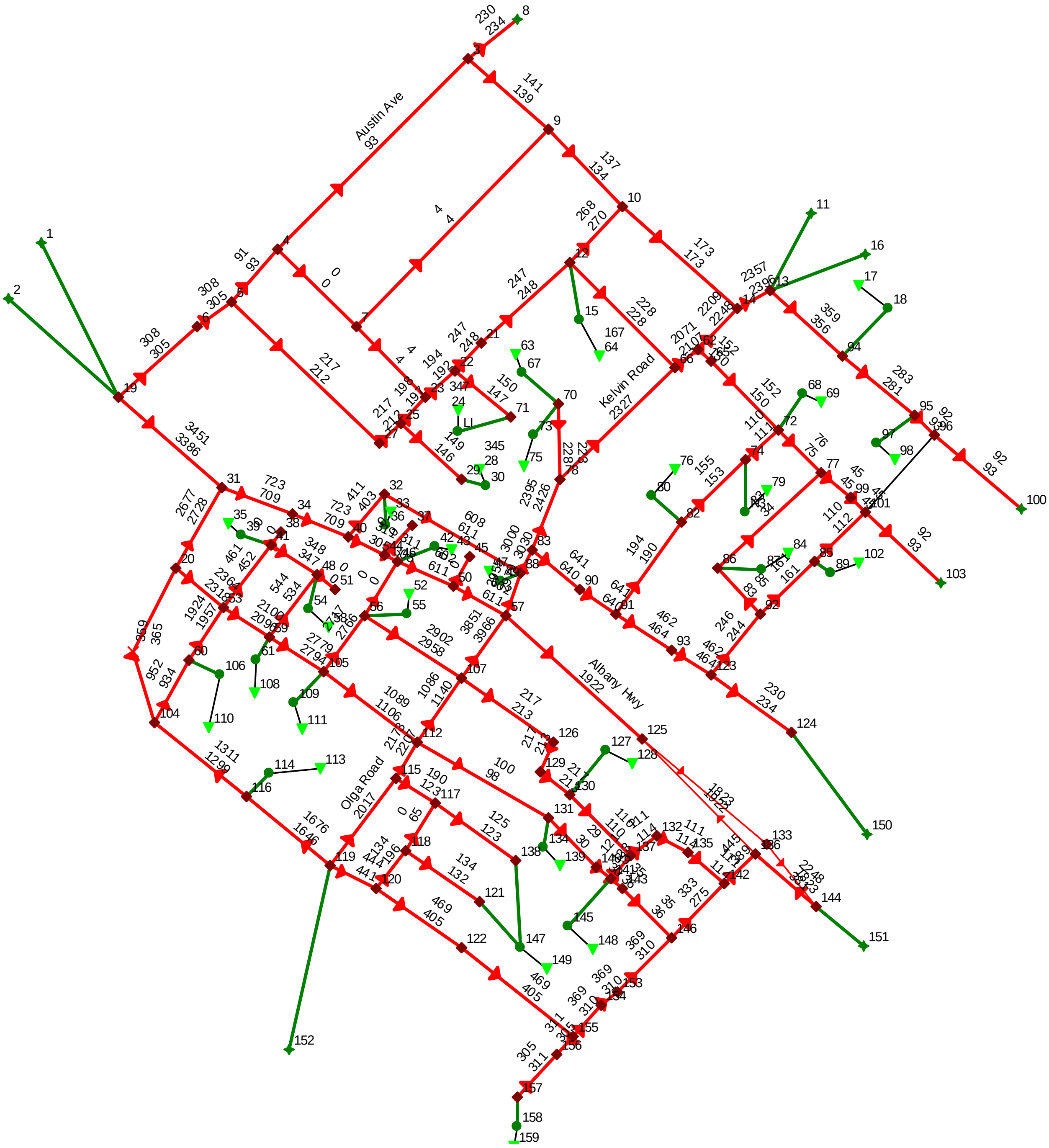
The SOP commercial development is based on TOD principles and a lower car trip generation rate is adopted for the commercial development in SOP. The trip rate of 5.75 trips per 100 square metres of floor space is adopted.

The retail development in the study area will have approximately 85,000 square metres of floor area. Based on the ITE equations a shopping centre of similar size will generate 33 trips per 100 square metres of floor space. Assuming the existing retail developments will not alter significantly and the new additional floor space is impacted by the TOD style redevelopment of the study area, a discount of 10% is applied to the retail trip generation rate. A rate of 30 trips per day is assumed.

For the commercial area within MTC and CM, given the scale of the development, it is assumed that is 15% trips to the commercial and retail attractors will be from within MTC and CM study area. Hence trips will be deducted from the residential trips. The external trips to the study area is hence estimated to be trips per day.

Appendix 3. QRS II Models

12.3 Existing Network



12.4 Ultimate Network