City of Swan

Transport Strategy

CEP02196

Prepared for
City of Swan

10 September 2014

Adopted by Council 10/09/2014

Cardno
Shaping the Future

Document Information

Prepared for	City of Swan
Project Name	Transport Strategy
File Reference	CEP02196_140206_report.docx
Job Reference	CEP02196
Date	10 September 2014

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Document Control

Version	Date	Author	Author Initials	Reviewer	Reviewer Initials
V1	08/07/2013	Andreas Wang / Jacob Martin	AW / JM	Ray Cook	RC
V2	19/08/2013	Andreas Wang / Jacob Martin	AW / JM	Ray Cook	RC
V3	27/09/2013	Andreas Wang / Jacob Martin	AW / JM	Ray Cook	RC
V4	02/12/2013	Andreas Wang / Jacob Martin	AW / JM	Ray Cook	RC
V5	10/02/2014	Andreas Wang / Jacob Martin	AW / JM	Ray Cook	RC
V6	25/03/2014	Andreas Wang / Jacob Martin	AW / JM	Ray Cook	RC
V7	10/09/2014	Andreas Wang / Jacob Martin	AW / JM	Ray Cook	RC

Executive Summary

Cardno has been commissioned by the City of Swan to prepare a Transport Strategy for the City of Swan, accommodating the existing and future transport requirements of the locality across all transport modes. This strategy is generally consistent with the process described in the Department of Planning *'Guidelines for Preparation of Integrated Transport Plans*' and focuses on an integrated transport model which includes land-use decisions, parking, public transport, road and pedestrian/cycling infrastructure.

The transport provision has been assessed at the neighbourhood, district and regional level to ensure that it addresses the residential, employment and recreational needs of the population.

The results of the Transport Assessment have been used to define realistic, clear and measurable goals for an integrated transport system throughout the municipality, providing a list of general principles and priority recommendations to be considered in the formation of Phase 2 of the overall project.

The following Strategy is an opportunity to create a high quality integrated planning and transport environment that supports economic, environmental and social activities. Within core areas of the City, particularly around Activity Centres, but also within Town Centres, local communities and near transport nodes the pedestrian environment forms the basis for transport and land-use synergies and must be considered in the context of the road environment and adjacent land uses. Other modes provide crucial links or efficient access within precinct boundaries and there is therefore a balance required between pedestrian demands and the requirements of other modes.

These competing needs have been investigated through the 'Moving People' framework (TransPriority concept). In this methodology, the hierarchy for each road is informed by large-scale land-use planning, within a broad framework as follows:

> Road networks based on appropriate use and connectivity, connecting origins and destinations but not forming barriers to sustainable modes.
> Land-uses define the requirements for car parking quantum and location (short stay and on-street parking close to retail precincts, long-stay commuter parking on the periphery of the centres near to employment centres and along regional access routes).
> Public transport routes designed to fit within the regional context and support sustainable transport access to activity, particularly employment.
> Pedestrian facilities to knit the various complementary land uses together to create a single, effective mixed-use community. Of particular importance are the 'Activated Pedestrian Zones' and routes from car parking to primary activity locations. Quality and safety are vital to the effective operation of pedestrian spaces.
> Cycling facilities follow primary desire lines and provide fine-grained access to all areas of the Activity Centre. Cycling is unique in that it allows both macro- and micro- levels of access to land-uses. Through the 'Moving People' framework assessment, cycling facilities are allocated as on-street or off-street, minimising conflict and safety issues for cyclists, cars and pedestrians. (e.g. in Activated Pedestrian Zones, cyclists are encouraged to ride on-street).
> Road hierarchies are then defined by combining the above requirements with the existing and expected future background traffic demands, as well as the traffic volumes expected to be generated by the Activity Centre itself. By considering the Activity Centre holistically in this manner, a functional and effective transport environment can be built up.

The following represents a summary of strategic transport recommendations across the City of Swan, resulting from the assessment of the existing infrastructure and the current state of planning across all levels of Government.

Each recommendation has been given an external trigger or timeframe and a priority ranging from "Low", "Medium" and "High". Priorities have been allocated within each respective category (Freight, Cycling, Public Transport, Pedestrians and Intersections/Roads). It should be noted that the prioritisation ranking has not been quantified and is based on engineering judgement and local knowledge of the study area.

Table 0-1 Summary of Strategic Transport Recommendations

	Chapter	Recommendation	Trigger / Timeframe	Priority
Freight				
Malaga	14	Investigate freight connectivity to Malaga as part of PDNH construction	Design Phase: PDNH	High
Hazelmere	14, 19.6	Investigate connectivity between Roe Highway and Hazelmere to provide a legitimate alternative link	Design Phase: Roe Highway Upgrade	High
Hazelmere	14, 19.6	Investigate Abernethy Road / Adelaide Street connection to improve internal legibility within the HEASP	Design Phase: Lloyd Street Southern Extension	Medium
Hazelmere	14, 19.6	Undertake Local Area Traffic Management planning exercise for the precinct surrounding the HEA, particularly focused on restricting HV access to the HEA via West Parade, Lloyd Street north of Clayton Street and Kalamunda Road	Design Phase: Lloyd Street Southern Extension	High
Midland	14.1	Continue to promote realignment of the Midland Freight Rail	Ongoing	High
Swan	14.2	Conduct a study to prioritise grade separation of critical rail crossings	2014	Medium
Cycling				
Swan	15	Introduce minimum infrastructure standards for cycling facilities into planning policies	2014	Low
Swan	15	Create a detailed City of Swan Bike Plan which develops the concepts of the WABN, incorporating and revisiting all works already completed.	2014/15	Medium
Swan	15	Implement the recommendations of the Swan CycleConnect plan	2014-2018	High
Albion	15	Undertake a review of the Urban Growth Corridor planning for cycling infrastructure, reflecting the changes to regional road linkages	2014/15	Medium
Midland / Bellevue	15	Support the extension of the Midland PSP to Roe Highway and Bellevue	Ongoing	Medium
Public Transport				
Ballajura / Malaga	16.1.1	Support connections between MAX and nearby residential / employment zones	Implementation Phase: MAX LRT	High
Ballajura / Malaga	16.1.1	Undertake an independent demand study to promote effective bus transport links to MAX	Design Phase: MAX LRT	High
Swan	16	Undertake an independent demand study to promote effective bus links	2014	Medium
Swan	16	Undertake a public transport connectivity assessment to ensure adequate access to public transport modes	2014	High
Ellenbrook	16.1.2	Support replacement of the 334, 335, 336 and 337 bus routes with an internal loop service as Ellenbrook redevelops	Ellenbrook redevelopment	Low
Ellenbrook	16.1.2	Support increased 955/956 service frequencies as an interim BRT	2014	Medium
Ellenbrook	16.1.6	Support implementation of Rapid Transit to Ellenbrook	2014/15	High
Ellenbrook / Bullsbrook	16.1.2	Support rapid transit between Ellenbrook and Bullsbrook either as a dedicated link or as an extension of Midland-Ellenbrook services.	2015	Medium

	Chapter	Recommendation	Trigger / Timeframe	Priority
Ellenbrook	16.1.2	Investigate the viability of an alternative Rapid Transit alignment from Ellenbrook via the Urban Growth Corridor to Midland, as it develops	2014/15	Medium
Ellenbrook / Albion	16.1.6	Support Rapid Transit alignments that meet the planning goals of the City (i.e. connections to the Midland Activity Centre and through the Urban Growth Corridor)	Development of the Urban Growth Corridor	High
Beechboro	16.1.3	Support frequency improvements for the 341, 342 and 343 bus routes as demand increases	2015/16 or as demand/densities increase	Medium
Beechboro / Malaga	16.1.3	Investigate the viability of connection between Beechboro and Malaga as a deviation of the 889 or additional service	2015/16	Medium
Beechboro	16.1.3	Support increased 955/956 service frequencies as an interim BRT	2014	Medium
Ballajura	16.1.4	Evaluate the function of the 378 and 379 coverage services and the replacement of these with improved 886/889 frequencies	2014/15	Medium
Stratton / Midland / Jane Brook / Swan View	16.1.5	Support improvements in existing services that are local to Midland	Redevelopment of Midland City Centre	Medium
Midland	16.1.5	Undertake an independent study to promote effective bus transport links to Midland, focusing on local precincts, optimal routes, frequency and demand	2015	High
Midland	16.1.7	Support implementation of the Midland Station relocation	2014	High
Pedestrians				
Swan	17.1	Introduce minimum infrastructure standards for pedestrian facilities into planning policies	2014	Low
Swan	17.1	Undertake Walkability Plans for precincts wherever significant change is expected, or in older suburbs without quality infrastructure	2014-2016, or coincident with significant redevelopment planning	Medium
Swan	17.1	Undertake a Pedestrian Crossing of Strategic Corridors Study for all strategic roads abutting public transport routes, schools, education or employment nodes to identify and mitigate connectivity or safety issues	2014/15	High
Midland	17.2	Implement the pedestrian-oriented aspects of the Midland Activity Centre Structure Plan and the Midland Place Plan	Redevelopment of Midland City Centre	High
Midland	17.2	Investigate pedestrian improvements to allow better crossing of GEH in Midland	2014/15	High
Guildford	17.3	Improve pedestrian crossing facilities at Meadow Street/Terrace Road	2015/16	Medium
Guildford	17.3	Support signalised pedestrian crossing at Guildford Station	2014/15	Low
The Vines	17.4	Implement the recommendations of The Vines Pedestrian Study	2014-2016	Medium
Intersections and Roads				

	Chapter	Recommendation	Trigger / Timeframe	Priority
Swan	18.1	Design and plan for road duplications as defined by the 2031 ROM This will include the identification of sections of road currently undersized compared to the 2031 ROM network, as well as sections of road that are expected to be undersized by 2031 that the 2031 ROM network does currently not include.	2015-2018	Medium
Swan	18.1	Monitor the requirements and triggers for road duplication	Ongoing	Medium
Midland	18.2	Revise Midland City Centre modelling to reflect the most recent ROM outputs, once the alignments of all strategic roads are finalised and assuming the inclusion of the Lloyd Street Southern Extension	2014	High
Midland	18.2	Undertake a GEH corridor study through Midland to determine the form and access opportunities for local traffic	2014	High
Midland	18.2	Investigate the opportunities to downgrade GEH through Midland to provide a better outcome for the City	2014	High
Guildford	18.3	Undertake LATM works to minimise heavy vehicle traffic along GEH and West Parade	Implementation Phase: Lloyd Street Southern Extension	High
Guildford	18.3	Improve alternative routes including Lloyd Street and GEH Bypass	Implementation Phase: Lloyd Street Southern Extension / HEASP	High
Guildford	18.3	Maintain the existing road constraints as a method of restraining undesirable traffic demand	Ongoing	High
Swan	18.4	Ensure large-scale infrastructure planning includes the impact on connecting roads and parallel routes	Design Phase: Roe Highway Upgrade/PDNH	High
Swan	18.4	Monitor intersection function adjacent to growth areas (e.g. Urban Growth Corridor / Ellenbrook)	LSP/Sub-Division Application	Medium
Swan	18.4	Consider ultimate intersection form in the context of the attached Transport Assessment	Ongoing	Medium
Beechboro	19.1	Support the diversion of heavy vehicle traffic away from Beechboro Road and Marshall Road towards Reid Highway and PDNH	Implementation Phase: PDNH	Medium
Beechboro	19.1	Plan for redevelopment of Beechboro Road and Marshall Road to improve their function as residential distributor roads	Implementation Phase: PDNH/Roe Highway Upgrade	Low
Malaga	19.1	Promote improvements to wayfinding to support heavy vehicle use of the primary road network	Implementation Phase: PDNH/Roe Highway Upgrade	Medium
Albion	19.2	Continue to advocate for connections between the regional road network and Midland / Urban Growth Corridor	Design Phase: PDNH/Roe Highway Upgrade	High
Midland / Albion	19.2	Support or undertake independent impact assessment of the proposed Roe Highway upgrades on the function of the sub-regional road network	Design Phase: Roe Highway Upgrade	High
Caversham	19.5	Investigate the long-term potential and cost/benefit of a direct link between Benara Road and Morrison Road, under the proposed strategic road network	2018-2020	Low
Bellevue	19.7	Undertake cost-benefit analysis and traffic impact assessment for the potential Katharine - Horace connection, including the possibility of future	2015/16	Medium

	Chapter	Recommendation	Trigger / Timeframe	Priority
		extension of the Midland passenger rail		
Bellevue	19.3	Undertake a review of Farrall Road with respect to the impacts of the Roe Highway Upgrade	Design Phase: PDNH/Roe Highway Upgrade	Medium
Midland	19.8	Investigate the constraints associated with the duplication of Morrison Road and undertake a cost/benefit analysis	2014/15	Low
Ellenbrook	19.10	Undertake modelling to determine the need and impact of the Ellenbrook Northern Access	2015/16	Low
Bullsbrook	19.1	Investigate the need for, and the implementation of, a connection from the PDNH in the vicinity of Maralla Road/Warbrook Road	Design Phase: PDNH	Low
The Vines	19.11	Undertake or request demand modelling for the Rose Street Bridge connection. Determine the future impact and benefits of this connection	2016/17	Low
Beechboro	19.12	Request specific improvements to the ROM for the Altone Road corridor	2014	High
Beechboro	19.12	Undertake an assessment of the Altone Road corridor performance for a revised 2031 scenario	2014	Medium
Beechboro	19.13	Investigate a revised Marshall Road corridor design consistent with its ultimate function, including multi-modal considerations	Post construction: PDNH/Roe Highway Upgrade	Medium
West Swan	19.14	Undertake a cost-benefit analysis for the Arthur Street Bridge under the proposed development scenario	2015/16	Low
Malaga	19.15	Request specific improvements to the ROM for the Hepburn Avenue corridor	2014	Medium
Malaga	19.15	Undertake an assessment of this corridor performance for a revised 2031 scenario	2014	Medium
Hazelmere	19.16	Request specific improvements to the ROM for the Lloyd Street corridor	2014	High
Hazelmere	18.1	Undertake traffic modelling to inform triggers and timing for the duplication of Midland Road	2015	Medium
Hazelmere	19.6	Support a bridge connection between the northern and southern portions of the HEASP over the GEHB	2014	High
Middle Swan / Midland / Hazelmere	19.16	Undertake an assessment of the Lloyd Street corridor performance for a revised 2031 scenario	2014	High
Middle Swan	19.16	Undertake a detailed analysis of the local traffic environment in the Lloyd Street / Great Northern Highway / Bishop Street precinct	Design phase: Lloyd Street Extension	High
Bullsbrook	19.1	Investigate the timing and form of Stock Road and associated intersection treatments as a result of regional road upgrades and local development requirements	Post construction: PDNH upgrade or Structure Plan Phase: Northern Gateway	Medium
Bullsbrook	19.1	Undertake a rail crossing upgrade study for the Stock Road rail crossing	Post construction: PDNH upgrade or Structure Plan Phase: Northern Gateway	Medium
Bullsbrook	19.17	The impact of potential improvements to Neaves Road, including grade separation at the PDNH, duplication and/or realignment should be evaluated	Post construction: PDNH upgrade	Medium
Gidgegannup	19.4	Undertake a study to identify development and traffic growth triggers for the Perth to Adelaide	2014/15	Low

	Chapter	Recommendation	Trigger / Timeframe	Priority
		National Highway (PANH) and Hills Spine Road		
Parking				
Midland	20.1.1	Implement policy changes, including mandatory cash-in-lieu, to create an internal parking cap for Midland	2014/15	Medium
Midland	17.2	Implement the parking recommendations of the Midland Activity Centre Structure Plan and the Midland Access and Parking Plan	Ongoing	Medium
Midland	20.1.1	Undertake an education program to ensure developers are not dissuaded from investing in the Midland Activity Centre	2014/15	High
Midland	20.1.1	Investigate the requirements and triggers for policy changes and infrastructure provision through to the full build-out of the Centre. (i.e. create a Transitional Parking Plan)	2014	High
Midland	20.1.1	Continue to modify the Midland Access and Parking Plan to transition towards the ultimate policy destination	Ongoing	Medium
Midland	16.1.7	Maintain pressure through adjacent parking management to minimise the impact of the proposed Park ‘n’ Ride	2016-18	Low
Ellenbrook	20.1.2	Complete a revised Parking Assessment for Ellenbrook, based on its existing form and forward projections for its feasible growth	2014	High
Ellenbrook	20.1.2	Implement a new, more equitable and feasible policy for parking provision within the Ellenbrook Centre as part of the Swan Parking Policy	2014/15	High
Ellenbrook	20.1.2	Create a simplified section of the Swan Parking Policy detailing the target and transition rates for parking provision within a simplified range of land uses	2015/16	Medium
Guildford	20.1.4	Development a parking strategy for Guildford, as part of the Swan Parking Policy.	2014/15	High
Malaga	20.1.4	Undertake a Malaga Parking Study, consisting of investigation, concept design and prioritisation works	2014	High
Albion	20.1.3	Develop a parking strategy for District Centres in concert with the progression of the Urban Growth Corridor, as part of the Swan Parking Policy	LSP/Sub-division Application Phase	Medium
Swan	20.1.5, 20.2.2	Consider the use of parking concessions, shared-use, on-street and reciprocal parking to minimise off-street supply requirements in the Swan Parking Policy	2015	Low
Swan	20.2.2	Consider the impact of alternative measures to encourage reduced parking provision on-site (end-of-trip facilities, green travel plans etc.)	2015	Medium
Swan	20.1.5	Prepare and implement Centre parking within the Swan Parking Policy consistent with the goals of individual Centres	205/16	Medium
Swan	20.2.2	Prepare and implement parking management strategies within the Swan Parking Policy which support the use of on-street facilities by residential visitors	2014/15	Low
Swan	20.2.5	Undertake a study of entertainment parking demands to establish a reasonable benchmark for	2015/16	Low

	Chapter	Recommendation	Trigger / Timeframe	Priority
		the Swan Parking Policy		
Swan	20.2.6	Undertake site-specific parking and access studies at all public education facilities designed to minimise the risks and improve the function at peak pick-up/drop-off times	2014/15	Medium
Swan	20.2.6	Require site-specific parking and access studies to be undertaken as part of any private school expansion	2014/15	Medium

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1 Introduction

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- Road hierarchies are then defined by combining the above requirements with the existing and expected future background traffic demands, as well as the traffic volumes expected to be generated by the Activity Centre itself. By considering the Activity Centre holistically in this manner, a functional and effective transport environment can be built up.

Transport Strategy

Transport Assessment

2 Purpose of the Transport Assessment

Cardno has undertaken a review of all relevant State Government and Local strategies and policies pertaining to public transport, road, pedestrian, cycling and freight provision. These documents have been used to establish the existing principles for transport provision in the City, at all levels.

The following documents have been included in this assessment:

Data Sources

- ABS Data (2011)
- Main Roads WA 2031 ROM (2013)
- Roe Highway Upgrade Plans (2013)
- Public Transport Authority Bus Network Maps (2013)
- City of Swan GIS (2013)
- Main Roads WA SCATS Data [various intersections] (2013)

State Government and Strategic Policies/Plans

- Directions 2031 and Beyond (2010)
- Eastern Corridor Major Roads Study (1989)
- Great Northern Highway Access Strategy (2011)
- Regional Integrated Transport Strategy (2013)
- Perth Darwin National Highway Plans (2013)
- Draft Public Transport for Perth in 2031 (2011)
- Swan Urban Growth Plan (2009)
- Western Australian Bicycle Network Plan (2012)
- State Planning Policy 4.2 Activity Centres for Perth and Peel (2013)
- Guidelines for Preparation of Integrated Transport Plans (2012)

Local Government Policies/Plans

- Caversham Traffic Report (2010)
- Albion Traffic & Transport Report (2011)
- Brabham LSP3A Transport Assessment (2010)
- Dayton LSP2B Transport Assessment (2011)
- City of Swan Local Planning Scheme (LPS) (2013)
- Ellenbrook Bus Rapid Transit Scheme (2013)
- Malaga Access Study (2007)
- Aveley Transport Access Report (2011)
- Whiteman Transport Assessment (2012)
- Ellenbrook Traffic Modelling Report (2009)
- Altone Place Plan (2009)
- Ballajura Place Plan (2008)
- Bullsbrook Place Plan (2008)
- Ellenbrook Place Plan (2011)
- Gidgegannup Place Plan (2004)
- Guildford/Hazelmere Place Plan (2007)
- Midland Place Plan (2010)
- Ellenbrook Traffic and Transport Report (2012)
- Dayton LSP4 Transport Assessment (2013)
- Egerton Structure Plan (2005)
- Ellenbrook Parking Strategy (2009)
- Swan CycleConnect (2013)
- Hazelmere Enterprise Area Structure Plan (2011)
- Guildford LATM Study (2013)
- Midvale and Bellevue LATM Study (2012)

- Malaga Parking Strategy (2011)
- Midland Access & Parking Strategy (2013)
- POL-TP-129 Vehicle Parking Policy (2013)
- Walkability & Wayfinding in Midland (2009)
- Midland Activity Centre Structure Plan (2012)
- Lloyd Street / Clayton Street Traffic Modelling and Analysis Report (2013)
- Albion District Structure Plan (2008)
- PBN Bike Map - Swan (2011)
- Bullsbrook Townsite Rural Strategy (2008)
- Kewdale - Hazelmere Integrated Masterplan (2013)
- Midland Health Campus and Workshops Integrated Transport Plan (2011)
- Henley Brook Road Reservation Review (2013)

Using the available literature and existing infrastructure, Cardno has conducted a review of the local road network and regional connections within the City and created an updated road hierarchy in accordance with Western Australian Planning Commission (WAPC) guidelines. This review has been performed for roads currently designed as a Local Distributor or higher (under the Main Roads Functional Hierarchy categories).

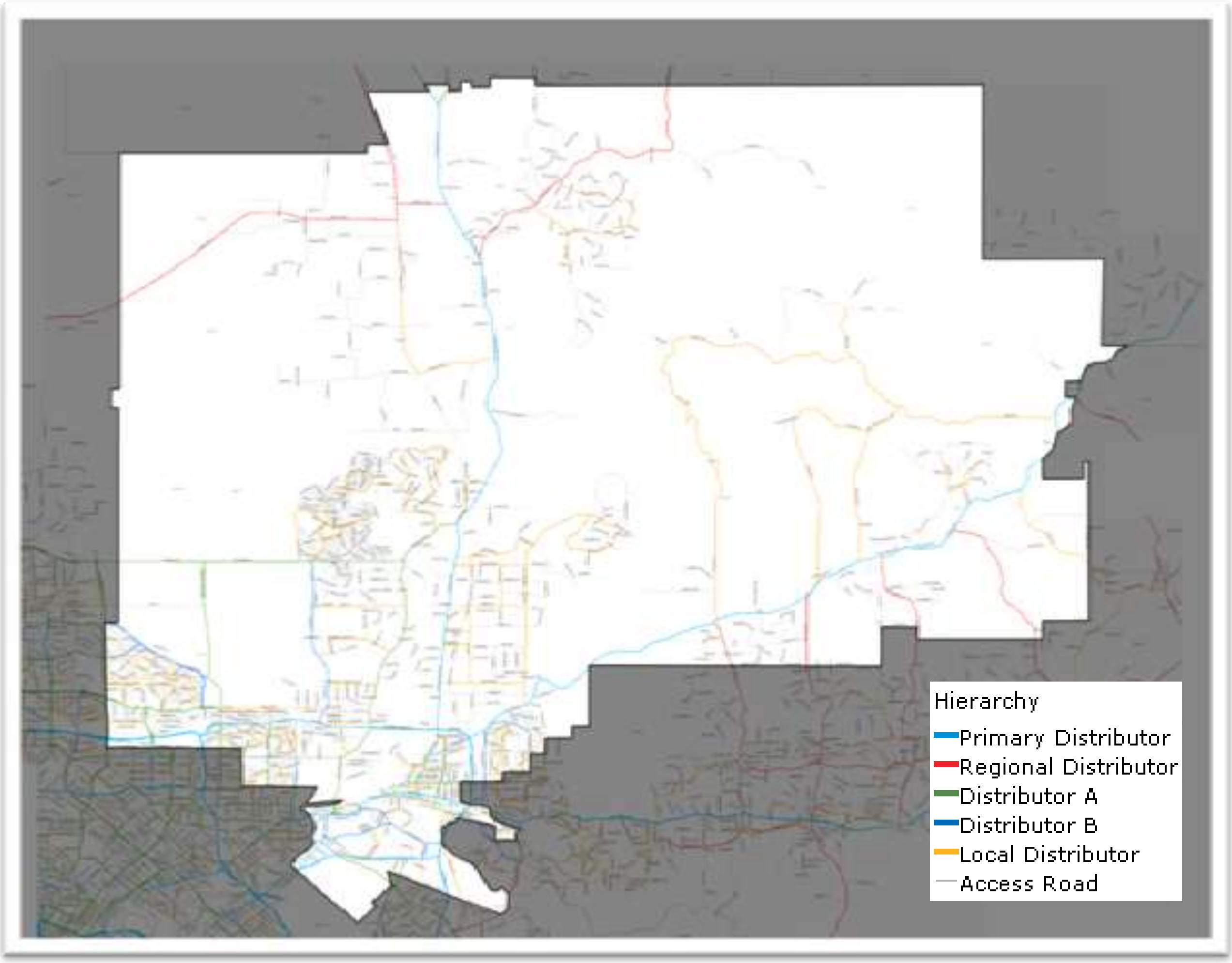
The proposed road hierarchy is based on a 20 year horizon and will consider the future functions of regional and local connections within the City, including the movement of private vehicles, pedestrians, cyclists, public transport and freight, in consultation with the City's officers and external stakeholders. Traffic volumes are taken from ROM data provided by Main Roads WA, and compared to theoretical road link capacities to identify roads which may require future upgrade.

3 Road Hierarchy

A review of the existing road network within the City has been undertaken to assess the sufficiency of the road hierarchy with respect to future operation of regional and local connections.

The existing road hierarchy, as defined by the Main Roads Functional Hierarchy, is described in **Figure 3-1**. Additional detail is available in **Appendix C**.

Figure 3-1 Existing Main Roads Functional Hierarchy (MRFH)



In general, the road hierarchy is considered to be consistent with the future requirements of the road network, with discrepancies and deficiencies discussed in **Section 10** of this report.

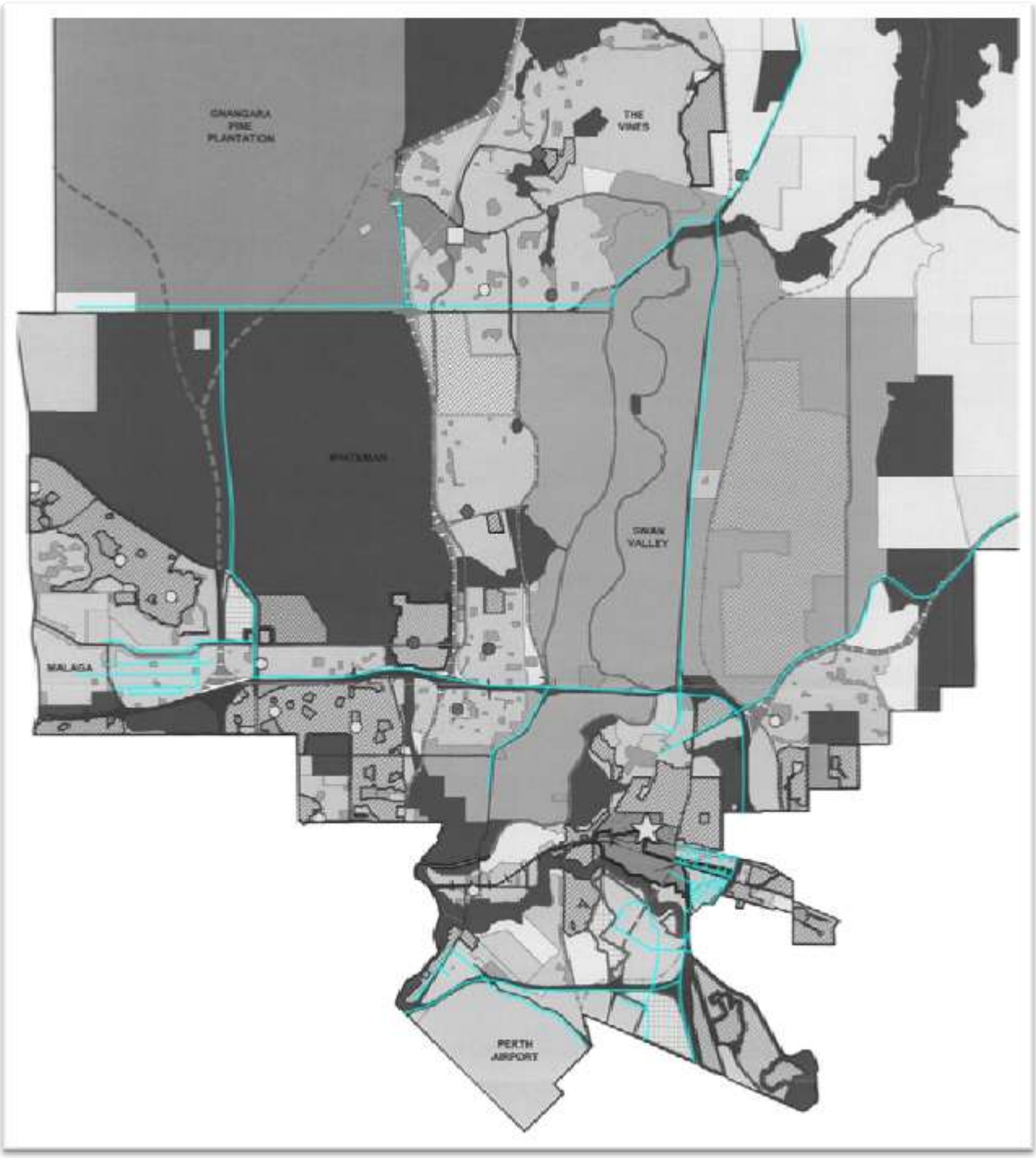
4 Freight

4.1 Road Freight

The existing Main Roads WA freight networks are shown in **Figure 4-1** for Restricted Access Vehicles (RAV) Networks 5, 6 and 7 and in **Figure 4-2** for RAV Networks 2, 3 and 4.

Figure 4-1 Existing RAV 5-7 Freight Network

Figure 4-2 Existing RAV 2-4 Freight Network



Freight connectivity is generally provided along strategic corridors and within industrial precincts, as reflected by the RAV Network 2 mapping above. Roe Highway, Reid Highway, Great Eastern Highway Bypass, Toodyay Road, Great Northern Highway, Gnangara Road and Beechboro Road represent the backbone of the freight network, providing access to the Hazelmere, Bellevue, South Guildford and Malaga Industrial Areas. While this backbone is strong, connections to the industrial uses is generally provided via only a few viable links. This increases the attractiveness of alternative, less desirable routes with a corresponding impact on nearby residential and light commercial development.

4.1.1 Hazelmere

Access to the Hazelmere Enterprise Area (HEA) is currently supported only via Great Eastern Highway Bypass, although alternative connections exist along West Parade/Bushmead Road, Kalamunda Road and ultimately, the Lloyd Street extension.

West Parade connects freight vehicles from Great Eastern Highway in Guildford directly into the northern HEA precinct, but with a detrimental impact on local residents, as well as traffic operation at the Bridge Street crossing (for freight originating in Bassendean, Malaga and Morley).

Similarly, the lack of access to the HEA south precinct from Roe Highway promotes the use of Kalamunda Road as a preferred access link.

Modifications to strategic connections in this area are proposed in the Hazelmere Enterprise Area Structure Plan (HEASP), but this is not expected to greatly improve freight links into the HEA, apart from presenting an alternative access into the northern precinct via Clayton Street and the Lloyd Street extension. Some concern remains that Lloyd Street will become a primary freight link, reducing the operation of this road for access to the Midland City Centre and the Midland Health Campus.

The truncation of Stirling Crescent to the north and south of the Great Eastern Highway Bypass is expected to be mitigated by the continuation of Lloyd Street to Abernethy Road, resulting in approximately equivalent access to the GEH Bypass.

4.1.2 Malaga

Access into the Malaga Industrial Area is currently provided via Beechboro Road (for Restricted Access Vehicles), and also via Reid Highway to Malaga Drive for As-of-Right Vehicles. This connectivity, via two significant strategic connectors is considered to be adequate under existing circumstances. However the construction of the Perth-Darwin National Highway (PDNH) has the potential to reduce connectivity to the Malaga Industrial Area by removing the existing connection between Beechboro Road and Reid Highway. This, combined with the grade separation of the PDNH and Marshall Road means that access to the primary road network is restricted to Reid Highway/Malaga Drive. Freight travelling along the PDNH will be required to access the Industrial Area via Reid Highway, effectively restricting freight access to a single point.

Minor access will continue to be viable via Beechboro Road to Marshall Road, but since Beechboro Road is expected to be downgraded as a result of the PDNH, this is not expected to mitigate the impact of the reduced connectivity. Therefore, while access to Malaga from the east and west will remain effective, utilising the Marshall Road / Beach Road links, access from the north and south will be funnelled onto Reid Highway and Malaga Drive. The redirection of traffic will be accommodated with the proposed grade separation of this intersection by Main Roads, but will require improved wayfinding to ensure the viability of the Malaga precinct.

4.1.3 Bellevue

Bellevue is primarily accessed via Clayton Street and ultimately, the Lloyd Street extension. The works associated with the proposed Roe Highway upgrade and the Lloyd Street extension will tend to improve access to the Bellevue Industrial Area by providing high quality access from the Great Eastern Highway Bypass and Roe Highway.

4.2 Rail Freight

The existing rail freight line runs alongside the passenger rail through the Midland City Centre and on to Bellevue. Current planning supports the relocation of this rail freight line along an alternative alignment which bypasses the City Centre. This realignment improves the legibility of the City Centre, allowing access across the existing rail corridor and connecting the historic City Centre with the Midland Workshops and MRA lands.

With a 50% growth in rail movements expected, this realignment will serve both freight function and development purposes.

Given the requirements for grade-separation of all new rail crossing points, this realignment creates the potential for new roads, including the Katharine Street link to Horace Street.

5 Cycling

5.1 Structure Plan Bicycle Networks

As part of this study, the bicycle networks included in the Caversham, Dayton, Albion, Ellenbrook and The Vale Structure Plans have been mapped (as shown on **Figure 5-1**) in order to identify potential gaps within the proposed network. It is noted the majority of these structure plans have assumed an alignment for the PDNH which follows the Lord Street alignment, which has since been superseded and may therefore require some revision to accurately reflect the future road functions.

Figure 5-1 Structure Plan Bicycle Networks in the Urban Growth Corridor

The provision of off-street cycle paths in Hazelmere (Bushmead Road) and Malaga (Victoria Road) will also, to some degree, compensate for the lack of public transport provision to these areas, as well as providing a means for people (particularly young people) without vehicle access to safely access these areas.

By closing the gaps in the existing cycling network and expanding the networks to developments as they occur, the cycling mode share is likely to increase and also assist in achieving the 5% cycling mode share for the Midland activity centre, as set out in the Midland Activity Centre Structure Plan.

With the introduction of Henley Brook Avenue, traffic volumes along West Swan Road are expected to decrease to below the current traffic flows, thereby making this road more attractive for commuter and recreational cyclists, particularly if on-road cycling facilities are provided to residential developments such as Ellenbrook and The Vale.

5.2 Proposed Future Bicycle Networks

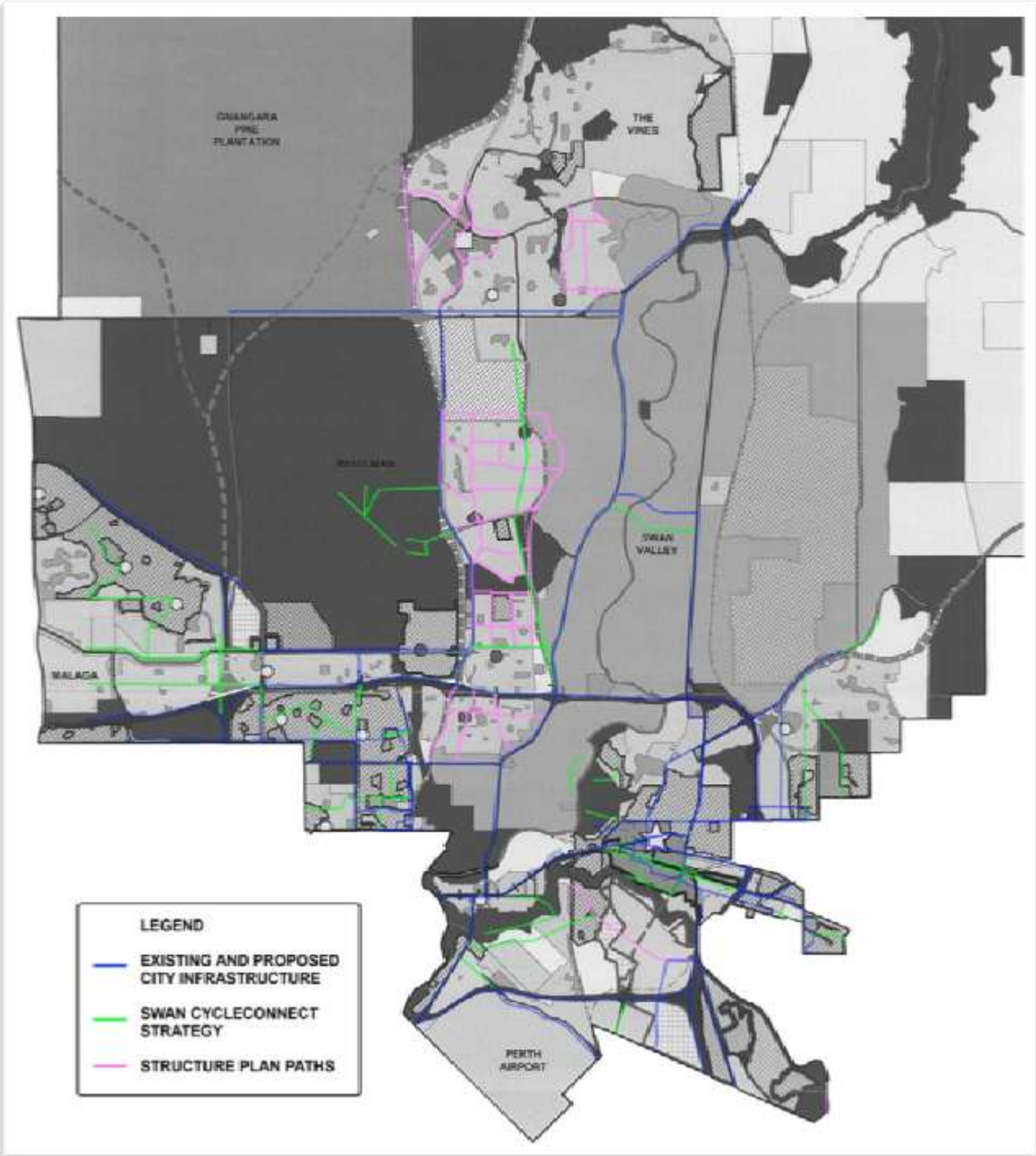
As part of this study, proposed future bicycle networks as described in a number of sources have been collated and shown in **Figure 5-2** overleaf. As can be seen from this figure, a number of discontinuities exist between the different future cycle networks.

In particular, areas outside the Urban Growth Corridor have not experienced the same level of modern planning, and hence do not have a development plan for pedestrian and cycling. Detailed cycle planning has been undertaken for developed lands within specific zones: Midland City Centre and the West Swan Road corridor, as well as for the Principal Shared Path, but this planning is generally self-contained and does not integrate with adjacent precincts. Strategic links assessed for the City's CycleConnect Strategy provide a higher-order view of core infrastructure, without delving deeply into the requirements for local links or design-scale analysis. However, this core infrastructure does provide a framework to improve connections within and across neighbourhoods, within the guidelines of the Western Australian Bicycle Network (WABN) Plan.

Recent work undertaken for the Perth Airport by EMRC attempted to coordinate cycle planning across LGAs, but the scope of this interaction is limited to the precinct in and around the Airport Terminal.

The proposed PSP extension includes provision for high quality infrastructure through to the proposed Cale Street station location. This gives certainty through to the relocation of the Midland Station, but does not provide further connectivity to the east. In particular, connections through to the Roe Highway PSP and potential Bellevue Station rail terminus are not included in current planning.

Figure 5-2 Existing and Proposed Cycle Paths as Described in the City of Swan CycleConnect, City of Swan GIS Data and Various Structure Plans



5.3 Principal Shared Path Upgrade

As identified in the Western Australian Bicycle Network Plan 2012 - 2021, the existing Principal Shared Path (PSP) along the Midland train line is currently being extended to Midland. Design work for extending this PSP through to Lloyd Street is also underway.

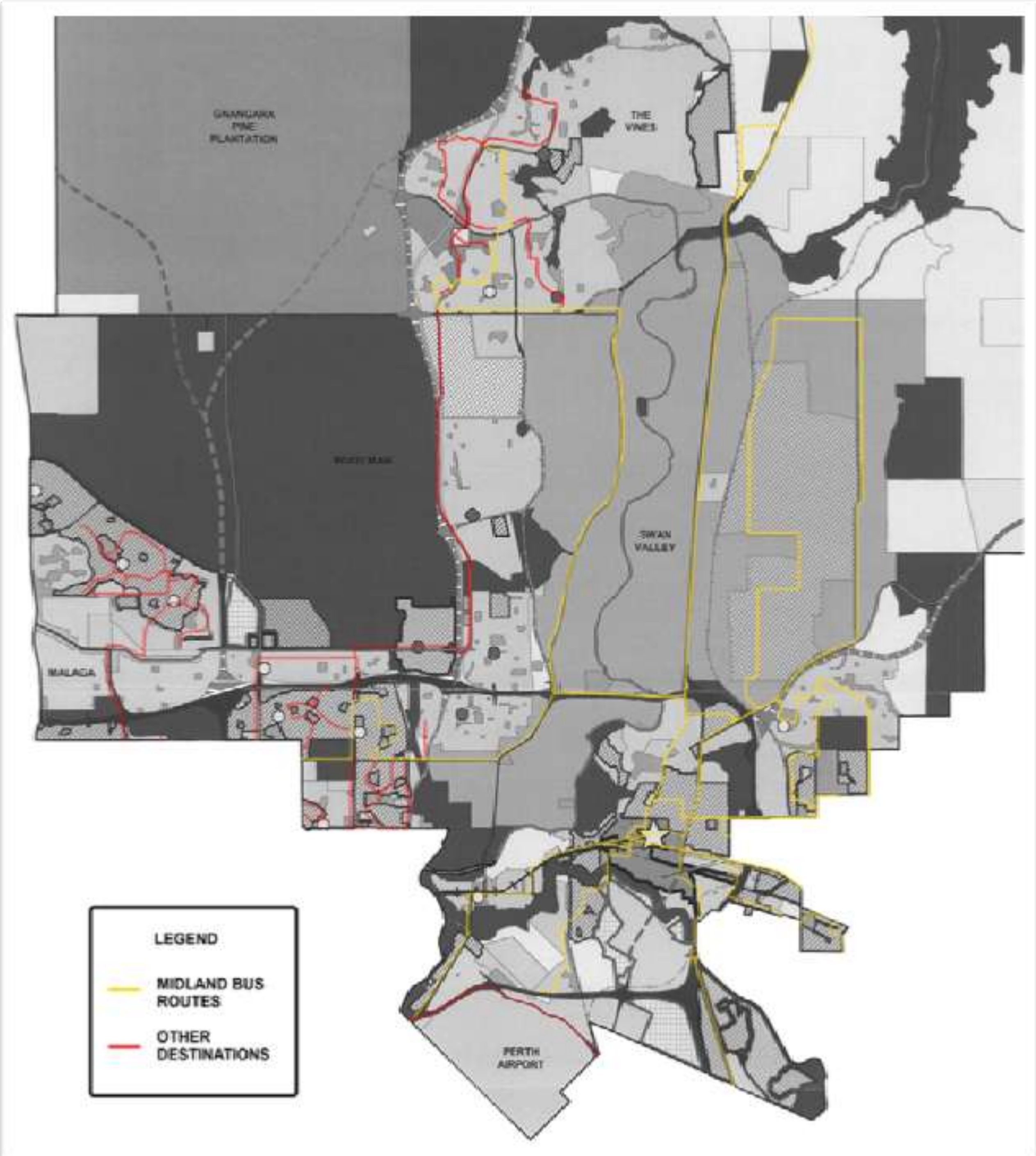
Grade separated PSPs are also proposed along all of the major highways and will greatly improve the permeability of the cycling network.

6 Public Transport

6.1 Existing Public Transport Network

The existing public transport network is shown in **Figure 6-1** below. The bus routes connect to centres including Midland, Bassendean, Bayswater and Morley. The distribution of bus routes has been disaggregated to show the connectivity to the Midland Strategic Centre, in contrast to other centres further to the west.

Figure 6-1 Existing Public Transport Network



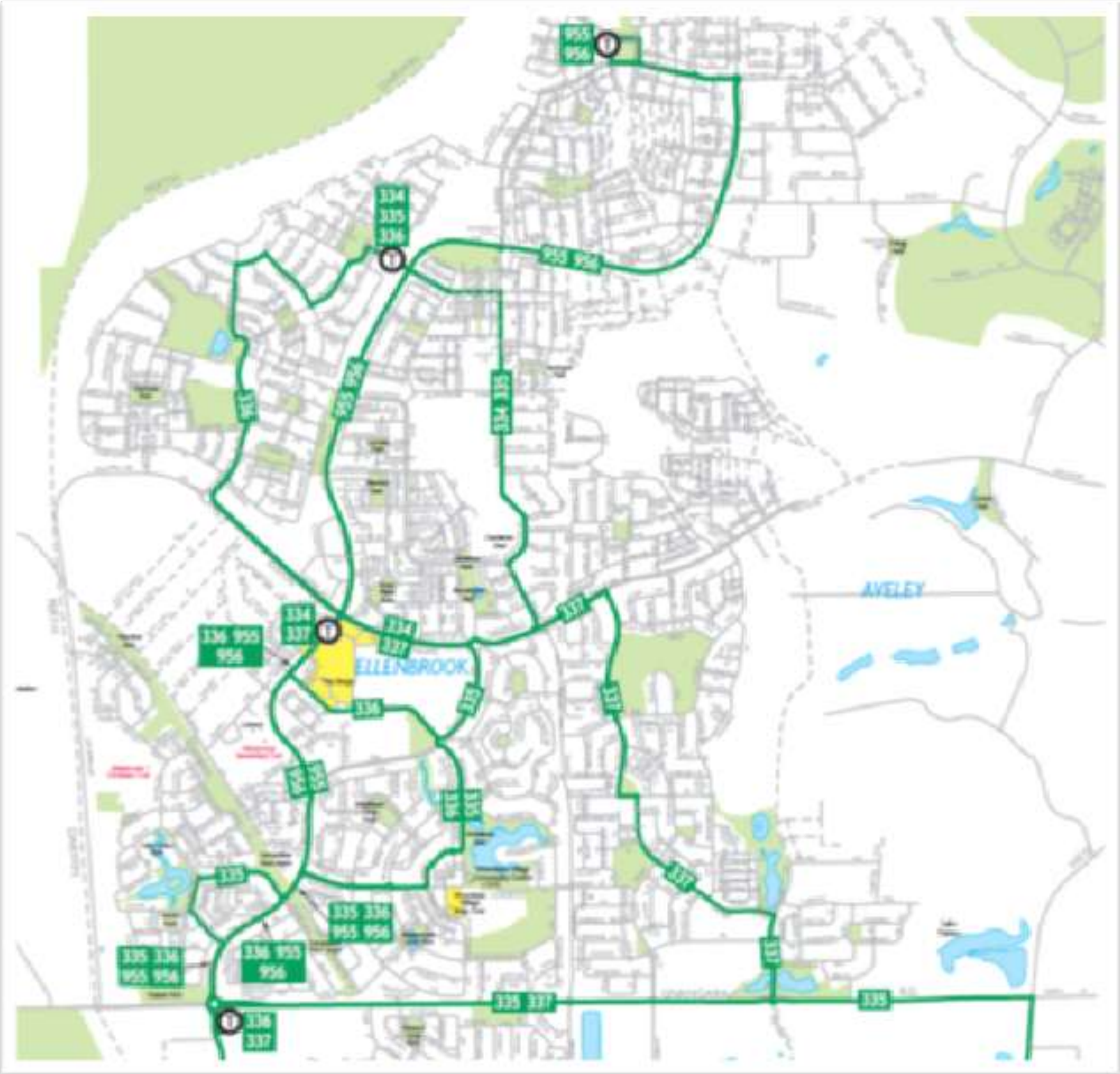
6.2 Local Bus Connections

The existing bus provision is relatively good from some areas and extremely sporadic from others. An increase in bus service along regional routes to minimum 60 minute headway (20 minutes during the peak) would allow outlying regional residential areas to utilise public transport in a way that is currently infeasible. This is important from both a mobility and equity standpoint, as those areas on the urban fringe are most sensitive to fluctuations in transport and housing costs. In particular, these areas are often occupied by those on fixed incomes, including retirees, and who may not have regular access to private transport.

Effective bus service is contingent on high frequency and direct access. Existing coverage routes are important to provide alternative access, but may never generate sufficient patronage to warrant significant expansion. However, areas within a 5-10km radius of Midland are easily accessible by buses. An increase in service provision in these areas would induce demand for bus connection into Midland, and beyond.

Excerpts from the Transperth Bus Network are shown below, for precincts within the City of Swan

Figure 6-2 Ellenbrook Bus Network (Source: Public Transport Authority, 2013)



Ellenbrook is served internally by the 334, 336 and 337 Bus Routes. These services operate at 20-30 minute frequencies throughout the weekday, but are effectively local shuttle routes between the residential catchments and the Ellenbrook Transfer Station. Access to the broader Transperth Network is achieved by the 955/956 Bus Route which connects Ellenbrook to Bassendean Station and the Morley Bus Station.

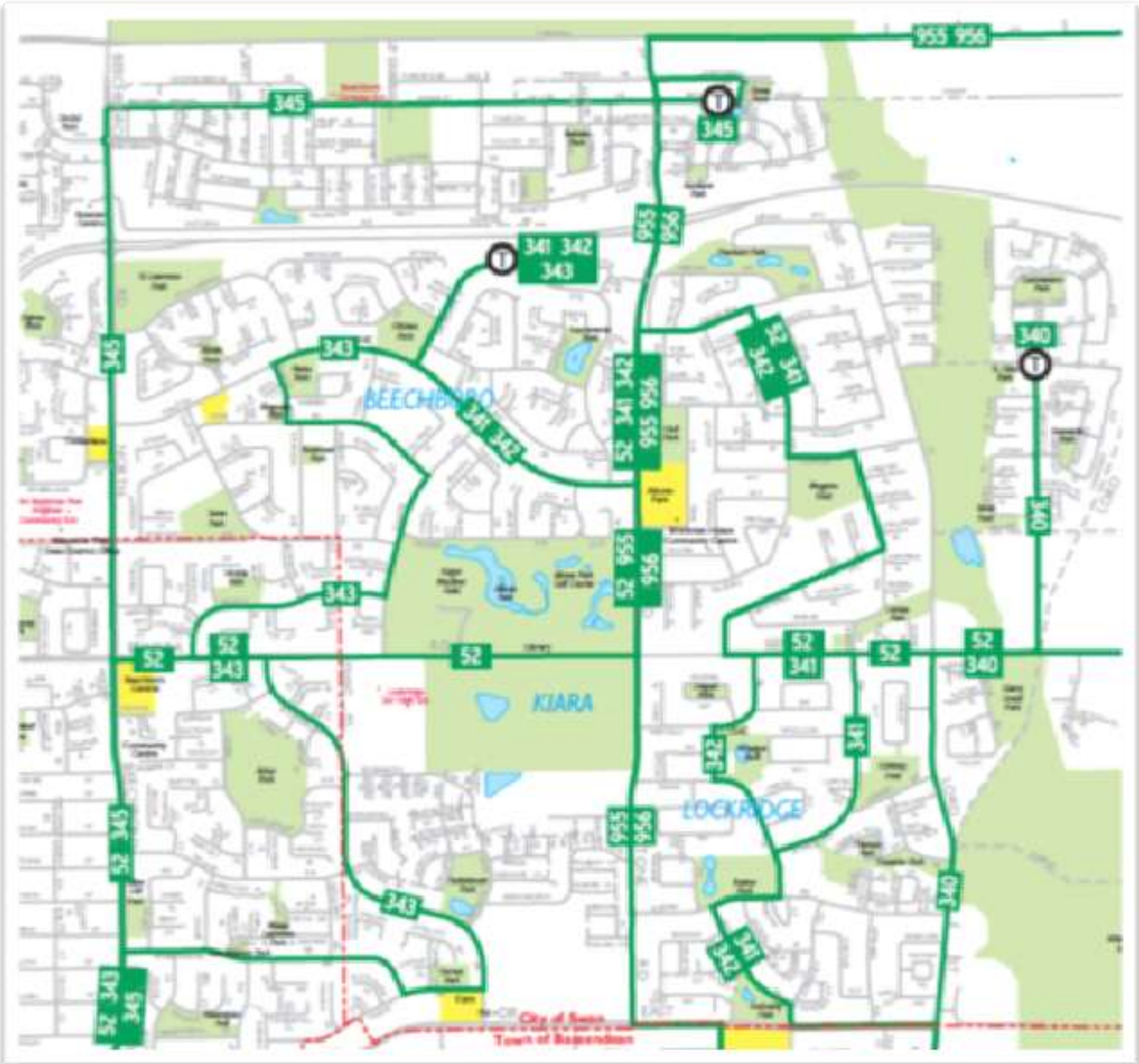
The interchange penalties and short circuit distances would generally suggest that patronage of the 334, 336 and 337 are likely to be low, especially given that the majority of the Ellenbrook catchment is within a reasonable walking distance to the 955/956 route (considered to be 800m for this trunk service).

The ultimate vision of Ellenbrook as a mixed-use precinct development including significant entertainment, retail and employment nodes is consistent with the bus network currently in place. However, this vision has not yet been realised.

While the need for the 334, 336 and 337 routes is not yet evident, the 955/956 route operates as a direct, strategic, limited stop service at reasonable frequencies throughout the day. However, this service is ultimately focused on a Perth CBD destination, and neglects the significant future role of Midland as an employment and recreation node. As the vision of the Midland City Centre is realised, an alternative high-frequency or BRT link to Midland would then be warranted.

Key bus stations in this network consist of the Ellenbrook Transfer Station, the Ellenbrook Shops and the 955/956 terminus. The 955/956 route also runs immediately adjacent to Ellenbrook Secondary College.

Figure 6-3 Beechboro Bus Network (Source: Public Transport Authority, 2013)



Beechboro is served by the 341, 342 and 343 Bus Routes, in addition to the parallel 340 Bus Route to Caversham. These services operate at 20-30 minute frequencies throughout the weekday, between the residential precincts and regional transport nodes, namely Bassendean Station and the Morley Bus Station.

These routes serve a coverage purpose and are therefore relatively indirect. The 955/956 operates through the centre of Beechboro and provides a limited stop service for those residents within a reasonable walking catchment.

Key bus stops in this network consist of the Beechboro Christian, Lockridge Senior High and John Septimus Roe Schools Transfer Station, retail centres at Beechboro Central and Altone Park.

Figure 6-4 Ballajura Bus Network (Source: Public Transport Authority, 2013)

Ballajura is well served by the 886 and 889 high frequency Bus Routes which operate between Marangaroo/Ballajura to destinations including Dianella Plaza, Edith Cowan's Mount Lawley Campus the Perth CBD. These buses operate every 10 minutes during the peak, transitioning to 30 minute headways throughout the day. The 344 Bus Route operates between Warwick and Morley as a coverage service, providing local residents access to destinations to the south and west.

The 378 and 379 Bus Routes are similar coverage services passing through Ballajura and terminating in Mirrabooka.

Despite the proliferation of bus routes through Ballajura, including the 886/889 high frequency Bus Routes, there is no direct access either to Midland or to the rail line. This means that access to Midland must be undertaken via Morley Bus Station with an additional bus transfer to access train services at Bassendean Station. This results in an average journey time in excess of 90 minutes each way.

Key bus stops in this network consist of the Ballajura Shopping Centre, Ballajura Central, Ballajura Community College and community facilities at Kingfisher Park.

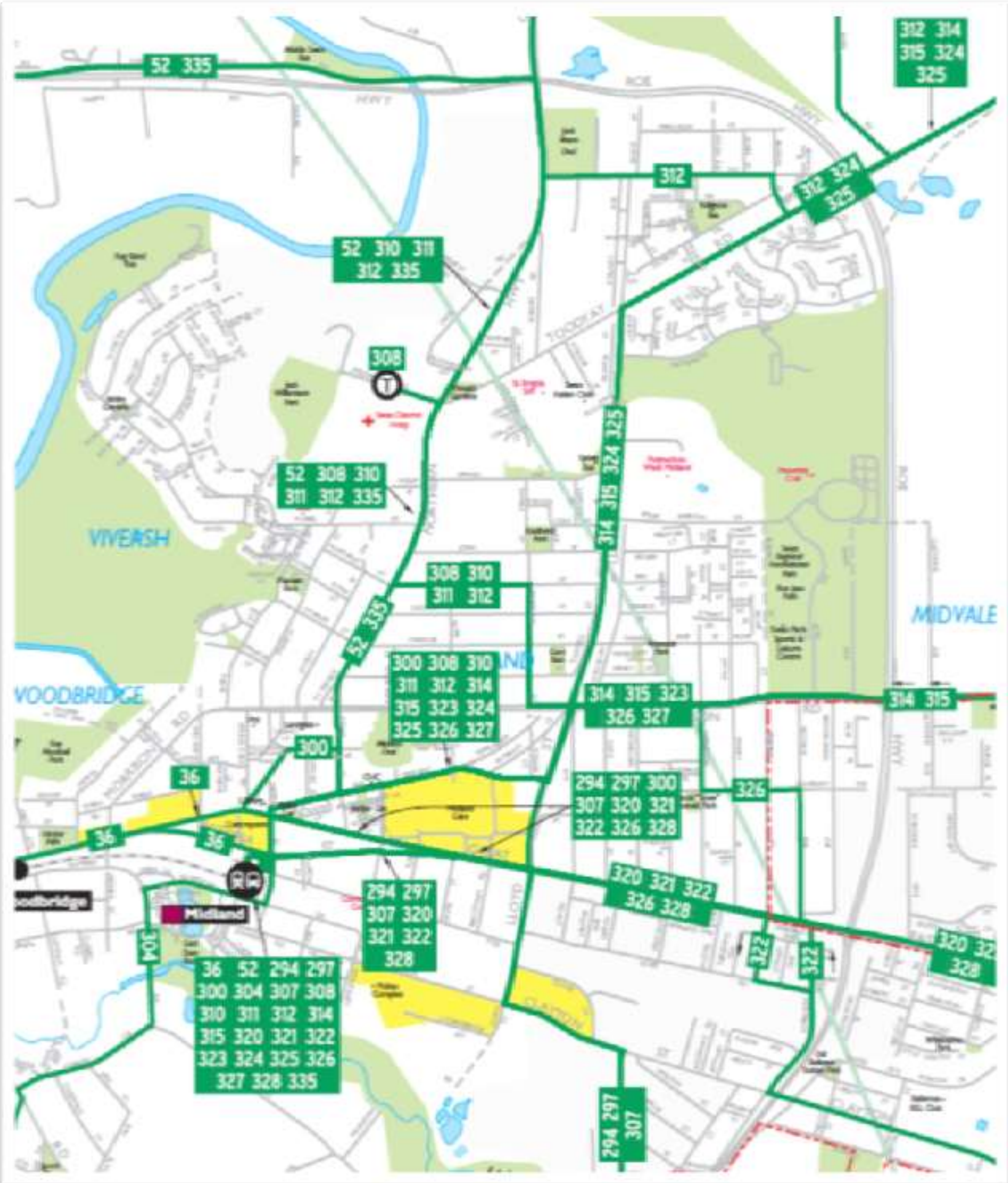
Figure 6-5 Stratton Bus Network (Source: Public Transport Authority, 2013)

Stratton is served by circular or 'petal' routes which operate both clockwise and anti-clockwise to Midland. These routes run in each direction only every 30 minutes during the peak, and every hour in the off-peak periods. Therefore, while the frequency along the trunk corridors (Great Eastern Highway/Toodyay Road/Lloyd Street) is reasonably high, service within the suburban area is relatively poor.

For these local services to be more effective, frequency would need to be improved. In the existing case, the opportunity cost of public transport use caused by wait penalties tend to support residents driving into the Midland Station to park 'n' ride.

Key bus stops in this network include Swan View Senior High School, Stratton Park Shopping Centre and adjacent local community facilities.

Figure 6-6 Midland Bus Network (Source: Public Transport Authority, 2013)



The Midland Train Station is located approximately 1km from Midland Gate and is considered to be beyond walking distance for the majority of customers. Therefore, connections to and from Midland Gate are mostly made by bus services from the Midland Station or from the eastern suburbs.

The typical frequency of bus services is summarised in **Table 6-1** while additional coverage service provision is shown in **Table 6-2**.

Table 6-1 Midland City Centre Bus Service Frequency

Route	Peak Frequency	Off-Peak Frequency
Great Eastern Highway		
36 (Midland – Perth)	20 min	60 min
294 (Midland – Westfield Carousel)	60 min	60 min
297 (Midland – Kalamunda)	30 min	60 min
320 (Midland – Mundaring)	20 min	60 min
321 (Midland – Glen Forrest)	20 min	60 min
322 (Midland – Glen Forrest)	20 min	60 min
The Crescent		
308 (Midland – Swan Districts Hospital)	30 min	60 min
310 (Midland – Upper Swan)	30 min	60 min
311 (Midland – Bullsbrook – Muchea)	30 min	60 min
312 (Midland – Baskerville)	30 min	60 min
314 / 324 (Jane Brook – Midland)	10 min	15 min
315 / 325 (Stratton – Midland)	10 min	15 min
323 / 327 (Swan View – Midland)	10 min	15 min
326 (Midland – Midvale)	10 min	15 min
Midland Shuttle		
300 (Midland Gate Shopping Centre)	20 min	20 min

As **Table 6-1** shows, the frequency of bus services is generally fairly high during the peak hour, particularly for high demand routes. Off-peak frequency is relatively poor, with 60 minute headways for the majority of routes. Some high frequency routes do service the Midland area, from Swan View, Jane Brook and Stratton, making these areas convenient to access via public transport throughout the day.

Table 6-2 Midland City Centre Infrequent Bus Service Frequency

Route	Services per Day
307 (Midland – Helena Valley)	3 per day
328 (Midland – Wundowie)	3-4 per day
52 (Morley – Midland)	3 per day
335 (Ellenbrook – Midland)	3 per day
304 (Midland – South Guildford)	10 per day

The infrequent bus services shown in **Table 6-2** are run as coverage routes only and are not effective in providing reliable connection to Midland.

Key bus stops in the Midland City Centre include the Midland Station and Midland Gate, as well as the Clayton Precinct.

7 Pedestrians

Pedestrian planning is generally undertaken at a precinct level as part of a Structure Plan, Place Plan or Walkability Plan. Structure planning (such as the Albion Structure Plan or Caversham LSP) includes consideration for the location and type of pedestrian facilities along specific roads within the development. This general form is given additional detail through sub-division applications and controlled by the City.

Specific policies regarding connectivity are generally part of the Local Planning Scheme, though a Local Planning Policy is still in effect which requires the construction of Pedestrian Access Ways (PAWs) at cul-de-sacs.

The existing planning framework for pedestrians operates as follows:

- Structure Plans/Subdivision Plans: Proposed infrastructure as part of greenfields development
- Place Plans: Proposed infrastructure as part of brownfields development
- Walkability Plans: Evaluation of existing infrastructure and dedicated pedestrian improvement in established development

Each of these forms of consideration is important to the provision of public pedestrian infrastructure. Consistency is the most important aspect at the Structure Planning and Sub-Division level. This ensures that an appropriate standard is maintained across all development within the City.

Place Plans and Walkability Plans are better able to address specific issues and to develop infrastructure in concert with land-uses. These are particularly important in older precincts that may have been built prior to new pedestrian standards. Areas such as Midland, Guildford and The Vines have benefited from detailed assessment of existing infrastructure gaps, with specific recommendations pertaining to their individual characteristics.

The Department of Transport’s *Walkability Audit Tool* is an effective way of assessing the existing infrastructure and can be used as part of a Walkability Plan to establish a baseline for improvements across a variety of disparate environments. This can assist the City in prioritisation of projects arising from these pedestrian assessment exercises.

8 Parking

For the purpose of parking assessment, areas within the City of Swan have been categorised by their function or environment. The role of parking within each category is described below, including general consideration for the following factors:

- the appropriateness and function of off-street parking
- requirements for on-site parking
- potential for synergies between adjacent land uses
- likelihood for statutory parking concessions
- provision of off-street public parking facilities
- other specific policies relating to individual areas

8.1 Activity Centres

8.1.1 Strategic Metropolitan Centre (Midland)

Midland operates as a significant strategic centre for both the local community and a wider catchment that extends into the Wheatbelt and to relatively remote residential catchments such as Ellenbrook and Mundaring. For this reason there will always be an important place for private vehicles, as these represent the only viable transport mode for a large proportion of this population. High quality parking will be required to accommodate this demand, as well as that of other visitors, residents and commuters.

However, a higher provision of car parking will result in an increase in demand for private vehicle modes, potentially beyond the capacity of the road network to support it. Car parking management methodologies will need to be introduced to maintain a level of supply and demand which can be sustained by the local road network.

Off-street parking in Midland is required to serve a variety of functions including:

> Retail
> Business/commercial
> Commuting (public transport)
> Residential

Significant amounts of both long-term and short-term parking is required to serve these land uses. Therefore, Midland requires a parking strategy that meets the needs of the various type of parking demand these land uses will generate.

A number of parking studies and resulting strategy documents have been completed for Midland Activity Centre, including:

> Midland Access and Parking Strategy, 2013
> Midland Activity Centre Structure Plan Transport Assessment, 2013
> Midland Gate Car Parking Review, 2011
> Midland Multi-deck Car Parking Study, 2009

The 2009 Study indicated that Multi deck parking stations are unlikely to be warranted until the future health campus, Midland Gate expansion and other larger developments are complete. The best current estimate of timing put this past 2020. Such future parking stations might be delivered through partnerships with State Government or private interests or by the City as a business opportunity.

Four sites are suggested in this Strategy:

> the Sidings car park on Yelverton Drive
> the No 3 Morrison Road Parking Station together with adjoining State land, currently also used as a public car park for paid parking

> PTA land along Railway Parade, east of Cale Street
> the north-west portion of the Midland Oval redevelopment area or another suitable site within the area as may be identified in a Master Plan currently being developed

More recently, the Midland Activity Centre Structure Plan Transport Assessment has provided an assessment of the required parking quantum for Midland to the 2031. This was calculated to be approximately 13,000 parking spaces when accounting for shared and reciprocal parking as well as an efficiency factor resulting from the dispersal of parking across a relatively wide area.

The 2031 parking quantum can be delivered by approximately adhering to the following nominal maximum parking rates proposed in the DoT *Activity Centres Parking Discussion Paper*, prepared in response to State Planning Policy 4.2 *Activity Centres for Perth and Peel*.

> Retail: 3-4 bays per 100sq.m
> Office: 1-2 bays per 100sq.m
> Showroom: 2 bays per 100sq.m
> Residential: 1 bay per unit

A comprehensive parking pricing and developer cash-in-lieu policy is proposed for Midland, proposing a transition towards paid parking in the Midland City Centre. Mandatory cash-in-lieu for car parking is recommended so that the required levels of public off-street parking can be funded and provided. These cash-in-lieu payments would also allow the City to fund additional infrastructure such as improvements to cycling facilities and public transport. Synergies between developments will reduce the need to provide on-site parking, allowing key land to be developed to its maximum potential.

The above cash-in-lieu proposal has not been incorporated into City of Swan policy and it is important that the implications of mandatory cash-in-lieu are fully understood before it is put into practice.

The *Midland Access and Parking Strategy* (POL-TP-129) is the document that drives policy in this precinct. This Strategy has been updated progressively over the last 5 years and accurately represents the attitudes and direction of parking provision in the City Centre. Cash-in-lieu of parking is expressly encouraged through this policy, but is applied only where developers require concessions for on-site parking. The cash-in-lieu provisions described by POL-TP-129 are considered to be robust for the current environment.

8.1.2 Secondary Centres (Ellenbrook Town Centre)

The Ellenbrook Town Centre (ETC) is part of the wider Ellenbrook Structure Plan Area, and will require significant on-site parking facilities to support the various retail and commercial land uses.

The ETC Parking Strategy notes that the majority of the parking (75 percent) will be provided as public parking, supported by a system of cash-in-lieu payments by developers to contribute to the public parking supply and other transport initiatives. Through sharing and reciprocal use of parking with the ETC core area, the ETC Parking Strategy contends that parking rates can be reduced by around 25 percent compared to the LPS 17 requirements.

The ETC is likely to develop over a long period of time and in 20 years it is expected that 80 percent of the available lands will have been developed. The streets in the ETC have potential to yield approximately 1,150 parking spaces, enough to meet the parking supply needs of the town centre, at least in the short-term. The level of on street parking is expected to decrease into the future due to creation of crossovers and street side landscaping. This decrease will be absorbed into the increased off-street public parking as these structures are built, resulting in an overall parking supply for the ETC of 10,650 spaces. When each land use is considered in isolation the LPS 17 requirement is 10,640 according to the ETC Parking Strategy.

This assessment suggests that the synergies associated with off-site parking are not being fully realised by the ETC Parking Strategy. If shared and reciprocal parking effects reduce demand by 25%, then the proposed supply would necessarily exceed peak demand by this amount. In addition, the restriction of on-site parking to 25% of the statutory rate may not be sufficiently attractive to developers who would likely seek to provide a majority of parking for their customers or employees within a convenient distance.

The ETC Parking Strategy proposes to provide parking at rates below the LPS 17 requirement within the town centre core and at rate equal to the LPS 17 for the overall ETC. This implies that the outer area of ETC will need to provide parking at rates in excess of the adopted standard. Furthermore, the privately owned parking spaces would appear to also contain the residential component within the strategy, (although slightly reduced from LPS 17 requirements); this suggests that as the overall parking for the non-residential aspects is actually higher than the LPS 17 requirement for these uses (as the overall ETC parking quantum is equivalent to the LPS 17 requirement). While this parking scenario does include a significant on-street quantum, it is clear that there is no accommodation for mode shift or leveraging of internal land use synergies.

8.1.3 District Centres (Albion)

Each urban cell within the Swan urban growth corridor is required to include a non-residential focus point for the local community, which will support the local catchment and complement larger neighbouring centres such as Ellenbrook and Midland.

District Centres include a mix of private and public off-street parking to support the various retail and employment land uses. According to the Swan Sub Regional Structure Plan, Albion will support 1,900 jobs with 10,000 sq.m of retail and 13,000 sq.m of non-retail floor area.

It is expected that the majority of parking will be provided as private off-street, supported by some public on-street parking which serves a very necessary commercial function. At the larger district centres such as Albion, public off-street parking may be warranted, and should be considered in a similar fashion to Ellenbrook and to a lesser extent, Midland City Centre.

8.1.4 Malaga (Industrial Precinct)

While the land within Malaga is zoned as “industrial” in the Metropolitan Region Scheme (MRS), it is understood that in the future it may include also office/commercial land uses.

The majority of parking facilities in Malaga are off-street, at-grade and provided for the employees and customers of the businesses within Malaga. While there are currently little to no public parking facilities within Malaga, such facilities are generally not deemed necessary for industrial areas as sufficient private facilities exist within these areas. The parking requirements for industrial land uses are described in the City of Swan Local Planning Scheme (LPS) 17 and are summarised in Section 8.2.1 of this report.

While some businesses exist within Malaga where the peak parking demand occasionally exceeds the supply, the overflow demand is typically dealt with by informal verge parking, as shown in **Figure 8-1** below.

As the parking supply requirements are typically significantly larger for office/commercial land uses, a cash-in-lieu policy may be appropriate for the provision of a public off-street parking facility for the area.

Figure 8-1 Informal Verge Parking in Malaga

8.1.5 Guildford

TBA

It is noted that the development of a Guildford parking strategy has been recommended as part of the Guildford LATM study and also as part of the Guildford Place Plan. From consultation with City of Swan planning officers, it is understood that a parking strategy for Guildford has been put forth in the 2014/15 business planning.

8.1.6 Neighbourhood and Local Centres

Neighbourhood and local centres provide access to every day goods and services such as:

- Convenience retail
- Medical/Dental/Pharmaceutical needs
- Community centres
- Small businesses
- Café/restaurant/other entertainment

It is expected that parking will mainly take place on-street, with private off-street parking provided for larger retail developments or grouped small to medium sized retail/services land uses.

8.2 Land-Use Precincts

8.2.1 Industrial

The industrial parking rates specified with LPS 17 are:

>	General/Light Industrial	3 spaces per 100 sq.m
>	Rural Industrial	1 space per 100 sq.m
>	Industry Service	4 spaces per 100 sq.m shop, 2 spaces per 100 sq. industrial
>	Warehouse	2 spaces per 100 sq.m

This can be compared to the parking rates specified within RTA guidance of 1.3 spaces per 100 sq.m for industrial uses. It is noted that the RTA similarly allows for increased parking rates where there is a significant office or retail component.

It is recommended that the City consider reducing the LPS 17 parking requirement for industrial land uses to perhaps 1.5 to 2.0 spaces per 100 sq.m.

8.2.2 Commercial/Business Park

The industrial parking rates specified with LPS 17 are:

>	Office	4 spaces per 100 sq.m

The above rate is considered high (1 space per 25 sq.m) compared to even the most conservative office parking supply requirements applied elsewhere in Perth.

It is recommended that the following rates are considered for adoption within a revised City parking policy:

>	Suburban	1 space per 40 sq.m
>	Centres	1 space per 50 sq.m

8.2.3 Retail

The retail parking rates specified with LPS 17 are:

>	Convenience Store	6 spaces per 100 sq.m
>	Home Store	5 spaces per 100 sq.m
>	Garden Centre	2 spaces per 100 sq.m
>	Market	10 spaces per 100 sq.m or 3 spaces per stall
>	Shop	8 spaces per 100 sq.m

The above parking rates are considered reasonable for Convenience Store, Home Store and Garden Centre for isolated land uses; however, the rates for Market and Shop are very high compared to parking demand rates observed elsewhere around metropolitan Perth.

The retail rate of 8 spaces per 100 sq.m is understood to be based on a Perth-wide shopping centre parking study conducted in the 1980s which recommended a design parking requirement of 7 spaces per 100 sq.m to accommodate the top 5 to 10 busiest days; 8 spaces per 100 sq.m was expected to cover every single day of the year. A rate of 10 spaces per 100 sq.m for a market is considered additionally excessive.

8.2.4 Residential

Residential developments are required to provide parking at rates specified in State Planning Policy 3.1 *Residential Design Codes* (R-Codes). This is considered a reasonable benchmark for residential parking provision, as a guide the following general rates should be adopted:

>	Small to medium apartment/townhouse	1 space per dwelling
>	Large townhouse/detached house	2 spaces per dwelling
>	Visitor parking	0.25 – 0.5 spaces per dwelling

8.2.5 Entertainment

The entertainment parking rates specified with LPS 17 are:

> - Amusement Parlour 10 spaces per 100 sq.m
> - Cinema 1 space per employee plus 1 space per 2.5 sq.m seating area
> - Nightclub 1 space for every 4 person accommodated, 1 space per employee
> - Restaurant 1 space for every 4 person accommodated
> - Tavern 1 space per 2 sq.m of gross bar and lounge area, reductions possible

The rates above are typical of conservative Perth Metropolitan planning scheme parking rates. Existing rates for Cinema are based on small movie theatres and not the large format multi-screen cinemas currently prevalent. In these cases, the cinema is often part of a larger integrated entertainment facility or even a shopping centre.

The scheme Nightclub and Tavern parking rates are also considered to be obsolete, and generally assume that nearly everyone in the building is driving (Tavern) or each group has a designated driver (Nightclub), which are no longer considered to be typical.

8.2.6 Education

The LPS 17 parking rates should be used as a reference only, in complete absence of any other supporting data. It is understood that the Department of Education stipulates parking provisions at public schools. It is recommended that parking for education facilities is based on parking assessments on a site specific basis and related to parking provided at other sites in similar circumstances.

9 Issues and Needs Criteria

9.1 Road and Intersection Capacity

A review of data from the Regional Operations Model (ROM) supplied by Main Roads Western Australia (MRWA) was undertaken with an aim of identifying road links within the study area that have potential capacity constraints. For the purpose of this initial assessment, all roads modelled as operating with a Volume / Capacity (V/C) ratio of 0.80 or greater in the 2031 AM peak hour and PM peak hour were included in this review. Intersections adjoining links with V/C ratios greater than 0.60 are likely to experience significant performance issues and may therefore require some form of mitigation measure to cater for the modelled 2031 peak hour volumes. **Section 9.2** of this report details intersections identified by these criteria, disaggregated according to suburb.

Where ever available, the most recent 2031 ROM traffic forecasts have been utilised to analyse the future expected performance of the intersections. However, it should be noted that the 2031 ROM network, on which some of the modelling was undertaken, included the Lord Street alignment of the Perth Darwin National Highway (PDNH), which is currently not the preferred alignment of the PDNH.

It is also noted that the proposed Lloyd Street Southern Extension between Clayton Street and Stirling Crescent has not been included in the 2031 ROM network, an erroneous link included between Altone Road and Iolanthe Street has been identified, Bellefin Drive has not been extended to Hepburn Avenue and Altone Road has only been modelled to include 1 lane in each direction for its entire length.

It is recommended that these issues be rectified in the 2031 ROM network and the performances of the intersections identified be re-evaluated if the modelled localised traffic volumes change significantly.

9.2 Intersection Capacity Assessment

The following section presents key intersections identified as likely to experience significant performance issues in the 2031 peak hour scenarios.

Using modelled link volumes for the intersections below, turning movements were estimated using a simple gravity model with a unitary friction factor such that the performance of the intersection could be analysed in SIDRA.

9.2.1 Caversham

9.2.1.1 Intersection of West Swan Road and Benara Road

As shown in **Figure 9-1**, the intersection of West Swan Road and Benara Road is currently a roundabout with a single approach and departure lane for each leg and a single circulating lane. Both West Swan Road and Benara Road are modelled as having a single lane in each direction in the 2031 ROM network.

Figure 9-1 Existing Geometry of Intersection of West Swan Road and Benara Road

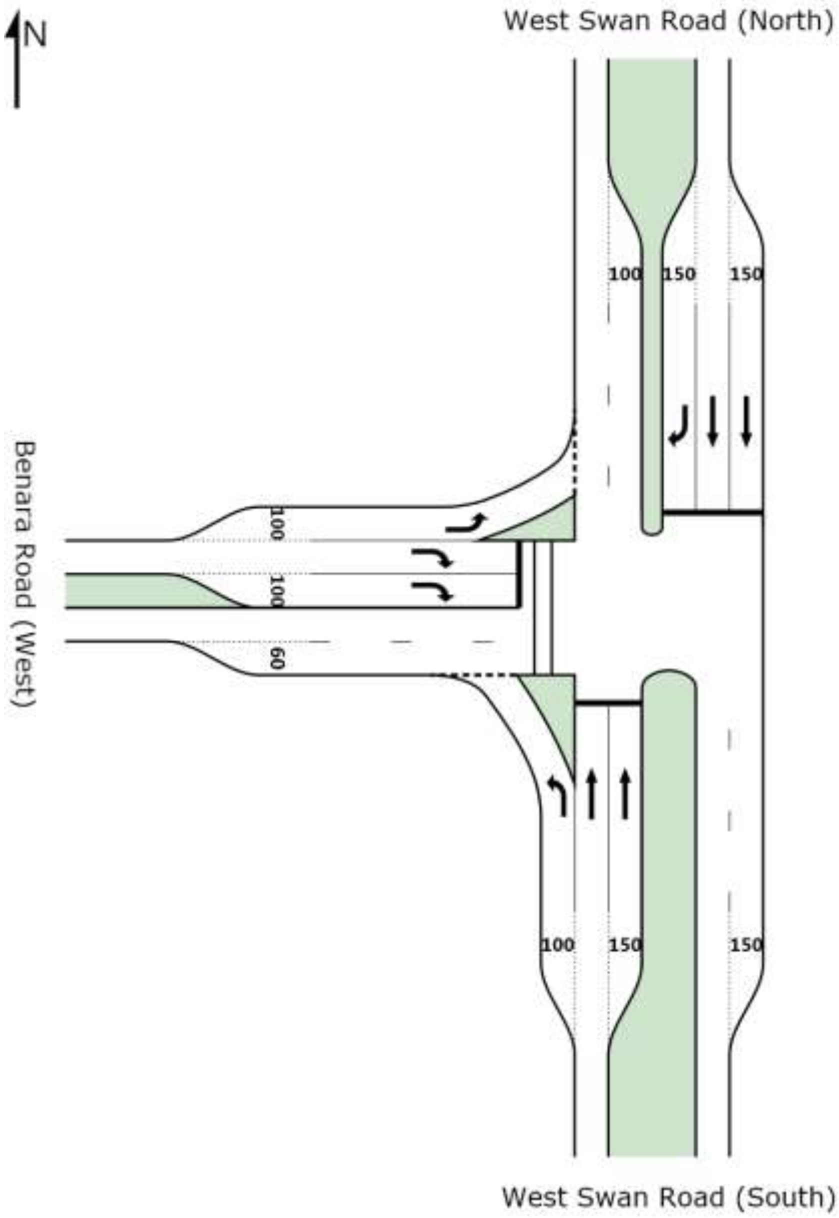
Using the existing geometry of this intersection with the modelled 2031 AM peak hour volumes, this intersection is expected to fail, with average delays extending past 8 minutes for all approaches.

Even if this intersection was to be upgraded to a roundabout with 2 approach and departure lanes for each leg, as well as dual circulating lanes, the average delays for the northern leg would remain unacceptable at greater than 150 seconds.

An intersection arrangement was determined that could be expected to operate at an acceptable LoS, and is shown in **Figure 9-2**. The identified modifications include signalisation of the intersection, as well as extensions to existing turning pockets and the introduction of a slip-lane for the southern leg of West Swan Road.

From the SIDRA movement summaries shown in **Appendix D** (**Table D-1** and **Table D-2**), the intersection is shown to operate acceptably for both 2031 AM peak hour and 2031 PM peak hour scenarios respectively, with the overall LoS of this intersection being C for both scenarios.

Figure 9-2 Proposed Signalised Intersection Layout of West Swan Road and Benara Road



9.2.2 West Swan

It is noted that a proposed upgrade of the intersection of Harrow Street and Lord Street (among others) is included in the Development Contribution Plan (DCP) for the Dayton Development Contribution Area (DCA) 2 as this has been identified to be required to provide sufficient access and connectivity to the area. The capital costs of the transport infrastructure items included in this DCP is shared by the City of Swan and the developers within the DCA.

9.2.2.1 Intersection of West Swan Road and Harrow Street

As shown in **Figure 9-3**, the intersection of West Swan Road and Harrow Street is currently a priority intersection with Harrow Street giving priority to West Swan Road. Both West Swan Road and Harrow Street are modelled as having a single lane in each direction in the 2031 ROM network.

Figure 9-3 Existing Geometry of Intersection of West Swan Road and Harrow Street

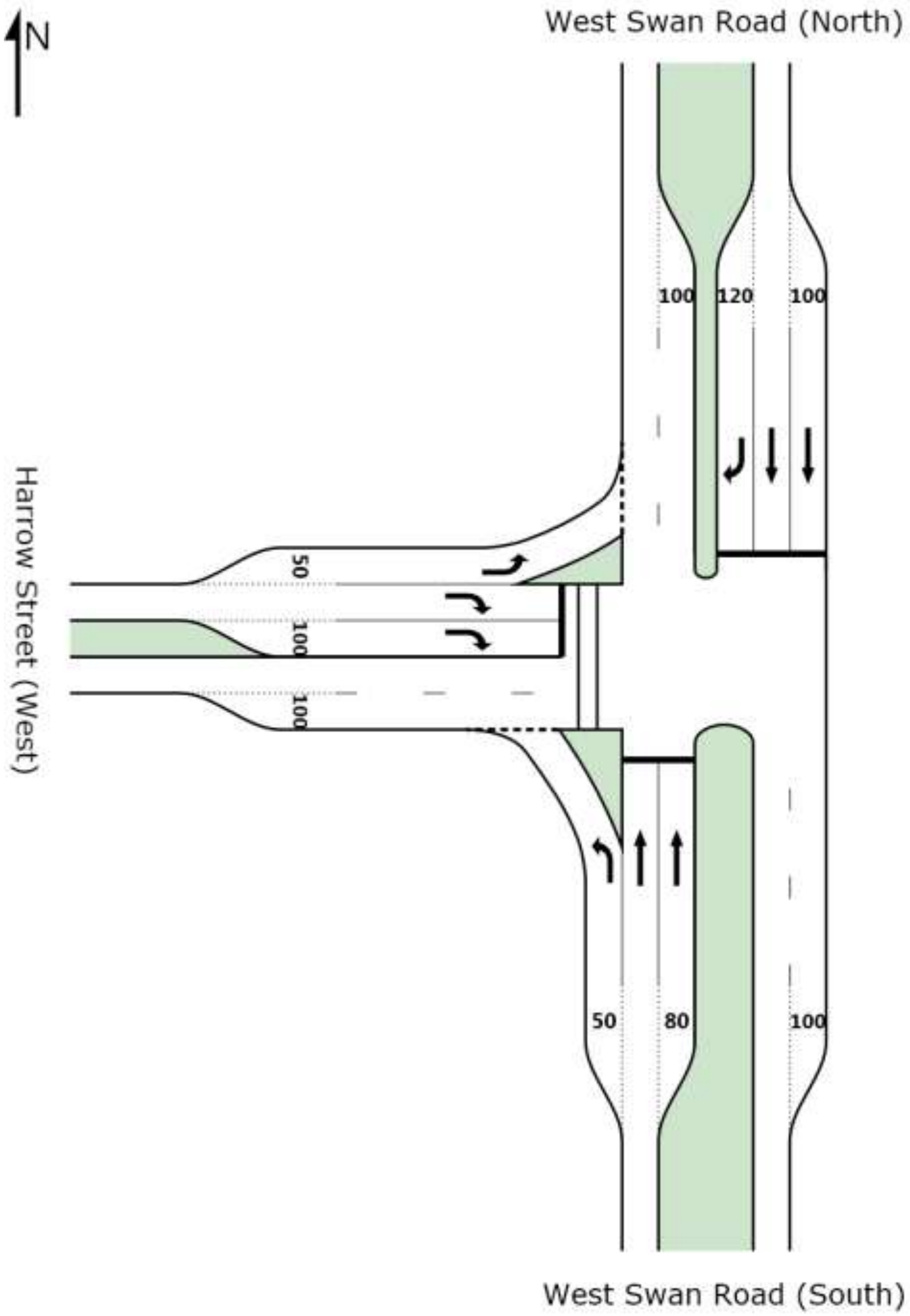
Using the existing geometry of this intersection with the modelled 2031 AM peak hour volumes, this intersection is expected to fail severely, with average delays extending past the study period for turns out of Harrow Street.

A number of options were analysed in order to identify a suitable treatment option that would result in an acceptable performance of this intersection. The results from this analysis suggested that even as a roundabout with 2 approach and departure lanes for each leg of the roundabout and dual circulating lanes, the overall LoS of the intersection would remain at F (unacceptable).

An intersection arrangement that was found to operate at an acceptable LoS is shown in **Figure 9-4** and includes the signalisation of the intersection, as well as localised widening of the road to allow for turning lanes and the introduction of left turn slip lanes for the left turn at Harrow Street and at the southern approach of West Swan Road. From the SIDRA movement summaries, as shown in **Appendix D** (**Table D-3** and **Table D-4**), the average delay for this intersection is 25 seconds and 19 seconds while the overall LoS of the intersection is C and B for the 2031 AM peak hour and 2031 PM peak hour scenarios respectively.

It should be noted that the Dayton Local Structure Plan 4 indicates that existing geometry of this intersection will be sufficient for the traffic volumes along both Harlow Street and West Swan Road until the scenario year of 2019. However, significant growth in traffic is expected along West Swan Road between 2019 and 2031 and it is expected that the intersection will require upgrading at some time within this period.

Figure 9-4 Proposed Signalised Intersection Layout of West Swan Road and Harrow Street



9.2.2.2 Intersection of Lord Street and Harrow Street

As shown in **Figure 9-5**, the intersection of Lord Street and Harrow Street is currently a priority intersection, with Harrow Street giving priority to Lord Street. Harrow Street is modelled as having a single lane in each direction in the 2031 ROM network, while Lord Street in this location is modelled as a 4-lane dual carriageway. This intersection is also likely to become a 4-way intersection, with the western leg connecting to the proposed Lord Street Extension.

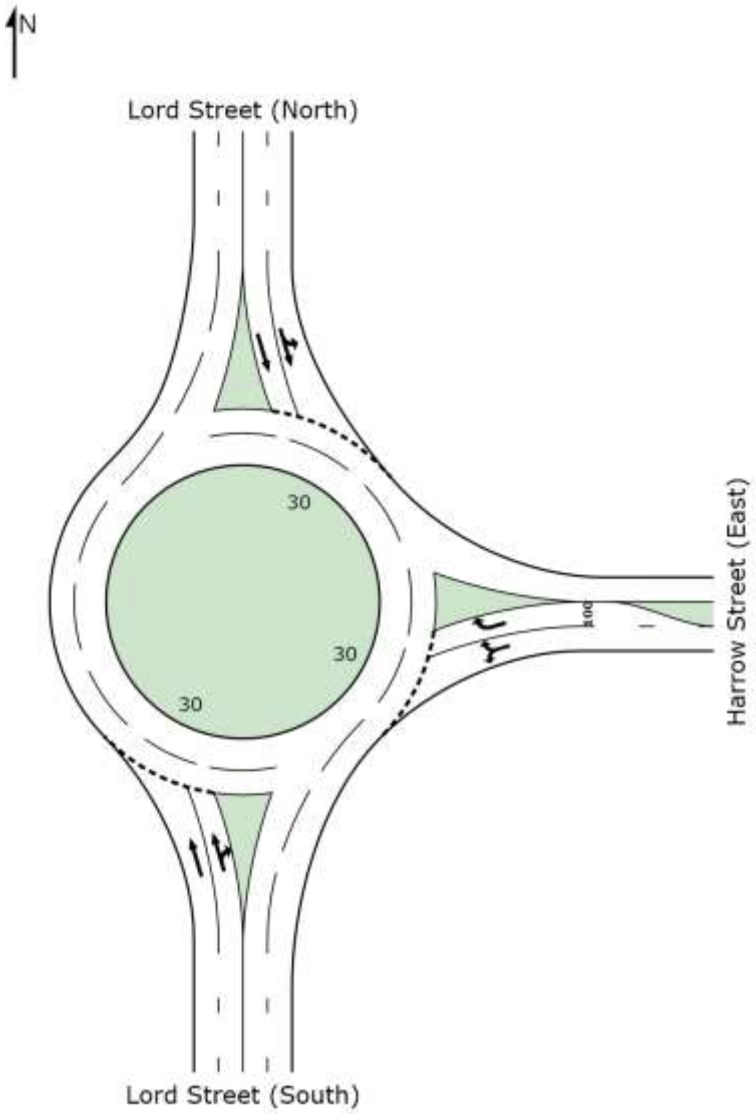
Figure 9-5 Existing Geometry of Intersection of Lord Street and Harrow Street

It is noted that the ROM does not model this intersection as a 4-way intersection at this time. Therefore, only the 3-way volumes have been modelled to assess the sufficiency of existing geometry.

Extending the existing geometry of this intersection to the modelled 2031 AM peak hour volumes, this intersection is expected to fail severely, with average delays extending past the study period for the turns out of Harrow Street.

An intersection arrangement that was found to operate at an acceptable LoS is shown in **Figure 9-6** and includes the conversion of the intersection to a roundabout with dual circulating lanes and localised widening of the Harrow Street approach lanes. This intersection treatment is generally consistent with the proposed intersection layout as described in the Dayton Local Structure Plan 4.

Figure 9-6 Proposed Roundabout Intersection Layout of Lord Street and Harrow Street



From the SIDRA movement summaries, as shown in **Appendix D** (**Table D-5** and **Table D-6**), the average delay for this intersection is 9 seconds and 13 seconds while the overall LoS of the intersection is A and B for the 2031 AM peak hour and 2031 PM peak hour scenarios respectively.

9.2.3 Belhus

9.2.3.1 Intersection of Great Northern Highway and West Swan Road

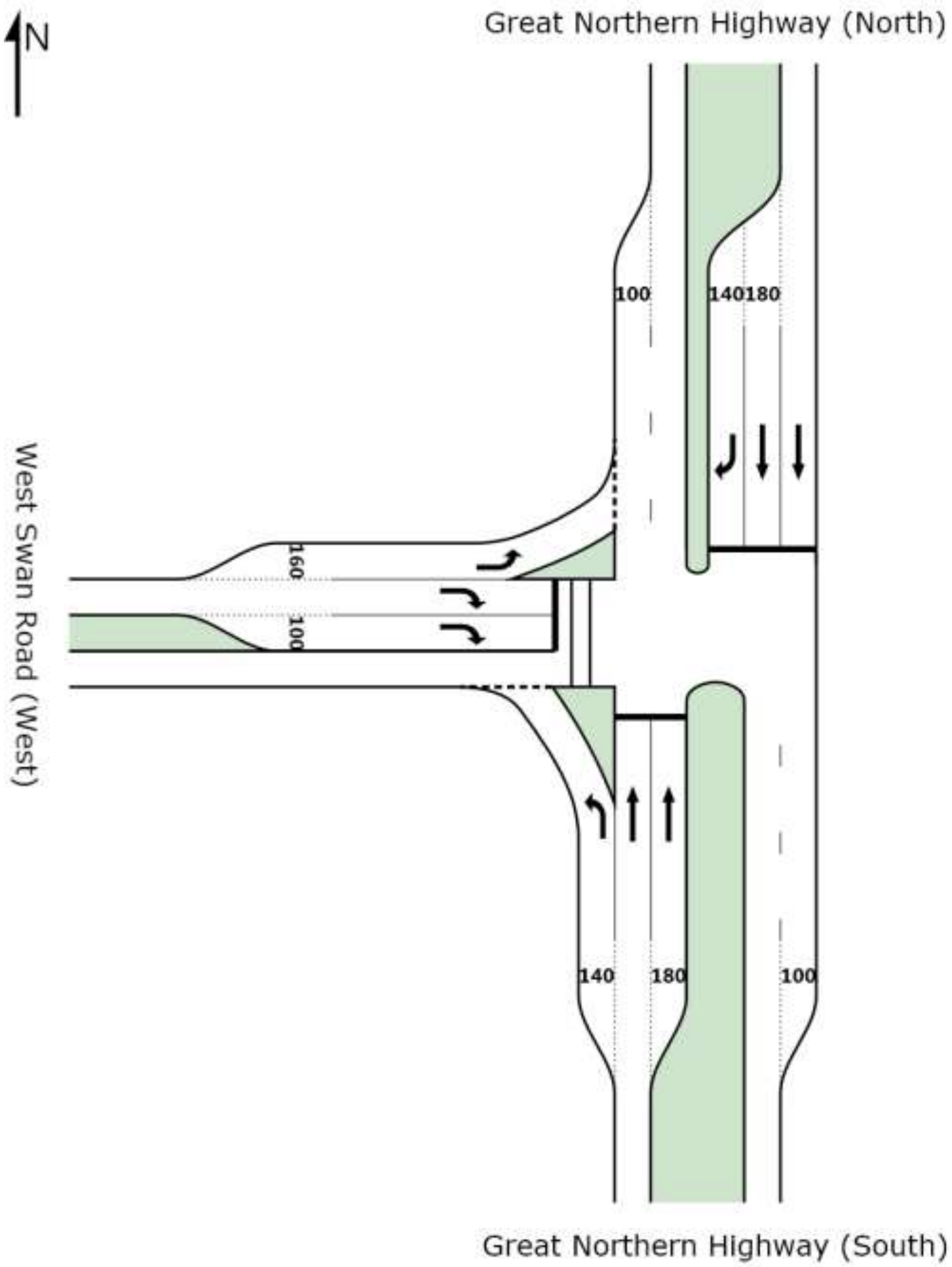
The intersection of Great Northern Highway and West Swan Road was upgraded from a priority intersection to a signalised intersection in 2009 due to the anticipated additional traffic through this intersection. The intersection in its current form, as shown in **Figure 9-7**, includes left-turn slip lanes and turn pockets of varying lengths. As identified in the Great Northern Highway Access Strategy (*Main Roads WA 2009*), this intersection is likely to require further treatment to adequately cater for the increased traffic volumes along these roads and may require the duplication of the existing bridge south of the intersection.

Figure 9-7 Existing Geometry of Intersection of Great Northern Highway and West Swan Road

Using the existing geometry of this intersection with the modelled 2031 AM peak hour volumes, this intersection is expected to fail as the average delays will increase to 140 seconds and the overall intersection LoS decrease to F.

An intersection arrangement that was found to operate at an acceptable LoS is shown in **Figure 9-8** and includes the introduction of extensions to existing turning pockets and slip lanes, as well as additional through lanes for the northern and southern approaches of Great Northern Highway.

Figure 9-8 Proposed Intersection Layout of Great Northern Highway and West Swan Road



From the SIDRA movement summaries, as shown in **Appendix D** (**Table D-7** and **Table D-8**), the average delay for this intersection is 30 seconds and 26 seconds for the 2031 AM peak hour and 2031 PM peak hour scenarios respectively, with the overall LoS of this intersection being C for both scenarios.

9.2.3.2 Intersection of West Swan Road and Millhouse Road

As shown in **Figure 9-9**, the intersection of West Swan Road and Millhouse Road is currently a priority intersection, with Millhouse Road giving priority to West Swan Road. Millhouse Road has been modelled as having a single lane in each direction in the 2031 ROM network, while West Swan Road is proposed to be duplicated to a 4-lane form.

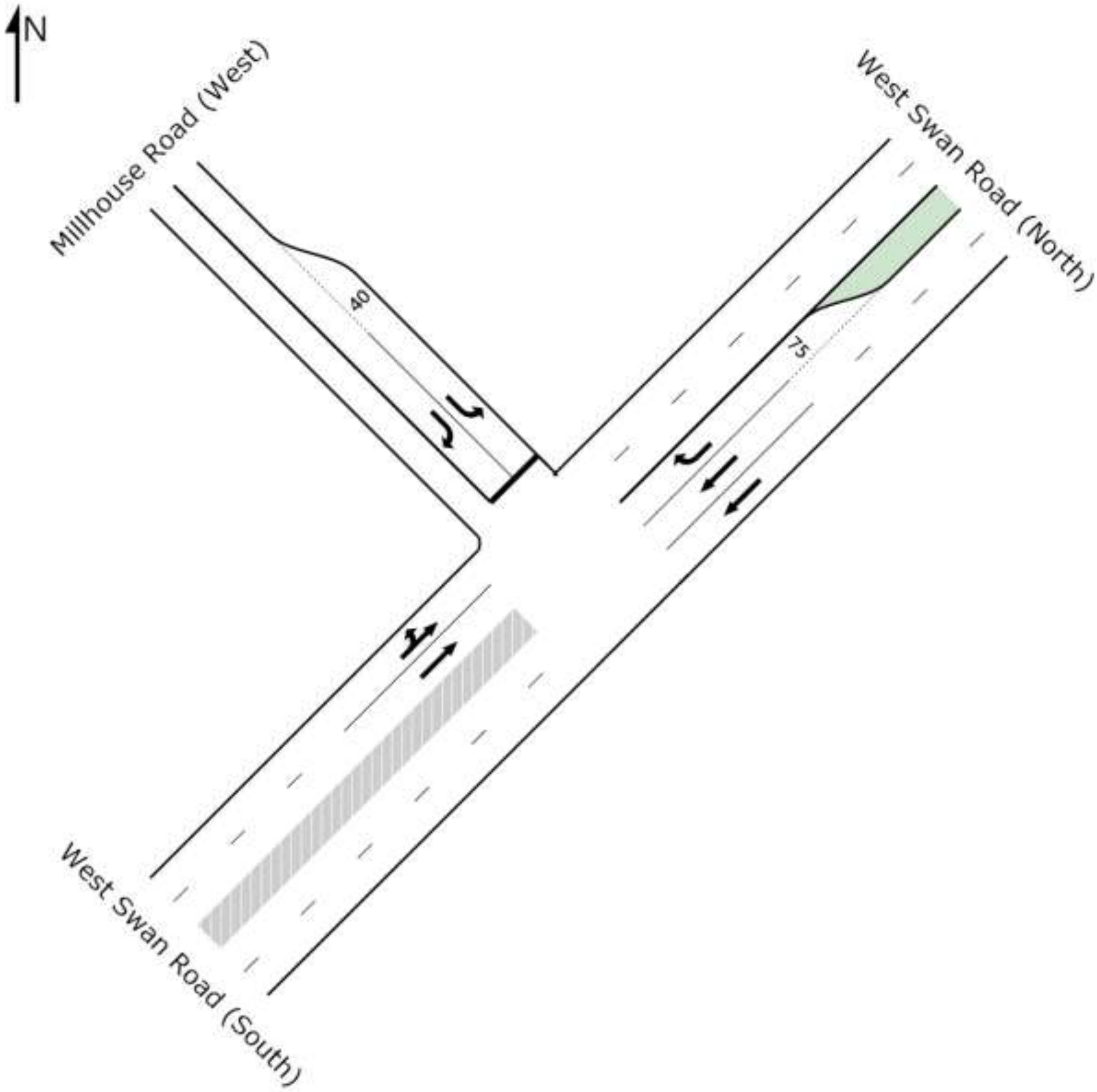
It is noted that the connection between Millhouse Road and The Promenade in Ellenbrook was completed in its entirety in May 2013 and that this may have created additional demand for existing vehicle movements along Millhouse Road. This connection is envisaged by the ROM and has been included in future analysis.

Figure 9-9 Existing Geometry of Intersection of West Swan Road and Millhouse Road

Using the existing geometry of this intersection with the modelled 2031 AM peak hour volumes, this intersection is expected to fail, with average delays of approximately 4 minutes for the turns out of Millhouse Road.

An intersection arrangement that was found to operate at an acceptable LoS is shown in **Figure 9-10**.

Figure 9-10 Proposed Priority Intersection Layout of West Swan Road and Millhouse Road



From the SIDRA movement summaries, as shown in **Appendix D** (**Table D-9** and **Table D-10**), the average delay for this intersection is 6 seconds and 9 seconds for the 2031 AM peak hour and 2031 PM peak hour scenarios respectively, with the overall LoS of this intersection being A for both scenarios. It is noted that due to the high demand for right turning movements into Millhouse Road, a channelized right turn is generally recommended.

9.2.4 Beechboro

With the general exception of the Malaga Industrial Area, access to Beechboro, Malaga and Lockridge will be generally improved through the construction of a grade separated interchange at Reid Highway/Malaga Drive. In keeping with Reid Highway interchanges at Mirrabooka Avenue and Alexander Drive, this will likely be a diamond interchange with signal control at the ramp terminals.

By 2021, travel times from the wider area should reduce due to the grade separation of intersections along Tonkin Highway north of Swan River, most prominently the freeway to freeway interchange at Reid Highway.

9.2.4.1 Intersection of Marshall Road and Altone Road

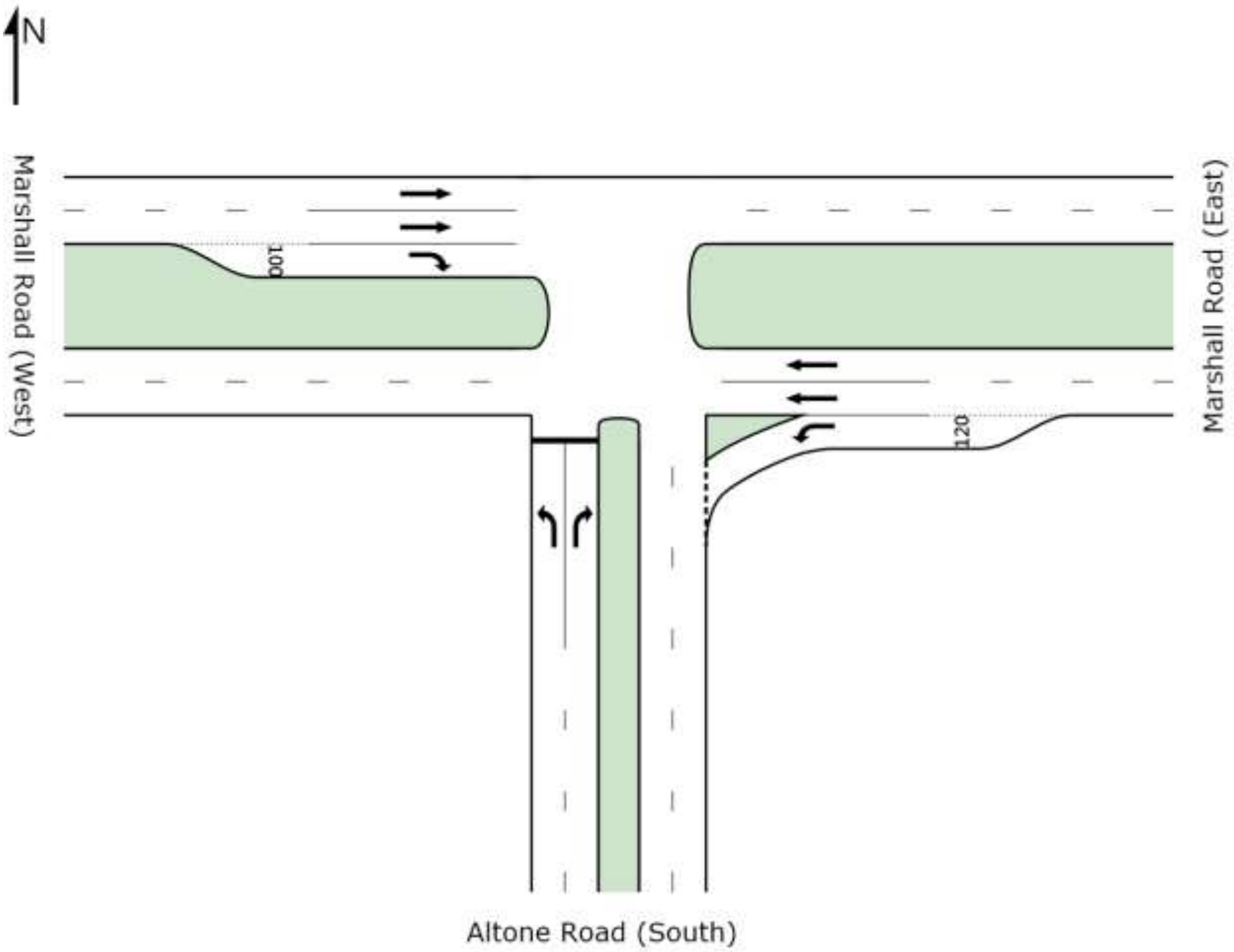
As shown in **Figure 9-11**, the intersection of Marshall Road and Altone Road is currently a priority intersection, with Altone Road giving priority to Marshall Road. Marshall Road currently has 1 lane in each direction but is expected to be upgraded to 2 lanes in each direction in line with the 2031 ROM network, while Altone Road remains with a single lane in each direction. Altone Road is expected to require upgrading to a 4-lane dual carriageway form prior to the 2031 horizon.

Figure 9-11 Existing Geometry of Intersection of Marshall Road and Altone Road

Using the existing geometry of this intersection with the modelled 2031 AM peak hour volumes, this intersection is expected to fail severely, with average delays of approximately 50 minutes for turns out of Altone Road.

An intersection arrangement that was found to operate at an acceptable LoS is shown in **Figure 9-12** and includes the construction of a wide central median to allow staged right-turn crossing.

Figure 9-12 Proposed Priority Intersection Layout of Marshall Road and Altone Road



From the SIDRA movement summaries, as shown in **Appendix D** (**Table D-11** and **Table D-12**), the average delay for this intersection is 17 seconds and 43 seconds for the 2031 AM peak hour and 2031 PM peak hour scenarios respectively, with the overall LoS of this intersection being between a C and D these two scenarios.

It is important to note that the two roundabouts used to access residential areas to the east and west of Altone Road are located approximately 220m and 370m from of this intersection. As these roundabouts have not been included in the ROM outputs but would have a significant impact on the capacity of Altone Road, the modelled traffic volumes on Altone Road are likely to be overestimated to some extent. This is particularly important when considering the long delays for right-turning traffic eastbound in the PM peak, which have been modelled at 160s seconds in this analysis. While signalisation may be applicable in the long-term, the impact of the PDNH and the adjacent road formation should be evaluated before this occurs.

9.2.4.2 Intersection of Marshall Road and Beechboro Road North

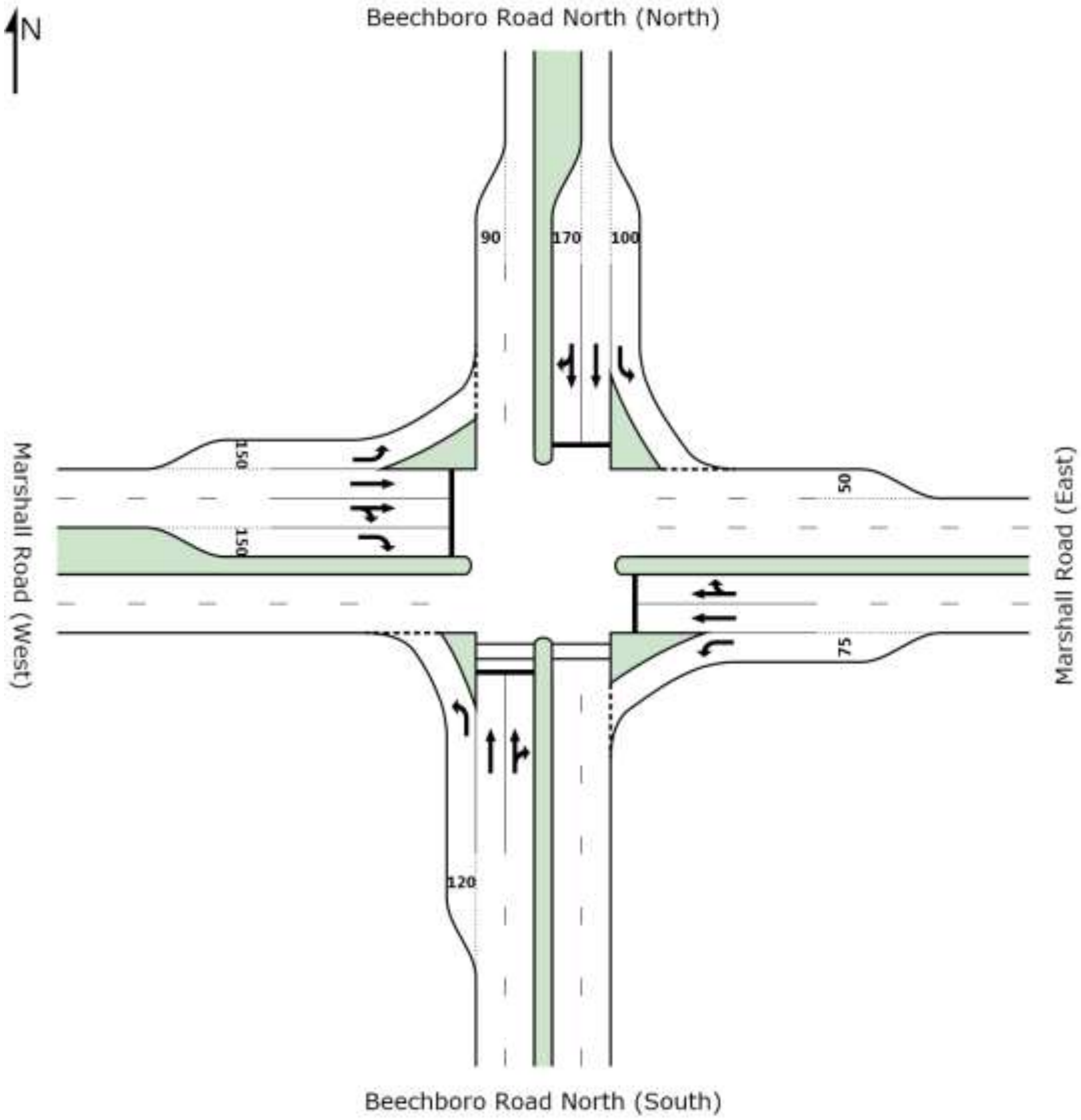
As shown in **Figure 9-13**, the intersection of Marshall Road and Beechboro Road North is currently a signalised intersection. Marshall Road is modelled as having 2 lanes in each direction in the 2031 ROM network, while Beechboro Road North is expected to remain in its current form of 2 lanes in each direction south of Marshall Road and 1 lane in each direction north of Marshall Road.

Figure 9-13 Existing Geometry of Intersection of Marshall Road and Beechboro Road North

Using the existing geometry of this intersection with the modelled 2031 AM peak hour volumes, this intersection is expected to fail severely, with average delays of over 11 minutes for this intersection.

An intersection arrangement that was found to operate at an acceptable LoS is shown in Figure 9-14 and includes the introduction of left turn slip lanes for all approaches, as well as localised widening of the road to allow for additional turn bays.

Figure 9-14 Proposed Intersection Layout of Marshall Road and Beechboro Road North



From the SIDRA movement summaries, as shown in **Appendix D** (**Table D-13** and **Table D-14**), the average delay for this intersection is 73 seconds and 26 seconds while the overall LoS of the intersection is E and C for the 2031 AM peak hour and 2031 PM peak hour scenarios respectively.

9.2.5 Guildford

Guildford operates as the western gateway to a large proportion of the City, with strategic connections along Meadow Street, Great Eastern Highway and West Parade acting as District Distributors to the Urban Growth Corridor, Midland and Hazelmere.

Road constraints imposed at 4 locations restrict the volumes of traffic travelling through Guildford through capacity constraint. These locations include the Bridge Street and Johnson Street river crossings, and the Meadow Street and East Street rail crossings. In the absence of these constraints, it is expected that regional traffic volumes through Guildford would increase. This suggests that any improvements to crossings designed to improve traffic operations would result in a significant increase in traffic volumes and a reduction in the use of the Great Eastern Highway Bypass. This is considered undesirable for the function of these two roads, the impact on local residents and the increased use of West Parade and Great Eastern Highway for through traffic.

The City has shown through the Hazelmere Enterprise Area Structure Plan and the Midland Activity Centre Structure Plan that they fully support the use of the primary road network (Roe Highway, Great Eastern Highway Bypass, Reid Highway, the PDNH etc.) by regional traffic. These goals are upheld by retaining the restriction of traffic through Guildford.

9.2.5.1 Intersection of Meadow Street and Swan Street

As shown in **Figure 9-15**, the intersection of Meadow Street and Swan Street is currently a roundabout intersection with single approach lanes and departure lanes for all directions and a single circulating lane. The southern approach of Meadow Street is modelled a having 2 approach and departure lanes in the 2031 ROM network, while all other features of the intersection are to remain the same.

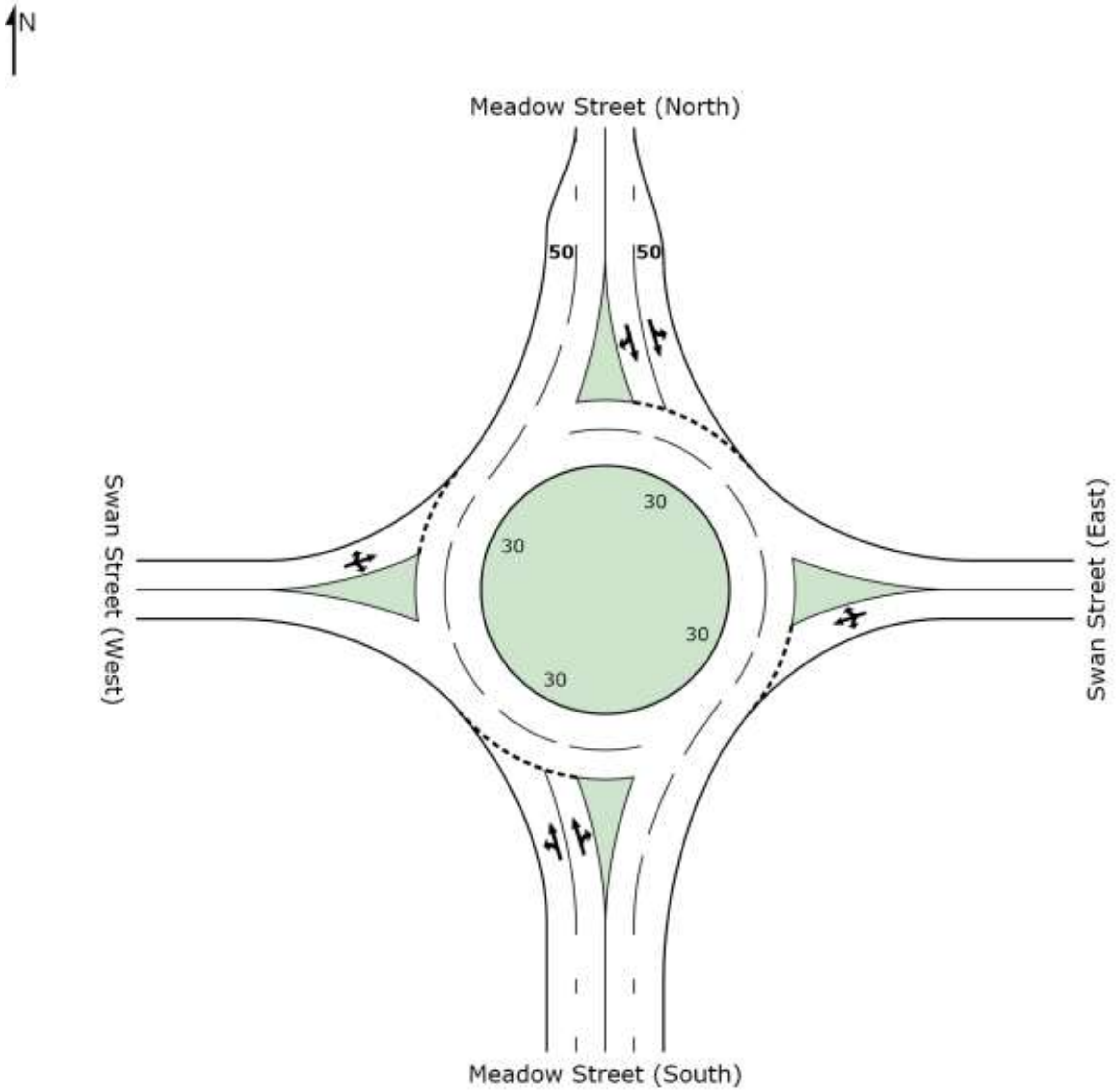
Figure 9-15 Existing Geometry of Intersection of Meadow Street and Swan Street

Using the existing geometry of this intersection with the modelled 2031 AM peak hour volumes, this intersection is expected to fail as the average delays will increase to 98 seconds and the overall intersection LoS decrease to F.

While the introduction of the additional approach and departure lane on the southern leg of the intersection will somewhat assist in alleviating some of the pressures on this intersection, the average delay only slightly decreases to 80 seconds and the intersection LoS remains at F. However, the addition of additional approach and departure lanes on the southern leg of the roundabout is likely require an increase in the island diameter from the existing 15m to approximately 30m. Due to the restrained location of the intersection, the widening of the roundabout is likely to require significant land acquisition of residential and commercial land adjacent to the intersection.

An intersection arrangement that was found to operate at an acceptable LoS is shown in **Figure 9-16** and includes the introduction of a turning lane for the northern approach of the roundabout, as well as the widening of the roundabout and the introduction of an additional approach and departure lane for the southern leg of the roundabout as previously described. Alternatively, the conversion of the intersection to a signalised intersection may be considered if land requirements are likely to become an issue.

Figure 9-16 Proposed Intersection Layout of Meadow Street and Swan Street



From the SIDRA movement summaries, as shown in **Appendix D** (**Table D-15** and **Table D-16**), the average delay for this intersection is 9 seconds and 7 seconds for the 2031 AM peak hour and 2031 PM peak hour scenarios respectively, with the overall LoS of this intersection being A for both scenarios.

9.2.6 Jane Brook

9.2.6.1 Intersection of Toodyay Road and Talbot Road

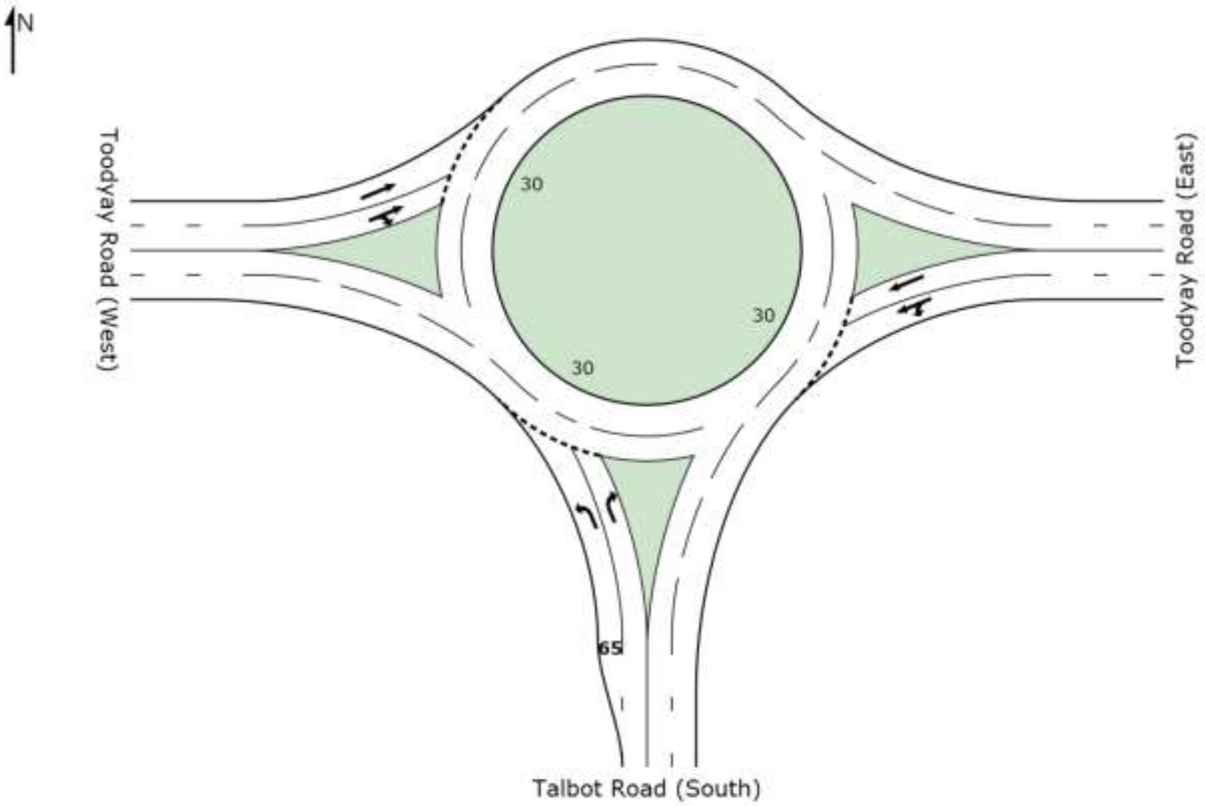
As shown in **Figure 9-17**, the intersection of Toodyay Road and Talbot Road is currently a priority intersection with Talbot Road giving priority to Toodyay Road. Toodyay Road currently has 1 lane in each direction but is expected to be upgraded to 2 lanes in each direction in line with the 2031 ROM network, while Talbot Road remains with a single lane in each direction.

Figure 9-17 Existing Geometry of Toodyay Road and Talbot Road

Using the existing geometry of this intersection with the modelled 2031 AM peak hour volumes, this intersection is expected to fail severely, with average delays of over 1 hour for the both turns out of Talbot Road.

An intersection arrangement that was found to operate at a mostly acceptable LoS is shown in **Figure 9-18** and includes the conversion of the intersection to a roundabout with dual circulating lanes. Alternative, signalisation may be considered for this intersection if the roundabout option is not desired.

Figure 9-18 Proposed Intersection Layout of Toodyay Road and Talbot Road



From the SIDRA movement summaries, as shown in **Appendix D** (**Table D-17** and **Table D-18**), the average delay for this intersection is 16 seconds and 10 seconds for the 2031 AM peak hour and 2031 PM peak hour scenarios respectively, with the overall LoS of this intersection being B for both scenarios.

9.2.7 Henley Brook

9.2.7.1 Intersection of West Swan Road and Gnangara Road

As shown in **Figure 9-19**, the intersection of West Swan Road and Gnangara Road is currently a roundabout intersection with single approach lanes and departure lanes for all directions and a single circulating lane. Both West Swan Road and Gnangara Road (west of Henley Brook Avenue) are modelled as having a single lane in each direction in the 2031 ROM network.

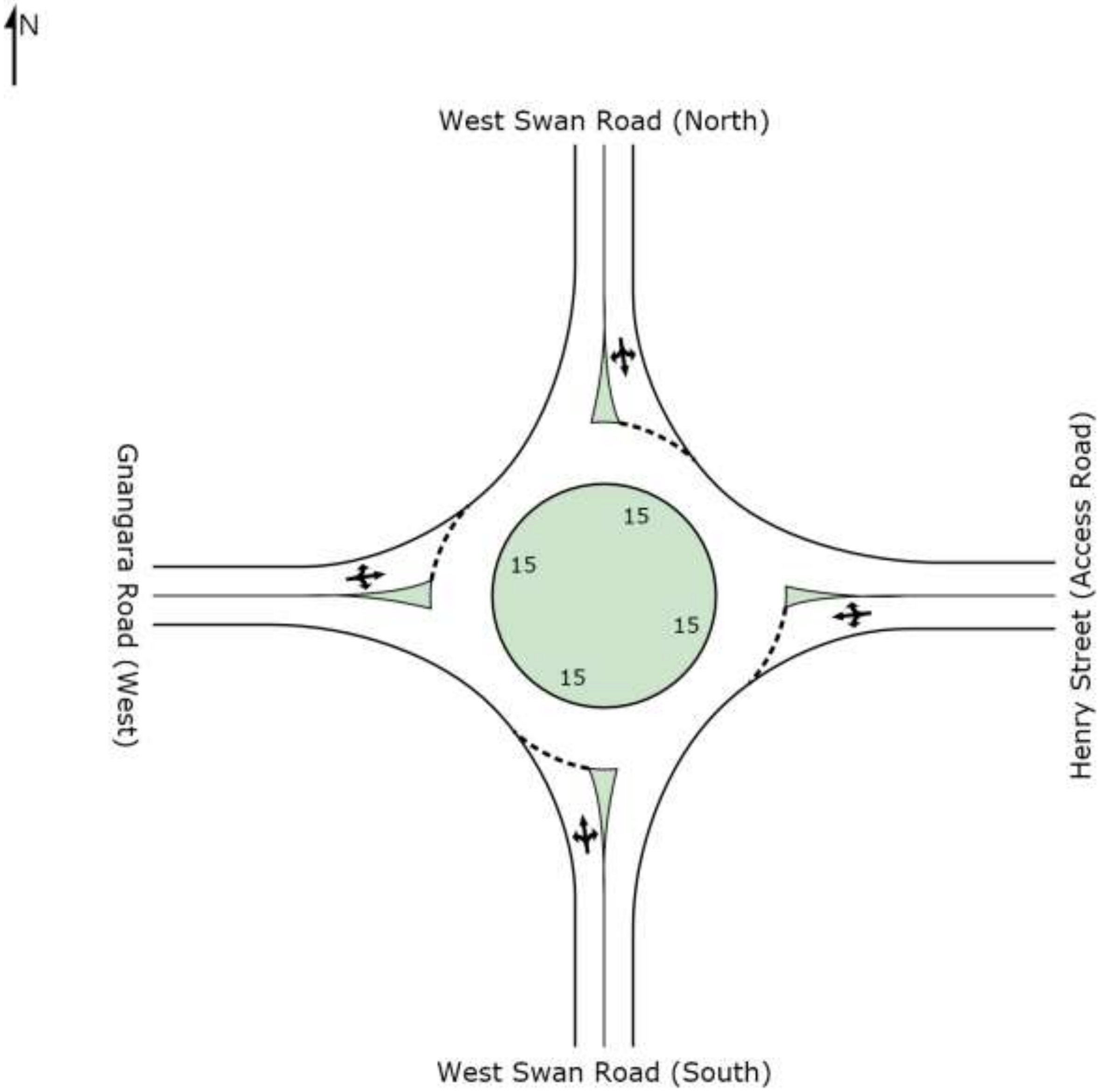
It is noted that the eastern approach of the intersection is used as a de-facto access road for a rural living dwelling on Henry Street.

Figure 9-19 Existing Intersection Layout of Gnangara Road and West Swan Road

With the introduction of Henley Brook Avenue in the 2031 ROM network, the majority of traffic associated with the residential developments within the Urban Growth Corridor is expected to utilise this road instead of West Swan Road. By 2031, the traffic on West Swan Road is therefore assumed to decrease to below existing levels and will predominantly consist of local traffic.

Using the existing geometry of this intersection with the modelled 2031 AM peak hour volumes, this intersection is expected to perform satisfactory, with average delays of approximately 10 seconds and a LoS B. However, as it is expected that the 2031 traffic volumes are less than the existing traffic volumes, it is likely that this roundabout is required in the short-medium term, prior to the full construction of the Henley Brook Avenue.

Figure 9-20 Assumed Intersection Layout of Gnangara Road and West Swan Road



Analysis of the roundabout From the SIDRA movement summaries, as shown in **Appendix D** (**Table D-19** and **Table D-20**), the average delay for this intersection is 25 seconds and 9 seconds while the overall LoS of the intersection is C and A for the 2031 AM peak hour and 2031 PM peak hour scenarios respectively.

It is noted that the MRS allows for a realignment of Gnangara Road such that the southern section of West Swan Road becomes the minor road and must give way for eastbound traffic on Gnangara Road. This realignment is due to the future function of West Swan Road (south of Gnangara Road) as a local road rather than a strategic link, as well as the relatively large northbound traffic volumes on GNH from Gnangara Road. If such a re-alignment is not undertaken prior to the assessed 2031 scenarios, the recommended intersection layout remains valid.

9.2.8 Midvale

9.2.8.1 Intersection of Morrison Road and Farrall Road

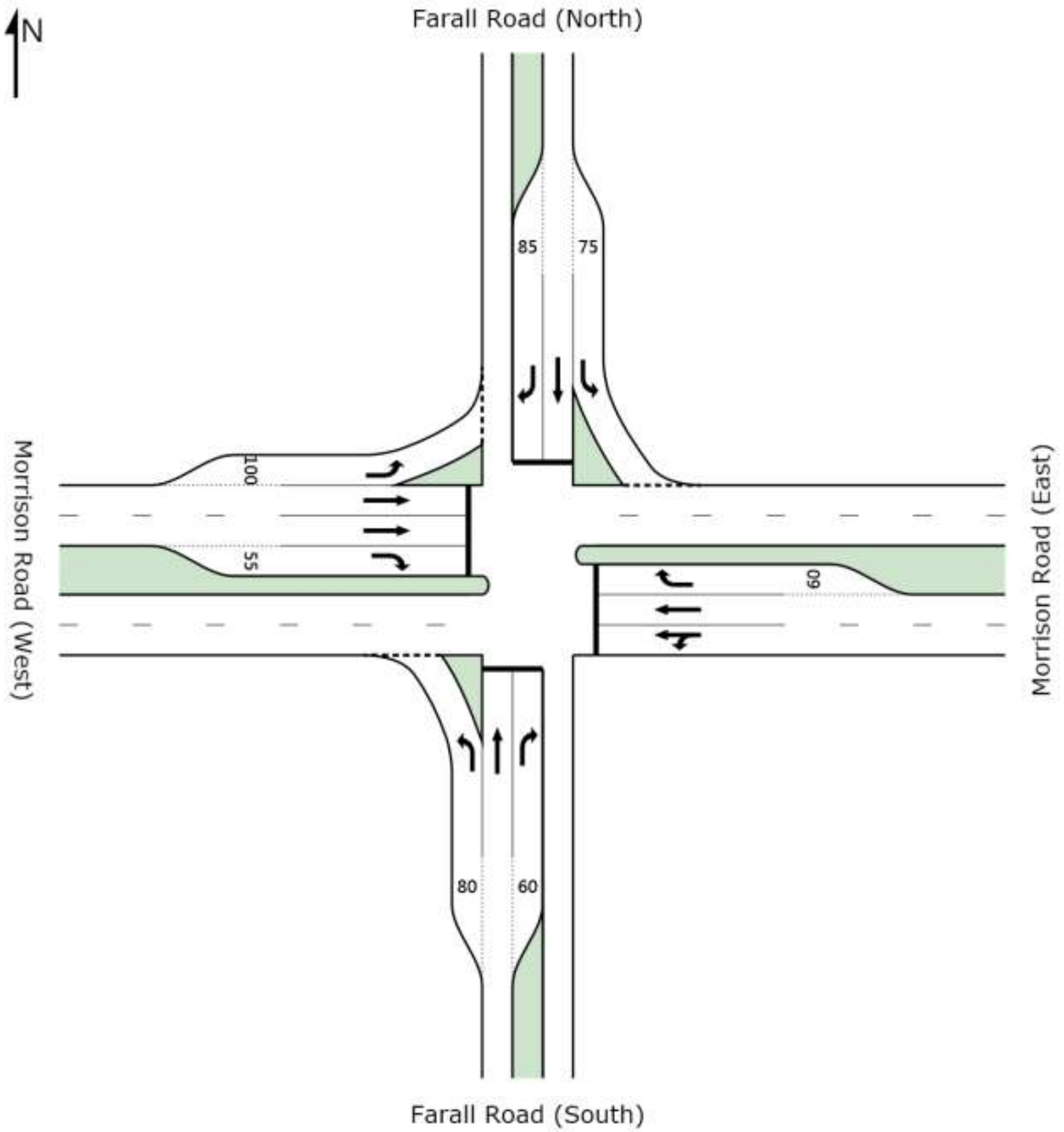
As shown in **Figure 9-21**, the intersection of Morrison Road and Farrall Road is currently a signalised intersection. Morrison Road is modelled as having 2 lanes in each direction in the 2031 ROM network, while Farrall Road is modelled as having a single lane in each direction.

Figure 9-21 Existing Intersection Layout of Morrison Road and Farrall Road

Using the existing geometry of this intersection with the modelled 2031 AM peak hour volumes, this intersection is expected to fail, with average delays for all right turns extending past 2 minutes.

An intersection arrangement that was found to operate at a mostly acceptable LoS is shown in **Figure 9-22** and includes the introduction of left-turn slip lanes on the northern, western and southern approaches. No consideration was given to the introduction of a left-turn slip lane for the eastern approach, as this would require significant land acquisition through existing residential dwellings.

Figure 9-22 Proposed Intersection of Morrison Road and Farrall Road



From the SIDRA movement summaries, as shown in **Appendix D** (**Table D-21** and **Table D-22**), the average delay for this intersection is 16 seconds and 10 seconds for the 2031 AM peak hour and 2031 PM peak hour scenarios respectively, with the overall LoS of this intersection being B for both scenarios.

9.2.9 Middle Swan

9.2.9.1 Intersection of Great Northern Highway and Bishop Road

Anecdotal evidence from City of Swan officers suggests that due to the existing large volume of vehicles turning right from Bishop Road on to Great Northern Highway, queues extending past 800m have been experienced on several occasions during the PM peak hour. This impact may be addressed at a regional level, as a result of the planned upgrades to Roe Highway.

Mitigation would be achieved through the provision of a signalised intersection at this location. The capacity of a possible roundabout treatment would be undermined by traffic platoons from Reid Highway and Great Northern Highway. A signalised intersection treatment would be configured to permit a coordinated green wave using SCATS signal control techniques. This would provide the best outcome for traffic progression for the nearby highways while also providing capacity for traffic exiting Bishop Road northbound. The future interchange configuration at Reid Highway/Great Northern Highway would also require a coordinated signal approach that incorporates Bishop Road, and it is likely the signal cycle time could be reduced, which would further reduce queues

The theoretical design of this intersection is contingent on a wide range of inputs and is considered beyond the scope of this investigation. However, it is clear that between the growth in traffic along Great Northern Highway and the impacts of the Reid Highway / Great northern Highway interchange, the situation at this intersection is likely to worsen.

9.2.10 Midland

9.2.10.1 Impact of Midland Health Campus and Railway Workshops Precinct

A study for the Midland Health Campus (MHC) and Railway Workshops Precinct has previously been undertaken. Peak hour analysis of the study area road network has identified that with the forecast traffic increases, all traffic signal intersections in the study area will require attention. The timing of any upgrades will depend on district traffic growth, but it is expected that full development of the Workshops Precinct and MHC will require works to the following:

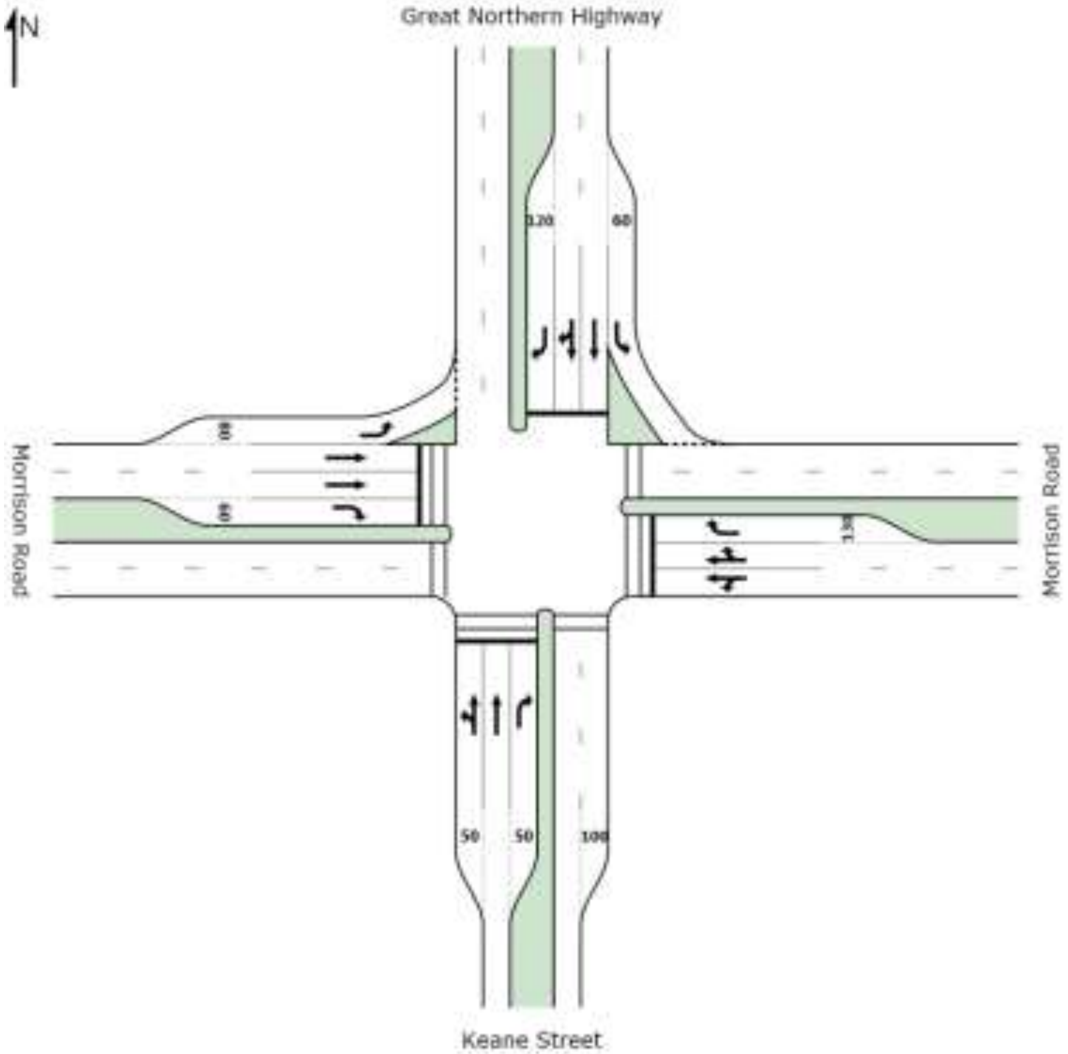
- Construction of the Lloyd Street underpass (required prior to MHC opening)
- Clayton Street / Lloyd Street
- Great Eastern Highway / Lloyd Street
- Centennial Place link to Lloyd Street (south of Police precinct).
- Saleyards Road Lloyd Street link to Clayton Street east.
- Roundabout on Lloyd Street at Centennial Place / Saleyards Road.
- Cowie Close link from Clayton Street to MHC parking

9.2.10.2 Morrison Road / Keane Street / Great Northern Highway

Changes to this intersection have been reduced as a result of relocating direct access to the Midland Oval Car Park to Morrison Road. This splits the traffic between two parallel streets and reduces the anticipated demand to a sustainable level. As a result, Keane Street can be retained as a two-lane boulevard with an intersection form as shown in **Figure 9-23**. This requires the following:

- Installation of left-turning pockets and slip lanes at all approaches;
- Extension of the Morrison Road east right-turning pocket and modification of through lane to a combined through/right-turn lane;
- Extension of the Great Northern Highway right-turning pocket;
- Provision of protected pedestrian facilities across the west, south and east approaches; and
- Modification of signal phasing including pedestrian phasing.

Figure 9-23 Proposed Intersection of Morrison Road and Keane Street



Appendix D (**Table D-23** and **Table D-24**) show the results of SIDRA analysis for the existing intersection geometry under the 2031 background plus full development scenario, for the AM and PM Peak respectively.

The results of assessment for this revised geometry show that the intersection will operate acceptably during the weekday peak periods. Queue lengths along Keane Street are maintained at a sustainable level that should minimise impact on nearby access locations and the heavy right turn from Morrison Road east towards Great Northern Highway is accommodated by modifying both the signal phasing and turning geometry.

9.3 Henley Brook Avenue Intersections

As included in the 2031 ROM network, Henley Brook Avenue will serve as a strategic north-south Integrator A type road with 2 lanes in each direction between Reid Highway and The Promenade (Ellenbrook). With the introduction of Henley Brook Avenue, the majority of traffic associated with the residential developments within the Urban Growth Corridor is expected to utilise this road instead of West Swan Road. By 2031, the traffic on West Swan Road is therefore assumed to decrease to below existing levels and will predominantly consist of local traffic.

This section of the report will focus on the expected performance of the major intersections along Henley Brook Avenue, with an emphasis on the types of intersections considered appropriate. It is noted that Henley Brook Avenue is designated as a “blue road” in the Metropolitan Region Scheme (MRS) and the jurisdiction of this road will therefore fall under the City of Swan.

9.3.1 Intersection of Henley Brook Avenue and Harrow Street

In the Dayton Local Structure Plan 4, it is assumed that Harrow Street will not extend to West Swan Road and a staggered-T, priority controlled intersection with staged right-turns over a 6m wide median was for this intersection.

However, as the 2031 ROM network assumes that Harrow Street will extend to West Swan Road, this is the scenario that has been analysed as part of this assessment. In line with the recommendation in the Dayton Local Structure Plan 4, an assessment has been carried out to determine the expected performance of a 4-way priority controlled intersection with staged right turns over a 6m wide median.

While it was found that a staggered-T intersection of this form would perform satisfactory during both the AM and PM peak hours, the staged right turns combined with the through traffic along Harrow Street present a number of conflict points and it is therefore not recommended that this option is considered for this intersection for safety reasons.

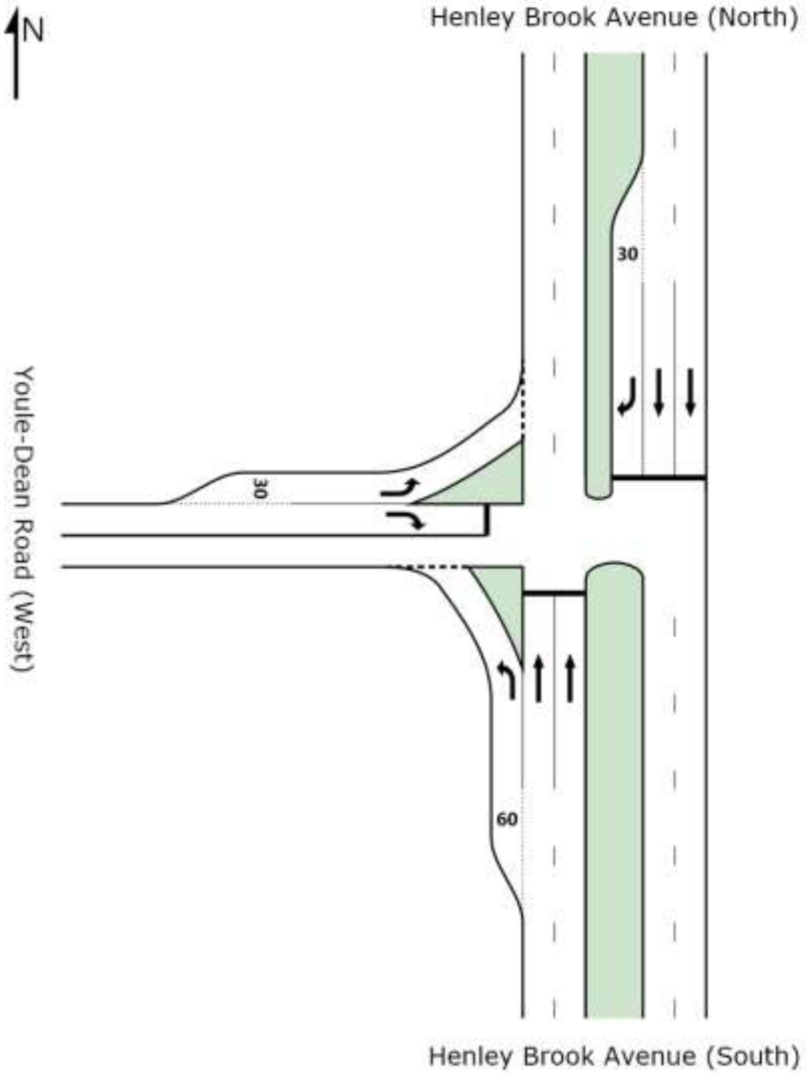
To address these issues, a signalised intersection has been agreed by the City. This treatment will necessarily introduce some level of additional delay for north and southbound traffic flows along Henley Brook Avenue, thereby reducing the attractiveness of this route for regional traffic movements. It is considered that this disadvantage is more than offset by the improved safety and operational control afforded by a signalised treatment.

9.3.2 Intersection of Henley Brook Avenue and Youle-Dean Road

In both the Albion District Structure Plan and the Henley Brook Road Reservation Review, it is stated that in the ultimate development scenario this intersection is to take form as a signalised intersection. This intersection was therefore analysed as a signalised intersection determine a suitable geometry for the intersection.

An intersection arrangement that was found to operate at an acceptable LoS is shown in **Figure 9-24** and includes left-turn turn bays for the southern and western approaches, as well as a 30m right-turn bay for the northern approach.

Figure 9-24 Proposed Intersection Geometry of Henley Brook Avenue and Youle-Dean Road



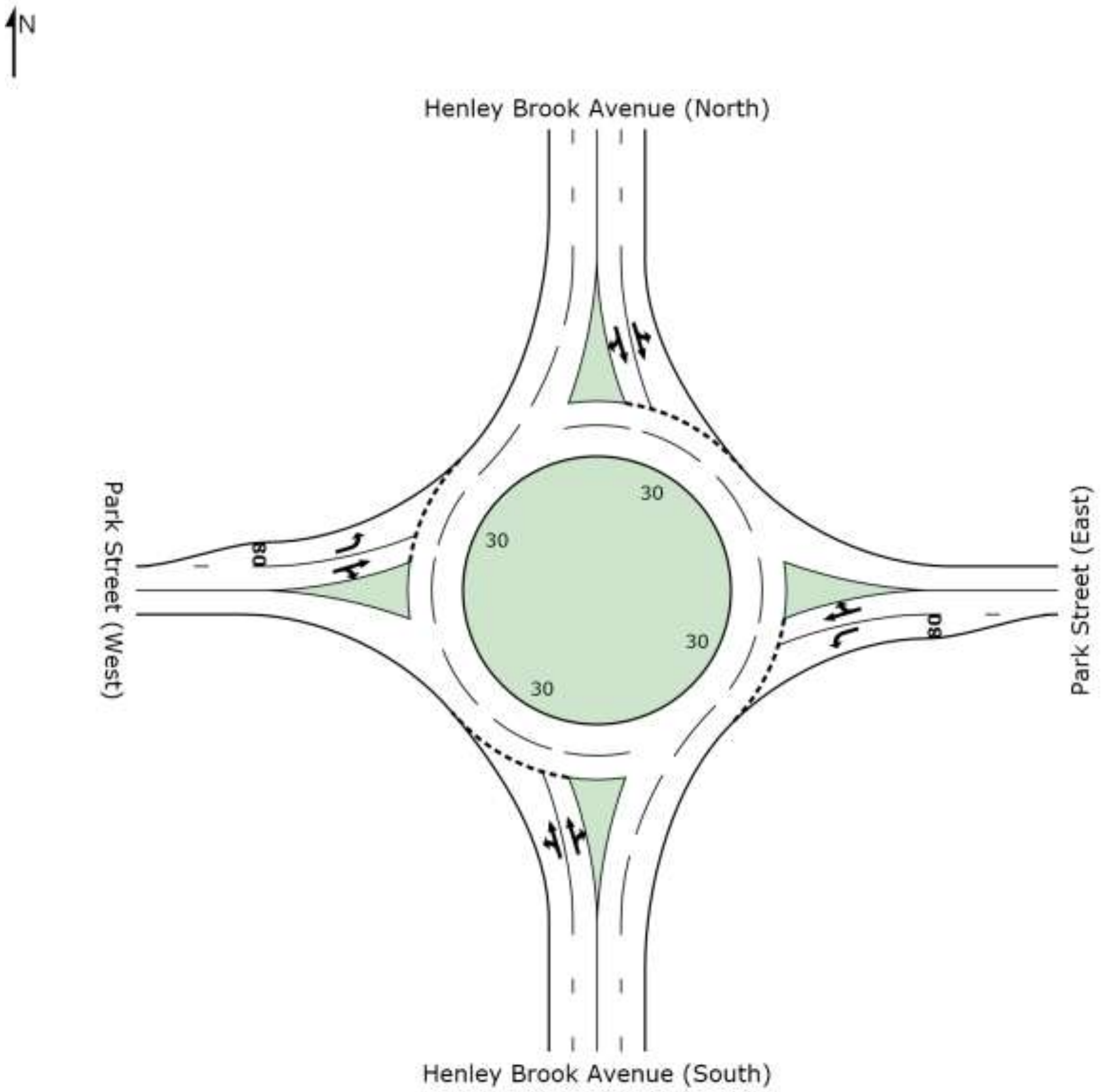
From the SIDRA movement summaries, as shown in **Appendix D** (**Table D-25** and **Table D-26**), the average delay for this intersection is 12 seconds and 11 seconds for the 2031 AM peak hour and 2031 PM peak hour scenarios respectively, with the overall LoS of this intersection being B for both scenarios.

9.3.3 Intersection of Henley Brook Avenue and Park Street

In the Park Street LSP3A Transport Assessment it is stated that in the ultimate development scenario, this intersection is to take form as a 4-way priority intersection. However, as the traffic modelling used as an input to the analysis is considered out-dated as it was based on an assumption of 13,000 vehicles per day (vpd) on Henley Brook Avenue (as compared to 20,000 vpd in the 2031 ROM), this intersection type is not expected to perform at an acceptable Level of Service with the updated modelled traffic volumes. While a 4-way controlled priority intersection with staged right turns most likely would perform satisfactory during the 2031 AM and PM peak hour volumes, the staged right turns combined with the through traffic along Park Street present a number of conflict points and it is therefore not recommended that this option is considered for this intersection for safety reasons.

An intersection arrangement that was found to operate at an acceptable LoS is shown in **Figure 9-25** and includes conversion of the intersection to a roundabout form in alignment with the Henley Brook Avenue Reservation Review.

Figure 9-25 Proposed Roundabout Intersection Layout for Henley Brook Avenue and Park Street



From the SIDRA movement summaries, as shown in **Appendix D** (**Table D-27** and **Table D-28**), the average delay for this intersection is 8 seconds for both the 2031 AM peak hour and 2031 PM peak hour scenarios, with the overall LoS of this intersection being A for both scenarios.

9.3.4 Intersection of Henley Brook Avenue and Gnangara Road

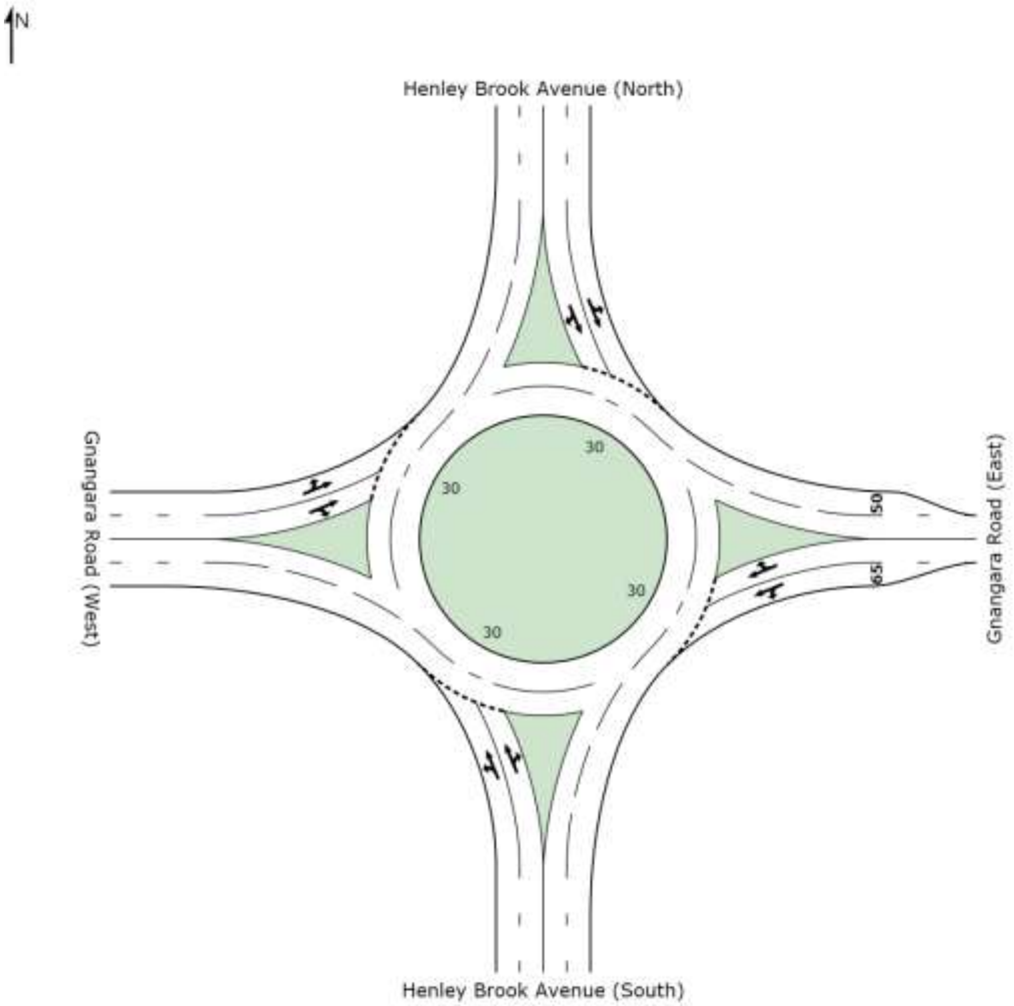
As shown in **Figure 9-26**, the intersection of Henley Brook Avenue and Gnangara Road currently exists as a roundabout with a single circulation lane and single approach and departure lanes for all approaches.

Figure 9-26 Existing Intersection Layout of Henley Brook Avenue and Gnangara Road

As the development intensification within the Urban Growth Corridor increases, both Henley Brook Avenue and Gnangara Road (west of Gnangara Road) are expected to be upgraded to 2 lanes in each direction, in accordance with the 2031 ROM network.

As these changes to both Gnangara Road and Henley Brook Avenue will necessitate an upgrade of the roundabout to include dual circulating lanes, this is the intersection type analysed as part of this assessment (as shown in **Figure 9-27** below). It is noted that this is also the intersection form assumed as part of the Henley Brook Road Reservation Review.

Figure 9-27 Proposed Intersection Layout of Gnangara Road and Henley Brook Avenue



From the SIDRA movement summaries, as shown in **Appendix D** (**Table D-29** and **Table D-30**), the average delay for this intersection is 8 for both the 2031 AM peak hour and 2031 PM peak hour scenarios, with the overall LoS of this intersection being A for both scenarios.

9.3.5 Intersection of Henley Brook Avenue and The Promenade

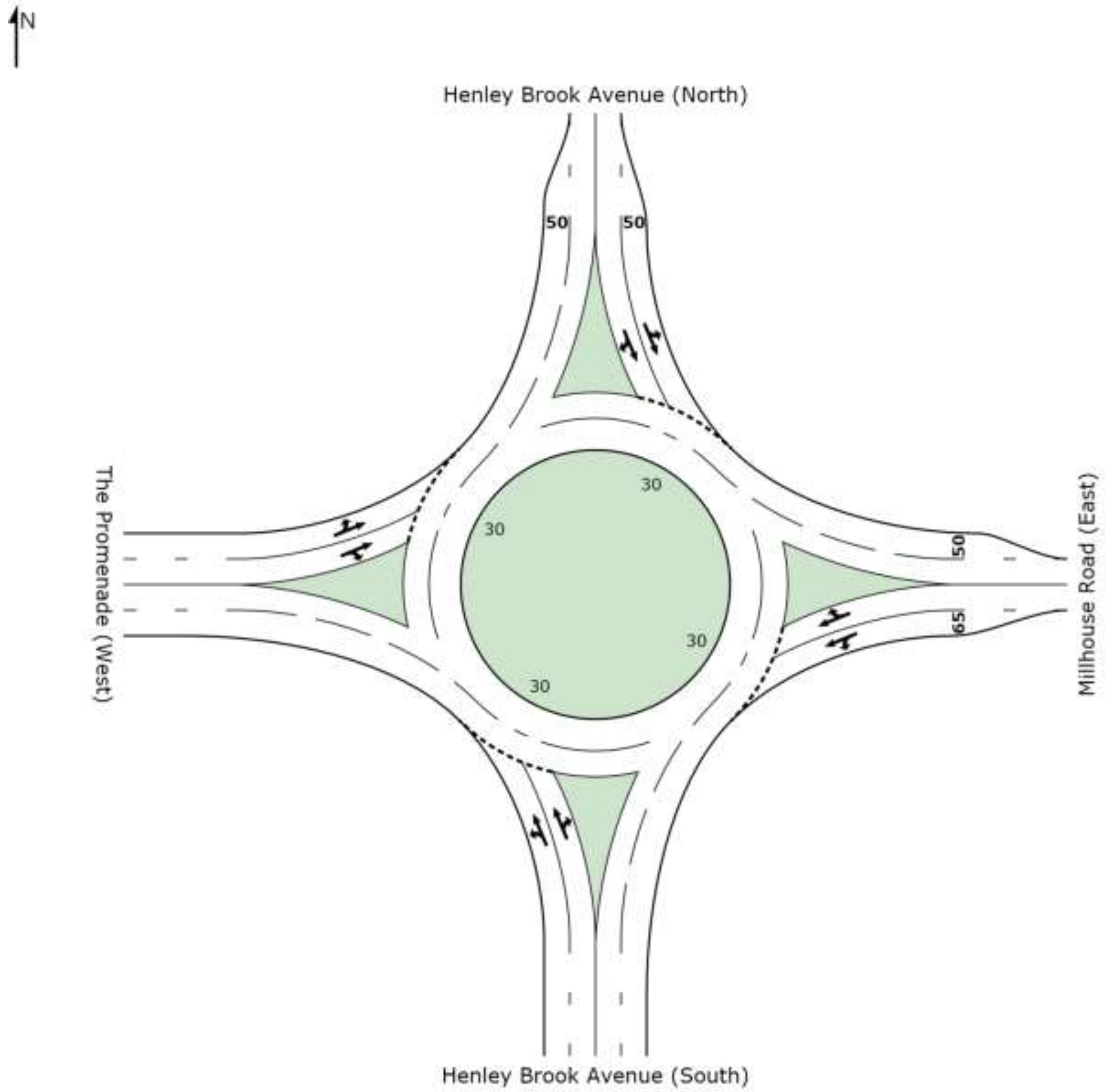
As shown in **Figure 9-28**, the intersection of Henley Brook Avenue and The Promenade currently exists as a roundabout with a single circulation lane and single approach and departure lanes for all approaches.

Figure 9-28 Existing Intersection Layout of Henley Brook Avenue and The Promenade

As the development intensification within the Urban Growth Corridor increases, it is expected that Henley Brook Avenue (south of The Promenade) and The Promenade (west of Henley Brook Avenue) will be upgraded to 2 lanes in each direction.

As these changes to both The Promenade and Henley Brook Avenue will necessitate an upgrade of the roundabout to include dual circulating lanes, this is the intersection type analysed as part of this assessment (as shown in **Figure 9-29** below). It is noted that this is also the intersection form assumed as part of the Henley Brook Road Reservation Review.

Figure 9-29 Proposed Intersection Layout of The Promenade and Henley Brook Avenue



From the SIDRA movement summaries, as shown in **Appendix D** (**Table D-31** and **Table D-32**), the average delay for this intersection is 8 seconds for both the 2031 AM peak hour and 2031 PM peak hour scenarios, with the overall LoS of this intersection being A for both scenarios.

10 Road Capacity Assessment

10.1 Modelled Road Duplication

Cardno has undertaken a review of the 2031 ROM to determine the assumptions regarding road form and capacity through to a 2031 horizon. This has been compared to the existing network and assessed in the context of 2031 projected traffic demands.

The results of this review are as follows:

Table 10-1 Main Roads WA 2031 ROM - Modelled Road Duplication

Modelled Road	Extents	Existing Form	Modelled Form
Kalamunda Road	South-East of: Great Eastern Highway Bypass	2 Lanes	4 Lanes
Great Northern Highway	Between: Morrison Road and Reid Highway	2 Lanes	4 Lanes
West Swan Road	North of: Reid Highway	2 Lanes	4 Lanes
Lord Street	Between: Morley Drive and Grimrey Road	2 Lanes	4 Lanes
Lord Street	Between: Reid Highway and Gnangara Road	2 Lanes	4 Lanes
Pinaster Parade	Between: Gnangara Road and Forestview Boulevard	2 Lanes	4 Lanes
Henley Brook Avenue	Between: The Promenade and Reid Highway	2 Lanes	4 Lanes
Youle-Dean Road	Between: Lord Street and Woollcott Avenue	2 Lanes	4 Lanes
West Swan Road	Between: Coast Road and Youle-Dean Road	2 Lanes	4 Lanes
Marshall Road	Between: Beechboro Road North and Lord Street	2 Lanes	4 Lanes
Reid Highway	Between: Tonkin Highway and West Swan Road	2 Lanes	4 Lanes
Gnangara Road	Between: Henley Brook Avenue and Alexander Drive	2 Lanes	4 Lanes

Modelled Road	Extents	Existing Form	Modelled Form
Hepburn Avenue	Between: Marshall Road and Alexander Drive	2 Lanes	4 Lanes
Tonkin Highway	Between: Benara Road and Park Street.	4 Lanes	6 Lanes
Roe Highway	Between: Great Northern Highway and Clayton Street	4 Lanes	6 Lanes
Roe Highway	Between: Bushmead Road and Helena Valley Road	4 Lanes	6 Lanes
Great Eastern Highway	Between: Morrison Road and Lloyd Street	4 Lanes	6 Lanes

The Degree of Saturation for each link in the ROM has been interrogated to identify intersection and mid-block capacity constraints. The results of this assessment are described below.

10.2 Altone Road

Altone Road is modelled in the 2031 ROM network as having a single lane in each direction and a theoretical capacity of 1200 vehicles/lane/hour.

For its entire length, Altone Road is modelled as experiencing a DoS of 0.82 – 1.25 during the AM peak hour period, thereby indicating that this road is operating above its designed capacity.

It is important to note that the 2031 ROM network includes a link between Altone Road and Iolanthe Street that is most likely of an erroneous nature. This inclusion is likely to over-estimate the traffic demand on Altone Road to an unknown extent as it provides vehicles with a convenient theoretical north-south corridor with direct access to Collier Road and by extension Guildford Road.

It is also important to note that Altone Road, between Benara Road and Reid Highway, currently has 2 lanes in each direction but in the 2031 ROM network has been modelled with only 1 lane in each direction, thereby decreasing the capacity of this segment of Altone Road by 50%.

In light of the issues identified above in the 2031 ROM network, it is recommended that these issues are rectified in the ROM network and that the modelling is re-undertaken for Altone Road in order to properly evaluate the performance of Altone Road during the 2031 AM and PM peak hour periods.

10.3 Marshall Road

East of Beechboro Road North, Marshall Road is modelled in the 2031 ROM network as having a single lane in each direction and a theoretical capacity of approximately 1200 vehicles/lane/hour. Between Beechboro Road North and Lord Street, Marshall Road is modelled as experiencing a DoS of 0.89 – 1.30 during the AM peak hour period and 0.78 – 1.06 during the PM peak hour period, thereby indicating that this section of Marshall Road will be operating above its designed capacity.

Options to upgrade Marshall Road include the introduction of a central median to provide a physical barrier between the two traffic lanes, as well as right turn pockets and left turn slip lanes, or alternatively a widening of the road to introduce an additional traffic lane in each direction.

In line with the latter recommendation above, Marshall Road in the updated 2031 ROM network (Option 4A), has been modelled as having 2 lanes in each direction while also forecast to carry slightly less traffic as a result of the PDNH alignment. It is assumed that this upgrade of Marshall has been modelled in the ROM 2031 network as it is intended to construct this upgrade prior to 2031.

As no AM or PM peak hour models exist for the updated 2031 ROM network (Option 4A), it has not possible to determine the performance of Marshall Road during the AM or PM peak hours. However, the capacity of Marshall Road increases significantly as a result of the upgrade and, as traffic along Marshall Road has been forecast to decrease slightly, it is not anticipated that Marshall Road is likely to encounter any capacity issues during the 2031 AM and PM peak hours.

10.4 West Swan Road

10.4.1 West Swan Road – South of Reid Highway

The section of West Swan Road between Reid Highway and Great Eastern Highway primarily serves as a strategic north-south connection between these roads and is forecast to carry between 20,000 - 22,000 vpd in the 2031 ROM network, with a Degree of Saturation (DoS) between 0.81 – 1.25, thereby indicating that this section of West Swan Road will be operating above its designed capacity.

10.4.2 West Swan Road – North of Reid Highway

With the introduction of Henley Brook Avenue, which is anticipated to carry the majority of north-south regional traffic to/from Ellenbrook and the residential developments within the Urban Growth Corridor, the section of West Swan Road that is north of Reid Highway is expected to be restricted to primarily local and tourist traffic only.

With the introduction of Henley Brook Avenue in the updated 2031 ROM network (Option 4A), it is forecast that traffic along West Swan Road will decrease by 40 - 60% (as compared to the original forecast traffic volumes). The decrease in traffic along West Swan Road is anticipated result in acceptable DoS for this section of West Swan Road during the 2031 AM and PM peak hours.

10.4.3 Arthur Street Bridge

Arthur Street is located between Harrow Street and West Swan Road and is, in its current form, severed by Reid Highway. The Metropolitan Region Scheme currently includes an allowance to provide a bridge over Reid Highway to connect the southern and northern section of Arthur Street, thereby providing a more direct connection between West Swan and Caversham. Such a connection is likely to further increase the forecast traffic volumes the southern section of West Swan Road but is also likely to decrease the forecast traffic volumes along the adjacent sections of Lord Street, Henley Brook Avenue and Reid Highway. However, further investigation may be required to determine the extent of the impact by the proposed Arthur Street Bridge. It should be noted that such a bridge would also enable more efficient public transport access to the activity corridor proposed for the Urban Growth Corridor, as well as a safer and more direct route to the proposed primary school included in the Caversham Local Structure Plan.

10.5 Hepburn Avenue

Hepburn Avenue, between the proposed Tonkin Highway extension and Alexander Drive, is modelled as having 2 lanes in each direction in the 2031 ROM network and a capacity of 1200 vehicles/lane/hour.

Between the proposed Tonkin Highway extension and Alexander Drive, Hepburn Avenue is modelled as experiencing a DoS of 0.97 – 1.20, thereby indicating that it is operating above its designed capacity.

As a result of the PDNH realignment in the updated 2031 ROM network (Option 4A), traffic along Hepburn Avenue is forecast to decrease from approximately 54,000vpd to 44,000vpd. However, it is important to note that Bellefin Drive is currently not connected to Hepburn Avenue in any of the ROM networks. From anecdotal evidence provided by the City of Swan planning officers, it is understood that significant amount of local traffic use Bellefin Drive to access Hepburn Avenue. As Bellefin Drive has recently been upgraded to a District Distributor B, it is recommended that this issue is rectified in the 2031 ROM network and that the modelling is re-run in order to properly evaluate the forecast traffic volumes along Hepburn Avenue prior to recommendations of potential treatment options are made.

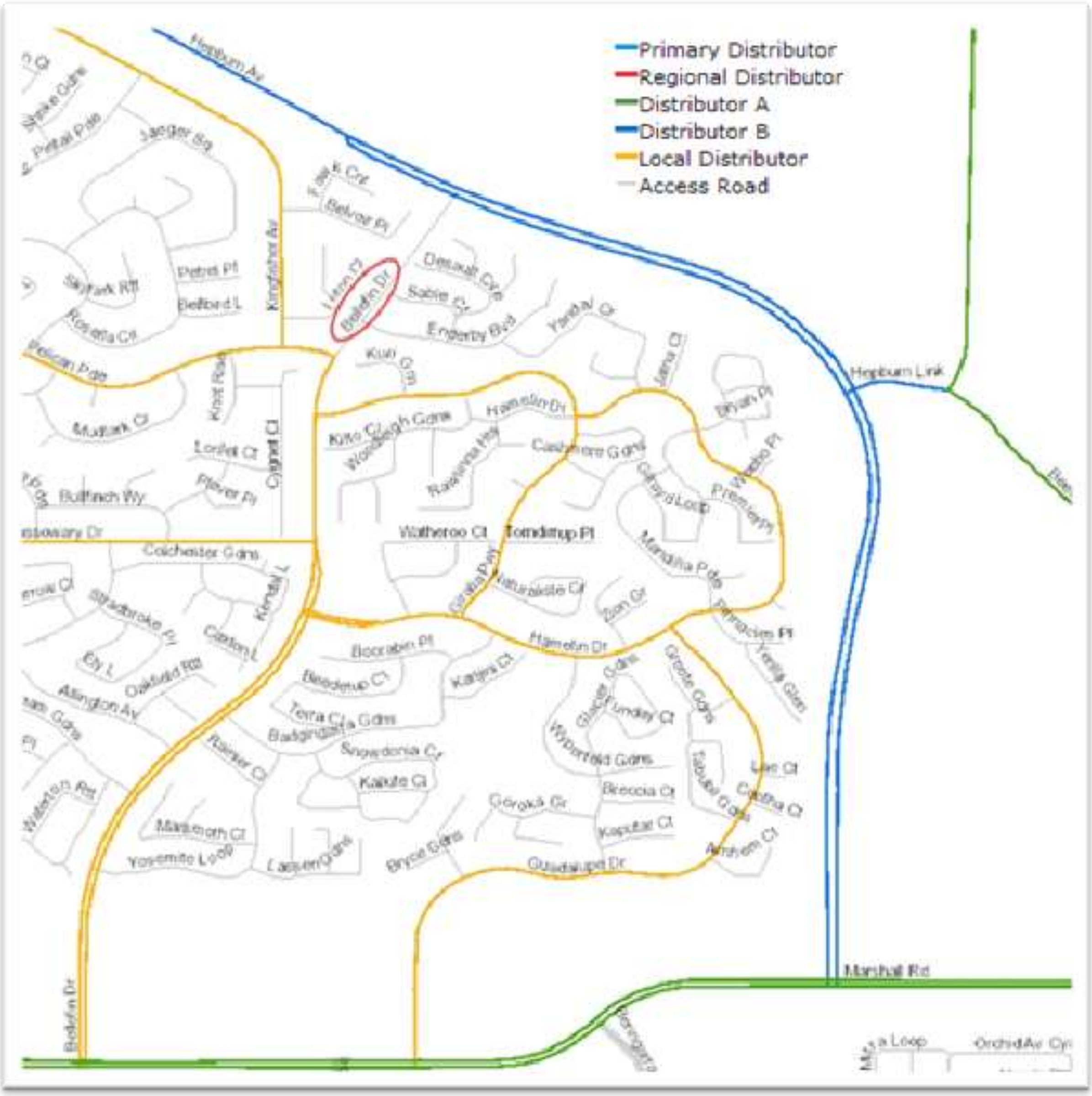
10.6 Bellefin Drive

Prior to July 2013, the section of Bellefin Drive between Marshall Road and Pelican Parade was classified as a Local Distributor under the Main Roads Functional Hierarchy, while the section of Bellefin Drive between Pelican Parade to Hepburn Avenue was classified as an Access Road as shown in **Figure 10-1**. As the function of Bellefin Drive is to distribute traffic from local roads onto higher order roads (i.e. Distributor A and B roads), it was recommended that the northern part of Bellefin Drive is upgraded to a Local Distributor or District Distributor B in order to more accurately describe the function of this road. It was noted that both sections of Bellefin Drive are almost identical in terms of their functional and physical characteristics, thereby providing further evidence that the northern part of Bellefin Drive should be upgraded to a Local Distributor.

At time of writing, Bellefin Drive has been reclassified as a District Distributor B.

It is recommended that the connection between Bellefin Drive and Hepburn Avenue is made in the 2031 ROM network in order to assess the anticipated future performance of this intersection and make recommendations as to whether any intersection treatment is required at this intersection, as well as the intersection of intersection of Bellefin Drive and Marshall Road.

Figure 10-1 Bellefin Drive MRWA Functional Hierarchy Classification



10.7 Gnangara Road Duplication

Construction of the Gnangara Road duplication between Alexander Drive and Pinaster Parade is currently scheduled to take place prior to the end of the 2014/15 financial year.

Gnangara Road currently serves as an important east-west link between Joondalup and Ellenbrook, with traffic volumes on Gnangara Road already exceeding 25,000 vpd. Gnangara Road also has a poor safety record with nearly 300 crashes, including 1 fatality and 17 hospitalisations over past 5 year. A duplication of Gnangara Road is expected to improve safety for all road users along Gnangara Road, as well as improve congestion and decrease the travel times associated with this road. The 2031 ROM estimates that west of Drumpelier Drive approximately 30,000 vpd will use Gnangara Road after its duplication in 2031 and approximately 7,500 vpd east of Drumpelier Drive. Based on these forecast traffic volumes it is not deemed viable to duplicate Gnangara Road to the east of Pinaster Parade.

It is noted that the MRS allows for a realignment of Gnangara Road such that the southern section of West Swan Road becomes the minor road and must give way for eastbound traffic on Gnangara Road. This realignment is due to the future function of West Swan Road (south of Gnangara Road) as a local road rather than a strategic link, as well as the relatively large northbound traffic volumes on GNH from Gnangara Road.

As Gnangara Road is proposed to include a diamond interchange with the Perth Darwin National Highway, as well as a half-diamond interchange as part of the future East Wanneroo Road, the duplication of Gnangara Road is vital to provide sufficient access to these future strategic roads.

10.8 Lloyd Street

10.8.1 Lloyd Street Southern Extension

The construction of phase 1 of the Lloyd Street extension is currently scheduled to commence in early 2014 and will ultimately see Lloyd Street extended from Great Eastern Highway to the Great Eastern Highway Bypass. This connection will provide a grade separation for the railway line and is also expected to reduce congestion around the Midland Health Campus. The Lloyd Street extension will connect Lloyd Street to Abernethy Road at the Great Eastern Highway Bypass and will serve as the primary north-south road within the Hazelmere Enterprise Area as it is proposed to close the connection of Stirling Crescent to the Great Eastern Highway Bypass once the Lloyd Street extension has been completed (currently anticipated to take place in 2016). The Lloyd Street extension has been suggested to be a very important component to the success of the Hazelmere Enterprise Area.

As the Lloyd Street extension has not been included in any of the ROM networks provided, it has not been possible to estimate the magnitude of traffic demand for the Lloyd Street extension.

10.8.2 Lloyd Street Underpass

Grade separation of Lloyd Street at the rail crossing is considered essential for the function of both the corridor and the hospital. Conflicts between freight trains and vehicles will occur up until the freight rail is realigned. In addition, there are opportunities to extend the Midland Line further to the east, along this corridor. At-grade rail crossings are not supported in this instance, by either State or Local Government.

In particular, any delay to emergency services vehicles in accessing or egressing from the Midland Health Campus is considered unacceptable.

10.8.3 Lloyd Street Duplication and Connection

As a result of the volume of traffic ultimately destined for Lloyd Street, caused by the population increase in the Urban Growth Corridor, improved regional connections and access routes to the Midland Health Campus and beyond, duplication is planned for Lloyd Street north of Morrison Road to Bishop Road.

However, the increased use of this road will strengthen the existing desire line between this north-south link and Great Northern Highway, via Bishop Road.

10.8.4 Abernethy Road Duplication

Main Roads modelling for 2031 indicates that Abernethy Road will require an upgrade from its current two lane undivided configuration to a four lane divided carriageway. This is due to additional traffic demand that will be realised by the Lloyd Street Southern Extension described above, along with increased freight traffic servicing the primary freight hub at Kewdale. The duplication of Abernethy Road will be at the discretion of the Shire of Kalamunda in conjunction with Main Roads and other stakeholders but is likely to be expedited due to the development of industrial land supporting the freight industry.

The Hazelmere Enterprise Area Structure Plan highlights that a connection between Abernethy Road and Adelaide Street is possible, creating a four-way intersection. This improvement mitigates the effects of severing Stirling Crescent south of Great Eastern Highway Bypass.

10.9 Lord Street Extension (South of Reid Highway)

In accordance with the recommendations within the Caversham Local Structure Plan (LSP) Transport Assessment, an extension of Lord Street from Reid Highway to Benara Road is recommended to take place in 2 stages. The extension from Lord Street from Reid Highway is recommended to take place prior to the developments within the Caversham LSP reach a total of 1,660 demand units (where 1 residential dwelling is the equivalent to 1 demand unit and 1 hectare of developed non-residential land use is the equivalent of 22 demand units) and the extension from Lord Street to Benara Road is recommended to take place prior to the developments within the Caversham LSP reach a total of 2,100 demand units.

Prior to the construction of the PDNH, this extension is expected to carry up to 25,000vpd although this is likely to decrease once the PDNH is completed. While it is noted that the intersection of Lord Street and Reid Highway is currently being upgraded from a priority intersection to a signalised intersection, it is assumed in the 2031 ROM network that this intersection will be upgraded to a grade separated diamond interchange and that Lord Street will eventually be extended into Lord Street in Bassendean.

The extension of Lord Street is likely to significantly impact traffic flows in the Beechboro and Lockridge areas and may have additional effects on traffic operations in these areas.

10.9.1 Benara Road Duplication

According to ROM modelling for 2031 traffic volumes along Benara Road will reach 15,000 upon implementation of both the proposed Lord Street extension and the currently preferred alignment of the Perth Darwin National Highway. This is at the lower limit where consideration should be given to the improvement to a 4-lane divided road; however, it is also recognised that intersection treatment is important and can reduce the need to fully upgrade an entire section of road.

2031 traffic volumes west of Altone Road suggest that improvement to four lanes to Danube Avenue will be required; however, this is not related to the extension of Lord Street.

The cross-section of Benara Road will also depend on whether it is extended eastward to meet Morrison Road, providing a local road connection to Midland. If included, this link could see traffic volumes increase along Benara Road to the point where four-lanes would be unavoidable.

10.10 Morrison Road Duplication (west of Frederic Street)

Traffic along Morrison Road is expected to remain at existing volumes west of Great Northern Highway, while experiencing some additional growth to the east. This is a result of the proposed changes to the regional road network which will redirect a substantial proportion of external traffic north along Great Northern Highway and Lloyd Street. Regional traffic will largely be replaced with the additional local traffic anticipated to use Morrison Road to access car parking and facilities within Midland Activity Centre. The existing form of Morrison Road is therefore considered sufficient to accommodate future demands. Minor improvements, consisting of the installation of right and left-turning pockets on some major road connections, are advised to ensure local traffic is encouraged to use Morrison Road in preference to Great Eastern Highway.

10.11 Midland Road Duplication

Midland Road will ultimately become the primary access point for Precinct 9 of the Hazelmere Enterprise Area. The increased residential and industrial traffic associated with the build-out of the HEASP suggests that Midland Road will need to be duplicated at this time.

10.12 Perth Airport – Valentine Road Extension

The 2031 ROM network assumes a link from Valentine Road / Newton Road through Perth Airport to Kalamunda Road. This link is assumed to consist of 1 lane in each direction and forecast to carry approximately 3,300 vehicles per day.

Due to the non-strategic nature of this road and its proximity to a number of higher order strategic roads, it is not expected that this link will carry much regional traffic. Instead, it is more likely to be used by vehicles associated with the proposed airport industrial developments (as described in the *Perth Airport Master Plan* 2009) and a significant proportion of traffic on this road is therefore likely to consist of a of freight vehicles. The separation distance of Valentine Road from the proposed Kalamunda Road / Great Eastern Highway Bypass grade-separated interchange will need to be considered in the long term, given the potential effects of weaving movements by freight vehicles.

10.13 Roe Highway Road Network Study

10.13.1 Introduction

A number of road network options developed by MRWA for Roe Highway have been reviewed by Cardno for the purpose of identifying the preferred option from an operational perspective, while simultaneously providing adequate connectivity for regional and local traffic to and from Midland.

The road network options have not been included, as they are part of an ongoing study, but are characterised according to the access provided.

10.13.2 Characterisation of Access Options

The base (most common) form, of the associated options is described as follows:

1. Movements to/from the South only on Roe Highway at Clayton Street (Half-Diamond Interchange)
2. All movements at Great Eastern Highway (Hybrid Parclo / Diamond Interchange)
3. All movements at Morrison Road (Parclo Interchange)
4. All movements (Freeway-Freeway Interchange)
5. Fully separated at Toodyay Road. Access via Farrall Road.
6. All Movements at Great Northern Highway (Diamond Interchange)

Deviations from this base form are described as follows:

- Option A: Morrison Road - Movements to/from the North only on Roe Highway (Half Diamond Interchange). Access between Morrison and PDNH via Farrall Road
- Option B: Morrison Road - Fully Separated. Access between Morrison and PDNH via Farrall Road
- Option C: Morrison Road - Movements to/from the North only on Roe Highway (Half Diamond Interchange)
- Option D: No change from base
- Option D1: No access to Toodyay Road
- Option E: PDNH on Toodyay Road alignment (Diamond Interchange)
- Option F: Morrison Road - Fully Separated. Access between Morrison and PDNH via Farrall Road
- Option G: Modified Great Northern Highway / Lloyd Street alignment (Hybrid Parclo/Diamond interchange)

10.13.3 Discussion of Proposed Options

As identified in the Midland Activity Centre Structure Plan, Morrison Road is viewed as the preferred primary access to Midland for local traffic. This reduces volumes along Great Eastern Highway through the Midland City Centre and alleviates congestion for this corridor. **Options B and F** suggest that the access from Morrison Road to Roe Highway is to be removed and an underpass provided for Morrison Road instead. These options restrict access from the north and south and have the potential to compromise the intent of the Midland ACSP and are therefore not supported.

Based on ROM 2031 data, Roe Highway south of Great Eastern Highway Bypass is likely to be used by between 21% and 24% of all regional traffic to or from Midland. Given that **Options A and C** only provide interchange ramps only to the north of Morrison Road, restricting access to one of Midland's largest catchments, these options are likewise not supported.

Due to the closely spaced interchanges along Roe Highway, construction of Collector/Distributor (CD) roads that run parallel to Roe Highway between Great Eastern Highway and Lloyd Street are viewed as desirable in order to minimise merging and weaving conflicts. On this basis, **Option D1** is not supported as it does not provide these CD roads.

While **Option G** appears to provide an acceptable level of connectivity to Midland, it is not believed that the signalised interchange at Great Northern Highway and Roe Highway will be able to perform at an acceptable LoS. On this basis, Option G is not supported due to the impact on regional traffic.

While **Option D** does not provide connectivity between Toodyay Road and Roe Highway, this is not considered significantly detrimental to the overall access to Midland, as connectivity is still provided via Morrison Road and Great Northern Highway.

However, anecdotal evidence from City of Swan officers suggests that due to the existing large volume of vehicles turning right from Bishop Road on to Great Northern Highway, queues extending past 800m have been experienced on several occasions during the PM peak hour. There may therefore be some merit to the severance of access between Bishop Road and Great Northern Highway if this intersection cannot be improved through signalisation or other treatment. In this case, traffic would be likely to redirect along Toodyay Road to Great Northern Highway, or Morrison Road to either Great Northern Highway or Roe Highway.

It is understood that the short distance between Morrison Road and the proposed free-flow interchange between Roe Highway and Perth-Adelaide Highway represents a significant issue for weaving traffic.

Option E removes the free-flow interchange between Roe Highway and the future Perth-Adelaide Highway, creating a diamond interchange at Toodyay Road, but is otherwise similar to Option D. As stated previously, this Toodyay Road connection is not considered vital to the function of the Midland City Centre or its immediate residential catchment. However, the additional road length to allow weaving movements is considered to be of significant benefit, while simultaneously retaining access to Morrison Road and into the Midland City Centre.

Options D and **E** provide the best access into the Urban Grown Corridor and Midland, and are therefore the preferred options for upgrade of Roe Highway.

10.14 Farrall Road

Farrall Road is a key connection into Jane Brook and Stratton, providing a parallel route alongside Roe Highway between Toodyay Road and Great Eastern Highway. A number of the Roe Highway Upgrade options leverage Farrall Road to retain local connectivity and funnel traffic into the primary interchanges at Toodyay Road (Perth-Adelaide National Highway) and Great Eastern Highway.

As such, the form and function of Farrall Road will need to be considered in a consistent and coherent manner. A standard will therefore be required to ensure its continued function both as a local connection for residents, and its higher-order strategic purpose.

Two of the Roe Highway Upgrade options described above, D1 and F, consider the extension of Farrall Road to Clayton Street. This may be worthwhile in a more general context as it allows connectivity to the south of the river, and to the industrial precincts adjacent to Clayton Street (Bellevue and Hazelmere).

10.15 Neaves Road

Neaves Road currently provides connectivity between Bullsbrook and the northern suburbs of Swan and Joondalup. This connection is proposed to be improved as part of the NorthLinkWA project, with a grade separated interchange at the Perth-Darwin National Highway. The impact of this change will be to create a high-capacity link between the Mitchell Freeway and Perth-Darwin National Highway.

The Department of Planning has recognised that Neaves Road, while not currently functioning as strategic roads, will require future consideration for upgrade, as this road is likely to “function as important east-west links between the north-west and north-east sub-regions in the medium to long-term.”

Changes to Neaves Road may require duplication works and realignment of the eastern portion (east of Railway Parade) to provide better legibility to Great Northern Highway. While the pre-eminence of the PDNH may serve to reduce traffic along this section of Neaves Road in the longer term, the overall function and usage of the eastern portion of Neaves Road will be greatly affected by the decision and timing of any realignment.

11 Summary of Findings

The preceding assessment provides the existing context for the City of Swan and discusses the usage, efficiency and effectiveness of transport networks within the City. This review has been undertaken at the neighbourhood, district and regional level and includes consideration for transport modes within the City's boundaries and beyond to other municipalities.

The projections for land-use and transport growth are based on a range of documents, including the Main Roads Regional Operations Model (ROM), to identify the impact that projected urban and industrial growth will have on the existing transport network.

The strengths, deficiencies, overlaps and opportunities in the City's existing transport network have been identified for all primary transport modes, (including local and regional roads, freight, public transport, cycling and pedestrian networks).

Through this assessment, a range of transport issues have been identified, either explicitly stated in the review of background material or arising from a holistic review of all documentation. The resulting gaps in regional understanding or actual infrastructure necessitate the production of an Integrated Transport Strategy for the City of Swan to outline the requirements for future initiatives.

The following section forms the Transport Strategy and integrates a range of environmental, health, social, cultural, economic, urban design, built form and engineering initiatives.

Transport Strategy

12 Purpose of the Transport Strategy

Cardno has compiled a Transport Strategy outline which identifies components of the transport framework which will need to be addressed or considered to ensure continued operation of the City of Swan network. The primary focus of this Transport Strategy is:

> To identify constraints in current and planned road capacity, using the projections of the City (as captured in the most recent update of the Main Roads ROM), *Directions 2031 and Beyond* and the Central Sub-regional Strategy.
> To identify measures to upgrade and improve the regional and local road connections to facilitate safe and efficient vehicle movement, manage freight movements and to reduce congestion.
> To consider the implementation and management of 'Moving People' (TransPriority) principles to facilitate an efficient movement system.
> To identify measures to upgrade and improve public transport connections and facilities to reduce congestion.

Based on the outcomes of the assessment works, Cardno has prepared a set of robust and practical recommendations, including a priority list, to be further addressed in the compilation of the Transport Infrastructure Implementation Plan.

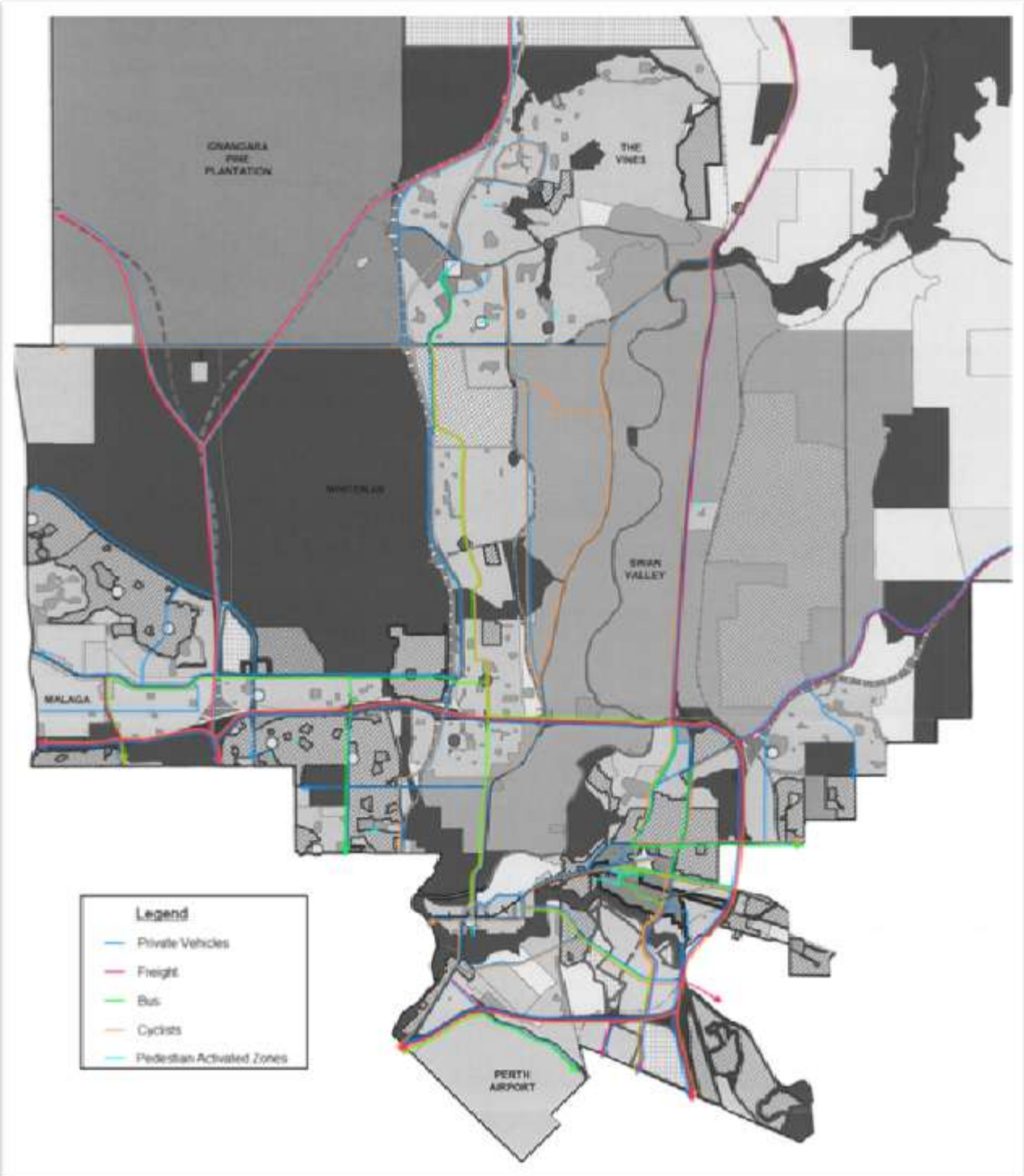
The competing needs of the various transport modes have been investigated through the 'Moving People' framework (TransPriority concept), with the hierarchy for each road informed by large-scale land-use planning, within a broad framework as follows:

> Road networks based on appropriate use and connectivity, connecting origins and destinations but not forming barriers to sustainable modes.
> Land-uses define the requirements for car parking quantum and location (short stay and on-street parking close to retail precincts, long-stay commuter parking on the periphery of the centres near to employment centres and along regional access routes).
> Public transport routes designed to fit within the regional context and support sustainable transport access to activity, particularly employment.
> Pedestrian facilities to knit the various complementary land uses together to create a single, effective mixed-use community. Of particular importance are the 'Activated Pedestrian Zones' and routes from car parking to primary activity locations. Quality and safety are vital to the effective operation of pedestrian spaces.
> Cycling facilities follow primary desirelines and provide fine-grained access to all areas of the Activity Centre. Cycling is unique in that it allows both macro- and micro- levels of access to land-uses. Through the 'Moving People' framework assessment, cycling facilities are allocated as on-street or off-street, minimising conflict and safety issues for cyclists, cars and pedestrians. (e.g. in Activated Pedestrian Zones, cyclists are encouraged to ride on-street).
> Road hierarchies are then defined by combining the above requirements with the existing and expected future background traffic demands, as well as the traffic volumes expected to be generated by the Activity Centre itself. By considering the Activity Centre holistically in this manner, a functional and effective transport environment can be built up.

13 Road Hierarchy

The proposed road hierarchy has a 20 year horizon and considers private vehicles, pedestrians, cyclists, public transport and freight. The proposed strategic road hierarchy is shown in **Figure 13-1** below and also in a larger format in **Appendix A**.

Figure 13-1 Proposed Future Strategic Road Hierarchy



14 Freight

As the combined freight volumes in Perth are expected to double over the period 2010 to 2030, it is considered imperative that the existing freight corridors and freight operations are protected from incompatible urban encroachment in order to for industrial development to grow within the Perth metro area.

Future road freight is primarily expected to follow the major highways within the City, with the most noticeable change being the construction of the Perth Darwin National Highway (PDNH). The PDNH will see a sizeable volume of freight vehicle use in preference to Great Northern Highway (GNH), although some freight vehicles are likely to remain on GNH as this is the only major regional north-south freight route that allows for “high and wide” freight vehicles (i.e. up to 10m high and 10m wide).

The provision of access for freight vehicles between the major industrial areas (Malaga and Hazelmere) and the regional road network is critical to the success of these areas. Access to the Hazelmere industrial area is primarily to be provided via the intersection at the Lloyd Street Southern Extension and the Great Eastern Highway Bypass (GEHB). It is recommended to discourage freight traffic northbound on the proposed Lloyd Street extension, through the Midland City Centre. This may be achieved via signage to alert drivers to use alternate accesses, as well as traffic calming devices to further discourage freight traffic using this access point.

Given the location of current interchanges, a potential engineered solution would involve a partial connection of Bushmead Road to Roe Highway in the north bound direction via Military Road. This may involve widening the Helena Bridge over Roe Highway to accommodate the merge taper.

Connection of Adelaide Street to Abernethy Road is supported due to the improved connection within the Hazelmere South precinct.

The following recommendations are made with respect to road freight and connections to industrial precincts

> Investigate freight connectivity to Malaga as part of PDNH construction
> Investigate connectivity between Roe Highway and Hazelmere to provide a legitimate alternative link
> Investigate Abernethy Road / Adelaide Street connection to improve internal legibility within the HEASP
> Undertake Local Area Traffic Management planning exercise for the precinct surrounding the HEA, particularly focused on restricting HV access to the HEA via West Parade, Lloyd Street north of Clayton Street and Kalamunda Road

14.1 Rail Freight

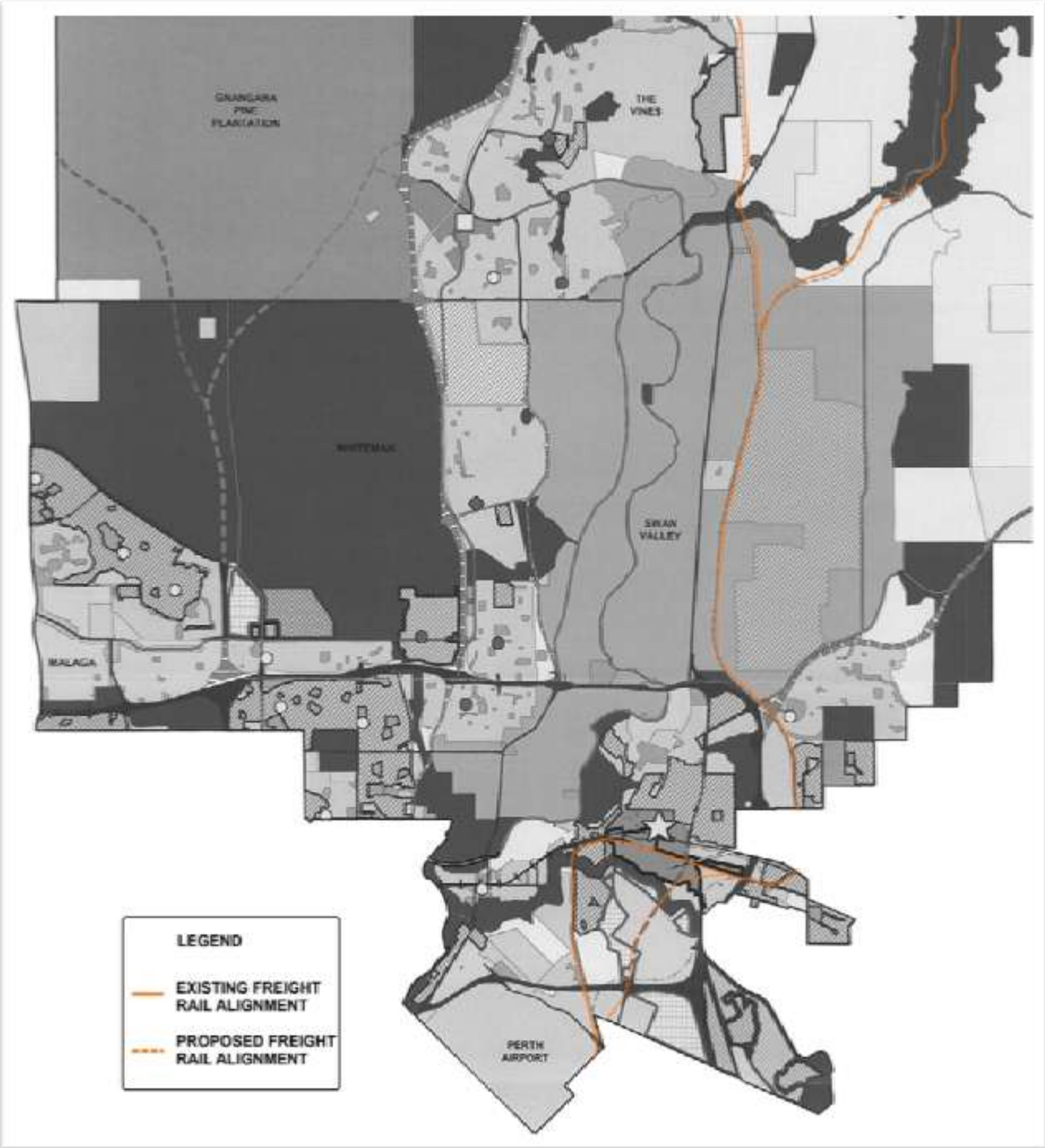
The rail freight corridor currently runs through the suburb of Woodbridge and along the southern boundary of Midland. As rail freight is expected to increase significantly over the next decade, it has been proposed to provide a new alignment of the freight rail, effectively allowing it to go through the Hazelmere industrial area and effectively bypass the suburbs of Woodbridge and Midland, as shown on **Figure 14-1** below.

Such an alignment would address a number of complaints raised by residents of Woodbridge relating to the noise and vibration associated with the rail line, as well as relocating the freight rail further from the Midland city centre and increasing the level of access to rail freight for the Hazelmere industrial area.

The proposed freight rail realignment is considered beneficial for the City and is recommended for further investigation. It is noted that the proposed realignment is subject to a full reassessment which may change aspects of the alignment.

> Continue to promote realignment of the Midland Freight Rail

Figure 14-1 Existing and Proposed Rail Freight Alignments



14.2 Rail Crossings

26 locations have been identified through previous assessments where grade separated crossings are required. In addition, all new rail crossings are expected to be constructed as grade separated crossings, in-line with State Government policies.

As train movements through the City are expected to double over the next 10 years, it is recommended a study be undertaken in the near future to identify and prioritise critical intersections. A rolling program of planned upgrades will be vital to ensure that the impacts of rail freight, and passenger rail movements, are minimised.

>	Conduct a study to prioritise grade separation of critical rail crossings

15 Cycling

It is recommended that the implementation and maintenance programmes proposed in the Swan CycleConnect Strategy are implemented in order to effectively improve the connectivity of the existing cycle network within the City. This will involve detailed planning, design and funding for the on-street and off-street routes proposed, including road widening. The cost of a full implementation of this Strategy is considered to be beyond the existing funding level provided by the City. Given the general lack of connectivity throughout the existing cycle network, and the great benefits that can be achieved for sustainability, health and safety as a result of cycle network improvements, an expansion of the existing funding is recommended to achieve the goals of the CycleConnect Strategy.

It is understood that the Swan CycleConnect Strategy is concerned primarily with the strategic connections between residential, employment and Activity Centre precincts throughout the City. It does not, however, provide guidance for finer-grained connectivity. Nor does it describe internal connections through areas such as the Urban Growth Corridor.

The Urban Growth Corridor structure planning documents include a range of bicycle paths which provide links within each area, and to future strategic pathways. With the realignment of the Perth-Darwin Highway, and the associated changes in road hierarchy, these proposed cycling links should be reviewed to ensure that they retain their strategic purpose in the absence of a strong PSP backbone. It is recommended that his form a core part of the future City of Swan Bike Plan.

In order to minimise gaps and maximise connectivity of the future bicycle network within the City, it is recommended that the different proposed networks be collated into a comprehensive City of Swan Bike Plan. Further, that existing residential, commercial and town centre environments should be reviewed with respect to the priorities described in the WABN Plan. This includes consideration for links between Activity Centres, schools and public transport nodes, in addition to safe connections through residential suburbs and to employment.

Where feasible, it is recommended that a minimum standard of on-street and off-street cycling infrastructure be set according to the hierarchy of the adjacent road network, to be influenced and justified with respect to its function as a pedestrian and cycling link.

As planning for the Midland PSP progresses, following the Midland Station relocation, promote further extension of this infrastructure towards Roe Highway and Bellevue. It is understood that planning for the PSP is already underway through to Lloyd Street.

> Introduce minimum infrastructure standards for cycling facilities into planning policies
> Create a detailed City of Swan Bike Plan which develops the concepts of the WABN, incorporating and revisiting all works already completed
> Undertake a review of the Urban Growth Corridor planning for cycling infrastructure, reflecting the changes to regional road linkages
> Implement the recommendations of the Swan CycleConnect Strategy, including extension of existing funding to achieve the network outcomes
> Support the extension of the Midland PSP to Roe Highway and Bellevue

16 Public Transport

Public transport will play a central role in the future transport system within the City of Swan. In particular, the Bus Rapid Transport (BRT) route between Bassendean and Ellenbrook will significantly improve convenience and connectivity. The proposed future road hierarchy includes a number of public transport priority links to increase the effectiveness of public transport provision and will assist in achieving the target of 18% bus mode share (currently 5%) for the Midland Activity Centre. It should be noted that the proposed public transport priority links do not necessarily require the provision of additional road space, The extent of works required to provide effective bus priority depends on a number of factors including the level of congestion and opportunities along the corridor (queue jump at signals etc.).

> Undertake an independent demand study to promote effective bus links

It should be noted that the BRT route is recommended to run through the activity corridor within the Urban Growth Corridor rather than along Lord Street in order to maximise the catchment for the service. This would, however, require the Arthur Street Bridge to be constructed in order to provide the necessary connectivity across Reid Highway.

The City of Swan has expressed a desire to support improved public transport access to existing and proposed urban development areas. It is noted that many of these areas are poorly served by public transport.

> Undertake a public transport connectivity assessment to ensure adequate access to public transport modes

16.1.1 Connection to Metro Area Express

The first phase of the proposed Metro Area Express (MAX) light rail will provide a link between the Perth CBD and the Polytechnic West institution in Balga, with a number of stations situated along Alexander Drive, Morley Drive and Mirrabooka Avenue. The full extent of the proposed MAX routes is shown in **Appendix B**.

As the lack of public transport to the Malaga industrial area has been identified as a deficiency by a number of Place Plans, an opportunity exists to provide additional bus services between Malaga and the MAX stations. This would particularly benefit young people without access to private vehicle that are undertaking training or apprenticeships in the Malaga industrial area.

While it is understood that an extension of the MAX into Ballajura is desirable in order to increase the provision of public transport to this area, the ultimate alignment of the MAX (post 2031) is likely to extend towards the north-west and a deviation to the east into Ballajura would therefore complicate the ultimate alignment of the MAX. It is therefore recommended that feeder bus services be provided between Ballajura and any future light rail station that may be constructed as a northern extension of the existing proposed terminal station at the Polytechnic West TAFE campus.

> Support connections between MAX and nearby residential / employment zones
> Undertake an independent demand study to promote effective bus transport links to MAX

16.1.2 Future Bus Network Expansion – Ellenbrook and Surrounds

The existing bus routes serve a variety of different purposes, from local distribution services to line-haul services. The following recommendations reference those existing services that would benefit from improvements to route or frequency.

The City of Swan has expressed ongoing support for the improvement of public transport access to Ellenbrook and its surrounds, recognising the limitations in the existing network. The growth of urban development in this area creates an increasing need for public transport infrastructure, to satisfy the economic and environment sustainability goals of the City.

Ellenbrook bus routes 334, 336 and 337 effectively provide local service within Ellenbrook. However, frequencies are low for each of these routes even during the peak. If Ellenbrook is expected to grow substantially, including significant densification and employment, formalisation of an internal loop service similar to the Subiaco Shuttle may be feasible as a replacement.

The 955/956 bus route provides critical public transport connection and could provide de-facto BRT service along its existing alignment. An alternative alignment connecting Ellenbrook to Midland would be beneficial when the Midland Activity Centre develops.

The Bullsbrook Townsite Land-Use Masterplan envisages a rapid transit route terminating at the Bullsbrook Town Centre. This rapid transit route would connect Ellenbrook to Bullsbrook and provide improved connectivity for residents in these developing areas. This link would also strengthen the need for public transport services between Ellenbrook and strategic land-use and transport destinations to the south, particularly the Midland City Centre.

> Support replacement of the 334, 335, 336 and 337 bus routes with an internal loop service as Ellenbrook redevelops
> Support increased 955/956 service frequencies as an interim BRT
> Support rapid transit between Ellenbrook and Bullsbrook either as a dedicated link or as an extension of Midland-Ellenbrook services.
> Investigate the viability of an alternative alignment from Ellenbrook via the Urban Growth Corridor to Midland, as it develops

16.1.3 Future Bus Network Expansion – Beechboro and Surrounds

The existing coverage services are considered largely sufficient to access high-capacity transport and strategic land-use destinations in the near-term, though frequency increases may be warranted as public transport usage improves. Improvements to the 955/956 bus route to create a de-facto BRT would benefit the community.

There is, however, no existing public transport service linking the residential suburb of Beechboro with the employment destination in Malaga. This means that despite their close proximity, employees and other visitors have little opportunity for non-car mode choice. An additional service or deviation of the 889 would provide a significant benefit by serving this desireline.

> Support frequency improvements for the 341, 342 and 343 bus routes as demand increases
> Support increased 955/956 service frequencies as an interim BRT
> Investigate the viability of connection between Beechboro and Malaga as a deviation of the 889 or additional service

16.1.4 Future Bus Network Expansion - Ballajura

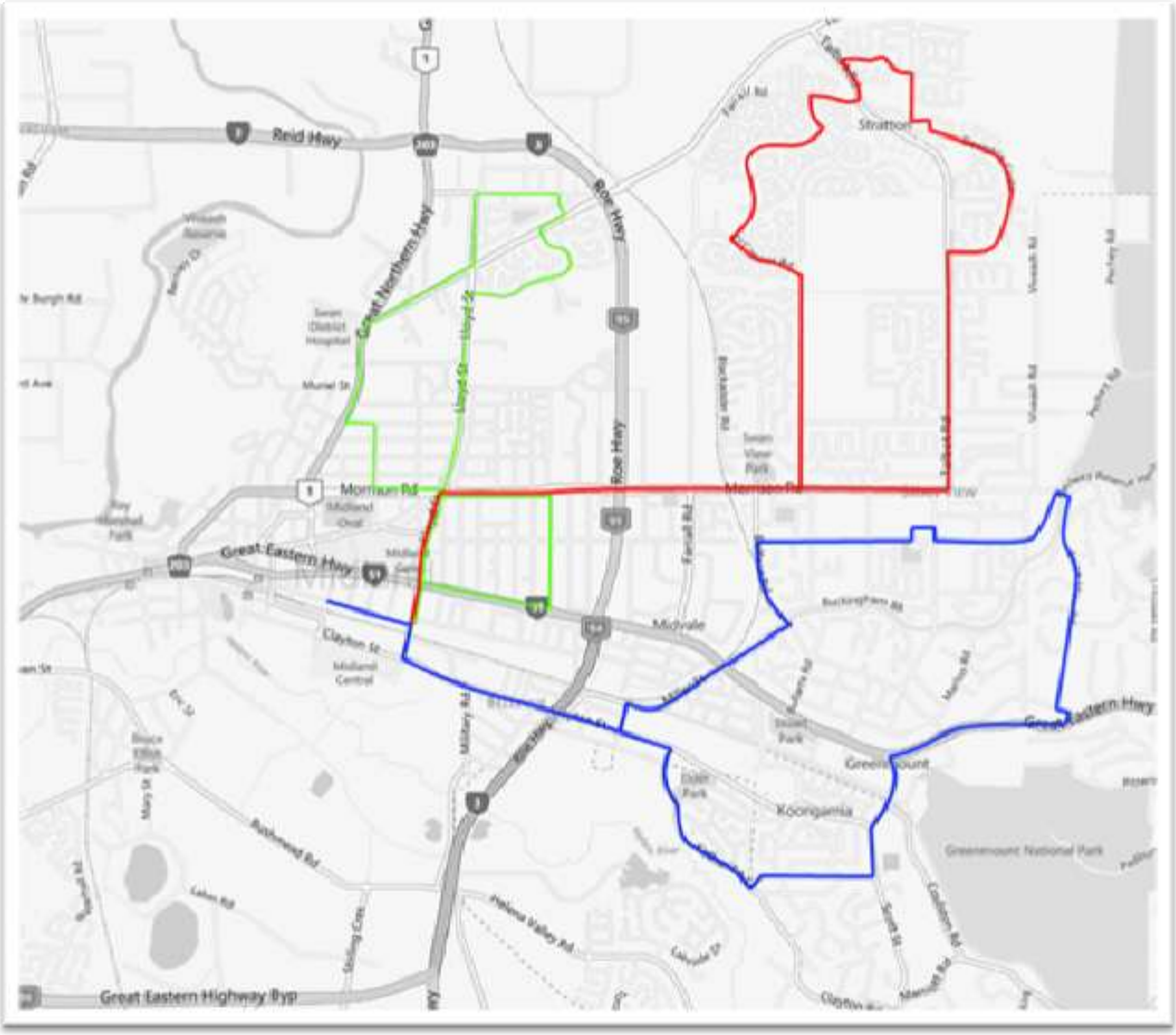
The existing coverage services are mostly duplicated by the relatively high-frequency 886/887/889 bus route. This suggests that there is some capacity for these services to be subsumed by the 886/887/889, with a corresponding increase in the 886/887/889 bus frequency. In particular, improvements to and extension of peak-hour frequency throughout the day is considered beneficial to support non-work based trips. Weekend service is currently poor, providing limited opportunity for public transport use outside of peak weekday periods.

> Consider the function of the 378 and 379 coverage services and the replacement of these with improved 886/887/889 frequencies

16.1.5 'Petal' Bus Routes

Analysis of sub-area matrices extracted from the 2031 ROM 24-hour model suggests that a significant amount of trips are made between the Midland City Centre and the nearby residential suburbs of Bellevue, Midvale, Swan View, Viveash and Middle Swan. This finding is consistent with the Midland Activity Centre Structure Plan in which analysis of licence plate surveys undertaken from the PTA Park 'n' Ride was used to identify potential local bus services along high frequency circular or paired two-way routes between the Midland Station and the surrounding commercial and residential catchments. Potential local routes are shown in **Figure 16-1** below.

Figure 16-1 Example Potential Local Route Bus Services



> Support improvements in existing services that are local to Midland
> Undertake an independent study to promote effective bus transport links to Midland, focusing on local precincts, optimal routes, frequency and demand

16.1.6 Proposed Ellenbrook Rapid Transit Scheme

As identified in the Public Transport For Perth in 2031 (*Department of Transport, 2011*), it is anticipated that a proposed Rapid Transit Scheme is to operate between Ellenbrook and the Bassendean Station, with the potential alignment shown in **Figure 16-2** below. As shown on this figure, the proposed route would connect the Bassendean Station to the Ellenbrook Busway Station via Ivanhoe Road, Altone Road, Marshall Road and Lord Street. Subsequent to the formal adoption of the Public Transport for Perth in 2031 plan, the WA State Government has indicated that this proposal is no longer supported due to a reprioritisation of funding.

As stated in the City of Swan Local Planning Strategy 2013, this proposed alignment is not supported by the City of Swan as a preferred alignment would serve the Urban Growth Corridor and terminate at the Midland Station instead. Such an alignment would also be more in line with the principles of the State Planning Policy 4.2 (*Activity Centres for Perth and Peel*), as it would provide a direct transport link between Ellenbrook (a secondary activity centre) and Midland (a strategic metropolitan centre) and also serve the substantial residential catchments within the Urban Growth Corridor. Extension of the Ellenbrook rapid transit service through to Bullsbrook would assist in serving this growth area, creating a legible connection through the northern residential catchment to the Strategic Centre.

From discussions with City of Swan planning officers, it is understood that a rail connection between Midland and Ellenbrook is the preferred option but not likely to eventuate within a foreseeable future due to the funding requirements. The alignment preferred by the City of Swan would include an extension of the existing Midland rail line (along the existing freight rail route) to Toodyay Road in Stratton, westbound along Reid Highway and then northbound along Lord Street to Ellenbrook. Such an alignment would benefit the existing residential communities in Midvale, Stratton and Ellenbrook, as well as the future communities along the Urban Growth Corridor. However, due to the rural land uses to the north of Roe Highway and Reid Highway, the catchment along this stretch Roe Highway and Reid Highway would likely be very low.

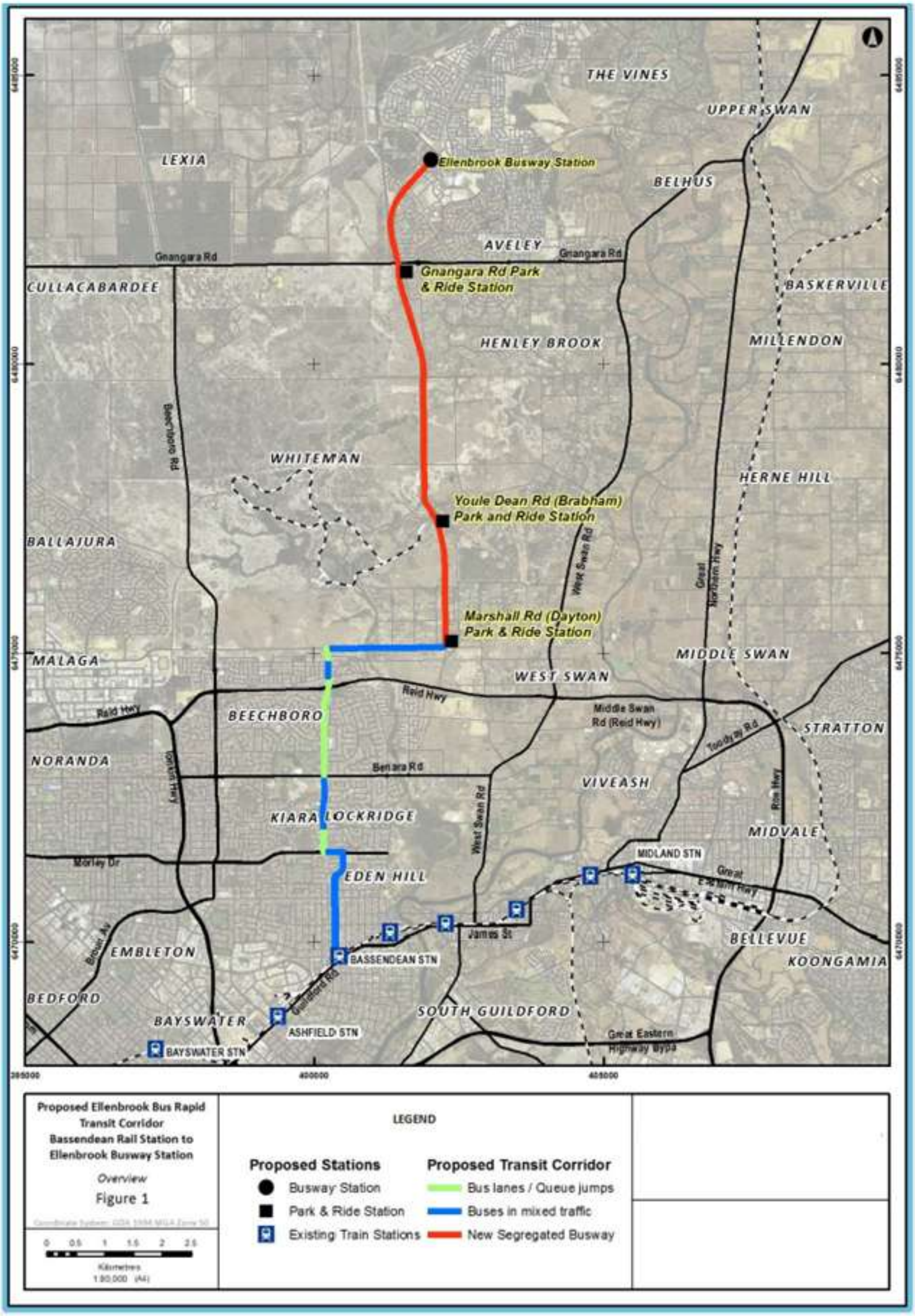
It is understood that the preferred rail connection to Ellenbrook by PTA would run along Tonkin Highway northbound, Reid Highway eastbound and then Lord Street northbound to Ellenbrook. Such a connection would serve the existing residential communities along Tonkin Highway and Reid Highway, as well as the future communities along the Urban Growth Corridor.

The Department of Transport have suggested that a rail connection to Ellenbrook would be likely to run parallel to the proposed PDNH alignment and terminate at the Bayswater Station. It is noted that the proposed Forrestfield-Airport Link is also planned to use Bayswater Station and that having 3 separate rail routes run through the Bayswater Station is likely to present a number of engineering challenges.

Due to the relatively low catchment along the expected alignment, it is not recommended to pursue a rail connection between Ellenbrook and Bayswater in the short or medium term, but may be investigated further as part of a long term integrated transport study as the combined population of Ellenbrook and the Urban Growth Corridor increases. Using the projected patronage of 35,000 passengers per day for the MAX Light Rail as a benchmark for political action, and a potential PT mode share of approximately 3% of all trips, a population of 130,000 could provide the catalyst required.

- Support implementation of Rapid Transit to Ellenbrook
- Support extension of the service to Bullsbrook
- Particularly support alignments that meet the planning goals of the City (i.e. connections to the Midland Activity Centre and through the Urban Growth Corridor)

Figure 16-2 Previously Proposed Ellenbrook BRT Route (Source: Department of Transport, 2013)



16.1.7 Midland Station Relocation

The location of the existing Midland Station, at the western boundary of the Activity Centre, is relatively distant from the local residential and business catchments. This reduces its effectiveness as a transport node and tends to promote a high reliance on park ‘n’ ride adjacent to the station, even for residents living nearby. To alleviate this issue, the Midland Station is proposed to be relocated approximately 1km to the east, towards the City Centre core. This will increase the catchment of residents and businesses within 800m and help promote alternative transport modes.

The relocation of Midland Station and additional inner-city public transport services will improve accessibility for commuters into Midland, and residents within and surrounding the Activity Centre. By reducing the reliance on private vehicle transport, parking rates in the Activity Centre can be reduced, freeing up land for more productive uses. The expansions of local public transport services also improves equity in the region, by supporting households to transition away from private vehicle ownership and thereby reduce their vulnerability to external economic impacts.

The PTA has also proposed to locate a significant quantum of parking, tied to public transport use, immediately adjacent to the new station. This parking will attract a significant quantity of private vehicle trips into the Activity Centre, with no associated benefit to the community. The proposed park ‘n’ ride is therefore supported only as a solution prior to the extension of the rail line. However, the location of the proposed park ‘n’ ride, adjacent to the Midland Health Campus and at the heart of the City provides an opportunity for transition to retail and hospital visitor parking in the longer-term, similar to the function of parking stations adjacent to the Perth Train Station.

Construction of a train station at Bellevue, east of Midland, would provide a number of significant benefits to the public transport network. This station would facilitate regional commuter transport from residential areas to the east without park ‘n’ ride trips adversely impacting the operation of the roads and intersections within the Activity Centre.

- Support implementation of the Midland Station relocation
- Maintain pressure through parking management to minimise the impact of the proposed Park ‘n’ Ride

16.1.8 Forrestfield-Airport Link

In September 2012, the Minister of Transport released a statement that a preferred route had been determined to the Perth Airport. Subsequently, the PTA has been investigating various engineering alignments to confirm the most appropriate route between Bayswater and the Perth Domestic Airport. The outcome of this investigation will be known in late 2014.

17 Pedestrians

The strategic nature of this document generally precludes detailed assessment of pedestrian movements, which are generally more local in nature. However, pedestrian studies have been completed for some precincts within the City, including Midland and Guildford. Similar studies within existing suburban areas are recommended to ensure the viability and safety of walking modes across the City.

Pedestrian planning within development zones currently operates within the guidelines determined by the Local Planning Scheme and Liveable Neighbourhoods. Where feasible, it is recommended that a minimum standard of pedestrian infrastructure be set according to the hierarchy of the adjacent road network, to be influenced and justified with respect to its function as a pedestrian and cycling link.

17.1 City of Swan

Pedestrian improvements are generally considered on a local scale, with recommendations arising from issues of fine-grained connectivity and access. However, at a City-wide level, pedestrians considerations can be addressed in a number of ways.

Pedestrian black spots identify specific points where safety issues may be addressed and, where the individual characteristics of a black spot are indicative of the local environment, changes to the corridor (or region) would be warranted.

In particular, pedestrian connectivity across major roads is extremely important to allow safe linkages between destinations. In particular, where bus services use major roads for efficient linkages, this automatically creates the demand for pedestrian crossing. Similarly, where schools, retail or employment occurs alongside strategic roads there is necessarily a desireline which crosses it.

It is recommended that these areas be identified and the existing pedestrian connectivity investigated. The results of this Pedestrian Crossing of Strategic Corridors Study would leverage current works by the City and Department of Transport with respect to TransPriority (SmartRoads) methodologies, and expand on ‘Safe Routes to Schools’ and other precinct investigations. Where safety or connectivity issues are identified, these would constitute locations subject to detailed design and funding.

Walkability Plans or Pedestrian Access Plans should be undertaken for existing developments wherever significant change is expected, or where the age of a suburban area suggests that infrastructure may be missing or degraded.

> Introduce minimum infrastructure standards for pedestrian facilities into planning policies
> Undertake Walkability Plans for precincts wherever significant change is expected, or in older suburbs without quality infrastructure
> Undertake a Pedestrian Crossing of Strategic Corridors Study for all strategic roads abutting public transport routes, schools, education or employment nodes to identify and mitigate connectivity or safety issues

17.2 Midland

Pedestrian activity is a critical factor in the effectiveness and vitality of Activity Centres such as Midland and Ellenbrook. For this reason, the pedestrian environment must be carefully considered, particularly along primary pedestrian desire lines. This includes construction of high quality paths, shade trees and street furniture to provide amenity. By allocating resources to the pedestrian environment, the use of pedestrian modes will grow, reducing the demand for other modes as well as the requirement for parking. It is recommended that a review of the existing pedestrian network is undertaken to ensure that adequate pedestrian footpaths and pedestrian crossing facilities are provided near these areas to further improve the connectivity and safety of the footpaths.

Parking location is the key to determining both traffic and pedestrian movement. The location of car parking towards the periphery limits the impact of parking on trip volumes and land consumption, but requires parkers to travel an additional distance to their destination. The demand for peripheral car parking will be significantly improved where attractive pedestrian facilities are provided. It is recommended that the distribution of parking, as proposed in the Midland Activity Centre Structure Plan, is adopted in order to promote pedestrian movements within the Activity Centre.

While the *Walkability and Wayfinding in Midland* Report recommends that zebra crossings are installed at all exits/entrances of roundabouts, this is generally not supported as motorists may not become aware of pedestrians on the zebra crossings until they exit the roundabout, at which point it may be too late for them to react in time to avoid the pedestrians. With vehicles giving way to crossing pedestrians, queues of cars may also extend into the roundabouts, thereby blocking other vehicles from entering the roundabouts and this may result in long queues for all approaches.

> Implement the pedestrian-oriented aspects of the Midland Activity Centre Structure Plan
> Implement the parking recommendations of the Midland Activity Centre Structure Plan and the Midland Access and Parking Plan
> Investigate pedestrian improvements to allow better crossing of Great Eastern Highway
> The installation of zebra crossings at roundabout is *not* recommended at this time

17.3 Guildford

As noted in section **9.2.5.1** of this report, the intersection of Meadow Street and Swan Street is forecast to operate with a LoS F by 2031. It is therefore recommended that this intersection is either upgraded to a dual lane roundabout or a signalised intersection. Due to the land area requirements of providing an additional approach, departure and circulating lane at this intersection and the large pedestrian volumes in this area, the most feasible operation would be to signalise this intersection.

In line with the recommendations made in the *Walkability and Wayfinding in Guildford* report, it is recommended that further investigation is conducted into the possibility of introducing a zebra crossing or pedestrian actuated traffic signal crossing point near the entrance of Guildford Station. Main Roads WA has provided results of an assessment showing pedestrian demand is currently low and therefore would not meet the warrants for either crossing facility type. There are, however, other considerations outside of simply observed demand, these include:

> Latent demand within town centre
> Community severance and detriment to amenity caused by the primary arterial
> No convenient crossing facilities within reasonable distance
> Delay to traffic would be negligible compared to at-grade rail crossing close-by.

> Improve pedestrian crossing facilities at Meadow Street/Terrace Road
> Continue to support signalised pedestrian crossing at Guildford Station

17.4 The Vines

The existing shared path network was observed to be of mixed quality, with some parts of the development having good quality but disparate provision, and others having no pedestrian provision at all. The lack of public facilities all but required the use of the private golf course to navigate and recreate. Construction of a network of public paths should create an alternative that does not adversely impact on the operation of the golf course. Where public access to the golf course is discouraged, signage should be installed by The Vines Resort, particularly during tournament events.

> Implement the recommendations of The Vines Pedestrian Study

18 Private Vehicles

Private vehicles will continue to play an important function for access to regional and industrial areas where the provision of public transport is expected to continue to have a minimal or non-existent presence.

The primary change to the road hierarchy for road vehicles is that once constructed, Henley Brook Avenue will take over the function as a strategic north-south connection between Reid Highway and Ellenbrook, as well as serving all of the residential areas within the Urban Growth Corridor. As Henley Brook Avenue will have a greater capacity and provide more direct route to Ellenbrook, the traffic flows along West Swan Road are expected to decrease significantly and to comprise almost entirely of local and tourist traffic. It is also envisioned that the Activity Corridor within the Urban Growth Corridor is only to be used by local traffic, buses, cyclists and pedestrians.

It is noted that the increased housing infill as a result of the Urban Housing Strategy has been accounted for in the ROM and is not likely to cause undue congestion up to 2031.

18.1 General Road Duplications

The road duplications as defined by the 2031 ROM and **Section 10.1** of this report are considered to be necessary in the context of the modelled traffic volumes. Periodic assessment of traffic growth will be required to ensure that the duplication of these roads is undertaken as needed. The triggers for duplication will primarily be local in nature, though a significant number are tied to regional network expansions such as the PDNH, Roe Highway upgrade or East Wanneroo Road.

It should be noted that the ROM defines a specific traffic demand scenario, driven by assumed conditions and land-use build-out. Therefore, changes in transport mode choice, traffic demand flows or build-out timeframes can significantly impact the requirement for significant road improvements. This suggests that the transport network must be continuously monitored to ensure that upgrades are completed in a timely manner, consistent with local and regional needs.

> Design and plan for road duplications as defined by the 2031 ROM. This will include the identification of sections of road currently undersized compared to the 2031 ROM network, as well as sections of road that are expected to be undersized by 2031 that the 2031 ROM network does currently not include.

> Monitor the requirements and triggers for road duplication

18.2 Midland Activity Centre

Select Link Analysis (SLA) plots from the 2031 ROM of traffic along Great Eastern Highway were provided by MRWA as part of this study. These plots, shown in **Figure 18-1** to **Figure 18-4**, reveal that of the 34,000 projected vehicles along Great Eastern Highway through the Midland city centre, 80% of these consist of traffic to/from Zone 491 (representing the Midland city centre) with the remaining 20% consisting of regional traffic. As the ROM is a strategic traffic demand model, it does not consider local access streets or the locations of major traffic producers/attractors within the zones, the actual traffic volumes along Great Eastern Highway within the Midland city centre are likely to be significantly lower than those forecast in the 2031 ROM network. If the distribution of traffic along Great Eastern Highway is considered indicative of future demands, it is therefore recommended that Great Eastern Highway be downgraded from a Primary Distributor to an Integrator level road (Town Centre Main Street, as described in Liveable Neighbourhoods) with a posted speed limit of 40-50 km/h and a capacity of up to 15,000-25,000 vehicles per day.

Figure 18-1 2031 ROM SLA Plot of Forecast Westbound Traffic along Great Eastern Highway, East of Padbury Terrace (Source: MRWA)

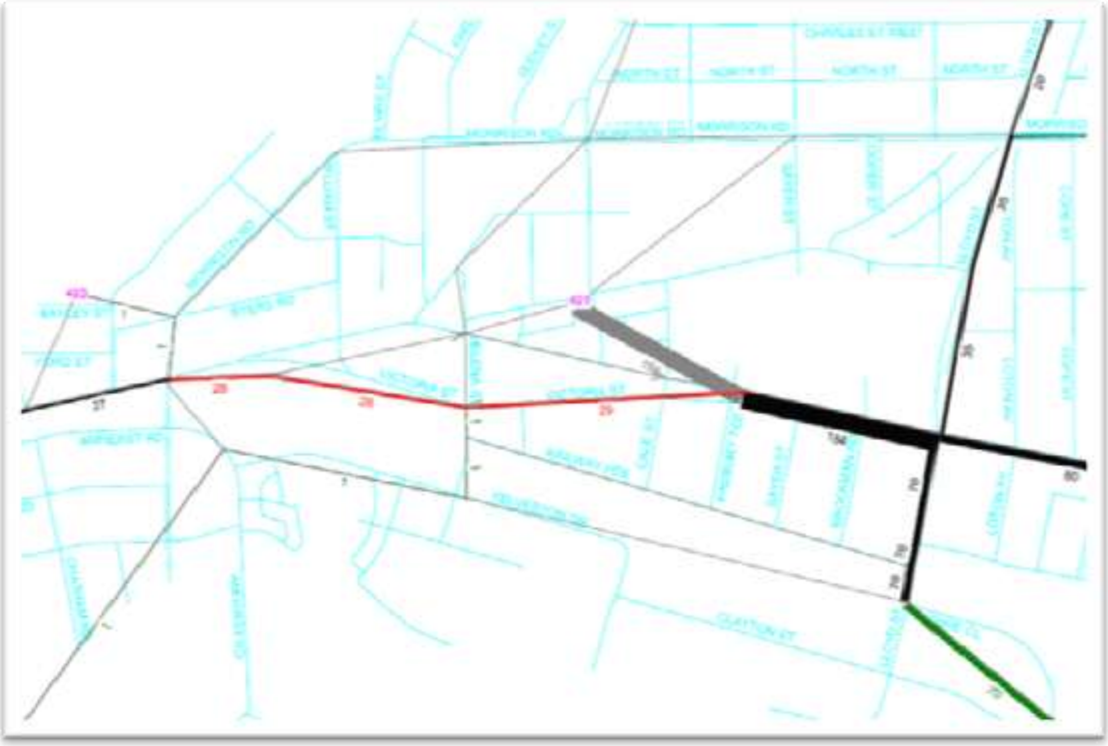


Figure 18-2 2031 ROM SLA Plot of Forecast Eastbound Traffic along Great Eastern Highway, East of Padbury Terrace (Source: MRWA)

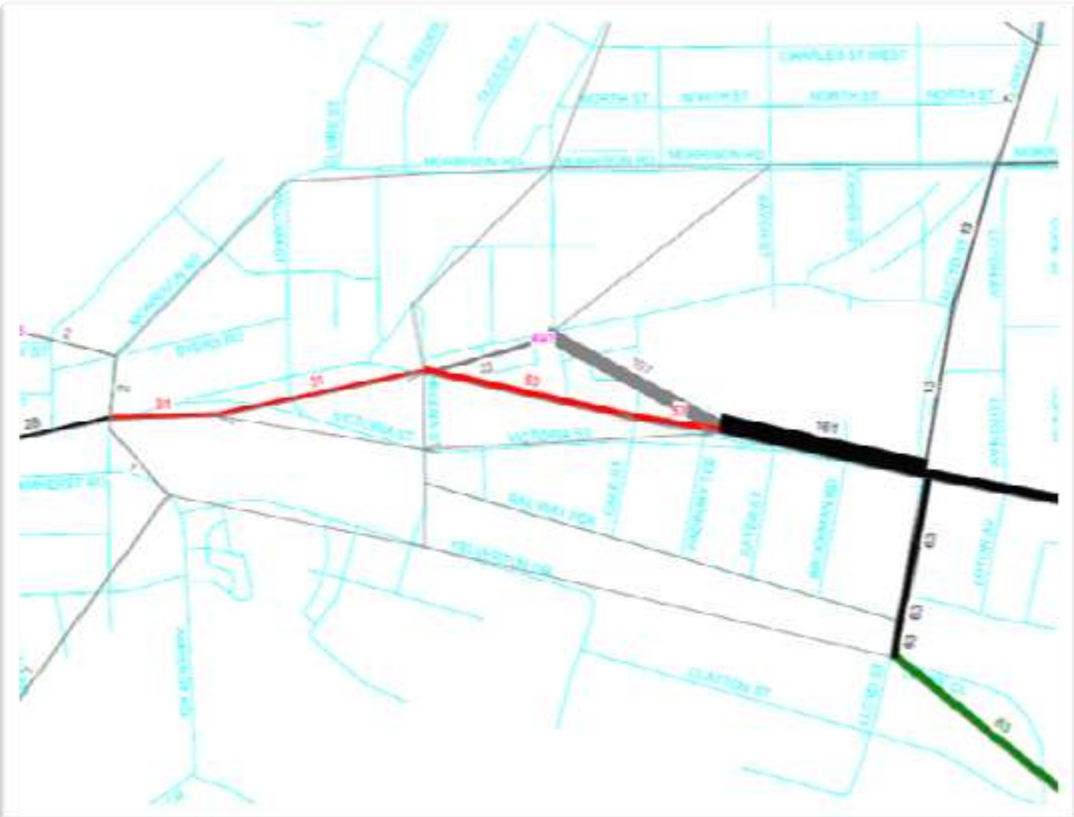


Figure 18-3 2031 ROM SLA Plot of Forecast Westbound Traffic along Great Eastern Highway, East of Morrison Road (Source: MRWA)

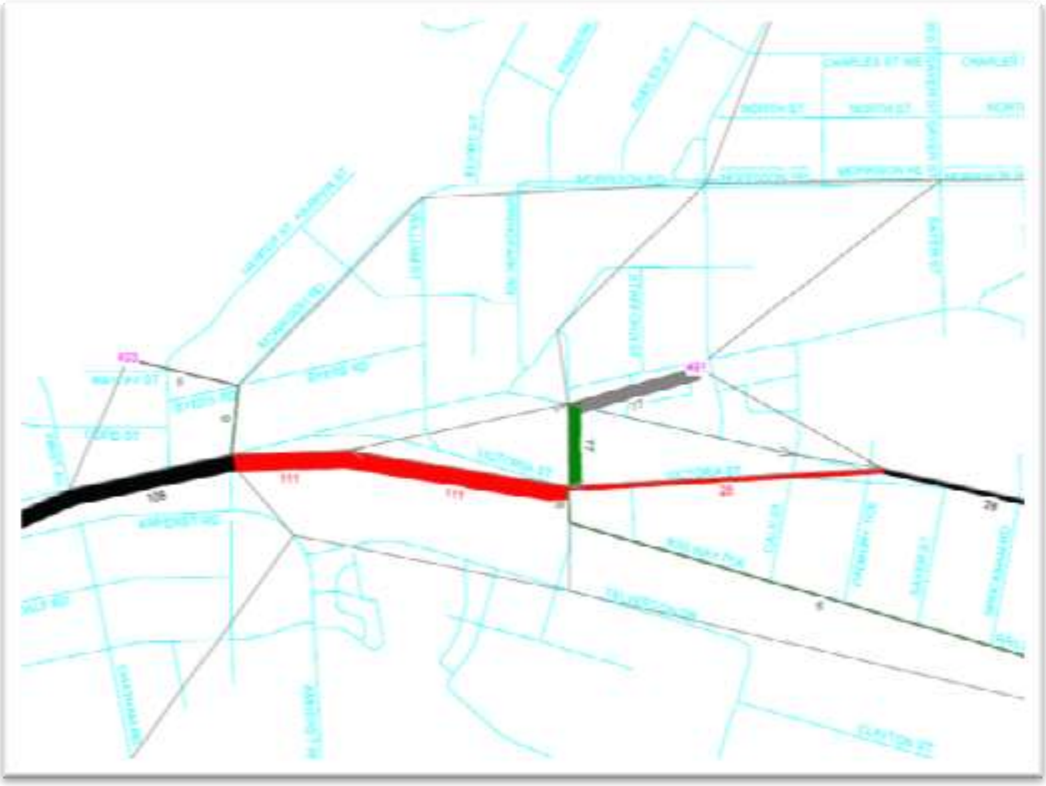
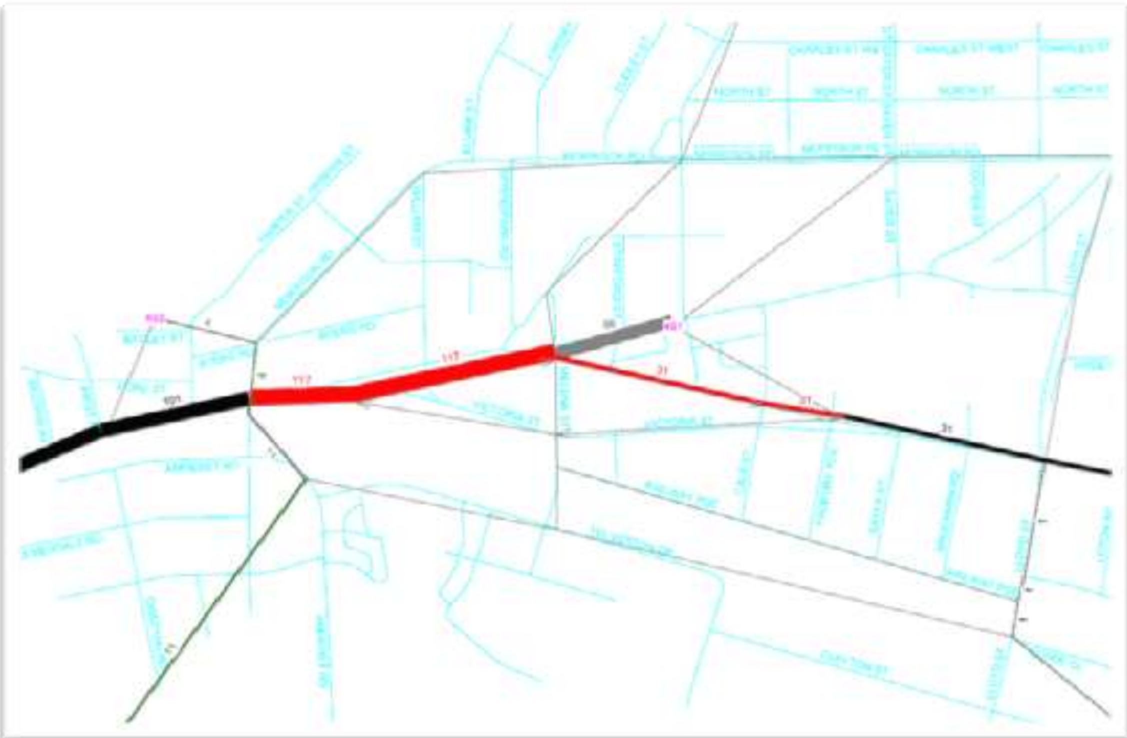


Figure 18-4 2031 ROM SLA Plot of Forecast Westbound Traffic along Great Eastern Highway, East of Morrison Road (Source: MRWA)



> Revise Midland City Centre modelling to reflect the most recent ROM outputs, once the alignments of all strategic roads is finalised and assuming the inclusion of the Lloyd Street extension
> Undertake a Great Eastern Highway corridor study through Midland to determine the form and access opportunities for local traffic and active modes
> Investigate the opportunities to downgrade Great Eastern Highway through Midland to provide a better outcome for the City and local community

18.3 Guildford

Guildford's road network provides access to a range of destinations, resulting in a high level of demand through a relatively constrained location. Guildford currently has two key arterial roads that converge and pass through the town centre: Guildford Road and Great Eastern Highway (Johnston Street/James Street/East Street). The constraints associated with the existing road network create some significant delays in accessing these destinations.

There have been previous attempts to increase capacity of bridges feeding through Guildford have met with strong opposition from local residents and businesses. Furthermore, the bridges are not the only source of constraint within the town; the at-grade rail crossings are a significant impediment to traffic flow, undermining road network performance.

It is considered that removal of these constraints is likely to result in an increase in traffic through the area, further reducing its viability as a Centre, detrimentally impacting local residents and shifting traffic away from the regional road network. Therefore, measures including duplication of the existing bridges and grade separation of the two rail crossings are not considered to be priorities.

Instead, modifications to the strategic road network, including improved access via Lloyd Street and Great Eastern Highway Bypass, are supported to reduce the demand for heavy vehicle traffic along Great Eastern Highway and West Parade into Hazelmere.

> Undertake LATM works to minimise heavy vehicle traffic along GEH and West Parade
> Improve alternative routes including Lloyd Street and GEH Bypass
> Maintain the existing road constraints as a method of restraining undesirable traffic demand

18.4 Intersection Geometry

The Transport Assessment included in this report describes potential intersection improvements at a range of critical intersections across the network. Given that the volumes assumed for these 2031 assessments are based on long-term modelling of significant regional road upgrades there is not yet sufficient data to fully determine the requirements for these intersections.

However, it is clear that the traffic volumes across the network will increase, and that a variety of changes will need to be made to ensure the ongoing function of the road network through to 2031.

Therefore, the City should continue to monitor the function of the road network, particularly focusing on those roads that are likely to experience significant demand growth as a result of regional road improvements. That is, the PDNH, Lloyd Street extension and future East Wanneroo Road. The impacts of these road improvements should be understood prior to their construction, and implementation of upgrades to connecting roads conducted in parallel, to avoid significant unanticipated network constraints.

Other intersection improvements are spurred by organic growth and development of such residential cells as the Urban Growth Corridor and Ellenbrook. Impacts of this form of growth are much more likely to occur gradually, and can be accommodated within the existing assessment framework.

> Ensure large-scale infrastructure planning includes the impact on connecting roads and parallel routes
> Monitor intersection function adjacent to growth areas
> Consider the ultimate intersection form in the context of the attached Transport Assessment

19 Strategic Connections

19.1 Perth to Darwin National Highway

The proposed Perth to Darwin National Highway (PDNH) creates significant opportunities for regional access into the primary road network. The proposed alignment reduces the demand for access along Marshall Road and Beechboro Road, improving accessibility within Beechboro.

However, the design of the PDNH does not allow for effective connectivity into the Malaga Industrial Area for north-south traffic, due to the impact of grade separation and the removal of several intersections. While it is not necessarily feasible to modify the design of Reid Highway and PDNH to accommodate Malaga traffic, it would be beneficial to improve wayfinding to this precinct along the major approach routes.

Despite the loss of access, retention of Beechboro Road and Marshall Road as a preferred heavy vehicle access corridor is not recommended, as this would diminish the advantages that result from the proposed Reid Highway / Malaga Drive interchange.

Stock Road will ultimately form a major link between the PDNH and Great Northern Highway, in addition to being the primary access to the South Bullsbrook Industrial Estate (Northern Gateway) and Marlin Bullsbrook residential development. This additional traffic is likely to necessitate an upgrade of the great Northern Highway/Stock Road intersection, as well as grade separation of the existing Stock Road rail crossing.

The proposed PDNH alignment north of Gnangara Road includes connections at The Promenade and Stock Road with a single connection between these, potentially at Elmridge Parkway into Northern Ellenbrook. The distance between proposed access points is therefore at least 7km, thereby providing limited connectivity between the primary freight route (the PDNH) and Great Northern Highway through the developing industrial precincts north of Ellenbrook. Additional consideration should be made for access to this area, supported by a connection to in the vicinity of Maralla Road/Warbrook Road.

> Support the diversion of heavy vehicle traffic away from Beechboro Road and Marshall Road towards Reid Highway and PDNH
> Plan for redevelopment of Beechboro Road and Marshall Road to improve their function as residential distributor roads
> Investigate the cross-section and timing requirement for upgrade of Stock Road
> Investigate the need for, and implementation of, a connection from the PDNH in the vicinity of Maralla Road/Warbrook Road
> Support improvements to wayfinding to promote heavy vehicle use of the primary road network

19.2 Roe Highway Upgrade

Based on the findings of the review carried out as part of this assessment, the options that will provide maximum connectivity to Midland, and are therefore beneficial to the City of Swan, are Option D and Option E. Acknowledging the difficulties associated with the tight available space, and the issues that this causes with respect to weaving movements and the potential for conflict, **Option E** is considered to be a better compromise option. Additional consideration should also be made regarding the existing Bishop Road connection to Great Northern Highway, and the impact of removing this link on delays and queuing in the region.

> Continue to advocate for connections between the regional road network and Midland / Urban Growth Corridor
> Support or undertake independent impact assessment of the proposed Roe Highway upgrades on the function of the sub-regional road network

19.3 Farrall Road Extension

The potential extension of Farrall Road has been raised as part of the Roe Highway upgrade, in the context of a parallel sub-regional route alongside Roe Highway through to Clayton Street or Helena Valley Road. This extension should be investigated with respect to the potential value of linking the residential and industrial precincts to the east of Roe Highway into the strategic road network. It should be noted that Farrall Road, under a range of options considered for the Roe Highway Upgrade, would serve a strategic, as well as local purpose and this will need to be considered in its ultimate form.

It is therefore recommended that a Farrall Road Review be undertaken to establish a standard environment for Farrall Road, and investigate the impacts of extending this road on the local and regional traffic in the area. The Roe Highway Upgrade study currently underway will form a necessary input into this Review.

If Farrall Road is extended to Clayton Street, the requirements of this intersection should be investigated to ensure that it functions as required. It is most likely that this intersection would be signalised, but there may be the potential for grade separation depending upon usage characteristics.

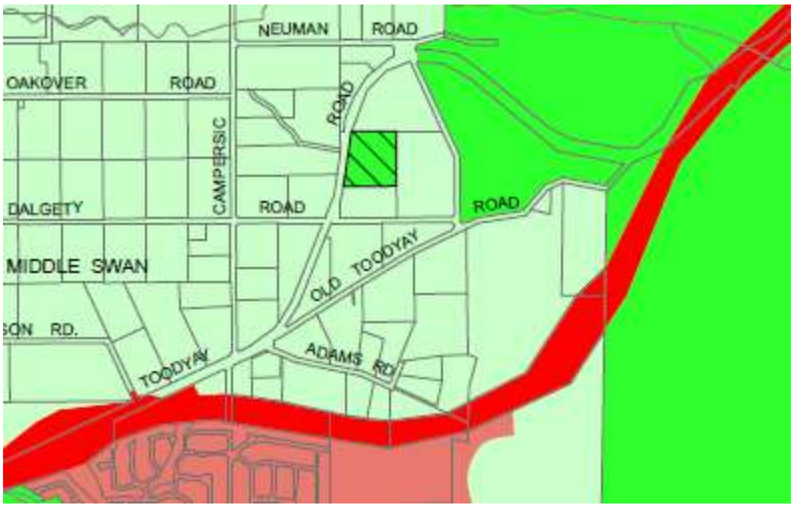
>	Undertake a review of Farrall Road with respect to the impacts of the Roe Highway Upgrade.

19.4 Perth to Adelaide National Highway (PANH) and Hills Spine Road

The Perth to Adelaide National Highway is included in the Metropolitan Region Scheme (MRS) as a red road (i.e. under the jurisdiction of MRWA). The PANH is proposed to consist of an alignment known as the Orange Route which includes sections of Toodyay Road and Great Eastern Highway, as well as a number of grade-separated interchanges. The proposed alignment of the PANH, as included in the MRS, is shown in Appendix E. As shown on Figure 19-1, the proposed PANH alignment is to include a deviation of the PANH to the south of the existing Toodyay Road alignment. This alignment, known as the Red Hill deviation, is understood to be a result of safety considerations, as achieving the grades required for the National Highway standard will be very difficult without this deviation.

2013 traffic counts provided by MRWA for Toodyay Road (west of Rowland Road) suggest that approximately 8,000 vehicles per day (vpd) currently use Toodyay Road, while approximately 9,000 vpd currently use Great Eastern Highway (west of Great Southern Highway).

Figure 19-1 PANH Alignment as included in the MRS (source: Metropolitan Region Scheme, Map 13)



The Hills Spine Road is proposed to consist of a road network that would include the extension of Cameron Road eastward to Bunning Road and westward potential to Toodyay Road. The Hills Spine Road is proposed to initially consist of a single carriageway road with provision to upgrade to a four-lane divided road if eventually required.

As noted in the Eastern Corridor Major Roads Study, the timing of both the PANH and the Hills Spine Road is dependent on the development and traffic growth in the area.

>	Undertake a study to identify development and traffic growth triggers for the PANH and Hills Spine Road.

19.5 Connection from Morley Drive or Benara Road to Morrison Road

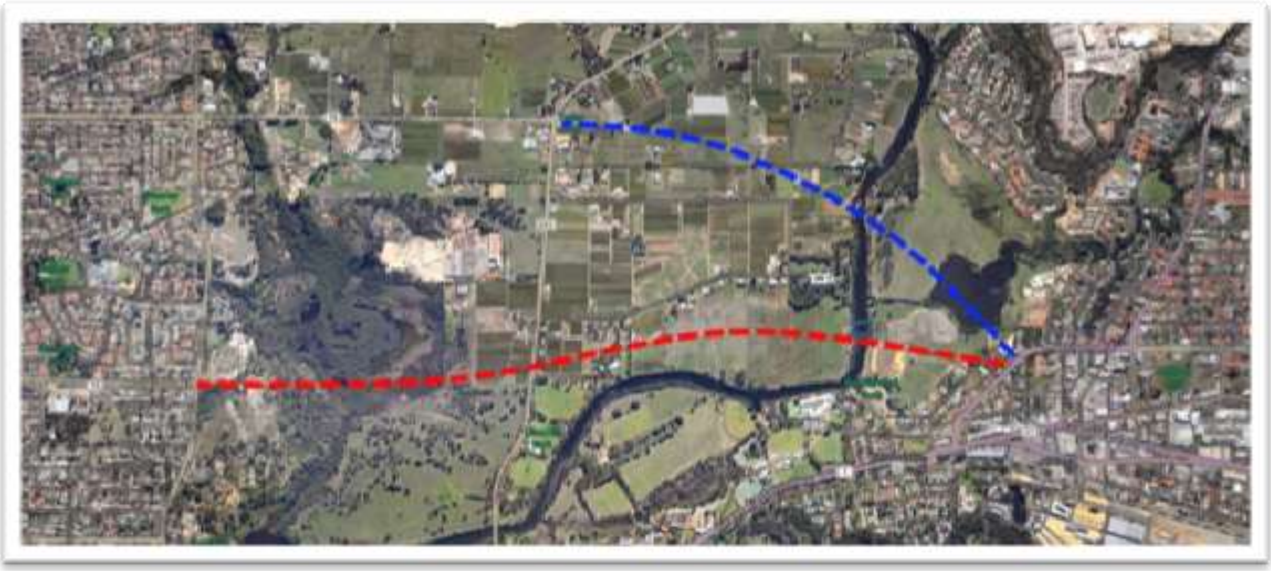
Morley Drive, classified as a Distributor A under the Main Roads Functional hierarchy, currently serves as a strategic east-west corridor and is bounded by Lord Street to the east and Wanneroo Road to the west. To the west of Wanneroo Road, Morley Drive becomes Karrinyup Road and extends out to West Coast Highway/Morrison Drive. Traffic travelling along Morley Drive to the Midland City Centre is forced down Lord Street, along Guildford Road and Great Eastern Highway to reach the city. A connection between Morley Drive and Morrison Road would alleviate pressure on the intersections along Guildford Road, Great Eastern Highway, Lord Street, West Swan Road and to some extent Reid Highway. A connection between Great Eastern Highway and Morley Drive would also provide an improved connection for eastbound regional traffic from the Stirling and the northern parts of Bayswater.

However, the practical implications of providing such a connection may prove quite challenging as the alignment would pass through land zoned as Bush Forever, Rural and Parks & Recreation, as well as an area identified as an Aboriginal heritage site. **It is therefore strongly emphasised that such a connection between Morley Drive and Morrison Road is not proposed and will not be supported on either a State or Local Government level.**

Alternatively, a connection between Benara Road and Morrison Road may prove less difficult to implement, although such a connection would provide fewer benefits, as Benara Road is classified as a Distributor B and only extends in the western direction to Camboon Road. Such a connection has previously been forecast to reduce traffic volumes on Reid Highway by 18,000 vpd, on Lloyd Street by up to 10,900 vpd, on West Swan Road by up to 9,800vpd and on Great Eastern Highway by up to 6,600vpd. This would significantly improve the performance of these roads and associated intersections.

Examples of possible connections to Morrison Road are shown in **Figure 19-2** below.

Figure 19-2 Possible Morrison Road Connections from Morley Drive (Red) and Benara Road (Blue)



> Investigate the long-term potential and cost/benefit of a direct link between Benara Road and Morrison Road, under the proposed strategic road network

19.6 Hazelmere Enterprise Area

As noted in the Freight and Logistics Industry and Urban Planning – October 2013 Report, the combined freight volumes in Perth are expected to double over the period 2010 to 2030. In order to facilitate and encourage industrial development within the Perth metro area, it is considered imperative that the existing freight corridors and freight operations are protected from incompatible urban encroachment.

Access to Hazelmere has been identified in the Hazelmere Enterprise Area (HEA) Structure Plan as one of the key parameters to ensure that this area lives up to its full potential as an industrial employment node.

The primary point of access for private and freight vehicles to/from the HEA is currently via Stirling Crescent, off the Great Eastern Highway Bypass (GEHB) but will change to the Lloyd Street Southern Extension once this has been constructed to connect with Abernethy Road. Once this extension has been completed, it is proposed to close the Stirling Crescent connection to the GEHB in order to maintain the controlled-access function of the GEHB.

This is unlikely to have a significant impact on regional traffic accessing the HEA from the GEHB, as the proposed Lloyd Street access should provide the same level of access as the existing. However, this plan would remove the existing link for heavy vehicle transfer movements across GEHB. This would disadvantage some businesses which operate on both sides of the GEHB, though this movement will still be accommodated via Lloyd Street/Lakes Road or Abernethy Road/Yagine Close. Recent preliminary discussions suggest that the Department of Transport and Main Roads would support retention of a connection across GEHB to link the northern and southern zones of the HEA. This link would assist in the function of the Structure Plan area as it pertains to internal goods and materials transfer and would likely be in the form of a flyover. Providing a connection between the northern and southern zones of the HEA would also reduce heavy vehicle movements on the section of GEHB between Stirling Crescent and Abernethy Road and improve the GEHB / Abernethy Road intersection performance.

Bushmead Road (west of Central Avenue) is currently not included in the MRWA Restricted Access Vehicle (RAV) network as this link primarily serves as an access to the residential areas in the western parts of Hazelmere. It is recommended that the function of this link is maintained in order to discourage freight vehicles going through the residential areas. It is also recommended to discourage freight vehicles using the Lloyd Street connection through the Midland city centre as a means to reach any of the regional freight routes. Lloyd Street is currently classified as a RAV 2 road and it is recommended that this classification remain once the Lloyd Street extension has been completed and that signage be posted at appropriate locations to alert freight vehicle operators not to use Lloyd Street through Midland to access the HEA.

The internal road network proposed in the HEA Structure Plan may provide sufficient access and circulation for freight vehicles associated with the industrial developments, with the connection of Adelaide Street to Abernethy Road. However, the form of this intersection should be investigated to ensure that it effectively serves its designated purpose.

While the lack of public transport to industrial areas has been identified as a deficiency in a number of Place Plans, it is unlikely that the low employment densities associated with the industrial land uses will provide a sufficient catchment to warrant increased or dedicated public transport services to this area.

> Investigate connectivity between Roe Highway and Hazelmere to provide a legitimate alternative link
> Investigate Abernethy Road / Adelaide Street connection to improve internal legibility within the HEASP
> Undertake Local Area Traffic Management planning exercise for the precinct surrounding the HEA, particularly focused on restricting HV access to the HEA via West Parade, Lloyd Street north of Clayton Street and Kalamunda Road
> Support connection between the northern and southern portions of the HEASP via a flyover connection across the GEHB

19.7 Bellevue Rail Crossing

The Bellevue East Land Use Study (BELUS) recommended a rail crossing between Horace Street and Katharine Road, to link two isolated industrial precincts. This link has previously been supported by Main Roads WA, due to the positive impact on traffic flows through the area and reduced demand for Roe Highway for transfer trips, but is currently not funded for construction.

The proposed freight rail realignment would eliminate the existing issue of crossing the rail line in the short term. However, any future extension of the Midland passenger rail would likely use the existing corridor and should be considered in this context. The State Government position on new rail crossings would imply that a connection between Horace Street and Katharine Road would require some form of grade separation.

The impact of this connection and the costs of construction have not been determined at this time, and will require modelling and cost-benefit analysis to determine the optimal arrangement and timeframe.

> Undertake cost-benefit analysis and traffic impact assessment for the potential Katharine - Horace connection, including the possibility of future extension of the Midland passenger rail

The results of opportunities and constraints mapping conducted for the BELUS are shown below, **Figure 19-3**.

Figure 19-3 Outcomes of Opportunities and Constraints Mapping

19.8 Morrison Road Duplication

The existing form of Morrison Road is considered sufficient to accommodate future demands. Minor improvements, consisting of the installation of right and left-turning pockets on some major road connections, are advised to ensure local traffic is encouraged to use Morrison Road in preference to Great Eastern Highway.

While there is considered to be sufficient capacity in the existing road to accommodate the projected traffic demands, duplication of Morrison Road between Great Eastern Highway and Frederick Street would improve connection between Great Eastern Highway and Great northern Highway, providing a more attractive option than Keane Street. For this reason, duplication of Morrison Road remains a viable and attractive opportunity.

> Investigate the constraints associated with the duplication of Morrison Road and undertake a cost/benefit analysis

19.9 Railway Parade Bridge

A bridge over Ellen Brook is part of a proposed DCP which would fund a connection between the northern portion of The Vines and Railway Parade, providing a strategic connection to Railway Parade. This would form alternative link from Ellenbrook to Upper Swan and south along Great Northern Highway. Developer Contributions for this infrastructure will be based on the outputs of demand modelling recently completed for the bridge.

19.10 Ellenbrook Northern Access

The future Stage 7B Ellenbrook is proposed to include a connection to Maralla Road which will provide access to Bullsbrook via one of two at-grade rail crossings. This will significantly improve journey times between these two precincts, but will require modelling assessment to determine demand and impacts.

> Undertake modelling to determine the need and impact of the Ellenbrook Northern Access

19.11 Rose Street Bridge

Access to The Vines is currently provided via West Swan Road/Millhouse Road. A bridge crossing at Rose Street would create a more direct connection to Railway Parade/Great Northern Highway. This crossing has been previously proposed in the Vines Structure Plan, but triggers and timing have not been determined. The recent completion of the Millhouse Road link between Ellenbrook and The Vines may create some momentum for future planning.

> Undertake or request demand modelling for the Rose Street Bridge connection. Determine the future impact and benefits of this connection

19.12 Altone Road

Issues with the current ROM network do not allow a reasonable estimation of the impact of future traffic demands. These should be rectified and a specific assessment of Altone Road undertaken.

> Request specific improvements to the ROM for the Altone Road corridor
> Undertake an assessment of this corridor performance for a revised 2031 scenario

19.13 Marshall Road

The proposed access and alignment of the PDNH results in a reduced demand for Marshall Road. This creates an opportunity for improvements to the cross-section and form of Marshall Road to allow for better residential distributor access. In particular, consideration for regional cycling and access to side streets would be achievable under a redesigned form.

> Investigate a revised Marshall Road corridor design consistent with its ultimate function, including multi-modal considerations

19.14 Arthur Street Bridge

The Arthur Street Bridge, as proposed, would have benefits for connectivity of public transport and active modes. However, it may have a detrimental impact on the function of West Swan Road.

> Undertake a cost-benefit analysis for the Arthur Street Bridge under the proposed development scenario

19.15 Hepburn Avenue / Bellefin Drive

Issues with the current ROM network do not allow a reasonable estimation of the impact of future traffic demands. These should be rectified and a specific assessment of Hepburn Avenue undertaken.

> Request specific improvements to the ROM for the Hepburn Avenue corridor
> Undertake an assessment of this corridor performance for a revised 2031 scenario

19.16 Lloyd Street Southern Extension / Abernethy Road

Issues with the current ROM network do not allow a reasonable estimation of the impact of future traffic demands. However, detailed design of the Lloyd Street/Clayton Street intersection has been undertaken based on other sources. This provides a better data point for evaluation of the corridor, but is not considered sufficient to determine the impact of the completed link throughout the precinct.

In particular the effect of the Lloyd Street extension and duplication on its northern terminus with Bishop Street is not fully understood. This, combined with the increased desireline through to Reid Highway and the

Great northern Highway suggests that significant modifications will be required to ensure the network continues to function.

> Request specific improvements to the ROM for the Lloyd Street corridor
> Undertake an assessment of this corridor performance for a revised 2031 scenario
> Undertake a detailed analysis of the local traffic environment in the Lloyd Street / Great Northern Highway

19.17 Neaves Road

Neaves Road is currently classified as a Regional Distributor under the Main Roads Functional Hierarchy (MRFH) and includes a single 7m carriageway with 1 lane in each direction. Neaves Road, along with Muchea South Road and Rutland Road, forms an important strategic link between the north-western suburbs and both the Great Northern Highway and Brand Highway. This link will become increasingly important as the Bullsbrook region is built out.

For this reason, the East Wanneroo Structure Plan has proposed Neaves Road to be reclassified as a Primary Regional Road under the control of Main Roads WA.

It is understood that Neaves Road is currently subject to a review and that Main Roads WA are undertaking a separate study of possible future alignment options. The ultimate alignment of Neaves Road is likely to have a significant impact on the function and operation of this corridor.

> The impact of potential improvements to Neaves Road, including grade separation at the PDNH, duplication and/or realignment should be evaluated as part of strategic decision-making.

20 Parking

For the purpose of parking strategy, areas within the City of Swan have been categorised by their function or environment. A review of parking within each category is described below, including general consideration for the following factors:

> the appropriateness and function of off-street parking
> requirements for on-site parking
> potential for synergies between adjacent land uses
> likelihood for statutory parking concessions
> provision of off-street public parking facilities
> other specific policies relating to individual areas

20.1 Activity Centres

20.1.1 Strategic Metropolitan Centre (Midland)

Parking quantum and location has been determined through analysis as part of the Midland Activity Centre Structure Plan. This has resulted in a maximum parking provision of 13,000 bays, roughly split into 6,000 long-stay (commuter) and 6,000 short-stay (visitor) bays, plus an additional 1,000 park 'n' ride bays associated with Midland Station. All parking within the City Centre is would be restricted to a maximum rate determined for general land uses, and partly offset through public provision via application of a mandatory cash-in-lieu policy.

This parking provision is sufficient to support a 65% private vehicle mode share, a significant reduction from the 95% mode share currently evidenced by commuters to Midland. The remainder of all non-residential trips (140,000 total) have been allocated among public transport, walking and cycling modes.

During the transition period (expected to be 10 or more years) the City will need to retain flexibility and gradually shift towards the goals defined in the Activity Centre Structure Plan.

> Implement policy changes, including mandatory cash-in-lieu, to create an internal parking cap for Midland
> Undertake an education program to ensure developers are not dissuaded from investing in the Midland Activity Centre
> Investigate the requirements and triggers for parking management changes and infrastructure provision through to the full build-out of the Centre
> Continue to modify the Midland Access and Parking Plan to reflect changing views on parking including transition rates for parking provision within a simplified range of land uses

20.1.2 Secondary Centres (Ellenbrook Town Centre)

It is not considered sufficient to provide parking within a town centre at rates equal to a district wide planning scheme such as LPS 17. It is therefore recommended that opportunities are explored to integrate the extensive existing off-street parking supply at retail sites within the ETC in a similar manner to Midland Gate Shopping Centre within the Midland Activity Centre. This may provide opportunities to reduce the eventual future parking requirements to significantly below LPS 17 requirements and result in more intensive development, as well as a more equitable distribution of public and private parking across the ETC.

> Complete a revised Parking Assessment for Ellenbrook, based on its existing form and forward projections for its feasible growth
> Implement a new, more equitable and feasible parking provision within the Ellenbrook Centre as part of the Swan Parking Policy
> Create a simplified section of the Swan Parking Policy detailing the target and transition rates for parking provision within a simplified range of land uses

20.1.3 District Centres (Albion)

A parking strategy should be developed as the intent of the internal centres emerge (retail or employment driven). At each centre the aim should be to develop a mix of land uses that provides the self-containment opportunities that will assist in lowering the required parking provisions through shared an reciprocal parking demands.

Furthermore, where circumstances permit, opportunities for shared parking should be explored in either publically available lots or in private lots through agreement, in an effort to maximise parking efficiency and the ability for intensive development to occur. LPS 17 parking rates should act as a guide for the maximum allowable parking rates for each development site, the aim should always be to provide lower parking than the scheme requires and there should be a preference for development approval in cases where a lower parking rate can be reasonably justified.

> Develop a parking strategy for District Centres in concert with the progression of the Urban Growth Corridor, as part of the Swan Parking Policy

20.1.4 Guildford and Malaga

Guildford currently experiences a range of issues associated with parking allocation and consumption that impact on its viability as a retail precinct. The proximity of the Guildford Station promotes informal park 'n' ride behaviour along the local roads, competing for space with residential demand.

Parking within the retail areas is shared between employees and visitors, but there are significant issues with the allocation and distribution of this parking, resulting in local shortfalls in some areas.

A Guildford Parking Study is recommended to investigate specific local requirements, culminating in a parking strategy to be included in the Swan Parking Policy.

Malaga is a commercial/industrial precinct which has undergone significant expansion and change over recent years. These changes generally comprise a transition away from pure industrial uses, which tend to have low rates of employment, to commercial and office uses which have higher employee load and hence an increase the demand for parking.

To accommodate the increased demand for parking, beyond the capacity available on-site, a Malaga Parking Study is recommended which identifies local demand hotspots and available public capacity within the local road reserves. The outcome of this review would be a series of concept designs and an associated prioritisation which allows cash-in-lieu of parking to be accepted, and infrastructure constructed, for the shared use of local businesses.

> Develop a parking strategy for Guildford, as part of the Swan Parking Policy
> Undertake a Malaga Parking Study, consisting of investigation, concept design and prioritisation works

20.1.5 Neighbourhood and Local Centres

Parking rates should be provided similar to LPS 17 with concessions made where it can be demonstrated that a reduction can be justified. The City should encourage cash-in-lieu for developers to provide on-street parking where possible such that off-street parking is minimised and sites can be developed to their full potential.

> Consider the use of parking concessions, shared-use, on-street and reciprocal parking to minimise off-street supply requirements in the Swan Parking Policy
> Prepare and implement Centre parking within the Swan Parking Policy consistent with the goals of individual Centres

20.2 Land-Use Precincts

20.2.1 Industrial

Industrial areas will be expected to provide the majority of parking in off-street private car parks. There may be opportunities for the City to open public car parks in certain areas, and therefore any planning strategies should retain the flexibility to allow this to occur.

On-street parking is permissible, and in fact preferred along some industrial access streets; however, this should be limited to areas where traffic volumes are expected to be sufficiently low that conflict between parked and moving vehicles will be minimal. Parking for industrial uses is for the most part day-long commuter parking, and this is inherently low turnover which naturally minimises this conflict throughout the day. However, traffic movements are heavily focused around AM and PM peaks, and therefore employees returning to parked cars will be doing so at the same time when the road network is busiest, hence the need to considered traffic volumes when deciding where to place on-street parking.

Industrial areas will contain supporting services such as small cafes and convenience retail. It is expected that these land uses will be entirely reliant on the surrounding employment population and therefore will rely on a majority of trade being walk-in. Parking requirements are expected to be minimal and perhaps limited to staff only. On-street parking would normally be sufficient to support these land uses.

20.2.2 Commercial/Business Park

These precincts can either be entirely isolated or form part of a wider city or town centre area. If isolated, it is expected that car travel would be a primary mode of travel and off-street parking will be critical to support this type of land use. Similarly to Industrial Precincts, it is expected the majority of parking in an isolated commercial/business precinct would be privately owned; however, there may be opportunities for the City to construct (at-grade) public car parks in certain areas. It is therefore recommended planning strategies should retain the flexibility to allow this to occur. Parking rates similar to LPS 17 should be adopted as the maximum supply requirement, with a preference to approve a lower level of parking if substantiating analysis is provided.

Incentives can be introduced to promote sustainable transport through parking policy. These include concessions (parking, height, site coverage etc.) on the basis of on-site provisions. Potential measures that may be supported include end-of-trip facilities, motorcycle parking, green travel plans and more. Other influences such as the proximity of development to public transport facilities may also be considered as part of a consistent and concise parking reduction formula. This methodology has been used successfully by other Local Governments, including the City of Vincent.

If part of a town centre development, there will exist the opportunity to share parking will adjacent land uses as well as provide reciprocal parking demand for other synergistic land uses such as retail and entertainment. When located in conjunction with other land uses, a rate of 2 spaces per 100 sq.m is recommended as a benchmark.

> Consider the use of parking concessions, shared-use, on-street and reciprocal parking to minimise off-street supply requirements in the Swan Parking Policy
> Consider the impact of alternative measures to encourage reduced parking provision on-site (end-of-trip facilities, green travel plans etc.)
> Prepare and implement parking management strategies within the Swan Parking Policy which support the use of on-street facilities by residential visitors

20.2.3 Retail

These parking supply rates are clearly outdated and it is recommended that the LPS 17 parking policy should be revised to reflect contemporary retail parking demands. A rate of 6 spaces per 100 sq.m is considered a reasonable starting point. A revised policy, when implemented, should allow for parking to be provided at lower rates, where sufficiently demonstrated through analysis or where approved structure plans permit.

> Implement lower retail parking provision standards that are consistent with the desired demand profile
> Prepare and implement a consolidated Swan Parking Policy consistent with the goals of individual Centres

20.2.4 Residential

Tenant parking within large multiple grouped dwelling developments should be provided off-street in secured facilities due to the general lack of passive surveillance from the street or the dwelling itself. Detached homes and large townhouse developments can provide open air parking in dedicated driveways on development lots. Visitor parking should be provided on-street, as a first preference in all instances, either indented or within the carriageway as road traffic volumes dictate.

> Prepare and implement a consolidated Swan Parking Policy which supports the use of on-street facilities by residential visitors

20.2.5 Entertainment

It is recommended that further work is undertaken to update the parking requirements for these land uses within the LPS 17 policy, or insert a requirement for developers to assess parking requirements on a case by case basis.

> Undertake a study of entertainment parking demands to establish a reasonable benchmark for the Swan Parking Policy

20.2.6 Education

Where education facilities are proposed in central locations, reduced on-site parking/no on-site parking should be the preference and the consideration of these land uses should be included in the parking strategy/management plan for these locations.

For isolated sites, consideration should be given to the effects of pick-up/drop-off and overspill parking into surrounding streets and the road safety implications of this occurring off-site. Pick-up/drop-off should be provided and managed on-site. Where this is not possible, the City should give consideration to enforcement of clearways and residential parking schemes such that the safety and amenity of surrounding streets is not compromised by peak school traffic volumes and parking.

> Undertake site-specific parking and access studies at all public education facilities designed to minimise the risks and improve the function at peak pick-up/drop-off times
> Require similar studies to be undertaken as part of any private school expansion

21 Summary of Strategic Recommendations

The preceding Transport Strategy outlines the need for a range of environmental, health, social, cultural, economic, urban design, built form and engineering initiatives. These initiatives are categorised by transport mode and function and compiled into a series of recommendations which are included in the Executive Summary at the start of this document.

The Transport Strategy attempts to address the vast range of needs of the City's current transport system, recognising the significant growth projected within the City. Through discussion of the gaps in information and infrastructure the goals of an integrated transport system are outlined. With prioritised recommendations and general principles considered for future implementation.

The issues identified through this process are considered important for the safe, effective function of the City transport environment. However, there is a substantial volume of work to be done in planning, policy and infrastructure which needs to be prioiritised and implemented. Therefore, a further body of work should be undertaken, constituting a Phase 2 to this Integrated Transport Strategy, consisting of the preparation of a Transport Infrastructure Implementation Plan.

This Transport Infrastructure Implementation Plan will draw from the goals established in the Transport Strategy component described herein and provide a set of measurable actions that the City will need to implement in order to achieve an integrated transport network throughout the municipality. This detailed action plan is intended to inform an implementation program which prioritises required actions for the City of Swan as well as external agencies such as Main Roads WA, Department of Transport, Department of Planning and Public Transport Authority.

Table 21-1 Summary of Strategic Transport Recommendations

	Chapter	Recommendation	Trigger / Timeframe	Priority
Freight				
Malaga	14	Investigate freight connectivity to Malaga as part of PDNH construction	Design Phase: PDNH	High
Hazelmere	14, 19.6	Investigate connectivity between Roe Highway and Hazelmere to provide a legitimate alternative link	Design Phase: Roe Highway Upgrade	High
Hazelmere	14, 19.6	Investigate Abernethy Road / Adelaide Street connection to improve internal legibility within the HEASP	Design Phase: Lloyd Street Southern Extension	Medium
Hazelmere	14, 19.6	Undertake Local Area Traffic Management planning exercise for the precinct surrounding the HEA, particularly focused on restricting HV access to the HEA via West Parade, Lloyd Street north of Clayton Street and Kalamunda Road	Design Phase: Lloyd Street Southern Extension	High
Midland	14.1	Continue to promote realignment of the Midland Freight Rail	Ongoing	High
Swan	14.2	Conduct a study to prioritise grade separation of critical rail crossings	2014	Medium
Cycling				
Swan	15	Introduce minimum infrastructure standards for cycling facilities into planning policies	2014	Low
Swan	15	Create a detailed City of Swan Bike Plan which develops the concepts of the WABN, incorporating and revisiting all works already completed.	2014/15	Medium
Swan	15	Implement the recommendations of the Swan CycleConnect plan	2014-2018	High
Albion	15	Undertake a review of the Urban Growth Corridor planning for cycling infrastructure, reflecting the	2014/15	Medium

	Chapter	Recommendation	Trigger / Timeframe	Priority
		changes to regional road linkages		
Midland / Bellevue	15	Support the extension of the Midland PSP to Roe Highway and Bellevue	Ongoing	Medium
Public Transport				
Ballajura / Malaga	16.1.1	Support connections between MAX and nearby residential / employment zones	Implementation Phase: MAX LRT	High
Ballajura / Malaga	16.1.1	Undertake an independent demand study to promote effective bus transport links to MAX	Design Phase: MAX LRT	High
Swan	16	Undertake an independent demand study to promote effective bus links	2014	Medium
Swan	16	Undertake a public transport connectivity assessment to ensure adequate access to public transport modes	2014	High
Ellenbrook	16.1.2	Support replacement of the 334, 335, 336 and 337 bus routes with an internal loop service as Ellenbrook redevelops	Ellenbrook redevelopment	Low
Ellenbrook	16.1.2	Support increased 955/956 service frequencies as an interim BRT	2014	Medium
Ellenbrook	16.1.6	Support implementation of Rapid Transit to Ellenbrook	2014/15	High
Ellenbrook / Bullsbrook	16.1.2	Support rapid transit between Ellenbrook and Bullsbrook either as a dedicated link or as an extension of Midland-Ellenbrook services.	2015	Medium
Ellenbrook	16.1.2	Investigate the viability of an alternative Rapid Transit alignment from Ellenbrook via the Urban Growth Corridor to Midland, as it develops	2014/15	Medium
Ellenbrook / Albion	16.1.6	Support Rapid Transit alignments that meet the planning goals of the City (i.e. connections to the Midland Activity Centre and through the Urban Growth Corridor)	Development of the Urban Growth Corridor	High
Beechboro	16.1.3	Support frequency improvements for the 341, 342 and 343 bus routes as demand increases	2015/16 or as demand/densities increase	Medium
Beechboro / Malaga	16.1.3	Investigate the viability of connection between Beechboro and Malaga as a deviation of the 889 or additional service	2015/16	Medium
Beechboro	16.1.3	Support increased 955/956 service frequencies as an interim BRT	2014	Medium
Ballajura	16.1.4	Evaluate the function of the 378 and 379 coverage services and the replacement of these with improved 886/889 frequencies	2014/15	Medium
Stratton / Midland / Jane Brook / Swan View	16.1.5	Support improvements in existing services that are local to Midland	Redevelopment of Midland City Centre	Medium
Midland	16.1.5	Undertake an independent study to promote effective bus transport links to Midland, focusing on local precincts, optimal routes, frequency and demand	2015	High
Midland	16.1.7	Support implementation of the Midland Station relocation	2014	High
Pedestrians				

	Chapter	Recommendation	Trigger / Timeframe	Priority
Swan	17.1	Introduce minimum infrastructure standards for pedestrian facilities into planning policies	2014	Low
Swan	17.1	Undertake Walkability Plans for precincts wherever significant change is expected, or in older suburbs without quality infrastructure	2014-2016, or coincident with significant redevelopment planning	Medium
Swan	17.1	Undertake a Pedestrian Crossing of Strategic Corridors Study for all strategic roads abutting public transport routes, schools, education or employment nodes to identify and mitigate connectivity or safety issues	2014/15	High
Midland	17.2	Implement the pedestrian-oriented aspects of the Midland Activity Centre Structure Plan and the Midland Place Plan	Redevelopment of Midland City Centre	High
Midland	17.2	Investigate pedestrian improvements to allow better crossing of GEH in Midland	2014/15	High
Guildford	17.3	Improve pedestrian crossing facilities at Meadow Street/Terrace Road	2015/16	Medium
Guildford	17.3	Support signalised pedestrian crossing at Guildford Station	2014/15	Low
The Vines	17.4	Implement the recommendations of The Vines Pedestrian Study	2014-2016	Medium
Intersections and Roads				
Swan	18.1	Design and plan for road duplications as defined by the 2031 ROM This will include the identification of sections of road currently undersized compared to the 2031 ROM network, as well as sections of road that are expected to be undersized by 2031 that the 2031 ROM network does currently not include.	2015-2018	Medium
Swan	18.1	Monitor the requirements and triggers for road duplication	Ongoing	Medium
Midland	18.2	Revise Midland City Centre modelling to reflect the most recent ROM outputs, once the alignments of all strategic roads are finalised and assuming the inclusion of the Lloyd Street Southern Extension	2014	High
Midland	18.2	Undertake a GEH corridor study through Midland to determine the form and access opportunities for local traffic	2014	High
Midland	18.2	Investigate the opportunities to downgrade GEH through Midland to provide a better outcome for the City	2014	High
Guildford	18.3	Undertake LATM works to minimise heavy vehicle traffic along GEH and West Parade	Implementation Phase: Lloyd Street Southern Extension	High
Guildford	18.3	Improve alternative routes including Lloyd Street and GEH Bypass	Implementation Phase: Lloyd Street Southern Extension / HEASP	High
Guildford	18.3	Maintain the existing road constraints as a method of restraining undesirable traffic demand	Ongoing	High
Swan	18.4	Ensure large-scale infrastructure planning includes the impact on connecting roads and parallel routes	Design Phase: Roe Highway Upgrade/PDNH	High

	Chapter	Recommendation	Trigger / Timeframe	Priority
Swan	18.4	Monitor intersection function adjacent to growth areas (e.g. Urban Growth Corridor / Ellenbrook)	LSP/Sub-Division Application	Medium
Swan	18.4	Consider ultimate intersection form in the context of the attached Transport Assessment	Ongoing	Medium
Beechboro	19.1	Support the diversion of heavy vehicle traffic away from Beechboro Road and Marshall Road towards Reid Highway and PDNH	Implementation Phase: PDNH	Medium
Beechboro	19.1	Plan for redevelopment of Beechboro Road and Marshall Road to improve their function as residential distributor roads	Implementation Phase: PDNH/Roe Highway Upgrade	Low
Malaga	19.1	Promote improvements to wayfinding to support heavy vehicle use of the primary road network	Implementation Phase: PDNH/Roe Highway Upgrade	Medium
Albion	19.2	Continue to advocate for connections between the regional road network and Midland / Urban Growth Corridor	Design Phase: PDNH/Roe Highway Upgrade	High
Midland / Albion	19.2	Support or undertake independent impact assessment of the proposed Roe Highway upgrades on the function of the sub-regional road network	Design Phase: Roe Highway Upgrade	High
Caversham	19.5	Investigate the long-term potential and cost/benefit of a direct link between Benara Road and Morrison Road, under the proposed strategic road network	2018-2020	Low
Bellevue	19.7	Undertake cost-benefit analysis and traffic impact assessment for the potential Katharine - Horace connection, including the possibility of future extension of the Midland passenger rail	2015/16	Medium
Bellevue	19.3	Undertake a review of Farrall Road with respect to the impacts of the Roe Highway Upgrade	Design Phase: PDNH/Roe Highway Upgrade	Medium
Midland	19.8	Investigate the constraints associated with the duplication of Morrison Road and undertake a cost/benefit analysis	2014/15	Low
Ellenbrook	19.10	Undertake modelling to determine the need and impact of the Ellenbrook Northern Access	2015/16	Low
Bullsbrook	19.1	Investigate the need for, and the implementation of, a connection from the PDNH in the vicinity of Maralla Road/Warbrook Road	Design Phase: PDNH	Low
The Vines	19.11	Undertake or request demand modelling for the Rose Street Bridge connection. Determine the future impact and benefits of this connection	2016/17	Low
Beechboro	19.12	Request specific improvements to the ROM for the Altone Road corridor	2014	High
Beechboro	19.12	Undertake an assessment of the Altone Road corridor performance for a revised 2031 scenario	2014	Medium
Beechboro	19.13	Investigate a revised Marshall Road corridor design consistent with its ultimate function, including multi-modal considerations	Post construction: PDNH/Roe Highway Upgrade	Medium
West Swan	19.14	Undertake a cost-benefit analysis for the Arthur Street Bridge under the proposed development scenario	2015/16	Low
Malaga	19.15	Request specific improvements to the ROM for the Hepburn Avenue corridor	2014	Medium
Malaga	19.15	Undertake an assessment of this corridor	2014	Medium

	Chapter	Recommendation	Trigger / Timeframe	Priority
		performance for a revised 2031 scenario		
Hazelmere	19.16	Request specific improvements to the ROM for the Lloyd Street corridor	2014	High
Hazelmere	18.1	Undertake traffic modelling to inform triggers and timing for the duplication of Midland Road	2015	Medium
Hazelmere	19.6	Support a bridge connection between the northern and southern portions of the HEASP over the GEHB	2014	High
Middle Swan / Midland / Hazelmere	19.16	Undertake an assessment of the Lloyd Street corridor performance for a revised 2031 scenario	2014	High
Middle Swan	19.16	Undertake a detailed analysis of the local traffic environment in the Lloyd Street / Great Northern Highway / Bishop Street precinct	Design phase: Lloyd Street Extension	High
Bullsbrook	19.1	Investigate the timing and form of Stock Road and associated intersection treatments as a result of regional road upgrades and local development requirements	Post construction: PDNH upgrade or Structure Plan Phase: Northern Gateway	Medium
Bullsbrook	19.1	Undertake a rail crossing upgrade study for the Stock Road rail crossing	Post construction: PDNH upgrade or Structure Plan Phase: Northern Gateway	Medium
Bullsbrook	19.17	The impact of potential improvements to Neaves Road, including grade separation at the PDNH, duplication and/or realignment should be evaluated	Post construction: PDNH upgrade	Medium
Gidgegannup	19.4	Undertake a study to identify development and traffic growth triggers for the Perth to Adelaide National Highway (PANH) and Hills Spine Road	2014/15	Low
Parking				
Midland	20.1.1	Implement policy changes, including mandatory cash-in-lieu, to create an internal parking cap for Midland	2014/15	Medium
Midland	17.2	Implement the parking recommendations of the Midland Activity Centre Structure Plan and the Midland Access and Parking Plan	Ongoing	Medium
Midland	20.1.1	Undertake an education program to ensure developers are not dissuaded from investing in the Midland Activity Centre	2014/15	High
Midland	20.1.1	Investigate the requirements and triggers for policy changes and infrastructure provision through to the full build-out of the Centre. (i.e. create a Transitional Parking Plan)	2014	High
Midland	20.1.1	Continue to modify the Midland Access and Parking Plan to transition towards the ultimate policy destination	Ongoing	Medium
Midland	16.1.7	Maintain pressure through adjacent parking management to minimise the impact of the proposed Park ‘n’ Ride	2016-18	Low
Ellenbrook	20.1.2	Complete a revised Parking Assessment for Ellenbrook, based on its existing form and forward projections for its feasible growth	2014	High
Ellenbrook	20.1.2	Implement a new, more equitable and feasible policy for parking provision within the Ellenbrook Centre as part of the Swan Parking Policy	2014/15	High
Ellenbrook	20.1.2	Create a simplified section of the Swan Parking	2015/16	Medium

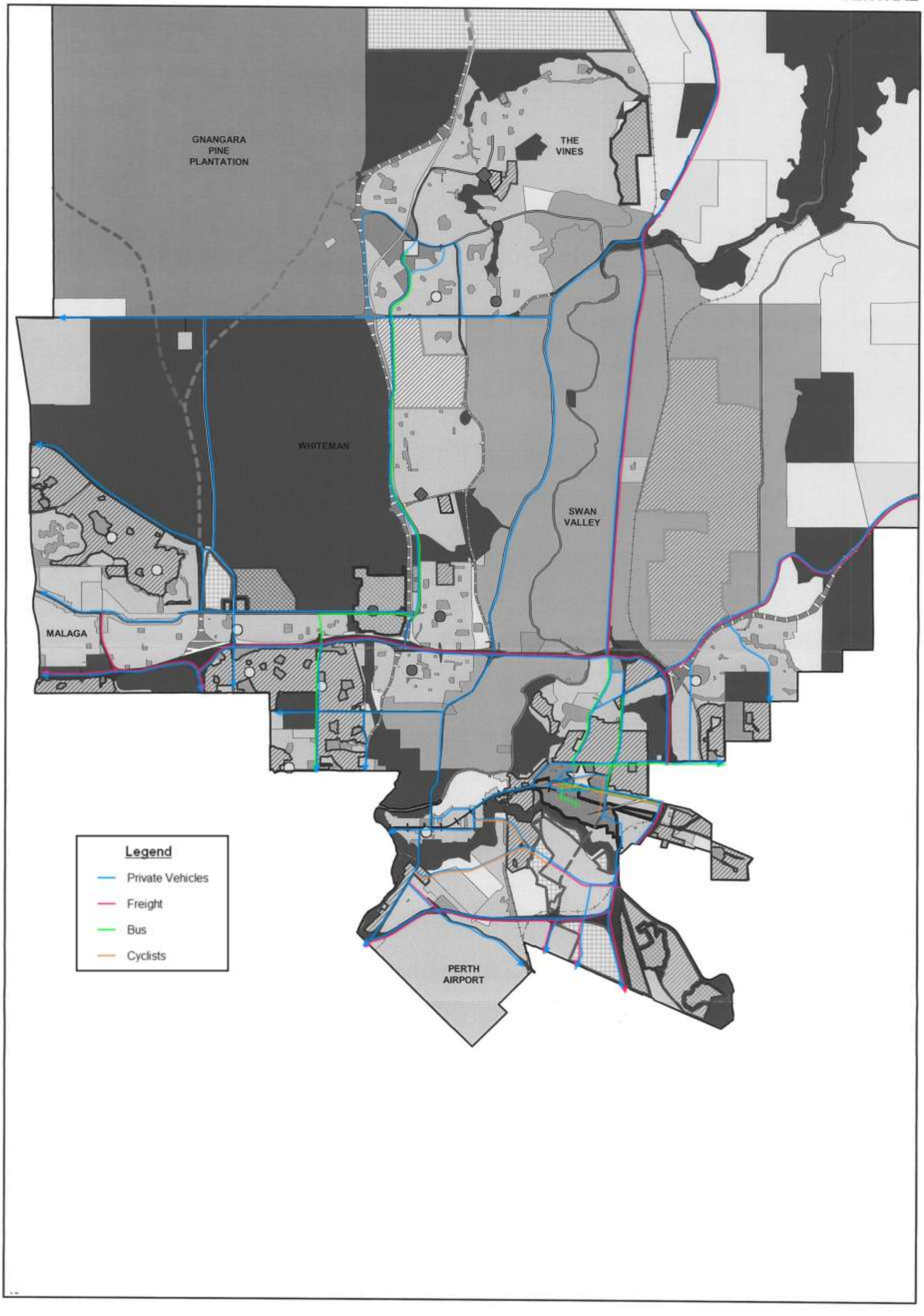
	Chapter	Recommendation	Trigger / Timeframe	Priority
		Policy detailing the target and transition rates for parking provision within a simplified range of land uses		
Guildford	20.1.4	Development a parking strategy for Guildford, as part of the Swan Parking Policy.	2014/15	High
Malaga	20.1.4	Undertake a Malaga Parking Study, consisting of investigation, concept design and prioritisation works	2014	High
Albion	20.1.3	Develop a parking strategy for District Centres in concert with the progression of the Urban Growth Corridor, as part of the Swan Parking Policy	LSP/Sub-division Application Phase	Medium
Swan	20.1.5, 20.2.2	Consider the use of parking concessions, shared-use, on-street and reciprocal parking to minimise off-street supply requirements in the Swan Parking Policy	2015	Low
Swan	20.2.2	Consider the impact of alternative measures to encourage reduced parking provision on-site (end-of-trip facilities, green travel plans etc.)	2015	Medium
Swan	20.1.5	Prepare and implement Centre parking within the Swan Parking Policy consistent with the goals of individual Centres	205/16	Medium
Swan	20.2.2	Prepare and implement parking management strategies within the Swan Parking Policy which support the use of on-street facilities by residential visitors	2014/15	Low
Swan	20.2.5	Undertake a study of entertainment parking demands to establish a reasonable benchmark for the Swan Parking Policy	2015/16	Low
Swan	20.2.6	Undertake site-specific parking and access studies at all public education facilities designed to minimise the risks and improve the function at peak pick-up/drop-off times	2014/15	Medium
Swan	20.2.6	Require site-specific parking and access studies to be undertaken as part of any private school expansion	2014/15	Medium

Strategic Transport Assessment

APPENDIX A
TRANSPRIORITY AND TRANSPORT NETWORK ASSESSMENT

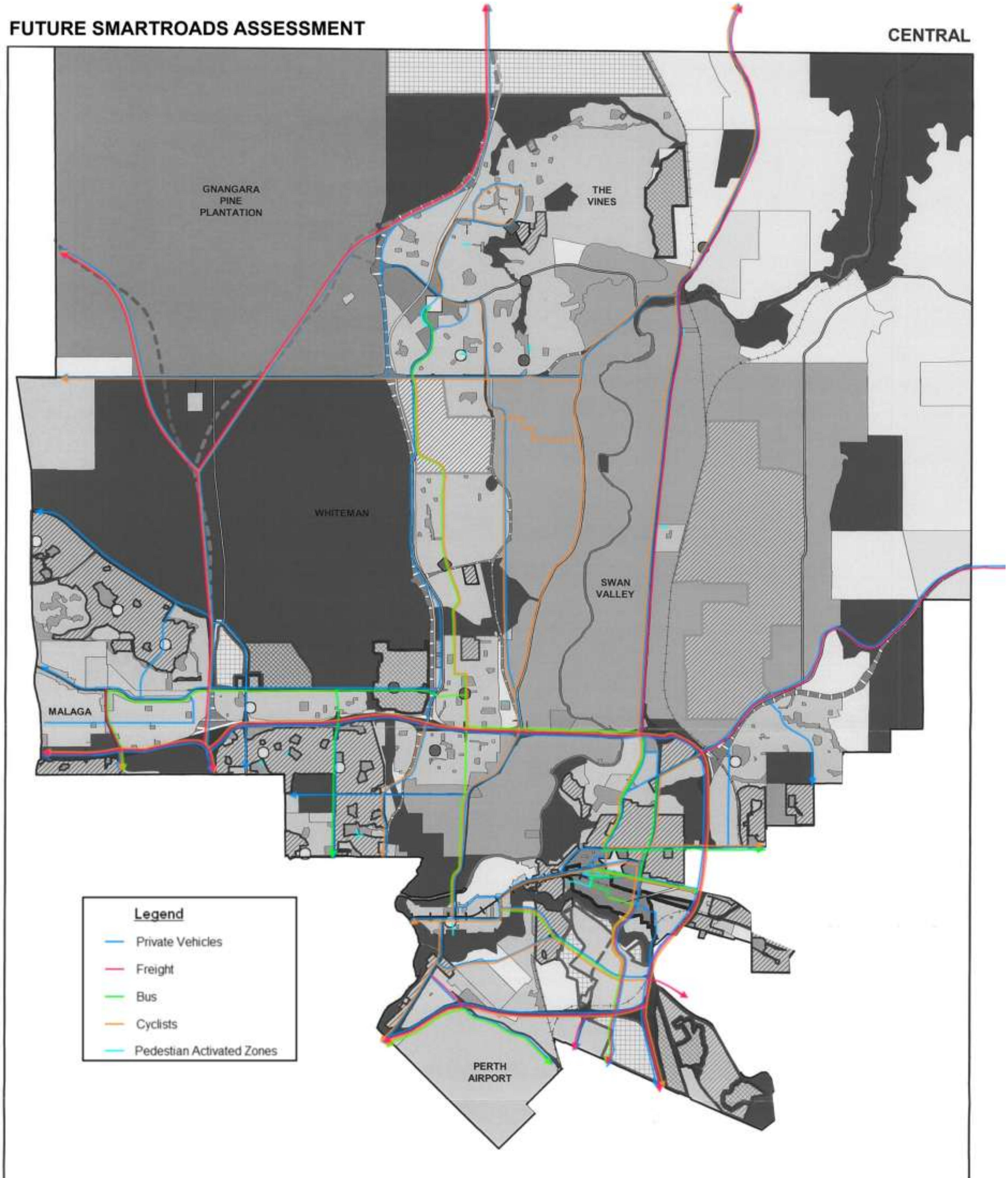
EXISTING SMARTROADS ASSESSMENT

CENTRAL



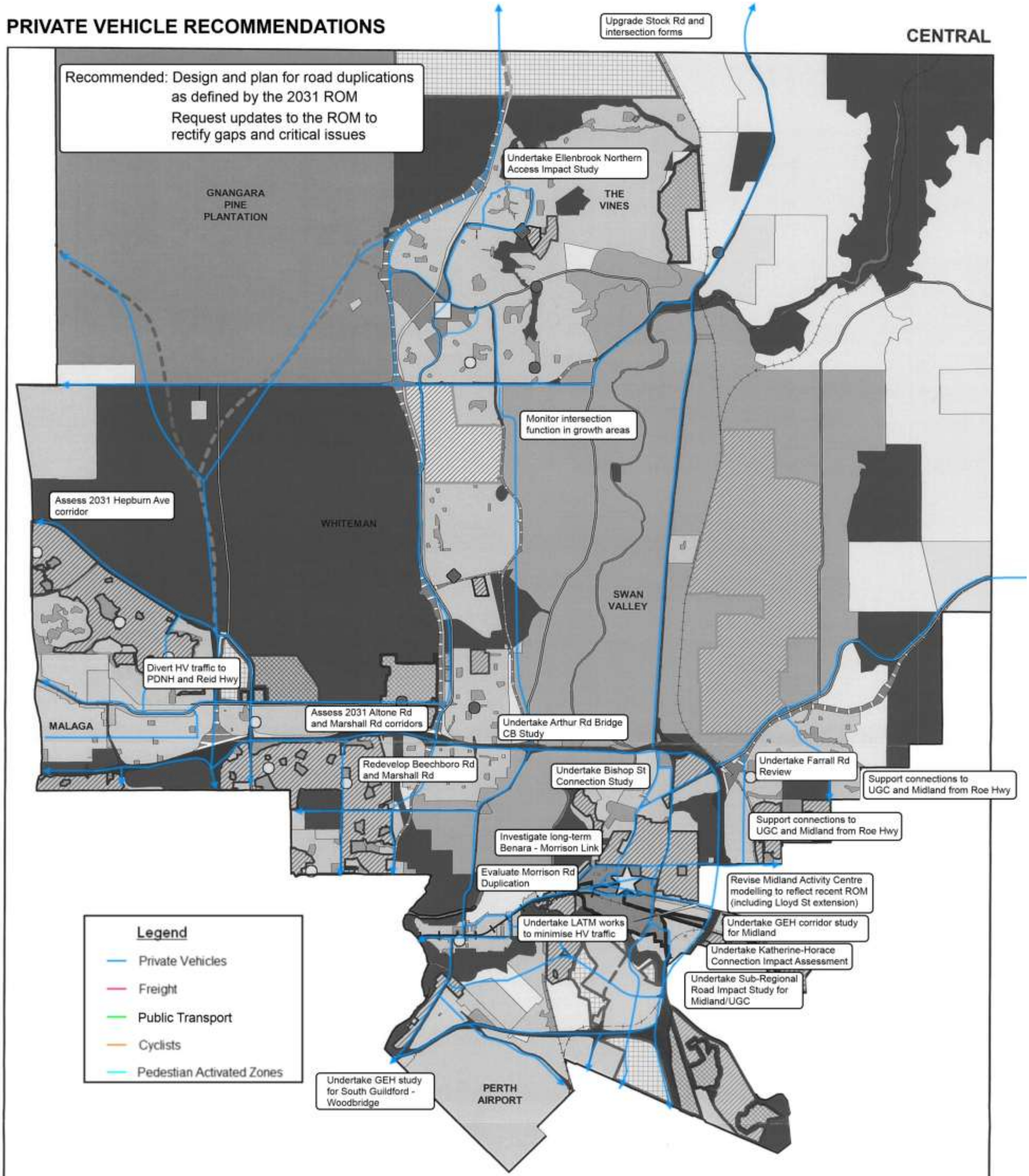
FUTURE SMARTROADS ASSESSMENT

CENTRAL



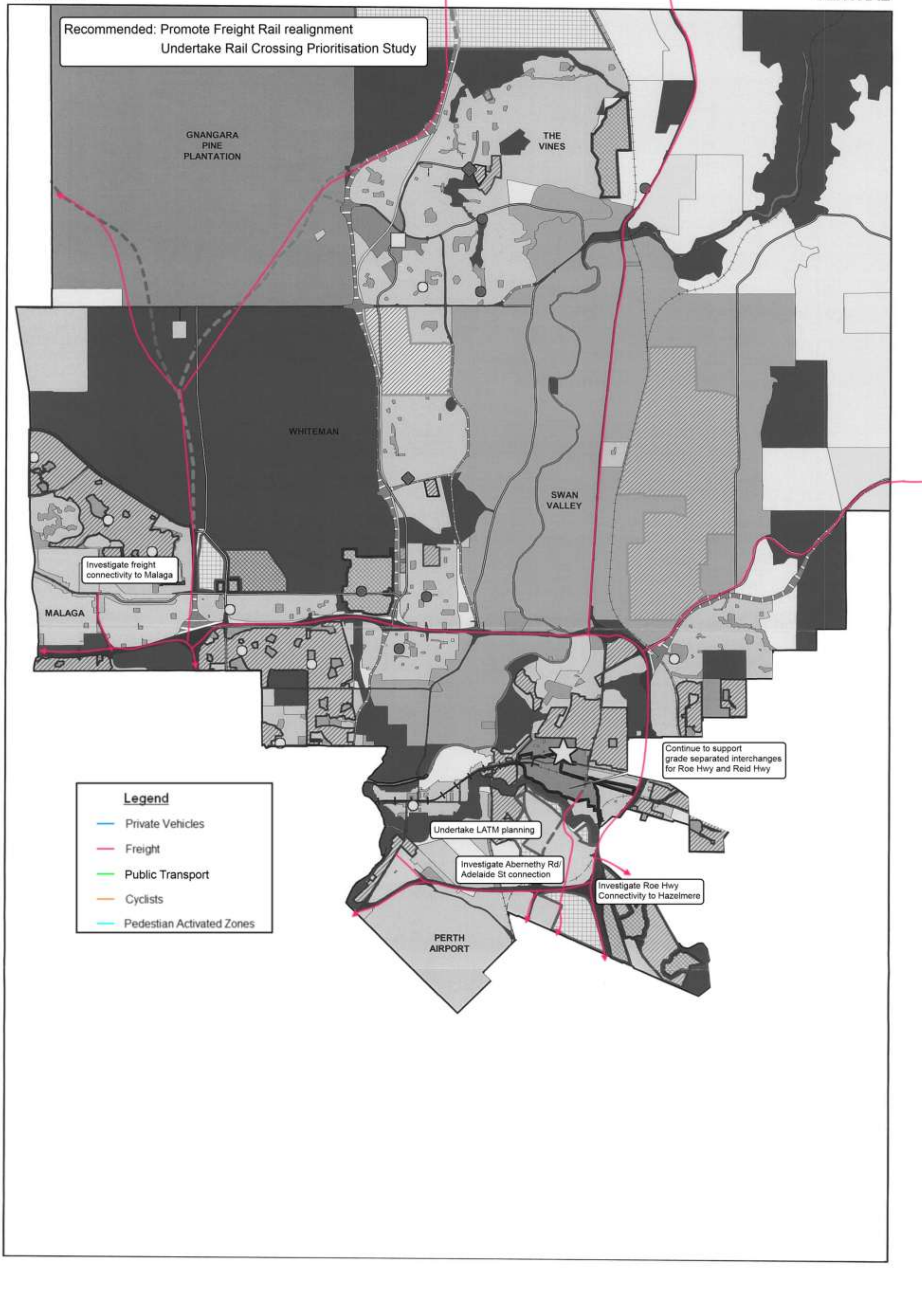
PRIVATE VEHICLE RECOMMENDATIONS

CENTRAL



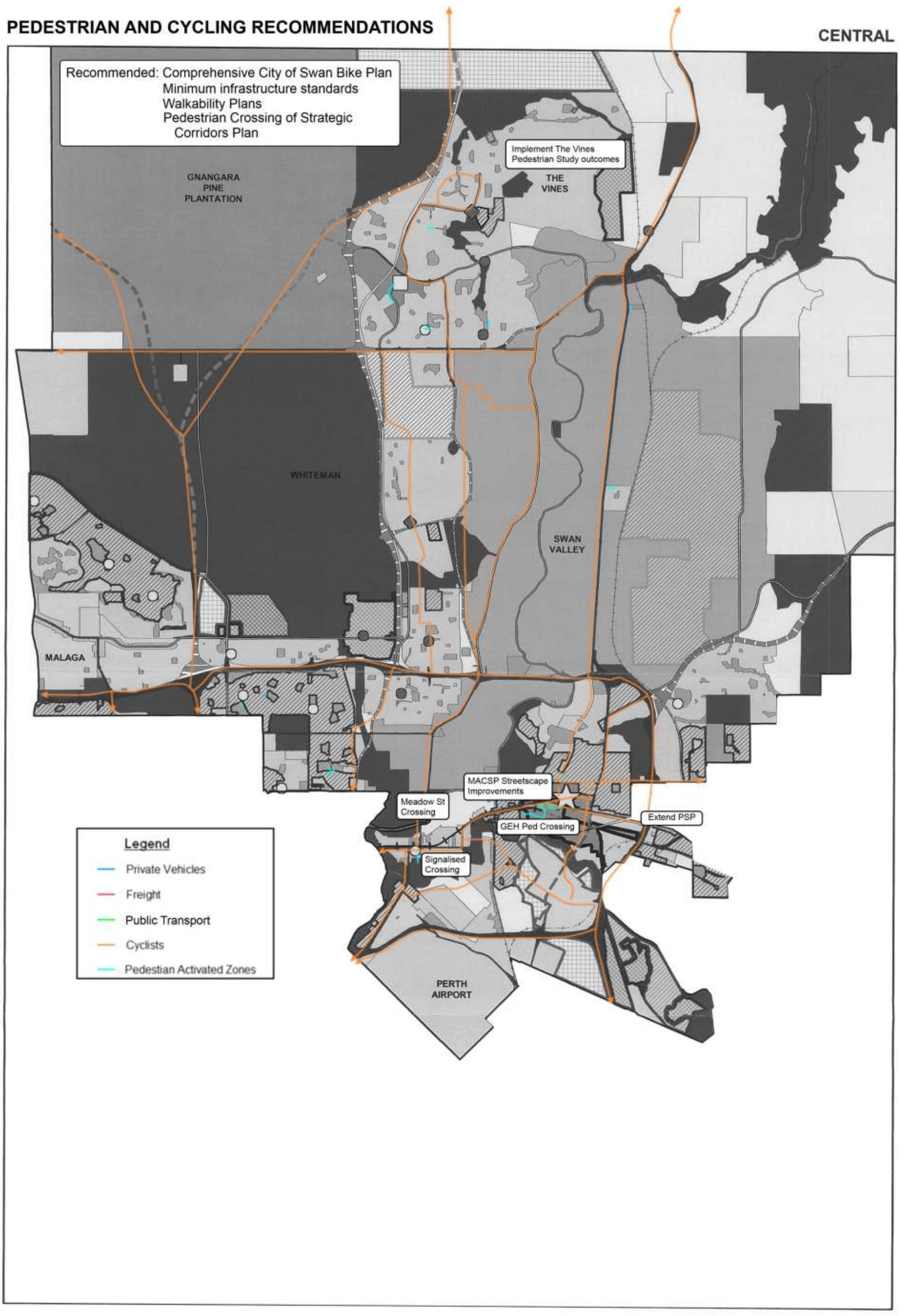
FREIGHT

CENTRAL



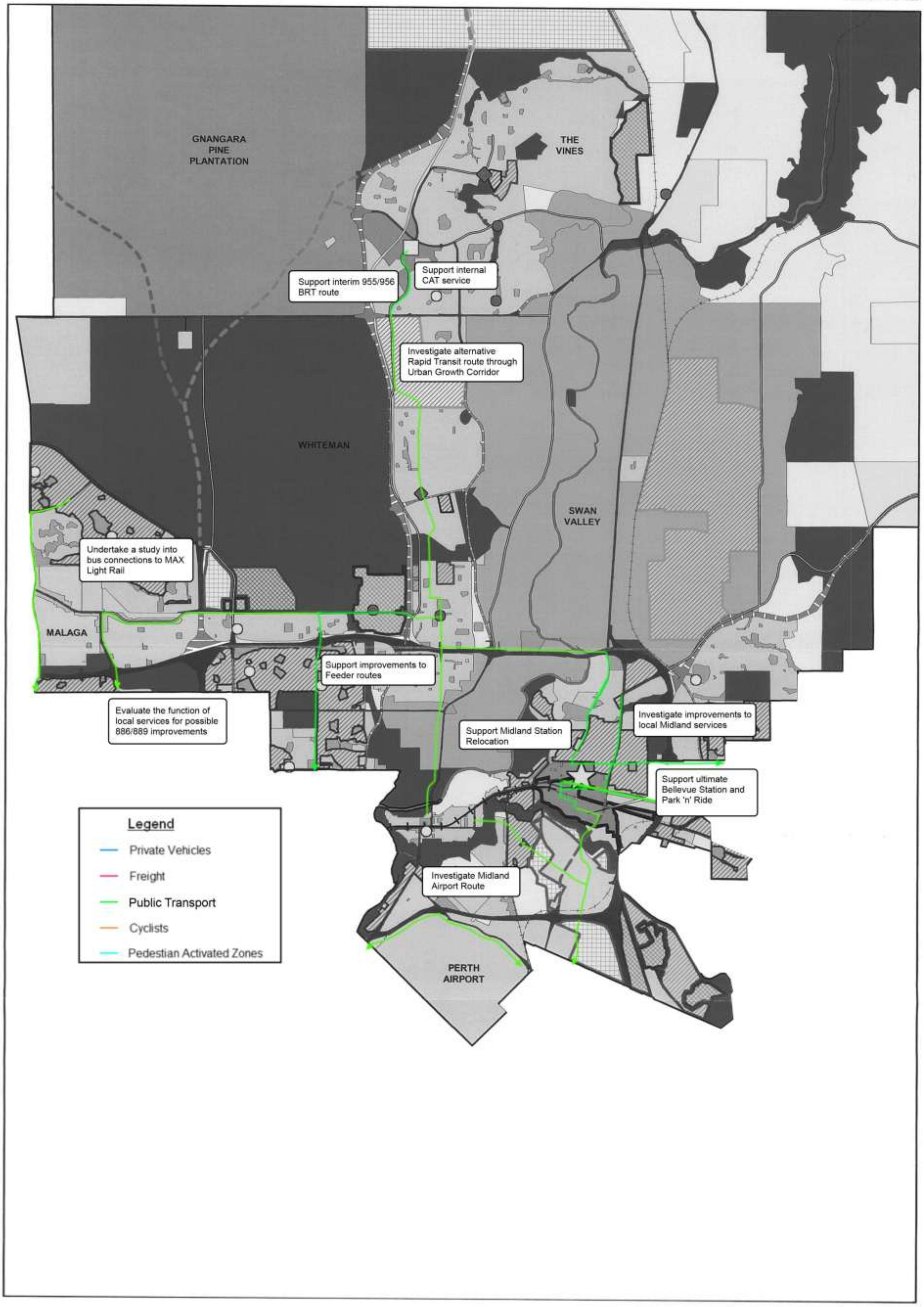
PEDESTRIAN AND CYCLING RECOMMENDATIONS

CENTRAL



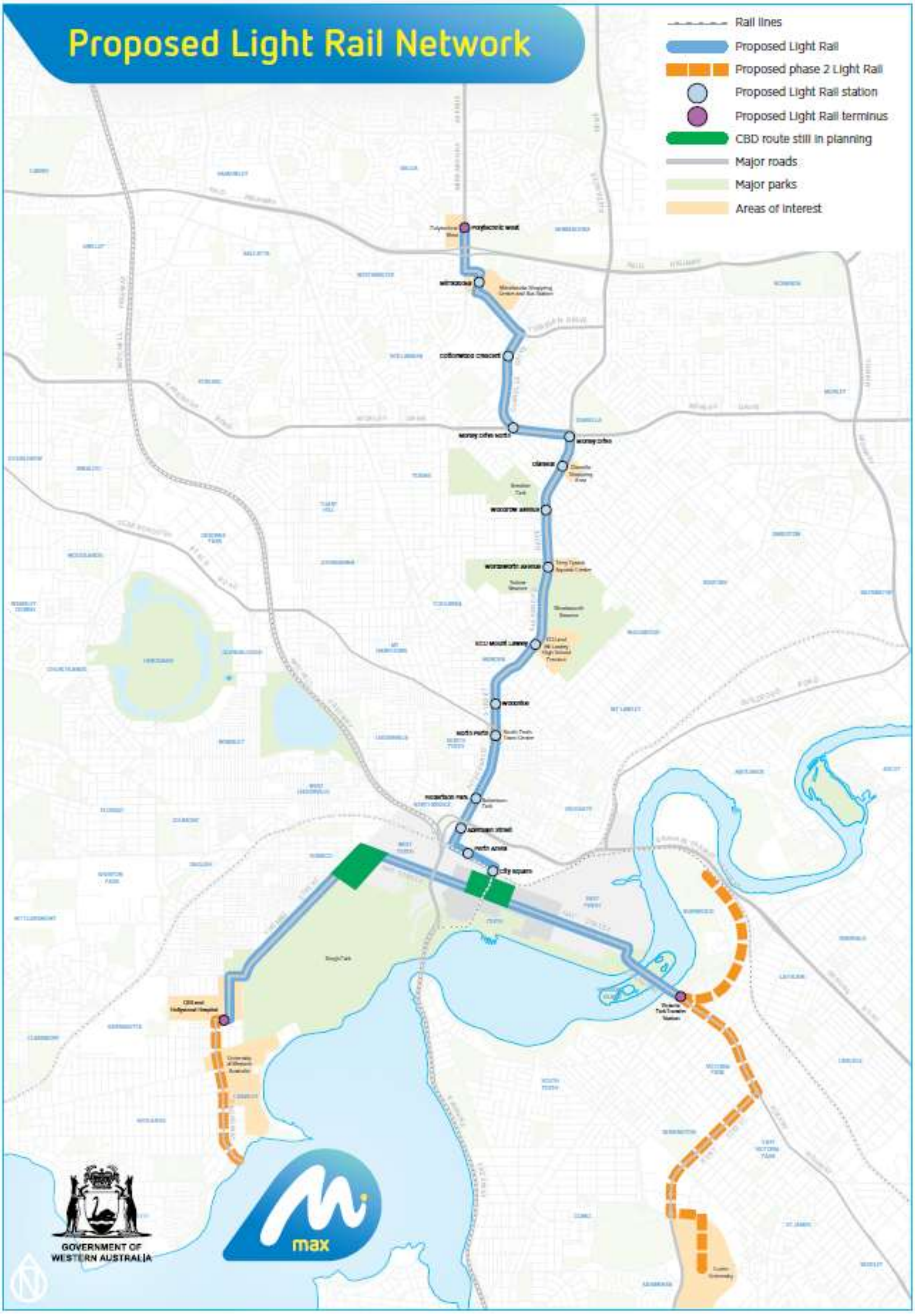
PUBLIC TRANSPORT

CENTRAL



Strategic Transport
Assessment

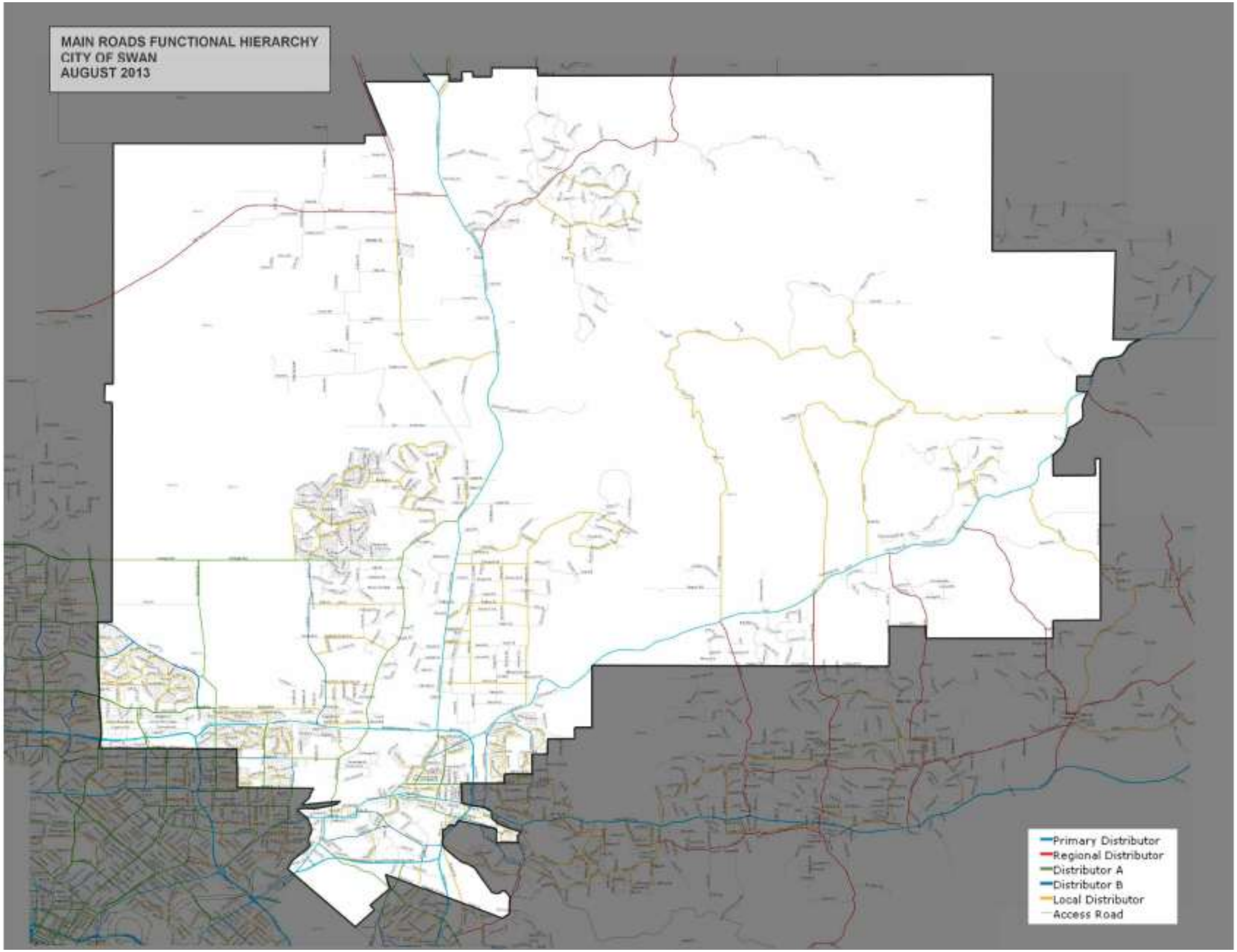
APPENDIX B
PROPOSED LIGHT RAIL ROUTE


Proposed Light Rail Network
Rail lines
Proposed Light Rail
Proposed phase 2 Light Rail
Proposed Light Rail station
Proposed Light Rail terminus
CBD route still in planning
Major roads
Major parks
Areas of interest
GOVERNMENT OF WESTERN AUSTRALIA
max

Transport Strategy

APPENDIX C
MAIN ROADS FUNCTIONAL HIERARCHY

Shaping the Future


MAIN ROADS FUNCTIONAL HIERARCHY
CITY OF SWAN
AUGUST 2013
Primary Distributor
Regional Distributor
Distributor A
Distributor B
Local Distributor
Access Road

Transport Strategy

APPENDIX D
SIDRA OUTPUTS

Cardno
Shaping the Future

Table D-1 SIDRA Outputs - West Swan Road and Benara Road (2031 AM Peak)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: West Swan Road (South)											
1	L	677	0.0	0.711	21.4	LOS C	18.4	128.9	0.81	0.85	42.5
2	T	603	0.0	0.821	41.6	LOS D	13.5	94.4	1.00	0.95	29.5
Approach		1280	0.0	0.821	30.9	LOS C	18.4	128.9	0.90	0.90	35.2
North: West Swan Road (North)											
8	T	878	0.0	0.399	6.9	LOS A	9.7	68.2	0.48	0.42	55.3
9	R	649	0.0	0.874	44.8	LOS D	29.8	208.8	0.99	0.97	29.6
Approach		1527	0.0	0.874	23.0	LOS C	29.8	208.8	0.70	0.66	40.5
West: Benara Road (West)											
10	L	539	0.0	0.497	12.6	LOS B	6.7	46.9	0.43	0.75	50.6
12	R	603	0.0	0.885	52.3	LOS D	16.0	112.1	1.00	0.94	27.0
Approach		1142	0.0	0.885	33.6	LOS C	16.0	112.1	0.73	0.85	34.7
All Vehicles		3949	0.0	0.885	28.6	LOS C	29.8	208.8	0.77	0.79	36.9

Table D-2 SIDRA Outputs - West Swan Road and Benara Road (2031 PM Peak)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: West Swan Road (South)											
1	L	667	0.0	0.591	15.3	LOS B	11.0	76.9	0.65	0.81	47.7
2	T	660	0.0	0.740	29.7	LOS C	11.3	79.3	0.99	0.89	34.7
Approach		1327	0.0	0.740	22.5	LOS C	11.3	79.3	0.82	0.85	40.2
North: West Swan Road (North)											
8	T	366	0.0	0.175	6.6	LOS A	3.1	21.6	0.47	0.39	55.7
9	R	429	0.0	0.808	39.7	LOS D	15.5	108.2	0.99	0.93	31.7
Approach		795	0.0	0.808	24.5	LOS C	15.5	108.2	0.75	0.68	39.6
West: Benara Road (West)											
10	L	479	0.0	0.439	12.8	LOS B	5.5	38.3	0.48	0.76	50.3
12	R	660	0.0	0.848	42.2	LOS D	13.9	97.4	0.99	0.92	30.7
Approach		1139	0.0	0.848	29.8	LOS C	13.9	97.4	0.77	0.85	36.7
All Vehicles		3261	0.0	0.848	25.5	LOS C	15.5	108.2	0.79	0.81	38.8

Table D-3 SIDRA Outputs - West Swan Road and Harrow Street (2031 AM Peak)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: West Swan Road (South)											
1	L	360	0.0	0.449	12.8	LOS B	3.7	26.2	0.47	0.74	50.4
2	T	749	0.0	0.780	28.4	LOS C	12.4	86.5	0.99	0.93	35.4
Approach		1109	0.0	0.780	23.3	LOS C	12.4	86.5	0.82	0.87	39.2
North: West Swan Road (North)											
8	T	952	0.0	0.614	10.4	LOS B	14.2	99.1	0.69	0.61	50.0
9	R	342	0.0	0.921	52.9	LOS D	14.3	99.8	1.00	1.08	26.8
Approach		1294	0.0	0.921	21.7	LOS C	14.3	99.8	0.77	0.73	40.8
West: Harrow Street (West)											
10	L	360	0.0	0.468	12.8	LOS B	3.8	26.9	0.47	0.75	50.3
12	R	722	0.0	0.892	40.8	LOS D	18.0	126.0	0.96	0.95	31.2
Approach		1082	0.0	0.892	31.5	LOS C	18.0	126.0	0.80	0.88	35.8
All Vehicles		3485	0.0	0.921	25.3	LOS C	18.0	126.0	0.80	0.82	38.6

Table D-4 SIDRA Outputs - West Swan Road and Harrow Street (2031 PM Peak)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: West Swan Road (South)											
1	L	632	0.0	0.682	13.1	LOS B	6.4	44.6	0.61	0.79	50.0
2	T	864	0.0	0.692	17.5	LOS B	9.9	69.3	0.93	0.83	42.6
Approach		1496	0.0	0.692	15.6	LOS B	9.9	69.3	0.79	0.82	45.5
North: West Swan Road (North)											
8	T	535	0.0	0.291	4.6	LOS A	4.0	28.0	0.48	0.40	58.4
9	R	287	0.0	0.859	38.8	LOS D	8.4	59.1	1.00	1.02	32.1
Approach		822	0.0	0.859	16.5	LOS B	8.4	59.1	0.66	0.62	45.5
West: Harrow Street (West)											
10	L	272	0.0	0.345	12.9	LOS B	2.5	17.2	0.53	0.75	50.2
12	R	369	0.0	0.902	39.6	LOS D	7.4	51.7	0.99	0.97	31.8
Approach		641	0.0	0.902	28.2	LOS C	7.4	51.7	0.80	0.88	37.7
All Vehicles		2959	0.0	0.902	18.6	LOS B	9.9	69.3	0.76	0.77	43.5

Table D-5 SIDRA Outputs - Lord Street and Harrow Street (2031 AM Peak)

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Lord Street (South)											
2	T	1037	0.0	0.702	8.2	LOS A	10.4	72.6	0.16	0.48	61.6
3	R	409	0.0	0.702	11.3	LOS B	10.4	72.6	0.17	0.77	46.5
Approach		1446	0.0	0.702	9.1	LOS A	10.4	72.6	0.16	0.56	56.6
East: Harrow Street (East)											
4	L	616	0.0	0.846	21.9	LOS C	10.7	74.7	1.00	1.27	42.1
6	R	12	0.0	0.027	18.7	LOS B	0.1	0.9	0.73	0.83	45.9
Approach		628	0.0	0.846	21.8	LOS C	10.7	74.7	0.99	1.26	42.2
North: Lord Street (North)											
7	L	8	0.0	0.438	8.5	LOS A	2.8	19.7	0.65	0.74	48.6
8	T	1106	0.0	0.616	11.6	LOS B	5.8	40.6	0.70	0.77	56.6
Approach		1114	0.0	0.616	11.6	LOS B	5.8	40.6	0.70	0.77	56.6
All Vehicles		3188	0.0	0.846	12.5	LOS B	10.7	74.7	0.51	0.77	53.2

Table D-6 SIDRA Outputs - Lord Street and Harrow Street (2031 PM Peak)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Lord Street (South)											
2	T	1074	0.0	0.429	8.1	LOS A	3.6	25.0	0.02	0.53	63.1
3	R	364	0.0	0.429	11.2	LOS B	3.5	24.8	0.03	0.80	46.7
Approach		1438	0.0	0.429	8.9	LOS A	3.6	25.0	0.02	0.60	58.1
East: Harrow Street (East)											
4	L	450	0.0	0.461	10.3	LOS B	2.9	20.4	0.71	0.80	51.9
6	R	1	0.0	0.002	16.8	LOS B	0.0	0.1	0.60	0.66	47.5
Approach		451	0.0	0.461	10.3	LOS B	2.9	20.4	0.71	0.80	51.9
North: Lord Street (North)											
7	L	1	0.0	0.308	7.3	LOS A	1.8	12.7	0.52	0.64	49.3
8	T	690	0.0	0.308	10.1	LOS B	1.8	12.7	0.53	0.66	58.2
Approach		691	0.0	0.308	10.1	LOS B	1.8	12.7	0.53	0.66	58.2
All Vehicles		2580	0.0	0.461	9.4	LOS A	3.6	25.0	0.28	0.65	57.0

Table D-7 SIDRA Outputs - Great Northern Highway and West Swan Road (2031 AM Peak)

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
South: Great Northern Highway (South)											
1	L	461	0.0	0.362	12.2	LOS B	7.3	50.8	0.45	0.72	44.9
2	T	887	0.0	0.896	39.2	LOS D	30.6	214.0	0.95	0.95	27.7
Approach		1348	0.0	0.896	30.0	LOS C	30.6	214.0	0.78	0.87	31.9
North: Great Northern Highway (North)											
8	T	1196	0.0	0.683	10.8	LOS B	20.6	143.9	0.61	0.55	44.2
9	R	473	0.0	0.907	60.6	LOS E	22.5	157.3	1.00	1.17	22.5
Approach		1669	0.0	0.907	24.9	LOS C	22.5	157.3	0.72	0.73	34.7
West: West Swan Road (West)											
10	L	515	0.0	0.476	16.1	LOS B	11.5	80.3	0.60	0.77	41.6
12	R	676	0.0	0.921	51.9	LOS D	23.3	163.2	0.97	0.93	24.7
Approach		1191	0.0	0.921	36.4	LOS D	23.3	163.2	0.81	0.86	30.0
All Vehicles		4208	0.0	0.921	29.8	LOS C	30.6	214.0	0.76	0.81	32.4

Table D-8 SIDRA Outputs - Great Northern Highway and West Swan Road (2031 PM Peak)

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
South: Great Northern Highway (South)											
1	L	463	0.0	0.387	12.4	LOS B	6.8	47.7	0.50	0.73	44.8
2	T	934	0.0	0.858	29.0	LOS C	25.7	180.2	0.93	0.91	31.8
Approach		1397	0.0	0.858	23.5	LOS C	25.7	180.2	0.79	0.85	35.2
North: Great Northern Highway (North)											
8	T	613	0.0	0.311	5.0	LOS A	5.8	40.9	0.40	0.35	51.0
9	R	521	0.0	0.894	50.3	LOS D	20.3	142.0	1.00	1.16	25.2
Approach		1134	0.0	0.894	25.8	LOS C	20.3	142.0	0.68	0.72	34.7
West: West Swan Road (West)											
10	L	448	0.0	0.451	15.6	LOS B	8.7	60.6	0.63	0.77	42.0
12	R	260	0.0	0.862	52.1	LOS D	11.6	81.5	1.00	0.99	24.7
Approach		708	0.0	0.862	29.0	LOS C	11.6	81.5	0.77	0.85	33.5
All Vehicles		3239	0.0	0.894	25.5	LOS C	25.7	180.2	0.74	0.80	34.6

Table D-9 SIDRA Outputs - West Swan Road and Millhouse Road (2031 AM Peak)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
North East: West Swan Road (North)											
25	T	440	0.0	0.226	0.0	LOS A	0.0	0.0	0.00	0.00	70.0
26	R	353	0.0	0.504	16.3	LOS C	3.2	22.4	0.69	1.02	46.7
Approach		793	0.0	0.504	7.3	NA	3.2	22.4	0.31	0.45	57.4
North West: Millhouse Road (West)											
27	L	328	0.0	0.581	20.7	LOS C	3.7	26.2	0.73	1.14	44.2
29	R	30	0.0	0.486	93.6	LOS F	1.6	11.1	0.96	1.05	18.4
Approach		358	0.0	0.581	26.8	LOS D	3.7	26.2	0.75	1.14	39.5
South West: West Swan Road (South)											
30	L	47	0.0	0.173	9.8	LOS A	0.0	0.0	0.00	1.10	53.9
31	T	624	0.0	0.173	0.0	LOS A	0.0	0.0	0.00	0.00	70.0
Approach		671	0.0	0.173	0.7	NA	0.0	0.0	0.00	0.08	68.6
All Vehicles		1822	0.0	0.581	8.7	NA	3.7	26.2	0.28	0.45	55.8

Table D-10 SIDRA Outputs - West Swan Road and Millhouse Road (2031 PM Peak)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
North East: West Swan Road (North)											
25	T	546	0.0	0.280	0.0	LOS A	0.0	0.0	0.00	0.00	70.0
26	R	291	0.0	0.298	12.0	LOS B	1.4	9.6	0.50	0.78	51.3
Approach		837	0.0	0.298	4.2	NA	1.4	9.6	0.18	0.27	62.2
North West: Millhouse Road (West)											
27	L	290	0.0	0.367	15.2	LOS C	1.9	13.3	0.53	0.99	49.0
29	R	9	0.0	0.089	46.4	LOS E	0.3	1.9	0.90	1.00	29.6
Approach		299	0.0	0.367	16.1	LOS C	1.9	13.3	0.54	0.99	48.0
South West: West Swan Road (South)											
30	L	6	0.0	0.100	9.8	LOS A	0.0	0.0	0.00	1.20	53.9
31	T	384	0.0	0.100	0.0	LOS A	0.0	0.0	0.00	0.00	70.0
Approach		390	0.0	0.100	0.2	NA	0.0	0.0	0.00	0.02	69.7
All Vehicles		1526	0.0	0.367	5.5	NA	1.9	13.3	0.20	0.35	60.4

Table D-11 SIDRA Outputs - Marshall Road and Altone Road (2031 AM Peak)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Altone Road (South)											
1	L	218	0.0	0.925	66.0	LOS F	8.2	57.3	0.98	1.73	22.3
3	R	148	0.0	0.550	33.9	LOS D	2.5	17.7	0.93	1.13	31.7
Approach		366	0.0	0.925	53.0	LOS F	8.2	57.3	0.96	1.49	25.4
East: Marshall Road (East)											
4	L	583	0.0	0.634	15.1	LOS C	6.0	41.9	0.69	1.02	50.1
5	T	1011	0.0	0.259	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		1594	0.0	0.634	5.5	NA	6.0	41.9	0.25	0.37	66.9
West: Marshall Road (West)											
11	T	488	0.0	0.125	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
12	R	417	0.0	0.956	52.6	LOS F	14.9	104.2	0.98	1.83	26.4
Approach		905	0.0	0.956	24.2	NA	14.9	104.2	0.45	0.84	43.3
South West: dummy											
32	R	148	0.0	0.212	13.4	LOS B	0.8	5.7	0.53	0.97	45.2
Approach		148	0.0	0.212	13.4	LOS B	0.8	5.7	0.53	0.97	45.2
All Vehicles		3013	0.0	0.956	17.3	NA	14.9	104.2	0.41	0.68	48.1

Table D-12 SIDRA Outputs - Marshall Road and Altone Road (2031 PM Peak)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Altone Road (South)											
1	L	375	0.0	0.651	20.4	LOS C	4.8	33.8	0.76	1.25	38.1
3	R	698	0.0	1.140	160.9	LOS F	68.8	481.7	1.00	5.24	12.0
Approach		1073	0.0	1.140	111.8	LOS F	68.8	481.7	0.91	3.84	15.8
East: Marshall Road (East)											
4	L	541	0.0	0.593	14.7	LOS B	5.1	35.6	0.66	0.99	50.6
5	T	393	0.0	0.101	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		934	0.0	0.593	8.5	NA	5.1	35.6	0.38	0.57	61.0
West: Marshall Road (West)											
11	T	572	0.0	0.147	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
12	R	423	0.0	0.435	13.1	LOS B	2.8	19.8	0.56	0.84	52.8
Approach		995	0.0	0.435	5.6	NA	2.8	19.8	0.24	0.36	66.8
South West: dummy											
32	R	148	0.0	0.237	14.3	LOS B	0.9	6.4	0.57	1.00	44.5
Approach		148	0.0	0.237	14.3	LOS B	0.9	6.4	0.57	1.00	44.5
All Vehicles		3150	0.0	1.140	43.0	NA	68.8	481.7	0.53	1.64	30.4

Table D-13 SIDRA Outputs - Marshall Road and Beechboro Road North (2031 AM Peak)

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: Beechboro Road North (South)											
1	L	697	0.0	0.859	28.8	LOS C	25.4	177.9	0.84	0.89	35.0
2	T	66	0.0	0.113	35.0	LOS D	3.0	20.9	0.76	0.59	31.4
3	R	155	0.0	0.489	55.9	LOS E	8.6	60.4	0.91	0.82	25.8
Approach		918	0.0	0.859	33.8	LOS C	25.4	177.9	0.84	0.86	32.7
East: Marshall Road (East)											
4	L	329	0.0	0.740	27.6	LOS C	12.1	84.8	0.63	0.81	39.3
5	T	939	0.0	1.012	108.2	LOS F	48.4	338.9	1.00	1.24	16.5
6	R	89	0.0	1.012	118.3	LOS F	48.0	336.3	1.00	1.24	17.0
Approach		1357	0.0	1.012	89.3	LOS F	48.4	338.9	0.91	1.14	19.1
North: Beechboro Road North (North)											
7	L	99	0.0	0.144	19.8	LOS B	2.3	16.1	0.44	0.72	48.6
8	T	204	0.0	0.349	40.6	LOS D	10.1	70.4	0.83	0.73	30.9
9	R	398	0.0	1.020	128.3	LOS F	39.6	277.1	1.00	1.13	14.6
Approach		701	0.0	1.020	89.1	LOS F	39.6	277.1	0.87	0.91	19.1
West: Marshall Road (West)											
10	L	281	0.0	0.242	11.3	LOS B	2.3	16.3	0.20	0.71	54.0
11	T	656	0.0	0.992	93.2	LOS F	51.7	361.8	1.00	1.22	18.6
12	R	1033	0.0	0.992	78.8	LOS E	49.8	348.7	1.00	0.99	19.8
Approach		1970	0.0	0.992	74.0	LOS E	51.7	361.8	0.89	1.03	21.4
All Vehicles		4946	0.0	1.020	72.6	LOS E	51.7	361.8	0.88	1.01	21.7

Table D-14 SIDRA Outputs - Marshall Road and Beechboro Road North (2031 PM Peak)

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: Beechboro Road North (South)											
1	L	511	0.0	0.474	12.3	LOS B	5.8	40.7	0.56	0.77	46.4
2	T	100	0.0	0.278	25.4	LOS C	2.8	19.8	0.90	0.70	35.2
3	R	176	0.0	0.636	38.5	LOS D	5.6	39.3	0.98	0.84	31.7
Approach		787	0.0	0.636	19.8	LOS B	5.8	40.7	0.70	0.78	40.4
East: Marshall Road (East)											
4	L	165	0.0	0.157	13.5	LOS B	1.7	12.2	0.45	0.73	52.2
5	T	620	0.0	0.683	25.0	LOS C	11.0	76.7	0.95	0.83	40.0
6	R	112	0.0	0.683	35.0	LOS C	10.8	75.7	0.95	0.88	39.5
Approach		897	0.0	0.683	24.1	LOS C	11.0	76.7	0.86	0.82	41.7
North: Beechboro Road North (North)											
7	L	60	0.0	0.060	14.6	LOS B	0.6	4.1	0.43	0.72	54.1
8	T	50	0.0	0.139	27.2	LOS C	1.4	9.6	0.87	0.68	39.5
9	R	187	0.0	0.776	44.0	LOS D	6.5	45.8	1.00	0.91	31.4
Approach		297	0.0	0.776	35.2	LOS D	6.5	45.8	0.86	0.83	35.8
West: Marshall Road (West)											
10	L	371	0.0	0.300	11.9	LOS B	2.7	18.6	0.36	0.74	53.2
11	T	653	0.0	0.801	28.7	LOS C	13.7	96.0	0.99	0.95	35.6
12	R	545	0.0	0.801	37.8	LOS D	13.5	94.3	0.99	0.94	31.8
Approach		1569	0.0	0.801	27.9	LOS C	13.7	96.0	0.84	0.90	37.2
All Vehicles		3550	0.0	0.801	25.8	LOS C	13.7	96.0	0.82	0.85	38.8

Table D-15 SIDRA Outputs - Meadow Street and Swan Street (2031 AM Peak)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Meadow Street (South)											
1	L	15	0.0	0.203	7.0	LOS A	1.0	6.7	0.52	0.66	34.1
2	T	955	0.0	0.807	8.9	LOS A	11.0	77.0	0.80	0.80	33.7
3	R	119	0.0	0.807	14.7	LOS B	11.0	77.0	0.84	0.93	29.1
Approach		1089	0.0	0.807	9.5	LOS A	11.0	77.0	0.80	0.81	33.1
East: Swan Street (East)											
4	L	94	0.0	0.624	13.7	LOS B	4.8	33.8	0.88	1.07	38.2
5	T	5	0.0	0.624	11.8	LOS B	4.8	33.8	0.88	1.05	37.6
6	R	281	0.0	0.624	19.7	LOS B	4.8	33.8	0.88	1.11	36.4
Approach		380	0.0	0.624	18.1	LOS B	4.8	33.8	0.88	1.10	36.8
North: Meadow Street (North)											
7	L	406	0.0	0.666	5.8	LOS A	3.6	25.5	0.72	0.55	42.9
8	T	1084	0.0	0.666	5.2	LOS A	5.9	41.4	0.53	0.48	49.3
9	R	52	0.0	0.666	10.9	LOS B	5.9	41.4	0.48	0.78	42.4
Approach		1542	0.0	0.666	5.5	LOS A	5.9	41.4	0.58	0.51	47.2
West: Swan Street (West)											
10	L	23	0.0	0.080	12.2	LOS B	0.5	3.2	0.85	0.84	39.7
11	T	3	0.0	0.080	10.3	LOS B	0.5	3.2	0.85	0.82	39.2
12	R	8	0.0	0.080	18.2	LOS B	0.5	3.2	0.85	0.90	37.7
Approach		34	0.0	0.080	13.5	LOS B	0.5	3.2	0.85	0.85	39.1
All Vehicles		3045	0.0	0.807	8.6	LOS A	11.0	77.0	0.70	0.69	42.2

Table D-16 SIDRA Outputs - Meadow Street and Swan Street (2031 PM Peak)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Meadow Street (South)											
1	L	14	0.0	0.194	6.4	LOS A	0.9	6.0	0.43	0.61	34.9
2	T	1013	0.0	0.774	7.0	LOS A	8.8	61.3	0.67	0.65	35.2
3	R	110	0.0	0.774	12.6	LOS B	8.8	61.3	0.70	0.84	31.2
Approach		1137	0.0	0.774	7.5	LOS A	8.8	61.3	0.67	0.66	34.7
East: Swan Street (East)											
4	L	73	0.0	0.338	6.8	LOS A	1.6	11.4	0.60	0.66	42.8
5	T	3	0.0	0.338	4.9	LOS A	1.6	11.4	0.60	0.56	42.3
6	R	221	0.0	0.338	12.8	LOS B	1.6	11.4	0.60	0.85	40.7
Approach		297	0.0	0.338	11.2	LOS B	1.6	11.4	0.60	0.80	41.2
North: Meadow Street (North)											
7	L	191	0.0	0.350	5.0	LOS A	1.4	9.8	0.32	0.49	44.8
8	T	581	0.0	0.350	4.9	LOS A	2.0	13.8	0.32	0.44	50.9
9	R	24	0.0	0.350	10.7	LOS B	2.0	13.8	0.32	0.84	42.4
Approach		796	0.0	0.350	5.1	LOS A	2.0	13.8	0.32	0.46	49.0
West: Swan Street (West)											
10	L	56	0.0	0.178	12.2	LOS B	1.0	7.2	0.85	0.91	39.7
11	T	6	0.0	0.178	10.3	LOS B	1.0	7.2	0.85	0.88	39.2
12	R	19	0.0	0.178	18.2	LOS B	1.0	7.2	0.85	0.97	37.7
Approach		81	0.0	0.178	13.5	LOS B	1.0	7.2	0.85	0.92	39.1
All Vehicles		2311	0.0	0.774	7.4	LOS A	8.8	61.3	0.55	0.62	42.5

Table D-17 SIDRA Outputs - Toodyay Road and Talbot Road (2031 AM Peak)

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
South: Talbot Road (South)											
1	L	294	0.0	0.674	20.4	LOS C	5.2	36.5	0.99	1.12	41.4
3	R	257	0.0	0.876	48.2	LOS D	7.7	53.6	0.98	1.30	29.4
Approach		551	0.0	0.876	33.4	LOS C	7.7	53.6	0.98	1.21	34.6
East: Toodyay Road (East)											
4	L	211	0.0	0.823	11.9	LOS B	14.0	97.8	0.92	0.75	53.9
5	T	1794	0.0	0.823	12.8	LOS B	14.1	99.0	0.94	0.77	54.6
Approach		2005	0.0	0.823	12.7	LOS B	14.1	99.0	0.93	0.77	54.5
West: Toodyay Road (West)											
11	T	1697	0.0	0.817	13.2	LOS B	13.7	96.2	0.94	0.80	54.4
12	R	229	0.0	0.817	19.2	LOS B	13.7	96.2	0.96	0.85	48.6
Approach		1926	0.0	0.817	13.9	LOS B	13.7	96.2	0.94	0.81	53.7
All Vehicles		4482	0.0	0.876	15.8	LOS B	14.1	99.0	0.94	0.84	50.5

Table D-18 SIDRA Outputs - Toodyay Road and Talbot Road (2031 PM Peak)

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
South: Talbot Road (South)											
1	L	163	0.0	0.246	10.7	LOS B	1.3	9.4	0.81	0.84	48.7
3	R	132	0.0	0.273	18.7	LOS B	1.4	9.5	0.80	0.95	44.0
Approach		295	0.0	0.273	14.3	LOS B	1.4	9.5	0.81	0.89	46.4
East: Toodyay Road (East)											
4	L	165	0.0	0.623	9.4	LOS A	5.8	40.8	0.64	0.66	55.8
5	T	1384	0.0	0.623	9.8	LOS A	5.8	40.8	0.65	0.65	57.0
Approach		1549	0.0	0.623	9.8	LOS A	5.8	40.8	0.65	0.65	56.9
West: Toodyay Road (West)											
11	T	1509	0.0	0.636	9.1	LOS A	6.8	47.5	0.56	0.56	57.7
12	R	223	0.0	0.636	14.6	LOS B	6.7	46.6	0.58	0.73	52.3
Approach		1732	0.0	0.636	9.8	LOS A	6.8	47.5	0.56	0.59	57.0
All Vehicles		3576	0.0	0.636	10.2	LOS B	6.8	47.5	0.62	0.64	55.9

Table D-19 SIDRA Outputs - West Swan Road and Gnangara Road (2031 AM Peak)

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
South: West Swan Road (South)											
1	L	218	0.0	0.712	14.9	LOS B	9.5	66.2	0.97	0.99	42.9
2	T	375	0.0	0.712	14.1	LOS B	9.5	66.2	0.97	0.98	43.0
3	R	1	0.0	0.712	19.1	LOS B	9.5	66.2	0.97	0.99	40.8
Approach		594	0.0	0.712	14.4	LOS B	9.5	66.2	0.97	0.98	43.0
East: Henry Street (Access Road)											
4	L	1	0.0	0.011	19.5	LOS B	0.1	0.5	0.97	0.71	39.0
5	T	1	0.0	0.011	18.6	LOS B	0.1	0.5	0.97	0.71	39.1
6	R	1	0.0	0.011	23.6	LOS C	0.1	0.5	0.97	0.72	37.4
Approach		3	0.0	0.011	20.6	LOS C	0.1	0.5	0.97	0.71	38.4
North: West Swan Road (North)											
7	L	1	0.0	0.950	31.5	LOS C	31.9	223.6	1.00	1.37	32.1
8	T	499	0.0	0.950	30.7	LOS C	31.9	223.6	1.00	1.37	32.2
9	R	402	0.0	0.950	35.6	LOS D	31.9	223.6	1.00	1.37	31.2
Approach		902	0.0	0.950	32.9	LOS C	31.9	223.6	1.00	1.37	31.7
West: Gnangara Road (West)											
10	L	449	0.0	0.878	22.7	LOS C	19.7	137.8	1.00	1.19	36.7
11	T	1	0.0	0.878	21.9	LOS C	19.7	137.8	1.00	1.19	36.7
12	R	325	0.0	0.878	26.8	LOS C	19.7	137.8	1.00	1.19	35.3
Approach		775	0.0	0.878	24.4	LOS C	19.7	137.8	1.00	1.19	36.1
All Vehicles		2274	0.0	0.950	25.2	LOS C	31.9	223.6	0.99	1.21	35.6

Table D-20 SIDRA Outputs - West Swan Road and Gnangara Road (2031 PM Peak)

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
South: West Swan Road (South)											
1	L	1	0.0	0.215	10.0	LOS A	1.3	9.0	0.61	0.73	47.5
2	T	189	0.0	0.215	9.2	LOS A	1.3	9.0	0.61	0.69	47.7
3	R	1	0.0	0.215	14.1	LOS B	1.3	9.0	0.61	0.85	44.5
Approach		191	0.0	0.215	9.2	LOS A	1.3	9.0	0.61	0.69	47.7
East: RoadName											
4	L	1	0.0	0.001	8.2	LOS A	0.0	0.0	0.52	0.51	48.5
5	T	1	0.0	0.002	7.1	LOS A	0.0	0.1	0.51	0.46	48.4
6	R	1	0.0	0.002	13.1	LOS B	0.0	0.1	0.51	0.68	45.2
Approach		3	0.0	0.002	9.5	LOS A	0.0	0.1	0.51	0.55	47.3
North: West Swan Road (North)											
7	L	1	0.0	0.364	6.8	LOS A	3.0	20.8	0.05	0.56	50.2
8	T	187	0.0	0.364	5.1	LOS A	3.0	20.8	0.05	0.38	52.2
9	R	429	0.0	0.364	11.1	LOS B	3.0	20.8	0.05	0.76	46.4
Approach		617	0.0	0.364	9.3	LOS A	3.0	20.8	0.05	0.65	48.0
West: Gnangara Road (West)											
10	L	263	0.0	0.246	8.2	LOS A	1.7	11.8	0.49	0.61	47.8
11	T	1	0.0	0.246	7.4	LOS A	1.7	11.8	0.49	0.56	48.0
12	R	1	0.0	0.246	12.5	LOS B	1.7	11.8	0.49	0.71	45.2
Approach		265	0.0	0.246	8.2	LOS A	1.7	11.8	0.49	0.61	47.8
All Vehicles		1076	0.0	0.364	9.0	LOS A	3.0	20.8	0.26	0.64	47.9

Table D-21 SIDRA Outputs - Morrison Road and Farrall Road (2031 AM Peak)

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
South: Farall Road (South)											
1	L	244	0.0	0.490	15.2	LOS B	3.9	27.0	0.79	0.80	42.4
2	T	42	0.0	0.179	22.8	LOS C	1.0	6.9	0.93	0.68	34.9
3	R	191	0.0	0.910	42.5	LOS D	6.0	41.7	1.00	1.10	27.7
Approach		477	0.0	0.910	26.8	LOS C	6.0	41.7	0.89	0.91	34.4
East: Morrison Road (East)											
4	L	379	0.0	0.702	14.6	LOS B	13.8	96.8	0.71	0.89	44.2
5	T	1354	0.0	0.702	6.4	LOS A	14.1	98.9	0.71	0.64	47.6
6	R	235	0.0	0.844	36.4	LOS D	7.7	53.8	0.95	1.10	30.0
Approach		1968	0.0	0.844	11.6	LOS B	14.1	98.9	0.73	0.74	43.9
North: Farall Road (North)											
7	L	128	0.0	0.221	11.7	LOS B	1.3	9.0	0.56	0.72	45.4
8	T	46	0.0	0.197	22.9	LOS C	1.1	7.6	0.93	0.69	34.9
9	R	163	0.0	0.767	35.4	LOS D	4.5	31.4	1.00	0.92	30.5
Approach		337	0.0	0.767	24.7	LOS C	4.5	31.4	0.82	0.81	35.6
West: Morrison Road (West)											
10	L	264	0.0	0.218	8.7	LOS A	1.1	7.7	0.32	0.68	48.0
11	T	1394	0.0	0.562	5.5	LOS A	9.7	68.1	0.61	0.54	49.1
12	R	223	0.0	1.006	88.2	LOS F	12.8	89.3	1.00	1.50	17.5
Approach		1881	0.0	1.006	15.8	LOS B	12.8	89.3	0.61	0.68	40.4
All Vehicles		4663	0.0	1.006	15.8	LOS B	14.1	98.9	0.71	0.74	40.6

Table D-22 SIDRA Outputs - Morrison Road and Farrall Road (2031 PM Peak)

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
South: Farall Road (South)											
1	L	304	0.0	0.396	10.7	LOS B	2.5	17.4	0.60	0.75	46.2
2	T	42	0.0	0.123	15.9	LOS B	0.7	5.1	0.87	0.64	39.4
3	R	209	0.0	0.626	26.4	LOS C	4.2	29.3	0.97	0.85	34.8
Approach		555	0.0	0.626	17.0	LOS B	4.2	29.3	0.76	0.78	40.7
East: Morrison Road (East)											
4	L	57	0.0	0.451	14.7	LOS B	5.7	40.0	0.66	0.91	44.9
5	T	864	0.0	0.451	6.5	LOS A	5.7	40.2	0.66	0.58	48.0
6	R	119	0.0	0.479	21.7	LOS C	2.1	14.8	0.86	0.79	37.6
Approach		1040	0.0	0.479	8.7	LOS A	5.7	40.2	0.69	0.62	46.4
North: Farall Road (North)											
7	L	45	0.0	0.077	11.7	LOS B	0.4	2.6	0.60	0.69	45.3
8	T	4	0.0	0.012	15.1	LOS B	0.1	0.5	0.85	0.54	40.0
9	R	65	0.0	0.212	24.3	LOS C	1.2	8.2	0.89	0.74	36.0
Approach		114	0.0	0.212	19.0	LOS B	1.2	8.2	0.77	0.72	39.4
West: Morrison Road (West)											
10	L	266	0.0	0.210	8.8	LOS A	1.0	6.8	0.37	0.69	47.8
11	T	1333	0.0	0.651	7.6	LOS A	9.7	67.6	0.77	0.69	46.7
12	R	128	0.0	0.371	17.9	LOS B	1.9	13.4	0.74	0.78	40.2
Approach		1727	0.0	0.651	8.5	LOS A	9.7	67.6	0.71	0.69	46.3
All Vehicles		3436	0.0	0.651	10.3	LOS B	9.7	67.6	0.71	0.69	45.1

Table D-23 SIDRA Outputs - Morrison Road and Keane Street (2031 AM Peak)

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: Keane Street											
1	L	52	0.0	0.433	41.0	LOS D	5.3	31.8	0.88	0.80	26.5
2	T	269	0.0	0.433	34.5	LOS C	7.6	45.4	0.90	0.73	26.7
3	R	84	0.0	0.274	40.8	LOS D	3.3	19.6	0.87	0.76	26.2
Approach		405	0.0	0.433	36.7	LOS D	7.6	45.4	0.89	0.75	26.6
East: Morrison Road											
4	L	44	0.0	0.478	42.0	LOS D	8.3	51.9	0.91	0.84	28.1
5	T	160	5.0	0.478	34.6	LOS C	8.3	51.9	0.91	0.76	29.0
6	R	397	5.0	0.526	44.7	LOS D	8.4	52.7	0.94	0.81	27.1
Approach		601	4.6	0.526	41.8	LOS D	8.4	52.7	0.93	0.80	27.6
North: Great Northern Highway											
7	L	501	5.0	0.502	9.4	LOS A	4.5	28.4	0.30	0.69	47.8
8	T	341	0.0	0.495	36.0	LOS D	8.8	52.8	0.91	0.75	28.6
9	R	333	5.0	0.882	59.2	LOS E	18.0	113.3	1.00	1.02	23.0
Approach		1175	3.5	0.882	31.2	LOS C	18.0	113.3	0.68	0.80	31.9
West: Morrison Road											
10	L	291	5.0	0.334	11.3	LOS B	3.8	23.9	0.38	0.70	45.9
11	T	190	5.0	0.478	45.2	LOS D	4.4	27.4	0.98	0.77	25.7
12	R	154	0.0	0.875	63.3	LOS E	8.3	49.5	1.00	1.01	21.1
Approach		635	3.8	0.875	34.1	LOS C	8.3	49.5	0.71	0.79	30.4
All Vehicles		2816	3.3	0.882	34.9	LOS C	18.0	113.3	0.77	0.79	29.7

Table D-24 SIDRA Outputs - Morrison Road and Keane Street (2031 AM Peak)

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: Keane Street											
1	L	101	0.0	0.462	41.0	LOS D	5.7	34.2	0.85	0.79	26.3
2	T	269	0.0	0.462	35.4	LOS D	10.1	60.5	0.89	0.74	26.5
3	R	84	0.0	0.294	43.3	LOS D	3.5	21.3	0.86	0.76	25.5
Approach		454	0.0	0.462	38.1	LOS D	10.1	60.5	0.87	0.75	26.2
East: Morrison Road											
4	L	49	0.0	0.780	52.9	LOS D	16.2	101.4	1.00	0.92	24.7
5	T	264	5.0	0.780	45.5	LOS D	16.2	101.4	1.00	0.92	25.3
6	R	699	5.0	0.930	74.5	LOS E	23.0	144.9	1.00	1.10	19.8
Approach		1012	4.8	0.930	65.9	LOS E	23.0	144.9	1.00	1.04	21.2
North: Great Northern Highway											
7	L	437	5.0	0.489	9.9	LOS A	4.8	30.5	0.31	0.69	47.2
8	T	333	0.0	0.942	43.9	LOS D	12.7	76.2	0.93	0.83	25.7
9	R	397	5.0	0.942	78.7	LOS E	25.3	159.4	1.00	1.12	19.1
Approach		1167	3.6	0.942	43.0	LOS D	25.3	159.4	0.72	0.88	27.2
West: Morrison Road											
10	L	514	5.0	0.745	18.3	LOS B	13.4	84.4	0.62	0.78	40.2
11	T	297	5.0	0.917	67.2	LOS E	9.2	57.8	1.00	1.08	20.4
12	R	136	0.0	0.854	67.3	LOS E	7.8	47.1	1.00	0.97	20.3
Approach		947	4.3	0.917	40.7	LOS D	13.4	84.4	0.79	0.90	27.9
All Vehicles		3580	3.6	0.942	48.2	LOS D	25.3	159.4	0.84	0.92	25.2

Table D-25 SIDRA Outputs - Henley Brook Avenue and Youle-Dean Road (2031 AM Peak)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Henley Brook Avenue (South)											
1	L	136	0.0	0.131	9.2	LOS A	0.7	4.9	0.36	0.67	47.8
2	T	850	0.0	0.605	14.5	LOS B	8.8	61.3	0.87	0.75	40.4
Approach		986	0.0	0.605	13.8	LOS B	8.8	61.3	0.80	0.74	41.3
North: Henley Brook Avenue (North)											
8	T	878	0.0	0.352	4.5	LOS A	5.0	35.0	0.50	0.43	51.2
9	R	322	0.0	0.618	16.2	LOS B	3.8	26.5	0.88	0.83	41.5
Approach		1200	0.0	0.618	7.7	LOS A	5.0	35.0	0.60	0.54	48.1
West: Youle-Dean Road (West)											
10	L	319	0.0	0.496	11.1	LOS B	3.2	22.2	0.55	0.74	45.8
12	R	139	0.0	0.624	33.0	LOS C	3.6	25.1	1.00	0.83	31.5
Approach		458	0.0	0.624	17.8	LOS B	3.6	25.1	0.68	0.76	40.3
All Vehicles		2644	0.0	0.624	11.7	LOS B	8.8	61.3	0.69	0.65	43.9

Table D-26 SIDRA Outputs - Henley Brook Avenue and Youle-Dean Road (2031 PM Peak)

Harrow

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Henley Brook Avenue (South)											
1	L	111	0.0	0.102	8.9	LOS A	0.5	3.5	0.34	0.66	47.9
2	T	697	0.0	0.536	13.6	LOS B	6.5	45.2	0.86	0.73	41.1
Approach		808	0.0	0.536	13.0	LOS B	6.5	45.2	0.79	0.72	42.0
North: Henley Brook Avenue (North)											
8	T	720	0.0	0.308	4.8	LOS A	3.9	27.4	0.52	0.45	50.7
9	R	264	0.0	0.524	15.6	LOS B	3.0	20.9	0.85	0.80	42.0
Approach		984	0.0	0.524	7.7	LOS A	3.9	27.4	0.61	0.54	48.0
West: Youle-Dean Road (West)											
10	L	261	0.0	0.355	10.4	LOS B	2.0	14.2	0.51	0.72	46.5
12	R	114	0.0	0.460	29.3	LOS C	2.5	17.6	0.96	0.77	33.2
Approach		375	0.0	0.460	16.1	LOS B	2.5	17.6	0.65	0.74	41.5
All Vehicles		2167	0.0	0.536	11.1	LOS B	6.5	45.2	0.68	0.64	44.4

Table D-27 SIDRA Outputs - Henley Brook Avenue and Park Street (2031 AM Peak)

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Henley Brook Avenue (South)											
1	L	204	0.0	0.281	7.2	LOS A	1.7	12.0	0.36	0.55	54.2
2	T	535	0.0	0.281	7.1	LOS A	1.7	12.0	0.37	0.51	55.4
3	R	1	0.0	0.281	13.0	LOS B	1.7	11.8	0.37	0.85	50.2
Approach		740	0.0	0.281	7.1	LOS A	1.7	12.0	0.36	0.53	55.1
East: Park Street (East)											
4	L	11	0.0	0.012	7.6	LOS A	0.1	0.4	0.58	0.59	48.3
5	T	3	0.0	0.014	7.1	LOS A	0.1	0.4	0.59	0.56	47.9
6	R	8	0.0	0.014	13.9	LOS B	0.1	0.4	0.59	0.74	44.7
Approach		22	0.0	0.014	9.8	LOS A	0.1	0.4	0.58	0.64	46.8
North: Henley Brook Avenue (North)											
7	L	1	0.0	0.249	7.2	LOS A	1.5	10.8	0.36	0.57	54.4
8	T	505	0.0	0.249	7.0	LOS A	1.5	10.8	0.37	0.51	55.3
9	R	142	0.0	0.249	13.0	LOS B	1.5	10.6	0.38	0.75	49.4
Approach		648	0.0	0.249	8.3	LOS A	1.5	10.8	0.37	0.56	53.9
West: Park Street (West)											
10	L	113	0.0	0.127	7.7	LOS A	0.6	4.2	0.55	0.67	48.4
11	T	1	0.0	0.144	6.1	LOS A	0.7	5.0	0.54	0.55	48.0
12	R	153	0.0	0.144	13.0	LOS B	0.7	5.0	0.54	0.75	44.4
Approach		267	0.0	0.144	10.7	LOS B	0.7	5.0	0.54	0.72	46.0
All Vehicles		1677	0.0	0.281	8.2	LOS A	1.7	12.0	0.40	0.57	52.8

Table D-28 SIDRA Outputs - Henley Brook Avenue and Park Street (2031 PM Peak)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Henley Brook Avenue (South)											
1	L	207	0.0	0.286	7.2	LOS A	1.8	12.3	0.36	0.55	54.1
2	T	544	0.0	0.286	7.1	LOS A	1.8	12.3	0.37	0.52	55.4
3	R	1	0.0	0.286	13.0	LOS B	1.7	12.1	0.38	0.85	50.2
Approach		752	0.0	0.286	7.1	LOS A	1.8	12.3	0.37	0.53	55.0
East: Park Street (East)											
4	L	11	0.0	0.012	7.7	LOS A	0.1	0.4	0.58	0.60	48.2
5	T	3	0.0	0.014	7.1	LOS A	0.1	0.4	0.59	0.57	47.8
6	R	8	0.0	0.014	14.0	LOS B	0.1	0.4	0.59	0.74	44.6
Approach		22	0.0	0.014	9.9	LOS A	0.1	0.4	0.59	0.64	46.7
North: Henley Brook Avenue (North)											
7	L	1	0.0	0.254	7.2	LOS A	1.6	11.0	0.37	0.57	54.4
8	T	513	0.0	0.254	7.0	LOS A	1.6	11.0	0.37	0.51	55.3
9	R	145	0.0	0.254	13.0	LOS B	1.5	10.8	0.38	0.75	49.4
Approach		659	0.0	0.254	8.3	LOS A	1.6	11.0	0.38	0.56	53.8
West: Park Street (West)											
10	L	115	0.0	0.130	7.8	LOS A	0.6	4.3	0.56	0.67	48.4
11	T	1	0.0	0.148	6.2	LOS A	0.7	5.1	0.54	0.55	47.9
12	R	156	0.0	0.148	13.0	LOS B	0.7	5.1	0.54	0.75	44.4
Approach		272	0.0	0.148	10.8	LOS B	0.7	5.1	0.55	0.72	46.0
All Vehicles		1705	0.0	0.286	8.2	LOS A	1.8	12.3	0.40	0.57	52.8

Table D-29 SIDRA Outputs - Henley Brook Avenue and Gnangara Road (2031 AM Peak)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Henley Brook Avenue (South)											
1	L	133	0.0	0.348	6.6	LOS A	2.0	13.8	0.45	0.59	49.4
2	T	467	0.0	0.348	5.5	LOS A	2.0	13.8	0.46	0.50	49.6
3	R	243	0.0	0.348	12.5	LOS B	1.9	13.4	0.47	0.77	45.6
Approach		843	0.0	0.348	7.7	LOS A	2.0	13.8	0.46	0.59	48.3
East: Gnangara Road (East)											
4	L	200	0.0	0.201	7.4	LOS A	1.0	6.8	0.57	0.65	48.3
5	T	42	0.0	0.201	6.5	LOS A	1.0	6.8	0.58	0.59	48.0
6	R	146	0.0	0.201	13.5	LOS B	0.9	6.5	0.58	0.84	44.8
Approach		388	0.0	0.201	9.6	LOS A	1.0	6.8	0.57	0.72	46.8
North: Henley Brook Avenue (North)											
7	L	175	0.0	0.332	7.4	LOS A	1.9	13.3	0.54	0.65	48.8
8	T	461	0.0	0.332	6.3	LOS A	1.9	13.3	0.54	0.57	48.9
9	R	96	0.0	0.332	13.3	LOS B	1.8	12.8	0.55	0.85	45.7
Approach		732	0.0	0.332	7.5	LOS A	1.9	13.3	0.54	0.63	48.4
West: Gnangara Road (West)											
10	L	96	0.0	0.127	8.4	LOS A	0.5	3.8	0.60	0.74	48.1
11	T	50	0.0	0.183	6.5	LOS A	0.9	6.0	0.60	0.59	47.8
12	R	131	0.0	0.183	13.4	LOS B	0.9	6.0	0.60	0.85	45.0
Approach		277	0.0	0.183	10.4	LOS B	0.9	6.0	0.60	0.76	46.4
All Vehicles		2240	0.0	0.348	8.3	LOS A	2.0	13.8	0.52	0.65	47.8

Table D-30 SIDRA Outputs - Henley Brook Avenue and Gnangara Road (2031 AM Peak)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Henley Brook Avenue (South)											
1	L	104	0.0	0.260	6.3	LOS A	1.4	9.5	0.36	0.56	49.9
2	T	373	0.0	0.260	5.1	LOS A	1.4	9.5	0.36	0.46	50.4
3	R	190	0.0	0.260	12.1	LOS B	1.3	9.3	0.37	0.74	45.9
Approach		667	0.0	0.260	7.3	LOS A	1.4	9.5	0.36	0.56	48.9
East: Gnangara Road (East)											
4	L	169	0.0	0.151	7.0	LOS A	0.7	4.7	0.49	0.62	48.7
5	T	30	0.0	0.144	6.2	LOS A	0.6	4.3	0.51	0.55	48.5
6	R	108	0.0	0.144	13.0	LOS B	0.6	4.3	0.51	0.79	45.1
Approach		307	0.0	0.151	9.1	LOS A	0.7	4.7	0.50	0.67	47.3
North: Henley Brook Avenue (North)											
7	L	125	0.0	0.246	6.8	LOS A	1.3	8.9	0.44	0.61	49.4
8	T	385	0.0	0.246	5.7	LOS A	1.3	8.9	0.45	0.52	49.7
9	R	68	0.0	0.246	12.7	LOS B	1.2	8.7	0.45	0.84	46.1
Approach		578	0.0	0.246	6.8	LOS A	1.3	8.9	0.45	0.57	49.2
West: Gnangara Road (West)											
10	L	71	0.0	0.086	7.8	LOS A	0.3	2.4	0.52	0.68	48.5
11	T	36	0.0	0.136	6.0	LOS A	0.6	4.1	0.51	0.54	48.5
12	R	112	0.0	0.136	12.8	LOS B	0.6	4.1	0.51	0.80	45.1
Approach		219	0.0	0.136	10.1	LOS B	0.6	4.1	0.52	0.72	46.7
All Vehicles		1771	0.0	0.260	7.8	LOS A	1.4	9.5	0.43	0.60	48.4

Table D-31 SIDRA Outputs - Henley Brook Avenue and Millhouse Road (2031 AM Peak)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Henley Brook Avenue (South)											
1	L	212	0.0	0.175	6.2	LOS A	0.8	5.7	0.29	0.51	50.0
2	T	28	0.0	0.219	4.8	LOS A	1.1	7.7	0.29	0.39	50.5
3	R	281	0.0	0.219	11.7	LOS B	1.1	7.7	0.29	0.67	45.6
Approach		521	0.0	0.219	9.1	LOS A	1.1	7.7	0.29	0.59	47.5
East: Millhouse Road (East)											
4	L	307	0.0	0.238	6.5	LOS A	1.2	8.5	0.39	0.56	49.4
5	T	121	0.0	0.136	5.5	LOS A	0.6	4.3	0.39	0.50	50.4
6	R	16	0.0	0.136	12.4	LOS B	0.6	4.3	0.39	0.85	46.4
Approach		444	0.0	0.238	6.4	LOS A	1.2	8.5	0.39	0.55	49.5
North: Henley Brook Avenue (North)											
7	L	15	0.0	0.027	7.3	LOS A	0.1	0.9	0.50	0.60	49.0
8	T	29	0.0	0.027	6.2	LOS A	0.1	0.9	0.50	0.53	49.2
9	R	11	0.0	0.027	13.2	LOS B	0.1	0.8	0.51	0.78	45.5
Approach		55	0.0	0.027	7.9	LOS A	0.1	0.9	0.50	0.60	48.3
West: The Promenade (West)											
10	L	11	0.0	0.097	7.2	LOS A	0.4	2.9	0.43	0.62	49.6
11	T	114	0.0	0.209	5.8	LOS A	1.1	7.4	0.43	0.52	49.8
12	R	219	0.0	0.209	12.4	LOS B	1.1	7.4	0.43	0.72	45.2
Approach		344	0.0	0.209	10.0	LOS B	1.1	7.4	0.43	0.65	46.7
All Vehicles		1364	0.0	0.238	8.4	LOS A	1.2	8.5	0.37	0.59	47.9

Table D-32 SIDRA Outputs - Henley Brook Avenue and Millhouse Road (2031 PM Peak)

Movement Performance - Vehicles

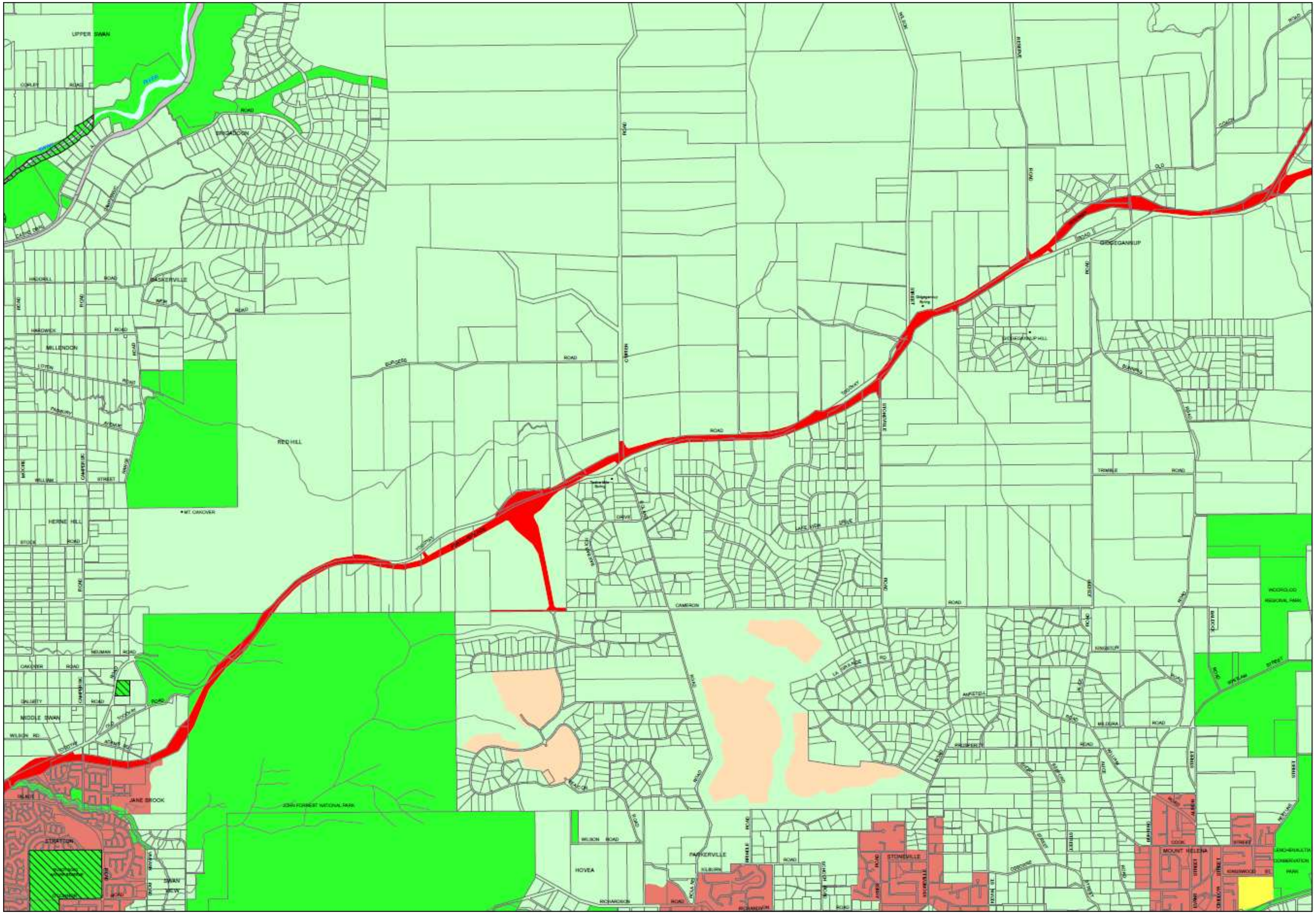
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Henley Brook Avenue (South)											
1	L	167	0.0	0.134	6.0	LOS A	0.6	4.2	0.25	0.49	50.3
2	T	22	0.0	0.170	4.7	LOS A	0.8	5.6	0.24	0.37	51.0
3	R	222	0.0	0.170	11.6	LOS B	0.8	5.6	0.24	0.66	45.8
Approach		411	0.0	0.170	8.9	LOS A	0.8	5.6	0.24	0.58	47.7
East: Millhouse Road (East)											
4	L	243	0.0	0.182	6.2	LOS A	0.9	6.1	0.33	0.52	49.8
5	T	95	0.0	0.103	5.2	LOS A	0.4	3.1	0.33	0.46	50.8
6	R	13	0.0	0.103	12.1	LOS B	0.4	3.1	0.33	0.85	46.6
Approach		351	0.0	0.182	6.2	LOS A	0.9	6.1	0.33	0.52	49.9
North: Henley Brook Avenue (North)											
7	L	12	0.0	0.020	6.8	LOS A	0.1	0.6	0.43	0.56	49.4
8	T	23	0.0	0.020	5.7	LOS A	0.1	0.6	0.44	0.48	49.7
9	R	9	0.0	0.020	12.7	LOS B	0.1	0.6	0.44	0.76	45.9
Approach		44	0.0	0.020	7.5	LOS A	0.1	0.6	0.44	0.56	48.7
West: The Promenade (West)											
10	L	9	0.0	0.073	6.8	LOS A	0.3	2.1	0.37	0.58	49.9
11	T	90	0.0	0.158	5.5	LOS A	0.7	5.2	0.37	0.47	50.3
12	R	173	0.0	0.158	12.0	LOS B	0.7	5.2	0.36	0.70	45.5
Approach		272	0.0	0.158	9.7	LOS A	0.7	5.2	0.36	0.62	47.0
All Vehicles		1078	0.0	0.182	8.2	LOS A	0.9	6.1	0.31	0.57	48.2

Transport Strategy

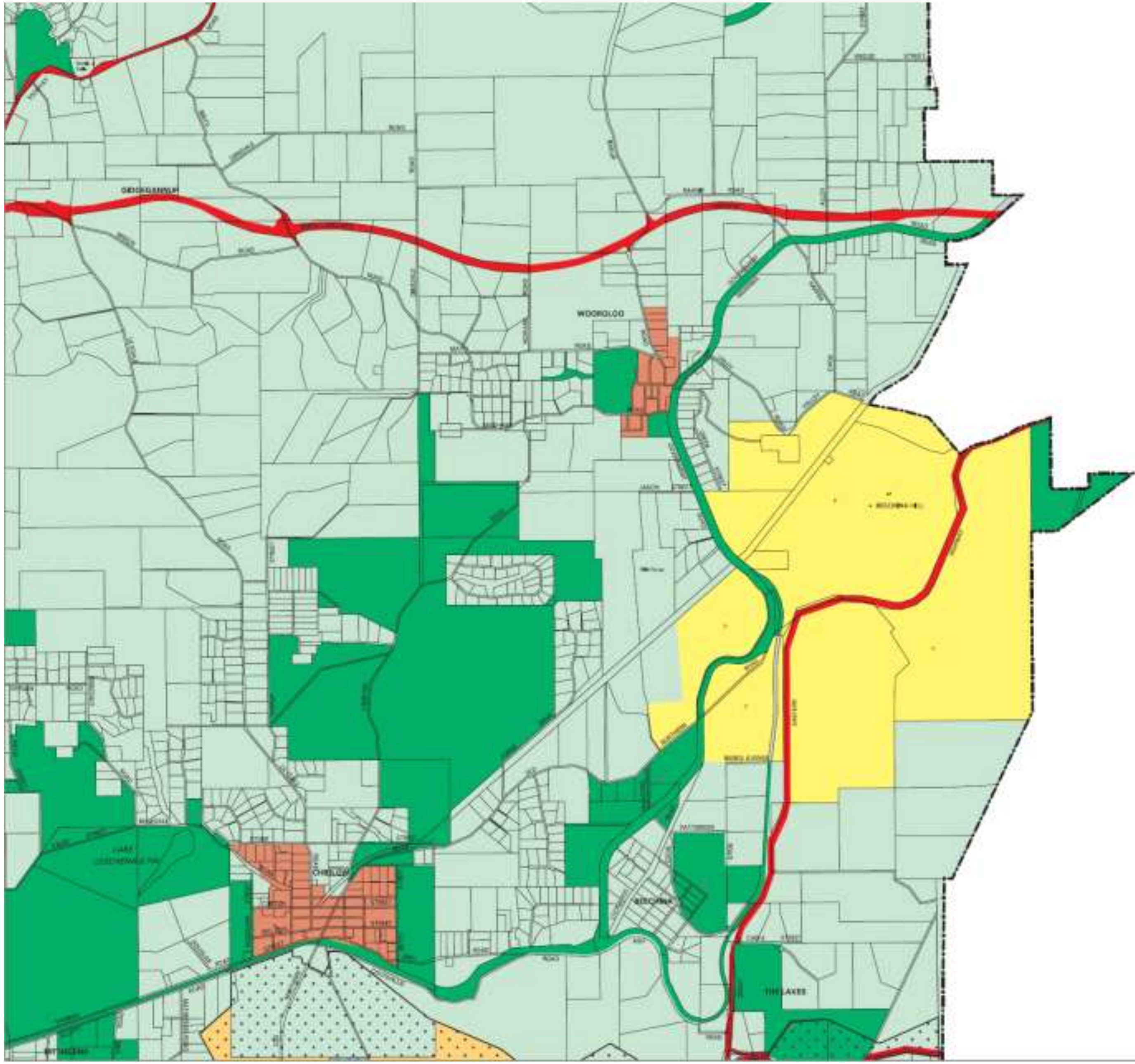
APPENDIX E

PERTH ADELAIDE NATIONAL HIGHWAY ALIGNMENT (MRS)

Cardno
Shaping the Future



UPPER SWAN
BRIGADOON
BASKERVILLE
MILLENDON
RED HILL
HERNE HILL
MIDDLE SWAN
JANE BROOK
STRATTON
JOHN FORREST NATIONAL PARK
HOVEA
PARKERVILLE
STONEVILLE
MOUNT HELENA
GIDGEGANNUP
CAMERON


WOOROLOO
THE LAKES