City of Kwinana

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Integrated Landuse and Transport Study

DRAFT

Integrated Transport and Land Use Study

CW1057900

Prepared for

City of Kwinana

15 April 2019

Cardno

Contact Information

Cardno (WA) Pty Ltd
ABN 77 009 119 000

11 Harvest Terrace
West Perth WA 6005
Australia

www.cardno.com
Phone +61 8 9273 3888
Fax +61 8 9486 8664

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Author(s):

Liam Tenardi
Undergraduate Traffic Engineer

Jessie Moore
Transport Planner

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Approved By:

Jacob Martin
Team Leader – Transport Planning

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1 Introduction

1.1 Scope of Works

The broad scope of the Integrated Land Use and Transport Study is outlined below:

- Evaluate the performance of the existing transport, travel and freight network and its effect on current land uses.
- Evaluate the implications of development approvals and options identified in the State, Regional and City-level strategic planning and policy documents on the City's transport network.
- Evaluate to what extent and how the current and future land use and development contributes to change in travel behaviours, and affect the transport network, including parking.
- Evaluate to what extent the Indian Ocean Gateway and Westport projects affect the City's road network, including freight transport network.
- Analyse the functions and characteristics of Activity Centres in the context of promoting land use diversity supported by a functional public transport system, including walking and cycling (Note that the City has produced a Bike and Walk Plan, which should be integrated in the ILAT Study).

1.2 Purpose and Objectives

This ILAT Study identified a series of existing and future transport requirements and land use conflicts or compatibilities for the locality across all transport modes. Recommendations have been made to mitigate these conflicts while creating a high-quality integrated planning and transport environment that supports economic, environmental and social activity.

The discussion and recommendations provided throughout the Study are intended to provide the City with the guidance for a 10-year development horizon, and long-term assessment for the potential enabling works for a 2050 scenario. The ILAT Study considers a holistic view of transport, travel, traffic and public parking requirements for the current and projected residential and employee population for the entirety of the City of Kwinana.

The *Strategic Community Plan 2017-2027* expressly identifies an objective of a "safe and efficient integrated network of roads, footpaths and cycle routes supported by a good public transport system". This ILAT Study provides a vehicle to express what this might mean for the City, and recommends enabling works necessary to support this objective, as development and the transport environment matures.

Included are network proposals across pedestrian, cycling, passenger vehicle and freight transport modes, relating directly to the needs of the community. This includes the individual requirements, opportunities and conflicts associated with future local structure planning for Industrial and Residential development (greenfields), densification and development of existing Activity Centres, the potential for Transit Corridors and Activity Corridors, and the site-specific needs of People Attractors.

The investigation into these requirements is expressed in an implementation framework, with guidance and prioritisation of actions, which will support integration of land use and transport networks for the City.

1.3 Vision

The City has developed a singular Vision through stakeholder and community consultation, as expressed in the *Strategic Community Plan 2017-2027*. The Integrated Land use and Transport Study is designed to achieve this vision through the following:

- **Alive with Opportunities:** Transport and land use integration that promotes job opportunities, access to a range of education and training facilities, a thriving revitalised retail centre and well-developed industrial area. This requires a coherent and connected network, capable of supporting the travel patterns and local requirements of the City's residents, employees and visitors. Key to this vision is maximising mode choice; creating equity for diverse needs and abilities through infrastructure provision, engineering design and streetscape amenity.
- **Surrounded by Nature**: Conservation of biodiversity and native vegetation by minimising the impacts of transport infrastructure on ecological corridors. Street trees provide pedestrian and cycling amenity, reduce traffic speed and increase social and commercial value. Improvements to streetscapes that

reinforce active transport modes also lead to healthier, more active lifestyles. Development that aims to reduce car dependency.

Figure 1-1 The Spectacles

(Claude Vinci)

- **It's all Here:** High-quality, multi-functional public spaces, connected and supported by a safe and efficient network of roads, footpaths, cycle routes and public transport. Attractive streetscapes turn streets into spaces, enhancing commercial, social and community outcomes.

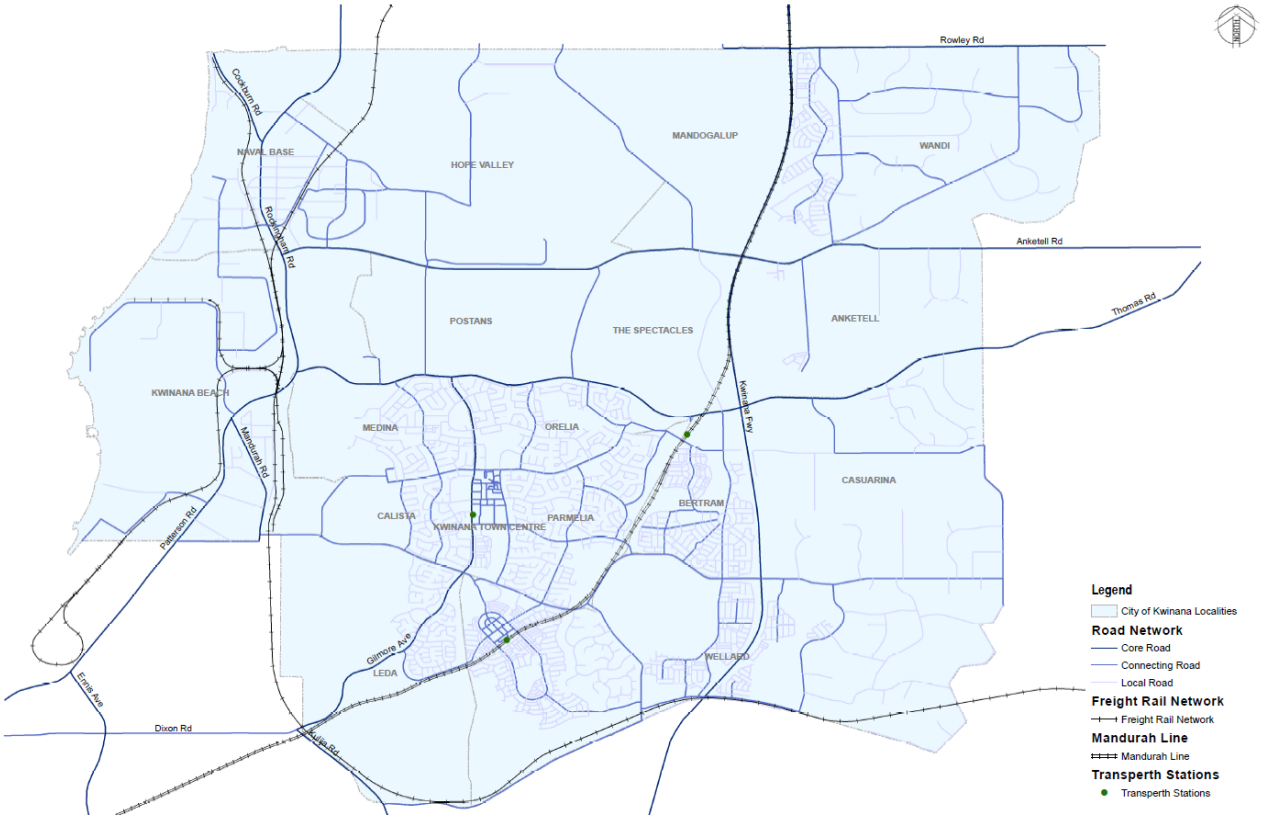
Figure 1-2 Attractive Streetscape Supporting Multifunctional Use

2 Project Background

2.1 Study Area

The City of Kwinana is located approximately 30km south of the Perth CBD and extends over 12,000 hectares. **Figure 2-1** shows the City in its regional context.

Figure 2-1 City of Kwinana Municipal Area



The City is comprised of established low-density residential suburbs, transitional rural-residential suburbs and the large and expanding Kwinana Industrial Area. This commercial/industrial zone is a significant and important employment area for Western Australia.

Regional parks and wetlands serve as a buffer between the industrial and residential zones. **Figure 2-2** and **Figure 2-3** show the Metropolitan Region Scheme (MRS), and Local Planning Scheme (LPS) zoning, respectively.

Figure 2-2 Metropolitan Region Scheme zoning map

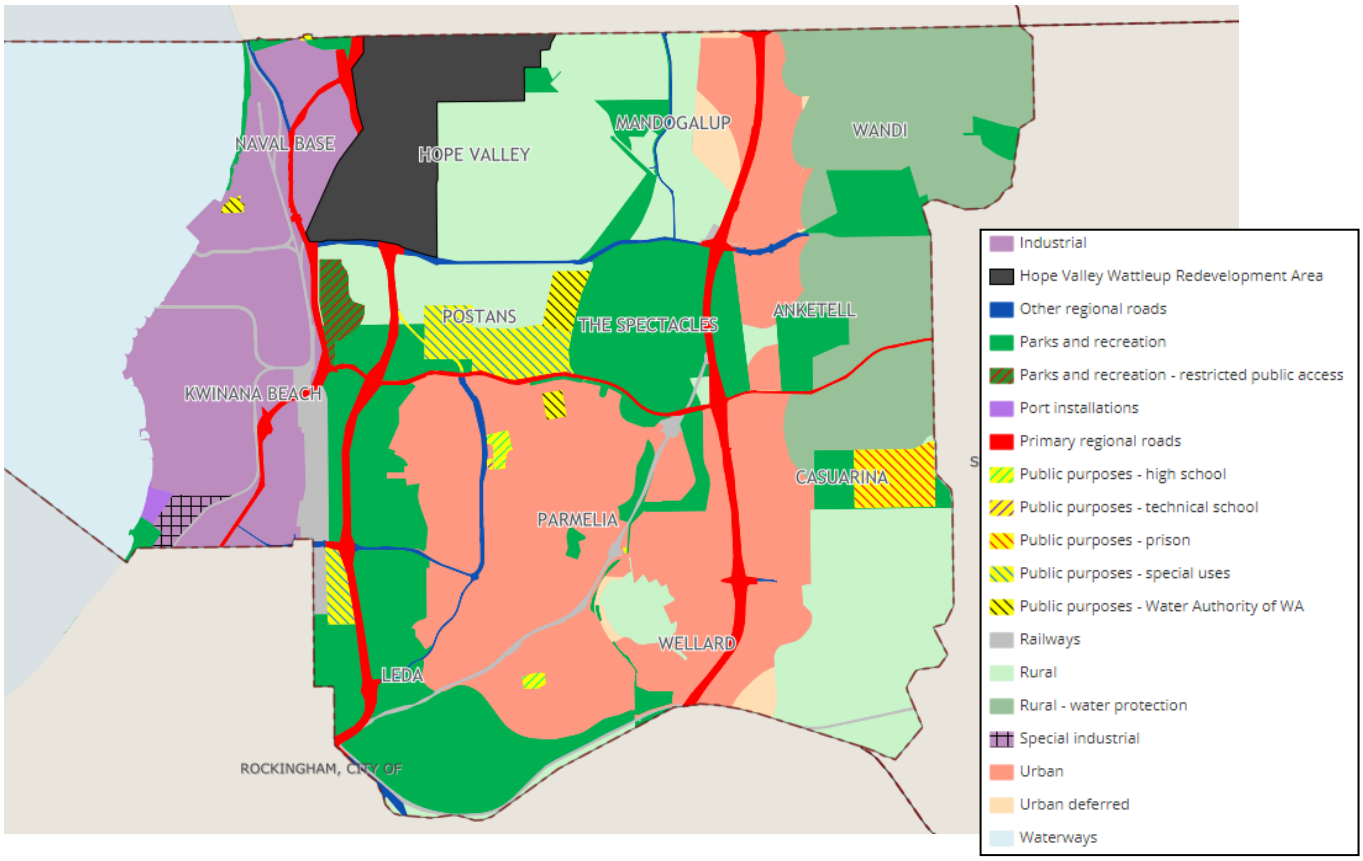
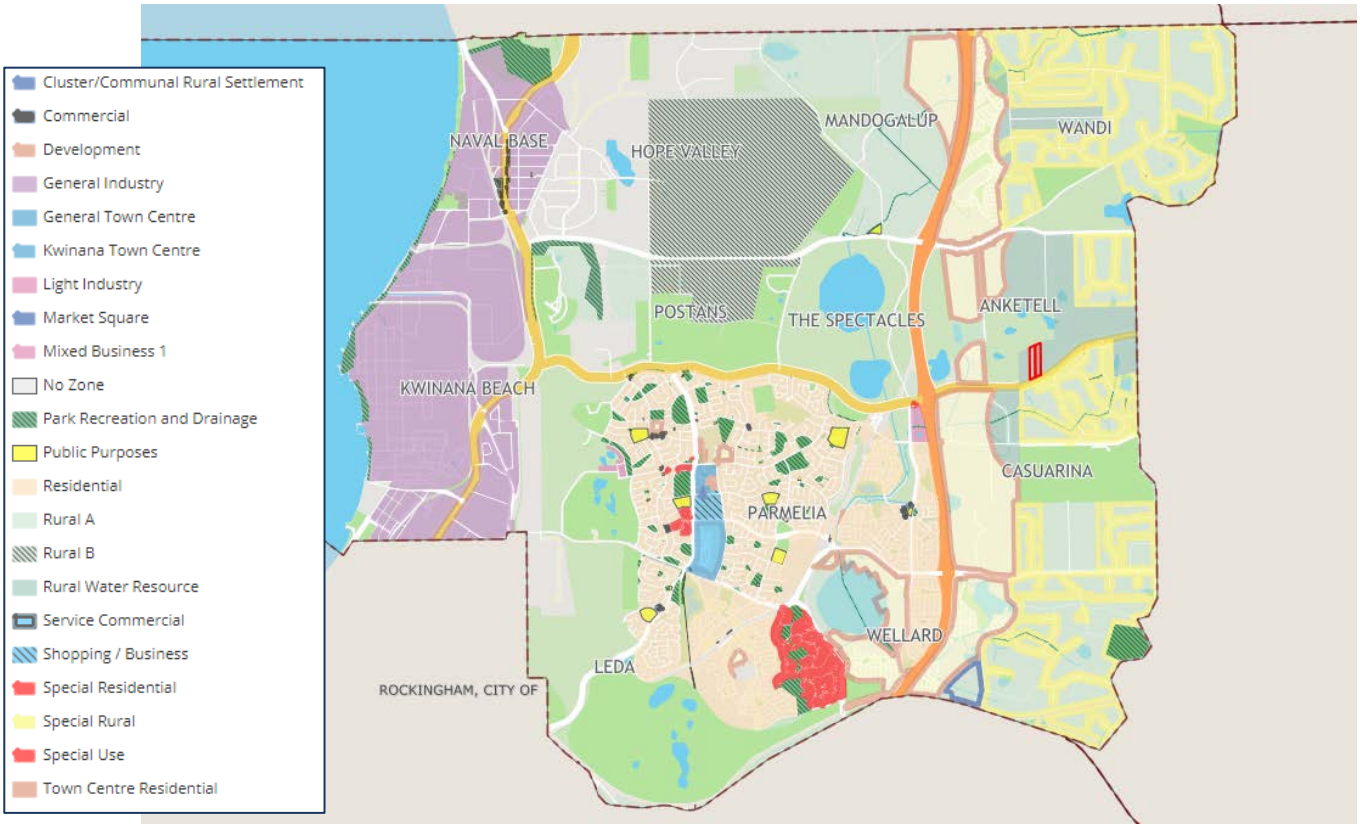
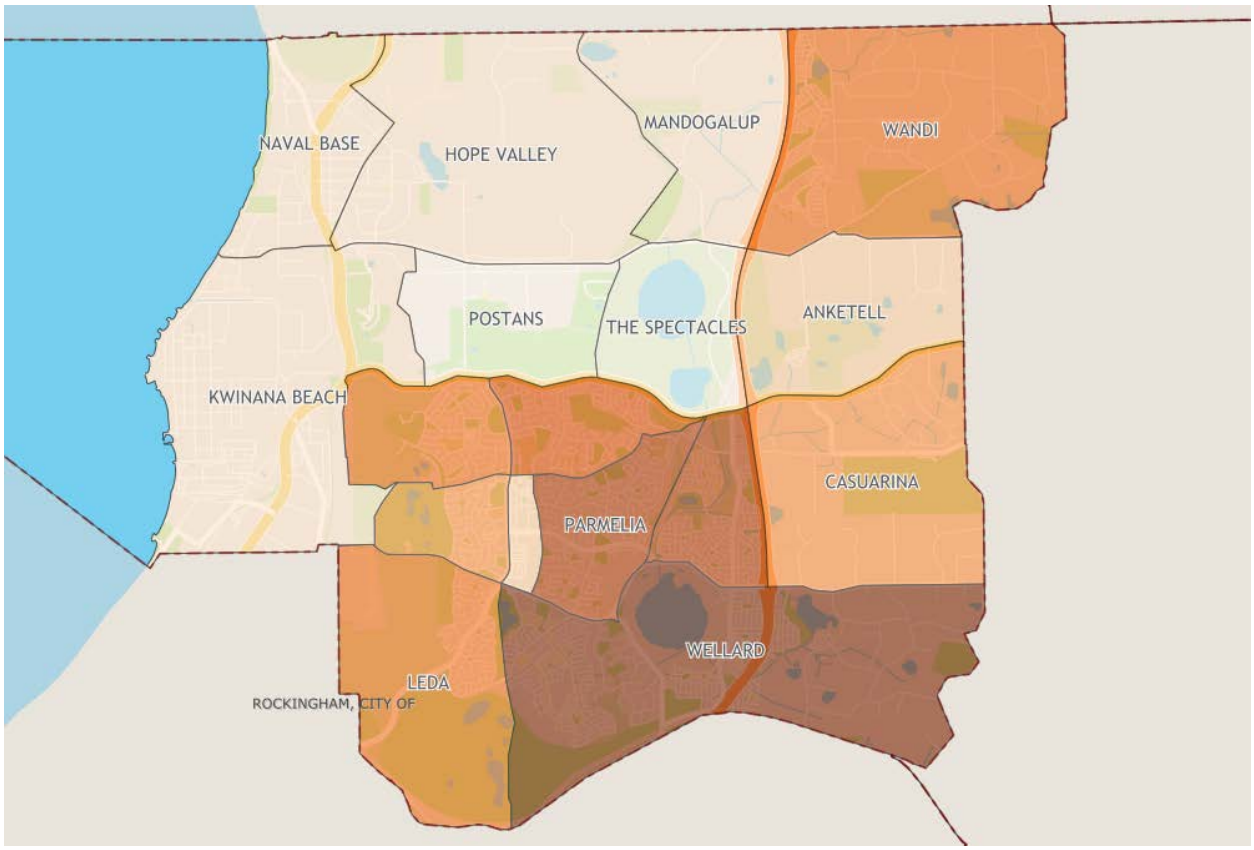


Figure 2-3 City of Kwinana Local Planning Scheme zoning map



The City of Kwinana has a population of nearly 42,000 residents, but an average population density of only 3.5 persons per hectare. **Figure 2-4** illustrates the distribution of population throughout the City.

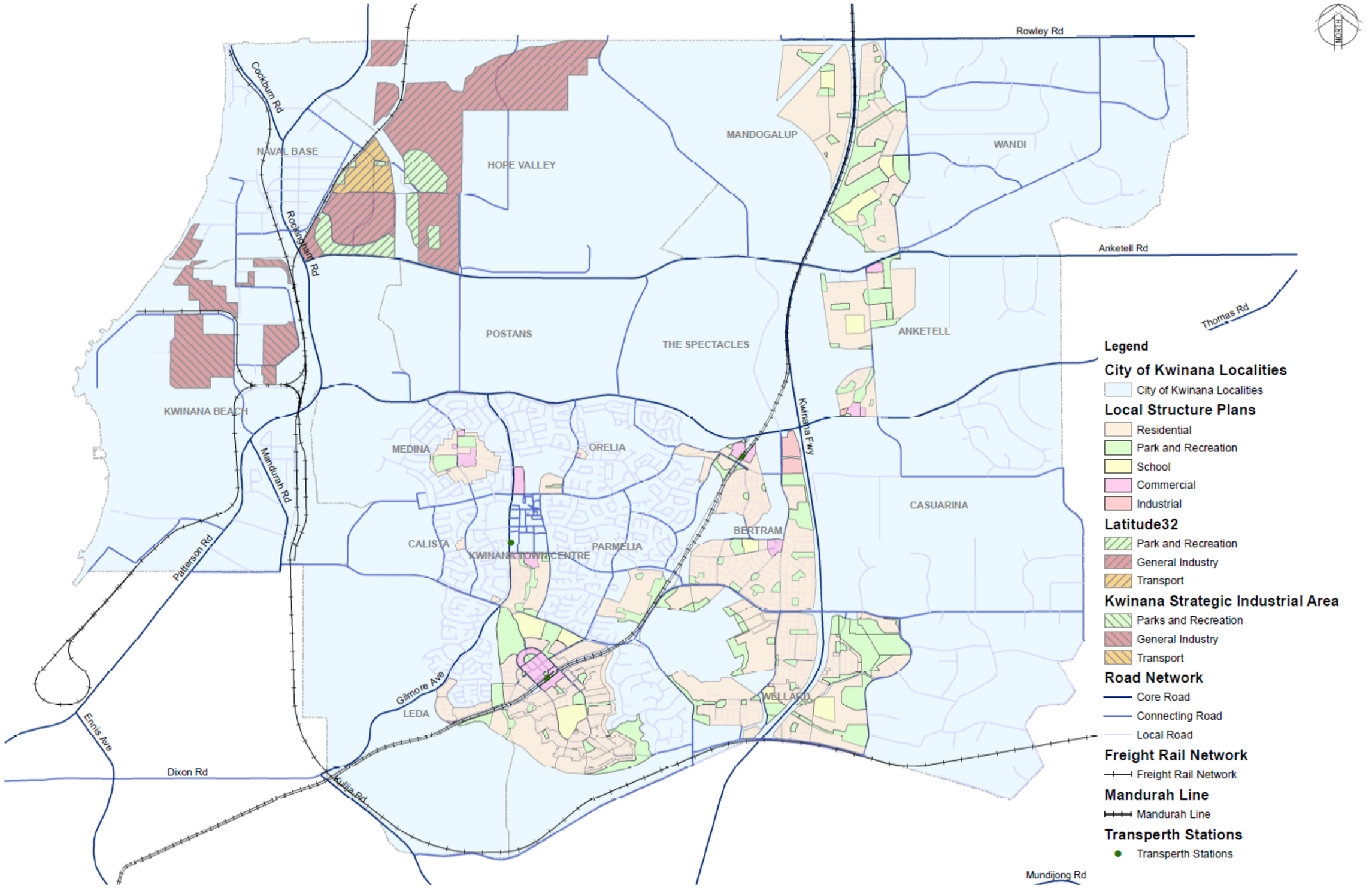
Figure 2-4 Population Density in the City of Kwinana



Forecasts for the City project that the population will reach 85,000 by 2036, doubling the current population over the next 17 years.

The following map shows expected future developments within the City.

Figure 2-5 Local Development Plans



2.2 Key Drivers of Change

There is a wide range of social, environmental and economic factors that combine to drive the need for efficient land use and transport networks. These drivers have been identified in consultation with the City as reflective of the changing regional and local context, and described as follows:

Population and Density Increase: As residential and employment populations grow, the demand for travel increases, putting pressure on the transport network as it reaches capacity. In its current form of low density residential and commercial/industrial development, the primary form of transport mobility is by private vehicle, leading to congestion and poor levels of service across the City. High-density and mixed-use development can mitigate this impact by greatly increasing the number of short-distance internal trips, and by providing opportunities for efficient high-quality public transport services. This Study has been prepared along with Housing, Employment and Economic strategies to inform the Local Planning Strategy. It is only by carefully considering all of these aspects of planning and transport, that an effective system be created and maintained.

- **Traffic Volumes and Street Capacity:** While the projected population of the City is expected to increase substantially, the road network has a fundamental capacity limit. In fact, several roads have already been identified as operating close to capacity, including sections of Rockingham Road, Thomas Road, Gilmore Avenue.

Ongoing development growth and car-dependency is likely to stretch key strategic roads past their limit. The resulting congestion would have negative consequences on the economic activity generated by industrial and commercial zones, and the viability of ongoing development, in addition to impacts on social, community and environmental outcomes.

This Study interrogates the opportunities for sustainable alternative transport, in support of the project objectives and City vision.

- **Cultural Factors:** As recognised in the City's policy on Access and Equity, the City of Kwinana is committed to promoting social inclusion. Social inclusion is the opportunity to participate in political, cultural, civic and economic life for all people and all communities, and is therefore directly related to the availability and accessibility of transport.

In this context, certain groups of people can be considered as transport-disadvantaged, and therefore merit specific consideration. This includes:

- People with physical and/or mental disabilities;
- People who are frail, often the elderly;
- People without a car, who are economically disadvantages or incapable of driving;
- People who are distant from suitable public transport, and
- People who lack confidence in social settings e.g. those who may not be able to understand or communicate effectively in English.

Census data shows in 2016, the proportion of households in the City with no motor vehicle rose was approximately 5%, with over half of these comprising low-income households.

Potentially of equal concern are the 1/3rd of low-income households with two or more vehicles, the maintenance of which is likely to constitute a very high percentage of their annual income. This creates a high degree of economic vulnerability to external pressures.

To ensure accessibility within the City for a diverse range of residents with varying resources, needs, and abilities, the City's transport and land use patterns must be well integrated, and provide the most opportunities for mode choice within parallel and overlapping transport networks.

- **Climate Change:** Future changes in the climate poses a number of threats and challenges to governments, industries and communities at all levels. The necessity for immediate action related to climate change is identified strongly by the City's '*Climate Change Policy*.'

The City of Kwinana *Climate Change Mitigation and Adaption Plan 2015-2020* notes the risk of increasing heat island effect, which is exacerbated by vegetation clearing for development and road expansion. The local cooling associated with canopy cover by street trees is greatly beneficial to mitigate this effect, but requires prioritising vegetation over hard infrastructure such as road pavement, crossovers and parking.

The development of sustainable transport alternatives to private vehicle transport will assist in minimising the growth in road pavement, as well as creating opportunities for increasing canopy cover. These effects are in addition to the reduction in carbon emissions related to public and active transport use.

- **Economic Outcomes:** The City of Kwinana is proposed to be home to the Outer Harbour, a bulk cargo port with strategic significance to Western Australia. Providing enhanced. Efficient transport networks and land use relationships will be vital to facilitate these activities. The Westport Task Force is currently investigating a port-specific freight networks that will largely define the function of strategic corridors across the City.

Other large-scale industrial developments including Latitude 32, the Postans and Hope Valley Industrial Areas and the IP14 Industrial Park in Rockingham. Given that manufacturing is the largest employment sector in the City, these future development plans are likely to contribute towards a substantial increase in the demand for transport and housing in the adjacent residential zones.

A well-integrated transport and land use network is necessary to support to the productivity of both the City and the wider Region, and provide the network capacity for further economic development.

- **Health and Safety:** Road safety issues for drivers, cyclists, pedestrians and public transport users are generally a function of poorly planned and poorly connected transport systems. These issues can be mitigated through the thoughtful integration of land use, transport, and urban design. Safer streets also encourage the uptake of active transport, resulting in an increase in the relative health and well-being of residents and employees.
- **Amenity:** Traffic congestion, noise, and air pollution negatively impact amenity residents, workers, and visitors to the City of Kwinana. Integrated land use and transport principles ensure that land uses are compatible and that the road, public and active transport networks are appropriate for the type and intensity of local and regional needs.

Good-quality streetscapes reinforce the place-making functions of a street, and enhance amenity through appropriate infrastructure, shade and positive accessibility measures. These attributes also encourage uptake of active transportation modes, increase the land value of adjacent development and induce additional economic activity.

- **Land Use Change:** Anticipated land use changes will change the nature of the transportation network. In particular, the shifts from rurally zoned land to residentially zoned land and densification along key corridors, creates opportunities to reinforce non-car transport modes through bus service and active transport infrastructure.

Within industrial zones, businesses that choose to consolidate office commercial uses on-site can put stress on the local parking and road infrastructure to accommodate the additional workforce. However, this increased employment density represents an opportunity to improve access by alternative modes, in a way that might be infeasible for purely manufacturing zones.

- **Technological Change:** Changes in lifestyle related to advancing technology will have implications for transport and land use patterns within the City. The uptake of autonomous vehicles and Mobility as a Service (MaaS) technologies are expected to have a substantial impact on private vehicle ownership and use, congestion and parking requirements. These implications have been considered in detail as they relate infrastructure and policy development over the next 10-30 years.
- **Cross Boundary Issues:** The City's transport and land use context cannot be considered in isolation from its surroundings. Population growth is forecast for the wider region, with wide-ranging impacts on the regional transportation network.

This includes development of Cockburn Sound and Cockburn Central, Rockingham Foreshore and the Rockingham Strategic Centre, and the Byford Area, among others. This regional development is likely to result in an increase and redistribution of transport demand, which may not be wholly accommodated by existing provision.

2.3 Census Data

Understanding the patterns of travel into, out of, and within the City of Kwinana is vital to the design of an efficient and well-integrated land use and transport network. Census data and growth projections provide some of the key demographic information for the broad understanding of how the system functions.

- **Employee Journey to Work:** Census data (ABS 2016) indicates a total of 12,600 workers employed within the boundaries of the City. Of these, approximately 25% of the workforce resided within the City.

An additional 40% of the City's workforce travelled from the adjoining City of Cockburn or City of Rockingham LGAs.

This statistic shows how important local transport networks are to the viability of businesses within Kwinana. However, the overwhelming dominance of private vehicles for journey to work (97% of trips) in the City of Kwinana (see **Table 2-1**), indicates that sustainable transport infrastructure is not adequate to support the needs of employees.

Table 2-1 Workers' Place of Residence and Travel Mode

	Public Transport	Private Vehicle	Active Transport	Total
Rockingham	44	3,388	11	3,441
Kwinana	86	2,175	123	2,386
Cockburn	18	1,063	5	1,087
All Other LGAs	*60*	*3,057*	*6*	*3,120*
Total	**208**	**9,683**	**145**	**10,034**

- **Resident Journey to Work:** Census data (ABS 2016) shows that 16,700 of the City's residents were employed, of which 80% commuted to work outside of the City. Car travel to work by Kwinana residents was observed to be similar to the Greater Perth Metropolitan average, relying primarily on accessibility by train.

The table **below** illustrates the travel modes of residents in the City of Kwinana on their journey to work.

Table 2-2 Residents' Place of Work and Travel Mode

	Public Transport	Private Vehicle	Active Transport	Total
Kwinana	86	2,175	123	2,386
Cockburn	114	2,057	6	2,174
Rockingham	92	1,413	14	1,520
Perth	1,012	313	13	1,338
Melville	163	697	0	862
Canning	44	820	0	861
Fremantle	52	648	4	698
All Other LGAs	*450*	*2,528*	*12*	*2,997*
Total	**2,013**	**10,651**	**172**	**12,836**

Predictably, high levels of public transport usage correspond to destinations with excellent public transport connectivity and low parking availability/high parking prices.

A high dependence on private vehicle use was also observed from the residents in Medina, Orelia, and the Kwinana City Centre – each of which has relatively poor access to the rail network.

- **Residential Development and Density:** Census data (ABS 2016) indicates that there were 15,300 dwellings, primarily in the form of 3+ bedroom single unit dwellings (~80% of housing stock). A comparison of household to dwelling size showed that a sizeable portion of the housing stock was under-occupied, as shown in **Table 2-3.**

Table 2-3 Dwellings and Occupancy

	One person	Two persons	Three persons	Four or more persons
One bedroom	177	30	6	3
Two bedrooms	500	393	85	50
Three bedrooms	1,253	1,916	928	874
Four or more bedrooms	642	1,699	1,348	2,695

Source: ABS Census (2016)

Half of the residential properties were observed to have fewer people than bedrooms. In the context of the City of Kwinana, with restricted residential zones and a population expected to double over the period to 2036, a pattern of under-occupation is likely to build pressure for densification of the area.

2.4 Relevant Policies

A variety of State, Regional and Local planning documents encompassing both strategic and statutory elements were reviewed in the context of the City for the purposes of this ILAT Strategy. A summary of these documents is included in the Literature Review **(Appendix A).**

2.4.1 State Level Documents

- State Planning Strategy 2050
- Activity Centres for Perth and Peel, State Planning Policy 4.2 (2010)
- Road and Rail Transport Noise and Freight Considerations in Land Use Planning SPP 5.4 (2009)
- Perth and Peel @ 3.5 million (2015)
- Perth and Peel Transport Plan for 3.5 million People and Beyond
- Bike Ahead: Bicycle Strategy for the 21st Century, Department of Transport.

2.4.2 Regional and Sub-Regional Level Documents

- South Metropolitan Peel Sub-Regional Planning Framework (March 2018)
- Eastern Residential Intensification Concept (ERIC)
- Westport: Port and Environs Strategy (in Progress)
- Indian Ocean Gateway
- Jandakot Structure Plan (JSP)

2.4.3 Local Level Documents

- Local Planning Scheme No.2 (1992) and No.3 (1998)
- Local Structure Plans
- Local Commercial and Activity Centres Strategy (2014)
- Strategic Community Plan (2017 - 2027)
- City of Kwinana Bike and Walk Plan (2018)
- City of Kwinana Community Infrastructure Plan 2011-2031 (2018)
- Mandogalup Future Development (2018)
- Guidelines for Structure Planning in the Casuarina Cell (2018)
- Kwinana Town Centre Masterplan and Design Guidelines (2018)
- City of Kwinana Local Planning Policy Site Requirements and Standards for Development within Industrial Zones (2018)
- City of Kwinana Local Planning Policy Designing Out Crime (2018)

3 Evaluation Process – TransPriority Assessment

3.1 TransPriority Overview

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

- **Private Vehicles and Road Freight:** Prioritisation is based on appropriate use and connectivity, connecting origins and destinations but not forming barriers to sustainable modes. Roads are important

and necessary corridors for almost all motorised transport trips, including freight, service/delivery, taxis, on-road public transport and private vehicle movements. Private vehicles form a vital component of the mobility task and are a key element to the success of the City; but should not be considered to the exclusion of other modes.

Private vehicles have been considered 'prioritised' in the TransPriority Assessment where Main Roads WA Functional Hierarchy classification is Local Distributor or higher, and where road function is not limited by additional capacity constraints.

Freight can be considered 'prioritised' where explicitly permitted by Main Roads WA's RAV Classification 1 or higher.

Freight rail operates outside of the road corridors and so is not included in the TransPriority Assessment.

- **Public transport:** Bus routes are designed to fit within the regional context and support sustainable transport access to activity, particularly employment. Bus transit is said to have a 'priority' where network design and modal conflicts do not inhibit bus movements.

Buses are considered 'prioritised' along strategic Transperth routes. However, where bus stops are provided in embayments along high traffic corridors, or congestion effects impact the reliability of bus service or headways, then this may remove sections of the route from the hierarchy.

Figure 3-1 Kwinana Bus Station

Train services are generally not considered as part of a TransPriority Assessment, as they are assumed to always be 'prioritised' along their dedicated corridors. However, train services may impact the function of other modal networks where level crossings or other interactions induce delays.

- **Cycling**: Facilities should follow primary desire lines and provide fine-grained access to key destinations, transport nodes and corridors across the City. Cycling is unique in that it allows both macro- and micro- levels of access to land-uses. Through the 'TransPriority' framework assessment, cycling facilities may be allocated as on-street or off-street, as required to minimise conflict and safety issues for cyclists, cars and pedestrians.

Figure 3-2 Tour de Wellard Cycling Event

Cycling is considered 'prioritised' where there is a marked cycle lane, high-quality shared path or other strategic cycling infrastructure is present, and where that facility is consistent with the environment where it is located. In particular, at any point where bicycles have to merge with vehicle traffic outside of a 30km/h environment, bicycle priority is removed from the hierarchy.

- **Pedestrian facilities**: Pedestrian paths knit the various complementary land uses together to create a single, effective mixed-use community. Of particular importance are 'Activated Pedestrian Zones' and routes from car parking, train stations or major bus stops to primary activity locations. Quality and safety are vital to the effective operation of pedestrian spaces. Within Activity Centres, pedestrian facilities are undoubtedly the most important transport component, as it is through the streetscape that people interact with retail, residential, employment and recreation opportunities.
- Pedestrian routes are included in the hierarchy only where pedestrians are provided with wide paths and safe crossing opportunities appropriate to the local traffic volume/speed environment

Multi-modal hierarchies are defined by combining the above requirements with the existing and expected future transport demands. By considering the network holistically in this manner, a functional and effective transport environment can be established. The synergies between land uses, as embodied by Integrated Land use and Transport Planning principles, can best be supported through a dense fabric of different transport networks.

Parking is an effective bridge between land-use and transport mode choice and constraining parking through planning policy can be an effective method to apportion road space for particular trip purposes (residents, employees or visitors). This helps to reduce private vehicle trip generation and to create a more sustainable land-use and transport environment.

3.2 Existing TransPriority by Mode

To establish a baseline for the City's multi-modal network function, a TransPriority assessment exercise has been completed for the existing infrastructure based on the above principles, and shown in **Figure 3-1.**

Commentary below describes an overview of transport infrastructure at a network level.

- **Private Vehicles:** Private vehicles dominate the road network in the City of Kwinana. Residential areas, industrial areas and activity centres are designed to support and promote private vehicle access and abundant parking. There are no significant corridors in the City of Kwinana that have been designed to discourage the use of private vehicles. As such, private vehicles are considered to have priority across the network.
- **Freight:** Critical strategic corridors in the City have been oriented towards access and mobility by freight transport. Freight priority along corridors is supported by high-speed, high capacity, low congestion roads, operating in free-flow conditions.

Intersection controls in particular illustrate the position of private vehicle and freight transport in network planning:

- Roundabouts along local connector and distributor roads are designed in accordance with Austroads *Guidelines* to maximize vehicle throughput and turning capacity, while maintaining high prevailing speeds (e.g. Sulphur Road)

  Due to the provisions in the *WA Road Rules,* roundabouts afford the least amenity for pedestrians and cyclists. The construction of roundabouts along a corridor indicates a reduction in the priority level for active transport.

  Roundabouts are also less than ideal for large heavy vehicle combinations, due to the requirements for trucks to stop without advance warning. The use of roundabouts along freight corridors is discouraged in Main Roads' *Intersection Control Guidelines*, but still promoted at an institutional level (e.g. Anketell Road, Armstrong Road).
- Regional corridors including Thomas Road and Gilmore Avenue are constructed as limited access corridors with a predominance of priority intersections. This minimizes the potential impacts of delay on vehicle travel along the corridor, but can result in long peak period delays to and from minor roads. This results in free-flow traffic conditions with a lack of punctuated flow and poor pedestrian crossing opportunities. The pelican crossing (pedestrian signal) located between the Kwinana Bus Station and Calista Primary School is a notable exception to the car-focused nature of the arterial network.
- Signalised intersections are designed primarily to support right-turning vehicles on higher-capacity roads. Pedestrian facilities are generally rudimentary at these intersections (e.g. Gilmore / Sulphur Rd), reflecting the low-density nature of land use and infrequent active travel.

- **Public Transport:** Provision is limited throughout the City, though in-lane stopping along Gilmore Avenue and the interchange opportunities given by the Kwinana Bus Station indicate a higher order of priority along this corridor.

Public transport priority is diminished along Rockingham Road, Patterson Road and Thomas Road where bus embayments introduce additional delays and timing uncertainty for bus routes. Along sections of Medina Avenue, Calista Avenue, Challenger Avenue, Bertram Road and Wellard Road similar bus embayments indicate that priority is given to cars over buses.

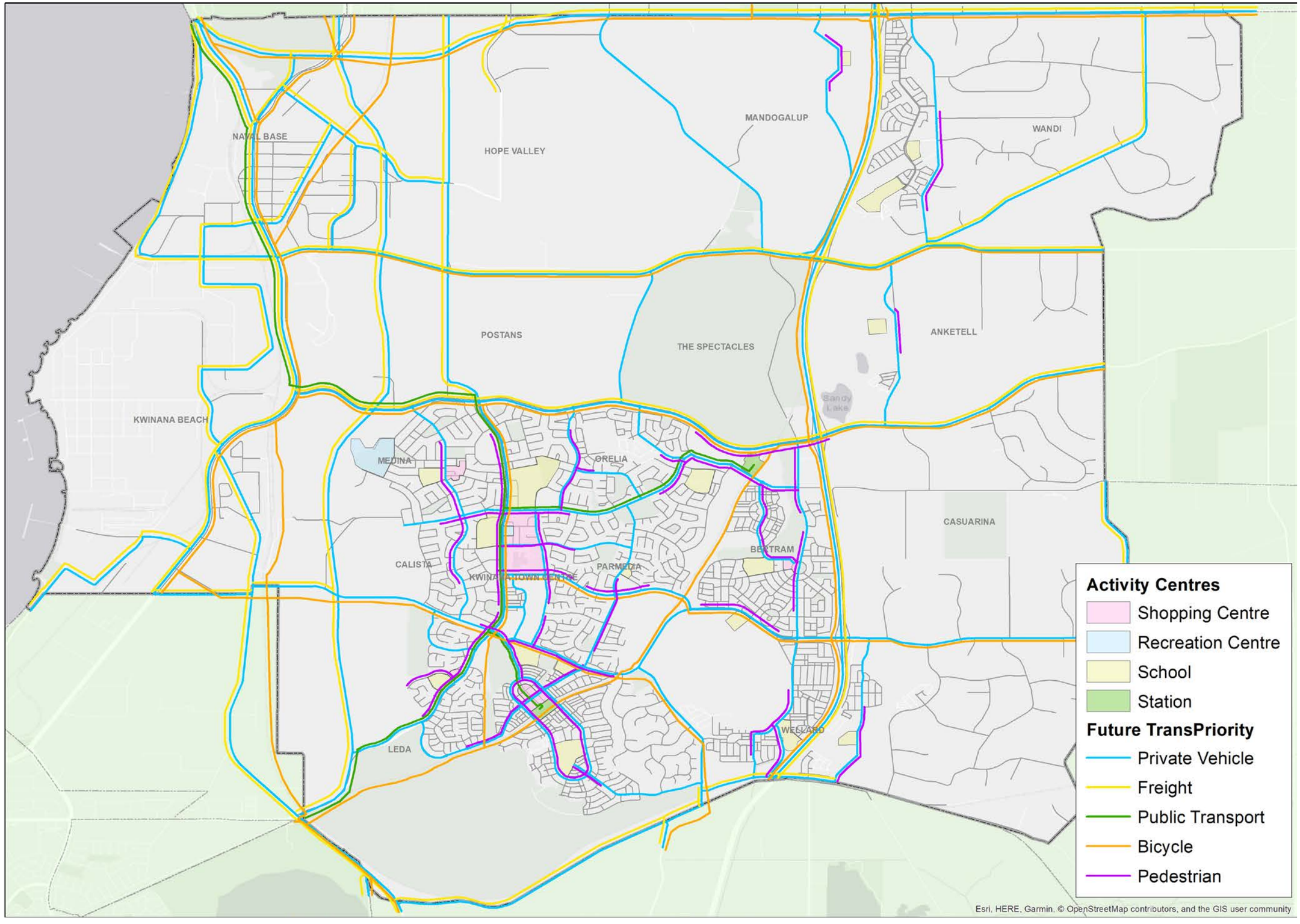
- **Cycling:** There are a number of road corridors that have been constructed with painted on-street bicycle lanes or sealed shoulders. However, these separated facilities provide no physical protection for cyclists and are often discontinued through roundabouts and signalized intersections. As such, there are no consistent corridors of on-street cycling priority in the City. (e.g. Rockingham Road cycling lanes transitioning to an off-street path at the Mandurah Road intersection).

Off-street shared paths are generally under width (to modern DoT standards), are constructed without geometric consideration for cyclists and priority across minor roads.

Pedestrian: Pedestrian priority facilities across the City are minimal. There are some locations where wider footpaths and relatively legible crossing points point to a local focus on pedestrian mobility, but not generally to a level that would indicate 'priority'.

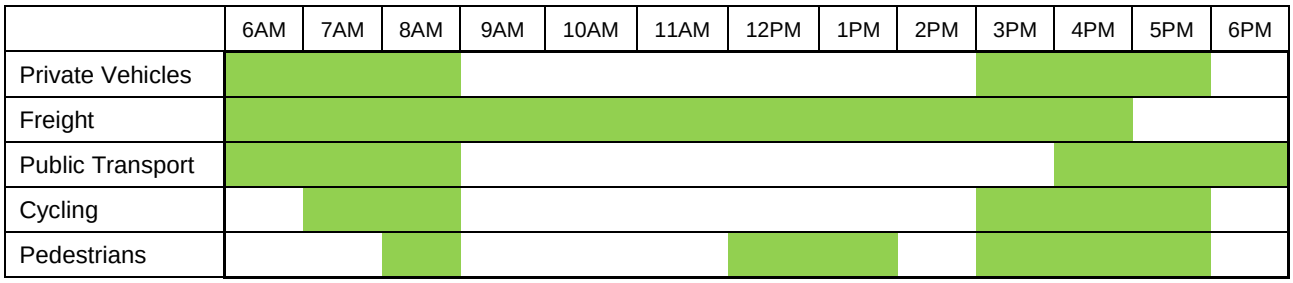
In particular, the Kwinana City Centre is primarily constructed to be accessible by car, not by walking. There are relatively few street trees to provide shade, and primary development access is from the large at-grade car parks rather than the street. The environment along The Strand is more conducive to pedestrian modes, with activity, seating, shade trees and slow road speeds.

Figure 3-3 TransPriority Assessment – Existing Network



3.3 TransPriority by Time Period

Analysis of Main Roads WA Traffic Map, Transperth Timetables, and the City of Kwinana Bike and Walk Plan 2018 indicates that the peak periods for travel by the various modes largely overlap in the following peak periods:



Transport priority for the existing network has been defined (along applicable road corridors) for certain times of day. This relates to the infrastructure provision and its function, as follows:

Table 3-1 Generalised Existing TransPriority - Industrial Areas (Weekday)

Priority	Peak	Off-Peak
1	Private Vehicle	Freight
2	Freight	Private Vehicle
3	Public Transport	Bicycle
4	Bicycle	Pedestrian
5	Pedestrian	Public Transport

Table 3-2 Generalised Existing TransPriority - Residential Areas (Weekday)

Priority	Peak	Off-Peak
1	Private Vehicle	Private Vehicle
2	Public Transport	Public Transport
3	Bicycle	Pedestrian
4	Pedestrian	Bicycle
5	Freight	Freight

Table 3-3 Generalised Existing TransPriority - Activity Centre (Weekday)

Priority	Peak	Off-Peak
1	Private Vehicle	Private Vehicle
2	Public Transport	Pedestrian
3	Pedestrian	Public Transport
4	Bicycle	Bicycle
5	Freight	Freight

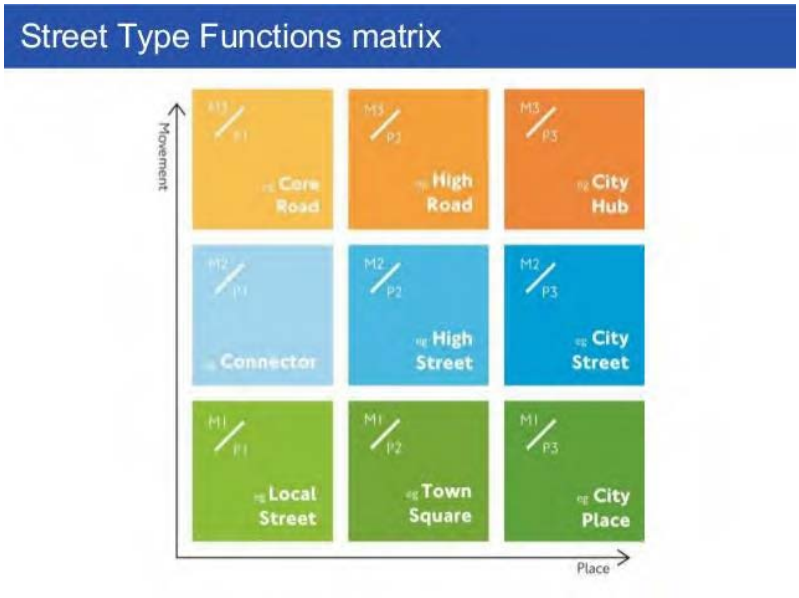
Conflicts can occur where demand overlaps and infrastructure prioritises one mode over another. Clear priorities that align with the function of a given location can minimize the impacts of these conflicts, so long as provision is safe and appropriate.

4 Evaluation Process - Link and Place Assessment

4.1 Link and Place Overview

Activity is a direct result of land use, with the type and intensity of activity defined by the land use choices within the Precinct or Corridor. This *ILAT Study* uses a simple Link and Place model popularised by Transport for London (Link and Place: A guide to Street Planning and Design, 2009) to specifically define the transport needs land use along individual road segments.

Figure 4-1 Link and Place Matrix



Source: Transport for London

This evaluation considers the pedestrian amenity, streetscape activation and development accessibility criteria of a location, and uses this to affect the form of the transport infrastructure to better support the desired land use planning outcomes.

Where activity levels are high (i.e. corridors have a greater 'place' function), infrastructure is designed to improve pedestrian amenity, street trees, furniture, al fresco dining opportunities. This type of corridor is characterised by pedestrian-scale retail, restaurant and entertainment venues, civic and recreational spaces. The street effectively acts as an extension of the land use and is typical of highly active City Centres.

These forms of land use and transport integration do not currently exist in the City of Kwinana.

Conversely, a road that serves primarily to provide for maximum mobility is built to ensure efficiency of travel for applicable modes. This may require bus lanes, access control, traffic lanes or bike facilities, but these roads are focused on the movement of people.

This is typical of arterial roads ***between*** Activity Centres, or any location where the road environment is constructed without consideration for the adjacent land uses, but instead focus primarily on mobility function.

'Core Road' corridors such as Thomas Road, 'Connectors' like Gilmore Avenue and local streets like Woodley Way all operate in this sphere.

In each of these instances, it is the land use that defines the local requirements for access. This method therefore allows us to interrogate land use planning; identifying changes that might be required to ensure the corridor performs its necessary function (e.g. locating highly active land uses away from a traffic-focused mobility corridor, increasing pedestrian-scale activation and improving amenity within a 'High Street' environment etc.).

The following examples demonstrate the application of 'Link and Place' analysis:

Thomas Road (Core Road)

- Full control with no direct access to properties by vehicle or pedestrians.
- Vehicle speeds and volumes are both high.
- Transport movements are generally uninterrupted.
- All land uses face away from Thomas Road.

Gilmore Avenue (High Street)

- Some integration with adjacent land uses.
- On-street parking and direct property access to large-scale parking lots
- Traffic movements slowed by differentiated environment.
- Traffic volumes remain relatively high.
- Some shade and shelter to support 'place function'
- Adjacent land uses do not currently take advantage of the streetscape.

The Strand (City Place)

- Low speed environment due to narrow width and short length.
- On-street car parking and shade trees introduces horizontal friction
- Land uses face the street and 'spill' out into the streetscape environment.
- Use of benches and communal spaces create a space to meet and dwell.

Areas of Conflict

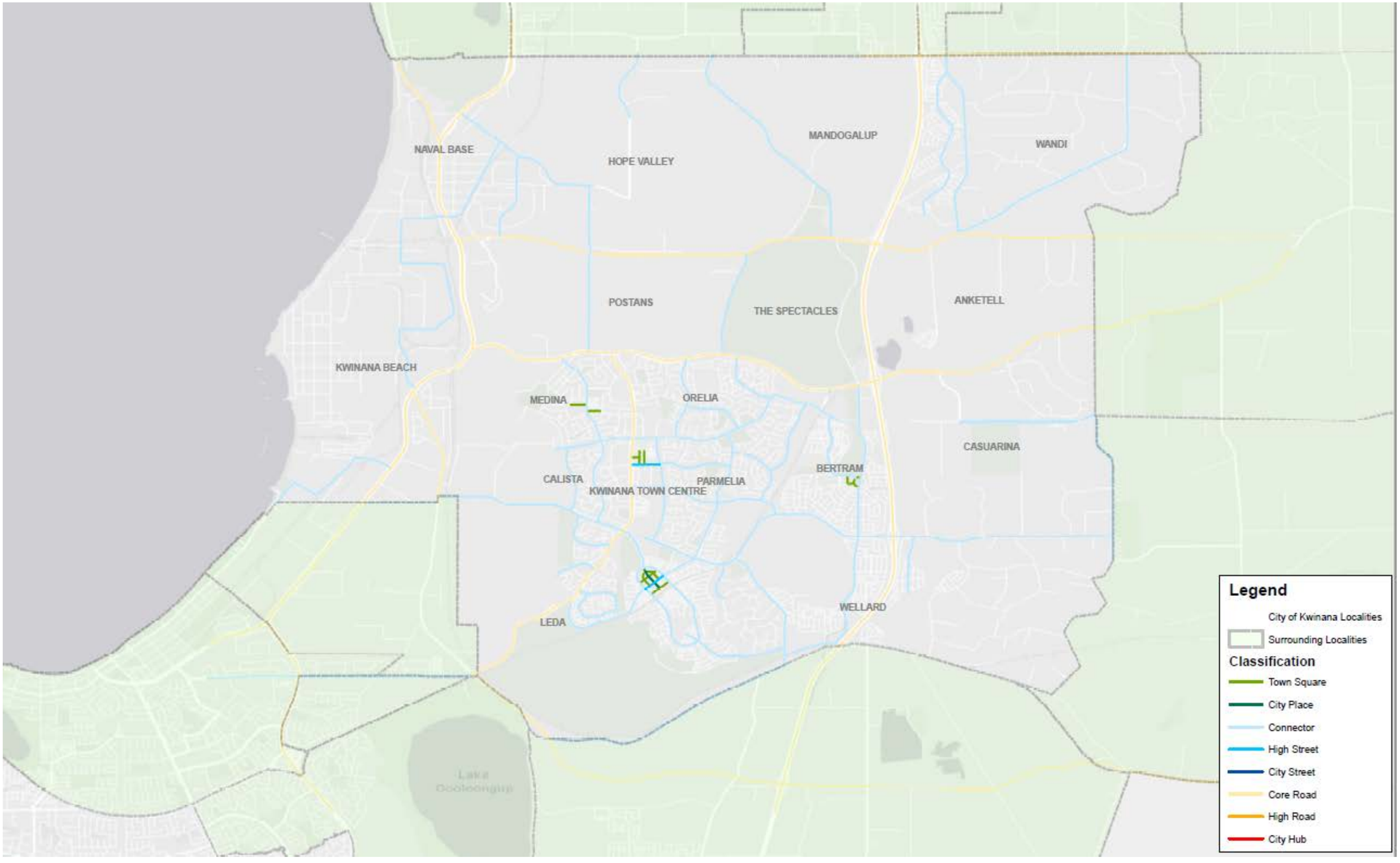
Requiring particular focus are those streets which perform a significant mobility function, while also being adjacent to high-activity land uses. These streets include segments of significant north-south and east-west corridors through Town Centre environments where high-activity land uses compete with high-volume traffic demands. This issue is likely to become more apparent as the City's Town Centres develop, and particularly where large at-grade car parks give way to development.

The corridor structure created by the upgrade to Chisham Avenue creates an environment that can support a higher value of 'place'. However, this can be diminished by high speed, high volume traffic along the corridor that reduces crossing opportunities and local pedestrian amenity.

4.2 Link & Place Mapping

The resulting Link & Place Map (represents an understanding of the existing integrated land use/transport system. The function described may not be desirable and may not reflect the future for the corridor or precinct, but it creates context for where changes to the environment would be beneficial.

Figure 4-2 Link and Place Map



5 Transport Networks

The transport networks in the City support a range of modes through specific infrastructure. For the purpose of this Study, the primary modes considered include:

- Private vehicles, including Parking;
- Cycling;
- Pedestrians;
- Public Transport; and,
- Freight, Service/Delivery and Waste.

The following discussion considers the transport within the City of Kwinana at a broad, network level for each of the above modes. Both existing and currently planned future infrastructure has been included to provide an analysis of the strengths, weaknesses, opportunities and threats for each mode.

The findings for each mode have then been used as a basis for the development of strategies and actions that integrate with the City's existing and planned land use types and categories.

6 Private Vehicle Infrastructure

6.1 Background

Private vehicles have traditionally played a significant role in the transportation network for the broader Perth Metropolitan region, as well as specifically for the City of Kwinana.

Private vehicles comprise the majority of traffic on the road network in the City of Kwinana. However, road capacity is finite, and continuing growth in development has the potential to stress the road network under business-as-usual conditions.

There are a number of options to mitigate these impacts, each dependent on land use and multi-modal transport decisions. Some of the key options are discussed as follows:

1. **Road capacity:** can be increased through duplication or intersection improvements. This can forestall congestion along key corridors, but ultimately results in negative traffic impacts in Centres and arterial roads, as well as diminished viability for all other forms of transport. Consistent increases in road capacity are also related to demand growth for parking, perpetuating car-centric development.
2. **Parking Constraint:** Parking is one of the key factors that drive the use of private vehicles. Where residential parking is abundant, vehicle ownership is high and driving makes up a larger proportion of trips. Reducing commercial all-day parking is one of the best ways to induce mode shift by employees.

   Decisions around parking provision are made at the policy, planning and implementation stages. The opportunities for parking management, and their impacts, are discussed further in **Section 11**.
3. **Proximity and Density:** Where destinations are located far away, private car use may be the only reasonably mode for access. For this reason, dense mixed-use developments generate far fewer car trips than disperse single-use neighbourhoods. The City's land use strategy can assist in creating effective communities that minimize travel to reach services.

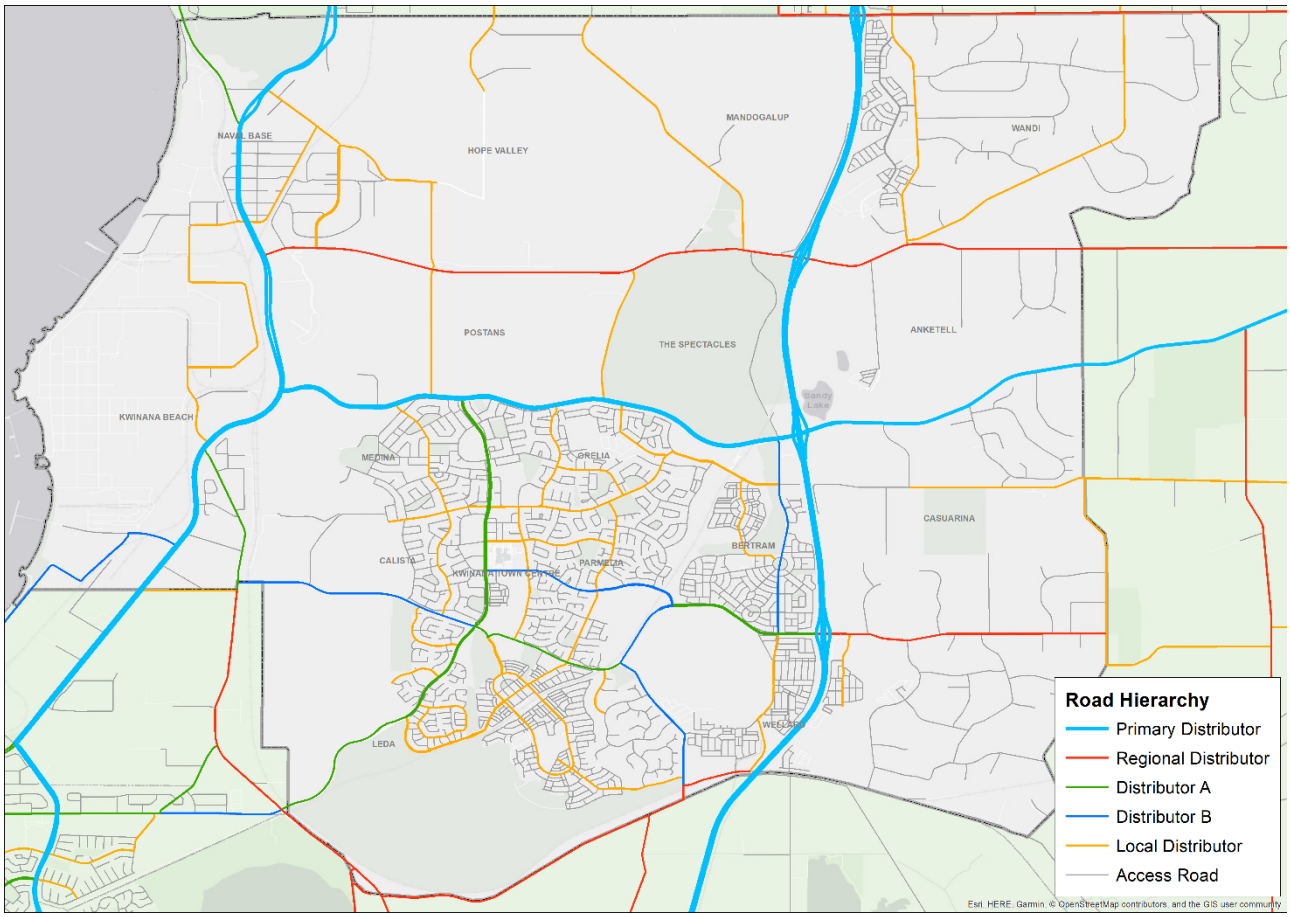
   Similarly, the combination of industrial development and nearby residential zones can help to limit travel distances, containing the impacts of trip generation and protecting the wider regional network.
4. **Mode Shift:** traffic congestion is one of the primary determinants of mode choice. Land use growth creates both the demand for alternative modes and the incentive (through congestion effects) to shift to them. However, if this demand is left unsatisfied, and sufficient public transport and safe cycling/pedestrian facilities are not provided, then development may stall or networks collapse.

6.1.1 Road Hierarchy

The private vehicle function of the road network is partially defined by its position in the Main Roads Functional Hierarchy (MRFH). However, the MRFH considers road function only in terms of private vehicle and freight movement. It does not consider the multi-modal function of the network or the role of land use in determining travel patterns.

Figure 6-1below shows the MRFH for the City of Kwinana.

Figure 6-1 Main Roads Functional Hierarchy



6.1.2 Traffic Speeds

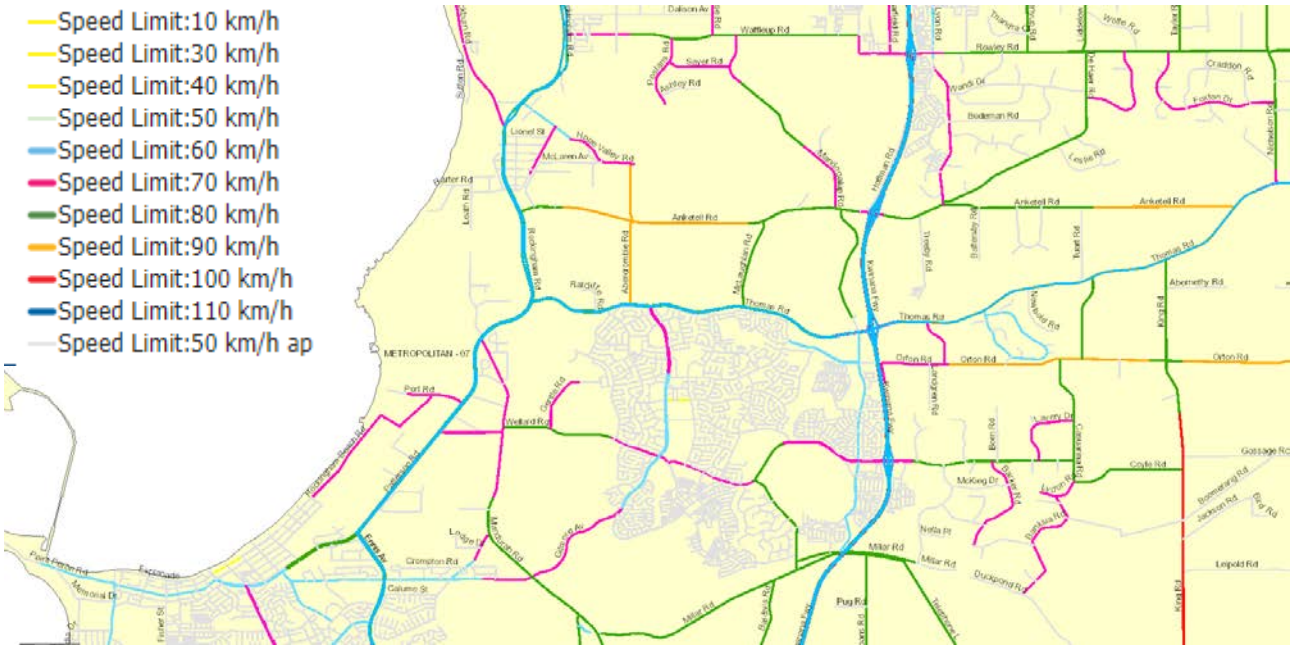
Traffic Speeds generally reflect the MRFH with primary distributors having higher speed limits.

In the City of Kwinana, the speed limits can be crudely defined as follows:

- 100 km/h along the Kwinana Freeway
- 80+ km/h along other Primary and Regional Distributors
- 60+ km/h for District Distributors
- 50km/hr on Local Distributors and Access Streets

Main Roads speed zone mapping is provided in **Figure 6-2** below for detail. In general, posted speeds reflect a sparsely populated, strategic road network designed for high capacity through movements. Recent and ongoing development has changed the nature of some of these roads, increasing the degree of local traffic and potentially suggesting lower speeds would be advisable.

Figure 6-2 Posted Speed Limits



Source: Main Roads Road Information Mapping System (April 2019)

6.1.3 Existing Traffic

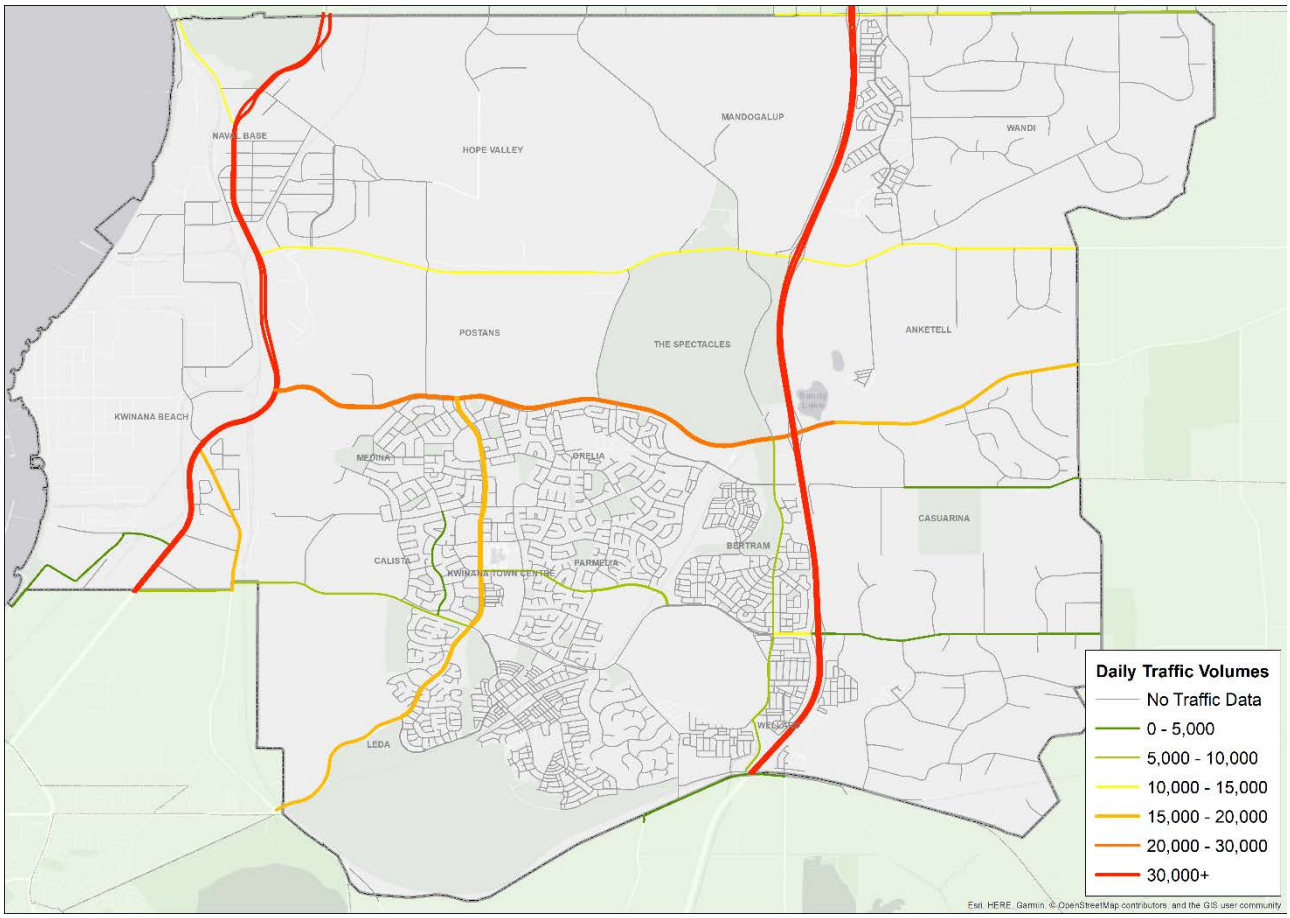
The latest traffic volumes available along roads in the City of Kwinana are mapped in **Figure 4-1** and provided in tabular form (**Table 6-1**).

Road capacities are considered only as a benchmark against the maximum theoretical mid-block capacity.

Table 6-1 Traffic Volumes along Major Distributors (per day) and as a Proportion of Corridor Capacity

Distributor	Traffic Volume (max)	% of Midblock Capacity
Kwinana Freeway	84,200	-
Rockingham Road	40,400	-
Patterson Road	33,400	-
Thomas Road	20,600	60%
Anketell Road	14,300	80%
Mortimer Road	4,900	30%
Millar Road	4,400	25%
Cockburn Road	12,100	65%
Gilmore Avenue	18,800	50%
Bertram Road	13,500	75%
Mandurah Road	15,100	85%
Wellard Road	8,000	45%
Challenger Avenue	7,300	40%

Figure 6-3 Latest Traffic Volumes



6.1.4 Congestion Effects

Traffic congestion occurs when peak period demand exceeds the carrying capacity of the road. However, for the purpose of strategic decision-making capacity is generally considered for daily traffic.

As a benchmark, a two lane road can continue to function effectively for traffic volumes of up to 16,000-18,000 vehicles per day (vpd), depending on access density, car parking and the provision of right-turning facilities. Similarly, a 4-lane road can carry 32,000-36,000vpd. These capacity limits assume sufficient and effective intersection controls.

Beyond these theoretical limits, congestion begins to occur, resulting in long delays at key intersections, as well as peak spreading, mode shift to alternative forms of transport, trip reduction or redirection to other destinations.

The results from network congestion are therefore not all negative. A degree of congestion is a necessary component of public transport viability, and also supports short-distance travel to local activity. Congestion in the wrong locations, or to an excessive degree, can have significant detrimental impacts on the viability of development

A number of intersections across the City of Kwinana experience substantial congestion during peak periods. These include along the following strategic roads:

- **Kwinana Freeway:** at the grade separated intersections at Rowley Road, Anketell Road, Thomas Road and Mortimer Road
- **Rockingham Road:** at Anketell Road, Thomas Road and Mandurah Road.

  In the City of Kwinana, Rockingham Road provides mobility for up to 40,000vpd, which meets or exceeds its theoretical capacity given the 4-lane form. As a consequence, Rockingham Road experiences a high degree of congestion during peak periods, and this extends throughout much of the day.

  The high proportion of freight vehicles reduces the efficiency of the corridor due to conflicts between heavy and light vehicle characteristics and the requirements for signal control suitable for large RAV combinations (see **Section 10**).

Thomas Road: at the minor road approaches of Abercrombie Road, Medina Avenue, Gilmore Avenue, Orelia Avenue and Johnson Avenue.

Thomas Road functions as the primary corridor for connection from the residential suburbs of Kwinana through to the Freeway, as well as a primary access route for industrial traffic to and from the Kwinana Industrial Area. The lack of signalised intersections along Thomas Road beyond Gilmore Avenue creates free-flow traffic conditions along its length, but does not well-support turning movements from minor roads.

Other streets operate as neighbourhood connectors, but access is constrained at peak times due to conflicts with adjacent land uses, the impacts of intersection controls, or other capacity-limiting effects.

- **Gilmore Avenue:** at Sulphur Road/Summerton Road and Harlow Road/Chisham Avenue.

  Gilmore Avenue is a 4-lane road accommodating 18,000vpd. This road forms the central access spine for the Kwinana City Centre, as well as a key strategic route from Thomas Road towards Rockingham.

  The configuration of the local arterial road network puts a great deal of pressure on these two signalised intersections. A large number of residential dwellings utilise Gilmore Avenue to provide access north to Thomas Road and south to Dixon Road.

  The network connections to Gilmore Avenue are compromised by turning restrictions at Challenger Avenue, Barrick Road and Christmas Avenue/Brownell Crescent, which funnels traffic into these klimited signalised intersections.

  Lane allocation at these intersections allow only split phase function for the minor roads, with consequences for the proportion of green time available for turning movements.

- **Lambeth Circle:** near Wellard Train Station Park ‘n’ Ride

  There is a very high demand for commuter parking adjacent to the Wellard Train Station, with all access via Charing Cross. The local street network is oriented around Lambeth Circle, which provides the only local crossing point over the train line to connect with the regional road network.

  As such, Lambeth Circle is simultaneously the main corridor for peak travel out of the suburb for residents, and the only access to Park ‘n’ Ride. This dual role creates conditions for congestion even prior to the full build-out of the sub-division.

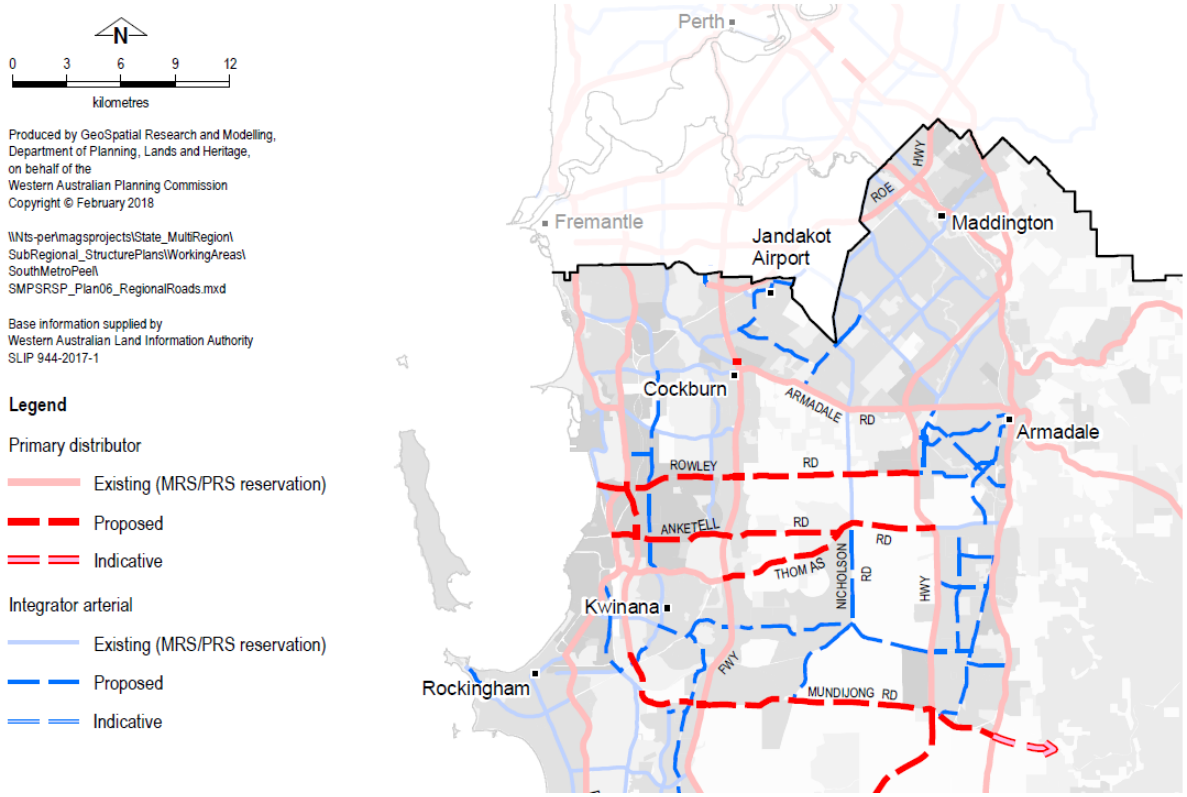
- **Bertram Road:** near King’s College

  Bertram Road functions as a primary connection (along with Johnson Road) to the Kwinana Freeway at Mortimer Road. It also is the only access point to King’s College. Peak period traffic movement clash and create a congested environment.

6.1.5 Future Traffic – State Planning Framework

The State's strategic planning for the region is defined by the *South Metropolitan Peel Sub-Regional Planning Framework.*

Figure 6-4 Future Transport Network



Extract from South Metropolitan Peel Sub-regional Planning Framework.

The following key changes to the network are likely to impact the form and function of private vehicle transport in the City of Kwinana.

- **Regional East-West Roads:** Rowley Road, Anketell Road, Thomas Road and Mundijong Road

  Future growth in residential and industrial traffic is likely to stretch the capacity of the strategic road network. This will be exacerbated by the needs of the Outer Harbour, along with supporting industry outside of the City.

  It is understood that Westport is considering the status of a number of east-west road links, which may be reconstructed as key freight corridors. Outcomes regarding the precise orientation of the regional freight network are still not fully determined, particularly the requirements for overheight & overwidth routes. Ultimately, these freight network decisions will result in a greater traffic capacity along certain alignments, and supporting higher private vehicle mode shares than the current network can sustain.

- **Fremantle-Rockingham Controlled Access Highway (FRCAH):** Mundijong - Rockingham Road

  This proposed free-flow freight corridor is intended to provide efficient, high-capacity, free-flow connection from the Kwinana Freeway through the Kwinana Industrial Area and connecting to the Outer Harbour and Fremantle Port. In doing so, it will alleviate pressure along the existing Patterson Road/Rockingham Road alignment

  One consequence of the FRCAH design is the modification of the Mundijong Road Freeway connection to a Freeway-Freeway Interchange (similar to the Tonkin/Roe Interchange). The size and scale of this infrastructure and requirements for ramps are expected to require modification of the Baldivis Road/Mundijong Road intersection to a simple flyover. The result is that connection to the freeway will be significantly reduced between Safety Bay Road and Mortimer Road, leading to a significant growth in traffic along Baldivis Road, Wellard Road and Bertram Road. The extent of the regional impact is not yet understood, but this could place a lot of pressure on these approach routes to the Freeway.

- **Gilmore Avenue Extension:** Thomas Road to Russell Road

  The sub-Regional Framework identifies a proposed Integrator Arterial extension to Gilmore Avenue, connecting through to Henderson Road in Munster. This alignment is not currently included in the MRS, but if constructed could have significant impacts on the nature and volume of traffic along Gilmore Avenue.

  By directly connecting the residential neighbourhoods in Kwinana with the industrial development zones through Postans, Hope Valley, Wattleup and Munster, these residential locations would become more attractive. This has the potential to be a catalyst for densification along the corridor. However, the route from industrial areas to the north through Kwinana to Dixon Road creates an attractive alternative alignment for heavy vehicle and industrial traffic, which could be detrimental to the development of the Kwinana City Centre itself, by increasing severance and reducing local amenity in the vicinity of Gilmore Road.

The forecast traffic demand for 2031 has been extracted from the City's SATURN model that covers the entire municipality of Kwinana. The model was developed utilising agreed and approved data from the City of Kwinana, Department of Planning and Main Roads WA (MRWA).

This model has been previously calibrated and validated to industry standard and is considered to be a reasonable source of future traffic demand for the City.

6.2 SWOT Analysis - Private Vehicles

Strengths:

- The availability of Primary Distributor roads throughout Kwinana provides an efficient transport network for strategic traffic during peak times.
- The extent of the network reduces the degree of bypass or 'rat-running' trips through residential streets.

Weaknesses:

- Many intersections along strategic Distributor roads are running close to capacity during peak times. This could hinder the ability for the network to accommodate future development growth. Improvements to the road network will be required to allow the network to operate effectively in the future.
- As congestion increases, traffic will likely redistribute to minor streets. Additional traffic calming measures will become necessary to retain resident amenity.
- The road reserve for some distributor roads is limited. It is expected that any substantial increase in demand will necessitate a change of transport mode.

Opportunities:

- The plans for the Outer Harbour and strategic connections to adjacent industrial zones will create new corridors for private vehicle transport to support the increase in traffic. There is the potential for these new roads to alleviate traffic on critical local road networks, retaining local amenity.
- The future of private vehicle travel is likely to be in electric vehicles, with European regulations acting as a forcing factor in the lead up to 2040. Electric vehicle charging stations will be required, with likely requirements for additional baseload power. This suggests that policies may be required to induce developers to incorporate EV charging into residential and office/commercial development.
- Autonomous vehicle transport (when it is realised) will have a fundamental impact on the way people travel. Current projections suggest that overall traffic demand will increase, but that public and private parking demand will fall dramatically. This presents opportunities for better streetscapes, reclaiming parking for transit, bike lanes, pedestrians and street trees.
- Jurisdictions across the world have adopted a 30km/hr residential speed limit, which allows for integration of mixed-traffic cycling and greatly improved road safety outcomes.

  The Department of Transport's Safe Active Streets provide one format for restraining speeds, but retrofitting this standard of infrastructure across the road network would be cost prohibitive. Nevertheless, creation of ubiquitous 30km/hr environments would be overwhelmingly positive for residents.
- In combination with low-ownership policies, car sharing schemes have been shown to be extremely effective in providing mobility to residents while heavily reducing kilometres travelled.

These schemes do not necessarily require public funding or support, beyond some enabling policies, though provision of on-street parking may be beneficial where cars are shared publicly or across multiple Lots.

- Parking policies imposed on employees, visitors and residents can be used to reduce traffic generation, and maintain effective road corridors.

Threats:

- A high proportion of traffic along the Primary Distributor road network in Kwinana originates from outside the City's boundaries. The city therefore has less control over the generation of this traffic, with fewer policy responses that can be applied to reduce vehicle trip generation.
- Changes to the strategic road network will likely increase the reliance on Local Distributors for regional traffic. At the same time that the FRCAH improves the capacity for east-west travel, it is expected to adversely impact the function of Baldivis Road, Johnson Road, Wellard Road and Bertram Road.
- The possible extension of Gilmore Road would increase traffic along the corridor, with consequences for access and amenity within the Kwinana City Centre.
- New development in the Kwinana Industrial Area will lead to an increase in vehicles along freight routes, displacing residential traffic to alternative routes.

6.3 Areas of Conflict

Mandogalup

The sections of Rowley and Anketell Road adjacent to Kwinana Freeway are of particular concern as their intended use conflicts with the future residential land classification.

As noted in the JSP the Mandogalup development proposes an urban redevelopment to both the East and West of Kwinana Freeway between Rowley and Anketell road, with two options for future rail interchange and four proposed schools. This development will see these roads used as key commuter routes for passenger vehicles looking to access schools and public transport.

Currently Anketell Road acts as a key freight route between Kwinana Freeway and the KIA. Future progression on the 'Indian Ocean Gateway' (Westport) may see the extension of Rowley road and the upgrade of Anketell Road, both for freight use. It has not yet been confirmed if one or both of these roads is to be used as access routes for Westport.

The potential function of Anketell and Rowley Roads as key freight corridors could hinder residents' ability to access local roads, schools and public transport. Future infrastructure delivery programs should consider all potential users of these strategic routes, including adequate turning capacity and crossing facilities.

Gilmore Avenue

Gilmore Avenue functions as an important regional route between Kwinana and Rockingham, but this role conflicts with its role as an access route to the Kwinana City Centre. The high traffic volume reduces opportunities for road crossing by school children and local residents, effectively creating a barrier for access to the Centre.

As demand continues to grow, and particularly if Gilmore Avenue were to be extended, the use of Gilmore Avenue by regional traffic can be expected to increase. This impinges upon its function as a key public transport corridor and reduces the potential for activity along the Activity Centre edge.

Local congestion along Gilmore Avenue that results from high traffic demands and restricted turning movements can be expected to get worse as regional traffic increases.

As such, as strategic view of the function of this road is required, weighing up the various needs and prioritising the value of activity, local access and regional purpose, public, private and active transport.

Freight Rail Crossings:

Industrial areas in the City of Kwinana are served by a network of freight rail lines that overlap the road network. Rail crossings are primarily at-grade, resulting in long delays and congestion where cars and freight give way to freight trains. The growth in industrial development, and particularly the requirements of the Outer Harbour and adjacent Inter Modal Terminal, are expected to increase the rail freight task. While this will take some pressure off the road network in general, the impacts at rail crossings will increase substantially.

An investigation of the options for grade-separated crossing is recommended. The viability of various options is related to the grade and turning requirements of rail vs road traffic, and the potential for double-stacked container transport.

7 Cycling Infrastructure

7.1 Background

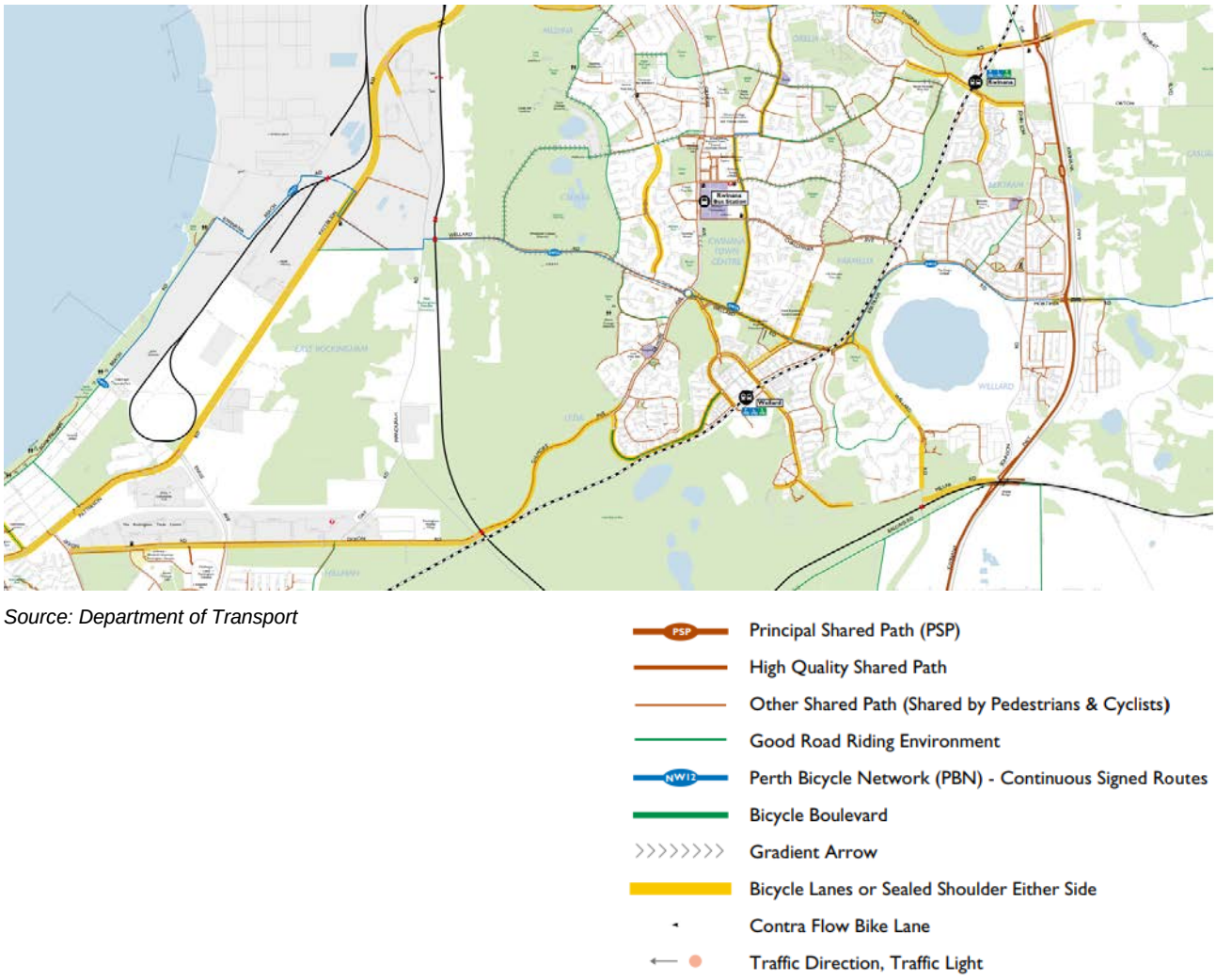
The cycling environment of Kwinana is largely captured in the *City of Kwinana Bike and Walk Plan* (*2018)*. This plan reviewed the extent and sufficiency of bicycle infrastructure and recommended changes based on establishing a network for cycling that improved safety, linking communities and facilities for all types of cyclists, as well as pedestrians.

7.1.1 Existing Network

An evaluation of the 2018 network showed that cycle network in Kwinana identified a number of “missing sections”. It is acknowledged that the City has made efforts to include cycling infrastructure in the majority of new developments, improving the connectivity for cyclists traversing the City, but historic suburban areas provide limited infrastructure for active modes.

The current designations for Principal Shared Paths (PSPs), High Quality shared paths and on-street Bike Lanes and Shoulders are described by the DoT *Cockburn and Rockingham Comprehensive Bike Map*, an extract of which is shown below,

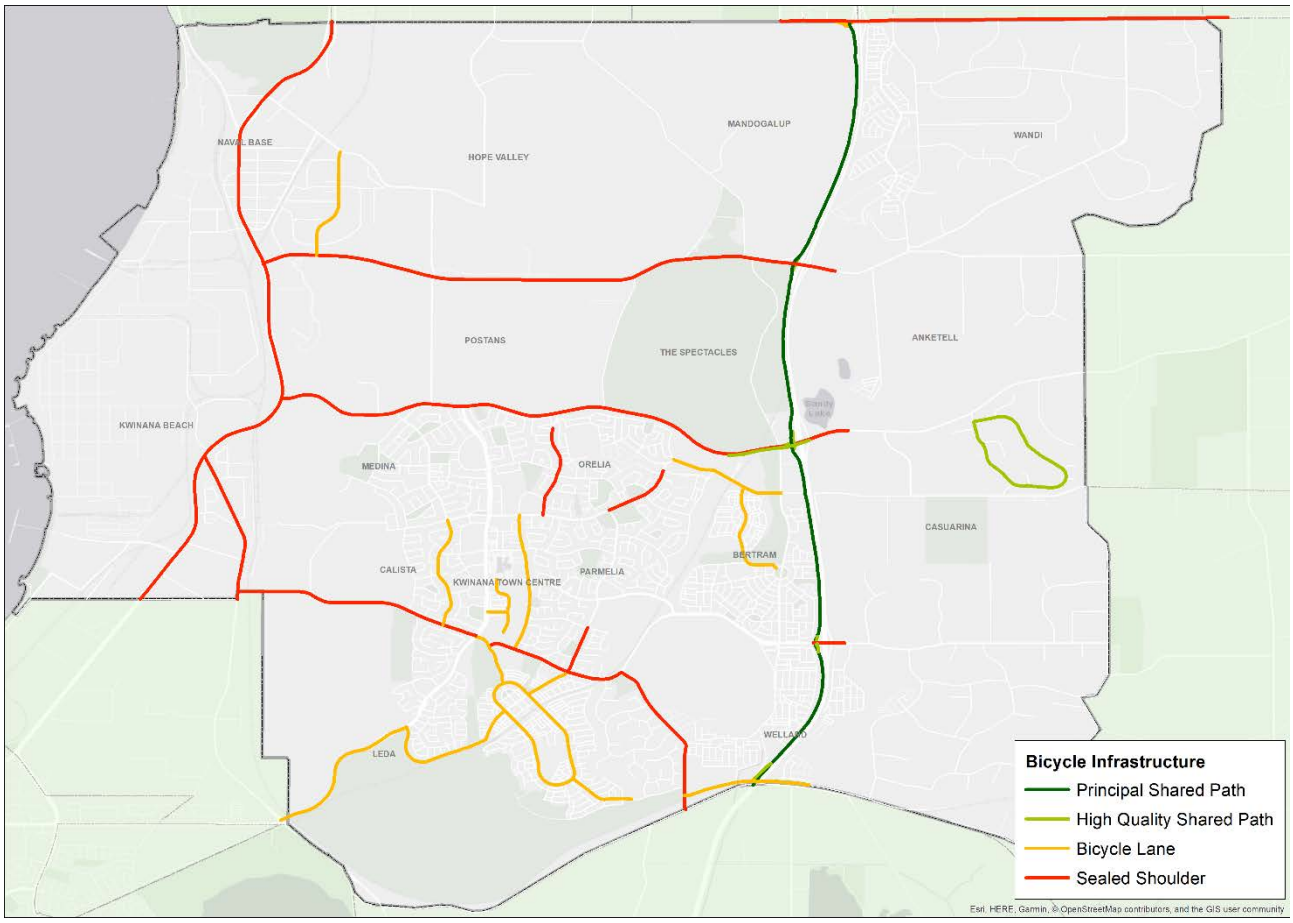
Figure 7-1 Extract from the *Cockburn and Rockingham Comprehensive Bike Map*



Source: Department of Transport

A simplified map of existing infrastructure is shown in **Figure 7-2**, collated from aerial images and using the *Cockburn and Rockingham Comprehensive Bike Map*.

Figure 7-2 Bicycle Infrastructure



Kwinana benefits from having a Primary Route in the form of a Principal Shared Path (PSP) running alongside Kwinana Freeway and connecting to Kwinana Train Station. However, the PSP does not provide access to the Wellard Train Station or the Kwinana City Centre.

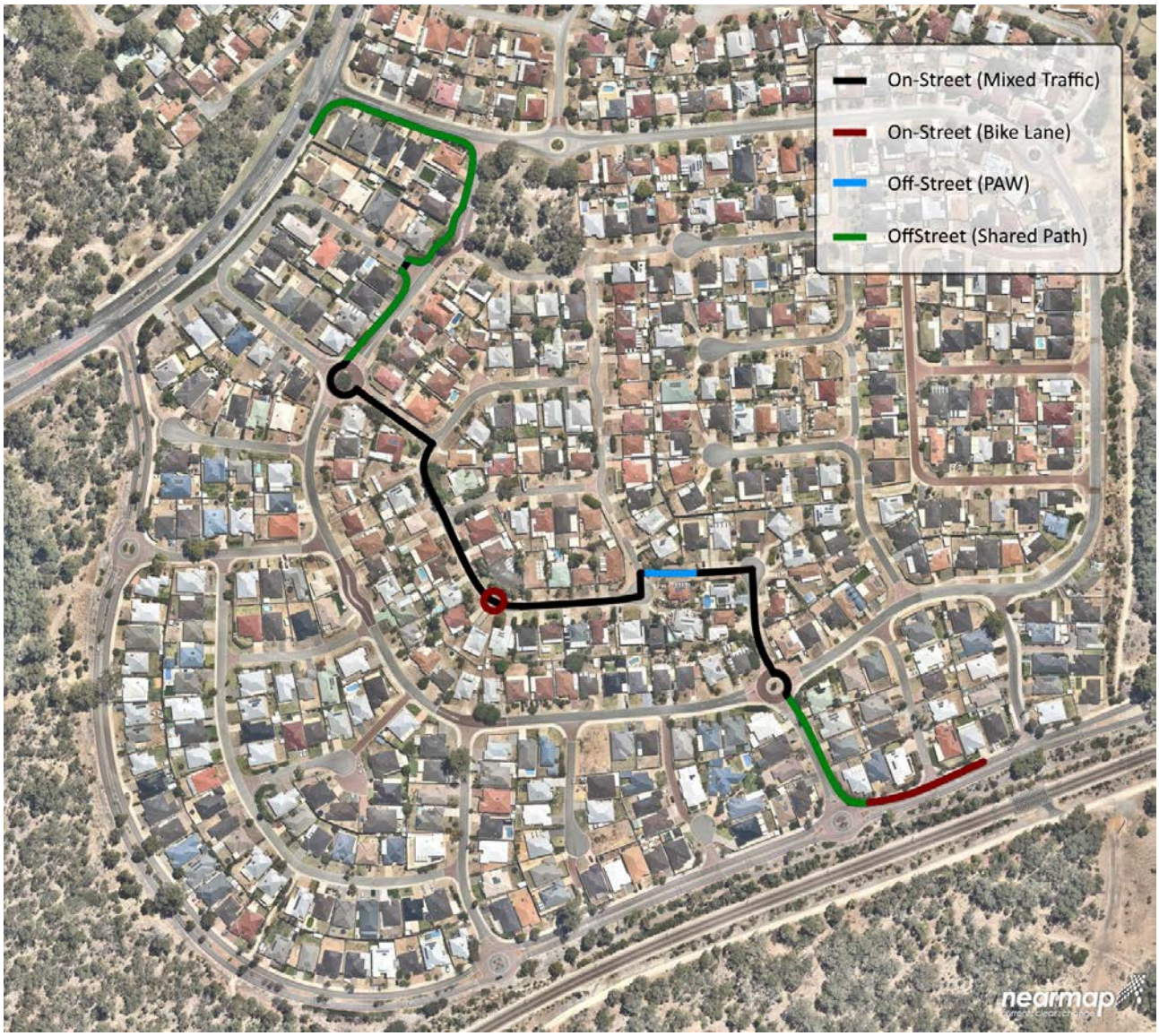
Recreational Shared Path runs along the ocean foreshore to the south (within the city of Rockingham) and the north (within the City of Cockburn). There is a sizeable gap in network which is a result of the Kwinana Industrial Area (KIA).

Sealed shoulders running along many of the strategic roads, including Thomas Road, Rockingham Road and Anketell Road provide long-distance connections for high confidence 'strong and fearless' commuter cyclists who are willing to travel alongside heavy vehicles at 80km/hr.

Cycling lanes all exist along much of the local distributor network: Gilmore Avenue (south of Runnymede Gate), Runnymede Gate, Lambeth Circle, Calista Avenue etc. The form of these cycling facilities generally consists of narrow unprotected lanes adjacent to traffic, and broken up by roundabouts where cyclists must merge into mixed traffic. Again, this form of infrastructure is suitable for high-confidence cyclists, but will not attract more cautious first-time commuters.

Quiet residential neighbourhood streets and slow-speed Activity Centre corridors allow safe cycling in mixed traffic. However, the structure of historic suburban development creates poor legibility for cyclists, as well as for cars (as illustrated in **Figure 7-3**). This combined with the distance between residential areas and activity centres greatly reduces the propensity for local trips by active transport modes.

Figure 7-3 Neighbourhood Connectivity

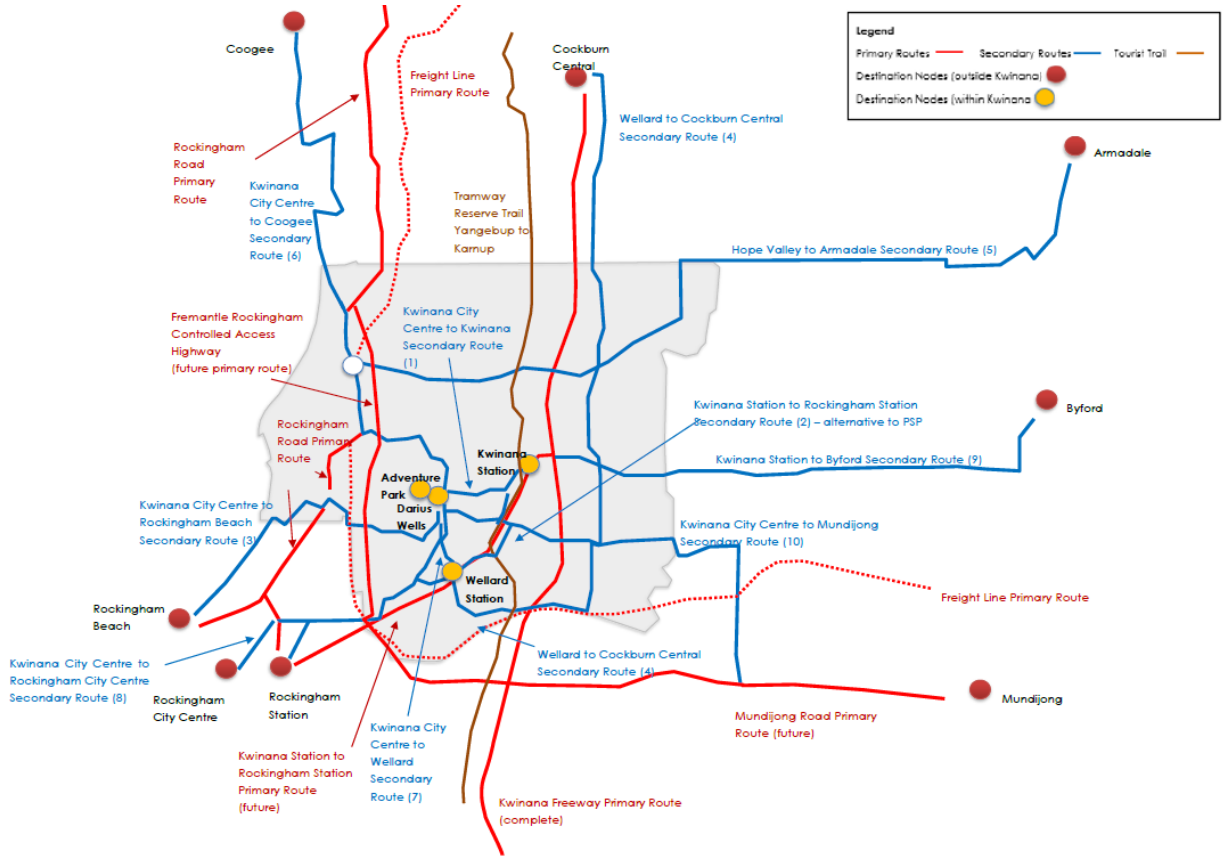


7.1.2 Future Network

The City's *Bike and Walk Plan* proposed a network of future off-street and on-street facilities at strategic and local scales. This comprehensive network of paths will support fine-grained cycling connections to destinations in the City, and regional connections to transport hubs and Primary Corridors.

The higher-order network of Primary and Secondary Routes has been extracted from the *Plan* and shown below, **Figure 7-4.**

Figure 7-4 City of Kwinana Long-Term Cycling Plan



Source: City of Kwinana Bike and Walk Plan 2018

This strategic network is broadly similar to the Department of Transport's planning for cycling facilities as expressed by the Bicycle Network Plan for Perth @ 3.5 million. However, the density of key routes as described by the City's planning is expected to better support the needs of the community.

Of note is the lack of strategic cycling corridors to and through the substantial industrial areas and in industrial development zones. Future growth in adjacent residential areas could be a catalyst for local trip containment which would benefit from high quality cycling connections.

7.2 SWOT Analysis – Cycling

Strengths:

- Cycling infrastructure around Kwinana's two main public transport hubs, Kwinana Train Station and Wellard Train Station, provide cyclists with an efficient and safe route when traversing key commuter routes.
- The City's investment in cycling along arterial roads creates a core structure for strategic commuter cycling. This strengthens the cycling connection between Kwinana and external destinations.
- Provision of bicycle racks at key activity centres in the City, including as Kwinana Recquatic, supports the use of bicycles for local trips. Residents, employees and visitors are thus more likely to cycle than in other Cities.
- Cycling in industrial areas is supported through the provision of sealed shoulders which, though intended for heavy vehicle breakdowns, provide a degree of separation from traffic.

Weaknesses:

- Narrow shoulders on Anketell and Thomas Road, combined with high posted speed limits and high volumes of heavy traffic, discourage cycling by less confident riders. However, while these roads are lacking in infrastructure, they still play a key role in the cycling network for anyone travelling East-West across the City.

Figure 7-5 Sealed Shoulders on Anketell Road

- Access to and through industrial development is rudimentary, contributing to a very low mode share for employees in these areas.
- The majority of on-road cycling facilities cede priority to traffic at critical location in the network, this reduces their attractiveness and risk performance. In particular, the requirement for cyclists to merge into traffic at numerous roundabout locations.
- The prevailing shared path alignment within neighbourhood streets and connector roads 'hugs' the kerbline around corners. This creates an unattractive environment that exacerbates the impacts of car priority and reduces both safety and compliance for cyclists.

Figure 7-6 Shared Paths with Connector Roads

- Roundabouts remain a barrier for cyclists across the network, even in reasonably quiet residential streets. The high speed differential between cars and bikes at these intersections effectively creates pinch points in the network, with a high risk profile.

Opportunities:

- Large road reserves of several major Distributor roads provide scope to construct buffered cycling lanes or high-quality off-street facilities.

- Passive wayfinding and signage can define an effective network with very little infrastructure spend. This is particularly important where cyclists must be directed to a safe crossing point or destination.
- Modification of suburban roundabouts to improve cycling safety requires very little change. The conversion of standard high-speed roundabouts to compact or European-style roundabouts could be of significant benefit along designated cycling corridors.
- The recent *Kwinana Bike and Walk Plan* recommends a range of paths, safe active streets and strategic on-road facilities. This *Plan* generally describes the specific opportunities inherent in the broader network. As part of road upgrade projects, the City will consider constructing cycling facilities where possible in accordance with the *Bike and Walk Plan*.
- Improvements to the cycling network indirectly benefit vulnerable members of society, including people with disabilities, the aging population, children and families. Infrastructure should be interrogated from this perspective as it is proposed and developed.

Threats:

- Road freight looking to access Kwinana Freeway from the industrial areas of Kwinana Beach and Naval Base are likely to use a combination of routes, including Rockingham Road, Thomas Road and Anketell Road. The resulting mix of heavy vehicles and cyclists creates a high-risk environment that is not mitigated by the existing shoulders. Improvements to infrastructure to create buffered bike lanes or high-quality off-street facilities are necessary unless alternative routes can be created.
- Traffic volumes generally are likely to increase along local distributor and collector roads, which will reduce the utility of these corridors for mixed-traffic cycling and painted cycle lanes. Facilities that may currently be adequate for high-confidence riders are not considered to be fit-for-purpose under future conditions and for the largest cross-section of the population.
- Increased traffic volumes also create severance effects for cyclists wanting to cross major roads. The current provision of primarily priority and roundabout intersections impedes crossing by maintaining free flow conditions. Infrastructure that supports safe pedestrian and cycling crossing priority should be considered at the intersections of Primary and Secondary Cycling Routes, and where major roads run adjacent to key destinations.

7.3 Areas of Conflict

A lack of planned cycling infrastructure hinders the ability to access the full range of modes in the KIA. This in turn increases the impact of private vehicle travel, and pressures on parking at the destination.

Proposed on road cycle lanes along Mason Road, Mandurah Road and Office Road have been scrapped due to the PSP on the freight line being the preferred option. While this PSP is useful for cyclists looking to travel North-South along the freight line, appropriate connections into the KIA are necessary to support workers accessing industrial and commercial destinations on both sides of Rockingham Road.

Future expansion of the KIA to the north and west of Kwinana creates the potential for a greater cycling mode share by workers. To ensure cyclists ease and safety in traversing the area; sufficient cycling infrastructure will need to be implemented, with particular consideration in corridors used for high-volume traffic and freight.

8 Pedestrian Infrastructure

8.1 Background

Pedestrian travel is much more localised than other transport modes, but vital for the function of land use and transport systems. Outside of centres, high quality pedestrian facilities support residential travel to shopping and schools, connection to public transport facilities and recreation. An attractive and safe pedestrian realm results in improved health and social outcomes for residents. Attractive pedestrian environments also improve economic outcomes, attracting more residents and businesses.

Pedestrian activity and connectivity are also critical factors in the effectiveness and vitality of Centres and Corridors. For this reason, the pedestrian environment must be carefully considered, particularly along primary pedestrian routes. This includes construction of high quality paths, shade trees and street furniture to provide amenity. By allocating suitable 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.

Parking location can be key to determining both traffic and pedestrian movement. The location of car parking towards the periphery of the Centre limits the impact of parking on trip volumes and land consumption, and requires parkers to travel an additional distance to their destination. The acceptance of peripheral car parking will be significantly improved where attractive legible pedestrian facilities are provided.

A pedestrian Level of Service approach considers the ***quality*** of the pedestrian experience across the length of the trip. Higher-traffic areas with a concentration of pedestrians require good quality, connected, covered and shaded paths, but so do paths which connect areas of high demand across relatively long distances, approaching or exceeding the nominal 400m or 800m walkable catchment.

8.1.1 Level of Service

The distance pedestrians are willing to walk depends on the type of activity (shopping, commuting, and recreation) and the quality of the built environment. The following **Table 8-1** describes the Level of Service pedestrians ascribe to walking connections, based on quality and distance.

For example, an 800m walk along a well-shaded path is equivalent to a 200m walk through a shopping centre car park.

Table 8-1 Distance (in metres) Pedestrians will Walk for a Level of Service

Conditions	LoS A	LoS B	LoS C	LoS D
Climate Controlled (including tree canopy)	400	800	1200	1600
Covered Walkway (i.e. awnings)	250	400	500	750
Unprotected Path	150	300	400	500
Through Car Park	100	200	300	400

8.1.2 Desirelines

Areas of key pedestrian need have been identified for the existing network, consisting of:

- Within Activity Centres and from peripheral parking to employment destinations.
- Along and across Activity Corridors
- Along and across Transit Corridors, and along adjoining minor streets within a 200m walking distance
- Within a 400m walking catchment of schools, shopping precincts and recreation venues, oriented towards the destination.
- Within 800m of a train station or high-priority transit, oriented towards the node

These pedestrian desire lines should correspond with a higher Level of Service, particularly with respect to crossing opportunities.

8.2 Pedestrian SWOT Analysis

Strengths:

- The pedestrian network throughout three of the major activity centres, Kwinana City Centre, Wellard and Bertram, is comprehensive. In these areas paths are mostly available on both sides of the road, providing efficient access to recreational centres, schools and commercial areas.
- Residential areas provide a broad network of paths, though frequently located on one side of the road throughout the suburbs.

Figure 8-1 Residential Development with Footpath on Singular Side, Wellard

> Wide cast in-situ concrete paths are utilised throughout the City, with the newest paths in areas of recent development, such as Wellard and Bertram, being constructed to modern standards.

Weaknesses

> The road network orientation within residential development areas creates long walking distances to bus routes and key destinations. Even where bus stops are located within 200m of residences (as the crow flies), walk distance are often twice as long, significantly reducing the attractiveness of public transport modes. This results in lower levels of patronage and longer bus headways even during peak periods.

> Many older suburban areas have been designed with insufficient pedestrian facilities or isolated Pedestrian Access Ways (PAWs). This reduction in accessibility is most keenly felt by the most vulnerable groups: people with disabilities, the aged, small children and young families.

Figure 8-2 Residential Development Without Footpaths, Wellard

> Crossing points along major corridors are widely spaced and generally provide no priority for pedestrians. These barriers induce car dependence by local residents, even where destinations are located nearby.

> The pedestrian environment is characterised by long distances and little to no shade or shelter. The introduction of street trees and awnings would benefit pedestrians and cyclists.

> The orientation of development in the Kwinana City Centre and other retail/commercial areas, where shops and restaurants face large at-grade car parks, is generally hostile to pedestrians.

> Pedestrian access to bus stops in many locations is lacking, even where DDA compliant stop infrastructure has been built.

Opportunities:

- The extent of street infrastructure in the recent development of Wellard would allow bus routes to travel down the majority of streets without major deviation from the current route.
- Recent development in The Strand attempts to address this through attractive streetscape and pedestrian-scale activity. Similarly, streetscape works along Chisham Avenue in the Kwinana City Centre will enable future pedestrian-oriented development.

Threats:

- Pedestrian environments are often squeezed by the demands of other transport modes with easily to define dimensions. In the search for a more efficient road network, verges are diminished to accommodate turning pockets, central median islands, parking bays and on-street bicycle facilities.

  This in turn creates a space that must provide for road signage, street furniture, above-ground utilities land use activation, street trees and pedestrian paths. To combat this pressure, the needs of pedestrians must be considered in the context of their priority, which is principally driven by adjacent land-use decisions.

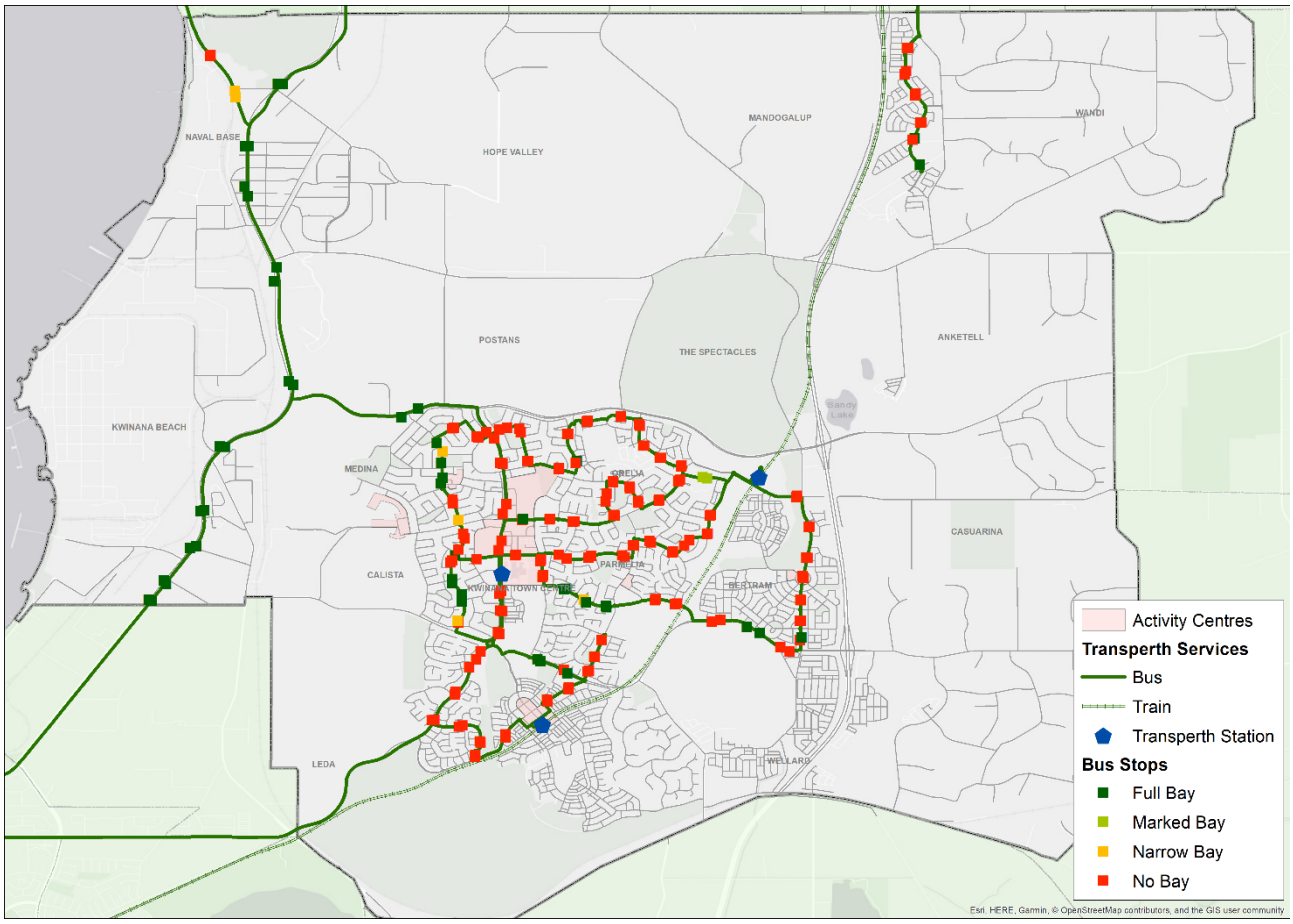
9 Public Transport Infrastructure

9.1 Background

Public transport within the City include a range of local collector bus services, limited long-haul coastal services and high capacity train service.

The following **Figure 9-1** describes the extent of the existing bus and train network within the City.

Figure 9-1 Public Transport Network



Population within the City of Kwinana will approximately double in the next 20 years. This will necessarily increase the demand for transport across the network. Given the overall growth in residential and employment over this period, there is likely to be insufficient road capacity to accommodate the corresponding transport demand under the current paradigm of predominantly peak-hour private vehicle trips.

As such, an alternative framework and infrastructure solution must be considered which prioritises the movement of people and goods over traffic. Public transport is an ideal mode, able to provide regional travel for large numbers of people within a relatively small cross-section.

Current use of Public Transport (as shown in PTA data) in the City of Kwinana is relatively low, with approximately 5,000 bus boardings/alightings and 7,000 train boarding/alightings per day. Nevertheless, this degree of public transport usage has a significant positive impact on the function of the local road network.

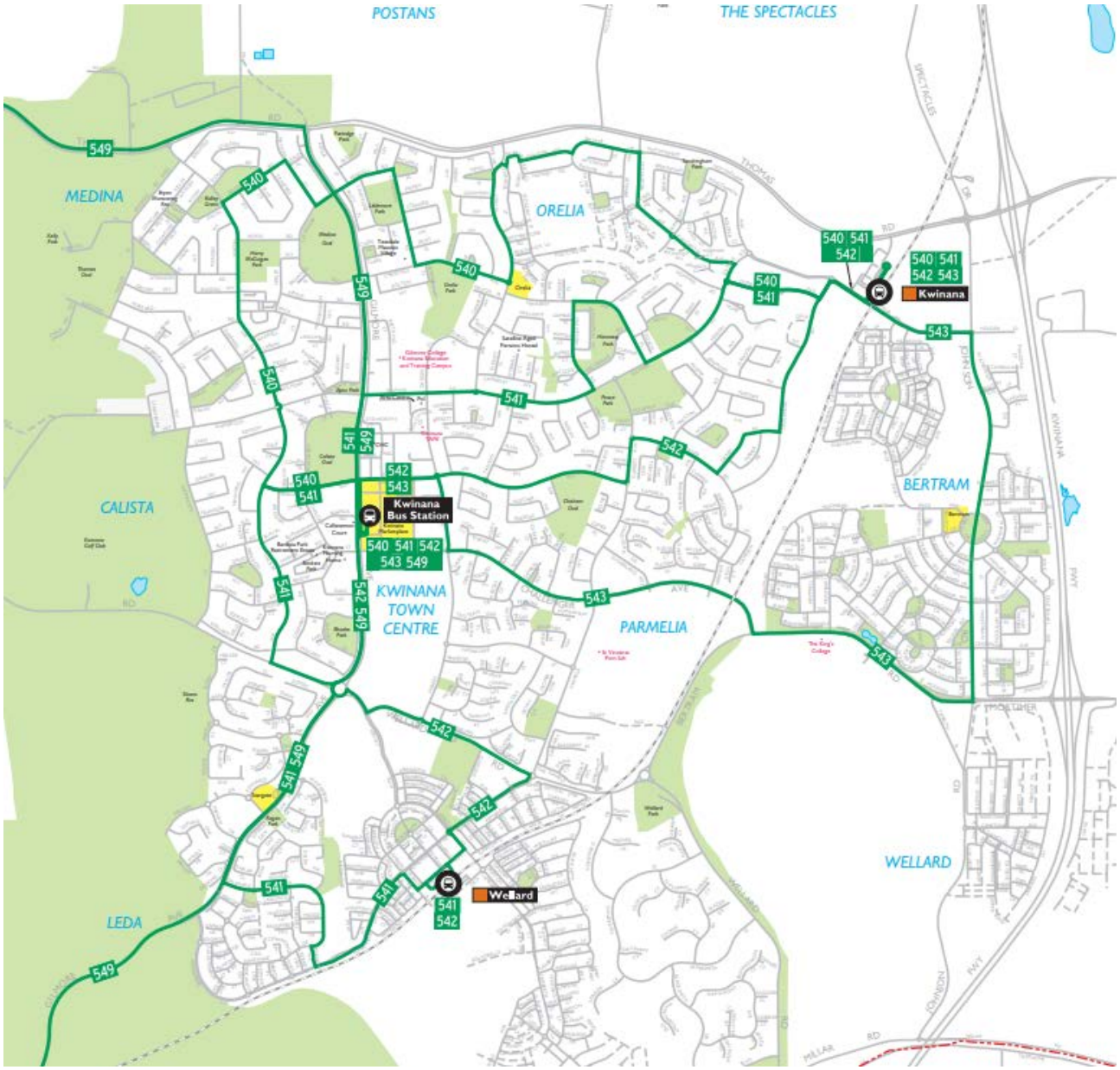
9.2 Bus Network

9.2.1 Bus Routes

The City of Kwinana is serviced by seven bus routes, as shown in **Figure 9-2.** The majority of these services run as relatively infrequent collector routes, operating approximately every 20 minutes routes during peak periods, and hourly off-peak.

The Routes 548 and 549 services provide the sole connection in the area between Kwinana and Fremantle, which is otherwise poorly served by the rail network. With the exception of the coastal Route 548, all buses connect to the Kwinana City Centre via the Kwinana Bus Station.

Figure 9-2 Bus Routes in the City of Kwinana (Central)



As a result of the overlap between services, some corridors in the City are already well-served by transit. The effect of frequency and route selection can be seen in the observed utilisation of public transport along key transit corridors. **Table 9-1** shows the relationship between these two factors.

Table 9-1 Bus Service Effective Average Headway (in minutes) and Average Daily Patronage by Corridor

Road Corridor	Peak Headway	Off-Peak Headway	Origin Trips	Destination Trips
Gilmore Avenue	***2.5***	***4***	***385***	***356***
Kwinana Bus Station			***330***	***267***
Johnson Road	20	55	81	91
Sulphur Road	20	45	62	105
Bertram Road	20	55	41	56
Chisham Avenue	20	45	29	54
Medina Avenue	20	45	35	25
Challenger Avenue	20	55	19	19
Calista Avenue	20	45	14	11
Rockingham Road / Patterson Road / Cockburn Road	*8*	*11*	*28*	*19*
Thomas Road	*12*	*15*	*5*	*3*
Runnymede Gate	*20*	*60*	*4*	*3*

Gilmore Avenue experiences significantly more bus services than any other corridor, and as a consequence, attracts much higher patronage. The daily patronage along other corridors in residential neighbourhoods ranges from 25 to 170 boardings and alightings per day.

Public transport use along Rockingham and Thomas Road is extremely low, reflective of the lack of adjacent destinations in the catchment. In contrast, Runnymede Gate is sufficiently close to the Wellard Train Station that it is assumed public transport users connect directly to train.

Structure plans currently under development generally do not have access to bus transport. The PTA can be expected to provide services as dwelling numbers reach a certain threshold, but this is likely to lag development by some years.

9.2.2 Bus Stops

The level of priority afforded to bus transport is partially indicated by the location and quality of bus stops, and particularly where decisions are made to create bus embayments or allow in-lane stopping.

Bus embayments are generally constructed to limit the impact of bus service on traffic flow. This infrastructure is therefore indicative of corridors where traffic is given priority over public transport. The effect of this is that buses must wait to re-enter traffic flow, with adverse consequences to travel time and consistency.

One exception to this is at timed stops and termini, where buses can be expected to wait for some considerable time. A review of bus stop infrastructure shows that the majority of services do stop in the traffic lane; the exceptions are along Rockingham Road / Cockburn Road and Wellard Road / Bertram Road.

9.2.3 Bus Priority

Public transport is at its most effective when it is provided in dedicated corridors with priority at key congestion points. There are no current provisions for bus lanes or queue jump facilities in the City.

9.3 Bus Network SWOT Analysis

Strengths:

- High incidence of bus-to-train interchange reduces the impact of park ‘n’ ride from nearby residential neighbourhoods.
- Coverage routes within many residential zones support viable peak period transfers to the Kwinana City Centre and rail nodes.

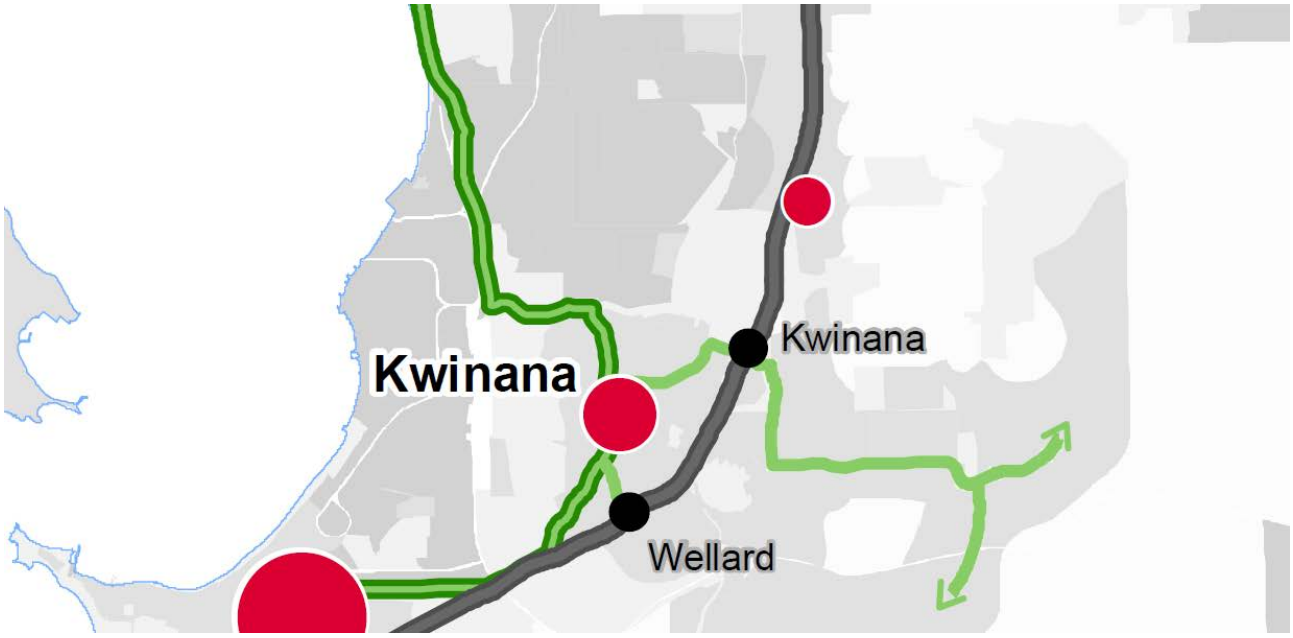
Weaknesses:

- Low utilisation of stops along transit corridors and residential areas due to low-density nature, inhospitable pedestrian environment and infrequent service; this is likely slow any service improvements to the bus network.
- Off-peak 60-minute headways make using the bus service inconvenient to travel within the City or to rail hubs.
- Bus services to industrial employment zones are extremely limited.
- Buses are subject to network congestion, with no priority measures to maintain consistent route times.

Opportunities:

- Development within future Structure Plan areas, particularly to the east of the Kwinana Freeway, can support higher-frequency service due to internal network design.
- Possibility for private or PPP transport services to be developed by businesses, Local and State Government partners. Services might consist of branded coaster-sized transit operating in a 'petal route' formation around the central rail hub or bus interchange. This service becomes more viable where multiple businesses see benefit, as electric vehicle technology reduces running costs, and following the advent of automated technology.
- The *South Metropolitan Peel Sub-Regional Framework* identifies two strategic bus corridors through the City of Kwinana, as described in the extract
- A 'High Frequency Transit Corridor' running between Kwinana Train Station and Wellard Train Station via the Kwinana City Centre. This could support increased land use density as an Activity Corridor (**Section 14**), or maintain consistent mobility goals as a Transit Corridor (**Section 15**), in whole or in part.
- A 'High Priority Transit Corridor' between Rockingham and Fremantle via the Kwinana City Centre. This would improve direct access to Kwinana, but is primarily intended to be an efficient commuter service delivering employees to destinations along the coast, including the Outer Harbour and supporting industry. This corridor is likely to require bus priority in the form of queue facilities or partial bus lanes to maintain consistent times.

Figure 9-3 High-Priority and High-Frequency Transit Corridors



Source: South Metropolitan Peel Sub-Regional Framework

Threats:

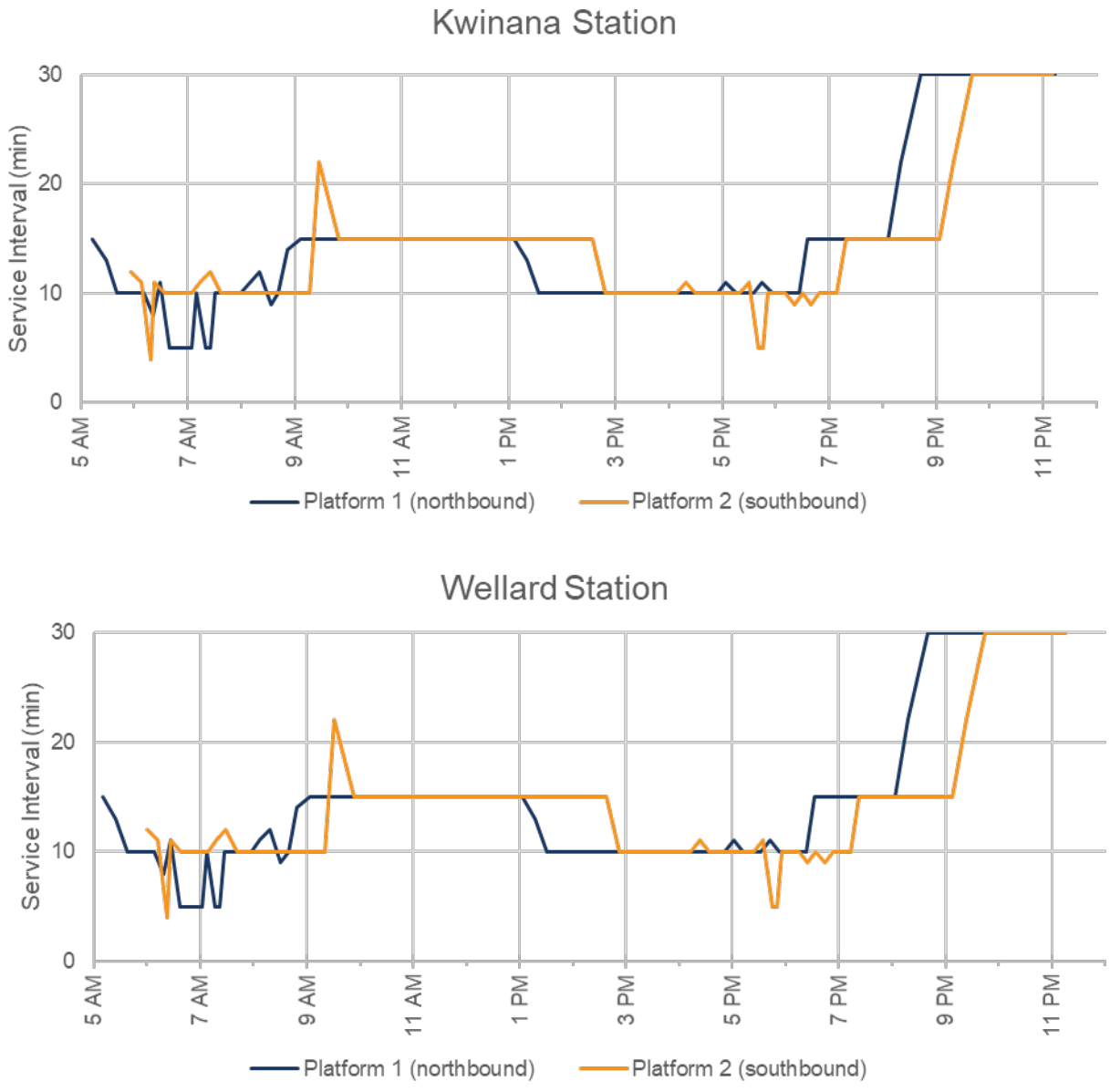
- High-capacity public transport is enabled by dense development adjacent to the corridor. Where residential areas primarily low-density, then demand is unlikely to support frequent or higher priority public transport.
- Existing routes do not currently cover new developments being constructed. The lag between housing construction and public transport service leaves residents without access to public transport. This issue results in travel behaviours that can last long-term, perpetuating a system of low sustainable transport usage and provision.

9.4 Train Network

The City of Kwinana is serviced by the Mandurah Train Line, stopping at Kwinana Train Station and Wellard Train Station.

The service frequency to both Kwinana and Wellard Train Stations is an average of 10 minutes during peak periods and 15 minutes off peak. **Figure 9-4** represents this frequency graphically, as the time between services.

Figure 9-4 Train Service Frequency at Kwinana and Wellard Train Stations



9.5 Train Network SWOT Analysis

Strengths:

- Service relatively high across the day.
- Stations provide for effective bus interchange.
- Secure bike shelters encourage cycling to the stations.

Figure 9-5 Bike Shelter at Kwinana Train Station

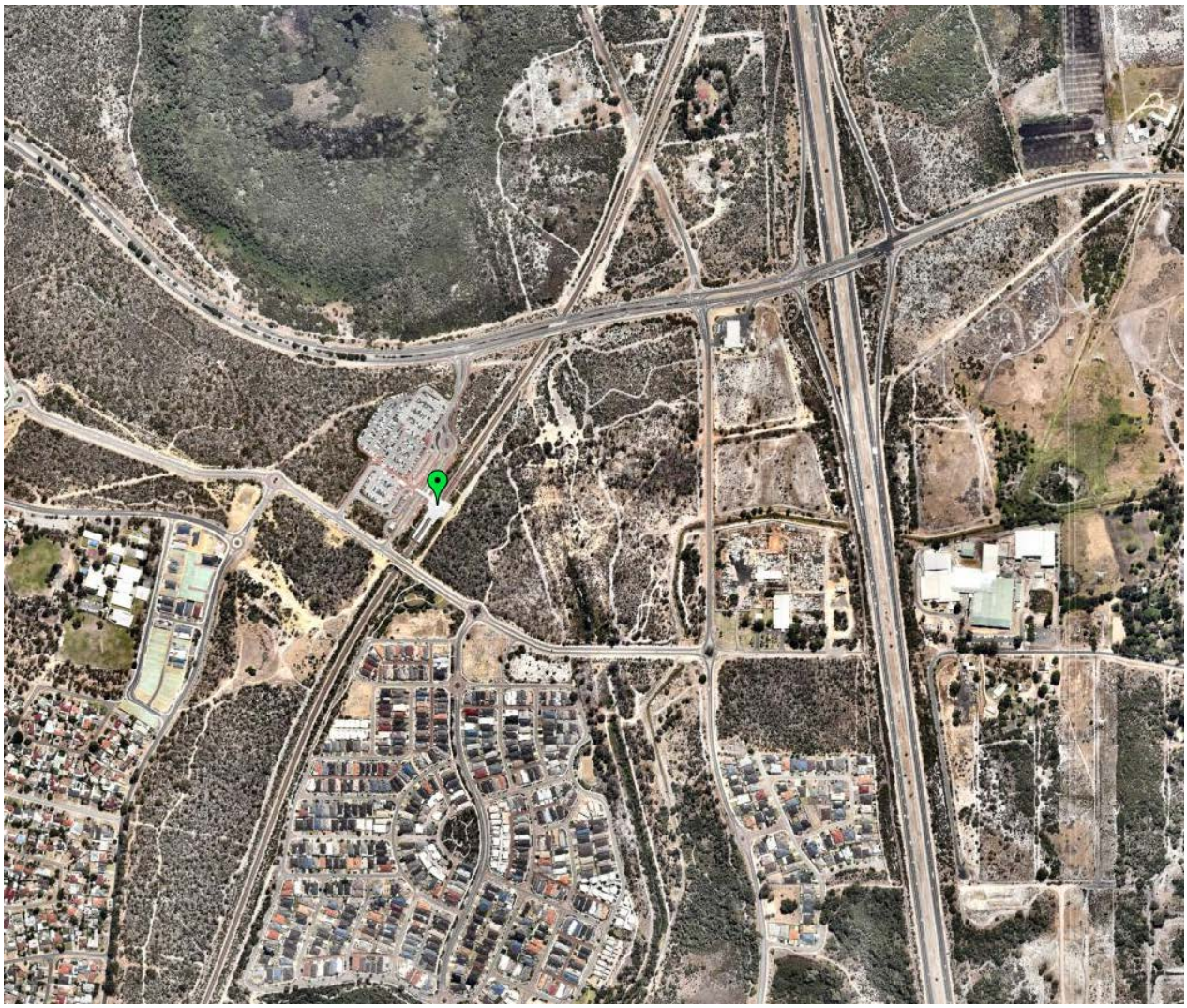
- Large car parks at Kwinana Train Station encourage use of park ‘n’ ride service, reducing long-distance commuting by car.
- Train travel time to the Perth CBD (approximately 35 min from Wellard Train Station, and 30 min from Kwinana Train Station) is equivalent to travel time by car. This encourages the use of train travel as a way to offset the variability in peak period travel time.

Weaknesses:

- The Kwinana Train Station is located well to the north of residential and commercial zones, reducing its local catchment by at least 50%. There are no residential developments within walking distance of Kwinana Train Station. This creates a high demand for the park ‘n’ ride service even from the surrounding residential development.
- Local residents must compete with regional demand for park ‘n’ ride at the station. This is exacerbated by the lack of bus transport alternatives in some new development areas.
- Limited car parking capacity at Wellard Train Station.
- Access to the Fremantle Train Line is limited to the Route 548/549 bus service. While frequent, this service is subject to congestion-related delays along its route.

Figure 9-6 Car Parking at Wellard Train Station

Figure 9-7 Location of Kwinana Train Station and Surrounding Context



Opportunities:

- Service frequency is likely to continue to increase as part of network-wide improvements across the system.
- The Stage 1 future Thornlie-Cockburn Rail Link will improve public transport connections to destinations throughout the south-east suburbs; particularly residential and employment zones.
- Previous investigations have been conducted into additional Stations in the Mandogalup/Anketell and Bertram locations.

  While these Stations are not currently under consideration by State Government agencies, there may be future opportunities to integrate high-capacity public transport hubs into the future District Shopping Centre at Anketell Road, or to create a Station with better accessibility to the Kwinana City Centre.

Threats:

- The ongoing growth of regional demand is likely to overwhelm the capacity of commuter park ‘n’ ride at the Station. Alternative arrangements including improved bus transit will be necessary to offset this impact. Otherwise, additional park ‘n’ ride facilities will be required, with a corresponding impact on local traffic volumes, congestion and amenity.

10 Freight Infrastructure

10.1 Background

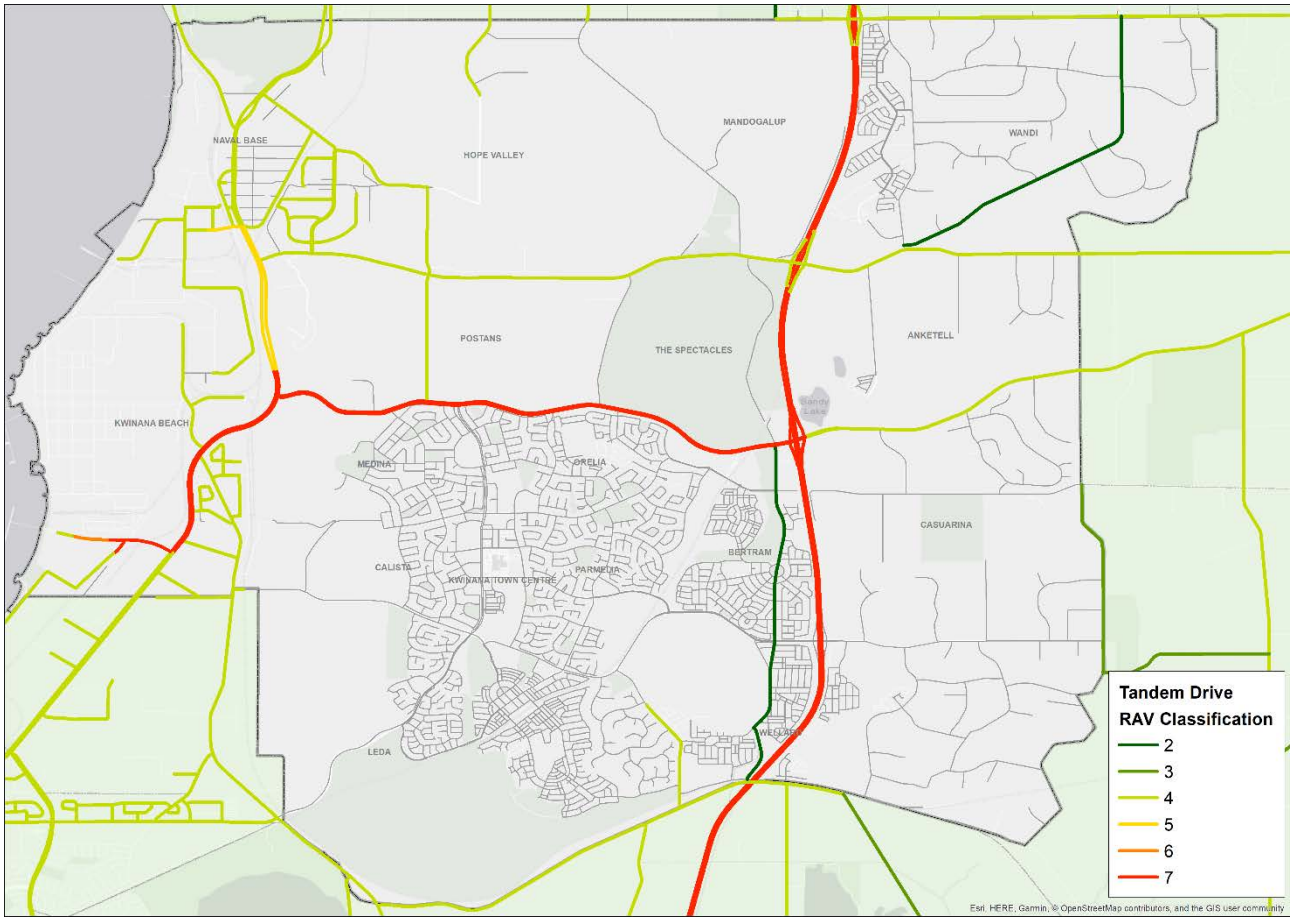
The freight network within the City is characterised by both road and rail infrastructure, servicing the Kwinana Industrial Area, Naval Base Industrial area, Latitude 32 and destinations to the south (e.g. Rockingham) and the north (e.g. Fremantle).

The Kwinana Freeway and Rockingham Road are the two primary north-south routes in the City, supported by east-west connections along Anketell Road and Thomas Road. Main Roads' RAV Network Classifications, which define the size and scale of freight transport along these corridors, are shown in **Table 10-1** and **Figure 10-1.**

Table 10-1 Freight Infrastructure Primary Route Details

Road	RAV	Daily Volume	Peak HV (%)
Kwinana Freeway	7	40,000	18
Rockingham Road	4,5,7	40,000	28
Thomas Road	7	20,000	22
Anketell Road	4	10,000	22

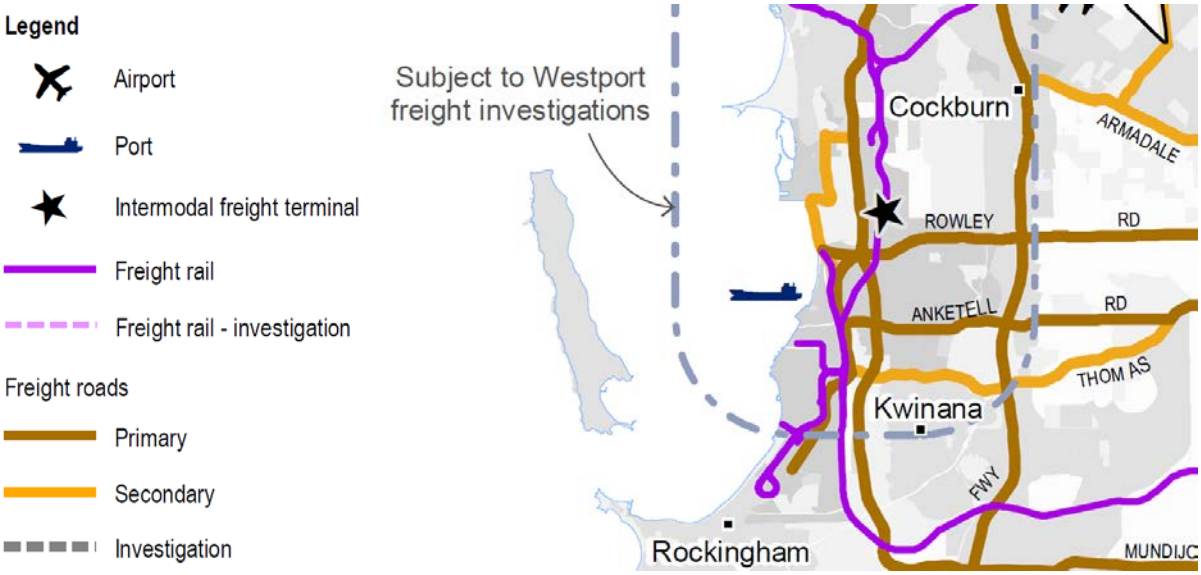
Figure 10-1 RAV Network Map



10.2 Future Freight Network

The future freight network is discussed in the *South Metropolitan Peel sub-Regional Framework* (see , but in this area is primarily defined by the Westport and Indian Ocean Gateway projects.

Figure 10-2 Proposed Freight Network

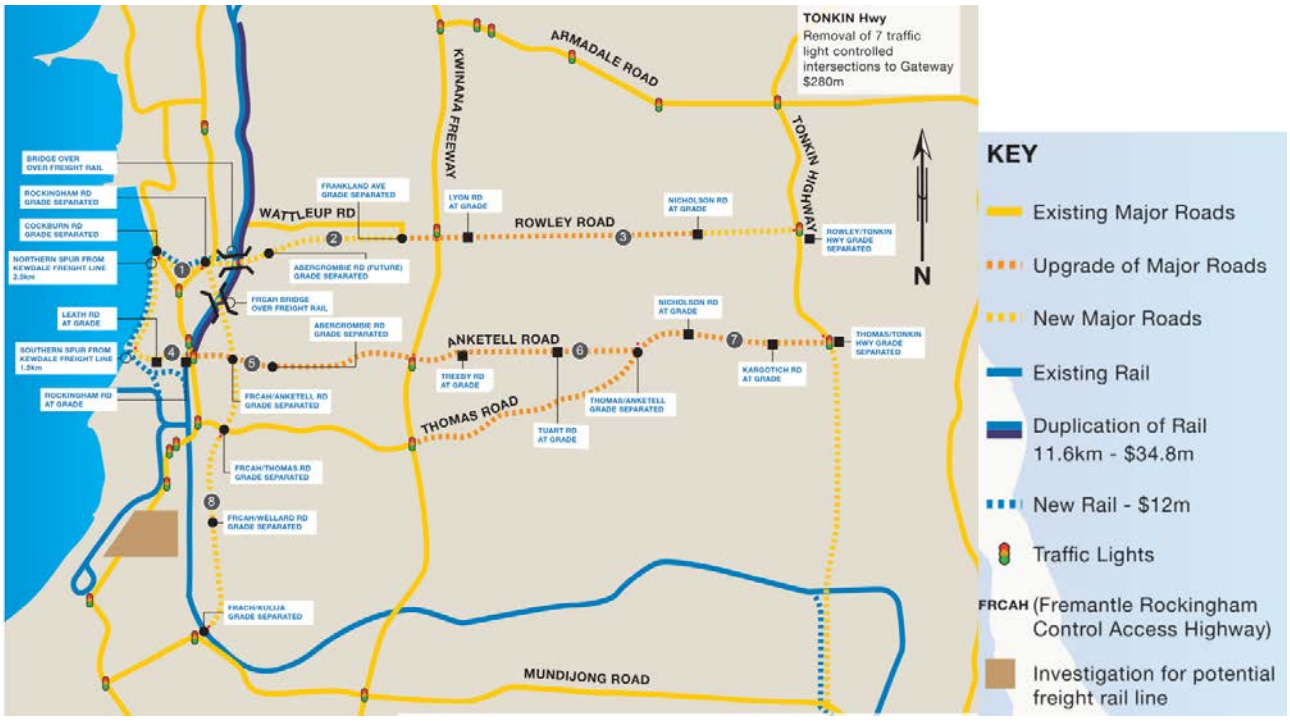


Source: South Metropolitan Peel Sub-Regional Framework

This extensive road network supports significant industrial land development through Latitude 32, Postans and Hope Valley, ongoing and intensified uses in the Kwinana Industrial Area and the additional requirements of the Outer Harbour and the associated land-side support facilities identified in the Indian Ocean Gateway.

It is important to note that key decisions regarding the various corridor infrastructure options are still being made at State Government level, and so there will inevitably be changes to the network required to support the scale and intensity of the freight transport task. The following image details the proposed road and rail network to support the Westport project.

Figure 10-3 Proposed Freight Road and Rail Links for Westport



Source: Indian Ocean Gateway Detailed Road and Rail Links Map (2018)

Additional demands placed on the freight rail network are expected to be accommodated by the existing infrastructure, but with impacts on overlapping road transport function where at-grade crossings impede traffic flow.

10.3 Freight SWOT Analysis

Strengths:

- Long distances without interruption enable heavy vehicles to maintain speed along east-west links. As a result, congestion is minimised at intersections.
- There is a lot of capacity for on-road freight transport within the current and projected road networks. Opportunities for road widening have already been identified along Anketell Road, and road network upgrades to Rowley Road and Mundijong Road (FRCAH) will add more high-capacity connections to and through critical industrial precincts.

Weaknesses:

- Rockingham Road, Patterson Road and Thomas Road are all critical for multiple transport modes. Conflicts in road priority consequently occur, representing inefficiencies in operation and high-risk interactions during peak demand periods.
- Thomas Road provides the main access to residential development in the Kwinana area. The needs of local access are at odds with the desire for free-flow through traffic. Noise pollution from heavy vehicles will affect residents in the northern portions of Orelia and Medina.
- Tight intersections in older industrial areas may require modifications to support the larger vehicle combinations projected for servicing the Outer Harbour and Inter Modal Terminal, among others.
- Many existing industrial streets, including Kwinana Beach Road, Leath Road and Donaldson Road are in poor condition for roads carrying up to RAV 7, and require resurfacing as a priority.

Opportunities:

- The reconfiguration of Anketell Road as a 4-lane freight corridor will support efficient access to Latitude 32 and the Kwinana Industrial Area. Upgrades will ease congestion along other freight routes.
- The extension of Rowley Road and potential connection to the Westport will similarly assist to distribute freight traffic.
- The Fremantle Rockingham Controlled Access Highway (FRCAH) proposed highway through Latitude 32 will divert traffic away from Rockingham Road, creating a highly efficient free-flow freight corridor through to Tonkin Highway.

Threats:

- There is no existing RAV 7 network access to the proposed Westport location. This suggests modifications to local networks will be required to support larger combinations.
- Residential development along the Kwinana Freeway will likely increase congestion and delays for freight movements.
- Despite the long-term plans for road capacity upgrades, local road intersections will constrain capacity at certain locations.

10.4 Areas of Conflict

The RAV classification of Johnson Road and Wellard Road conflict with the expected growth of car traffic along these corridors. The majority of Johnson Road lies within residential areas, with small sections at Bertram Town Centre and to the north of Sulphur Road having commercial applications. Johnson Road will need to support improved infrastructure for public transport, private vehicle and cycling modes as the Bertram area develops. As such, the City should consider removing the RAV classification from these roads to reflect the priority of other transport modes.

Large heavy vehicle combinations do not interact well with roundabouts, as while they provide opportunities for uninterrupted flow, trucks are required to cede priority to turning vehicles in accordance with WA Road Rules. This reduces the attractiveness of certain routes, where there is a need for controlled right-turns.

Freight movements are also fundamentally at odds with the provision of a safe cycling environment. Separation of bike facilities from heavy vehicles is necessary to create a safe, attractive environment. The infrastructure developed along shared priority corridors must therefore carefully considered.

11 Parking

11.1 Background

Like the majority of the Perth Metropolitan area, the City of Kwinana has historically been reliant on private vehicles for mobility. Car ownership and usage is consistently high, with over 95% of all households owning at least 1 car (65% of households own 2 or more).

These high levels of private vehicle ownership result in correspondingly high demands for car parking across all land uses: residential, employment, retail and recreational. This parking serves not only local residents but also workers, commuters, shoppers, visitors, students, freight and service delivery.

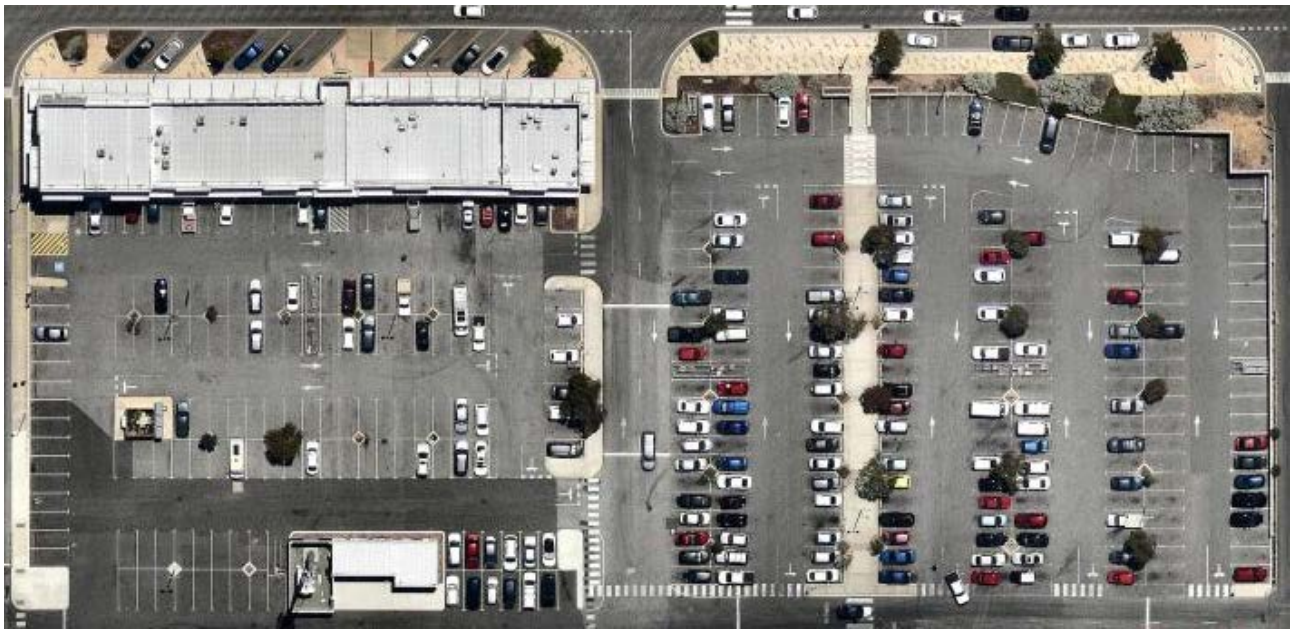
Strategic policy directions made by Local Government can provide a clear, concise and manageable context for decision-making, with a significant effect on mode choice, land development, economic viability and place-making. Parking infrastructure is an essential and inherent component of both the transport and land use system, and is unique in that behaviour can be influenced directly at the planning and policy stage (rather than solely through infrastructure provision). In this context, an appropriate supply of quality, well-located car parking is a critical issue for people and businesses.

The needs for parking differ very greatly across the City, in accordance with the activity in the area, the density and variety of development, and the availability of alternative transport modes. Best-practice provision and management of parking across the various land use categories is discussed in detail in later Sections.

11.2 Parking Context

Unique to all of the transport components of the network, Local Government has purview over decision-making for the vast majority of the parking supply, in one way or another. Private car parking is constructed in accordance with the City's TPS and parking policies, and certain types of parking are explicitly supported in this way (particularly on-site, self-contained provision).

Figure 11-1 Kwinana City Centre Parking



Public parking is enabled by the City along public roadways, and managed through signage and line-marking, in addition to large public car parks adjacent to community uses and parks.

One exception to this control is the commuter parking facilities located adjacent to the Kwinana and Wellard Train Stations, which are operated and maintained by the State Government.

In general, parking in the City is abundant and free. Private parking minimums are in-line with expected demand rates, suggesting that overspill onto the adjacent network would be limited. Parking on-street is unrestricted, or managed by time and duration only.

Strengths:

- Low density development results in a large number of on-street public parking.

Figure 11-2 On-Street Residential Visitor Parking, Wandi

- Historic parking minimums throughout the City provide a large stock of off-street private parking.

  These bays, located almost exclusively in at-grade surface, represent a long-term potential for further development – effectively a 'land bank' in Town Centres and Activity Centres

Figure 11-3 On-Site Residential Parking (Rear), Wandi

- Park 'n' ride at stations supports regional transport by train
- Abundant parking supports access from areas with poor alternative transport infrastructure.

Weaknesses:

- Abundant at-grade parking reduces the capacity for pedestrian-scale activation, with corresponding effects on commercial viability and social cohesion. This is exemplified by the significant majority of developments face internal car parks rather than the street.
- These parking lots increase the 'spread' of development in Centres. This diminishes the value of attractive streetscape improvements and public transport, perpetuating a 'car-centric' urban form.

- Despite local parking 'hotspots' in and around the Aquatic Centre and other specific locations, there is a generalised oversupply of car parking in most areas (on-street and off-street).

In such areas, the market rate for parking is $0, removing the financial incentive for Local Government to effectively manage the public supply. This has consequences with respect to revenue which result in under-resourcing of parking enforcement services.

- In industrial areas, insufficient on-site supply leads to overspill into public road network and within verges. This can result in illegitimate parking in dangerous locations, obstructing driveways and obscuring sightlines.

Opportunities:

- The extent of at-grade parking means that the City is actually quite robust to behaviour change. As demand grows, parking can be reconstructed in multi-deck facilities and conversely, if demand shrinks, it can be used as development sites.
- A large proportion of industrial and residential areas are yet to be built. Policy changes can therefore affect the development of these greenfields sites at the large scale, and without the transition period associated with brownfields redevelopment.
- Future densification can be a catalyst for changes to parking provision, ownership and location.
- Policy changes in industrial zones can support rezoning applications which tend to intensify parking demand but establishing a cash-in-lieu of parking strategy to fund well designed on-street parking embayments.

Threats:

- The lack of paid parking across the City means that there is likely to be considerable opposition to its introduction.
- The majority of land development remains in low-density neighbourhoods and commercial/industrial zones. These types of development create a separation between residence, work and activity which perpetuates car-focused transport choices.
- The unconstrained construction of parking infrastructure, especially at Stations, can have a detrimental impact on both land use and alternative transport viability.

Figure 11-4 Car Parking at Kwinana Train Station

12 Integrated Land Use and Transport

Given the City's capacity to influence land use zoning and development controls then, the City is able to shape the transportation and land use organisation. When the relationship between land use and transport is well-integrated it is effective and efficient at providing for the needs of the community, the environment, and businesses alike. Looking ahead, the City of Kwinana seeks to balance transport and land use in alignment with the overall strategy and vision of the City.

The City's vision for the integration of transportation and land use, was developed through the vision set in the City's *Strategic Community Plan*, as outlined in **Section 1.3** of this document. Briefly, the core components of the vision for this integrated transport and land use strategy are as follows:

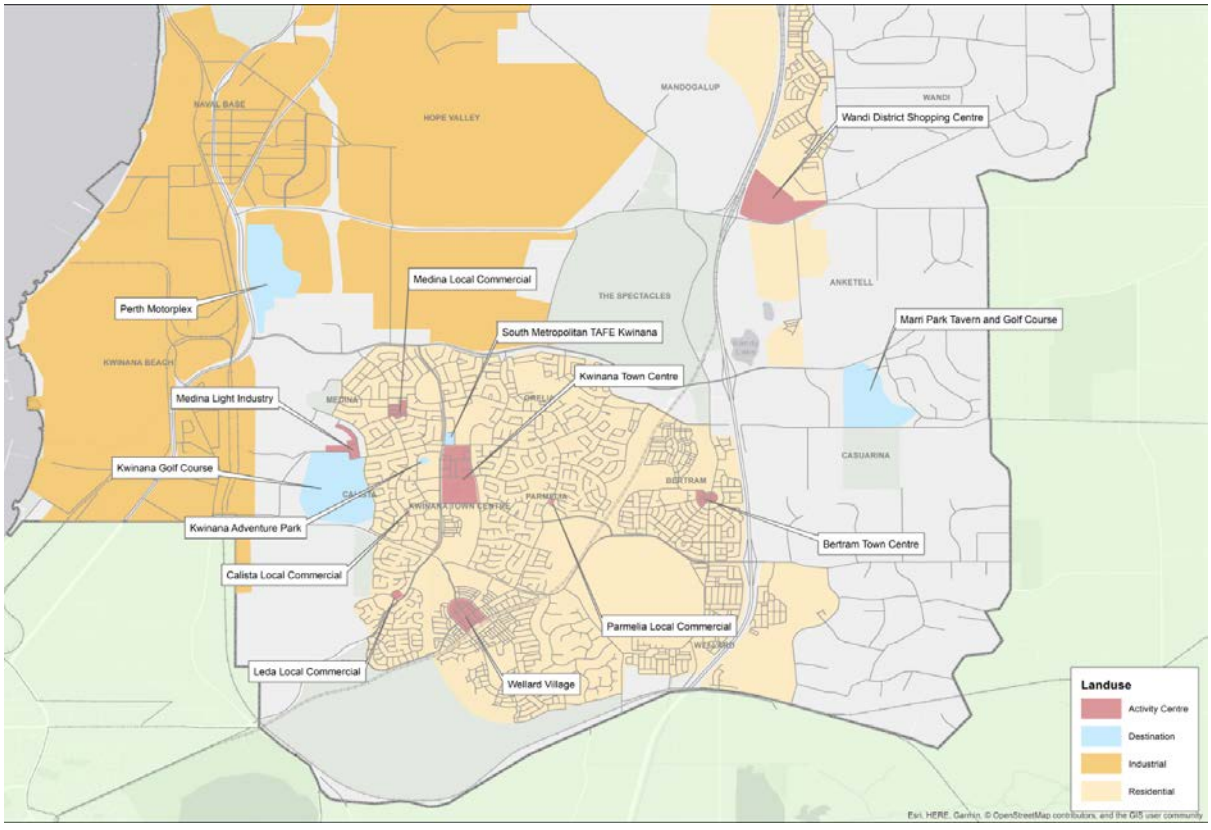
- Alive with opportunities;
- It's all here, and
- Surrounded by nature.

In applying this vision to the integration of transport and land use within the City, firstly broad issues and needs, and opportunities and threats of land use integration at different levels are discussed. These levels include:

- Activity Centres;
- Activity Corridors;
- Transit Corridors;
- Industrial Areas;
- Residential Areas;
- People Attractors; and
- Local Structure Plans.

The following figure identifies the spatial layout of these land uses within the City, with dominant land uses being Industrial and Residential.

Figure 12-1 City of Kwinana Land Use Map



Definitions of each type of land use are provided in the following. Transportation modes are discussed within each land use in separate segments.

12.2 Activity Centres

Activity Centres are community focal points providing for a range of activities and services, including retail and commercial, entertainment, civic/community, education, government and medical services. Centres usually combine the benefits of both activity corridors and transit corridors (discussed below) to substantially reduce the need for private vehicles, as well as creating excellent opportunities for shared parking facilities

The overall strategic activity centre hierarchy is outlined within State Planning Policy 4.2 Activity Centres for Perth and Peel. The hierarchy is as follows:

- Capital City;
- strategic metropolitan centres;
- secondary centres;
- district centres;
- neighbourhood centres; and
- local centres.

12.3 Activity Corridors

Activity corridors share the typical characteristics of activity centres, providing for a mixture of land uses and a pedestrian-oriented built form with activated ground floor uses, but are linear rather than nodal, and generally follow the road alignment. Activity corridors provide an opportunity for urban infill and higher density residential living within 1 or 2 street blocks of the route.

The following are characteristics of well-designed, efficient and effective activity corridors:

- High-quality, prioritised public transit with convenient stops for pedestrian access along the route;
- Roadway environments and infrastructure which allow comfortable and convenient pedestrian permeability across and along the carriageway;
- Low speed of motorised vehicles; and,
- Balanced through- and local traffic priority.

12.4 Transit Corridors

Transit corridors are high-frequency, road-based public transport routes connecting centres of economic activity. By emphasising public transport options, as well as cycling and pedestrian activity, transit corridors can be used to establish a pattern of walkable neighbourhoods connected to commercial, employment, institutional and recreational areas.

Transit corridors provide an opportunity to increase residential density along a public transport route, which includes both train catchments and bus routes. Bus-based transit oriented design is particularly appropriate for low-density suburban conditions like those in the City of Kwinana.

Land suitability for the development of transit corridors can be determined by the relationship between a combination of factors, including: proximity to the route, existing land uses, and the existing density of population.

Walkable access to road-based transit is considered reasonable at distances less than 400m, though in locations where high quality stops and interchanges are provided, walking distances as long as 800m may be sustainable.

The density of population is key to a successful transit corridor. Since patronage for transit services is directly related to proximity, residential and employment immediately adjacent to the route is highly beneficial to supporting frequent service.

Transit corridors are designed primarily for mobility. They support high-frequency public transport and regional traffic, within a cross-section that preferences peak-period speed and consistency over access.

The focus of these corridors in providing for large-scale movement of *people* supports the prioritisation of public transport over private vehicles.

Transit corridors allow for high-quality links to a small number of suburban residential areas, but the routes along any given corridor do not cater well to the full residential catchment.

Transit corridors are therefore best supported in areas of high employment and residential density, which will generate and sustain a high demand for public transport.

12.5 Residential Areas

Residential areas in the City generally comprise large-lot single-unit and low-scale housing, interspersed with various single-use destinations: schools, parks and local retail centres.

Transport infrastructure is necessary to support mobility through residential areas to access local schools, neighbourhood retail centres and strategic transport routes. The focus of this transport provision should be on ensuring safe connections through and beyond the neighbourhood, rather than efficient movement.

12.6 Industrial Areas

Industrial areas generate activity as centres of employment, and support a high number of jobs. Industrial land use areas need to be located in proximity to strategic transport infrastructure including road and rail networks.

However, industrial areas can struggle to provide high priority to sustainable of transportation (walking, cycling and public transport), due to the low employment density inherent to the structure of development.

12.7 People Attractors

People attractors are any use which attracts significant volumes of visitors, whether for recreation, entertainment or as an employment centre.

While Town centres and employment zones function as people attractors due to their mix of uses and employment opportunities, respectively, this category is intended to capture isolated individual uses with specific functions and characteristics.

13 Activity Centres

13.1 Background

The Kwinana City Centre is the main activity centre within the broader City of Kwinana, and is defined as a secondary centre under the State Planning Policy 4.2 *Activity Centres for Perth and Peel*. Wandi has been identified as an emerging district centre.

While local and neighbourhood centres are not identified in SPP 4.2, they have some of the same needs as larger centres. Nevertheless, due to the environment in which small centres function, they have been incorporated into the discussion regarding Residential Ares (**Section 16**).

The land-use function of an Activity Centre defines its built form and its relationship to the supporting transport network. This built form; the spatial allocation of different land uses, parking and its access to the street network, is key to its success. Therefore, every activity centre should be considered as an integrated system of land use and transport, where all components are designed to maximise the desired outcome.

As an example, the Kwinana City Centre can be described as following a ‘fried egg’ form, with isolated single-function developments surrounded by car parking, and limited engagement at the street level. This geography is a consequence of its function as a regional centre for a wide catchment, in an era where alternative transport was poor. As a result, the City Centre has developed as a car-oriented space, with priority for private vehicles over pedestrians and cyclists. Recent changes such as the road upgrades to Chisham Avenue suggest a shift away from this historic form, with more support for pedestrian-scale development and activity.

In contrast, The Strand, as part of the Wellard Town Centre has developed with a ‘high street’ style, which uses the street as a meeting place and supports activity at ground level, with direct integration of land use into the public realm.

13.2 By Mode

- **Private Vehicles:** In general, private vehicle use is ideally maintained at the periphery of the City Centre and supported through strategic location of peripheral car parking to minimise the volume of traffic in pedestrian-oriented areas.

The existing City Centre is bound by Gilmore Road, which acts as a distributor, and by the connector roads Sulphur Road, Challenger Avenue, and Meares Avenue. Constraining regional vehicular traffic to a few key streets and controlling these through cross-section and priority measures can work to minimise the impact of traffic on the City Centre.

Chisham Avenue is an example of this attempt in the City Centre, however the success of this streetscape infrastructure requires a supportive land use pattern that is yet to be realised. In this case, the large at-grade car parks diminish the desirability of walking along the roadside, far removed from retail destinations. Large 9m turning radii reinforce higher-speed turning movements and, combined with the geometry of on-street parking, reduce pedestrian crossing opportunities. Nevertheless, the streetscape along Chisham Avenue is indicative of a change in the Kwinana City Centre.

- **Pedestrians:** Pedestrian activity is a critical factor in the effectiveness and vitality of an activity centre. For this reason, the pedestrian environment must be carefully considered, particularly along primary pedestrian routes. This includes construction of high quality paths and the provision of shade trees and street furniture to provide amenity.

The activated central core should be oriented towards pedestrian accessibility with wide, attractive pedestrian footways and legible road crossings. Areas nearer to the edge of the Centre, where densities are lower, will not have as significant a pedestrian focused design.

All streets within an Activity Centre should provide some form of off-street pedestrian path, with a higher standard of provision along critical and high-demand links. A fine-grained network of pedestrian paths allows the network to more closely match the desirelines of commuters, residents and visitors moving through the network.

Pedestrians are most important where activated building frontages and public spaces are proposed, as these rely on pedestrian traffic to retain their commercial viability and place-making appeal.

A Level of Service approach considers the quality of the pedestrian experience across the length of the trip. Higher-traffic areas with a high concentration of pedestrians require good quality, covered and shaded paths, as do paths that connect areas of high demand across relatively long distances, oriented towards centralised parking locations, popular trip attractors and public transport nodes.

- **Cycling:** Cycling facilities should follow primary desire lines and provide fine-grained access to all areas of the Activity Centre. They can take on a number of different forms including:
  - High-quality separated or shared paths;
  - Bi-directional protected bike lanes;
  - Protected on-road bike lanes;
  - Slow-speed mixed traffic roads; or
  - Designated Safe Active Streets.

On-street paths are preferred in activated spaces to minimise conflicts with pedestrians. For these reasons, cycling provision in Activity Centres is usually focused primarily on-street, either through dedicated cycle lanes on strategic approach roads, or in car/cycle lanes where appropriate on slow-speed streets.

A low prevailing speed within the Activity Centre (30km/hr or less) allows cyclists to ride safely in mixed traffic even where segregated facilities are not available. However, high-speed, high-volume traffic corridors around an Activity Centre can make cycling intimidating for many cyclists. Careful management of the cycling environment is necessary to ensure cycling is support both to the Centre and within it.

Appropriate end of trip facilities are vital for both commuter and leisure cyclists, designed to support cycling as a comfortable, practical mode choice. The level of end of trip facility provided depends on the target demographic and the available infrastructure funding sources. Consideration should be given to utilising on-street parking areas for bike parking in pedestrian activation areas where the potential risk of pedestrian/cycle conflict is high.

- **Public Transport:** Public transport is a high priority for a Town Centre as it provides regional connections and interchange opportunities.

The Kwinana City Centre and Wellard Town Centre are both well-served by existing public transport routes, which is a necessary first step to reduce dependence on private vehicles for local trips. The use of high-frequency public transport also permits reductions in parking rates in the Centre, freeing up land for more productive uses.

Activity Centres can support public transport through the provision of high-quality, attractive bus stop infrastructure. Using shade and shelter to minimise the impact of waiting times, and placing bus stops adjacent to key activity nodes will help mode shift towards public transport options.

Pedestrian connections to the City Centre from the Kwinana Bus Station on Gilmore Avenue see pedestrians traversing a large expanse of car parking lot before reaching their destination. At this key interchange there would be significant benefit in infrastructure measures to increase the comfort, amenity, safety and accessibility of pedestrian trips as part of public transport.

The expansion of local public transport services also improves equity across the region, allowing low-income households to transition away from private vehicle ownership, assisting access and mobility for people with disabilities, or without access to private transport.

- **Servicing and Deliveries**: Local service/delivery traffic is generally encouraged to utilise major approaches, although there will be provision both on-street and within development particularly in 'main street' precincts, and where smaller office/retail development is located to ensure effective operation.

Service/delivery is often conflated with waste collection services, due to the size and needs of these vehicles. Where possible, shared facilities either on-street or in loading docks will best support the economic function of the Activity Centre. Consideration for other modes and activity needs should also be included in decision-making, with large-scale truck movements and waste collection taking place outside of peak activity periods.

- **Parking**: The demand for parking is intrinsically related to the type, location, and density of development. Currently, Activity Centres across the City are characterised by large expanses of (mostly private) at-grade parking.

The need for this type of infrastructure is diminished as land-use density increases. Land values will rise as land area is consumed by development, leading to a push for higher-cost basement and multi-deck parking.

Land uses define the requirements for car parking quantity and location, with short stay and on-street parking close to retail precincts and long stay commuter parking ideally on the periphery of the Town Centre, near to employment centres and accessible along regional access routes.

Public car parking allows a more efficient and equitable allocation of parking resources across multiple land uses. Therefore, a proportion of public car parking is beneficial to the operation of the City Centre and should be supported through the local planning scheme or other statutory means.

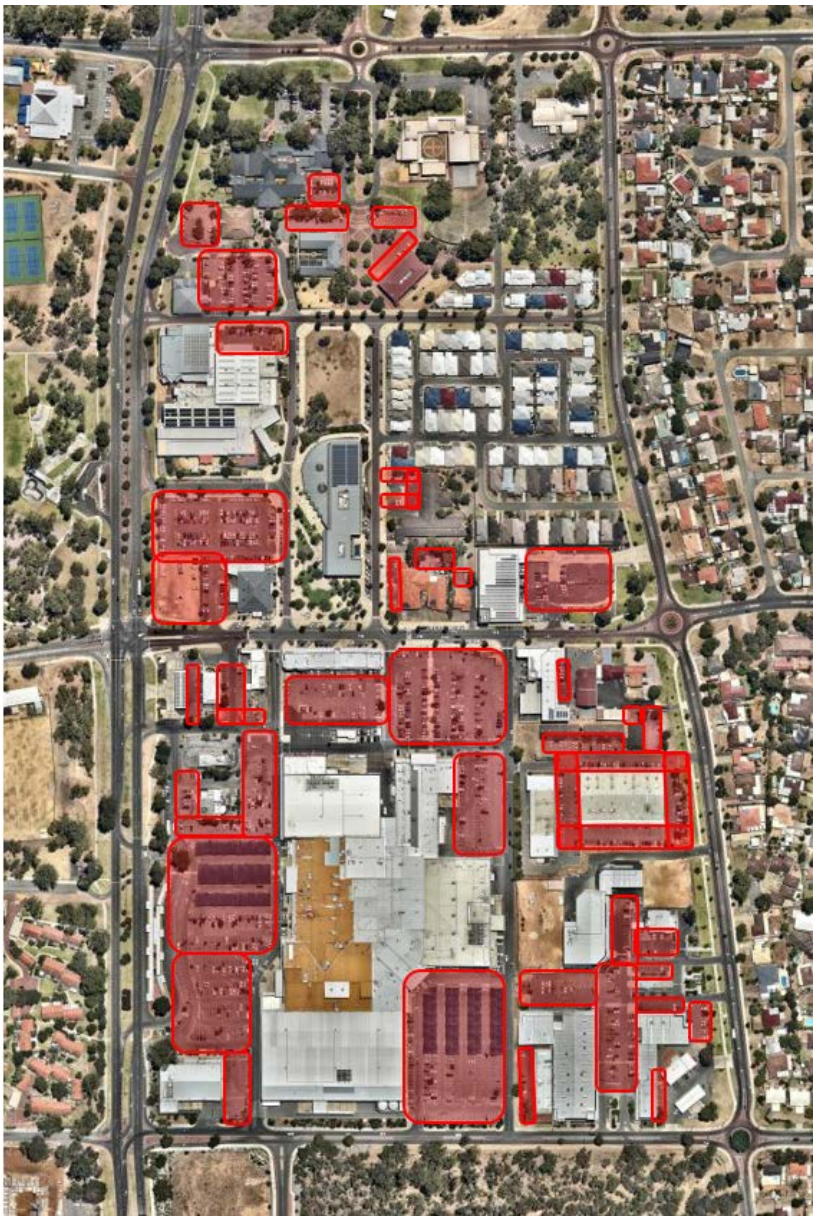
Commuter parking tends to be of lesser value to the Centre and should be provided on the periphery of the Centre (where possible), and managed to support all-day parking. Commuters tend to arrive during the roadway peak and have a significant impact on traffic operations (and congestion). Removing this demographic from the main activity area improves pedestrian and cycling safety, public transport efficiency and intersection operation. Commuters are more willing to walk long distances, particularly if the pedestrian environment is attractive.

Other specialised parking categories are also important and should be included in the on- and off-site parking supply. This includes:

- Disabled parking;
- Loading bays;
- Bus stops along service routes;
- Taxi stands, and
- Other types of very short-stay parking (near ATMs, post boxes, emergency service zones, etc.).

The Kwinana City Centre currently provides expansive parking, segmenting uses from the street and creating a somewhat unattractive street environment for pedestrians (see **Figure 2-1** following)

Figure 13-1 Parking in the Kwinana City Centre



13.2.2 Example of Integrated Transport in Activity Centres

The following **Figure 2-2** depicts an open car-oriented streetscape typical of current Activity Centres in the City of Kwinana. This cross-section includes a high provision of on-street parking, in addition to the adjacent off-street supply. Consequently, the pedestrian environment is 'squeezed' and the opportunities for street trees and pedestrian crossing opportunities are reduced.

Figure 13-2 Open Car-oriented Activity Centre Environment

An alternative example is shown below using the same road reserve. This cross-section prioritises an activated pedestrian and cyclist-oriented streetscape by removing on-street parking and reallocated some of the space to safe, attractive on-street cycling facilities. In addition, wider verges allow for better pedestrian paths, tree planting, street furniture, lighting, and alfresco dining/activity opportunities.

Figure 13-3 Alternative Multi-modal Activity Centre Streetscape

14 Transit Corridors

14.1 Background

Transit corridors are designed primarily for mobility. They support high-frequency public transport and regional traffic, within a cross-section that preferences peak-period speed and consistency over access. The focus of these corridors in providing for large-scale movement of *people* supports the prioritisation of public transport over private vehicles.

Transit corridors allow for high-quality links to a small number of suburban residential areas, but the routes along any given corridor do not cater well to the full residential catchment. They are therefore best supported in areas of high employment and residential density, which will generate and sustain a high demand for public transport.

The hierarchy of other transport modes is directly related to the needs of high-frequency public transport service.

There are no existing transit corridors within the City of Kwinana, there is scope to develop an effective and efficient transit corridor along the alignment identified in the *South Metropolitan Peel Sub-Regional Framework* (Sulphur Road; Gilmore Avenue and Henley Boulevard).

14.2 By Mode

- **Public Transport:** The *South Metropolitan Peel Sub-Regional Planning Framework* identifies a high-priority transit corridor joining Rockingham City Centre, Kwinana City Centre, and Fremantle. The route bisects the KIA. High-frequency transit corridors are identified to link Wellard and Kwinana Train Stations with the Kwinana City Centre.

Transit corridors should be supported with queue jump facilities and other enabling infrastructure to prioritise consistency in travel times. The residential and employment catchment for these corridors is key to their success. As density increases, ongoing demand for public transport services naturally results in higher frequencies and this induces further mode shift.

Transit corridors require wide footpaths, sheltered waiting areas and safe, convenient crossing points. Public transport is disproportionally used by people with disabilities, school children and the elderly, and supporting pedestrian infrastructure should reference the additional needs of these groups.

- **Pedestrians:** Public transport users begin and end their trips as pedestrians. The quality of the pedestrian environment is therefore at least as important as the frequency of service.

Along high-volume transit corridors, the safety and quality of crossing facilities is a crucial element to their success. Any pedestrian must cross the corridor at least once per day, and where facilities are poor this will have a substantial impact on the attractiveness of public transport use.

To address this, many aspects of design should be considered, including stop location proximal to signalised pedestrian crossings, reasonable wait times even during peak periods, considerations for DDA compliant and disability-aware infrastructure, and the quality of bus stops, shelters etc.

- **Cyclists:** Along wide corridors, commuter cycling can be supported in segregated facilities either on-street or off-street. However, mixed-traffic cycling becomes increasingly problematic as bus frequencies increase. As such, where space is constrained, cycling facilities are better located along alternative, parallel street alignments.
- **Private Vehicles:** May retain a high priority, particularly where public transit volumes gradually increase along a corridor or is used to supplement or replace private vehicle travel.
- **Parking:** The need for parking in or adjacent to Transit Corridors is greatly reduced, as residents with access to frequent public transport have less need to own private vehicles (and can self-select), while business employees are well-supported to use alternative modes.
- **Freight:** Generally speaking, freight transport is in conflict with high-frequency public transport due to the increased pedestrian demand and the delays to traffic created by prioritising public transport stopping over efficient through-movements.

This impact should be considered as part of any potential extension of Gilmore Avenue through to Henderson Road, which could induce additional heavy vehicle traffic adjacent to the Kwinana City Centre and along this critical part of a potential Transit Corridor.

15 Activity Corridors

15.1 Background

Activity Corridors differ from Transit Corridors in the types of development they support. Rather than the focus being on mobility (movement of people along the corridor to external destinations), with adjacent high density residential and office/commercial activity generating demand, Activity Corridors are designed to be destinations in themselves.

The effectiveness of an Activity Corridor is firstly determined by its land use. This mix of retail, business commercial, restaurants and entertainment venues, combined with dense residential development immediately adjacent or in close proximity, is unique to the economic environment in the area. This function requires an entirely different perspective on the design of infrastructure, with priority given to accessibility over mobility.

In the broader Perth metropolitan context, Scarborough Beach Road in Mount Hawthorn and Albany Highway in East Victoria Park provide two example of a functioning Activity Corridor. Note that a corridor may function as both a Transit Corridor and an Activity Corridor, though this tends to compromise its function for both accessibility and mobility.

Activity Corridors are not a pattern of development that the City of Kwinana has previously pursued: most activity is located in district, local, and neighbourhood activity centres. However, there is scope to develop effective Activity Corridors which promote economic activity through a diverse land use mix. For example, a new Local Structure Plan corridor such as Honeywood Avenue in Wandi could be developed into an Activity Corridor, leveraging new urban development and the strength of its connection to Aubin Grove Train Station.

15.2 By Mode

- **Cycling:** The intensity of pedestrian demand along a corridor is likely to limit the suitability of shared paths. Alternative provision in the form of segregated cycle lanes, or slow-speed (30km/hr) road environments are more likely to support cycling to and through the area.

High-quality cycling infrastructure can also be provided along parallel roads, with connections via minor roads to specific nodes.

To further support on-street cycling, end-of-trip provision should be provided in bike corrals (grouped bike racks), located on-street in highly conspicuous locations.

- **Parking:** On-street parking has an important role in the function of Activity Corridors. It provides opportunities for private vehicle trips that facilitate short-stay retail and entertainment function while also insulating pedestrians and activity from traffic. Parking can provide a degree of ongoing passive surveillance, as it tends to spread activity along the corridor.

Since parking demand coincides with peak activity, but tends to occur outside of peak *mobility* periods, the designation of road space to on-street parking can support part-time bus lanes; increasing the person-trip capacity of the road by a significant percentage.

On-street parking is appropriately regulated through fee payment and timing restrictions. Unrestricted parking along Activity Corridors tends to be detrimental for all transport users as well as local business.

- **Pedestrians:** Given that the primary function is Activity, pedestrian-scale infrastructure is paramount. This includes attractive, shaded streetscapes; closely spaced and convenient road crossings (preferably controlled or with pedestrian priority); and wide footpaths.
- **Private Vehicles:** High traffic volumes and speeds adversely impact all other transport modes. Therefore, the use of Activity Corridors for through traffic should be diminished wherever

Slower speeds, signalised crossings and other forms of Local Area Transport Management (LATM) can be used to assist other modes while reducing the attractiveness of the corridor for through- vehicles.

- **Public Transport:** Services should link external transport nodes in a fine-grained manner to destinations along the corridor.

Public transport provision should be focused more on high stop-density adjacent to activity destinations and stop amenity for waiting passengers.

However, the nature of the activity along the corridor reduces the likely demand for bus transport, when compared with Transit Corridors. This is due to the lower public transport mode share for entertainment/recreation trip purposes, and non-car trips are more likely to occur by taxi or ride-hailing. Facilities to support pick-up/drop-off activity are therefore important to the function of transport.

In-lane stopping is appropriate for all stops except Timed Stops and terminating services, but it is unlikely that there would be sufficient demand to support queue jump or bus lanes in the City.

15.2.1 Example of Integrated Transport in Activity Corridors

The following figure illustrates an existing cross-section of an example Activity Corridor, including buffered bike lanes and on-street parking along one side. This road cross-section has been chosen to fit within the existing Honeywood Avenue road reserve, for illustration purposes.

Figure 15-1 Potential Activity Corridor with On-Street cycling

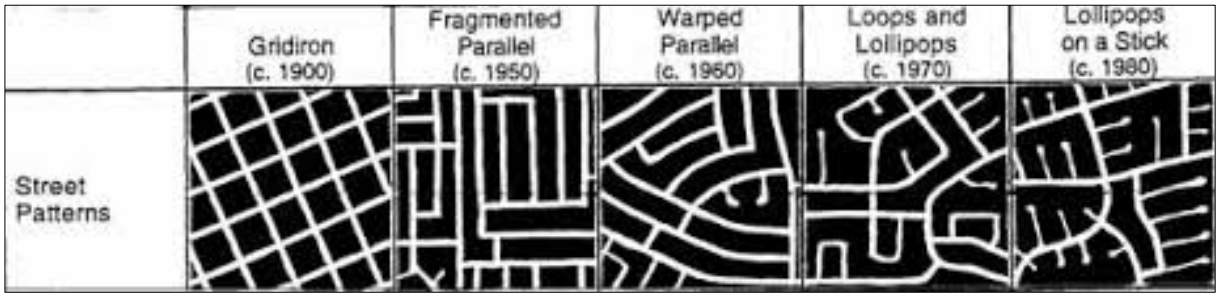
16 Residential Areas

16.1 Background

Residential areas across the City generally comprise large-lot single-unit and low-scale housing, in addition to various single-use developments. Recent density developments typically still provide for low-density residential, though at higher yields (e.g. shifting from a residential density code of R12.5 to R30).

In these areas, the density of trips is generally low, with network coverage being the most important factor for function. Transport infrastructure is necessary to support mobility through residential areas to access local schools, neighbourhood retail centres and strategic transport routes. Local transport infrastructure should provide access to public transport, pedestrian and cycling routes and strategic roads.

Figure 16-1 Street Network Types



Source: Southworth and Ben-Joseph (2017)

Residential neighbourhoods in the City of Kwinana are typified by a 'Loops and Lollipops' street layout, which are intended to limit forward vision for private vehicles by eliminating long, straight lines. However, lack of horizontal and vertical friction creates a unrestricted visual landscape that tends to promote higher speeds.

16.2 By Mode

> **Cycling:** A slow-traffic residential environment facilitates cycling as a mode of transport. This can be in the form of a highly-engineered Safe Active Street, or as part of LATM works across a suburban fabric.

The residential areas of the City were designed with street layouts intended to intentionally restrict through movements by external traffic. However, the orientation of these streets funnels local traffic into specific corridors which then form barriers to safe and attractive cycling. The open nature of street design with wide pavements, large development offsets and few obstructions also results in higher speeds.

The result is a network with poor legibility along low-volume streets and high levels of conflict along primary access corridors.

Figure 16-2 Road Layouts - Bertram and Parmelia

The Kwinana Bike and Walk Plan 2018 specifies particular local route upgrades to the cycling network within the City with access to local schools as a high priority.

> **Pedestrians:** In a low-density suburban environment attractions are typically further away. This reduces the capacity for walking trips to form a significant component of mode choice. Key destinations that remain within a reasonable walking distance include local schools, parks, and shops, and these should form the focal points of the pedestrian network.

The road layout (as seen above) creates increased walking distances, even where destinations may be relatively close.

The implementation of Liveable Neighbourhoods has been demonstrated to have a positive relationship with the uptake of active transport modes including cycling and walking. The provisions of Liveable Neighbourhoods require a pedestrian path on at least one side of all roads, inclusive of small access roads.

The *Kwinana Bike and Walk Plan* (2018) relates to both retrofitting existing neighbourhoods and providing strategic guidance for future residential developments. The long-term goal for the City is a path on either side of the road along all school access routes and in the short term, a footpath on at least one side of the road within 400m of schools.

Figure 16-3 Bertram Primary School View Corridor

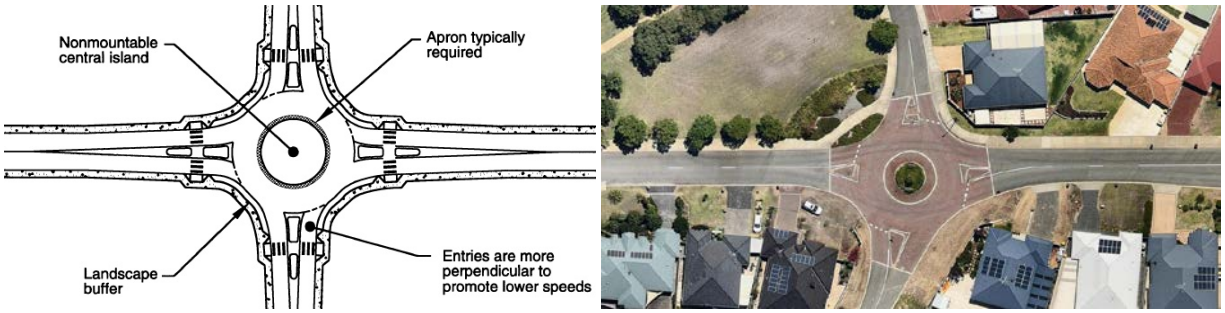
Safe pedestrian crossings and effective street tree coverage are two key components to create a safe and attractive environment that encourages residents to walk for transport and for recreation.

- **Private Vehicles:** Private vehicles are well provided for within the City's residential areas, though in general the street geometry is designed to eliminate through-trips. Conversely, the extra travelling distance adversely impacts car travel the least, leading to greater trip generation by local residents.

Private vehicle speeds through residential areas could be reduced through a series of Local Area Traffic Management Plans, aimed at addressing precise local issues and performed in consultation with the local community.

Another potential measure that could assist both reduce speeds and improve on-street cycling safety is to restructure existing high-speed Austroads-compliant roundabouts into an alternative geometry, the compact or European roundabout (common in the UK). These compact roundabouts are specifically designed to reduce the negotiation speed to 15-20km/hr, greatly reducing the safety risk for cyclists, and further reducing crash risk for vehicles.

Figure 16-4 Compact Roundabout Geometry vs Conventional High-Speed Roundabout Geometry



- **Parking:** The assumption is made that residential parking is typically contained on-site, with on-street parking intended for residential visitors.

The supply of on-street parking for residential visitors is much higher than the demand in most residential areas. Where parking overspill is prevalent, this is often due to the use of on-street parking by residents in instances where garages are used for purposes other than vehicle parking.

This behaviour is unlikely to have substantial implications in areas of low-density residential development, but may result in a shortage of public on-street parking as densities increase. When this occurs, local parking management may be necessary to reinforce the purpose of on-street parking for visitors.

- **Service/Delivery and Waste Collection:** Service/delivery and waste collection are presumed to occur thoughout residential neighbourhoods. There is not considered to be a need for specific provisions to be introduced.

IPWEA Subdivision Guidelines recommend corner radii in the order of 3m in residential streets as sufficient for waste collection trucks. This is a smaller radius than is used in the majority of the City's residential neighbourhoods. The benefits are largely in better pedestrian crossing alignments and slower turning speeds for cars.

- **Public Transport**: It is important to emphasise walkable connections to public transport facilities within residential areas. Safe crossings, an urban canopy providing shade, and appropriate bus stop infrastructure are able to support the increased use of public transport from residential areas.

As noted previously, the street layout can provide a barrier to walking to public transport by increasing walking distance to stops. It is therefore important to enhance walkability by increasing permeability, providing shade along walking routes, and providing shade at bus stops.

Bus stops throughout the City are frequently disconnected from the pedestrian network and are constructed with no shade or shelter. Improvements to these facilities will improve accessibility and mobility for vulnerable community members.

Figure 16-5 Bus Stop at Dalrymple Drive, Leda

17 Industrial Areas

17.1 Background

The existing Kwinana Port and industrial areas make significant contributions to the State's economy. With anticipated infrastructure development, efficient freight corridor connections are considered essential for the continued productivity of the region. State, Regional and local level planning documents all indicate an increase in activity related to port, freight, and industrial activity within the City.

Expansion of industrial areas and hence freight volumes will occur with the development of master-planned industrial areas (such as Latitude 32/Hope Valley) and infrastructure developments including the Fremantle Rockingham Controlled Access Highway, Intermodal Freight Terminal, and WestPort infrastructure.

17.2 By Mode

> **Freight:** Freight networks within the City are comprised of both road and rail infrastructure. Additional freight traffic is expected within the City as a result of Outer Harbour Projects and intensified industrial development.

Requirements for road freight include wide pavement sections with sealed shoulders to support breakdown and loading, wide corner radii to ensure safe turning movements, and good visibility to allow for inbound and outbound vehicle movements in an around crossovers. The geometric requirements for industrial neighbourhoods is related to the size of heavy vehicle combinations permitted by the RAV Network. Areas that allow RAV 7 Network vehicles should be constructed specifically to enable safe movements through the network for these trucks.

Where freight rail intersects with roads in industrial areas, this can create issues with respect to safety. The queuing distance of even a few heavy vehicles can overspill the available stacking distance at level crossings.

> **Parking:** Car parking in industrial areas is typically contained on-site. Issues arise when industrial uses are converted to office or commercial uses, or when such uses are co-located on sites with industrial activity. Parking overspill from these uses creates further parking demand, in the absence of viable alternative transportation modes. If this parking demand is not able to be accommodated on site, then informal parking including verge parking is likely to occur.

In cases where non-industrial land uses as either sole or ancillary uses are introduced within industrial zones then embayed parking within the public road reserve, funded through a cash-in-lieu scheme rather than by the City, could be implemented to accommodate greater parking demand.

- **Private Vehicles:** There are a lack of feasible alternative transportation modes within the City's industrial zones, which then requires that workers and visitors of this area use private vehicles as their means of transportation to and from these zones.

Private vehicles tend to 'fit' within the road network provided for freight. However, the intersection controls that might otherwise be suitable for cars (roundabouts, in particular) may not be feasible for large truck combinations. Likewise, under low-traffic operation, priority T-intersections function appropriately for trucks, but may no longer operate effectively for high turning peak-period movements. Therefore, intersections must be considered under both peak period conditions (for cars) and heavy vehicle geometric requirements.

- **Cycling:** Cycling as a means of transport to the KIA presents several safety concerns for riders concerns as sealed shoulders drop out along roads shared by private vehicles and freight vehicles, limiting uptake of cycling as a mode of transport to, from, and within the City's industrial zones.

The provision of sealed shoulders within industrial zones is usually sufficient to accommodate cycling along low-volume roads. However, key collector and distributor roads require additional infrastructure to support commuter cycling by employees.

The *City's Bike and Walk Plan* (2018) recommends that a separate Bike and Walk Plan be produced for industrial areas. The production of such a plan would provide strategies and actions to enhance the safety and accessibility of a strong cycling network within the City's industrial areas.

- **Pedestrians:** As with cycling, walking is not a core mode of transportation to/from or within the industrial zones. Large industrial lots increase the walking distances to local destinations, and typically wide vehicle crossovers act as structural barriers to connected pedestrian networks. As the industrial areas intensify, the opportunities for walking to internal destinations increase.

Some degree of active transport is also necessary to facilitate uptake of public transport as a mode of transportation to industrial areas. To this end, there are wide footpaths along at least one side of most streets in the City's industrial zones.

The footpath network and safety of crossing points should be examined along public transport access desirelines.

- **Public Transport:** There are two existing bus routes bisecting the KIA; Route 548 travels along Cockburn, Rockingham and Patterson Roads, and Route 549 connects with the Kwinana City Centre. Both route numbers are anchored to Rockingham City Centre and Fremantle City Centre.

Public transport services in industrial areas struggle to connect bus stops with uses. Wide road reserves and long industrial blocks form a structural barrier to connections with businesses, particularly where there is a lack of pathway infrastructure. Large-scale, at-grade car parking within lots also increases the distance from bus stops and employment opportunities.

Figure 17-1 Bus Stops on Rockingham Road with Mason Road

Source: Nearmap (February 2019)

18 People Attractors

18.1 Background

People attractors are primary uses that bring people to a specific location, such as entertainment venues, hospitals, or large-scale educational facilities. Secondary uses then grow in response to primary uses. Within the City of Kwinana there are several key people attractors.

The Kwinana City Centre can be described as a people attractor, as people are attracted to the mix of land uses, recreation, entertainment, and employment opportunities the City Centre provides. The Kwinana Industrial Area acts as a people attractor due to its role as a centre of employment. Both of these areas are dealt with in separate sections of this report.

One key attractor in the City is the Perth Motorplex, which holds a number of large events each year and attracts significant attendance by people from all over the greater Perth area.

Figure 18-1 Perth Motorplex

18.1 Perth Motorplex – by Mode

- **Private Vehicles:** The demand for private vehicle access far outstrips the road capacity during peak arrival periods. There is only one entry/exit route for the venue, and this single location cannot accommodate the turning movements during the busiest times, even with active traffic management. This can have substantial impacts on the function of Anketell Road.
- **Parking:** It is reasonable to provide a certain quantum of parking for event venues. The Perth Motorplex currently provides a relatively small formal parking lot, alongside an extensive overflow parking area.

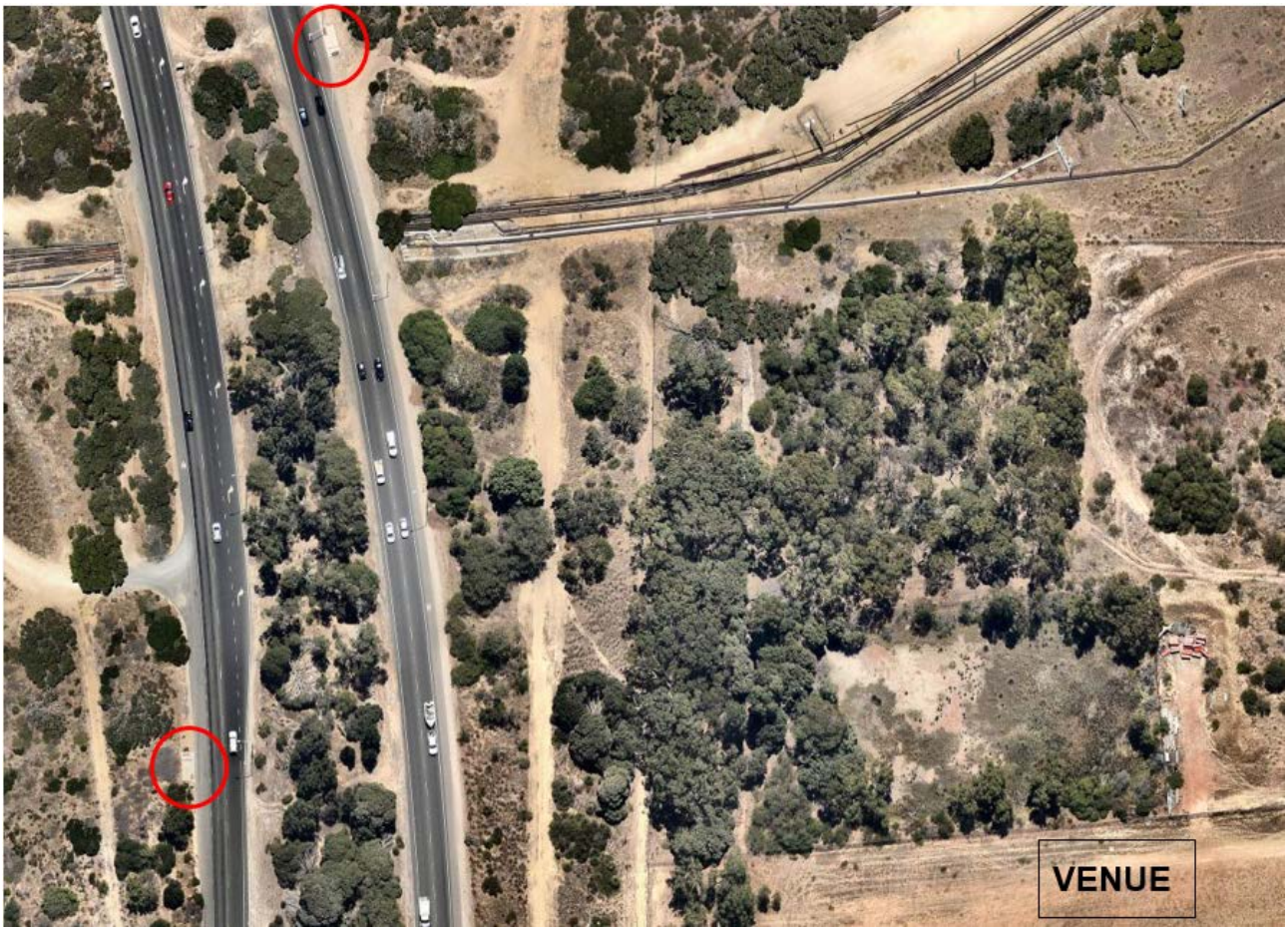
However, given that the surrounding road network is not capable of facilitating effective movements to accommodate those vehicles, alternative arrangements should be pursued. One potential is to provide locations for remote satellite car parking and shuttle bus services to alleviate pressure at the entrance and improve operations of the road network.

- **Public Transport:** The site is located close to bus stops served by Route Nos. 548 and 549 on Rockingham Road, however these are relatively low frequency routes.

There are currently no specialised public transport options for events, but such services would be highly beneficial to the function of Anketell Road and the safety of the network. A system of Transperth Event buses has been highly successful for other event venues including the Perth Stadium.

- **Pedestrians:** There is a pedestrian element to all public transit journeys. While there are bus stops in the vicinity of Perth Motorplex, their pedestrian connections are limited. These bus stops are located on a four-lane dual carriageway and serves as a structural barrier impeding pedestrian access routes. There is no pedestrian infrastructure supporting safe pedestrian connection between the bus stop and the venue.

Figure 18-2 Location of Bus Stop



- **Cycling:** The City's *Bike and Walk Plan* (2018) details the importance of cycling connections to people attractors, however the Plan does not discuss the KIA.

Rockingham Road and Anketell Road both provide sealed shoulders which are appropriate for confident cyclists, but as with pedestrians there are no safe connections from these shoulders to the venue. Lack of appropriate alternative transportation modes reinforces reliance on private vehicles.

19 Local Structure Plans

Residential development in the City has typically taken the form of structure-planned low-density residential estates. It is considered that future residential development in the City is likely to retain the relatively low-density character typical of the City.

Going forward, there is an opportunity for Local Structure Plans to define their function without disrupting the existing land use fabric of an established neighbourhood. For example, future structure plans may be used to define Activity Corridors appropriate to higher-density residential development, providing for a locally suitable mix of retail, business commercial, dining and entertainment uses.

Retrofitting such environments into the existing network requires an expenditure of both time and money, with substantial implications to existing residents. Future structure plans provide an opportunity to establish the appropriate built form for land use in the first instance. In this way Local Structure Plan developments have the opportunity to support the City's vision, as well as housing and economic strategies, and provide for well-connected transport networks.

In addition to the above, there are noted issues in active transport capability associated with older street layouts of previous development, with gaps in network connectivity. These have been addressed within this report. Future residential development in the City is likely to retain the relatively low-density character typical of the City, while also providing an opportunity to emphasise greater transport network connectivity.

20 Travel Demand Management

Travel Demand Management, which may also be described as Behaviour Change, refers to a system of policies and programs that aims to create a sustainable transport system. This primarily involves efforts to shift individual's travel mode away from private vehicles and onto alternative transport.

There are a wide range of initiatives that can be utilised as part of a TDM suite. These effectively operate under several different paradigms, as follows:

- **Information:** Effective decisions can only be made when all options are clearly understood. As such, many behaviour change programs focus on providing comprehensive information on the availability of services for each of the transport modes.

  The Department of Transport's 'Your Move' program is a best-practice example of this form of information. It provides aggregated information for public transport, walking and cycling routes, as well as offering personalised one-on-one information to businesses schools and even individual households (for specific studies such as Cockburn and Wanneroo).

  In addition to route option information, explicit discussion of the benefits (or costs) associated with the various transport modes can be used to affect choice (e.g. vehicle ownership and parking infrastructure costs, pollution and other environmental impacts, and the health benefits of active transport modes).

- **Provision:** Mode shift to alternative transport modes is only possible where alternative infrastructure is available. As such, the provision of bus and train service, paths and cycle ways is a prerequisite of any Travel Demand Management regime.

  Public transport is at its most effective when it functions as a 'turn up and go' service. The threshold for this changes by location, but is generally associated with headways of 10 minutes or less. Where bus routes share a corridor, this can create the environment for attractive public transport use even where individual routes are relatively infrequent.

  Pedestrian and cycling paths define areas of effective active transport, with the specific infrastructure treatment or streetscape environment relevant to the type of experience and target activity. However, it is the transitions and crossing points that really define the path network. An inhospitable environment with difficult or unsafe crossing points will result in very low levels of active transport.

- **Supply Constraints:**

  Just as the provision of sustainable transport is a necessary component of mode shift (and hence TDM), supply constraint of private vehicle-supporting infrastructure is fundamental to the equation. In particular, congestion and parking availability are two of the main causes of mode shift.

  Alternative modes are *almost never* competitive with private vehicle transport in free-flow conditions, but become more attractive as the effects of congestion increase, or where parking is hard to find or located further from destinations. It can be argued that congestion is a *necessary* component of the transport system, in that it makes more sustainable, healthier and less impactful transport modes viable for a range of journey types.

  Parking restrictions are one of the few aspects of the transport network that can be specified by Local Government at the planning and policy stages. Through its various functions, Local Government has purview over the supply of private parking (through its TPS) and public parking (through Engineering Services), as well as the management and pricing of public supplies (through Ranger Services). An abundant supply of parking located immediately adjacent to destinations makes driving the de facto mode choice for the vast majority of trips. Once parking is restricted, people are more likely to consider other modes or destinations.

- **Economic (Demand) Impacts:**

  The preceding sections effectively describe infrastructure solutions to travel demand management. However, one of the simplest and most effective ways to affect mode choice is through direct cost. One of the primary ways Local Government can do this is by introducing paid parking into high-demand zones. The cost of parking is a primary determinant of where people are willing to park, and for how long. Careful application of paid parking management can be used to improve the efficiency of parking in a given area, but should be combined with parking supply restrictions (where abundant parking is provided, the only reasonable price per bay is $0).

The effects of parking on travel demand management are discussed in detail in **Section 11** of this Study.

20.1.1 Recommendations for TDM in Kwinana

Not all trips are viable for all modes, and so travel demand management methods may be used to specifically support certain kinds of behaviour change (a shift away from driving to work, an increase in local walking trips to a Neighbourhood Centre). TDM therefore requires an understanding of how incentives affect mode choice, for the various different destinations and journey types.

The following are some examples of non-infrastructure TDM measures that could be employed to support behaviour change, with application to specific types of trip.

Activity Centre Parking Supply Management:

- SPP4.2 and the corresponding Draft Activity Centres Parking Policy recommends the use of parking caps to determine the level of activity that can be sustained within a given Centre. The concept of parking caps can be applied with reference to the economic development potential of a Centre, provided decision-makers have a detailed understanding of how City Centre parking and lands uses interact.

  Combining economic needs assessment with a detailed parking model can be used to identify a sustainable parking supply play and demand management framework for Activity Centre development, the ongoing need for public parking, reasonable mode share targets and infrastructure delivery requirements, as well as assisting in determining a realistic internal employment catchment.

- Recommendation: Undertake land use / parking modelling for future development plans of all Activity Centres. Use the outcomes of these studies to define an economically viable parking cap and a mode share target for each Centre.

Congestion Pricing:

- Under some predictions for the future, autonomous vehicles and/or Mobility as a Service (MaaS) may obsolete the current demand management mechanisms associated with parking pricing and supply restriction, as vehicles can drive to a remote location once passengers are delivered. In addition, some of the congestion-based disincentives for private vehicle travel are likely to be diluted if drivers become passengers, with access to additional leisure activities while travelling. These effects could have wide-ranging impacts on residential location, increasing commuting times and intensifying peak travel.

  To offset these negative effects, road pricing becomes an increasing necessity, including possibly both cordon charges and distance-based taxation, potentially varying across the day. Any such initiative would be introduced at State Government level, but will absolutely require representation from Local Governments to identify the potential impacts at the local and precinct levels.

  Any road-pricing program is only likely to happen in the long-term, but can be expected within the 30-year horizon.

- Recommendation: Work with State Government to define the potential of, and issues with, congestion pricing models, in the context of the City of Kwinana, its residents and employees.

Affordable Housing:

- Affordable housing is a significant issue, and one that is exacerbated by the propensity for developers to supply additional parking (particularly where Local Government employs conservative parking supply requirements).

  There are a number of mechanisms that can be employed to improve housing affordability (reduced residential size, partial ownership, unbundled parking, design changes to reduce costs for construction and maintenance etc.)

  Developers are often wary of some of these avenues, as they represent additional risk in terms of a reduced buyer pool and increased selling time. There is an opportunity to combine a research project, potentially in coordination with a university, with a demonstration project via public or private development.

  Reducing the number of parking bays within transit-connected developments would greatly reduce the car-as-driver mode share and support initiatives such as shared cars, increased density, inner-urban living and public transport provision.

  This can be achieved through policies supportive of separating the purchase of parking bays from residential units (unbundling) and off-site provision (decoupling). These forms of parking supply are not subject to many of the risks associated with under and oversupply, and are also more robust to the future impacts of technological change.

- Recommendation: Consider a partnership with the Department of Communities or LandCorp to determine the actual demand for parking provision if owners are given the choice to purchase the bays at market rate separate from their unit. A model for delivery of this project is suggested as follows:

  Determine the optimal provision for parking for affordable housing, and possibly extend the concept across the entire stock of multiple-dwelling units. This first part would consist of a pure research aspect, undertaken with the assistance of a public or private research organisation

  There is the opportunity to follow this up with an actual demonstration project to be used as the basis for policy recommendations on affordable housing in the City. This would require buy-in from a developer, who would test the market through provision of off-the-plan affordable housing, allowing buyers to choose to purchase a car parking bay on need, and with the full understanding of the cost implications. This could be combined with other affordable housing measures (partial ownership etc.) as part of a package. This second phase would benefit from industry participation on a wider scale (UDIA, PIA, REIWA etc.)

  The risks of oversupply can be managed through construction of 'convertible' parking bays (areas that can be redeveloped into commercial, retail or residential units if parking demand drops, by unbundling parking or decoupling parking (using the opportunities inherent in the recent change to Strata Title legislation).

TDM Application:

- Despite the efforts of the TravelSmart team, the population still does not adequate understand the real financial and time costs of their transport choices. An app which combines traditional TravelSmart information on provision, route and duration with the financial costs of these choices across a year would be of great benefit to improve the awareness of households.

  The app could allow households to input their primary and occasional travel demands, number of vehicles etc. and then investigate the impact of mode shift on time and cost of individual trips, as well as reducing the number of vehicles. It is important to base this on real costs with a transparent breakdown of the elements. The app could be expanded to suggest respondents reduce their travel distance (by moving house or workplace), change their mode, reduce the number of vehicles in the household etc.

- Recommendation: A partnership across several Local Governments, Department of Transport and (possibly the RAC) to develop an application where residents and employees can assess the cost of transport alternatives.

E-bike opportunities:

- One of the primary (non-infrastructure) barriers to cycling in the hilly dunes of Kwinana is the initial requirements for fitness. E-bikes provide a cost-effective solution to overcome this hurdle, and while they still rely on an effective cycling network, dramatically lower the barrier to entry for new cyclists.

  Support for e-bike purchase by City of Kwinana employees, and publication of information across the Region, could jump-start the use of e-bikes in the City.

- Recommendation: Consider introducing e-bikes as a trial for Local Government Employees, along with purchase or salary package options to promote their ongoing use.

Green Travel Plans:

- Green travel plans have been included as a mandatory requirement for development applications in the UK for quite some time. Currently, green travel plans are largely used to obtain concessions on parking and trip generation assumptions from State or Local Governments, or to fulfil the requirements of Green Star applications. Unfortunately, there is often a disconnect between the goals of the green travel plan and the Traffic Impact Assessment, at least outside of Activity Centre Structure Plans. That is, the improvements in accessibility and mode shift targets do not tend to translate into reduced road infrastructure or parking requirements. This may be due to the Development Application and approval process in which conditions are generally built such that they can be signed off at construction. Conditions therefore reference creation of a "plan", but the actions contained in this plan are rarely reviewed or monitored. This diminishes Government trust in implementation and shifts the conversation to the provision of infrastructure by developers, rather than modifying activity.

  To improve the uptake and integration of green travel plans into the provision of infrastructure, and to show the value of travel plans in reducing financial costs for businesses, it would be valuable to create a package of guidance material, aimed across all sectors, to improve the uptake of travel plans at development and occupation stages, and to mandate the inclusion of Green Travel Plans with Development Applications.

The documents would use TravelSmart information to outline the benefits to employees and visitors, but would go further into the financial benefits to businesses and developers, reinforced by reasonable concessions which could be granted by the City based on various TDM measures.

Ideally, any Green Travel Plan policy would reference mode share targets determined on a Precinct basis by the City. This would mean that all development applications would be working under to a common transport goal.

> Recommendation: Define a policy for Green Travel Plans related to the transport goals of the City and mandate inclusion of Green Travel Planning with Development Applications.

APPENDIX A

LITERATURE REVIEW

1 Literature Review

Relevant local and regional policy and strategic guiding documents have been reviewed in the context of City of Kwinana in the production of its Integrated Land Use and Transport Plan.

2 Local Policy

2.1 Local Commercial and Activity Centres Strategy (2014)

The City of Kwinana recognises that Local Commercial and Activity Centres play a vital role in both the local economy and residents' quality of life. In order to support the growing population and consequential increase in number of dwellings, a Retail Needs Assessment has been undertaken for the City. The RNA is intended to assist the identification and / or confirmation of activity centres so that shopping and other commercial / community needs of the population can be satisfied to the maximum practicable extent.

In its role as an emerging District Centre, nearly 50% of the total increase in shop / retail provision is predicted to occur in Wandi by 2031 (19,000sqm out of 40,100sqm for the City of Kwinana). Other notable areas of development include, Kwinana Town Centre, Bertram, Casarina, Wellard, Thomas Road and Mortimer Road. There has been no further need for retail development identified in established suburbs of Orelia, Leda, Medina, Summerton, Calista, Naval Base and Kwinana Beach.

In order to address the disparity in investment between businesses located in the Kwinana Central Business District (**CBD**) and those in other local shopping centres, City of Kwinana have set up a grant funding request for the following Local Commercial and Activity Centres: Medina (including the Light Industrial Area); Parmelia; Calista; and, Orelia. These smaller centres serve a vital purpose in making goods and services accessible to members of the community who may find it difficult to reach the CBD. The funding intends to allow the development of these areas to more effectively serve the needs of their local community and reduce the need to travel into the CBD.

2.2 City of Kwinana - Local Planning Strategy (In Development)

The City of Kwinana is currently in the process of preparing a new Local Planning Strategy to guide strategic growth and development in line with the aspirations identified by the community in the Strategic Community Plan 2017-2027 (reviewed below). The Local Planning Strategy is to be supported by a series of Sub-Strategies relating to Local Commerce, Local Industry, and Local Housing, in addition to this document which relates to Transport.

2.3 City of Kwinana - Town Planning Scheme No.2 (1992) and No.3 (1998)

Two (2) Town Planning Schemes are applicable within the City of Kwinana. These are Town Planning Scheme No. 2 (TPS2) (1992), applying to all land within the LGA, and Town Planning Scheme No. 3 (1998) which applies to the Kwinana Town Centre.

The objectives of TPS2 are as follows:

- Reserving land required for public purposes;
- Zoning the balance of the land for the various purposes described in the Scheme;
- Providing development controls for the purpose of securing and maintaining an orderly and properly planned use and development of land within the Scheme area;
- Introducing measures by which places of natural beautify and places of historic or scientific interest may be conserved

The objectives of the TPS3 are as follows:

- Provide development controls for the purpose of securing and maintaining an orderly and properly planned due and development of land within the Scheme Area
- Implementing development proposals contained in the Town Centre Strategy plan adopted by Council

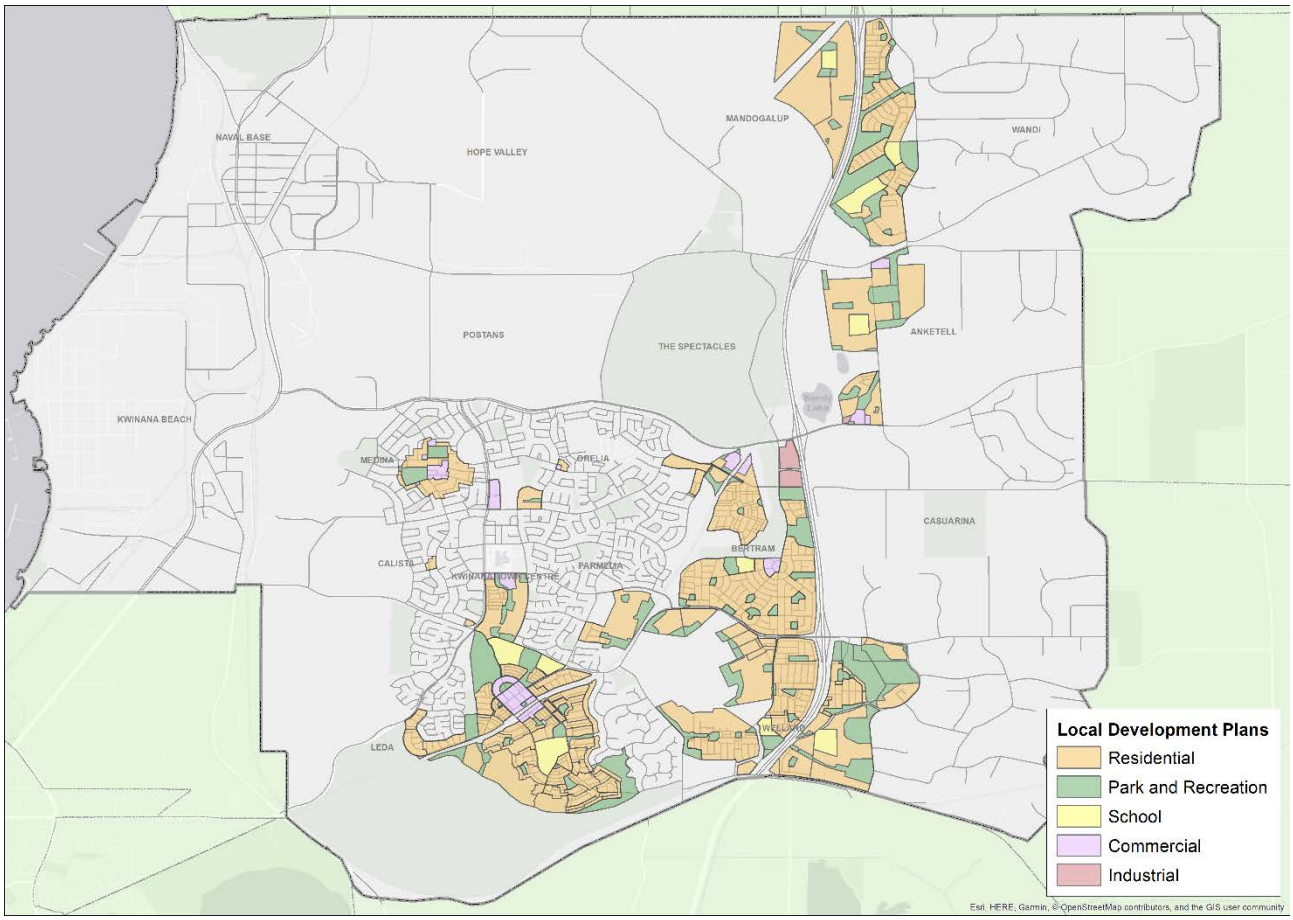
These aims are compatible with this Strategy document.

TPS2 is currently under review.

2.4 City of Kwinana - Local Structure Plans

Approved Local Structure Plans for the City of Kwinana indicate that development occurring along the Kwinana Freeway corridor will generally serve residential and commercial purposes. Some areas of Light Industrial land are located on Johnson Road near Thomas Road, and on Thomas Road in Anketell. However, these areas are small in the context of the surrounding development. **Figure 2-1** below shows the approved structure plan land zoning. Development in many of these areas has already been completed.

Figure 2-1 Local Development Plans



2.5 City of Kwinana - Strategic Community Plan (2017 -2027)

The Strategic Community Plan 2017 - 2027, is the guiding document for the City of Kwinana over the next 10 years. Based on 1,300 community responses, the Plan is a revision of the 2013 version of the document and reinforces the idea of Kwinana's vision statement, "*Rich in Spirit; Alive with Opportunities; Surrounded by Nature; It's All Here*".

The Plan identifies the need to develop a diverse and thriving economy which benefits the residents by providing employment opportunities and enhanced services. Particular emphasis has been placed on Local Commercial and Activity Centres as areas that both serve and reflect the unique sense of place in each community.

A key focus of the Plan is to '*provide a safe and efficient integrated network of roads, footpaths and cycle routes, supported by a good public transport system*' (Objective 4.6). This includes the production of an Integrated Transport Strategy (in production) and a Bike and Walk Plan (November 2018). The measures have been designed to increase community satisfaction with footpaths and cycleways, traffic management on local roads, and access to public transport.

The Strategic Community Plan also emphasises the importance of development in Kwinana's industrial areas being efficiently and effectively integrated within the City's transport network. Objective 2.4 of the Plan reads '*The Western Trade Coast Precinct is development with maximum leverage being gained from investments in new infrastructure.'* The integrated development of this precinct will allow the City to maximise the benefit received from further development of this key strategic infrastructure while safeguarding community happiness.

2.6 City of Kwinana - Bike and Walk Plan (2018)

The plan seeks to increase walking and cycling use within the City by making recommendations for improvements to existing infrastructure and developing new infrastructure where demand requires it. The Vision for the plan is:

Develop a safe, connected and attractive cycling and walking network so that active travel becomes an integrated part of daily life for all types of trips, enabling people to lead healthier lifestyles and stay more active and independent for longer.

The objectives of the plan are as follows:

- To have an interconnected, continuous and well maintained bicycle and pedestrian network that pedestrians and cyclists of all abilities feel comfortable using;
- To be a city where walking and cycling is the first choice for transport (for all ages) for short trips (1-2km);
- To have a network of safe roads designed to Safe Active Travel Street principles to encourage the short trip journeys;
- To improve the City's health issues by actively promoting new cycle and walking infrastructure as implemented; and
- To improve walking and cycling access to schools, train stations, parks and recreational facilities.

The plan recognises concern about the residents' health that could be improved through regular exercise, obtainable through 1-2km cycle and walking trips in local neighbourhoods. The plan provides a series of maps that demonstrates these short distance trips are feasible with majority of schools, shops and recreational facilities within distances conducive to active travel within local neighbourhoods. It is acknowledged that the greatest gain, and financial benefit, will come from increasing these local level trips rather than regional level trips that require significant investment for a much smaller proportion of residents.

Neighbourhood plans that define long-term objectives and implementation priorities have been developed for individual communities within Kwinana with priority given to Bertram, Medina and Leda. The plan recommends completing one neighbourhood at a time.

The presence of the major road corridors, Thomas Road, the Kwinana Freeway, Rockingham Road and Mandurah Road surrounding the townsite means through traffic does not need to transverse the residential township, creating an environment tailored towards local movement across neighbourhoods, rather than regional movement across local government boundaries.

The industrial area is not a focus of the plan due to uncertainties in current State Government planning for the area and to allow the City to concentrate on residential neighbourhoods.

Top cycling issues identified through online community engagement were Thomas Road (freeway to Marri Park), Rockingham Road / Thomas Road intersection and Cockburn Road (Hogg Street to Sutton Road). Further issues are identified in Table 6.1 of the plan. Top walking issues were concentrated around Bertram and Kwinana City Centre with most issues relating to deficiencies in infrastructure (no footpath or no crossing).

2.7 Westport Port and Environs Strategy (In Progress)

The Westport Port and Environs Strategy relates to the provision of infrastructure for the freight and logistics needs of Perth and the South West over the next 50-100 years. The Strategy will relate to the future of the Fremantle Outer Harbour in Kwinana and its connection to the broader freight network, providing for efficient connections between port facilities.

Rowley Road and Anketell Road are identified as the Primary Regional Roads to service Outer Harbour and the Kwinana Industrial Area. The Westport project will also take into consideration the Indian Ocean Gateway project (discussed below) in developing the Outer Harbour.

2.8 Indian Ocean Gateway

The Indian Ocean Gateway project, undertaken on behalf of the City of Kwinana, has proposed to upgrade Rowley Road, Anketell Road and Thomas Road. It also proposes three new grade separated roads and a new at grade road. These roads will link Rowley Road to the Outer Harbour, provide a road in Outer Harbour, and link Rowley Road to Kulija Road (which connects with Mundijong Road at Kwinana Freeway). These upgrades

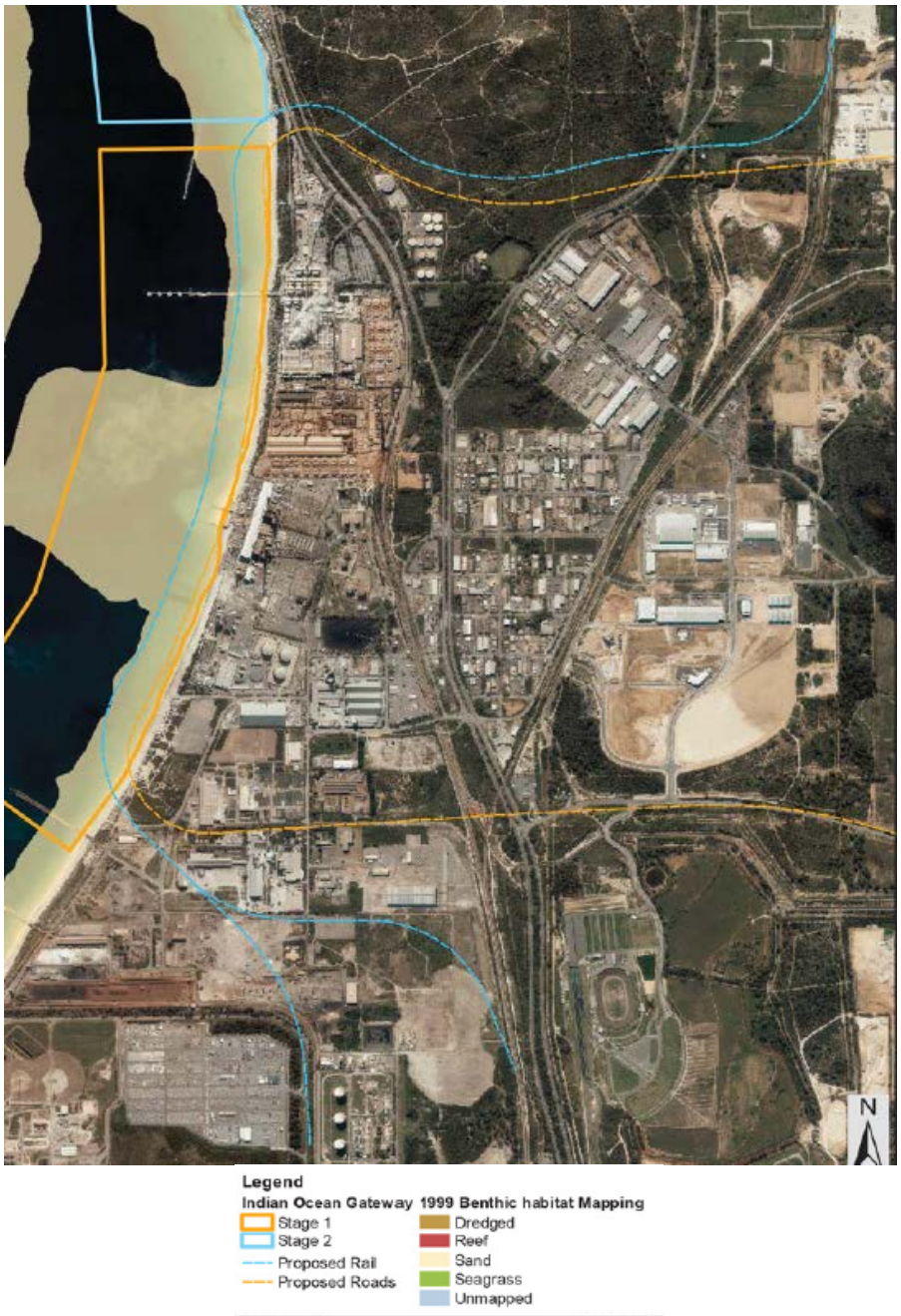
and new roads are shown in Figure 2-2. Outside of the City of Kwinana municipal area, a new grade separated road is proposed to link Tonkin Highway and Rowley Road.

Figure 2-2 Proposed Freight Road and Rail Links (Source: Indian Ocean Gateway 'Detailed Road and Rail Links (Map)')

Freight rail is proposed for better access to the Outer Harbour, this is within the port area as seen in **Figure 2-2** and **Figure 2-3**.

Another proposal is an extension of Tokin Highway, however this has no budgeted cost identified in the above map.

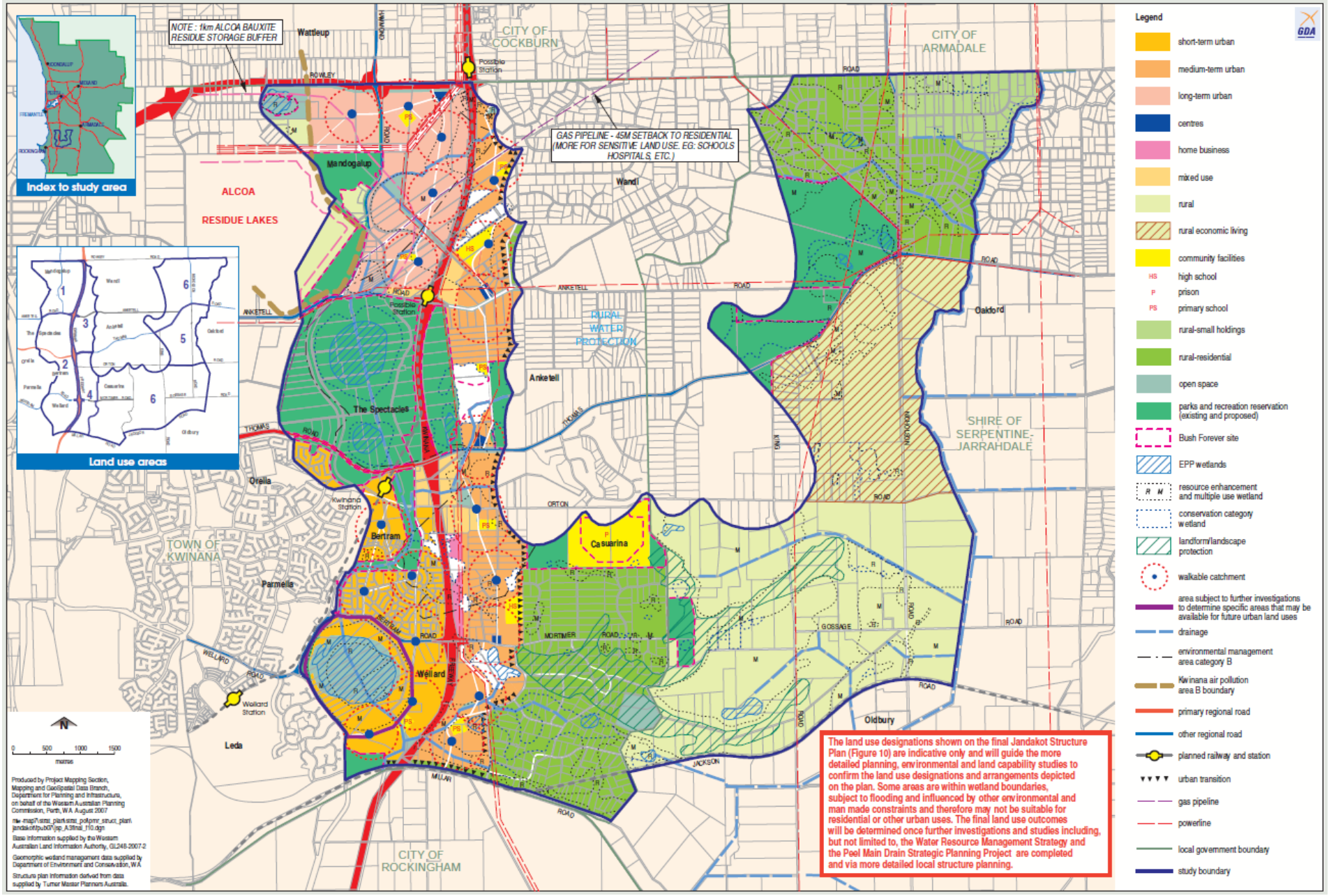
Figure 2-3 Freight Network Through the Outer Harbour (Source: Indian Ocean Gateway 'Port Area – Absence of Seagrass (Map)')



2.9 Jandakot Structure Plan (JSP)

The Jandakot Structure Plan was produced in response to a review decreasing the Jandakot Underground Water Pollution Control Area coverage and is authorised by the WAPC. The report spans the local government jurisdictions of the City of Kwinana and the Shire of Serpentine-Jarrahdale. The intention of the report is to guide future urban development in the area in a manner consistent with the aims of the Jandakot Land Use and Water Management Strategy (WAPC 1995), balanced with the ongoing management of environmental issues.

The JSP provides for expanded urban development with retail needs served by the Kwinana Town Centre and the gateways regional centre, as well as proposing five (5) local centres located on Rowley, Anketell, Thomas, Mortimer, and Bertram roads. The below image shows the adopted structure plan, which overall provides for a total population capacity of approximately 41,500 persons.

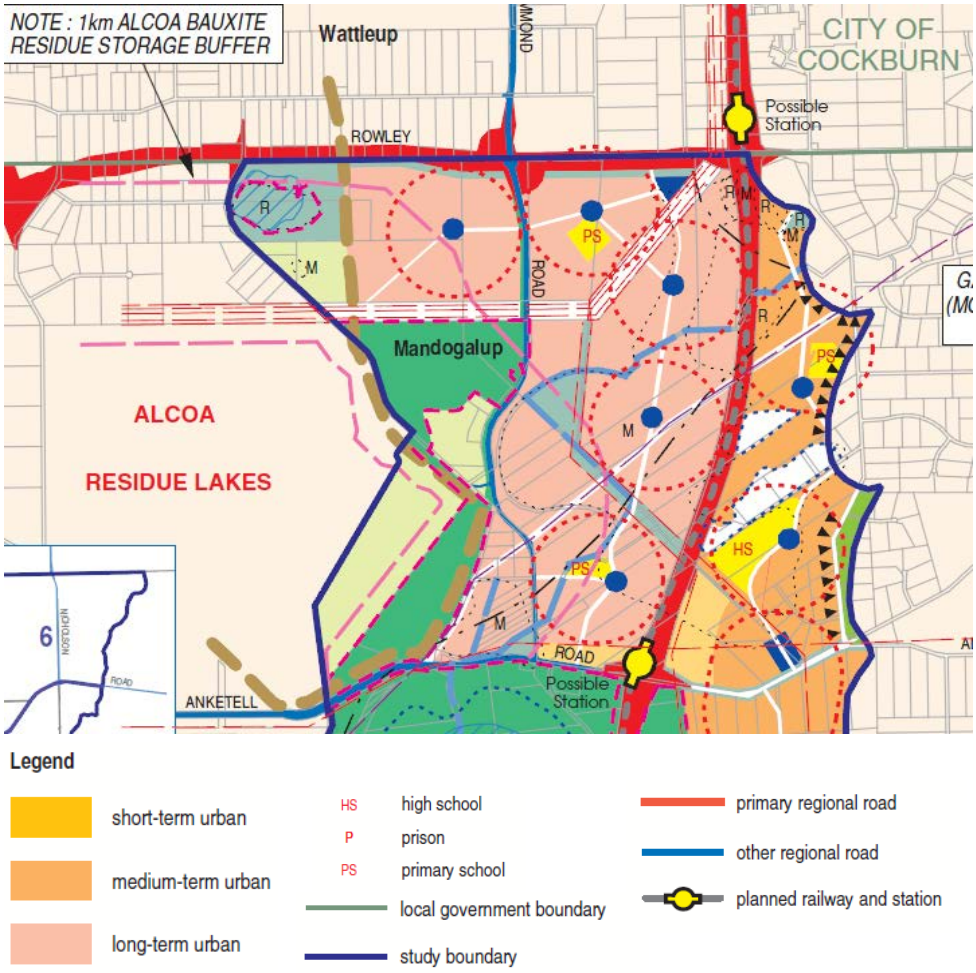

NOTE : 1km ALCOA BAUXITE RESIDUE STORAGE BUFFER
GAS PIPELINE - 45M SETBACK TO RESIDENTIAL (MORE FOR SENSITIVE LAND USE. EG: SCHOOLS HOSPITALS, ETC.)
Index to study area
Land use areas
ALCOA
RESIDUE LAKES
RURAL WATER PROTECTION
CITY OF COCKBURN
CITY OF ARMADALE
SHIRE OF SERPENTINE-JARRAHDALE
TOWN OF KWINANA
CITY OF ROCKINGHAM
Wattleup
Mandogalup
Wandi
Anketell
The Spectacles
Oreila
Bertram
Casuarina
Parmelia
Wellard
Leda
Oakford
Oldbury
Kwinana Station
Wellard Station
Possible Station
ROWLEY ROAD
ANKETELL ROAD
THOMAS ROAD
ORTON ROAD
MORTIMER ROAD
GOSSAGE ROAD
JACKSON ROAD
MUNDIJONG ROAD
KARNUP ROAD
WELLARD ROAD
BERTRAM ROAD
MILLAR ROAD
0 500 1000 1500 metres
Produced by Project Mapping Section, Mapping and GeoSpatial Data Branch, Department for Planning and Infrastructure, on behalf of the Western Australian Planning Commission, Perth, WA August 2007
file: map*\struc_plan\struc_polypmr_struct_plan jandakot\pubKP.jpg, A3final_110.dgn
Base information supplied by the Western Australian Land Information Authority, GL248-2007-2
Geomorphic wetland management data supplied by Department of Environment and Conservation, WA
Structure plan information derived from data supplied by Turner Master Planners Australia.
The land use designations shown on the final Jandakot Structure Plan (Figure 10) are indicative only and will guide the more detailed planning, environmental and land capability studies to confirm the land use designations and arrangements depicted on the plan. Some areas are within wetland boundaries, subject to flooding and influenced by other environmental and man made constraints and therefore may not be suitable for residential or other urban uses. The final land use outcomes will be determined once further investigations and studies including, but not limited to, the Water Resource Management Strategy and the Peel Main Drain Strategic Planning Project are completed and via more detailed local structure planning.
Legend
GDA
short-term urban
medium-term urban
long-term urban
centres
home business
mixed use
rural
rural economic living
community facilities
HS high school
P prison
PS primary school
rural-small holdings
rural-residential
open space
parks and recreation reservation (existing and proposed)
Bush Forever site
EPP wetlands
R M resource enhancement and multiple use wetland
conservation category wetland
landform/landscape protection
walkable catchment
area subject to further investigations to determine specific areas that may be available for future urban land uses
drainage
environmental management area category B
Kwinana air pollution area B boundary
primary regional road
other regional road
planned railway and station
urban transition
gas pipeline
powerline
local government boundary
study boundary

For the City of Kwinana, the following are significant elements of the JSP:

2.9.1 Mandogalup

The JSP proposes two new train stations; at the intersection of Kwinana Freeway and Rowley Road and the intersection of Kwinana Freeway and Anketell Road. The Rowley Road station will lie on the City of Cockburn side of Rowley Road. Both stations will be servicing the existing urban region and proposed short, medium and long term urban development in the suburb of Mandogalup. This includes three proposed primary schools and one proposed high school as seen in **Figure 2-4**.

Figure 2-4 Mandogalup Proposed Development

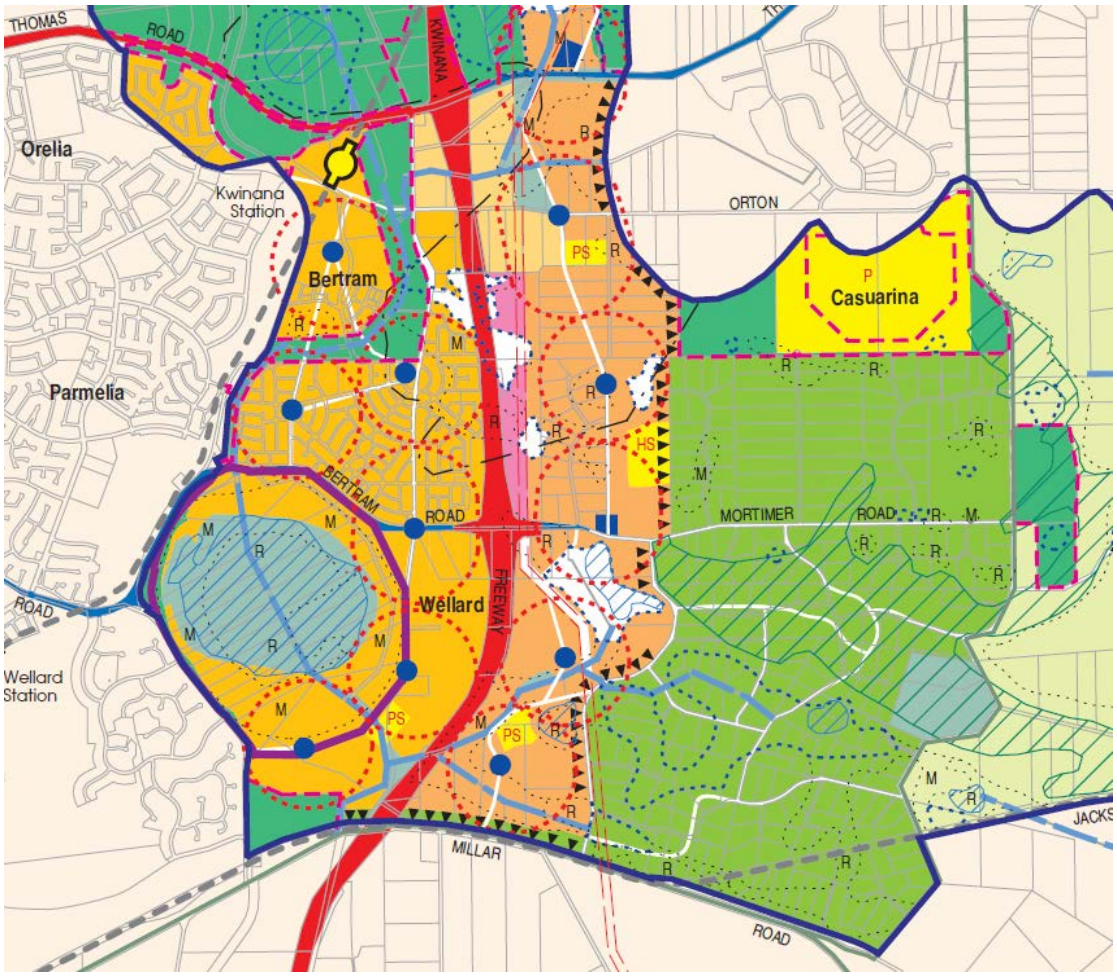


We note that ALCOA plans to operate its proximate residual disposal area for more than 20 years, which is likely to negatively impact upon air quality in the region. The Mandogalup cell has a resultant reduced demand for community infrastructure needs to be immediately catered for. Urban development is, as indicated by the JSP, a long-term goal for the cell.

2.9.2 Bertram-Wellard-Casuarina

Along the west side of Kwinana Freeway, the JSP indicated areas for short and medium term urban development. **Figure 2-5** shows the proposed urban development in this region. Residential developments are underway or completed in the areas marked for short-term development. The areas indicated for medium-term residential development are not yet developed. On the western side of the freeway, the primary school in Wellard has been developed, however the high school and two (2) primary schools to the east of the freeway are yet to be developed. We note that the Wellard East cell has been rezoned to urban deferred due to its proximity to livestock holding facilities.

Figure 2-5 Bertram-Wellard-Casuarina Proposed Development



Legend

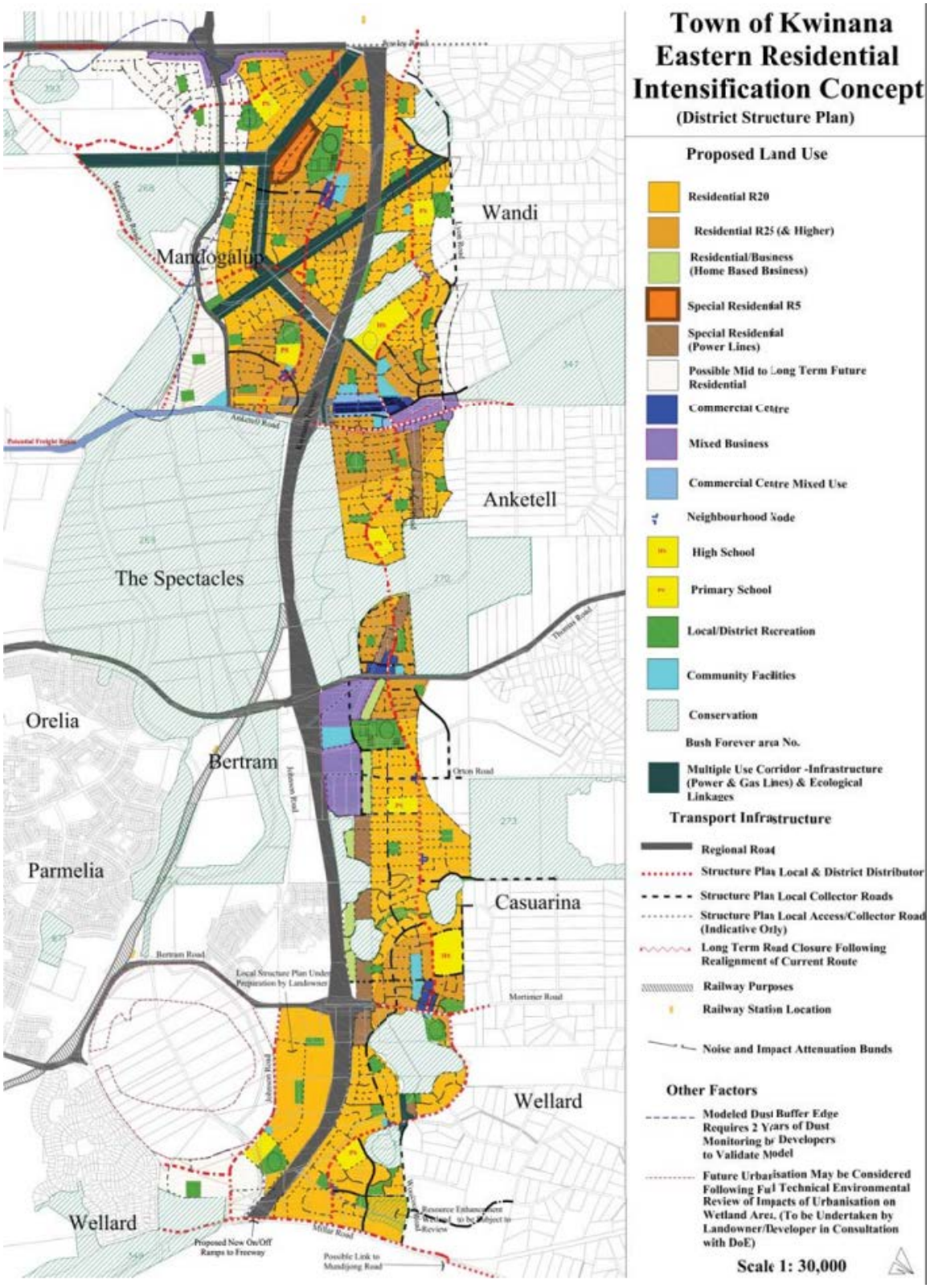
- short-term urban
- medium-term urban
- long-term urban
- HS high school
- P prison
- PS primary school
- local government boundary
- study boundary

HS high school
P prison
PS primary school

2.10 Eastern Residential Intensification Concept (ERIC)

The Eastern Residential Intensification Concept district structure plan was built on the JSP for a more detailed planning of the urban growth areas as seen in **Figure 2-6**. It contains the same proposed schools and urban development areas. One thing to note is that it proposes a new on/off ramp on the Millar Road intersection with Kwinana freeway.

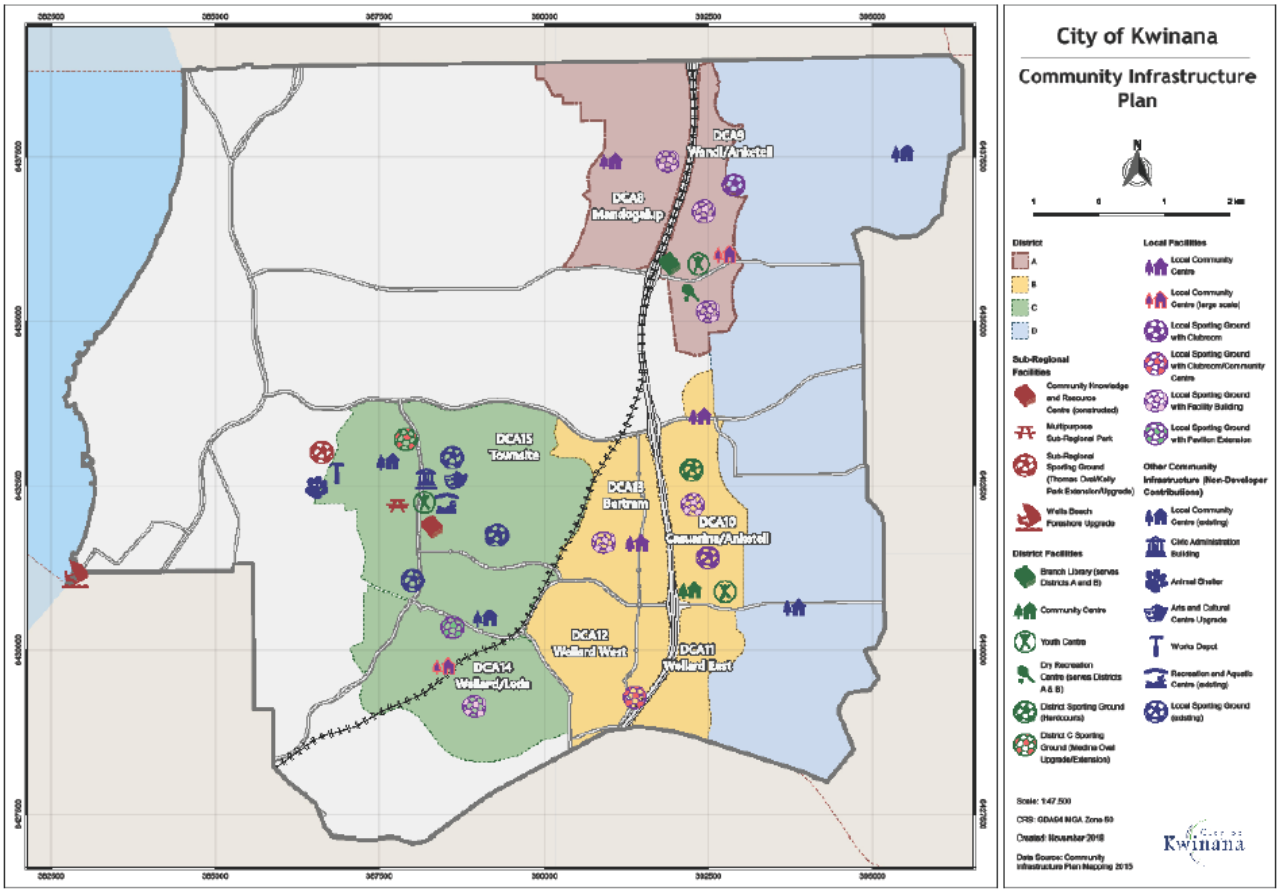
Figure 2-6 ERIC district Structure Plan



2.12 City of Kwinana Community Infrastructure Plan 2011-2031

The City of Kwinana Community Infrastructure Plan 2011-2031 outlines community infrastructure needs based off population estimates in each district. Significant population changes are predicted in districts A, B and C requiring urban development in districts A and B. **Figure 2-7** maps the districts and proposed community infrastructure. Each of these is discussed below.

Figure 2-7 Community Infrastructure Plan Map



2.12.2 District A

District A is made up of Mandogalup (DCA 8) and Wandi/Anketell North (DCA 9) areas.

District A is predicted to have a population of approximately 13,800 by 2031, comprising 19% of the City's total population. The population is expected to reside in the existing land zoned for residential purposes to account for continued industrial development and ongoing industrial activity (including ALCOA tailings dams) in the surrounding area.

Proposed community infrastructure for District A is indicated to include the following:

- Two Local Community Centre – one large
- Three Local Sporting Grounds
- One District Youth Centre
- One District Hard Courts – shared with District B
- One District Library – shared with District B
- One District Recreation Centre – shared with District B

2.12.3 District B

District B is made up of Casuarina/Anketell South (DCA 10), Wellard East (DCA 11), Wellard West (DCA 12), Bertram (DCA 13). The District is predicted to have a population of approximately 25,700 people by 2031, comprising 35% of the City's total population.

Wellard West and East are expected to account for the bulk of residential development and population growth, as Bertram is near full-development. Wellard West is expected to have the largest population within this district.

Proposed community infrastructure for District B is indicated by the Plan to include the following:

- Two Local Community Centres
- Two Local Sporting Grounds
- One District Community Centre
- One District Youth Centre
- One District Hard Courts – shared with District A
- One District Library – shared with District A
- One District Recreation Centre – shared with District A

2.12.4 District C

District C is made up of Wellard Leda (DCA 14) and Medina/Orelia/Parmelia/Calista/Town Centre (DCA 15). The District is predicted to have a population of 35,000 people by 2031, comprising 47% of the City's total population. The DCA 15 area is expected to grow to urban infill, while DCA 14 is expected to grow due to urban development.

The proposed community infrastructure in this District is one local sporting ground.

2.12.5 District D

District D is made up of the remaining rural areas in Wandi, Casuarina and Wellard. The District does not have sufficient population to require Sub-Regional infrastructure within the area.

3 Regional Policy

3.1 Activity Centres for Perth and Peel, State Planning Policy 4.2 (2010)

The Perth and Peel regional planning framework seeks to:

- Reduce the overall need for travel;
- Support the use of public transport, cycling and walking for access to services, facilities and employment; and
- Promote a more energy efficient urban form.

Activity centres are community focal points and include a range of land uses including commercial, retail, higher density housing, entertainment, tourism, civic/community, higher education, government and medical services. Activity centres can vary in size and diversity and are designed to be well-serviced by public transport.

Kwinana is identified as a Secondary Centre in the Activity Centres State Planning Policy (SPP) 4.2. The main role of this type of centre is to serve as a regional activity centre with a smaller catchment, offering a more limited range of services, facilities and employment opportunities than a Strategic Metropolitan Centre or Perth Capital City. Regarding transport connectivity and accessibility, Kwinana should be an 'important focus for passenger rail and/or high frequency bus network.'

Wandi is identified as an emerging District Centre. The main role of this type of centre is to service the daily and weekly needs of the residents. Their smaller catchment enables them to have greater local community focus and provide services, facilities and jobs opportunities that reflect the needs of their catchment. Transport connectivity and accessibility should be a focal point for the bus network.

A key objective of SPP 4.2 is to reduce private car trips and maximum access to activity centres by active and public transport..This is particularly relevant in the Neighbourhood Centres such as Bertram, Leda, Medina, and Parmelia and Local Centres such as Wellard, Orelia, Calista, Anketell and Madogalup.

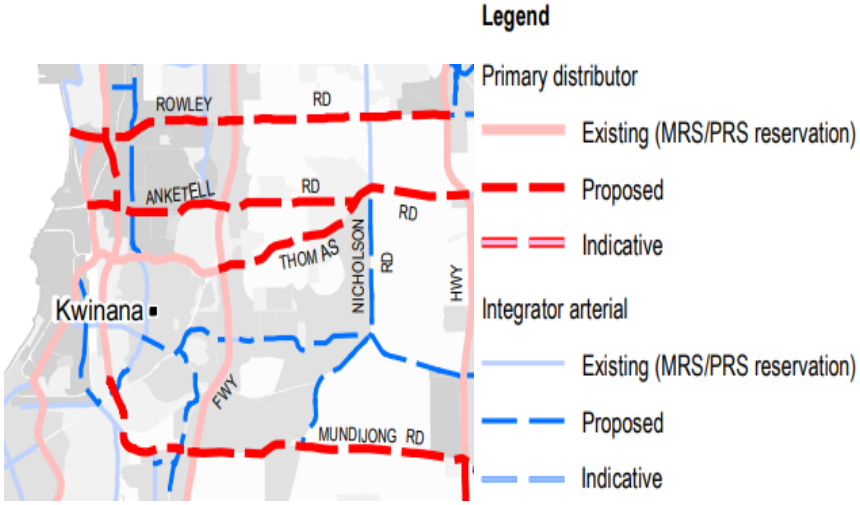
3.2 Perth and Peel @ 3.5 Million (2018)

The Perth and Peel @ 3.5 Million documents are a set of strategic documents intended to guide the Perth and Peel area in future growth, providing land use planning and infrastructure frameworks to create a compact, consolidated and connected city and enhance sustainability.

Having a sustainability focus, Perth and Peel @ 3.5 Million seeks to increase public transport use, increase cycling and walking and reduce the mode share of private vehicles in Perth. By 2050, Kwinana Freeway and Tonkin Highway will form the main north-south network for the Perth and Peel region, along with the increased importance of Roe Highway which lies to the north east of the City's boundary.

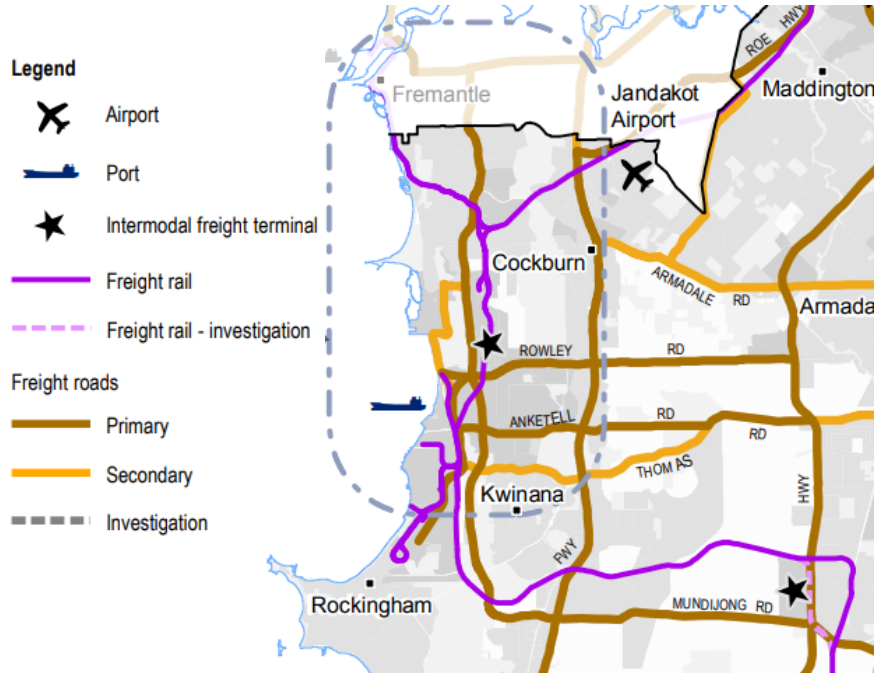
Perth and Peel @ 3.5 Million outlines the proposed 2050 road network subject to Westport freight investigations and aligns with the proposed road network in the Indian Ocean Gateway project, as seen in **Figure 3-1**.

Figure 3-1 Proposed Road Network 2050 (Source: Perth and Peel @ 3.5 million)



There is no proposed freight rail in this report, however this is under investigation from Westport project seen in **Figure 3-2**.

Figure 3-2 Freight Rail Section Under Investigation (Source: Perth and Peel @ 3.5 million)



3.3 Perth and Peel Transport Plan for 3.5 Million People and Beyond (2016)

The aim of this document is to increase public transport use, increase cycling and walking and reduce the mode share of car driver in Perth. It outlines the following parking strategies:

- Combine the use of long and short term parking charges or levies
- Limit the number of parking spaces in a particular area
- Reduce car travel to activity centres by up to 30 percent when good transport alternatives are made available
- Travel plans to minimise traffic congestion will be required for activity centres and industrial areas
- Local governments will be encouraged to implement strategies that support the use of active and public transport.

This document seeks to provide the conditions for a reduced level of car travel. This will have a positive impact on congestion and traffic safety.

3.4 Department of Transport WA - Bike Ahead: Bicycle Strategy for the 21st Century (1996)

This document was produced in companion to the *Perth Bicycle Network Plan* to support the 1995 *Metropolitan Transport Strategy*, which set out the following targets for cycling:

- Increase mode share for cycling, with cycling to account for 11.5% of trips in Perth by 2029
- Emphasise road safety and reduce instances of road crashes across all transport modes
- Incorporate walking and cycling guidelines into all metropolitan local authority town planning and transport schemes.

The document seeks to develop comprehensive and connected cycle facilities which are safe and accessible, by setting out key strategies for the continued enhancement of cycling as a means of transport and recreation in Perth.

Several of the strategies within the document (including Strategy 6 and Strategy 9) relate to use of urban design to encourage bicycle traffic, integrating bicycle use and traffic calming and encouraging cycling without necessarily requiring totally separate bicycle facilities.

Most cycling trips are identified as being over short distances, and ideally local cycle routes would correspond to the broader regional cycling network, to emphasis connectivity within the City and to external areas. Strategy 8 of this document emphasises the importance of connectivity between cycling and public transport in enhancing accessibility.

These strategies have been incorporated into the strategies and actions developed as part of this Integrated Land Use and Transport Study.

3.5 Department of Transport WA - Parking Guidelines for Activity Centres (2016)

The purpose of this document, produced by the Department of Transport, is to 'set out an approach to planning parking provision and management for major activity centres and provide direction on appropriate principles and management techniques to be considered when developing access and parking plans for these activity centres.' It demonstrates:

- Evolution of parking policy from 'predict and provide'
- Application to small activity centres
- Principles of planning, pricing and managing parking
- Approach to assessing centre accessibility and road network capacity
- Preparation of a Parking Management and Travel Plan
- Parking as one way of protecting the capacity of the road network

The outcome of these guidelines will realise accessible and well-connected activity centres that ease or assist in alleviating transport demand on the entire network and can be applied in the City particularly in activity centres such as the Kwinana Central Business District.

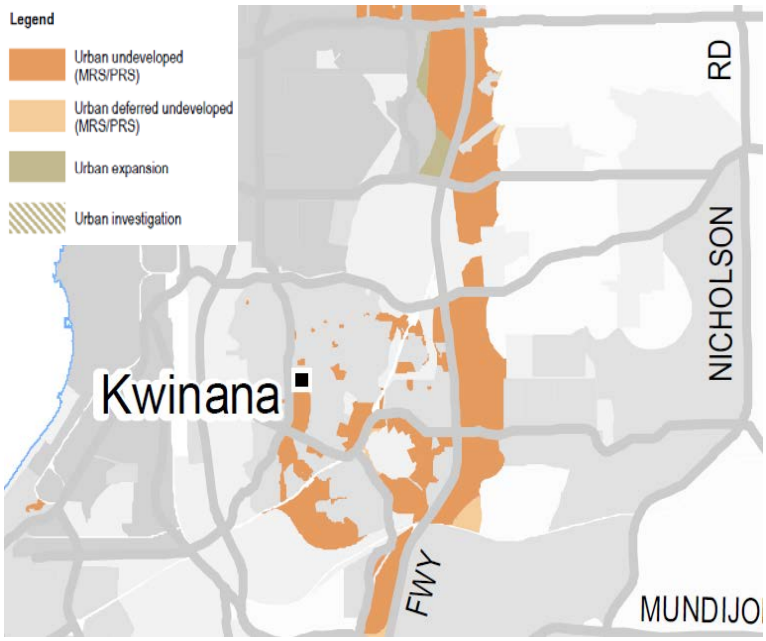
3.6 South Metropolitan Peel Sub-Regional Planning Framework (March 2018)

The South Metropolitan Peel Sub-Regional Planning Framework builds on Direction 2031 and Metropolitan Planning, Beyond the Horizon. The population in Perth and Peel region is predicted to increase to 2.9 million by 2031 and 3.5 million by 2050.

3.6.1 Urban Development

Urban expansion is proposed along the Kwinana Freeway between Rowley Road and Anketell Road. Urban development proposed along the Kwinana Freeway through the City of Kwinana and some within Kwinana Town Centre as seen in **Figure 3-3**. There are no new proposed areas for investigation within the City of Kwinana within the Framework.

Figure 3-3 City of Kwinana Urban Development Map



Minimum infill dwelling targets for 2050 are 1,370 with an estimated population of 3,010. Existing dwellings and population in 2011 are 11,490 dwellings and 30,700 people which is expected to grow to 31,040 dwellings and 80,200 people in 2050.

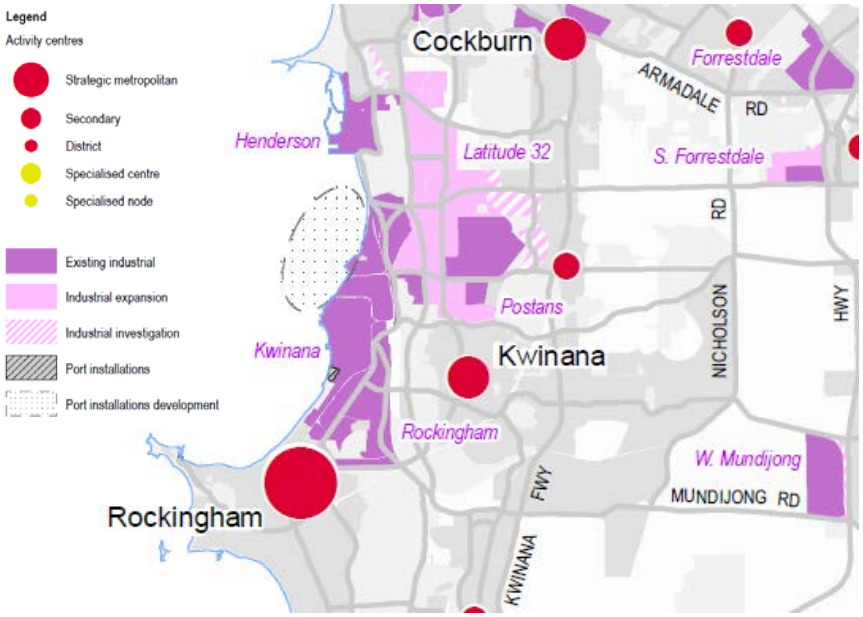
3.6.2 Industrial Development

Major development will be around existing port facilities and proposed port installations, including freight infrastructure in this area. These developments include:

- Outer Harbour
- Intermodal Freight Transfer Facilities in the Latitude 32 Industrial area
- Improved linkages between Kwinana Freeway and the Industrial Area

The Kwinana industrial area and Rockingham industrial zone are projected to need 775 hectares of additional land by 2050. Economic profile is not expected to change. **Figure 3-4** maps the industrial regions within the City of Kwinana and surrounding regions.

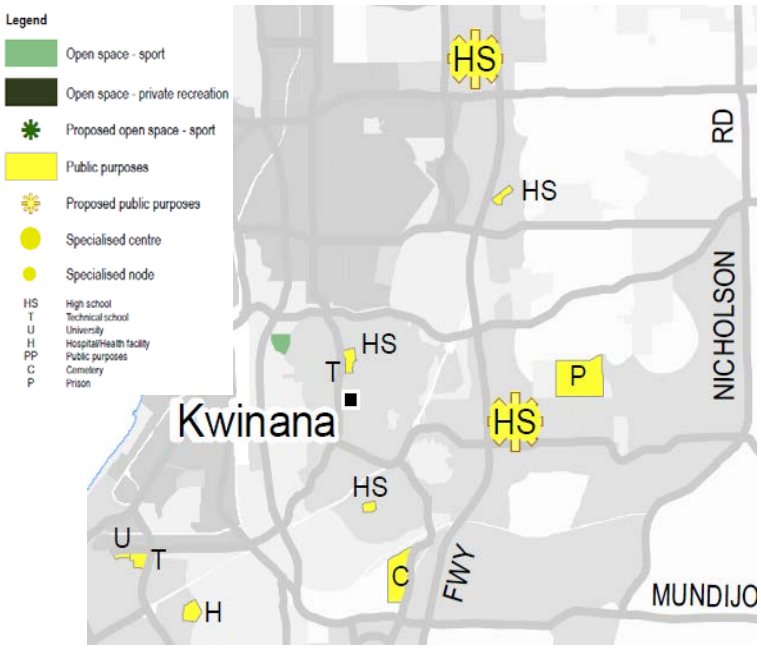
Figure 3-4 City of Kwinana Industrial Development Map



3.6.3 Social Infrastructure

One proposed high school lies within the City of Kwinana. Another proposed high school is situated just north of the municipal of the City of Kwinana. **Figure 3-5** shows the location of social infrastructure existing and proposed in the City of Kwinana.

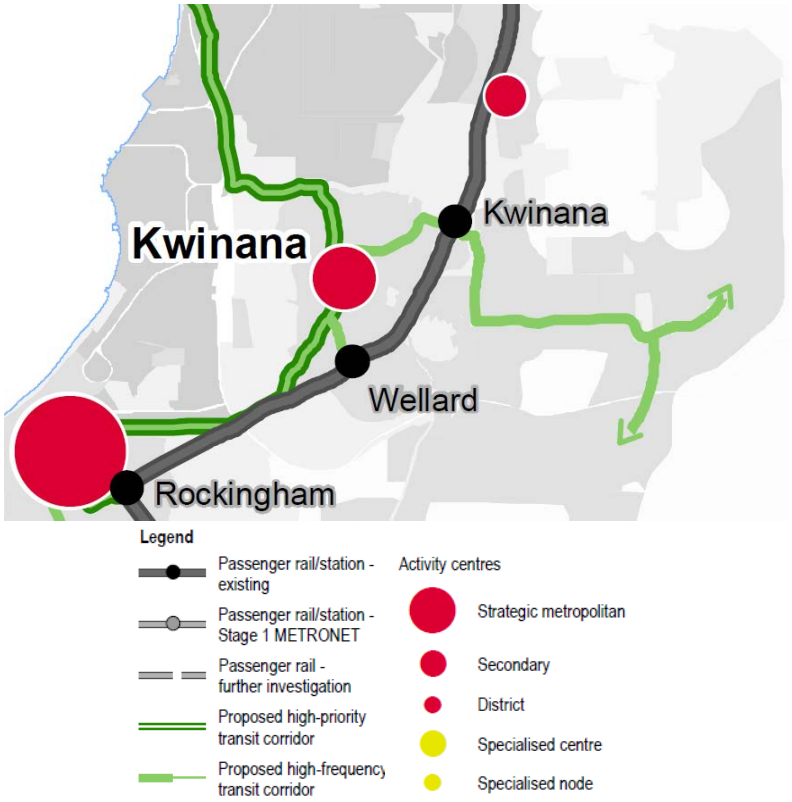
Figure 3-5 City of Kwinana Social Infrastructure Map



3.6.4 Public Transport

Developments in public transport will include High Priority Transit Corridors (HPTC) and High Frequency Transit Corridors (HFTC) within the City of Kwinana. These plans are shared with METRONET. **Figure 3-6** shows the proposed HFTC and HPTC networks in the City of Kwinana.

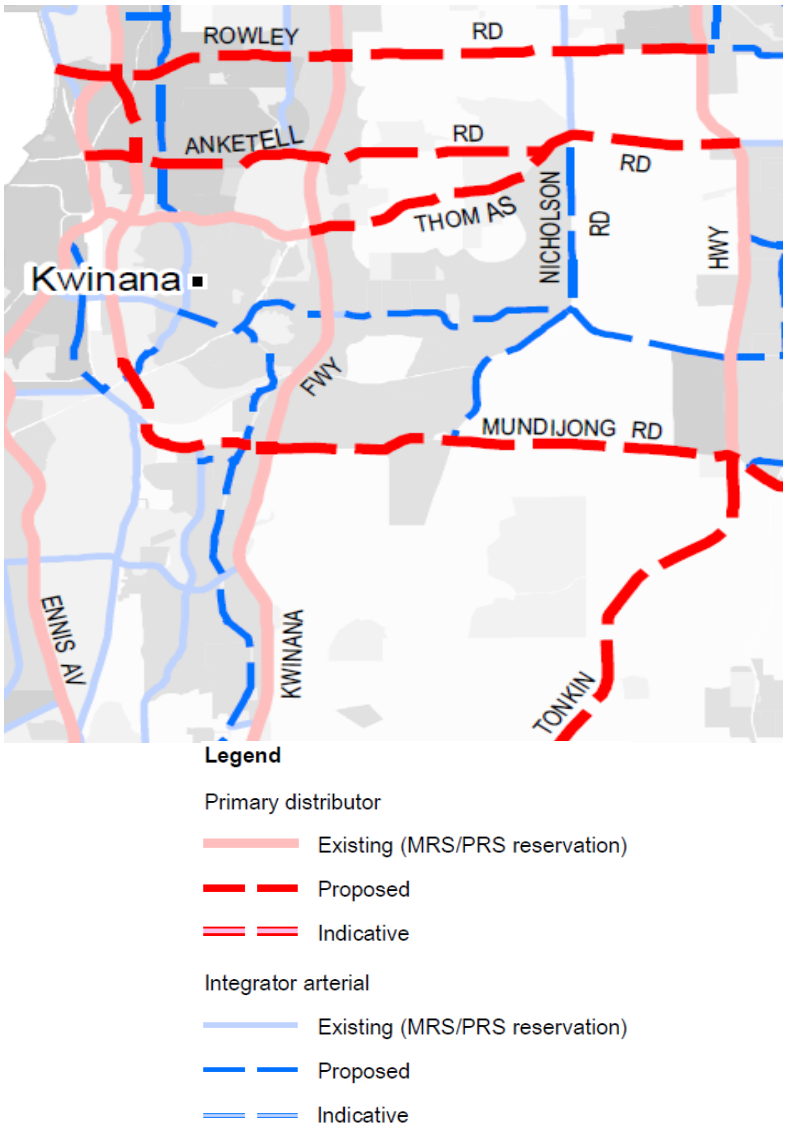
Figure 3-6 City of Kwinana Proposed Public Transport Network



3.6.5 Freight Networks

Freight network developments align with Perth and Peel at 3.5 million plans, as well as Indian Ocean Gateway plans. One major development to note is the extension of Tonkin Highway to Pinjarra which runs parallel to Kwinana Freeway and is proposed to be a primary freight distributor. Figure 3-7 shows the proposed road freight networks within the City of Kwinana.

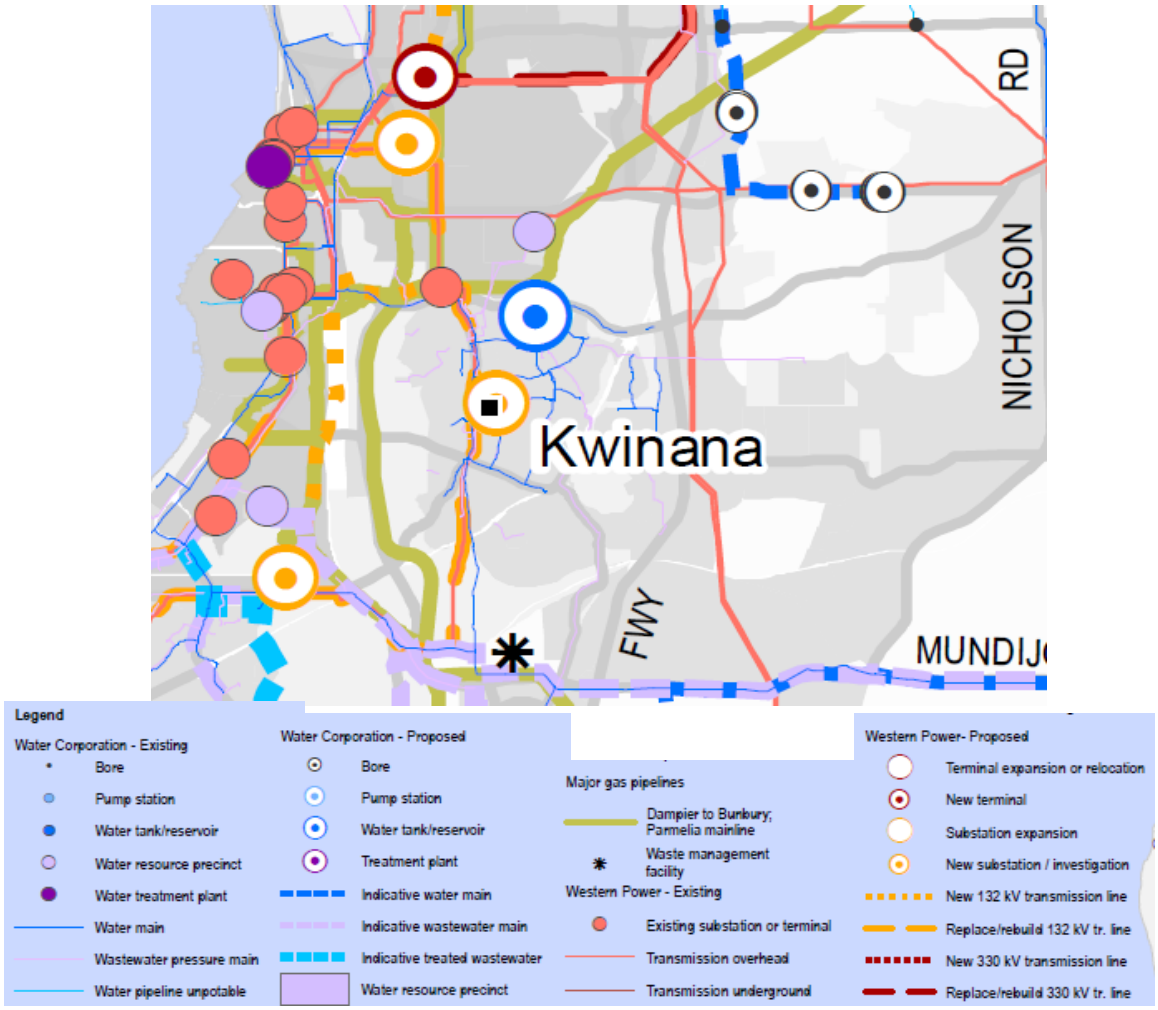
Figure 3-7 City of Kwinana Proposed Freight Networks



3.6.6 Service Infrastructure

A new terminal is proposed for Hope Valley along with two new substations in the City of Kwinana. A new water reservoir is also proposed in the City of Kwinana. **Figure 3-8** shows service infrastructure proposed by 2050 in the City of Kwinana.

Figure 3-8 City of Kwinana Service Infrastructure Map



3.6.7 Infrastructure Staging

The following details of expected staging of infrastructure development within the City are detailed within the Framework:

- Tonkin Highway: extend to Forrest Highway (2022-2031)
- Freemantle-Rockingham Highway: extend to Kwinana Freeway (2022-2031)
- Identify additional rail option for Kwinana Industrial area (2022-2031)
- High Priority Transit Corridor: Fremantle-Cockburn Coast-Kwinana-Rockingham (2022-2031)
- Tonkin Highway: upgrade to freeway standard to Mundijong Road (2031-2050)
- Rowley Road: construct 4 lane divided freight route (2031-2050)
- Anketell Road: construct 4 lane divided freight route (2031-2050)
- Mundijong Road: construct 4 lane divided freight route (2031-2050)
- Transfer systems in Outer Harbour (2031-2050)
- Duplicate freight rail track between Cockburn Triangle, Latitude 32 and Kwinana Triangle (2031-2050)

These developments and staging details have been considered in the recommendations of this ILAT.

3.7 Summary

A range of planning documents are applicable across the City of Kwinana in reference to the production of an integrated land use and transport planning strategy. These documents span state-level strategic policies related to population growth across the Perth metropolitan area, to local strategic plans and policies, as well as structure plans and infrastructure-specific studies. This document is intended to support the development

of a City-wide Local Planning Strategy, working within the planning framework and being informed by all relevant local and regional strategic policy direction.

About Cardno

Cardno is a professional infrastructure and environmental services company, with expertise in the development and improvement of physical and social infrastructure for communities around the world. Cardno's team includes leading professionals who plan, design, manage and deliver sustainable projects and community programs. Cardno is an international company listed on the Australian Securities Exchange [ASX:CDD].

Contact

11 Harvest Terrace
West Perth WA 6005
Australia

Phone +61 8 9273 3888
Fax +61 8 9486 8664

Web Address
www.cardno.com