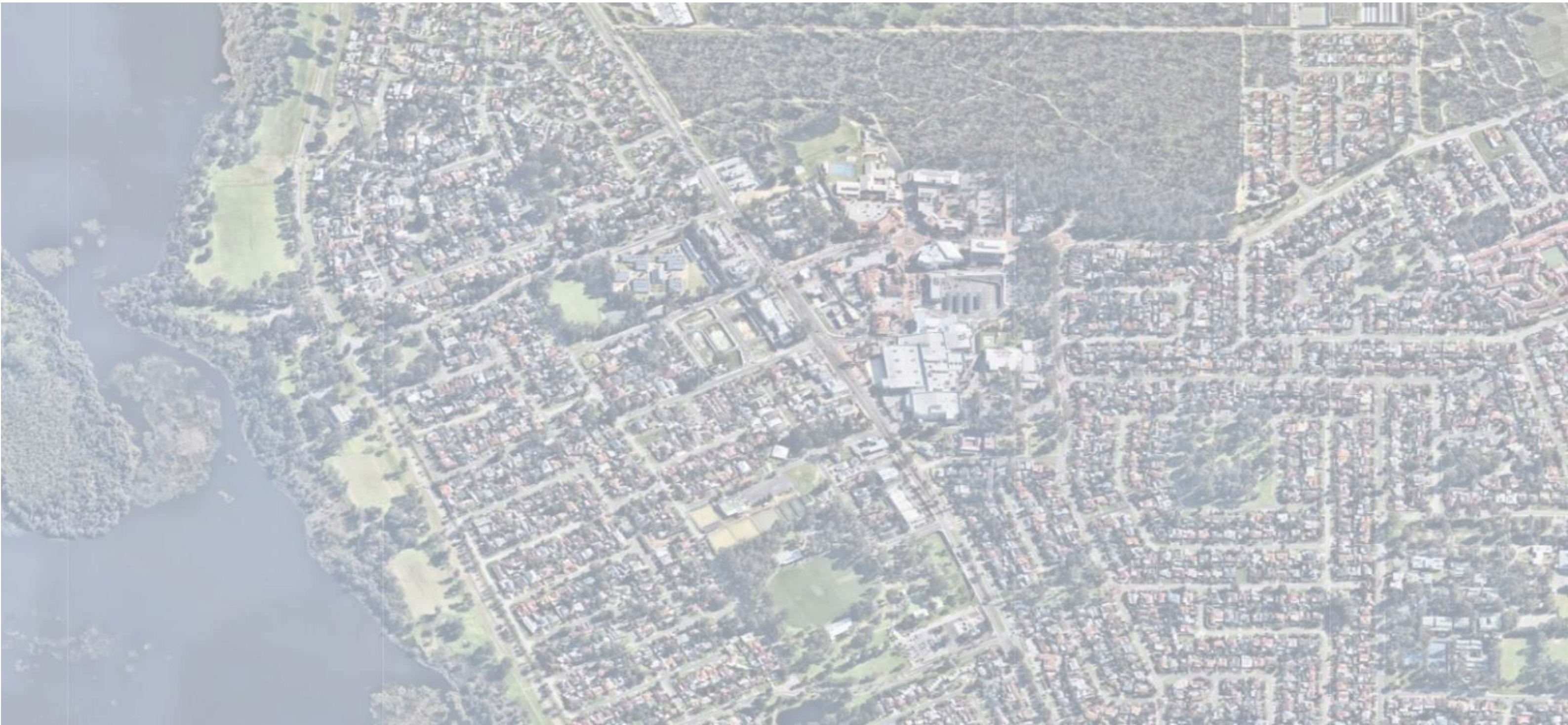


A stylized, semi-transparent map of a city grid is visible in the upper left corner of the page. The map shows a network of streets and blocks, with a blue overlay that matches the page's background color. The text is positioned over this map area.

APPENDIX 2

TRAFFIC AND TRANSPORT MANAGEMENT STRATEGY



Wanneroo Town Centre

TRAFFIC AND TRANSPORT MANAGEMENT STRATEGY

PROJECT	81113-313 Wanneroo Town Centre			
Revision	Description	Originator	Review	Date
0	Draft	CS	SCK	5/10/2018
A	Issued	CS	SCK	12/10/2018
1	Issued	CS	CAS	18/10/2018

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1. INTRODUCTION

1.1 Traffic and Transport Management Strategy Report

The Traffic and Transport Management Strategy Report has been prepared in support of the Wanneroo Town Centre Planning Framework Review, which identified the need for a revised Activity Centre Structure Plan for the City of Wanneroo's Town Centre and its surroundings.

The purpose of this report is to inform the development of the plan and provide information that is required within State Planning Policy 4.2 - Activity Centres for Perth and Peel (SPP 4.2) relating the function of the transport network.

1.2 Wanneroo Town Centre Planning Framework Review

In late 2017 the City of Wanneroo initiated a review into the local planning framework for the Wanneroo Town Centre (WTC) study area. The review was aligned with the City's aspirations for the development of the WTC into a vibrant, progressive and prosperous secondary centre as envisaged by SPP 4.2.

The review concluded an Activity Centre Structure Plan was required for the WTC study area.

Relating to transport and movement, the City requires the Activity Centre Structure Plan to create a more accessible and connected Town Centre.

1.3 State Planning Policy 4.2 (SPP 4.2)

The Western Australian Planning Commission's State Planning Policy 4.2 (SPP 4.2) guides the development of Activity Centre Plans. SPP 4.2 has a number of objectives relating to transport and movement, as follows:

- Ensure activity centres provide sufficient development intensity and land use mix to support *high-frequency* public transport.
- Maximise access to activity centres by walking, cycling and public transport while reducing private car trips.
- Plan activity centre development around a legible street network and quality public spaces.

1.4 Report Structure

This report sets out the required responses to the key areas set out in SPP 4.2. Outside of the introduction section of the Report, there are six key areas that are examined within the report.

- Regional Perspective
- Public Transport
- Pedestrian Movement and Amenity
- Cycling
- Vehicle Movement and Access
- Parking

2. REGIONAL PERSPECTIVE

2.1 Regional Location

The WTC is located 23 km north of the Perth CBD, and approximately 1km to the east of Lake Joondalup. The transport network is dominated by Wanneroo Road, a primary regional road carrying between 28,000 and 35,000 vehicles per day (vpd) which bisects the WTC.

The location of the WTC in a regional perspective is shown in Figure 1.

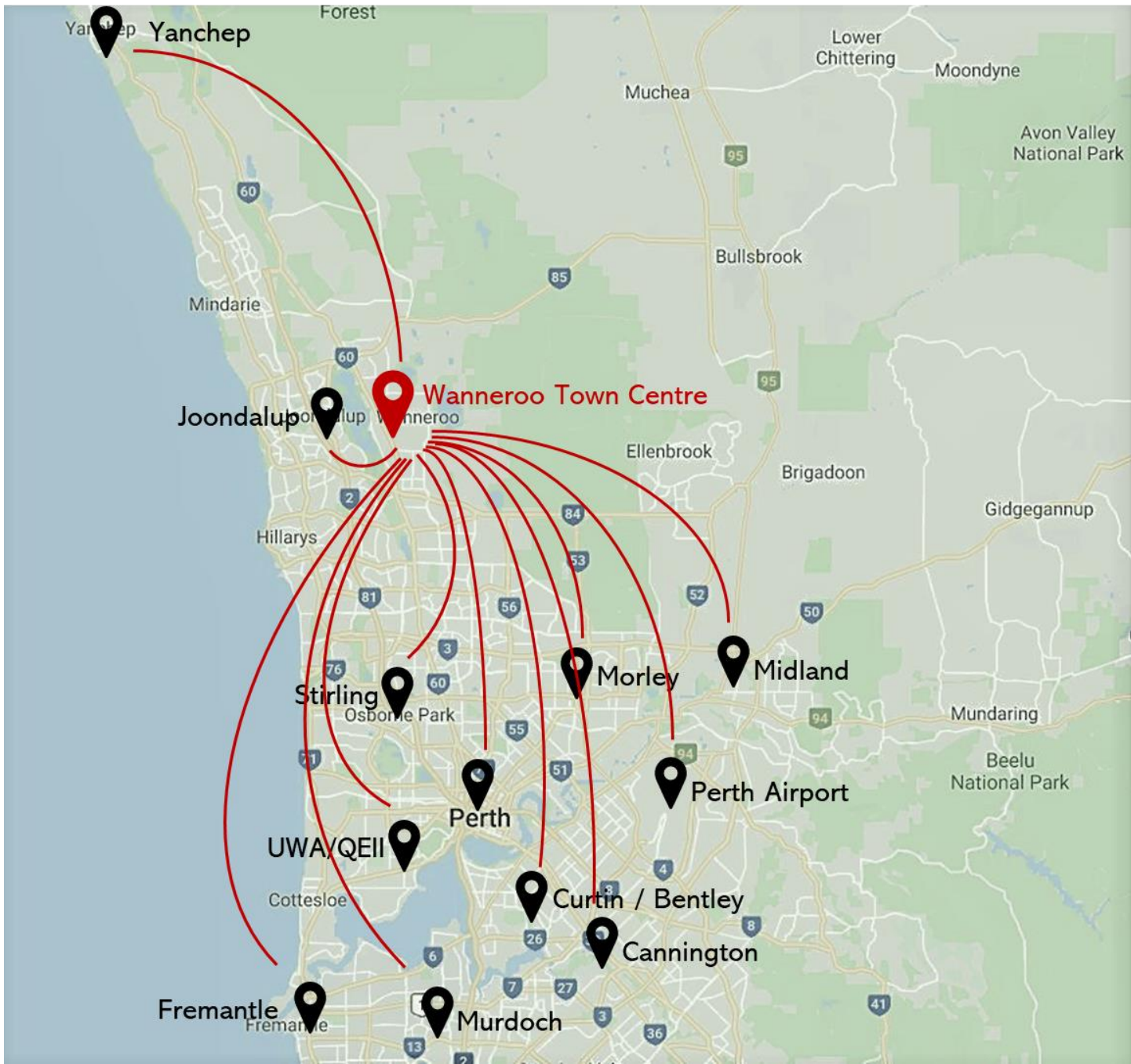


Figure 1 Location of Activity Centre

Travelling from the main intersection of Wanneroo Road and Dundebur Road, the WTC is approximately:

- 33 km from Perth Airport
- 27 km from Yanchep

- 9 km from Joondalup
- 24 km to Morley

2.2 Regional Perspective – Road Hierarchy

With the exception of Wanneroo Road, which is under the care and control of Main Roads WA (MRWA), the street network within the WTC is dominated by Access Streets and Local Distributors, all maintained and controlled by the City of Wanneroo. The road network within the study area, and their designations under the MRWA road hierarchy, are shown in Figure 2.

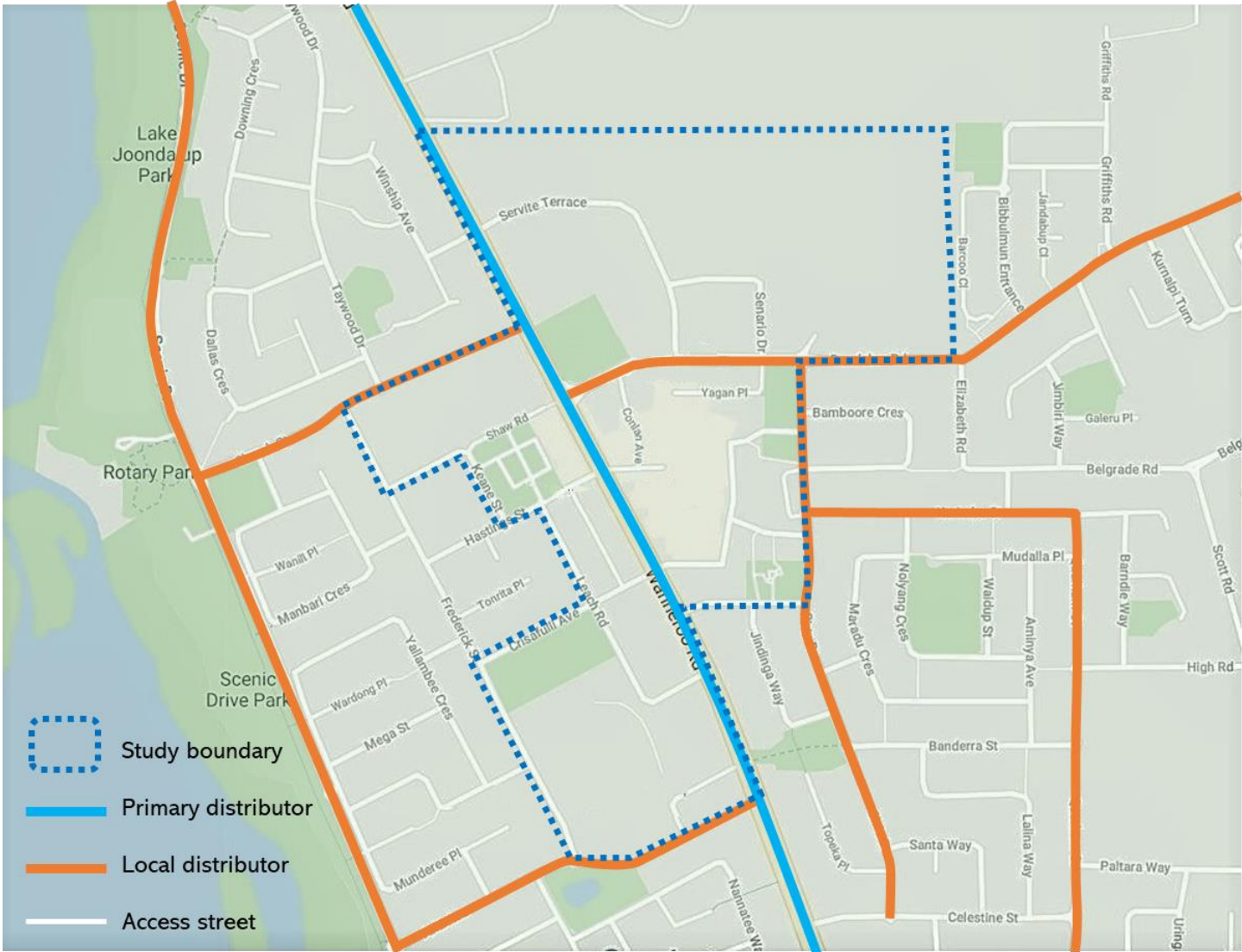


Figure 2 Road hierarchy

The main distributor level roads are:

- Wanneroo Road – Primary Distributor
- Dundebur Road – Local Distributor
- Civic Drive – Local Distributor
- Church Street – Local Distributor
- Ariti Avenue – Local Distributor

All other streets shown in Figure 2 are classified as Access Streets.

2.3 Regional Perspective – Road Speed Zones

With the exception of Wanneroo Road, all streets within the WTC have a posted speed limit of 50km/h. The speed limit of Wanneroo Road through the WTC is 60km/h, although this increases to 70km/h 760m to the north and 340m to the south of the study area boundary.

The posted speed limits are shown in Figure 3.

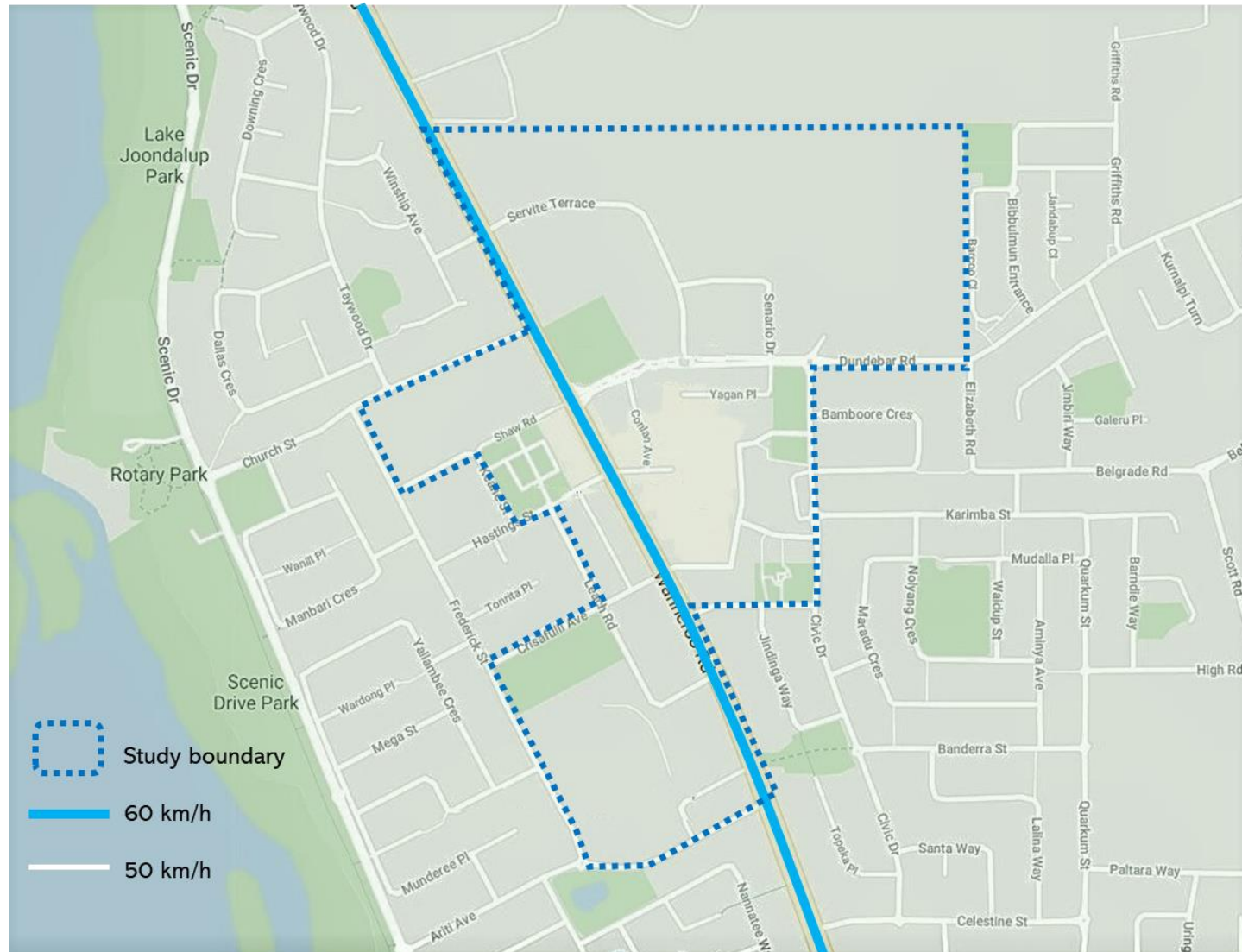


Figure 3 Speed zones

2.4 Regional Perspective – Points of Arrival

The WTC has a range of unique arrival points per mode, as indicated in Figure 4.

- Wanneroo Road provides the main entry points for vehicles to the WTC from the south and north. Dundobar Road provides a vehicle entry point from the east.
- Bus services enter the WTC from Wanneroo Road north and south, from Dundobar Road to the east and Elizabeth Road to the south.
- A Principal Shared Path (PSP) for cyclists and pedestrians runs around Lake Joondalup adjacent to Scenic Drive. The local street and footpath network provide connections between the PSP and the WTC.

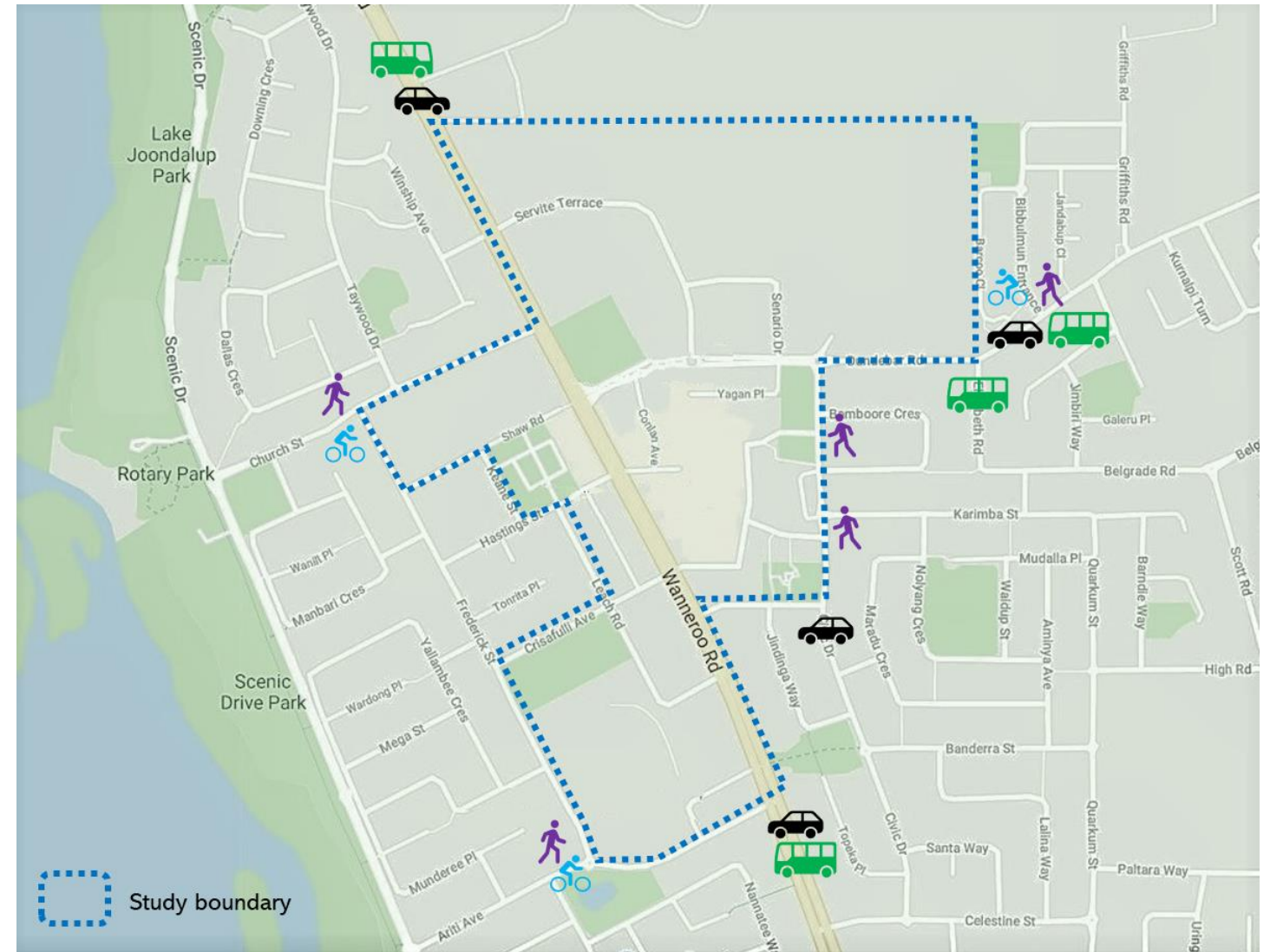


Figure 4 Points of arrival

There are a range of other lower order, localised entry points for all modes, including Civic Drive from the south, Church Street and Ariti Avenue which provide connections from Lake Joondalup to the west, and Bamboore Crescent and Karimba Street from the east.

2.5 Regional Perspective – Key Sites

There are a number of key sites within the WTC, ranging from existing features through to sites that could substantially impact the network in the future. The sites, as indicated on Figure 5, are:

- The recently redeveloped Wanneroo Central Shopping Centre is a major trip attractor within the WTC.
- The civic heart of the WTC includes the City of Wanneroo Council offices, the Wanneroo Library, Wanneroo Regional Museum and ECU Health Centre, located close to the key intersection of Dundobar Road with Servite Terrace and Rocca Way.
- Wanneroo Showgrounds is the venue of the annual Wanneroo Agricultural Show. The Wanneroo Amateur Football Club, the Wanneroo Sports and Social Club and skate park also attract trips on a more regular basis.
- The future end terminus of a transit link between the WTC and the East Wanneroo Transit route to be located in the north eastern corner of the Wanneroo Road / Dundobar Road intersection or the north eastern corner of the Dundobar Road / Civic Drive intersection.

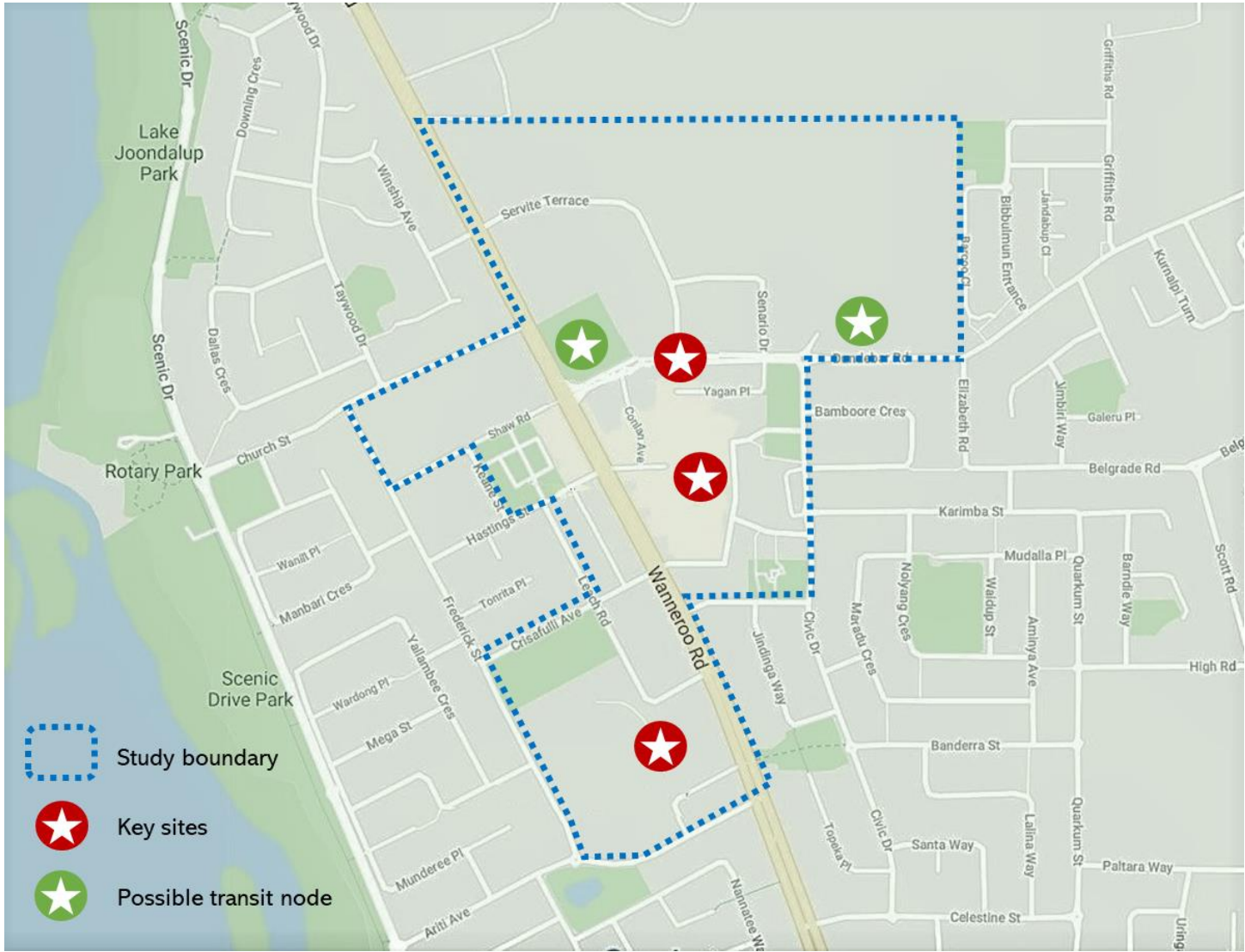


Figure 5 Key sites

There are 2 schools within the WTC; Wanneroo Primary School and St Anthony's School. Students being driven to and from these schools causes significant impact on the road network in their immediate vicinity at school start and finish times.

2.6 Regional Perspective – Travel Context

In order to benchmark the existing travel patterns and allow for an understanding of the impacts of future travel patterns, the Census Journey to Work information, which captures the main mode of transport from a place of residence to employment, was analysed.

The 2016 Journey to Work information for the WTC (removing non-working respondents) is shown in Figure 6. The WTC area was approximated by combining 3 Statistical Area 1 (SA1) units; SA1 5110820, SA1 5110831 and SA1 511032.

In comparison to Greater Perth in 2016, the WTC had more car trips and fewer bus trips, which is reflective of the proximity of Wanneroo to key employment centres and its existing public transport network.

Census mode split data for the journey to work for 2011 and 2016 are compared in Figure 7.

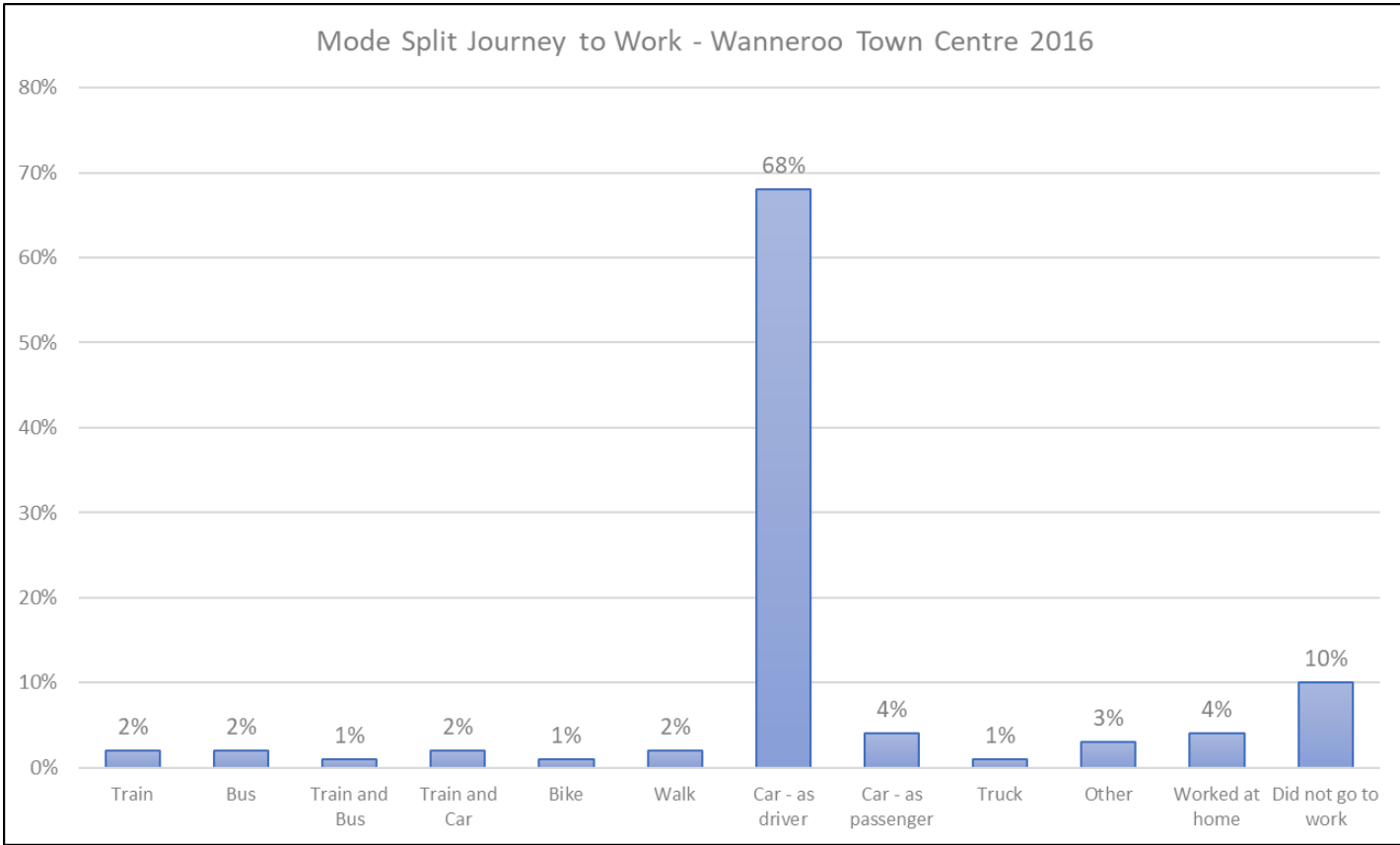


Figure 6 Mode split journey to work (2016 Census)

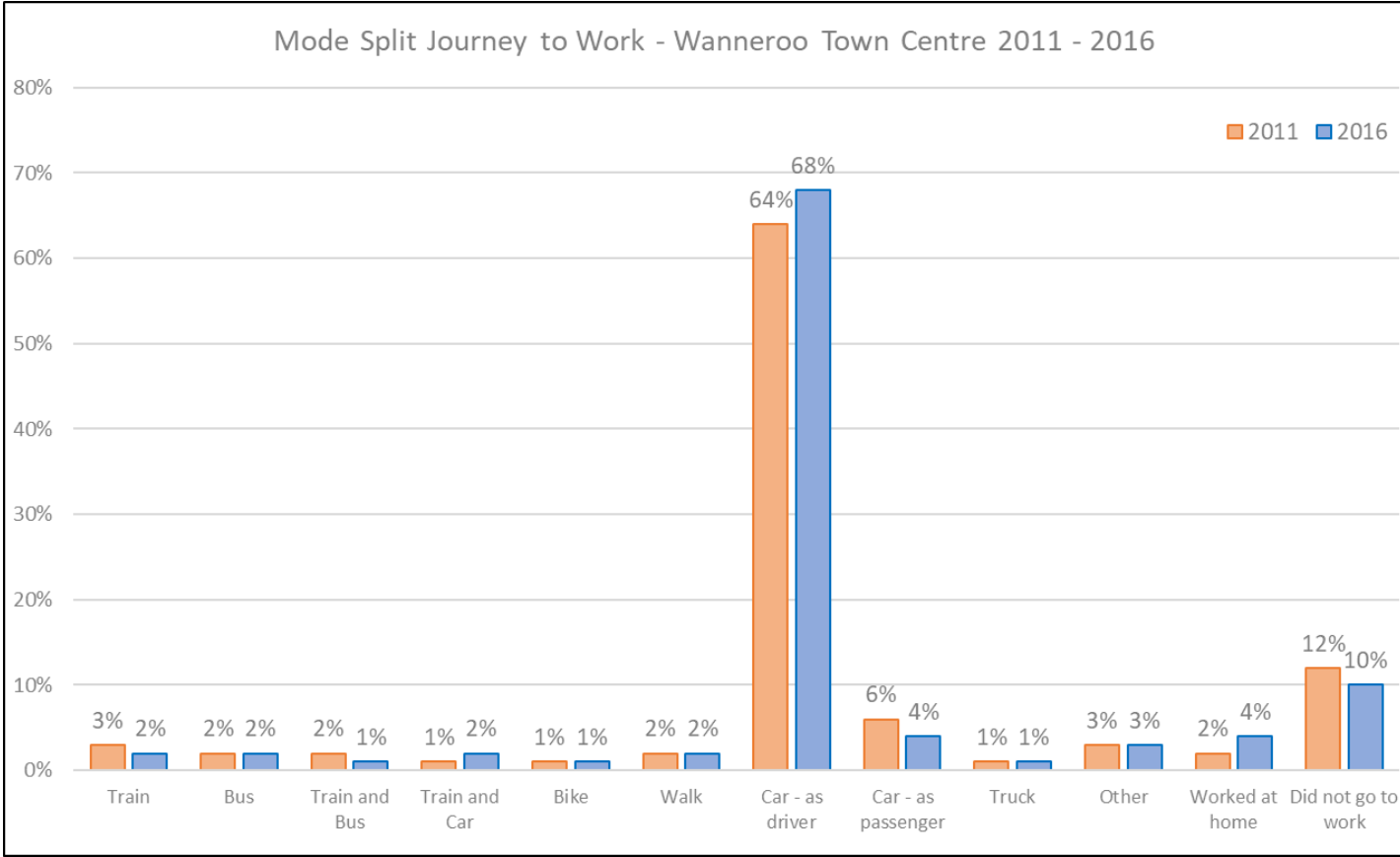


Figure 7 Journey to work trends - 2011 to 2016

The headline changes between 2011 and 2016 are:

- A rise in the proportion of people driving to work from 64% to 68%
- A reduction in the proportion of people driven to work as a car passenger from 6% to 4%
- An increase in the proportion of people working from home from 2% to 4%
- A decrease in the proportion of people not going to work on Census day from 12% to 10%
- A reduction in the proportion of residents taking public transport to work from 8% to 7%

The movement of people to and from Wanneroo for employment purposes was also examined to understand travel from a sub-regional perspective. For this analysis the Wanneroo Statistical Area 2 (SA2) unit was used.

Outbound trips are shown in Figure 8 while inbound trips are shown in Figure 9.

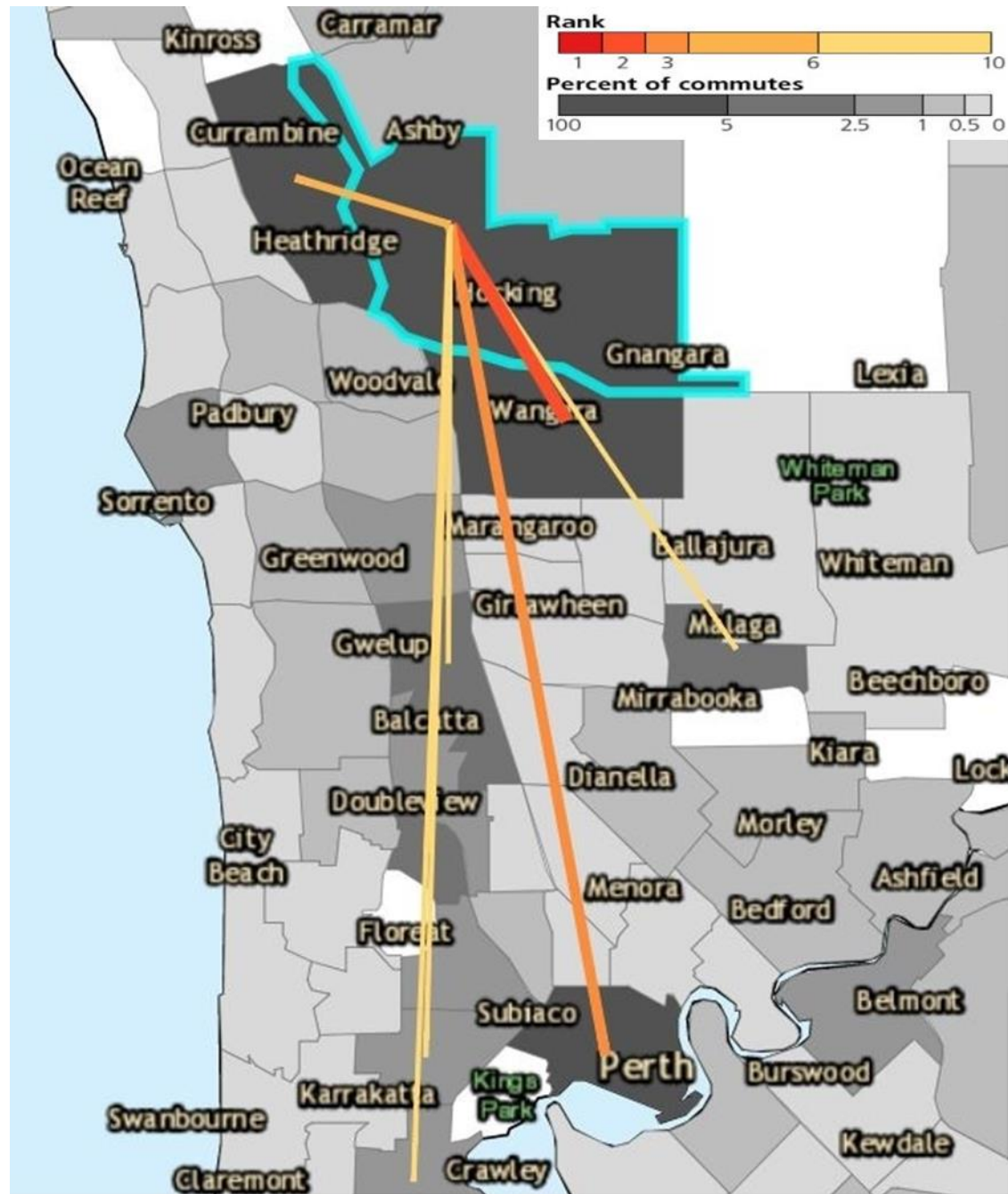


Figure 8 Journey to work – key destinations from Wanneroo

For outbound trips from place of residence to place of employment, there was a significant degree of self-containment with 15.5% of outbound trips destined for employment within Wanneroo. Other popular destinations include:

- Madeley/ Darch/ Landsdale (10.5%)
- Perth (10.2%)
- Joondalup (7.1%)
- Osborne Park (3.5%)
- Balcatta (2.9%)
- Subiaco (1.4%)
- Stirling, Hillarys and Wembley (1.1% each)

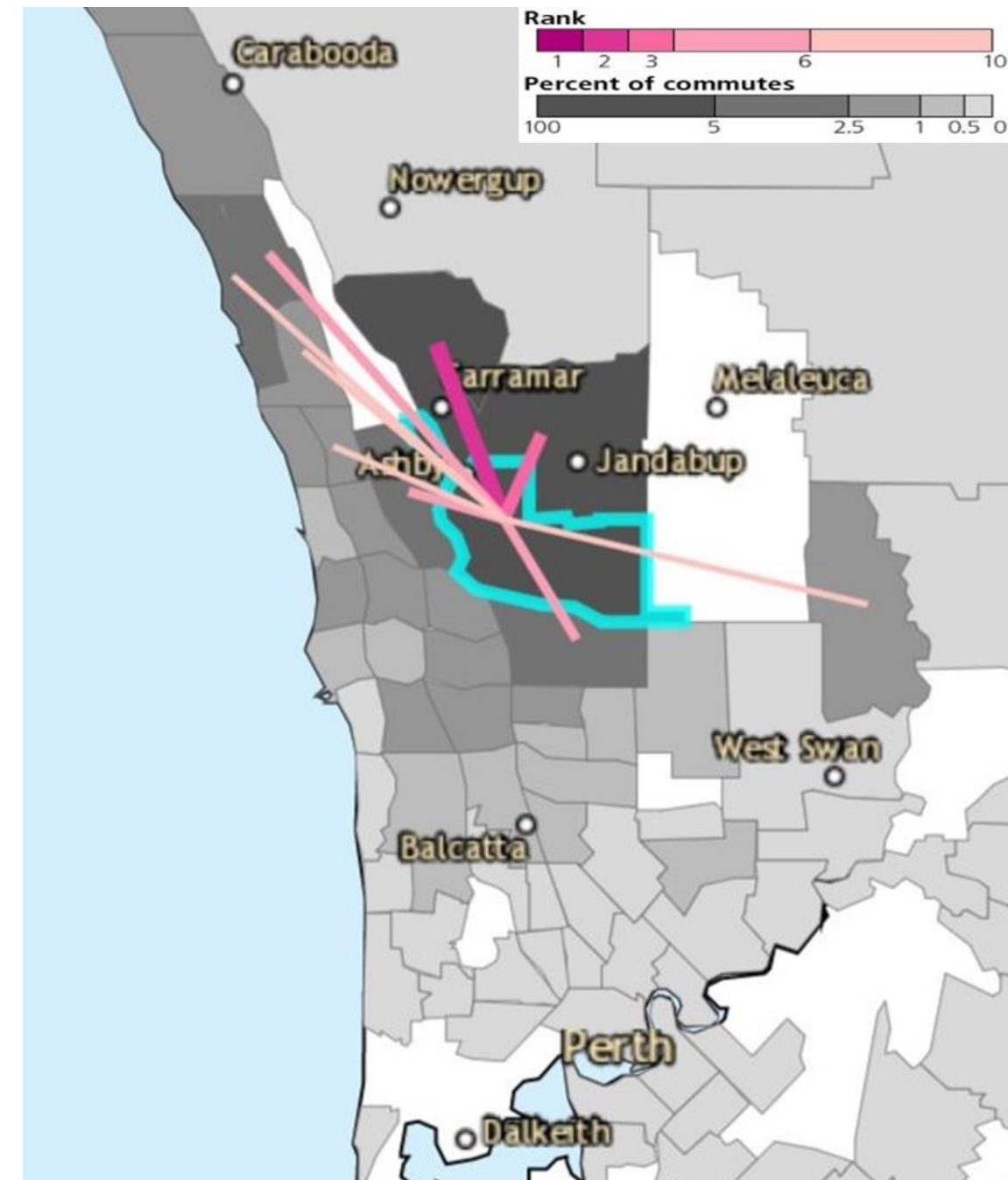


Figure 9 Journey to work – origin suburb to Wanneroo

For inbound trips to employment destinations in Wanneroo, 34.3% were from residences within Wanneroo. Other popular origins include:

- Carramar (6%)
- Tapping/ Ashby/ Sinagra (5.2%)
- Butler/ Merriwa (3.3%)
- Joondalup/ Edgewater (3.1%)
- Mindarie/ Quinns Rocks/ Jindalee (2.6%)
- Clarkson (2.1%)
- Ellenbrook (2%)

Travel times between Activity Centres and key locations around the WTC were also examined to understand the context of travel choice. The exercise involved:

- Using the travel and route tool within Google Maps to gain an understanding of travel times for different modes in the AM peak period.
- Five locations were examined – Mindarie, Joondalup, Hillarys Boat Harbour, Kingsway Shopping Centre and Perth.
- Three travel modes were examined – car, public transport (bus only or bus and train for travel to Perth), and bike.
- The time of the comparison was 8.15am on a typical Tuesday.
- The starting point of the trips was the intersection of Dundebur Road and Wanneroo Road.

A range of journey times were provided for car and public transport trips, to reflect peak hour movements being variable and bus routes having multiple options. For Perth, the end point location was 140 William Street. Each of the resulting times were then ranked by mode to understand how people may make travel decisions between the WTC and key transport nodes.

The results were overlaid on a map image as shown in Figure 10.

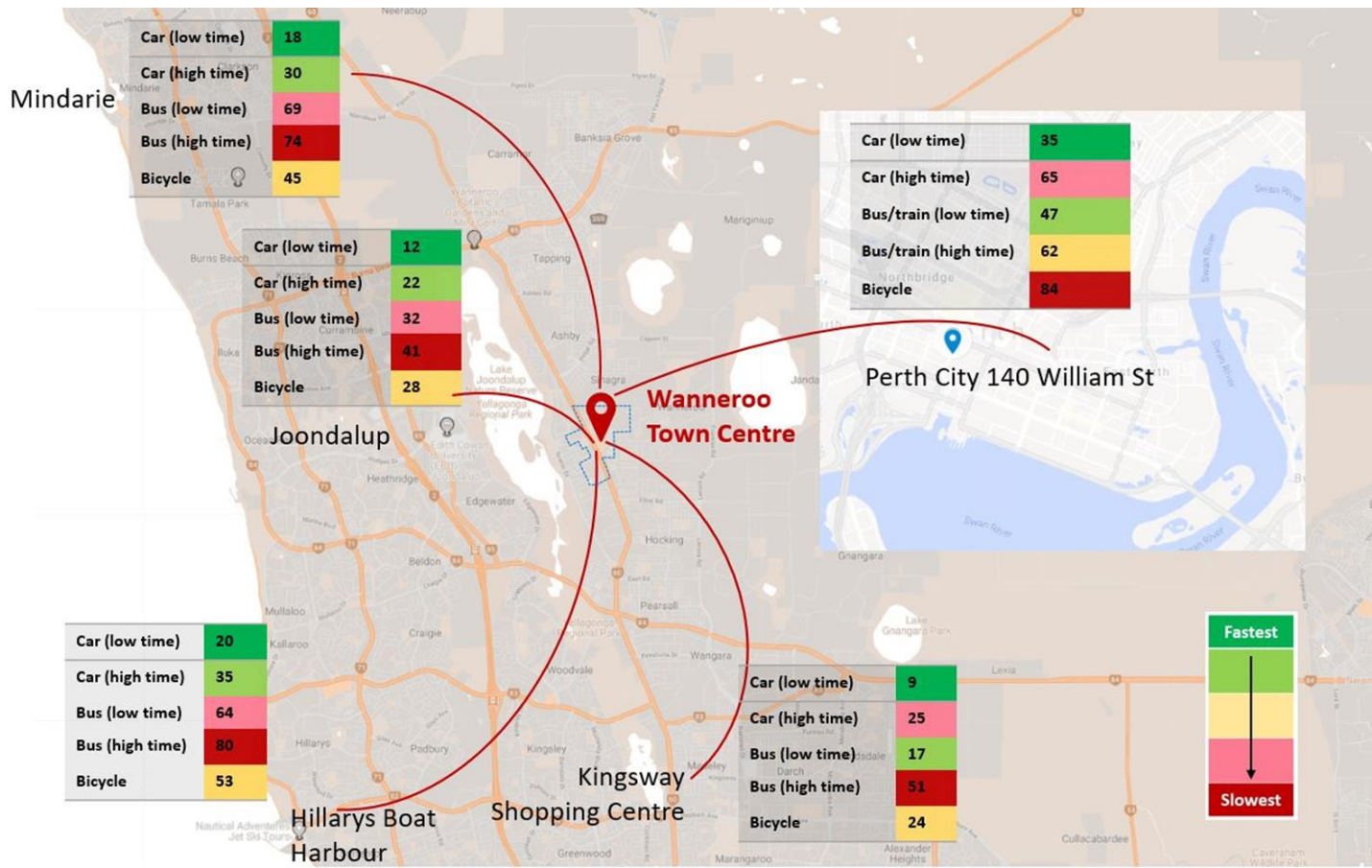


Figure 10 Comparison of typical travel times

The travel time comparison showed some obvious patterns which have dictated overall peak hour travel patterns:

- Travel times for car trips are fastest.
- Bus travel times are generally the slowest, reflecting the impact of frequent stops, indirect routes and lack of priority.
- Bicycle trips are competitive over shorter distances, although that is qualified by the potential lack of attractive infrastructure along these routes.

The Census provides details on car ownership by household. A review of the reported responses in the Wanneroo Suburb between 2006 and 2016 was undertaken, as shown in Figure 11. The number of overall households in the Wanneroo Suburb during this time fluctuated from 4,004 in 2006, to 4,374 in 2011 and down to 4,361 in 2016, with an overall increase of 360 households.

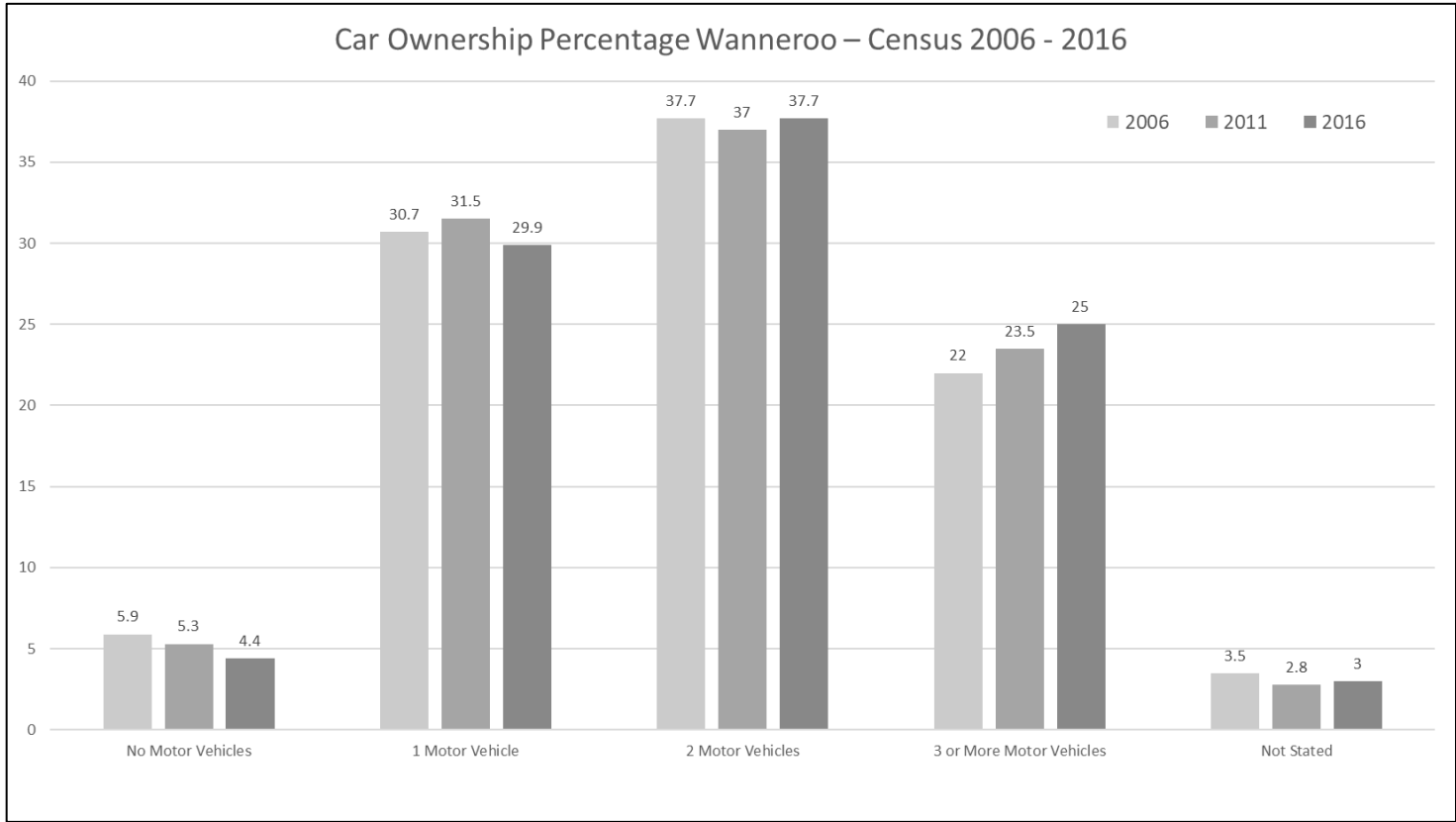


Figure 11 Car ownership percentage - Wanneroo between 2001 and 2016

These outcomes, which reflect a lower proportion of households without a car, and a higher proportion of households with 3 or more cars, demonstrates a clear disconnect between strategic land use and transport integration policies and local statutory policies during this period.

There are 414 additional vehicles associated with residential dwellings in Wanneroo over the 12-year period. This has contributed to traffic related congestion.

3. PUBLIC TRANSPORT

3.1 Public Transport Network

The Transperth public transport network within the WTC (shown in Figure 12) includes three bus routes, as follows:

- Route 389 - Perth to Wanneroo via Wanneroo Road;
- Route 467 - Whitfords Station to Joondalup Station via Pearsall, Hocking, Ashby; and
- Route 468 - Whitfords Station to Joondalup Station via Wanneroo Road.

The existing bus network generally caters for local movements to Joondalup and Whitfords Stations, and for sub-regional movements along the Wanneroo Road/ Charles Street corridor to Perth.

The three routes provide a total of 226 weekday bus services through the WTC, described in Table 1. There are no bus priority measures, either on road or through signal priority, within or around the WTC.

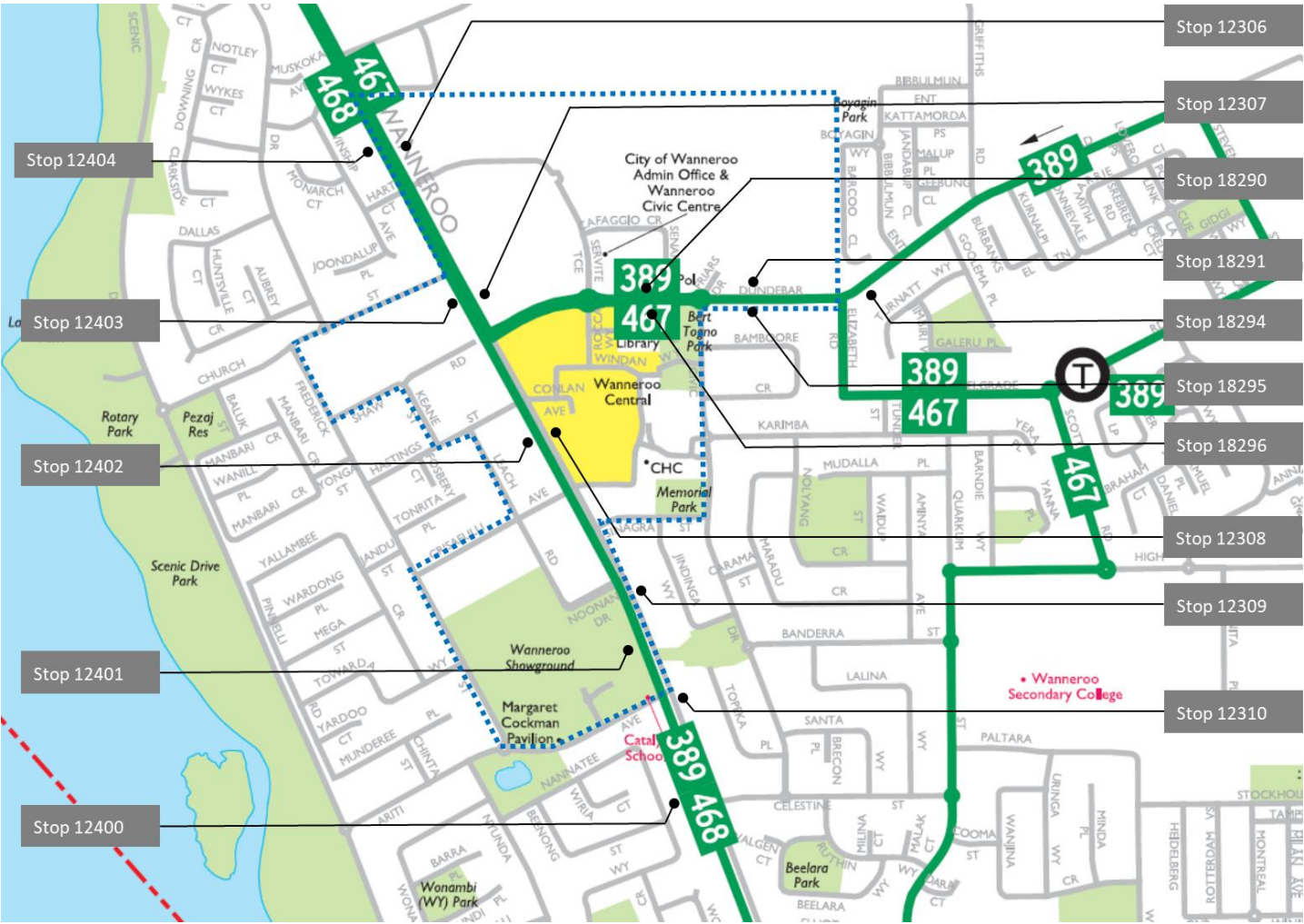


Figure 12 Transperth network map - WTC area

Table 1 WTC Bus Services

Bus Route	Travel between	Weekday	Saturday	Sunday/ Public holiday
389	Perth – Wanneroo	29 services (6:31am to 11:47pm) AM peak - every 30 mins PM peak - every 10 mins	17 services (7:55am to 12:15am) hourly	13 services (8:45am to 8:55pm) hourly
	Wanneroo – Perth	25 services (5:41am to 10:39pm) AM peak - every 30 mins PM peak - every 30 mins	17 services (7:00am to 11:05pm) hourly	12 services (7:43am to 7:05pm) hourly
467	Whitfords – Joondalup	44 services (5:53am to 8:02pm) AM peak - every 15 mins PM peak - every 15 mins	12 services (7:11am to 6:41pm) hourly	12 services (7:11am to 6:26pm) hourly
	Joondalup – Whitfords	46 services (6:01am to 8:00pm) AM peak - every 10 mins PM peak - every 15 mins	12 services (7:29am to 6:23pm) hourly	12 services (7:32am to 7:02pm) hourly
468	Whitfords – Joondalup	41 services (6:24am to 12:09am) AM peak - every 15 mins PM peak - every 15 mins	20 services (6:54am to 12:39pm) hourly	12 services (8:32am to 8:09pm) hourly
	Joondalup – Whitfords	41 services (5:18am to 11:18pm) AM peak - every 15 mins PM peak - every 20 mins	18 services (5:56am to 10:15pm) hourly	12 services (7:39am to 7:15pm) hourly

Average weekday bus stop utilisation for the month of August 2018 was obtained from the Public Transport Authority (PTA). This data includes all SmartRider boardings and alightings, but it does not capture patrons using cash fares, therefore underestimating patronage at stops with a proportion of cash fares (which may be the case within the WTC). Nonetheless, bus stop utilisation provides an indication of the existing level of public transport patronage within the WTC.

On an average weekday there were 246 boardings and 224 alightings within the WTC; an average of 19 daily boardings and 17 daily alightings per stop. This is a low level of public transport patronage, equivalent to 2.1 passengers per daily service.

For stops along Wanneroo Road there were a total of 179 boardings and 154 alightings per day, and for stops along Dundee Road a total of 68 boardings and 69 alightings per day. Average weekday utilisation of each stop along Wanneroo Road is presented in Figure 13, while utilisation of each stop along Dundee Road is presented in Figure 14.

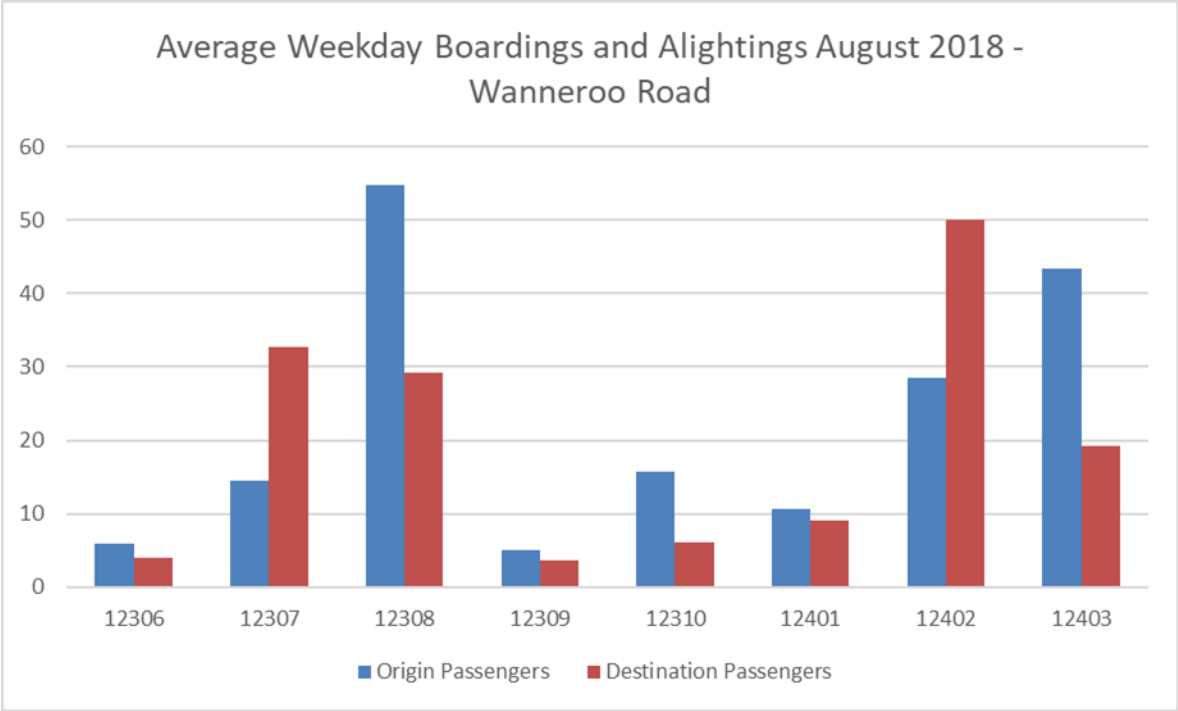


Figure 13 Wanneroo Road bus stop patronage (August 2018)

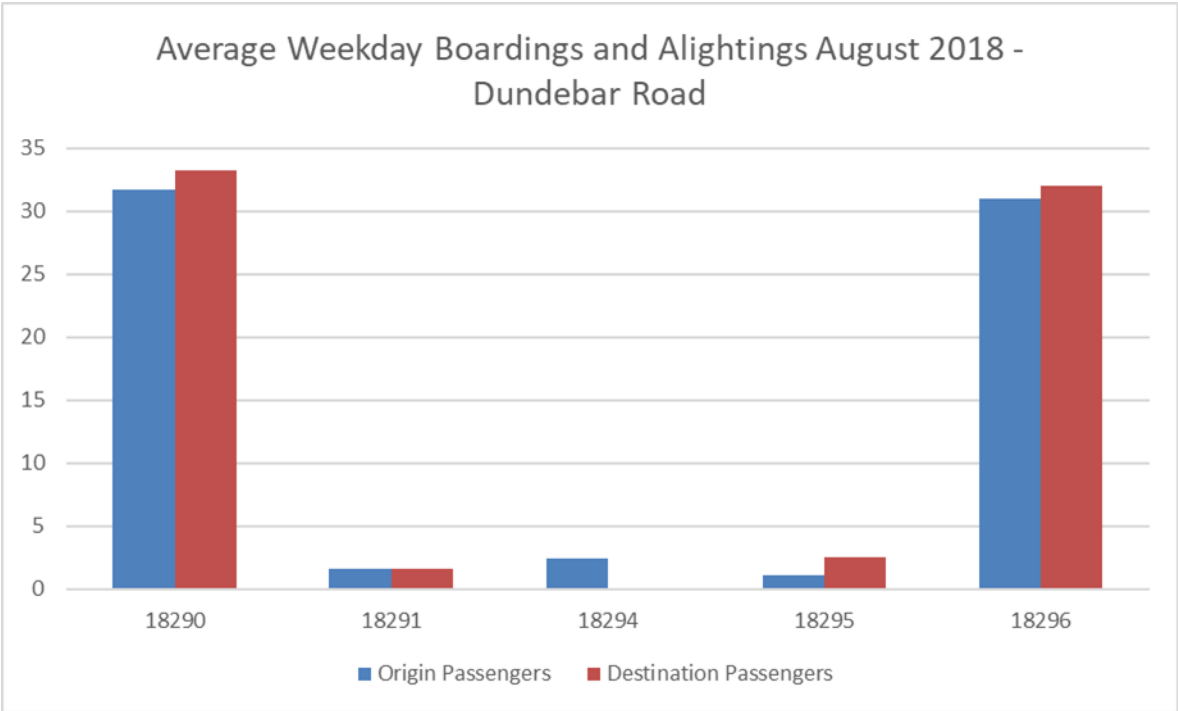


Figure 14 Dundeebar Road bus stop patronage (August 2018)

The bus stops with the highest patronage are those closest to the Wanneroo Central shopping centre and the City of Wanneroo administration building, as shown in Figure 15 and summarised in Table 2. These 6 stops account for 83% of all boardings and 88% of all alightings within the WTC.

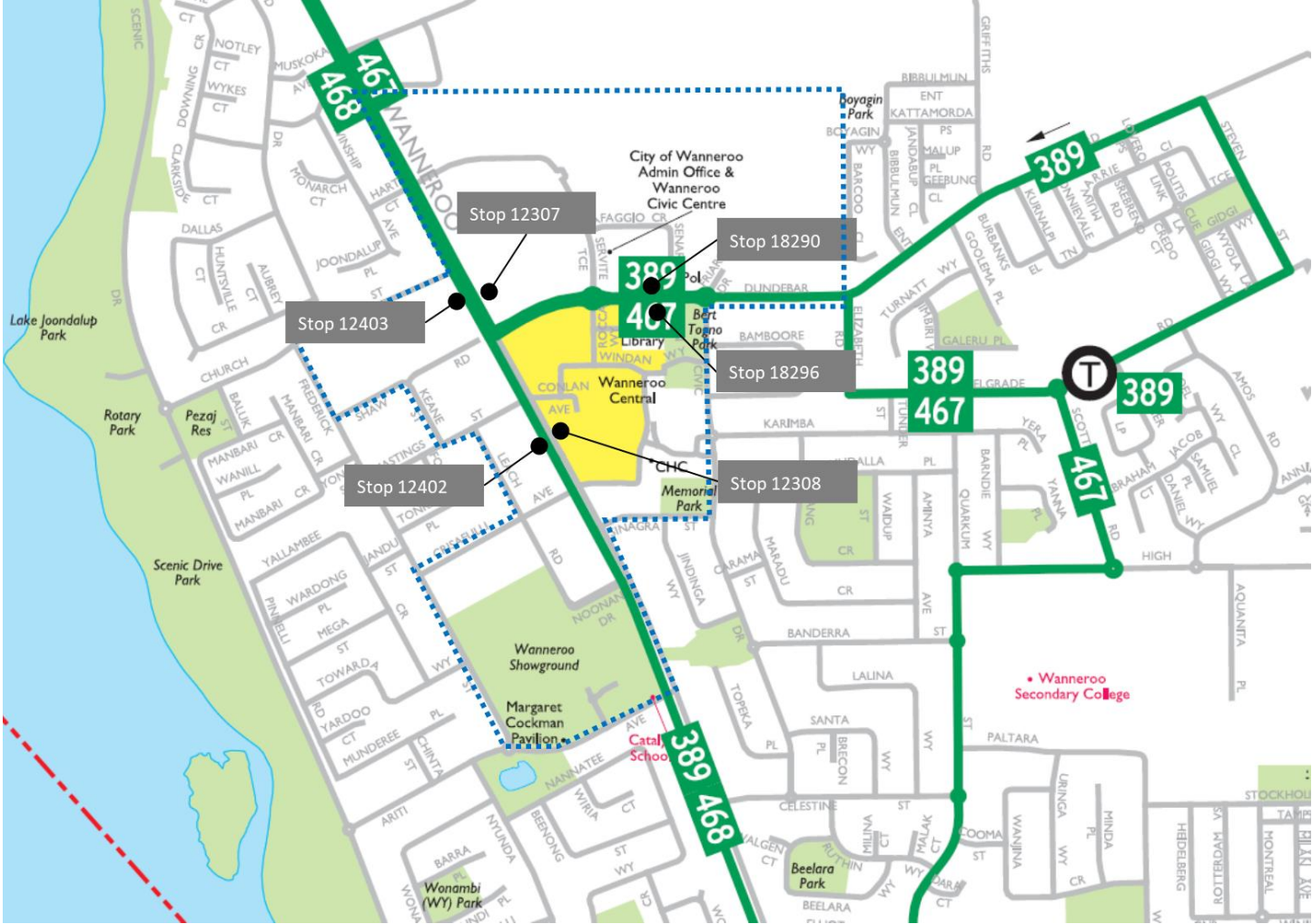


Figure 15 Bus stops with highest utilisation in WTC

Table 2 WTC Bus Services

Bus Stop	Location	Average Weekday Boardings	Average Weekday Alightings
12307	Wanneroo Rd southbound, north of Dundeebar Rd	14	33
12308	Wanneroo Rd southbound, in front of Wanneroo Central	55	29
12402	Wanneroo Rd northbound, opposite Wanneroo Central	29	50
12403	Wanneroo Rd northbound, north of Dundeebar Rd	43	19
18290	Dundeebar Rd eastbound, east of Servite Tce	32	33
18296	Dundeebar Rd westbound, between Yagan Place and Servite Tce	31	32

The variation of all boardings and alightings within the WTC over a typical weekday in August 2018 is shown in Figure 16. The data shows two distinct peak periods for boardings, from 7am to 9am and then from 3pm to 6pm. Alightings also have two peak periods, between 8am and 9am and then between 3pm and 5pm.

The variation in use over a typical weekday demonstrates the WTC as both an origin and a destination of public transport trips. It also demonstrates the predominant use by commuters travelling to and from work.

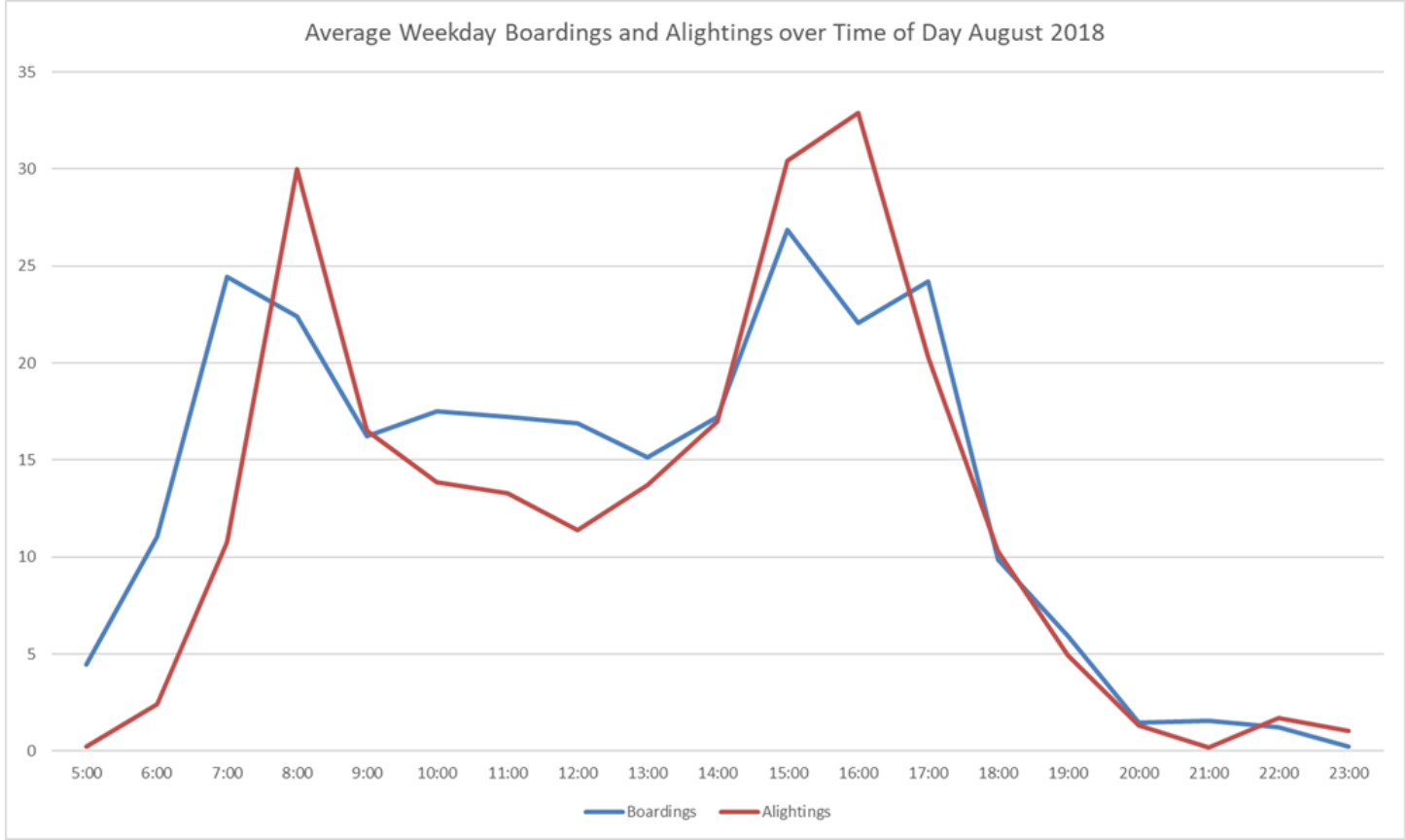


Figure 16 Utilisation of WTC bus stops over time of day (August 2018)

Overall bus patronage within the WTC is low. This is supported by the 2011 and 2016 Census data which shows a reduction in people travelling to work by bus or bus and train from 4% to 3%. This conclusion is consistent with the comparison of typical times for travel by car, bus and bike (shown in Figure 10) that reveals bus travel times to be the slowest.

4. PEDESTRIAN MOVEMENT AND AMENITY

4.1 Pedestrian Movement

There is a moderate level of pedestrian facility provision in the WTC, with many existing streets having footpaths on both sides. Pedestrian activity within the WTC is predominantly related to leisure activities, shopping and school trips.

The core of most pedestrian desire lines is the precinct bounded by Wanneroo Road, Dundebur Road, Civic Drive and Sinagra Street which contains Aquamotion, Wanneroo Regional Museum, the City of Wanneroo council offices, various cafes and the Wanneroo Central Shopping Centre.

The key pedestrian desire lines, as shown on Figure 17, are:

- East west movements to the north of the Wanneroo Central Shopping Centre.
- North south movements between the Dundebur Road civic precinct and the Wanneroo Central Shopping Centre.
- East west movements along Dundebur Road.
- East west movements between Scenic Drive and Wanneroo Road.



Figure 17 Desire lines - WTC

Pedestrian movement within the WTC faces two main barriers; the four lane Wanneroo Road carrying 28,000 vpd to the south of Dundebur Road, and the topography of the WTC, where existing retaining walls restrict access within the core pedestrian precinct.

Wanneroo Road pedestrian crossing opportunities are shown in Figure 18. Along the almost 1.5 km length of Wanneroo Road within the WTC study area boundary there are 10 pedestrian crossings; 4 of them at the signalised intersections with Dundebur Road and Hastings Street/ Conlan Avenue, with the 6 remaining crossings located close to the unsignalised intersections. The unsignalised crossings include kerb ramps, hazard tactile ground surface indicators (TGSi) and median facilities. There is an average of 126m between Wanneroo Road pedestrian crossing facilities, increasing to 152m if the short distance between the two crossings at each signalised intersection are excluded.



Figure 18 Wanneroo Road existing pedestrian crossing facilities

Popular routes for walkers and joggers are revealed by heat mapping from the commercial product Strava. As shown in Figure 19, the key recorded routes within the WTC are:

- Along Dundebur Road
- Along Wanneroo Road
- Along Civic Drive
- Along Church Street, Ariti Avenue and Frederick Street to the west of Wanneroo Road.

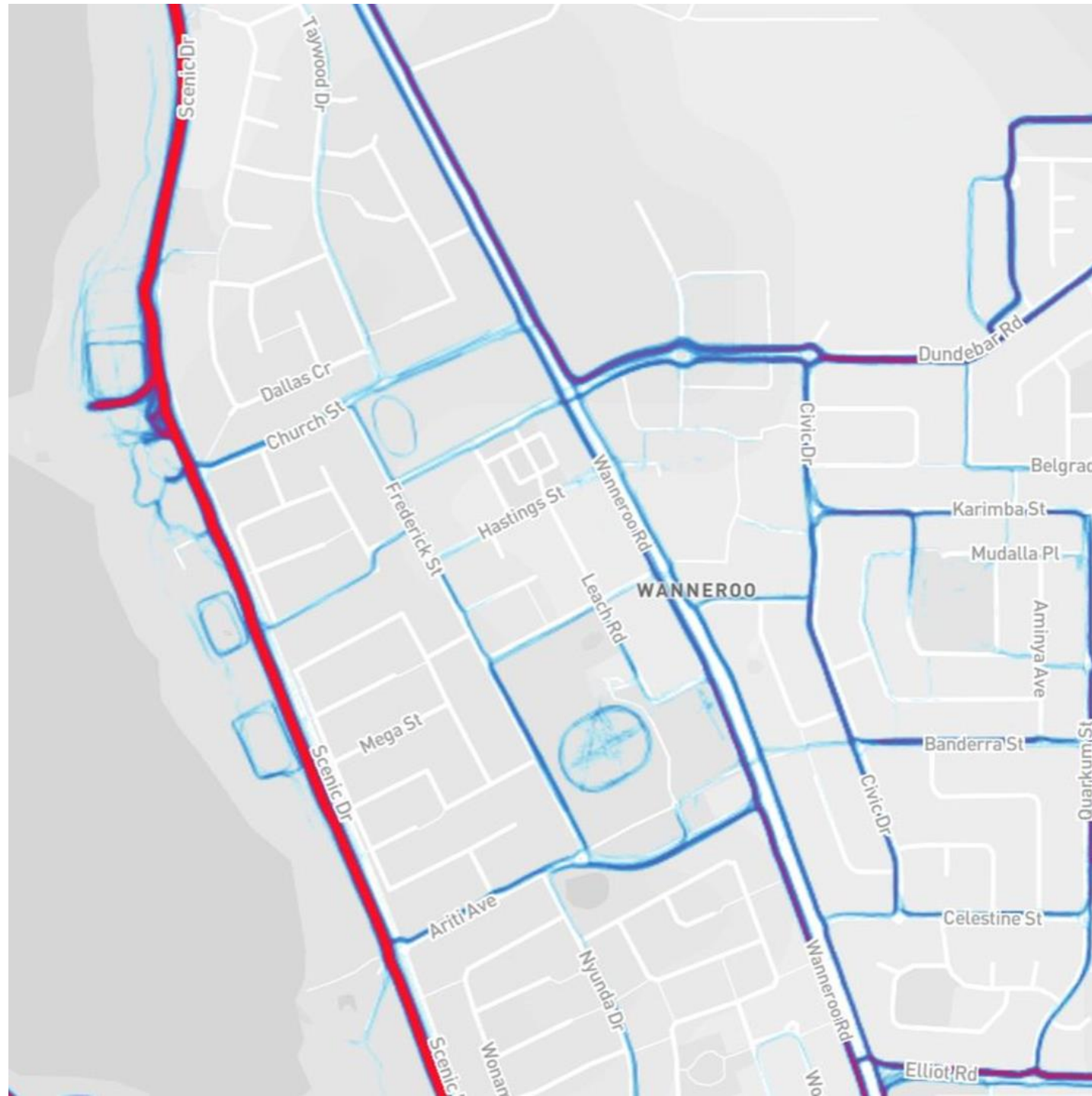


Figure 19 Strava heatmapping for run activities - WTC (source: Strava)

By far the most popular route identified by Strava is the Scenic Drive shared path, approximately 360m to the west of the WTC study area boundary.

WalkScore, a commercial product assessing walking and transit access, was used to examine the existing walkability of the WTC. The walkability scores ascribed to locations within the WTC are shown in Figure 20. WalkScore bandings are:

- 90–100 Walker's Paradise: Daily errands do not require a car
- 70–89 Very Walkable: Most errands can be accomplished on foot
- 50–69 Somewhat Walkable: Some errands can be accomplished on foot
- 25–49 Car-Dependent: Most errands require a car
- 0–24 Car-Dependent: Almost all errands require a car

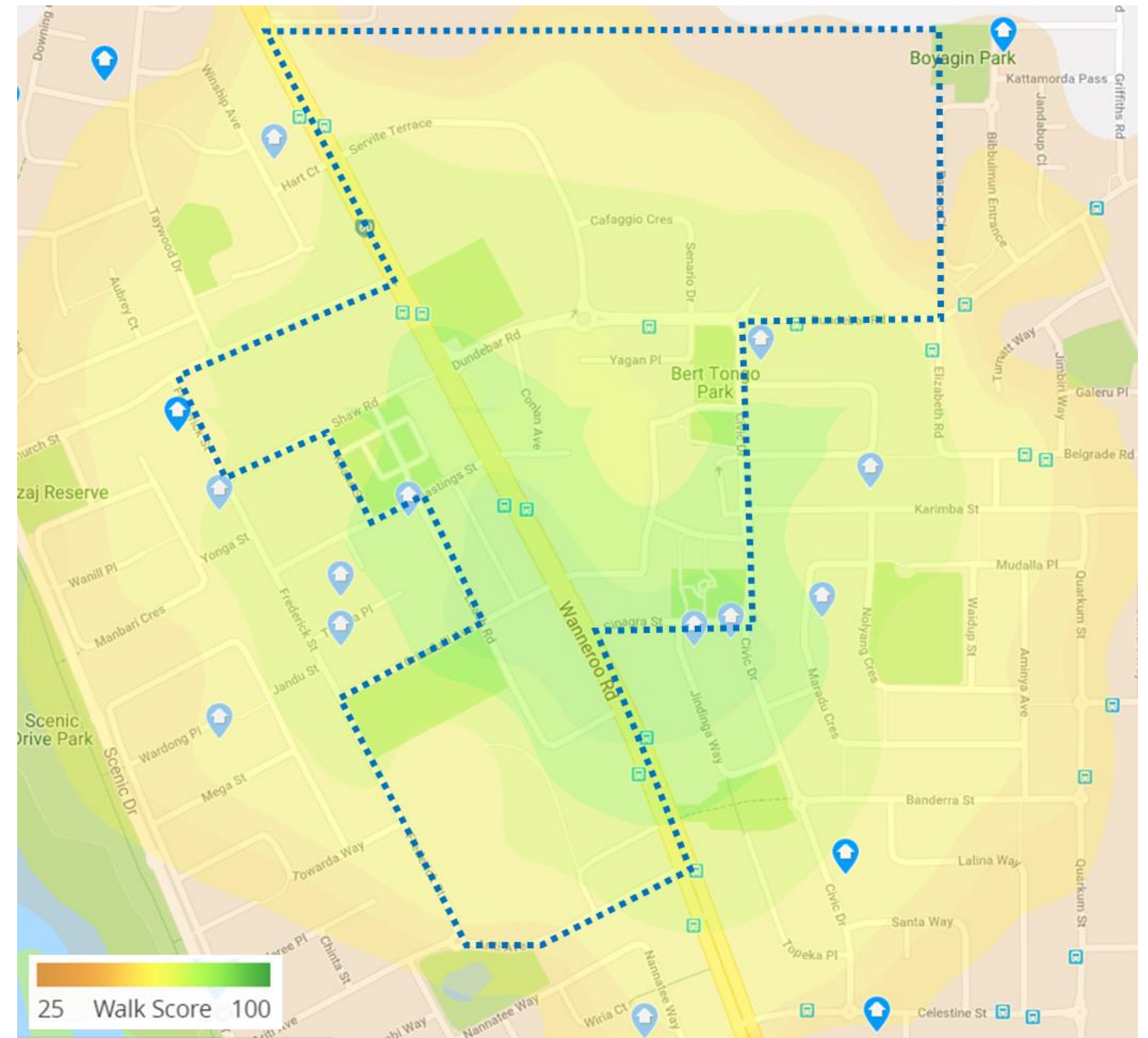


Figure 20 WalkScore bandings - Activity Centre

Walkability within the WTC was rated between 50 and 80, which is considered 'somewhat walkable' to 'very walkable'. This is generally high for a metropolitan location and reflects the range of amenities within the WTC.

Apart from the large parcel of currently undeveloped land, the least walkable areas within the WTC are in the south west corner of the Wanneroo Showgrounds, near the intersection of Ariti Avenue and Frederick Street.

WalkScore considers the area centered along Wanneroo Road, between Conlan Avenue and Crisafulli Avenue, to be the most walkable areas within the WTC.

5. CYCLING

5.1 Cycle Network

The existing cycle network within and around the WTC is shown in Figure 21. The main elements include a shared path on the eastern side of Wanneroo Road, shared paths and on-street bike lanes along Dundebur Road and Servite Terrace, and shared paths along Cafaggio Crescent and Senario Drive. There are also a number of local roads considered to provide a good riding environment, due to low traffic volumes and traffic speeds.

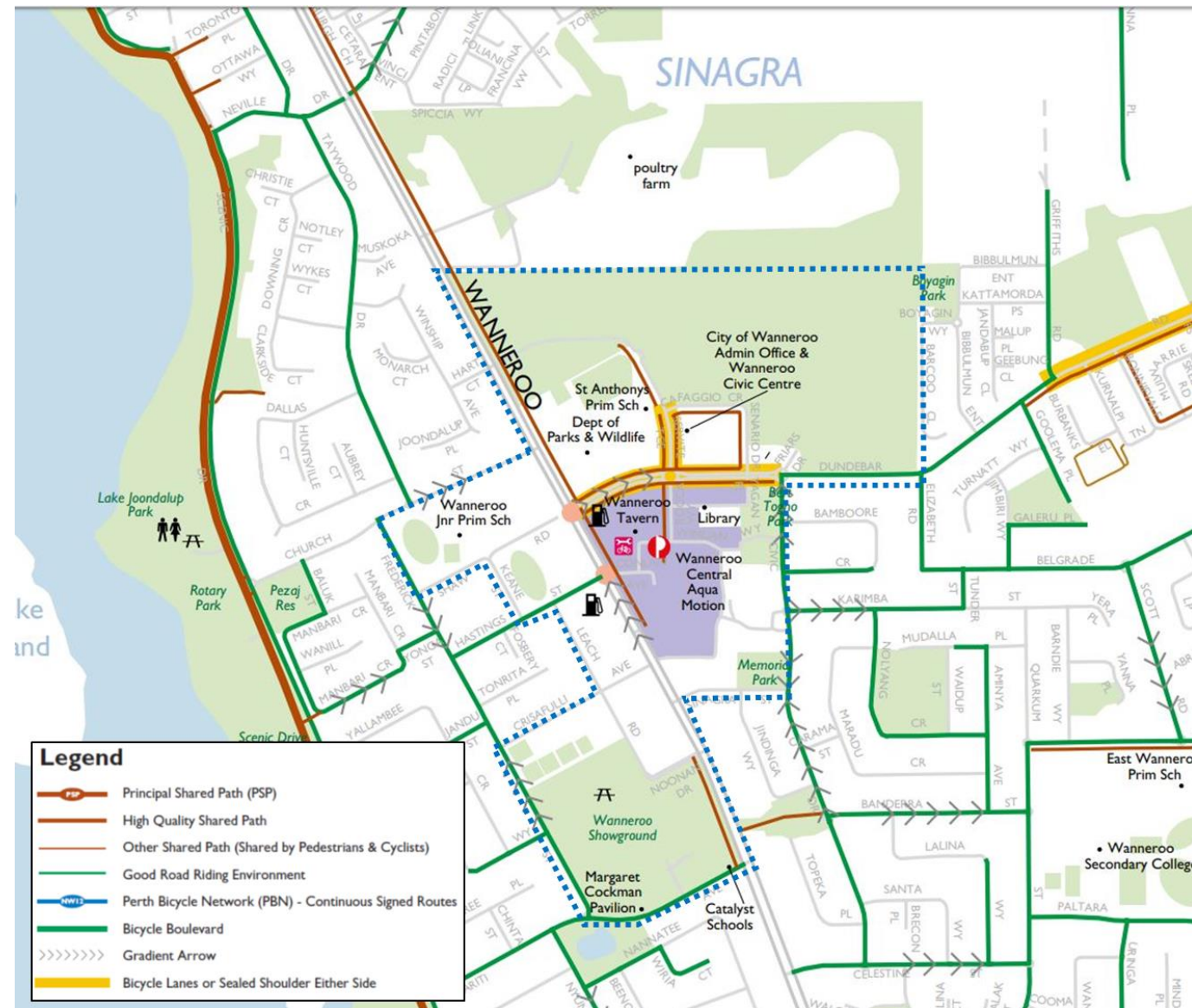


Figure 21 Department of Transport cycle map - Activity Centre

The City of Wanneroo has recently updated its Bike Plan although this has not yet been endorsed. Within the WTC the plan includes a connection between Scenic Drive and Wanneroo Road along Church Street. Dundebur Road is also a local route.

Strava heatmapping has been used to determine popular cycling routes within and around the WTC. As shown in Figure 22, the key recorded routes within the WTC are:

- Along Wanneroo Road
- Along Dundebur Road
- Along Civic Drive
- Along Church Street, Ariti Avenue and Frederick Street to the west of Wanneroo Road.

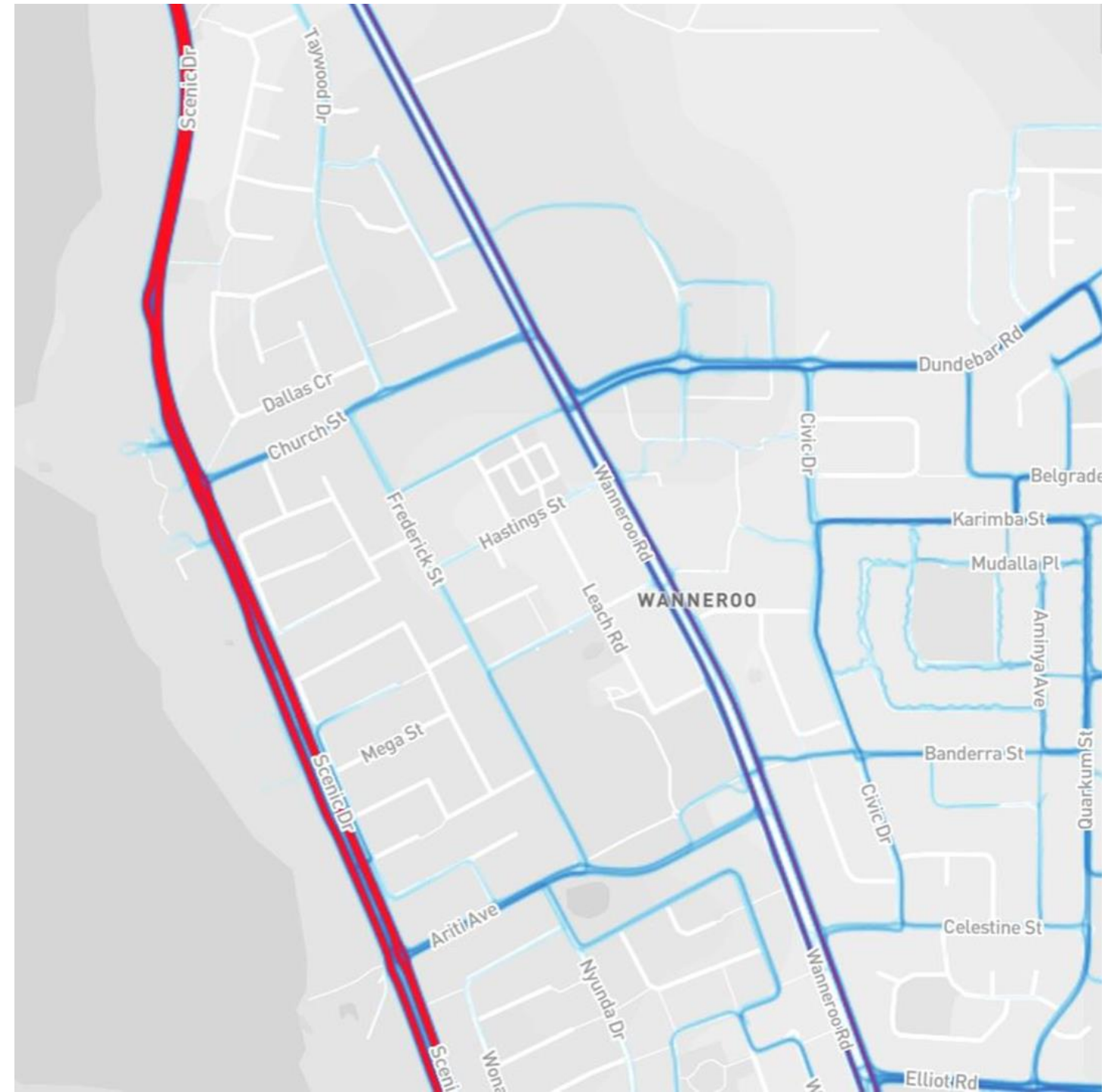


Figure 22 Strava heatmapping for cycling activities - Activity Centre (source: Strava)

By far the most popular route identified by Strava is Scenic Drive, approximately 360m to the west of the WTC study area boundary. Cyclists using Strava prefer to ride on-road along Scenic Drive instead of the shared path to the west. This is probably due to the nature of Strava users, who are more likely to be commuting cyclists than recreational users.

6. VEHICULAR MOVEMENT AND ACCESS

6.1 Road Network

The WTC's proximity to Wanneroo Road ensures quick and convenient access to the strategic road network. This is important for operational (service and delivery) and mobility purposes.

Traffic volumes in the WTC were obtained from MRWA and the City of Wanneroo (CoW) and are replicated in Figure 23. Data for Wanneroo Road and Dundobar Road date from 2016 while local road volumes were collected largely within the past 5 years. It is not expected local road traffic volumes would have substantially changed over that period.



Figure 23 Average weekday traffic volumes

The WTC is dominated by Wanneroo Road which carries approximately 28,000 vpd to the south of Dundobar Road and 35,000 vpd to the north of Dundobar Road. Of note is the proportion of heavy vehicles, at 8.3%. Wanneroo Road is part of the secondary freight network, approved to carry heavy vehicles up to 27.5m in length and up to a mass of 87.5 tonnes. Dundobar Road is carrying 10,500 vpd with 6.3% heavy vehicles, which is a high volume given its designation as a Local Distributor.

Figure 23 reveals traffic flows on Wanneroo to be highly tidal, with large southbound flows in the AM peak and northbound flows in the PM peak. This is further supported by the proportion of total daily traffic occurring in the existing peak hours, which has been determined from analysis of SCATS count data for the intersection of Wanneroo Road with Dundee Road (as shown in Table 3). This highlights the primacy of the movement of sub-regional traffic through the WTC.

Table 3 Peak hour proportions from SCATS volumes - September 2018

Road Link	Direction	AM Peak hour	PM Peak hour
Wanneroo Road south of Dundebur Road	northbound	5.3%	10.9%
	southbound	10.3%	6.0%
Dundebur Road east of Wanneroo Road	eastbound	12.4%	7.0%
	westbound	7.1%	10.4%

Traffic speed data has been extracted from the counts obtained from MRWA and the CoW. The 85th percentile traffic speeds are shown in Figure 24. The 85th percentile speed represents the speed that 85% of vehicles travel at or under, which only 15% of vehicles exceed. Speeding issues are indicated where the 85th percentile speed exceeds the zoned limit.



Figure 24 Weekday traffic speeds

Figure 24 demonstrates that speeding could be an issue along Hastings Street, Civic Drive, Sinagra Street and Wanneroo Road (although for Wanneroo Road this is only a concern between 8pm and 7am, daytime congestion prevents speeding). For the other roads for which data is available, the 85th travel speeds are appropriate for within a town centre.

The Google Maps typical traffic travel speed tool has been used to assess the existing levels of congestion within the WTC between 6am and 10pm, as shown in Figure 25.

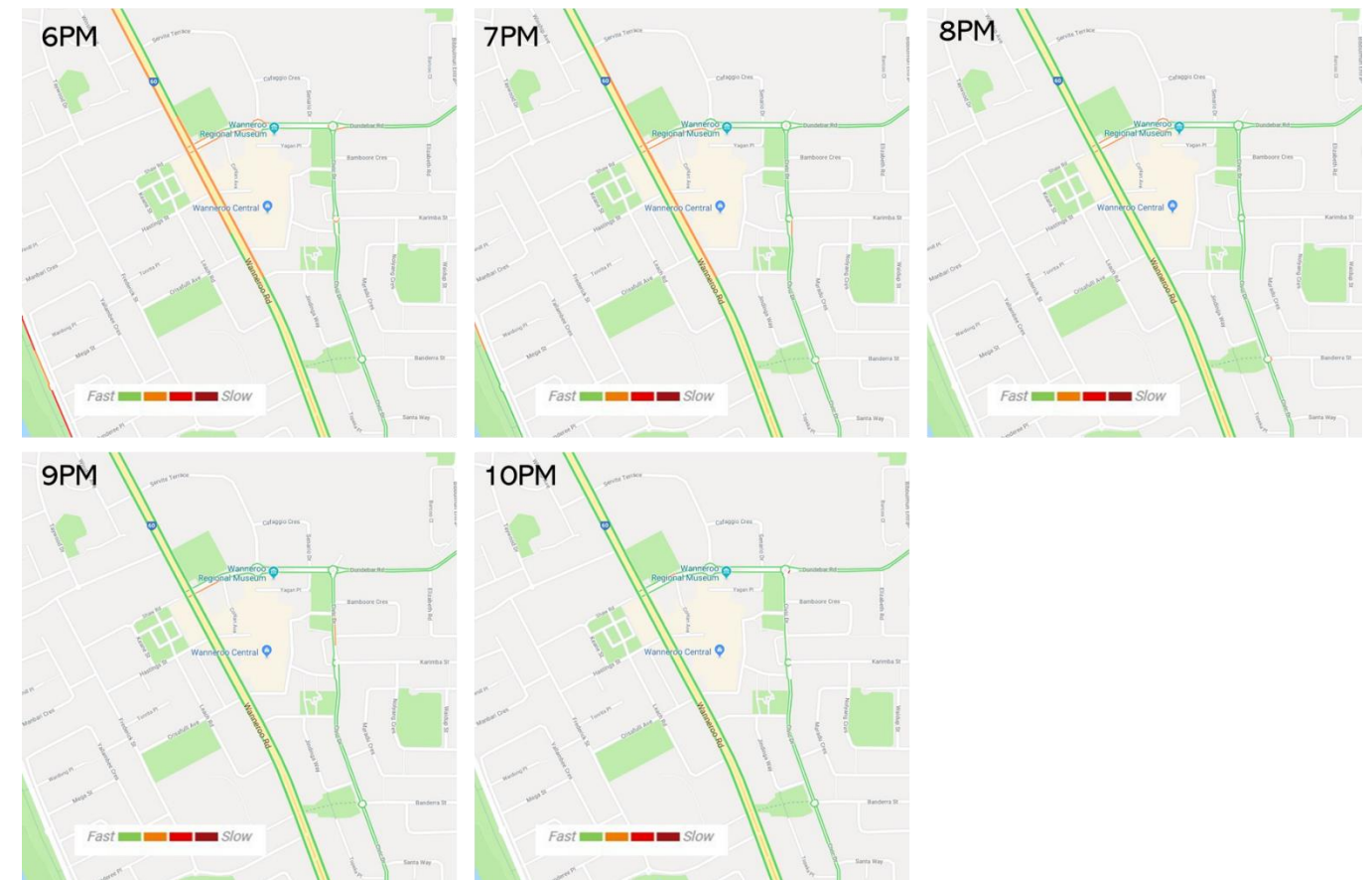
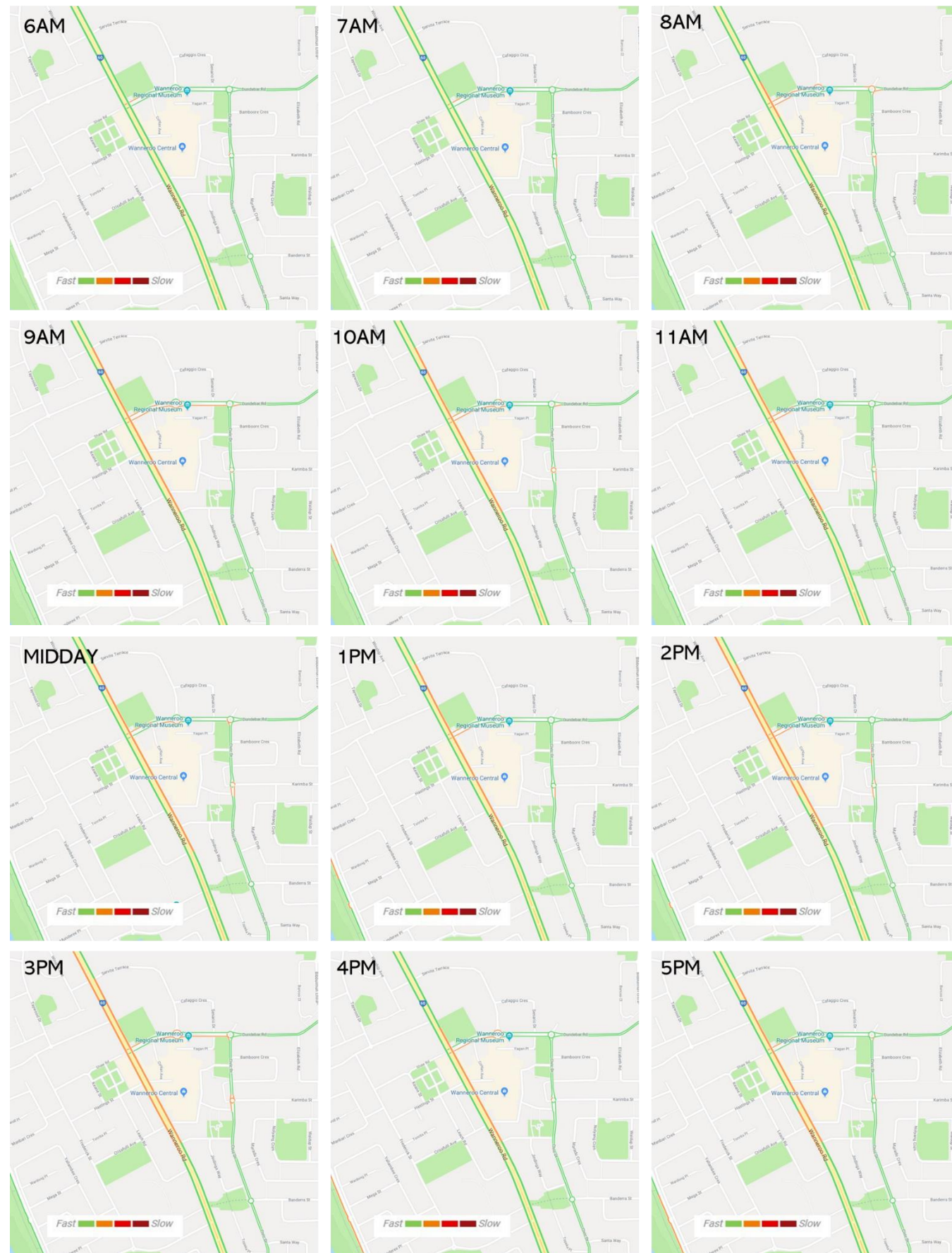


Figure 25 Google Maps typical traffic speeds measure of congestion

This Google Maps speed analysis shows congestion along the southbound lanes of Wanneroo Road is consistent between 8am and 7pm, while for the northbound lanes, congestion is shown between 2pm and 3pm, and again between 5pm and 6pm. Dundee Road experiences low level congestion throughout the day, associated with the operation of the signalised intersection of Wanneroo Road and Dundee Road. Network congestion is also influenced by school traffic.

6.2 2031 Forecast Traffic Volumes

To understand the strategic traffic movements within and around the WTC, output from MRWA's Regional Operations Model 24 (ROM24) was examined. ROM24 provides forecast traffic volume information based on land use details from the WA Planning Commission (WAPC) and road network proposals by MRWA.

The ROM24 forecasts are based on a 'business as usual' mode split, with a continued reliance on private cars and limited mode shift towards public transport, walking and cycling.

The ROM24 road network within the WTC includes only Wanneroo Road (with two lanes in each direction) and Dundee Road (with a single lane in each direction). Forecast daily volumes for 2031 are shown in Figure 26, and are compared with existing (2016) traffic volumes in Table 4. Strong growth is predicted for Dundee Road, and for Wanneroo Road south of Dundee Road.

As the ROM24 road network is limited in the vicinity of the WTC it is likely the forecast volumes are higher than they would otherwise be, as there are no alternate roads to travel on. This is particularly the case for Dundee Road.



Figure 26 ROM24 forecast all day model output for 2031

Table 4 Forecast daily traffic volume analysis

Road Link	Direction	2016 Volumes	2031 Forecast	% Increase
Wanneroo Road north of Dundee Road	northbound	17,400	18,400	5.7%
	southbound	17,900	18,500	3.4%
Wanneroo Road south of Dundee Road	northbound	13,700	16,800	22.6%
	southbound	13,900	16,700	20.1%
Dundee Road east of Wanneroo Road	eastbound	4,700	8,000	70.2%
	westbound	5,800	7,900	36.2%

AM and PM peak period forecasts were also obtained from ROM24. The 2031 AM peak period forecasts (for the two hours between 7am and 9am) are shown in Figure 27 while the 2031 PM peak period forecast (for the two hours between 4pm and 6pm) are shown in Figure 28.

The 2031 peak forecasts are compared with existing (2016) peak volumes in Table 5. The existing and forecast peak volumes are for the two hours between 7am and 9am and between 4pm and 6pm. This analysis shows large increases are expected on Wanneroo Road northbound traffic in the AM peak period, and for both directions of travel on Dundee Road in both peak periods.



Figure 27 ROM24 2031 AM peak period forecast vehicle movements (7am – 9am)



Figure 28 ROM24 2031 PM peak period forecast vehicle movements

Table 5 Forecast 2-hour peak period traffic volume analysis

Road Link	Direction	2016 AM	2031 AM	% Increase	2016 PM	2031 PM	% Increase
Wanneroo Road north of Dundobar Road	northbound	1,620	2,440	50.3%	3,760	4,350	15.6%
	southbound	3,870	4,450	15.1%	1,950	2,150	10.4%
Wanneroo Road south of Dundobar Road	northbound	1,260	2,290	81.3%	3,060	3,890	27.3%
	southbound	2,960	3,820	29.3%	1,560	1,980	26.7%
Dundobar Road east of Wanneroo Road	eastbound	850	1,750	106.5%	680	1,210	77.6%
	westbound	710	1,270	78.9%	1,120	1,490	33.4%

In addition, forecast volume to capacity ratios (VCR) were also obtained for each of the peak periods. VCRs are a measure of the level of congestion on a section of road. A VCR of 1 indicates that the road is operating at 100% capacity, while a VCR under 1 indicates the road has spare capacity. Forecast 2031 VCRs for the AM peak period are shown in Figure 29 while the forecast VCRs for the PM peak period are shown in Figure 30. The VCR analysis is also presented in Table 6.

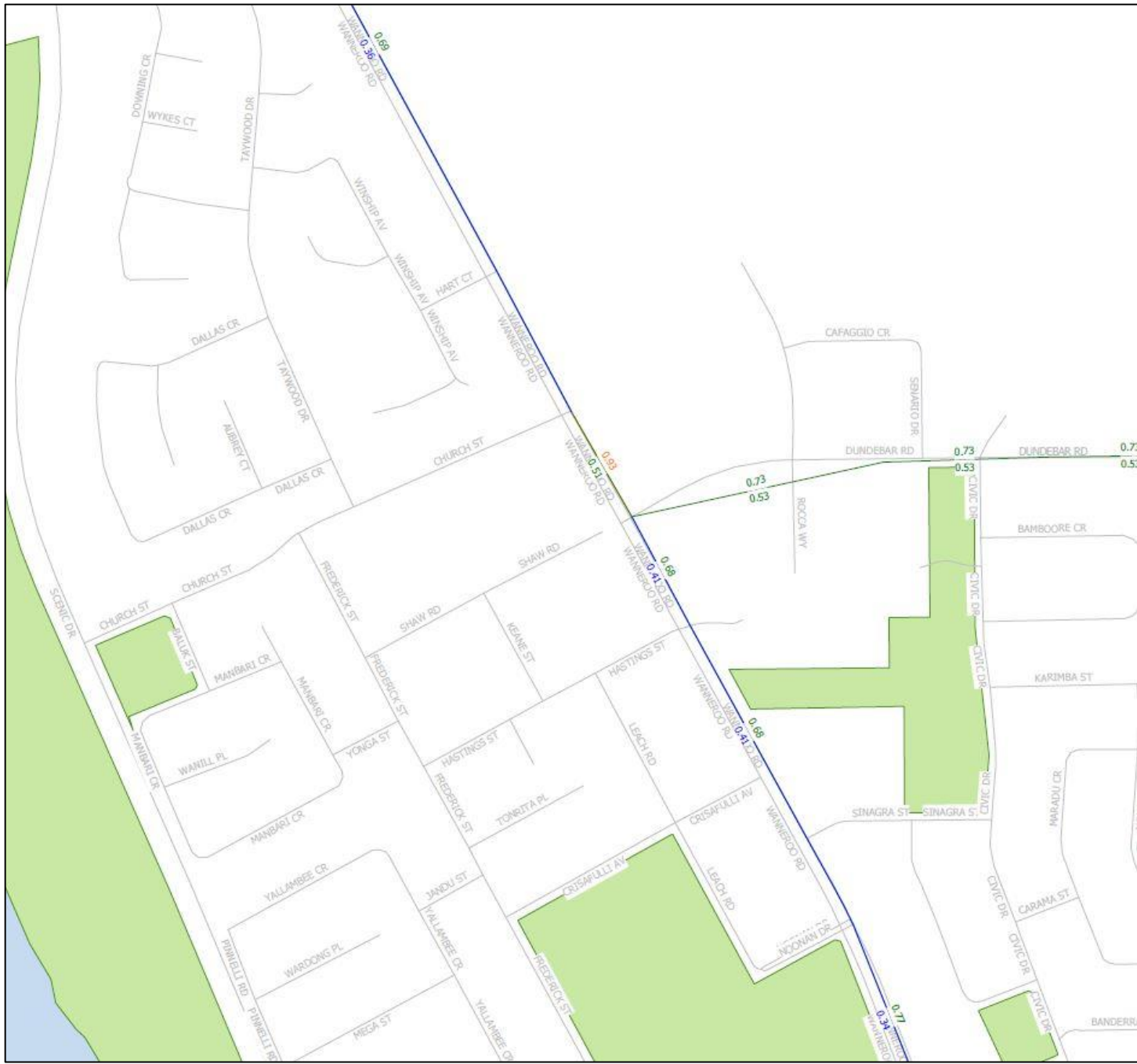


Figure 29 ROM24 2031 AM peak period forecast VCR



Figure 30 ROM24 2031 PM peak period forecast volume to capacity ratio

Volume to capacity analysis, as shown in Table 6, indicates there is requisite midblock capacity within the WTC strategic road network to accommodate the 2031 forecast volumes. However, the forecast VCR for the section of Wanneroo Road, north of Dundebur Road, is between 0.8 and 1 for the southbound lanes in the AM peak period and for the northbound lanes in the PM peak period. This suggests this section of Wanneroo Road will be approaching peak period capacity by 2031, with limited ability to accommodate further traffic volume increases. Any further growth in traffic is likely to cause the peaks to extend over an increased time period (known as peak spreading).

Table 6 Forecast peak hour VCR analysis

Road Link	Direction	AM Peak Period VCR	PM Peak Period VCR
Wanneroo Road north of Hart Court	northbound	0.36	0.69
	southbound	0.69	0.32
Wanneroo Road north of Dundebur Road	northbound	0.51	0.91
	southbound	0.93	0.45
Wanneroo Road south of Dundebur Road	northbound	0.41	0.7
	southbound	0.68	0.35
Wanneroo Road south of Noonan Drive	northbound	0.34	0.68
	southbound	0.77	0.4
Dundebur Road east of Wanneroo Road	eastbound	0.73	0.5
	westbound	0.53	0.62

Wanneroo Road, which passes through the WTC and effectively divides it in two, is an important element of MRWA’s strategic road network. ROM24 analysis has shown Wanneroo Road will continue to carry significant volumes of traffic, with daily and particularly peak period traffic volumes forecast to increase. As Wanneroo Road traffic volumes and congestion levels increase, travel speeds will decrease.

Dundebur Road is also forecast to undergo significant traffic growth. It will be important to manage the additional traffic along Dundebur Road to prevent it becoming a barrier to movement within the WTC.

7. PARKING

7.1 Off-Street Parking

Within the WTC it is estimated there are 2,270 off-street parking bays, approximately distributed as shown in Figure 31. Parking within the WTC is currently provided in discrete areas, with each lot providing its own parking and no consideration given to reciprocal usage.

The current off-street parking provision equates to approximately 1 bay for every 30.5m² of commercial development within the WTC.

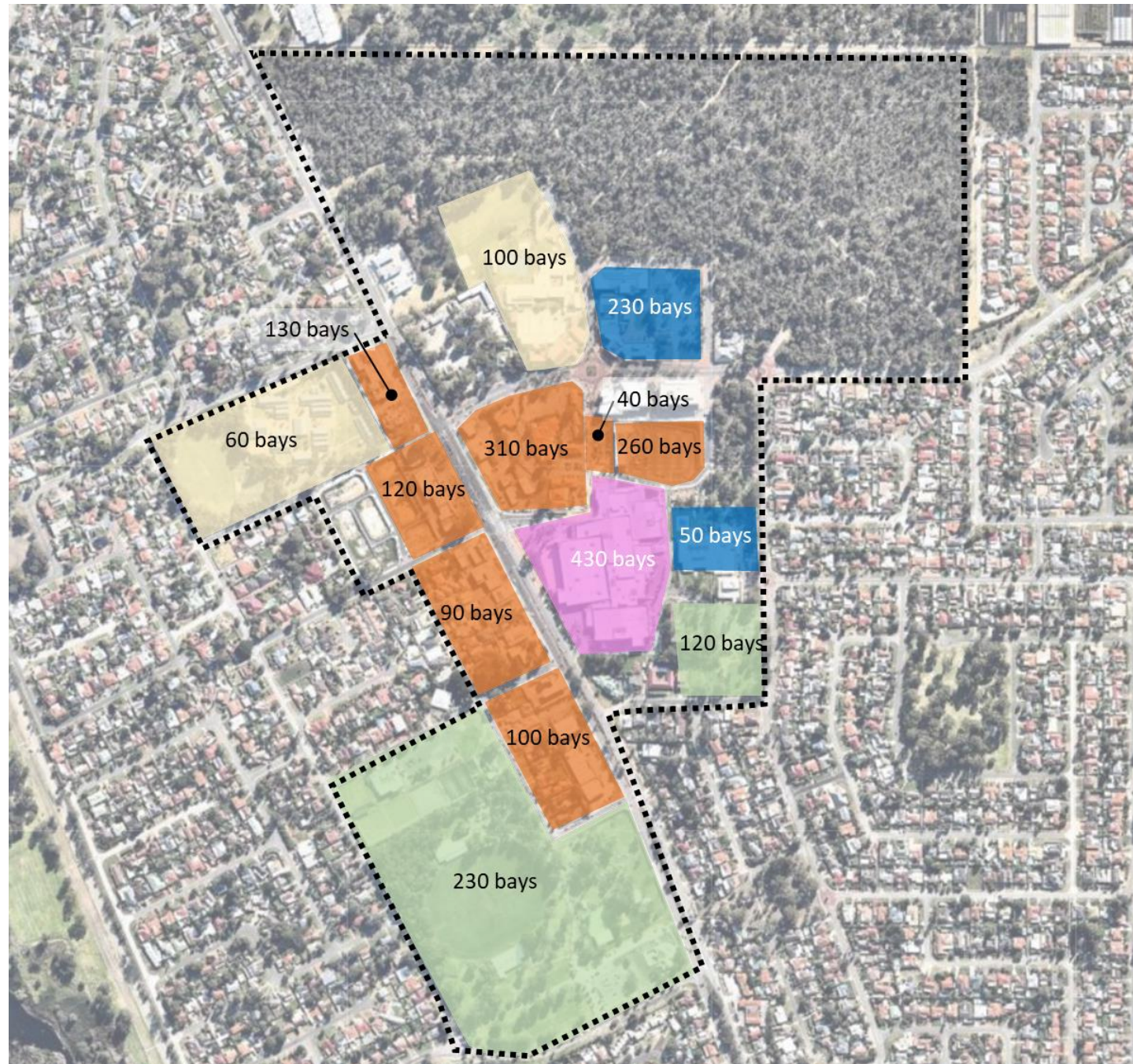


Figure 31 WTC Off-street parking

7.2 On Street Parking

There are 312 on-street parking bays within the WTC, with their approximate location identified in Figure 32. The majority of the on-street parking is provided as parallel bays, although there are sections of angled parking along Rocca Way, Cafaggio Crescent, Senario Drive and Servite Terrace. Angled parking allows more bays per length of road, however parallel parking allows more verge space for footpaths,

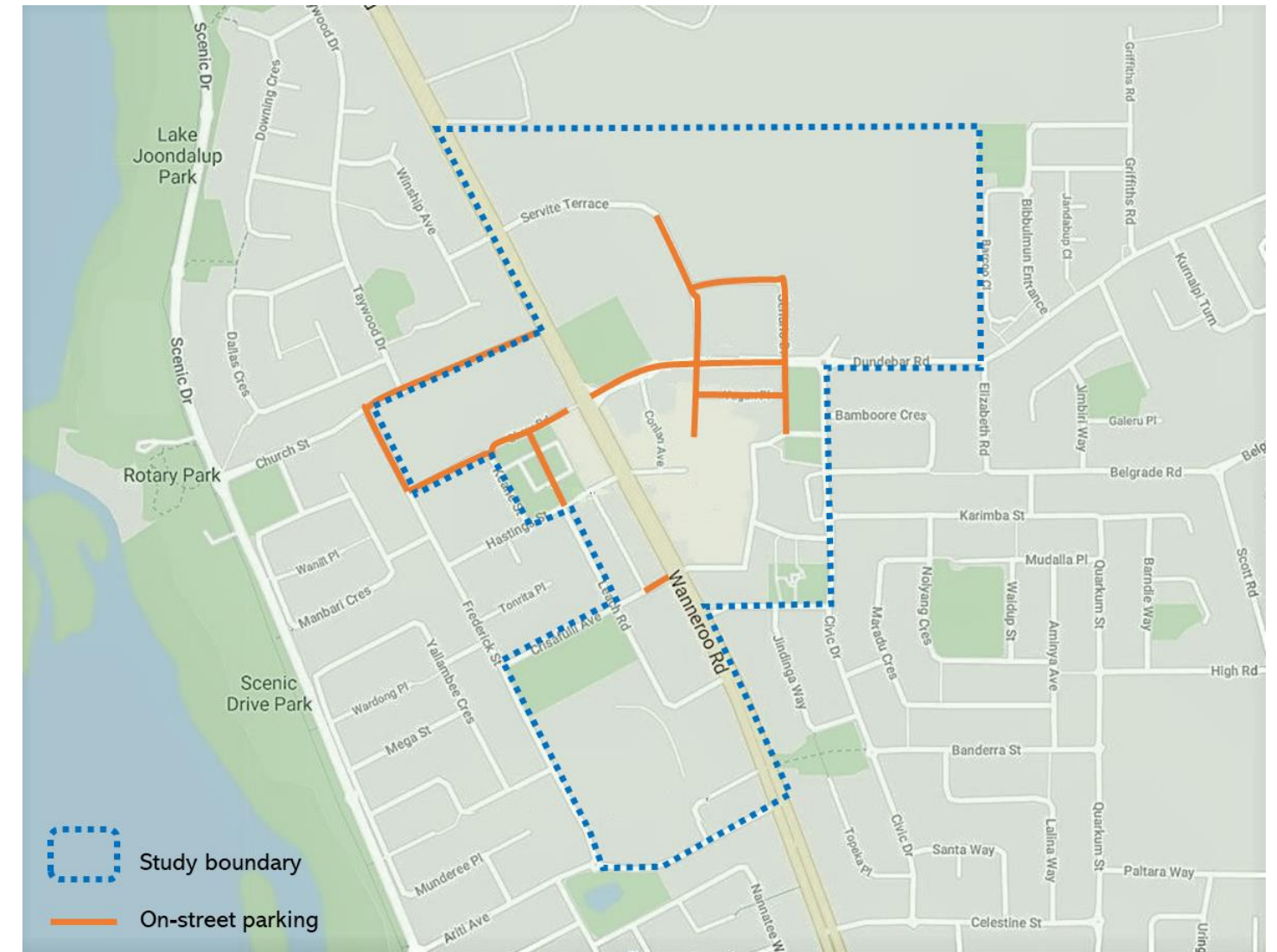


Figure 32 Streets within WTC with on-street parking

Most parking bays are unrestricted (without time limits), and all bays are exempt from parking fees. The following on-street parking is subject to time restrictions:

- Church Street – 15 minute bays along the Wanneroo Primary School frontage
- Shaw Road – 30 minute and 5 minute kiss and drive bays along the Wanneroo Primary School frontage
- Dundee Road – 15 minute bays east of Servite Terrace

On-street parking includes ACROD permit parking and motorcycle parking. Two on-street bays along Cafaggio Crescent are electric vehicle charging stations.

8. MOVEMENT NETWORK PLAN – WANNEROO TOWN CENTRE

8.1 Movement

SPP 4.2 Peel establishes the five key movement network elements that are required to be addressed. These elements are then tied to performance indicators. They are set out in Table 7.

Table 7 Performance Indicators

Content Required	Performance Indicators
Public Transport Infrastructure	Prioritisation of public transport
Walking and Cycling	Provision of end of trip facilities Improved access and facilities for pedestrians and cyclists
Traffic Assessment	Improved access by all modes, including freight vehicles
Freight Servicing	Improved access by all modes, including freight vehicles
Centre Parking policy	Provides for upper limits and common use of car parking

This section sets out the response to these five elements that will allow the WTC to achieve the performance indicators set out in SPP 4.2.

8.2 Public Transport

Within the WTC there is currently no on-street priority for public transport. Overall use of public transport is low, and the volume of buses, and total passengers, that pass through the main intersections in the WTC would not currently justify on-street priority measures.

Given the projected increase in trip generation and land use in the WTC, public transport upgrades are required to increase patronage and reduce private car dependency.

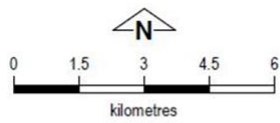
The existing bus network generally caters for local movements to and from Joondalup and Whitfords Stations, and for sub-regional movements along the Wanneroo Road/ Charles Street corridor to Perth. Many of the factors which influence the low level of public transport patronage within the WTC (such as congestion along Wanneroo Road) are far outside the influence of the WTC.

The East Wanneroo Rail Link (EWRL), a potential passenger rail service to connect the existing Joondalup and planned Ellenbrook rail lines in the long term, was identified in The Transport Network document of the Perth and Peel @3.5 Million growth strategy. The alignment of this potential rail line is currently under investigation.

The City of Wanneroo is eager for a public transport link between the potential EWRL and the WTC. An area within the WTC, to the northeast of the intersection of Dundebur Road and Friars Drive, has been identified as a future transit node, to serve as the terminus of this public transit link. However, given the long-term nature of the EWRL, more immediate public transport improvements are required.

Also identified in The Transport Network document of the Perth and Peel @3.5 Million growth strategy is the need to improve bus connectivity between Whitfords and Joondalup via Wanneroo. As part of this project a high priority transit corridor will be constructed along Wanneroo Road, between Whitfords Avenue and just south of Pinjar Road, in the medium term. The transit corridor is shown in Figure 33, reproduced from Perth and Peel @3.5 Million Transport Network report.

The transit corridor will improve travel times and service reliability and will accommodate high frequency bus services between Joondalup, Wanneroo and Whitfords. This would enable public transport to provide a legitimate alternate to private vehicle modes.



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SLIP 944-2017-1

Legend

- Passenger rail/station - existing
- Passenger rail/station - proposed Stage 1 METRONET
- Passenger rail - further investigation
- Proposed high-priority transit corridor
- Proposed high-frequency transit corridor
- Activity centres
 - Strategic metropolitan
 - Secondary
 - District

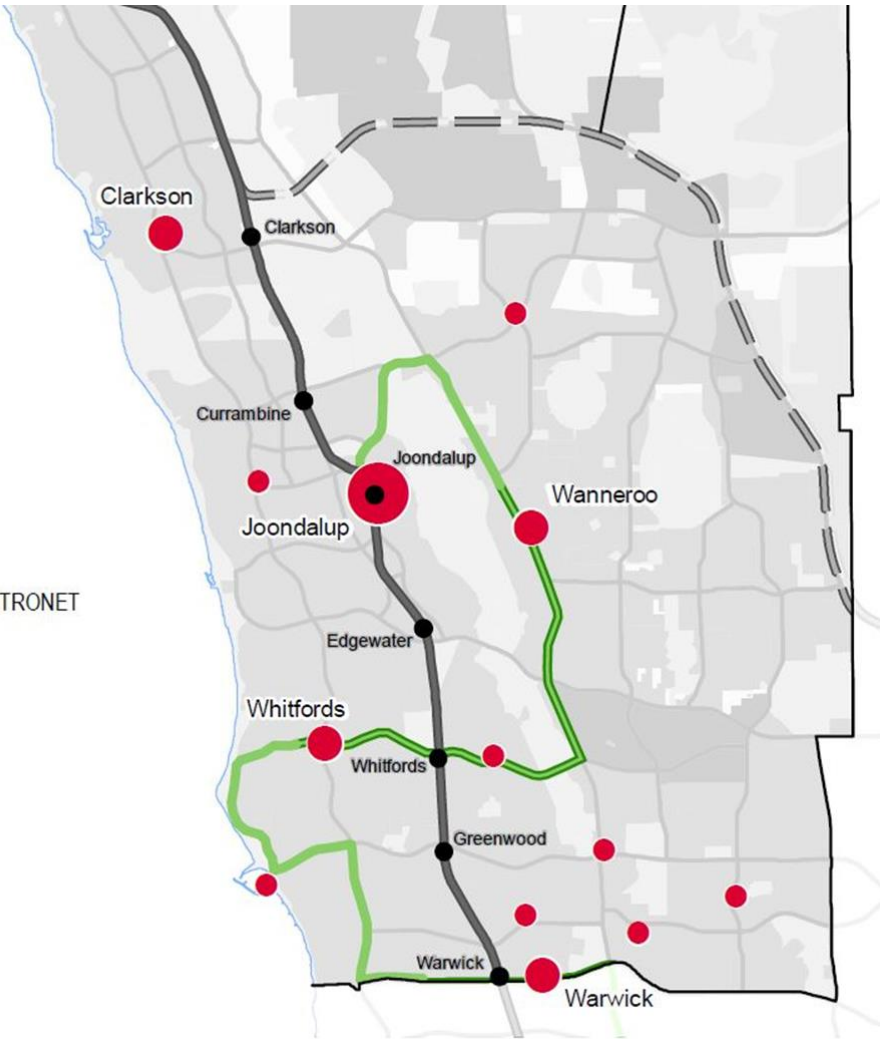


Figure 33 2050 public transport network - excerpt from Perth and Peel @ 3.5 Million

The proposed high priority/ high frequency corridor will pass through the WTC. An area within the WTC, to the northeast of the intersection of Wanneroo Road and Dundebur Road, has been identified as a future transit node, to serve as a stop (or station, depending on the nature of the service).

As the East Wanneroo area develops, local bus services should be expanded to provide a connection for residents to opportunities within the WTC.

The City of Wanneroo should continue to lobby the PTA for improved public transport services and to bring forward the planned high priority transit corridor.

All bus stops within the WTC should incorporate shelter, seating and a bin. Currently stops 12306 and 12404 along Wanneroo Road (north of Hart Court) and stops 18291 and 18295 along Dundebur Road (east of Civic Drive) do not have shelters or bins. The PTA’s Bus Shelter Subsidy Program provides funding for the installation of shelters at bus stops, however stops need to achieve an average of at least 15 weekday boardings to be eligible. The identified stops do not yet achieve the required threshold.

8.3 Walking and Cycling

The WTC plan has been developed to ensure walking and cycling are the primary modes of transport for travel within the WTC, replacing the need for short car trips. Priority has been given to pedestrians rather than traffic, through:

- Implementation of a 40km/h posted speed zone within the WTC to the east of Wanneroo Road (the street lengths within the WTC to the west of Wanneroo Road may be too short to incorporate a 40km/h posted speed zone within the WTC).
- Retention and improvement of pedestrian phases at all approaches at signalised intersections.
- Modification of the intersection of Dundobar Road with Servite Terrace and Rocca Way from roundabout to traffic signal control.
- Any new town centre streets to have a footpath on both sides, or a footpath on one side, and a shared path the other side.
- All intersecting streets along Dundobar Road, Civic Drive and Servite Terrace to incorporate Wombat Crossings for pedestrian priority – except at signalised intersections (Wombat Crossings being raised, marked crossings to slow vehicles but provide pedestrians with an unimpeded path along the street).



Figure 34 Pedestrian based measures within the WTC

In addition, several key pedestrian routes have been identified within the WTC Plan.

The City of Wanneroo has recently updated its Bike Plan although this has not yet been endorsed. Within the WTC the plan includes a connection between Scenic Drive and Wanneroo Road along Church Street. It is recommended the existing 1.2m insitu concrete footpath on the northern side of Church Street be upgraded to a 2.5m shared path.

The development of the hard infrastructure must be complimented by additional planning measures aimed at supporting trips by bicycle. Planning controls must mandate the appropriate provision of cycle parking for public and private use and end of trip facilities (including showers, change rooms and lockers). The suggested provision of bicycle parking is:

- Tenant and employee bicycle parking – 1 bay per 200m² non-residential use
- Visitor bike parking – 1 bay per 400m² non-residential use
- 1 locker per tenant/employee bike bay
- 1 male and 1 female shower for every 10 tenant/employee bike bays

8.4 Traffic

To introduce additional road network capacity in the WTC would make it more attractive to sub-regional traffic, entrenching existing travel patterns through the Activity Centre. Additional road capacity would induce more traffic. This would exacerbate existing peak hour issues and reduce the ability of the network to accommodate trips associated with future development.

The opportunity to introduce additional road network capacity was canvassed with MRWA during consultation for the Activity Centre Plan. MRWA's only request was for the Wanneroo Road reserve north of Dundobar Road to be widened to match the reserve width south of Dundobar Road. This has been adopted in the WTC Plan.

The strategic road network within the WTC will remain unchanged in form in the future, however its function will be required to change.

The following changes are proposed for the local road network:

- Northwards extension of Servite Terrace through the large parcel of undeveloped land.
- Northwards extension of Friars Drive through the large parcel of undeveloped land.
- New east west connection between Wanneroo Road (opposite Hart Court, with left in left out intersection) and Servite Terrace, through the undeveloped land.
- New east west connections between extended Servite Terrace and Friars Drive, and between Friars Drive and Boyagin Way.
- New connection between Wanneroo Road (opposite Crisafulli Avenue, with left in left out control) and Windan Way
- New connection between Civic Drive and abovementioned Windan Way connection.
- Widening of Cafaggio Crescent and Senario Drive road reserves to include footpaths/ shared paths on the currently undeveloped sides.
- Creation of laneways or service roads (similar to Pupil Lane) for access to lots fronting the west side Wanneroo Road.

The recommended road hierarchy for the proposed road network is shown in Figure 35 and road cross section are shown in Figure 36. The road hierarchy and typical cross sections have been developed through an assessment of the likely traffic volumes resulting from the proposed development yield.

Road hierarchy recommendations have been made for existing roads within the WTC. For the most part, these recommendations are consistent with the current road hierarchy (displayed in Figure 2).

The following notes are made regarding the road hierarchy:

- While Servite Terrace has been designated as a 'Neighbourhood Connector A', with a road reserve of 24.4m, it is not proposed to widen the section of road currently constructed, or to widen the road reserve of this section of road. It is proposed to maintain the current Servite Terrace cross section. The proposed road reserve width and cross sections will apply to the northwards extension of Servite Terrace through the large parcel of undeveloped land.
- While Rocca Way / Conlan Avenue has been designated as 'Main Street', the cross section and reserve should most closely resemble that of Access Street B. The section of Rocca Way will, however, have a wider reserve (due to wider verges) than that of Access Street B.
- The Neighbourhood Connector B classification has been proposed with a road reserve width varying between 19.4 and 20.0. The variation in road reserve is due to the width of the on-street parking bays, with a range between 2.1 and 2.3m.

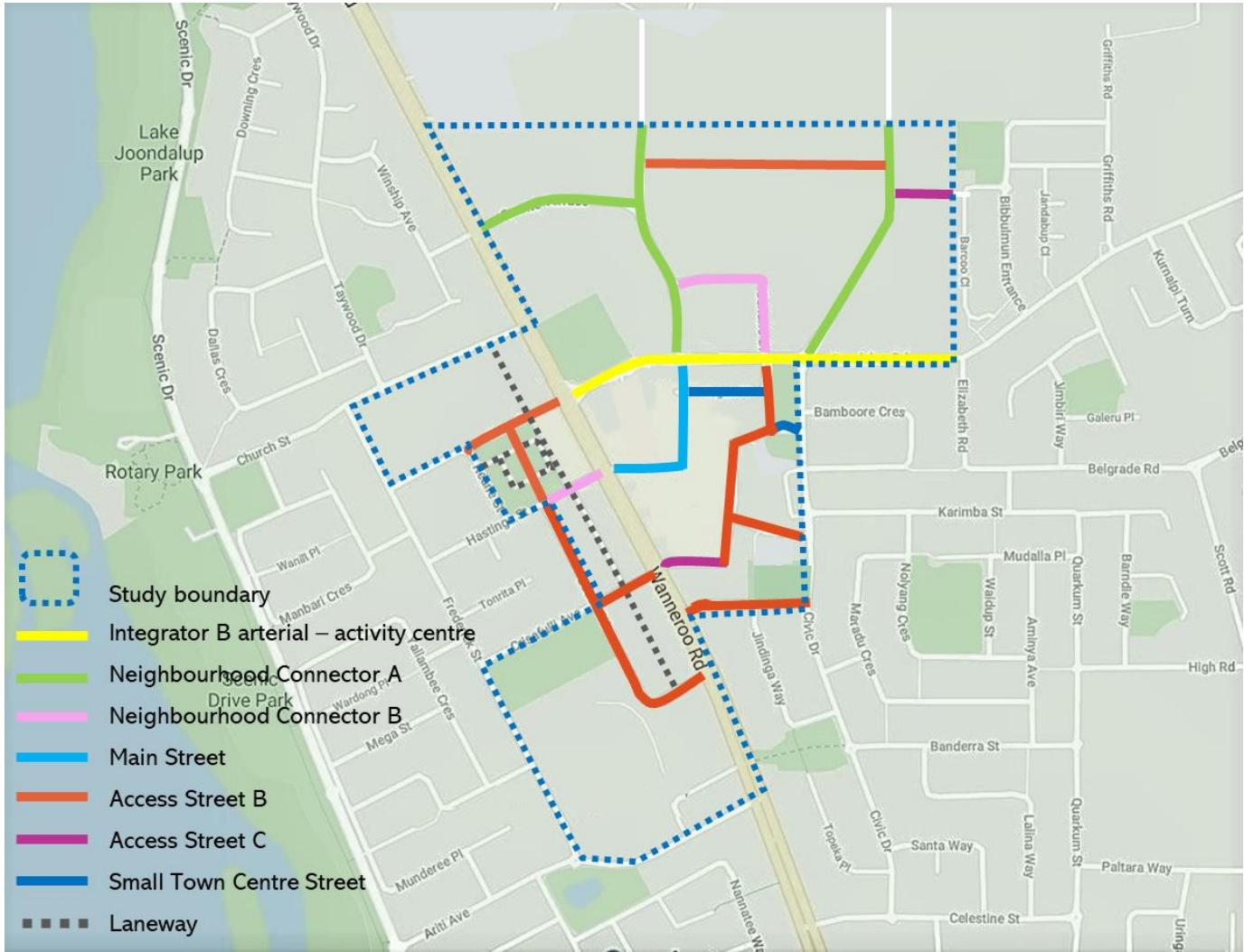


Figure 35 Proposed WTC new network road hierarchy

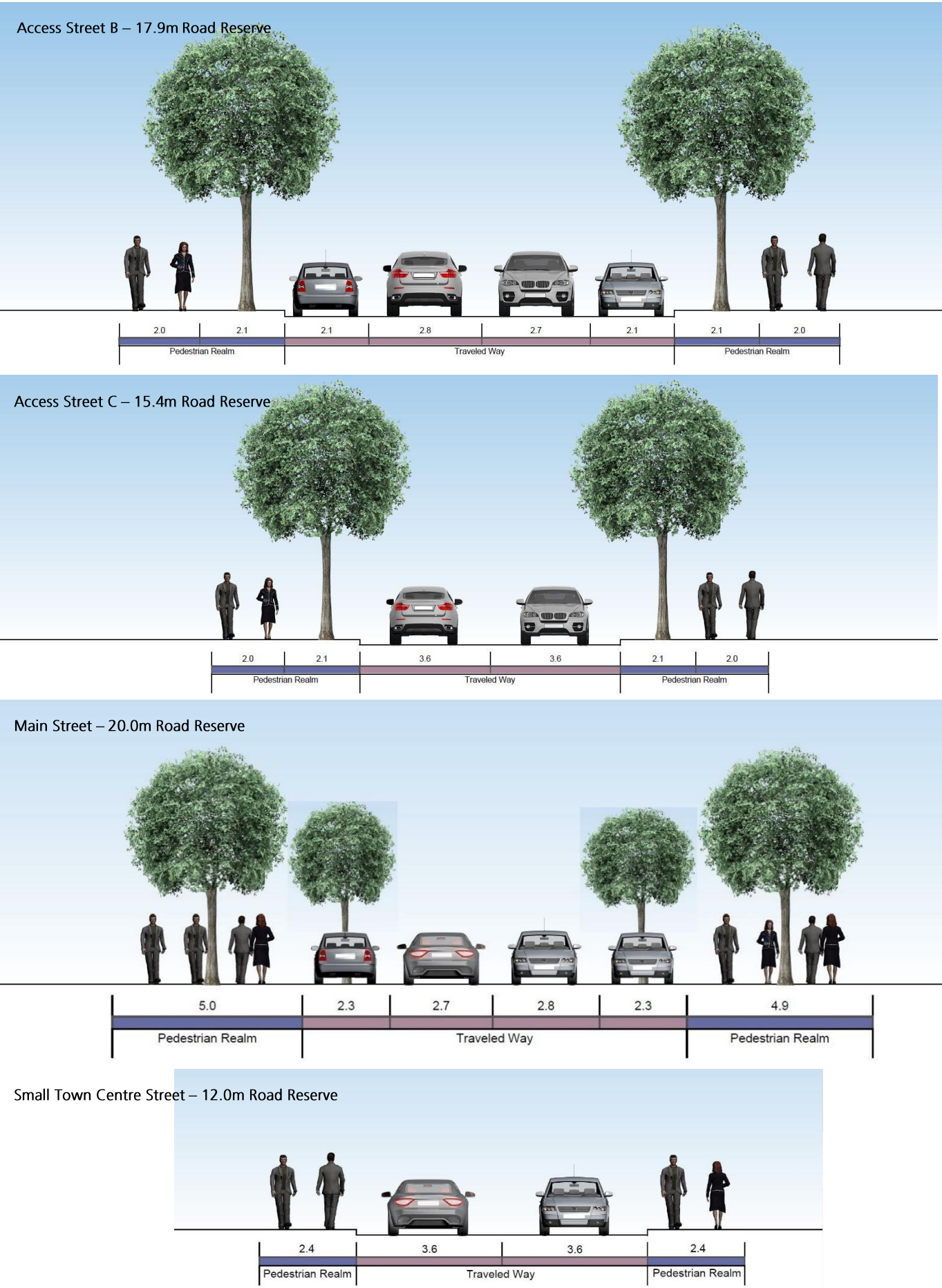
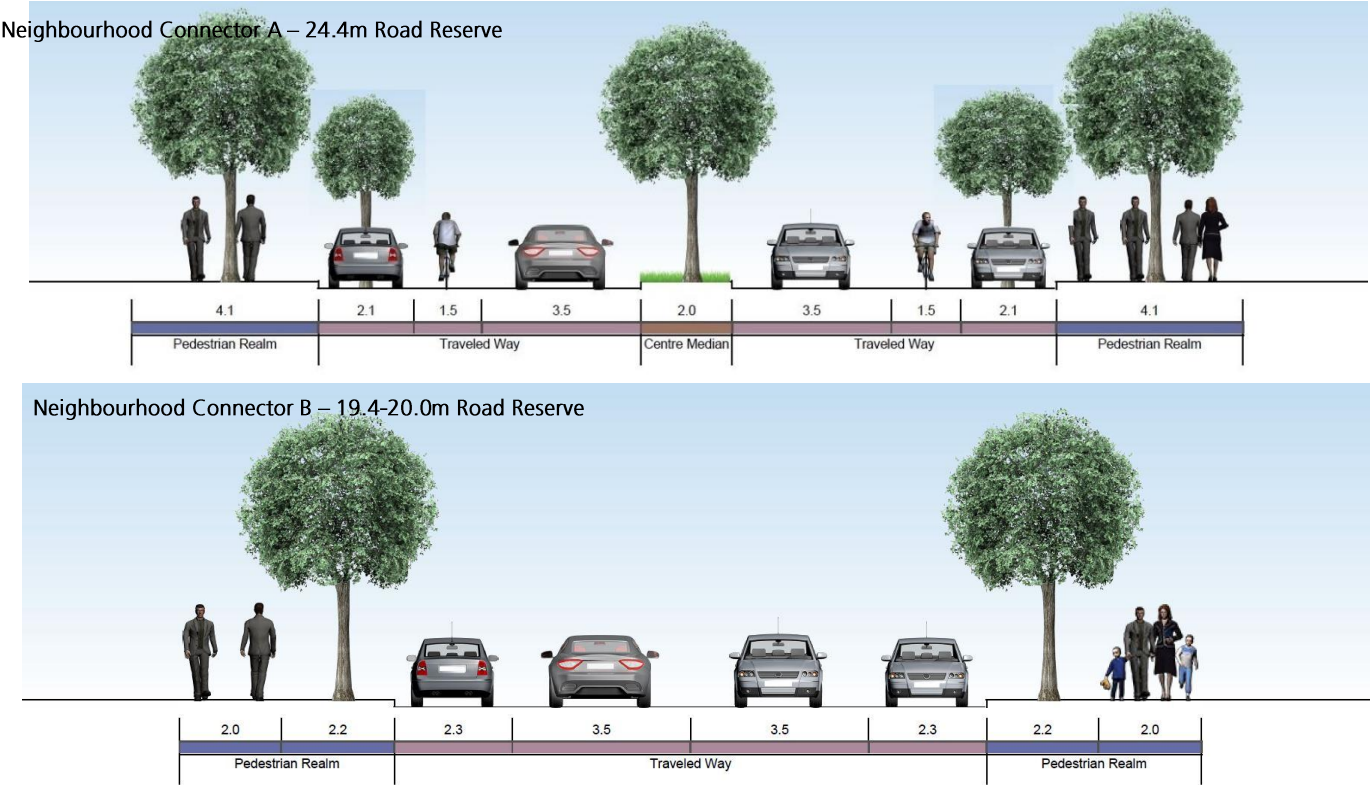


Figure 36 Proposed WTC new network cross sections

There are two existing roads where the current road hierarchy designations are not appropriate given the existing, or forecast traffic volumes, as follows:

- Dundobar Road – currently carries 10,500 vpd, well over the traffic volume upper threshold for a local distributor. With the intensification of land use is forecast to carry up to 15,000 vpd. Dundobar Road be designated as an Integrator Arterial B (activity centre) or a District Distributor B under the MRWA definitions.
- Hastings Street – currently carries 2,000 vpd however with intensification of land use is forecast to carry up to 4,000 vpd. It also forms the fourth approach of the signalised intersection between Wanneroo Road and Conlan Avenue. Hastings Street is currently classified as an Access Street, but this should be upgraded to a Neighborhood Connector B or a Local Distributor under the MRWA definitions. This does not require any widening to the existing road reserve.

Within the WTC, all T-intersections should operate under priority control (excluding certain intersections along Wanneroo Road which should operate under signal control, or priority control restricted to left in left out movements). Additional roundabout controlled intersections should be avoided, due to their impact on pedestrian and cyclist safety and accessibility. Proposed intersection treatments area shown in Figure 37.

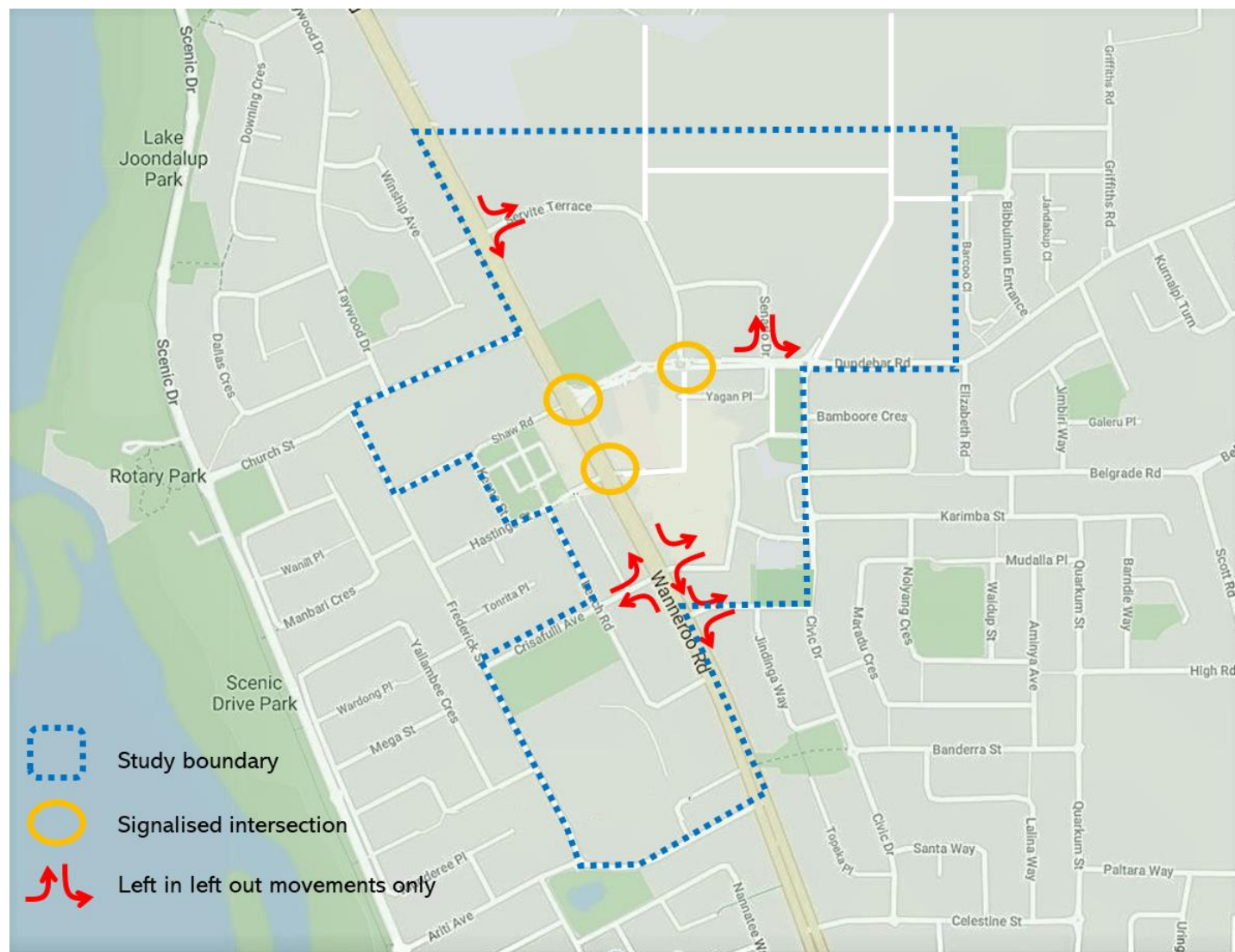


Figure 37 Proposed intersection treatments within the WTC

The proposed intersection of Wanneroo Road with the new east west connection (opposite Hart Court) requires careful consideration. For safety reasons, a priority controlled four-way intersection is not recommended. Instead the new east west connection should be limited to left in left out movements.

The four-way intersection of Dundobar Road with Servite Terrace and Rocca Way will be modified from roundabout control to signal control to improve pedestrian and cyclist safety. The four-way intersection of Dundobar Road with Yagan Place and Senario Drive will be maintained in its current form.

8.5 Freight Servicing

Wanneroo Road is part of the secondary freight network, approved to carry restricted access vehicles (RAVs) up to 27.5m in length and up to a mass of 87.5 tonnes. Wanneroo Road will continue to serve as part of the freight network for the foreseeable future.

Service vehicle access to the Wanneroo Central shopping centre loading docks will be via the new road connection between Wanneroo Road and Windan Way. This is currently a shopping centre crossover and internal road.

8.6 Centre Parking Policy

Outside of school areas and the Wanneroo Library frontage along Dundobar Road, on-street parking within the WTC is not subject to time restrictions. Short stay parking should be given priority over long stay parking within the WTC, therefore consideration should be given to the adoption of short stay time restrictions (for all on-street parking).

Off-street parking within the WTC is currently provided in discrete areas, with each lot providing its own parking and no consideration given to reciprocal usage. The WTC Plan seeks to change the approach to parking to that of 'park once', where parking serves the entire WTC, and not just individual or particular developments.

It is recommended the WTC adopt a parking management strategy where upper limits are applied to car parking provision, for example:

- 2 bays per 100m² for showrooms and offices and 4-5 bays per 100m² for shops.
- An alternative is the provision of a single non-residential parking rate, in the order of 3-3.5 bays per 100m².

The introduction of upper limits to parking provision needs to coincide with an improvement to pedestrian infrastructure within, and public transport services to and from the WTC.

For all development sites within the WTC where there is a mixed land use composition, reciprocal rights for parking use and unbundling parking bays from land uses should be encouraged. Each application would need to demonstrate:

- Total parking mix proposed in comparison to current requirements.
- Current on-street parking supply and use within 200m of front door of development.
- Implications for trip generation and impact of development site.
- Overall management plan.
- Retention of visitor bays.
- Provision or enhancement of End of Trip and bicycle parking facilities.

8.7 Indicator Measurements

The success of the movement network measures proposed in the Activity Centre Plan are based on the ability of strategies and statutory controls being able to support the intent of SPP 4.2 and the objectives of that policy.

The relationship between measures proposed and the performance indicators is set out in Table 8.

Table 8 Performance indicator measures

Measure	Indicator	How indicator is achieved
Public Transport Infrastructure		
Identify and preserve transit nodes as stations / stops for future transit services	Prioritisation of public transport	Increases attractiveness of public transport and modal shift.
Pursue high frequency / high priority transit corridor along Wanneroo Road between Whitfords Avenue and just south of Pinjar Road	Prioritisation of public transport	Provides high quality, fast and high capacity public transport service to provide a legitimate alternate to private vehicle modes.
Pursue public transit link between the potential East Wanneroo Rail Line and the WTC	Prioritisation of public transport	Provides high quality, fast and high capacity public transport service to provide a legitimate alternate to private vehicle modes.
Expand local bus services between WTC and the future residential areas in East Wanneroo	Prioritisation of public transport	Makes WTC more accessible, increases economic activity, supports use of public transport
Upgrade bus stop facilities within WTC	Prioritisation of public transport	Increases attractiveness of bus travel
Walking and Cycling		
Implementation of a 40km/h posted speed zone within the WTC to the east of Wanneroo Road	Provision of end of trip facilities Improved access and facilities for pedestrians and cyclists	Provides safer environment for pedestrians and cyclists and improves attractiveness of local trips within WTC by foot or bicycle.
Retention and improvement of pedestrian phases at all approaches at signalised intersections	Improved access and facilities for pedestrians and cyclists	Supports movement of pedestrians over busiest intersections and attractiveness of non-private vehicle modes.
Modification of the intersection of Dundobar Road with Servite Terrace and Rocca Way from roundabout to traffic signal control	Improved access and facilities for pedestrians and cyclists	Improves safety for the movement of pedestrians and cyclists through this intersection
Any new town centre streets to have a footpath on both sides, or a footpath on one side, and a shared path the other side	Improved access and facilities for pedestrians and cyclists	Supports movement of pedestrians as the primary mode of transport for travel within the WTC
All intersecting streets along Dundobar Road, Civic Drive and Servite Terrace to incorporate Wombat Crossings for pedestrian priority – except at signalised intersections	Improved access and facilities for pedestrians and cyclists	Prioritises pedestrian movement without restricting vehicles. Put clear emphasis on safety outcomes rather than vehicle speeds being the most important aspect of street network.
Implement recommendations of Bike Plan when finalised	Improved access and facilities for pedestrians and cyclists Provision of end of trip facilities	Supports travel by bicycle and makes WTC safer to move around. Assists in achieving modal shift away from private vehicle use.
Upgrade existing 1.2m insitu concrete footpath on the northern side of Church Street to a 2.5m shared path	Improved access and facilities for pedestrians and cyclists	Supports travel by bicycle and makes WTC safer to move around. Assists in achieving modal shift away from private vehicle use.

Measure	Indicator	How indicator is achieved
Planning controls must mandate the appropriate provision of cycle parking for public and private use and end of trip facilities (including showers, change rooms and lockers)	Provision of end of trip facilities	Provides end of trip facilities. Supports use of bicycle for commuting trips and maximises benefit from new cycling infrastructure.
Traffic		
Implementation of a 40km/h posted speed zone within the WTC to the east of Wanneroo Road	Improved access by all modes, including freight vehicles	Provides safer environment for pedestrians and cyclists and improves attractiveness of local trips within WTC by foot or bicycle. Doesn't impact on travel times by vehicle, nor restrict access.
Retention and improvement of pedestrian phases at all approaches at signalised intersections	Improved access by all modes, including freight vehicles	Supports movement of pedestrians over busiest intersections and attractiveness of non-private vehicle modes. No impact on access for private or service vehicles.
Modification of the intersection of Dundebur Road with Servite Terrace and Rocca Way from roundabout to traffic signal control	Improved access by all modes, including freight vehicles	Improves safety for the movement of pedestrians and cyclists through this intersection. Limited impact on access or travel times for private or service vehicles.
All intersecting streets along Dundebur Road, Civic Drive and Servite Terrace to incorporate Wombat Crossings for pedestrian priority – except at signalised intersections	Improved access by all modes, including freight vehicles	Prioritises pedestrian movement without restricting vehicles. Put clear emphasis on safety outcomes rather than vehicle speeds being the most important aspect of street network.
Provision of proposed street connections within WTC	Improved access by all modes, including freight vehicles	Improves access to all modes
Widening of Cafaggio Crescent and Senario Drive road reserves to include footpaths/ shared paths on the currently undeveloped sides	Improved access by all modes, including freight vehicles	Supports movement of pedestrians as the primary mode of transport for travel within the WTC
Creation of laneways or service roads (similar to Pupil Lane) for access to lots fronting the west side Wanneroo Road	Improved access by all modes, including freight vehicles	Rear access to lots fronting Wanneroo Road provides opportunity to rationalise Wanneroo Road crossovers, improving traffic flow along Wanneroo Road
Freight Servicing		
New street connection between Wanneroo Road (opposite Crisafulli Avenue, with left in left out control) and Windan Way, provides access to Wanneroo Central loading docks	Improved access by all modes, including freight vehicles	Provides preferred connection for service vehicles
Centre Parking Policy		
Apply upper limits to car parking provision	Provides for upper limits and common use of car parking	Maximises use of parking in WTC and reduces potential over provision. Assists in achieving modal shift away from private vehicle use.
Introduction of time restrictions to all on-street parking	Provides for upper limits and common use of car parking	Encourages efficient use of on-street parking bays by short term visitors and not long stay parkers. Assists in achieving modal shift away from private vehicle use.
In mixed land use composition, reciprocal rights for parking use and unbundling parking bays from land uses is encouraged.	Provides for upper limits and common use of car parking	Maximises use of parking in WTC and reduces potential over provision.



APPENDIX 3 BUSHFIRE MANAGEMENT PLAN

Bushfire Management Plan

Wanneroo Town Centre Structure Plan

Project No: EP17-133(03)

**Prepared for City of Wanneroo
October 2018**



Bushfire Management Plan

Wanneroo Town Centre Structure Plan



Document Control

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	Report issued to client.				

Disclaimer:

This document has been prepared in good faith and is derived from information sources believed to be reliable and accurate at the time of publication. Nevertheless, it is distributed on the terms and understanding that the author is not liable for any error or omission in the information sources available or provided to us, or responsible for the outcomes of any actions taken based on the recommendations contained herein. It is also expected that our recommendations will be implemented in their entirety, and we cannot be held responsible for any consequences arising from partial or incorrect implementation of the recommendations provided.

This document has been prepared primarily to consider the layout of development and/or the appropriate building construction standards applicable to development, where relevant. The measures outlined are considered to be prudent minimum standards only based on the standards prescribed by the relevant authorities. The level of bushfire risk mitigation achieved will depend upon the actions of the landowner or occupiers of the land and is not the responsibility of the author. The relevant local government and fire authority (i.e. Department of Fire and Emergency Services or local bushfire brigade) should be approached for guidance on preparing for and responding to a bushfire.

Notwithstanding the precautions recommended in this document, it should always be remembered that bushfires burn under a wide range of conditions which can be unpredictable. An element of risk, no matter how small, will always remain. The objective of the Australian Standard AS 3959-2009 is to "prescribe particular construction details for buildings to reduce the risk of ignition from a bushfire while the front passes" (Standards Australia 2009). Building to the standards outlined in AS 3959 does not guarantee a building will survive a bushfire or that lives will not be lost.

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Executive Summary

The City of Wanneroo (CoW) (the proponent) is seeking to progress the *Wanneroo Town Centre Structure Plan* (SP) (herein referred to as 'the Structure Plan'), which will guide future development of the Wanneroo town centre (herein referred to as 'the site'). The site comprises an area of land within Wanneroo and Sinagra, zoned as 'Centre' under the CoW District Planning Scheme (DPS) No. 2, in addition to the adjoining portion of Wanneroo Road. Combined it is approximately 90 hectares (ha) in size.

The northern portion of the site is currently identified as being within a 'bushfire prone area' under the state-wide *Map of Bush Fire Prone Areas* prepared by the Office of Bushfire Risk Management (OBRM 2018). The identification of land within a declared bushfire prone area requires assessment of the bushfire risk utilising the methodology describe in AS3959-2009. The suitability of the land, for the intended land use, is assessed for its consistency with the intent and objectives of *State Planning Policy 3.7 Planning in Bushfire Prone Areas* (SPP 3.7) (WAPC 2015), by the process described in the *Guidelines for Planning in Bushfire Prone Areas Version 1.3* (the Guidelines) (WAPC and DFES 2017).

The policy intent of SPP 3.7 is to preserve life and reduce the impact of bushfire on property and infrastructure. The purpose of this BMP is to assess bushfire hazards, within and nearby the site, and identify the 'management' strategies required to mitigate the threat posed by the hazards to ensure the preservation of life and to reduce the impact of bushfire on property and infrastructure and upon the continued function of the community.

The majority of the site is non-vegetated consisting of commercial, residential and public use buildings, and areas of existing public open space. The northern portion of the site (Lot 9000) consists of woodland (Class B) vegetation, with woodland vegetation located adjacent to the north-east boundary of the site. Woodland and grassland (Class G) vegetation has been identified within a private landholding to the north of the site.

In order to resolve the potential for bushfire to affect the site, a post development scenario has been assumed in which all classified vegetation within the site its either removed or managed in a 'low threat' standard. This excludes a small portion of vegetation in the north-eastern portion of the site, which has been identified for retention as a conservation area. Vegetation outside the site will remain the same as the pre-development assessment.

The outcomes of this BMP demonstrate that as development progresses, it will be possible for an acceptable solution to be adopted for each of the applicable bushfire protection criteria outlined in the Guidelines. This includes:

- **Location:** future habitable buildings can be located, on completion, within a Moderate Bushfire Gazard area. Habitable buildings can be constructed in areas subject to a BAL rating of BAL-29 or less.
- **Siting and Design:** all future habitable buildings can be sited within the proposed development so that BAL-29 or less can be achieved based on the proposed structure plan and assumed management within the proponent's landholdings.
- **Vehicular Access:** the majority of the site currently consists of an integrated road network, with Wanneroo Road providing the main access to two different destinations (north and south

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of the site), in addition to further destinations via the multiple connector roads within and surrounding the site. The structure plan demonstrates that the future development within the northern portion of the site will be able to connect to existing road network, providing access to at least two different destinations.

- **Water:** the development will be provided with a permanent and reticulated water supply to support onsite firefighting requirements.

The measures to be implemented through this structure plan and associated future subdivision process have been outlined as part of this BMP and can be used to support future planning and development approval processes. A revised BMP is likely to be required to support any future subdivision applications, particularly if the lot layout detail is different, and will respond to the subdivision design.

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Appendices

Appendix A

Wanneroo Town Centre Structure Plan (TBB 2018)

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List of Abbreviations

Table A1: Abbreviations – General terms

General terms	
AHD	Australian Height Datum
APZ	Asset Protection Zone
AS 3959	<i>Australian Standard 3959-2009 Construction of buildings in bushfire prone areas</i>
BAL	Bushfire Attack Level
BMP	Bushfire Management Plan
BPAD	Bushfire Planning and Design
FDI	Fire Danger Index
FZ	Flame Zone
MRS	Metropolitan Regional Scheme

Table A2: Abbreviations – Organisations

Organisations	
BoM	Bureau of Meteorology
CoW	City of Wanneroo
DFES	Department of Fire and Emergency Services
OBRM	Office of Bushfire Risk Management
SES	State Emergency Services
WAPC	Western Australian Planning Commission

Table A3: Abbreviations – Legislation and policies

Legislation	
Guidelines	<i>Guidelines for Planning in Bushfire Prone Areas version 1.3 (WAPC and DFES 2017)</i>
SPP 3.7	<i>State Planning Policy 3.7 Planning in Bushfire Prone Areas (WAPC 2015)</i>

Table A4: Abbreviations – Planning and building terms

Planning and building terms	
AS 3959	<i>Australian Standard 3959-2009 Construction of buildings in bushfire prone areas</i>
DPS	District Planning Scheme

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1 Introduction

1.1 Background

The City of Wanneroo (CoW) (the proponent) is seeking to progress the *Wanneroo Town Centre Structure Plan* (SP) (herein referred to as ‘the Structure Plan’), which will guide future development of the Wanneroo town centre (herein referred to as ‘the site’), with the proposed Structure Plan layout provided in **Appendix A** and the site boundary shown in **Figure 1**. The site incorporates an area of land within Wanneroo and Sinagra zoned ‘Centre’ under the CoW District Planning Scheme (DPS) No. 2, in addition to the adjoining portion of Wanneroo Road, and is approximately 90 hectares (ha) in size.

The northern portion of the site is currently identified as being within a ‘bushfire prone area’ under the state-wide *Map of Bush Fire Prone Areas* prepared by the Office of Bushfire Risk Management (OBRM 2018), as shown in **Plate 1**. The identification of land within a declared bushfire prone area requires assessment of the bushfire risk utilising the methodology describe in AS3959-2009. The suitability of the land, for the intended land use, is assessed for its consistency with the intent and objectives of *State Planning Policy 3.7 Planning in Bushfire Prone Areas* (SPP 3.7) (WAPC 2015), by the process described in the *Guidelines for Planning in Bushfire Prone Areas Version 1.3* (the Guidelines) (WAPC and DFES 2017).

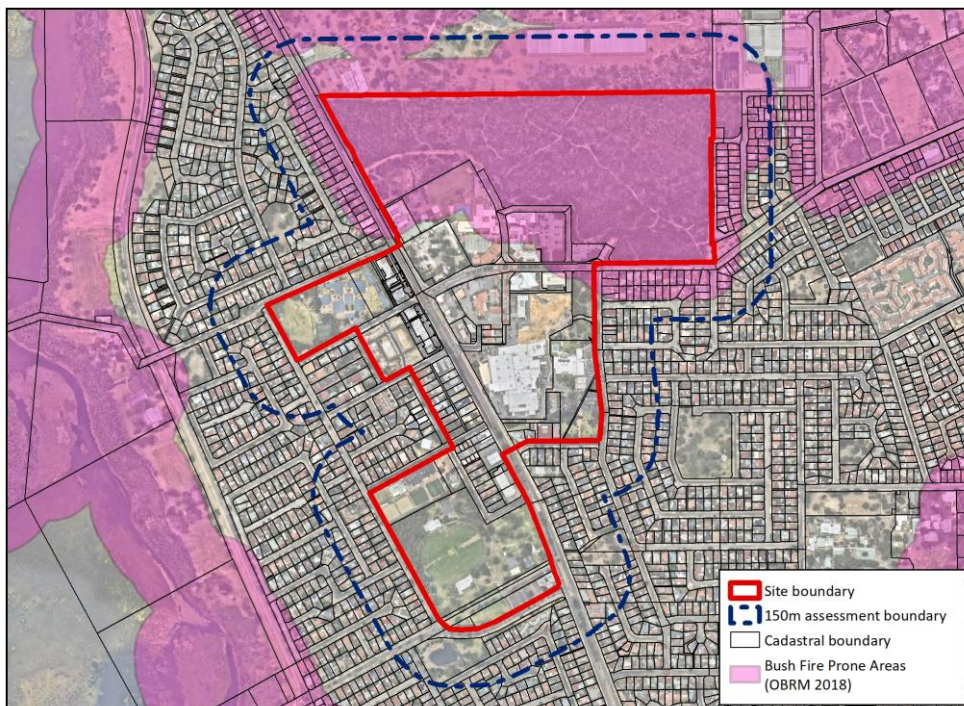


Plate 1: Areas within and surrounding the site identified as ‘bushfire prone areas’ (as indicated in purple) under the state-wide Map of Bush Fire Prone Areas (OBRM 2018).

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1.2 Aim of this report

The purpose of this BMP is to assess bushfire hazards within the site, and nearby, to ensure that the threat posed by any identified hazards can be appropriately mitigated and managed. It has been prepared to support the proposed subdivision of the site and addresses the requirements of SPP 3.7 (WAPC 2015), the Guidelines (WAPC and DFES 2017) and *Australian Standard 3959-2009 Construction of buildings in bushfire prone areas* (AS 3959) (Standards Australia 2009). The document includes:

- An assessment of the existing classified vegetation in the vicinity of the site (within 150 m) and consideration of bushfire hazards that will exist in the post development scenario (**Section 3**).
- Commentary on how the future development can achieve the bushfire protection criteria outlined within the Guidelines including an indication of BAL ratings likely to be applicable to future development (**Section 5**).
- An outline of the roles and responsibilities associated with implementing this BMP (see **Section 6**).

1.3 Statutory policy and framework

The following key legislation, policies and guidelines are relevant to the preparation of a BMP:

- *Fire and Emergency Services Act 1998*
- *Bush Fires Act 1954*
- *Planning and Development Act 2005*
- *Building Act 2011*
- *State Planning Policy 3.7 Planning in Bushfire Prone Areas* (WAPC 2015)
- *Guidelines for Planning in Bushfire Prone Areas version 1.3* (WAPC and DFES 2017)
- *Australian Standard AS 3959 – 2009 Construction of buildings in bushfire prone areas* (Standards Australia 2009)

1.4 Description of the proposed development

The proposed Structure Plan is provided in **Appendix A** and proposes the following land uses across the site:

- Residential, including areas of medium and higher densities.
- Education
- Civic and community
- Mixed uses
- Open space
- Conservation
- Urban space.

A range of existing land uses across the site are proposed to continue into the future (as discussed in **Section 1.5**), whilst other areas have been identified for intensification or modification to their existing land use (such as Lot 9000, which is identified to primarily support future residential development). The site is subject to the existing *Wanneroo Town Centre Structure Plan*, which was

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adopted by the City of Wanneroo in 2001, which has undergone a number of amendments since it was first adopted, and will be replaced by the proposed SP.

The proposed land uses within the site are consistent with the Metropolitan Region Scheme (MRS) zoning across the site, with the majority of the site 'Urban', the area to the north of Dundee Road 'Urban deferred' and Wanneroo Road identified as a 'Primary regional road', as shown in **Plate 2**. The 'Urban deferred' zone across the northern portion of the site was established to maintain suitable separation from urban areas and the Ingham's poultry processing facility to the north, preventing encroachment of sensitive land uses into adjacent areas. However, following the recent closure of this facility and sale of this land to facilitate urban development, it is likely that the 'urban deferred' zoning can now be lifted to enable urban development of this land (including the northern portion of the site).

The site is located in an area with an existing public road network, which includes Wanneroo Road which runs on a north-south orientation through the site, with multiple connector roads providing access throughout the site and surrounding suburbs.

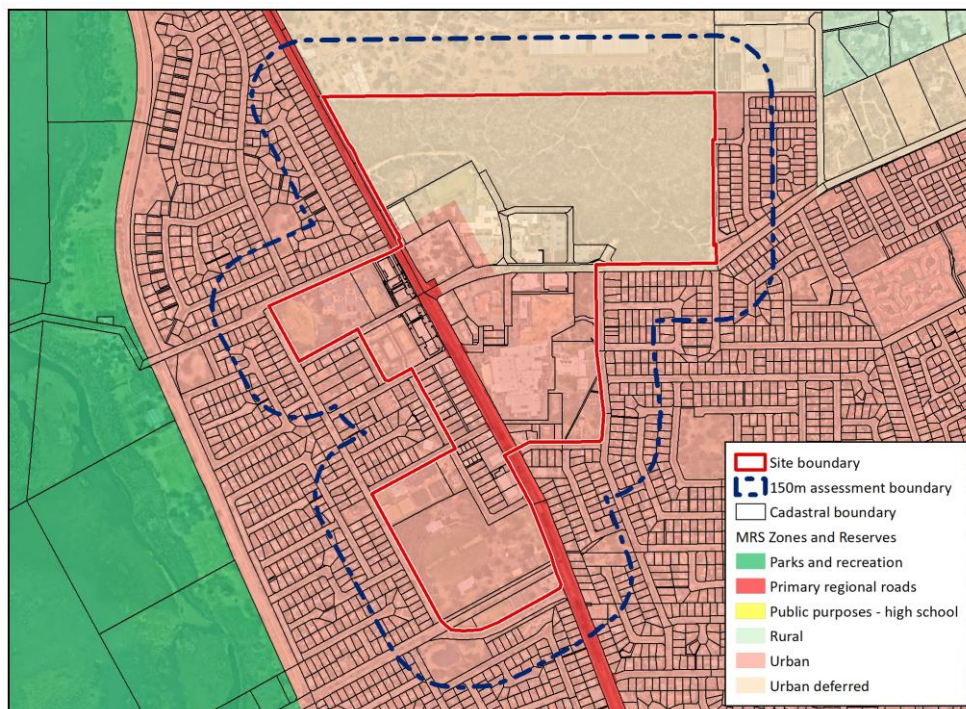


Plate 2: MRS zones and reserves within and surrounding the site (DPLH 2018)

1.5 Description of the site characteristics

The site has historically been cleared of remnant native vegetation, except for the northern portion of the site (Lot 9000 Wanneroo Road). A review of historical aerial imagery indicates the majority of the southern portion of the site was cleared prior to 1965, with the majority of the remainder of the site (except for Lot 9000) cleared between 1965 and 1974 to facilitate development across the central portion of the site (Landgate 2018).

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The site currently supports a range of existing land uses, including:

- Civic buildings and open space areas
- A number of commercial shopping centres and associated commercial premises
- Two primary schools
- Sporting clubs and grounds, including football, lawn bowls and cricket ovals.
- A number of service stations
- A large area of intact remnant vegetation in the north
- Road reserves.

The site is characterised by undulating terrain, but generally slopes down toward Lake Joondalup to the west of the site. The maximum elevation of the site is 75 metres Australian Height Datum (mAHD) in its north-eastern extent, whilst the minimum elevation of the site is 29 m AHD in its southern-most extent (DoW 2008).

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2 Environmental Considerations

As the majority of the site currently supports existing residential and commercial development, the environmental values of the site have been significantly reduced. Based on the Environmental Assessment and Management Strategy prepared by Emerge Associates (2018), the key environmental values identified within and surrounding the site include:

- Remnant vegetation within the northern portion of the site (Lot 9000), which potentially represents a threatened ecological community, in addition to containing potential foraging and roosting habitat for threatened fauna.
- Lake Joondalup, a conservation category wetland is located approximately 470 m to the west of the site.

Remnant vegetation within the site is potentially representative of the '*Banksia Woodlands of the SCP*' threatened ecological community based on the findings of a reconnaissance flora and vegetation survey carried out by Emerge in 2018. However, additional spring flora and vegetation surveys would be required to confirm this.

In addition, intact native vegetation within the northern portion of the site is considered likely to be also representative of the potential '*Tuart Woodlands and Forests of the SCP*' ecological community, which has been recently been nominated to be listed as a threatened ecological community. Whilst an outcome regarding the potential listing has yet to be reached, if the community is listed as threatened, additional spring flora and vegetation surveys would be required to confirm this community occurs within the site.

Vegetation within the site provides potential habitat for threatened species of black cockatoo, including Carnaby's black cockatoo (CBC) and forest red-tailed black cockatoo (FRTBC). This includes potential foraging, roosting and nesting habitat associated with intact native vegetation within Lot 9000.

Future development within the site will need to consider the environmental values, and if the vegetation within the site is determined to represent threatened ecological communities and/or habitat for the threatened species of black cockatoo, it is likely that a referral to the federal Department of Environment and Energy pursuant to the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) will be required to determine if future development within the site represents a significant impact. Future subdivision planning may need to reflect any changes to the amount of land identified as 'conservation' in the proposed SP, which will be determined at future detailed planning stages.

Future development within the site is not proposed to impact on Lake Joondalup, due to the distance to the waterbody, and the limited amount of development proposed to occur within the site.

3 Bushfire Assessment Results

Bushfire risk for the site has been appropriately considered in the specific context of the Guidelines (WAPC and DFES 2017) and AS 3959.

The objective of AS 3959 is to reduce the risk of ignition and loss of a building to bushfire. It provides a consistent method for determining a radiant heat level (radiant heat flux) as a primary consideration of bushfire attack on a building or object. It also prescribes simple construction responses that can resist the determined radiant heat level at a given distance from the fire and is based on six Bushfire Attack Level (BAL) ratings: BAL-LOW, BAL-12.5, BAL-19, BAL-29, BAL-40 and BAL-FZ.

Two separate methods are outlined in AS 3959 for determining the impact of bushfire on dwellings and have been outlined below:

- **Method 1**, outlined in Section 2 and Appendix A of AS 3959, provides a basic assessment of radiant heat flux levels at various distances from classified vegetation (up to 100 m). This method assumes standard fuel loads for classified vegetation as outlined in AS 3959 and considers the effective slope beneath vegetation. This method can be used to determine appropriate setbacks to dwellings to achieve different levels of radiant heat exposure (i.e. BAL-12.5 to BAL-FZ).
- **Method 2**, outlined in Appendix B of AS 3959, provides access to the formula used to derive the Method 1 values. Where justified it enables the inputs used in Method 1 to be varied, to reflect true site conditions to provide a site-specific assessment of the radiant heat level at any given distance from the fire.

Not all vegetation is a classified bushfire risk. Vegetation and ground surfaces that are exempt from classification, as a potential hazard, is identified as low threat under Section 2.2.3.2 of AS 3959. Low threat vegetation includes the following:

- a) Vegetation of any type more than 100 m from the site.
- b) Single areas of vegetation less than 1 ha in area and not within 100 m of other areas of vegetation being classified.
- c) Multiple areas of vegetation less than 0.25 ha in area and not within 20 m of the site or each other.
- d) Strips of vegetation less than 20 m wide (measured perpendicular to the elevation exposed to the strip of vegetation) regardless of length and not within 20 m of the site or each other, or other areas of vegetation being classified.
- e) Non-vegetated areas, including waterways, roads, footpaths, buildings and rocky outcrops.
- f) Low threat vegetation, including grassland managed in a minimal fuel condition, maintained lawns, golf courses, maintained public reserves and parkland, vineyards, orchards, cultivated gardens, commercial nurseries, nature strips and wind breaks.

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3.1 Bushfire Attack Level Assessment

In accordance with Appendix Five of the Guidelines, there is an option to complete a bushfire hazard level assessment to support structure plans. Therefore, this BMP includes a bushfire hazard level assessment as well as a method 1 BAL assessment in order to determine the BAL ratings likely to be applicable to future habitable buildings based on the vegetation classifications and effective slopes detailed in **Table 1**.

3.1.1 Assessment inputs

Assessing bushfire hazards takes into account the classes of vegetation within the site and surrounding area for a minimum of 100 m, in accordance with AS 3959. The assignment of vegetation classifications is based on an assessment of vegetation structure, which includes consideration of the various fuel layers of different vegetation types. For example, fuel layers in a typical forest environment can be broken-down into five segments as illustrated in **Plate 3** below. These defined fuel layers are considered when determining the classification of vegetation and associated bushfire hazard levels.

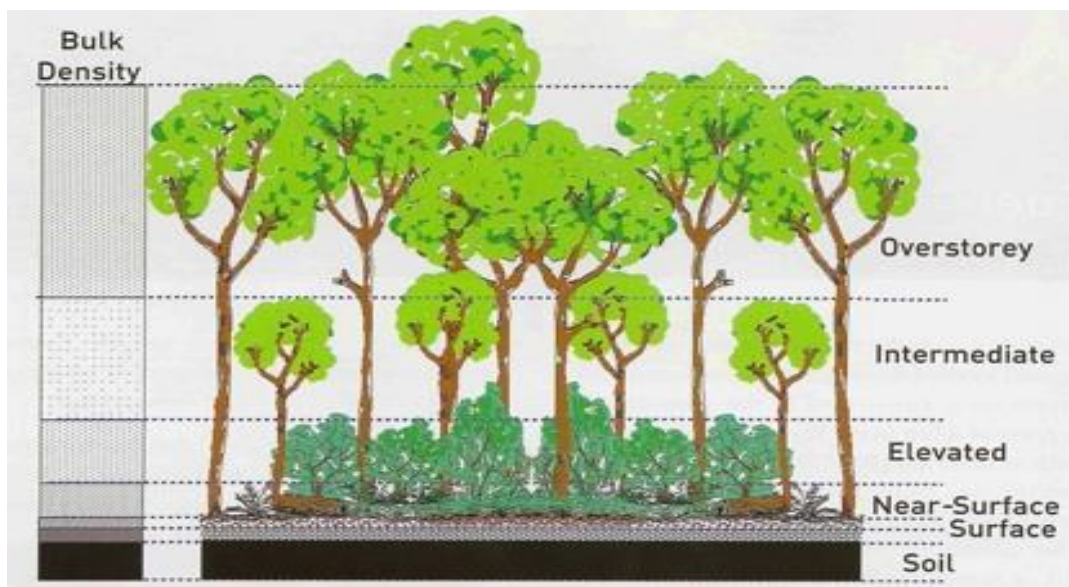


Plate 3: The five fuel layers in a forest environment that could be associated with fire behaviour (Gould et al. 2007)

An assessment of existing vegetation within the site and surrounding 150 m was undertaken on **23 March 2018** in accordance with AS 3959 and the Guidelines.

Table 1 below outlines the type of vegetation observed within and surrounding the site, the classification of each area of vegetation in accordance with Section 2.2.3 and Table 2.4.3 of AS 3959, and its assumed post-development classification and any associated management of this vegetation (where applicable).

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As outlined in **Table 1**:





- The pre-development AS 3959 vegetation classifications (and associated photo locations) are shown in **Figure 2**.
- The bushfire hazard ratings are shown in **Figure 3**.
- The post-development AS 3959 vegetation classifications are shown in **Figure 4**.
- The effective slope for each area of classified vegetation present in the post-development scenario is shown in **Figure 5**.

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Table 1: Vegetation classification, effective slope and future management

Pre-development (see Figure 2 and Figure 3)			Post development (see Figure 4 and Figure 5)	
Plot no.	AS 3959 classification	Site photo/s (location points shown in Figure 2)	Plot no.	AS 3959 classification, effective slope and assumptions
1 - 4	<p>AS 3959 classification (Figure 2): Woodland (Class B)</p> <p>Bushfire hazard level (Figure 3): Extreme</p> <p>Woodland vegetation has been identified within the northern portion of the site (Lot 9000), in addition to the north of the site within a private landholding and to the north-east within Boyagin Park.</p> <p>Vegetation within these plots is characterised by areas with open canopies and surface and near-surface fuels consisting of native species including <i>Macrozamia</i> and <i>Xanthorrhoea</i> and non-native grass species.</p>	 <p>Photo location 1: woodland vegetation located in the northern portion of the site</p>  <p>Photo location 3: woodland vegetation located in the northern portion of the site</p>	 <p>Photo location 2: woodland vegetation located in the northern portion of the site</p>  <p>Photo location 4: woodland vegetation located in the northern portion of the site</p>	<p>1, 3 - 4</p> <p>AS 3959 classification (Figure 4): Woodland (Class B)</p> <p>Effective slope (Figure 5): Flat/upslope</p> <p>Woodland vegetation identified within the north-eastern portion of the site (Plot 1) will be retained as future conservation vegetation. This vegetation has been assumed to remain in its current state in perpetuity, and will therefore pose a bushfire risk to the site.</p> <p>Woodland vegetation to the north-east of the site, within Boyagin Park, will be retained in perpetuity as it occurs outside of the site, and current management of the area will continue into the future, therefore posing a bushfire risk to the site.</p> <p>Woodland vegetation to the north of the site (Plot 4) has been assumed to remain as a temporary hazard. As the 'Urban deferred' zoning is lifted from the landholding it is likely to be developed, but as the timing for this development is unknown, this vegetation has been assumed to remain a temporary bushfire hazard to the site.</p>

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Table 1: Vegetation classification, effective slope and future management (continued)

Pre-development (see Figure 2 and Figure 3)			Post development (see Figure 4 and Figure 5)	
Plot no.	AS 3959 classification	Site photo/s (location points shown in Figure 2)	Plot no.	AS 3959 classification, effective slope and assumptions
1 - 4			6	<p>AS 3959 classification (Figure 4): Non-vegetated (Exclusion 2.2.3.2(e))</p> <p>Effective slope (Figure 5): Not applicable</p> <p>The majority of woodland vegetation within the northern portion of the site (Plot 2) will be removed as future development which will result in currently vegetated areas being converted to non-vegetated areas comprised of public roads and/or residential lots.</p>
			7	<p>AS 3959 classification (Figure 4): Low threat vegetation (Exclusion 2.2.3.2(f))</p> <p>Effective slope (Figure 5): Not applicable</p> <p>Areas of woodland vegetation in the northern portion of the site (Plot 2) will be converted to public open space and will be landscaped and managed as low threat vegetation (exclusion clause 2.2.3.2(f)). This will be the responsibility of the future developer initially, then the City of Wanneroo following handover.</p>

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Table 1: Vegetation classification, effective slope and future management (continued)

Pre-development (see Figure 2 and Figure 3)			Post development (see Figure 4 and Figure 5)	
Plot no.	AS 3959 classification	Site photo/s (location points shown in Figure 2)	Plot no.	AS 3959 classification, effective slope and assumptions
5	<p>AS 3959 classification (Figure 2): Grassland (Class G)</p> <p>Bushfire hazard level (Figure 3): Moderate</p> <p>Grassland has been identified to the north of the site within a private landholding. This vegetation is characterised by unmanaged weed species.</p>	No photos available	5	<p>AS 3959 classification (Figure 4): Grassland (Class G)</p> <p>Effective slope (Figure 5): Flat/upslope</p> <p>Grassland vegetation to the north of the site has been assumed to remain as a temporary hazard. As the 'Urban deferred' zoning is lifted from the landholding it is likely to be developed, but as the timing for this development is unknown, this vegetation has been assumed to remain a temporary bushfire hazard to the site.</p>

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Table 1: Vegetation classification, effective slope and future management (continued)

Pre-development (see Figure 2 and Figure 3)			Post development (see Figure 4 and Figure 5)	
Plot no.	AS 3959 classification	Site photo/s (location points shown in Figure 2)	Plot no.	AS 3959 classification, effective slope and assumptions
6	<p>AS 3959 classification (Figure 2): Non-vegetated (Exclusion 2.2.3.2(e))</p> <p>Bushfire hazard level (Figure 3): Low, however as required under the Guidelines, any areas within 100 m of moderate or extreme hazards would be considered moderate hazard, to reflect the potential increased risk.</p> <p>Non-vegetated areas such as roads, driveways, waterbodies, existing residential and commercial buildings and areas of mineral earth within and surrounding the site have been excluded in accordance with Clause 2.2.3.2(e) of AS 3959.</p>	 <p><i>Photo location 5: non-vegetated area within the northern portion of the site</i></p>  <p><i>Photo location 7: non-vegetated area within the northern portion of the site</i></p>	 <p><i>Photo location 6: non-vegetated area within the northern portion of the site</i></p>  <p><i>Photo location 8: non-vegetated area within the southern portion of the site</i></p>	<p>6</p> <p>AS 3959 classification (Figure 4): Non-vegetated (Exclusion 2.2.3.2(e))</p> <p>Effective slope (Figure 5): Not applicable</p> <p>The existing maintenance regimes for all existing non-vegetated areas surrounding the site are assumed to continue in the long-term based on current land uses and management arrangements.</p> <p>In addition, areas within the site that have been identified as non-vegetated will remain non-vegetated when converted to public roads and/or residential and lots as part of the proposed development of the site.</p>

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Table 1: Vegetation classification, effective slope and future management (continued)

Pre-development (see Figure 2 and Figure 3)			Post development (see Figure 4 and Figure 5)	
Plot no.	AS 3959 classification	Site photo/s (location points shown in Figure 2)	Plot no.	AS 3959 classification, effective slope and assumptions
	<p>AS 3959 classification (Figure 2): Low threat vegetation (Exclusion 2.2.3.2(f))</p> <p>Bushfire hazard level (Figure 3): Low, however as required under the Guidelines, any areas within 100 m of moderate or extreme hazards would be considered moderate hazard, to reflect the potential increased risk.</p> <p>Within the site and surrounds, areas of low threat vegetation have been identified and are largely associated with existing school gardens and ovals, public ovals and reserves, and managed road verges.</p>	 <p>Photo location 9: low threat vegetation within the central portion of the site</p>  <p>Photo location 11: low threat vegetation in the central portion of the site</p>	 <p>Photo location 10: low threat vegetation to the north-east of the site</p>  <p>Photo location 12: low threat vegetation in the southern portion of the site</p>	<p>AS 3959 classification (Figure 4): Low threat vegetation (Exclusion 2.2.3.2(f))</p> <p>Effective slope (Figure 5): Not applicable</p> <p>The existing maintenance regimes for all existing low-threat vegetation surrounding the site are assumed to continue in the long-term based on current land uses and management arrangements, in accordance with the requirements of the City of Wanneroo and community expectations.</p>

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3.1.1.1 Post development assumptions

The BAL assessment, to determine the predicated BAL ratings, has assumed the following:

- **Designated FDI:** 80
- **Flame temperature:** 1090 K
- **Vegetation classification:** woodland (Class B) and grassland (Class G) vegetation identified within the post-development scenario, see **Figure 4**.
- **Effective slope beneath classified vegetation:** flat/upslope (see **Figure 5**)
- **Setback distances:** as per Table 2.4.3 in AS 3959 with the relevant distances used to inform the BAL contour plan provided in **Figure 6** and summarised in **Table 2**.

In addition to the above, the following key assumptions have informed this assessment:

- Areas outside the site, within private landholdings, public areas and road reserves, that have been identified as low threat will continue to be managed and/or considered to achieve low threat (in accordance with Section 2.2.3.2 of AS 3959) based on the existing maintenance regimes, and/or as per the City of Wanneroo Firebreak Notice.
- All classified vegetation within the site, except for the woodland vegetation in the north-eastern portion of the site which will be retained for conservation purposes, will be removed or modified to achieve low threat in accordance with Section 2.2.3.2 of AS 3959. This may include:
 - Clearing of vegetation
 - Regular maintenance including removal of weeds and dead material
 - Low pruning of trees
 - Application of ground covers such as mulch or non-flammable materials
 - Regularly mowing/slashing of grass to less than 100mm in height.
- Classified grassland vegetation to the north of the site has been assumed to be removed in the long-term as the 'Urban deferred' zoning under the MRS is lifted allowing for future urban development. However, as the timing for the removal of this vegetation is unknown, it has been assumed to remain in its current state in the short-to-medium term, and will therefore remain a bushfire risk to development within the site.

3.1.2 Assessment outputs

For the BAL assessment, **Table 2** provides a summary of the setback distances necessary from classified vegetation to achieve the indicated BAL ratings, with the BAL Contour Plan (**Figure 6**) being a visual representation of these distances. The setback distances are based on the post-development classified vegetation (**Figure 4**), effective slope (**Figure 5**) and are taken from Table 2.4.3 of AS 3959.

The BAL assessment indicates that a BAL rating of BAL-29 or less can be achieved at future habitable buildings based on the indicated spatial layout of the structure plan and proposed public roads.

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Table 2: Setback distances based on vegetation classification and effective slope and Table 2.4.3 of AS 3959, as determined by the method 1 BAL assessment

Post development plot number (see Figure 4)	Vegetation classification	Effective slope (see Figure 5)	Distance to vegetation	BAL rating
Plot 1, 3 - 4	Woodland (Class B)	Flat/upslope	< 10 m	BAL-FZ
			10 - < 14 m	BAL-40
			14 - < 20 m	BAL-29
			20 - < 29 m	BAL-19
			29 - < 100 m	BAL-12.5
			> 100 m	BAL-LOW
Plot 5	Grassland (Class G)	Flat/upslope	< 6 m	BAL-FZ
			6 - < 8 m	BAL-40
			8 - < 12 m	BAL-29
			12 - < 17 m	BAL-19
			17 - < 50 m	BAL-12.5
			> 100 m	BAL-LOW

4 Identification of Bushfire Hazard Issues

From a bushfire hazard management perspective, the key issues that are likely to require management and/or consideration as part of future development within the site include:

- Provision of appropriate separation distance from permanent bushfire hazards in the north-eastern portion of the site to ensure a BAL rating of BAL-29 or less can be achieved at future built form.
- Fuel management of the development is staged to ensure temporary fuels do not impact on development and/or public open space is appropriately designed and managed to achieve low threat standards, in accordance with AS 3959 and the requirements of Liveable Neighbourhoods and the City of Wanneroo, where low threat vegetation is identified in **Figure 4**.
- Provision of appropriate vehicular access to ensure that when development within the site is fully constructed, egress to at least two different destinations will be available to residents/future workers and emergency personnel. As part of staged development, temporary access routes/egress may be required including emergency access ways or temporary turnaround areas.
- Provision of appropriate water supply and associated infrastructure.

These issues are considered further in **Section 5**.

5 Assessment against the Bushfire Protection Criteria

This BMP provides an outline of the mitigation strategies that will ensure that as subdivision and the associated development progresses, an acceptable solution and/or performance-based system of control is adopted for each of the bushfire protection criteria detailed within Appendix Four of the Guidelines (WAPC and DFES 2017). The bushfire protection criteria identified in the Guidelines and addressed as part of this BMP are:

- Element 1: Location of the development
- Element 2: Siting and design of the development
- Element 3: Vehicular access
- Element 4: Water supply.

As part of future development, it is likely that an 'acceptable solution' will be able to address the intent of all four bushfire protection criteria as part of future subdivision of the site. A summary of how this can be achieved and an associated compliance statement for each has been provided in **Table 3**.

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Table 3: Summary of bushfire protection criteria and compliance statement

Bushfire protection criteria	Intent	Method of compliance	Proposed bushfire management strategies	Compliance Statement
		Acceptable solution		
Element 1: Location	To ensure that strategic planning proposals, subdivision and development applications are located in areas with the least possible risk of bushfire to facilitate the protection of people, property and infrastructure.	A1.1 Development location	<p>Future development (i.e. future habitable buildings) within the site can be located in an area subject to a low or moderate bushfire hazard in the post-development scenario and is therefore able to achieve the bushfire protection criteria. The BAL contour plan (see Figure 6) indicates that future habitable buildings within the site will be able to achieve a BAL rating of BAL-29 or less.</p> <p>Further planning at the subdivision application stage will inform the proposed lot layout for the site, with an updated BMP (and associated BAL assessment) to be prepared to ensure that future dwellings/buildings are still able to achieve a BAL rating of BAL-29 or less.</p>	Based on the outlined management measures, future development would be able to comply with and meet the intent of Element 1: Location.
Element 2: Siting and design	To ensure the siting and design of development minimises the level of bushfire impact.	A2.1 Asset Protection Zone	<p>One of the most important bushfire protection measures influencing the safety of people and property is to create an Asset Protection Zone (APZ) around buildings. The APZ is a low fuel area immediately surrounding a building, and can include non-flammable features such as irrigated landscapes, gardens, driveways and roads.</p> <p>The post development vegetation classification (Figure 4) identifies permanent bushfire hazards within the north-eastern portion of the site and to the north-east of the site. In addition, temporary bushfire hazards are also identified to the north of the site.</p> <p>The structure plan, through the location of public roads and public open space provides suitable separation to enable a BAL rating of BAL-29 or less to be achieved of future habitable buildings. As development progresses the minimum distances detailed in s to achieve BAL-29 or less should be accommodated within future subdivision through public roads, public open spaces or with deeper lots where necessary.</p> <p>Class 1a, 2 and 3 buildings, where located within an area subject to a BAL rating higher than BAL-12.5 will be subject to higher construction standards in accordance with AS 3959. It is relevant to note that the requirements of SPP 3.7 and the Guidelines, as well as increased construction standards in accordance with AS 3959 are not applied retrospectively to existing development, therefore the dwellings across the majority of the site is not subject to the requirements in this (or subsequent) BMP(s).</p>	Based on the outlined management measures, future development would be able to comply with and meet the intent of Element 2: Siting and design.

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Table 3: Summary of bushfire protection criteria and compliance statement (continued)

Bushfire protection criteria	Intent	Method of compliance	Proposed bushfire management strategies	Compliance Statement
		Acceptable solution		
Element 3: Vehicular access	To ensure vehicular access serving a subdivision/development is available and safe during a bushfire event.	A3.1 Two access routes	<p>The majority of the site currently consists of an integrated road network, with Wanneroo Road providing the main access to two different destinations (north and south of the site), in addition to further destinations via the multiple connector roads within and surrounding the site, as shown in Appendix A.</p> <p>The future development within the northern portion of the site will be able to connect to existing road network, providing access to at least two different destinations. In addition, as future development occurs to the north of the site, development will be connected with the interconnected road network, allowing further egress options.</p>	Based on the outlined management measures, future development would be able to comply with and meet the intent of Element 3: Vehicular access.
		A3.2 Public road	Existing surrounding public roads and all new internal roads can and will comply with the minimum standards outlined in Appendix Four of the Guidelines (WAPC and DFES 2017), which includes a minimum 6 m-wide trafficable surface.	
		A3.3 Cul-de-sac (including dead-end-road)	At this stage of the planning process, there are currently no roads cul-de-sacs proposed as part of the future development of the site. If as part of future development of the site, including if future development is proposed to be staged, cul-de-sacs are proposed, they should be provided with suitable turn-around areas for emergency service vehicles, and will meet the minimum standards outlined in the Guidelines (or as agreed with the City of Wanneroo).	
		A3.4 Battle-axe	Not applicable. No battle-axe properties are proposed as part of the structure plan.	
		A3.5 Private driveway longer than 50 m	Not applicable. No private driveways longer than 50 m are proposed based on the structure plan and the density of residential development.	
		A3.6 Emergency access way	Given the proposed structure plan accommodates various access routes, emergency access ways are not required as part of the proposed development of the site. However, as part of future subdivision and/or development temporary emergency access ways may be required to provide access to different destinations and if required, these should as a minimum have a 6 m-wide trafficable surface suitable for two-wheel drive vehicles (but does not necessarily need to be constructed to a full public road standard).	
		A3.7 Fire service access routes (perimeter roads)	Future development within the site will be provided with appropriate vehicular access, as outlined above, and therefore fire service access routes are unlikely to be required.	

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Table 3: Summary of bushfire protection criteria and compliance statement (continued)

Bushfire protection criteria	Intent	Method of compliance	Proposed bushfire management strategies	Compliance Statement
		Acceptable solution		
Continued from above.	Continued from above.	A3.8 Firebreak width	Once subdivision is progressed within the site, in accordance with the City of Wanneroo Firebreak Notice (or as specified by the City of Wanneroo in accordance with Section 33 of the <i>Bush Fires Act 1954</i>), the following is required: <ul style="list-style-type: none"> For lots less than 2024 m² the proponent (and future landowners) will be required to “Have the entire land clear of all flammable material by mowing, slashing or other means. All grasses are to be maintained below five (5) centimetres in height.” 	Continued from above.
Element 4: Water	To ensure water is available to the subdivision, development or land use to enable people, property and infrastructure to be defended from bushfire.	A4.1 Reticulated areas	Development is located within an Emergency Services Levy (ESL) Category 1 area, which indicates that bushfire events are responded to by a network of metropolitan career Fire and Rescue Services and the State Emergency Service. Fire response services require ready access to an adequate water supply during bushfire emergencies. The site will connect with a reticulated water supply and will include fire hydrants installed by the developer to meet the specifications of Water Corporation (Design Standard DS 63) (or similar standard, as agreed with the relevant water authority) and DFES. Fire hydrants on land zoned for residential purposes are generally required to be sited at or within 200 m of residential dwellings (Class 1a).	Based on the outlined management measures, future development would be able to comply with and meet the intent of Element 4: Water.
		A4.2 Non-reticulated areas	Not applicable.	
		A4.3 Individual lots within non-reticulated areas (only for use if creating 1 additional lot and cannot be applied cumulatively)	Not applicable.	

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Wanneroo Town Centre Structure Plan



5.1 Additional management strategies

5.1.1 Future approval considerations

The BAL assessment within this document is considered to be a conservative assessment of potential bushfire risk posed to future habitable buildings within the site based on the proposed management of vegetation and assumptions outlined in **Section 3**.

The measures to be implemented through this structure plan and associated future subdivision process have been outlined as part of this BMP and can be used to support future planning and development approval processes. A revised BMP is likely to be required to support any future subdivision applications, particularly if the development layout detail is different to that outlined within this document, and will need to respond to the subdivision design.

As noted in **Table 3**, the requirements of SPP 3.7 and the Guidelines, as well as increased construction standards in accordance with AS 3959 are not applied retrospectively to existing development, therefore the existing dwellings are not subject to the requirements in this BMP (or subsequent), apart from addressing the City of Wanneroo Firebreak Notice (or as directed by the City of Wanneroo in accordance with Section 33 of the *Bush Fires Act 1954*).

5.1.2 Landscape management

5.1.2.1 Within the site

A number of public open space areas, including those for recreation, drainage and visual/acoustic amenity purposes, have been identified within the site.

The design and construction of public open space areas is generally a condition of subdivision approval. The detailed design of the public open space areas within the site will be determined by the future developer in collaboration with the City of Wanneroo as part of the standard development process and is assumed to be designed to achieve low threat vegetation in accordance with Section 2.2.3.2 of AS 3959, and in line with City of Wanneroo requirements. Management may include:

- Clearing of vegetation
- Irrigation of grass and garden beds (where required)
- Regular maintenance including removal of weeds and dead material
- Low pruning of trees
- Application of ground covers such as mulch or non-flammable materials
- Regularly mowing/slashing of grass to less than 100mm in height

The future developer will be responsible for the initial maintenance of these areas, and following handover the City of Wanneroo will be responsible for the long-term maintenance of the public open space areas to a low threat standard.

In addition, the existing areas of public open space and managed vegetation within private landholdings and road reserves will continue to be managed to a low threat standard as per the existing management regimes for these areas.

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5.1.2.2 Surrounding the site

Within public open space

The public open space surrounding the site is assumed to be managed by the City of Wanneroo in accordance with the City of Wanneroo Firebreak Notice in perpetuity and/or in accordance with existing maintenance regimes.

Within private landholdings

The private landholdings surrounding the site are assumed to be managed by the applicable landowners in accordance with the City of Wanneroo Firebreak Notice in perpetuity and/or in accordance with existing maintenance regimes. All other vegetation will remain in its existing condition for the foreseeable future.

5.1.3 City of Wanneroo Firebreak Notice

The City of Wanneroo releases a Firebreak Notice on an annual basis to provide a framework for bushfire management within the City. The City of Wanneroo are able to enforce this notice in accordance with Section 33 of the *Bush Fires Act 1954*. In addition, Section 33 1(b) also provides the City with additional power to direct landowners to undertake works to remedy conditions conducive to the outbreak or spread of bushfire

Until subdivision is progressed within the northern portion of the site, the landowner will be required to comply with the Firebreak Notice, including the maintenance of minimum 3 m-wide perimeter firebreaks (or as agreed with the City of Wanneroo).

Existing landowners within the site are required to comply with the Firebreak Notice, including the maintenance of minimum 3 m-wide perimeter firebreaks (or as agreed with the City of Wanneroo).

5.1.4 Vulnerable or high-risk land uses

There are no vulnerable or high-risk land uses, as defined under SPP 3.7, proposed within the site at this stage of the development process. Should vulnerable or high-risk land uses be proposed in the future, the requirements of SPP 3.7 may need to be addressed at future development approvals (i.e. subdivision / development application) (when specific detail on the land use is known) and may include the preparation of an emergency evacuation plan and/or risk assessment for onsite flammable materials where applicable. This is generally only a consideration where a BAL rating greater than BAL-LOW applies.

5.1.5 Public education and preparedness

Community bushfire safety is a shared responsibility between individuals, the community, government and fire agencies. DFES has an extensive Community Bushfire Education Program including a range of publications, a website and Bushfire Ready Groups. The DFES publication '*Prepare. Act. Survive.*' (DFES 2014) provides excellent advice on preparing for and surviving the bushfire season. Other downloadable brochures are available from

<http://www.dfes.wa.gov.au/safetyinformation/fire/bushfire/pages/publications.aspx>

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The City of Wanneroo provides bushfire safety advice to residents available from their website http://www.wanneroo.wa.gov.au/homepage/61/fire_information. Professional, qualified consultants also offer bushfire safety advice and relevant services to residents and businesses in high risk areas in addition that that provided in this BMP.

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6 Responsibilities for Implementation and Management of Bushfire Measures

Table 4 outlines the future responsibilities of the developer and the City of Wanneroo associated with implementing this BMP with reference to ongoing bushfire risk mitigation measures for existing land uses (through compliance with the City of Wanneroo Firebreak Notice) or future mitigation measures to be accommodated as part of future subdivision (in particular, consideration of spatial layout requirements). These responsibilities will need to be considered as part of the subsequent planning process.

Additional bushfire mitigation responsibilities will be outlined as part of future BMP/s prepared to support detailed subdivision for the site, including responsibilities for future lot owners.

Table 4: Responsibilities for the implementation of this BMP

Management action	Timing
Developer/landowner	
Provide a copy of this BMP to the relevant decision makers to support approval of the proposed local structure plan.	To support the local structure plan approval process.
Prepare a new/revised BMP in accordance with SPP 3.7, the Guidelines and AS 3959 to support future subdivision applications based on the proposed detailed layout and in consideration of existing bushfire hazards or those that will be present following development.	To support each future subdivision application.
Where required, and based on the outcomes this BMP or subsequent BMP/s, make spatial provision within the subdivision layout/design to accommodate: <ul style="list-style-type: none"> • A suitable public road network that provides access to at least two different destinations. Public roads should be at least 6 m-wide and consider the minimum requirements of Appendix Four in the Guidelines (or as agreed with the City of Wanneroo). The proposed local structure plan currently supports this requirement. • Where possible avoid cul-de-sacs and battle axe lots, or where utilised ensure these consider the general requirements outlined in Table 3 and Appendix Four of the Guidelines, or as agreed with the City of Wanneroo. • Ensure future habitable buildings are able to be located so that BAL-29 or less applies. Separation distances should be in accordance with the minimum distances outlined in Table 2 of this BMP for the corresponding vegetation plot/classification, or as determined in subsequent BAL assessments. This may include the provision of public roads and/or managed public open space between habitable buildings and bushfire hazards, or by ensuring lots are an adequate depth or width to ensure BAL-29 is not exceeded at future habitable buildings. 	To support each future subdivision application.
Comply with the City of Wanneroo Firebreak Notice until subdivision progresses, including providing firebreaks of at least 3 m-wide.	At all times, where applicable.
The City of Wanneroo	
Monitoring vegetation fuel loads in private landholdings against the requirements of the City's firebreak notice (and/or existing maintenance regimes outlined in this BMP) and liaising with relevant stakeholders to maintain fuel loads at minimal/appropriate fuel levels.	Ongoing, as required.
Maintaining fuel loads in existing public road reserves (under their management) to appropriate standards to minimise fuel loads (as per current maintenance regimes).	Ongoing, as required.

Bushfire Management Plan Wanneroo Town Centre Structure Plan



7 Applicant Declaration

7.1 Accreditation

This BMP has been prepared by Emerge Associates who have been providing bushfire risk management advice for more than six years, undertaking detailed bushfire assessments (and associated approvals) to support the land use development industry.

Anthony Rowe is a Fire Protection Association of Australia (FPAA) Level 3 Bushfire Planning and Design (BPAD) accredited practitioner (BPAD no. 36690) with over nine years' experience and is supported by a number of team members who have undertaken BPAD Level 1 and Level 2 training and are in the processing of gaining formal accreditation.

7.2 Declaration

I declare that the information provided is true and correct to the best of my knowledge.

Signature:

A handwritten signature in black ink, appearing to read "Anthony Rowe", written over a light grey dotted line.

Name: Anthony Rowe

Company: Emerge Associates

Date: 9 October 2018

BPAD Accreditation: BPAD no. 36690

8 References

8.1 General references

Department of Fire and Emergency Services (DFES) 2014, *Prepare. Act. Survive.*, Perth.

Standards Australia 2009, *AS 3959-2009 Construction of buildings in bushfire-prone areas*, Sydney.

Western Australian Planning Commission (WAPC) 2015, *State Planning Policy 3.7 Planning in Bushfire Prone Areas*, Perth.

Western Australian Planning Commission and Department of Fire and Emergency Services (WAPC and DFES) 2017, *Guidelines for Planning in Bushfire Prone Areas Version 1.3*, Western Australia.

8.2 Online references

Department of Water 2008, *LIDAR derived 1 m elevation contours* dataset, Government of Western Australia.

Landgate 2018, *Map Viewer*, viewed September 2018, <https://www0.landgate.wa.gov.au/maps-and-imagery/interactive-maps/map-viewer>

Office of Bushfire Risk Management (OBRM) 2018 Map of Bush Fire Prone Areas, viewed September 2018, <https://maps.slip.wa.gov.au/landgate/bushfireprone/>

Figures



Figure 1: Site Location and Topographic Contours

Figure 2: Existing Conditions – AS 3959 Vegetation Classification

Figure 3: Existing Conditions – Bushfire Hazard Level

Figure 4: Post Development Conditions – AS 3959 Vegetation Classification

Figure 5: Post Development Conditions – Effective Slope

Figure 6: Bushfire Attack Level Contour Plan

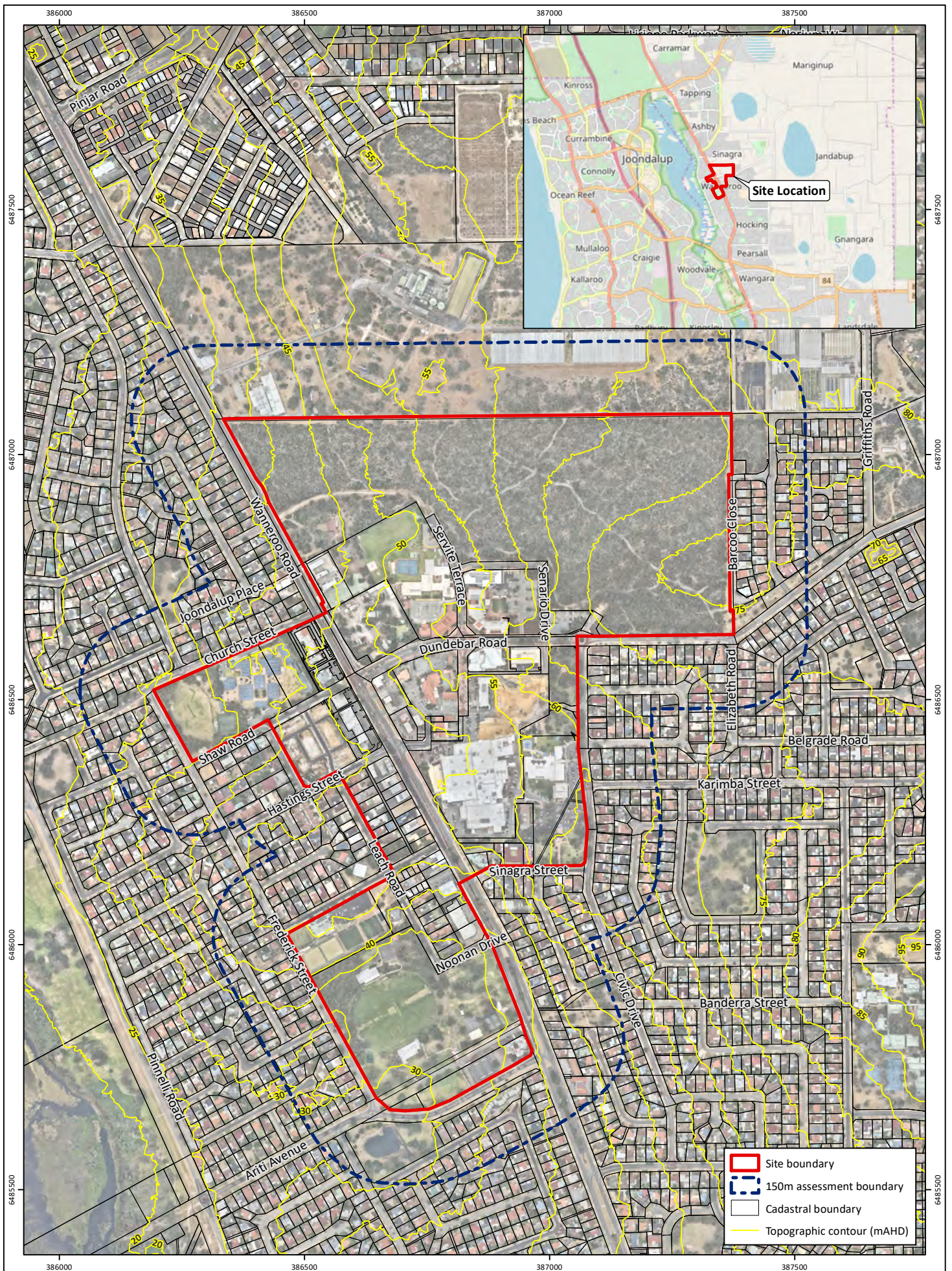


Figure 1: Site Plan and Topographic Contours

Project: Bushfire Management Plan
Wanneroo Town Centre Structure Plan

Client: City of Wanneroo

Plan Number: EP17-133(03)-F10
Drawn: SCM
Date: 04/10/2018
Checked: AJR
Approved: AJR
Date: 09/10/2018



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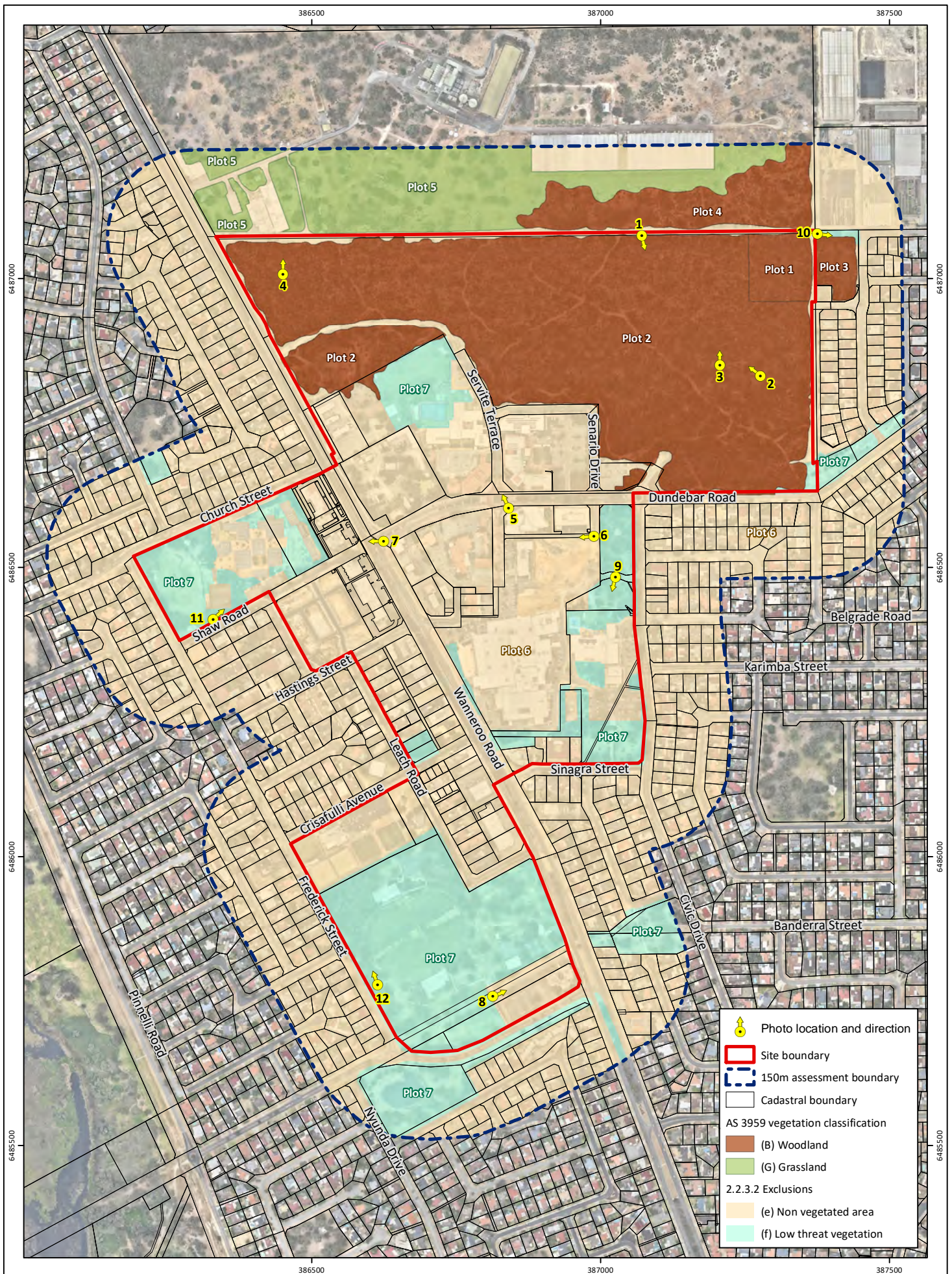


Figure 2: Existing Conditions - AS 3959 Vegetation Classification

Project: Bushfire Management Plan
Wanneroo Town Centre Structure Plan

Client: City of Wanneroo

Plan Number: EP17-133(03)--F11
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Checked: AJR
Approved: AJR
Date: 09/10/2018



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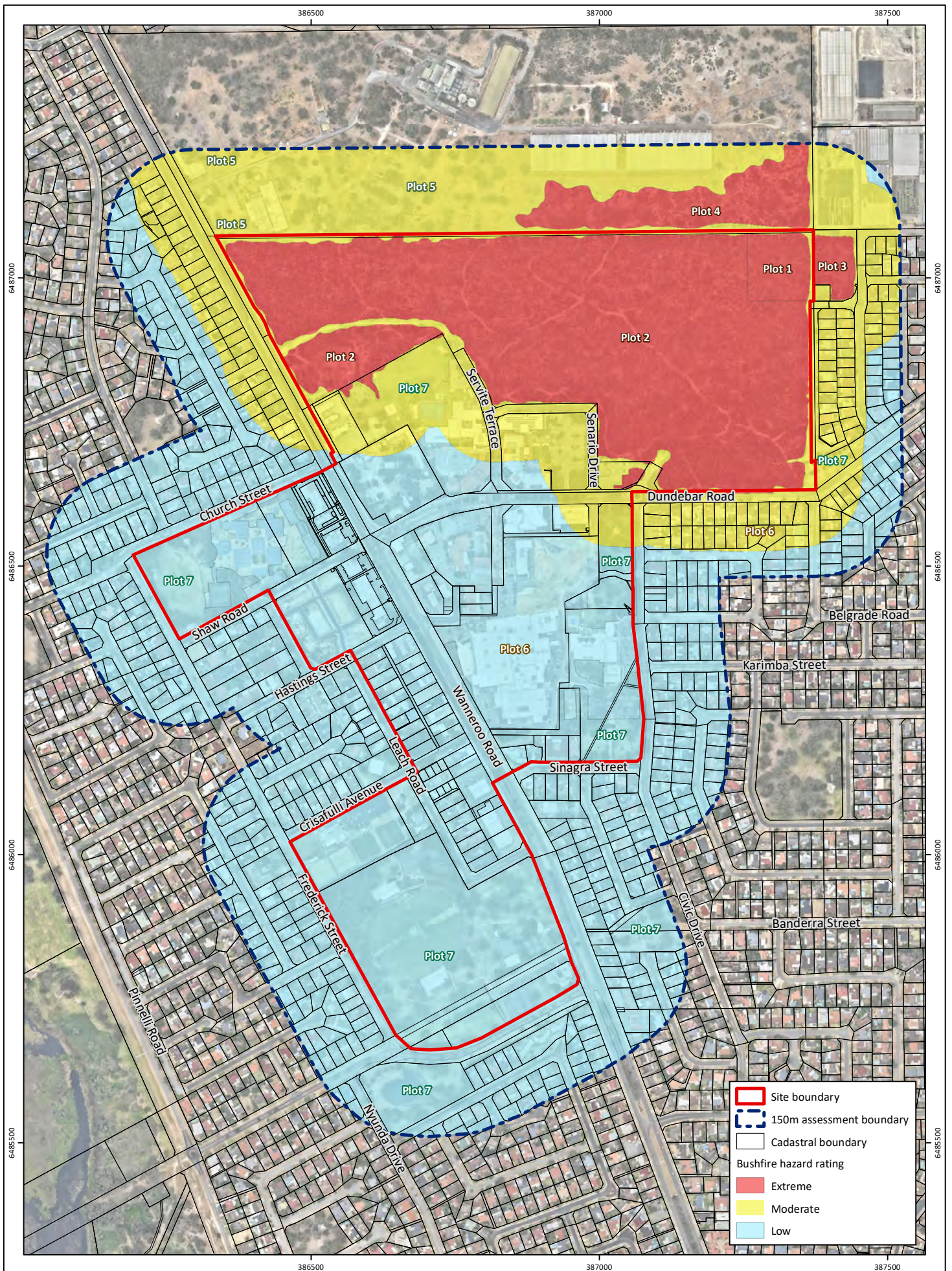


Figure 3: Existing Conditions - Bushfire Hazard Rating

Project: Bushfire Management Plan
Wanneroo Town Centre Structure Plan

Client: City of Wanneroo

Plan Number: EP17-133(03)--F12
Drawn: SCM
Date: 04/10/2018
Checked: AJR
Approved: AJR
Date: 09/10/2018



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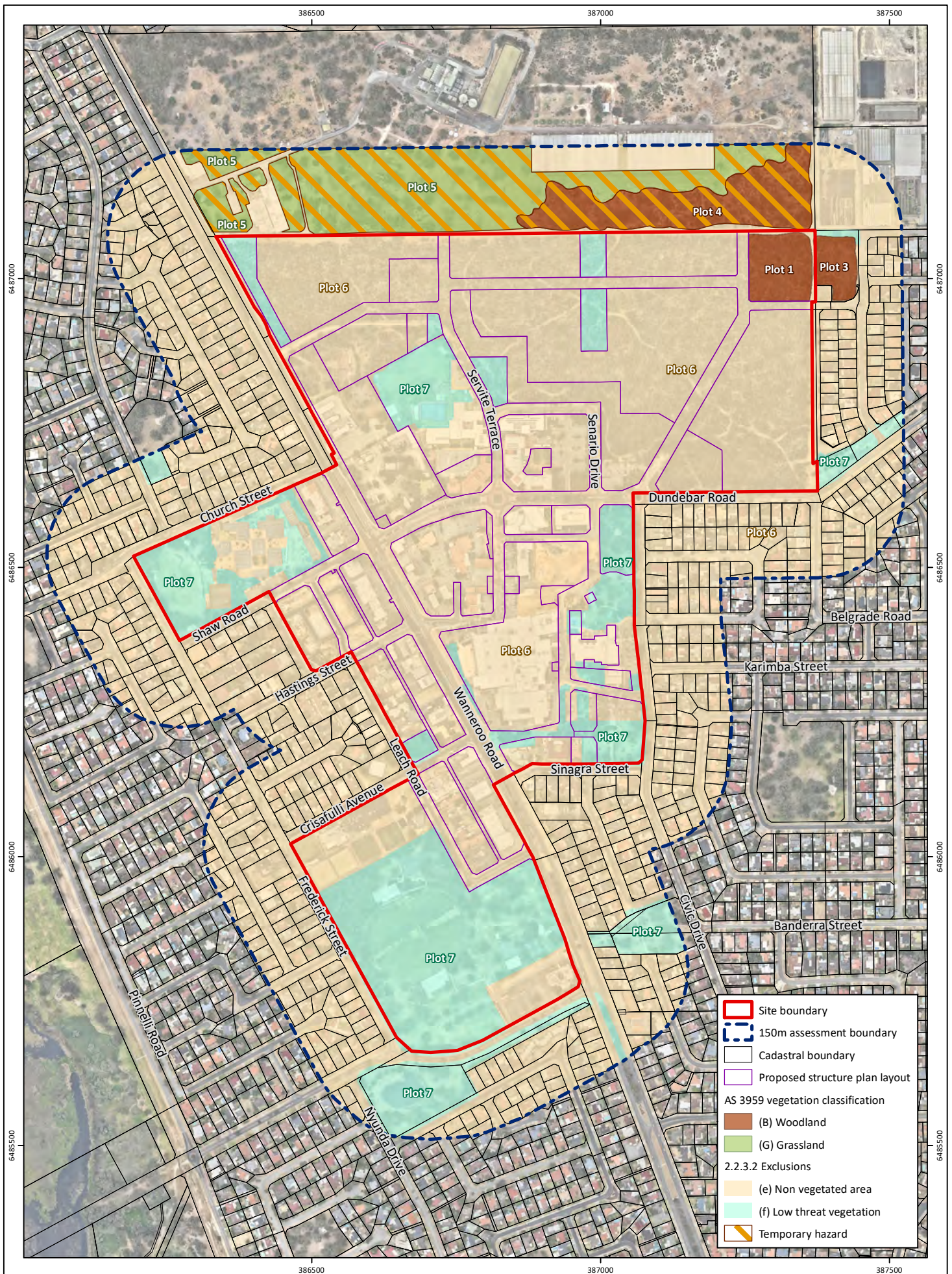


Figure 4: Post Development Conditions - AS 3959 Vegetation Classification

Project: Bushfire Management Plan
Wanneroo Town Centre Structure Plan

Client: City of Wanneroo

Plan Number: EP17-133(03)--F13
Drawn: SCM
Date: 04/10/2018
Checked: AJR
Approved: AJR
Date: 09/10/2018



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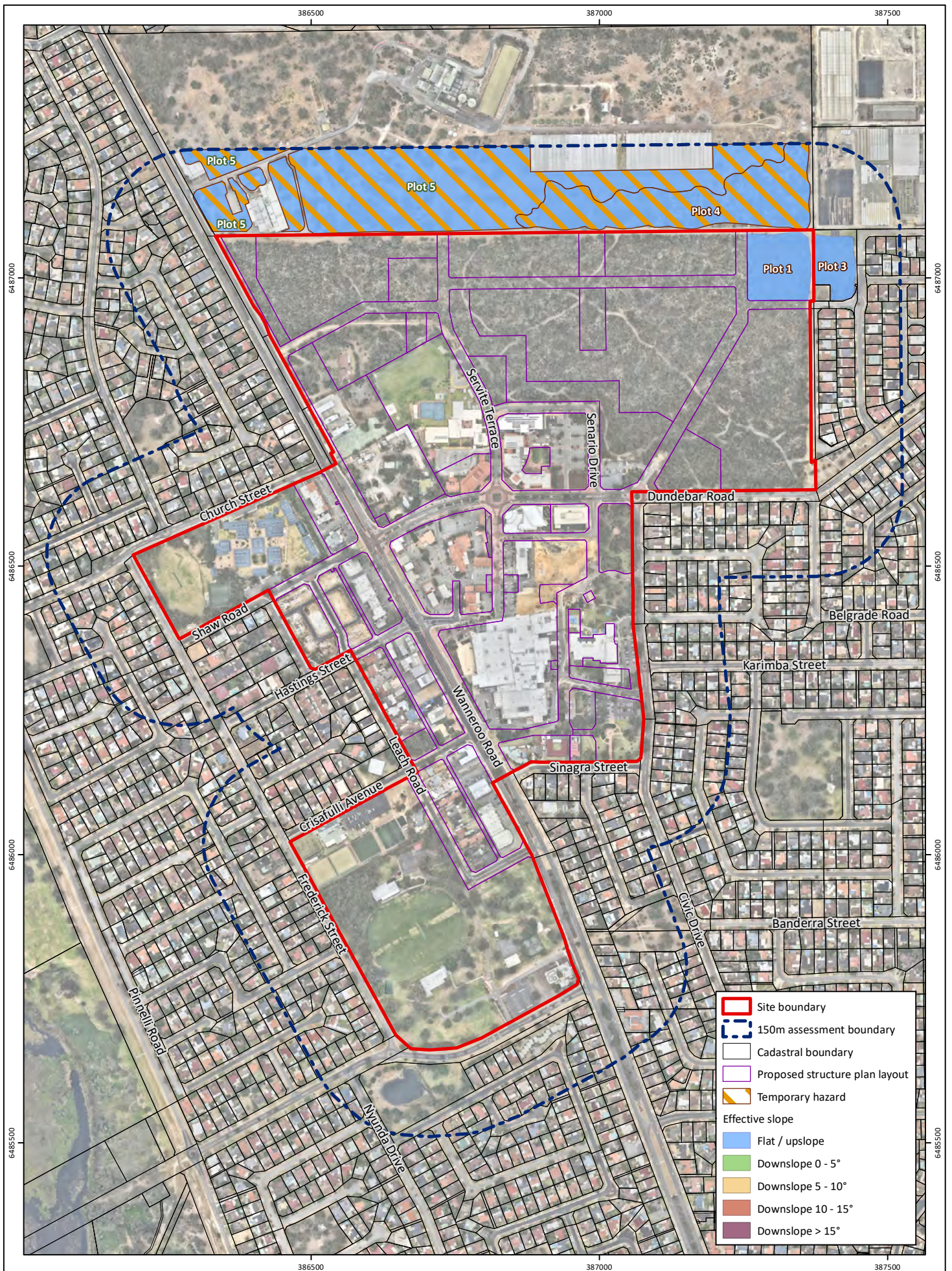


Figure 5: Post Development Conditions - Effective Slope

Project: Bushfire Management Plan
Wanneroo Town Centre Structure Plan

Client: City of Wanneroo

Plan Number: EP17-133(03)--F14
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Date: 04/10/2018
Checked: AJR
Approved: AJR
Date: 09/10/2018



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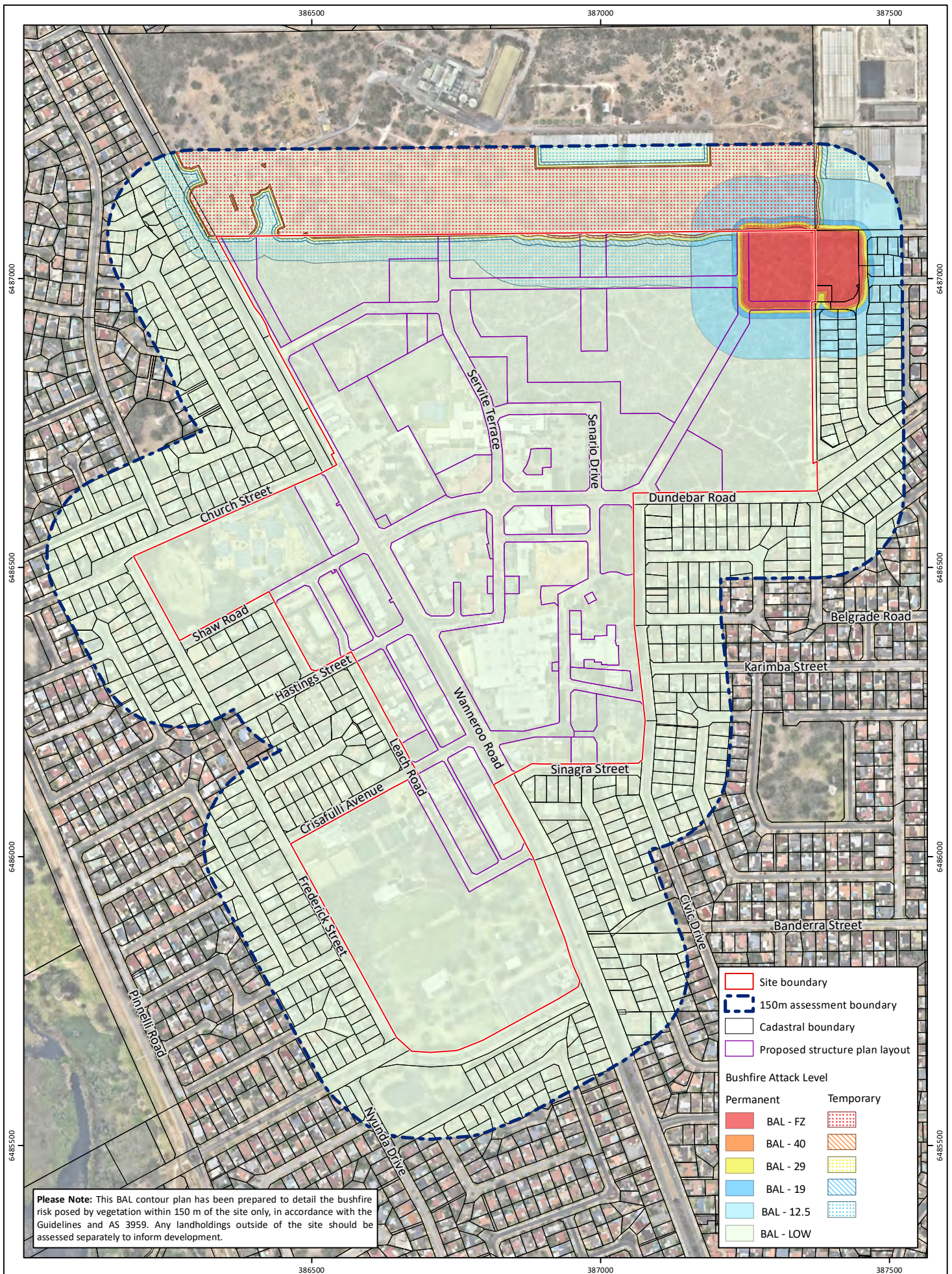


Figure 6: Bushfire Attack Level Contour Plan

Project: Bushfire Management Plan
Wanneroo Town Centre Structure Plan

Client: City of Wanneroo

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Date: 09/10/2018



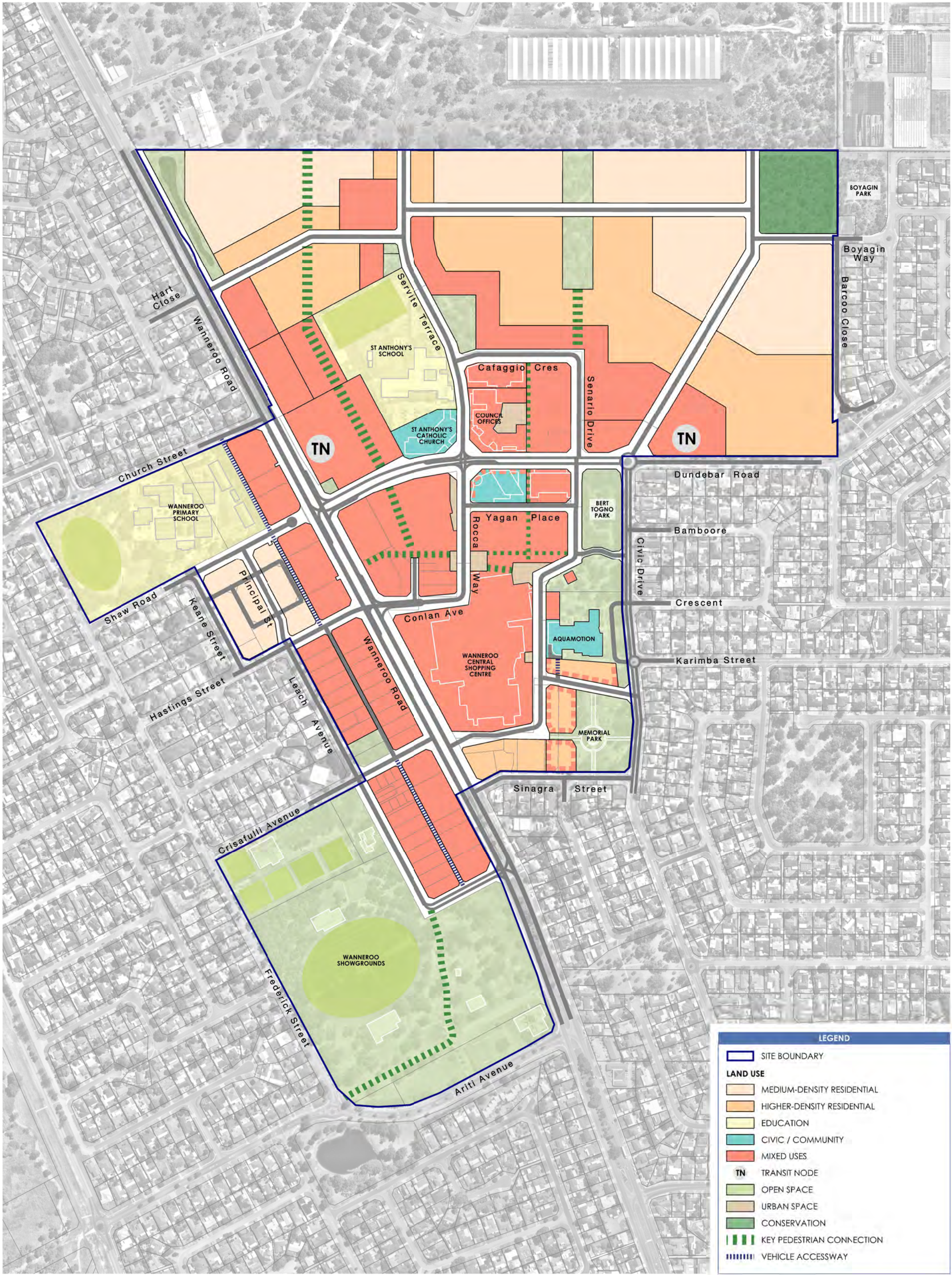
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GDA 1994 MGA Zone 50



Appendix A

Wanneroo Town Centre Structure Plan (TBB 2018)







APPENDIX 4 ECONOMIC, RETAIL AND EMPLOYMENT STRATEGY



Taylor Burrell Barnett

Wanneroo Town Centre Economic, Retail and Employment Strategy

October 2017

Document Control				
Document Version	Description	Prepared By	Approved By	Date Approved
v 1.0	Draft Strategy	Dawson D-Huning Aaron Kosovich	Per Sauer	7 September 2018
v 2.0	Final Strategy	Dawson D-Huning	Per Sauer	4 October 2018

Disclaimer

This report has been prepared for **Taylor Burrell Barnett**. The information contained in this document has been prepared with care by the authors and includes information from apparently reliable secondary data sources which the authors have relied on for completeness and accuracy. However, the authors do not guarantee the information, nor is it intended to form part of any contract. Accordingly, all interested parties should make their own inquiries to verify the information and it is the responsibility of interested parties to satisfy themselves in all respects.

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1 EXECUTIVE SUMMARY

The Economic, Retail and Employment Strategy (ERE strategy) provides background economic analysis for consideration in the development of the Wanneroo Town Centre Planning Framework (the Framework). The Framework will establish a desired future state for the Wanneroo Town Centre (the Centre) that will guide long-term development for both residential and non-residential¹ uses.

A 'place experience' can be defined as the types, quality, concentration, diversity and intensity of activity created by users in a place. User groups include residents, workers, visitors and enterprises. The behaviour of these groups can be understood by examining the transactions that occur between users, or between users and their environment. The goal of economic development of the Centre should therefore be to increase the quality and intensity of economic, social and environmental transactions in the Centre. From a planning perspective, this leads to a number of key practical considerations, which are summarised below:



Sufficient planned floorspace

The analysis of employment and floorspace currently in the Centre shows that it is almost exclusively a population-driven centre. Population surrounding the Centre is projected to grow at between 1.8% and 3.1% until 2041.² Future floorspace scenarios were provided by TBB and compared to the population growth estimates. The results of the analysis show that the planned floorspace capacity is sufficient to accommodate projected population-driven demand with a possibility that full development could be achieved before 2041. Growth outside of population-driven activity is expected to be limited but should be monitored over time to inform future planning decisions.



Improved place activation

The Centre was assessed using the 'six principles of economic place activation'³. There are opportunities to increase economic activation of the Centre by creating an interspersed network of origins and destinations within the Centre, and increasing the permeability of the Centre to the surrounding residential areas (i.e. increasing walkability). This will encourage visitors to experience other attractive offerings within the Centre and can be further encouraged by introducing an additional anchor tenant(s) in the north of the Centre, ideally with a unique offering that will increase diversity and active use hours within the Centre.

¹ All employment based floorspace

² See Section 6, Population Growth

³ See Section 4.1, Economic Activation in the Wanneroo Town Centre

Parking should be redistributed to the boundaries of the Centre to create greater pedestrian traffic flows through the core of the Centre and allow for active frontages to replace parking lots (i.e. along Rocca Way).

The Centre will inevitably mature as the surrounding population grows, presenting both new development and redevelopment opportunities. The City of Wanneroo (the City) therefore has the opportunity to reshape the Centre by applying the principles of economic activation to help create a centre that has high levels of economic activation and liveability.



Diversified employment opportunities

Economic and Retail analysis of the Centre shows that it serves an important role in providing population-driven goods and services to surrounding communities, which can be further developed over time through pro-active planning. Population growth will increase the demand for these goods and services and present the opportunity to attract a greater diversity of population-driven offerings to the Centre (e.g. comparison retail and entertainment).

Continued maturation of the Centre beyond specialised retail needs provides the City with the opportunity to actively attract knowledge intensive service industries through:

- Encouraging communication channels with key local industry stakeholders (i.e. business perception survey, direct communication with ECU and other high-knowledge local enterprises)
- Investigating and promoting the industry advantages available within the Centre (i.e. through the development of a business attraction strategy or locational advantages survey)

Employment in knowledge intensive industries is higher skilled, is more resilient and generally offers higher wages. Such employment will increase the competitiveness of the Centre relative to surrounding centres in terms of desirability as a place to live and work.

The City will need to be actively involved in the implementation of the Framework in order to achieve the desired outcomes. There are three general roles the City can play in encouraging economic development within the Centre: control, influence and monitoring. Certain factors that the City can control include regulating within the Centre, the approval of development applications that support economic activation, the location of parking lots and communication with private industry stakeholders and the broader community. The Planning Framework should support communication with State government to improve pedestrian accessibility across Wanneroo Road and public transport access to and from the Centre. Monitoring processes could be implemented to understand local business perception in the Centre and track activity in high-knowledge or export-orientated industries should demand for office floorspace in the Centre grow.

The Framework presents the City with the opportunity to shape the Centre into a highly liveable place that encourages a high intensity of transactions and provides residents and visitors with a balance of work, retail

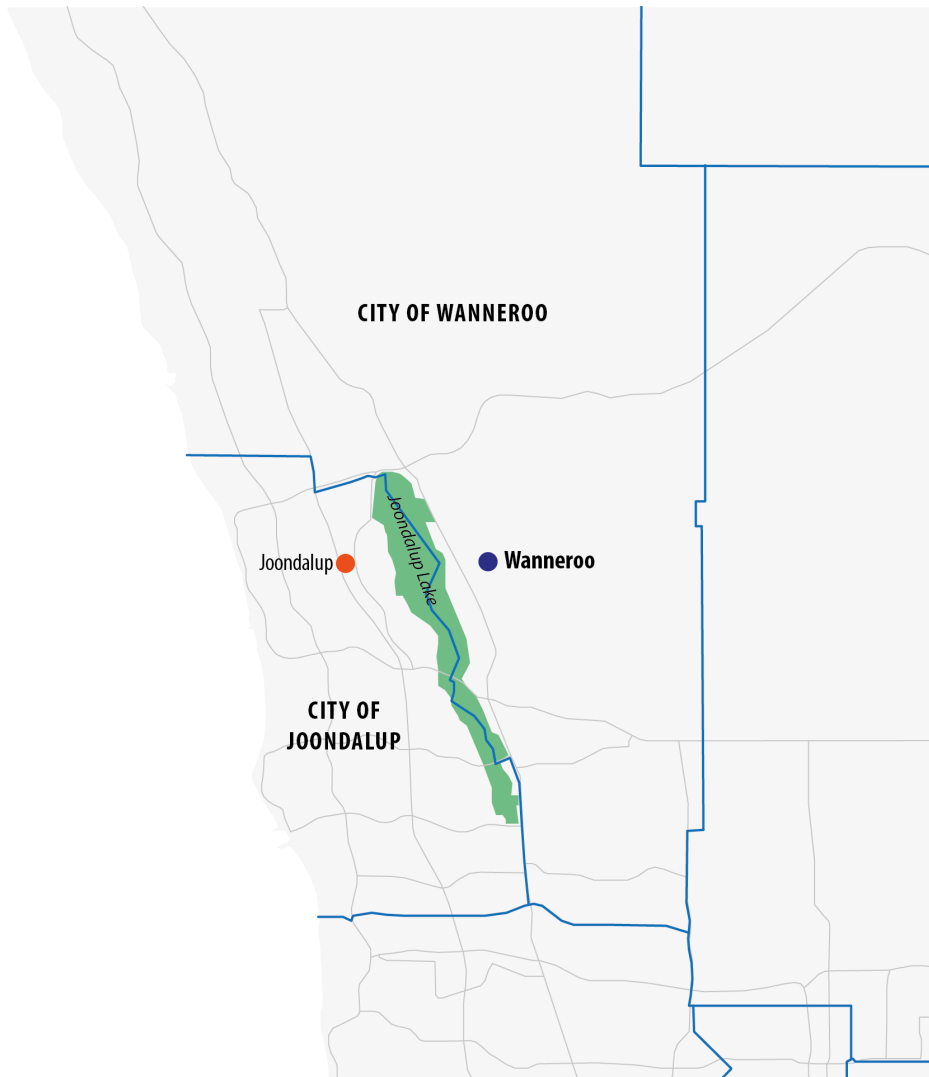


and entertainment opportunities. Through better use of place activation principles and the attraction of skilled employment opportunities the Centre will stand apart from other centres in the Perth Metropolitan area.

2 INTRODUCTION

The Wanneroo town centre (the Centre)⁴ is a secondary activity centre in Perth’s northern suburbs. It plays a critical role in providing population services and employment for local residents (Figure 1).

Figure 1. Wanneroo Town Centre



The City of Wanneroo (the City) is currently undertaking an update of the Town Centre Planning Framework (the Framework), establishing the long-term vision that will guide development of the Centre. Establishing the vision requires a sound understanding of a myriad of factors, including:

- The Centre’s population catchment (see Section 3) and desired function
- Retail Performance
- Economic Analysis
- Centre Development Scenarios

⁴ See Section 10, Appendix 3: Outline of Wanneroo Town Centre



This strategy considers each of these factors and provides a set of key opportunities and challenges for the Centre based on capacity and drivers for economic growth. Floorspace and employment scenarios have subsequently been provided that will help the Framework provide the necessary flexibility and capacity to meet the needs of the future residential and business communities.

3 WANNEROO TOWN CENTRE CONTEXT AND FUNCTION

The City is located in the North-East Sub-region of the Perth Metropolitan area and has a total residential population of approximately 190,000⁵. The Centre lies in the south eastern section of the City and has a notional population catchment⁶ (the Centre Catchment) with approximately 67,000 residents⁷ (Figure 2).

Figure 2. Centre Catchment



Source: ABS 2016, GmapGIS 2017

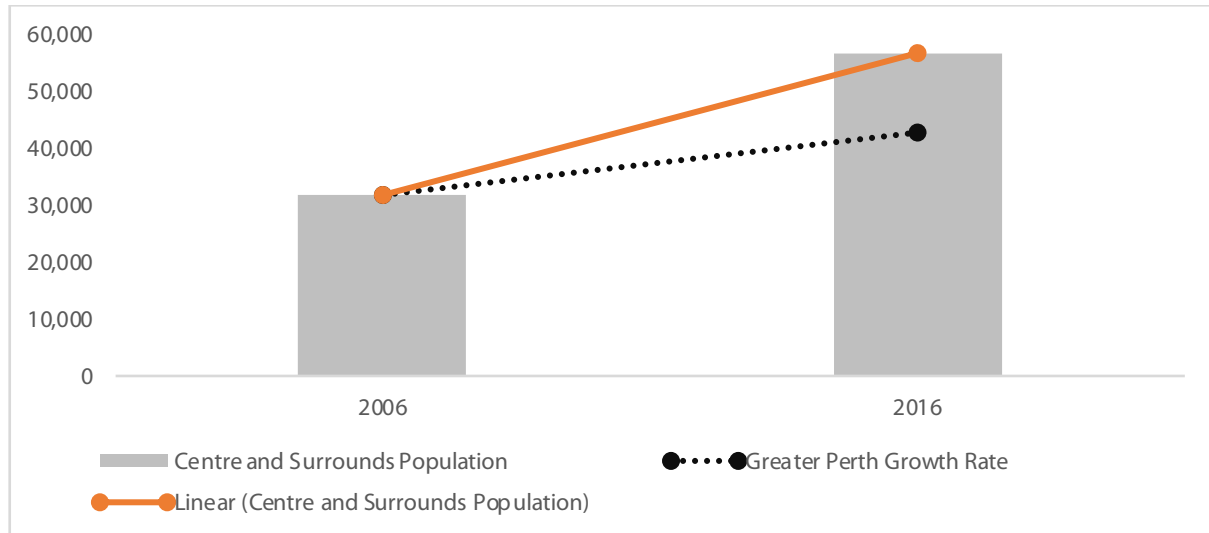
⁵ ABS Quickstats 2016, Available at: <https://bit.ly/2N2TBVI>

⁶ The catchment was based on distance to surrounding centres and the barrier created by Joondalup Lake

⁷ Forecast.id 2018: <https://bit.ly/2wP7Wvd>

It is estimated that the Centre Catchment has achieved 5.9% annual growth since 2006, almost double that of the Greater Perth area (3%). Population growth creates demand for population-driven industries such as retail, health, education and community services.

Figure 3. Population Growth from 2006 – 2016



Source: ABS 2006 and 2016

The Centre is identified as a Secondary centre in the State activity centre hierarchy.⁸ Secondary centres are multipurpose centres that provide a wide range of economic and community services necessary for the communities in their catchments. A set of common factors have been established to guide the development of Secondary centres; the Centre provides some of these functions but is still developing in certain areas (Figure 4).

Figure 4. Secondary Centre Comparison

Indicator	Secondary Centre – State Planning Policy 4.2	Wanneroo Town Centre Assessment
Transport	Transport orientated centres with an important focus for passenger rail and/or high frequency bus routes	Transport to/from the Centre is minimal with three regular bus services and no train station or high-speed bus route
Retail	Facilitate multi-purpose visits through a wide range of retail offerings	Retail offering is adequate for given the size of the population. Comparison retail is one potential area for growth
Commercial	Include major offices for professional and service businesses	The Centre provides district level office development that supports local professional and community services
Residential	Include medium to high-density residential developments	There is no residential development in the Centre itself. The Centre catchment is typically made up of low-density freestanding dwellings

⁸ Department of Planning, Lands and Heritage 2010, State Planning Policy 4.2

Size	Support population catchments of between 50,000 and 150,000 people	The Centre Catchment population is approximately 67,000 persons
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Sources: Department of Planning, Lands and Heritage 2010, ABS Census 2016

The Centre Catchment is projected to experience significant growth in coming decades that will create greater demand for services and employment opportunities and better public transport connections to and from the Centre (see Section 6.1, Population Growth). This demand will necessitate that the Centre develops more of the functions expected of a secondary centre in order to meet the employment self-sufficiency (ESS) objectives of State Planning Policy 4.2 (SPP 4.2).⁹ SPP4.2 indicates that activity centres should play an important role in meeting sub-regional ESS targets due to the concentration of employment generating activities. The Framework will provide a path for future development that will assist the City in ensuring that the Centre is able to fulfil its desired function as population grows.

⁹ Employment self-sufficiency (ESS) is the ratio of local jobs to local labourforce. An ESS of one for a given area indicates that there is one job opportunity for every resident in the labourforce.

4 RETAIL PERFORMANCE

The Centre plays a significant role in delivering retail goods and services to the local community. The current retail performance of the Centre has been evaluated through:

- Application of economic activation assessment principles in the Centre
- Analysis of retail supply and demand surrounding the Centre

4.1 Economic Activation in the Wanneroo Town Centre

The City intends to promote and maintain a successful, vibrant and active town centre. Economic activation is defined as the frequency and concentration of social and economic transactions carried out by the diverse user groups of a place. A successful place must understand what its user groups need and want and provide an environment that both attracts and retains people. The City can reconfigure the town centre to maximise its potential as a commercial centre through the application of sound economic activation principles.

A clear set of economic activation principles have been developed which, when implemented via centre planning and ongoing management, ensure that a place is user-friendly and contributes to increasing the number and duration of visits. These principles of economic or place activation have been developed to apply to urban renewal projects that would apply to the long-term planning for the Centre (Figure 5).

Figure 5. Six Principles of Activation

Principles	Description
Purpose of Place	Determine what the activity centre represents to its target user group (residents, workers, visitors) <ul style="list-style-type: none"> • Value is added by designing places which maximise: <ul style="list-style-type: none"> ○ Frequency of transactions ○ Concentration of transactions
Access Arrival points	Decisions about access begin 5km away from the place <ul style="list-style-type: none"> • Users should be directed to the 'front door' of the place • Good design funnels users into the core of the place. • Congestion and a mix of transport nodes is beneficial for economic activity
Origins Car parking and transport nodes	Strategic distribution of origin points will maximise pedestrian movement <ul style="list-style-type: none"> • Origin points should be spaced around the Centre to encourage pedestrian flow • Parking is the driver of pedestrian movement • Location of carparks is more important than the number
Exposure Pedestrian movement	Economic activation is driven by frequency and concentration of transactions <ul style="list-style-type: none"> • Channel pedestrian movements <ul style="list-style-type: none"> ○ Concentrate transactions by pushing people past as many shop windows as possible ○ Rents and sales are directly related to pedestrian traffic (e.g. corner locations are generally more desirable due to extra traffic flow)

Principles	Description
	<ul style="list-style-type: none"> ○ Minimise possible routes from origin to destination points (e.g. Bus stop to main attraction) as architectural ‘permeability’ is not always a good thing
Destinations Major attractions	The main destination must be clearly defined <ul style="list-style-type: none"> • Assess user behaviour <ul style="list-style-type: none"> ○ Number of visits ○ Timing of visits (time of day, seasonality) • Give major destinations special treatment <ul style="list-style-type: none"> ○ Understand what they need ○ Build centre around them • Amplify the impact of attractions by creating support amenity and infrastructure to maximise frequency, length of stay and expenditure
Control Strategic sites	Tenure control is vital for overall development success <ul style="list-style-type: none"> • Identify active frontages and take control of key sites • Corner sites determine uses on either side • Not all areas in a place need to be active – be selective

Source: Pracsys 2018

These principles have been used to evaluate the current economic activation within the Centre. There are currently several access points, destinations, origin points, and strategic sites in the Centre are shown in Figure 6.

Figure 6. Centre Economic Activation Points

Source: Google Maps 2018, Pracsys 2018

Each activation principle has been assessed and opportunities identified where applicable.

Purpose of Place

At present the Centre acts as the major hub for retail, commercial, and Local Government administration activity in the City. This gives it a clearly defined purpose that its users can relate to.

Access

Wanneroo Road is a multi-lane, free flowing arterial highway providing access for significant traffic into the Centre. Several intersecting local roads passing east-west across Wanneroo Road feed local traffic to the

Centre. The size of Wanneroo road presents a major barrier for local traffic traveling east-west through the Centre, especially for pedestrians. This barrier hinders pedestrian permeability which is problematic for economic activation as it encourages car transport over pedestrian routes. The Centre has consequently evolved to accommodate the needs of car travel over the needs of pedestrians. Reliance on car transport is not conducive to economic activation as the success of brick and mortar retail businesses relies in large part on a steady flow of pedestrian traffic.

Opportunities

Access to the Centre should be designed in a way which encourages foot traffic through the Centre. Greater walkability has been shown to increase retail expenditure. Some specific opportunities for improving access include:

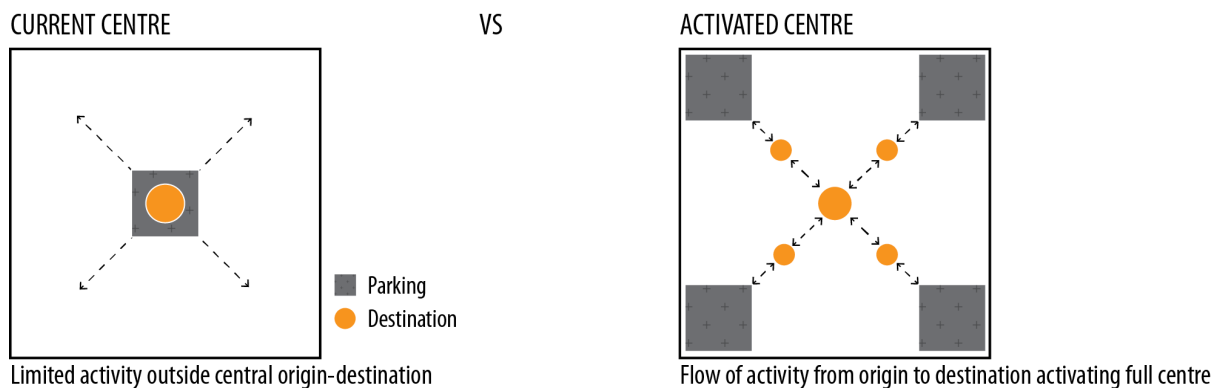
- Creating a natural access point to the Centre for motor vehicles via Conlan Avenue. It has been proposed that Conlan Avenue be linked to Rocca Way, creating a more visible and logical entry to the Centre from Wanneroo Road
- Working with Main Roads WA to find a suitable solution to improve pedestrian access across Wanneroo Road. Potential solutions could include reducing the speed limit along Wanneroo Road as it passes through the Centre.

Origins

Parking is widely disbursed across the Centre. The low density of retail and commercial facings has encouraged the development of destination specific parking which does not lend itself to generating pedestrian traffic. The distribution of parking and the barrier formed by Wanneroo Road are likely to cause users to undertake separate car trips between destinations to facilitate their needs. A key origin point is the Wanneroo Central shopping centre which acts as both an origin and strategic destination point given its large carpark and significant retail offering and lack of integration with the rest of the Centre.

Opportunities

A consolidated parking solution would be beneficial for economic activation as it would route pedestrian traffic through the core of the Centre. By collecting the widely disbursed parking bays across the Centre and repositioning them strategically, pedestrians can be directed along desired paths between parking and final destinations. One suggested solution would be to provide parking at the perimeter of the Centre and limiting parking in the core of the Centre (Figure 7).

Figure 7. Centre Economic Activation Points

Strategies should be implemented to encourage Wanneroo Central patrons to exit the shopping centre and visit the core of the Centre as Wanneroo Central will likely continue to provide the main parking facility.

To the West of the Centre, there is also an opportunity to encourage parking to be shifted to the rear via laneway access that would run adjacent to Wanneroo Road. This would allow for active frontages along Wanneroo Road rather than parking lots. The transition toward active frontages would represent an inviting retail destination with a clear entry statement that makes the area part of the Centre and stops it acting as a commercial corridor on a bustling main arterial route. Improving the link between the east and west of the Centre will contribute to additional visitation, pedestrian activity and increased economic activation for businesses in the Centre.

Exposure

There is little opportunity for exposure in the Centre as most shop fronts are separated from the street by parking spaces. This represents a missed opportunity for these tenants as these carpark spaces are permeable to pedestrian traffic, dispersing user activity and reducing the likelihood that shops can attract passing traffic. The current spread of origin points and destinations is more conducive to car trips than pedestrian movement through the Centre, reducing the frequency and concentration of pedestrian traffic. This further reduces the potential for exposure for tenancies in the core of the Centre.

Shop facings in the Centre do not receive the economic activation typically enjoyed by traders in locations with high pedestrian traffic flow where walk-by opportunities and impulse buying are commonplace. This is likely to have a negative impact on their opportunity for commercial success.

Opportunities

Pedestrian traffic can be concentrated on Rocca Way, the main passage from North to South in the Centre. Parking lots in this area would need to be removed in order to provide active street frontages that could attract the attention of passing pedestrian traffic. This would maximise exposure to future shop fronts and improve the viability of potential future retail activity.

Destinations

The key strategic destinations of the Centre are the Wanneroo Central shopping centre, City council offices, library and GP super clinic. The shopping centre is a large format shopping mall that serves as an anchor tenant, capable of drawing large volumes of visitors. The absence of another major strategically located commercial tenant (i.e. entertainment or retail) within walking distance from Wanneroo Central reduces the incentive for pedestrians to leave the shopping centre. As such, the shopping centre serves as an origin and a destination point that can monopolise visitation. This reduces the opportunity to intensify activity throughout the Centre's core. While there are strategic destinations to the north of the Centre, these too serve as origin and destination due to their functions; people who are visiting the City's offices or the GP Clinic are generally going for a specific purpose and are not as likely to undertake a multi-purpose visit as someone that is shopping or coming to eat/drink. While the Library could attract visitors for multi-purpose visits, it is not likely to create the visitation necessary to activate Rocca Way.

Opportunities

The City should support the attraction of a suitable anchor tenant in the north of the Centre to balance the attractiveness of Wanneroo Central. This would be ideally be a retail or entertainment tenant that would encourage visitors to walk from/to Wanneroo Central. Creating the impetus for foot traffic between the North and South of the Centre is key to activating the core of the Centre and supporting more active frontages along Rocca Way. Shop frontages along Rocca Way should be developed with the goal of turning the core of the Centre into a destination.

Control

The City can effect change on City owned land and guide future private development but cannot control when private land is developed. The Framework is a critical component of the City's control mechanisms for achieving the desired future outcome for the Centre.

Summary of Economic Activation

Economic activation within the Centre is constrained by the following factors:

- Wanneroo Rd restricts pedestrian access from the west
- Parking is dispersed and separates shop frontages from passing traffic
- There is a lack of potential for exposure to shop fronts
- There's an imbalance of activity, with no suitable anchor tenant to attract visitors into the Centre's core from Wanneroo Central

It is suggested that the City apply the principles of economic activation in conjunction with other planning principles when considering future development of the Centre (Figure 5). A selection of potential opportunities for improved activation have been developed using the economic activation framework:

- Provide appropriate pedestrian access across Wanneroo Rd
- Consolidate parking in areas that can distribute pedestrian traffic through the Centre's core

- Develop shop frontages along pedestrian passages (remove parking from in front of commercial premises in the Centre's core)
- Support the attraction of a suitable anchor tenant in the north of the Centre

4.2 Retail Supply and Demand

Supply

The Centre provides a significant retail offering for surrounding communities. The distribution of District, Secondary and Strategic Metropolitan centres was assessed for a 10km catchment of the Centre (Figure 8).

Figure 8. Main Retail Supply – 10km Radius



Source: Pracsys 2018

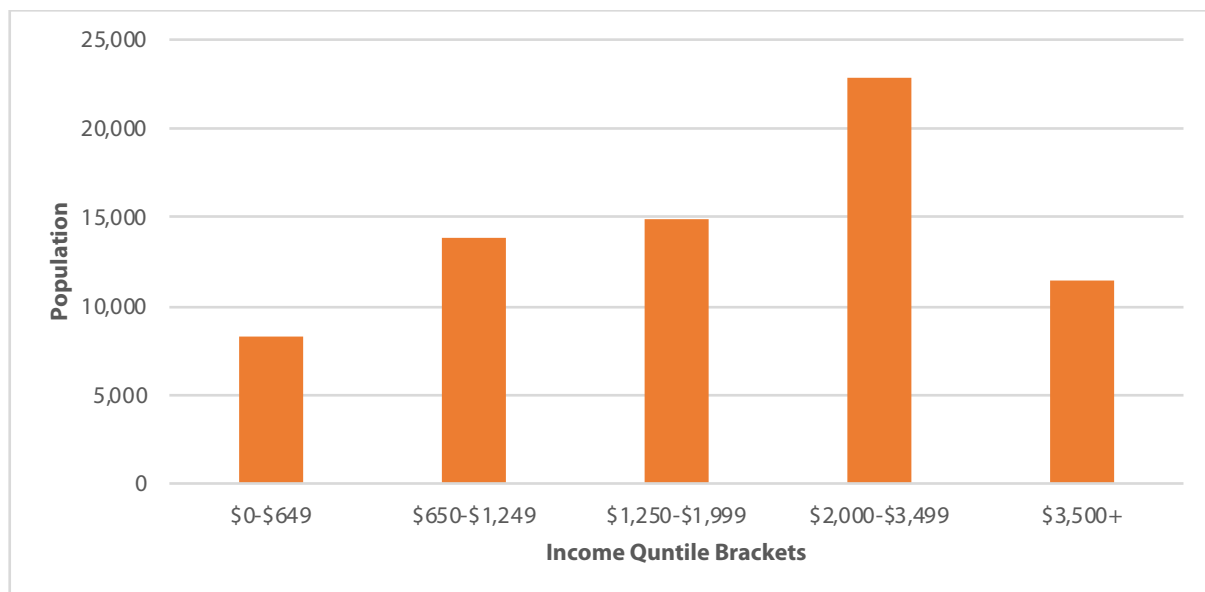
The Centre is the only Secondary centre in the North West Sub-region that is east of Lake Joondalup, increasing the dependence of the local population. Lake Joondalup is a significant barrier for residents within the Centre Catchment, reducing the likelihood that they will access Joondalup Strategic Metropolitan centre for daily or weekly needs.

The Centre Catchment population grew significantly between 2006 and 2016, experiencing annual growth rates of approximately 5.9%, significantly higher than the Perth Metropolitan average of 3%. Retail floorspace in the Centre grew at an annual rate of approximately 10% per annum between 2007 and 2015, almost doubling in size. This highlights the importance of the Centre as a retail destination for the rapidly growing surrounding communities.

Demand

Demand was assessed at the same spatial level as supply (10km catchment surround the Centre). Demand for retail goods and services in an area depends on the income profile of the area and the number of households. The analysis found that the defined area has a relatively high-income distribution with almost 50% of households in the top two income quintiles (Figure 9).

Figure 9. Catchment Area Population Income Profile by Quintile



Sources: ABS Census 2016, ABS Household Expenditure Survey 2016

Higher income levels indicate a higher level of discretionary spending available to local retailers. It is estimated that there is approximately \$2.5 billion in demand for retail goods and services in a 10km radius from the Centre and \$700 million in demand in the Centre Catchment alone. Wanneroo Central is the main retail provider in the Centre and had a reported turnover of approximately \$121.8 million in 2013, indicating there is a large pool of retail expenditure that escapes the catchment. Wanneroo Central is currently working with the City to expand its premises and include active frontages towards Rocca Way. Private investment such as this is another indicator that there is greater demand for retail goods and services than is currently being met

in the Centre. The use of appropriate activation techniques and planned growth in retail floorspace could help increase the proportion of retail demand that is captured by the Centre.

5 ECONOMIC ANALYSIS

Analysis was undertaken to understand the current economic trends in and around the Centre. The analysis incorporates:

- Centre Floorspace Analysis
- Employment Analysis
- Benchmark Centre Comparisons

The type of employment/industry was considered through each stage of the analysis. Broadly employment can be categorised under two primary drivers:

- **Population-driven employment:** Population-driven employment is employment resulting from economic activity servicing the needs of a limited population catchment. This type of employment tends to grow in line with population. This includes; retail and hospitality, construction and industrial services, civic, healthcare and education, and local professional services. Population-driven employment has been summarised in the Pracsys employment quality model as Consumer Services, Knowledge Intensive Consumer Services (KICS) and a component of Producer Services (see Appendix 2: Glossary)
- **Export-orientated employment:** Export-orientated employment includes both direct exports, such as mining, tourism and agriculture, and supporting high-knowledge (producer) services such as professional services and IT. This type of employment does not grow in accordance with population; existing and planned strategic infrastructure guides the agglomeration of highly productive and intense jobs. Areas with industrial land that service external markets can generate substantial export-orientated employment. Export-orientated employment has been summarised in the Pracsys employment quality model as Exports, Knowledge Intensive Producer Services (KICS) and a component of Producer Services (see Appendix 2: Glossary)

Understanding the types of employment that are located in the Centre, and historical trends, offers insights that contribute to identifying key opportunities and constraints, providing valuable input into the Framework.

5.1 Centre Floorspace Analysis

Floorspace analysis was undertaken to understand the current capacity for different types of employment within the Centre. The growth of floorspace was also interrogated to provide an understanding of potential drivers for growth within the Centre.

Floorspace Capacity

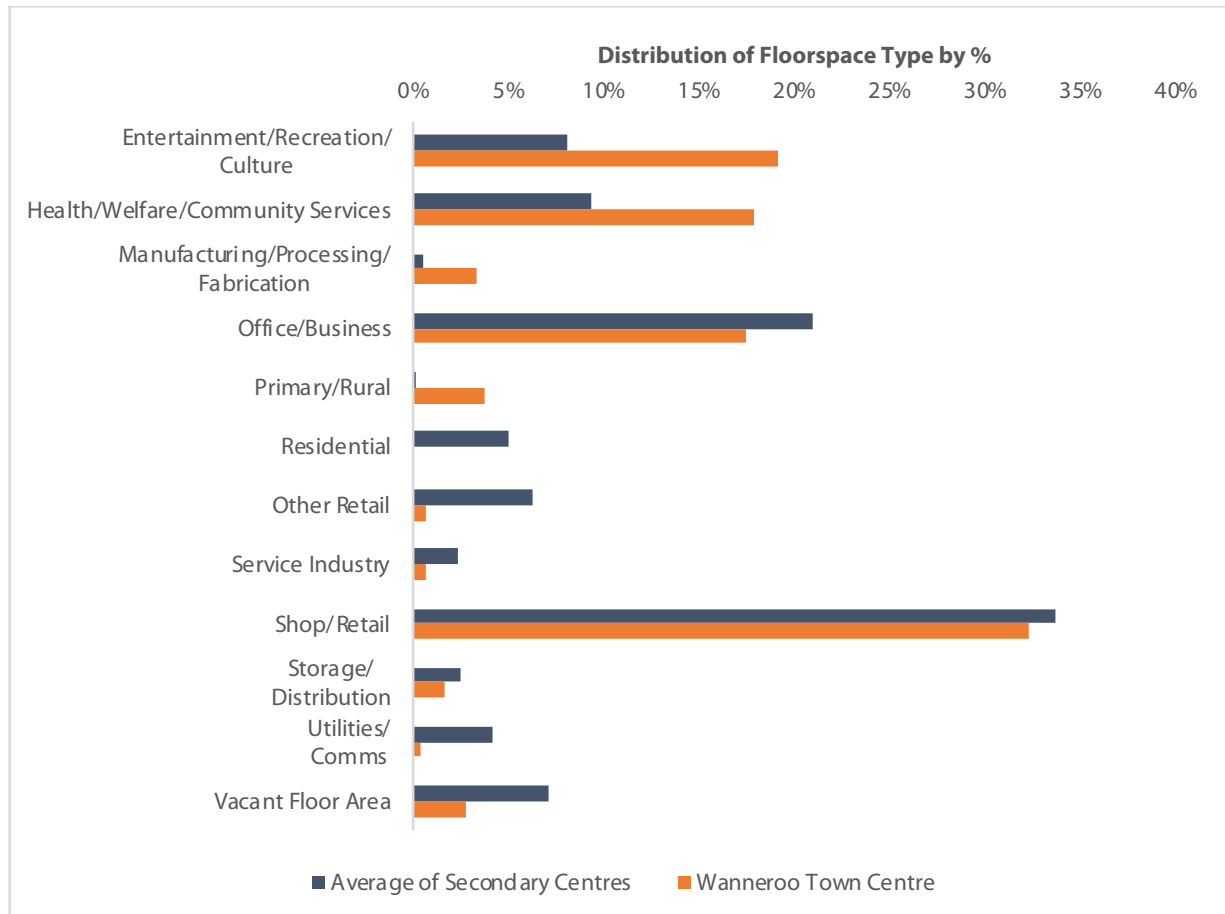
The Centre has a total employment floorspace of approximately 68,000 m² and no residential floorspace¹⁰. The Centre likely plays a greater community-based role when compared to other Secondary centres¹¹, as it has a

¹⁰ According to the Land Use and Employment Survey, Residential floorspace includes: hotels, short stay accommodation and residential properties, for further clarification of land use categories see Section 8, Appendix 1: Floorspace Definitions

¹¹ As defined by State Planning Policy 4.2

high proportion of population-driven employment floorspace supporting uses such as shop retail, entertainment and health/education (Figure 10).

Figure 10. Centre Floorspace and Average Secondary Centre Comparison¹²



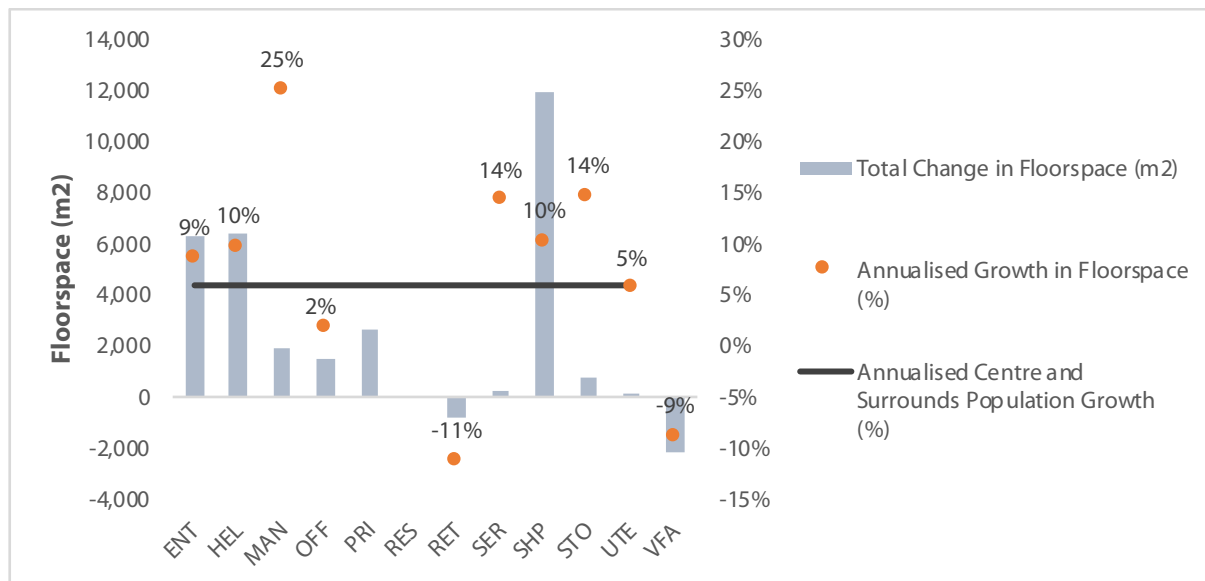
Sources: Department of Planning, Lands and Heritage 2007 – 2015

There is a lower proportion of office floorspace in the Centre. A lack of office floorspace could potentially restrict the potential for more knowledge intensive industries to locate in the Centre.

Floorspace Trends

Total employment floorspace in the Centre grew at approximately 7% per annum between 2007 and 2015, just above population growth in the Centre Catchment (Figure 11).

¹² For floorspace type definitions, please see Section 8, Appendix 1: Floorspace Definitions

Figure 11. Floorspace Growth 2007 - 2015

Sources: Department of Planning, Lands and Heritage 2007 – 2015

The Centre appears to be performing well with the vacancy rate dropping from 10% to 3%, meaning an estimated 2,100 m² of additional floorspace is being used. Most floorspace uses grew at a higher rate than population between 2007 and 2015 with three floorspace types lagging over the period: bulky goods retailing (RET), office (OFF) and residential (RES). Slow growth in office space be an indication of limited demand for export-orientated industries to locate in the Centre. Had office floorspace grown at the same rate as population growth there would be an additional 4,700 m² of floorspace.

Floorspace Analysis Summary

The Centre has grown significantly in recent years and fulfills its function as a service-based activity centre for surrounding communities. The centre appears to be performing well with vacancy rates dropping even as total floorspace grew. Three areas where the Centre could potentially improve include:

- **Residential floorspace:** the Centre's function as a secondary centre includes catering for high density residential development. The City is already looking to include residential floorspace in the Framework
- **Bulky good floorspace:** bulky good floorspace is not a suitable use for the core of an activity centre. There may be the potential to support bulky good retailing in the Centre to the west of Wanneroo Rd, where consistent with the vision and objectives of the Activity Centre Structure Plan. This area is separated from the core of the Centre and alternative uses could be considered, so long as they are in keeping with the desired role and design parameters of the Centre as a whole
- **Office floorspace:** office floorspace is used for both local professional services (population-driven) and export-orientated industries. Growth in these industries is not population-driven; demand is based on private industry need. A significant disruptive event such as the development of a train

station in the Centre could provide the impetus for growth in demand for office floorspace. The City should monitor State infrastructure projects that might impact the Centre and the number and type of development applications being received for land within the Centre.

At a minimum, the City should ensure the Framework allows for enough floorspace capacity to accommodate growth in employment floorspace equivalent to population growth (see Section 6.2, Floorspace Scenarios). Current employment floorspace should be considered when developments are proposed for land in the Centre, with the overall aim of maintaining sufficient capacity in non-residential¹³ floorspace to meet future demand (see Section 6.2, Floorspace Scenarios).

5.2 Employment Analysis

Employment analysis was undertaken for the Centre and Centre Catchment to establish the types of industry that currently locate in the Centre and surrounding employment areas. The analysis provides key insights into the role of the Centre, industry demand relevant to the Centre and export-orientated industries in the Centre.

Employment Quality

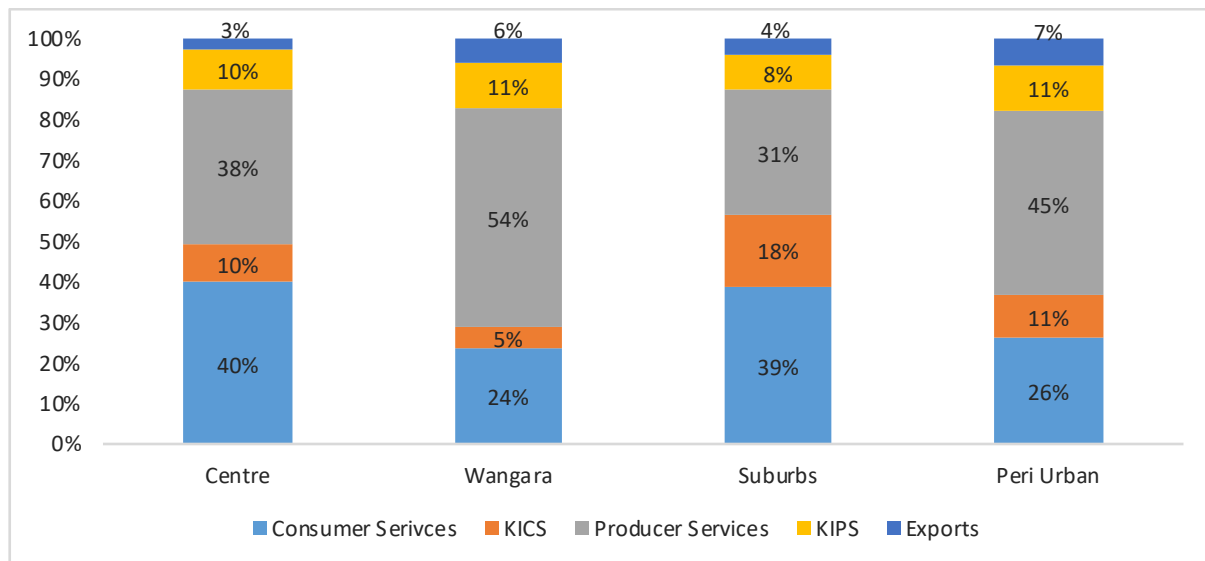
Employment quality provides a breakdown of the employment by end use and knowledge intensity¹⁵ and was estimated for sections of the Centre Catchment, including:

- the Centre
- Adjacent suburbs
- Wangara industrial precinct
- Peri-urban areas (agricultural land to the east of the Centre).

The Centre's employment is predominately population-driven with 50% of employment in Consumer Services and Knowledge Intensive Consumer Services (KICS) alone. There is also a high proportion of Producer Services (38%), a large proportion of which is in Local Government activity (40%) indicating it is predominantly population-driven. Population-driven employment in the Centre will likely grow at a similar rate to population growth in the Centre Catchment.

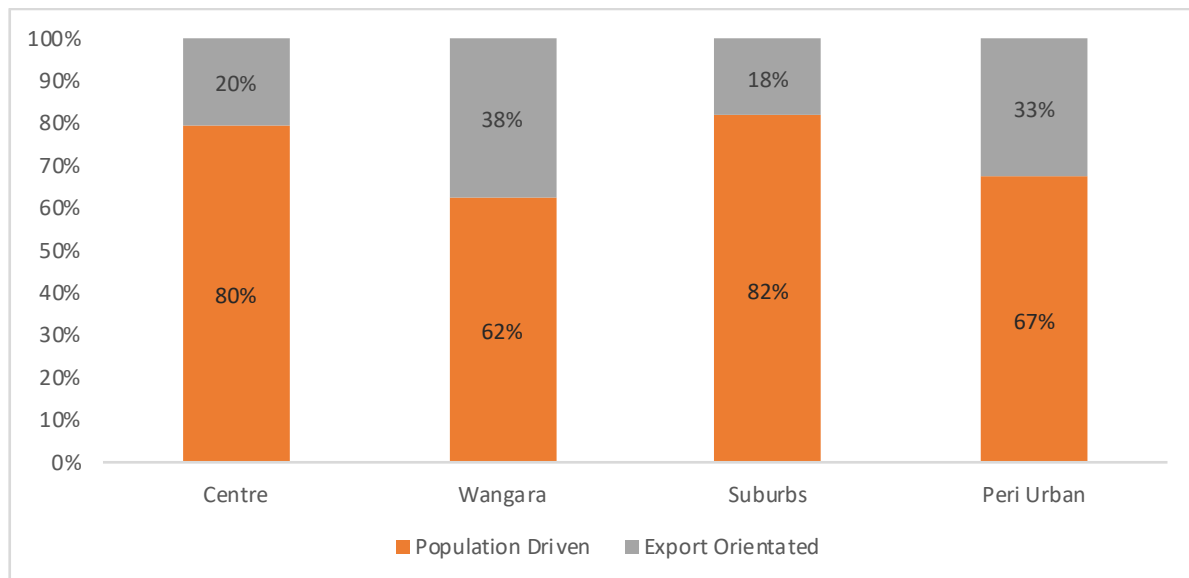
¹³ Non-residential floorspace represents all employment based floorspace

¹⁵ See Section 9, Appendix 2: Glossary

Figure 12. Employment Quality in the Centre and Surrounding Areas

Source: ABS Census 2016

The Wangara industrial area and surrounding agricultural land provide the most export-orientated employment (38% and 33% respectively). Export-orientated employment will likely continue to locate in these areas due to the type of industry and incompatibility with residential development (Figure 13).

Figure 13. Population Drive and Export-orientated Employment

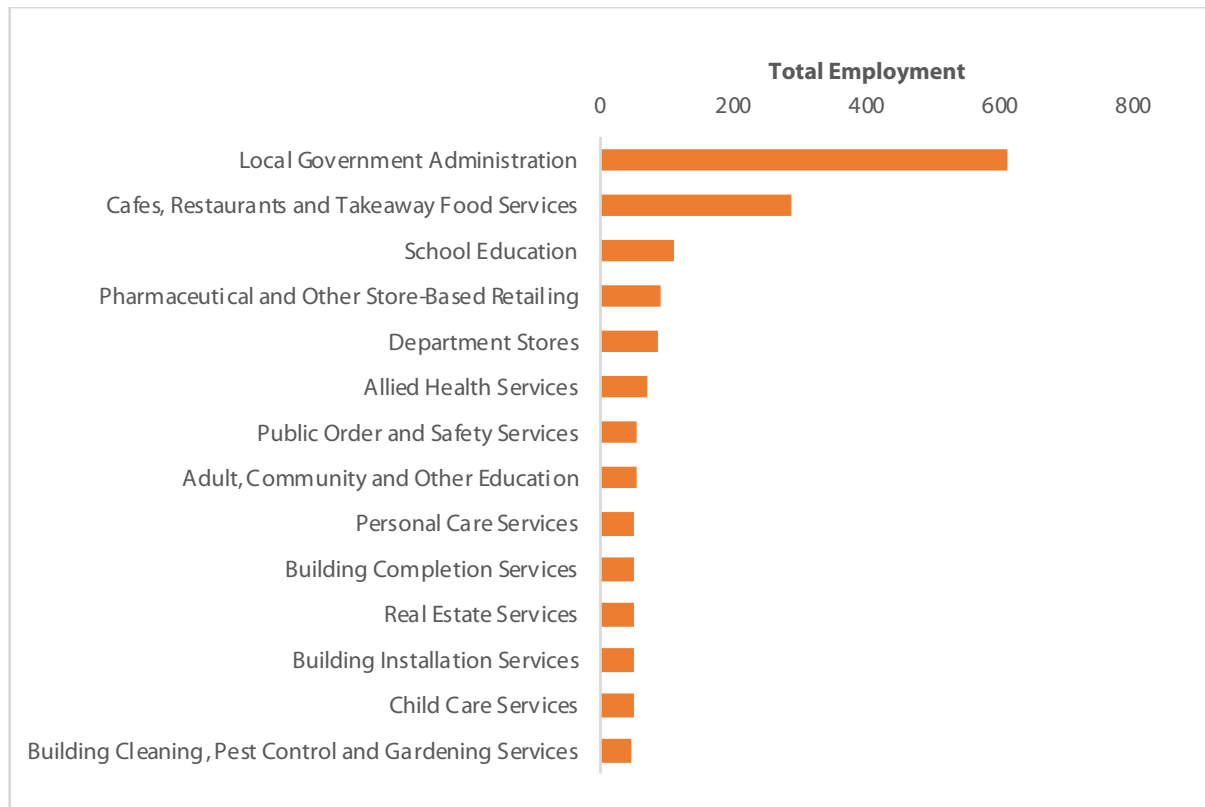
Source: ABS Census 2016

Certain export-orientated employment such as that in professional service industries is well suited to the Centre and opportunities to facilitate these industries should be monitored.

Industry Analysis

The Centre employs approximately 2,800 persons. The top industries in the Centre are Local Government (22%) and Cafes, Restaurants and Takeaway Food Outlets (11%).

Figure 14. Employment by ANZSIC Level 3 Industry Categories



Sources: ABS Census 2016

A Shift Share analysis¹⁶ was performed to identify potential industry strengths in the Centre Catchment as a whole. The Shift Share looks at changes in employment in local industries over a period and compares them to the State trends for those industries over the same period, establishing local growth industries. All but two ANZSIC 1 industries in the Centre Catchment were outperforming compared to State averages¹⁷ (Figure 15).

¹⁶ See Section 9, Appendix 2: Glossary

¹⁷ The two industries that underperformed were: Mining and Wholesale Trade

Figure 15. ABS ANZSIC 1 Industries that Have Outperformed the State Average (State Trend Indicated as High/Low Growth)



Source: ABS Census 2006 – 2016

Most of the growth in the Centre Catchment occurred in population-driven industries. Examining the growth at a more detailed industry level (ABS ANZSIC 3 Categories) shows the industries that experienced the most growth were: School Education, Cafes, Restaurants and Takeaway Food Services and Supermarket and Grocery Stores. Industries high in population-driven employment are suited to the Centre, presenting opportunities to concentrate activity and create economies of scale. Growth in export-orientated employment was further analysed and the follow industries were identified as high growth (Figure 16).

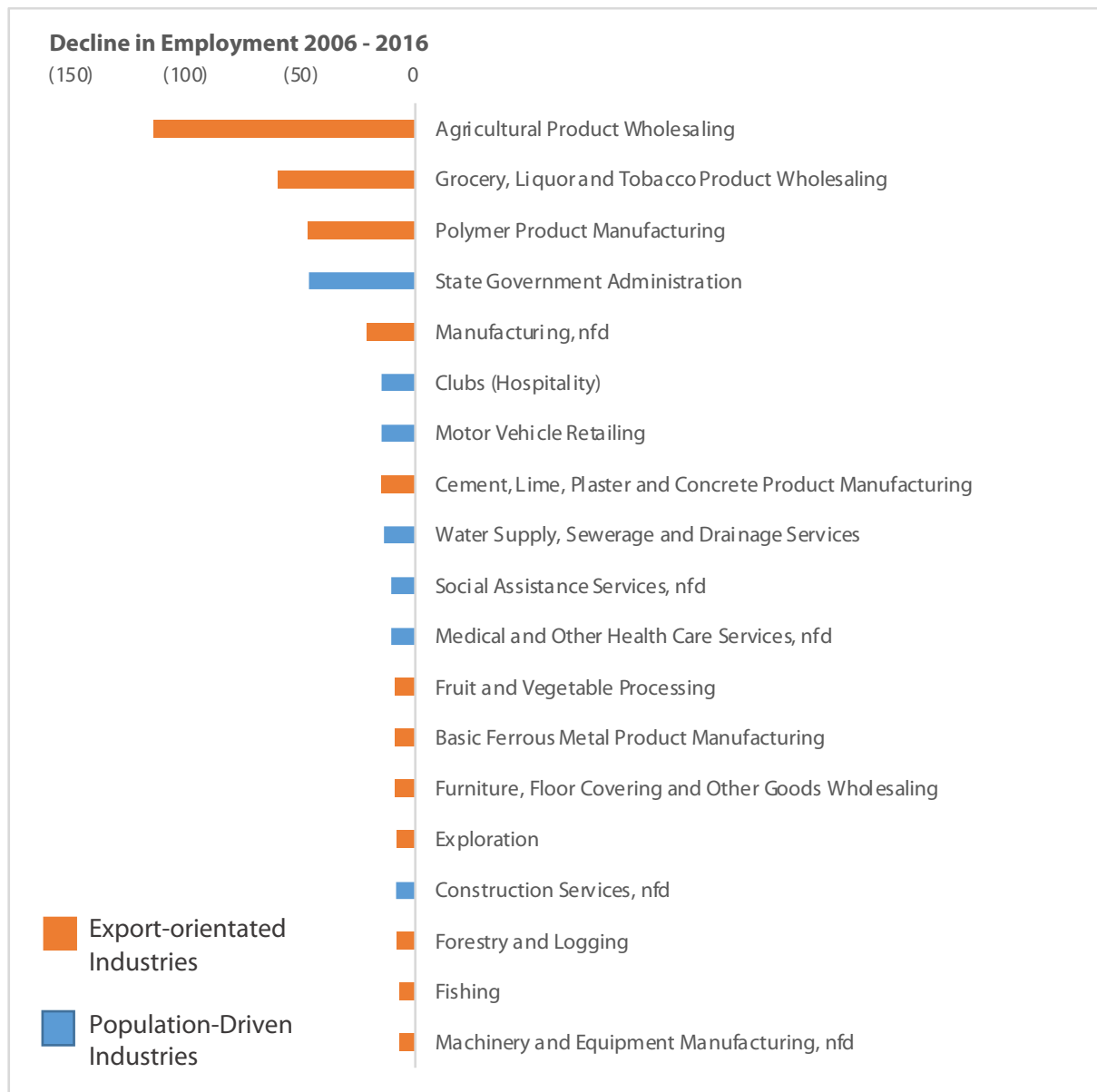
Figure 16. Centre Catchment Employment Growth in Export-orientated Industries ANZSIC 3 Industry

ANZSIC 1 Industry	ANZSIC 3 Industry	Employment Growth
Agriculture, Forestry and Fishing	Nursery and Floriculture Production	68
	Agriculture and Fishing Support Services	36
Professional, Scientific and Technical Services (Professional Services)	Legal and Accounting Services	52
	Computer System Design and Related Services	33
	Architectural, Engineering and Technical Services	29
	Other Professional, Scientific and Technical Services	21
Financial and Insurance Services (Professional Services)	Auxiliary Finance and Investment Services	34
	Depository Financial Intermediation	18
Manufacturing	Other Wood Product Manufacturing	23

Source: ABS Census 2006 – 2016

The most substantial growth in export-orientated employment was in professional services. A total of 240 additional employment opportunities were created in these industries in the Centre Catchment. Employment in these industries is suited to the Centre as they require office space. It is likely that the level of growth in office space in the Centre between 2007 to 2015 (1,440 m²) was sufficient to accommodate this employment.

The worst performing industries at an ANZSIC 3 level were comprised of export-orientated industries with 60% of employment decline in wholesaling, manufacturing or primary industries (Figure 17).

Figure 17. Worst Performing ANZSIC 3 Industries 2006 - 2016

Source: ABS 2006 - 2016

Poor performance in these industries is potentially due to: incompatible land uses as residential areas are developed, increased demand for space from population-driven industries and /or increased property and lease prices. Employment in these industries is not suitable for the Centre.

Employment Analysis Summary

The Centre predominantly supports population-driven employment with most of the employment in KICS, CS and PS employment (78%). Many of these industries have experienced growth rates higher than the State average, indicating the strength of the Centre in providing goods and services for the Centre Catchment population. The Centre appears to be catering to the current level of demand from export-orientated industries.

5.3 Benchmark Analysis

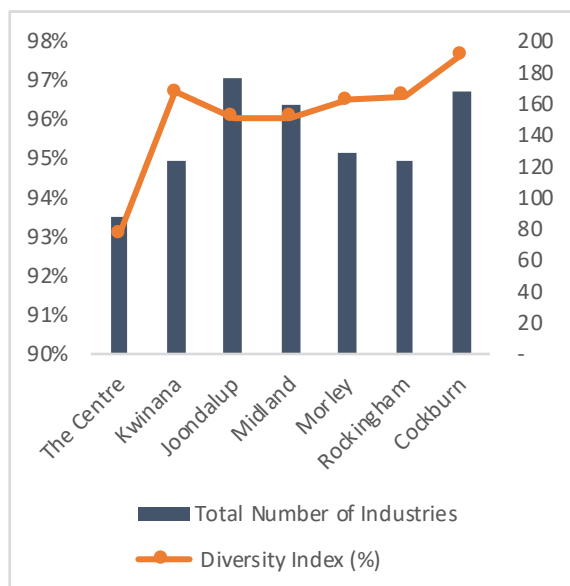
Benchmark analysis was used to assess the Centre's performance against similar centres and larger Strategic Metropolitan centres. This allowed for a gap analysis to identify potential industry opportunities that are specific to the Centre. The analysis identified six benchmark town/city centres:

- Rockingham
- Kwinana
- Cockburn
- Morley
- Midland
- Joondalup

Industry Comparison

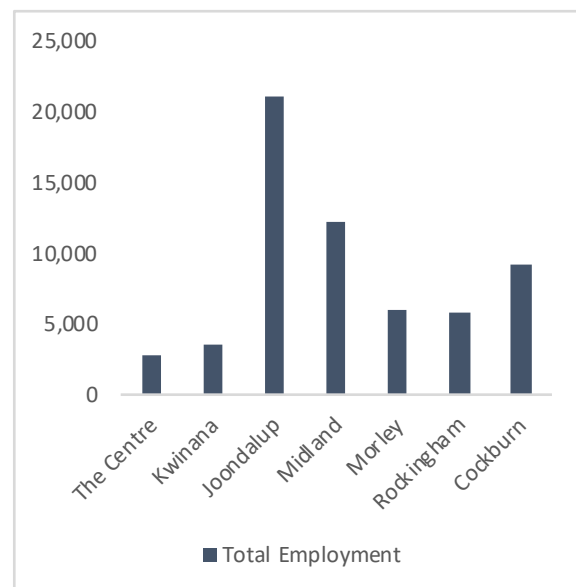
The analysis compared the diversity of industries in the Centre by both total industries and a diversity index (the closer the diversity score is to one the more diverse the economy) (Figure 18). Industry diversity is an indicator of economic resilience and is important for maintaining local employment opportunities. The Centre was found to have fewer total industries and less diversity of local industries (the Centre had the least total employment, likely impacting its total number of industries – Figure 18 and 19).

Figure 18. Benchmark Diversity Comparison



Sources: ABS Census 2016

Figure 19. Total Employment Benchmark Centres



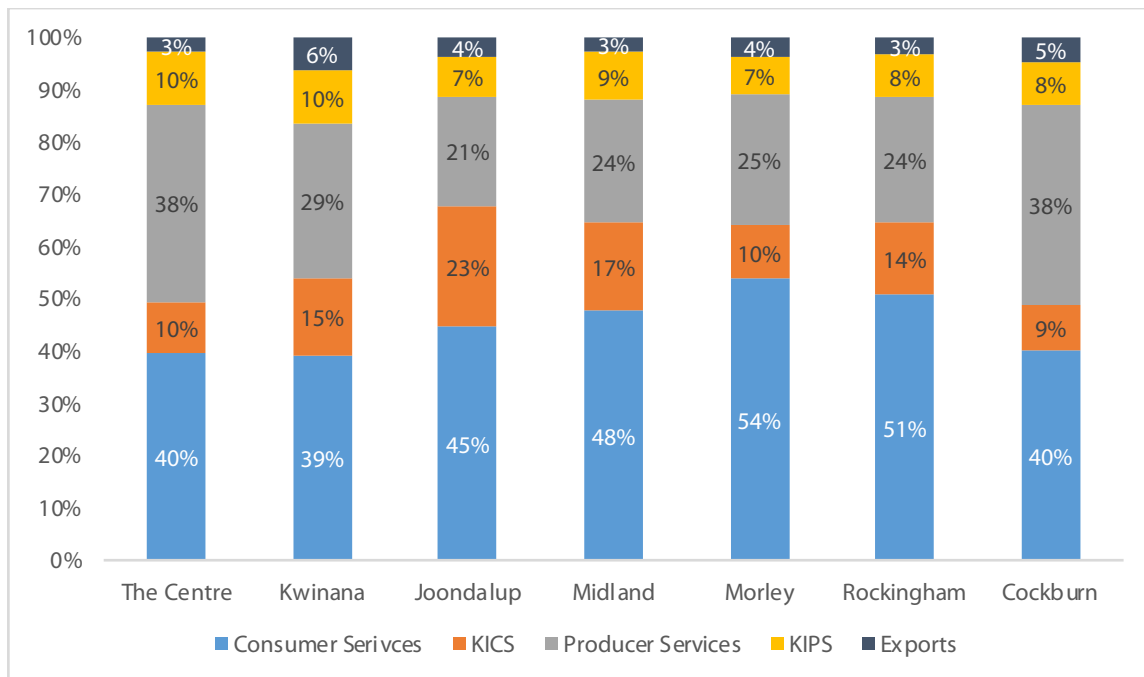
Sources: ABS Census 2016

Industry diversity among other town centres was consistently greater than the Centre, meaning there is likely an opportunity for growth in certain population-driven industries that are not currently represented in the Centre.

Employment Quality

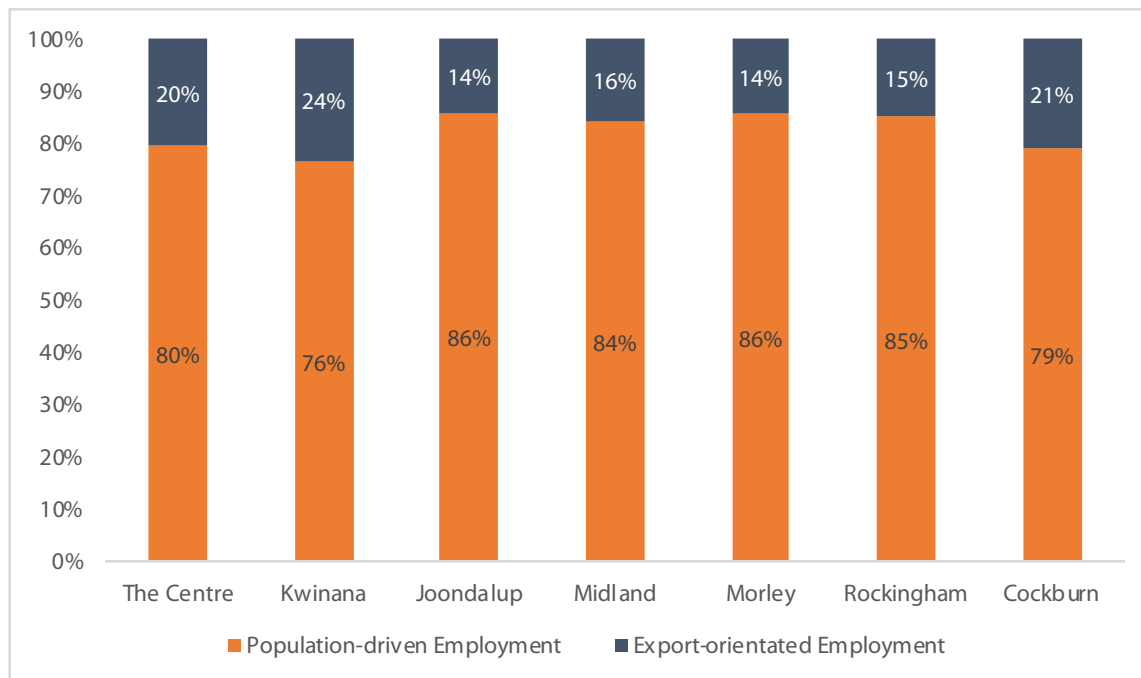
Comparing benchmarks using employment quality shows the Centre has a slightly lower proportion of KICS employment than the average benchmark (this includes doctors, university professors, etc.) (Figure 20). The centre also tends to have a lower proportion of CS employment compared to larger town/city centres.

Figure 20. Employment Quality Benchmark Comparison



Source: ABS Census 2016

The centre has a higher proportion of PS employment, due mostly to City of Wanneroo employees and their role in providing services to the entire Wanneroo population. The proportion of population-driven to export-orientated employment in the Centre is relatively consistent with that of other centres (Figure 21).

Figure 21. Benchmark Population-driven and Export-orientated Employment

Source: ABS Census 2016

Centre Strengths and Growth Opportunities

The benchmark analysis adjusted total employment in benchmarks relative to employment in the Centre. This enabled an industry gap analysis identifying local strengths and potential opportunities for growth. The Centre was found to have greater relative employment than the benchmarks in the following industries.

Figure 22. Centre Strengths

Industry	Strengths	Floorspace Type
Public Administration	The City of Wanneroo Local Government is headquartered in the Centre	OFF, HEL
Retail	The centre outperforms benchmarks in supermarket and grocery stores, indicating its role as more of a convenience retail centre	SHP
Arts and Recreation Services	The Centre has a significant community focus including its library services, the theatre and the recreation centre	ENT
Health Care and Social Services	The centre provides a relatively high level of childcare	HEL
Education	Education and training services that perform well in the Centre include adult and community education and preschool education	HEL
Construction	Many construction services operate in the Centre and are likely associated with the growth in residential development in the City	OFF

Industry	Strengths	Floorspace Type
Accommodation and Food Services	The Centre provides a relatively high quantum of café, restaurant and takeaway food related employment	SHP
Property Services	There is a relatively high concentration of employment in real estate and building cleaning services in the Centre	OFF

Source: ABS Census 2016

The main strengths in the Centre are population-driven industries. Floorspace in the SHP, ENT, HEL and OFF categories will need to be monitored to ensure these industries continue to thrive and meet the needs of the local population.

The analysis investigated industries that were underperforming in the Centre when compared with benchmarks. These are potential growth opportunities as they are examples of industries that are currently located in other similar centres. Further research would be required to identify potential factors that decide where these industries choose to locate and how they could potentially be attracted to the Centre.

Figure 23. Growth Opportunities

Opportunity	Specific Industries	Floorspace
Comparison Retail	There is an opportunity for the Centre to expand the range of specialty retail stores and become more of a comparison retail destination. Opportunities to grow include but are not limited to: clothing and footwear retail and department stores	SHP
Health Care	Opportunities for the Centre to expand its local health services include: aged care services, social services, allied health services, medical services, and pathology and diagnostic imaging services	HEL
Bulky goods retail	There is the potential for bulky goods retail along Wanneroo Rd where consistent with the vision and objectives of the Activity Centre Structure Plan. Opportunity industries include: hardware, building and garden supplies, electrical and electronic goods, recreational goods, furniture, floor coverings and houseware, and motor vehicle retailing (potentially not suited to a town centre)	RET
Education and Training	Opportunities for the Centre to increase employment in education include: school education, tertiary education (limited potential in tertiary due to proximity to Joondalup)	HEL
Professional Services	While there has been growth in professional services in the Centre and Surrounds, there are still some industries that have not yet met benchmark levels, these include: legal and accounting services, computer system design and related services, architectural, engineering and technical services, scientific research services, market research, and statistical services, management and related consulting services	OFF
Financial Services	The Centre has the opportunity to expand certain financial services, including: financial asset investing, and health and general insurance	OFF

Source: ABS Census 2016

Most of the opportunity industries are population-driven in nature and could potentially be attracted to the Centre given the significant population growth over the past decade. There may be certain constraints in the Centre that are impeding these industries from locating in the Centre, including a lack of appropriate floorspace, cost of premises and proximity to Joondalup. Floorspace types that need to be expanded to provide capacity for these industries include SHP, RET and HEL. Export-orientated industry opportunities include professional and financial services. Further research would be required to identify potential factors that affect where these industries choose to locate and how they could potentially be attracted to the Centre. Increased capacity in OFF floorspace would be required to accommodate growth in these industries but will not attract these industries unless there is the underlying demand.

Benchmark Comparison Summary

The Framework should provide flexibility to allow greater industry diversity within the Centre. This could include policies that allow for flexibility in floorspace uses (i.e. allowing a space to operate as retail, health or office). The Centre was found to support a higher proportion of PS and KIPS employment than benchmarked centres and a slightly lower proportion of KICS employment. The City should investigate the potential to encourage growth in knowledge intensive industries. Some strategies could include but are not limited to:

- Developing a business attraction strategy that communicates the key locational preferences that could attract knowledge intensive industries
- Encourage health related industries to locate next to the Super GP Clinic

Benchmark comparison identified opportunities for the City to increase the provision of particular types of population-driven employment in the Centre. Growth in population in the Centre Catchment would provide demand for additional services such as comparison retail offerings. The City should investigate potential strategies that could be used to attract these industries.

6 CENTRE DEVELOPMENT SCENARIOS

6.1 Population Growth

Growth in the Centre Catchment was investigated to assess potential future scenarios for Centre floorspace. Population growth was estimated to 2041 using two sources¹⁸:

- WA Tomorrow – Band C: provided a more conservative annual growth estimate of 1.8%
- Forecast.id: provided a more optimistic population growth estimate of 3.1%

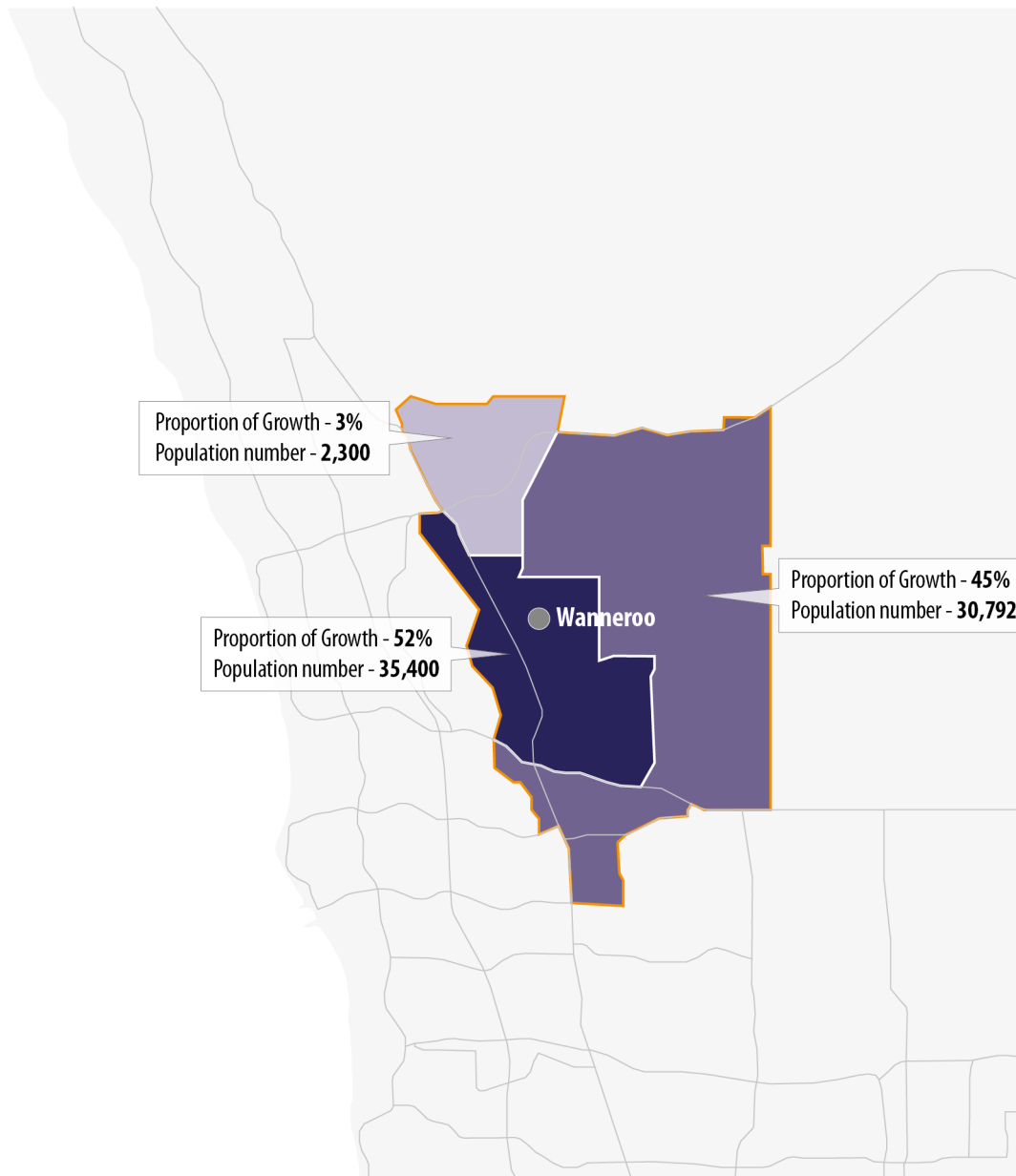
The population growth estimates provide a lower and upper bound for estimating potential growth of non-residential floorspace in the Centre. Total population of the Centre Catchment could reach between 105,000 and 135,000 persons by 2041,¹⁹ indicating the Centre will likely need to develop into a large Secondary centre (the guide for maximum catchment population for a secondary centre is 150,000²⁰). The identified growth rates are considered conservative given that residential development is expected to be concentrated around the Centre.

¹⁸ These estimates are considered feasible as growth in the area averaged 5.9% annually from 2006 to 2016

¹⁹ The upper population estimate of 135,000 assumes that 835 dwellings are developed in the centre, significantly less than what is allowed for in the Activity Centre Structure Plan.

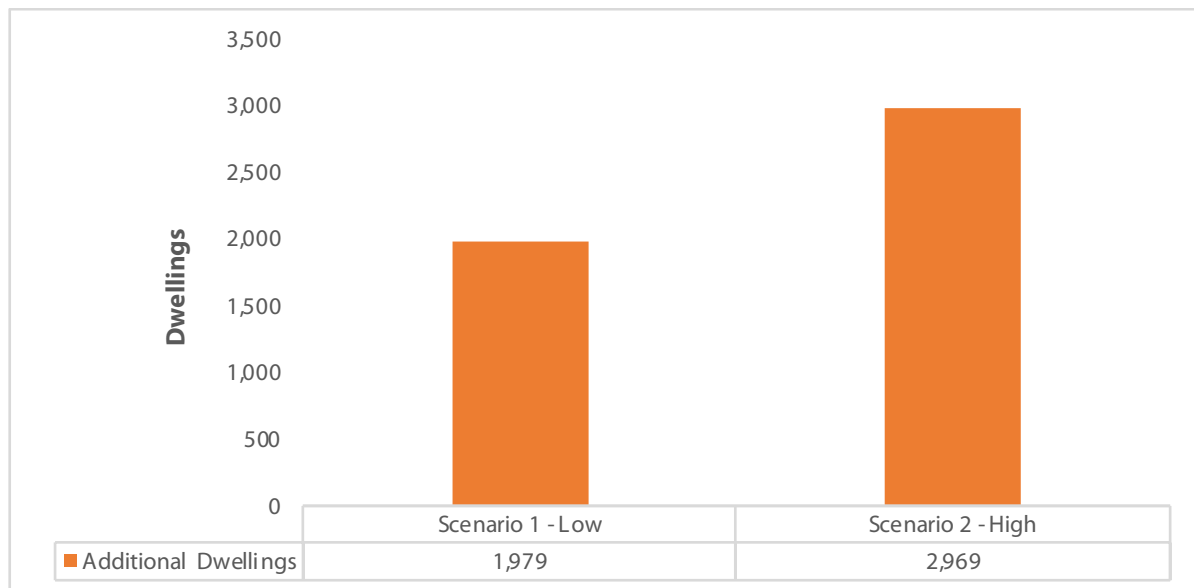
²⁰ Department of Planning, Lands and Heritage 2010, State Planning Policy 4.2, p4147

Figure 24. Distribution of Center Catchment Growth



Source: Forecast.id 2018

Long-term plans indicate that there could be up to 2,969 new dwellings in the Centre upon full development (Figure 23).

Figure 25. Centre - New Residential Dwellings

Source: TBB 2018

Significant growth in residential dwellings in the Centre will necessitate additional population services as it would naturally be expected that residents living within the Centre would be more likely to acquire goods and services from the Centre. The planned dwellings would create an additional expenditure pool of between \$70 million and \$110 million per annum in retail goods and services alone. It will be crucial to ensure the Centre can provide the necessary amenity and services for new Centre residents and residents of the broader Centre Catchment.

6.2 Floorspace Scenarios

The Framework should be informed by population growth estimates to allow sufficient non-residential floorspace to meet the service and employment demand of the future Centre Catchment population. State Planning Policy 4.2 indicates that activity centres should play an important role in contributing to sub-regional ESS targets due to the concentration of employment generating activities. Taylor Burrell Barnett (TBB) has developed non-residential floorspace estimates for the Centre in conjunction with the City and Stakeholder consultation (Figure 26).

Figure 26. TBB Centre Non-Residential Floorspace Scenarios

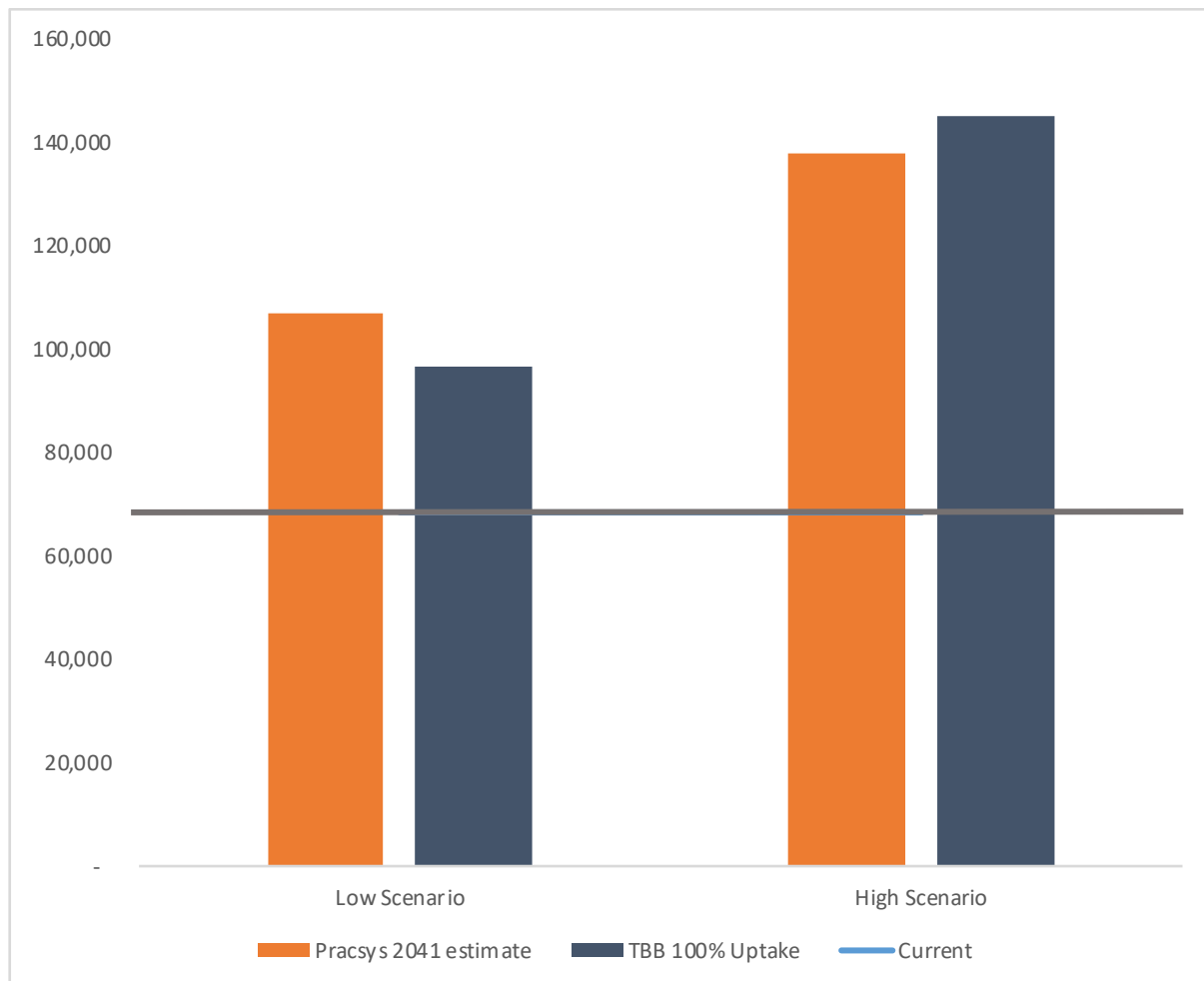
	Scenario 1 - Low	Scenario 2 - High
Total non-residential floorspace	96,666	144,999

Source: TBB 2018

The growth estimates provided by TBB were assessed against the identified population growth estimates for the Centre Catchment. The population growth estimates indicate that demand for floorspace based on population growth is well aligned with the planned floorspace growth. There is the potential that the demand

for floorspace will marginally exceed supply by 2041 should the low growth scenario and low development estimate be achieved (Figure 27).

Figure 27. Floorspace: Population Growth Compared to TBB Capacity Scenarios



Source: TBB 2018, Forecast.id 2018, WA Tomorrow 2015

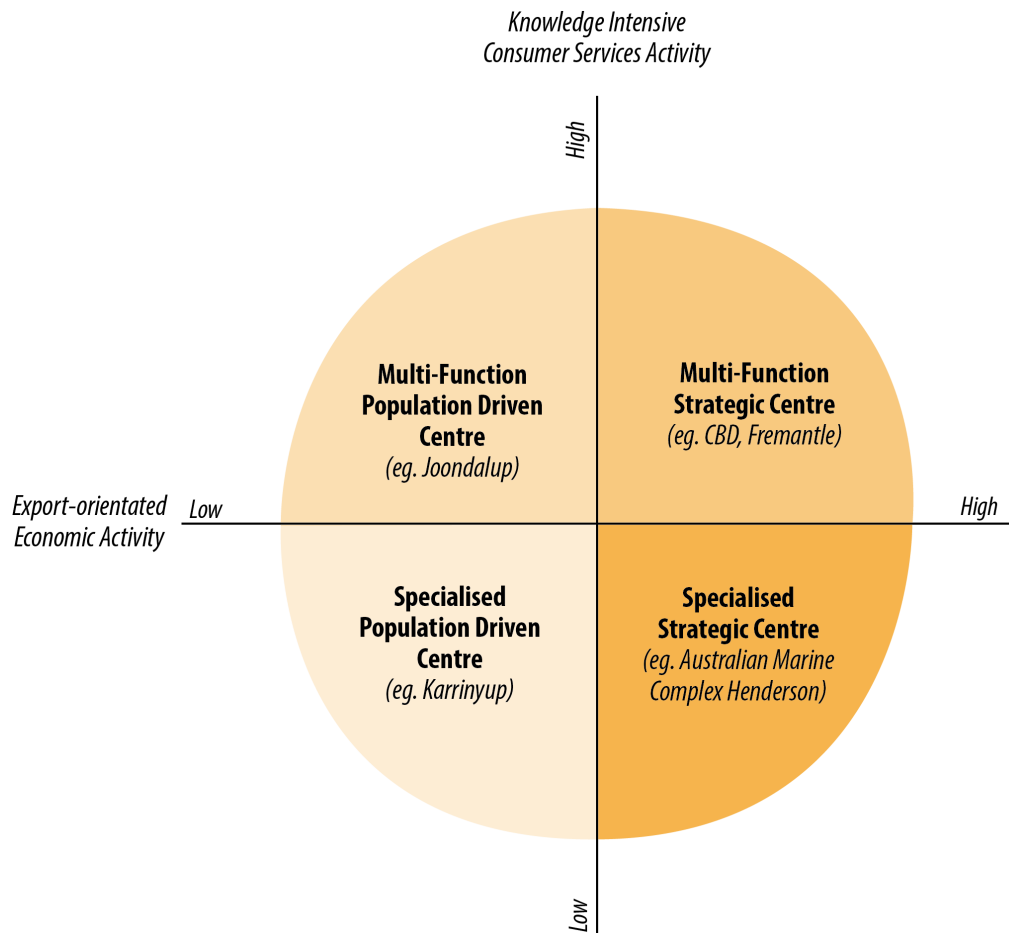
The projections provide the City with an indication of the level of development of the Centre that should be taken into consideration when approving development in the Centre. Proposed Development Applications should be assessed based on:

- Their location
- The type of uses proposed
- The current total non-residential floorspace on the relevant land
- The proposed level of non-residential floorspace
- The principles of economic activation (i.e. would the proposed ground floor uses provide attractive frontages that could contribute to increased pedestrian activity in the Centre or is the development in a part of the Centre that should not be activated so as to focus traffic in the Centre's core)

Floorspace Mix Scenarios

There are four broad activity centre typologies that can be applied to most centres. The typologies demonstrate the primary focus of an activity centre.

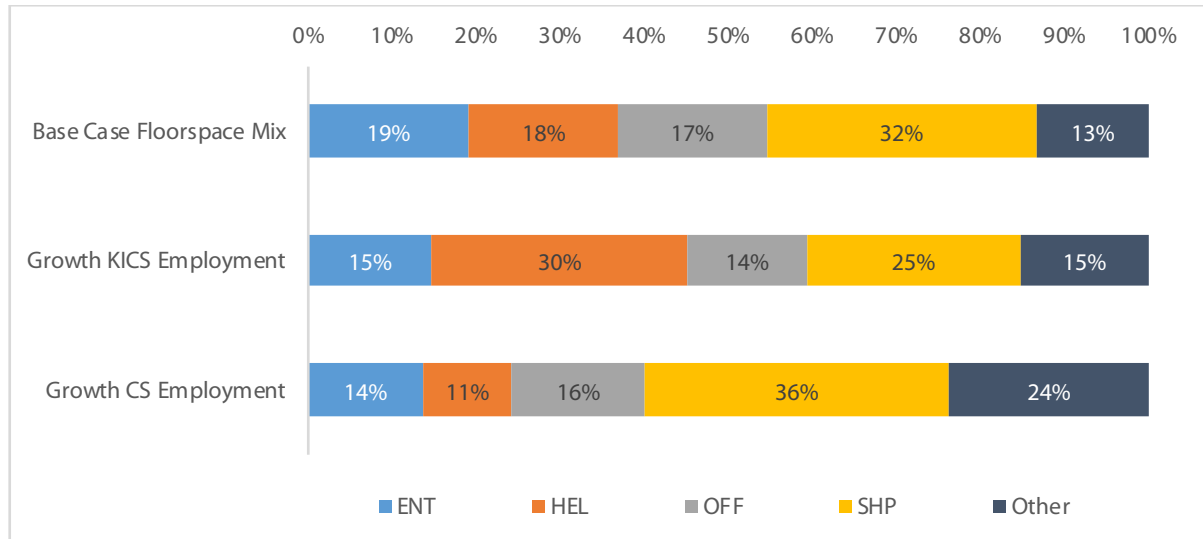
Figure 28. Activity Centre Typologies



This focus typically shifts and changes over time as centre maturation occurs through increased population density, greater employment intensity and diversity, and expanded transport networks around. In order to set a vision for any activity centre, it must be understood where the Centre sits within this matrix, and where it is desired to sit in the future. Floorspace mix scenarios were developed based on benchmarked centres, including:

- A base case where the mix stays the same (population-driven centre with some other functions)
- A scenario where there is a higher rate of growth in KICS related industries such as health and education (Multi-function Population-driven Centre)
- A scenario where there is a high rate of growth in CS related industries such as retail (Specialised Population-driven Centre)

These scenarios were used to estimate the distribution of floorspace uses for both the low and high growth scenario (Figure 29 and Figure 30).

Figure 29. Floorspace Use Scenarios

Source: Department of Planning, Lands and Heritage 2015

Figure 30. Floorspace use Scenarios Total m²

Growth Scenario	Floorspace use Scenario	ENT	HEL	OFF	SHP	Other	Total
High	Base Case Floorspace Mix	26,000	25,000	24,000	45,000	18,000	138,000
	Growth KICS Employment	20,000	42,000	20,000	35,000	21,000	
	Growth CS Employment	19,000	15,000	22,000	50,000	32,000	
Low	Base Case Floorspace Mix	20,112	19,338	18,565	34,809	13,924	107,000
	Growth KICS Employment	15,471	32,488	15,471	27,074	16,244	
	Growth CS Employment	14,697	11,603	17,018	38,677	24,753	

Source: Department of Planning, Lands and Heritage 2015

The results provide an understanding of the predominant floorspace uses depending on alternative growth scenarios:

- Knowledge Intensive Consumer Services:** this scenario uses Joondalup City Centre as a benchmark for additional floorspace. Should there be a higher rate of growth in industries such as health care, education or community services, it could be expected that a greater proportion of floorspace growth will occur in HEL floorspace. There would be a higher level of employment quality as the Centre matures to include more knowledge intensive uses in this scenario
- Consumer Services:** this scenario uses Morley City Centre as a benchmark for additional floorspace. Should there be a higher rate of growth in industries such as convenience retail, comparison retail, trade services, etc., it could be expected that a greater proportion of floorspace growth will occur in

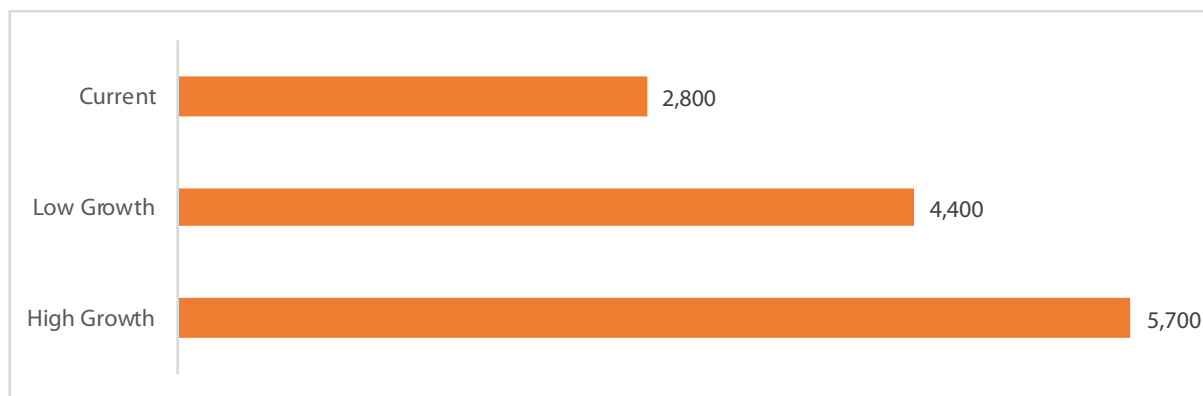
SHP, SER (Other) and RET (Other) floorspace. This would lead to a higher performing population-driven centre, however would not necessarily provide improved employment opportunities

Ideally, both KICS and Consumer Service industries would perform well, leading to a satisfactory mix of employment opportunities that meets the need of the Centre Catchment population. Employment in knowledge intensive industries is higher skilled, is more resilient and generally offers higher wages. Such employment will increase the competitiveness of the Centre relative to surrounding centres in terms of desirability as a place to live and work.

6.3 Employment Scenarios

Employment in the Centre is assumed to grow at a similar pace to population; the majority of employment is population-driven in nature (80%) and the Centre currently has an average level of export-orientated employment (see Section 5.3, Benchmark Analysis) compared to town/city centre benchmarks. It is estimated that employment in the Centre could grow to 5,700 employees by 2041 (Figure 31).

Figure 31. Employment Growth Scenarios



Sources: ABS Census 2016, WA Tomorrow 2015, Forecast.id 2018

Greater employment in the Centre will provide increase worker expenditure for local retail goods and services. Proper activation of the Centre can help to maximise the ability of local business to capture worker expenditure. Workers will also require improved transport opportunities and/or parking to access employment. The City should allow for sufficient parking while working with the State government to provide appropriate public transport to and from the Centre.

Establishing a Framework that provides sufficient capacity for future non-residential floorspace demand and facilitating industry growth will allow the centre to accommodate either the low or high employment scenario. Ensuring the Centre can meet demand for employment will contribute positively to maintaining and potentially surpassing sub-regional ESS targets and meeting SPP 4.2 objectives.

Economic Development of the Centre

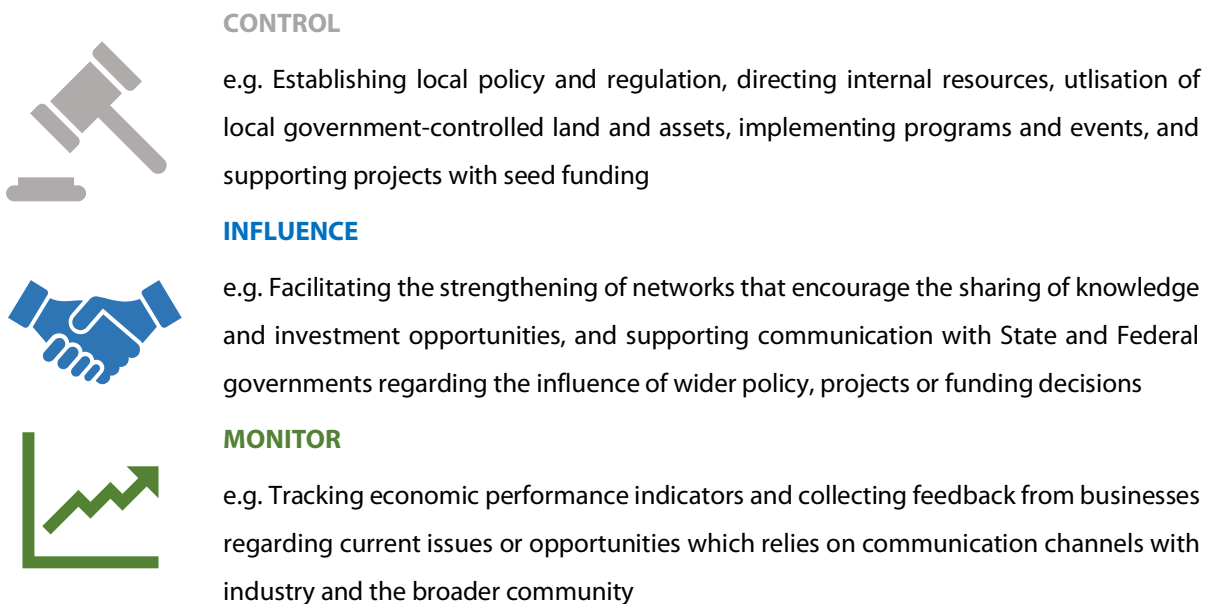
The employment estimates are based on the following assumptions:

- The Framework will provide sufficient capacity to accommodate employment growth

- The City will facilitate employment growth through appropriate economic development policies
- Employment will grow at a similar pace to population growth (including export-orientated employment)

The Framework will provide a guide to establishing the capacity for future non-residential floorspace development. It is assumed the City will facilitate employment growth through an understanding of the key drivers that attract businesses to the Centre.

In creating an attractive business environment within the Centre, the role of the City is to act as a central regulator, coordinator and facilitator, working to understand the challenges facing local businesses including; linking businesses with appropriate resources, advocating on behalf of local businesses, and supporting specific projects where appropriate. The levers available to the City can be described under the following hierarchy:



Using these levers, the City can actively attract and retain local businesses through an understanding of the relative strengths and weaknesses of the Centre and how they relate to a business's locational preference drivers and hence it's operational productivity. These considerations differ depending on the nature of a business, with population/consumption-oriented businesses having different needs to those that operate business-to-business or are export driven. Primary research in areas comparable to the City has identified:

- The locational preferences of both population-driven and export-orientated industries
- The functions that private industry would like local governments to focus on

Figure 32. Business Attraction/Retention Insights

Research Area	Common to all Industries	Population-driven Industry	Export-orientated Industry
Locational Preferences	Transport Links	High-Density Residential Development	Internet Speed

Research Area	Common to all Industries	Population-driven Industry	Export-orientated Industry
(reasons businesses choose to be in a location)	Affordable and suitable premises	High levels of footfall	Access to shared or collaborative workspaces
	Availability of Parking	Quality Streetscapes	Agglomeration Economies
Key actions that private industry want Local Government to focus on	Efficient planning, zoning and approvals processes	Support high-density residential development	Create Networking Opportunities
	Small business support	Support commercial office space development	Improving walkability/cycle paths
	Easily accessible communication tools and feedback loops	Event coordinating/ visitor attraction	Improving Public Transport Connections

Source: Pracsys 2018

These factors should be assessed within the context of the City's overarching strategic goals, such as the prioritisation of high-quality employment. The development of a set of strategically aligned goals forms a natural starting point to attracting businesses to the Centre, which should incorporate both local business feedback and established business locational preference principles. The City should focus on controlling and influencing the attractors that are suited to population-driven industries as population growth continues in and around the Centre. This includes:

- Establishing a Framework that allows for residential and non-residential development
- Ensuring appropriate development consistent with the vision and objectives of the Wanneroo Town Centre Activity Centre Structure Plan
- Actively developing City owned land
- Lobbying for better transport linkages
- Creating a more walkable environment in the Centre and for local residents surrounding the Centre
- Promoting communication channels with current KICS industries (e.g. ECU) and potential future KICS industries (i.e. medical support services)

Export-orientated industry drivers are not as strong in the Centre (i.e. agglomeration economies, resources, etc.) and the City should use a monitoring approach to identify potential growth in these industries. This includes:

- Monitoring the type of industries present in the Centre
- Establishing and monitoring the vacancy in office space in the Centre
- Tracking potentially significant projects that could transform the area (train station, bridge across lake Joondalup, etc.)
- Promoting communication channels with current and future export-orientated industries, particularly KIPS related industries (i.e. bio-pharmaceutical manufacturing)

7 SUMMARY OF FINDINGS

The analysis has identified key findings that can contribute to the Framework and information to guide the City in achieving desirable economic outcomes. The findings have been categorised as follows:

- Centre strengths and opportunities
- Potential actions for the City

7.1 Centre Strengths and Opportunities

The Centre Catchment experienced significant growth between 2006 and 2016 with an annual growth rate of approximately 5.9%, compared to 3% for Greater Perth. The Centre has achieved a similar level of growth in non-residential floorspace as a result of the increase in demand for population-driven services. The Centre plays an important role in providing community services to the Centre Catchment with high proportions of health, education, community and retail floorspace. The Centre appears to be performing well with a vacancy rate of 3% and private investment in the form of the Wanneroo Central expansion.

Many population-driven industries in the Centre Catchment have performed better than the State average, including:

- Retail Trade
- Education and Training
- Health Care and Social Assistance
- Accommodation and Food Services

These industries are likely to continue growing with significant population growth projected for the Centre Catchment. Opportunities specific to the Centre include:

- Improving the economic activation of the Centre to increase pedestrian traffic through the core of the Centre
- Medium to High density residential development in the Centre
- Encouraging increased diversity in retail offering (e.g. comparison retail such as clothes and footwear shopping) to capture more of the Centre Catchment's retail expenditure
- Facilitating growth in health-related services around the Super GP clinic
- Communication channels with ECU should be promoted to help encourage further knowledge related activity in education

7.2 Potential Actions for the City

Through the Framework, the City is establishing the direction for residential and non-residential floorspace in the Centre. The City has the opportunity to contribute directly to achieving desirable outcomes as the Framework is implemented. A set of potential actions has been identified for the City to consider:

- Applying the principles of economic activation when developing Centre modification projects (streetscapes, parking, etc)

-
- Applying the principles of economic activation to development applications and ensuring that the current level of non-residential floorspace is maintained across the Centre as a whole
 - Implementing flexible floorspace policies, where appropriate, that allow for multiple potential uses
 - Continue lobbying for improved transport linkages
 - Monitor floorspace vacancy with specific attention paid to the level of office vacancy
 - Monitor or identify potential transformational projects in the vicinity of the Centre that could contribute to a change in its function

8 APPENDIX 1: FLOORSPACE DEFINITIONS

Planning Land Use Categories	Department of Planning - Definition
PRI	Land use activities which usually involve the use of large areas of land including mining, agriculture, fishing and nature conservation. The function of many of these activities is to make use of, or extract from, the land in its natural state. Since such activities are the first step in the production process they are quite distinct from the other categories
MAN	This category includes land use activities involving the manufacture, processing and fabrication of all general goods. Both the scale and associated environmental impact of these activities separate them from other land use categories.
STO	Any land use activity which involves the storage, warehousing or wholesaling of goods usually conducted from large structures, or involving large bulky goods, but does not include activities that attract general retail trade activities.
SER	This category includes service industries offering a range of services. The scale and environmental impact of such activities require their separation from other land uses. These services include film processing, cleaning, motor vehicle and other repair services, and other servicing activities, including some construction activities.
SHP	Any activity which involves the sale of goods from a shop located separate to and/or in a shopping centre other than those included in category – Other Retail.
RET	Many of these activities normally are not accommodated in a shopping centre. By virtue of their scale and special nature, the goods of these activities separate them from the Shop/Retail category (e.g. car sales yard, carpet showroom).
OFF	Administrative, clerical, professional and medical offices are activities which do not necessarily require the land area/floorspace or exposure of other land uses. Although offices require building and parking facilities, these needs are quite distinct from those of commercial uses and service industries.
HEL	Includes government, government-subsidised and non-government activities which provide the community with a specific service, such as hospitals, schools, personal services and religious activities.
ENT	Activities which provide entertainment, recreation and culture for the community and which occur in building and/or on land, such as passive and active sports venues, museums, amusements, gambling services, hotels and the like.
RES	Includes all types of residential land use ranging from single housing to nursing homes for the aged, residential hotels, motels, other holiday housing, institutions and religious housing. Floorspace and employment on private Residential land uses are not included in the output of the Commercial Land Use Survey.
UTE	All forms of local, State, national and international communication, transport and other utilities (electricity, gas, water, sewerage, roads, parking and other transport or communication related activities, etc.) covering the public and private sectors.

9 APPENDIX 2: GLOSSARY

Consumer services (CS)

Consumer services have a high transaction frequency and must locate in close proximity to their customer base in order to deal directly with them. Like retail tenancies, consumer services often locate in centres to minimise trip generation and benefit from convenience good attractors. Consumer services can include real estate agents, travel agents, shoe repair, dry cleaning services and beauty salons.

Producer services (PS)

Producer services deal directly with other businesses, rather than consumers. Like retail locates close to consumers; wholesale producer services must locate close to the businesses they serve, due to the frequency of transactions required. For example, the Coles distribution warehouses must occupy a central location in order to carry out daily delivery of goods to supermarkets. Producer service industries include manufacturing, construction, and distribution.

Knowledge intensive consumer services (KICS)

Knowledge intensive consumer services are those specialist services that deal directly with consumers, yet typically have a higher productivity and lower transaction frequency. KICS provide a skilled service to consumers that usually requires a higher level of education or training. Depending on the scale of their catchment, KICS may choose to locate within major or regional centres, or larger business districts with greater soft infrastructure and amenity levels. Examples of KICS include general practitioners, accountants, veterinarians and legal services.

Knowledge intensive producer services (KIPS)

Knowledge intensive producer services (KIPS) involve businesses dealing directly with other businesses, rather than consumers. Transactions are less frequent, however generally have a higher monetary value, due to the intellectual property or knowledge involved. KIPS businesses often locate near their client businesses, although with low transaction frequency and good communications infrastructure, they are to an extent 'footloose'. This means they can choose to locate in places with relevant physical infrastructure, high retail amenity, or soft infrastructure such as access to a solid education base. Examples of KIPS are engineers, architects, medical scientists and computer software developers.

Export-oriented activity (Export)

Export refers to jobs in industries that take advantage of an areas comparative advantage. These are generally thought of as strategic due to growth and development through the export of goods/services and the inflow of funds. Export jobs are producer services, however they tend to occurring in strategic industries such as agriculture, mining, oil and gas and defence. Export jobs are likely to be hands on, involving the physical construction of a marine vessel or operation of machinery on a mine site - as opposed to the mathematical or

scientific analysis carried out by KIPS. Strategic industries tend to require physical infrastructure, such as ports, airports or universities.

Shift share analysis

Shift share analysis is a technique that aims to identify the industries that are most competitive in a defined region, through an analysis of employment growth. Employment growth is broken down into different components to determine what share of the growth can be attributed to growth in the State economy, what percentage can be attributed to the industry mix, and the remainder is then assumed to result from particular competitive strengths developed in the defined region.

10 APPENDIX 3: OUTLINE OF WANNEROO TOWN CENTRE





APPENDIX 5 ENVIRONMENTAL ASSESSMENT AND MANAGEMENT STRATEGY

Environmental Assessment and Management Strategy

Wanneroo Town Centre Structure Plan

Project No: EP17-133(01)

**Prepared for City of Wanneroo
October 2018**



Environmental Assessment and Management Strategy

Wanneroo Town Centre Structure Plan



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	Issued to City of Wanneroo				

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Environmental Assessment and Management Strategy

Wanneroo Town Centre Structure Plan



Executive Summary

This *Environmental Assessment and Management Strategy* (EAMS) has been prepared on behalf of the City of Wanneroo to support the *Wanneroo Town Centre Structure Plan* (SP) developed by Taylor Burrell Barnett (TBB). The purpose of the SP is to guide the future urban development of the Wanneroo Town Centre ('the site'), an area of approximately 90 hectares located in the outer northern Perth suburbs of Wanneroo and Sinagra.

The site is zoned 'centre' under the CoW District Planning Scheme (DPS) No. 2 and 'urban' or 'urban deferred' under the Metropolitan Region Scheme (MRS). The 'urban deferred' zoning is related to the land immediately north of the site which historically supported an Inghams poultry processing facility. This land use has since ceased and the land is likely to be developed for urban land uses.

This EAMS is the key environmental document supporting the structure planning process, ultimately facilitating the consideration of environmental issues by the assessing local and state government authorities. It provides a synthesis of information regarding the environmental aspects of the site, with relevant environmental attributes and values of the site summarised as follows:

- The site has historically been cleared of the majority of native vegetation. Development has progressively intensified over time into a built-up urban environment which supports a range of existing land uses.
- Topography of the site ranges from 29 m Australian Height Datum (AHD) in the west to 76 m AHD in the north east.
- The site is classified by the Department of Water and Environmental Regulation as having 'no known risk' of acid sulfate soils occurring within 3 m of the natural soil surface.
- Intact native vegetation was observed to be generally limited to an area of approximately 27.6 ha in the northern extent of the site (Lot 9000). A Reconnaissance Flora and Vegetation Survey of this vegetation was completed by Emerge Associates on 23 March 2018.
- Vegetation is generally similar across Lot 9000 and comprises a banksia woodland structure, with either jarrah or marri being the dominant overstorey species. The condition of the vegetation was observed to generally be highest in the north-east corner of the land parcel. It is likely that the intact vegetation within Lot 9000 represents the *Banksia Woodlands of the Swan Coastal Plain* Threatened Ecological Community. However, detailed spring flora and vegetation surveys would be required to confirm this.
- Areas of parkland cleared vegetation scattered across the remainder of the site do not comprise intact native vegetation communities and were observed to be in 'degraded' or 'completely degraded' condition.
- Vegetation within the site provides potential habitat for threatened species of black cockatoo, including potential foraging, roosting and nesting habitat associated with intact native vegetation within Lot 9000. Scattered mature trees across the remainder of the site may also provide some potential black cockatoo habitat, however of a comparatively lower quality.
- Maximum groundwater level (MGL) across the site ranges between 24 m AHD near the western boundary and 40 m AHD in the north east of the site, with MGL ranging from 0 m to 36 m below ground level.
- The site does not contain any surface water, waterway features or geomorphic wetlands.

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- The portion of the site west of Wanneroo Road is identified as a Priority 3 Public Drinking Water Source Area.
- No Registered Aboriginal Sites are identified are known to occur within the site. Three Other Heritage Places are mapped within the site but do not meet the definition of a Registered Aboriginal Site for the purpose of the *Aboriginal Heritage Act 1972*, and as such are not afforded statutory protection under the Act.
- Eight places listed in the CoW Local Heritage Survey (2016) occur within the site, three of which are also listed on the CoW Scheme Heritage List and as such as afforded statutory protection under the *Heritage of Western Australia Act 1990* and the *Deemed Provisions of District Planning Scheme No. 2*.

The following SP design responses have been developed with consideration to the identified environmental values of the site:

- Identification of a conservation public open space (POS) area in the north-east of the site, aligning with areas of intact native vegetation and associated terrestrial fauna habitat.
- Proposed continuation of existing land uses for some identified non-indigenous heritage values, including the Wanneroo Showgrounds.

A range of recommendations regarding the future management of environmental values of the site have also been proposed as follows:

- Where development is proposed in areas supporting mature trees, proponents should undertake a *Significant Tree Survey* to inform retention of significant trees in the subdivision design process.
- Where clearing of native vegetation and/or MNES habitat is proposed, individual proponents will need to attain appropriate approvals pursuant to the *Environmental Protection Act 1986* and/or the *Environment Protection and Biodiversity Conservation Act 1999*.
- It is anticipated that a *Reserve Management Plan* will be included as a condition of any future subdivision approval incorporating Lot 9000, which will detail the establishment and ongoing management requirements for any future conservation POS area/s.
- Where clearing of potential fauna habitat is proposed, a *Fauna Relocation Plan* is likely to be required to be prepared and implemented, prior to the commencement of any clearing.
- Commissioning of an Aboriginal heritage archaeological survey of areas supporting remnant native vegetation should be considered. If commissioned, the results of this survey should inform the future subdivision and development process undertaken by proponent/s, with regard to both the development design and also the manner in which development is undertaken.
- Proponents of future subdivision and/or development proposals which may impact upon identified heritage places may be required to undertake heritage assessments by discretion of the City. In addition, such proposals would also require planning approvals (for heritage considerations), referral to the Heritage Council of WA (DPLH) and public consultation.

Overall, the environmental attributes and values of the site can be accommodated within the SP design or can be managed appropriately through the future subdivision and development phases in line with the relevant state and local government legislation, policies and guidelines.

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Appendices

Appendix A

Proposed Wanneroo Town Centre Structure Plan

Appendix B

Wanneroo Town Centre Aboriginal Heritage Desktop Assessment Report

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1 Introduction

1.1 Background

Taylor Burrell Barnett (TBB), on behalf of the City of Wanneroo (CoW) have prepared the *Wanneroo Town Centre Structure Plan* (SP) to guide the future urban development of the Wanneroo Town Centre (herein referred to as 'the site'). The proposed SP is provided in **Appendix A**. The site is located within the City of Wanneroo municipality and covers an area of approximately 90 hectares (ha) within the outer northern Perth suburbs of Wanneroo and Sinagra (**Figure 1**).

The site is zoned 'centre' under the CoW District Planning Scheme (DPS) No. 2 and 'urban' or 'urban deferred' under the Metropolitan Region Scheme (MRS). The 'urban deferred' zoning is related to the land immediately north of the site which historically supported an Inghams poultry processing facility. This land use has since ceased and the land has been sold to facilitate future urban development.

The site has historically been cleared of the majority of native vegetation, with development progressively intensifying over time into a built-up urban environment which supports a range of existing land uses, including:

- Civic buildings and open space areas
- A number of commercial shopping centres and associated commercial premises
- Two primary schools
- Sporting clubs and grounds, including football, lawn bowls and cricket ovals.
- A number of service stations
- A large area of intact remnant vegetation in the north
- Road reserves.

1.2 Purpose of this report

The purpose of this *Environmental Assessment and Management Strategy* (EAMS) is to provide a synthesis of information regarding the environmental aspects of the site. Specifically, this report:

- Identifies the existing environmental values and attributes of the site
- Discusses how the SP design responds to the existing environment
- Outlines how the future environmental management framework will be addressed through future planning stages.

The EAMS is the key supporting environmental document supporting the structure planning process, ultimately facilitating the consideration of environmental issues by the assessing local and state government authorities. It is consistent with the Western Australian Planning Commission's *Structure Plan Framework* (WAPC 2015).

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1.3 Scope of this report

The environmental assessment documented in this EAMS is based on a range of site-specific investigations, as well as a comprehensive desktop review of the available information on environmental conditions within and surrounding the site. This EAMS also presents the findings of the following technical investigations prepared or commissioned by Emerge Associates (Emerge) to inform the preparation of the SP:

- A Reconnaissance Flora and Vegetation Survey undertaken in March 2018 (incorporated into this EAMS)
- *Ethnographic and Aboriginal Heritage Assessment* (Horizon Heritage Management 2018) (included as **Appendix B**).
- *Local Water Management Strategy* (Emerge Associates 2018)
- *Bushfire Management Plan* (Emerge Associates 2018).

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2 Environmental Assessment

2.1 Landforms and terrestrial environment

2.1.1 Landforms and soils

The site is located within the Spearwood Dune System in the central portion of the Swan Coastal Plain (SCP). The Spearwood Dune system typically consists of siliceous sands over limestone, with hilly to undulating terrain (R. Salama *et al.* 2005).

Regional soil landscape mapping published by the Department of Primary Industries and Regional Development (DPIRD) indicates the site comprises sands and limestone substrates, consistent with the Spearwood Dune system, as detailed in **Table 1**. The majority of the site comprises the Karrakatta sand yellow phase.

Table 1: Soil types occurring within the site (DPIRD 2018)

Soil type	Description
Karrakatta sand yellow phase	Low hilly to gently undulating terrain. Yellow sand over limestone at 1-2 m.
Karrakatta shallow soils phase	Low hills and ridges. Bare limestone or shallow siliceous or calcareous sand over limestone.
Spearwood sand phase	Irregular banks of karst depressions. Some limestone outcrops. Shallow brown sands.

2.1.2 Acid sulfate soils

Acid sulfate soils (ASS) is the name commonly given to naturally occurring soils and sediment containing iron sulphide (iron pyrite) materials. In their natural state, ASS are generally present in waterlogged anoxic conditions and do not present any risk to the environment. However, when oxidised ASS can produce sulphuric acid, which can impart a range of impacts on the surrounding environment, infrastructure and human health.

Acid sulfate soil (ASS) risk mapping prepared by the Department of Water and Environment Regulation (DWER) indicates that the site has no known risk of ASS occurring. The nearest identified area of land identified as having some risk of ASS occurrence is associated with Lake Joondalup, approximately 500 m west of the site. The peaty sands of Lake Joondalup vary significantly to the siliceous sands underlying the site.

2.1.3 Topography

The site is characterised by undulating terrain typical of the Spearwood Dune system, but generally slopes down toward Lake Joondalup to the west of the site. The maximum elevation of the site is 76 metres Australian Height Datum (mAHD) in its north-eastern extent, whilst the minimum elevation of the site is 29 m AHD in its southern-most extent (DoW 2008).

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2.2 Flora and vegetation

2.2.1 Regional context

Regional vegetation complex mapping undertaken by Heddle *et al.* (1980) indicates that the site is situated within the Karrakatta – Central and South vegetation complex, which is described as comprising predominantly open forest of *Eucalyptus gomphocephala* (tuart), *Eucalyptus marginata* (jarrah) and *Corymbia calophylla* (marri), and woodland of *Eucalyptus marginata* and Banksia species.

23% of the original (pre-European) extent of the Karrakatta – Central and South vegetation complex across the SCP currently remains, whilst 16.8% of its original extent across the Perth and Peel regions currently remains (EPA 2015).

2.2.2 Site-specific surveys and investigations

A Reconnaissance Flora and Vegetation Survey of the site was completed by Emerge Associates on 23 March 2018. The methods and results of this survey are documented in this EAMS. This investigation was completed to the standard required of a reconnaissance survey in accordance with the Environmental Protection Authority's (EPA's) *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016). The purpose of this survey was to provide sufficient information on the flora and vegetation values within the site to inform the preparation of the SP development process.

In addition, a Level 2 Flora and Vegetation Survey of Lot 9000 (which incorporates the large area of remnant vegetation in the northern extent of the site) was completed by Strategen in 2017, on behalf of the land owner. It is noted that Emerge have only been privy to the vegetation mapping outputs of this survey for the purpose of preparing the SP, with the complete survey report being withheld.

2.2.3 Survey methods

One botanist from Emerge visited the site on 23 March 2018 to conduct the reconnaissance flora survey. Given the distribution of intact native vegetation is limited to the northern portion of the site, specifically Lot 9000, this area was the focus of the survey. Lot 9000 was traversed on foot with the composition and condition of vegetation recorded and potentially suitable habitat for threatened and/or priority flora species noted.

Sampling of native vegetation was undertaken using a non-permanent relevé, which was completed over an approximate 10 x 10 m area to provide an indication of the composition and condition of native vegetation.

The data recorded within the relevé included:

- site details (site name, site number, observers, date, location)
- environmental information (slope, aspect, bare-ground, rock outcropping soil type and colour class, litter layer, topographical position, time since last fire event)
- biological information (vegetation structure and condition, degree of disturbance and species present).

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Additional plant taxa not observed within the relevé were recorded opportunistically as the botanist traversed the site. Photographs were taken throughout the field visit to show particular site conditions.

All plant specimens collected during the field survey were dried, pressed and named in accordance with requirements of the Western Australian Herbarium. Identification of specimens occurred through comparison with named material and through the use of taxonomic keys. Flora species not native to Western Australia are denoted by an asterisk (*) in text and raw data.

Vegetation condition was assigned at the relevé and changes in vegetation condition were also noted and mapped across the site. The condition of the vegetation was assessed using the vegetation condition scale from Keighery (1994) (**Table 2**).

Table 2: Vegetation condition scale applied during the field assessment

Condition	Definition (Keighery 1994)
Pristine	Pristine or nearly so, no obvious signs of disturbance.
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
Very good	Vegetation structure altered obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
Completely degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees or shrubs.

The local plant communities within the site were identified from the sample data collected during the field survey, and separated according to species composition. Once the communities were defined, the vegetation was described according to the dominant species present using the structural formation descriptions of the *National Vegetation Inventory System* (NVIS) (ESCAVI 2003). The identified plant communities were then mapped on aerial photography from the sample point/s and boundaries were interpreted from aerial photography. Vegetation condition was mapped on aerial photography based on the location/s and notes recorded during the field survey to define areas with changes in condition.

2.2.4 Plant communities

Based on the reconnaissance survey, intact native vegetation was observed to be generally limited to the northern extent of the site (Lot 9000), as the remainder of the site has been historically cleared to support various residential, commercial, education, community or open space land uses. Some fragmented native vegetation also remains in parkland areas; however, these exist in a cleared

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setting, whereby native understorey has been cleared and some large trees and occasional shrubs have been retained and/or planted.

Vegetation within Lot 9000 incorporates a generally contiguous area of approximately 27.6 ha, with the exception of minor clearing for access tracks and firebreaks. The composition of this vegetation can be split into two plant communities, as detailed in **Table 3** and shown in **Figure 2**. However, vegetation is generally similar across this land and comprises a banksia woodland structure, with either jarrah (plant community **EmBW**) or marri (plant community **CcOf**) being the dominant overstorey species. The composition of this vegetation is consistent with the mapped Karrakatta – Central and South regional vegetation complex.

Table 3: Plant communities within the site (Emerge 2018)

Community	Description	Area (ha)
EmBW	Open woodland to open forest of <i>Eucalyptus marginata</i> (also with <i>Corymbia calophylla</i> , <i>Eucalyptus gomphocephala</i> and <i>Allocasuarina fraseriana</i>) over open woodland to woodland of <i>Banksia attenuata</i> and <i>B. menziesii</i> over shrubland of <i>Macrozamia riedlei</i> and <i>Xanthorrhoea preissii</i> over low shrubland <i>Hibbertia hypericoides</i> , <i>Petrophile macrostachya</i> and forbland <i>Haemodorum</i> spp., <i>Mesomelaena pseudostygia</i> , <i>Alexgeorgea nitens</i> and <i>Desmocladius flexuosus</i> .	14.1
CcOf	Woodland to open forest of <i>Corymbia calophylla</i> (also with <i>Eucalyptus marginata</i> and <i>Eucalyptus gomphocephala</i>) over sparse to open woodland of <i>Banksia attenuata</i> and <i>B. menziesii</i> over shrubland of <i>Macrozamia riedlei</i> and <i>Xanthorrhoea preissii</i> over low shrubland <i>Hibbertia hypericoides</i> , <i>Petrophile macrostachya</i> and forbland <i>Haemodorum</i> spp., <i>Mesomelaena pseudostygia</i> , <i>Alexgeorgea nitens</i> and <i>Desmocladius flexuosus</i> .	13.5
Parkland cleared	Open parkland of various native and exotic overstorey species (including <i>Corymbia calophylla</i> , <i>Eucalyptus gomphocephala</i> , <i>Allocasuarina fraseriana</i> , <i>Eucalyptus rudis</i> , <i>Melaleuca raphiophylla</i> , * <i>Eucalyptus</i> spp.) over introduced grasses and occasional shrubs.	
Cleared	Cleared firebreaks and access tracks amongst areas of intact vegetation.	

The reconnaissance survey included a comparison of recorded species frequencies to that within the Keighery *et al.* (2012) weed and native flora dataset for the SCP, in order to determine the likely floristic community types (FCTs) of intact vegetation within the site (which is limited to vegetation within Lot 9000). This analysis indicated that vegetation within Lot 9000 had the highest similarities to the following FCTs:

- FCT 23a: central *Banksia attenuata* - *Banksia menziesii* woodlands
- FCT 23b: northern *Banksia attenuata* - *Banksia menziesii* woodlands
- FCT 28: Spearwood *Banksia attenuata* or *Banksia attenuata* - *Eucalyptus* woodlands.

All of these FCTs are known to occur in the region and landform. However, FCTs 23a and 23b tend to be restricted to the Bassendean system (as opposed to the Spearwood system of the site) and marri-jarrah woodlands (such as those occurring within Lot 9000) rarely occur in these FCTs. On this basis, it was concluded that it is most likely that vegetation within the site represents FCT 28. However, detailed spring surveys would be required to confirm this.

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2.2.5 Vegetation condition

The reconnaissance survey included an initial assessment of vegetation condition against the Keighery (1994) condition scale. Intact native vegetation (i.e. vegetation in 'good' or better condition) was observed to be limited to Lot 9000. Areas of parkland cleared vegetation scattered across the remainder of the site do not comprise intact native vegetation communities and were observed to be in 'degraded' or 'completely degraded' condition.

Within Lot 9000, the condition of vegetation was observed to generally be highest in the north-east corner of the land parcel. This is consistent with vegetation condition mapping prepared by Strategen (2017). However, detailed spring flora and vegetation surveys would be required to confirm vegetation condition across the site.

Vegetation condition within Lot 9000 is summarised in **Table 4** and shown in **Figure 3**.

Table 4: Vegetation condition within the site (Emerge 2018)

Condition	Area (ha)
Pristine	0
Excellent	0
Excellent – very good	8.8
Very good	10.9
Good	6.5
Degraded	1.6
Completely degraded	

2.2.6 Threatened and priority ecological communities

'Threatened ecological communities' (TECs) are ecological communities that are recognised as rare or under threat and therefore warrant special protection.

Selected TECs are afforded statutory protection at Federal level under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). TECs listed under the EPBC Act are categorised as either 'critically endangered', 'endangered' or 'vulnerable'. Any action likely to have a significant impact on a 'critically endangered' or 'endangered' TEC listed under the EPBC Act requires approval from the Federal Minister for the Environment.

Based on the findings of the reconnaissance flora and vegetation survey completed by Emerge, and considering diagnostic characteristics, condition thresholds, minimum patch size criteria and surrounding context, it is likely that the intact vegetation within Lot 9000 represents the *Banksia Woodlands of the SCP* TEC. However, additional spring flora and vegetation surveys would be required to confirm this. This TEC is listed as 'endangered' under the EPBC Act and is synonymous with the 'banksia dominated woodlands of the Swan Coastal Plain IBRA region' state priority ecological community (PEC).

It is also important to note that the *Tuart Woodlands and Forests of the SCP* ecological community (herein referred to as the 'Tuart Woodlands TEC') was nominated to be listed as 'Critically

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Endangered' pursuant to the EPBC Act in October 2017, and the associated nomination assessment process is currently being completed. An outcome regarding the potential listing of this community pursuant to the EPBC Act is yet to be reached and a decision is expected during 2018. While intact native vegetation within Lot 9000 is considered likely to also be representative of the potential Tuart Woodlands TEC listing, additional spring flora and vegetation surveys would be required to confirm this.

2.2.7 Threatened and priority flora

Certain flora species that are considered to be rare or under threat warrant special protection under state and/or federal legislation. At a federal level, flora species may be listed as 'threatened' pursuant to the EPBC Act and any action likely to have a significant impact on a listed threatened species requires approval from the Commonwealth Minister for the Environment.

At a state level, plant species could formerly be classed as threatened flora (TF) under the *Wildlife Conservation Act 1950* (WC Act). Species which were potentially rare or threatened, or meet the criteria for near threatened, or have recently been removed from the threatened species list are classed as 'priority' flora (PF) species. The recently proclaimed *Biodiversity Conservation Act 2016* will replace the WC Act and provide increased statutory protection for TF. However, the provisions of the BC Act relating to TF are not expected to be enacted under corresponding regulations until January 2019.

The March 2018 reconnaissance survey did not involve targeted searches for TF or PF species, however any occurrences were recorded when opportunistically observed. No TF species were observed within Lot 9000 or the wider site, however two Priority 4 flora species were observed based on preliminary identifications.

Based on known occurrences of TF and PF species in the region, the landform characteristics and given the intact condition of the vegetation, a number of additional TF and PF species are considered to have the potential to occur within Lot 9000.

2.3 Terrestrial fauna

2.3.1 Regional context

The site forms part of a larger regional urban corridor generally cleared of remnant vegetation. Notwithstanding this, these urban areas are interspersed with large natural features which provide fauna habitat values, including regional lakes and wetlands (e.g. Lake Joondalup, Jandabup Lake, Lake Mariginiup), as well as large areas of intact native vegetation (such as that comprising Lot 9000 within the site). In addition, urban tree canopies also provide habitat for fauna species.

2.3.2 Habitat types

Whilst site specific fauna investigations have not been undertaken as part of the structure planning process, the results of the reconnaissance flora and vegetation survey completed by Emerge provide an indication of the general fauna habitat types which occur within the site.

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The three general fauna habitat types within the site include:

- Areas of upland Banksia woodland vegetation, comprising an intact vegetation structure of native understorey, midstorey and overstorey flora species (limited to within Lot 9000).
- Parkland cleared areas with mixed native and exotic overstorey species.
- Urban canopy and street trees.

2.3.3 Black cockatoo habitat

Vegetation within the site provides potential habitat for threatened species of black cockatoo, including Carnaby's black cockatoo (CBC) and Forest Red-tailed black cockatoo (FRTBC). This includes potential foraging, roosting and nesting habitat associated with intact native vegetation within Lot 9000. Scattered mature trees across the remainder of the site may also provide some potential black cockatoo habitat, however of a comparatively lower quality.

This is consistent with regional potential habitat mapping published by the (DoP 2011), which indicates that Lot 9000 within the site contains potential CBC foraging habitat. However, the site and immediate surrounds are not identified as supporting any known (previously recorded) black cockatoo roosts (Peck *et al.* 2017).

Whilst site specific fauna investigations were not undertaken as part of the structure planning process, a separate black cockatoo habitat assessment has been completed for Lot 9000 by Strategen on behalf of the associated landowner. The results of this survey indicate:

- Intact native vegetation within Lot 9000 represents high quality black cockatoo foraging habitat (approximately 27.6 ha).
- Lot 9000 contains approximately 117 potential black cockatoo habitat trees (native species with a diameter at breast height of at least 500 mm). This includes 59 marri trees, 41 jarrah trees and 17 tuart trees. The location of potential habitat trees are shown in **Figure 2**.

2.4 Hydrology and inland waters

2.4.1 Groundwater

The *Perth Groundwater Map* (DWER 2018a) indicates that the regional historic maximum groundwater level (MGL) across the site ranges from approximately 24 m AHD to 40.4 m AHD, flowing from east to west.

Depth to historic MGL approximately ranges from 0 m to 36 m below ground level (BGL). Groundwater clearance is generally shallower along the western boundary, particularly towards the southernmost boundary of the site, and highest along the north-eastern boundary of the site.

2.4.2 Surface water and waterways

The site does not contain any surface water or waterway features. The vegetated northern portion of the site is characterised by sands with high infiltration capacity, which leads to little to no surface runoff except during extreme events. Stormwater runoff from road reserves across the remainder of the site is conveyed by the existing pit and pipe network or via overland flow.

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2.4.3 Wetlands

The site does not contain any wetland features. This is consistent with the Department of Biodiversity, Conservation and Attractions (DBCA) geomorphic wetland mapping, which identifies the closest wetland to the site occurring approximately 500 m to the west, associated with Lake Joondalup.

2.5 Land use planning mechanisms

2.5.1 Conservation areas and reserves

The site is not identified within any areas or reserves identified for conservation land uses, including:

- Metropolitan Region Scheme 'Parks and Recreation' reserves
- Metropolitan Region Scheme Bush Forever sites
- CoW DPS No. 2 'Conservation' reserves
- National Parks

2.5.2 Local natural areas

The draft *CoW Local Biodiversity Plan 2018/19-2023/34* (LBP) (CoW 2018) defines natural areas as physical areas containing native species or ecological communities in a relatively natural state and hence contain biodiversity. Local natural areas (LNAs) are defined as all unprotected natural areas over which the CoW can exercise the most control through its decision-making powers, policies and reserve management. The CoW LBP provides long term goals for the protection, retention and management of biodiversity within the CoW.

The LBP identifies one LNA within the site, being the large area of remnant vegetation within Lot 9000 in the northern extent of the site. However, given this area is subject to the approved *Wanneroo Town Centre Structure Plan* (adopted in 2001), the draft LBP does not specifically consider this LNA or its priority for retention, as there is a general presumption of the draft LBP that vegetation within approved structure plan areas will be cleared to facilitate development.

2.5.3 Ecological linkages

The site does not occur within any mapped regional or local ecological linkages, as identified in the draft *CoW Local Biodiversity Plan 2018/19-2023/34*. Notwithstanding this, the large area, contiguous coverage and intact condition of vegetation within the northern portion of the site, suggests this vegetation would likely provide ecological linkage functionality, particularly given its situation between regionally significant natural areas such as Lake Joondalup, Mariginiup Lake and Jandabup Lake.

2.5.4 Environmentally sensitive areas

No declared environmentally sensitive areas (ESA) are mapped by DWER as occurring within or directly adjacent to the site. The nearest declared ESA to the site is situated approximately 350 m to the west associated with Lake Joondalup.

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2.5.5 Public drinking water source areas

The portion of the site situated west of Wanneroo Road is identified as a Priority 3 Public Drinking Water Source Area (PDWSA), associated with the Perth Coastal and Gwelup Underground Water Pollution Control Area.

PDWSAs are proclaimed by the DoW to protect identified drinking water sources, which can be surface water or groundwater sources (DoW 2009). They are proclaimed under the *Metropolitan Water Supply, Sewerage and Drainage Act 1909* or the *Country Areas Water Supply Act 1947* as Water Reserves, Catchment Areas or Underground Water Pollution Areas. PDWSAs provide Western Australia with the majority of its drinking water supplies and can be vulnerable to contamination from a range of land uses and water-based activities. Once an area is identified as a PDWSA, consideration needs to be given to the intended land use and associated activities to ensure that they are appropriate in meeting the water protection quality objectives of the area.

2.6 Heritage

2.6.1 Aboriginal heritage

An *Aboriginal Heritage Desktop Assessment* (Horizon Heritage Management 2018) has been completed for the site and is provided in **Appendix B**. Based on a review of the Department of Planning, Lands and Heritage (DPLH) *Aboriginal Heritage Inquiry System* (AHIS), no Registered Aboriginal Sites are mapped as occurring within the site. However, three Other Heritage Places are mapped within the site, all of which are associated with modified trees. The recorded details of these Other Heritage Places are summarised in **Table 5** and their locations are shown in **Figure 4**.

Table 5: Other Heritage Places identified within the site (DPLH 2018)

DPLH ID	Name	Status	Description
16058	Shaw Road, Wanneroo	Stored data / not a site	Modified/scar tree
20054	Wanneroo Primary School Scarred Tree #1	Stored data / not a site	Modified/scar tree
20055	Wanneroo Primary School Scarred Tree #2	Stored data / not a site	Modified/scar tree

The *Aboriginal Heritage Desktop Assessment* (Horizon Heritage Management 2018) included a review of the relevant site assessment and survey reports for each of the identified Other Heritage Places. Based on this review, historical technical investigations determined that the scars on each of the modified trees were unlikely to be caused by Aboriginal activity, but more likely by natural processes or due to fire.

Whilst no Registered Aboriginal Sites were identified within the site, a number are located in close proximity, including Lake Joondalup (DPLH 3740) and Wanneroo Scarred Tree (DPLH 3657), demonstrating the wider locality and urbanised areas still support important Aboriginal cultural sites.

The *Aboriginal Heritage Desktop Assessment* determined that highly developed areas of the site are unlikely to support surface expressions of cultural material (Aboriginal artefacts), due to historical disturbances to the natural environment. However, northern areas of the site supporting remnant vegetation could potentially contain Aboriginal heritage values such as modified trees or surface

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expressions of cultural material, given there has been limited disturbance to the natural environment and given significant Aboriginal heritage values are known to occur in the wider locality. As such, one of the recommendations of the desktop assessment was to consider commissioning an Aboriginal heritage archaeological survey of these native bushland areas.

2.6.2 Non-indigenous heritage

The following databases were reviewed to determine if any non-indigenous heritage values are recorded as occurring within the site:

- World Heritage List
- National Heritage List
- Commonwealth Heritage List
- Register of National Estate
- State Register of Heritage Places (inHerit database)
- City of Wanneroo Scheme Heritage List
- City of Wanneroo Local Heritage Survey.

Based on this review, eight places listed in the CoW Local Heritage Survey (2016) occur within the site (**Table 6**). Places identified in the Local Heritage Survey (2016) are recognised by the City as places of important local heritage, but are not afforded statutory protection (CoW heritage management category 3 or lower).

Of these eight places, three are also listed on the CoW Scheme Heritage List (CoW heritage management category 2 or higher), and are therefore afforded statutory protection under the *Heritage of Western Australia Act 1990* and the *Deemed Provisions of District Planning Scheme No. 2*. However, none of these places are listed as State Registered Places by the Department of Planning, Lands and Heritage.

The approximate locations of these identified heritage places are shown in **Figure 4**.

Table 6: CoW Local Heritage Survey (CoW 2016) places within the site

Place name	InHerit ID	CoW ID	CoW category	Description and current status
Wanneroo Show Grounds*	9500	52	2	Existing urban open space area which first hosted Wanneroo Agricultural show in 1909.
Wanneroo War Memorial*	13045	54	2	Existing single monument constructed in 1921 and relocated multiple times.
Wanneroo Shire Offices (fmr)*	9499	64	2	Existing single building which was the original shire office constructed in 1960.
St Anthony's Priory (fmr)	17938	41	3	Existing single building which was formerly used as a priest residence, constructed in c1953.
Wanneroo Civic Precinct	9516	53	3	Existing multiple buildings and open space areas constructed onward from c1960s.
Forestry House (fmr)	17525	55	3	Existing single building constructed in 1960 for use by the Forestry Department.

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Place name	InHerit ID	CoW ID	CoW category	Description and current status
Wanneroo School Classroom (fmr) and site	17526	56	3	Existing single building constructed c1910 for use as a primary school building
St Anthony's Church (site)	9498	65	4	Site of a former Catholic church opened in 1932. Building demolished in 2009.

**Those places afforded statutory protection are highlighted (CoW heritage management category 2 or higher)*

2.7 Land use considerations

2.7.1 Historic and existing land uses

Based on a review of historical aerial imagery published by Landgate, land uses within the site have progressively developed and intensified over time. Some of the key changes in land uses over time within the site include:

- Early 1970s, widespread clearing and residential subdivision of the locality commences, as well as the construction of the first portion of the primary central shopping complex.
- Late 1970s, major widening of Wanneroo Road and further clearing of remnant vegetation to facilitate expansion of central shopping complex.
- Early 1980s, clearing to facilitate expansion of open space area associated with current playing fields of St Anthony's School.
- 1990s, increase in number of commercial premises along Wanneroo Road and establishment of various civic buildings, including leisure centre.
- Early 2000s, significant clearing of northern portion of site to facilitate construction of St Anthony's School and new City of Wanneroo council buildings on Dundobar Road. Continued expansion of commercial premises along Wanneroo Road.
- Mid 2000s, construction of Wanneroo Primary School, continued expansion of central shopping centre complex and increase of commercial premises along Wanneroo Road.
- 2010s, residential subdivision of Lot 500 Shaw Road precinct and continued expansion and general increase in extent of central commercial premises.

The site currently supports a range of existing land uses, including:

- Civic buildings and open space areas
- A number of commercial shopping centres and associated commercial premises
- Two primary schools
- Sporting clubs and grounds, including football, lawn bowls and cricket ovals.
- A number of service stations
- A large area of intact remnant vegetation in the north
- Road reserves.

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2.7.2 Potential contamination

No known contaminated sites are identified on the DWER *Contaminated Sites Database* as occurring within the site. As such, none of the following classifications affect any land parcels within the site:

- Contaminated – remediation required
- Contaminated – restricted use
- Remediated for restricted use.

However, the publicly available *Contaminated Sites Database* does not identify any land parcels which may have been reported as potentially contaminated, but are awaiting classification.

A number of existing land uses within the site are identified as potentially contaminating land uses in the document *Assessment and management of contaminated sites: Contaminated sites guidelines* (DER 2014), including:

- Automotive repair workshops
- Service stations and fuel storage facilities.

2.7.3 Surrounding land uses

The site is surrounded by existing residential land uses to the west, south and east. Land immediately north of the site historically supported an Inghams poultry processing facility. However, this land use has since ceased and the land has been sold to facilitate future urban development.

With the closure of the historical poultry processing facility to the north of the site, there are currently no known significant potential land use conflicts affecting the site.

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3 Proposal

3.1 Historical planning and environmental assessment context

The site comprises the following MRS zones and reserves:

- 'urban' across the majority of the site, encompassing existing urbanised areas.
- 'urban deferred' across the portion of the site generally north of Dundebur Road.
- 'primary regional roads' across the Wanneroo Road reserve.

The portions of the site zoned 'urban' and 'urban deferred' under the MRS are zoned 'Centre' under the CoW DPS No. 2.

The 'urban deferred' zone across the northern portion of the site was established to maintain suitable separation from urban areas and the Ingham's poultry processing facility to the north, preventing encroachment of sensitive land uses into adjacent areas. However, following the recent closure of this facility and sale of this land to facilitate urban development, it is likely that the 'urban deferred' zoning can now be lifted to enable urban development of this land (including the northern portion of the site).

The site is not known to have been subject to any historical scheme amendments (either to the MRS or DPS No. 2). As such, no referrals of scheme amendments to the EPA under Section 48 of the EPA Act directly applicable to the site are known to have occurred. The future lifting of the MRS 'urban deferred' zone over the northern portion of the site will not trigger the statutory mandatory requirement for referral to the EPA under Section 48 of the EP Act.

The site is subject to the existing *Wanneroo Town Centre Structure Plan*, which was adopted by the CoW in 2001 and proposed the following land uses:

- Business land uses along Wanneroo Road
- Commercial land uses associated with expansion of the central shopping complex
- Civic and cultural land uses associated with the new council chambers
- Extension of primary school along Church Street
- Residential land uses in the northern portion of the site comprising Lot 9000, including small area of 'parks and recreation' land uses, the largest being in the north-east corner.

The existing *Wanneroo Town Centre Structure Plan* has been subject to a range of amendments since it was first adopted by the CoW and will be replaced by the proposed SP.

3.2 Proposed structure plan

3.2.1 Layout and land uses

The proposed SP is provided in **Appendix A** and proposes the following land uses across the site:

- Residential, including areas of medium and higher densities.
- Education
- Civic and community

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- Mixed uses
- Open space
- Conservation
- Urban space.

A range of existing land uses across the site are proposed to continue into the future (such as the Wanneroo Showgrounds and Wanneroo Primary School), whilst other areas have been identified for intensification or modification to their existing land use (such as Lot 9000, which is identified to primarily support future residential development).

3.2.2 Design response to environmental values

Based on the environmental assessment completed across the site, the following key environmental values were identified:

- The large area of intact native vegetation incorporating Lot 9000 in the northern portion of the site. This area provides flora and vegetation values, in addition to terrestrial fauna habitat.
- The potential for Aboriginal heritage values to occur within areas of site supporting remnant vegetation, given they have not been historically disturbed and the locality is known to support significant Aboriginal heritage values.
- Non-indigenous heritage values, including heritage places identified on the CoW Local Heritage Survey.

The proposed SP responds to these key environmental values through:

- Identification of a conservation public open space (POS) area in the north-east corner of the site, aligning with areas of intact native vegetation and associated terrestrial fauna habitat.
- Proposed continuation of existing land uses for some identified non-indigenous heritage values, including the Wanneroo Showgrounds.

3.2.3 Consultation

Preparation of the SP has involved consultation with a range of stakeholders including the CoW, state government agencies, servicing authorities, relevant land owners and the general public.

With specific regard to environmental considerations, the proposed SP design has been discussed with the CoW's Strategic Land Use Planning and Environment team, in addition to the CoW Land Development Team. This consultation did not raise any significant concerns regarding the design of the proposed SP, and has informed its finalisation and provided an understanding of CoW's expectations regarding the desired environmental outcomes.

3.3 Future planning process

Subject to approval and endorsement of the proposed SP by the CoW and the WAPC, urban and commercial development the site will likely be progressed through a combination of subdivision and development approvals. Given the site comprises a large number of land parcels of varying ownership, it is likely that a range of proponents will drive the future subdivision and development process (and thus implement the SP).

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It is likely that future subdivision and development approvals issued by CoW and/or WAPC to facilitate implementation of the proposed SP will incorporate conditions to manage relevant environmental considerations, where needed. It is anticipated that this will be most relevant to the future subdivision of Lot 9000, which supports the greatest environmental values within the site.

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4 Environmental Management Strategies

4.1 Flora and vegetation

4.1.1 Management objective

In the context of environmental impact assessments, the EPA's objective for flora and vegetation is *'to protect flora and vegetation so that biological diversity and ecological integrity are maintained'*. Where a proposal may potentially impact upon flora and vegetation values, the avoid, minimise and offset mitigation hierarchy should be applied to minimise potential impacts.

The CoW *Local Planning Policy (LPP) 4.3: Public Open Space* also provide guidance on the planning, provision, location, design, development and interim maintenance of POS areas, to be considered through the planning process. LPP 4.3 include a range of provisions relating to POS requirements, of which the most relevant to the proposed SP include:

- A minimum of 10% of a gross sub-divisible area is to be ceded as POS. However;
 - Greater than 10% may be considered acceptable or necessary where there are specific environmental, cultural or historic values that require protection to enhance of the character of the local area.
 - Less than 10% may be considered appropriate in 'centre' zones where higher densities are proposed, subject to 10% being provided in the wider catchment and cash in lieu payments.
- A minimum of 3% of a gross sub-divisible area shall be provided as POS for the purpose of conservation and recreation, when following significant natural assets exist, such as (but not limited to) TECs or PECs, TF or PF, wetlands, conservation significant fauna species, matters of national environmental significance listed pursuant to the EPBC Act, vegetation complexes with less than 30% of their original extent remaining.

The CoW *Local Planning Policy 1.1: Conservation reserves* provides guidance relating to the reservation of POS area for 'conservation' under the DPS No. 2. Land uses within conservation reserves are limited to protecting the natural environment such as flora, fauna and other biodiversity values. Conservation reserves typically provide a mechanism for the long-term protection of retained remnant bushland within areas of POS and differs from other types of POS, which may be suited to more 'active' uses. There are a range of criteria that must be satisfied for an area of POS to be reserved for 'conservation' under the DPS No. 2, including (but not limited to):

- Vegetation being in 'good' or better condition
- Vegetation satisfies the 'ecological viability' criteria set out in LPP 4.3 POS, as shown in **Plate 1**.
- The reserve being at least 1 ha in size with a minimum 50m width, unless it contains (amongst other values) significant trees (as defined by the CoW policy), TF or PF, TECs or PECs, high priority vegetation complexes, or conservation or resource enhancement wetlands.

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Viability Factor	Category	Score
Size	Greater than 20ha	5
	Greater than 10ha less than 20ha	4
	Greater than 4ha less than 10ha	3
	Less than 4ha	2
	Less than 1ha	1
Shape	Circle, square or squat rectangle	3.5
	Oval, rectangle or symmetrical triangle	3
	Irregular shape with few indentations	2.5
	Irregular shape with many indentations	2
	Long thin shape with large proportion of area greater than 50 m wide	1.5
	Long thin shape with large proportion of area less than 50 m wide	1
Perimeter to Area Ratio	Less than 0.01	4
	Greater than 0.01 less than 0.02	3
	Greater than 0.02 less than 0.04	2
	Greater than 0.04	1
Vegetation Condition	Pristine	10 x % =
	Excellent	8 x % =
	Very Good	6 x % =
	Good	4 x % =
	Degraded	0 x % =
	Completely Degraded	0 x % =
	Total Calculated Score	
Connectivity	Forms part of a Regional Ecological Linkage* and is contiguous with a protected natural area** greater than 4ha	5
	Not part of a Regional Ecological Linkage but contiguous with a protected natural area greater than 4ha	4.5
	Forms part of a Regional Ecological Linkage and is within 500 m of more than 2 protected natural areas having an area greater than 4 ha	4
	Not part of a Regional Ecological Linkage but within 500 m of more than 2 protected natural areas having an area greater than 4 ha	3.5
	Forms part of a Local Ecological Linkage*** and is contiguous with a protected natural area greater than 4ha	3
	Not part of a Local Ecological Linkage but contiguous with a protected natural area greater than 4ha	2.5
	Forms part of a Local Ecological Linkage and is within 500 m of more than 2 protected natural areas having an area greater than 4 ha	2
	Not part of a Local Ecological Linkage but within 500 m of more than 2 protected natural areas having an area greater than 4 ha	1.5
	Forms part of a Regional or Local Ecological Linkage but is not within 500 m of any protected natural areas having an area greater than 4ha	1

Plate 1: CoW conservation POS viability assessment criteria (from LPP 4.3)

4.1.2 Structure plan response

A conservation POS area is indicatively shown on the SP in the north-east corner of the site. This aligns with areas of existing intact remnant vegetation generally in a high level of vegetation condition, which is potentially representative of the Banksia Woodlands TEC. The primary purpose of the conservation POS designation is to provide for the future retention of environmental values (in this case, intact remnant vegetation) as part of the future development process. The final location and size of the conservation POS area will be resolved in accordance with CoW policies and in discussion between the landowner, CoW and other relevant authorities at subdivision stage.

4.1.3 Future management requirements

The proposed SP sets out the proposed land uses of the site and the indicative development layout. It is a high-level statutory plan which, subject to its approval, will guide the future subdivision and development process across the site. Given the site incorporates a number of land parcels of varying ownership, the future implementation of the proposed SP through subdivision and development will be undertaken by individual proponents and landholders, who will be responsible for addressing the future environmental management requirements of the site, where applicable.

The following flora and vegetation considerations will need to be addressed by proponents as part of the future subdivision and development process:

- Based on consultation with the CoW Strategic Land-use Planning and Environment team undertaken prior to lodgment of the proposed SP, the City has identified the retention of significant trees across the site as a high priority. Therefore, where development is proposed in areas supporting mature trees, proponents should undertake a *Significant Tree Survey* and the

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- results should be used to inform the subdivision design process. Potential opportunities for the retention of significant trees as part of future development include within active POS areas, streetscapes, verges, medians and within/around drainage areas.
- Where native vegetation is proposed to be cleared to facilitate development, individual proponents will need to attain a clearing permit approval under Part V of the EP Act, or alternatively qualify for an applicable exemption (such as a subdivision approval). The extent of vegetation proposed to be cleared, as well as any impact avoidance, mitigation or offset commitments are to be determined by individual proponents to support this approvals process.
 - Similarly, where Matters of National Environmental Significance (MNES) values (such as black cockatoo habitat or vegetation representative of the Banksia Woodland TEC) are proposed to be impacted to facilitate development, individual proponents should consider their obligations for potential referral under the EPBC Act. The extent of vegetation proposed to be cleared, as well as any impact avoidance, mitigation or offset commitments are to be determined by individual proponents to support this approvals process.
 - The proponent of the future subdivision of Lot 9000 will likely be responsible for implementation of the proposed conservation POS area identified in the proposed SP in the north-east of the site. It is anticipated that a requirement for the preparation and implementation of a *Reserve Management Plan* (or similar) will be included as a condition of any future subdivision approval incorporating this land. The *Reserve Management Plan* should guide the establishment of the proposed conservation POS area and the ongoing management of fauna habitat, flora and vegetation values within it.

4.2 Terrestrial fauna

4.2.1 Management objective

In the context of environmental impact assessment, the EPA's objective for terrestrial fauna is '*to protect terrestrial fauna so that biological diversity and ecological integrity are maintained*'. The application of the mitigation hierarchy should be applied to avoid or minimise impacts to terrestrial fauna where possible.

The EPBC Act also provides protection for listed 'threatened' species, including black cockatoos, with potential habitat identified within the site. Any proposed action which is considered likely to result in a 'significant' impact upon these species, identified by the DoEE as Matters of National Environmental Significance (MNES), should be referred to the Commonwealth Department of Environment and Energy.

4.2.2 Structure plan response

Fauna habitat values within the site are generally limited to native and exotic mature trees, with the exception of the large area of intact remnant vegetation in the north of the site. The primary response of the SP with regard to fauna habitat values is the identification of a conservation POS area in the north-east of the site, as detailed in **Section 4.1.2**. This conservation POS area contains intact native vegetation which provides habitat values for native terrestrial fauna species and represents high quality black cockatoo foraging habitat.

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4.2.3 Future management requirements

The following fauna considerations will need to be addressed by proponents as part of the future subdivision and development process:

- Where clearing of fauna habitat (including intact native vegetation or mature trees) is proposed, a *Fauna Relocation Plan* (or similar) is likely to be required to be prepared and implemented, prior to the commencement of any clearing. The aim of this plan should be to appropriately manage the fauna habitat clearing process such that direct impacts to fauna species are avoided.
- Where MNES habitat values (such as black cockatoo habitat) are proposed to be impacted to facilitate development, proponents should consider their obligations for potential referral under the EPBC Act. The extent of vegetation proposed to be cleared, as well as any impact avoidance, mitigation or offset commitments are to be determined by individual proponents to support this approvals process.
- The proponent of the future subdivision of Lot 9000 will likely be responsible for implementation of the proposed conservation POS area identified in the proposed SP in the north-east of the site. It is anticipated that a requirement for the preparation and implementation of a *Reserve Management Plan* (or similar) will be included as a condition of any future subdivision approval incorporating this land. The *Reserve Management Plan* should guide the establishment of the proposed conservation POS area and the ongoing management of fauna habitat, flora and vegetation values within it.

4.3 Aboriginal heritage

4.3.1 Management objective

Registered Aboriginal Sites, whether known or unknown, are protected under the *Aboriginal Heritage Act 1972* (AH Act). Permission under Section 18 of the AH Act is required to impact or disturb any Registered Aboriginal heritage site.

4.3.2 Structure plan response

No Registered Aboriginal Sites are identified are known to occur within the site. Whilst three Other Heritage Places are mapped within the site, they do not meet the definition of a Registered Aboriginal Site for the purpose of the AH Act, and as such are not afforded statutory protection under the AH Act.

On this basis, the proposed SP does not include in specific land uses or design features which respond to Aboriginal heritage within the site.

4.3.3 Future management requirements

The *Aboriginal Heritage Desktop Assessment* determined that northern areas of the site supporting remnant vegetation could potentially contain Aboriginal heritage values such as modified trees or surface expressions of cultural material, given there has been limited disturbance to the natural environment and given significant Aboriginal heritage values are known to occur in the wider locality.

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As such, one of the recommendations of the desktop assessment was to consider commissioning an Aboriginal heritage archaeological survey of these native bushland areas. If commissioned, the results of this survey should inform the future subdivision and development process undertaken by proponent/s across this portion of the site, with regard to both the development design (if spatial responses to any identified heritage values are required) and also the manner in which development is undertaken (for example, closely monitoring ground disturbing works to identify and appropriately manage any potential archaeological findings).

4.4 Non-indigenous heritage

4.4.1 Management objective

At state level, the *Heritage of Western Australia Act 1990* provides for the protection of non-indigenous heritage values and '*provides for and encourages the conservation of places which have significance to the cultural heritage of the State*'. Where proposals involve modification to any State Registered Places listed under the Act, they may require referral to the State Heritage Council (part of DPLH) for their consideration and advice. It is noted that whilst a new *Heritage Act 2018* has been passed by parliament in September 2018, it is yet to be proclaimed and such is not yet in effect.

At a local level, the CoW DPS and associated *Deemed Provisions of District Planning Scheme No. 2* provides for the '*identification of places and areas of heritage value so that development in the Scheme can, as far as possible, be consistent with the conservation of heritage values*'. Part 3 of the Deemed Provisions relates to heritage protection and outlines that where a development proposal relates to a heritage place listed under the CoW Scheme Heritage List (i.e. CoW heritage category 2 or high), the City may require a heritage assessment to be completed. Such proposals would also require planning approvals (for heritage considerations), referral to the Heritage Council of WA (DPLH) and public consultation.

4.4.2 Structure plan response

The proposed SP identifies a variety of land uses across the site, including continuation of some existing uses (and boundaries), in addition to some changes to existing land use in specific areas. **Table 7** provides a summary of each existing non-indigenous heritage place identified within the site in the context of its existing land use and the proposed future land use identified in the SP. This includes an assessment of the potential for impacts to existing heritage places as a result of future development proposals associated with any proposed changes in land use identified in the SP.

Table 7: Summary of future land uses proposed in the SP and potential impacts on heritage places

Place name	CoW category	Proposed SP land use	Potential impacts
Wanneroo Show Grounds*	2	Continuation of existing 'open space' land use proposed.	Unlikely
Wanneroo War Memorial*	2	Continuation of existing 'open space' land use proposed, with the exception of the western portion of the existing parkland, which is proposed to be intensified to accommodate future 'mixed use' development.	Potentially due to intensification.
Wanneroo Shire Offices (fmr)*	2	Continuation of the existing 'mixed use' land use proposed. However, future proposals may involve redevelopment.	Potentially, if redeveloped.

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Place name	CoW category	Proposed SP land use	Potential impacts
St Anthony's Priory (fmr)	3	Intensification of existing low-density rural-residential land use to facilitate 'higher-density residential' land uses.	Likely due to intensification.
Wanneroo Civic Precinct	3	Continuation of the existing 'mixed use' land use proposed. However, future proposals are likely to involve intensification and/or redevelopment of this land.	Likely due to intensification/redevelopment.
Forestry House (fmr)	3	Intensification of existing low-density land use to facilitate 'mixed use' land uses.	Likely due to intensification
Wanneroo School Classroom (fmr) and site	3	Intensification of existing low-density land use to facilitate 'mixed use' land uses.	Likely due to intensification
St Anthony's Church (site)	4	Intensification of existing vacant land uses to facilitate 'mixed use' land uses.	Likely due to intensification

**Those places afforded statutory protection are highlighted (CoW heritage management category 2 or higher)*

4.4.3 Future management requirements

Consistent with the requirements of the CoW DPS No. 2 (and associated deemed provisions) outlined in **Section 4.4.1**, proponents of future subdivision and/or development proposals which may impact upon identified heritage places afforded statutory protection (CoW management category 2 or higher), may be required to undertake heritage assessments by discretion of the City. In addition, such proposals would also require planning approvals (for heritage considerations), referral to the Heritage Council of WA (DPLH) and public consultation.

Given there are no State Registered Places located within the site, all non-indigenous heritage requirements are likely to be managed through the CoW under the DPS No. 2. Notwithstanding this, this may still involve or require interaction with State government agencies such as DPLH.

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5 Conclusions

5.1 Key environmental values

Based on the environmental assessment completed across the site, the following key environmental values were identified:

- The large area of intact native vegetation incorporating Lot 9000 in the northern portion of the site. This area provides flora and vegetation values, in addition to terrestrial fauna habitat.
- The potential for Aboriginal heritage values to occur within areas of site supporting remnant vegetation, given they have not been historically disturbed and the locality is known to support significant Aboriginal heritage values.
- Non-indigenous heritage values, including heritage places identified on the CoW Local Heritage Survey.

5.2 Structure plan responses to environment

The proposed SP responds to these key environmental values through:

- Identification of an area of conservation public open space (POS) in the north-east corner of the site, aligning with areas of intact native vegetation and associated terrestrial fauna habitat.
- Proposed continuation of existing land uses for some identified non-indigenous heritage values, including the Wanneroo Showgrounds.

5.3 Future environmental management requirements

Given the site incorporates a number of land parcels of varying ownership, the future implementation of the proposed SP through subdivision and development will be undertaken by individual proponents and landholders, who will be responsible for addressing the future environmental management requirements of the site, where applicable.

A range of recommendations regarding the future management of environmental values have been proposed:

- Where development is proposed in areas supporting mature trees, proponents should undertake a *Significant Tree Survey* and the results should be used to inform the subdivision design process and prioritise significant trees retention.
- Where the cleared of native vegetation and/or MNES habitat is proposed, individual proponents will need to attain appropriate approvals pursuant to the EP Act and EPBC Act.
- It is anticipated that a *Reserve Management Plan* (or similar) will be included as a condition of any future subdivision approval incorporating Lot 9000. This document will focus on the establishment and ongoing management of the identified conservation POS area.
- Where clearing of fauna habitat (including intact native vegetation or mature trees) is proposed, a *Fauna Relocation Plan* (or similar) is likely to be required to be prepared and implemented, prior to the commencement of any clearing.

Environmental Assessment and Management Strategy

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- Commissioning of an Aboriginal heritage archaeological survey of areas supporting native vegetation should be considered. If commissioned, the results of this survey should inform the future subdivision and development process undertaken by proponent/s, with regard to both the development design and also the manner in which development is undertaken.
- Proponents of future subdivision and/or development proposals which may impact upon identified heritage places afforded statutory protection (CoW management category 2 or higher), may be required to undertake heritage assessments by discretion of the City. In addition, such proposals would also require planning approvals (for heritage considerations), referral to the Heritage Council of WA (DPLH) and public consultation.

Environmental Assessment and Management Strategy

Wanneroo Town Centre Structure Plan



6 References

6.1 General references

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Environmental Assessment and Management Strategy

Wanneroo Town Centre Structure Plan



Figures



Figure 1: Site Location

Figure 2: Plant Communities and Black Cockatoo Habitat Trees

Figure 3: Vegetation Condition

Figure 4: Heritage Places

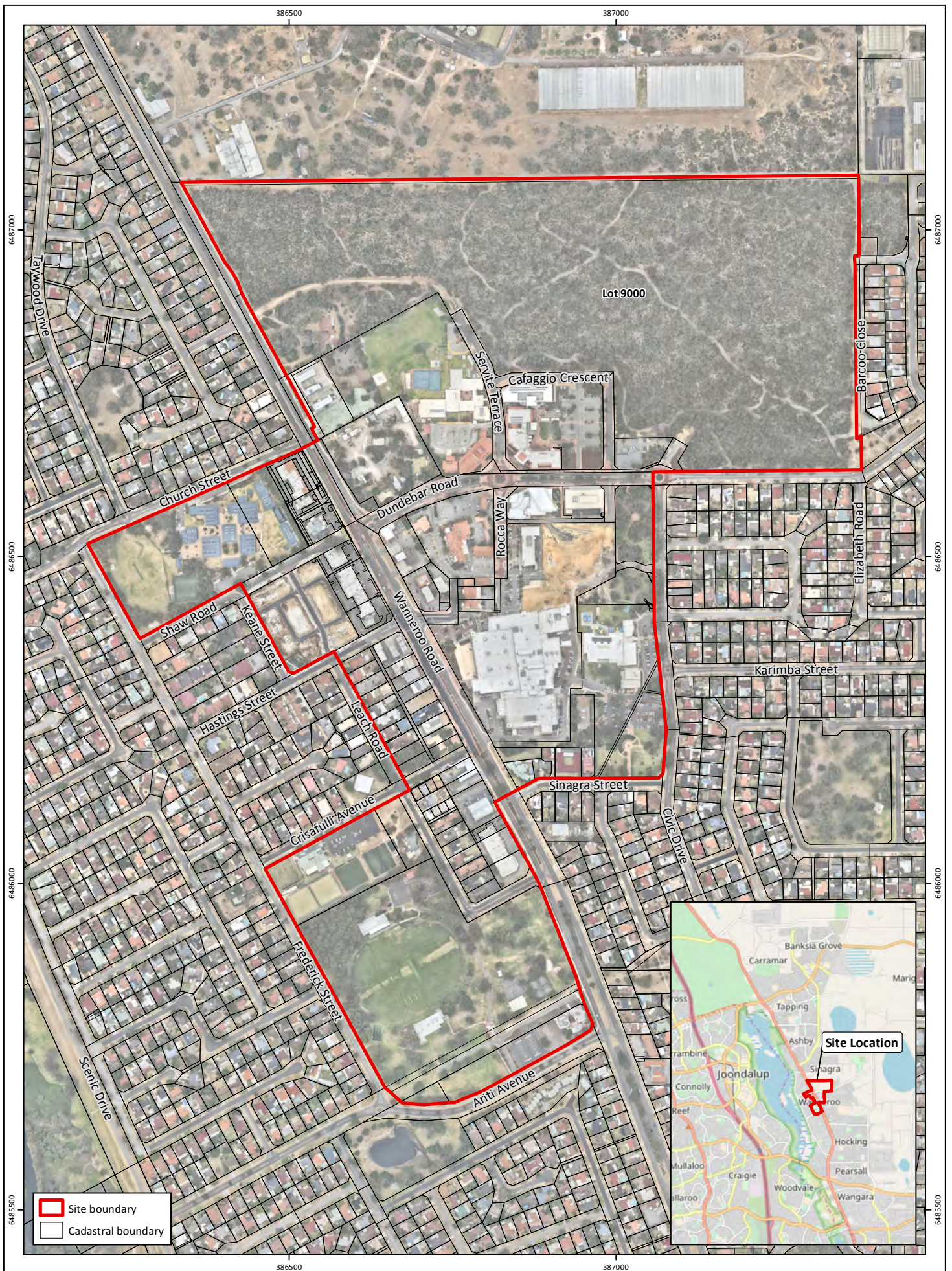


Figure 1: Location Plan

Project: Environmental Assessment and Management Strategy
Wanneroo Town Centre

Client: City of Wanneroo

Plan Number:
EP17-133(01)-F22

Drawn: ADB

Date: 11/10/2018

Checked: ADB

Approved: JMM

Date: 11/10/2018



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ASSOCIATES

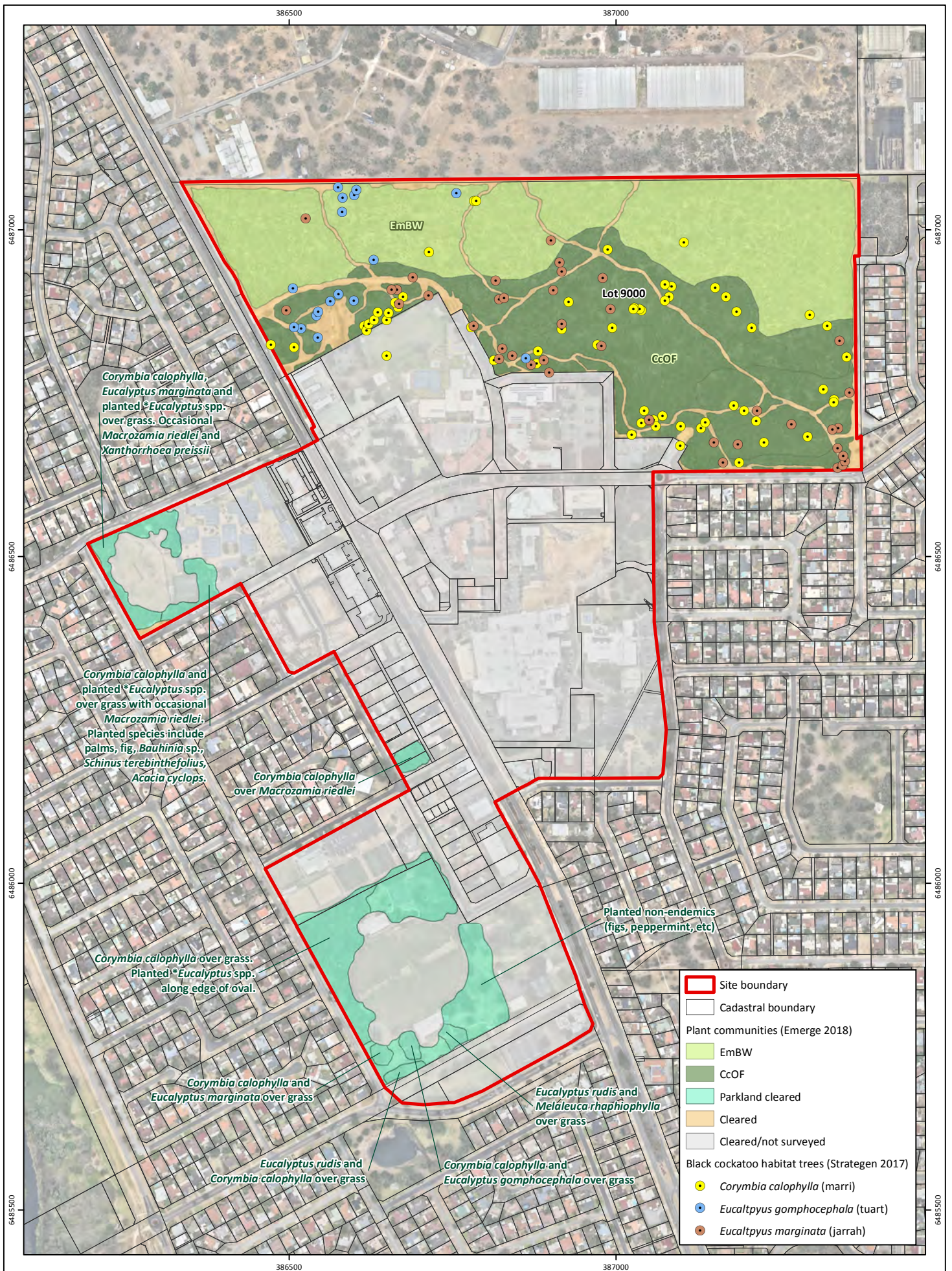


Figure 2: Plant Communities and Potential Black Cockatoo Habitat Trees

Project: Environmental Assessment and Management Strategy
Wanneroo Town Centre

Client: City of Wanneroo

Plan Number: EP17-133(01)-F23
Drawn: ADB
Date: 11/10/2018
Checked: ADB
Approved: JMM
Date: 11/10/2018



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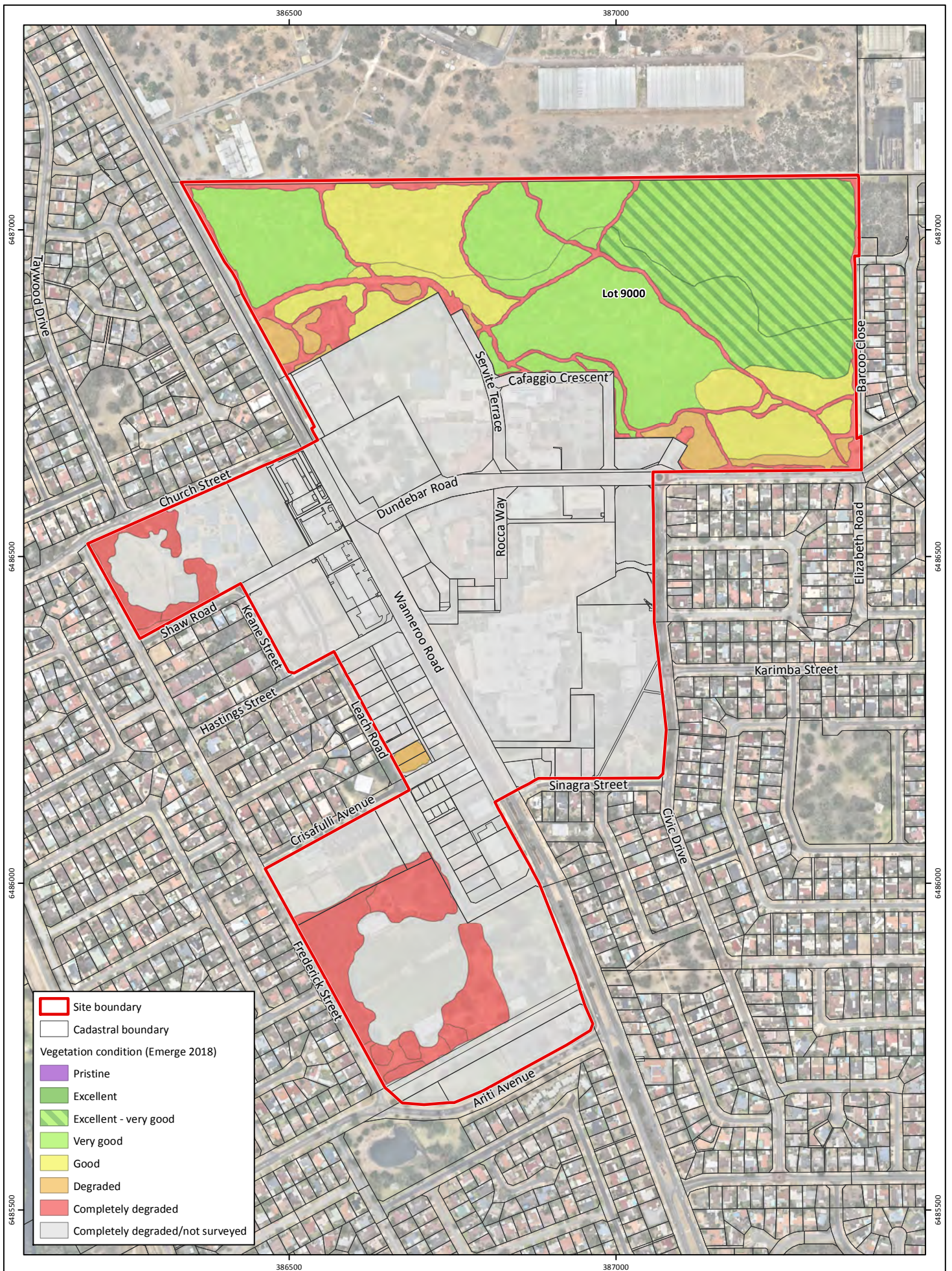


Figure 3: Vegetation Condition

Project: Environmental Assessment and Management Strategy
Wanneroo Town Centre

Client: City of Wanneroo

Plan Number: EP17-133(01)-F24

Drawn: ADB

Date: 11/10/2018

Checked: ADB

Approved: JMM

Date: 11/10/2018



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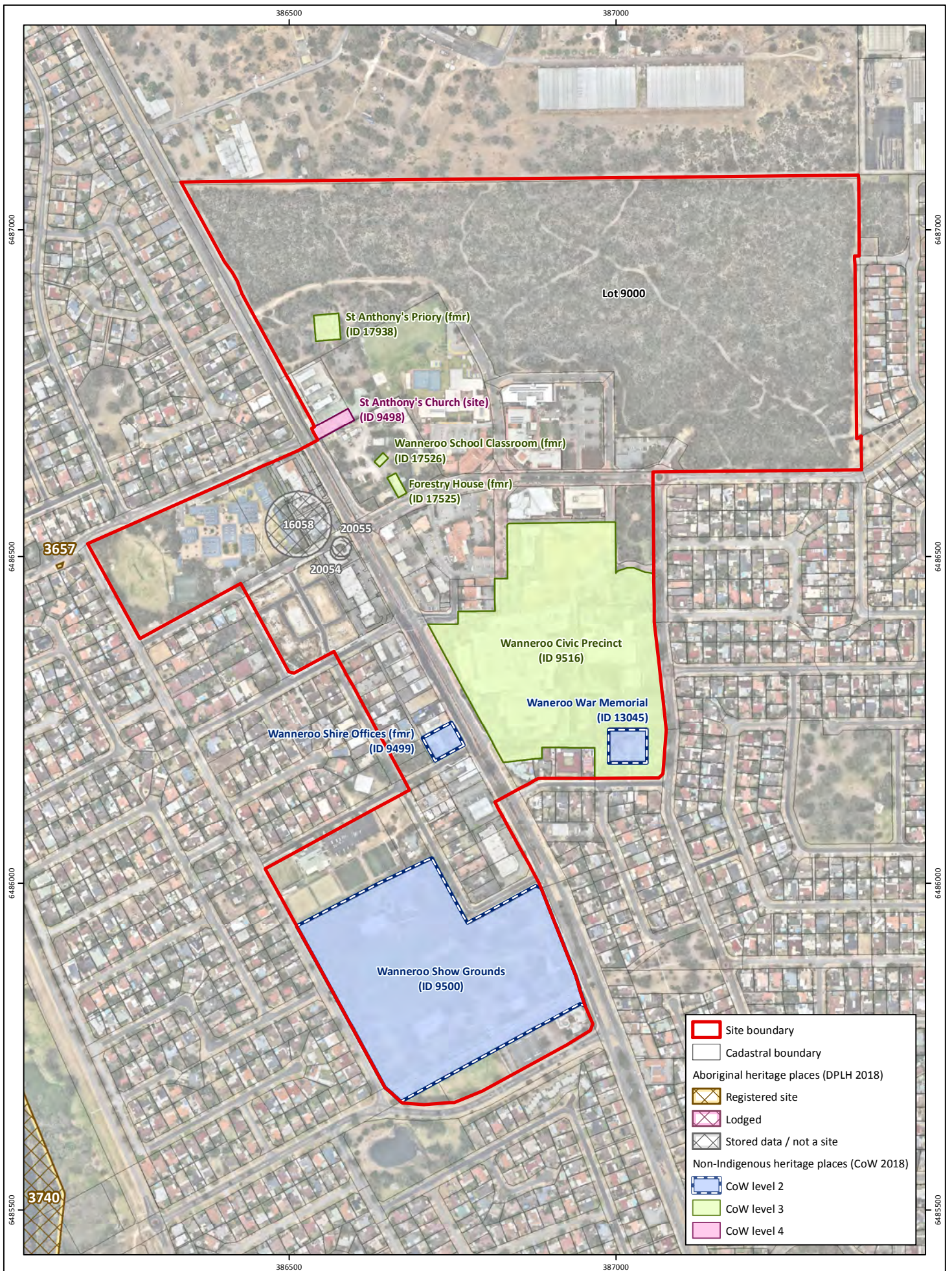


Figure 4: Heritage Places

Project: Environmental Assessment and Management Strategy
Wanneroo Town Centre

Client: City of Wanneroo

Plan Number:
EP17-133(01)--F25

Drawn: ADB

Date: 11/10/2018

Checked: ADB

Approved: JMM

Date: 11/10/2018



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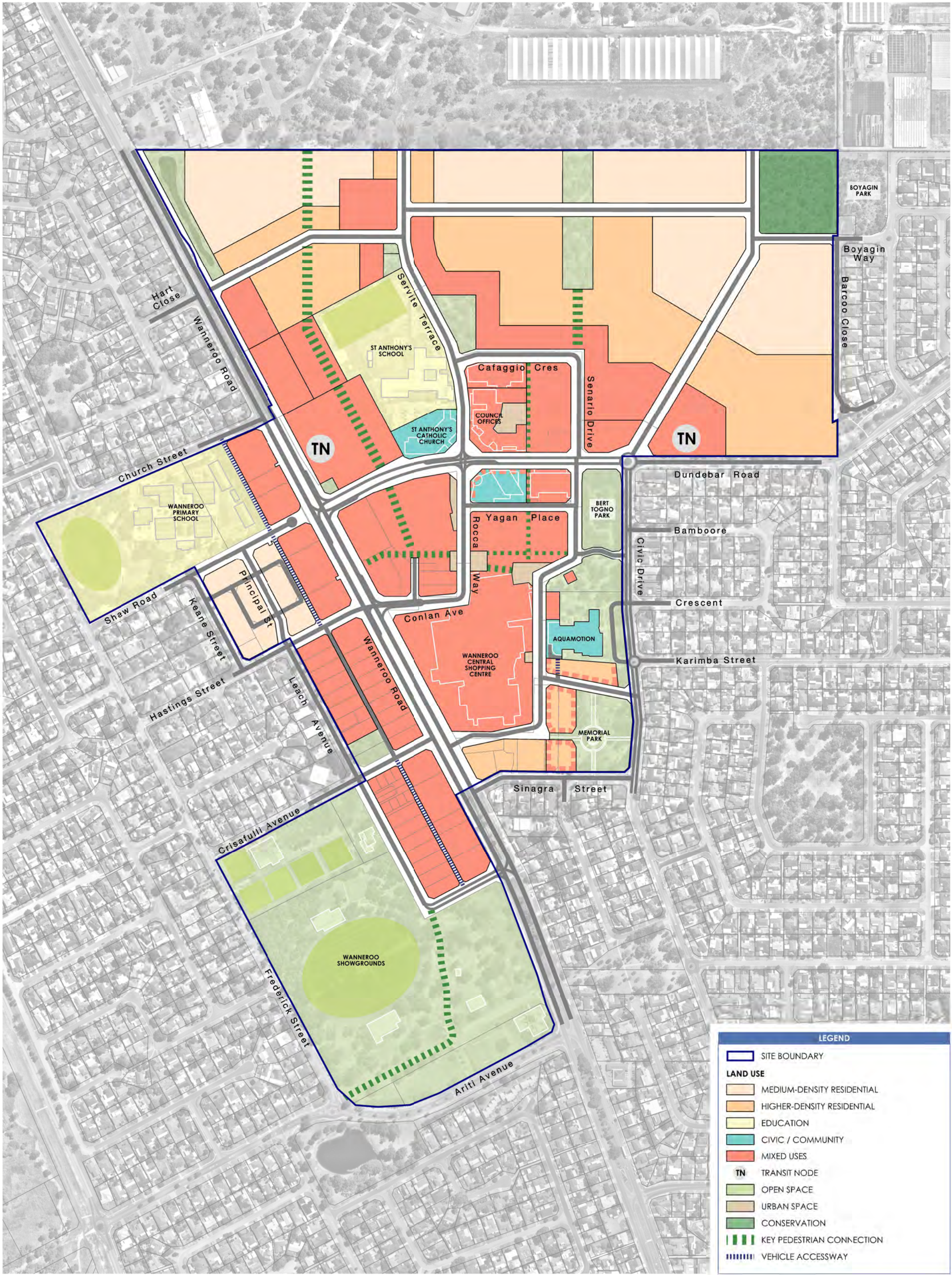
GDA 1994 MGA Zone 50



Appendix A

Proposed Wanneroo Town Centre Structure Plan





Appendix B

Wanneroo Town Centre Aboriginal Heritage Desktop
Assessment Report





OPEN REPORT

Wanneroo Town Centre Aboriginal Heritage Desktop Assessment Report

October 2018

Damien Lafrentz

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Horizon Heritage Management acknowledges and pays respect to the Whadjuk Noongar Traditional Owners and community.

1 PROJECT BRIEF

Horizon Heritage Management was engaged to undertake a desktop assessment in order to understand the extent and characteristics of any known and likely Aboriginal heritage values in proximity to the Wanneroo Town Centre.

2 DPLH RESEARCH

A search of the Department of Planning, Lands and Heritage (DPLH) online register of Aboriginal sites; the Aboriginal Heritage Inquiry System (AHIS) was conducted on the 8th of September, 2018. This search was used to provide contextual Aboriginal heritage information for inclusion and evaluation within the Wanneroo Town Centre Planning Framework.

The research determined both the registered ethnographic and archaeological sites and other heritage places within the project area and the nature and frequency of Aboriginal heritage surveys undertaken. In turn, the potential impact of the Wanneroo Town Centre Planning Framework upon these sites and places and the likelihood of identifying additional sites and heritage issues were assessed in preparation of this desktop research.

2.1 DPLH Aboriginal Heritage Inquiry System Results

There are no (0) registered Aboriginal sites and three (3) Other Heritage Places identified on the DPLH AHIS as being located within the Wanneroo Town Centre project area. These are DPLH 16058 Shaw Road, Wanneroo, DPLH 20054 Wanneroo Primary School Scarred Tree #1 and DPLH 20055 Wanneroo Primary School Scarred Tree #2.

DPLH Other Heritage Places:

The following are the Other Heritage Places located within the Wanneroo Town Centre project desktop area:

Table 1: DPLH Other Heritage Places located within the desktop area

DPLH ID	PLACE NAME	TYPE	STATUS	LOCATION	COMMENTS
16058	Shaw Road, Wanneroo	Modified Tree	Stored Data / Not A Site, No Restrictions	386514mE 6486549mN Zone 50 Reliable	Not the result of Aboriginal activity
20054	Wanneroo Primary School Scarred Tree #1	Modified Tree	Stored Data / Not A Site, No Restrictions	386578mE 6486510mN Zone 50 Reliable	Not the result of Aboriginal activity
20055	Wanneroo Primary School Scarred Tree #2	Modified Tree	Stored Data / Not A Site, No Restrictions	386580mE 6486515mN Zone 50 Reliable	Not the result of Aboriginal activity

DPLH 16058 Shaw Road, Wanneroo

This modified tuart tree was recorded in 1999 by Noongar informants and Madge Schwede. It was described as being located in a vacant block at the corner of Shaw Road and Wanneroo Road. It is about 10-15 m from the corner. It is a direct line with the Church Road scarred tree. The block was heavily vegetated with numerous zamia palms and xanthorrea trees.

The scar is located on the eastern side of the tree facing Wanneroo Road. The scar is approximately 2.5-3 m high, rising as a point, from a 0.5 m incision at the bottom. A secondary cut has been made on the southern side of the scar.

It was assessed by the Aboriginal Cultural Materials Committee (ACMC) and determined to not be a site within the meaning of section 5 of the *Aboriginal Heritage Act (1972)* at ACMC meeting id 404 on the 8th February, 2000.

This tree was removed during land clearing for a mixed business development that had building approval in 2000. Photographic images of the tree and the general area featuring the tree were assessed by Quatermaine Consultant archaeologists post its removal to determine if any other trees displayed scar modifications. Along with examining photographs of the original tree, several still standing trees were assessed with the archaeologists conclusion that although not certain, the scars are likely natural or non-Aboriginal in origin or perhaps a combination of the two. This was deemed highly likely due to the age of the tree (50 – 100 years) and the surrounding European development of the area as firstly a market garden and then as a school site.

DPLH 20054 Wanneroo Primary School Scarred Tree #1

This modified marri tree was recorded by Noongar People and Wayne Glendenning in 2003. It is located at the Wanneroo Primary School near to the intersection of Shaw Road and Wanneroo Road. It bears an elliptical scar on the eastern side of the trunk, which may be due to removal of bark for use as a shield. The scar is located 0.35 m above the ground level and is approximately 1.5 m in length. At its widest the scar measures 0.5 m., with scar regrowth of 10 cm indicating a lengthy period of time from when the tree was scarred. The tree is approximately 5 m southwest of Wanneroo Primary School Scarred Tree #2. Another scarred tree (DPLH 16058) several metres to the north of Wanneroo Primary School Scarred Tree #1 it is claimed was destroyed due to development.

This tree and Wanneroo Primary School Scarred Tree #2 were appraised by Dr Barrie Machin for the WA Department of Education and Training in October 2005. It was his conclusion that the wounds were not the results of Aboriginal activity but rather from damage caused by fire. He recommended that the trees be removed from the register of Aboriginal sites.

DPLH 20054 Wanneroo Primary School Scarred Tree #2

This modified tuart tree was recorded by Noongar People and Wayne Glendenning in 2003. It is located at the Wanneroo Primary School near to the intersection of Shaw Road and Wanneroo Road. The tree is approximately 5 m northeast of Wanneroo Primary School Scarred Tree #1. The scar is at the base of the tree on the northeastern side of the trunk and

is in general the shape of a triangle. The scar measures approximately 0.8 m wide by 1.5 m high. There is some evidence of old regrowth over the scar.

This tree and Wanneroo Primary School Scarred Tree #1 were appraised by Dr Barrie Machin for the WA Department of Education and Training in October 2005. It was his conclusion that the wounds were not the results of Aboriginal activity but rather from damage caused by fire. He recommended that the trees be removed from the register of Aboriginal sites.

DPLH Registered Aboriginal Sites:

*These two sites have been chosen for inclusion in this desktop to demonstrate that important Aboriginal cultural sites, features and materials are still found within heavily developed and urbanised residential areas.

The following are two significant Whadjuk Aboriginal sites located adjacent to but outside the Wanneroo Town Centre project desktop area:

Table 2: DPLH Registered Aboriginal sites adjacent to the desktop area

DPLH SITE ID	SITE NAME	SITE TYPE	STATUS	LOCATION
3657	*Wanneroo Scarred Tree	Modified Tree	Registered Site	Outside Survey Area
3740	*Lake Joondalup	Mythological, Camp, Hunting Place	Registered Site	Outside Survey Area

DPLH 3657 Wanneroo Scarred Tree

This site is a modified tree located on the corner of Church Street and Fredrick Street in Wanneroo, approximately 500m east of Lake Joondalup. It is described as an old Jarrah tree with two scars near its base of which one shows evidence of a metal axe indicating the scars to be relatively modern. This site is located marginally outside the desktop area.

DPLH 3740 Lake Joondalup

Lake Joondalup is a permanent lake in the northern suburb of Joondalup in Perth. It is known to have been a favoured Noongar camping area in traditional and more recent times. It was also a resource area where turtle and wildfowl were hunted. The area around Lake Joondalup was called *Joondal* (crayfish) and the area was a significant place mainly because there was plenty of food and covering for winter. A Noongar story is also associated with Malup Island within Lake Joondalup. Lake Joondalup is approximately 500 m west of the desktop area.

DPLH Heritage Survey Reports:

There are fourteen heritage survey reports lodged with the DPLH which relate to the Other Heritage Places and Registered Sites discussed above. Only *three (3) heritage survey reports are related to the three modified tree places (DPLH 16058, 20054 & 20055) found within the Wanneroo Town Centre desktop area.

Table 3: DPLH Heritage Survey Reports

DPLH HSR ID	REPORT TITLE	AUTHOR
*18458	Report on a preliminary archaeological assessment of an Aboriginal scarred tree site Lots 1 and 152, Shaw Road, Wanneroo	Quartermaine, G
21909	Study of groundwater - related Aboriginal Cultural Values on the Gnangara Mound, Western Australia	McDonald, E
21910	Study of groundwater - related Aboriginal Cultural Values on the Gnangara Mound, Western Australia : Volume 1 restricted report	McDonald, E
21911	Study of groundwater - related Aboriginal Cultural Values on the Gnangara Mound, Western Australia : Volume 2 inventory of registered sites restricted report for Department of Environment	McDonald, E
*22144	An ethnographic appraisal of a Tuart and Marri Tree at the junction of Shaw Road and Wanneroo	Machin, B
*22146	Report of an archaeological survey of the Wanneroo Primary School development site	Glendenning, W
22599	Report on an Aboriginal Heritage Investigation under the Aboriginal Heritage Act 1972 to support a public submission on the draft East Wanneroo Land Use and Water Management Strategy	Australian Interaction Consultants
22781	Site Identification survey of the proposed closure of several caves in Yellagonga Regional Park, Joondalup, WA	Australian Interaction Consultants
101370	Final Report: Cultural Significance of Aboriginal Sites in the Wanneroo Area : 1998	Kauler, Lily Bhavna.
104314	Report of an archaeological and ethnographic survey for Aboriginal sites Neerabup Wanneroo	Murphy, A
104512	Report of an archaeological and ethnographic survey for Aboriginal sites on the northern suburbs rail line Ocean Reef Road to Burns Beach Road	Smith, J
104620	Yellagonga Regional Park: city of Wanneroo position paper	Brittain, R
105116	Lake Joondalup regional open space north – west portion: landscape master plan	James, B
106162	A report of an archaeological survey of Beenyp Waste Water Treatment Plant Craigie, Western Australia	Allen, C

2.2 Summary Discussion

Very few Aboriginal heritage surveys have been conducted within the Wanneroo town centre desktop area. The increased rate of urbanisation in the Perth area and connected developments has resulted in great disturbance to the original environmental contexts. This directly affects the likelihood of locating further surface Aboriginal cultural material (archaeological). The natural environment has been heavily disturbed with vegetation clearing and the development of the Wanneroo area.

Despite this, an indication of potential Aboriginal heritage within the vicinity of the development may be derived from looking at the local environment and ascertaining what sites have previously been reported from such land units, as well as what previous research conducted in the surrounding area has reported.

Lake Joondalup as a prominent water body, especially as a fresh water source, was of vital importance to Whadjuk Noongar people as it is to all Aboriginal people across Australia. The rivers, pools and wetlands were a consistent source of food and water which also often linked campsites along walking tracks and places of mythological and spiritual significance.

In the South West of Western Australia the Rainbow Serpent or *Waugal* is central to Noongar cultural beliefs. Noongars believe that the *Waugal* is both a creative force, shaping the landscape during *Nyittiny* (creation times) and a retributive force having the ability to harm, particularly against those who offend it by not carrying out their cultural responsibilities in protecting country, especially water sources. Creation time stories remain in the oral tradition of many Whadjuk Noongar families. It is these set of associations in particular that concern contemporary Whadjuk Noongar people.

Lake Joondalup (DPLH 3740) as a natural feature and mythological associations with the *Waugal* makes it a highly significant place. Its maintenance and protection is vital to help preserve Whadjuk Noongar cultural heritage values. The rivers, pools and wetland areas of the Perth metropolitan area were part of an extensive communication network that linked Aboriginal groups across the Swan Coastal Plain with other Noongar groups to the north (Yued), south (Gnaala Karla Boodja) and east (Ballardong).

The fresh water lake systems and their surrounding land found in the broader Wanneroo Joondalup areas were exploited by the Whadjuk Noongar People in pre-contact times and by both Whadjuk Noongar People and Europeans in the years following contact. Several possible modified trees (DPLH 3657, 16058, 20054 & 20055) have previously been identified within or adjacent to the desktop area. Modified trees (those that display signs of deliberate removal of bark or wood) are associated with natural resource utilisation and it has been suggested are often found near to or linked with traditional Noongar campsites. The lack of any surface expression artefacts or stone tools is not surprising considering the development of the Wanneroo area.

The contentious nature of determining whether a tree has been modified by natural processes (fire, disease or storm) or deliberate human activities has seen the majority of the possible modified trees (16058, 20054 & 20055) found within the Wanneroo Town centre

desktop area deemed to not be of Aboriginal origin. There is an area in the north of the Wanneroo Town Centre desktop area that appears to be natural bush vegetation. Due to the previously identified modified trees within the developed area of the Wanneroo Town Centre desktop area; examination and assessment of this natural area for mature (Tuart & Marri) trees that could have modifications associated with Whadjuk Noongar cultural practices should be considered as a cultural heritage management strategy.

Whadjuk Noongar people have concerns that their culture cannot continue if the natural environment is destroyed. Natural resources are integral to the maintenance, continuance and transmission of Whadjuk Noongar culture. The Whadjuk Noongar's close connection with *booja* (country) forms the foundation for much of their culture, spirituality and identity.

3 WHADJUK PEOPLE

3.1 Identification of key Aboriginal Stakeholder Group

The existence of a native title claim (NTC) is seen as sufficient to establish an Aboriginal person's 'right to speak' about heritage issues.

Identified Stakeholder Group

The table below outlines the Whadjuk (Noongar) people:

Table 4: Aboriginal group identified as a key stakeholder in the Wanneroo Town Centre desktop

NTC GROUP	NTC	CONTACT
Whadjuk People	WC2011/009 WAD242/2011	SWALSC

Whadjuk People

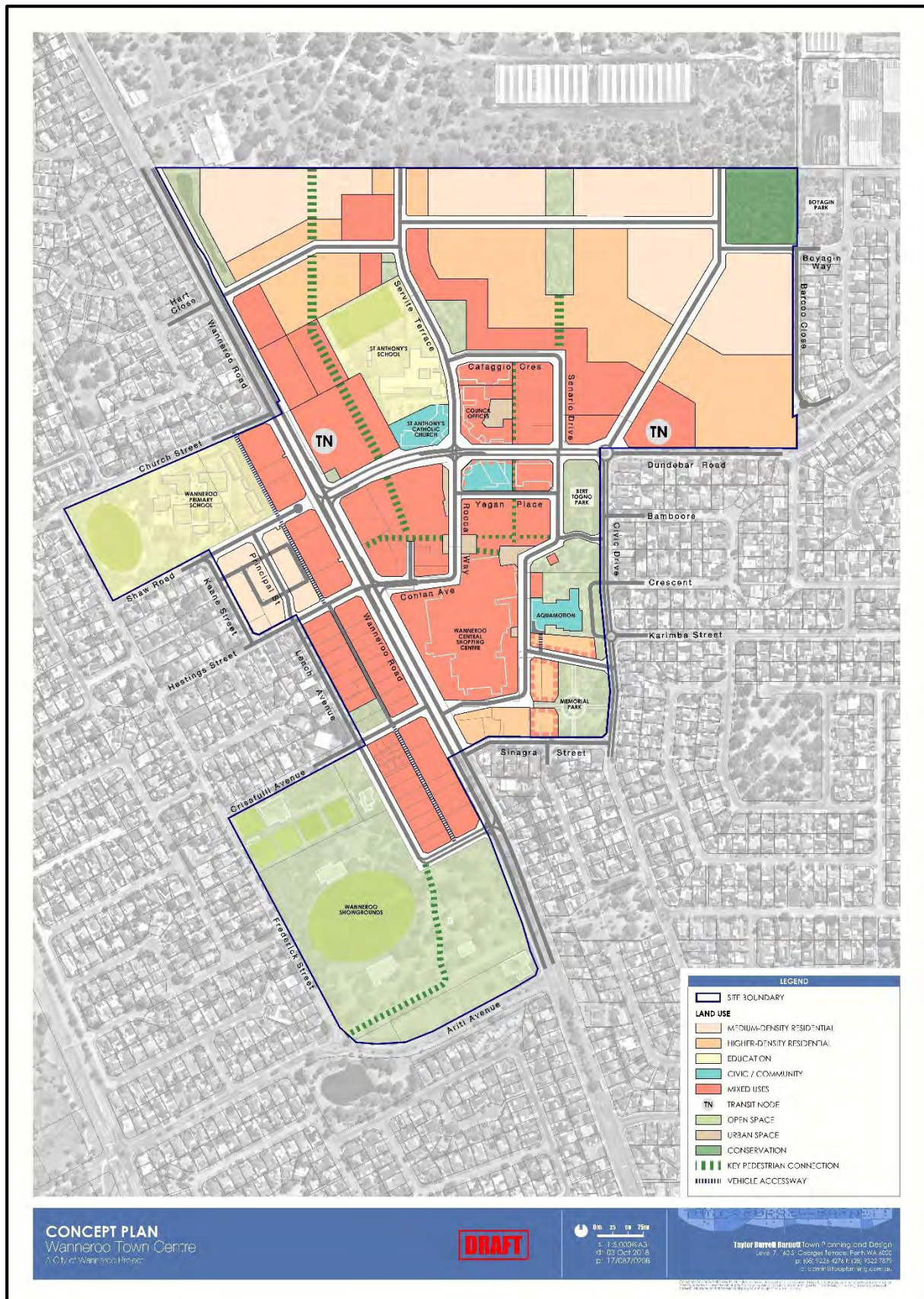
The Whadjuk People have had a registered Native Title Claim since 2011 which covers the: City Of Armadale, City Of Bayswater, City Of Belmont, City Of Canning, City Of Cockburn, City Of Fremantle, City Of Gosnells, City Of Joondalup, City Of Melville, City Of Nedlands, City Of Perth, City Of South Perth, City Of Stirling, City Of Subiaco, City Of Swan, City Of Vincent, City Of Wanneroo, Shire Of Beverley, Shire Of Chittering, Shire Of Gingin, Shire Of Kalamunda, Shire Of Mundaring, Shire Of Northam, Shire Of Peppermint Grove, Shire Of Toodyay, Shire Of York, Town Of Bassendean, Town Of Cambridge, Town Of Claremont, Town Of Cottesloe, Town Of East Fremantle, Town Of Mosman Park and the Town Of Victoria Park.

4 DESKTOP CONCLUSIONS AND RECOMMENDATIONS

Horizon Heritage Management makes the following conclusions and recommendations:

- Limited Aboriginal heritage surveys have been undertaken within the Wanneroo Town Centre desktop area.
- No (0) registered Aboriginal sites; afforded protection under the *WA Aboriginal Heritage Act (1972)*, are located within the Wanneroo Town Centre desktop area.
- Important landscape features connected with mythological associations are absent within the Wanneroo Town Centre desktop area. Lake Joondalup is such a feature and is located outside of the desktop area to the west.
- The majority of the Wanneroo Town Centre desktop area has been so highly developed and disturbed from its original natural environment that is unlikely any surface expressions of cultural material (artefacts) would be present. However, potential modified trees could be present as demonstrated by those previously identified near the Wanneroo Primary School within the Wanneroo Town Centre desktop area.
- Within the northern portion of the Wanneroo Town Centre desktop area a section of remnant native bushland remains which could potentially contain Aboriginal heritage values such as modified trees or surface expressions of cultural material (artefacts).
- The key Aboriginal stakeholder group for the Wanneroo Town Centre desktop area is the Whadjuk People.
- The City of Wanneroo should consider undertaking heritage consultation with the Whadjuk People of the Wanneroo Town Centre structure plan and consider commissioning an Aboriginal heritage archaeological survey of the remnant native bushland identified in the northern portion of the structure plan.

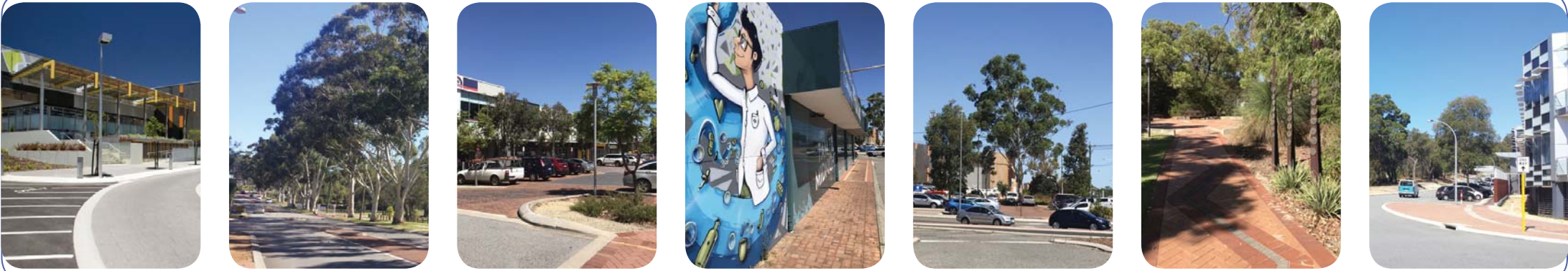
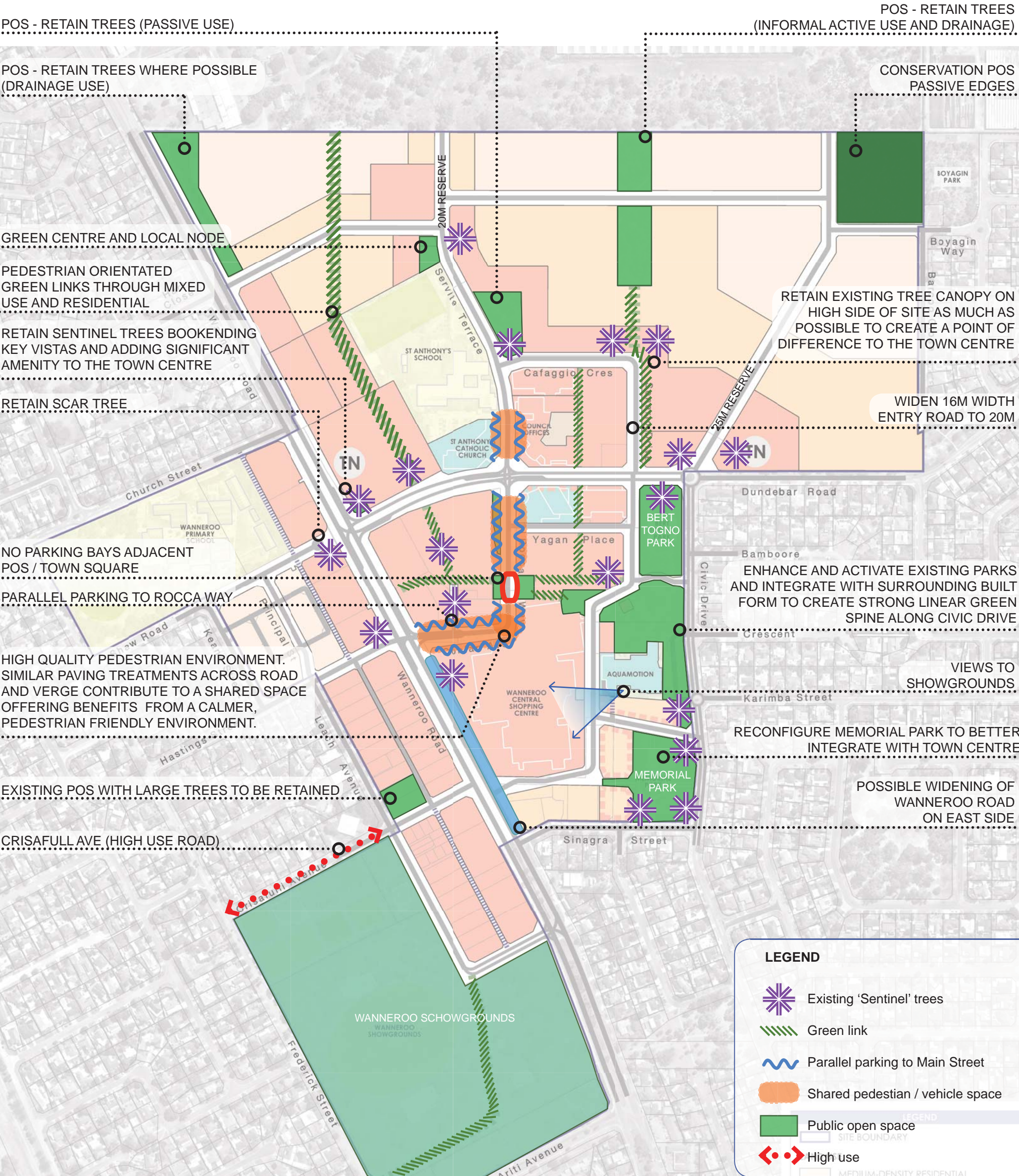
Figure 1: Wanneroo Town Centre Concept Plan Map





APPENDIX 6

LANDSCAPE CONCEPT PLAN AND ROCCA WAY CONCEPT PLAN AND PERSPECTIVE



EXISTING SITE PHOTOS

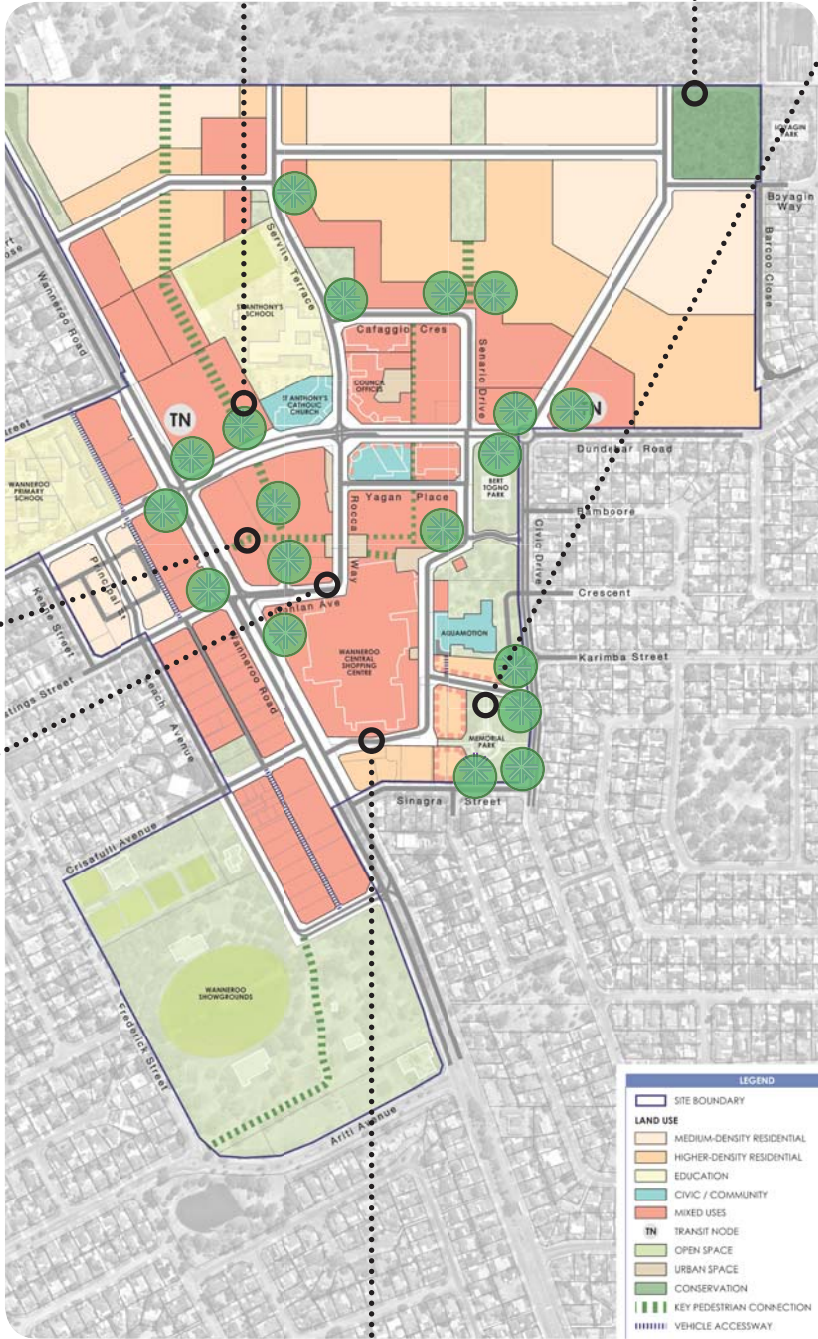


CONSERVATION POS

RETENTION OF EXISTING TREES



GREEN LINK PEDESTRIAN CONNECTIONS



PUBLIC OPEN SPACE



PLAZA



STREETSCAPE AMENITY





WANNEROO TOWN CENTRE LANDSCAPE CONCEPT

DWG COW-04-L03
ISSUE B
DATE 16-10-2018
SCALE 1:300 @ A3
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UNCURRENT PROJECTS\COW\WannerooTownCentre\Drawings\Scans\01_02_ConceptPlans\Scans\Graphics\02_LIVEDwg\01_OverallProjectPlans\Design\COW\WannerooTownCentre\SM.indd



TIMBER SEATING PODS INTEGRATED WITH STREET TREE PLANTING TO PROVIDE WELL SHADED SEATING AREAS ALONG MAIN STREET BOULEVARD. FURNITURE ON THIS ALIGNMENT WILL ALSO PROVIDE PROTECTION FROM VEHICLES



WELL SHADED POS AREAS PROVIDING FOR CASUAL SEATING AND ENCOURAGING OPPORTUNITIES FOR ACTIVATION THROUGH ALFRESCO DINING AND INFORMAL EVENT SPACES



ROCCO WAY

DUNDEBAR ROAD

YAGAN PLACE



DOUBLE ROW OF TREES TO PROVIDE SHADE AND AMENITY PRIORITISING PEDESTRIAN EXPERIENCE. TREES WILL ALSO PROVIDE PROTECTION FROM VEHICULAR TRAFFIC AND OPPORTUNITIES FOR SMALL SEATING AND RESTING SPOTS



TIMBER SEATING PODS WITH FEATURE TREE AND GARDEN BEDS TO PROVIDE SEATING FOR LARGER GROUPS.



DWG COW-04-L04
ISSUE B
DATE 16-10-2018

SCALE 1:100 @ A3
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WANNEROO TOWN CENTRE
LANDSCAPE CONCEPT





WANNEROO TOWN CENTRE
ROCCA WAY PERSPECTIVE

DWG COW-04-L05
ISSUE B
DATE 18-10-2018 SCALE NTS
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APPENDIX 7

INFRASTRUCTURE AND SERVICING REPORT



the**civil**group

CITY OF WANNEROO

**Wanneroo Town Centre
Planning Framework Review**

Engineering Aspects

4th October 2018

Project Ref N°: 8002

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1. Context, proposals, and impact of infrastructure

1.1 Introduction

This report, with its comments about the utilities and related infrastructure and their capacity within the Wanneroo Town Centre (the Centre), supports the Planning Framework Review (PFR) being prepared by the Town Planner, Taylor Burrell Barnett.

The purpose of the review is part of the City's goal to activate its Town Centre and to realise a unique sense of place. Much of the Centre has recently had its zoning increased, and City's aim is to have well planned multiple-use developments that complement existing land uses. The densification of the Centre may necessitate upgrades to the capacity of existing utilities. Such services' upgrades may include some or all the wastewater collection, water supply, firefighting water supply, electricity, gas, and communications services.

A concept plan of the proposed development of the Centre is shown in Appendix A.

1.2 Timing and funding the cost of infrastructure upgrades

An impediment to piecemeal development can occur when an individual development triggers a large upgrade of a utility service. The provision of the upgrade may need to be funded by the proponent or the utility provider. For larger scale infrastructure such as transmission lines, water distribution mains, and main sewers, the utility provider would generally consider funding the upgrade. For such main services, the timing of the upgrade is often out of a developer's control and may delay a project. Upgrades to reticulation water mains, sewer reticulation mains, high voltage (HV) feeders, and low voltage (LV) power cables would usually be borne by the developer. If a service upgrade results in a development being unfeasible as judged by the developer, it can stall development in that area, since no developer wants to be the one who pays for an upgrade that may benefit many others with little or no chance of sharing the cost.

A Development Contribution Plan (DCP) can be beneficial to fund and share the cost of infrastructure as all those who benefit pay for the increase in capacity. DCP's can be complex and difficult to manage and implement.

An impediment to a DCP working for infill development such as that proposed within the City, is that often the infrastructure must be upgraded early to allow development to take place, but often there is not enough development occurring to collect sufficient funds in the DCP to pay for the works upfront. Timing and sequencing therefore become critical issues. This may mean that the City must borrow the funds for the upgrades and then collect DCP payments as development proceeds to repay the loan.

This report that supports the Planning Framework review will not attempt to solve these problems, but some DCP's will need to be considered and adopted before development progresses too far beyond when such a DCP is impractical. In other words, any DCP's must be adopted early in the process of development of precincts or parts of precincts. The aim of this document is, however, to identify infrastructure that may require upgrading as development in the Town Centre progresses.

2. Geology, Topography and Groundwater

The Centre generally slopes east to west at an average grade of about 4 to 5%. Whilst this average slope is quite steep, existing development has levelled many of the lots within the Centre. Topography is shown in Appendix B.

Soils on the Centre are Coastal Limestone formation, predominantly quartz sand (Geological Survey of Western Australia, 1978), therefore the Centre is suitable for disposing of stormwater by infiltration.

Groundwater generally is very deep across most of the Centre - generally more than 10 metres below the ground surface. It is, however, shallower within the showgrounds, where the maximum known groundwater level is within 2 metres of the surface (Perth Groundwater Atlas, DWER). There is a pond in Nyunda Park which is an expression of groundwater. Except for the Showgrounds area, groundwater will not be an impediment to development.

3. Water – potable and fire-fighting

The Water Corporation has been consulted regarding the current potable water infrastructure within the Centre, the proposed areas of dwelling increase, and what upgrades may be required into the future.

Wanneroo's water is supplied from the Wanneroo Reservoir, located about 2 kilometres to the east of the Centre. Several trunk mains pass through the Centre, taking water to and from the reservoir. A 1,000 mm trunk main is located on the northern boundary of the Centre, through undeveloped land. This main is currently contained within a 5-metre-wide easement. Future development will need to consider this easement and trunk main and ideally locate it within a road reserve. The two other trunk mains are located mostly in tandem on the southern boundary of the showgrounds and on the eastern boundary of the Centre, in Civic Drive.

The Centre appears to be well served with water reticulation. A 250 mm diameter reticulation main is located in Dundobar Road and a 305 mm diameter main is located in Civic Drive between Dundobar Road and Karimba Street. Reticulation mains are generally asbestos cement or PVC. Where reticulation mains are 100 mm or less (mainly on the western side of Wanneroo Road) developments requiring water for fire-fighting purposes will require larger reticulation mains. There is a small section of 50 mm main on Shaw Road which will require upgrading. The cost of upgrading mains is generally borne by an

individual developer, however where an upgrade may benefit multiple land owners, a DCP could be implemented.

Refer to Appendix **C** for details of the current network

4. Wastewater

The Water Corporation was also consulted regarding potential constraints to development due to limits on the capacity of existing sewers in some of the precincts.

The Centre has two 225 mm diameter sewers passing through it, and therefore appears to have adequate capacity for the transfer of wastewater. All wastewater from the Centre currently flows to the Ariti Avenue Wastewater Pumping Station (WWPS) and is then directed to the Beenypup Wastewater Treatment Plant.

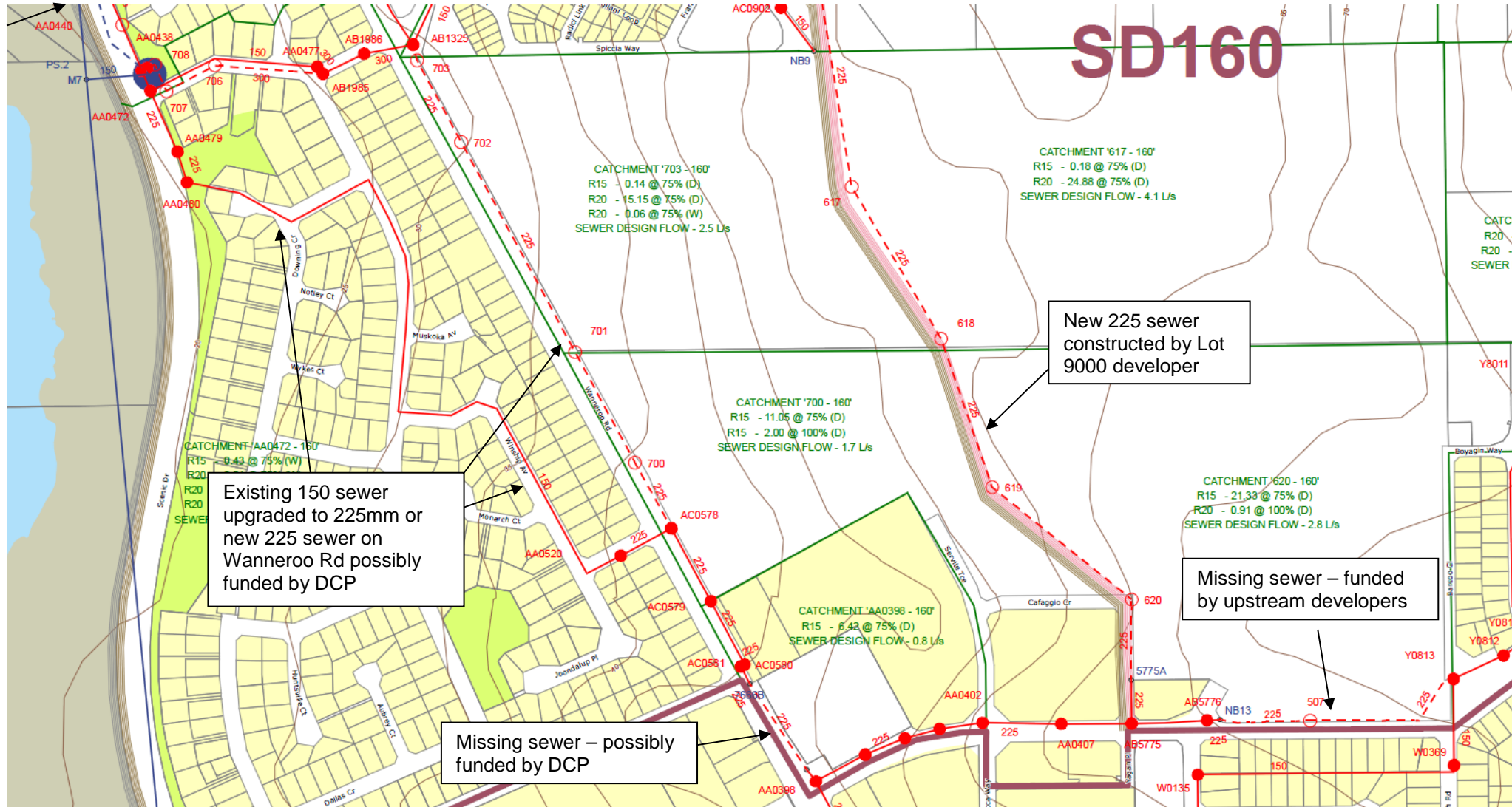
Refer to Appendix **D** for the current network of sewer mains

Water Corporation planning shows that part of the Centre north of Dundebur Road is in the Neerabup Sewer catchment, however for flows to reach the Scenic Drive WWPS, a missing section of sewer needs to be constructed on Wanneroo Road, between Dundebur Road and Church Street. Then a section of 150 mm sewer downstream of this would at some stage also require upgrading to 225 mm, or a new section of 225 mm sewer would need to be constructed along Wanneroo Road, between Hart Court and Neville Drive to take the increased flows. The exact timing of these upgrades will be dependent on the speed and density of development in the Town Centre. When yield forecasts are finalised, the Water Corporation will be able to model the forecast flows and determine where capacity constraints may arise.

Once this modelling is completed, and there is more certainty around the timing and magnitude of the required upgrades, it may be worth considering whether the costs of these offsite upgrades can be captured in a DCP.

There is also another missing section of 225 mm sewer on Dundebur Road, upstream of the Centre, although it's construction will be driven and funded by the need of developers upstream. Water Corporation planning shows this sewer continuing north through Lot 9000 which will need to be built when this lot is developed. Locations of future upgrades are shown in Figure 1.

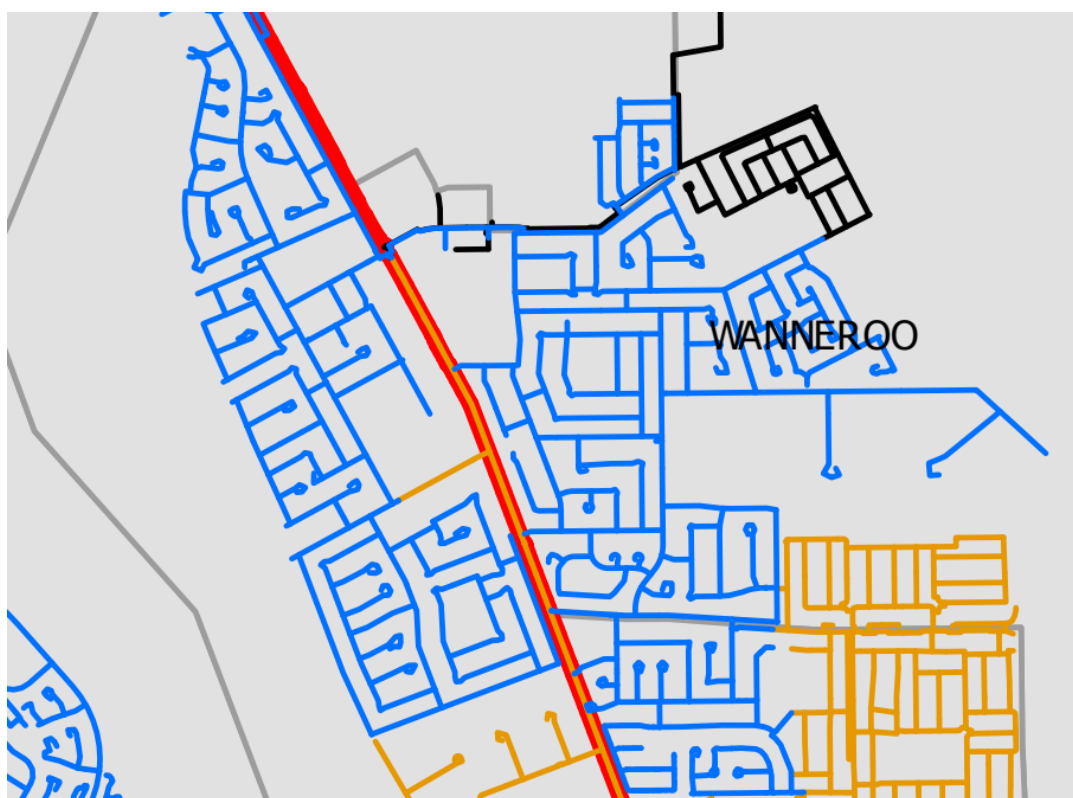
Figure 1 – Potential sewer upgrades



5. Gas Supply

Reticulated gas is available throughout the Centre (refer Figure 2) supplied from a network of medium-low pressure (blue), medium pressure pipes (orange), polyethylene high pressure pipes (black) and high-pressure pipes (red).

Figure 2 – ATCO Gas Network



Although gas is not an essential or required service there appears to be sufficient supplies and networks in place to support development. If mains are to be upgraded, it will be progressive and supported from the network of high pressure mains.

6. Electricity

Electricity to the Centre is supplied via the Wanneroo Zone Substation located on Wanneroo Road in Tapping.

Extracts from Western Power's Network capacity mapping tool are provided in Appendix E for the years 2018, 2020 and 2031. This Tool provides a forecast of the available capacity at Western Power's zone substation. Western Power has forecasted that for the next 2 years there will be between 5 and 10 mega-volt amps (MVA¹) of capacity available. In 2020, this increases to 10 to 15 MVA (presumably this increase coincides with the completion of the Mariginiup Substation which is yet to be confirmed) but then drops back to 5 to 10 MVA in 2031. It is likely that a new high voltage feeder will be required from one of the nearby substations to serve the increased number of dwellings. To determine the timing of this upgrade would require a feasibility study to be undertaken by Western Power.

It is Western Power's responsibility to ensure the power transmission (i.e. delivery of HV to the zone substations) keeps up with demand. But it will not step in to deliver system upgrades beyond the Zone Substations via feeders or distribution cables.

High costs for upgrading can be incurred by developers when there are insufficient HV feeders from the zone substations to serve larger scale developments. Unfortunately, at present the only way for Western Power to advise if a development triggers an upgrade to a High Voltage feeder is through multiple precinct type feasibility studies, which must not only be paid for by the developer but be based on an assumed development programme and staging. Such staging is almost impossible to predict now and this uncertainty about electricity capacity is of some concern.

Western Power says it is difficult to predict future requirements due to the technological advancements of power generation and storage. Spare capacity is used on a first come first served basis and upgrades to their system are provided only as needed. This uncertainty and lack of logic is a concern with implementation of the goals of the Planning Framework for example and a Centre development such as is planned for Wanneroo.

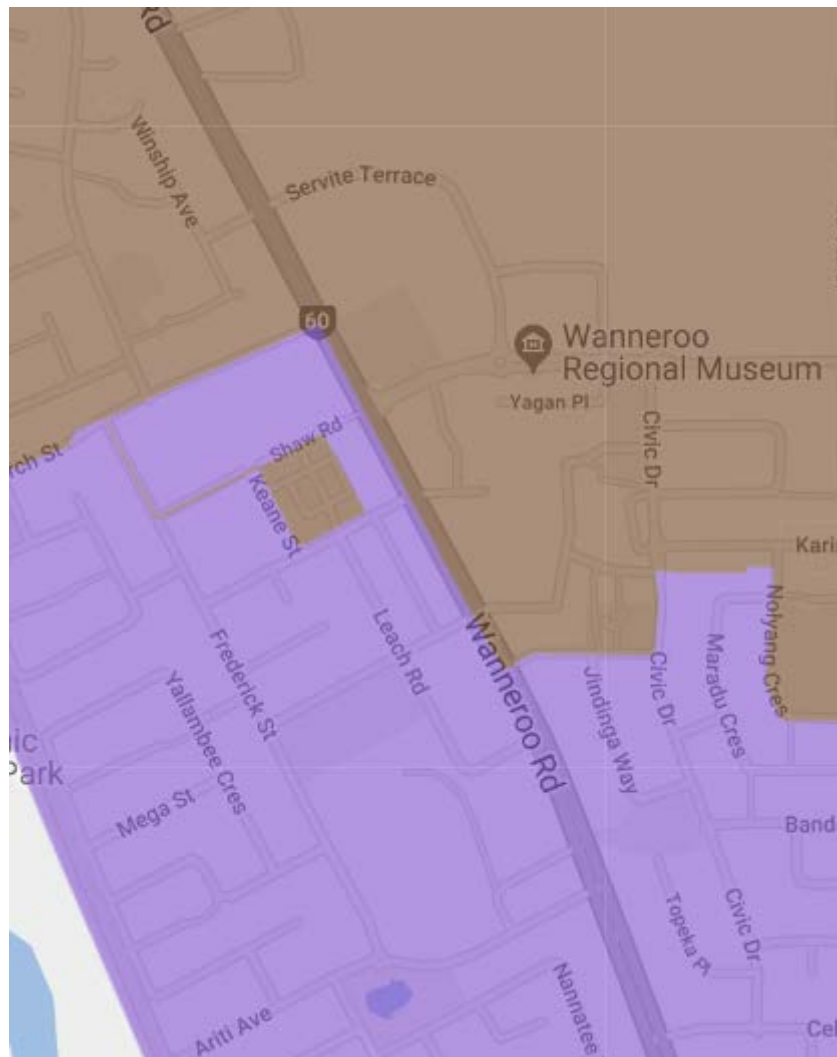
Western Power has recognised this as an issue and is looking at options to better manage this process. When or how they might do this is not yet known.

¹ MVA is a measure of electrical power. 5 MVA, for example, is an approximate measure of the power to about 1,250 high density dwellings

7. Communications

The NBN Co is currently installing their network throughout most of the Town Centre, as shown in Figure 3 below. The area shown in purple is already connected to the NBN using a combination of fibre to the node technology (east of Wanneroo Road) and fibre to the kerb (FTTK) (west of Wanneroo Road). The area shown in brown is currently being built using FTTK technology with an anticipated completion date of January - March 2019.

Figure 3 – Extract from NBN “Rollout Map” – 10th August 2018



It is not expected that broadband capacity will be a burden to future development once the NBN Co system has been implemented throughout the Centre.

8. Stormwater

The City manages stormwater drainage within the Centre and there are no Water Corporation main drains nearby.

The development and densification of the Centre will lead to more impermeable surfaces and therefore greater stormwater runoff. As the land slopes westward toward Lake Joondalup, consideration must be given to ensure this sensitive water body is not impacted. Water Sensitive Urban Design practices must be adhered to.

Stormwater within the Centre is currently directed to infiltration devices (i.e. sumps) or basins. The southern part of the Centre drains to a pond/basin in Nyunda Park. The catchment along Dundobar Road and east of Servite Terrace drains to a temporary basin at the end of Servite Terrace. The remainder forms part of a larger catchment which drains to a bioretention basin at the end of Church Street, adjacent to Lake Joondalup.

The soils of the Centre are sandy and therefore likely to be very permeable meaning that disposal of stormwater at source is a viable and environmentally effective way of managing stormwater. Where the disposal of stormwater by infiltration is practicable, the City expects that major event runoff is contained within the lot and does not enter the City's stormwater system.

Refer to the Local Water Management Strategy (Emerge, 2018) for more details on stormwater management.

9. Summary

A summary of this “Engineering Aspects Report” about key servicing infrastructure follows. The summary comments on what is serving the Town Centre now as well as what upgrades are needed.

Wastewater

The Town Centre is currently served by gravity sewer reticulation mains that flow to the Ariti Avenue Wastewater Pumping Station (WWPS) in the Wanneroo Sewer District. The Water Corporation's sewer planning proposes that the northern portion of the Town Centre will be in the Neerabup Sewer District that will outfall into the Neerabup WWPS No 2 on Scenic Drive. There are some gaps in the existing sewer infrastructure that is preventing this from occurring. The development of the Town Centre will eventually trigger the need for these connections to be constructed. The timing and need will be confirmed by the Water Corporation as development progresses.

Water Supply

The Town Centre is presently serviced with water via an established network of large and small reticulation mains. In general terms, any new development can be connected to this system by

extensions and upgrades to the Wanneroo Gravity Scheme served by the Wanneroo Reservoir. No new distribution mains are likely to be needed.

A 1,000mm diameter water distribution main runs inside a 5-metre-wide easement along the northern boundary of the Town Centre area. The main will need to be adequately protected within a pipe reserve or road reserve and any new development adequately set back from the main.

Most of the development is served by 150mm or larger diameter reticulation mains, the minimum size for firefighting requirements. There are some exceptions, however, where there are some reticulation mains that are 100mm or less in diameter and these mains will require upgrading for firefighting purposes.

Electricity and Communications

Electricity to the Town Centre is supplied via the Wanneroo Zone Substation located on Wanneroo Road in Tapping.

Western Power has forecasted that for the next 2 years there will be between 5 and 10 mega-volt amps (MVA) of capacity available and over the next decade that supply will increase to 10 to 15 MVA. At some stage in the future it is likely that a new high voltage feeder will be required from one of the nearby substations to serve the increased number of dwellings. In the meantime, supplies will be provided from existing high and low voltage infrastructure in and near the Town Centre. Some minor upgrades of the HV infrastructure may be needed in localised areas as demands change.

The NBN Co is currently installing their communications network throughout most of the Town Centre using a combination of fibre to the node (east of Wanneroo Road) and fibre to the kerb (west of Wanneroo Road) with anticipated completion dates of early to mid-2019. This network will serve the development of the Town Centre.

Funding infrastructure upgrades

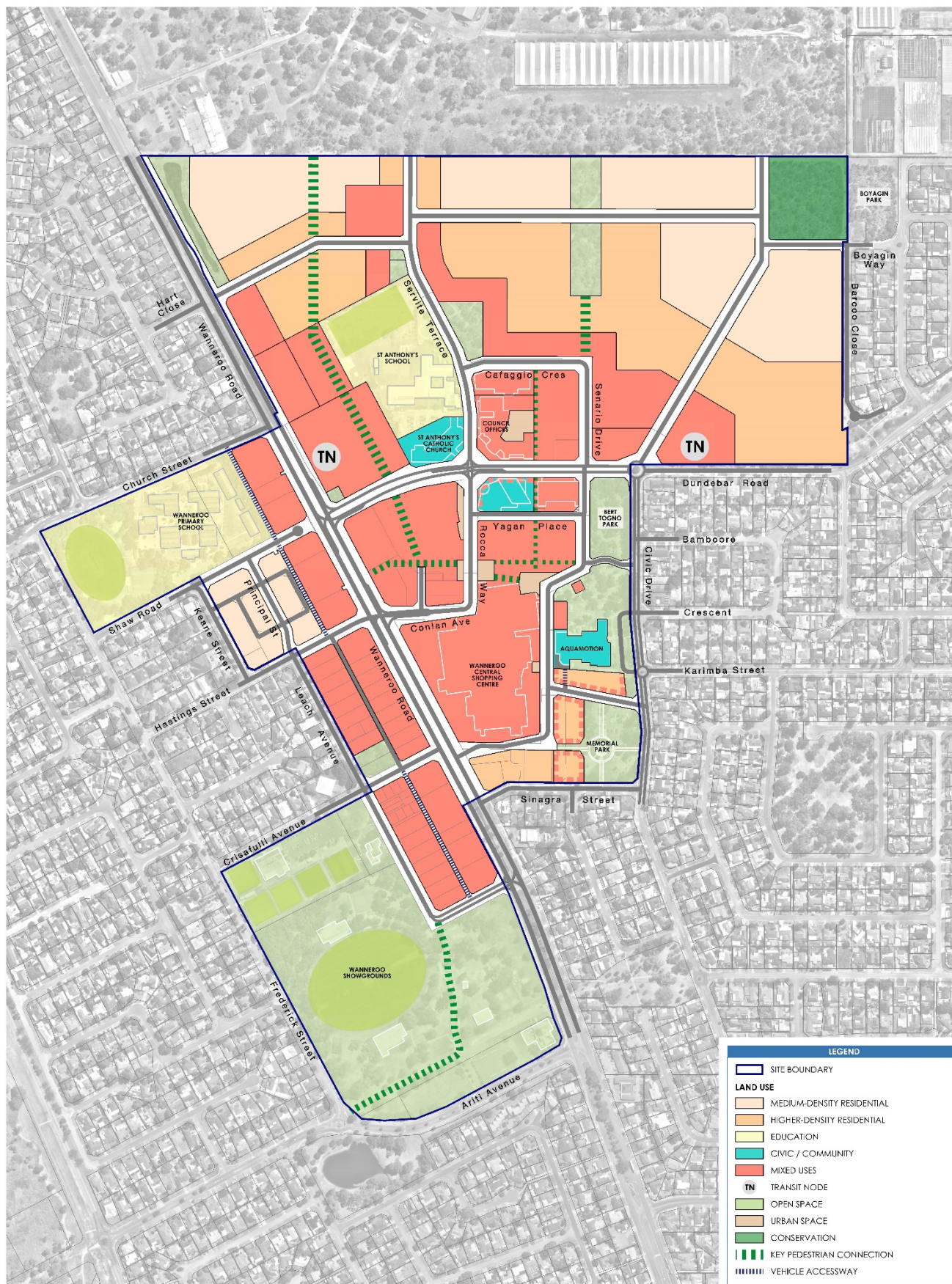
High costs for upgrades to key infrastructure can suppress or slow development, therefore funding mechanisms such as Development Contribution Plans should be considered by the City.

APPENDIX A

Concept Plan

Taylor Burrell Barnett

1st October 2018



CONCEPT PLAN
Wanneroo Town Centre
A City of Wanneroo Project

DRAFT

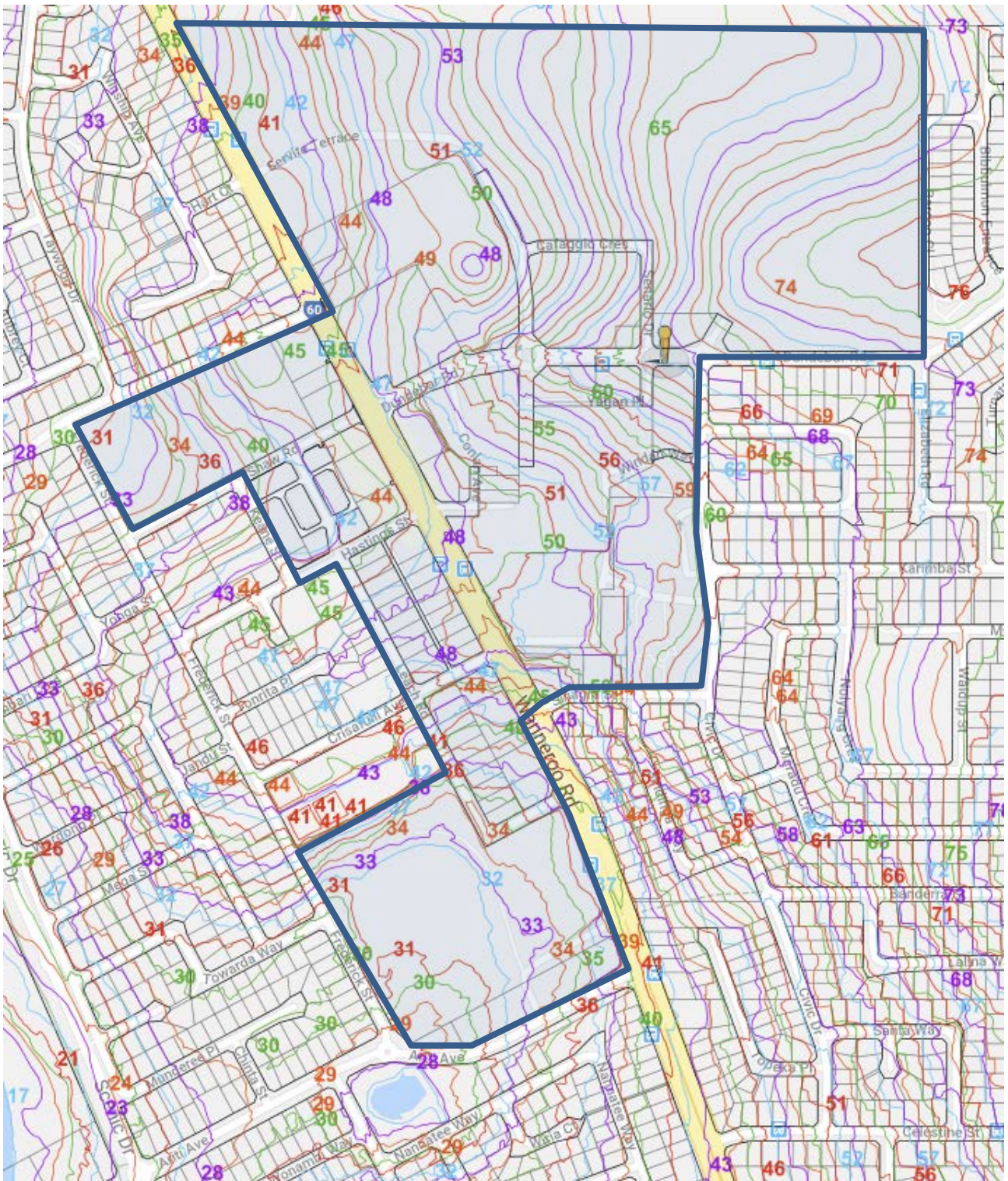
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p: 17/087/0208

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e: admin@tbbplanning.com.au

APPENDIX B

Topography

Water Corporation August 2018



APPENDIX C

Existing Water Infrastructure

Water Corporation

Legend

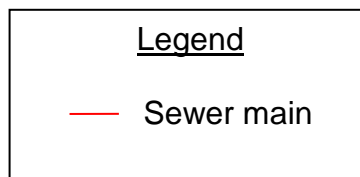
 Existing water main

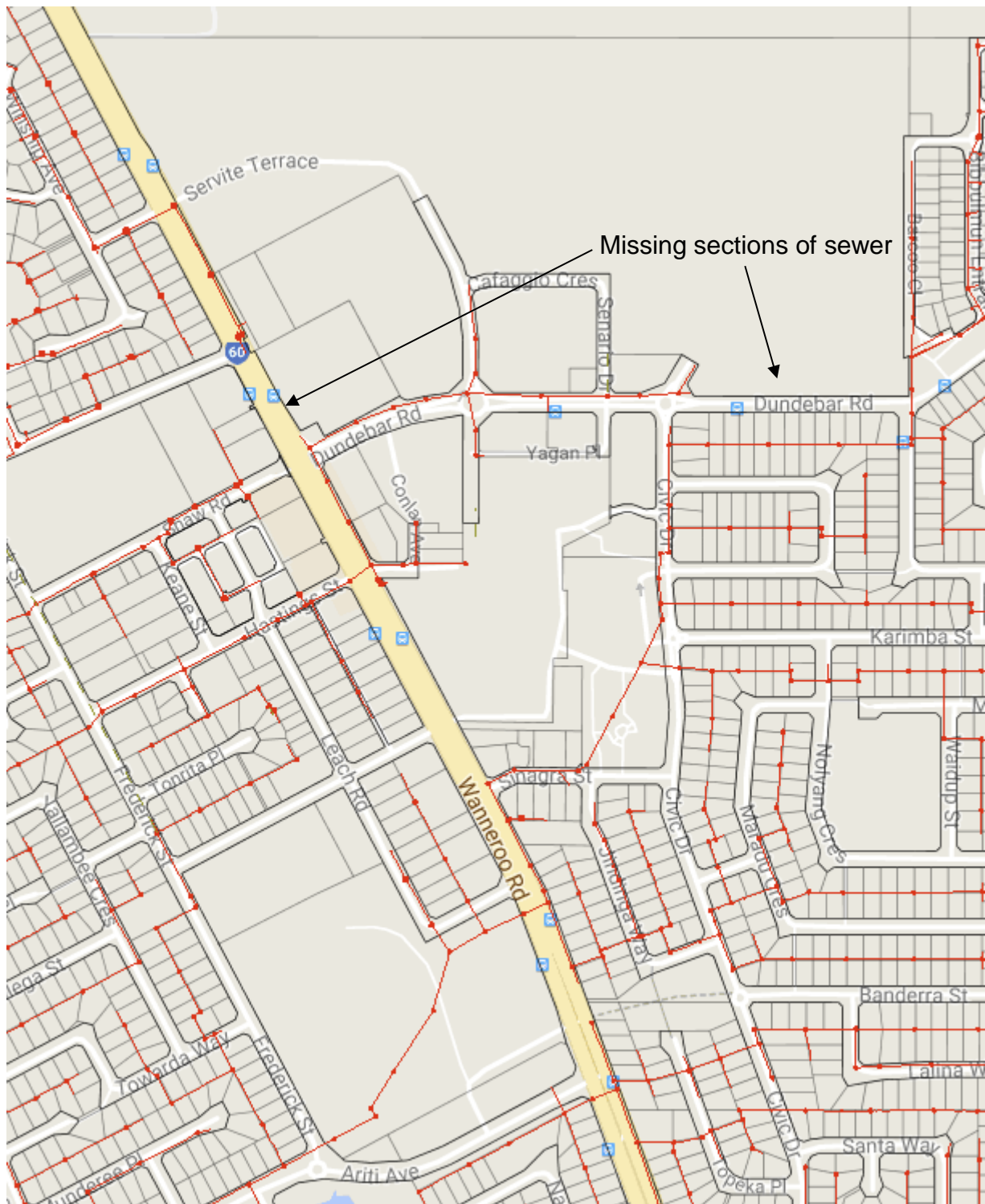


APPENDIX D

Existing Wastewater Infrastructure

Water Corporation





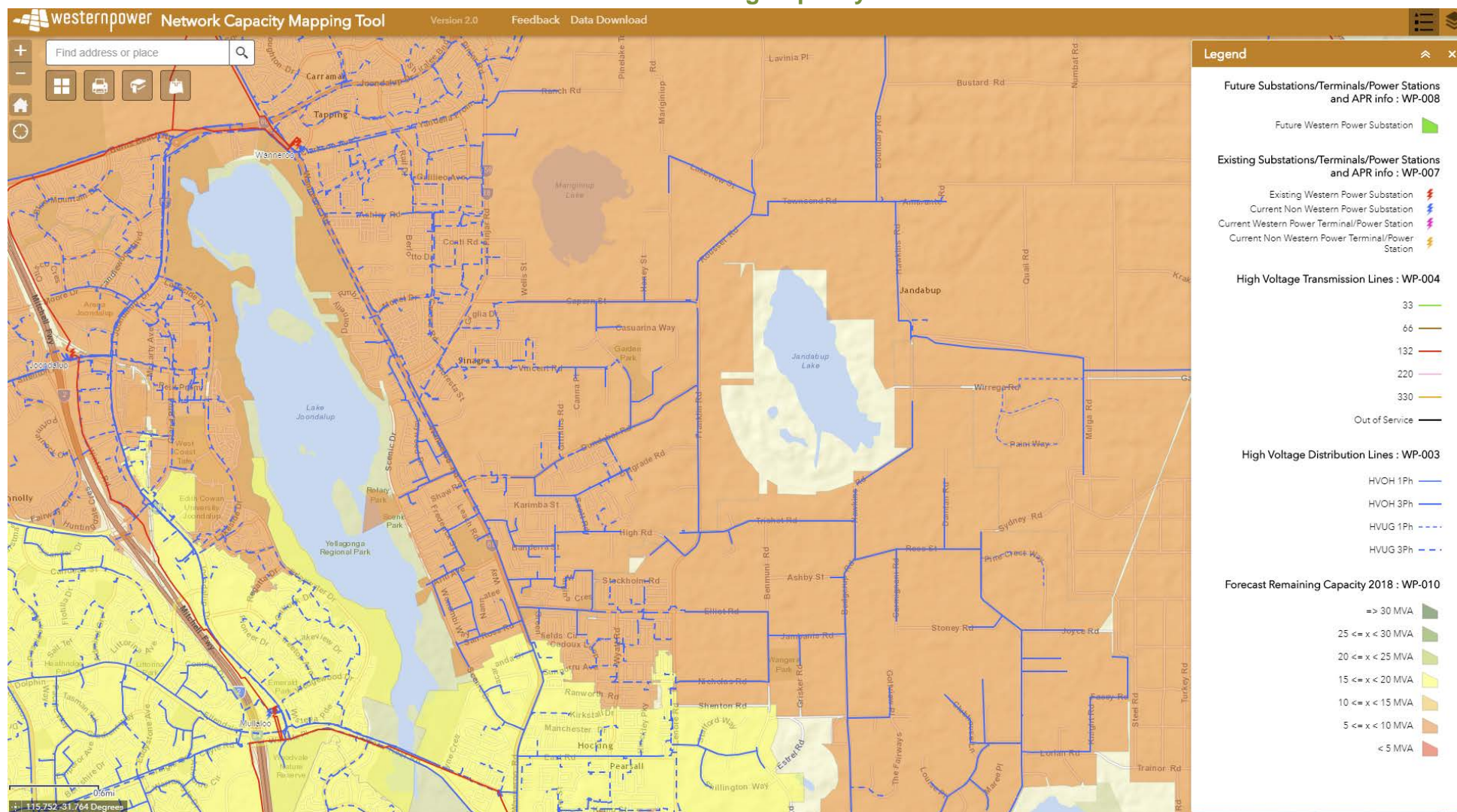
APPENDIX E

Western Power

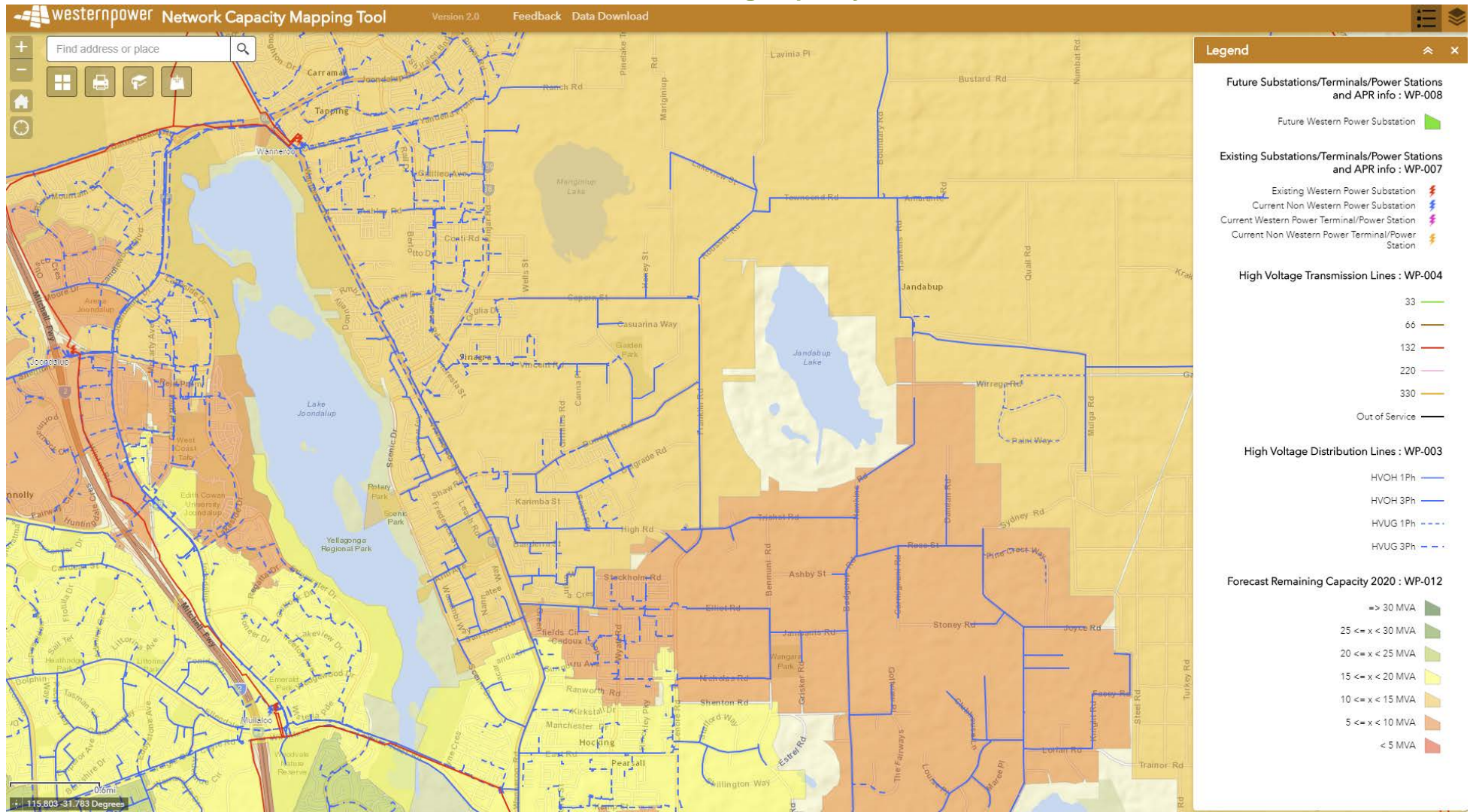
Forecast Network Capacity

2018, 2020, and 2031

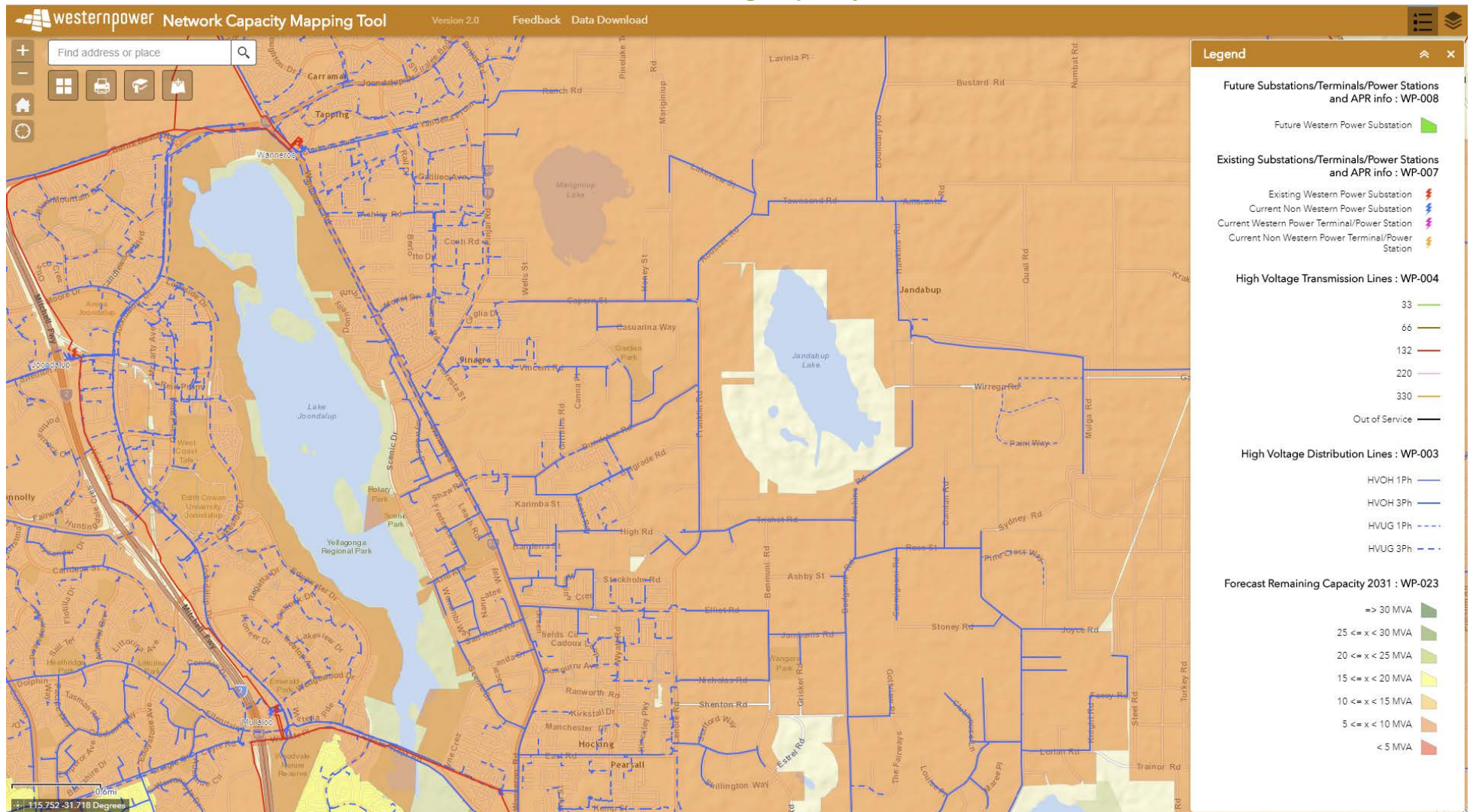
Forecast Remaining Capacity – 2018



Forecast Remaining Capacity – 2020



Forecast Remaining Capacity – 2031





APPENDIX 8

LOCAL WATER MANAGEMENT STRATEGY

Local Water Management Strategy

Wanneroo Town Centre

Project No: EP17-133(02)

**Prepared for City of Wanneroo
October 2018**

Local Water Management Strategy

Wanneroo Town Centre



Document Control

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				Rachel Evans	RLE
	For project team review				

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Executive Summary

The Wanneroo Town Centre (WTC) structure plan area (herein referred to as the 'site') covers approximately 90 ha within the City of Wanneroo (CoW). The site is located approximately 23 km north of Perth Central Business District and includes the existing WTC and areas adjacent to Wanneroo Road.

The site is zoned 'urban' and 'urban deferred' under the Metropolitan Region Scheme and 'centre' under the CoW's *Town Planning Scheme No. 2*. The site largely consists of retail, commercial and community infrastructure as well as a large area of remnant vegetation to the north that has remained undeveloped. This undeveloped portion is referred to as the northern development area (NDA). Several major community and commercial assets are located within the site including Wanneroo Central Shopping Centre, Wanneroo Primary School, Wanneroo Showgrounds and the CoW government office. The site is surrounded by existing residential development and an Inghams poultry farm to the north of the site (proposed to be relocated and the lot developed for urban land use).

Taylor Burrell Barnett has prepared an activity centre structure plan (SP) on behalf of CoW to support and guide the proposed redevelopment and land use changes within the site. The WTC SP project vision is to revitalise the town centre and expand development into the northern section of the site.

The existing WTC will be rezoned to incentivise the establishment of land uses appropriate to an expanding secondary centre, while undeveloped land to the north will be able to be developed into a mix of medium and higher density residential areas.

This local water management strategy (LWMS) details the water management approach to support the WTC SP and is intended to satisfy the requirement to prepare a LWMS in accordance with *Better Urban Water Management*.

Water will be managed using an integrated water cycle management approach. The first step in applying integrated water cycle management in urban catchments is to establish agreed environmental values for receiving waters and their ecosystems. In summary, the environmental investigations conducted to date indicate that:

- The site receives an average annual rainfall of 732.8 mm with the majority of the rainfall received between the months of June and August.
- Topography of the site ranges from 29 m Australian height datum (AHD) in the west to 76 m AHD in the north east.
- Regional geological mapping indicates that soils beneath the site are likely to be sand derived from Tamala Limestone (S7). Sand derived from Tamala Limestone (S7) is understood to have a high phosphorous retention index.
- Infiltration rates measured in the northern region of the site range between 40 and 62 m/day.
- The site is classified as having 'no known risk' of acid sulfate soils occurring within 3 m of natural soil surface.
- The northern portion of the site is dominated by high infiltration capacity sands resulting in stormwater infiltrating at source. Stormwater runoff from road reserves within the existing WTC

Local Water Management Strategy

Wanneroo Town Centre



area is conveyed by the existing pit and pipe network or via overland flow towards a number of locations, mostly beyond the site, including: a sump north of Servite Terrace, the Wanneroo Showgrounds, Wanneroo Dunk Pond to the south of the site etc.

- The portion of the site west of Wanneroo Road is within a Priority 3 Public Drinking Water Source Area.
- Maximum groundwater level (MGL) across the site ranges between 24 m AHD near the western boundary and 40 m AHD in the north east of the site, with MGL ranging from 0 m to 36 m below ground level.
- There are no geomorphic wetlands within or immediately adjacent to the site.
- The site encompasses the historic and current WTC. A large section of remnant native vegetation is located in the northern section of the site.

The overall objective for integrated water cycle management for urban development is to minimise pollution and maintain an appropriate water balance. The design objectives presented in this LWMS seek to deliver best practice outcomes using a water sensitive urban design (WSUD) approach, including detailed management objectives for:

- Water supply, conservation and wastewater
- Stormwater quantity and quality management
- Groundwater management.

The overall approach to water supply is to utilise scheme water from the Water Corporation's Wanneroo Gravity Scheme and implement water conservation measures (e.g. water efficient fixtures and appliances (WEFA), waterwise gardening (WWG) principles, rainwater tanks (RWT)) to reduce water requirements.

Stormwater management focuses on maintaining the current drainage network within the existing WTC area, with the addition of WSUD structures to be considered as part of any redevelopment. For the northern portion of the site, WSUD structures will be utilised to treat small rainfall event runoff on site and major rainfall event runoff retained within the site. Surface water quality is also proposed to be addressed through non-structural measures (including street sweeping, minimising fertiliser use, education etc).

Similarly, groundwater management focuses on the use of structural and non-structural measures to achieve groundwater quality design criteria. Achieving minimum clearances to MGLs through the use of sand fill in some areas and/or appropriate design within lots is also considered.

The water management design criteria identified for the site, and the manner in which they are proposed to be achieved are presented in **Table E 1**. This table provides a readily auditable summary of the required outcomes which can be used in the future detailed design stage to demonstrate that the agreed objectives for water management for the development have actually been achieved.

This LWMS demonstrates that, by following the recommendations detailed in the report, the site is capable of being developed.

Local Water Management Strategy

Wanneroo Town Centre



Table E 1 Water management criteria and compliance summary

Management aspect	Criteria number	Criteria description	Manner in which compliance will be achieved	Responsibility for implementation	Timing of implementation
Water conservation	WC1	Use fit for purpose water sources throughout the development.	Lots will be provided with potable water through the Water Corporation's Wanneroo Gravity Scheme.	Proponent / Water Corporation	Detailed civil design
			Groundwater will continue to be utilised to irrigate existing and proposed public open space (POS) areas within the existing WTC.	CoW	Ongoing
			POS areas within the NDA will be irrigated by groundwater or dry landscaped will be implemented (pending groundwater allocation).	Proponent	Landscape design
			RWTs can be utilised for irrigation and to supplement internal building, non-potable uses.	Lot developer	Lot and building design
			Greywater can be utilised for sub-surface irrigation and internal non-potable uses.	Proponent	Detailed civil design and landscape design
				Lot developer	Lot and building design
	WC2	Consumption target for water of 100 kL/person/year, including not more than 40-60 kL/person/year of scheme water.	Mandated use of water efficient fixtures and fittings.	Lot developer	Building design
			Promotion of RWTs, WEFA, greywater systems and WWG principles for use within lots.	Lot developer	Lot and building design
			Education of the community through the Waterwise Council Program, Switch Your Thinking and/or specific educational materials.	Proponent	During lot sales
				CoW	Ongoing
	WC3	Maintain an average irrigation rate of 6,750 kL/ha/year.	Use of WWG principles within POS.	Proponent / CoW	Landscape design
			No establishment or ongoing irrigation will be required for conservation POS areas.	Proponent / CoW	Landscape design

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Table E 1 Water management criteria and compliance summary (continued)

Management aspect	Criteria number	Criteria description	Manner in which compliance will be achieved	Responsibility for implementation	Timing of implementation
Water conservation	WC3	Maintain an average irrigation rate of 6,750 kL/ha/year.	POS areas will be limited to an irrigation rate of 6,750 kL/ha/year.	Proponent / CoW	Landscape design
Stormwater management	SW1	All runoff up to the major rainfall event to be retained on site.	Lots will retain major event runoff on site through a number of strategies including flood storage areas (FSAs), subsurface soakage/soakwells, rainwater tanks (RWT), temporary flooding of hardstand areas etc.	Lot developer	Lot and building design
			Treatment structures and FSAs located within the NDA will retain runoff from road reserves up to the major rainfall event on site. Maintenance of the existing drainage network within the remainder of the site will ensure major event runoff is retained within the existing structures (e.g. sumps, POS within the Wanneroo Showgrounds, Wanneroo Duck Pond etc).	Proponent	Detailed civil design and landscape design
	SW2	Finished floor levels to have a minimum of 300 mm clearance above the major rainfall event in road reserves and 500 mm clearance from the major rainfall event in FSAs.	Localised and minor sand fill may be required to ensure finished floor levels of habitable buildings meet the required clearances.	Proponent	Detailed civil design and landscape design
	SW3	Ensure minor roads remain passable in the minor rainfall event.	The use of a pit and pipe network will ensure roads remain passable in the minor rainfall event.	Proponent	Detailed civil design
	SW4	Retain and treat the small rainfall event runoff as close to source as possible.	Lots will treat the small rainfall event runoff on site. A number of on-lot treatment options can be considered including landscaped areas, vegetated treatment structures, subsurface soakage/soakwells etc.	Lot developer	Lot and building design
			Treatment structures within road reserves and/or POS will be utilised to treat the small rainfall event within the site. These structures can include bio-pockets, tree-pits, swales, and bio-retention areas (BRAs).	Proponent	Detailed civil design and landscape design
	SW5	Size treatment areas in the NDA to (at least) 2% of the connected impervious area.	BRAs have been sized to be at least 2% of the connected impervious area, which is the impervious portion of the contributing road reserve.	Proponent	Detailed civil design and landscape design

Local Water Management Strategy

Wanneroo Town Centre



Table E 1 Water management criteria and compliance summary (continued)

Management aspect	Criteria number	Criteria description	Manner in which compliance will be achieved	Responsibility for implementation	Timing of implementation
Stormwater management	SW6	Surface runoff retained within stormwater management structures in the NDA will fully infiltrate within 96 hours.	Infiltration will occur within one day, based on a maximum water depth of 300 mm and 1.2 m and design infiltration rate of 5 m/day and 10 m/day for BRAs and FSAs, respectively.	Proponent	Detailed civil design and landscape design
Groundwater management	GW1	Maintain groundwater water quality at pre-development levels.	Treating runoff in WSUD structures including bio-pockets, tree-pits, swales and BRAs.	Proponent	Detailed civil design and landscape design
	GW1	Maintain groundwater water quality at pre-development levels.	Street sweeping on a regular basis.	Proponent / CoW	Ongoing
			Maintenance of WSUD features.	Proponent / CoW	Ongoing
			Minimising fertiliser use to establish and maintain vegetation within POS and landscaped areas (e.g. within verge, lot etc).	Proponent / CoW	Ongoing
			Utilising drought tolerant plant species that require minimal water and nutrients.	Proponent / CoW	Landscape implementation
			If utilised, turf species will be drought tolerant and require minimal water and nutrients.	Proponent / CoW	Landscape implementation
				Proponent	During lot sales
			Education of lot owners, residents and tenants regarding fertiliser application and the use of nutrient absorbing vegetation.	CoW	Ongoing
	GW2	New stormwater management structures to have a minimum clearance of 500 mm above the MGL.	Localised and minor sand fill may be required to ensure stormwater management structures meet the required clearances.	Proponent	Detailed civil design and landscape design

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Local Water Management Strategy

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Appendix A

Structure Plan

Appendix B

Existing Pit and Pipe Network

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Abbreviation Tables

Table A1: Abbreviations – general terms

General terms	
AHD	Australian height datum
ASS	Acid sulfate soils
BMP	Best management practice
BRA	Bioretention area
BUWM	Better Urban Water Management
CBD	Central Business District
DA	Development approvals
FSA	Flood storage area
LWMS	Local water management strategy
MGL	Maximum groundwater level
NDA	Northern development area
NWGC	North-West Growth Corridor
PDWSA	Public Drinking Water Source Area
POS	Public open space
PRI	Phosphorus retention index
REW	Resource enhancement wetland
RWT	Rainwater tanks
SP	Structure plan
UWMP	Urban water management plan
WA	Western Australia
WEFA	Water efficient fixtures and appliances
WHPZ	Wellhead protection zone
WSUD	Water sensitive urban design
WTC	Wanneroo Town Centre
WWG	Waterwise gardens

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Table A2: Abbreviations – organisations

Organisations	
ABS	Australian Bureau of Statistics
ANZECC	Australian and New Zealand Environment and Conservation Council
ARMCANZ	Agriculture and Resources Management Council of Australian and New Zealand
BoM	Bureau of Meteorology
CoW	City of Wanneroo
DBCA	Department of Biodiversity, Conservation and Attractions
DER	Department of Environmental Regulation (now DWER)
DoW	Department of Water (now DWER)
DPLH	Department of Planning, Lands and Heritage
DWER	Department of Water and Environmental Regulation
EA	Engineers Australia
EPA	Environmental Protection Authority
TCG	The Civil Group
WAPC	Western Australian Planning Commission

Table A3: Abbreviations – units of measurement

Units of measurement	
ha	Hectare
kL	Kilolitres
kL/annum	Kilolitres per annum
kL/ha/annum	Kilolitres per square meter per annum
km	Kilometre
m	Metre
m AHD	Metres in relation to the Australian height datum
m/day	Meters per day
m ²	Square metre
m ³	Cubic metre
m ³ /ha	Cubic metre per hectare
m ³ /s	Cubic metre per second
m ³ /s/ha	Cubic metre per second per hectare
mm	Millimetre

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Table A3: Abbreviations – units of measurement (continued)

Units of measurement	
mg/L	Milligrams per litre
µg/L	Micro-grams per litre
°C	Degrees centigrade
%	Percentage
mS/cm	Millisiemens per centimetre

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1 Introduction

1.1 Background

The Wanneroo Town Centre (WTC) structure plan (SP) area (herein referred to as the 'site') covers approximately 90 ha within the City of Wanneroo (CoW). The site is located approximately 23 km north of Perth Central Business District (CBD) and includes the existing WTC and areas adjacent to Wanneroo Road. The site is surrounded by existing residential development and an Inghams poultry farm to the north of the site (proposed to be relocated and the lot developed for urban land use).

The site largely consists of retail, commercial and community infrastructure as well as a large area of remnant vegetation to the north that has remained undeveloped. Several major community and commercial assets are located within the site including Wanneroo Central Shopping Centre, Wanneroo Primary School, Wanneroo Showgrounds and the CoW government office.

The location and extent of the site is shown in **Figure 1**.

1.2 Town planning context

The site is zoned 'urban' and 'urban deferred' under the Metropolitan Region Scheme (WAPC 2018) and 'centre' under the CoW's *Town Planning Scheme No. 2* (DPLH 2018).

1.3 Purpose of this report

Taylor Burrell Barnett has prepared an activity centre SP on behalf of CoW to support and guide the proposed redevelopment and land use changes within the site (see **Appendix A**). Following the approval of the SP, redevelopment will be achieved through subdivision approvals and/or development approvals (DAs), in accordance with the approved SP layout. This local water management strategy (LWMS) details the water management approach to support the SP and is intended to satisfy the requirement to prepare a LWMS in accordance with *Better Urban Water Management* (BUWM) (WAPC 2008).

1.4 Policy framework

There are a number of State Government policies of relevance to the site. These policies include:

- *State Water Strategy* (Government of WA 2003)
- *State Planning Policy 2.9: Water Resources* (WAPC 2006a)
- *Statement of Planning Policy No. 3: Urban Growth and Settlement* (WAPC 2006b)
- *State Water Plan* (Government of WA 2007)
- *Liveable Neighbourhoods (4th Edition)* (WAPC 2007, 2015)
- *Guidance Statement No. 33: Environmental Guidance for Planning and Development* (EPA 2008)
- *Local Planning Policy 4.4: Urban Water Management* (CoW 2013)
- *Local Planning Policy 4.3: Public Open Spaces* (CoW 2016)
- *Better Urban Water Management* (WAPC 2008).

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In addition to the above policies, there are a number of published guidelines and standards available that provide direction regarding the water discharge characteristics that urban developments should aim to achieve. These are key inputs that relate either directly or indirectly to the site and include:

- *Australian Rainfall and Runoff* (Engineers Australia 2016)
- *National Water Quality Management Strategy* (ANZECC and ARMCANZ 2000)
- *Stormwater Management Manual for Western Australia* (DoW 2007a)
- *Decision Process for Stormwater Management in Western Australia* (DWER 2017)
- *North West Growth Corridor (NWGC) licensing schedule and guidelines* (DoW 2013)
- *North West Growth Corridor Water Supply Strategy* (DoW 2014)
- *Development Design Specification WD5: Stormwater Drainage Design* (CoW 2015).

The guidance documents listed indicate a need for accurate baseline information prior to urban development. This will ensure that any future development is able to fulfill the stormwater management requirements of Department of Water and Environmental Regulation (DWER) and engineering standards specified by CoW, but will also ensure that realistic water management criteria that are practically achievable are adopted.

1.5 LWMS objectives

In the absence of any overarching water management studies or documentation, this LWMS has been developed based on the objectives outlined in *Better Urban Water Management* (WAPC 2008). It is intended to support the Wanneroo Town Centre SP, and is further based on the following major objectives:

- Maintain the existing hydrological regime.
- Provide a broad level stormwater management framework to support future urban development.
- Develop a water conservation strategy for the site that will ensure the efficient use of all water resources.
- Minimise construction costs for the SP, which will result in reduced land costs for future home owners.
- Incorporate appropriate best management practices (BMPs) into the drainage system that address the environmental and stormwater management issues identified.
- Ensure that sufficient land area is set aside in the SP to manage urban runoff.
- Minimise ongoing operation and maintenance costs for the land owners and CoW.
- Gain support from DWER and CoW for the proposed method to manage stormwater within the site.

Detailed design criteria for water management within the site are further discussed in **Section 4**.

2 Proposed Development

The WTC SP project vision is to revitalise the town centre and expand development into the northern section of the site. The overall vision is to develop the WTC into a vibrant, progressive and prosperous secondary centre comprising of a range of residential, commercial/retail, educational, community and recreational spaces.

The existing WTC area (see **Figure 1**) will be rezoned to incentivise the establishment of land uses appropriate to an expanding secondary centre. Redevelopment will allow the expansion of Wanneroo Central Shopping Centre, the expansion of public open space (POS) / urban space, the accommodation of mixed-use areas throughout the WTC, the retention of key civic and community assets and the provision for retail frontage.

Undeveloped land to the north (approximately 32 ha) is currently restricted due to an odour buffer requirement of a portion of this land. It will be developed into a mix of medium and high density residential areas, with POS proposed to provide both conservation and drainage functions, and tree-lined streets. Higher density dwellings will be provided in areas of high amenity, around POS and urban spaces, and adjacent to transit nodes, the majority being within 400 metres of activity and community centres. This area is herein referred to as the northern development area (NDA) and is shown in **Figure 1**).

The proposed WTC SP is included in **Appendix A**.

3 Pre-development Environment

3.1 Sources of information

The following sources of information were used to provide a broad regional environmental context for the site:

- *Acid Sulfate Soil Risk Map - Swan Coastal Plain* (DWER 2018c)
- *Contaminated Sites Database* (DER 2017)
- *Geomorphic Wetland Database – Swan Coastal Plain* (DBCA 2018)
- *Perth Metropolitan Region 1:50 000 Environmental Geology Series* (Gozzard 1986)
- *Public Drinking Water Source Area Protection Zones* (DWER 2017)
- *Perth Groundwater Map* (DWER 2018a)
- *Urban Nutrient Decision Outcomes Tool* (DWER 2018b)
- *Water Information Reporting* (DWER 2018d)
- *Weather and Climate Statistics Data* (BoM 2018).

3.2 Historical and current land uses

A review of historical images from 1965 onwards indicates that the town site was established prior to the earliest available imagery. Some grouped buildings as well as recreational areas are visible, including the relatively unchanged Wanneroo Showgrounds oval and tennis courts and the Wanneroo Primary School oval. The areas immediately adjacent to the town site had also been cleared prior to 1965. Significant clearing and urbanisation occurred between 1965 and 1974 and reached the extent of the current day residential sprawl by around 1977.

Current land uses within the existing WTC area include commercial, retail, residential, POS and civic spaces. This area is surrounded by existing residential lots. In addition to the school and showground noted above, notable land uses include:

- Wanneroo Central Shopping Centre and various retail providers along Conlan Avenue
- A commercial strip to the west of Wanneroo Road
- Bert Togno, Memorial Park and other POS
- Aquamotion, Limelight Theatre, Museum and Community Centre
- CoW and Department of Biodiversity, Conservation and Attractions (DBCA) offices
- St Anthony's School and Catholic Church
- Police station.

A large undeveloped portion of the site is located north of CoW and DBCA offices, and St Anthony's School and Catholic Church. This area is well vegetated and surrounded by existing residential lots, Boyagin Park and the Inghams poultry farm. Land use within this portion of the site is currently restricted due to an odour buffer associated with the poultry farm. The poultry farm is proposed to be moved and this lot be redevelopment for urban development, after which the odour buffer requirement will be lifted.

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3.3 Climate

The site experiences a Mediterranean climate of hot dry summers and cool wet winters. Long term climatic averages indicate that the site is located in an area of moderate to high rainfall, receiving 732.8 mm on average annually with over half of the regions rainfall received between June and August (BoM 2018). The region experiences rainfall (>1 mm) on 81 days annually (on average) (BoM 2018).

3.4 Geotechnical conditions

3.4.1 Topography

The site is characterised by irregular changes in elevation throughout the existing WTC, generally sloping to the west and south. The NDA more gradually and consistently slopes westward. Topography ranges in height from approximately 29 m Australian height datum (AHD) to 76 m AHD (DWER 2018a). The highest elevations occur in the north east of the site, with the lowest elevations at the western boundaries. Topographic contours are shown in **Figure 2**.

3.4.2 Soils and geology

The site is situated within the coastal belt of the Swan Coastal Plain, within the Spearwood Dunes geomorphological unit (Gozzard 1986). The regional pre-development geology of the site consists entirely of pale and olive yellow, medium to coarse grained, moderately sorted sand derived from Tamala Limestone (S7). This geological region typically displays medium permeability, some ability to attenuate pollutants due to small clay content and usually a considerable depth to the water table. The Phosphorous Retention Index (PRI) of the Spearwood Dune soil types are understood to be high (11) (DWER 2018b). Geological mapping is provided in **Figure 3**.

3.4.3 Infiltration testing

Four infiltration tests were conducted by Emerge Associates in September 2018 within the NDA (locations E-01, E-02, E-03 and E-04 shown in **Figure 3**). Infiltration results ranged from 40 to 89 m/day with an average of 62 m/day across the four test locations.

3.4.4 Contaminated lands and acid sulfate soils

The *Acid Sulfate Soil Risk Map* (DWER 2018c) classifies the entire site as having 'no known risk' of acid sulphate soils (ASS) occurring within 3 m of natural soil surface.

A search of the *Contaminated Sites Database* (DER 2017) found there to be no classified contaminated sites within or adjacent to the site, the nearest contaminated site is approximately 3 km to the south west.

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3.5 Surface water

The hydrological characteristics of the NDA are dominated by high infiltration capacity sand. This leads to little to no surface runoff except during extreme events. Therefore, for the purposes of stormwater management in this area, there will be no runoff leaving the site during small, minor or major rainfall events.

Stormwater runoff from road reserves within the existing WTC area is conveyed by the existing pit and pipe network (as shown in **Appendix B**) or via overland flow (e.g. Crisafulli Avenue). Stormwater runoff is directed to a number of locations, many beyond the site. These include (but are not restricted to) a sump north of Servite Terrace, POS within the Wanneroo Showgrounds adjacent to Leach Avenue, the Wanneroo Primary School oval, and the Wanneroo Dunk Pond location to the south of the site.

3.6 Public drinking water source areas

The section of the site to the west of Wanneroo Road is classified as being a Priority 3 (P3) public drinking water source area (PDWSA). P3 areas are designated to protect water sources from pollution in areas of development (DoW 2009). The remainder of the site to the east of Wanneroo Road is not within a PDWSA. There are no wellhead protection zones (WHPZ) within or downstream of the site (DWER 2017). The location and extent of the P3 PDWSA is shown in **Figure 2**.

3.7 Groundwater

The *Perth Groundwater Map* (DWER 2018a) indicates that the regional historic maximum groundwater level (MGL) across the site ranges from approximately 24m AHD to 40 m AHD, flowing from east to west, as shown in **Figure 2**.

Depth to historic MGL ranges from 0 m to approximately 36 m below ground level (BGL). Groundwater clearance is generally shallower along the western boundary, particularly towards the southernmost boundary of the site, and highest along the north-eastern boundary of the site. The areas with the lowest depth to groundwater are located within the existing Wanneroo Showground, which is not proposed to be redeveloped. The clearance to regional historic MGL within areas designated for redevelopment is lowest at the corner of Leach Road and Noonan Drive at approximately 2.6 m BGL. Clearance from regional historic MGL within redevelopment areas is generally > 5 m, with the exclusion of areas within the immediate vicinity of the Wanneroo Showground.

Groundwater elevations have been measured at a DWER monitoring bore (site reference number 61610683) located adjacent to Bert Tongo Park from 1975 to the current day (DWER 2018d). This data set indicates that the measured MGL of 38 m AHD (28 m BGL) was reached in 1975. Measured MGL at this bore is consistent with regional mapping; therefore, the regional historic maximum groundwater mapping is considered an appropriate estimate of MGL for the purposes of structure planning. The location of the monitoring bore is shown in **Figure 2**.

There is no groundwater quality data available within the site.

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3.8 Wetlands

A review of the *Geomorphic Wetlands, Swan Coastal Plain (DBCA-019)* dataset indicates that there are no geomorphic wetlands within or adjacent to the site (DBCA 2018). The nearest conservation category geomorphic wetland is Lake Joondalup approximately 440 m to the west of the site.

3.9 Summary of existing environment

In summary, the environmental investigations conducted to date indicate that:

- The site receives an average annual rainfall of 732.8 mm with the majority of the rainfall received between the months of June and August.
- Topography of the site ranges from 29 m AHD in the west to 76 m AHD in the north east.
- Regional geological mapping indicates that soils beneath the site are likely to be sand derived from Tamala Limestone (S7). Sand derived from Tamala Limestone (S7) is understood to have a high PRI (i.e. 11).
- Infiltration rates measured in the NDA range between 40 and 62 m/day.
- The site is classified as having 'no known risk' of ASS occurring within 3 m of natural soil surface.
- The NDA is dominated by high infiltration capacity sand and consequently, there will be no runoff leaving the site. Stormwater runoff from road reserves within the existing WTC area is conveyed by the existing pit and pipe network or via overland flow towards a number of locations, mostly beyond the site.
- The area to the west of Wanneroo Road is within a P3 PDWSA.
- MGL across the site ranges between 24 m AHD near the western boundary and 40.4 m AHD in the north east of the site, with MGL ranging from 0 m to 36 m BGL.
- There are no geomorphic wetlands within or immediately adjacent to the site.
- The site encompassed the historic and current Wanneroo Town Centre. A large section of remnant native vegetation is located in the northern section of the site.

4 Design Criteria and Objectives

4.1 Water conservation

Water conservation design criteria have been determined in line with the guidelines presented in *BUWM* (WAPC 2008). This LWMS proposes the following water conservation criteria:

Criteria WC1 Use fit for purpose water sources throughout the development.

Criteria WC2 Consumption target for water of 100 kL/person/year, including not more than 40-60 kL/person/year of scheme water.

Criteria WC3 Maintain an average irrigation rate of 6,750 kL/ha/year.

4.2 Stormwater management

Criteria SW1 All runoff up to the major rainfall event to be retained on site.

Criteria SW2 Finished floor levels to have a minimum of 300 mm clearance above the major rainfall event in road reserves and 500 mm clearance from the major rainfall event in flood storage areas (FSA).

Criteria SW3 Ensure minor roads remain passable in the minor rainfall event.

Criteria SW4 Retain and treat the small rainfall event runoff as close to source as possible.

Criteria SW5 Size treatment areas in the NDA to (at least) 2% of the connected impervious area.

Criteria SW6 Surface runoff retained within stormwater management structures in the NDA will fully infiltrate within 96 hours.

4.3 Groundwater management

Criteria GW1 Maintain groundwater water quality at pre-development levels.

Criteria GW2 New stormwater management structures to have a minimum clearance of 500 mm above the MGL.

5 Water Source Allocation, Infrastructure and Fit-for-Purpose Use

5.1 Fit-for-purpose water

Conservation of water through fit-for-purpose use and best management practices (BMPs) is encouraged so that waste of scheme water is mitigated and includes scheme water, groundwater, rainwater tanks (RWT) and greywater.

5.1.1 Scheme water

Scheme water will be utilised within lots for all potable water uses and some non-potable water uses, should an alternative source not be available.

The site is well served with scheme water via Water Corporation's Wanneroo Gravity Scheme given the proximity of the Wanneroo Reservoir. There are many trunk, distribution and larger reticulation mains that run through and nearby the existing WTC. In general terms, any new development can be connected to this system by extensions and upgrades to the Wanneroo Gravity Scheme served by the Wanneroo Reservoir (TCG 2018).

A 1 m diameter water distribution main runs inside a 5 m wide easement along the northern boundary of the site. This will need to be adequately protected within a pipe reserve or road reserve and any new development adequately set back from the main. There are some reticulation mains that are 100 mm in diameter or less, which may require upgrading for firefighting purposes (TCG 2018).

5.1.2 Groundwater

The *Water Register* (DWER 2018c) indicates that most of the site is located within the Perth groundwater area and that all aquifers within this area are fully allocated. With the exception of the current DBCA district office, the portion of the site north of Dundobar Road is located within the Wanneroo groundwater area. The Superficial Swan and confined Leederville aquifers beneath this area are fully allocated. The confined Yarragedee North aquifer has 'limited information', but is generally considered too deep to be a practical water source for non-potable uses (e.g. irrigation).

There are three existing groundwater licences within the site, all for the Superficial Swan aquifer. These are:

- 22,5000 kL/year, The Roman Catholic Archbishop of Perth Corporation Sole
- 1,178,070 kL/year, Department of Education
- 1,568,405 kL/year, CoW.

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5.1.3 Rainwater tanks

Harvest of runoff from roof surfaces can be undertaken, with this water stored within RWT for later use. This water is of high quality and can be used to substitute non-potable water requirements. Harvested rainwater may be used for irrigation requirements however this will need to be supplemented with scheme water towards the end of the summer period. During the higher rainfall months, the majority of the stored rainwater can be used to supplement internal building, non-potable uses.

5.1.4 Greywater

Greywater can be described as all the wastewater from the dwelling besides that from toilets and kitchens. This water has moderate concentrations of solids and nutrients. Greywater can be used for sub-surface irrigation and, if treated appropriately, for internal non-potable uses. Residential greywater systems must be approved by the CoW and potentially the Department of Health.

5.2 Water conservation approach

5.2.1 Water efficient fixtures, fittings and appliances

Significant reduction in internal uses can be achieved with the use of water efficient fixtures and appliances (WEFA). Water efficient fixtures and fittings will be mandated through the building licence. Based on typical uptake rates informed by Australian Bureau of Statistics (ABS) reports (ABS 2013), 40% of residential dwellings will utilise water efficient appliances.

5.2.2 Waterwise gardens

Employing WWG measures can significantly reduce total water usage within residential lots. Water use can also be reduced within landscaped areas of mixed use, civic and commercial lots and within verges and POS areas. WWG principles will be utilised in all POS areas and assumed to be used within 50% of private residential lots (as informed by ABS studies (ABS 2013)).

A variety of methods and approaches will be considered including any or all of the following:

- Improve soil with conditioner certified to Australian Standard AS4454 to a minimum depth of 50 mm where turf is to be planted and a minimum depth of 75 mm for garden beds.
- Minimise the amount of turf areas where possible and adopt xeriscaped gardens (garden beds are landscaped using 'waterwise plants').
- Mulch garden beds to 75 mm with a product certified to Australian Standard AS4454.
- Design and install the irrigation system according to best water efficient practices:
 - Control systems must be able to irrigate different zones with different irrigation rates.
 - Emitters must disperse coarse droplets or be subterranean.
 - Irrigation will not be utilised during winter months and rain sensors may be utilised.
- Implementation of hydrozoning design practices, which will group plant species with similar irrigation requirements.
- Retain remnant native trees and vegetation within POS where possible. This will provide shade and reduce water requirements during POS establishment.

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- Garden beds within POS will utilise 'waterwise' plants, which are (where possible) locally native species or plants from regions with similar climates. These plants require less water input than exotic species.
- Minimise water requirements for POS maintenance. This will be achieved by implementing an appropriate management and maintenance program for POS.

5.2.3 Education

CoW has committed to participate in the Water Corporation's 'Waterwise Council Program' and is a 'Switch Your Thinking' partner. Consequently, the community (including businesses, community groups and individuals) already have access to special events, information and rewards regarding water conservation and sustainable living.

Further to the above, future subdivision developers can provide educational material to lot purchasers on water efficiency and quality protection measures that they can implement within lots. This is anticipated to occur within the NDA. Specific water conservation and protection topics that should be addressed include:

- Reducing water use behaviours
- Water efficient technologies
- Plant species
- Fertiliser and pesticide use
- WWG practices.

5.3 Water use

5.3.1 Lot scale water use analysis

A water use analysis for the NDA has been undertaken to demonstrate the effectiveness of the water conservation strategy for residential lots. The NDA is proposed to include Medium-Density Residential, Higher-Density Residential and Mixed-Uses; no Low-Density Residential is proposed.

During the SP process, forecasting regarding the ultimate densities across the SP were completed, which included the anticipated range (i.e. lower and upper density estimates). The analysis is based on two potential density scenarios (being the lower and upper estimates). It considers realistic uptakes of non-mandatory water conservation measures including WEFA, RWTs and WWG as informed by the latest ABS findings (ABS 2013, 2014). The water use analysis assumes an average of 2.6 people per lot for single dwellings, a value provided by the ABS for new housing developments in Perth (ABS 2017). The assumptions presented in **Table 1** are considered to cover the likely range of development configurations.

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Table 1: Lot scale water use analysis assumptions

Scenario	Lot sizes (m ²)	Number of single dwellings
Scenario 1 (lower density estimate)	120	191
	220	367
	300	206
Scenario 2 (upper density estimate)	75 (group housing)	546
	150	538
	180	344

It is estimated that water use within residential lots within the NDA would use up to 70 kL/person/year without the uptake of any conservation measures, and as low as 34 kL/person/year through the uptake of measures. Water use estimates achieve the state water consumption target of no more than 100 kL/person/year and the *BUWM* (WAPC 2008) aspirational goal of 40-60 kL/person/year, and satisfies **Criteria WC2**.

5.3.2 Water use within existing WTC area

POS within the existing WTC area will continue to be serviced by the groundwater allocations outlined in **Section 5.1.2**. Additional POS / urban spaces to be provided in the WTC as part of the SP will need to be irrigated by the CoW within their existing license allocations.

For example, the existing carpark (approximately 2,000 m²) near Aquamotion is proposed to be upgraded into a 'shared-space' street design that includes some POS / urban space. Similarly, a portion of the carpark near Memorial Park (approximately 3,000 m²) is proposed to be reconfigured. These areas would require approximately 3,400 kL/year for ongoing irrigation, though it is anticipated that the area required to be irrigated will be lower given the urban form of these POS areas. It is anticipated that redevelopment of these areas would be completed by the CoW and therefore, the design will appropriately reflect the CoW's existing license allocations and conservation efforts in other areas to make allocation available for these changes where required.

5.3.3 Water use within NDA

POS within the NDA will need to either be irrigated by an appropriate fit-for-purpose water source (described further below) or be designed such that post-establishment irrigation is not required (e.g. as conservation POS or 'dry parks').

As discussed in **Section 5.1.2**, aquifers suitable for irrigation purposes are fully allocated within this area. If ongoing irrigation is proposed, the volume may be met by one of the following options:

- Agreement with the CoW to utilise some of their existing groundwater allocation. This may require modification (e.g. conversion of turfed areas into planted garden beds) of existing POS areas within the CoW.
- Trade with an existing license holder with a license in the Superficial Swan aquifer within the Wanneroo groundwater area and Joondalup sub-area.

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The proposed SP suggests the NDA will be composed of medium to high density residential and mixed uses lots. These may be up to six storeys high and therefore, the use of precinct scale rainwater tanks and/or other alternative water supply options may be feasible. However, this solution is highly dependent on the subdivision developer and whether one party progresses a significantly large area (which includes both lots and the POS area proposed to be irrigated) and ultimate design of the subdivision area.

Once conceptual landscape designs have progressed and an estimate of the ongoing irrigation volume determined, negotiations can begin with the CoW and/or a potential trade partner, or a precinct scale non-potable water source be investigated.

Should no groundwater allocation be secured, POS within the NDA can be designed as 'dry parks'. These designs utilise any existing vegetation that can be retained, mulched garden beds and hardscape. Tubestock plant species that do not require ongoing irrigation should be specified within the design and can be planted during winter to minimise the requirement for establishment irrigation.

5.4 Wastewater

The site is currently served by gravity sewer, which flows to the Ariti Avenue Wastewater Pumping Station. From here, wastewater is pumped to the Beenyup Wastewater Treatment Plant. Future Water Corporation planning shows that the area north of Dundobar Road is in the Neerabup sewer district however there is missing sewer infrastructure that is preventing this from occurring. It is understood that development of the site will trigger the requirement for these connections to be constructed. The timing and need will be confirmed by the Water Corporation as development progresses (TCG 2018).

5.5 Water conservation design criteria compliance

A summary of the proposed water conservation design criteria and how these are addressed within the site is provided in **Table 2**.

Table 2: Water conservation compliance summary

Criteria number	Criteria description	Manner in which compliance will be achieved
WC1	Use fit for purpose water sources throughout the development.	Lots will be provided with potable water through the Water Corporation's Wanneroo Gravity Scheme.
		Groundwater will continue to be utilised to irrigate existing and proposed POS within the existing WTC. Within the NDA, POS will be irrigated by groundwater, if an agreement with the CoW or a trade can be secured. Dry parks will be utilised where necessary.
		RWTs can be utilised for irrigation on lots and to supplement internal building, non-potable uses.
		Greywater can be utilised for sub-surface irrigation and internal non-potable uses within lots.

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Table 2: Water conservation compliance summary (continued)

Criteria number	Criteria description	Manner in which compliance will be achieved
WC2	Consumption target for water of 100 kL/person/year, including not more than 40-60 kL/person/year of scheme water.	Mandated use of water efficient fixtures and fittings.
		Promotion of RWTs, WEFA, greywater systems and WWG principles for use within lots.
		Education of the community through the Waterwise Council Program, Switch Your Thinking and/or specific educational materials.
WC3	Maintain an average irrigation rate of 6,750 kL/ha/year.	Use of WWG principles within POS.
		No establishment or ongoing irrigation will be required for conservation POS areas.
		POS area will be limited to an irrigation rate of 6,750 kL/ha/year.

6 Stormwater Management Strategy

The principle behind the stormwater management strategy for the site is to maintain the existing hydrology. In the NDA this is achieved by treating small rainfall event runoff as close to source as possible and to retain runoff from all events up to the major rainfall event on site. Within the existing WTC area this is achieved by maintaining the existing drainage network and, where possible, introducing water sensitive urban design (WSUD) features for the treatment of small event runoff.

The stormwater management strategy consists of three main components:

- Lot drainage
- Existing WTC area drainage
- NDA drainage.

The stormwater management strategy for the WTC SP has been developed in accordance with the guidance documents detailed in **Section 1.4**, in consideration of the existing environment (see **Section 3**) and proposed land uses (see **Section 2**). Each WSUD structure has been designed to achieve the objectives and criteria stated in **Section 4.2**.

6.1 Lot drainage

6.1.1 Treatment of small rainfall event runoff

All lots are required to retain and treat stormwater runoff up to the small rainfall event (first 15 mm) at source, thereby mimicking pre-development hydrology. A number of strategies are available to assist in achieving this criteria. Strategies may include but are not limited to:

- Surface areas designed to infiltrate runoff during the small event such as:
 - Pervious vegetated garden areas
 - Vegetated swales
 - Vegetated bio-retention areas (BRAs)
- Subsurface soakage/soakwells where there is sufficient clearance to MGL. The invert of soakage structures must be at or above MGL.

The invert of treatment structures should be set such that a minimum clearance of 500 mm from MGL is achieved.

Some lots may choose to implement a rainwater harvesting and storage system. In this case, runoff from roof areas may be directed to RWTs for internal and external uses or to be used as on-lot stormwater runoff storage (as discussed in **Section 5.1.3**). Excess runoff from RWTs is to be directed to additional on-lot retention systems. Where RWTs are used as part of the stormwater management system for lots, a low flow outlet must be provided to ensure adequate storage capacity is available following rainfall events.

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The implementation of on-lot treatment is the responsibility of the lot owner and should be designed in consideration of individual lot characteristics. The design of lot drainage will be submitted to the CoW at the DA stage. Treating small event runoff at source will assist in achieving Criteria **GW1**, **SW1**, and **SW4**.

6.1.2 Retention of minor and major event runoff

All lots (regardless of land use) are required to retain stormwater runoff from rainfall events up to and including the major event on lot. A number of strategies are available to assist in achieving this criteria. Strategies may include but are not limited to:

- On-lot infiltration structures including flood storage areas (FSAs), swales, basins and subsurface soakage/soakwells
- RWTs
- Temporary flooding of car parks or hardstand areas.

A maximum flooding depth of 300 mm and average flood depth of 50 mm is recommended within car park areas for stormwater retention purposes. The invert of stormwater features should be set such that a minimum clearance of 500 mm from MGL is achieved.

The implementation of on-lot retention is the responsibility of the lot owner and should be designed in consideration of individual lot characteristics. The design of lot drainage will be submitted to the CoW at the DA stage. Retaining the major event runoff at source will assist in achieving Criteria **GW1** and **SW1**.

6.2 Existing WTC area drainage

The existing WTC drainage system incorporates a pit and pipe network and overland flow paths which discharge into various sumps and POS areas, as discussed in **Section 3.5**.

Road reserves and POS proposed within the SP (see **Appendix A**) are generally equivalent to the existing WTC area. Minor differences include the realignment and/or construction of some minor roads, laneways and easements and the conversion of what is currently parking lots to POS and urban spaces. Land use changes due to the implementation of the SP are not anticipated to increase the extent of impervious areas and therefore drainage requirements for the WTC area remain unchanged. Hence, the drainage strategy for the WTC area is to maintain the current drainage network.

Redevelopment of any road reserves within the WTC area presents an opportunity to retrofit WSUD measures such as those outlined in **Section 6.3** below. Given the space restrictions expected when upgrading any existing road reserves, the most appropriate WSUD measures include bio-pockets, swales and tree pits. Retrofitting WSUD will provide at source treatment of road reserve runoff, thereby reducing the nutrient load within existing downstream FSAs such as the Wanneroo Duck Pond which will help to achieve criteria **SW4**.

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6.3 NDA drainage

Future development of road reserves and POS within the NDA will be required to treat runoff from the small event and retain runoff (up to the major event) on site within stormwater management and WSUD features, as outlined below.

6.3.1 Bio-pockets

Surface runoff within the road reserves can be conveyed to roadside bio-pockets via slotted or flush kerbing (see example in **Plate 1**). Bio-pockets can contribute to the treatment of the first 15 mm of runoff generated within road reserves. Once the bio-pockets are at capacity, stormwater can enter the piped drainage network via side entry pits or overflow onto the road surfaces.

Bio-pockets will be designed to inundate to a maximum depth of 300 mm and will be vegetated with plant species suitable for the removal of nutrients from surface runoff, consistent with the *Vegetation guidelines for stormwater biofilters in the south-west of Western Australia* (Monash University 2014).

Bio-pockets are not required to be underlain with an engineered or amended soil for nutrient treatment purposes as naturally occurring soils are expected to exhibit a high PRI (11), as discussed in **Section 3.4.2**.



Plate 1: Example of bio-pocket

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6.3.2 Tree-pits

Tree-pits can be located within road reserves to provide detention and capture of small events (see **Plate 2** for an example design). Tree-pits provide a minor storage volume individually, however collectively they can assist in achieving infiltration and treatment higher in the catchment. Tree-pits can receive runoff via direct sheet flow over flush kerbing and/or via online connection to the stormwater treatment train. Tree-pits are not required to be underlain with an engineered or amended soil for nutrient treatment purposes as naturally occurring soils are expected to exhibit a high PRI (11), as discussed in **Section 3.4.2**.



Plate 2: Example of tree pit

6.3.3 Swales

Vegetated swales can be located within widened medians (see **Plate 3** for an example design) along selected roads or adjacent to road surfaces within verges. The design of swales should meet CoW requirements (CoW 2015). Swales are not required to be underlain with an engineered or amended soil for nutrient treatment purposes as naturally occurring soils are expected to exhibit a high PRI (11), as discussed in **Section 3.4.2**. Appropriately placed swales will treat runoff as close to source as possible.

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Plate 3: Example of median swale

6.3.4 Bio-retention areas

Runoff generated from the road surfaces during the small event, not retained higher in catchment within treatment structures (described above), will be required to be retained within vegetated BRAs in downstream POS. These will have a maximum depth of 300 mm and 1:6 side slopes. BRAs will be vegetated with species that are efficient in nutrient removal and, as discussed in **Section 6.3.1**, are not required to be underlain with amended or engineered soils.

To support structure planning it is appropriate for the LWMS to determine the BRA areas required to treat stormwater runoff from the small rainfall event, conservatively assuming bio-pockets, tree-pits and swales are not provided. Implementation of specific treatment structures (as described from **Section 6.3.1** to **6.3.4**) will be determined at subdivision and documented within future urban water management plans (UWMPs).

Three catchments have been identified within the NDA in response to the SP (see **Appendix A**) and existing topographic contours (as shown in **Figure 2**). Surface runoff modelling using XPSWMM hydrological and hydraulic software (as described in **Appendix C**) was completed to determine the spatial area required for treatment of the small rainfall event from the contributing road reserves. These results are shown in **Figure 4**. Inundation within the small rainfall event is shown in **Figure 5**.

Runoff beyond the capacity of BRAs will overflow into the relevant downstream FSA (detailed in **Section 6.3.5** below).

6.3.5 Flood storage areas

Runoff beyond the capacity of treatment structures will be conveyed by the pipe drainage network and overland flow to FSAs located in downstream POS (shown in **Figure 4**). FSAs have been designed with minimum 1:6 side slopes and a maximum inundation depth of 1.2 m. FSAs will be turfed or vegetated depending on the overarching landscape concept design and whether BRAs (which are required to be vegetated) are proposed to be collocated within FSAs.

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Surface runoff modelling (as described in **Appendix C**) was completed to determine the spatial area required for retention of the major rainfall event from the contributing road reserves. These results are shown in **Figure 4**. Inundation within the minor and major rainfall events are shown in **Figure 6** and **Figure 7**, respectively.

6.4 Non-structural water quality measures

The structural measures proposed within the site provide both a storage and treatment function to stormwater runoff, as detailed in **Sections 6.1, 6.2 and 6.3**. Guidance for the development and implementation of non-structural water quality improvement measures is provided within the *Stormwater Management Manual for Western Australia* (DoW 2007b).

A number of non-structural measures will be implemented within the site to help reduce nutrient loads within stormwater runoff. These measures include:

- Street sweeping on a regular basis.
- Maintenance of WSUD features.
- Minimising fertiliser use to establish and maintain vegetation within POS and landscaped areas (e.g. within verge, lots etc).
- Utilising drought tolerant plant species that require minimal water and nutrients.
- If utilised, turf species will be drought tolerant and require minimal water and nutrients.
- Education of lot owners, residents and tenants regarding fertiliser application and the use of nutrient absorbing vegetation.

6.5 Stormwater design criteria compliance

The proposed stormwater design criteria and how these are addressed are summarised in **Table 3**.

Table 3: Stormwater management compliance summary

Criteria number	Criteria description	Manner in which compliance will be achieved
SW1	All runoff up to the major rainfall event to be retained on site.	Lots will retain major event runoff on site. A number of on-lot options can be considered.
		Treatment structures and FSAs will retain runoff from road reserves up to the major rainfall event on site.
SW2	Finished floor levels to have a minimum of 300 mm clearance above the major rainfall event in road reserves and 500 mm clearance from the major rainfall event in FSAs.	Localised and minor sand fill may be required to ensure finished floor levels of habitable buildings meet the required clearances.
SW3	Ensure minor roads remain passable in the minor rainfall event.	The use of a pit and pipe network will ensure roads remain passable in the minor storm event.
SW4	Retain and treat the small rainfall event runoff as close to source as possible.	Lots will treat the small rainfall event runoff on site. A number of on-lot treatment options can be considered.
		Treatment structures within road reserves and/or POS will be utilised to treat the small rainfall event within the site. These include bio-pockets, tree-pits, swales and BRAs.

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Table 3: Stormwater management compliance summary (continued)

Criteria number	Criteria description	Manner in which compliance will be achieved
SW5	Size treatment areas in the NDA to (at least) 2% of the connected impervious area.	BRAs within the NDA have been sized to be at least 2% of the connected impervious area, which is the impervious portion of the contributing road reserve.
SW6	Surface runoff retained within stormwater management structures in the NDA will fully infiltrate within 96 hours.	Infiltration within stormwater management structures in the NDA will occur within one day. This is based on a maximum water depth of 300 mm and 1.2 m and design infiltration rate of 5 m/day and 10 m/day for BRAs and FSAs, respectively.

7 Groundwater Management Strategy

The principle behind groundwater management is to maintain the existing hydrology across the site, provide appropriate protection from groundwater inundation, and maintain or improve the existing groundwater quality.

7.1 Groundwater quality management

The main objective for the management of the groundwater quality is to maintain or improve the existing groundwater quality. This can be achieved by treating surface runoff prior to infiltration via application of appropriate WSUD measures, thereby reducing the total nutrient load into the groundwater that originates from the development.

The reduction of nutrient load to the groundwater will be achieved by:

- Treating runoff in WSUD structures (discussed in **Section 6**).
- Street sweeping on a regular basis.
- Maintenance of WSUD features.
- Minimising fertiliser use to establish and maintain vegetation within POS and landscaped areas (e.g. within verge, lot etc).
- Utilising drought tolerant plant species that require minimal water and nutrients.
- If utilised, turf species should be drought tolerant and require minimal water and nutrients.
- Education of lot owners, residents and tenants regarding fertiliser application and the use of nutrient absorbing vegetation.

The above measures will improve the quality of the water prior to it infiltrating into the underlying groundwater, and will assist in achieving **Criteria GW1**.

7.2 Groundwater level management

Criteria GW2 stipulates that stormwater management structures are required to achieve a minimum clearance of 500 mm between their inverts and the MGL. For the majority of the site, depth to MGL is greater than 5 m and is therefore not considered a constraint. As noted in **Section 3.7**, depth to MGL is shown to be less than 5 m from the surface level (to within 2.6 m BGL) within a small portion of the site adjacent to the Wanneroo Showgrounds. The MGL must be considered during stormwater management design within this area to ensure compliance to **Criteria GW2**. All stormwater management features will be designed to achieve a minimum clearance of 500 mm from MGL as stipulated by **Criteria GW2**.

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7.3 Groundwater criteria compliance summary

A summary of the proposed groundwater design criteria and how these are addressed is given in **Table 4**.

Table 4: Groundwater management compliance summary

Criteria number	Criteria description	Manner in which compliance will be achieved
GW1	Maintain groundwater water quality at pre-development levels.	Treating runoff in WSUD structures.
		Street sweeping on a regular basis.
		Maintenance of WSUD features.
		Minimising fertiliser use to establish and maintain vegetation within POS and landscaped areas (e.g. within verge, lot etc).
		Utilising drought tolerant plant species that require minimal water and nutrients.
		If utilised, turf species should be drought tolerant and require minimal water and nutrients.
		Education of lot owners, residents and tenants regarding fertiliser application and the use of nutrient absorbing vegetation.
GW2	New stormwater management structures to have a minimum clearance of 500 mm above the MGL.	Localised and minor sand fill may be required to ensure stormwater management structures meet the required clearances.

8 Subdivision and Development Application

The requirement to undertake preparation of more detailed water management plans to support subdivision is generally imposed as a condition of subdivision. The development of any future UWMP should follow the guidance provided in *UWMPs: Guidelines for Preparing Plans and for Complying with Subdivision Conditions* (DoW 2008).

Development of areas progressed under DA may not be required to prepare additional water management plans (i.e. UWMP) to support the application. In this case, detailed designs presented in DAs should be reviewed by the CoW in conjunction with the design criteria presented in this LWMS to ensure the appropriate elements of the water management strategy discussed herein are implemented.

While strategies have been provided within this LWMS that address planning for water management within the site, future development stages will need to clarify details not provided within this LWMS. The main areas that will require further clarification include:

- Confirmation of irrigation sources and conceptual landscape design
- Modelling, design and configuration of drainage structures
- Lot drainage
- Implementation of water conservation strategies
- Non-structural water quality improvement measures
- Management and maintenance requirements
- Construction period management strategy
- Monitoring and evaluation program.

These are further detailed in the following sections. Ongoing monitoring of groundwater will be detailed in the UWMP or DA applications (where no subdivision is proposed to occur), however in this LWMS is also outlined broadly in **Section 9**.

8.1 Confirmation of irrigation sources and conceptual landscape design

POS areas within the NDA will need to either be irrigated by an appropriate fit-for-purpose water source or be designed such that post-establishment irrigation is not required (e.g. as conservation POS or 'dry parks'). Once conceptual landscape designs have progressed and an estimate of the ongoing irrigation volume determined, negotiations can begin with the CoW and/or a potential trade partner, or a precinct scale non-potable water source be investigated.

POS within the existing WTC area will continue to be serviced by the current groundwater allocations. Additional POS / urban spaces will need to be irrigated by the CoW within their existing licence.

All irrigation sources should be confirmed and detailed within future UWMPs.

8.2 Modelling, design and configuration of drainage structures

The design of the drainage system within the NDA to date has been undertaken at an appropriate level for structure planning and surface runoff modelling of the stormwater drainage system may need to be reviewed once detailed drainage design has commenced for the area.

The exact location, type and size of WSUD structures will still need to be specified and presented within future UWMPs/DAs. In order to review the final stormwater management configuration, the model developed to support this LWMS may need to be refined in light of stakeholder feedback or to accommodate other design considerations. It is expected that the civil drainage designs will be progressed to a level that provides detailed cross-sections, sizes of storage areas, pipe sizes, inverts, etc. The ultimate aim of revising the model will be to confirm that the post-development drainage system is able to meet the performance criteria proposed in **Section 4** of this LWMS.

The exception to the requirement to revise the surface runoff modelling is if the catchment details and WSUD structure designs are consistent with the assumptions made in this LWMS. If this were the case it would be acceptable to provide design calculations for the drainage network and WSUD structures to demonstrate compliance with the LWMS.

8.3 Lot drainage

The stormwater management strategy requires that all lots will treat the small rainfall event and retain runoff from the minor and major rainfall events within the lot. It is the lot owner's responsibility to ensure that the appropriate storage is provided within lot. Lot designs, including stormwater drainage, are to be approved by CoW at building approval or DA stage prior to construction.

8.4 Implementation of water conservation strategies

A number of potential measures to conserve water have been presented within this LWMS. These water conservation strategies will be incorporated into the design and the ongoing maintenance of all POS, landscaped areas and within the built form throughout the site. Design measures that will be incorporated into the water conservation strategy will be further detailed within future UWMPs or DAs for individual lot development.

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8.5 Non-structural water quality improvement measures

Guidance for the development and implementation of non-structural water quality improvement measures is provided within the *Stormwater Management Manual for Western Australia* (DoW 2007a).

Some measures will be more appropriately implemented at a local government level, such as street sweeping. Many can be implemented relatively easily within the design and maintenance of the drainage network, including swales and detention areas. Others are more appropriately managed by individual lot owners (e.g. fertiliser application on landscaped areas). It is expected that the future UWMPs/DAs will provide a list of appropriate non-structural measures including timing and responsible parties.

8.6 Management and maintenance requirements

The management measures to be implemented to address surface water quality (e.g. the use of vegetation within treatment structures) will require ongoing maintenance. Therefore, it is expected that future UWMPs will set out the design (e.g. landscape surface treatments) maintenance actions (e.g. nutrient application), timing (e.g. how often it will occur), locations (e.g. exactly where it will occur) and responsibilities (e.g. who will be responsible for carrying out the actions). Alternatively, these actions could be specified within a dedicated management plan, whichever is most appropriate. Given that approval from the CoW will be sought for the proposed measures, it is anticipated that consultation with CoW will be undertaken and reference to guiding policies and documents will be made.

8.7 Construction period management strategy

It is anticipated that the construction stage will require some management of various aspects (e.g. dust, surface runoff, noise, traffic etc.). The management measures undertaken for construction management will be addressed in future UWMPs, DAs or a separate construction management plan. Given the existing WTC area, it is possible that road design and implementation will need to be undertaken by the CoW. In this case the appropriate construction measures and their implementation will be the responsibility of the CoW.

8.8 Monitoring and evaluation program

It will be necessary to confirm that the management measures that are implemented are able to fulfill their intended management purpose, and are in a satisfactory condition at a point of management handover to the CoW. A post-development monitoring program will be developed to provide this confirmation, and it will include details of objectives of monitoring, relevant issues and information, proposed methodology, monitoring frequency and reporting obligations. These monitoring programs are discussed in **Section 9** of this LWMS and will be further detailed at the UWMP or DA stage.

9 Monitoring and Maintenance

Given that there will be no surface water discharge from the site during a small rainfall event it will be very difficult to collect a water quality sample for treated surface runoff. Further, groundwater quality is unlikely to be representative of the management practices of the site above due to the depth to groundwater across the site.

Therefore, post-development monitoring will instead focus on the condition of newly constructed WSUD structures within the NDA. As the drainage strategy within the existing WTC area is not proposed to be modified (with the exception of considering installation of WSUD structures during the upgrade of road reserves), it is unlikely that a monitoring program will be required within the existing WTC. This should be confirmed with the CoW during design and construction of any WSUD structures within the existing WTC.

9.1 Condition monitoring

It is proposed that the overall condition of WSUD structures in the NDA be monitored on a bi-annual basis. It should begin following completion of the civil and landscaping works, and will continue for a period of two years to ensure that the functionality is maintained.

A visual assessment will be undertaken to monitor the condition, with the aim to ascertain that the maintenance activities (as detailed in **Section 8.6**) are achieving the objectives of the management plan. The parameters that will be monitored and remedial actions that will be implemented if required are detailed in **Table 5**.

Table 5: Condition monitoring parameters and remedial actions

Parameter	Trigger for remedial action	Remedial action
Gross pollutants	If present	Remove gross pollutants and dispose of at approved facility
Sediments	If present	Remove sediments
Terrestrial weeds	Excessive weed growth	Manually remove weeds
		Apply herbicide at manufacturer's recommended rate
Irrigation	Evidence of damage to irrigation system (if any)	Repair irrigation system (if any)
Vegetation density	If significant number of plant deaths/thefts occur	Remove dead plants
		Conduct infill planting to maintain species densities
Paths, benches, walkways, play equipment and other infrastructure	Damage to, theft or vandalism of infrastructure adjacent to WSUD structures	Repair or replace damaged infrastructure

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9.2 Infiltration capacity

In order to provide confirmation that the design infiltration rates that have been used to size the BRAs and FSAs within the NDA are appropriate, and to ensure runoff continues to infiltrate within the necessary timeframe following rainfall events, the infiltration rates within basins will be measured following implementation of the landscaping within the basins.

Saturated infiltration rates within the BRAs and FSAs will be measured, inclusive of the turf and any clogging layer which is apparent. These measurements will be undertaken three times during the two year post-development maintenance period; once following initial landscaping, once after a 12 month period and once prior to management handover to CoW.

The infiltration monitoring parameters, triggers and remedial actions are summarised in **Table 6**.

Table 6: Infiltration capacity monitoring parameters and remedial actions

Parameter	Trigger for remedial action	Remedial action
Saturated soil infiltration rate - initial	If infiltration rate is > design rate	Seek reconsideration of design infiltration rates for future POS areas from CoW
	If infiltration rate is = design rate	Inform CoW of measured infiltration rate, review following future monitoring to determine effects of clogging.
	If infiltration rate is < design rate	Remove any accumulated sediment layer, aerate/core plug entire invert of basin and re-measure. Inform CoW if rate is not achieved.
Saturated soil infiltration rate – at 12 months	If infiltration rate is ≥ design rate	No further action required.
	If infiltration rate is < design rate	Remove any accumulated sediment layer, aerate/core plug entire invert of basin and re-measure. Inform CoW if rate is not achieved.
Saturated soil infiltration rate – prior to handover to CoW	If infiltration rate is ≥ design rate	No remedial action required. Seek reconsideration of design infiltration rates for future POS areas from CoW if appropriate.
	If infiltration rate is < design rate	Aerate/core plug/scalp surface of entire invert of basin and re-test. Inform CoW if rate not achieved. Utilise updated infiltration rate and clogging rate to inform future design of infiltration basins if necessary.

The key output from the infiltration monitoring will be measured infiltration rates. This will guide any remedial actions required and will allow calculation of inundation times following a storm event. This data will be included in a final monitoring report to CoW and will also be available on request.

10 Implementation

The LWMS is a key supportive document for the SP of the site. The development of the LWMS has been undertaken with the intention of providing a structure within which subsequent development can occur consistent with an integrated water cycle management approach. It is also intended to provide overall guidance to the general stormwater management principles for the area and to guide the development of future UWMPs/DAs and individual lot development.

10.1 Roles and responsibility

The LWMS provides a framework that the CoW can utilise to assist in establishing stormwater management methods that have been based upon site-specific investigations and which are consistent with relevant State and Local Government policies.

The responsibility for working within the framework established within the LWMS rests with the CoW (where they are the proponent, and will need to upgrade any of the roads and construct associated drainage infrastructure), future subdivision developers, and lot owners/lot developers. The roles are summarised in **Table 7** below. Responsibilities related to non-structural measures will be detailed in future UWMPs / DAs, as indicated in **Section 8.5**.

Table 7: Roles and responsibility

Role	Responsibility
Implement and maintain lot drainage strategy	Lot owner/lot developer
Provision of lot drainage connection points	Subdivision developer (where subdivision occurs in a coordinated manner) or CoW (e.g. where the CoW choose to redevelop car parks within the existing WTC area)
Construct and maintain WSUD structures	

In order to support any future subdivisions, it is anticipated that UWMPs will be developed in consultation with the CoW and in consideration of other relevant policies and documents. Where DA applications are prepared these should be undertaken consistent with this LWMS and in close consultation with CoW.

10.2 Funding

Funding for lot drainage infrastructure will be the responsibility of the lot owner.

It is anticipated that the NDA will progress through subdivision and then DA by a developer. In this area the developer will need to fund construction, maintenance and monitoring of drainage infrastructure located within road reserves and/or POS.

The existing WTC area is more likely to progress through DAs for individual lots, with road upgrades and the redevelopment of some areas into additional POS likely to be progressed by the CoW. Funding for works within individual lots will be the responsibility of the lot owner/developer. The construction and maintenance of any drainage infrastructure within public road reserves and/or POS within the existing WTC will be the responsibility of the CoW.

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10.3 Review

It is not anticipated that this LWMS will be reviewed, unless additional land parcels/lots are added to the SP area prior to subdivision, or the SP undergoes significant change post-lodgment of the LWMS. If additional areas are required to be covered by the LWMS it is most likely that an addendum to cover these areas could be prepared. If the SP is substantially modified surface runoff modelling undertaken for this LWMS will need to be reviewed and the criteria proposed revised to ensure that all are still appropriate.

10.4 Conclusions and recommendations

The recommended approach to water management for the WTC SP site includes:

- Connecting to the integrated water supply system and reticulated sewer network.
- Promotion of water conservation measures and alternative water supply options for use within lots and education of the community.
- Treatment of the small rainfall event and retention of the major rainfall event within lots.
- Use of WWG principles within POS areas.
- Use of WSUD structures to treat small rainfall event from road reserves and FSAs integrated in POS to retain major rainfall event runoff from road reserves within the NDA.
- Maintain the existing drainage network within the existing WTC portion of the site.
- Implementation of non-structural measures to ensure surface water and groundwater quality objectives are achieved.

This LWMS demonstrates that, by following the recommendations detailed above, the WTC and NDA are able to be revitalised and developed for residential, commercial/retail, educational, community and recreational uses.

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Local Water Management Strategy

Wanneroo Town Centre



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Figure 6: Inundation Mapping - Minor Rainfall Event.

Figure 7: Inundation Mapping - Major Rainfall Event.

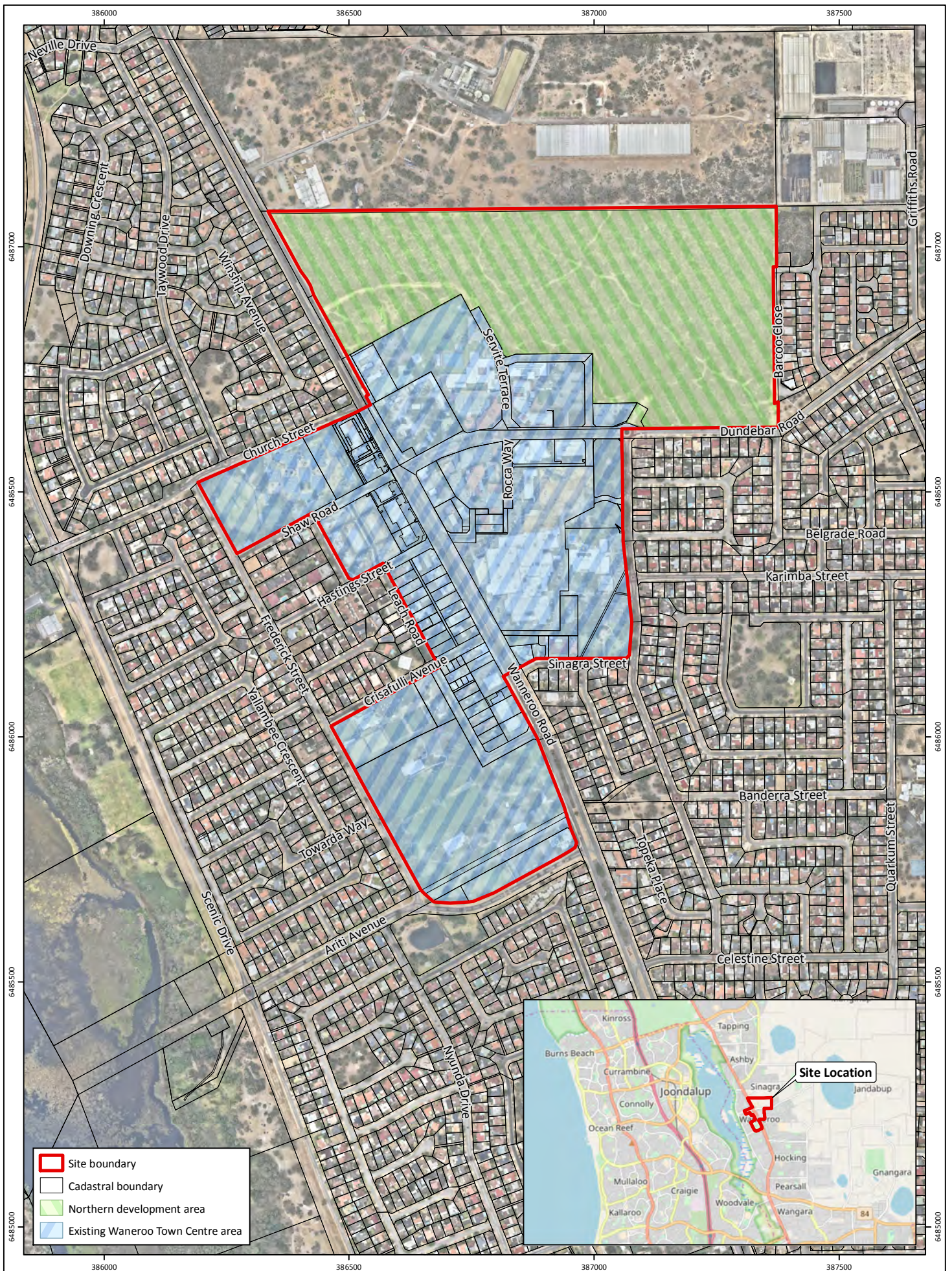


Figure 1: Location Plan

Project: Local Water Management Strategy
Wanneroo Town Centre

Client: City of Wanneroo

Plan Number: EP17-133(02)--F07
Drawn: KNM
Date: 17/09/2018
Checked: ASC
Approved: RLE
Date: 11/10/2018



Scale: 1:10,000@A4
GDA 1994 MGA Zone 50





Figure 2: Topography and Groundwater Levels

Project: Local Water Management Strategy
Wanneroo Town Centre

Client: City of Wanneroo

Plan Number: EP17-133(02)--F08
Drawn: KNM
Date: 17/09/2018
Checked: ASC
Approved: RLE
Date: 11/10/2018



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GDA 1994 MGA Zone 50

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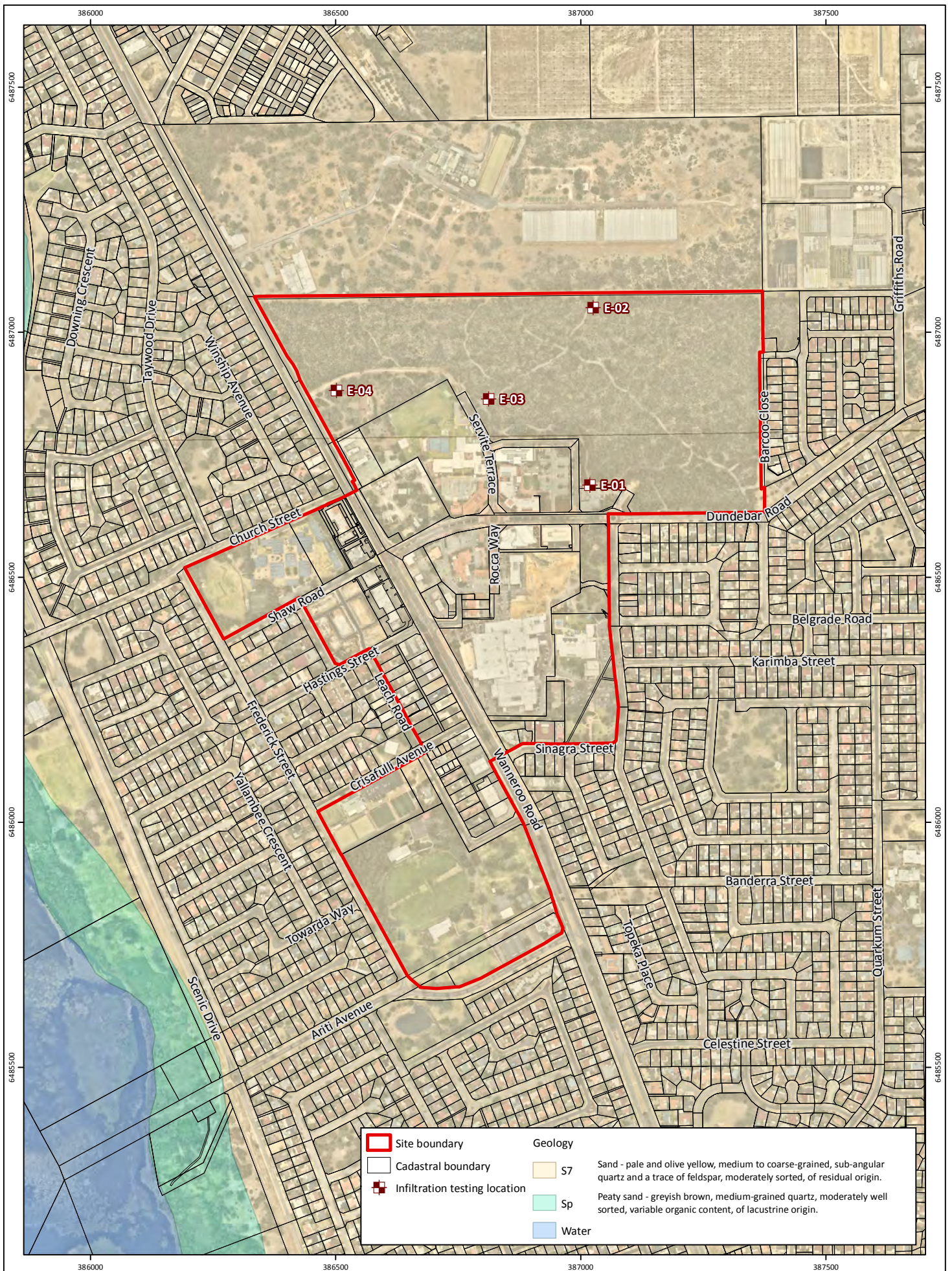


Figure 3: Geological Mapping

Project: Local Water Management Strategy
Wanneroo Town Centre

Client: City of Wanneroo

Plan Number: EP17-133(02)--F09
Drawn: KNM
Date: 17/09/2018
Checked: ASC
Approved: RLE
Date: 11/10/2018



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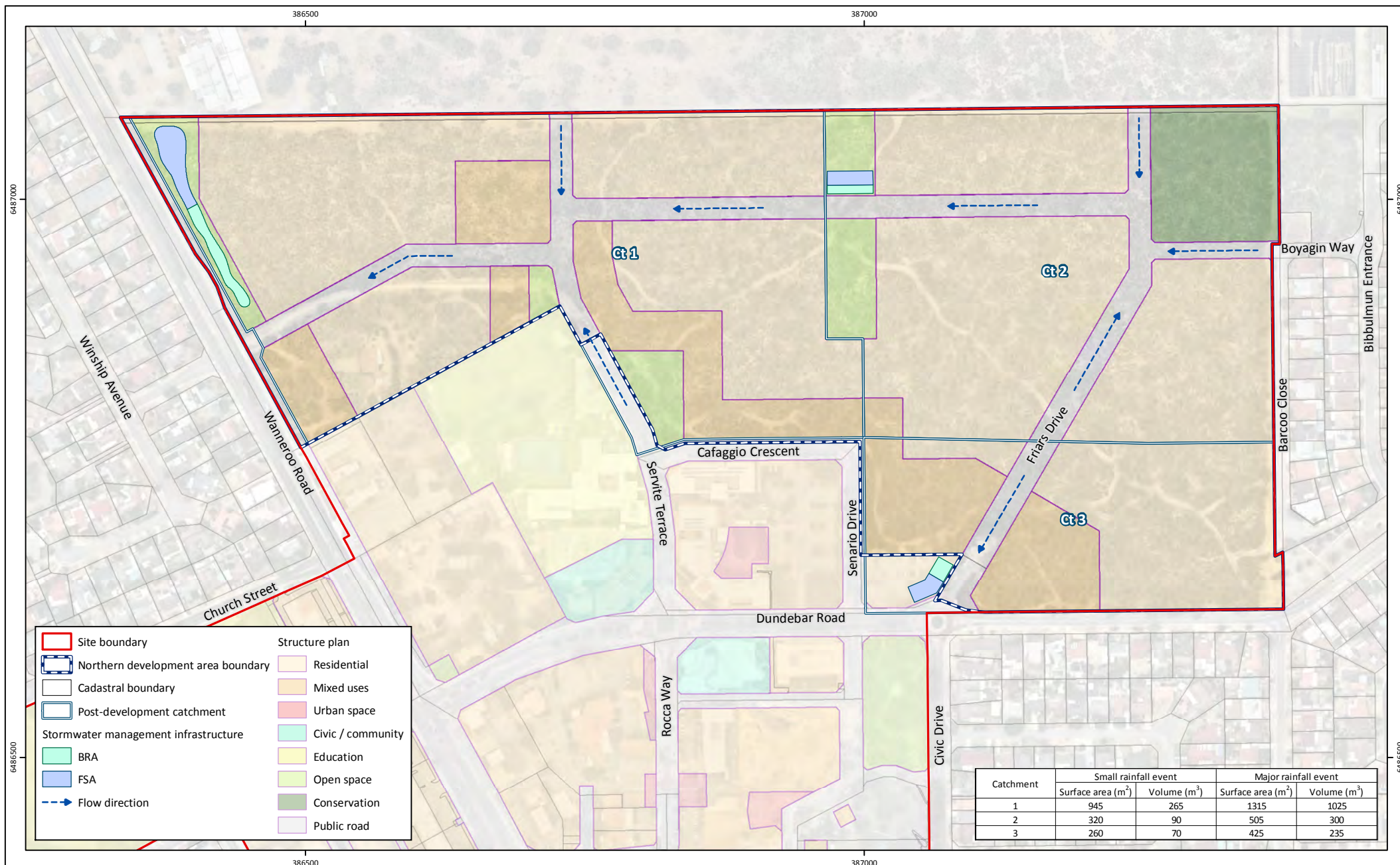


Figure 4: Stormwater Management Plan – Northern Development Area

Project: Local Water Management Plan
Wanneroo Town Centre

Client: City of Wanneroo

Plan Number:
EP17-133(02)--F16

Drawn: KNM

Date: 08/10/2018

Checked: ASC

Approved: RLE

Date: 11/10/2018



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GDA 1994 MGA Zone 50

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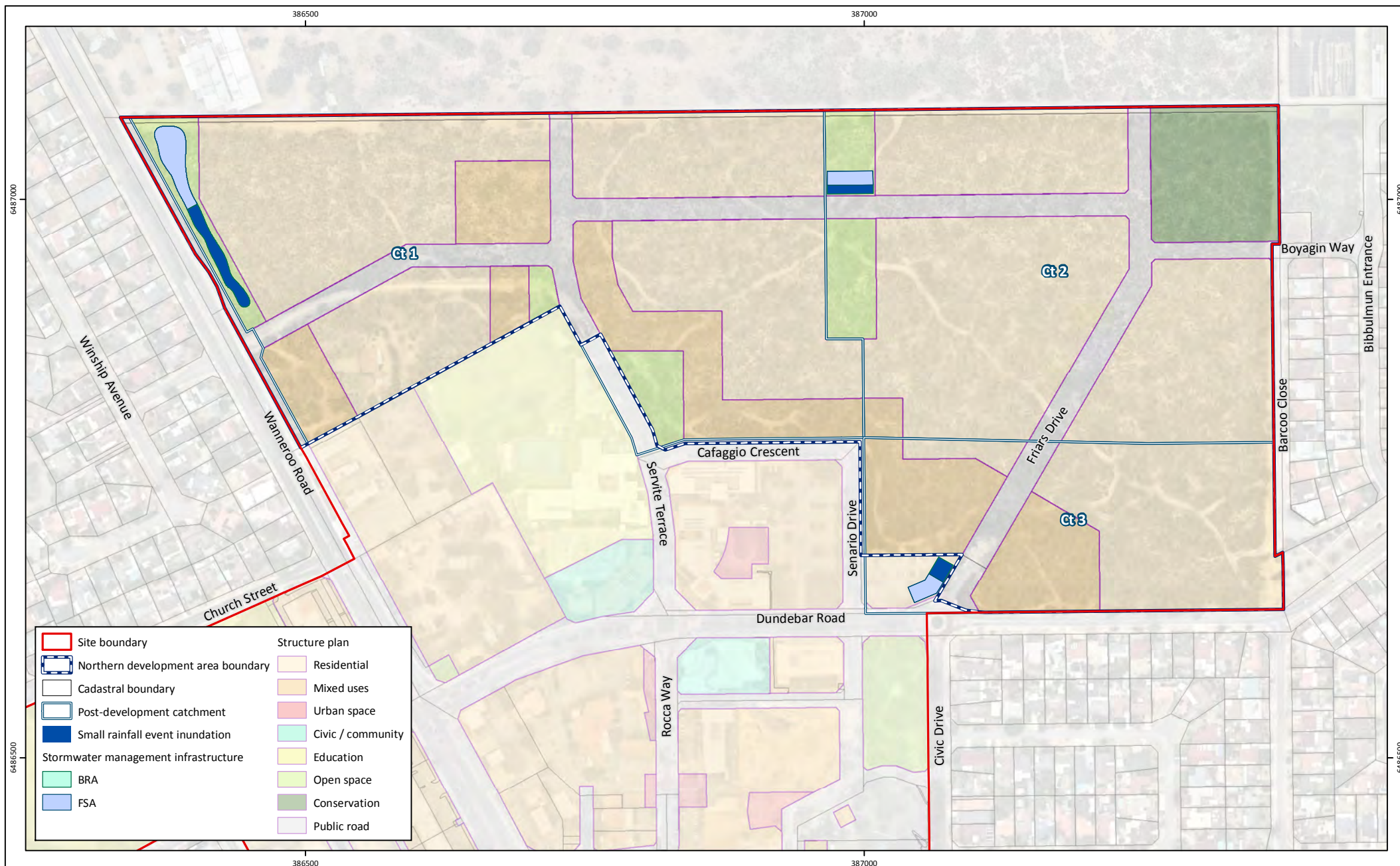


Figure 5: Inundation Mapping - Small Rainfall Event

Project: Local Water Management Plan
Wanneroo Town Centre

Client: City of Wanneroo

Plan Number:
EP17-133(02)--F17

Drawn: KNM

Date: 08/10/2018

Checked: ASC

Approved: RLE

Date: 11/10/2018



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GDA 1994 MGA Zone 50

emerge
ASSOCIATES

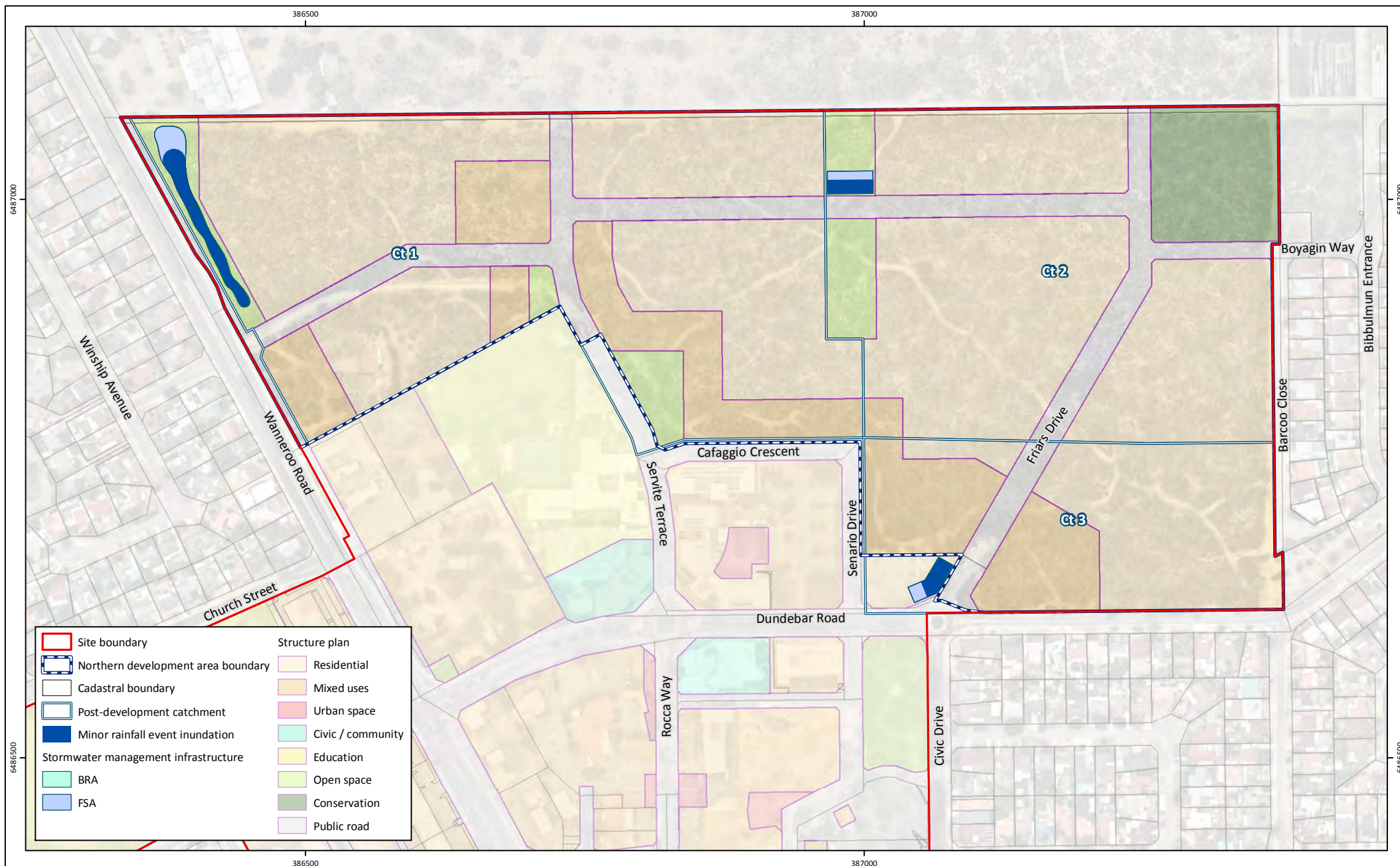


Figure 6: Inundation of the Minor Rainfall Event

Project: Local Water Management Plan
Wanneroo Town Centre
Client: City of Wanneroo

Plan Number:
EP17-133(02)--F18
Drawn: KNM
Date: 08/10/2018
Checked: DRAFT
Approved: DRAFT
Date: --/--



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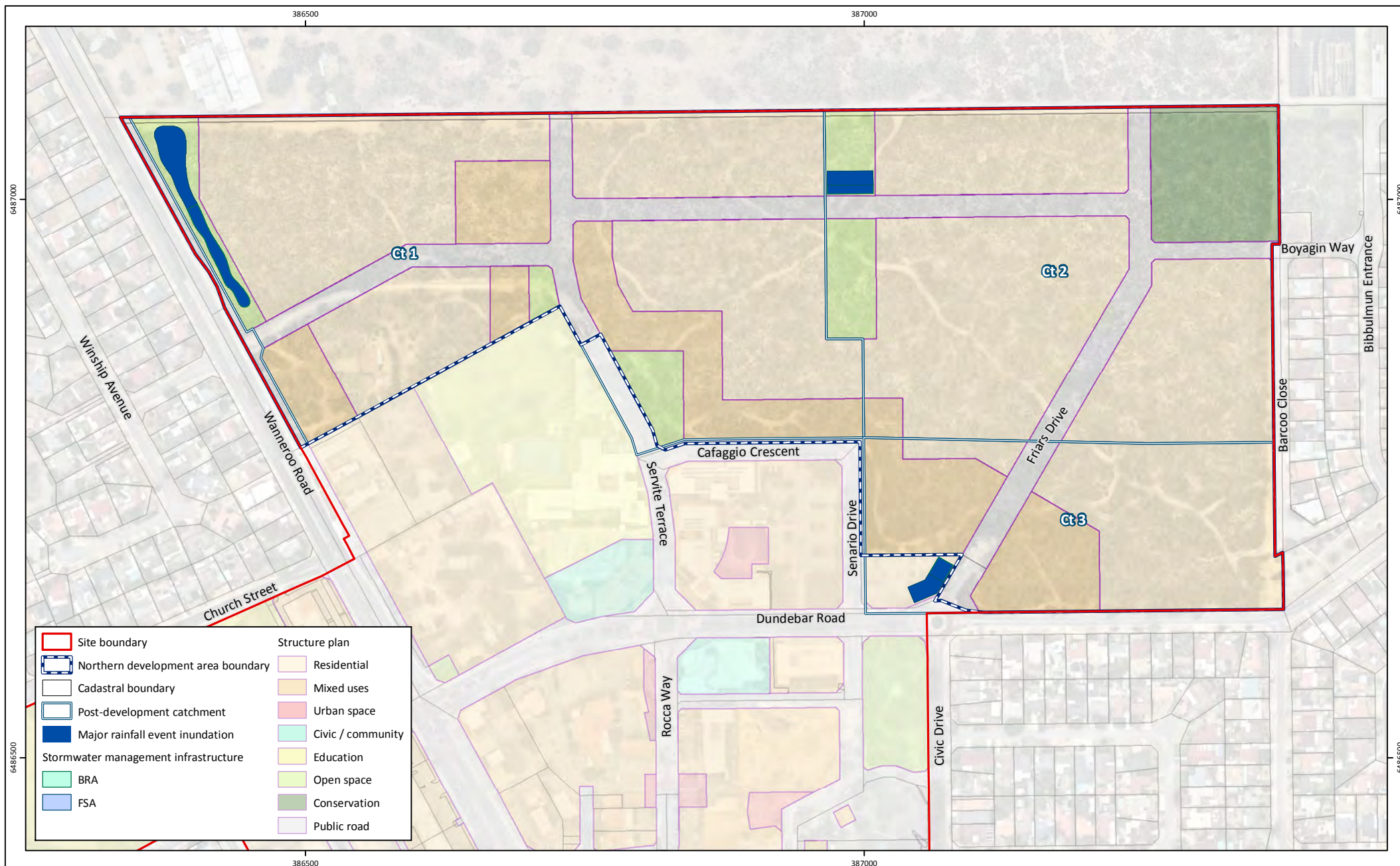


Figure 7: Inundation Mapping - Major Rainfall Event

Project: Local Water Management Plan
Wanneroo Town Centre

Client: City of Wanneroo

Plan Number:
EP17-133(02)--F19

Drawn: KNM

Date: 08/10/2018

Checked: ASC

Approved: RLE

Date: 11/10/2018



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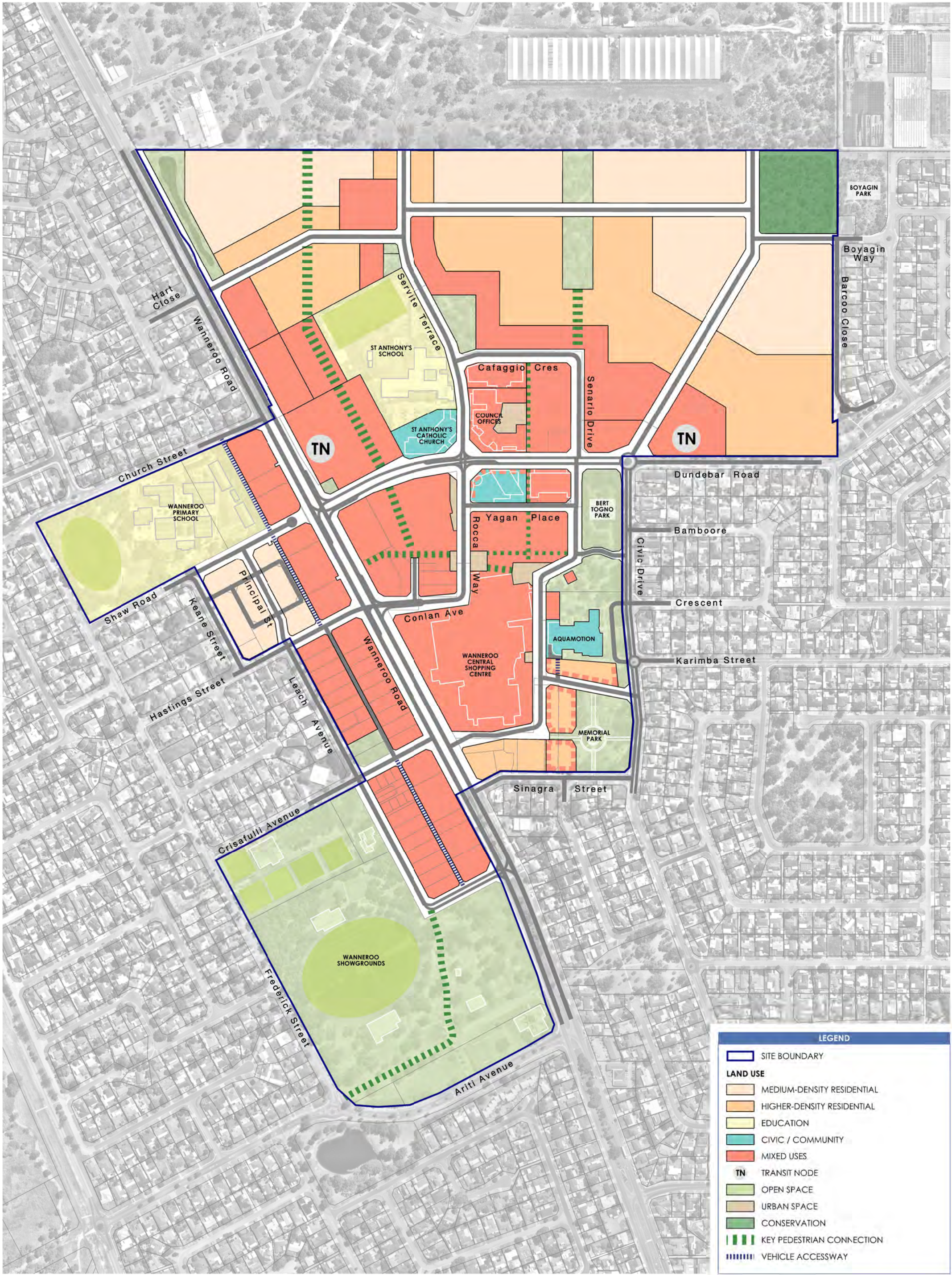
GDA 1994 MGA Zone 50



Appendix A

Structure Plan





Appendix B

Existing Pit and Pipe Network





Appendix C

Modelling Assumptions

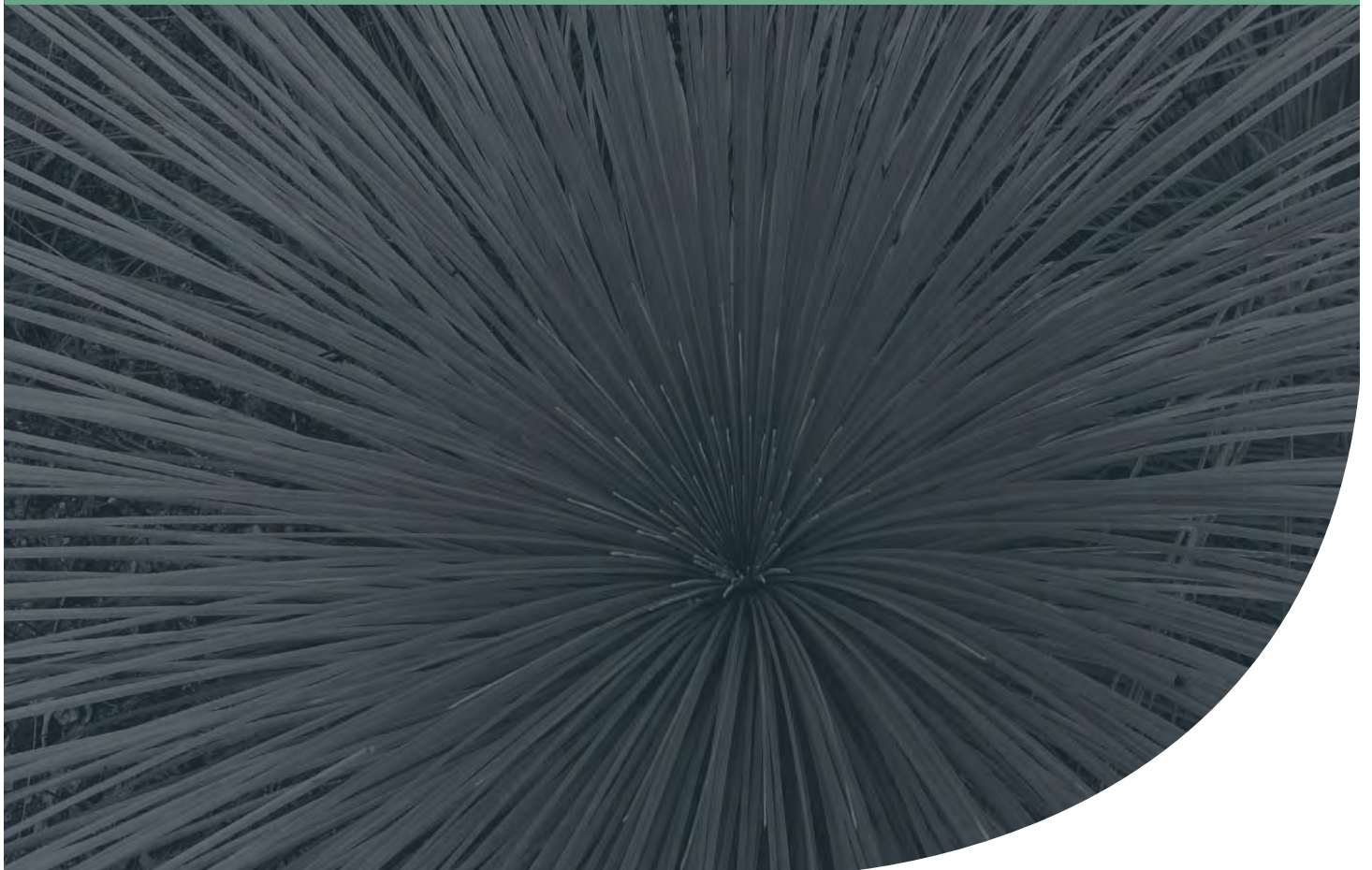


Modelling Assumptions Report

Wanneroo Town Centre

Project No: EP17-133(02)

**Prepared for City of Wanneroo
October 2018**



Modelling Assumptions Report

Wanneroo Town Centre



Document Control

Doc name:	Modelling Assumptions Report Wanneroo Town Centre				
Doc no.:	EP18-133(02)—013 GHT				
Version	Date	Author		Reviewer	
1	October 2018	Gavin Treacy	GHT	Aisha Chalmers	ASC
				Rachel Evans	RLE
	Appendix to LWMS				

Modelling Assumptions Report

Wanneroo Town Centre



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Modelling Assumptions Report

Wanneroo Town Centre



1 Modelling Assumptions

XPSWMM hydrologic and hydraulic modelling software (v18.1) was used to calculate the surface water runoff volumes within the undeveloped northern area of the proposed Wanneroo Town Centre Structure Plan.

The hydrologic component of the software uses the Laurenson non-linear runoff-routing method to simulate runoff from design storm events. Key assumptions regarding the hydrologic model include:

- Runoff is proportional to slope, area, infiltration and percentage of imperviousness of a catchment.
- Sub-catchment areas and slopes are determined from the structure plan concept provided by TBB dated 24th July 2018 and existing topographic contours.
- Infiltration rates and percentage imperviousness have been selected based on in-situ measurements undertaken by Emerge Associates and experience with model preparation for similar soil conditions within the City of Wanneroo.

Runoff from each sub-catchment is routed through the catchment using the hydraulic component of XPSWMM. Generally, assumptions associated with the hydraulic component of the model include:

- Virtual links (i.e. purely for model construction, not equivalent to flow path onsite) between nodes within a sub-catchment are given the length of 10 m and slope of 5% to minimise the lag time of conveying the water from a sub-catchment node to a 'storage' node, a 'dummy intermediate' node or a conduit/link.
- Links between sub-catchment storages act as conveyance channels (e.g. sheet flow within roads in a 1% annual exceedance probability (AEP) event). These links are given lengths and slopes that are representative of the site conditions and actual pathway lengths between catchments.
- All channels are designed with a width of 5 m, roughness of 0.014 (Manning's n) and are trapezoidal in shape. This allows for easy conveyance and represents concrete pipes and road surfaces within the model.
- Bio-retention areas (BRAs) and flood storage areas (FSAs) are modelled as nodal-reservoirs with infiltration rates as detailed in **Section 3**.

Modelling Assumptions Report

Wanneroo Town Centre



2 Pre-development Model

A pre-development model was not constructed for the site due to the high infiltration rates of underlying soils across the site, and the requirement to retain all runoff up to the 1% AEP event.

Modelling Assumptions Report

Wanneroo Town Centre



3 Post-development Model

As the proposed residential and mixed use lots must retain the major rainfall event (i.e. 1% AEP), only road reserve catchments have been included in the model.

The post-development model uses an “initial loss – continuing loss” infiltration method with parameters chosen based on project team experience on other projects in the region similar to Wanneroo. Loss parameters used within the post-development model are provided in **Table 1**.

Table 1: Post-development model loss parameters

Land use type	Initial loss (mm)	Continual loss (mm/hr)	Manning's n
Road surface	1	0.1	0.02
Road verge	9	1.5	0.05

The infiltration rates used within the model were predominately based upon the following assumptions:

- Lot assumptions:
 - All runoff is retained on the lot up to the 1% AEP event.
- Road reserve assumptions
 - There will be no infiltration on roads, pavements and driveways. There will however be some minor adsorption storage loss, which is accounted for in the loss values provided in **Table 1**.
 - Road reserves contain 40% pervious (i.e. verge) and 60% impervious (i.e. asphalt, crossovers and footpaths) areas.
- Green space assumptions:
 - Green spaces are assumed to be 100% pervious and fully retains runoff up to the 1% AEP event.
- Storage assumptions:
 - No allowance is made for any infiltration through the pit and pipe network that conveys stormwater to BRAs/FSAs.
 - BRAs have been sized for small event runoff (i.e. the first 15 mm) from road reserves. BRAs have a maximum water depth of 300 mm and 1 in 3 side slopes.
 - FSAs have been sized to retain the major rainfall event. FSAs have a maximum water depth of 1.2 m and 1 in 6 side slopes.
- Storage infiltration assumptions:
 - Infiltration rates within BRAs and FSAs were taken from in-situ infiltration testing conducted within the site. Measured infiltration rates were between 40 m/day and 80 m/day. 10 m/day was adopted as the maximum design infiltration rate with a clogging factor of 50% applied to the BRA's.
- Stormwater losses through evapotranspiration were assumed to be negligible when compared to the total runoff volume, due to the relatively short duration of the critical storm. Therefore, default XPSWMM evapotranspiration assumptions are utilised.

Modelling Assumptions Report

Wanneroo Town Centre



Post-development catchments (shown in Figure 4 of the LWMS) were assumed by assessing the pre-development topographic contours and the proposed structure plan. Catchments may be varied in the future depending on the final layout, staging and earthworks design. Catchment areas are provided in **Table 2**.

Table 2: Post-development catchment areas

Catchment	Total area (ha)	Road reserve area (ha)
Ct1	18.34	4.59
Ct2	4.65	1.16
Ct3	5.76	1.44

A critical duration event analysis was completed for the major rainfall event within each catchment. This was undertaken by reviewing water depth in each FSA for a variety of durations. The critical duration for each catchment is the 6 hour event. There is little variation in the water depth, however, from the 1 hour to the 12 hour duration event.