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CARNARVON AIRPORT PRECINCT STRUCTURE PLAN REPORT

SHIRE OF CARNARVON

Hames Sharley
www.hamessharley.com.au

Prepared for Shire of Carnarvon
15 AUGUST 2014

ENDORSEMENT PAGE

This structure plan is prepared under the provisions of the Shire of Carnarvon Local Planning Scheme No. 13

IT IS CERTIFIED THAT THIS STRUCTURE PLAN WAS APPROVED BY RESOLUTION OF THE WESTERN AUSTRALIAN PLANNING COMMISSION ON:

01 August 2014

In accordance with Schedule 2, Part 4, Clause 28 (2) and refer to Part 1, 2. (b) of the *Planning and Development (Local Planning Schemes) Regulations 2015.*

Date of Expiry: **19 October 2035**

Pre-lodgement consultation

AGENCY	DATE OF CONSULTATION	METHOD OF CONSULTATION	SUMMARY OF OUTCOME
Land owners within and adjacent to the structure plan area	19 Sept 2012	Vision Workshop	Vision for airport site and key site selection criteria
Department of Water	Jul-Aug 2012	Information gathering	Acquisition of information
Department of Environment and Conservation	Jul-Aug 2012	Information gathering	Acquisition of information
Department of Education	Jul-Aug 2012	Information gathering	Acquisition of information
Main Roads Western Australia	Aug 2013	Information gathering	Acquisition of information
Department of Transport	Jul-Aug 2012	Information gathering	Acquisition of information
Horizon Power	Aug 2013	Information gathering	Acquisition of information
Water Corporation	Aug 2013	Information gathering	Acquisition of information
Gascoyne Development Commission	Jul-Aug 2012	Information gathering	Acquisition of information
Carnarvon Chamber of Commerce	Jul-Aug 2012	Information gathering	Acquisition of information
Gwoonwardu Mia	Aug 2013	Information gathering	Acquisition of information

REVISION SCHEDULE

NO.	DATE	DETAILS	CM
1	02/08/13	Draft	RS
2	06/08/13	Final Draft for Council endorsement	RS/DJ
3	04/10/13	Revisions from Council	DJ
4	06/01/14	WAPC Amendments	DJ
5	11/04/14	Soil contamination advice and heritage	DJ
6	01/08/14	Amendments to legal description and ownership table	DJ
7	15/08/14	WAPC revision prior to endorsement	DJ

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Executive summary

A study into future options for Carnarvon Airport was commissioned by the Shire of Carnarvon to guide the strategic master planning of the airport and related development opportunities. The Shire has set the vision for a jet aircraft capable airport in Carnarvon which would require an extension to the existing main runway from 1679m to a minimum of 2000m. Based on this vision the objective of this study was to initially re-investigate the suitability of the current airport facility and compare three alternative sites to determine the most appropriate site for a new airport. Through a comprehensive site selection process and engagement program, it was determined that considering a number of factors, the current airport precinct represented the best location for a new airport.

The airport precinct represents a large tract of land which is strategically located near the town and its infrastructure and is not impacted by flood risk (subject to further flood mitigation). It is envisaged that new development around the airport will act as the catalyst to drive economic and population growth within the town.

The Structure Plan for Carnarvon Airport will set the strategic framework for future development of land uses within the airport site and immediate surrounds. This Structure Plan report acknowledges the two stage implementation process and identifies a third stage, should the airport facility relocate to another site in the future, thus releasing the remaining land for development.

The vision for the Carnarvon Airport site is:

> *To develop an **efficient** and fully **functioning** airport of **regional significance**, supported by appropriately located land uses including residential, recreation, community, industrial and commercial. Together, they will **maximise** Carnarvon's **competitive advantage**, **facilitate economic development** and **job growth** in such a way that **strengthens the identity** of Carnarvon.*

The Structure Plan will provide a strategic basis for land use planning decisions within the Structure Plan area over the next 20 years and assist the Shire and the Western Australian Planning Commission in assessing subdivision applications and development proposals.

Contents

Part One – Statutory Section

1. STRUCTURE PLAN AREA

This part applies to the Carnarvon Airport Precinct Structure Plan (CAPSP) being all of the land contained within the inner edge of the dashed red line shown onthe plan below.

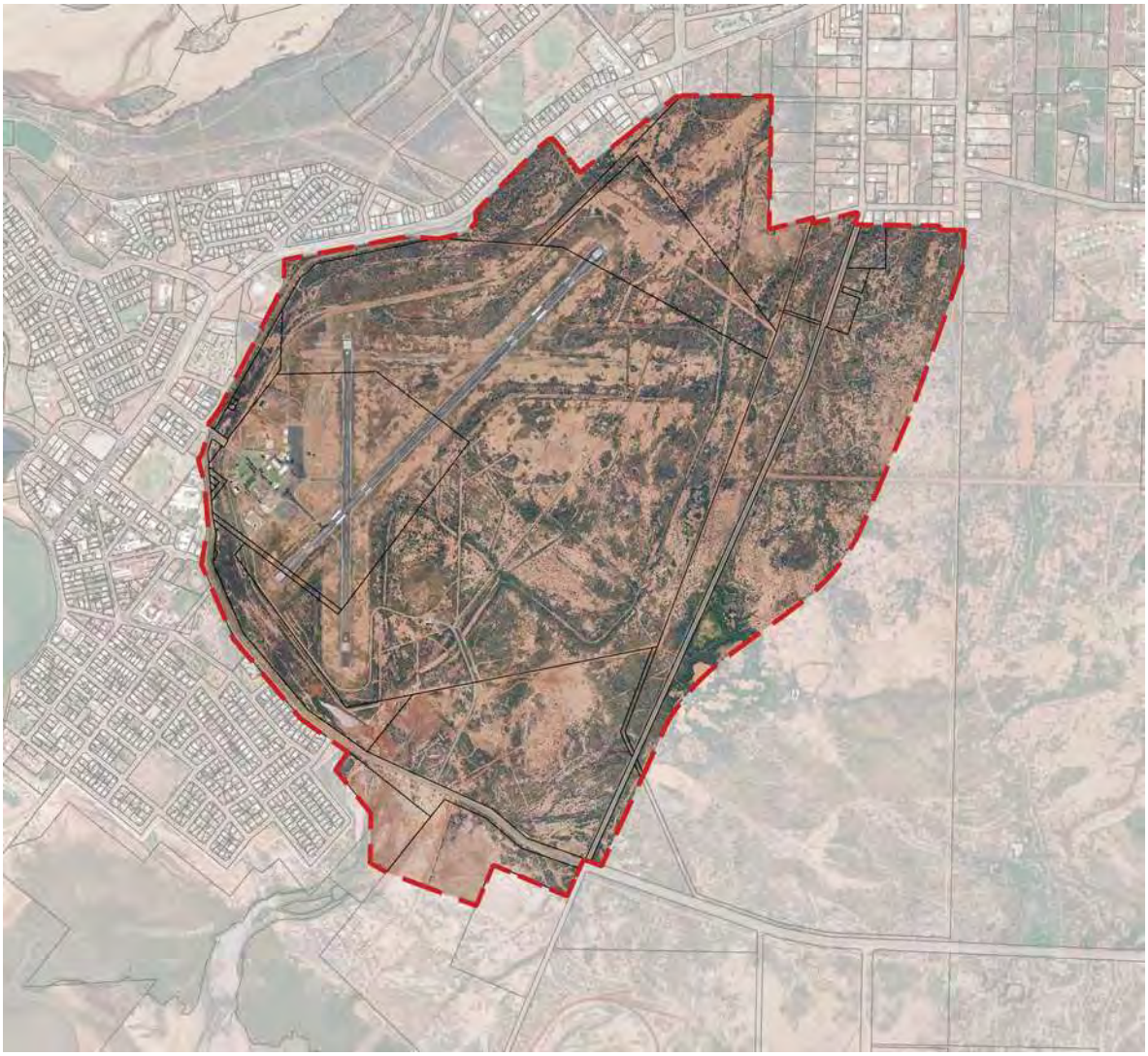

Figure 1: *Location Plan*

2. STRUCTURE PLAN CONTENT

This District Structure Plan comprises:

- Part One – Statutory section which comprises the structure plan map and statutory planning provisions and requirements
- Part Two – Explanatory (non-statutory) information which is used as a reference guide to interpret and justify the implementation of Part One
- Appendices – Technical reports, plans, maps and supporting documents

3. INTERPRETATIONS AND SCHEME RELATIONSHIP

The words and expressions used in this CAPSP shall have the respective meanings given to them in the *Shire of Carnarvon Town Planning Scheme 10* (TPS10).

In the absence of any specific provisions contained within TPS10 to guide the preparation and enable the implementation of structure plans, this Structure Plan has been prepared in accordance with the Western Australian Planning Commission's *Structure Plan Preparation Guidelines* (August 2012) and best practice as a predominantly strategic, non-statutory District Structure Plan.

4. OPERATION

This CAPSP shall not come into effect until the Carnarvon Shire Council adopts it under relevant provisions of a Local Planning Scheme. Until formal adoption, the CAPSP shall provide the non-statutory strategic guidance to land use and development within the CAPSP area.

5. LAND USE AND SUBDIVISION

The Shire of Carnarvon may recommend subdivision (or approve the development) of land within the structure plan area if the local government is satisfied that this will not prejudice the specific intent, purposes and requirements of the structure plan area. Where the Shire is not satisfied that the principles of proper and orderly planning as set out by the framework presented in the structure plan can be achieved, more detailed Local Structure Plans will be required.

6. STATUTORY STRUCTURE PLANS

A statutory structure plan is a type of structure plan that is required to be prepared and approved under a local planning scheme for land within a development (or similar) zone or where there is a general head of power provided in the local planning scheme that requires a structure plan to be prepared. Once endorsed by the WAPC it will have statutory effect.

A structure plan incorporates a report, structure plan map, additional technical supporting documents and plans, to provide a framework for the coordinated provision and arrangement of future land use, subdivision and development in new urban areas (greenfield sites) and in existing developed/ redevelopment areas (brownfield sites). A structure plan is a particularly important planning instrument for land held in fragmented or multiple ownership. It often accompanies a region scheme amendment or local planning scheme amendment proposal in order to illustrate future development and subdivision intentions.

A structure plan must address and incorporate regional strategies, relevant state planning policies, and any other relevant WAPC policies and guidelines. It must align with the objectives, provisions and requirements of the relevant local planning scheme and consider any local planning policies adopted under the local planning scheme. It coordinates the provision of transport networks, public open space (POS), utility and service networks, urban water management, development standards and community and other infrastructure investment and staging programs.

Structure plans follow a hierarchy being sub-regional, district, local and activity centre which are classified based on both the area covered by the structure plan and the detail contained within it. The WAPC has classified the CAPSP as a district structure plan. A district structure plan is defined as a high-level, predominantly strategic, document that provides guidance on future land use, employment, density targets and the coordination and provision of major infrastructure.

7. LOCAL DEVELOPMENT PLANS

Local Development Plans prepared within the CAPSP area shall be generally in accordance with the provisions, standards and requirements of this structure plan.

Part Two – Explanatory section

1. PLANNING BACKGROUND

The structure plan for Carnarvon Airport will set the strategic framework for future development of land uses within the airport site and immediate surrounds. The structure plan acknowledges the two stage implementation process and identifies a third stage, should the airport facility relocate to another site in the future, thus releasing the remaining land for development.

The vision for the Carnarvon Airport site is:

> *To develop an **efficient** and fully **functioning** airport of **regional significance**, supported by appropriately located land uses including residential, recreation, community, industrial and commercial. Together, they will **maximise** Carnarvon's **competitive advantage**, **facilitate economic development** and **job growth** in such a way that **strengthens the identity** of Carnarvon.*

1.1 INTRODUCTION AND PURPOSE

This report has been prepared in support of the Carnarvon Airport Precinct Structure Plan (herein referred to as the Structure Plan). The Structure Plan has been prepared taking into account the future relocation of the runway and terminal facilities, the existing floodway, height limitations and the need to provide a robust framework for land uses appropriate to this strategic site.

The Structure Plan will provide a strategic basis for land use planning decisions within the Structure Plan area over the next 20 years and assist the Shire and the Western Australian Planning Commission in assessing subdivision applications and development proposals.

The airport site represents a large tract of land which is strategically located near the town and its infrastructure and is not impacted by flood risk (subject to further mitigation). It is envisaged that new development around the airport will act as the catalyst to drive economic and population growth within the town.

1.2 LAND DESCRIPTION

1.2.1 Location

Figure 2: *Regional Location Plan*

Carnarvon is the commercial, administrative and population centre for the surrounding Gascoyne region. The traditional or anchor industries comprise fishing, mining, pastoral and horticulture. The area is particularly well known for its salt farming, prawns, fruit and vegetable production (mainly bananas, mangoes, tomatoes and beans).

The Carnarvon townsite and built up areas cover an area of approximately 15,000 hectares and are located approximately 900 km north of Perth (refer to Figure 2). The settlement sits within the Gascoyne River delta and at the junction of the North West Coastal Highway and the Carnarvon-Mullewa Road, which are the two principal transport routes in and out of the Shire.

Carnarvon Airport is a major regional airport running daily passenger services from the Gascoyne Region via Geraldton and Monkey Mia en route south to Perth. It also provides an air transport link to other destinations for lighter aircraft including charters and general aviation.

Carnarvon's Airport was originally built as a WWII airstrip and first opened for passenger travel when it was transferred to the Department of Civil Aviation in 1947. The original terminal building was also constructed in 1947. A newer terminal has since been erected but this remains very much a minimal facility servicing a single airline which operates a limited service to Perth by twin propeller aircraft. Control of the airport site was transferred to the Shire of Carnarvon in 1993 by the Commonwealth Department of Transport and Communication.

Discussions about redevelopment or relocation of the airport have been on the agenda for some time. A desire for a jet capable runway has led to several studies being commissioned within the past decade to look at the opportunities at the existing airport land or to investigate the potential of new sites outside the town. The assessment of these sites has led to the production of this structure plan.

Under the current Department of Transport intrastate aviation framework, Skipper's Aviation operates Regular Public Transport services daily between Carnarvon and Perth. Typically Skippers operate Bombardier Dash 8-300 and Dash 8-100 as well as Embraer "Brasilia" EMB 120 aircrafts which accommodate up to 50, 30 and 36 passengers respectively.

1.2.2 Area and land use

The existing airport enjoys a central location within the Carnarvon townsite, to the east of the town centre. A precinct has been defined around the airport for the purposes of this study (see Figure 3). The airport lot itself occupies some 334 hectares. The wider precinct is approx 510 hectares.

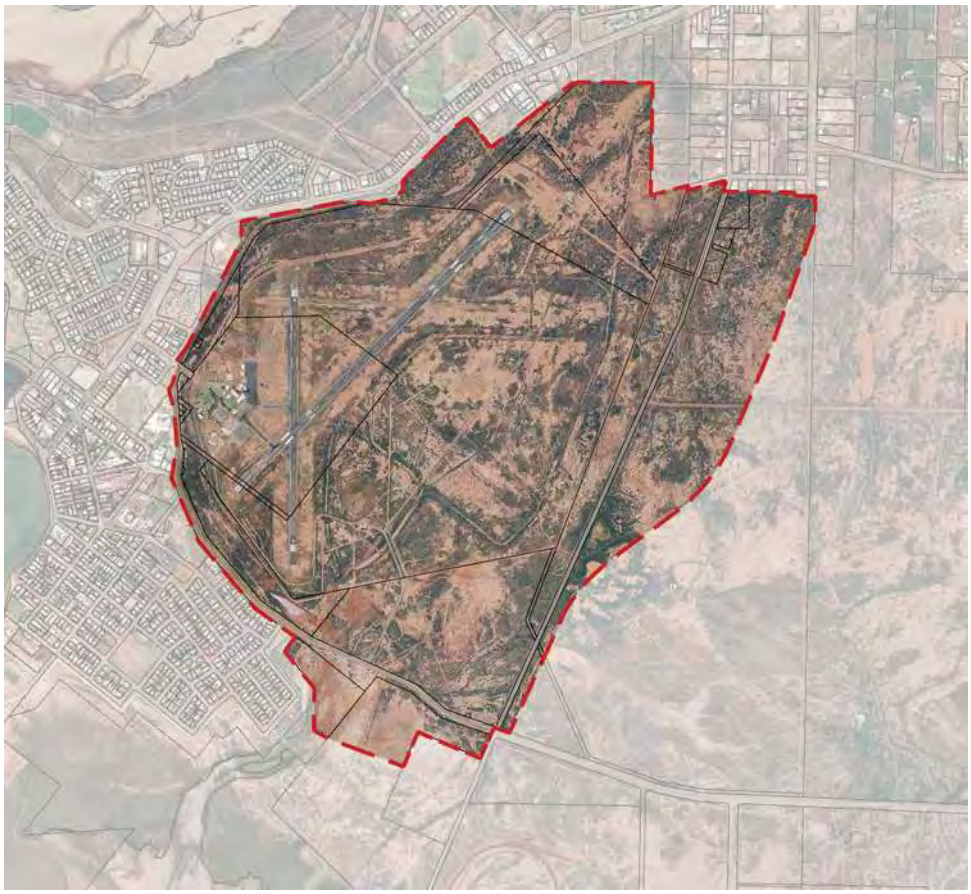

Figure 3: *Location Plan*

The airport contains three runways. The principal 04/22 Runway is classified as a Code 3 instrument non-precision runway. It is 1679m long and 30m wide and has a bitumen sealed surface. The secondary 18/36 Runway is classified as a Code 2 non-instrument runway. It is 1140m long and 30m wide and has a bitumen sealed surface. The 09/27 Runway is a Code 1 non-instrument runway and is used by aircraft that are less than 3500kg in weight and officially closed. It is 478m long and 20m wide and has a silt/sand natural surface (Connell Wagner 2005). Further explanation of the aviation coding is set out in Section 5 and Appendix 2 to this report.

Public access to the airport terminal is via James Street from Robinson Street. The access road leads to the terminal building, car park, car rental, passenger drop off area, bus/taxi stand and hangars.

Other than the main terminal building and hangars, there are a number of support facilities within the airport including refuelling compound, engineering and maintenance compound for the aviation businesses and operators, ground maintenance, navigational equipment and standby power generators.

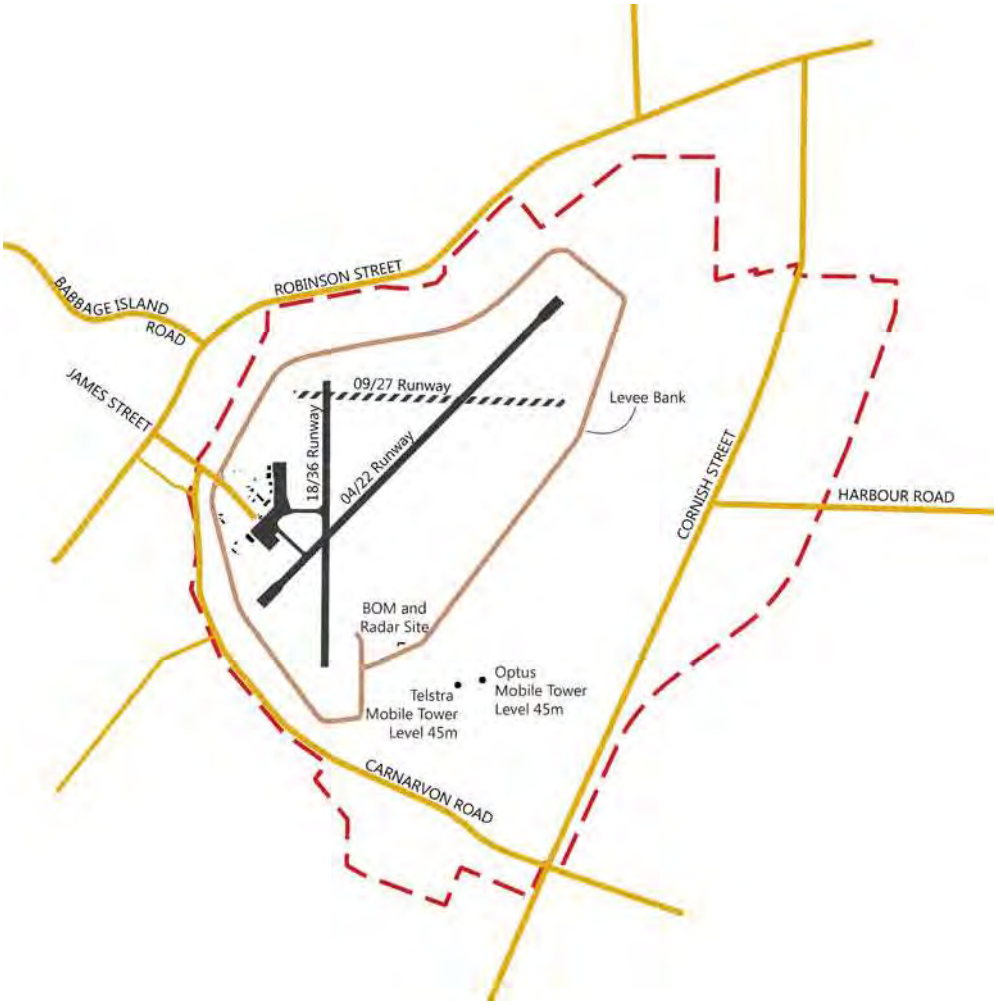

Figure 4: *Site Plan*

1.2.3 Legal description and ownership

The structure plan is comprised of the following lots:

LOT	VOL/FOLIO	OWNERSHIP
Lot 517 on P144031	1971-644	Shire of Carnarvon
Lot 518 on P144031	1971-644	Shire of Carnarvon
Lot 519 on P144031	1971-644	Shire of Carnarvon
Lot 425 on P139018	1971-644	Shire of Carnarvon
Lot 433 on P139018	1971-644	Shire of Carnarvon
Lot 535 on P205438	1971-644	Shire of Carnarvon
Lot 536 on P205438	1971-644	Shire of Carnarvon
Lot 547 on P219203	1971-644	Shire of Carnarvon
Lot 551 on P205438	1971-644	Shire of Carnarvon
Lot 559 on P219214	1971-644	Shire of Carnarvon
Lot 563 on P205438	1971-644	Shire of Carnarvon
Lot 564 on P205438	1971-644	Shire of Carnarvon
Lot 565 on P205438	1971-644	Shire of Carnarvon
Lot 648 on P206509	1971-644	Shire of Carnarvon
Lot 12 on P75043	2814-292	WA Land Authority
Lot 13 on P75043	2814-293	WA Land Authority
Lot 14 on P75043	2814-294	WA Land Authority
Lot 15 on P75043	2814-295	WA Land Authority
Lot 9000 on P75043	2814-296	WA Land Authority
Lot 9001 on P75043	2814-297	WA Land Authority
Lot 500 on P72605	2784-554	WA Land Authority
Lot 1355 on P29408	LR3136-500	State of WA
R26844 Lot 501 on P72430	LR3161-424	State of WA
R32169 Lot 1183 on D37331	LR3121-113	State of WA
R41346 Lot 1283 on P189063	LR3023-841	State of WA
R34513 Lot 1305 on P217963	LR3040-293	State of WA

The structure plan is comprised of the following reserves:

RESERVE NUMBER	CURRENT VESTING	CURRENT PURPOSE
R26844	Department for Planning and Infrastructure	Rubbish Disposal Site
R32169	Department for Planning and Infrastructure	Protection of Levee Banks
R41346	Shire of Carnarvon	Drainage
R34513	Shire of Carnarvon	Arboretum

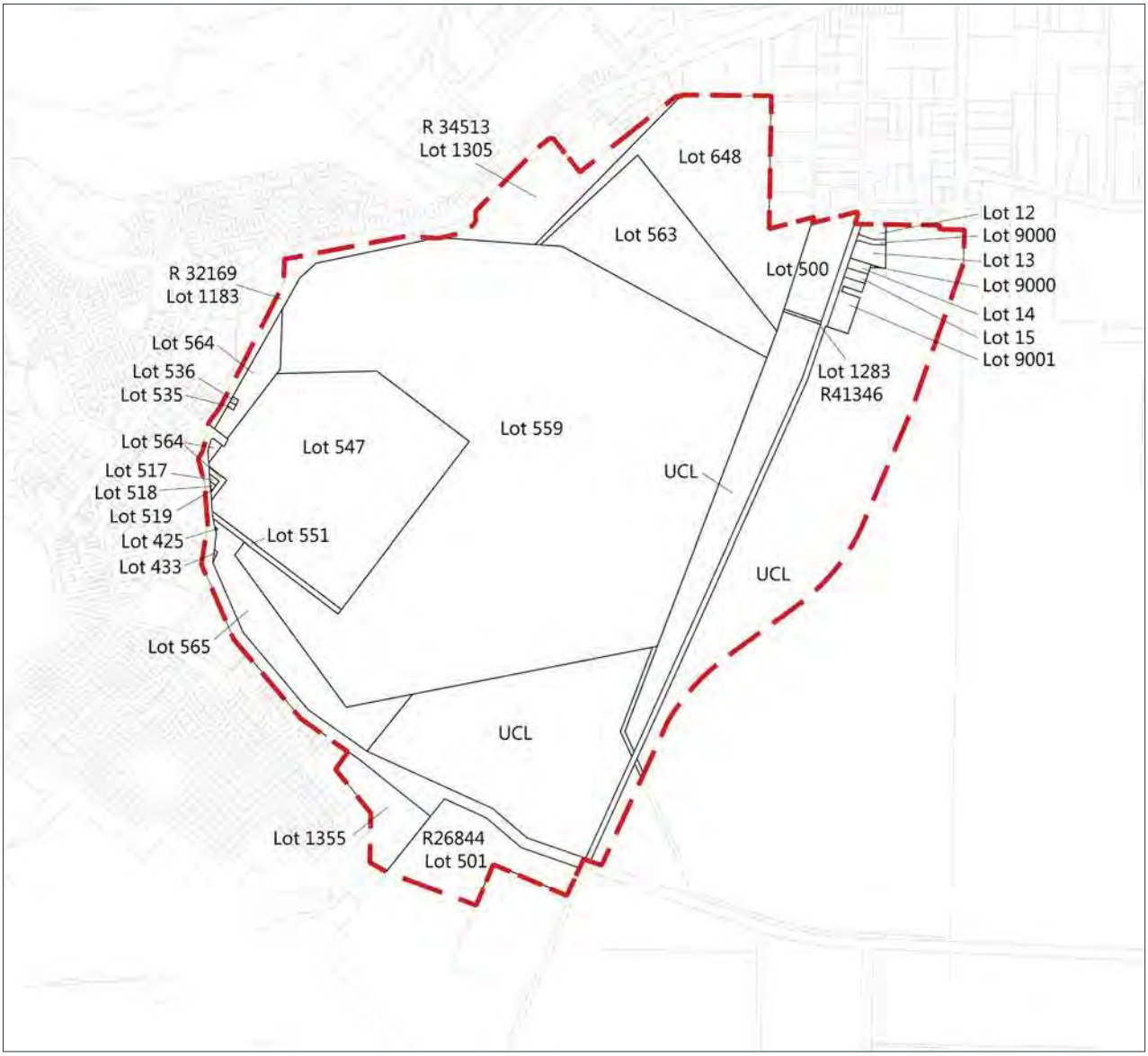

Figure 5: *Lot Boundaries*

1.3 REGIONAL AVIATION

Carnarvon Airport is one of many regional airports along the coastline of WA and the second busiest in the Gascoyne region. However, there are many larger airports within 500km of Carnarvon, refer to Figure 6.

Paraburdoo is the busiest and largest airport within this region with 301,183 Regular Public Transport (RTP) and 3,887 aircraft movements in 2012 (BITRE 2013). The impact of the mining boom has seen passenger numbers increase 600% since 2002, making it the 26th busiest airport in Australia in passenger numbers (BITRE 2013). The airport is currently owned and operated by Rio Tinto. According to a report by Rio Tinto in 2008, the airport is restricted to Code 3C sized jets and extensive work is required to meet changing Federal Government security requirements and Rio Tinto's workload (Rio Tinto 2008).

Geraldton Airport currently accommodates 138,066 RTP passengers and 3,851 aircraft movements in 2012, up 30% from the previous year (BITRE 2013). Large scale infrastructure projects including Oakajee Mid-West Development project, the Australian Square Kilometre Array Pathfinder and high population growth Geraldton Airport is projected to reach 151,355 RTP passengers within the next decade (City of Greater Geraldton 2011). The recent Geraldton Airport Master Plan proposes a runway length of 2,600 metres, which would allow for wide bodied aircraft operations up to B787 and A330 (up to 165 seats). Such a length would allow for international flights into Asia and New Zealand. Currently, Skywest offer international flights from Geraldton to Bali, Indonesia via Port Hedland.

Learmonth is the next busiest airport accommodating 92,404 RTP passengers and 2,196 aircraft movements in 2012 and also has capacity to accommodate large jet aircraft used for international flights. Currently, the Shire of Exmouth is investigating the future of the runway in the event of the Air Force return to the facility, and a Master Plan is in preparation. Learmonth is also increasingly being used as a base and operational airport for helicopters servicing off-shore oil and gas rigs.

In 2012, Rio Tinto announced a proposal to establish daily regional FIFO out of Learmonth Airport (Exmouth township) to work at Rio Tinto's Brockman 4 iron ore mining operation. The plan involves 120 to 150 workers being housed in 6 accommodation properties in Exmouth and boarding at 5.30am every morning and returning by aeroplane at 6.30pm each night.

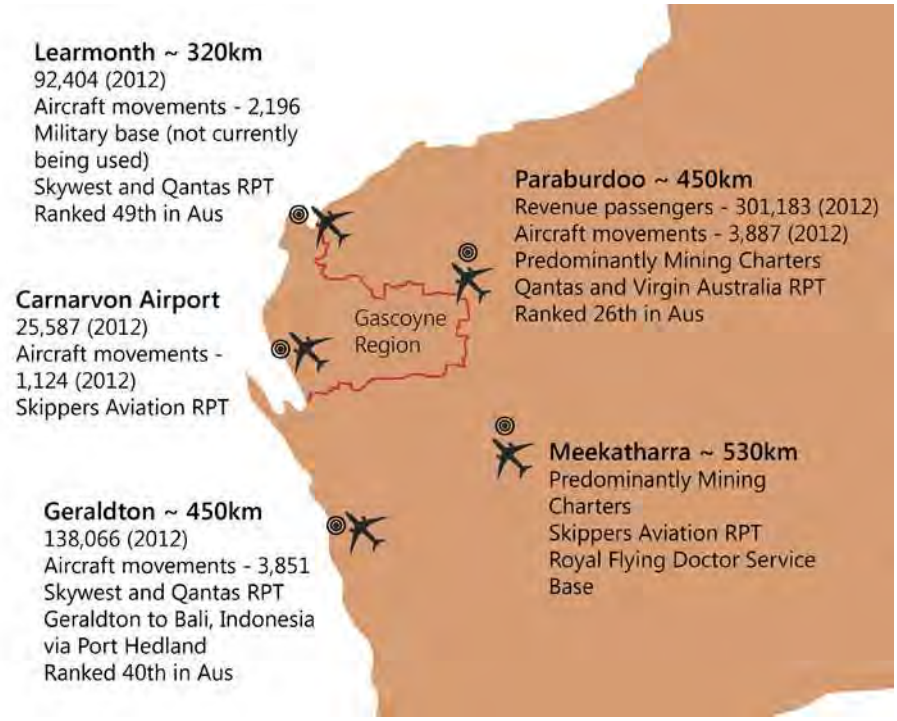

Figure 6: *Contextual Map*

1.4 PLANNING FRAMEWORK

As part of the planning for this project, a list of key documents was compiled. This included important local planning strategies and relevant state policies and guidelines.

1.4.1 Zoning and reservations

Shire of Carnarvon Town Planning Scheme No.10

The Shire of Carnarvon Town Planning Scheme No.10 (the Scheme) has classified the current airport site as a Local Scheme Reserve 'Public Purpose - Airport', surrounded by a mix of industrial, residential and public purpose zoned land.

Section 3.2c of the TPS 10 refers to Reserves and states that in regard to the use and development of Local Reserves that; "In granting its Planning approval, the Council shall have regard to the ultimate purposes intended for the reserve", which, in this case, is the Airport.

There is no requirement under the Scheme for a Structure Plan over the subject site but given the scale of the site a District Structure Plan is considered appropriate to guide future development over the site.

The Scheme contains Policy Statement No. 4 which establishes development controls around the airport related to height and land use; however, the area of impact is not identified in the Scheme Map. In the case of the North Eastern Flight Path, the policy states the Council will generally oppose any residential development and in the case of the South West Flight Path, the form of development should minimise amenity loss from aircraft movements. Subsequent to the approval of this Structure Plan the statement may need to be reworded, although the restrictions in height for the OLS are still required.

The Airport Study area includes commercial, residential and industrial zoned land, as well as land reserved for Parks and Recreation, and a school (refer to Figure 7).

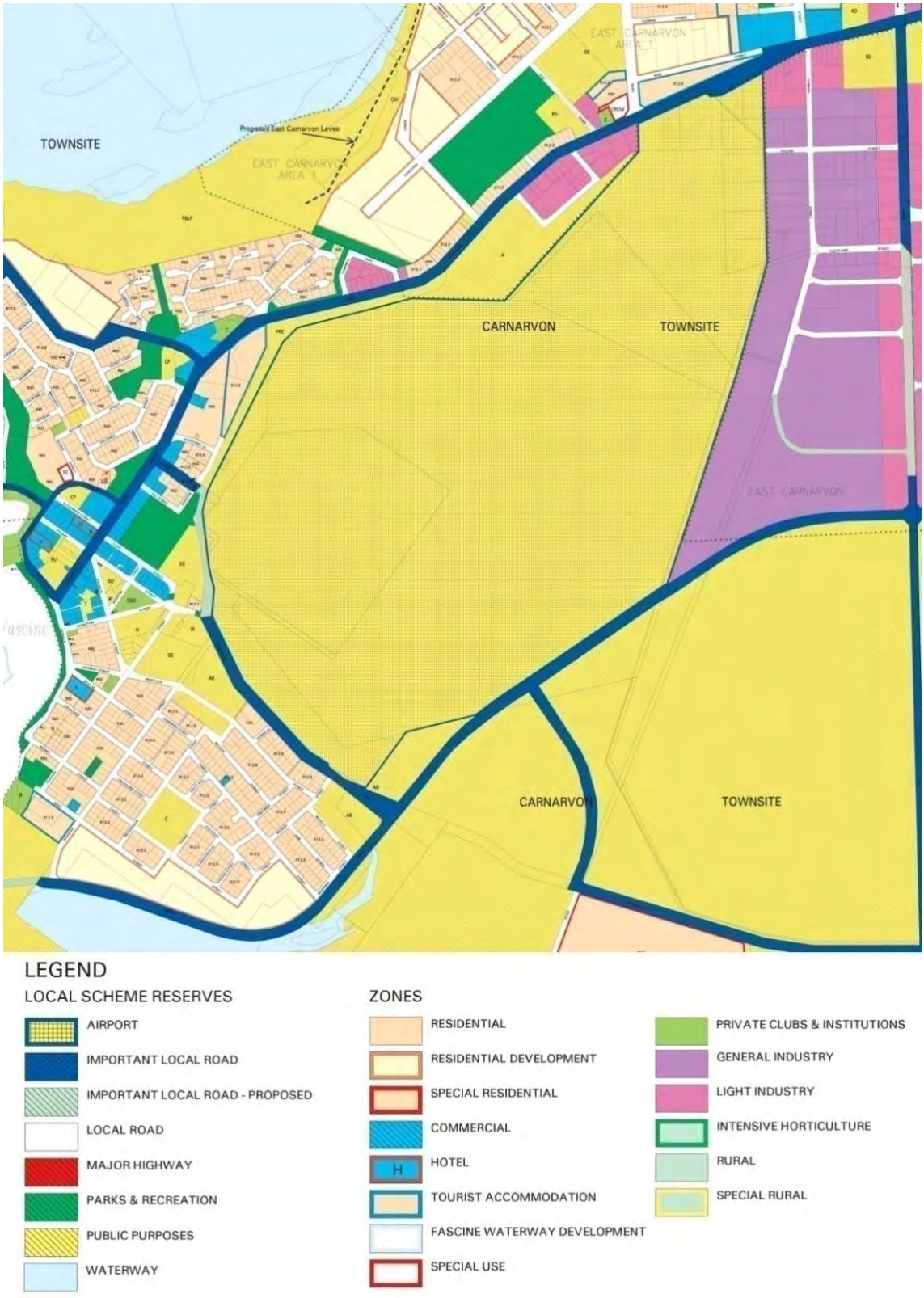

Figure 7: *Excerpt from Carnarvon TPS 10*

1.4.2 Policies

Manual of Standards Part 139 - Aerodromes

Civil Aviation Safety Authority – March 2012

The Manual sets out the standards and operating procedures for certified, registered aerodromes and other aerodromes used in air transport operations. In order for the Carnarvon Airport (regardless of the location) to be certified by the Civil Aviation Safety Authority it must meet the standards outlined in this document. These Standards will limit the potential uses and locations of land uses around the airport as well as the location of the airport itself.

Some important factors which need to be taken into account include:

- VHF Omni Range (VOR) Facilities require a 300 m buffer from all other structures. Cables can be run above the ground from 300 m to 600 m radius from a VOR, if they are aligned radially to the VOR.
- Distance Measurement Equipment (DME) Facilities - Small structures, small buildings, overhead lines and fences are allowable adjacent to the DME antenna location within a 600 m radius, providing that they do not project above the mounting point of the DME antenna to the DME mast.
- Non-Directional Beacons (NDB) - The immediate surrounding area within a radius of 150 m of the antenna should be free of buildings exceeding 2.5 m in any dimension.

SPP 2.6 Coastal Planning Policy

Western Australian Planning Commission – July 2013

This policy promotes urban development to be concentrated in and around existing settlements around coastal areas, particularly those with established infrastructure and services. Given the largely flood free nature of the land within the Precinct and its location so close to town, infill development complies with this policy. It is also intended that water sensitive urban design and integrated water cycle management be implemented in the more detailed works to follow.

SPP 2.9 Water Resources

Western Australian Planning Commission – December 2006

This policy, as the name indicates, focuses on the impact development has on water resources. In respect to the Structure Plan, it relates to the Gascoyne River and its intermittent floodway through the site. Through a District Water Management Strategy, currently being undertaken separately to this process, initiatives discussed in the Policy document will be addressed.

SPP 3 Urban Growth and Settlement

Western Australian Planning Commission – March 2006

This policy document sets out broad principles which apply to planning for urban growth and settlements in Western Australia. This Structure Plan inherently captures many of the key elements listed within the regional context of Carnarvon.

SPP 3.4 Natural Hazards and Disasters

Western Australian Planning Commission – April 2006

The primary objective of this policy is to include planning for natural disasters as a fundamental element in the preparation of statutory documents such as these. Specific to the Precinct is flood risk, as the Gascoyne River floodway traverses the site. Also, storm surge as a result of cyclone activity is another risk based on the *Cyclonic Inundation and Coastal Process Modelling* developed for Carnarvon. Department of Water have developed modelling for the Gascoyne based on stage two flood mitigation.

SPP 4.1 Industrial Buffer Policy

Western Australian Planning Commission – May 1997

The purpose of this Policy is to provide a consistent approach for the protection and long-term security of industrial zones and airports. The policy requires off-site buffers to be defined for new industry and infrastructure, however, for light and service industry, which is likely to include Composite Industry on-site buffer areas should be sufficient to address local amenity. Off-site buffers related to the airport are discussed in 3.3.3 Buffers.

SPP 5.4 Road and Rail Transport Noise and Freight Considerations in Land Use Planning

Western Australian Planning Commission – September 2009

This policy facilitates the development and operation of an efficient freight network. The North West Coastal Hwy and Robinson St are listed as state freight roads, subsequent to this Structure Plan and the adjacent structure plan for East Carnarvon and Kingsford may reduce the load on Robinson and focus it towards the industrial area adjacent to the airport via an upgrade of Harbour Road.

1.4.3 Regional and sub-regional Framework

Ningaloo Coast Regional Strategy Carnarvon to Exmouth

Western Australian Planning Commission – August 2004

The Ningaloo Coast Regional Strategy Carnarvon to Exmouth is a regional strategy providing a 30 year strategic planning framework. The strategy identifies that the Carnarvon airport land is well suited to future urban land use, as the report states that it is well protected against the risk of flooding and has gradually been surrounded by the development of the town. The Structure Plan diagram for Carnarvon contained in the coastal strategy is illustrated below in Figure 8.

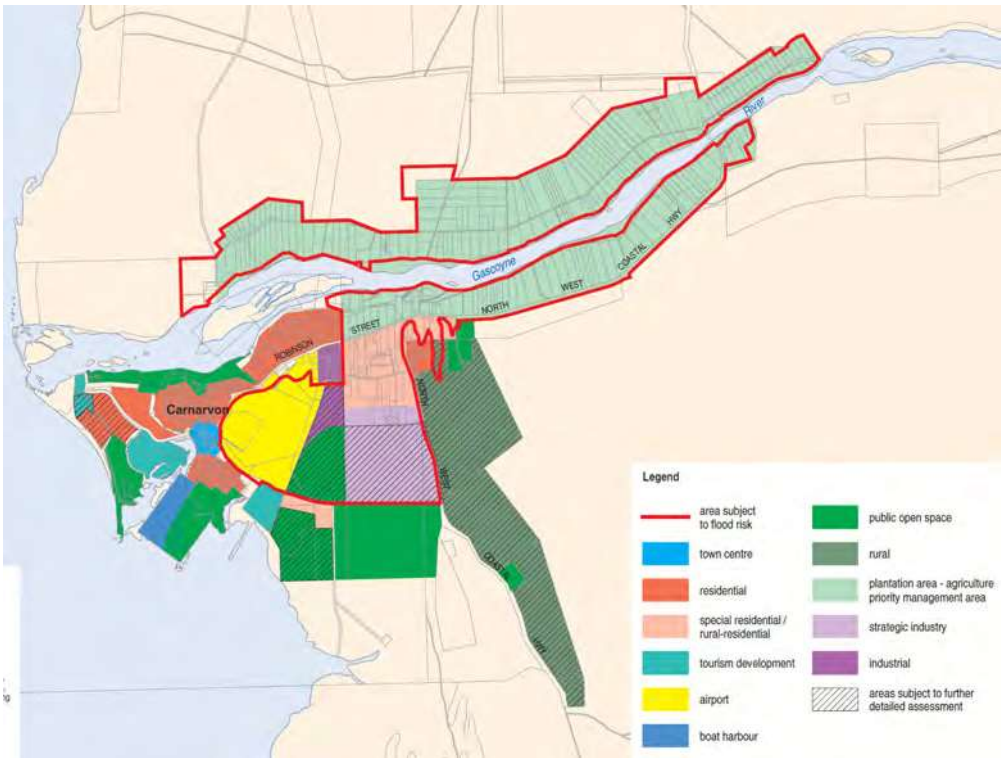

Figure 8: *Ningaloo Coast Regional Strategy Carnarvon to Exmouth - Carnarvon Structure Plan*

The strategy identifies a range of action and objectives, those with relevance to the study area include:

FLOOD MANAGEMENT

- Introduce no-dwelling areas adjacent to any levee in the unlikely case of levee failure or overtopping;
- Encourage flood-proofing of commercial and industrial premises;
- Encourage relocation of buildings/premises in areas of high flood risk; and
- Designate identified floodways and introduce controls to preclude building and restrict other forms of land use and development (e.g. fences, landfill, embankments etc) within them.

RESIDENTIAL

- To encourage appropriate residential infill in existing residential areas within flood levee banks; and
- Encourage medium-density development within close proximity to the town centre to accommodate aged and dependent persons' accommodation.
- Special residential/rural residential
- Provide a limited amount of special residential/rural-residential land in appropriate locations that will not constrain future residential or other land use expansion within the townsite.

INDUSTRIAL LAND

- To provide adequate land, appropriately located and serviced, for a range of industrial uses; and
- To minimise the impact on the natural environment of future industrial development.
- Urban design and townscape
- Continue the streetscape landscaping project for Carnarvon to make the town more walkable.

Draft Gascoyne Regional Planning & Infrastructure Framework

Western Australian Planning Commission – July 2012

The draft Gascoyne Regional Planning and Infrastructure Framework sets a regional overview for the Gascoyne, identifies opportunities for growth and projects to enable these opportunities. The Framework fits within the structure of the State Planning Strategy and acts as a regional strategy. Once finalised, the status of the other regional land-use strategies such as the Ningaloo Coast Regional Strategy Carnarvon to Exmouth (2004) which are encompassed by the Framework will be determined.

The Framework identifies tourism, mining, agriculture and fisheries as prominent sectors in the economy of the Gascoyne region, with a Gross Regional Product estimated to be $651 million (Department of Regional Development and Lands, 2011). Tourism is considered to be the region's most valuable industry sector contributing an average of $197 million annually (07-09), over 30 per cent of the Gascoyne's gross regional product.

Mining is noted as an increasingly valuable industry sector for the Gascoyne, contributing $142.3 million to the gross regional product in 2009-10. The industry is primarily based around salt production at Useless Loop in the Shire of Shark Bay and at Lake MacLeod near Cape Cuvier, north of Carnarvon, accounting for nearly half of the state's total salt production. Rio Tinto, the parent company of the salt miner Dampier Salt plans to expand operations at Lake MacLeod by 2016, from the current 764 hectares to 1000 hectares (Dampier Salt 2013).

The Framework identifies the opportunity for the relocation of the airport facilities at Carnarvon to make available land in the close proximity to the town. This was based on direction from the Shire at the time and pre-dates this study which looked at a range of site options including the northern site. It also recognises Carnarvon Airport as a future specialised centre with the development of adjacent commercial and industrial land.

Draft Western Australian State Aviation Strategy

Department of Transport - August 2013

The Draft Western Australian State Aviation Strategy of August 2013 (SAS), prepared by the Department of Transport, "proposes a suite of actions whereby the State will work in partnership with airports, airlines and the resources and energy sector to ensure adequate services continue to meet our demands."

The vision for the SAS is "that Western Australia will have a world-class aviation network and infrastructure that supports and promotes the State's economic and social development. The vision will be attained through the pursuit and achievement of the following objectives for the strategy:

a. To support the economic and social development of Western Australia through the provision of safe, affordable, efficient and effective aviation services and infrastructure.

b. To provide a sound framework for policy setting and future planning and investment in Western Australian international and domestic air services and airport infrastructure

The SAS reports that the State is not required to be involved in airport planning, however it is beneficial if more coordination at a State level is undertaken between the Department of Transport, the relevant local authority and the national regulating bodies.

The SAS does not identify Carnarvon Airport as a major regional airport and does not identify the airport as being a future gateway to the State from interstate and international services. The identified major regional airports are as follows:

- Albany
- Derby-Curtin
- Esperance
- Geraldton
- Kalgoorlie
- Karratha
- Kununurra
- Learmonth
- Newman
- Port Hedland

In specific reference to Carnarvon, the SAS highlights the less than satisfactory nature of airport's runway and financing issues:

"Carnarvon airport has a seriously degraded runway that requires resurfacing and possible replacement but has difficulty in funding maintenance and capital works owing to modest traffic throughput and airport revenues."

The Strategy also highlights the importance of regional tourism and the regulated routes:

"An important issue for the regional tourism and intrastate aviation is the policy of route regulation. At the present time, the following routes remain regulated: Albany, Derby, Carnarvon, northern Goldfields, Esperance and Monkey Mia."

The Department of Transport has noted the following:

"Route regulation policy into the future:

The existing Deeds for services to Albany, Esperance, Carnarvon, Kalbarri, Monkey Mia, Leinster, Wiluna, Meekatharra, Mount Magnet, Leonora, Laverton and Exmouth are in place until 27 February 2016, unless surrendered by the operator or in case of a breach of the Deed. A mid-term review, to be completed by 27 February 2014, will recommend to the Minister for Transport whether or not to exercise the additional up-to five- year option."

This is to be actioned as per the Strategy's recommendations. The preparation of the Carnarvon Airport Structure Plan meets the future planning recommendations of the SAS. The SAS states: "Airport planning in WA should be coordinated at a network level to reduce the risk of underinvestment in airport infrastructure and a lack of airport capacity acting as a restriction on economic and social development." The Carnarvon Airport Structure Plan process has met these needs.

1.4.4 Local Planning strategies

Shire of Carnarvon Draft Local Planning Strategy

The Draft Local Planning Strategy (LPS) has been prepared on the premise that the airport will move to the northern location, approximately 19km from town, in the future. This was based on direction from the Shire at the time and pre-dates this study which looked at a range of site options including the northern site. The LPS identifies that the removal of the airport would allow for a more direct road access from the industrial area to the town centre and Babbage Island Road. After engagement with the community around the future of the airport this was not considered important as there is a desire to limit industrial related traffic within the town where possible.

According to the draft LPS, present airport operations are considered not to adversely impact adjoining land uses. However, any substantial residential development close to the airport or an increase in aircraft movements could change this, hence the recommendation for its relocation. Subsequent to the airport investigation work, which has been completed, the Shire Council has resolved to proceed with the current proposal as per this structure plan and identify an alternate airport site for the long term aviation need (up to 50 years) for the updated draft Local Planning Strategy, which could include the northern site.

Carnarvon Tourism Strategy

This latest Tourism Strategy by the Carnarvon Tourism Alliance reports that the local visitor market has remained unchanged over recent years and comprises mostly elderly travellers on extended stay, families on short term holidays and travellers passing through Carnarvon heading for nearby or further destinations. Although visitation and visitor nights have been declining since 2006, Carnarvon hosts on average around 137,800 overnight visitors staying 793,730 nights annually.

The tourism market, dissected seasonally, is composed of:

- Families staying during school holidays;
- Elderly travellers, nomads and young families staying for extended periods during the winter months;
- International visitors staying for short visits year-round including the hotter summer months; and
- Day visitors from nodes within 200km of Carnarvon (visiting mostly for supplies and/or a change of scenery).

Tourism visitation to Carnarvon is mostly during April to September, peaking in July with most of the accommodation fully utilised. In recent years, overflow camping has been increasing and proven to be problematic, which has led to anecdotal evidence of illegal camping in random location within Carnarvon and surrounding areas.

Carnarvon has short stay accommodation capacity of around 2,752 beds with the majority (69%) in caravan parks and a minority (19%) in hotel/motels and apartments/units/B&B (8%). The report states that this supply of budget style accommodation has remained largely unchanged since the 1980's.

Critical gaps relevant to future tourism land use include:-

- Carnarvon's limited accommodation and peak utilisation in July is potentially forcing some visitors to leave Town and/or camp in areas unwelcomed by the Shire and community.
- Car parking in around Town for long vehicles is lacking and not well signposted.
- Carnarvon's year-round average temperature of 26oC is truly Mediterranean, however, there is limited opportunity for visitors to dine and socialise outdoors.
- Carnarvon has no high-end accommodation such as resorts, eco-safari or luxury apartments.

The report notes that limited air capacity to Carnarvon restricts the scope to develop package holidays and that the comparatively high cost of airfares to Carnarvon (with no competition in air carriers) is deterring visitors. Coral Bay and Exmouth are, in contrast, adding more hotel/resort capacity encouraging tour operators and high-end visitors to by-pass Carnarvon en-masse.

The Alliance's Strategy suggests the Shire of Carnarvon and the Gascoyne Development Commission have identified a range of infrastructure opportunities that could substantially improve Carnarvon's appeal as a tourism destination. One of the most significant infrastructure opportunities includes the establishment of a "new, larger airport north of the Gascoyne River with capacity for jets and wide-bodied aircraft" (p.42). The strategy projects relocation could enable the development of 300 or more new residential homes/apartments/units during 2015-2025.

Apart from the obvious benefits that a new jet capable airport in Carnarvon could deliver to the tourism appeal of the Gascoyne region, the Alliance Strategy recognizes there are a number of opportunities that could potentially be addressed in land use planning for the Airport Precinct, including:

- Increased accommodation including new camping overflow and short stay transit area.
- Collective bargaining by stakeholders and local agencies to have Government release unallocated Crown land or vacant Crown land for accommodation development.
- Establish a hotel and/or self-contained short stay accommodation facility within close proximity to town, the Fascine or marina/boat harbour precinct, with capacity to accommodate 60-80 bus/coach passengers and host corporate function and event groups.

1.5 RATIONALE FOR THE RELOCATION

A study into future options for Carnarvon Airport was commissioned by the Shire of Carnarvon to guide the strategic master planning of the airport and related development opportunities. The Shire has set the vision for a jet aircraft capable airport in Carnarvon which would require an extension to the existing main runway from 1679m to a minimum of 2000m. Based on this vision the objective of this study was to initially re-investigate the suitability of the current airport facility and compare three alternative sites to determine the most appropriate site for a new airport. The investigation involved a number of project stages. The key steps in the lead up to this structure plan were:

- Initial site investigations and literature review (August 2012);
- Key stakeholder consultation (July-August 2012);
- Preliminary Baseline Report (early September 2012);
- Community Forum and Visioning (late September 2012);
- Findings from Community Visioning (early October 2012);
- Strategic Workshop (October 2012); and
- Council Endorsement of Selected Site (February 2013).

The intent of the engagement methodology used throughout the process was to undertake an informed, objective and transparent assessment of the various alternative sites for the airport. In the processes leading up to the Strategic Workshop, information and data was collected in order to form accurate understandings of the sites and the desired outcomes from the community, key stakeholders and technical requirements. The findings from the forum identified the following:

- Infrastructure and housing form two of the biggest development issues in Carnarvon;
- Proximity of the airport to town for access purposes during floods is highly valued with a strong resistance to the airport moving;
- The airport facilities need to be improved to achieve compliance and better service the community;
- Affordable housing is the most desired development in place of the airport should it eventually move to an alternative location; and
- There is a desire for a 21st century extended runway with improved passenger aircraft services.

A Working Group workshop in Carnarvon was arranged in order to evaluate the respective sites based on the background material collected using a broad Multi-Criteria Analysis (MCA) method to assess the relative merits of the different locations. The MCA process considered a range of criteria including Economy, Accessibility, Site Environment, Operational Compatibility, and Delivery issues. The MCA approach is most effective with input from stakeholder and technical representatives. This can draw upon local expertise and experience so that stakeholder and community concerns are incorporated into the strategic planning process.

One feature of MCA that distinguishes it from the other methodologies is that it includes a process of weighting the criteria - that is, making a value based decision as to how important a particular criterion is in relation to other considerations.

This process was applied to the options for Carnarvon Airport which are as follows:-

+ An extension or relocation within the airport precinct of the current runway as well as an upgrade or replacement of the facilities.
+ The eastern option, located to the east of the airport precinct.
+ The northern option, located west of the North-West Coastal Highway, four kilometres north of the Gascoyne River Bridge.
+ The southern option, located west of the North-West Coastal Highway, eight kilometres south of the 'T' intersection with Robinson Street

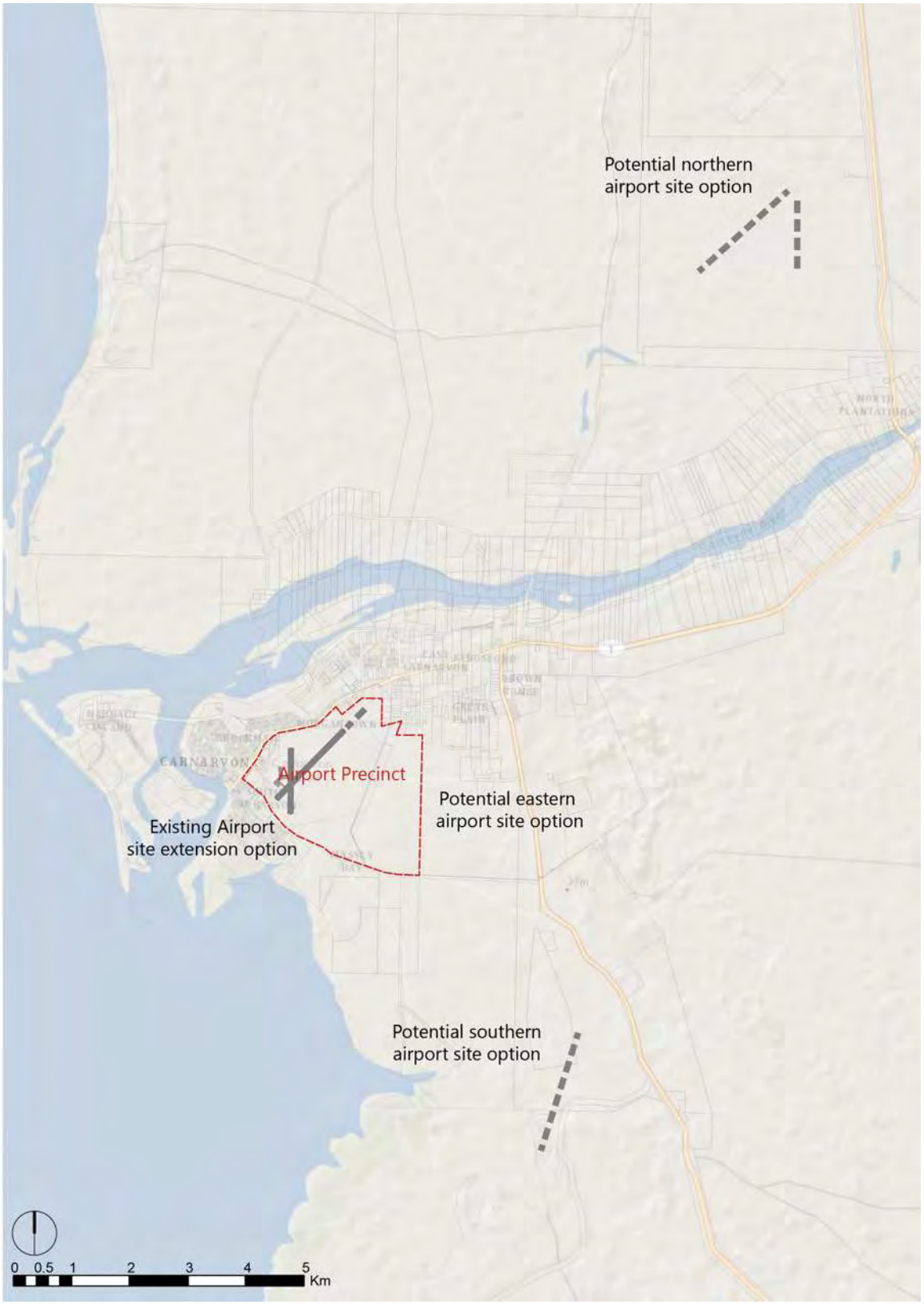

Figure 9: *Proposed Airport Sites*

The first stage of the MCA process was the identification of appropriate criteria against which the performance of each option could be assessed. The criteria were to serve two purposes; to allow differentiation between the site options and to reflect significant impacts.

A starting point of the criteria development was the establishment of redundant criteria, that is, criteria which have been assumed to be constant for all sites in the assessment. As the alternative options (except for the eastern option) have been subject to previous planning and design studies, it was assumed that all alternative sites could support an expansion of airport operations in terms of:

- Airspace
- Runway Length and Orientation
- Land Area
- Weather Conditions
- Basic Utilities

The criteria list agreed upon during the strategic workshop (October 2012) in discussions with the Project Working Group are presented in Table 1, with additions/deletions to the preliminary list noted.

Table 1: *Evaluation Criteria*

Economic and Community
+ Co-location benefits (being located both close to town and to the airport)
+ Release of land for development around the existing airport
+ Industry generator (close to freight routes)
Accessibility
+ Access during emergency (natural events) including aircraft accessibility to runway
+ Patient transfer/emergency response
+ Local access for the community (passenger, residents, business)
Site Environment
+ Geotechnical conditions
+ Adequate levels of flood protection / impact on flood levels
+ Environmental impacts of airport (in operation)
+ Impacts on amenity and the sensitive environment (local drainage, wildlife, etc)
Operational compatibility
+ Community (sensitivity)
+ Flooding of the airport (Note: during the scoring process, it was determined that this criteria was addressed sufficiently under flooding in Site Environment)
+ Safety (populated urban areas)
+ Potential for expansion (long term)
Delivery
+ Meeting community aspirations
+ Feasibility
+ Approvals

The consultant team convened during a recess in the workshop on Day 1 and assessed the four sites with respect to each criterion. A score was applied reflecting the magnitude of the predicted impact. This was based on consideration of all the information gained through the data gathering phase of the investigation. It was determined that the best location for the Airport was to retain it in its current precinct as it provided significant economic, accessibility and delivery outcomes. The next highest scoring site was the southern option due to its operational benefits, accessibility during flooding and that it allowed for the release of all of the airport land for development. The two lowest scoring sites were the northern and eastern options. The northern option was limited by the inability to access during floods, distance from the town and environmental considerations. The eastern option, whilst still within the townsite and allowed for synergies with industry was limited by the inability to expand, proximity to Mungullah Aboriginal Community and requiring a complete redirection of the existing floodway.

The existing option represents the best environmental outcome and ability to create economic development within the town related to the aviation industry including those servicing tourists, logistics and mechanical maintenance. In further analysis, it was also identified that while rebuilding the existing runway is a realistic option that should be further explored, the concurrent use of the runway could present an operational challenge and additional cost to the project due to need for night construction and possible lengthy project delays. Thus, an alternative is to construct a parallel runway within the existing precinct as a possible viable option. Accordingly, this structure plan represents the final outcome of the investigations based on a pragmatic staged approach in recognition of the following considerations by the Shire Council:

- The desire for the airport facility to be located within a flood mitigated area;
- The absence of substantiated economic growth indicators; a sound business case and available capital/ funding to support the construction of a new airport facility outside of the townsite;
- The opportunity to stage development (including a 2,000m long runway) in a realistic and manageable way without placing a considerable financial burden on the Carnarvon ratepayers;
- The potential to yield additional urban development over western the portion of the existing airport land holdings, whilst retaining the convenience of the airport within the existing precinct to foster linkage with future industrial and transport opportunities in East Carnarvon;
- The opportunity to relocate the airport outside of the town site should future need arise substantiated by economic growth indicators, a sound business case and available capital/funding to building a new airport facility;
- An indication from higher tiers of government that capital funding would not be forthcoming in the foreseeable future due to the economic climate unless a substantial business case could be presented;
- Advice that construction of a larger airport with a Code 3C sized runway to accommodate jet aircraft would require considerable investment and recurrent operational costs to meet changing Federal Government security requirements and the Civil Aviation Safety Authority standards.

These considerations are reflected in the Council's resolution passed at its ordinary meeting in February 2013, which reads as follows:-

1. ***Nominate the existing airport landholding (accounting for land expansion if required west of Cornish Street to incorporate a 2,000 metre runway and new airport terminal) as the preferred site to cater for Carnarvon's aviation needs in the foreseeable future (up to 20 years).***

2. ***Identify an alternate airport site or sites for designation in the Shire draft Local Planning Strategy for the long term aviation need (up to 50 years) subject to further investigation. This investigation is to be triggered by substantiated economic growth indicators; a sound business case and available capital/funding to building a new airport.***

3. ***Continue with the Carnarvon Airport Planning project under the guidance of the Working Group with initiation of further more detailed site analysis and preparation of a draft Structure Plan over the existing Carnarvon Airport Site and surrounds. The Structure Plan should be based on a staged approach that encompasses:***

    i. ***redevelopment of the existing airport, but not necessarily based on its existing layout and configuration;***

    ii. ***short to medium term development of peripheral land with closure of the existing cross runway,***

    iii. ***long term development of the existing airport landholding integrated with the peripheral and surround land, if or when, the airport is to be relocated to an alternative site in line with point 2 above.***

2. SITE CONDITIONS AND CONSTRAINTS

2.1 URBAN STRUCTURE

2.1.1 Existing Land uses

The current site contains predominantly airport related facilities and ancillary uses including the general aviation terminal, several hangars, fuel storage and services compound, Shire maintenance depot and car park. The Shire has also constructed two houses for employees located north west of the car park. The Bureau of Meteorology has a weather station located on the south eastern side of the runway along with two mobile phone towers.

2.1.2 Site analysis

Townscape

Figure 10: *Townscape analysis*

There are two entry points into town; one from the south via HMAS Sydney II Memorial Avenue/Carnarvon Road and the other from the north via Robinson Street. The route from the south is relatively new and not clearly sign posted. Robinson Street, on the other hand, has historically been the entry into town and is used more. Entry by Robinson Street begins with a horticulture character with pleasant tree lined entrance, however, the industrial frontage onto Robinson lacks amenity and detracts from the streetscape. The Arboretum, Chinaman's Pool and Gwoonwardu Mia are local assets and key destinations.

Figure 11: *Horticulture Character Area*

Figure 12: *Industrial Character Area*

Figure 13: *Carnarvon Arboretum*

Figure 14: *Gwoonwardu Mia*

Figure 15: *Chinaman's Pool*

Opportunities

Open Space

The site analysis has identified a linear series of public and cultural spaces which could be built upon in the proposed design. By linking these spaces with the structure plan and with each other assists in creating character and identity for Carnarvon. This link also promotes walking throughout the town.

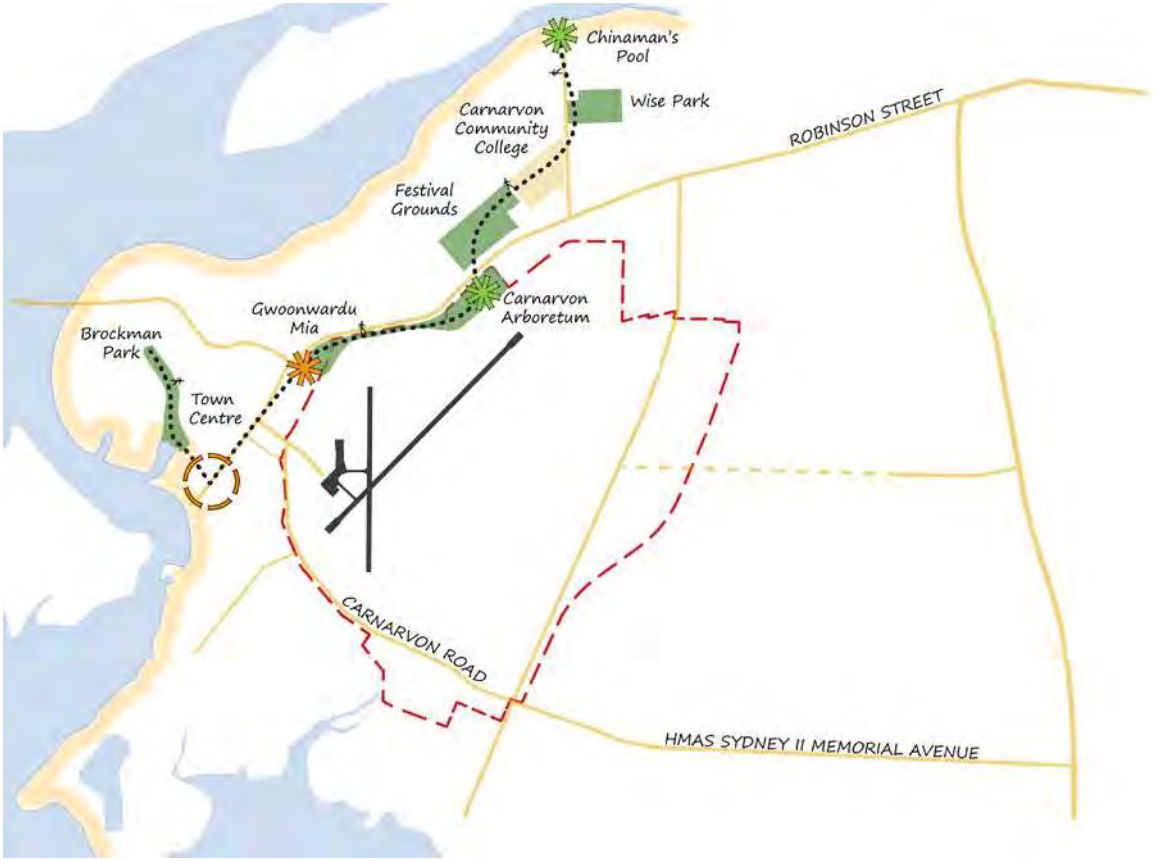

Figure 16: *Open space opportunities*

The creation of a heritage trail via this open space linkage provides the opportunity for a variety of activities, including:

- Running trails for sports clubs and schools;
- Orienteering courses
- Tourists walks; and
- Sporting events based on completing the trail.

Industrial Synergies with airport

The existing transport and industrial precincts have the potential to link with the airport to create synergies between the two and possibly private sector activities with an aviation focus. The sealing of Harbour Road would assist in removing industrial traffic off urban roads and provide direct access to North West Coastal Hwy.

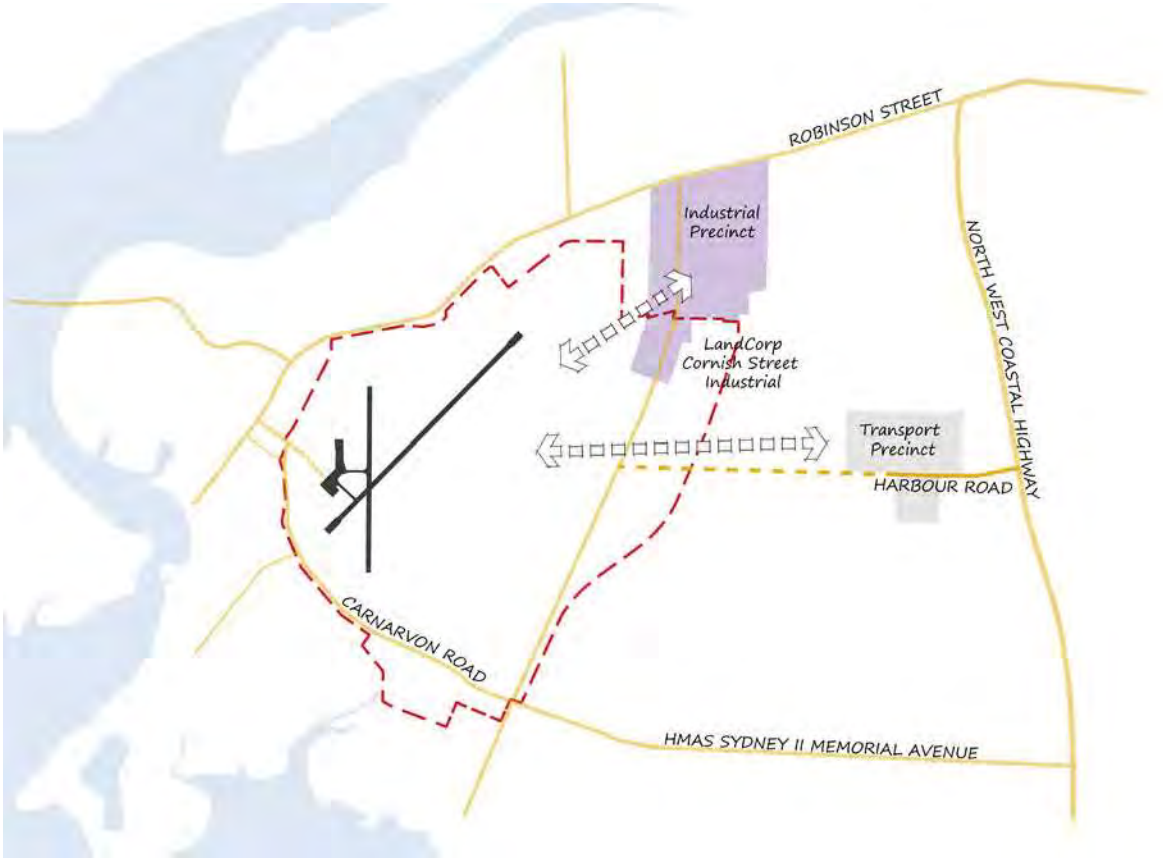

Figure 17: *Industrial synergies opportunities*

This synergistic relationship between industry and the airport enables the creation of a major transportation and industrial hub. This will provide greater incentive to businesses to establish or expand in an area that has access to air and land freight facilities. This key growth opportunity is lost if the airport is located outside of the townsite.

Creating an entry into town

The intersection of Babbage Island Road and Robinson Street will be a significant landmark feature with the new courthouse, police station, and existing Gwoonwardu Mia - the Gascoyne Aboriginal Heritage and Cultural Centre. The current entry into town from the airport and from HMAS Sydney II Memorial Avenue/ Carnarvon Road lacks any form of landmark and may be considered underwhelming. The Shire envisions that Babbage and Whitlock Islands will maintain its significance due to its location and natural environs, the existing Carnarvon Jetty, continued development of the of the Carnarvon Heritage Precinct and a new structure plan for the area being prepared that will highlight future tourist development opportunities. By linking HMAS Sydney II Memorial Avenue/Carnarvon Road with the entry to Babbage Island the intersection becomes an established node and welcoming feature.

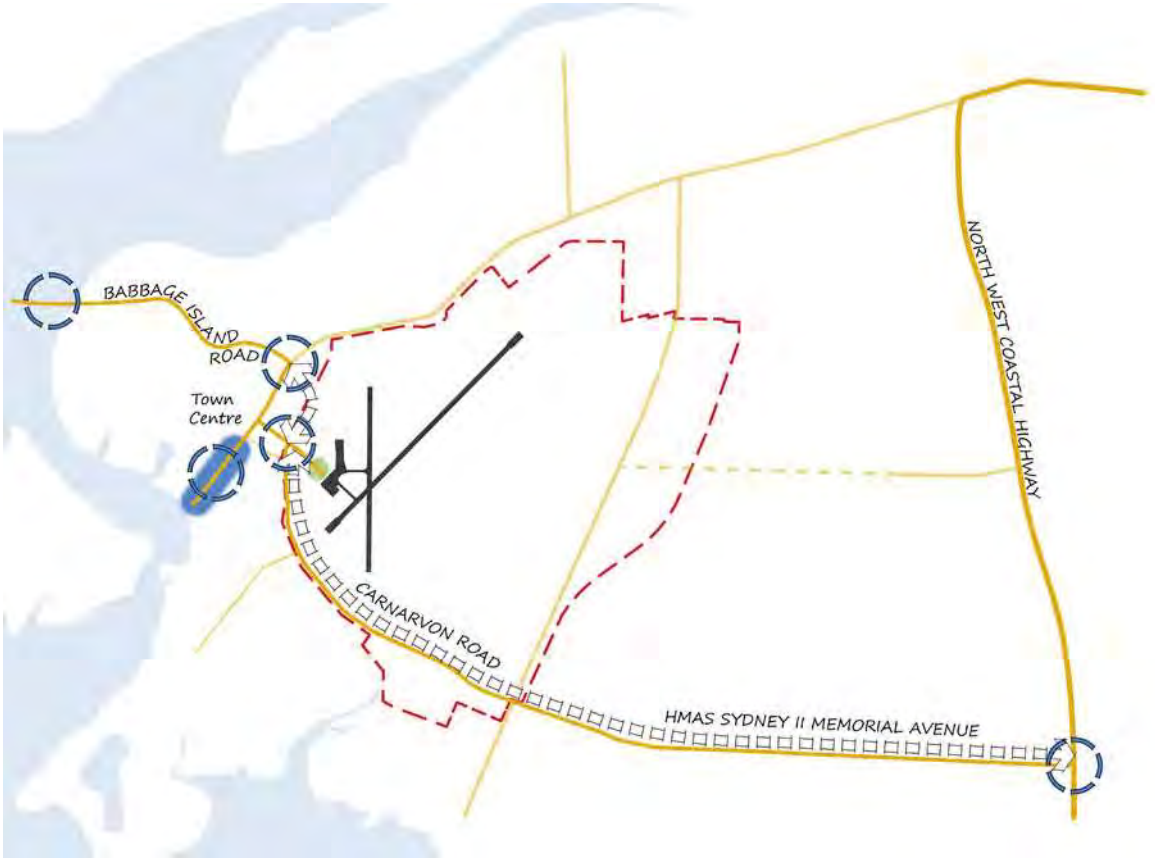

Figure 18: *Opportunities for enhancing the entry into town*

By entering the Carnarvon townsite via HMAS Sydney II Memorial Avenue visitors are provided with a more direct route into town. This route will also bypass a variety of industrial uses that currently greets visitors to the town when travelling along Robinson Street.

Link with the town centre

The ability to walk into town from the airport is a unique quality and seen as a key strength of the site, particularly in the event of a major flood. This accessibility should be retained and enhanced to the benefit of both without compromising amenity.

Figure 19: *Opportunities to link with the town centre*

Constraints

Height Limits

Obstacles in the vicinity of an airport, whether they are natural or constructed, may seriously limit the scope of aviation operations into and out of an airport. The approach and departure surfaces as well as circling areas surrounding an Airport are defined by Obstacle Limitation Surfaces (OLS). OLS are conceptual surfaces associated with a runway and are measured at a set gradient from the natural surface of the Runway End Safety Area (RESA). The exiting OLS restricts clearance requirements and height limits within the existing urban area of Carnarvon.

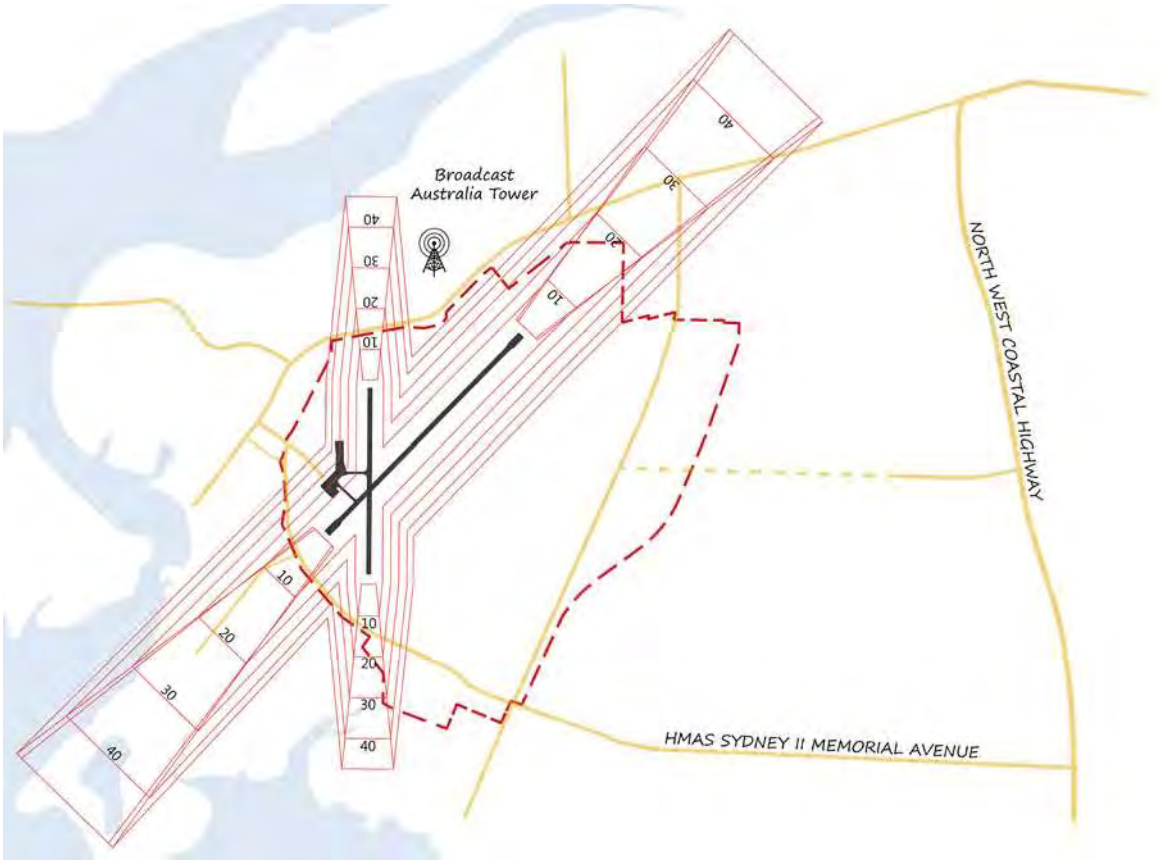

Figure 20: *Existing OLS*

Floodway

Whilst a key strength of the structure plan is that the airport land is predominantly flood free, the established floodway effectively surrounds the site and limits potential redevelopment and infill opportunities. The assessment undertaken for the airport site requirements indicates that the current site may be redeveloped subject to an amendment to the floodway marginally to the south east.

Figure 21: *Existing Floodway*

Need for a better entrance into town

The Shire has a desire to establish HMAS Sydney II Memorial Avenue as a primary entrance into town for tourists heading north. However, the current route has limited landscaping, lack of landmarks or focal points, poor signage and ends at a 'T' intersection with James Street. As the primary entrance into town for air traffic visitors it should provide a greater level of amenity. This matter should be addressed as a separate exercise beyond the scope of this structure plan.

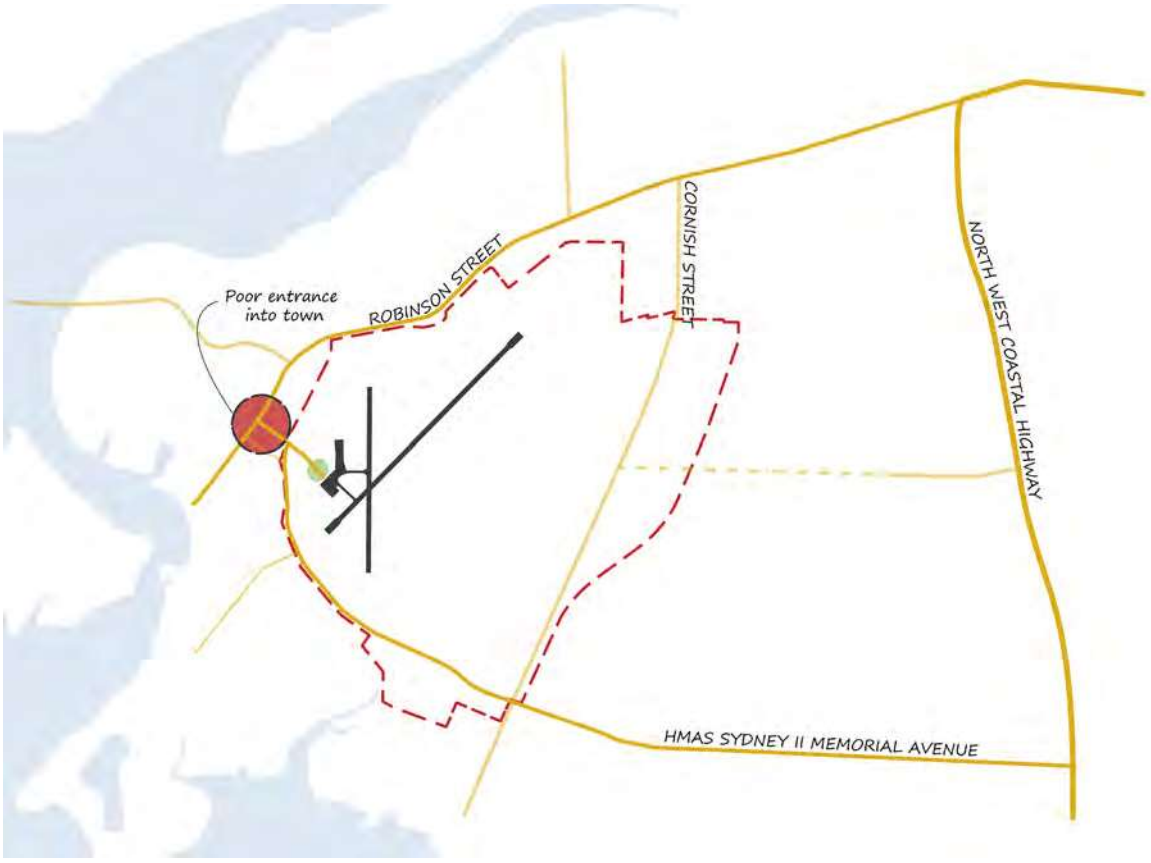

Figure 22: *Entrance constraint*

Dampier to Bunbury Natural Gas Pipeline corridor

The Dampier to Bunbury Natural Gas Pipeline (DBNGP) corridor is located within the structure plan area (as shown in blue below). The DBNGP easement is approximately 15 m wide and is a feeder line to the existing Carnarvon power station. Once the new Mungullah Power Station is completed, Carnarvon power station will be decommissioned and transformed to a network substation. Thus it is envisioned that the easement and pipe infrastructure will no longer be needed. On this basis it is anticipated the easement will not restrict development in the future.

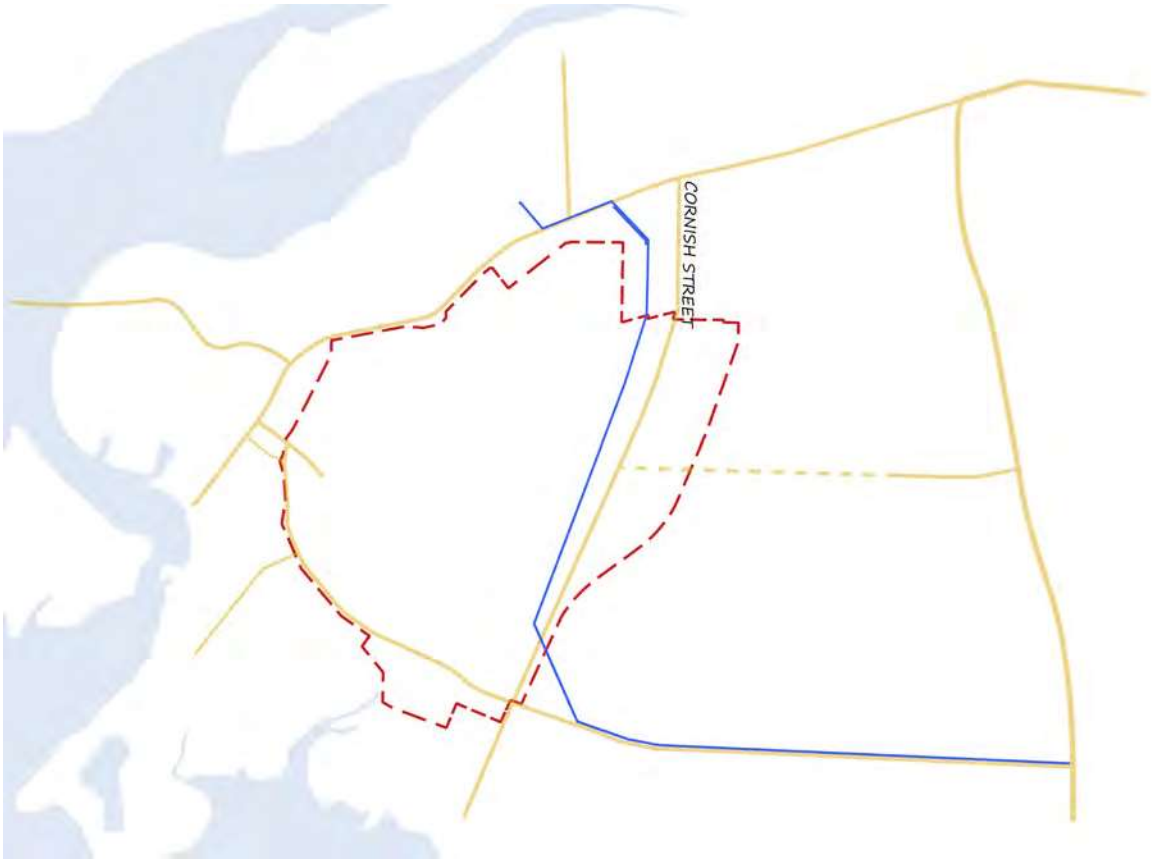

Figure 23: *DBNGP* corridor

2.1.3 Existing Lot typologies

Research into the existing residential typology in Carnarvon reveals that there is a standard lot dimension of 20m by 40m with sizes varying from 600m^2 to 1600m^2 within the town and 3200m^2 to 8400m^2 in East Carnarvon and Kingsford. This desire for 800m^2 lots was reflected in the initial public engagement and stakeholder consultation.

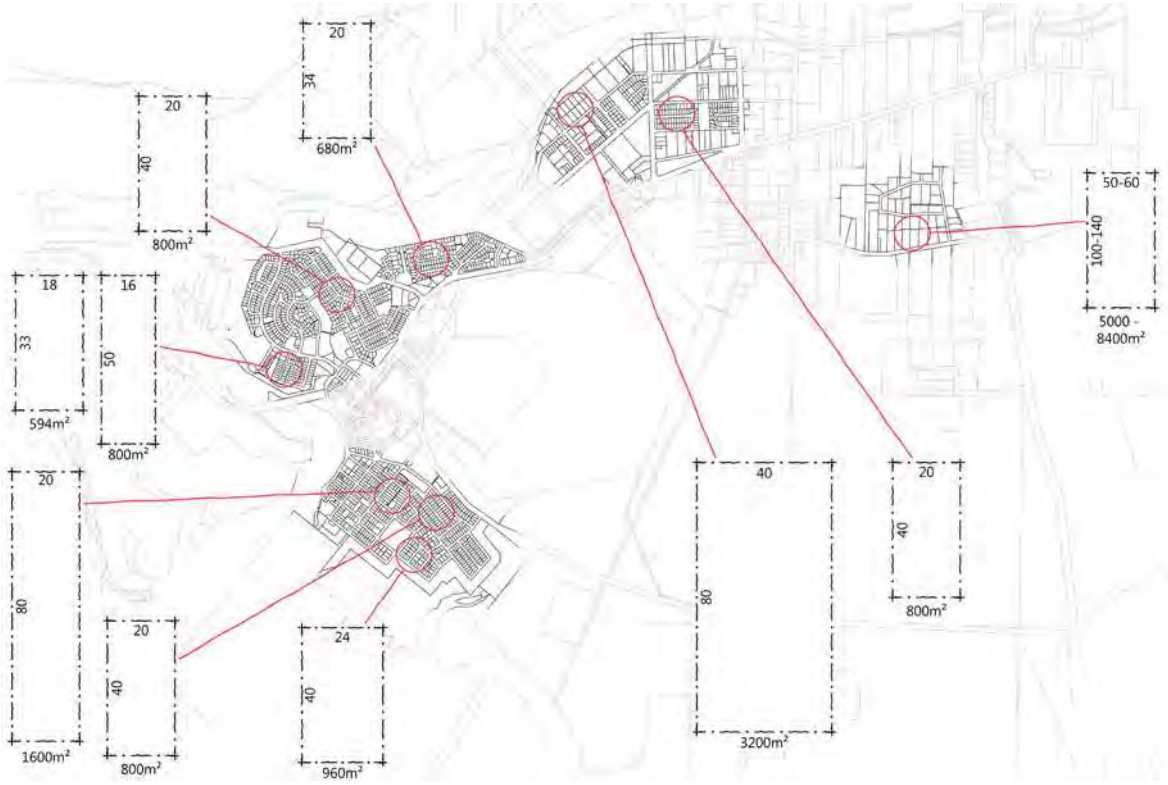

Figure 24: *Residential Lot Typology*

The industrial subdivision on Cornish Street currently being developed by LandCorp proposes lots ranging from 2,880m^2 to 8,970m^2, which reflects a standard typology in the surrounding industrial area. The majority of lots have a frontage of 40 to 50m and up to 100m in some cases, while lot depths range from 50 to 160m.

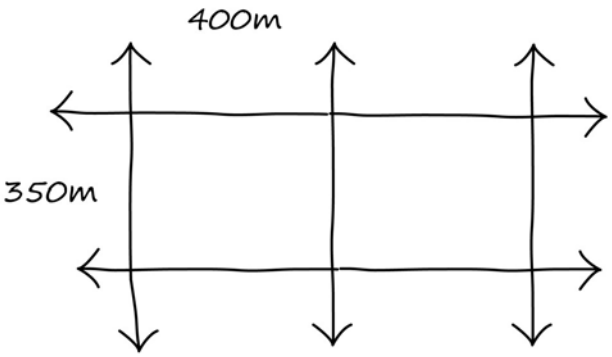

Figure 25: *Industrial Precinct Street Morphology*

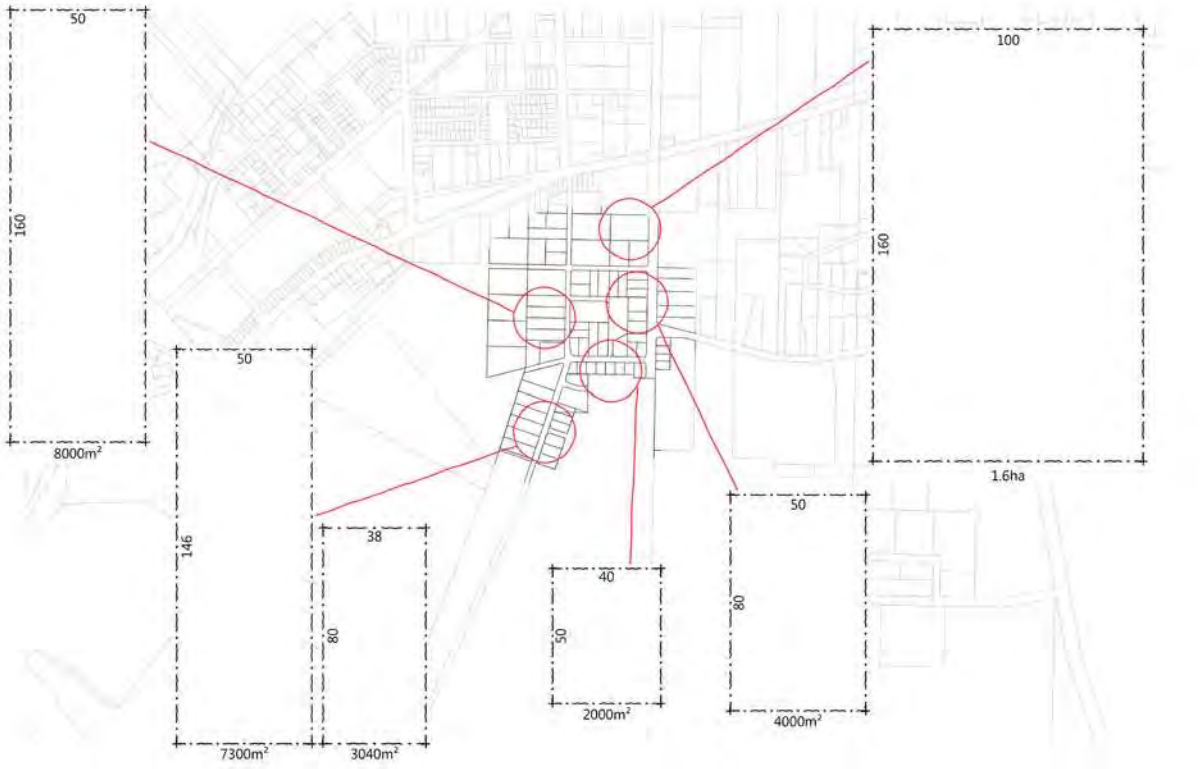

Figure 26: *Industrial Lot Typology*

2.2 BIODIVERSITY AND NATURAL AREA ASSETS

Due to the nature of airport operations, the site and the immediate surrounds are extensively modified by human activity and contain little undisturbed natural vegetation or fauna. No environmental studies have been undertaken on the site; however, below is a desktop investigation of flora and fauna which are likely to be present within the study area and need to be accounted for in any future redevelopment.

2.2.1 Flora

Vegetation of the Carnarvon area is mainly dominated by arid perennial shrub associations such as acacia shrublands, with variable understoreys of low shrubs and grasses, including the introduced buffel grass (*Cenchrus ciliaris)*, which is widespread in the Carnarvon area, and although it is a weed species, it provides groundcover and stabilisation of soil surface.

A search of the DSEWPaC Protected Matters search did not identify any flora species of National Environmental Significance (NES) within the study area. A search of the DEC and WA Herbarium database, NatureMap was undertaken for the study area in June 2013. There are no Threatened Flora species known to occur within the area, however, the search identified two DEC Priority species; *Acacia ryaniana* (Priority 2) and *Bergia auriculata* (Priority 2).

Acacia ryaniana is a prostrate shrub, growing between 0.1 m and 0.4 m high, and is found in the Carnarvon Interim Biogeographic Regionalisation for Australia (IBRA) Region. Habitat for this species comprises white / red sand and coastal sand dunes (DEC 1997). This habitat is not present within the study area, and therefore will not need to be considered in preparing the Structure Plan.

Much of the study area has already been cleared for aviation purposes and additional land that requires clearing will be subject to a Native Vegetation Clearing Permit application, under the *Environmental Protection Act 1986*.

2.2.2 Fauna

A search of the DEC NatureMap database was conducted for the study area in June 2013. The database search determined that there may be 32 species with the potential to occur within the study area, including the following 26 species protected under international agreements and species that are rare or likely to become extinct:

Actitis hypoleucos Common Sandpiper IA

Apus pacificus subsp. pacificus Fork-tailed Swift IA

Ardea ibis Cattle Egret IA

Ardea modesta Eastern Great Egret IA

Calidris acuminata Sharp-tailed Sandpiper IA

Calidris alba Sanderling IA

Calidris canutus Red Knot IA

Calidris ferruginea Curlew Sandpiper T

Calidris ruficollis Red-necked Stint IA

Calidris subminuta Long-toed Stint IA

Calidris tenuirostris Great Knot T

Limosa lapponica Bar-tailed Godwit IA

Limosa lapponica subsp. menzbieri Bar-tailed Godwit (northern Siberian) T

Merops ornatus Rainbow Bee-eater IA

Numenius madagascariensis Eastern Curlew T

Numenius minutus Little Curlew IA

Numenius phaeopus Whimbrel IA

Philomachus pugnax Ruff IA

Pluvialis fulva Pacific Golden Plover IA

Pluvialis squatarola Grey Plover IA

Rostratula benghalensis subsp. australis Australian Painted Snipe T

Sterna dougallii Roseate Tern IA

Tringa brevipes Grey-tailed Tattler IA

Tringa nebularia Common Greenshank IA

T - Rare or likely to become extinct

IA - Protected under international agreement

2.3 LANDFORM AND SOILS

The Shire lies within a large sedimentary basin known as the Carnarvon Basin. This basin slopes gently towards the coast and is characterised by low relief (approx 200 metres AHD), open drainage and large gently undulating sand plains, except for outcropping of Permian Rocks (rising to over 300 metres AHD) in the east (Kennedy Ranges) and north (Giralia Range). The development site is bounded north by the Gascoyne river, which consists of mainly saline soils with low lying shrub lands of blue bush and saltbush widely degraded and eroded.

The soil types for the development site range from tidal flats and mangrove swamps to calcareous clay silt and sand material. The soils are easily powdered and prevailing south western winds can cause the odd dust storms. Extensive efforts have previously gone into rehabilitation and dust control program for this region, where portions of the area have been identified as being severely degraded. Sandplain and sand dune deposits are particularly prominent around the Gascoyne River.

Figure 27: *Topographic Plan*

Further detailed drainage and geotechnical investigation would be required to be undertaken to determine the suitability of the land for development.

2.3.1 Acid Sulphate Soils

A review of the Australian Soil Resource Information System (ASRIS) was undertaken to identify the probability of occurrence of acid sulfate soils (ASS). The database determined that the majority of the area has an Extremely Low Probability of Occurrence (1-5% chance of occurrence). Dissecting the south western edge of the boundary, the database determined there was an area of High Probability of Occurrence (greater than 70% chance of occurrence).

Landgate data (WA Atlas) for acid sulphate soils was overlain over the study area, and indicates that along the south western boundary of the study area there are areas of high to moderate risk of ASS occurring. Refer to Figure 28 below.

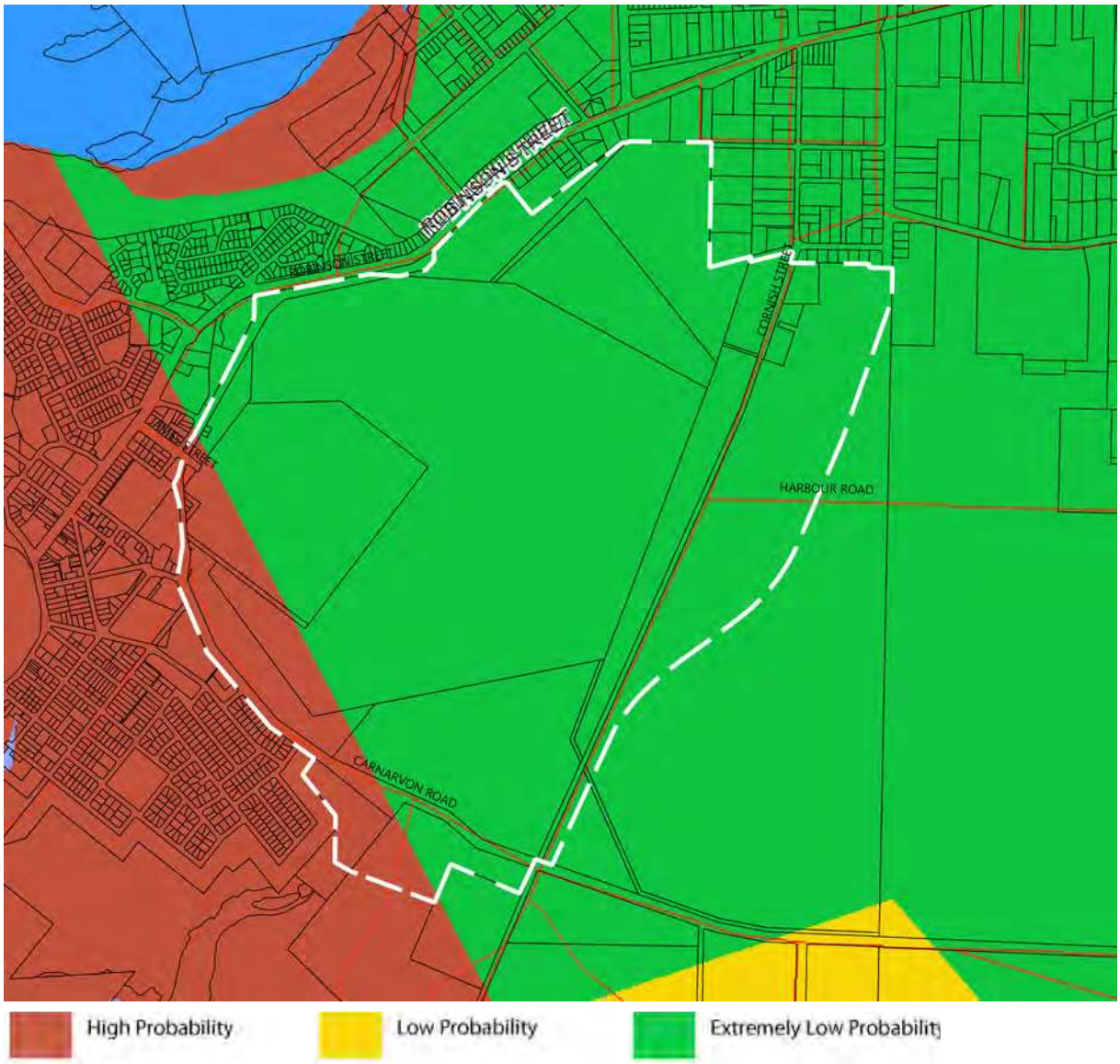

Figure 28: *Acid Sulphate Soil Risk*

When ASS are disturbed, either by excavation or lowering of the watertable below natural seasonal levels, sulfides present are exposed to air, allowing oxidisation and consequently, the formation of sulfuric acid. Acidic conditions generated by ASS can corrode concrete and steel (pipes, underground services and other infrastructure) and can result in the rapid deterioration of asphalt surfaces where they overlie ASS.

It should be recognised that some ancillary developments (e.g. large residential swimming pools) may result in the disturbance of ASS at depths or volumes the primary use is unlikely to disturb.

The "high to moderate risk of acid sulfate soils occurring" along the south western border will need to be assessed and managed in accordance with the WAPC (2008) Acid Sulphate Soils Planning Guidelines and the DEC (2013) Identification of Acid Sulphate Soils and Acidic Landscapes, Acid Sulphate Soils Guidelines Series.

As part of this structure plan, it is recommended that further detailed studies are undertaken to determine the likely presence and distribution of ASS on the land identified for further investigation. In the event that ASS are present, a feasibility should be undertaken to determine the cost of measures to mitigate impacts from ASS from occurring.

2.3.2 Soil Contamination

A search of the Contaminated Sites Database has identified Lot 547 on Plan 205438 within the site precinct as being classified '*Contaminated- remediation required*' under the *Contaminated Sites Act 2003*. According to the Basic Summary of Records Search Response, a contamination assessment was conducted following the failure of a pressure test of the fuel hydrant line in 2000 and a reported fuel spill in 1994 in the vicinity of the Aviation Depot. The assessment found that hydrocarbons (such as those found in aviation fuel) were present in soils in 2001 and 2002 at concentrations exceeding Ecological Investigations Levels.

Figure 29: *Site of contamination*

A groundwater monitoring event undertaken in October 2011 indicated a re-occurrence of PSH in several monitoring wells that previous monitoring events had found to contain reducing hydrocarbon concentrations, suggesting that there was a fresh release of hydrocarbon contamination from the primary source or from a secondary source.

Remedial works consisting of dismantling and removing 4 fuel hydrant lines, excavation of approximately 550m^3 of soil and placement of the hydrocarbon impacted soil on purpose built bioremediation beds was undertaken in April 2012 with the aim of removing the primary source of hydrocarbon contamination. Validation results from the soil on the bioremediation beds indicated that the remedial works were successful and contaminants of concern posed no risk to human health and the soil was considered suitable for re-use on site.

Limited information is available to demonstrate that all impacted soil had been excavated and validated on site as the base and walls of the excavation pit were not validated by the collection of soil samples. Therefore, it is not known if hydrocarbon-impacted soils are potentially still acting as a source of further increases in groundwater hydrocarbon contamination. Further groundwater monitoring events planned for the future will provide more information as to whether groundwater quality is improving since the soil remedial works were undertaken.

As of October 2013 the latest groundwater quality data dated October 2011 indicated PSH was present in groundwater, which is acting as a source of dissolved phase groundwater contamination and presents a risk to human health, the environment, or environmental values, as such the site remains classified as 'contaminated - remediation required'.

Geotechnical and contamination investigations will need to be undertaken to confirm whether any localised soil or groundwater contamination has occurred and identify any remediation works that may be required prior to future urban development.

2.4 LEVEE MANAGEMENT

Carnarvon region has a history flooding from the Gascoyne River, thus the town is protected by an extensive levee bank system as shown in Figure 30.

The airport area is within its own levee with tide flaps (refer to Figure 4 on page 13), there is a major floodway from about Robinson Street south along the western side of the area that discharges into Violet Creek at the southern end of the area. There is also a major floodway that will run south along the eastern side of the proposed new Boundary Road that also discharges into Violet Creek at the southern end of the area.

Existing surface water flows along the Gascoyne River are significant however, full recharge of the aquifers following a flow event. During periods of river flow, unrestricted access is provided to both groundwater and surface water, however during no flow periods, restricted access is permitted.

It is expected that with the completion of Stage 2 Flood Mitigation works along the Gascoyne River, Nickol Bay Flats and six mile area to the south east by March 2014 will alleviate the level of risk from flood events on the airport precinct and surrounding areas.

2.5 GROUNDWATER AND DRAINAGE

Whilst the airport infrastructure is protected by its own internal levee system, the study area is low lying with a high water table and it has been previously reported that repeated pavement failures have resulted in deformations to the existing runway strips due to the poor underlying sub grade. It is anticipated that similar ground conditions will be encountered throughout the study area.

The storm water management in Carnarvon is managed by directing the runoff from minor rainfall events from impervious areas onto pervious areas such as lawns, gardens and POS to allow for infiltration into the ground.

The existing drainage network in the surrounds of the proposed developed site consists of pipe network and open drains. The runoff is collected at low points where it is then transferred into the river, the sea or other storm water outlets. Public open spaces have also been designed around the Town to act as a retaining basin during a flooding event.

Relocation of the runway and terminal facilities will require upgrading of the existing drainage system. Relocation works will produce vast areas of hard surfaces that will need to be allowed for and integrated into the existing town's drainage network.

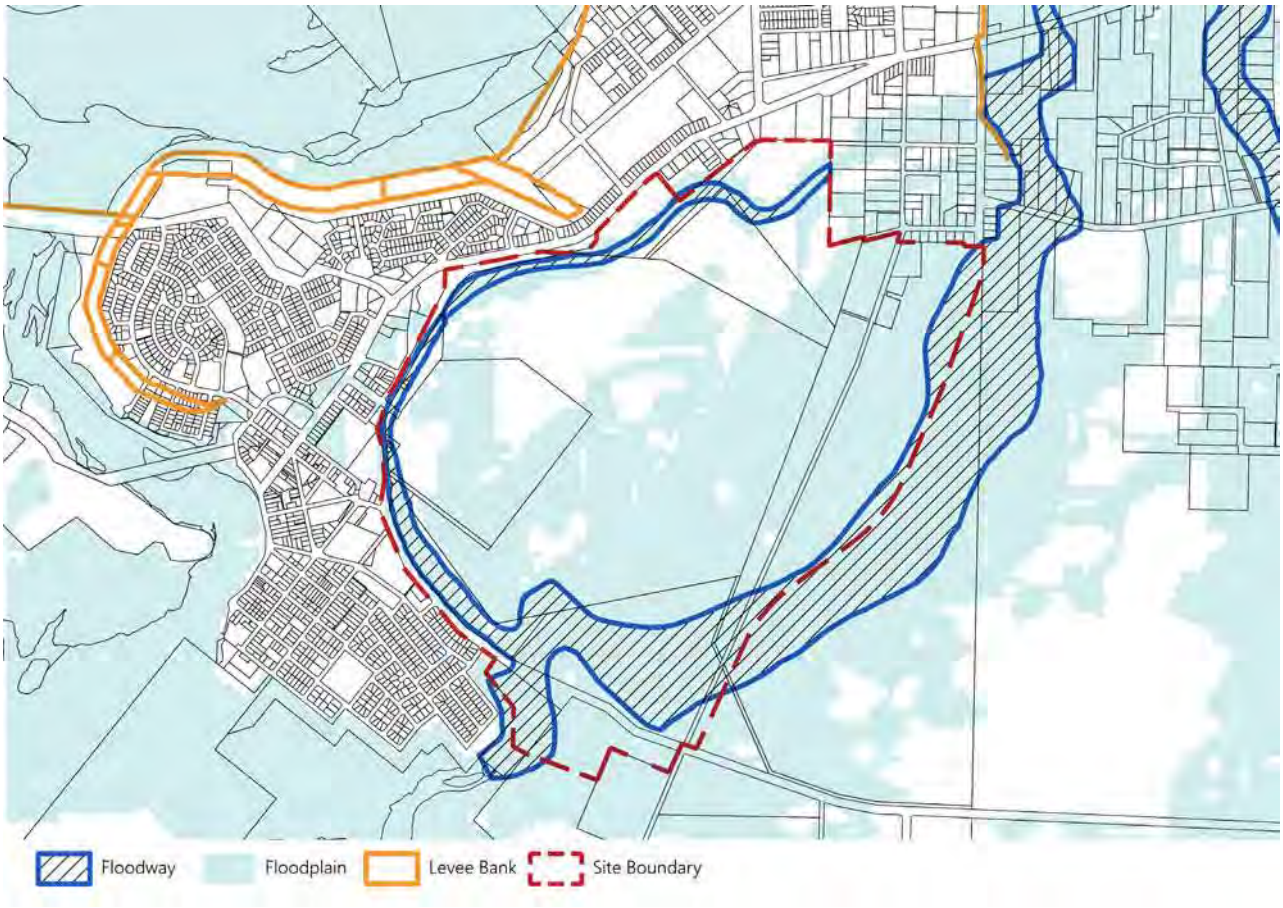

Figure 30: *Existing floodway, floodplain and levees (DoW 2012)*

2.6 BUSHFIRE HAZARD

According to the DSEWPaC (2008) fire was insignificant during the 1997–2005 period, with a maximum of 3.4% of the Carnarvon bioregion burnt in 2000. The frequency of fire between this same period was very low. The risk of bushfires within the study area is negligible.

2.7 HERITAGE

2.7.1 Aboriginal Heritage Inquiry System

Aboriginal heritage sites are protected in Western Australia through the following overlapping state and federal legislation:

- *Aboriginal Heritage Act 1972 (WA);*
- *Australian Heritage Commission Act 1975 (Commonwealth);*
- *Aboriginal and Torres Strait Islander Heritage Protection Act 1984 (Commonwealth); and*
- *Native Title Act 1993 (Commonwealth)*

The project area falls within the registered Gnulli Native Title claim area (WC1997/028) lodged in 1997 and as yet undetermined. The information in this report is sourced from the Department of Aboriginal Affairs (DAA) Aboriginal Heritage Inquiry System (AHIS). Based on the DAA search area, a print out of previous survey reports and sites was obtained. The purpose of the search is to provide a background to registered sites in the area, and give an indication of the heritage surveys that have been conducted in the area under the *Aboriginal Heritage Act* (1972). The results of the search establish the heritage context from which the potential impact of proposed works and the likelihood of identifying further sites or heritage issues may be assessed.

The search revealed six surveys have been conducted over the area, identifying previously recorded sites in the general area as shown in the table below:

ID	NAME	STATUS	ACCESS	RESTRICTION	TYPE
7130	Lewer Road Watersnake	Registered Site	Closed	No restriction	Mythological
7132	Breakwater No. 2	Registered Site	Closed	No restriction	Mythological, Artefacts / Scatter
7190	Titiwarra Soak	Registered Site	Closed	No restriction	Mythological
7232	Moburn Tree	Registered Site	Closed	No restriction	Ceremonial, Mythological
7233	Njuni Talu	Registered Site	Closed	No restriction	Ceremonial
7234	Kuwinwardu Soak	Registered Site	Closed	No restriction	Mythological

The DIA Site Register has relevance to this project as it means there is a legal responsibility for the Shire of Carnarvon to comply with the provisions of the *Aboriginal Heritage Act 1972*.

The spatial information regarding these identified sites is noted as 'reliable' on the AHIS and may be reasonably relied upon for land use planning. However, the Shire of Carnarvon may consider undertaking an Aboriginal survey specific to the development of a Structure Plan in order to provide confidence that they will not be in breach of Section 17 of the *Aboriginal Heritage Act 1972*. This will allow for a due diligence strategy to be in place to manage the previously recorded Aboriginal sites in the Shire of Carnarvon. The survey may also limit the likelihood of unintentional and preventable damage to any registered Aboriginal site.

2.7.2 European Heritage

A search of the draft Municipal Heritage Inventory and the Heritage Council of WA (HCWA No. 4596) identified an aircraft hangar located at the Airport which was built in 1924, and having a high level of protection. According to the report, it is believed that Sir Charles Kingsford Smith used the hangar when he operated aircraft from Carnarvon. In 1924 Kingsford Smith formed a partnership with fellow pilot Keith Anderson and began operating a trucking business from Carnarvon known as the Gascoyne Transport Company. During consultation with the community, it has been questioned whether this is actually the case. Below is an image of the hangar. The Heritage Council of Western Australia

It has been suggested that the hangar was built for Skippers Aviation in 1965. This is due to an incorrect image used in the consultation document. The amended image is identified in Figure 31.

Figure 31: *Heritage listed aircraft hangar*


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3. LAND USE AND SUBDIVISION REQUIREMENTS

3.1 PROJECT PRINCIPLES

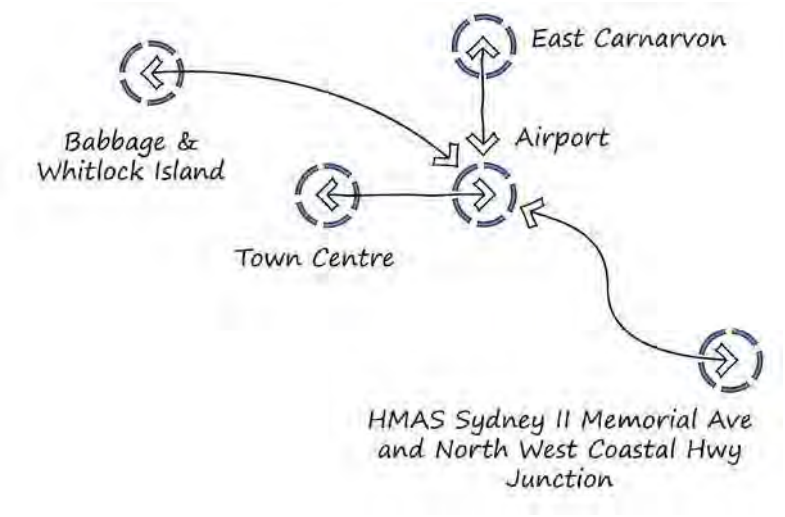
The development of the Carnarvon Airport Precinct will act as the economic catalyst that will underpin prosperity and population growth in the region. The following design principles have been applied through the formulation of this district structure plan, and will need to be carried through to ensure that detailed planning and development achieves the intended outcomes.

- Increase housing stock diversity and choice and allow scope to maximise affordability, through the provision of a range of lifestyle choices;
- The Airport's strategic location will act as a facilitator and generator of economic and business activity through value-added production in the commercial and industrial sectors;
- Enhance Carnarvon as a regional centre to service the growing mineral and exploration development of the Pilbara and Kimberley as well as a node for tourism for the Australian Coral Coast;
- Efficiently utilise land and infrastructure through the location of appropriate development, in sequence with the provision of services;
- Enhance an integrated system of open space;
- Ensure good connectivity for pedestrians, cyclists and vehicles; and
- Retain the semi-rural character and amenity of areas within the Carnarvon district.

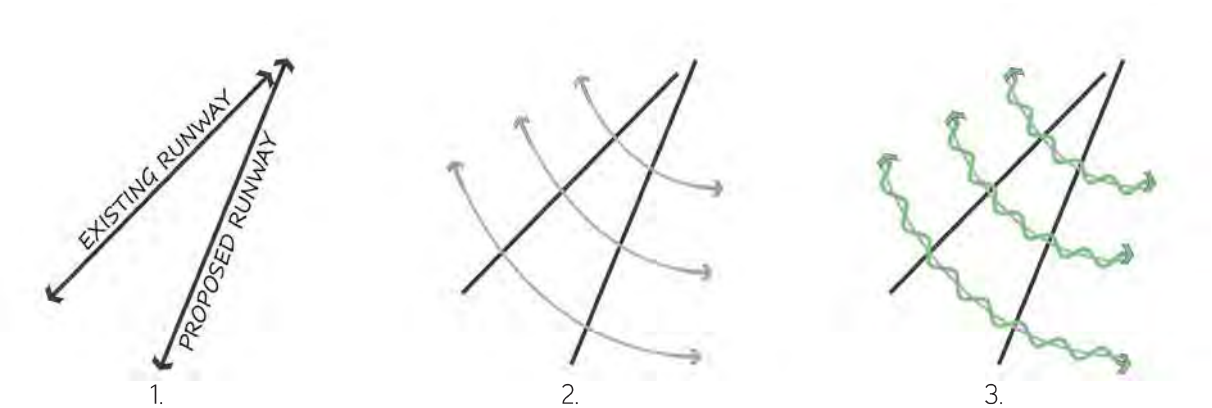
3.2 DESIGN PRINCIPLES

Building on the site analysis, the structure plan has been directed by five key principles that reflect an overarching design. These principles are essentially the key 'building blocks' that will shape the future Precinct.

Key Design Principle 1. Linkages



Key Design Principle 2. Place Based Solution



1. 2. 3.

1. Using a place based approach to the development; an innovative adaption of existing infrastructure opened the possibility to create a unique legacy and sense of history through the retention of the runway alignment.

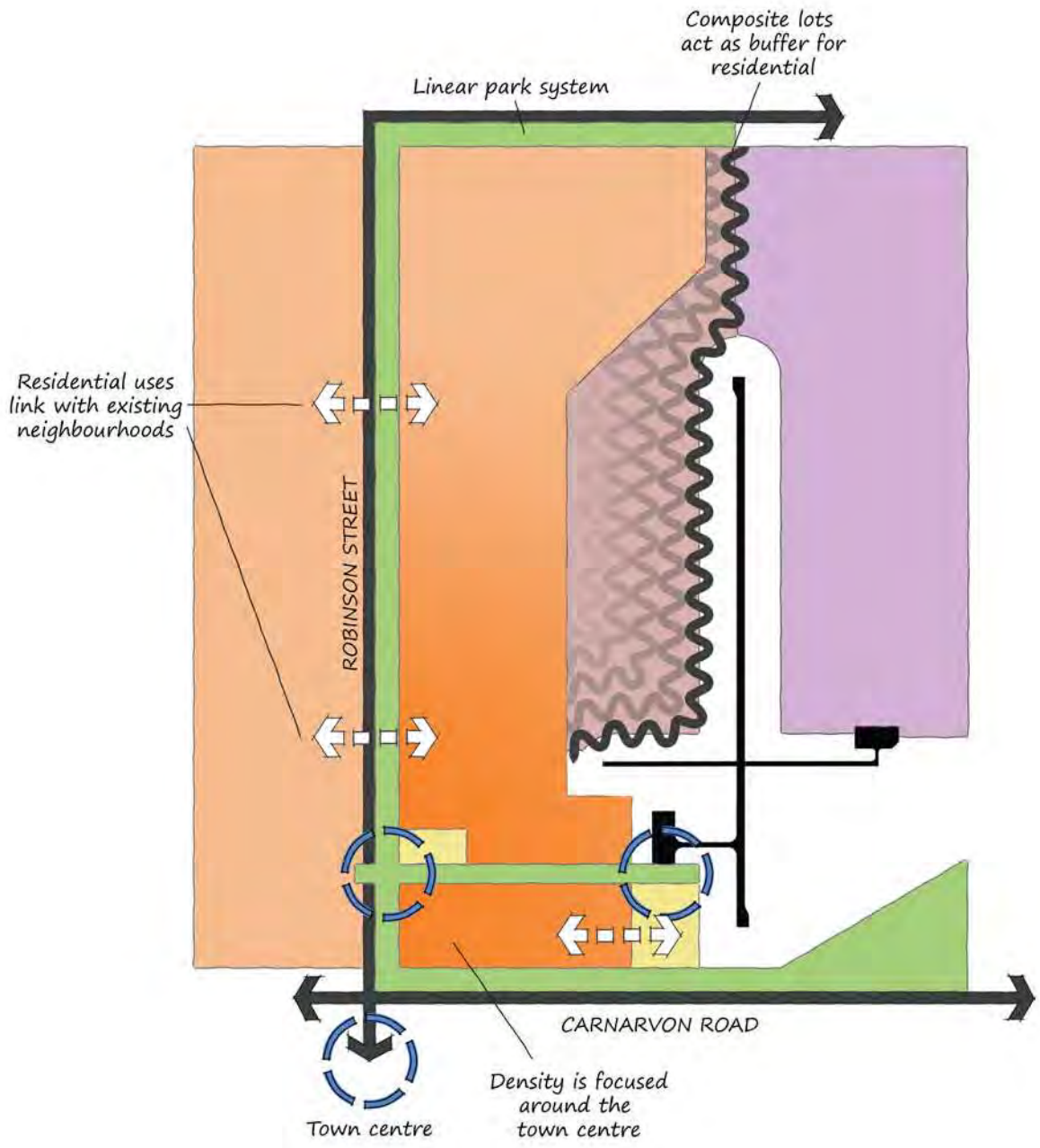
2. The alignments of the runways create a difficult land parcel to develop, by providing arcs perpendicular to the runways they 'stitch' together the development.

3. This provides the possibility to incorporate Water Sensitive Urban Design (WSUD) as an integral element in the design of new streets including bio-retention and limiting areas of impervious surfaces to improve natural percolation and storm water management.

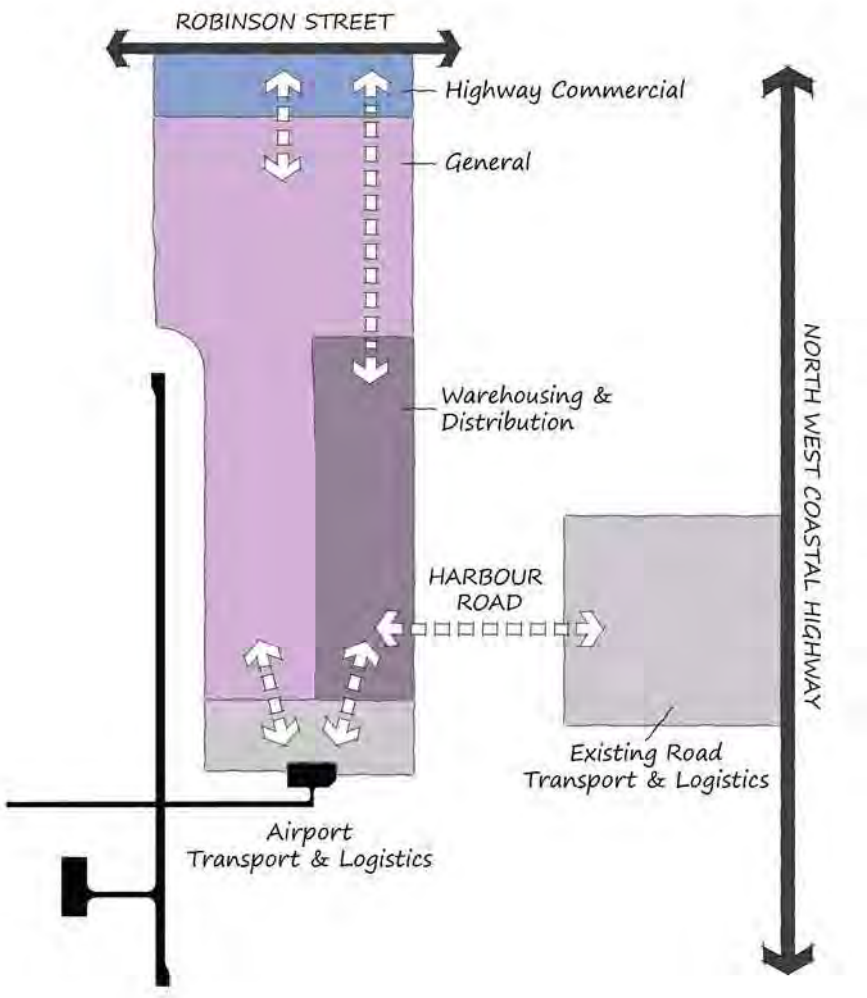
Key Design Principle 3. A String of Open Spaces

Open spaces form an integrated, connected network designed for a variety of users, across different spatial scales. These will provide for the needs of the Carnarvon community as well as build upon the identity and character for Carnarvon.

Key Design Principle 4. Residential interface



Key Design Principle 5. Industrial Synergies



In conjunction with this Structure Plan, the Carnarvon Airport Master Plan identifies the layout of the airport and terminal facilities. Proximity to the airport may provide some land uses with a significant advantage, particularly industrial.

Development within the proximity of the airport needs to take into account compatibility with the airport operations. The airport's aerial contours or obstacle limitation surfaces must be protected from the infringement of structures and dwellings for the safe operation of aircraft at Carnarvon Airport. Height restrictions are not considered to be a significant development impediment, provided that landowners are advised of the development restrictions.

Figure 32: *Composite conceptual diagram demonstrating design principles in practice*

3.3 LAND USE

3.3.1 Land Use Budget

The Structure Plan covers a gross development area of 510 hectares and once regional and district open space, arterial roads and community facilities are removed, approximately 397 hectares is available for development. Refer to Table 2 for a breakdown of areas.

Table 2: *Land Use Breakdown*

DESCRIPTION	HECTARES	% TOTAL PRECINCT
Gross area	510.34	
Non Developable		
HMAS Sydney II Memorial Avenue/Carnarvon Road	7.41	1.45%
James Street	2.27	0.44%
Boundary Road	6.88	1.35%
Heritage listed aircraft hangar	0.07	0.01%
Proposed Durack facility	2.00	0.39%
Community Space	9.72	1.90%
Floodway Reserve	47.89	9.38%
Arboretum	7.63	1.50%
Linear arrival park	19.97	3.91%
Levee Bank Reserve	9.20	1.80%
Available for Development	397.30	
Airport and Associated Development	147.22	37.05%
Residential	121.33	30.54%
Composite (Residential-Industrial) Lots	44.11	11.10%
Industry	84.68	21.31%

3.3.2 Proposed Land Uses

The land use framework facilitates a diversity of residential, commercial, retail, entertainment, hospitality, and community oriented uses that complement the existing activities in surrounding areas, while bringing additional opportunities that may not currently be available.

Residential

Objectives

- Ensure that affordable housing options are available, including appropriate housing for renters, first-time homebuyers and the moderate to low-income housing market.
- Provide a wide choice of housing that caters for a full range of household types, life stages and income levels.
- Approximately 121.33 hectares of the structure plan area has been designated primarily for residential development. The district structure plan area proposes a range of densities and recognises that some locations have a greater propensity for accommodating density, particularly those close to the town centre and amenities.

The lot type mix generally translates into the following residential typologies:

Rural Residential – 2000-5000m^2
Rural residential development provides a lifestyle option for households wanting the best of both rural and urban environments. These lots trade off distance from employment and community services for increased space, privacy and character. Larger lots may incorporate some agricultural uses.

The demand for rural residential living is driven principally by population growth and market conditions. It is envisioned that 'sea changers' and 'grey nomads' are likely to fuel the demand for rural residential lots.

Figure 33: *Example of Rural Residential typology*

Carnarvon Residential – 600- 1000m^2

As discussed, the standard typology of residential lots in Carnarvon ranges from 600m^2 to 1600m^2, with a typical lot size of 800m^2. These lots will provide a transition between the denser urban options to the rural residential and composite lots.

Figure 34: *Example of* ***Carnarvon Residential typology***

Urban Residential – 300-600m^2

In order to provide a variety of lot types and different product, a smaller lot typology is being introduced. This is aimed at first homebuyers and retirees wanting to downsize. This also provides a form of affordable housing, which was identified in the community consultation phase as a strong desire.

Figure 35: *Indicative urban residential design* ***(source: Onyx)***

Residential Airpark – 800-2000m^2

Residential airparks are residential blocks which back onto a taxiway connected to the runways. Lots are designed to look like a standard residential property from the front to accommodate the house, garage, and a hangar at the rear. Anecdotal evidence suggests 50 metre wide lots allow for easy manoeuvring of aircraft within the lot (Rehbein AOS 2009), however, typically the light aircrafts used in airparks range from 5m to 15m.

Currently, airparks exist in only a limited number of airports and are seen as premium lots due to their niche market segment, including Temora NSW, Whitsundays QLD and Kensington QLD. As the demand for this product is unknown in Carnarvon, their location allows for their removal or reclassification to residential or composite lots should the full potential not be reached.

Figure 36: *Indicative residential airpark design* ***(source: Kensington Parkside Airpark)***

The following table provides a breakdown of the projected residential typology yields based on the available data collected. Precise lot and dwelling yields will only be known as detailed subdivision design progresses. The design phase of works will occur as part of the implementation of the structure plan, thus ensuring that each stage is carefully planned for site responsiveness.

Table 3: *Residential Yields Budget*

Total area	121.328ha	
Local Open Space[1]	1ha	0. 82%
Developable area	120.328ha	

LOT TYPOLOGY	AV LOT AREA (M^2)	ROAD%	AREA%	AREA (HA)	ROAD (HA)	DEVELOPABLE AREA (HA)	YIELD (LOTS)
Carnarvon	1000	21.79%	10%	12.03	2.62	9.41	94
Carnarvon	800	21.79%	25%	30.08	6.56	23.53	294
Urban	600	27.57%	25%	30.08	8.29	21.79	363
Urban	540	27.57%	15%	18.05	4.98	13.07	242
Urban	450	27.57%	10%	12.03	3.32	8.72	193
Urban	375	27.57%	5%	6.02	1.66	4.36	116
Rural Res	2000	16.58%	5%	6.02	1.00	5.02	25
Rural Res	5000	8.83%	5%	6.02	0.53	5.49	11
Totals			100%	120.33	28.95	91.37	1338

Note:

1. Considering the high amount of regional and district open space in the locality only 1 hectare of local open space has been provided to service the needs of the immediate community within each catchment.

These densities will be finalised through the local structure plans which would guide development and provide a mechanism for cost sharing for infrastructure should the Shire act as the developer. These will need to be developed for each precinct based on a detailed economic analysis for demand which is yet to be undertaken by the Shire. This is to ensure feasibility and vitality of residential development at each stage of the Airport Precinct redevelopment.

It is desirable to ensure equilibrium between demand and supply in the release of lots and as the Shire is the predominant landowner, land should be released strategically and in accordance with an implementation plan.

Composite (Residential-Industrial) Lots

Objectives

- To ensure there are opportunities for diverse and emerging employment generating businesses.
- To provide flexibility to landowners and small business owners to live and work on the same property.
- Reduce incompatibilities between residential and general industrial land uses.

Composite lots allow for small business owners to live and work on the same property. From the street, these lots appear as standard large residential blocks and provide an attractive streetscape, as opposed to industrial style streetscapes. Access to the rear industrial area of the lot is via a side driveway and the residential portion screens the parking and workshop. These lots will provide a transition between the residential areas to the west and the industrial areas to the east as well as the airport during stage two. Composite lots will be subject to building envelope plans which designate the parcels available to each land use. These lots will range in size depending on the scale of industrial use, however, it is envisioned that the residential component would be approximately 600-800m^2 and the industrial business would require a 5m wide driveway.

Table 4: *Composite Lot Yields Budget*

AV LOT AREA (M^2)	ROAD%	AREA%	AREA (HA)	ROAD (HA)	DEVELOPABLE AREA (HA)	YIELD (LOTS)
2400	11.85%	100%	44.11	5.23	38.88	162

Industry

Objectives

- To ensure there are opportunities for diverse and emerging employment generating businesses.
- To ensure existing and future employment activities can continue and establish unencumbered by conflicting land uses on adjoining land.
- To promote value-added production through a linkage with transport infrastructure (highway and airport).
- To encourage opportunities for high tech aviation industries and aviation support.

The main drivers of the supply and demand of industrial land are population growth, economic growth, location criteria and market preferences. Assuming positive economic and population growth, this structure plan aims to focus on location criteria and market preferences. Below is a table identifying industrial typologies and location criteria.

Table 5: *Industrial Typologies and Location Criteria*

INDUSTRY TYPOLOGY	POTENTIAL LAND USES	LOCATION CRITERIA
General	Agriculture and food processing Metal fabrication	Regional arterial roads Small lots (up to 2,000m^2) and some medium sized lots (4,000m^2)
Light/Commercial	Manufacturing that utilises partially processed materials to make products Showroom and services	Highly accessible, visible frontage, transport/activity corridors/some residential locations Very close to centres of population and trade
Warehousing & Distribution	Storage and display of goods	Road freight routes Linked to logistics and transport industries Very large sites
Transport & Logistics	Transport and courier depot and services Distribution centre Packaging, parts and services Disposal, recycling	Strategically located in relation to source of produce/goods, transport corridor and/or ports and the market Links to warehousing sites Very large sites 4000m^2 - 8ha

Based on the above table, Key Design Principle 5 - Industrial Synergies demonstrates the spatial relationships that can potentially be formed. The development of synergies between new commercial industrial land uses and airside activities will be promoted throughout this precinct, with support for high tech aviation industries and aviation support where precinct land abuts the periphery of aviation land.

Airport and Associated Development

Objectives

- To improve air transport experience for Carnarvon residents, business travelers and tourists.
- To improve freight transport facilities and the potential for direct air access to interstate and international food markets.
- To potentially allow for air transport services to the mining industry including, for example, fly-in and fly-out services for contractors and staff.
- Provide facilities for the safe, efficient and economic handling of aircraft, passengers, freight and related services and support facilities.

Terminal

The existing terminal building has capacity to support Carnarvon in the short term whilst the main 04/22 runway remains in place, however, the relocation of the runway will require a new terminal building. It is envisioned that this will be a landmark feature, located at the termination of the James Street extension. Potentially, it can be reused once the runway relocates as a new community facility servicing the emerging community.

The site investigations and community engagement identified that the terminal lacks facilities, including tourist information and refreshments. The new terminal will allow for the greatest amount of flexibility and future adaptability through an open plan building that makes use of moveable partitioning.

Pedestrian Plaza

The Pedestrian Plaza is an essential component of the development providing an appropriate transition zone between the terminal and the car park. The Carnarvon Airport Master Plan proposes to establish a people focused plaza to create a relaxed, unique Carnarvon experience designed to integrate the terminal with the car park.

Car Parking

Subject to detailed design, the car parking will be located within the buffer of the Bureau of Meteorology building as this land area will have restrictions in terms of height and permitted activities.

Dedicated Transport & Logistics Apron

A dedicated transport & logistics apron is depicted on the eastern side of the new cross runway to serve the potential needs of the resource and agriculture sector.

Community

Objectives

- To provide for a range of health, educational, government, cultural and social facilities to serve the local community.
- To provide space that maximises community benefit.
- Encourage access to space in order to conduct a range of community activities that enhance the physical activity, social interaction and cultural development of the community.

The community use reserves proposed in the plan complement the mixed use/community facility terminal building once the airport and general aviation facilities eventually relocate. It is envisioned that the area will provide key community facilities and services such as emergency service, community meeting space and entertainment, education and sport and recreation. Prior to this structure plan, the Shire has allocated a portion of the airport precinct near James Street to Durack Institute of Technology (a State regional training provider). This site has been assumed to be approximately 2ha in size and is marked indicatively on the plan.

One way of considering facilities that should be provided in an area is the use of ratios of facilities per head of population. These provision standards provide an indicator of potential needs and allow reference to standards applied elsewhere.

Based on recommended population ratios on the provision of community facilities, a needs assessment was undertaken based on an approximate population of 3,750. These ratios do not take into account the location of the facility within the structure plan area and/or existing services in Carnarvon.

Table 6: *Needs Assessment*

FACILITY	PROVISION	RATIO (1 PER X)
Playing Fields	1.07	3,500 population
Skate Park	1.07	3,500 population
BMX Track	0.38	10,000 population
Playground and playspaces	1.34	500 children aged 0-12 years
Primary School	1.00	1,500 lots
Indoor Recreation Centre	0.54	7,000 population
Local Community Centre (GFA: 200-800m^2)	0.75	5,000 population
Seniors Centre	0.38	10,000 population
Childcare Centre	0.75	5,000 population
Library	0.63	6,000 population

RECREATION FACILITIES	LOCATIONAL CRITERIA
Playing Fields	Preferably located close to schools. Can be on flood prone land. AFL and cricket can share fields
Skate Parks	Co-located with youth recreation facilities, key suburb parks
BMX Track	Can be located on undulating land. Flood prone land appropriate
Primary School	Located near denser areas of residential land, can be co-located with playing fields
Multi-purpose community centre	Located on a main street with street frontage for optimum visibility and accessibility

Open Space

Objectives

- Create a network of pedestrian and bicycle access throughout the site through linear open spaces and to provide appropriate links to existing spaces and nodes.
- Provides safe, convenient and legible networks for walking and cycling to points of attraction and beyond the development while preserving maximum visual amenity.
- Provides public open space that meets requirements for outdoor recreational and social activities and contributes to the identity, environmental health and safety of Carnarvon.
- Assist in the disposal of stormwater and cater for flooding events.

The structure plan designates the location of the district-level public open space for the Airport Precinct and it is intended that additional local-level public open space will be identified during the more detailed planning phases. Local open space should have a range of play spaces and opportunities and cater to older children and young people as well as the traditional playground for young children.

Table 7: Liveable Neighbourhoods Public Open Space Provision

	HECTARES
Gross area	**510.34**
Deductions	
Airport and Associated Development	147.22
Industry	84.68
Proposed Durack facility	2
Net Subdivisible area	**276.44**
Public open space @ 10 per cent	**27.64**
Public open space contribution	**94.48**
Unrestricted public open space sites	**38.96**
Community Space	9.79
Linear arrival park (Passive recreation and amenity)	19.97
Levee Bank Reserve (Passive recreation and amenity)	9.2
Restricted use public open space sites	**55.52**
Floodway Reserve (Floodway and playing fields)	47.89
Arboretum (Passive recreation and conservation)	7.63

Figure 37: Open Space Plan

3.3.3 Buffers

Navigational Aid Equipment

The CASA Manual of Standards Part 139 - Aerodromes requires that VHF Omni-directional Radio Range (VOR) buffers are measured 1500m from the centre of the VOR antenna. Development proposals between 100m and 1500m from the centre of the VOR antenna that exceed an angle of elevation of 2.0°, measured from ground level at the centre of the VOR antenna, require assessment by a VOR technical authority. 300m from the antenna, the height limit (10.5m) is not considered to be a constraint on development. Within 100m the VOR and 150m of the Non-Directional Beacon requires very limited interference as per CASA standards. Buffer heights are detailed in the figure below.

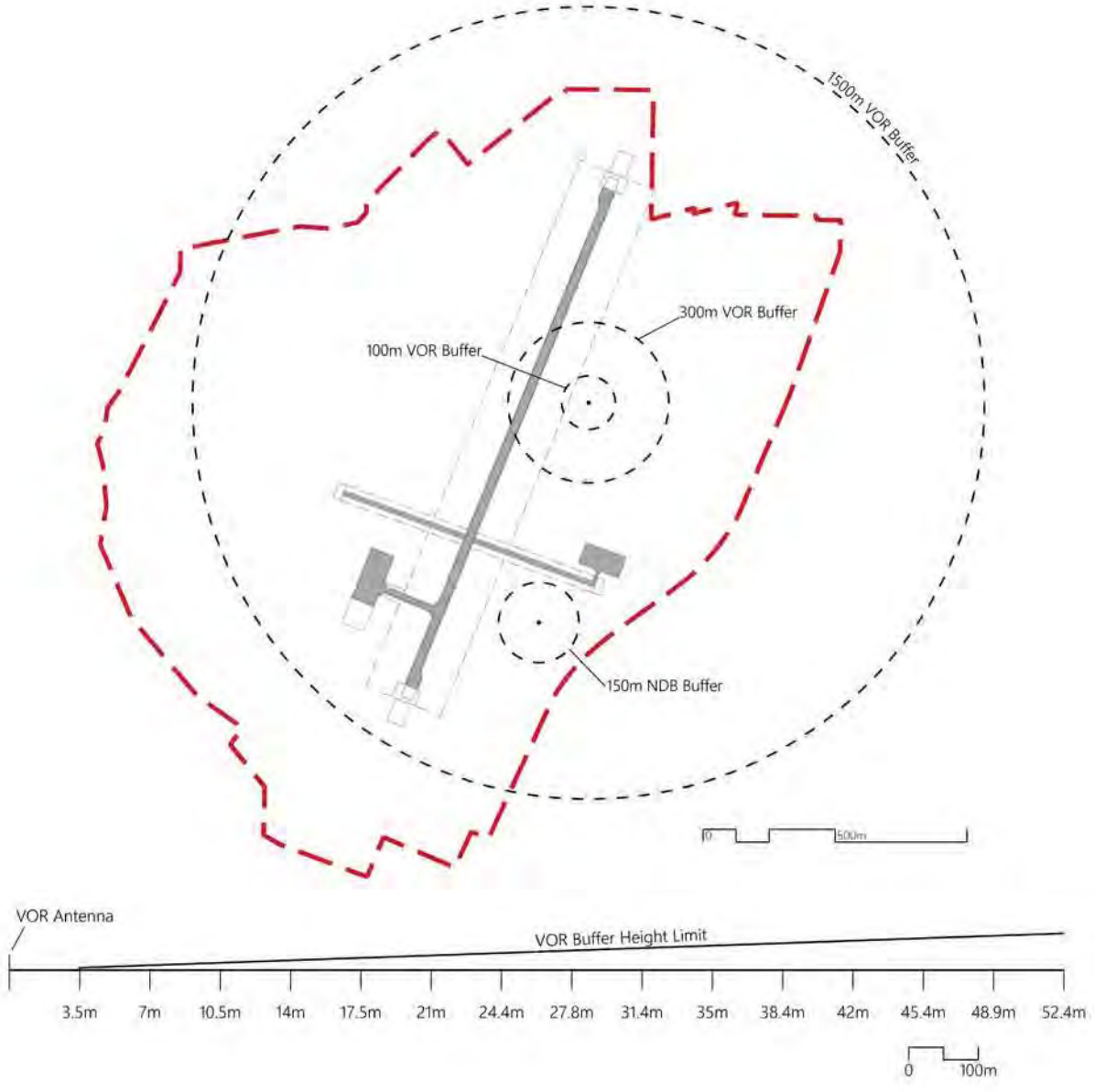


Figure 38: Navigational aid equipment *height limits*

Obstacle Limitation Surface

The Obstacle Limitation Surfaces (OLS) are a series of surfaces that set the height limits of objects around an aerodrome. They are established in accordance with International Civil Aviation Organisation (ICAO) specifications, as adopted by Australia's Civil Aviation Safety Authority (CASA). Obstacles penetrating above the OLS are considered a hazard to aircrafts and will are marked and/or lit, unless removed.

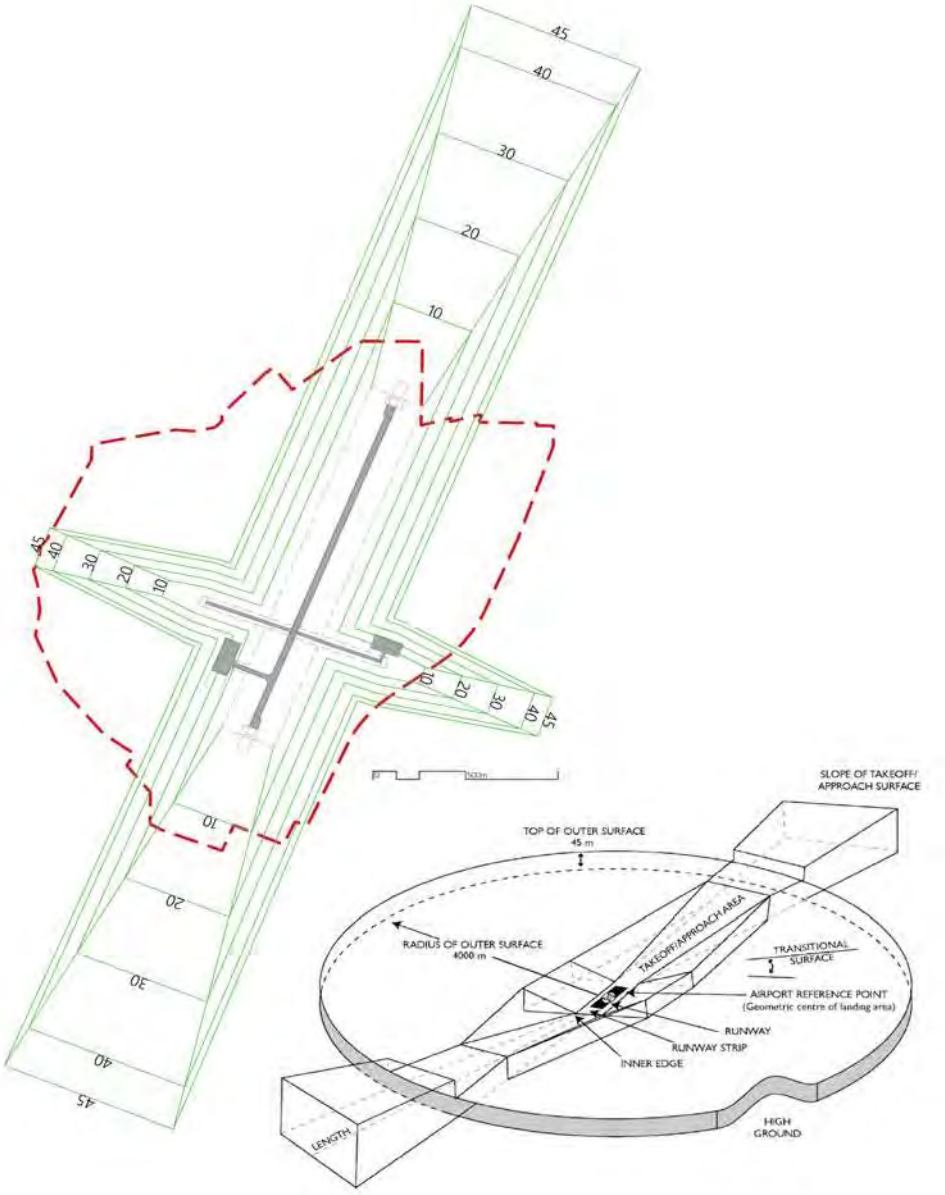


Figure 39: Obstacle Limitation Surfaces

Noise Exposure

Aircraft operating in Australia must meet noise standards specified in the *Air Navigation (Aircraft Noise) Regulations 1984* and noise levels for land uses are set by the EPA. An Australian Noise Exposure Forecast (ANEF) is a forecasting methodology that is used throughout Australia to produce a chart of varying degrees of aircraft noise exposure for the areas surrounding an airport. The contours produced result from calculations based upon forecast aircraft movements. The contours are not measures of aircraft noise expressed in decibels. They are mathematical contours based upon a forecast volume of aircraft movements. For example, one very noisy aircraft movement in one year, whilst it would be loud, would not change the model. A large number of movements of quieter aircraft would change the model, because of the volume of movements. The below figure details the forecasted Australian Noise Exposure Concept.

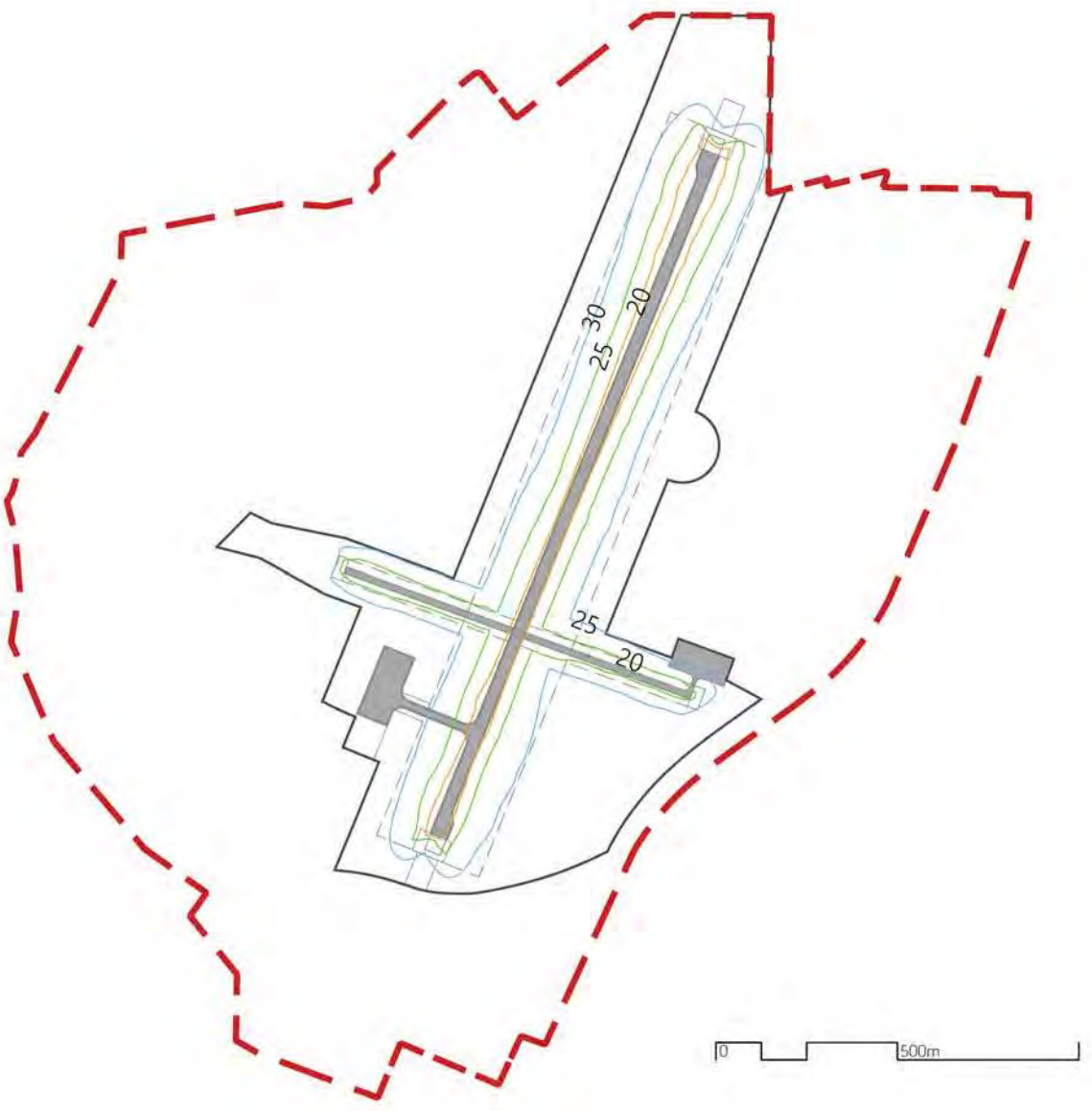


Figure 40: *ANEC 2024 based on Connell Wagner (2005)*

Figure 41: *The Structure Plan (Short-Medium Term Option)*

3.4 MOVEMENT NETWORKS

3.4.1 The Site And Surrounding Road Network

Roads of importance to the project are considered below. Roads are discussed where they comprise an important part of the road network and are classified as local, district or regional distributor roads. Local residential streets provide for local residential connectivity only.

North West Coastal Highway

The North West Coastal Highway is located about 3.5km east of the subject land and is a primary regional road under the control of Main Roads Western Australia (MRWA). The North West Coastal Highway is the primary road connection to Carnarvon and links Geraldton to Port Hedland. The Highway is constructed as a regional rural highway with a typical 7 to 9 metre sealed carriageway. Intersections are controlled by give way or stop signs and a posted speed limit of 110kph is provided along most of its length.

Traffic data on the MRWA website shows that to the north of Blowholes Road, there are on average 510 vehicles per day (vpd) of which 36% are heavy goods vehicles. South of the townsite there are 660vpd, of which 32% are heavy goods vehicles. The data suggests an average of approx 200 truck movements per day passing through Carnarvon. Locally to Carnarvon, traffic volumes increase between the townsite and the river crossing with approx 1,400vpd.

Access to Carnarvon is made by either HMAS Sydney II Memorial Avenue or Robinson Street. The southern leg of North West Coastal Highway yields to Robinson Street / North West Coastal Highway north.

HMAS Sydney II Memorial Avenue

HMAS Sydney II Memorial Avenue provides the southern connection of the town to the North West Coastal Highway. It is constructed to a rural standard with a pavement of over 7 metres width. Adjacent to the south side of the Airport, HMAS Sydney II Memorial Avenue changes in name to Carnarvon Road and is restricted to 80kph. Traffic data supplied by MRWA (July 2009) indicates an average daily volume of 230vpd.

Robinson Street

Robinson Street forms the major entry road into the town centre and is constructed as a single carriageway road. Between Olivia Terrace and Campbell Way there is a section of divided road, some parts providing four lanes. The intersections of Francis Street and Olivia Terrace are controlled with roundabouts to provide traffic management through the commercial centre of the town. Between the two roundabouts a wide boulevard is provided with parking to the centre of the street. The below figure shows various points views along Robinson Street.

Figure 42: *Robinson Street*

Traffic data supplied by MRWA (June 2010) indicates an average daily volume of 7,900vpd close to the town centre. The daily volume on Robinson Street reduces to about 6,400vpd east of Marmion Street and 3,100vpd to the west of North West Coastal Highway.

Cornish Street

Cornish Street is an existing constructed road bordering the east of the airport. It provides a convenient link between Carnarvon Road and Robinson Street. No traffic data is available, but it would be expected to carry less than 500 vehicles per day.

Carnarvon Airport

The airport is presently accessed from James Street (off Robinson Street). Carnarvon Road also intersects James Street to connect the airport to the south. An assessment of the future expansion of Carnarvon Airport suggests that by 2032, there could be up to 8 flights per day, which can be expected to generate approx 400vpd.

Figure 43 shows the indicative stage 3, where the airport is relocated. This report considers three stages of possible development of the subject land as shown in Appendix B of the Carnarvon Airport Structure Plan Traffic Report attached in Appendix .

Figure 43: *Stage 3 Indicative Plan (Long Term Structure Plan)*

3.4.2 Traffic Modelling

Traffic modelling was undertaken based on Stage 3 so as to reduce the need to rebuild roads to cater for increased demand should the land be redeveloped. The development of the airport land could increase present day traffic movements by a level that would be deemed to have an impact. To assess the impact, a traffic model has been developed using the Saturn suite of programs to consider the existing and proposed land uses. The model distributes traffic to the local road network based on travel time / distance and road operational capacity. The expected trips are discussed below.

Figure 44 shows the expected traffic movements of the structure plan area. The flows shown by the model output need to be factored by ten to show expected daily volumes. It should be noted that due to spot loading of development cells (zones), traffic flows might change significantly between each road section. For a further discussion on the assumptions used to create a matrix of vehicle trips please refer to Appendix 3.

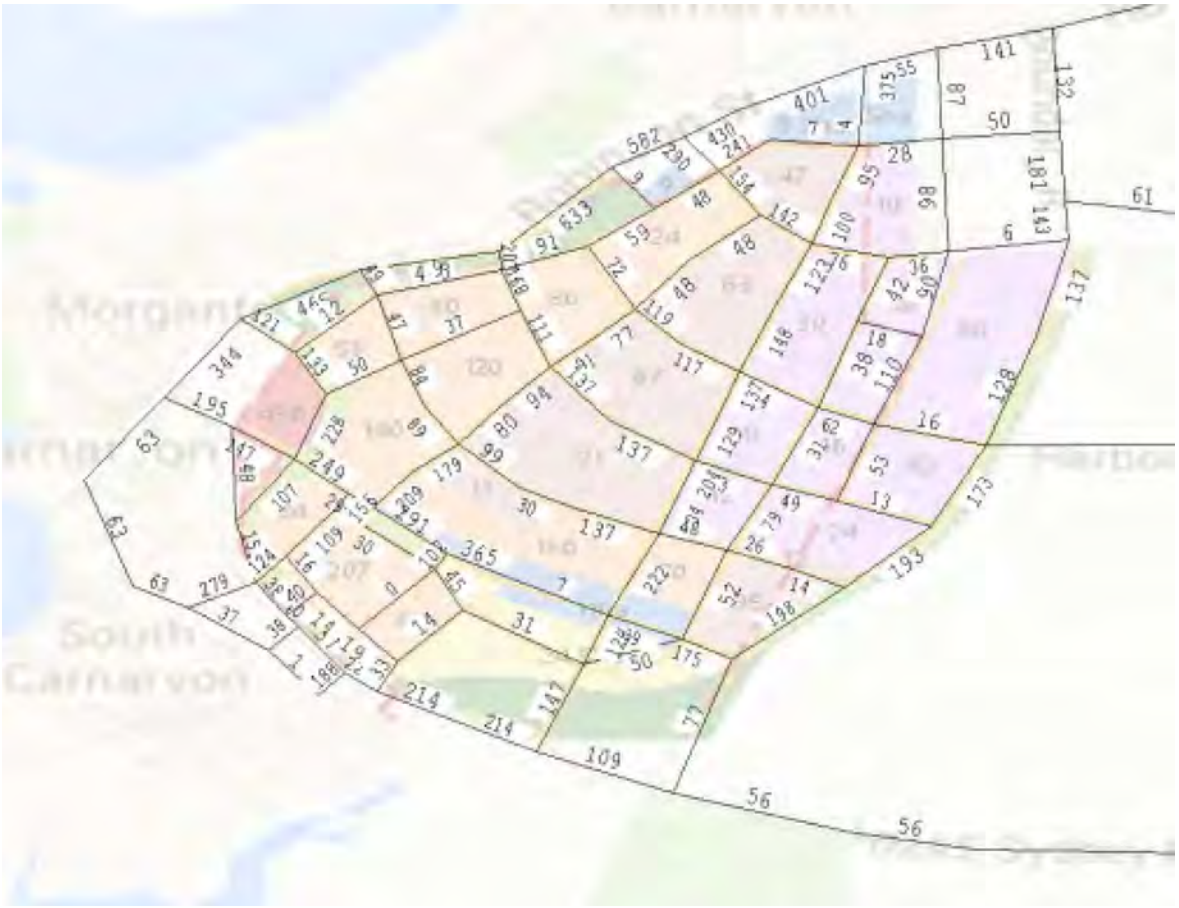


Figure 44: *Structure Plan Area Traffic Forecasts >300vpd (daily flow x 10) (Note: this modelling was based on a plan with greater detail than the plans illustrated within this structure plan report).*

3.4.3 The Local Road Network

The traffic model has been interrogated to determine the expected daily traffic movements on local streets. Figure 43 graphically shows the modelled forecast flows based on road hierarchy traffic flow ranges.

Roads less than 1,500vpd

Roads 1,500–3,000vpd

Road 3,000 – 7,000vpd

Roads >7,000vpd

Figure 45: *Saturn Model Graphic Volume Plots*

The forecast traffic flows provide a basis to develop an internal road hierarchy. Table 8 reproduces the advice on road types recommended by *Liveable Neighbourhoods*. Generally, the road hierarchy is based on the traffic demands of each street to determine its function and road reservation requirements. However, where future traffic forecasts are low, there is a need to identify higher order streets that should promote vehicular movements through the precinct.

Table 8: Liveable Neighbourhoods Road Hierarchy

INDICATIVE DAILY TRAFFIC FLOW*	DESIGNATION	STREET CHARACTERISTICS
< 1,500 vpd	Access Street	Roads exist at 7.2 metres
1,500 vpd to 3,000 vpd	Higher Order Access Street	Wider access streets (7 to 7.5m) cater for higher traffic volumes and are located closer to neighbourhood centres.
3,000 vpd to 7,000 vpd	Neighbourhood Connectors	Generally 2-lane undivided. These are 'special' streets and their design needs to have regard to context, function and adjacent land uses.
7,000vpd +	Arterial Streets	These are major roads that should not normally occur within residential areas.

* Function of streets needs to be considered as well as traffic volume.

The future traffic demands are shown to be low and most roads are shown to accommodate less than 1,500vpd. The local road hierarchy has been developed to recognise the importance of local roads in terms of access to differing land uses. Figure 46 shows the recommended road hierarchy.

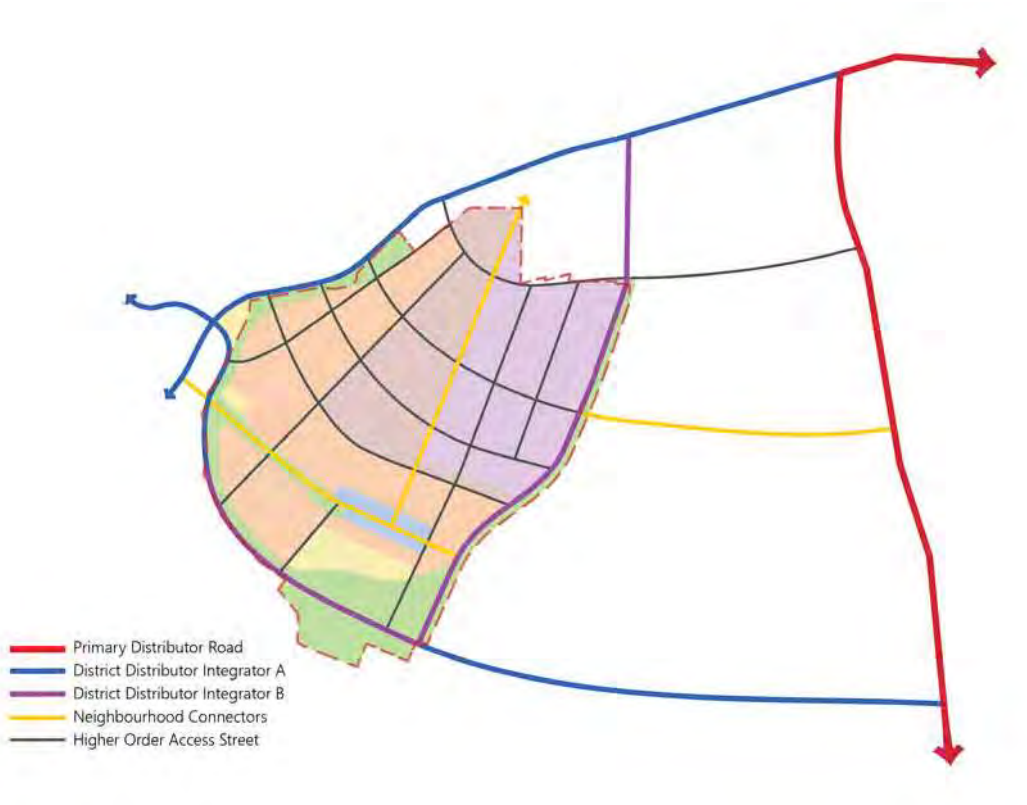


Figure 46: Recommended Road Hierarchy

The following road reservation requirements identify the minimum recommended width to be provided. The road reserves may be wider to provide additional landscaping opportunities or to incorporate the drainage strategy.

Integrator Arterials

Integrator arterial streets are higher order roads providing a district level function. A road reservation of 25.2m to 29.2m is advised by Liveable Neighbourhoods. At the request of the WAPC the east-west connection from Cornish Street to Stuart Street has been classified as an 'Integrator B' arterial road (25.2m wide cross section) to account for the town centre function and land use, rather than the traffic volumes predicted.

Neighbourhood Connectors

Liveable Neighbourhoods provides the following comment on neighbourhood connectors:

> *Neighbourhood connectors link neighbourhoods and towns are carefully designed to calm traffic, limit noise and facilitate pedestrian use. They have frequent local street connections. They should not attract substantial long distance through traffic, but provide for safe and convenient local travel to and from arterial routes, usually at signal controlled intersections.*

Roads shown in yellow in Figure 46 are considered as neighbourhood connectors as they provide the primary access to the structure plan area. Daily traffic flows on these roads are typically below 3,000 vehicles and a standard 7.2 metre carriageway in a 20 metre road reservation is recommended. *Liveable Neighbourhoods* indicates a road reservation width of 19.4m to 24.4m (to provide on-street parking in higher density locations).

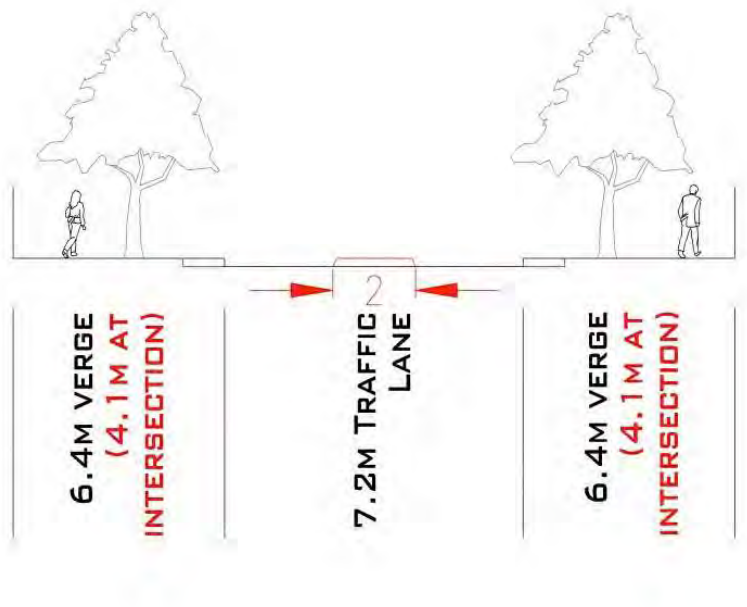


Figure 47: *20m Cross-Section*

At higher order intersections a median island of 2.0 metres width would be desirable to provide safer pedestrian crossing points and to highlight the intersection. A minimum verge width of 4.1 metres could be used resulting in a minimum road reservation of 17.4 metres.

Figure 47 shows a typical road cross-section incorporating localised widening to accommodate a pedestrian median. The cross-section uses a 20 metre road reservation to provide robustness to the reservation and permit on-street parking embayments of 2.2 metres (providing a residual verge of 4.2 metres). A 20.0 metre cross-section is recommended for neighbourhood connector roads.

Higher Order Access Streets

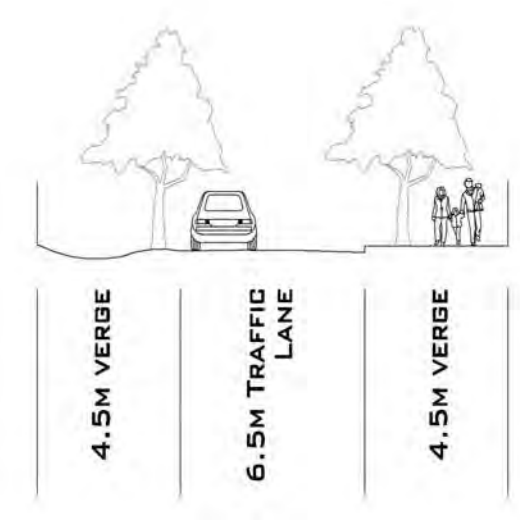


Figure 48: *16m Cross-Section*

Higher order access streets are the main streets within the structure plan area and provide direct lot access. These higher order streets would be provided with a 6.0 metre to 7.0 metre carriageway depending on bus routes and Local Government requirements.

Figure 48 shows a typical road reservation for a higher order access street with a 6.5 metre wide carriageway and 4.5 metre verges. If higher density dwellings are proposed, then a wider road reservation to accommodate on-street parking should be considered. A 16.0 metre cross-section is recommended for higher order access streets.

It is recommended that the minimum carriageway width be provided to encourage a slower speed environment in residential streets. Many streets with 7.0+ metre carriageways and lower density lots frequently experience traffic speeds well in excess of the posted 50kph limit. A reduced carriageway width will assist in achieving a more appropriate 40kph typical travel speed.

Industrial Access Streets

Although most roads are identified as higher order access streets within the structure plan area based on the forecast daily flow, a wider carriageway may be more suited to roads with industrial lot access. A wider carriageway of 9.0 metres is commonly used to provide ample access for large trucks and on street stopping but discourage high speeds. However DC Policy 4.1 indicates a wider carriageway of 10.0m, which allows for 3 traffic lane widths. A standard 5.1 metre verge is also used to allow greater turning opportunity from the road to the industrial lot.

Access Streets

Access streets with daily traffic flows less than 1,500 vehicles are shown coloured cyan in Figure 46. A reduced carriageway width of 5.5 metres is suited to these low volume streets and is supported by *Liveable Neighbourhoods*. Using two residual 4.5 metre verges, a road reservation of 16 metres would be sufficient for these streets. There should be no need to provide medians in these low volume streets. A 16.0 metre cross-section is recommended for access streets.

A 14.2 metre road reservation is the practical minimum road reservation that can be utilised for access streets. Occasional on-street parking can be accommodated to cater for visitors without significant impact to traffic movement. Such road reserves should only be used where the access street provides no major linkage to other access streets. Access streets can be provided with a 14.2 metre reservation where on-street parking is not expected.

Roads Adjacent to Open Space

Where the road reservation abuts Public Open Space (POS), bushland etc, there is limited need to provide a verge. The verge may be reduced where parking and/or services are not required and should be considered at the time of subdivision. A minimum verge of 0.75 metres is recommended by current road planning standards to accommodate street furniture. Footpaths do not need to be adjacent to the road where POS is provided, but must be provided in a safe and appropriate manner. Figure 49 shows an example of a reduced road reservation adjacent to open space.

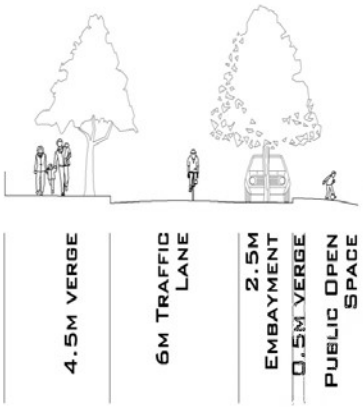


Figure 49: *Road Adjacent to Open Space*

Boulevards

The development of local streets as boulevards adds opportunity for landscaping and reduces the visual level of blacktop. The use of divided carriageways with median treatments requires that a minimum carriageway width of 4.1 metres be provided to conform to Austroads. Commonly boulevards are provided with a carriageway width of 4.5 metres, often designated as a 3.0 metre traffic lane and a 1.5 metre cycle lane. Figure 50 shows a 4.5 metre wide carriageway indicating that ample width exists to pass a stationary vehicle in the event of a breakdown.

Figure 50: *Boulevard Treatment*

Roads with Table Drains

Where table drains or other similar features are used, a wider road reservation would be required to accommodate the drain. Figure 51 shows a cross-section for a local access street with a table drain. The resultant road reservation will depend upon the drain requirements. The table drain does not need to be adjacent to open space as indicated by Figure 51. A table drain can be used adjacent to lots, but attention to the location of lot access will be required. Further, a table drain may also be provided within a median. The use of these features is site specific and the details should be discussed at the subdivision stage.

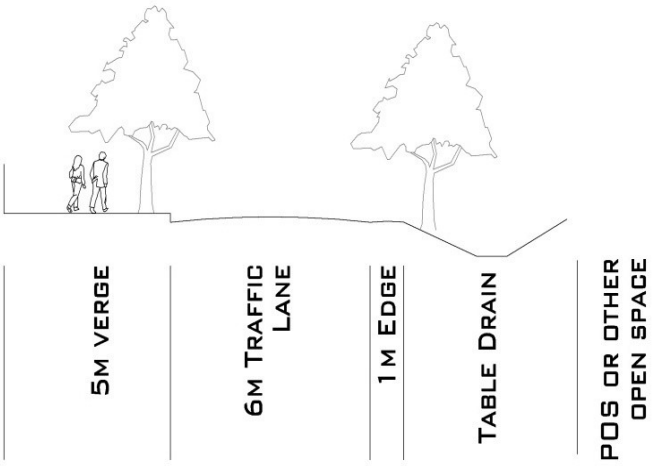


Figure 51: *Roads with Table Drains*

Traffic Management

Figure 52 shows the location of traffic management devices that may be required within the structure plan area.

Four-way intersections

Four-way intersections are indicated in the concept plan and are not considered to be a road safety hazard where traffic volumes are less than 2,000vpd (as set out by Liveable Neighbourhoods). Four-way priority control intersections may also be appropriate on residential streets with volumes less than 5,000vpd where an offset on the terminating streets is provided. Alternatively medians on the terminating streets could also be used.

Where daily traffic flows exceed these levels, a roundabout would be recommended to control movement at the intersection and reduce traffic speeds. Figure 52 identifies where roundabouts may be appropriate. Within industrial areas roundabouts are not the preferable traffic management option due to difficulties of turning by large trucks. Four-way intersections in industrial areas should be reviewed at the time of development.

Figure 52: *Traffic Management*

On residential streets alternative methods of control are acceptable and Figure 53 shows the treatments recommended by Liveable Neighbourhoods. On industrial roads, the use of roundabouts is not recommended due to the damage caused by large vehicles. In industrial areas, four-way priority control is considered acceptable, subject to capacity considerations.

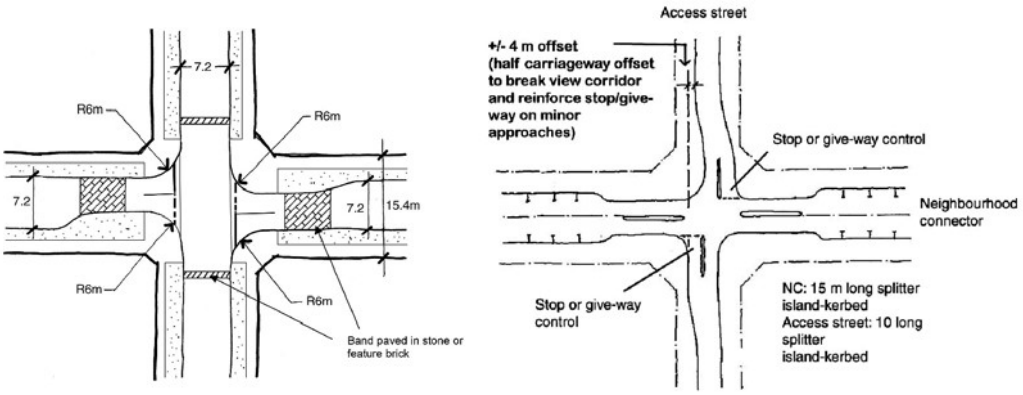


Figure 53: *Liveable Neighbourhoods Four-way Intersections.*

Left: Access street to access street with-four way and stagger.

Right: Left-right minor offset four-way on neighbourhood connector (derived from Austroads Guide to traffic engineering, Part 5 Intersections, Figure 5-8).

Local Intersection Design

To reduce the opportunity for speeding it is recommended that corner radii advised by *Liveable Neighbourhoods* be used within the subdivision. The recommended radii are:

- 6.0 metres - access street / access street intersections
- 9.0 metres - access street / neighbourhood connector

Where larger vehicles are expected, such as cars towing boats and buses accessing the school, larger radii may be required and should be considered at subdivision stage. Within the industrial area, corner radii of 12 metres to 15 metres may be required to provide access for trucks.

3.4.4 External Intersection Controls

As a result of the full development of the structure plan area, key intersections may require some form of upgrading. It is commonly accepted that the peak hour equates to 10%[1] of the daily flow and the major movement during the peak period is typically 70% in the peak direction. These basic assumptions are applied to the modelled flows to assess what form of control can be expected to be required at key intersections. The main intersections are detailed below and further discussed in Appendix 3.

1 Actual values vary from about 7% to 9%.

Access A (James Street / Robinson Street) Intersection

The peak flow on Robinson Street at Access A is expected to be in the order of 1,134 vehicles with a side road demand of (195 x 70%) 140 vehicles (James Street). A priority intersection can be expected to operate with a peak demand up to about 1,500 vehicles. Access A is shown to have a demand of 1,140 vehicles and should operate within practical absorption capacity. It can be expected that a second traffic lane on James Street would be required. James Street will require an additional lane approaching Robinson Street.

Access B (Babbage Island Road / Robinson Street)

Access B is indicated to form a four-way intersection and current planning guidelines require that some form of control be provided. A roundabout is considered suitable to this intersection, as a high pedestrian movement would not be anticipated. Access B would require a roundabout.

Access H (Robinson Street / Cornish Street / Angelo Street)

Access H is the existing intersection of Robinson Street / Cornish Street / Angelo Street. The modelling indicates that the side road demand on Cornish Street will increase by about (87 x 70%) 61 vehicles. The increase is not too significant and the intersection may continue to operate in an acceptable manner. However, as a four-way intersection, current planning guidelines require that some form of control should be provided (regardless of future development). The existing intersection of Robinson Street / Cornish Street / Angelo Street should be controlled.

Access I (Boundary Road)

Access I is the existing intersection of Robinson Street / Boundary Road. The peak flow on Robinson Street at Access I is expected to be in the order of 480 vehicles with a side road demand of (132 x 70%) 92 vehicles. Table 4.1 in Appendix 3 indicates that uninterrupted flow conditions will exist. A simple priority intersection should suffice for Access I.

Access M (Cornish Street / Carnarvon Road / HMAS Sydney II Memorial Ave)

Access M has a peak demand of (77 x 70%) 54 vehicles and based on 100 vehicles using Carnarvon Road, Table 4.1 in Appendix 3 indicates that uninterrupted flow conditions will exist. A simple priority intersection should suffice for Access M.

Pedestrians, Cyclists and Public Transport

Current planning guidelines suggest that all streets should be provided with a footpath wherever possible. Where traffic flows exceed 1,000 vehicles per day, a footpath to both sides of the road should be provided. All new subdivisions will be required to provide footpaths in accordance with current planning standards (*Liveable Neighbourhoods*). A standard footpath of 1.5 metres is desirable to every street.

Cycling

Most streets within the structure plan area have forecast future traffic flows below 1,500vpd and therefore cycling on street would be considered as safe and acceptable. Figure 54 shows roads where dual use paths and cycle lanes are desirable.

Figure 54: *Dual Use Paths and Cycle Routes*

Public Transport

There is no public transport service expected to be implemented in Carnarvon, however, local buses can be expected to transfer work camp residents between the airport and places of work. Planning for future bus services is recommended for structure plans, even thought the introduction of such services may not occur for many years. Figure 55 shows streets that should be planned for future bus services.

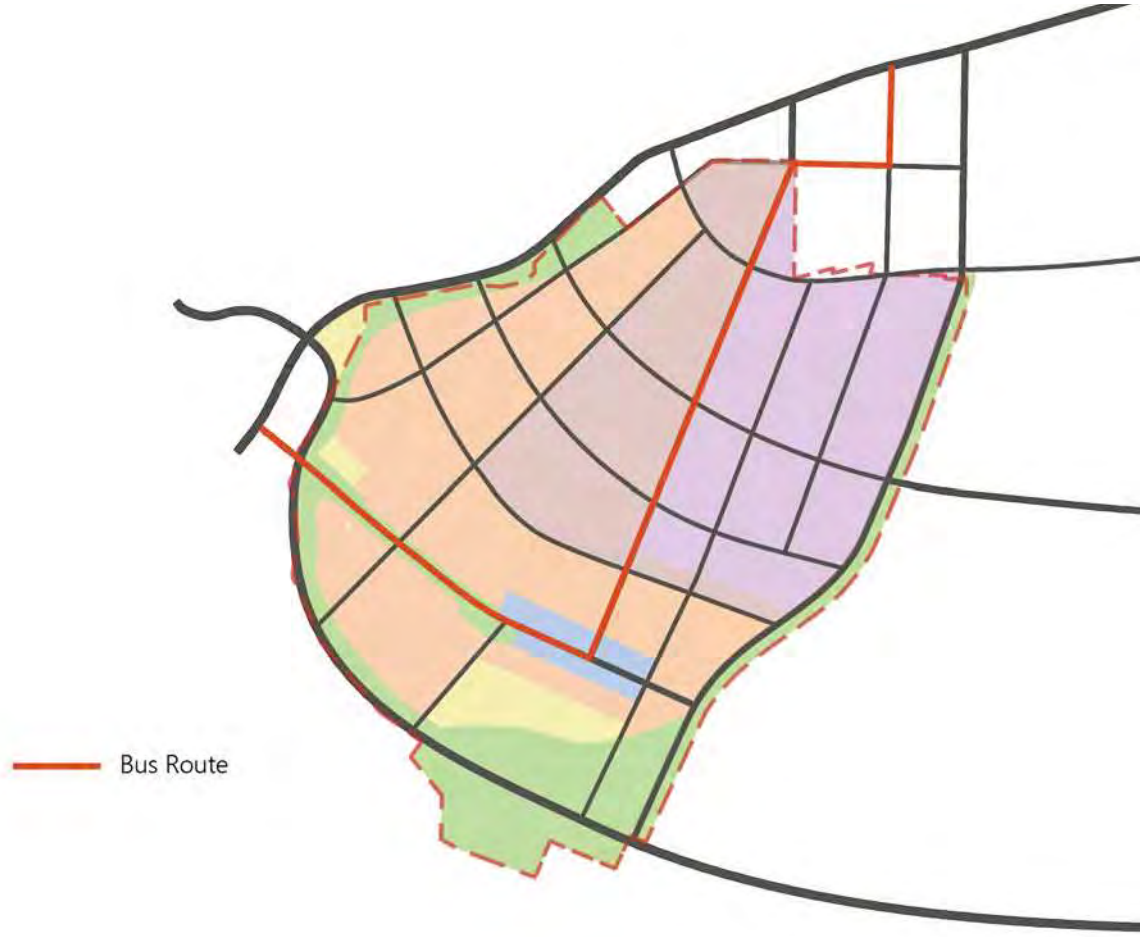


Figure 55: *Roads to be suitable for Buses*

3.5 EDUCATION FACILITIES

Current WAPC and Department of Education (DoE) guidelines require the provision of one primary school for every 1500 lots. In the case of the project area however, the DoE has indicated that there is existing capacity at the proposed Carnarvon Community College which is the amalgamation of two primary schools and the high school. The project involves planning to develop the site into a new K-12 School, divided into three stages. Stage one and two comprise new pre-primary, primary, and general school facilities while stage three comprises new high school learning areas, a full size oval as well as the refurbishment of existing buildings. A new trade training centre specialising in metal fabrication and building construction is also planned for in stage one.

In the future, should another school be required, there is sufficient capacity within the site designated for community use to include a primary school. In addition, the completion of the Carnarvon Community College will leave the Carnarvon Primary School vacant. It is recommended that this site be utilised for housing and open space. This site may be amended during the Local Planning Scheme Review from 'Education' to 'Residential R15'.

3.6 EMPLOYMENT

Encouraging the development of new jobs and employment industries which meets the needs of the local community is a key component of the structure plan. The Shire is proposing to conduct an economic needs assessment for Carnarvon; this will determine demand for particular land uses and may result in changes to land uses in the structure plan to reflect this. In the mean time, using the employment multipliers used in the *Industrial Land Needs Study* (Syme Marmion & Co 2008) it was estimated each employee working in industrial estates over the Perth and Peel areas has 0.082 gross hectares (820m^2). The overall long-term employment generated through the implementation of the structure plan was estimated to be 1400 jobs, this includes 285 jobs generated by composite lots (1.5 jobs per lot).

3.7 INFRASTRUCTURE COORDINATION AND SERVICING

3.7.1 Water and Wastewater

Existing Water Corporation Network

The existing water and wastewater management assets are the sole responsibility of the Water Corporation of Western Australia. The ground water within the Carnarvon aquifer system provides a permanent water supply for the towns potable water requirements. The town climate is noted as having high temperatures with high level of evaporations and seasonally variable rainfall.

Currently, the water supply for Carnarvon is sourced from a series of bores along the Gascoyne River. The raw water is chlorinated before it is reticulated into the town distribution system. The existing chlorination system used for the town water supply is located from Brown Range to the Brickhouse Storage complex and treats all the potable water in the Carnarvon area. Water supply is thus reticulated to each lot via Water Corporation owned network.

The existing sewerage is treated at the Carnarvon sewerage treatment plant, which is located on Babbage Island Road. Although some areas of Carnarvon are serviced via gravitated sewer network other areas do not have such infrastructure in place. There is no reticulated sewerage system in the eastern art of Carnarvon. The existing areas surrounding the development site have a combination of gravitated sewer and pump stations. In most cases, the gravity sewer runs on the rear side of the lots.

Refer to rear of *Appendix 4 – Water Corporation Existing Infrastructure* for further details.

Proposed Infrastructure Requirement

Initial consultation with Water Corporation has concluded that there is currently no planning allowance for the expansion of existing water and sewer networks to service the proposed development. Water Corporation will need to be heavily involved in the initial planning phase as the proposed staging plan is a significant change in the current land use.

Once the change in land use is considered in the water and wastewater planning, this area will be considered on the Infrastructure Planning Branch Statewide Planning Program as part of rezoning of the area. Water Corporation will then prioritise against other areas that also require planning consideration.

Water Corporation has confirmed that there is likely to be significant upgrades required to the scheme water, such as water main extensions and increased storage at the existing tank site. Wastewater will require new pump stations to transfer increase waste flow to the proposed treatment plant and disposal plant site.

3.7.2 Power Supply

Horizon Power own and operate the electrical supply network within the area and therefore all electrical supply equipment and cables will need to be installed in accordance with Horizon Power's specifications.

Existing Power Infrastructure

The distribution network in Carnarvon in the area of the Airport is 22kV and is supplied from the existing Power Station near the corner of Robinson Street, however, it is expected the newly installed Mungullah Power Station will be operational sometime this year (2013) and once fully operational the Mungullah Power Station will provide 18MW of capacity for Carnarvon and will have limited capacity to service future growth. The old Power Station will be decommissioned once the Mungullah Power Station is operational.

The distribution 22kV high voltage network is made up of both overhead and underground type networks. Typically each 22kV network can service some 8MVA, subject to Horizon Power's feeder loading policies. Refer to the rear of Appendix 4 – *Snapshot of Existing Power Infrastructure* for further details on the existing connection layouts.

Proposed Infrastructure Requirement

The current power supply arrangement to the Airport would lack the ability to supply the development. This essentially means new high voltage feeders are required to service the development.

For Stage 2 development, an estimated 1500 residential lot release would require a power supply of approximately 6MVA. The industrial land demand is complex due to the size of the land proposed for development. Based on 72ha, the Horizon Power supply allocation would yield approximately 14MVA. Due to the large lot sizes it is recommended to reduce the power supply to 100kVA, which would yield a demand for 7MVA.

Based on the above the supply required for Stage 2 equates to approximately 13MVA which means at least three 22kV feeders are needed.

For a Stage 3 development with estimated industrial, commercial and composite lot land release over a 50-100 year timeframe, the power supply required to cater for this stage would be anticipated around 9MVA. It is likely the Mungullah Power Station will require additional generators to be able to service the parts of Stage 2 and Stage 3.

Any overhead power line that traverses the lots to be developed will need to be converted to an underground type network.

Please note that this information is very high level and as such we would recommend further investigations with Horizon Power to confirm the above.

3.7.3 Telecommunications

The town of Carnarvon is currently serviced by Telstra for residential communication requirements. Existing Telstra assets exist in the surround road reserves.

As a result of the Australian Government's decision to roll out a National Broadband Network (NBN) the ownership issues of delivering the wholesale fibre to the home system have been transferred to the Government with a number of retail service providers likely to offer services over the network.

Coverage maps for the NBN Co indicate that Carnarvon is to be included in the rollout. Preliminary investigations have confirmed that fibre construction will commence in April 2014 and this phase is likely to be completed over 2014 to 2017. The areas of roll out are currently only limited to Brockman, Brown Range, Carnarvon, East Carnarvon, Kingsford, Morgantown and South Carnarvon.

Developers of new residential estates have the option to pay an extra fee to Telstra or an alternative service provider for provision of a high speed broadband network. In either case the developer will be responsible for the installation of all pit and pipe infrastructure which will be required to accommodate a future high speed broadband network.

General communication services for the development will consist of the installation of a standard pit and pipe network in accordance with NBN Co guidelines and standards. The current design practice for road reserves,

pavement and verge provisions will make adequate allowance for services including broadband in accordance with the agreed Utilities Service Providers handbook. There will be some local land requirements for equipment sites, similar to current provisions which will be accommodated at detailed subdivision stage.

Further planning discussions with an NBN provider are highly recommended so that staging development of site area can be incorporated into their roll out programme over the coming years.

3.7.4 Gas

The Dampier to Bunbury Natural Gas Pipeline (DBNGP) corridor passes through the eastern portion of the study area, and delivers gas to the existing Carnarvon Power Station (see Figure 56). There is no reticulated gas service provided to Carnarvon and no plans to do so in the future. Thus the gas supply with in the town is supplied by bottled gas.

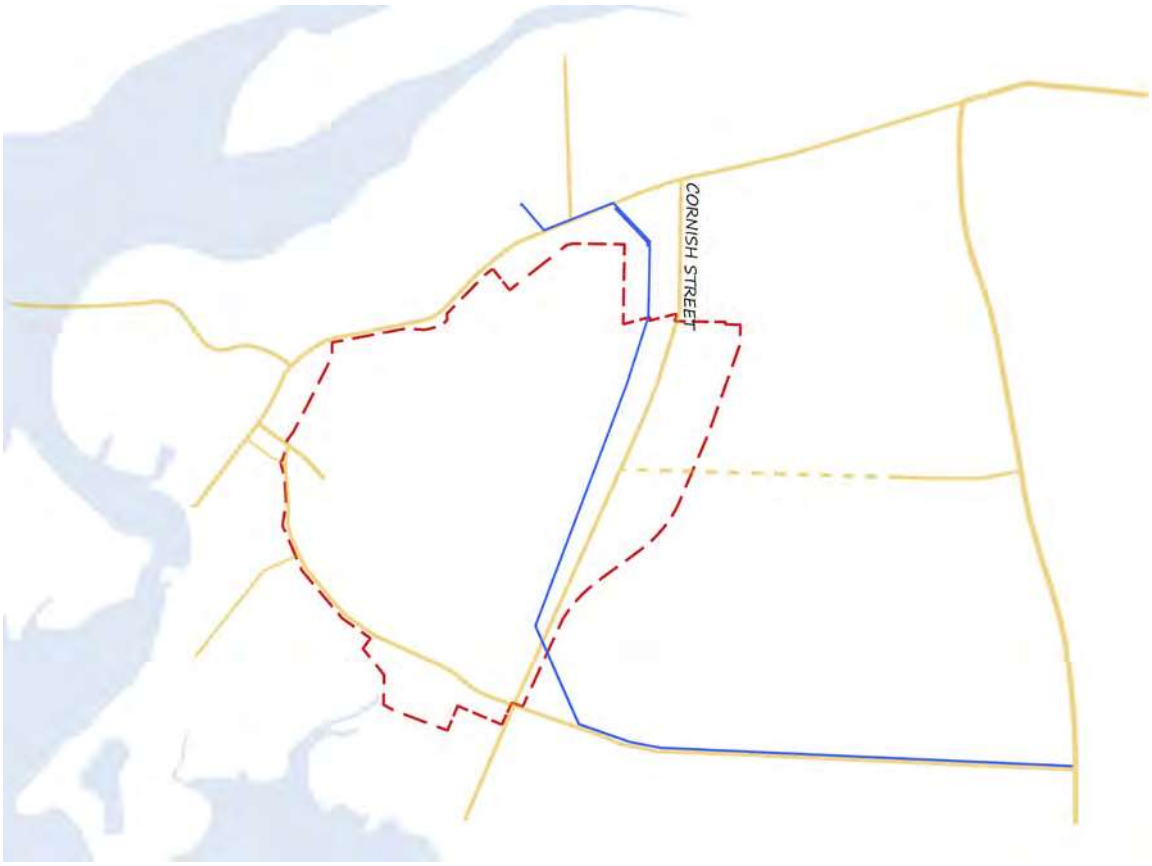


Figure 56: *Gas distribution within the study area*

At this stage, the existing gas pipeline corridor will remain even when the old power station is decommissioned. The buffer zone for the existing corridor is 15 m wide with an additional 150m setback zone. The proponent of any works planned within this corridor would need to submit an application to the Department of Lands.

The Land Use Guidelines for the DBNGP Corridor should be consulted for any planning of works within this corridor. Furthermore, works within the pipeline easements cannot commence until an application made and approval received by the Pipeline Asset Owners and the Department of Regional Development &Lands.

As discussed earlier, it is important to the development of the precinct that the pipe infrastructure is decommissioned once it's no longer required. Thus it is envisioned that the easement and pipe infrastructure will be removed so as not to restrict development in the future.

3.7.5 Earthwork Requirements

For a mixed use development around the airport site that is adjacent to flood levee and high water table levels, significant amount of earthworks will be required in the long term for property development and the expansion of various land uses. Allowance for dust control measures and erosion control for the coastal land system should be incorporated into the planning phase for the development site.

Earthworks will include the import of general and structural fill material for each staged development. The necessity of earthworks will ensure the workability of road networks, lot drainage management and the construction of underground utility services within the confines of design and regulation parameters.

Further detailed geotechnical investigation would be required to be undertaken to determine the suitability of this site for structural development and management of storm water drainage. In addition, detailed environmental and site contamination investigations are required during the planning phase in support of the proposed development.

Some of the potential risk items that require detailed investigation include:

- Levee studies from Department of Water and Department of Transport
- Identification of potential Wetlands in the surrounding region
- Sound understanding of Acid Sulphate Soils through core sampling

In summary, based on future geotechnical advice being acceptable it is expected that no specialized ground improvement works will be required other than typical importation of fill and compaction. All earthworks will need to be carried out in accordance with Australian Standard AS3798-2007 "Guidelines on earthworks for residential and commercial development". The bulk earthworks will also need to be undertaken in accordance with any recommendations resulting from a detailed geotechnical investigation to ensure suitable site classifications are achieved.

It is anticipated based on an acceptable geotechnical investigation that the material over the majority of the sites will result in a site classification of M-D in accordance with AS2870-2011. The exception to this is where collapsible soils i.e. Gilgai Clays are located. There is always a risk of encountering these highly expansive soils in low lying areas within Carnarvon. If collapsible soils are present then the site would likely be required to be improved by specific site improvement techniques and engineering solution.

3.7.6 Levee Requirements

The development phases under the District Structure Plan would require the existing levees to be strengthened and increased in height to potentially withstand a 1 in 100 year flood event. Future levee works will need to take into consideration rising sea levels and be in accordance with State Planning Policy 2.6 Coastal Planning Policy.

The proposed new Boundary Road is shown on the final plan running along the eastern side of the airport precinct area and bordering the existing natural floodway. This road will continue to form a levee to protect the airport. For major rainfall events during flood events, there is some detention capacity within the levee system. The volume of this detention storage will need to be reviewed with the proposed increase of impervious area to maintain a satisfactory level of inundation protection.

Further flood mitigation studies are required for the region; however a typical cross section of the levee may include a 4 metre berm with stable batter slopes and compaction of the levee soil material.

JDSi recommends further detail geotechnical assessment of the existing levee structures. To determine the land area suitable for development a flood/storm surge protection study and water level assessment will also need to be commissioned.

3.7.7 Drainage Network Infrastructure Requirement

The storm water drainage from the development area will need to be designed and constructed in accordance with Department of Water, Department of Transport and Shire of Carnarvon in line with their Local Planning Strategy once completed. However, it is anticipated that stormwater run-off will be controlled via typical methods utilised in Carnarvon. All lots will need to graded so runoff can be retained on site and then disposed of through a suitable drainage network, such as towards the roads or open drains. Roadways will be used to convey flows, which will then discharge into the open drain at the front of the site.

Roads will require earth working to ensure stormwater runoff is adequately controlled and conveyed to the open drain.

Culverts will need to be installed under all roads entering the development. These will be sized to accommodate the design flows from the catchment area. Stone pitched outlets and kerb openings will be constructed at all locations where stormwater is to enter the drain from the development site.

3.7.8 Roads

Existing surrounding road network will require varying degree of upgrading to tie into the development network, the scope of this upgrade is dependent on the extent of the construction during staging of the development.

Internal roads within the development will need to be constructed in accordance with Shire of Carnarvon guidelines and specifications. Roads will generally be constructed within Livable Neighborhood Guideline with a 16-25m road reserve width incorporating v-drains to tie in with the storm water drainage.

Most internal roads will require kerbing and use of intersection treatments, such as brickpaving to provide an indication of priority as well as providing important aesthetic value.

For further information regarding traffic engineering, refer to part 3.4 Movement Networks or Carnarvon Airport Structure Plan Traffic Report3.

4. IMPLEMENTATION

4.1 IMPLEMENTATION PROCESS

The Carnarvon Airport Precinct District Structure Plan is intended to be a flexible planning instrument for the long term development of the Precinct. Given the range of parameters that can affect the timing of development, the structure plan does not provide specific timeframes. To achieve the overall vision and successful implementation of the structure plan it relies upon several critical elements;

1. The relocation of the runway and associated airport infrastructure to the proposed location;
2. Amendments made to the planning and legal framework, to ready the land for development;
3. Geotechnical and contamination investigations into Lot 547 to identify any remediation works that may be required prior to future urban development;
4. An extension of Boundary Road and the levee bank to protect the runway and future industrial area; and
5. An extension of James Street to the new terminal facility.

Subsequently, the planning framework should reflect and dovetail the ambitions and principles of the structure plan. This will include the incorporation into the new town planning scheme to protect aviation airspace with appropriate buffers to meet safety requirements and the finalisation of the draft local planning strategy. The Shire has advised that land within the Structure Plan boundary is designated as an area for off-road vehicle use under the Control of Vehicles (Off-road Areas) Act 1978. It is understood that in order to remove the area Council will need to make a formal request to the Minister for Local Government who will have it referred to the Control of Vehicles (Off-road Areas) Act Advisory Committee.

At any stage (refer to Section 4.2) it should be accepted that flexibility within the Structure Plan may be exercised in response to a change in circumstances and at the discretion of the Shire Council accounting for due process as required under the relevant legislation.

4.2 STAGING OF DEVELOPMENT

The district structure plan is intended to be a staged process, whilst the final stage of this document is stage two, an indicative layout has been provided to demonstrate how the site could look, should the airport relocate in the long term. This has allowed for the structure plan to be dynamic and able to provide additional capacity should the need to move the airport be required.

The actual timing of development will depend on a range of factors, including the critical elements outlined in 4.1 Implementation Process, as well as the state of the economy, market conditions including the demand for additional housing and the ability to provide key infrastructure services (power, water and sewerage). A flexible and dynamic approach to implementation is therefore required to respond to these changing conditions in a timely and cost effective manner.

Considering the somewhat stagnant market conditions in Carnarvon it is important to remember that, once zoned, it can take a number of years (and sometimes decades) for release areas to fully develop. The staging plan includes the following stages:

4.2.1 Short term

In the short term, there are a number of crucial elements to be developed. At this point landscaping could commence in accordance with the linear parkland proposed, as vegetation will take some time to mature. It is understood that the construction of the new court house and police station will involve a new roundabout at the intersection of Robinson Street and Babbage Island Road; the design should cater for the proposed link with Carnarvon Road/HMAS Sydney II Memorial Avenue so as to reduce additional construction costs when the works are finally carried out. Therefore, additional works should be undertaken on engineering design of Carnarvon Road north of James Street to link with Robinson Street with the drainage system that adjoins Carnarvon Road to be established as public open space and beautified through landscape works.

A review and possible amalgamation of multiple land titles, particularly to the south of James Street, should occur in readiness for future rezoning and detailed local structure planning.

An engineering and cost benefit analysis should be a priority to determine the capability and suitability of the proposed runway realignment to the east of the existing facility in comparison to the remedial or upgrade works to the existing airport infrastructure, or the complete relocation of the airport (the long term option).

Further discussions should also be entertained with the utility providers on the capacity and availability of extended infrastructure and services to accommodate a gradual change in land use. More detailed investigation of extending Boundary Road as a levee and re-aligning the southern end of the eastern flood way should also be entertained in the short term. This will involve survey, road dedication and engineering design accounting for re-arrangement of Cornish Street.

The sealing of Harbour Road should also be viewed as a priority by the Shire as this section of road is critical to the success of the potential synergies as it provides direct access to the industrial precinct. It also removes large road trains and such vehicles from urban and tourist focused roads.

A further priority is finalising an entry statement design and beautification for HMAS Sydney II Memorial Avenue as the southern entry to the airport and town centre. Whilst not part of this structure plan process, the enhancement of HMAS Sydney II Memorial Avenue is integral to the broader promotion of Carnarvon.

Prior to this structure plan, the Shire has allocated a portion of the airport precinct near James Street to Durack Institute of Technology (a State regional training provider). This has been incorporated into the Structure Plan.

Upon successful completion of the detailed investigations and cost benefit analysis for the airport, including extensions to Boundary Road as a flood levee and re-aligning the southern end of the eastern flood way, consideration should be given to raising the necessary capital funding to action the recommendations arising the investigation and analysis processes, and proceeding with detailed engineering design and construction works.

It is understood the Shire is currently preparing a new Planning Scheme, to ensure flexibility, it is recommended that the Scheme designates the land within the precinct as Development Zone, which requires subdivision and development in accordance with local structure plans approved by the Shire. As the land is largely government owned developer contributions are not applicable as the Shire can recoup the cost through the sale of land.

Additional to the standard requirements necessary for local structure plans, due to the nature of development within the airport precinct, additional considerations and inclusions addressed in future LSP's should address the aviation buffer requirements as well as landmark and gateway locations, particularly along HMAS Sydney Memorial Drive.

Considering the nature of airport operations and the historical use of the site land around the airport and re-fuelling area may be contaminated and during decommissioning the area should be assessed under the Contaminated Sites Act 2003.

The Shire is also currently in the process of undertaking a district water management strategy as part of the current local planning strategy and should reflect the planning outcomes of the this Structure Plan in accordance with the WAPC's Better Urban Water Management.

Hydraulic modelling will need to be conducted to identify the developable and non-developable land areas within the Structure Plan. The hydraulic modelling will also need to provide specific guidance to ensure that the proposed development has adequate flood protection from a 100 year ARI flood, and that the proposed development does not detrimentally impact on the 100 year ARI flooding regime of the general area. This will need to be undertaken in consultation with Department of Water.

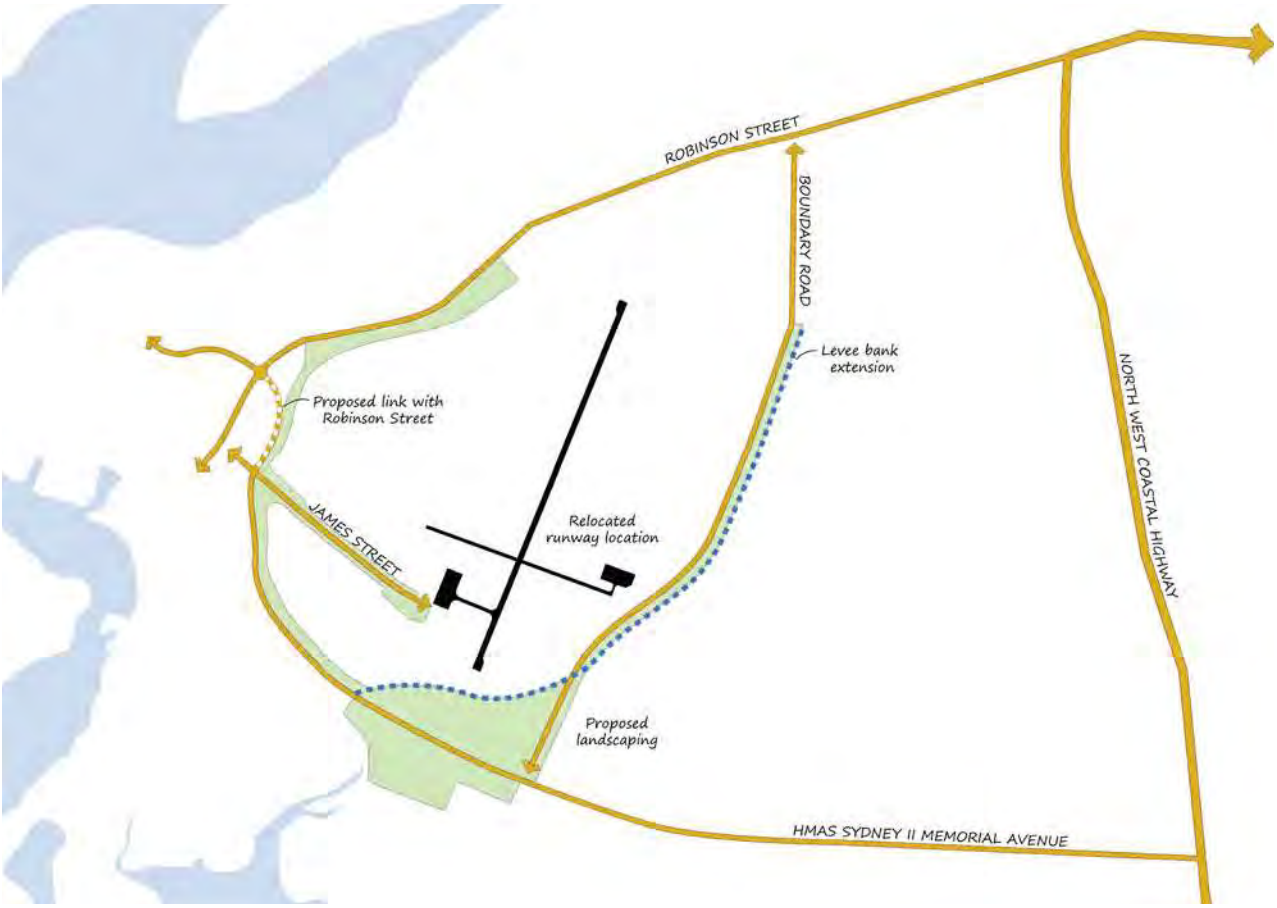


Figure 57: *Short term development to facilitate the structure plan*

4.2.2 Medium term

Following the release of the airport land through relocation of the airport facility to the east, land to the south and west should progressively be developed for residential use in response to market demand, while activities and services which support and enhance the local and regional economy should be encouraged on the eastern side of the runway and uses requiring access to regional transport links (airport or highway) should be given priority access to these sites.

The residential areas identified will require detailed planning through local structure or development area plans to facilitate rezoning and subdivision that incorporates appropriate drainage. Particular attention to soil testing as discussed in 2.3.1 Acid Sulphate Soils will also need to be entertained.

The existing airport heritage listed hangar could ideally be reconfigured to perform a community focused purpose if structurally possible. This could be in the form of an aviation museum or history of European settlement museum which could link with the Indigenous cultural centre, Gwoonwardu Mia to the north.

Potential exists for LandCorp (and/or others) to assist the Shire in developing the airport land considering their involvement in the town already and given the strategic nature of the project. This model would be dependent on an appropriate partnership and funding framework being established between LandCorp and the Shire, and possibly the Department of Housing as a third contributor to deliver affordable housing.

CASA is an Australian Government agency which has the ability to determine where aircraft fly in the vicinity of airports and hence which areas are exposed to aircraft noise. CASA establishes the operating rules which determine the location of flight paths into and out of airports. If the construction of a building or structure is approved which penetrates an airport's Obstacle Limitation Surface (OLS) CASA may require restrictions on aircraft movements in the vicinity of the airport (eg changes in flight paths) to ensure the safety of aviation.

As discussed, the market's desire for airparks is unknown, as such, the area for these to occur has been identified; however, it is unlikely that the full extent of the area will be required. Where this is the case, the zoning is to reflect the adjoining land. Approval would need to be sought from CASA and EPA as well as be in accordance with reference to Australian Standard AS 2021. This may also require a reassessment of the noise levels and a Noise Management Plan to be approved by the EPA.

The estimate lot yield for this medium term stage will yield approximately, 1,500 residential lots, with an estimated population of 3,750 people. This is expected to cater for Carnarvon's residential market indefinitely.

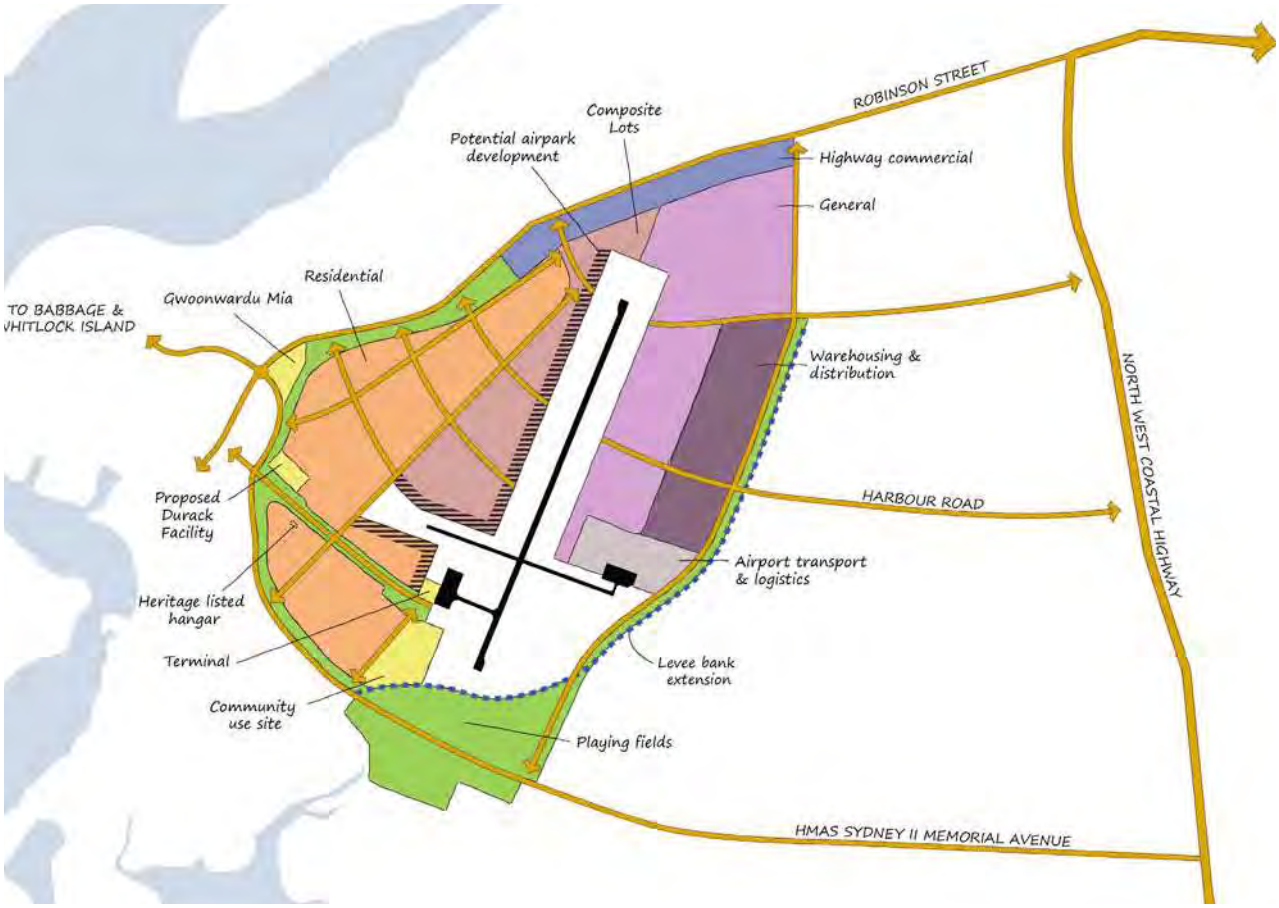


Figure 58: *Stage 2 Indicative Medium Term Land Use Plan*

4.2.3 Long term

Through preparation of the Shire's Local Planning Strategy alternative site(s) for a new airport outside of the Carnarvon town site should be designated for future investigation. Should the need arise to relocate the airport due to land supply pressures, if the airport begins to limit development potential around town, or a significant economic driver that demands an increase to aviation capacity beyond the current facility, the following plan has been used to illustrate how the future development of the existing landholding in its entirety will occur.

Whilst most of the development is a logical expansion of land uses, a new 'mixed use' district is also proposed. The objective of this precinct is to provide a community focused, flexible multiple use district allowing for the reuse of the airport terminal buildings and where possible other structures to evoke a sense of place once the airport relocates in the longer term.

The 'mixed use' zoning makes use of the terminal building once the airport and general aviation facilities relocate. It is envisioned that this area will complement the town centre as well as the local centre in East Carnarvon with a greater community use focus.

It is not possible for the district structure plan to specify the types of uses that should be established in this area as market demand for residential and commercial uses will fluctuate over time. Given that Stage Three is indicative and potentially 50 years before the land is released, it is not possible to designate specific floor space requirements or uses. However, considering the scale of Stage Three releases, there is the opportunity for a wide variety of commercial uses that are compatible with residential and community uses.

Suitable uses that could be entertained in the 'mixed use' areas are:

- Residential;
- Retail, service retail;
- Café or restaurant;
- Commercial or small showroom;
- Office; and
- Community facilities.

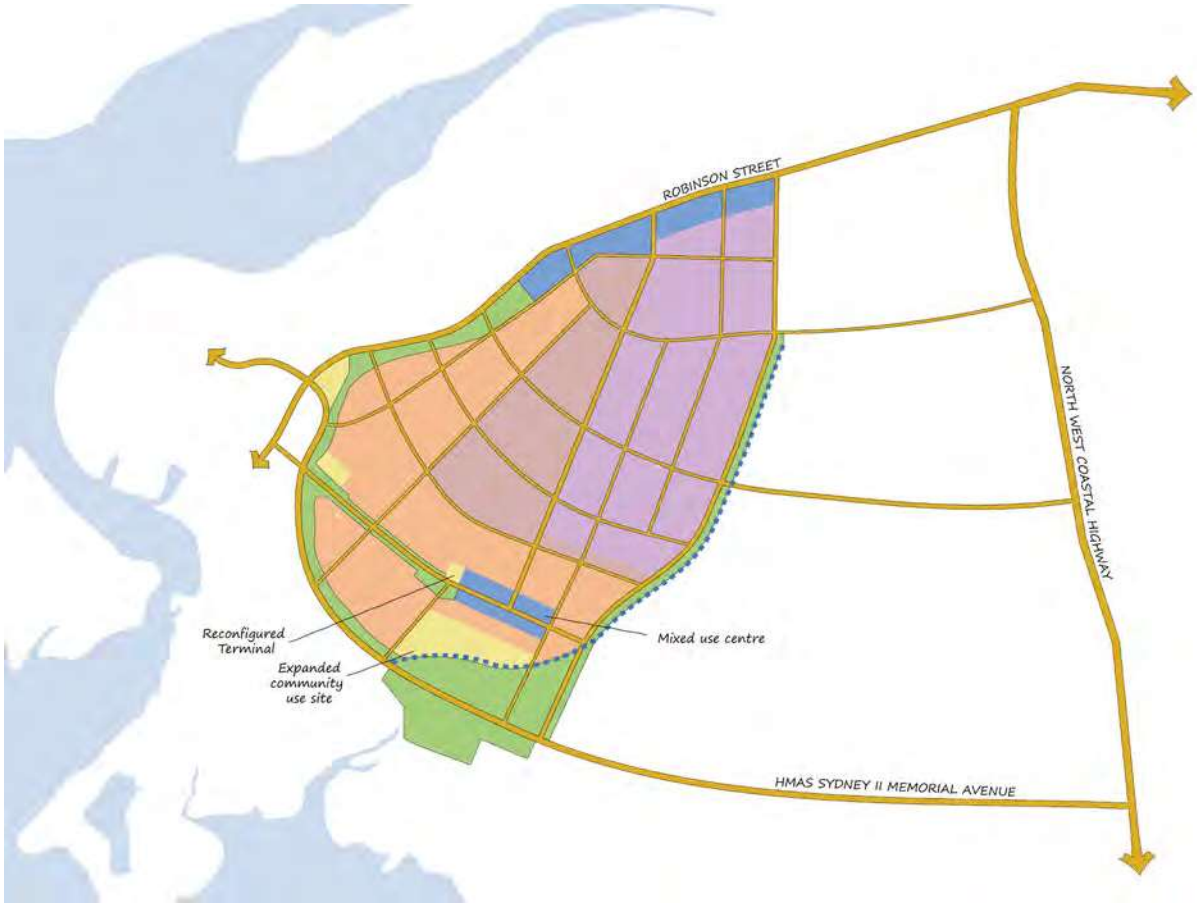


Figure 59: *Stage 3 Indicative Long Term Land Use Plan*

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Appendix 1

A3 PLANS

NOTE:
Refer to Buffer Plans for additional buffers related to uses surrounding the airport

CARNARVON AIRPORT PRECINCT STRUCTURE PLAN

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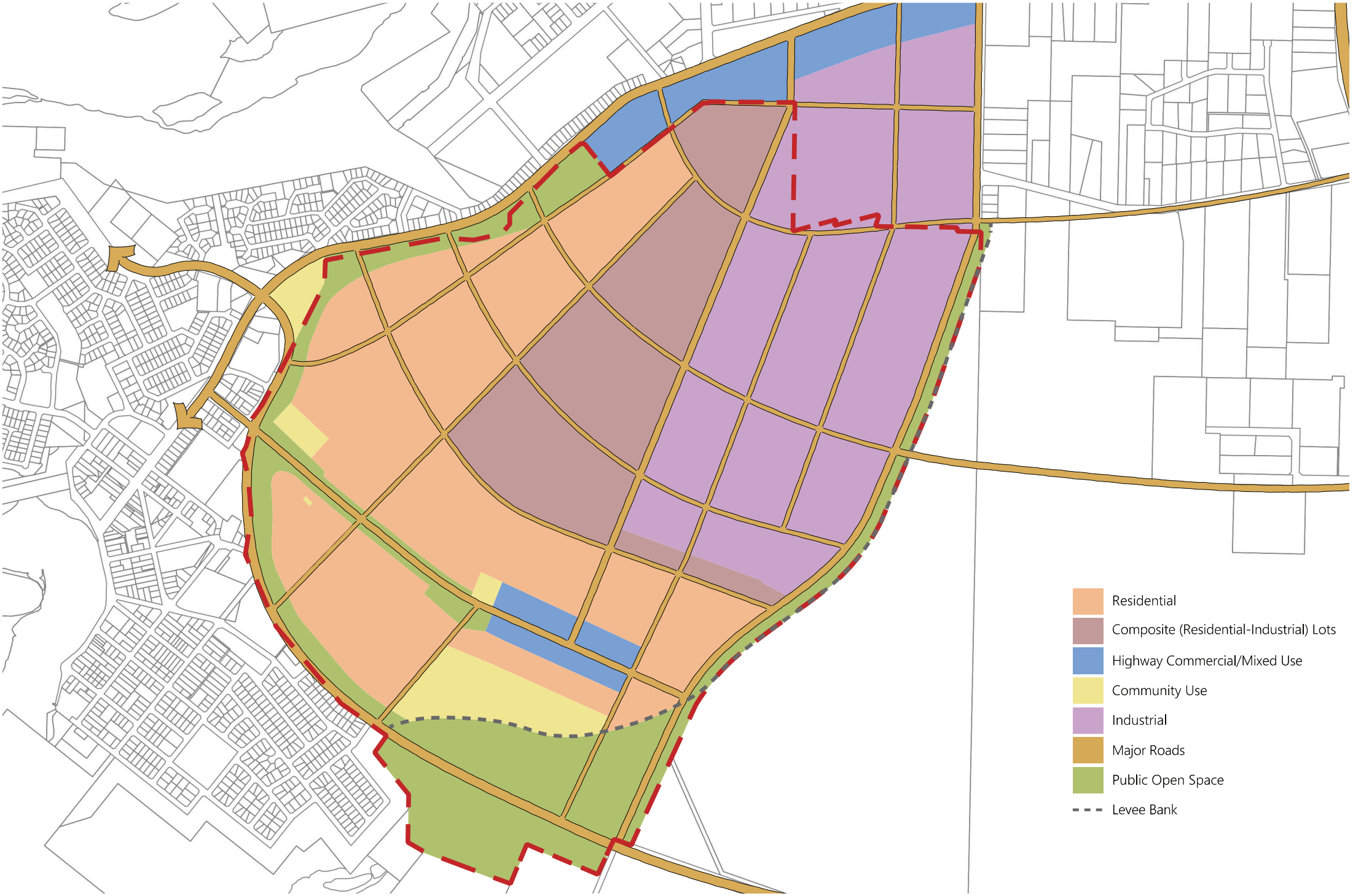
Hames Sharley



CARNARVON AIRPORT PRECINCT LONG TERM INDICATIVE DEVELOPMENT PLAN

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CARNARVON AIRPORT PRECINCT NAVIGATIONAL BUFFERS PLAN

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Subject to survey

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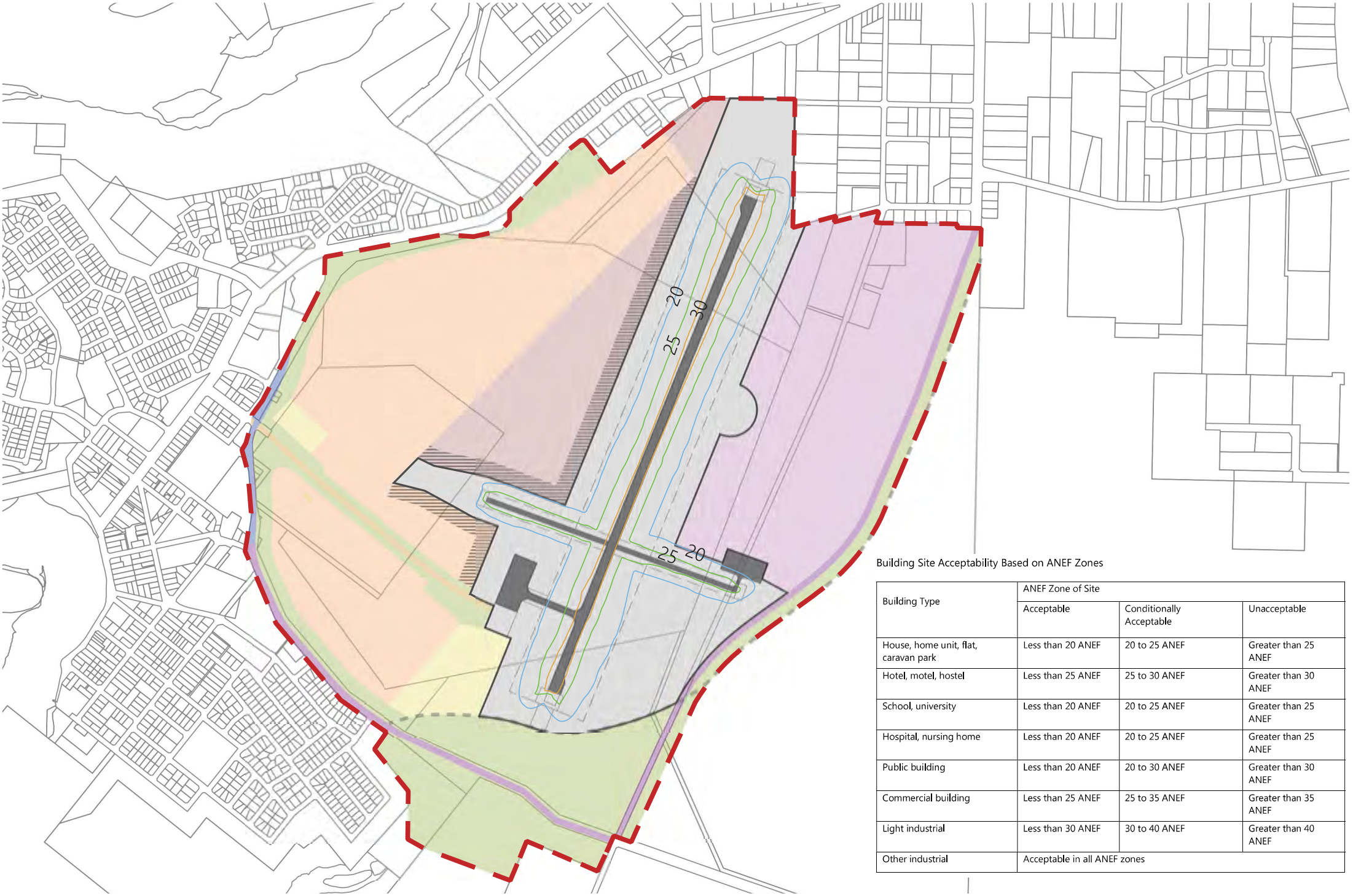

Building Site Acceptability Based on ANEF Zones

Building Type	ANEF Zone of Site		
	Acceptable	Conditionally Acceptable	Unacceptable
House, home unit, flat, caravan park	Less than 20 ANEF	20 to 25 ANEF	Greater than 25 ANEF
Hotel, motel, hostel	Less than 25 ANEF	25 to 30 ANEF	Greater than 30 ANEF
School, university	Less than 20 ANEF	20 to 25 ANEF	Greater than 25 ANEF
Hospital, nursing home	Less than 20 ANEF	20 to 25 ANEF	Greater than 25 ANEF
Public building	Less than 20 ANEF	20 to 30 ANEF	Greater than 30 ANEF
Commercial building	Less than 25 ANEF	25 to 35 ANEF	Greater than 35 ANEF
Light industrial	Less than 30 ANEF	30 to 40 ANEF	Greater than 40 ANEF
Other industrial	Acceptable in all ANEF zones		

CARNARVON AIRPORT PRECINCT ANEC BUFFERS PLAN

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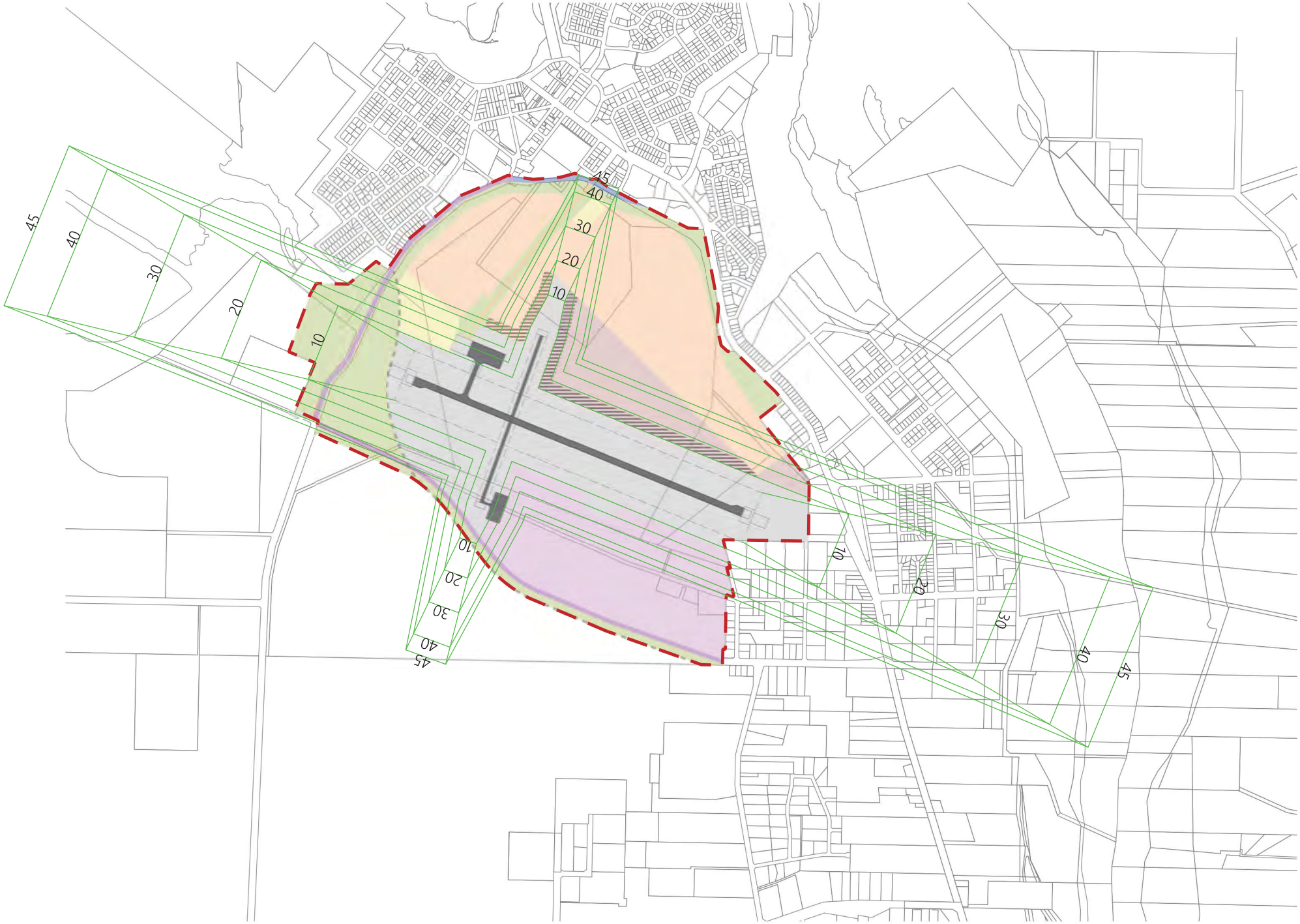

CARNARVON AIRPORT PRECINCT OBSTACLE LIMITATION SURFACES

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Subject to survey

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Hames Sharley

Appendix 2

CARNARVON AIRPORT MASTER PLAN

Aerodrome Management Services

Aerodrome Management Services Pty Ltd

ABN 50 406 443 766
PO Box 6127 East Perth WA 6892
Phone: 08 9221 6777
Fax: 08 9221 6776
Web: www.amsaustralia.com
Email: ams@amsaustralia.com

Runway Design Parameters
Carnarvon Airport Master Plan

For

Hames Sharley

Final Draft 04 September 2013

1 Background

The Shire of Carnarvon have contracted Hames Sharley to carry out a master-planning project for the Carnarvon Airport precinct.

A location and orientation fitting the proposed master plan was selected for the new primary and secondary runways and provided in consultation with AMS. The primary runway location and orientation was somewhat pre-determined by the requirement to use the existing airport site, and fit the runway within planned flood protection structures whilst maximising the land made available for residential development on the western side of the existing airport.

The Shire has determined that the existing airport site will continue to be used for the foreseeable future, with the option to investigate new sites if aircraft traffic and size dictate after 20 years or so.

This document details the design parameters for the new runways.

2 Design Aircraft and Runway Parameters

The initial design aircraft is the Fokker 100 jet, which is a Code 3C aircraft. As this may change, allowances for Code 4C operations on the main runway have been made, particularly in the siting of the apron and the Obstacle Limitation Surfaces (OLS). The runway would also have to be widened to 45m for Code 4C operations.

Code 4C aircraft include the Boeing 737 and Airbus A320, both commonly used in Western Australia. Other common Code 3C aircraft include the Boeing 717, the BAe 146 and the Fokker F50 turbo-prop. The Dash 8 Q-400 is a Code 3D aircraft but has been certified by CASA to operate from "ICAO Code 3C Aerodromes" which include a 30m wide runway but a full 300m runway strip.

In their Concept Report of 2010, Airbiz considered that a 2,000m runway would allow the largest aircraft, being the 737 and 717, to take off at close to Maximum Take Off Weight (MTOW) on a 440 Nautical Mile flight to Perth. This figure was determined using an average hottest day of 37.2° (at a different site). Given that the actual site has a lesser average hottest day of 32.5° this is considered a satisfactory length.

The main runway and taxiway will be lit, and a non-precision RNAV-GNSS approach designed for both approaches.

The proposed flood protection for Carnarvon would preclude the runway being any longer than this within this site. This is also the reason for the orientation and location of the main runway.

A secondary runway, to cater for General Aviation/light aircraft has been incorporated at the Shire's request. This runway is designed to cater for up to Code 1B aircraft and is 1,000m long. This runway will not be lit.

2.1 Runway Parameters

The primary runway is designed with the following initial parameters, and allowances made for future expansion if required:

Parameter	Initial Construction	Ultimate State
Runway Length	2,000m	No Change
Runway Width	30m + 3m sealed shoulders	45m
Taxiway Width	15m + 3.5m sealed shoulders	No Change
Runway Strip Width	90m graded 150m overall Ref ultimate state if Q400 operations required	150m graded 300m overall
Clearway Length	60m	No Change
RESA	60m wide x 90m long	90m wide x 90m long
Taxiway Strip Width	25m graded 52m overall	No Change
Apron Parking	2 x 737/A320 aircraft	3 x 737/A320 aircraft

Furthermore, the secondary runway has the following parameters:

Parameter	Initial Construction
Runway Length	1,000m
Runway Width	18m
Taxiway Width	10.5m (12m for RFDS operations)
Runway Strip Width	60m graded
Clearway Length	30m
RESA	Not Required
Taxiway Strip Width	25m graded 43m overall
Apron Parking	Free parking (leased hanger areas)

Due to the crosswind tolerances of the RFDS aircraft, it is not envisaged that they would require use of the cross runway and hence the length is not the minimum required by the RFDS (1,200m). Depending on those operating GA aircraft at the airport, the length may be able to be reduced or the runway built in stages, such as a shorter gravel runway eventually upgraded to a longer sealed runway.

2.2 Apron Parameters and Facilities

The RPT apron has initially been sized for two 737-800/A320 aircraft, which are the largest that will be able to use the facility with the planned runway length. Future construction of a third bay to the south-west has been allowed for.

A fuel farm containing a 55,000 litre Jet A1 tank is proposed to the north-east of the terminal building. This fuel would be delivered to aircraft by bridger truck.

A generic terminal of 5,000m^2 has been allowed for. This is a similar size to Geraldton's terminal building, and is expected to be the ultimate state for Carnarvon. A terminal building that is easy to extend would allow for staged construction to meet future increases in passenger numbers.

The GA parking apron is indicative of current use at Carnarvon, and is set in a separate area to the RPT apron to separate small and large aircraft traffic. This will also allow easy expansion to meet demand, such as for additional hanger space. It is envisaged that an RFDS/St John Ambulance patient transfer facility would be located on this apron, hence designing the taxiway to RFDS requirements.

The fuel facility on the GA apron would likely contain both Jet A1 and Avgas delivered through a card-swipe bowser, and it is likely that tank sizes would be much smaller than on the RPT apron. Demand would have to be assessed to determine the actual requirements.

A dedicated helicopter landing area has not been allowed for but could be easily included if demand existed.

3 Runway Orientation and Location

A runway orientation of 022°/202° was selected based on the need to fit a runway between proposed flood protection structures.

Wind data was collected from the current Carnarvon Airport BOM station, between 2008 and 2013, for 15 minute intervals. Daytime data (between 0600 and 1800 hours) was analysed, as the secondary runway will only be available during the day. Wind direction was rounded to the nearest 10 degrees, and wind speed to the nearest knot.

The prevailing wind for the site is south-south-west, approximately 200°-210°.

Based on the selected runway orientation of 022°/202°, the usability with a maximum 10 knot crosswind was 82.9%. The optimal runway orientation was found to be eight degrees anti-clockwise, at 016°/196°, with a marginally better usability of 83.1%.

For the selected main runway orientation, 95% usability has a crosswind of 14.4 knots. For aircraft with an Aerodrome Reference Field Length of greater than 1,500m (such as the Fokker 100 – 1,695m), ICAO recommends a maximum crosswind of 20 knots.

ICAO recommends a maximum crosswind of 10 knots for small aircraft, however most modern small aircraft have a higher tolerance than this. The addition of the secondary runway on a 110°/290° alignment gives usability of 95.9% with a 10 knot crosswind.

Therefore, the airport with both runways meets the 95% usability with a 10 knot crosswind recommended by ICAO.

4 Obstacles

Obstacle protection, in the form of the OLS, has been shown for Code 4C operations.

The location of the airport will require removal/relocation of some existing obstacles such as mobile telephone towers which may infringe the Inner Horizontal surface of the OLS.

The current 300m radius protection zone around the VHF Omni-Range (VOR) is likely to be infringed by the secondary runway, and the installation may have to be relocated. The Non-Directional Beacon (NDB) towers may infringe the OLS, but the installation will have to be relocated anyway, to allow for car parking areas or the like.

Airservices Australia have informed AMS that they have major maintenance planned for the navigation aids, in Q1 2014, and it is strongly suggested that the Shire engage with Airservices as soon as possible, with a view to having this maintenance delayed if the installations are to be moved. This may reduce the cost to the Shire of moving them, as some of the cost may be offset by Airservices.

Some other towers in the vicinity of the airport may also infringe, depending on the final design requirements for embankment construction. Further study should be carried out during detailed design. However, the ones of most concern are to the east so it is likely that the no-circling area to the east will be maintained.

Addendum 1 - Aircraft Noise Measurement and Forecasting: the Australian Noise Exposure Forecast (ANEF)

(This Addendum was supplied by Hames Sharley for inclusion in the AMS document)

An Australian Noise Exposure Forecast (ANEF) is a forecasting methodology that is used throughout Australia to produce a chart of varying degrees of aircraft noise exposure for the areas surrounding an airport. The contours produced result from calculations based upon forecast aircraft movements.

The contours are not measures of aircraft noise expressed in decibels. They are mathematical contours based upon a forecast volume of aircraft movements. For example, one very noisy aircraft movement in one year, whilst it would be loud, would not change the model. A large number of movements of quieter aircraft would change the model, because of the volume of movements.

Table 1. Building Site Acceptability Based on ANEF Zones

Building Type	ANEF Zone of Site		
	Acceptable	Conditionally Acceptable	Unacceptable
House, home unit, flat, caravan park	Less than 20 ANEF	20 to 25 ANEF	Greater than 25 ANEF
Hotel, motel, hostel	Less than 25 ANEF	25 to 30 ANEF	Greater than 30 ANEF
School, university	Less than 20 ANEF	20 to 25 ANEF	Greater than 25 ANEF
Hospital, nursing home	Less than 20 ANEF	20 to 25 ANEF	Greater than 25 ANEF
Public building	Less than 20 ANEF	20 to 30 ANEF	Greater than 30 ANEF
Commercial building	Less than 25 ANEF	25 to 35 ANEF	Greater than 35 ANEF
Light industrial	Less than 30 ANEF	30 to 40 ANEF	Greater than 40 ANEF
Other industrial	Acceptable in all ANEF zones		

NOTES:
1. 'Acceptable' means that noise attenuation is usually not required to reduce aircraft noise.
2. 'Conditionally Acceptable' means noise attenuation may be required to reduce aircraft noise.
3.'Unacceptable' means that the development should not normally be considered.
4. The Note 1 associated with Table 2.1 in AS 2021-2000 states:

> *The actual location of the 20 ANEF contour is difficult to define accurately, mainly because of variation in aircraft flight paths. Because of this, the procedure of Clause 2.3.2 may be followed for building sites outside but near to the 20 ANEF contour. Clause 2.3.2 relates to "conditionally acceptable" development and sets out the procedure for determining noise attenuation measures.*

The following information is based on a review of the ANEF projections undertaken by Connell Wagner (2005).

ANEC- Australian Noise Exposure Concept
This is a noise contour map that may be produced during consideration of options for airport

development. It is based on a hypothetical set of conditions of runways, aircraft types, etc., and there may be several ANEC maps prepared for the same future year. It may be a supposition for a long way into the future, and may never occur.

Because it has a hypothetical basis and/or may not have been subject to review by relevant authorities, an ANEC map has no official status and cannot be used for land-use planning purposes. An ANEC map may be converted into an ANEF map only through endorsement by Airservices Australia.

The ANEF is constructed using a computer model to generate contours that link together similar points of equal forecast exposure. The contour levels of 20, 25, 30, 35 and 40 are usually used as ANEF units with the severity of noise exposure increasing with the ANEF value. The model/technique allows a scientific measure of noise exposure levels around an airport taking into consideration the following factors:

- The intensity, duration, tonal content and spectrum of audible frequencies occurring in aircraft take-off, and landing (and reverse thrust after landing) manoeuvres
- The forecast frequency of aircraft types and movements on flight paths
- The average daily distribution of aircraft take-off and landing movements in daytime (defined as 7am to 7pm) and night time (7pm to 7am).

To put the contours, described above, in context, residential development is commonly considered acceptable in areas outside (below) the ANEF 20 contour, conditionally acceptable in the range of 20-25, and simply not acceptable in the range above 25 ANEF.

It is important to note that contours are sometimes influenced by meteorological influences, as described above, and other factors such as individual flight paths etc. For this reason, the ANEF 20 contour is normally shown with a dashed line to reflect the inherent variability in its actual location.

Noise exposure forecasts provide guidance for land use planning in areas surrounding airports. Table 2 details the land use planning guide incorporated in AS 2021 which protects both the community from excessive noise and the longevity of the airport (in terms of encroaching incompatible land uses). Being difficult to retrospectively introduce these guidelines, the table usually provides guidance for new developments.

Table 2. ANEC for Carnarvon Airport based on the forecast aircraft traffic in the year 2024

Runway	Aircraft	Landings Day	Take-Offs Day	Landings Night	Take-Offs Night
022	F100	0.970	0.970	0	0
	BEC58P	1.438	1.438	0.177	0.177
	COMSEP	1.863	1.863	0	0
202	F100	0.416	0.416	0	0
	BEC58P	0.617	0.617	0.076	0.076
	COMSEP	0.799	0.799	0	0
016	BEC58P	0.617	0.617	0	0
	COMSEP	0.799	0.799	0	0
196	BEC58P	0.264	0.264	0	0
	COMSEP	0.342	0.342	0	0

NOTES:

1. FK100 is a Fokker 100 jet aircraft
2. BEC58P is a typical twin-engined propeller-driven aircraft
3. COMSEP is typical combined single-engined propeller-driven aircraft (with provision for typical % variable pitch and fixed pitch propellers)
4. All FK100 movements are on the 22/202 Runway
5. All BEC58P and COMSEP movements are distributed with 70% on 22/202 Runway and 30% on 16/196 Runway
6. For the 22/202 Runway, 30% of aircraft movements occur on RWY 202 and 70% of aircraft movements occur on RWY22
7. For the 16/196 Runway, 30% of aircraft movements occur on RWY 196 and 70% of aircraft movements occur on RWY16
8. Helicopter and ultralight aircraft operations have been excluded from the study (these are considered unlikely to be significant)
9. Growth of 2% per annum has been assumed for BEC58P and COMSEP movements

Figure 1 indicates only a marginal increase in the size of the noise footprint, with all noise contours up to 20 ANEC located within the proposed airport levee and floodway system. The footprint could be expected to increase in size with additional F100 flights and/or the introduction of jet aircraft larger than the F100.

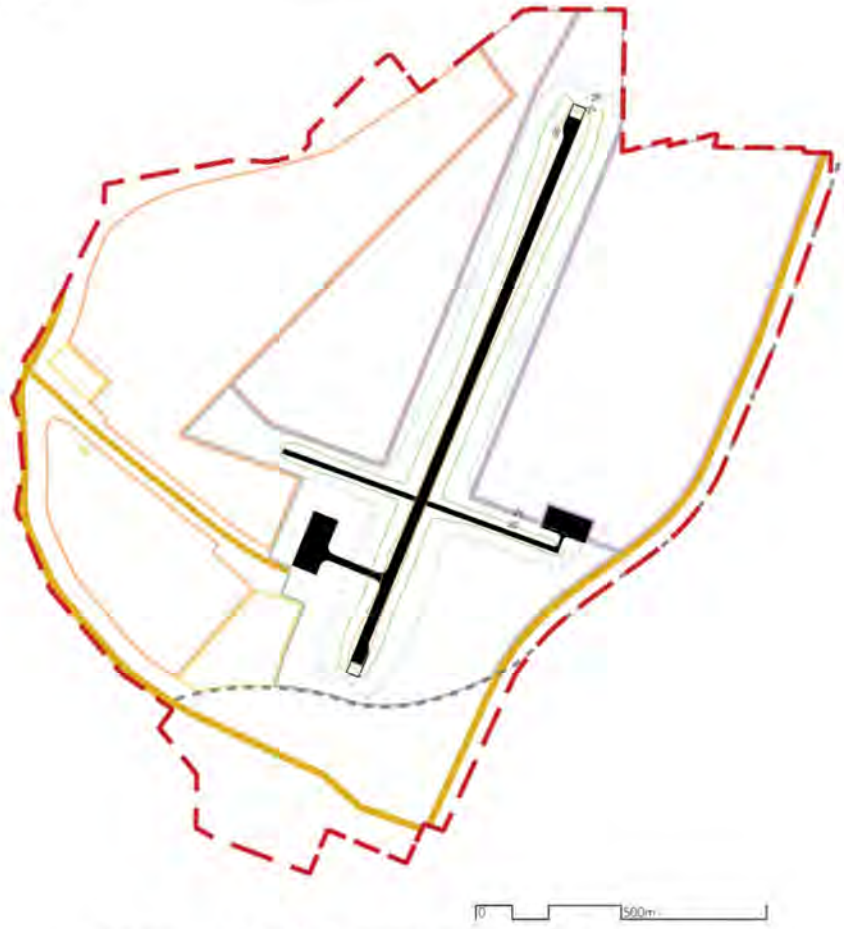
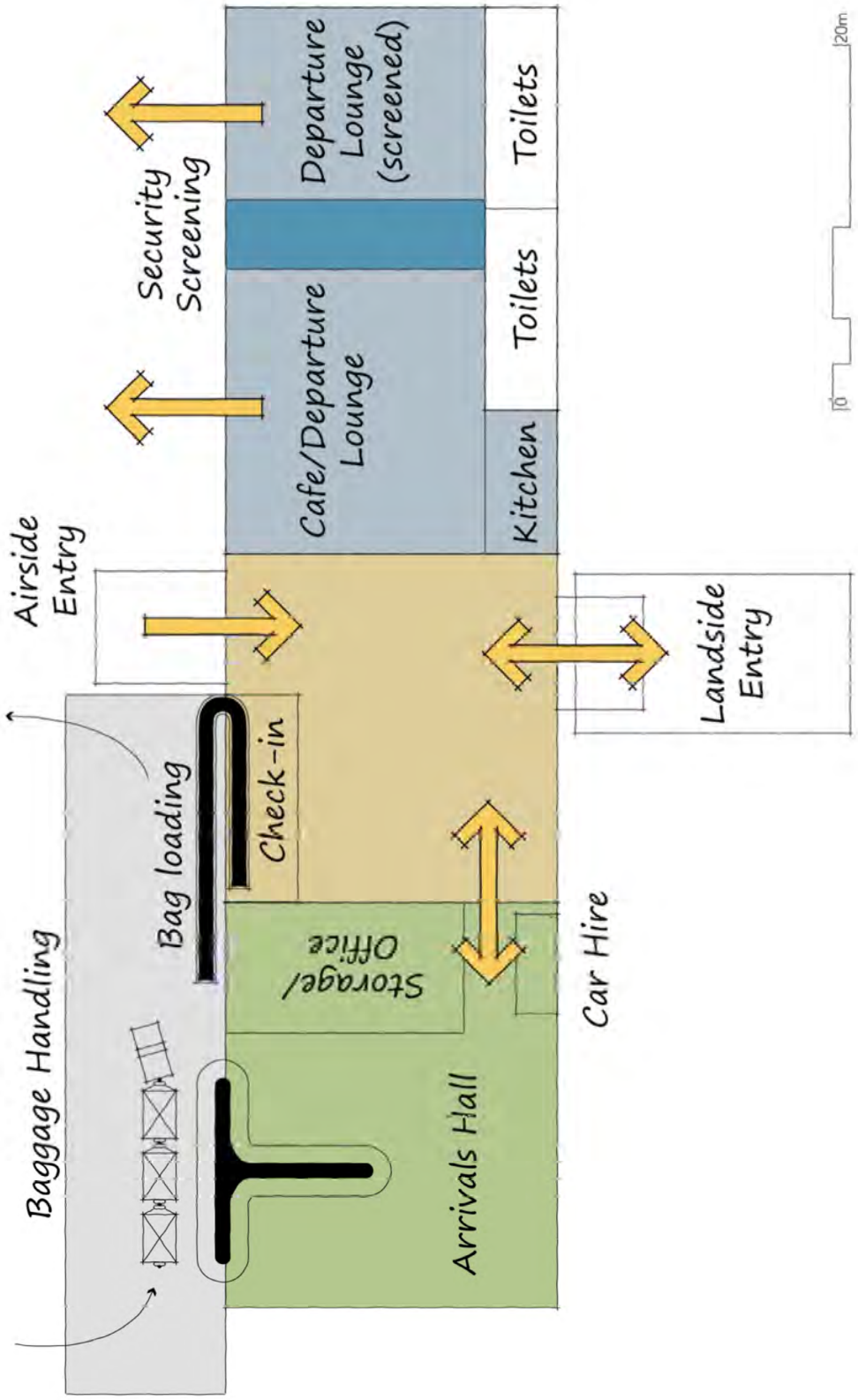
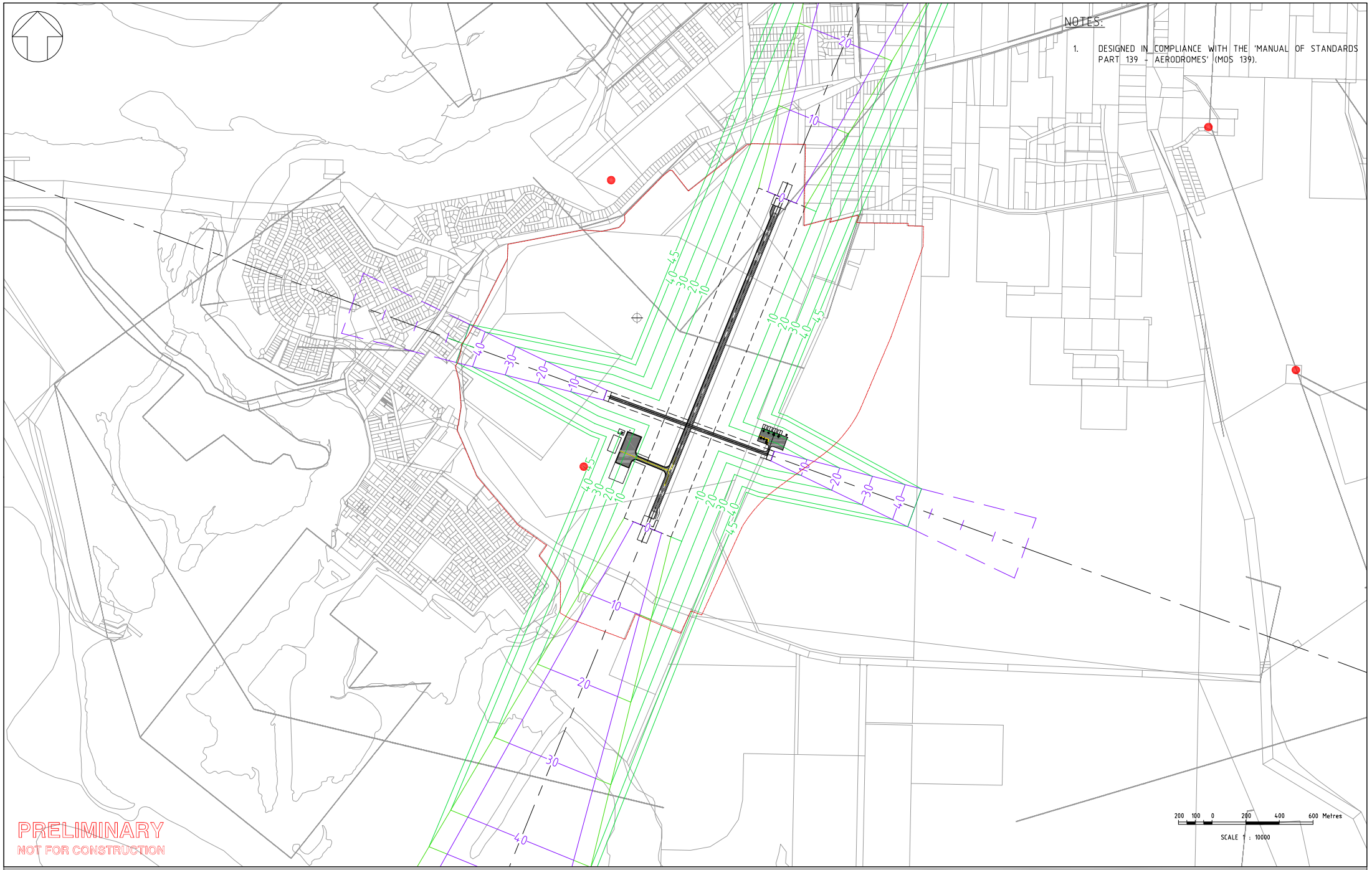


Figure 1. ANEC 2024 based on Connell Wagner (2005)

Addendum 2 – Indicative Terminal Layout

(This Addendum was supplied by Hames Sharley for inclusion in the AMS document)





REV	DATE	AMENDMENTS	DRG. NO.	REFERENCE DRAWING
B	23/07/13	OBSTACLES UPDATED. AD BOUNDARY ADDED		
A	23/07/13	ISSUED FOR REVIEW		

AMS
Aerodrome Management Services Pty Ltd
29 West Parade PERTH W.A. 6000
Telephone (08) 9221 6777 • Facsimile (08) 9221 6776 • Email ams@amsaustralia.com

CLIENT
CARNARVON
SHIRE OF CARNARVON

	BY	DATE
DRAWN:	A.B.	22/07/13
DESIGNED:		
CHECKED:		
ORIGINATOR:		
COMPANY:		
APPROVED:		

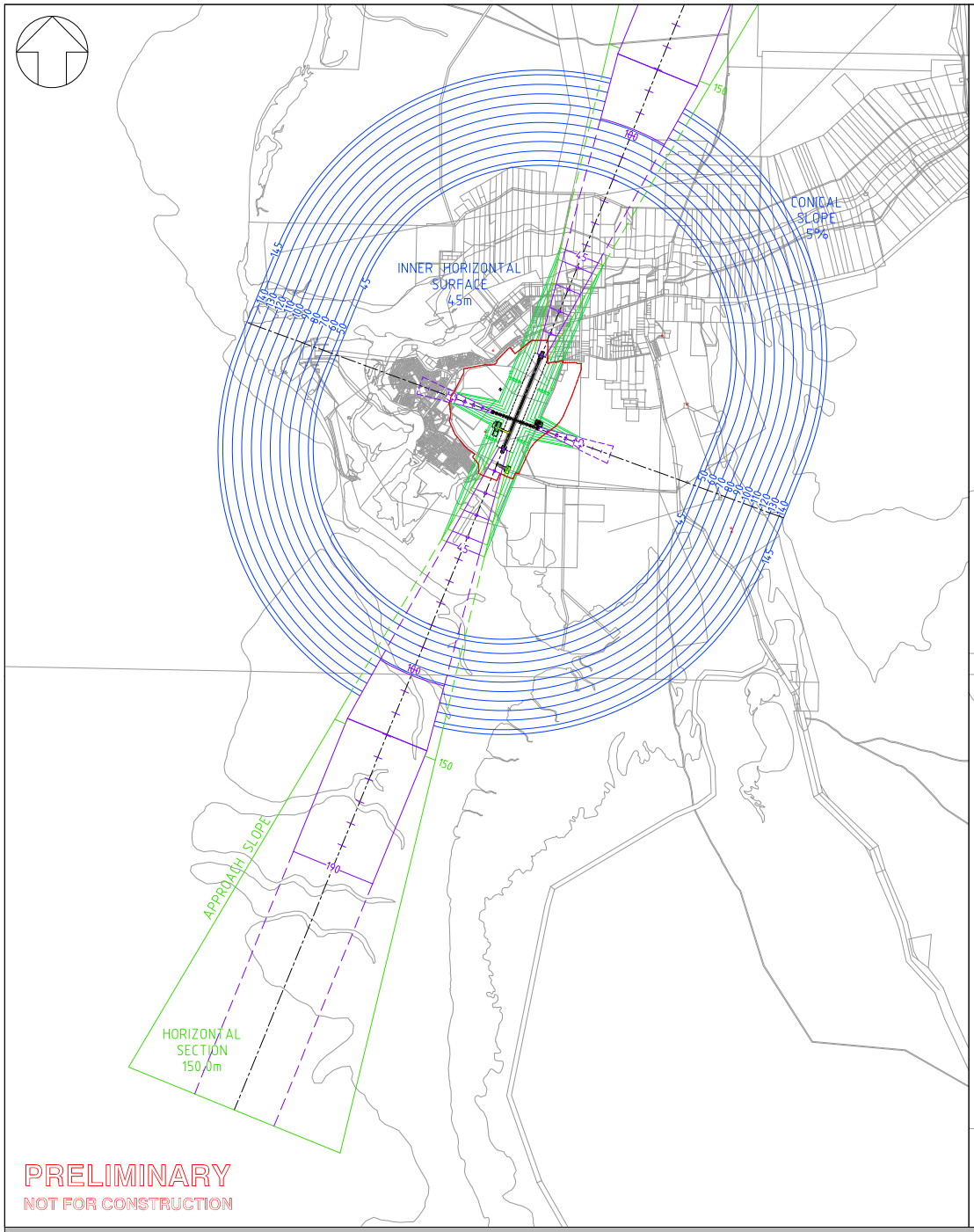
TITLE
CARNARVON AERODROME (YCAR)
WESTERN AUSTRALIA
RUNWAY RELOCATION
OLS TRANSITIONAL SURFACES

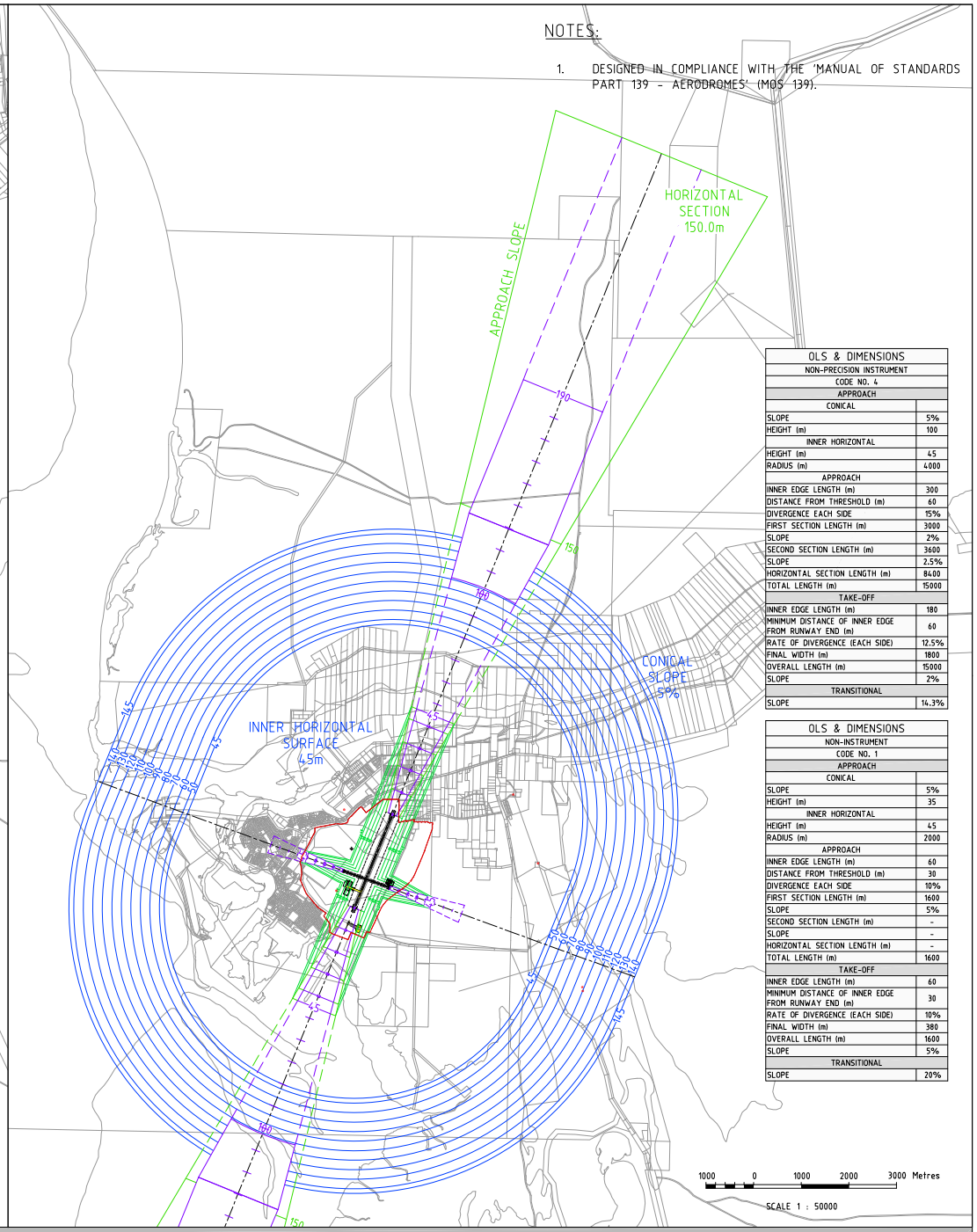
SCALE
1:10,000 @ A1

DRAWING No. YCAR-DR-003

REV B

A1 Border v1.4





NOTES:

1. DESIGNED IN COMPLIANCE WITH THE 'MANUAL OF STANDARDS PART 139 - AERODROMES' (MOS 139).

OLS & DIMENSIONS	
NON-PRECISION INSTRUMENT	
CODE NO. 4	
APPROACH	
CONICAL	
SLOPE	5%
HEIGHT (m)	100
INNER HORIZONTAL	
HEIGHT (m)	45
RADIUS (m)	4000
APPROACH	
INNER EDGE LENGTH (m)	300
DISTANCE FROM THRESHOLD (m)	60
DIVERGENCE EACH SIDE	15%
FIRST SECTION LENGTH (m)	3000
SLOPE	2%
SECOND SECTION LENGTH (m)	3600
SLOPE	2.5%
HORIZONTAL SECTION LENGTH (m)	8400
TOTAL LENGTH (m)	15000
TAKE-OFF	
INNER EDGE LENGTH (m)	180
MINIMUM DISTANCE OF INNER EDGE FROM RUNWAY END (m)	60
RATE OF DIVERGENCE (EACH SIDE)	12.5%
FINAL WIDTH (m)	1800
OVERALL LENGTH (m)	15000
SLOPE	2%
TRANSITIONAL	
SLOPE	14.3%

OLS & DIMENSIONS	
NON-INSTRUMENT	
CODE NO. 1	
APPROACH	
CONICAL	
SLOPE	5%
HEIGHT (m)	35
INNER HORIZONTAL	
HEIGHT (m)	45
RADIUS (m)	2000
APPROACH	
INNER EDGE LENGTH (m)	60
DISTANCE FROM THRESHOLD (m)	30
DIVERGENCE EACH SIDE	10%
FIRST SECTION LENGTH (m)	1600
SLOPE	5%
SECOND SECTION LENGTH (m)	-
SLOPE	-
HORIZONTAL SECTION LENGTH (m)	-
TOTAL LENGTH (m)	1600
TAKE-OFF	
INNER EDGE LENGTH (m)	60
MINIMUM DISTANCE OF INNER EDGE FROM RUNWAY END (m)	30
RATE OF DIVERGENCE (EACH SIDE)	10%
FINAL WIDTH (m)	380
OVERALL LENGTH (m)	1600
SLOPE	5%
TRANSITIONAL	
SLOPE	20%

1000 0 1000 2000 3000 Metres

SCALE 1 : 50000

PRELIMINARY

NOT FOR CONSTRUCTION

REV	DATE	AMENDMENTS	DRG. NO.	REFERENCE DRAWING
B	23/07/13	OBSTACLES UPDATED. AD BOUNDARY ADDED		
A	23/07/13	ISSUED FOR REVIEW		

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AMS
Aerodrome Management Services Pty Ltd
29 West Parade PERTH W.A. 6000
Telephone (08) 9221 6777 : Facsimile (08) 9221 6776 : Email ams@amsaustralia.com

CLIENT
CARNARVON
SHIRE OF CARNARVON

	BY	DATE
DRAWN :	A.B.	22/07/13
DESIGNED :		
CHECKED :		
ORIGINATOR :		
COMPANY :		
APPROVED :		

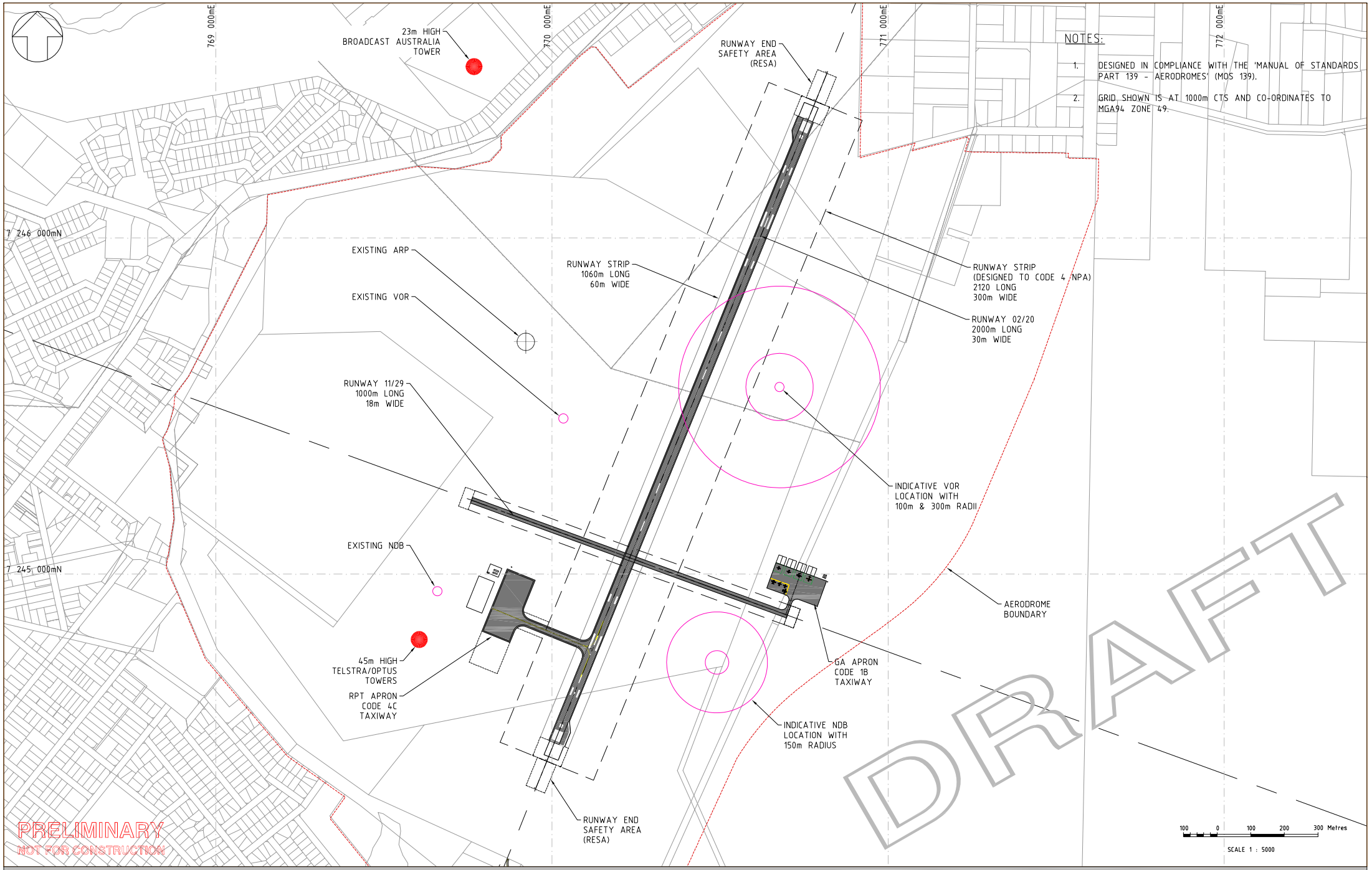
TITLE
CARNARVON AERODROME (YCAR)
WESTERN AUSTRALIA
RUNWAY RELOCATION
OVERALL OBSTACLE LIMITATION SURFACES (OLS)

SCALE
1:50,000 @ A1

DRAWING No. YCAR-DR-002

REV B

A1 Border v1.4



REV	DATE	AMENDMENTS	DRG. NO.	REFERENCE DRAWING
B	05/08/13	NDB & VOR INDICATIVE LOCATIONS ADDED		
A	23/07/13	ISSUED FOR REVIEW		

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AMS
Aerodrome Management Services Pty Ltd
29 West Parade PERTH W.A. 6000
Telephone (08) 9221 6777 : Facsimile (08) 9221 6776 : Email ams@amsaustralia.com

CLIENT
CARNARVON
SHIRE OF CARNARVON

	BY	DATE
DRAWN:	A.B.	22/07/13
DESIGNED:		
CHECKED:		
ORIGINATOR:		
COMPANY:		
APPROVED:		

TITLE
CARNARVON AERODROME (YCAR)
WESTERN AUSTRALIA
RUNWAY RELOCATION
GENERAL ARRANGEMENT AND LOCATION

SCALE
1:5,000 @ A1

DRAWING No. YCAR-DR-001

REV B

A1 Border v1.4

Appendix 3

CARNARVON AIRPORT STRUCTURE PLAN TRAFFIC REPORT

Riley Consulting

CARNARVON AIRPORT
STRUCTURE PLAN TRAFFIC REPORT

September 2013

PO Box Z5578
Perth WA 6831
0413 607 779 Mobile

Issued on	2 September 2013	Amendment	Date
Version	V1	Fig 14 amended	2/10/13
Reference	678		

CONTENTS

1.0 EXECUTIVE SUMMARY

This report has been prepared to consider the traffic matters arising from the structure planning for additional dwellings on land presently occupied by Carnarvon airport. This report considers the existing road network in the locality to assess current operating conditions and identify any constraints. The pertinent findings of this report are:

- The existing road network in Carnarvon is to a suitable standard to accommodate the forecast traffic increases of the structure plan area. However, it is known that other structure plans are being prepared in Carnarvon and the cumulative impacts should be reviewed.

- The full development of the structure plan area (as indicated in Figure 5) can be expected to impact external intersections and the following treatments have been identified:
    - James Street / Robinson Street - roundabout or traffic signals maybe required.
    - Babbage Island Road / Robinson Street / Access B - roundabout recommended.
    - Robinson Street / Access D - roundabout or traffic signals maybe required.
    - Robinson Street / Cornish Street / Angelo Street - roundabout or traffic signals maybe required.

2.0 THE SITE AND SURROUNDING ROAD NETWORK

Carnarvon is located approximately 900 kilometres by road north of Perth and is accessed from the North West Coastal Highway. Recent studies of Carnarvon Airport have identified a need to relocate the airport. It is expected that the airport relocation will be to the east of the current site. Existing airport land is proposed to be used for future residential expansion.

Figure 2 shows the location of the structure plan area (indicative).

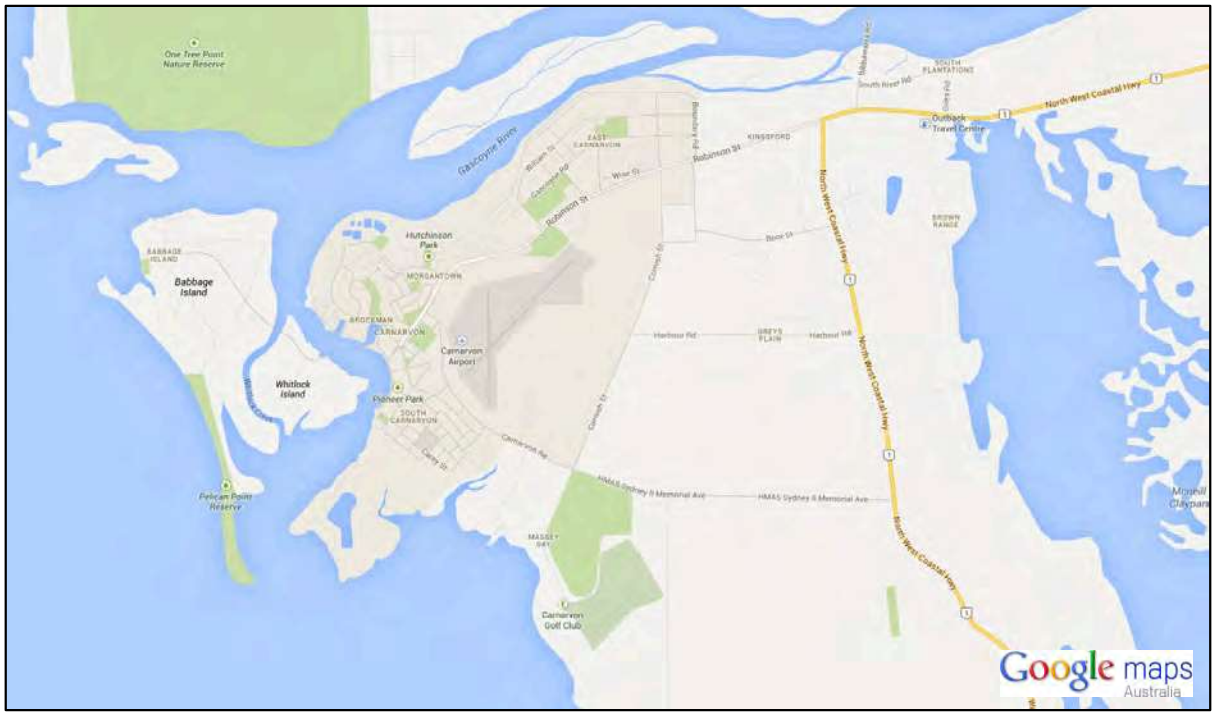

Figure 1 Location of Structure Plan Area

The Australian Bureau of Statistics shows that Carnarvon has a current population of 5,787 persons and 3,721 private dwellings (Appendix A). The detail information suggests 294, or 13.1% of dwellings were recorded as “unoccupied” in the 2011 census. This indicates a household density of 1.69 persons per dwelling, about 30% lower than the standard 2.4 persons per dwelling. The lower dwelling density will result is a slight reduction to traffic generation of the area being considered.

Roads of importance to the project are considered below. Roads are discussed where they play an important part of the road network and are classified as local, district or regional distributor roads. Local residential streets provide for local residential connectivity only.

North West Coastal Highway

The North West Coastal Highway is located about 3.5km east of the subject land and is a primary regional road under the control of Main Roads Western Australia (MRWA). The North West Coastal Highway is the primary road connection to Carnarvon and links Geraldton to Port Hedland (where it joins the North West Coastal Highway). The Highway is constructed as a regional rural highway with a typical 7 to 9 metre sealed carriageway. Intersections are controlled by give way or stop signs and a posted speed limit of 110kph is provided along most of its length.

Traffic data on the MRWA website shows that to the north of Blowholes Road, there are on average 510 vehicles per day (vpd) of which 36% are heavy goods vehicles. South of the townsite there are 660vpd, of which 32% are heavy goods vehicles. The data suggests an average of about 200 truck movements per day passing through Carnarvon.

Locally to Carnarvon, traffic volumes increase between the townsite and the river crossing. The website shows about 1,400vpd.

Access to Carnarvon is made by either HMAS Sydney II Memorial Avenue or Robinson Street. The southern leg of North West Coastal Highway yields to Robinson Street / North West Coastal Highway north.

HMAS Sydney II Memorial Avenue

HMAS Sydney II Memorial Avenue provides the southern connection of the town to the North West Coastal Highway. It is constructed to a rural standard with a pavement of over 7 metres width. Figure 2 shows the view looking west from North West Coastal Highway.

Figure 2 HMAS Sydney II Memorial Drive

Adjacent to the south side of the Airport, HMAS Sydney II Memorial Drive changes name to Carnarvon Road and is restricted to 80kph. Traffic data supplied by MRWA (July 2009) indicates an average daily volume of 230vpd.

Robinson Street

Robinson Street forms the major entry road into the town centre and is constructed as a single carriageway road. Between Olivia Terrace and Campbell Way there is a section of divided road, some parts providing four lanes. The intersections of Francis Street and Olivia Terrace are controlled with roundabouts to provide traffic management through the commercial centre of the town. Between the two roundabouts a wide boulevard is provided with parking to the centre of the street. Figure 3 shows the view along Robinson Street approaching James Street.

Figure 3 Robinson Street

Traffic data supplied by MRWA (June 2010) indicates an average daily volume of 7,900vpd close to the town centre. The daily volume on Robinson Street reduces to about 6,400vpd east of Marmion Street and 3,100vpd to the west of North West Coastal Highway.

Cornish Street

Cornish Street is an existing constructed road bordering the east of the airport. It provides a convenient link between Carnarvon Road and Robinson Street. No traffic data is available, but it would be expected to carry less than 500 vehicles per day. Figure 4 shows Cornish Street from its intersection with Carnarvon Road.

Figure 4 Cornish Street Looking North

Harbour Road

Harbour Road is an east-west connection linking Cornish Street to the North West Coastal Highway. It is constructed between North West Coastal Highway and Hudson Road to provide access to a road train assembly area. No traffic data is available for Harbour Road.

Boor Street

Boor Street is a constructed road that provides an east-west connection between Cornish Street and the North West Coastal Highway. Land uses adjacent to Boor Street are more residential in nature. No traffic data is available for Boor Street.

Carnarvon Airport

The airport is presently accessed from James Street (off Robinson Street). Carnarvon Road also accesses James Street to connect the airport to the south. An assessment of the future expansion of Carnarvon Airport suggests that by 2032, there could be up to 8 flights per day, which can be expected to generate about 400vpd.

Figure 5 shows the indicative structure plan. This report considers three stages of possible development of the subject land as shown in Appendix B.

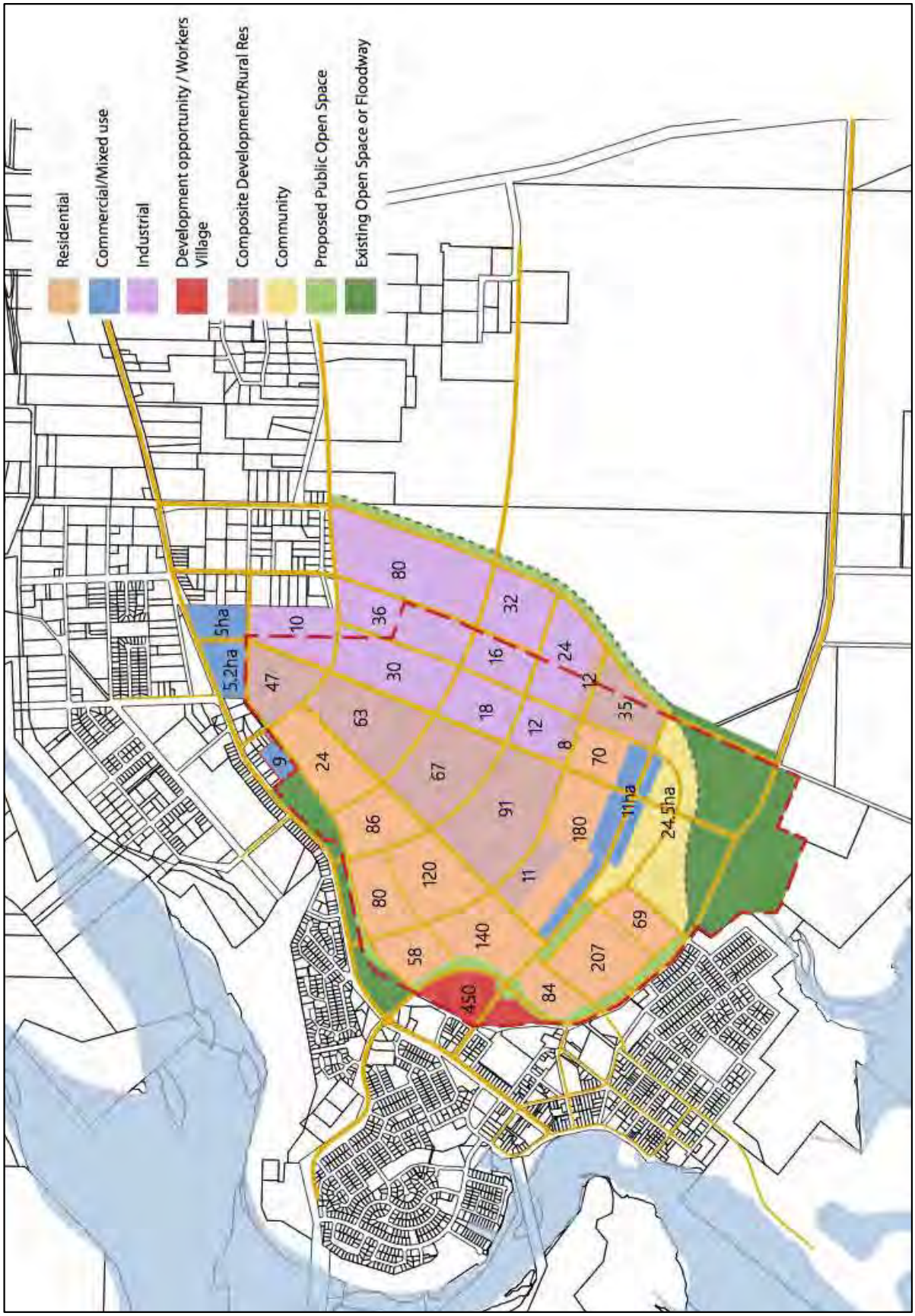

Figure 5 **Indicative Structure Plan** (refer to planner)

3.0 TRAFFIC MODELLING

The development of the airport land could increase present day traffic movements by a level that would be deemed to have an impact. To assess the impact, a traffic model has been developed using the Saturn suite of programs to consider the existing and proposed land uses. The model distributes traffic to the local road network based on travel time / distance and road operational capacity. The expected trips are discussed below.

Residential

The standard residential trip rate in Western Australia is in the order of 8 to 10 trips per dwelling per day. ABS data indicates that dwelling occupancy is 30% less in Carnarvon than expected and on this basis, the model has been developed using 8 trips per dwelling per day.

Retail / Commercial

The indicative structure plan shows areas for future commercial/mixed use development that would be expected to comprise of smaller retail opportunities and business units. It is anticipated that major retail opportunities will be developed within the existing town centre to cater for the increased population. For structure planning purposes, a trip rate of 30 trips per $100m^2$ floor area would typically be used for these land uses. Factoring this indicative trip rate to land area equates to about 1,050 trips per hectare of land (the structure plan identifies gross area).

Industrial

Research of industrial estates in Karratha indicated a typical trip rate of 60 trips per hectare of development. The trip rate is approximately 50% to 70% of the trip rate of industrial estates in the Perth metropolitan region, which is to be expected.

Worker's camp opportunity

The worker's camp is indicated to comprise of up to 450 dwellings (or rooms). A study for a worker's camp at South Hedland concluded a trip rate of 0.52 trips per day per room, which includes rostered days and bus transport to work sites.

Composite Development

Areas of land have been identified as composite development and are expected to be used for work from home opportunities. Indicatively a larger lot will be provided so that a dwelling

and business unit can be built. A typical occupier could be, for example, a self-employed bobcat operator. The residential trip rate is applied to these lots.

The above assumptions have been used to create a matrix of vehicle trips for input into the Saturn suite of modelling software.

Figure 6 shows the expected traffic movements of the structure plan area. The flows shown by the model output need to be factored by ten to show expected daily volumes. It should be noted that due to spot loading of development cells (zones), traffic flows might change significantly between each road section.

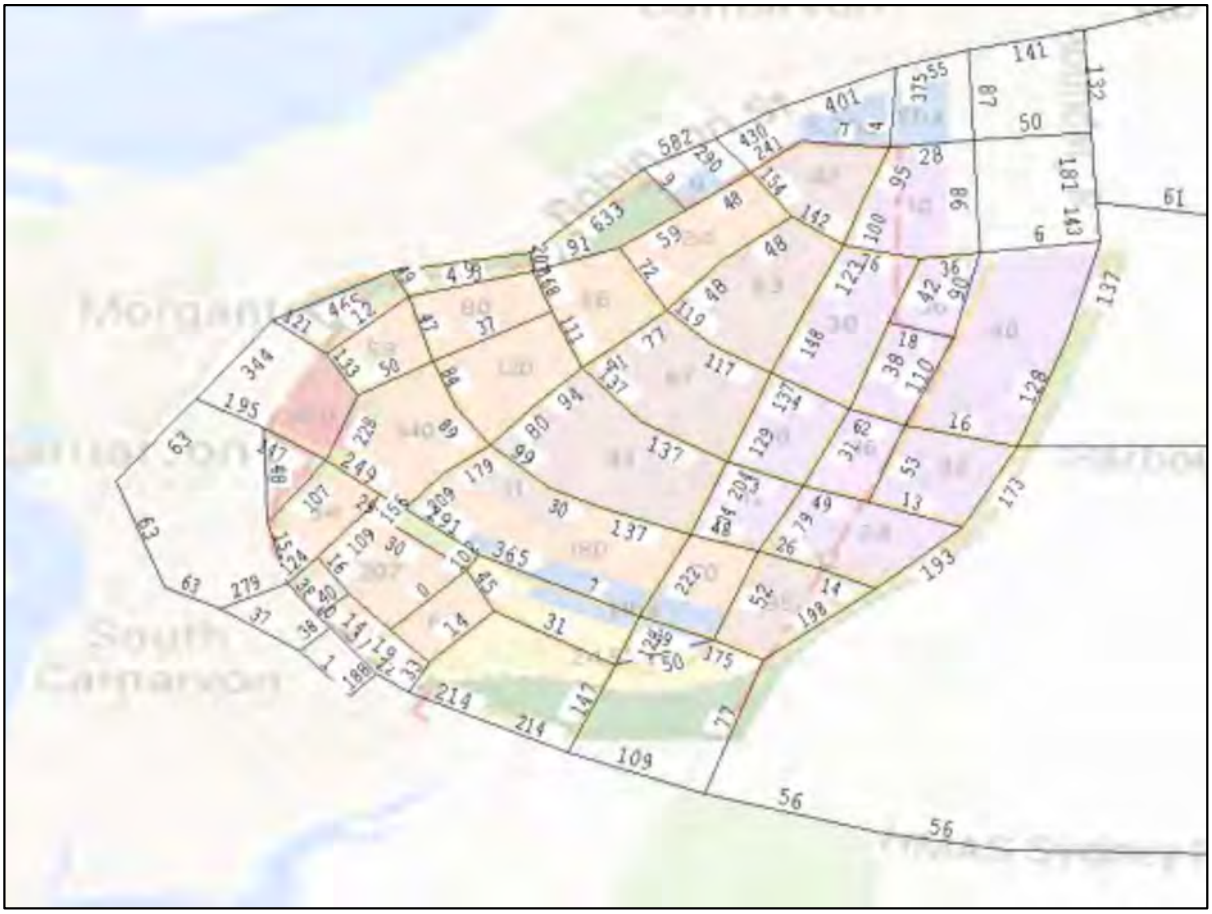

Figure 6 Structure Plan Area Traffic Forecasts >300vpd (daily flow x 10)

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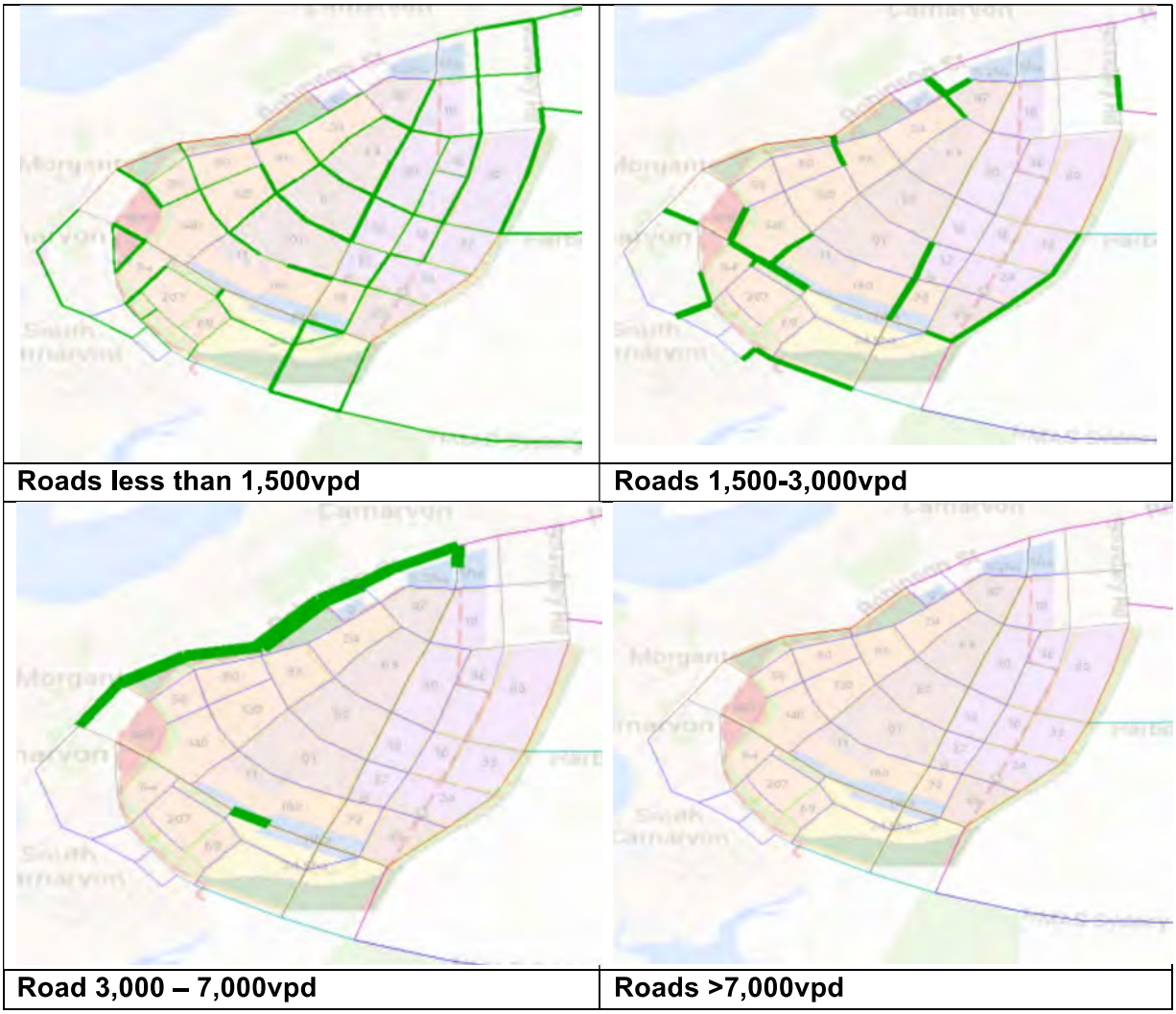
4.0 THE LOCAL ROAD NETWORK

The traffic model has been interrogated to determine the expected daily traffic movements on local streets. Figure 7 graphically shows the modelled forecast flows based on road hierarchy traffic flow ranges.



Roads less than 1,500vpd	Roads 1,500-3,000vpd
Road 3,000 – 7,000vpd	**Roads >7,000vpd**

Figure 7 Saturn Model Graphic Volume Plots

The forecast traffic flows provide a basis to develop an internal road hierarchy. Table 1 reproduces the advice on road types recommended by *Liveable Neighbourhoods.* Generally the road hierarchy is based on the traffic demands of each street to determine its function and road reservation requirements. However, where future traffic forecasts are low, there is a need to identify higher order streets that should promote vehicular movements through the precinct.

Table 1 *Liveable Neighbourhoods* Road Hierarchy

Indicative Daily Traffic Flow*	Designation	Street Characteristics
< 1,500 vpd	Access Street	Roads exist at 7.2 metres
1,500 vpd to 3,000 vpd	Higher Order Access Street	Wider access streets (7 to 7.5m) cater for higher traffic volumes and are located closer to neighbourhood centres.
3,000 vpd to 7,000 vpd	Neighbourhood Connectors	Generally 2-lane undivided. These are 'special' streets and their design needs to have regard to context, function and adjacent land uses.
7,000vpd +	Arterial Streets	These are major roads that should not normally occur within residential areas.

* Function of streets needs to be considered as well as traffic volume.

The future traffic demands are shown to be low and most roads are shown to accommodate less than 1,500vpd. The local road hierarchy has been developed to recognise the importance of local roads in terms of access to differing land uses. Figure 8 shows the suggested road hierarchy.

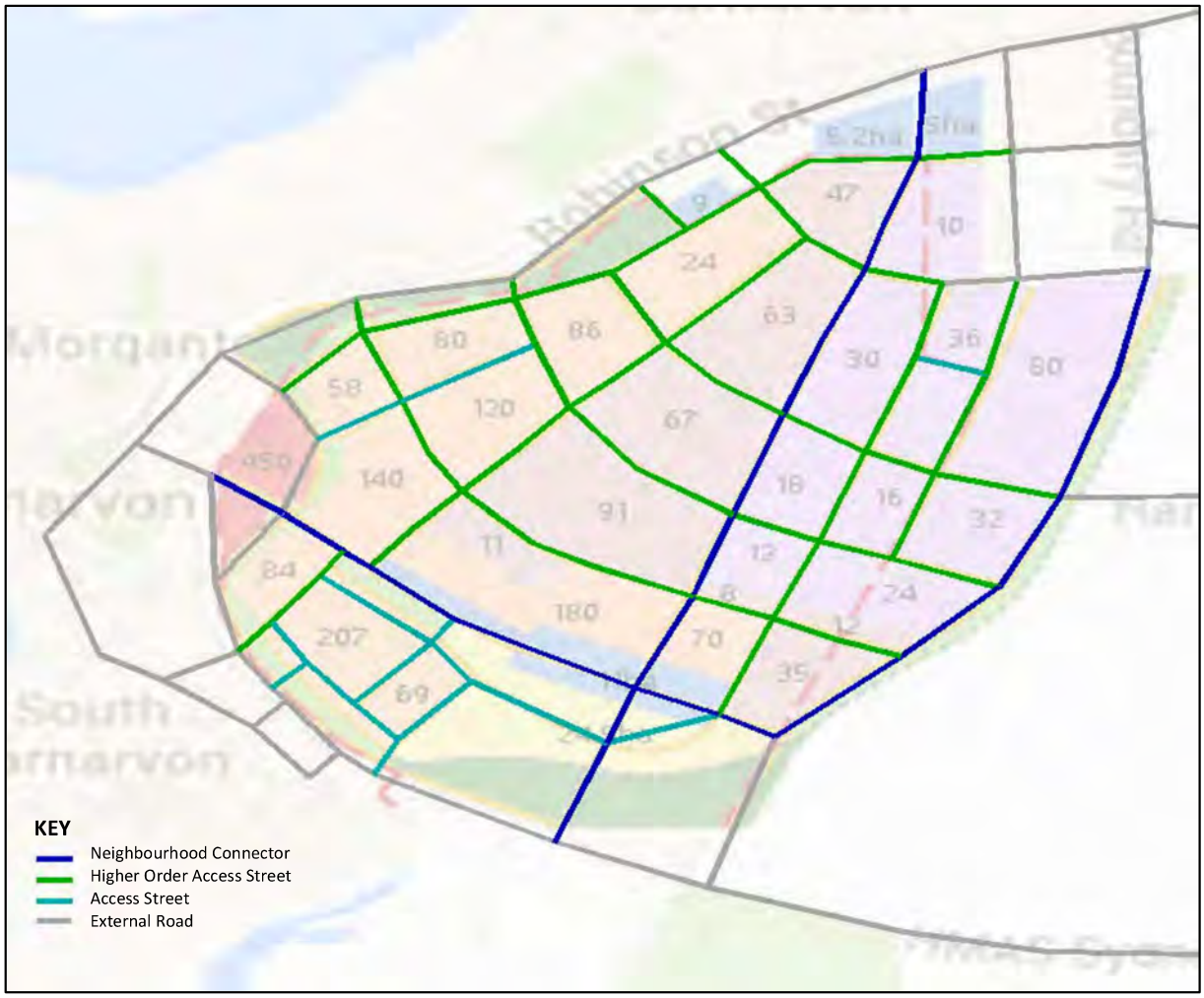


Figure 8 Recommended Road Hierarchy

The following road reservation requirements identify the minimum recommended width to be provided. The road reserves may be wider to provide additional landscaping opportunities or to incorporate the drainage strategy.

Neighbourhood Connectors

Liveable Neighbourhoods provides the following comment on neighbourhood connectors:

> *Neighbourhood connectors link neighbourhoods and towns, are carefully designed to calm traffic, limit noise and facilitate pedestrian use. They have frequent local street connections. They should not attract substantial long distance through traffic, but provide for safe and convenient local travel to and from arterial routes, usually at signal controlled intersections.*

Roads shown blue in Figure 8 are considered as neighbourhood connectors as they provide the primary access to the structure plan area. Daily traffic flows on these roads are typically

below 3,000 vehicles and a standard 7.2 metre carriageway in a 20 metre road reservation is recommended.

At higher order intersections a median island of 2.0 metres width would be desirable to provide safer pedestrian crossing points and to highlight the intersection. A minimum verge width of 4.1 metres could be used resulting in a minimum road reservation of 17.4 metres.

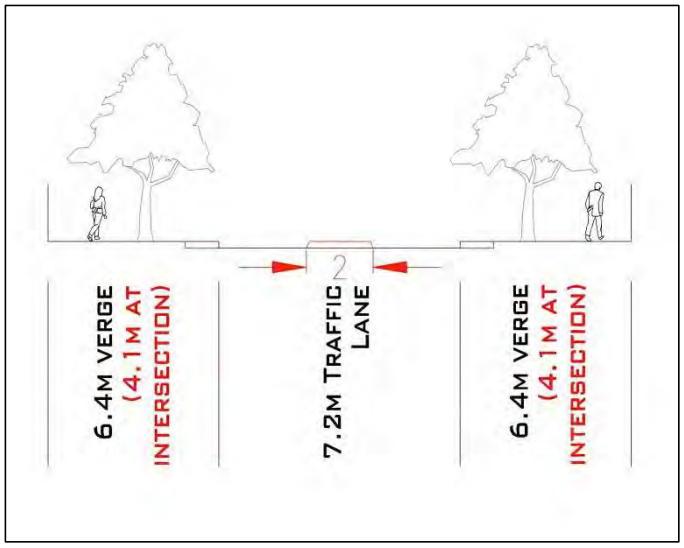


Figure 9 20m Cross-Section

Figure 9 shows a typical road cross-section incorporating localised widening to accommodate a pedestrian median. The cross-section uses a 20 metre road reservation to provide robustness to the reservation and permit on-street parking embayments of 2.2 metres (providing a residual verge of 4.2 metres).

A 20.0 metre cross-section is recommended for neighbourhood connector roads.

Higher Order Access Streets

Higher order access streets are the main streets within the structure plan area and provide direct lot access. These higher order streets would be provided with a 6.0 metre to 7.0 metre carriageway depending on bus routes and Local Government requirements.

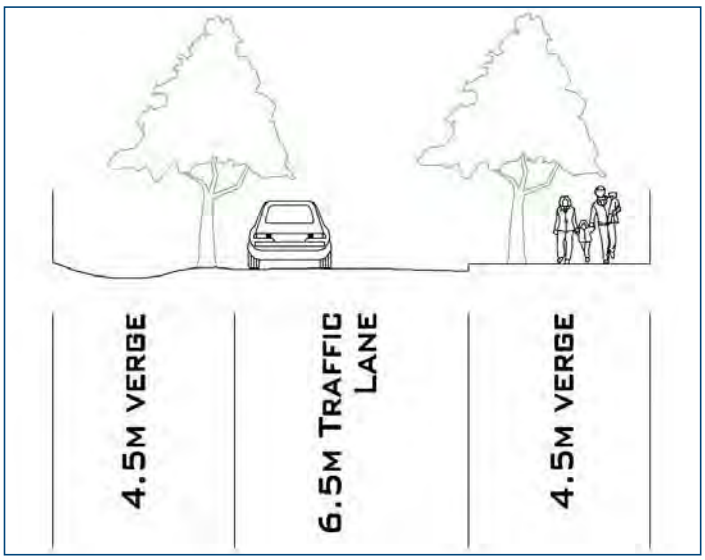


Figure 10 16m Cross-Section

Figure 10 shows a typical road reservation for a higher order access street with a 6.5 metre wide carriageway and 4.5 metre verges. If higher density dwellings are proposed, then a wider road reservation to accommodate on-street parking should be considered.

A 16.0 metre cross-section is recommended for higher order access streets.

It is recommended that the minimum carriageway width be provided to encourage a slower speed environment in residential streets. Many streets with 7.0+ metre carriageways and lower density lots frequently experience traffic speeds well in excess of the posted 50kph limit. A reduced carriageway width will assist in achieving a more appropriate 40kph typical travel speed.

Industrial Access Streets

Although most roads are identified as higher order access streets within the structure plan area based on the forecast daily flow, a wider carriageway may be more suited to roads with industrial lot access. A wider carriageway of 9.0 metres is commonly used to provide ample access for large trucks and on street stopping. A standard 5.1 metre verge is also used to allow greater turning opportunity from the road to the industrial lot.

Industrial access streets may be provided with a 20 metre road reservation.

Access Streets

Access streets with daily traffic flows less than 1,500 vehicles are shown coloured cyan in Figure 8. A reduced carriageway width of 5.5 metres is suited to these low volume streets and is supported by *Liveable Neighbourhoods*. Using two residual 4.5 metre verges, a road reservation of 16 metres would be sufficient for these streets. There should be no need to provide medians in these low volume streets.

A 16.0 metre cross-section is recommended for access streets.

A 14 .2 metre road reservation is the practical minimum road reservation that can be utilised for access streets. Occasional on-street parking can be accommodated to cater for visitors without significant impact to traffic movement. Such road reserves should only be used where the access street provides no major linkage to other access streets.

Access streets can be provided with a 14.2 metre reservation where on-street parking is not expected.

Roads Adjacent to Open Space

Where the road reservation abuts POS, bushland etc, there is limited need to provide a verge. The verge may be reduced where parking and/or services are not required and should be considered at the time of subdivision. A minimum verge of 0.75 metres is advised by current road planning standards to accommodate street furniture. Footpaths do not need to be adjacent to the road where POS is provided, but must be provided in a safe and appropriate manner. Figure 11 shows an example of a reduced road reservation adjacent to open space.

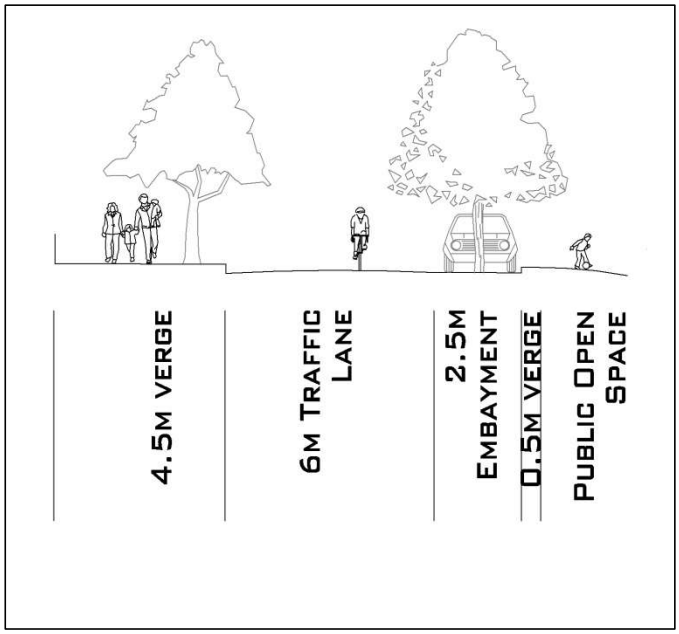


Figure 11 Road Adjacent to Open Space

Boulevards

The development of local streets as boulevards adds opportunity for landscaping and reduces the visual level of blacktop. The use of divided carriageways with median treatments requires that a minimum carriageway width of 4.1 metres be provided to conform to Austroads. Commonly boulevards are provided with a carriageway width of 4.5 metres, often designated as a 3.0 metre traffic lane and a 1.5 metre cycle lane. Figure 12 shows a 4.5 metre wide carriageway indicating that ample width exists to pass a stationary vehicle in the event of a breakdown.

Figure 12 Boulevard Treatment

Roads with Table Drains

Where table drains or other similar features are used, a wider road reservation would be required to accommodate the drain. Figure 13 shows a cross-section for a local access street with a table drain. The resultant road reservation will depend upon the drain requirements. The table drain does not need to be adjacent to open space as indicated by

Figure 13. A table drain can be used adjacent to lots, but attention to the location of lot access will be required. Further, a table drain may also be provided within a median.

The use of these features is site specific and the details should be discussed at the subdivision stage.

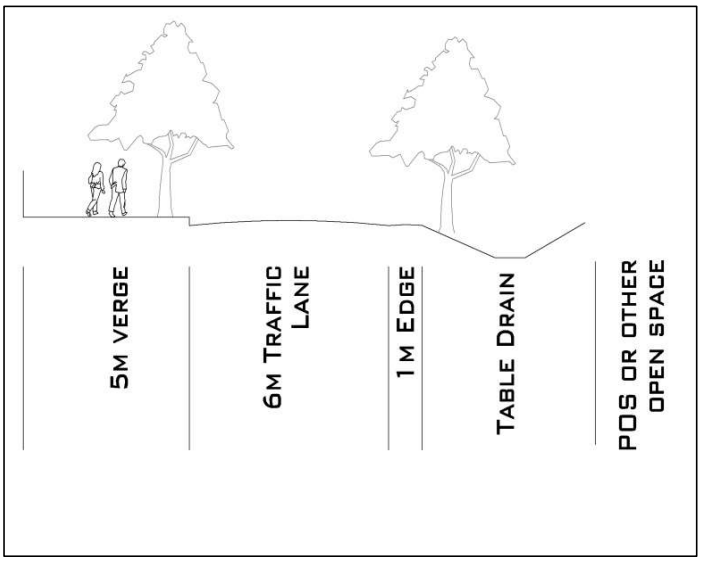


Figure 13 Roads With Table Drains

Traffic Management

Figure 14 shows the location of traffic management devices that may be required within the structure plan area.

Four-way intersections

Four-way intersections are indicated in the concept plan and are not considered to be a road safety hazard where traffic volumes are less than 2,000vpd (as set out by *Liveable Neighbourhoods*). Four-way priority control intersections may also be appropriate on residential streets with volumes less than 5,000vpd where an offset on the terminating streets is provided. Alternatively medians on the terminating streets could also be used.

Where daily traffic flows exceed these levels, a roundabout would be recommended to control movement at the intersection and reduce traffic speeds. Figure 14 identifies where roundabouts may be appropriate.

Figure 14 Traffic Management

On residential streets alternative methods of control are acceptable and Figure 15 shows the treatments recommended by *Liveable Neighbourhoods.* On industrial roads, the use of roundabouts is not recommended due to the damage caused by large vehicles. In industrial areas, four-way priority control is considered acceptable, subject to capacity considerations.

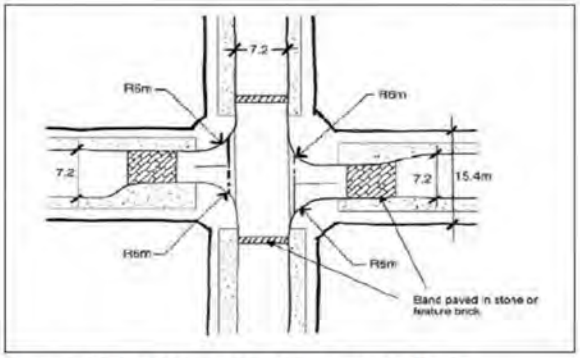


Figure 29A: Access street to access street with-four way and stagger.

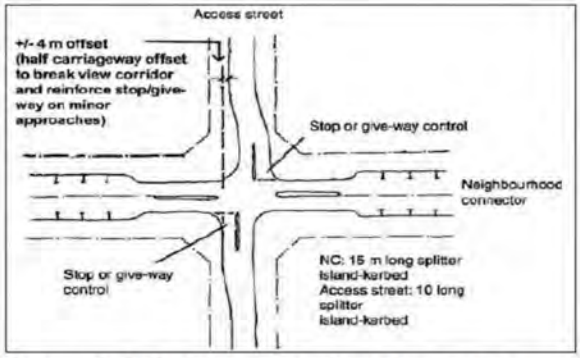


Figure 31: Left-right minor offset four-way on neighbourhood connector (derived from Austroads Guide to traffic engineering, Part 5 Intersections, Figure 5-8).

Figure 15 Liveable Neighbourhoods Four-way Intersections

Local Intersection Design

To reduce the opportunity for speeding it is recommended that corner radii advised by *Liveable Neighbourhoods* be used within the subdivision. The recommended radii are:

- 6.0 metres - access street / access street intersections
- 9.0 metres - access street / neighbourhood connector

Where larger vehicles are expected, such as cars towing boats and buses accessing the school, larger radii may be required and should be considered at subdivision stage. Within the industrial area, corner radii of 12 metres to 15 metres may be required to provide access for trucks.

5.0 EXTERNAL INTERSECTION CONTROLS

As a result of the full development of the structure plan area, key intersections may require some form of upgrading. It is commonly accepted that the peak hour equates to 10%[1] of the daily flow and the major movement during the peak period is typically 70% in the peak direction. These basic assumptions are applied to the modelled flows to assess what form of control can be expected to be required at key intersections.

Reference to Austroads Table 4.1 (reproduced below in Figure 16) shows the traffic flows at priority controlled intersections where uninterrupted flow conditions will exist. Austroads advises that in such conditions, no further assessment of the intersection is required as excellent operating conditions can be expected. Where uninterrupted flow conditions do not exist, control may be required. Austroads Table 5.5 (reproduced below in Figure 16) indicates the typical limits of intersection capacity by control method.

Table 4.1 — Intersection Capacity - Uninterrupted Flow Conditions

Major Road Type[1]	Major Road Flow (vph)[2]	Minor Road Flow (vph)[3]
Two-lane	400	250
	500	200
	650	100
Four-lane	1000	100
	1500	50
	2000	25

Notes:
1. Major road is through road (i.e. has priority).
2. Major road design volumes include through and turning movements.
3. Minor road design volumes include through and turning volumes.

Table 5.5 — Typical Limits of Intersection Capacity (vph)

(Four way intersection with equal demand for all movements

Approach Width	Type of Control		
	No signals (a)	Round-about(b)	Signals(c).
1 lane	1500	2600	1500
2 lanes	1500	4560	3000
3 lanes	1500	6000	4500
4 lanes	1500	na.	6000

Notes:
(a) Based on practical absorption capacities of unsignalised intersections.
(b) Based on gap acceptance criteria.
(c) Based on four split phases (120s cycle).

Figure 16 Austroads Intersection Tables

The average traffic demand during the peak hour is shown in Appendix C. Appendix C identifies the key intersections reviewed below.

Access A (James Street / Robinson Street)

The peak flow on Robinson Street at Access A is expected to be in the order of 1,134 vehicles with a side road demand of (195 x 70%) 140 vehicles (James Street). Table 4.1 indicates that uninterrupted flow conditions will not exist.

[1] Actual values vary from about 7% to 9%.

Table 5.5 indicates that a priority intersection can be expected to operate with a peak demand up to about 1,500 vehicles. Access A is shown to have a demand of 1,140 vehicles and should operate within practical absorption capacity. It can be expected that a second traffic lane on James Street would be required.

James Street will require an additional lane approaching Robinson Street.

Access B (Babbage Island Road / Robinson Street)

Access B is indicated to form a four-way intersection and current planning guidelines require that some form of control be provided. A roundabout is considered suitable to this intersection, as a high pedestrian movement would not be anticipated.

Access B would require a roundabout.

Access C

The peak flow on Robinson Street at Access C is expected to be in the order of 1,233 vehicles with a side road demand of (49 x 70%) 34 vehicles. Table 4.1 indicates that uninterrupted flow conditions will exist.

A simple priority intersection should suffice for Access C.

Access D

The peak flow on Robinson Street at Access D is expected to be in the order of 1,423 vehicles with a side road demand of (207 x 70%) 145 vehicles. Table 4.1 indicates that uninterrupted flow conditions will not exist.

Table 5.5 indicates that a priority intersection can be expected to operate with a peak demand up to about 1,500 vehicles. Access D is shown to exceed the level set out in Table 5.5 and some form of control may be required at this intersection.

Some form of control maybe required at Access D.

Access E

Access E is shown to have a peak demand of (9 x 70%) 6 vehicles and the demand is considered to be insignificant.

A simple priority intersection should suffice for Access E.

Access F

The peak flow on Robinson Street at Access F is expected to be in the order of 1,070 vehicles with a side road demand of (290 x 70%) 203 vehicles. Table 4.1 indicates that uninterrupted flow conditions will not exist.

Table 5.5 indicates that a priority intersection can be expected to operate with a peak demand up to about 1,500 vehicles. Access F is shown to have a demand of 1,273 vehicles and should operate within practical absorption capacity. It can be expected that two approach lanes will be required.

A simple priority intersection with two approach lanes should suffice for Access F.

Access G

The peak flow on Robinson Street at Access G is expected to be in the order of 1,041 vehicles with a side road demand of (375 x 70%) 262 vehicles. Table 4.1 indicates that uninterrupted flow conditions will not exist.

Table 5.5 indicates that a priority intersection can be expected to operate with a peak demand up to about 1,500 vehicles. Access G is shown to have a demand of 1,303 vehicles and should operate within practical absorption capacity. It can be expected that two approach lanes will be required.

A simple priority intersection with two approach lanes should suffice for Access G.

Access H

Access H is the existing intersection of Robinson Street / Cornish Street / Angelo Street. The modelling indicates that the side road demand on Cornish Street will increase by about (87 x 70%) 61 vehicles. The increase is not too significant and the intersection may continue to operate in an acceptable manner. However, as a four-way intersection, current planning guidelines require that some form of control should be provided (regardless of future development).

The existing intersection of Robinson Street / Cornish Street / Angelo Street should be controlled.

Access I (Boundary Road)

Access I is the existing intersection of Robinson Street / Boundary Road. The peak flow on Robinson Street at Access I is expected to be in the order of 480 vehicles with a side road demand of (132 x 70%) 92 vehicles. Table 4.1 indicates that uninterrupted flow conditions will exist.

A simple priority intersection should suffice for Access I.

Access J

Access J intersects with Carnarvon Road and no current data is available for this street. Based on the flow of 230vpd on HMAS Sydney II memorial Drive, a flow of about 1,000vpd could be expected. The peak flow on Carnarvon Road at Access J is assumed to be about 100 vehicles. Access J has a peak demand of (124 x 70%) 87 vehicles and reference to Table 4.1 indicates that uninterrupted flow conditions will exist.

A simple priority intersection should suffice for Access J.

Access K

Access K has a peak demand of (40 x 70%) 28 vehicles and based on 100 vehicles using Carnarvon Road, Table 4.1 indicates that uninterrupted flow conditions will exist.

A simple priority intersection should suffice for Access K.

Access L

Access L has a peak demand of (33 x 70%) 23 vehicles and based on 100 vehicles using Carnarvon Road, Table 4.1 indicates that uninterrupted flow conditions will exist.

A simple priority intersection should suffice for Access L.

Access M

Access M has a peak demand of (147 x 70%) 103 vehicles and based on 100 vehicles using Carnarvon Road, Table 4.1 indicates that uninterrupted flow conditions will exist.

A simple priority intersection should suffice for Access M.

Access N

Access N has a peak demand of (77 x 70%) 54 vehicles and based on 100 vehicles using Carnarvon Road, Table 4.1 indicates that uninterrupted flow conditions will exist.

A simple priority intersection should suffice for Access N.

6.0 PEDESTRIANS, CYCLISTS AND PUBLIC TRANSPORT

Current planning guidelines suggest that all streets should be provided with a footpath where ever possible. Where traffic flows exceed 1,000 vehicles per day, a footpath to both sides of the road should be provided. All new subdivisions will be required to provide footpaths in accordance with current planning standards (*Liveable Neighbourhoods*). A standard footpath of 1.5 metres is desirable to every street.

Cycling

Most streets within the structure plan area have forecast future traffic flows below 1,500vpd and therefore cycling on street would be considered as safe and acceptable. Figure 17 shows roads where dual use paths and cycle lanes are desirable.

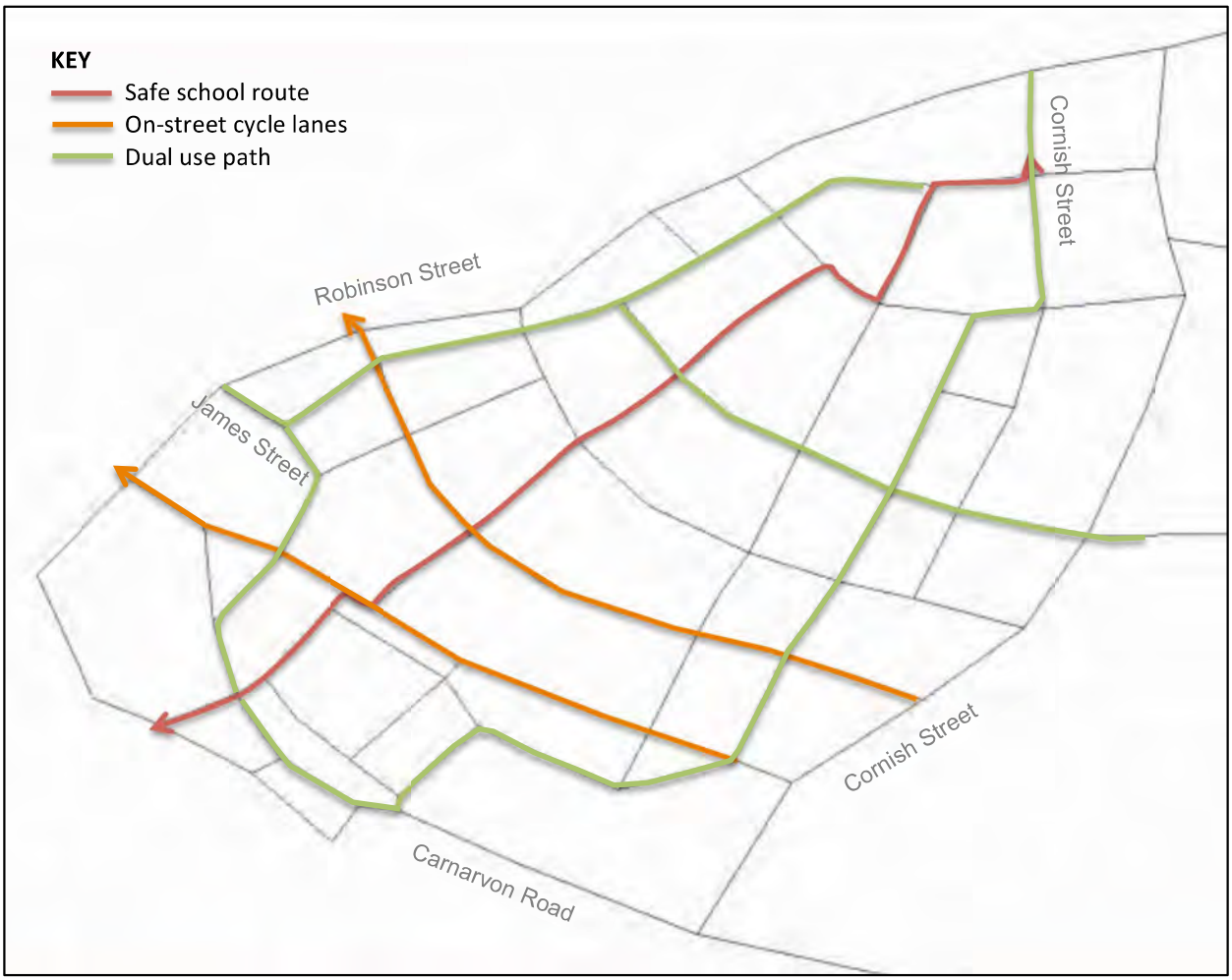


Figure 17 Dual Use Paths and Cycle Routes

Public Transport

There are no public transport services expected to be implemented in Carnarvon. However, local buses can be expected to transfer work camp residents between the airport and places of work. Planning for future buses services is recommended for structure plans, even thought the introduction of such services may not occur for many years. Figure 18 shows streets that should be planned for future bus services.

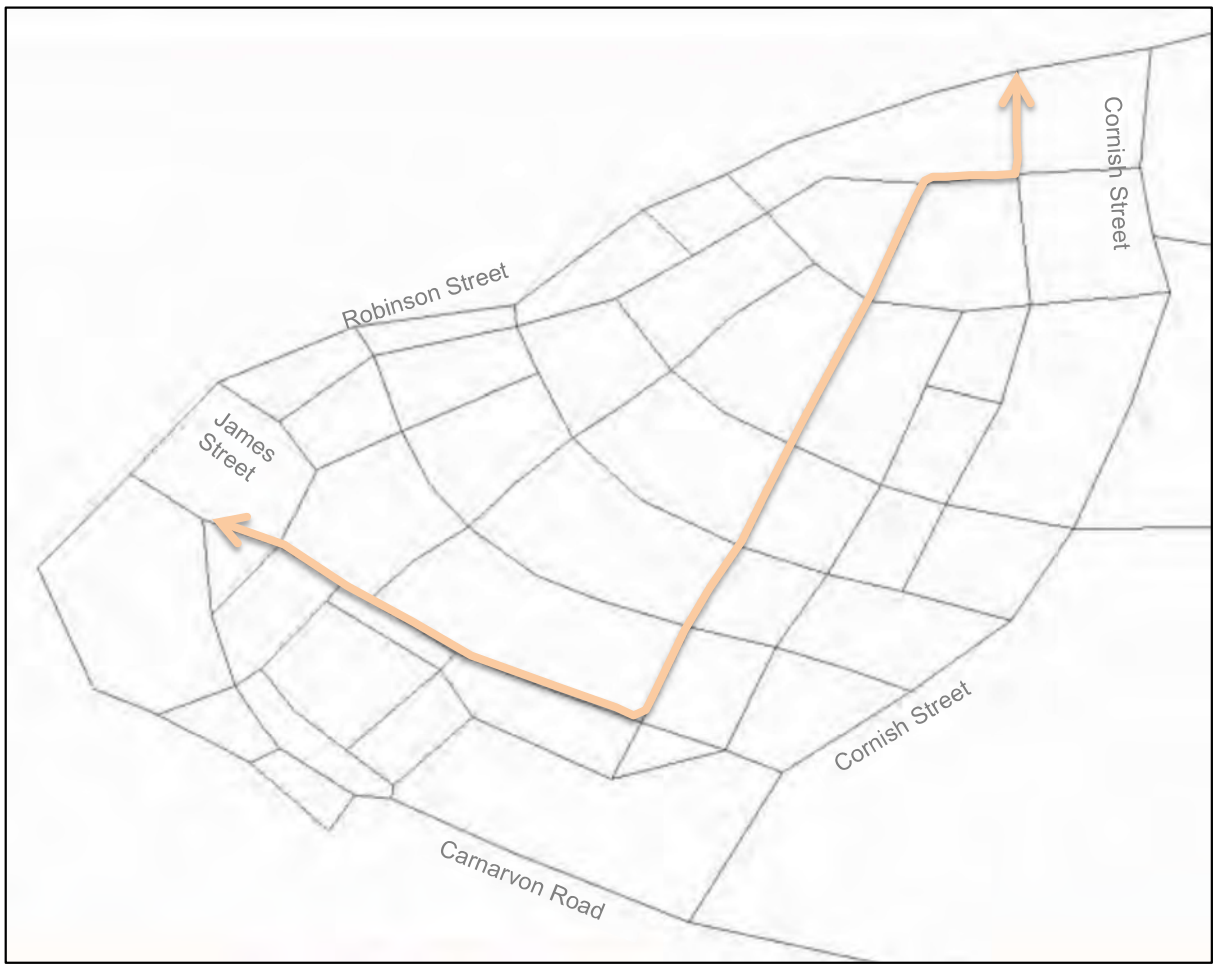


Figure 18 Roads to be suitable for Buses

APPENDIX A

ABS data

2011 Census QuickStats

All people - usual residents

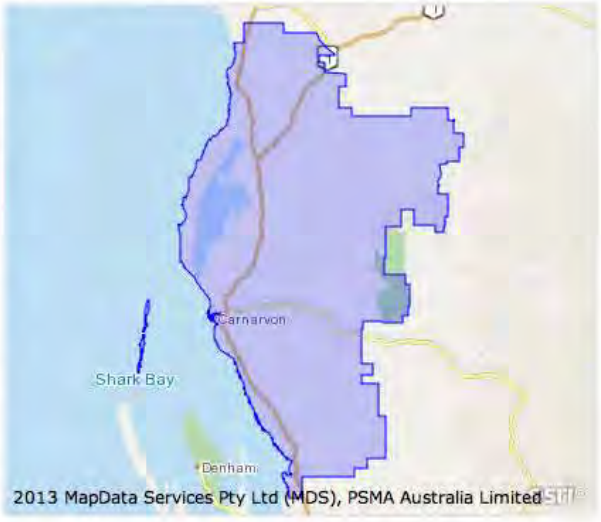
Australia | Western Australia | Local Government Areas

Carnarvon (S)

Code LGA51540 (LGA)

People	**5,787**
Male	2,964
Female	2,823
Median age	38
Families	**1,369**
Average children per family	2
All private dwellings	**3,721**
Average people per household	2.5
Median weekly household income	$1,107
Median monthly mortgage repayments	$1,517
Median weekly rent	$155
Average motor vehicles per dwelling	1.9

Community profile | QuickStatsSearch | Enter a location | GO



People includes demographics & education | cultural & language diversity | employment >

Families includes family composition | weekly incomes | employment status of couple families >

Dwellings includes dwelling structure | household composition | mortgage & rent | number of motor vehicles v

Dwellings — dwelling structure

dwelling structure | household composition | mortgage & rent | number of motor vehicles

Dwelling tables exclude visitor only and other non-classifiable households

Dwelling type	Carnarvon (S)	%	Western Australia	%	Australia	%
Occupied private dwellings	1,949	86.9	794,159	87.9	7,760,320	89.3
Unoccupied private dwellings	294	13.1	109,328	12.1	934,470	10.7

In Carnarvon (S) (Local Government Areas), 86.9% of private dwellings were occupied and 13.1% were unoccupied.

Dwellings — number of motor vehicles

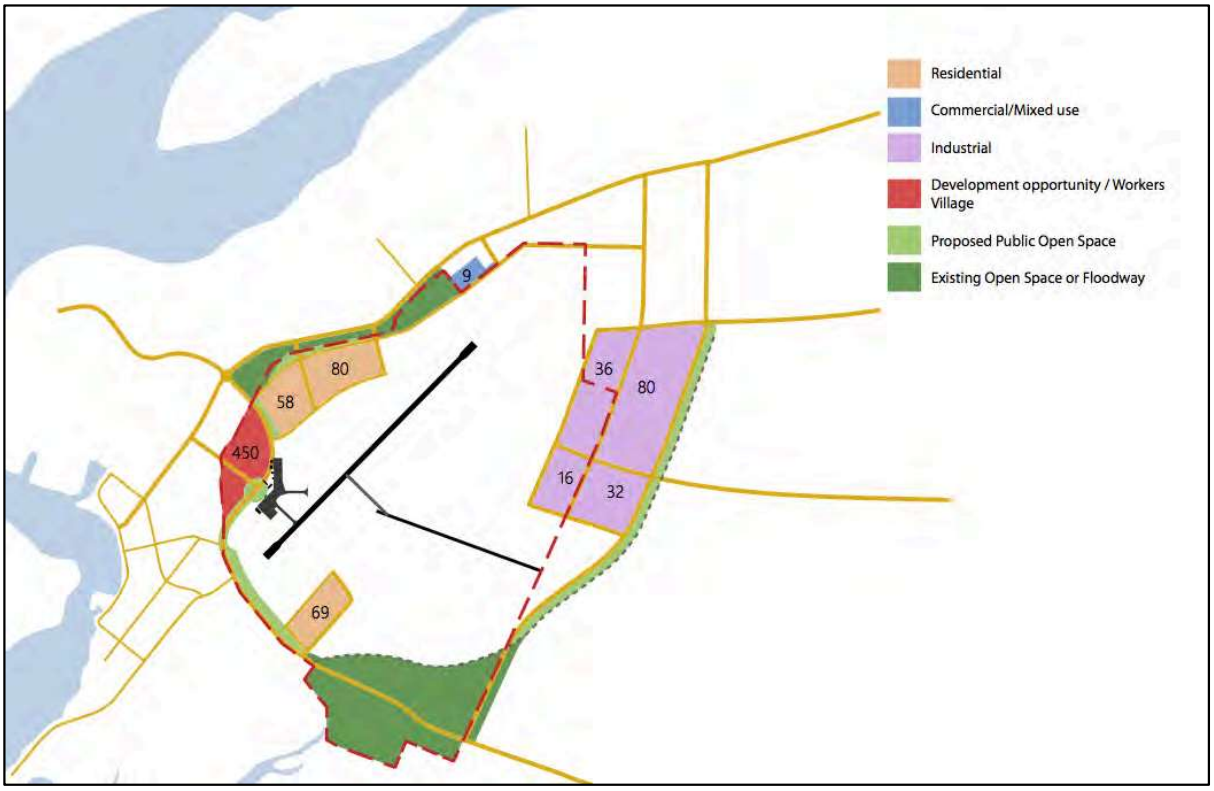
dwelling structure | household composition | mortgage & rent | number of motor vehicles

Number of registered motor vehicles	Carnarvon (S)	%	Western Australia	%	Australia	%
None	178	9.1	48,447	6.1	665,852	8.6
1 motor vehicle	631	32.4	258,942	32.6	2,778,576	35.8
2 motor vehicles	620	31.8	305,676	38.5	2,802,468	36.1
3 or more vehicles	383	19.6	158,860	20.0	1,279,134	16.5
Number of motor vehicles not stated	138	7.1	22,234	2.8	234,292	3.0

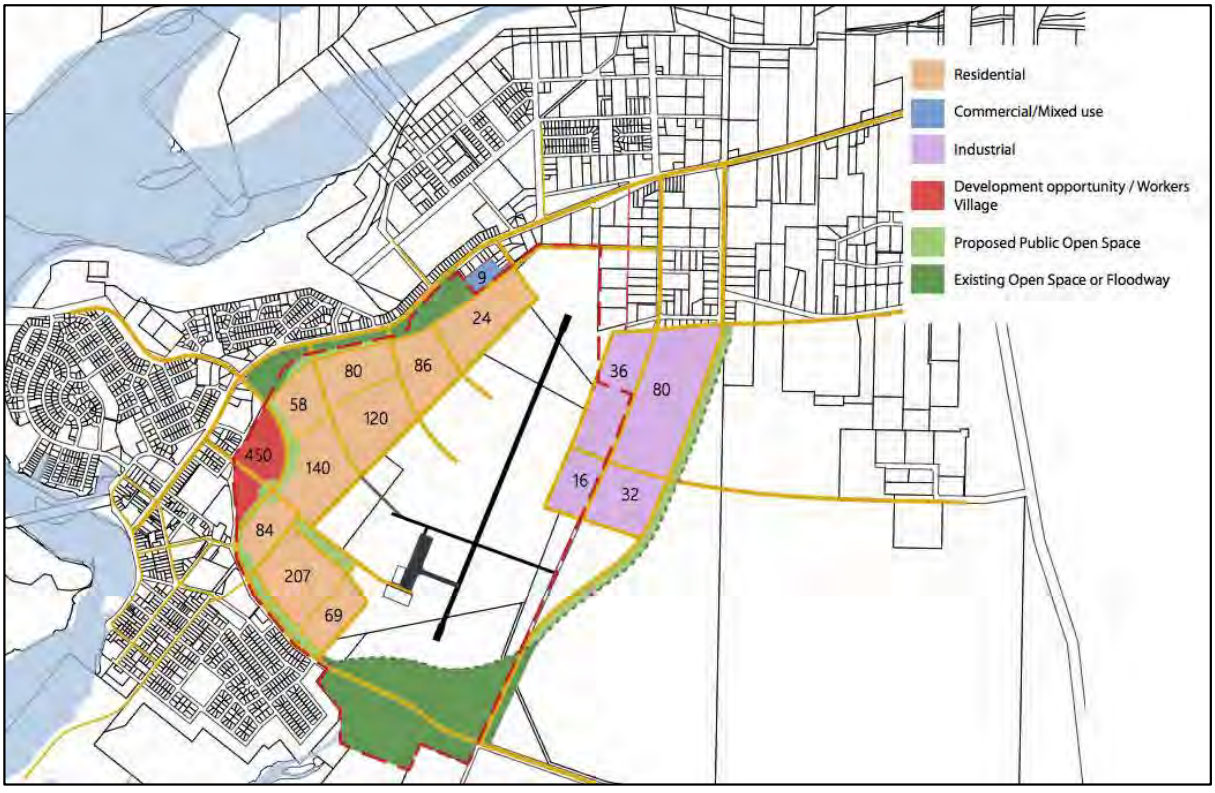
In Carnarvon (S) (Local Government Areas), 32.4% of occupied private dwellings had one registered motor vehicle garaged or parked at their address, 31.8% had two registered motor vehicles and 19.6% had three or more registered motor vehicles.

APPENDIX B

Planning Stages



Stage 1

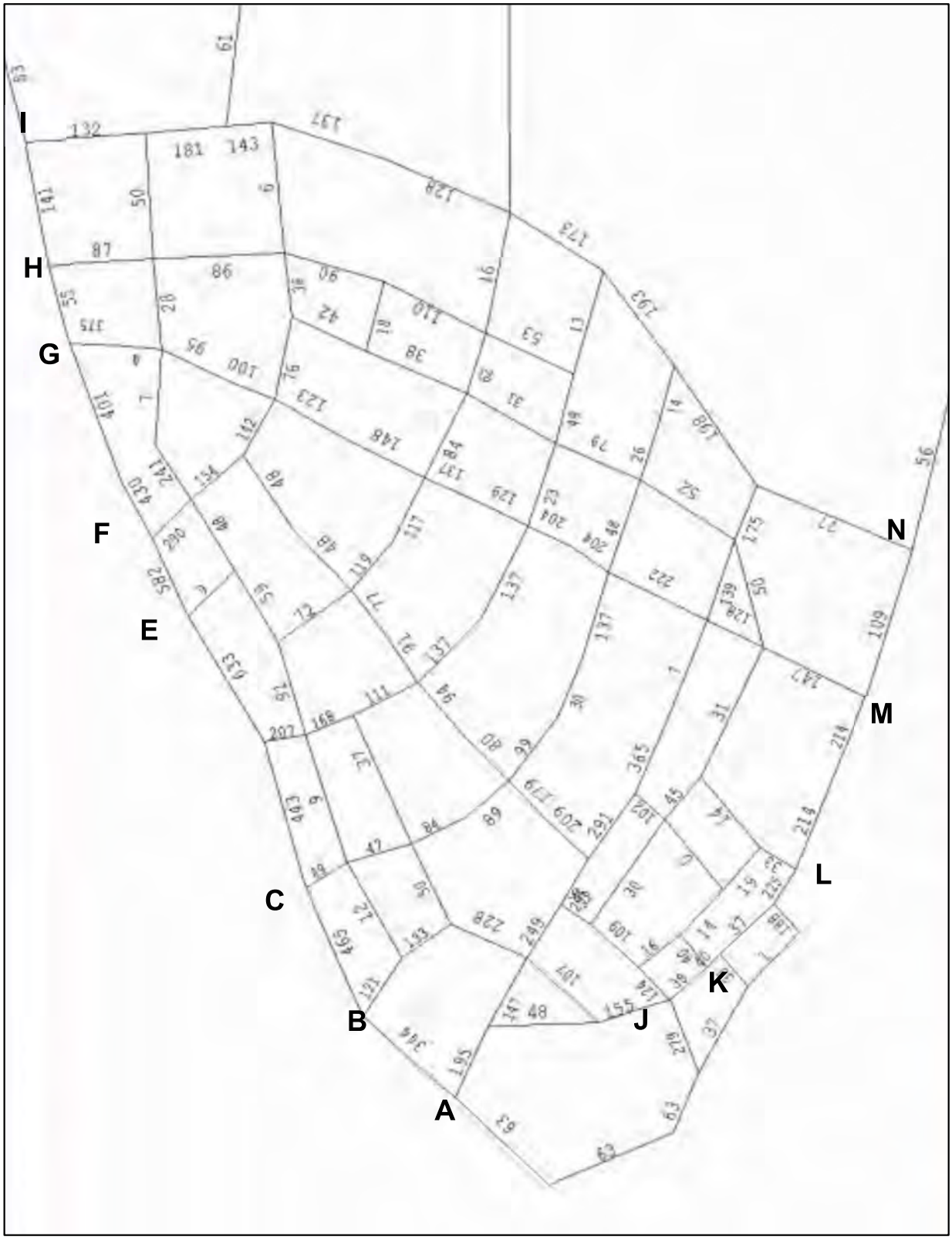


Stage 2

Stage 3 as per Figure 5

APPENDIX C

Model Output and Key Intersections



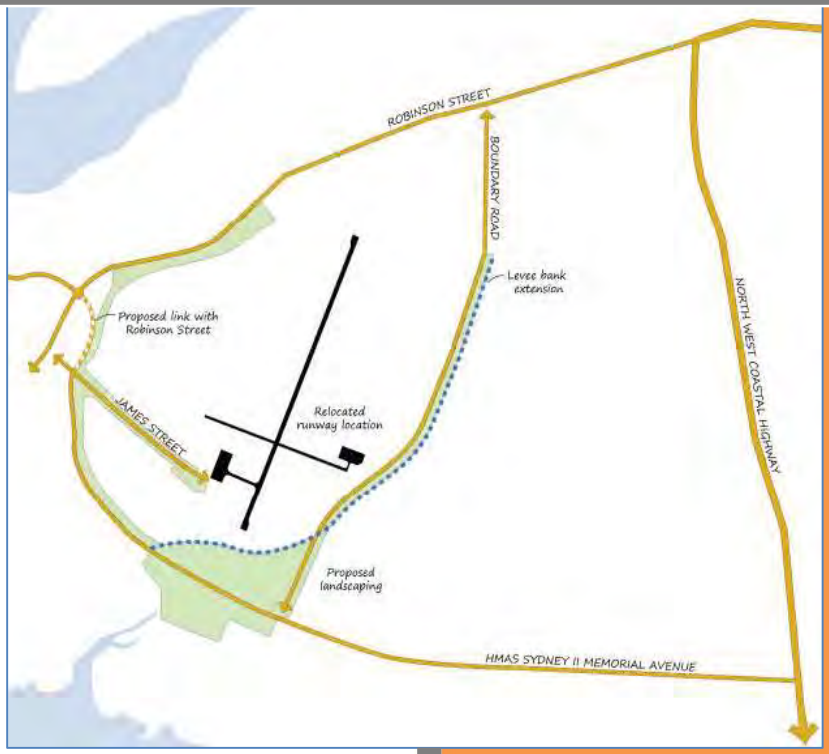
X 10 for daily volume

Appendix 4

EXISTING SERVICES

JDSi Consulting Engineers

CARNARVON DISTRICT PLAN – ENGINEERING SERVICING REPORT



Submitted by

JDSi Consulting Engineers

AUGUST 2013

Project No. JDS12570

FINAL

Contents

DOCUMENT REVIEW				
Revision	**Date Issued**	**Written By**	**Reviewed By**	**Approved By**
Draft_Rev A	02/08/13	K.Pannu	J.Gray	
Final	05/09/13	K.Pannu	G.Coffey	J.Gray

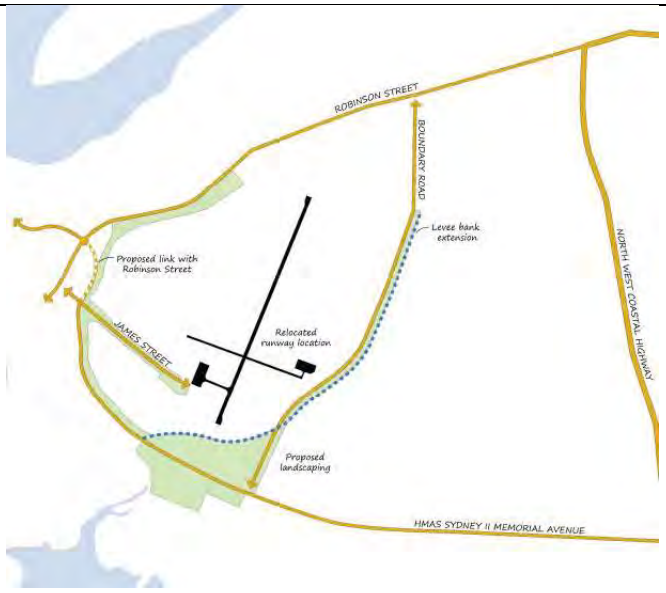
1.0 Introduction

This engineering service report has been prepared by JDSi Consulting Engineers to assist Hames Sharley prepare a Structure Plan Guideline for the Carnarvon airport site development.

The proposed staging of this development is noted below in Figure 1.0.

Figure 1.0: Proposed Staging Plan

<table>
<tr>
<td> 

Existing – Carnarvon Airport Site</td>
<td> 

Stage 1: Approx. 400 lots plus

Time frame: 2-3 Year Plan</td>
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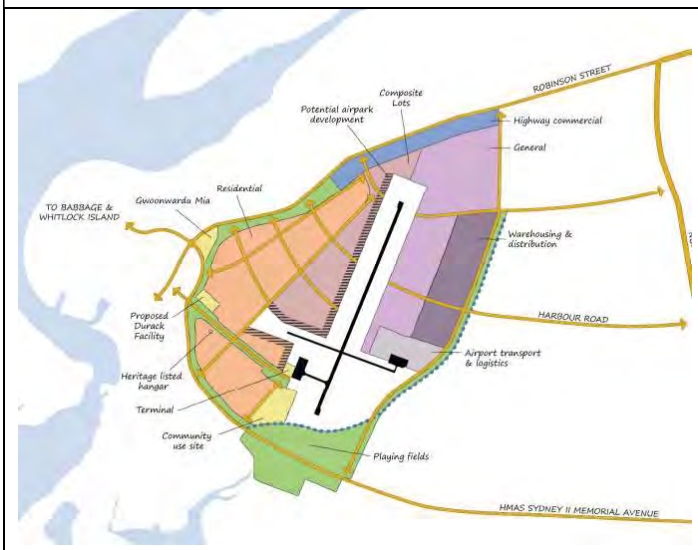
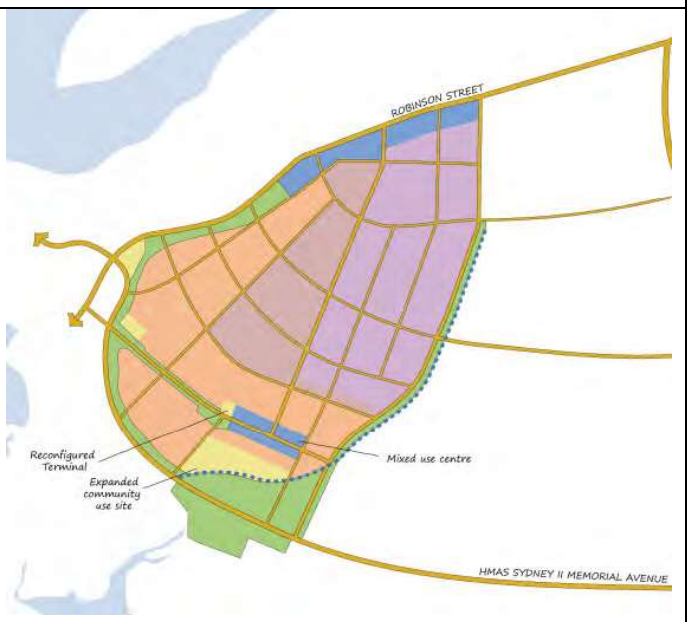
<td> 

Stage 2: Approx. 1,000 lots plus

Timeframe: 5-10 Year Plan</td>
<td> 

Stage 3: Approx. 1,500 lots plus

Timeframe: 50 -100 Year Plan</td>
</tr>
</table>

The key objectives of this report are to:

- Review the proposed staged structure plan and the forecast yields.
- Investigate and assess the existing infrastructure assets surrounding the proposed development.
- Liaise with relevant service authorities for input into this servicing report.
- Provide desktop engineering advice on implementation of key infrastructure requirements.

The following proposed development elements have been assumed as provided by Hames Sharley, July 2013:

Table 1.0: Assumed Development Elements

Lot Yields
Stage 1: 400 lots (mixed used) Stage 2: 1,000 lots (mixed used) Stage 3: 1,500 lots (mixed used)
Areas:
Gross Area of Site: 510 hectares Developable Area: 400 hectares (*where Stage 1: 100 Ha, Stage 2: 70 Ha and Stage 3: 230 Ha)* *(Developable area includes: Residential/Commercial/Mixed use/Industrial, Worker's Village, P.O.S and existing Floodway)*

This report covers the engineering infrastructure requirements to service the proposed development. The engineering review has covered power demand, telecommunications, earthworks, drainage and roads, water and wastewater and gas infrastructure.

The investigations and preparation of the report are largely based on preliminary advice from the various service authorities. The information is current as of September 2013 and is subject to change as development proceeds.

2.0 Geographical Characteristics

The proposed development site has a total land area of approximately 510 Ha. It consists of the existing Carnarvon Airport and its surrounding land which is generally on low lying region with a potential high seasonal water table.

The main road networks that bound the site are Carnarvon Road to the South, Robinson Street to the north and Cornish Road to the east.

Developed land fronts Robinson Road, the northern section of Cornish Street and the majority of Carnarvon Road. The majority of Cornish Street and approximately 1km of the southern section of Carnarvon Road has no fronting urban or industrial development.

Although the Carnarvon Airport is low lying, neither drainage nor flooding has been major issues, due to the effectiveness of the current levee system around the existing site. The northern half of the site including the existing airport is generally at RL4 with the southern section of the site as low as RL 2.

All land areas noted for expansion are low lying and have potential overland water flood risks. Most areas of this development region are subject to inundation during exceptional floods and are characterized by erosion prone. Some areas are also susceptible to storm surge.

To determine the land area suitable for development a flood/storm surge protection study and water level assessment will need to be commissioned.

3.0 Power Supply

Horizon Power own and operate the electrical supply network within the area and therefore all electrical supply equipment and cables will need to be installed in accordance with Horizon Power's specifications.

3.1 Existing Power Infrastructure

The distribution network in Carnarvon in the area of the Airport is 22kV and is supplied from the current 'old' Power Station near the corner of Robinson Street however it is expected the newly installed Power Station (Mungullah) will be operational sometime this year (2013) and once fully operational the Mungullah Power Station will provide 18MW of capacity for Carnarvon and will have limited capacity to service future growth. The old Power Station will be decommissioned after the Mungullah Power Station is service.

The Mungullah Power Station is located near the corner of HMAS Sydney II Memorial Avenue and North West Coastal Highway.

The distribution 22kV high voltage network is made up of both overhead and underground type networks. Typically each 22kV network can service some 8MVA subject to Horizon Power's feeder loading policies.

Refer to **Appendix A –** *Snapshot of Existing Power Infrastructure* for further details on the existing connection layouts.

3.2 Proposed Infrastructure Requirement

The current power supply arrangement to the Airport would lack the ability to supply the development. This essentially means new high voltage feeders are required to service the development.

For Stage 1 development, an estimated 400 lot release the power supply required to cater for this stage would be around 2.4MVA. It is expected the current 22kV network would have some capacity to service the initial stages, however there may be some headworks required in the latter part of the development.

Commercial component would represent a supply requirement of around 420kVA based on the current Horizon Power supply allocation of 200kVA per ha.

The industrial land demand is complex due to the size of the land proposed for development. Based on 72ha, the Horizon Power supply allocation would yield approximately 14MVA. Due to the large lot sizes it is recommended to reduce the power supply to 100kVA, which would yield a demand for 7MVA.

Based on the above the supply required for Stage 1 equates to around 10MVA which means at least two 22kV feeders are needed.

Stage 2 development is estimated on 1,000 lot release and the power supply required to cater for this stage would be around 6MVA. This would trigger the need for another 22kV feeder to service this stage and the industrial component was serviced as part of the Stage 1 works.

For a Stage 3 development with estimated 1500 lot release over a 50-100 year timeframe, the power supply required to cater for this stage would be anticipated around 9MVA. It is likely the Mungullah Power Station will require additional generators to be able to service the parts of Stage 2 and Stage 3.

Any overhead power line that traverses the lots to be developed will need to be converted to an underground type network.

This information is very high level and as such we would recommend further investigations with Horizon Power to confirm the above.

4.0 Telecommunications

4.1 Existing Telecommunication Infrastructure

The town of Carnarvon is currently serviced by Telstra for residential communication requirements. Existing Telstra assets exist in the surround road reserves.

4.2 Proposed Infrastructure Requirement

As a result of the Australian Government's decision to roll out a National Broadband Network (NBN) the ownership issues of delivering the wholesale fibre to the home system have been transferred to the Government with a number of retail service providers likely to offer services over the network.

Coverage maps for the NBN Co indicate that Carnarvon is to be included in the rollout. Preliminary investigations have confirmed that fibre construction will commence in April 2014 and this phase is likely to be completed over 2014 to 2017. The areas of roll out are currently only limited to Brockman, Brown Range, Carnarvon, East Carnarvon, Kingsford, Morgantown and South Carnarvon.

Developers of new residential estates have the option to pay an extra fee to Telstra or an alternative service provider for provision of a high speed broadband network. In either case the developer will be responsible for the installation of all pit and pipe infrastructure which will be required to accommodate a future high speed broadband network.

General communication services for the development will consist of the installation of a standard pit and pipe network in accordance with NBN Co guidelines and standards. The current design practice for road reserves, pavement and verge provisions will make adequate allowance for services including broadband in accordance with the agreed Utilities Service Providers handbook. There will be some local land requirements for equipment sites, similar to current provisions which will be accommodated at detailed subdivision stage.

Further planning discussions with NBN provider are highly recommended so that staging development of site area can be incorporated into their roll out programme over the coming years.

5.0 Earthworks and Geological Characteristics

5.1 Existing Ground Levels

The town of Carnarvon is a relatively flat region with man-made levee systems to protect the surrounds from flooding by the Gascoyne River. The existing Levee system is shown below in **Figure 2.0.**

Figure 2.0: Existing Levee System

The development site is bounded north by the Gascoyne river, which consists of mainly saline soils with low lying shrub lands of blue bush and saltbush widely degraded and eroded.

The soil types for the development site range from tidal flats and mangrove swamps to calcareous clay silt and sand material. The soils are easily powdered and prevailing southwestern winds can cause the odd dust storms. Extensive efforts have previously gone into rehabilitation and dust control program for this region, where portions of the area have been identified as being severely degraded.

5.2 Earthwork Requirements

For a mixed use development around the airport site that is adjacent to flood levee and high water table levels, significant amount of earthworks will be required in the long term for property development and the expansion of various land uses. Allowance for dust control measures and erosion control for the Coast land system should be incorporated into the planning phase for the development site.

Earthworks will include the import of general and structural fill material for each staged development. The necessity of earthworks will ensure the workability of road networks, lot drainage management and the construction of underground utility services within the confines of design and regulation parameters.

Further detailed geotechnical investigation would be required to be undertaken to determine the suitability of this site for structural development and management of storm water drainage. In addition, detailed environmental and site contamination investigations are in required during the planning phase in support of the proposed development.

Some of the potential risk items that require detail investigation include:

- Levee studies from Department of Water and Department of Transport
- Identification of potential Wetlands in the surrounding region
- Sound understanding of Acid Sulphate Soils

In summary, based on future geotechnical advice being acceptable it is expected that no specialized ground improvement works will be required other than typical compaction and importation of fill. All earthworks will need to be carried out in accordance with Australian Standard AS3798-2007 “Guidelines on earthworks for residential and commercial development”. The bulk earthworks will also need to be undertaken in accordance with any recommendations resulting from a detailed geotechnical investigation to ensure suitable site classifications are achieved.

It is anticipated based on an acceptable geotechnical investigation that the material over the majority of the sites will result in a site classification of M-D in accordance with AS2870-2011. The exception to this is where collapsible soils i.e. Gilgai Clays are located. There is always a risk of encountering these highly expansive soils in low lying areas within Carnarvon. If collapsible soils are present then the site would likely be required to be improved by specific site improvement techniques.

6.0 Levee Management

6.1 Existing Levees

Carnarvon region has a history flooding from the Gascoyne River, thus the town is protected by an extensive levee bank system as shown above in **Figure 2.0.**

The airport area is within its own levee with tide flaps, there is a major floodway from about Robinson Street south along the western side of the area that discharges into Violet Creek at the southern end of the area. There is also a major floodway that will run south along the eastern side of the proposed new Boundary Road that also discharges into Violet Creek at the southern end of the area.

The proposed new Boundary Road is shown on the final plan running along the eastern side of the area. For major rainfall events during flood events, there is some detention capacity within the levee system. The volume of this detention storage will need to be reviewed with the proposed increase of impervious area to maintain a satisfactory level of inundation protection.

Existing surface water flows along the Gascoyne River are significant however, full recharge of the aquifers following a flow event. During periods of river flow, unrestricted access is provided to both groundwater and surface water, however during no flow periods, restricted access is permitted.

6.2 Proposed Infrastructure Requirement

The development phases under the District Structure Plan would require the existing levees to be strengthened and increased in height to potentially withstand a 1 in 500 year flood event. Future levee works will need to take into consideration rising sea levels and be in accordance with State Planning Policy Guidelines Number 2.6.

Further flood mitigation studies are required for the region; however a typical cross section of the levee may include a 4 metre berm with stable batter slopes and compaction of the levee soil material.

JDSi recommends further detail geotechnical assessment of the existing levee structures. To determine the land area suitable for development a flood/storm surge protection study and water level assessment will also need to be commissioned.

7.0 Drainage Network

7.1 Existing Drainage Network

The storm water management in Carnarvon is managed by directing the runoff from minor rainfall events from impervious areas onto pervious areas such as lawns, gardens and POS to allow for infiltration into the ground.

The existing drainage network in the surrounds of the proposed developed site consists of pipe network and open drains. The run off is collected of low points where it is then transferred into the river, the sea or another storm water outlet. Public open spaces have been designed around the Town to act as a retaining basin during a flooding event.

7.2 Proposed Infrastructure Requirement

The storm water drainage from the development area will need to be designed and construction in accordance with Department of Water, Department of Transport and Shire of Carnarvon and in line with their Local Planning Strategy. However, it is anticipated that stormwater run-off will be controlled via typical methods utilised in Carnarvon. All lots will need to graded so runoff can be retained on site and then disposed of through a suitable drainage network, such as towards the roads or open drains. Roadways will be used to convey flows, which will then discharge into the open drain at the front of the site.

Roads will require earth working to ensure stormwater runoff is adequately controlled and conveyed to the open drain.

Culverts will need to be installed under all roads entering the development. These will be sized to accommodate the design flows form the catchment area. Stone pitched outlets and kerb openings will be constructed at all locations where stormwater is to enter the drain from the development site.

8.0 Roads

8.1 Existing Roads Network

The proposed development site is bounded by Robinson Street, North West Coastal Highway and HMAS Sydney II Memorial Avenue. Figure 2 below illustrates the proposed internal road network within the development site. The proposed layout of minor and major arterial roads shown in Figure 2 enhances the connectivity of the site to existing surround town land uses.

All roads are owned and maintained by the Shire of Carnarvon with the exception of North West Coast Highway, which is owned and maintained by Main Roads WA. Proposed new road connections to the NWCH will require Main Roads WA approval.

8.2 Proposed Infrastructure Requirement

Existing surrounding road network will require varying degree of upgrading to tie into the development network, the scope of this upgrade is dependent on the extent of the construction during staging of the development.

Internal roads within the development will need to be construction in accordance with Shire of Carnarvon guidelines. Roads will generally be constructed within Livable Neighborhood Guideline with a 20-25m road reserve width incorporating v-drains to tie in with the storm water drainage.

Some internal roads may require kerbing and use of intersection treatments, such as brickpaving to provide an indication of priority as well as providing important aesthetic value.

For further information regarding traffic engineering, refer to report by Jon Riley Traffic Engineering, August 2013.

Figure 3.0: Proposed Road Network

9.0 Water and Wastewater

9.1 Existing Water Corporation Network

The existing water and wastewater management assets are sole responsibility of the Water Corporation of Western Australia.

The ground water within the Carnarvon aquifer system provides a permanent water supply for the towns potable water requirements. The town climate is noted as high temperatures with high level of evaporations and seasonally variable rainfall.

Currently the water supply for Carnarvon is sourced from a series of bores along Gascoyne River. The raw water is chlorinated before it is reticulated into the town distribution system. The existing chlorination system used for the town water supply is located from Brown Range to the Brickhouse Storage complex and treats all the potable water in the Carnarvon area. Water supply is thus reticulated to each lot via Water Corporation owned network.

The existing sewerage is treated at the Carnarvon sewerage treatment plant, which is located on Babbage Island Road. Although some areas of Carnarvon are services via gravitated sewer network other areas do not have such infrastructure in place. There is no reticulated sewerage system in the eastern Carnarvon. The existing areas surrounding the development site have a combination of gravitated sewer and pump stations. In most cases, the gravity sewer runs on the rear side of the lots.

Refer to Appendix A – *Water Corporation Existing Infrastructure* for further details.

9.2 Proposed Infrastructure Requirement

Initial consultation with Water Corporation has concluded that there is currently no planning allowance for the expansion of existing water and sewer networks to service the proposed development. Water Corporation will need to be heavily involved in the initial planning phase as the proposed staging plan is a significant change in the current land use.

Once the change in land use is considered in the water and wastewater planning, this area will be considered on the IPB state wide planning programme as part of rezoning of the area. Water Corporation will then prioritise against other areas that also require planning consideration.

Water Corporation has confirmed that there is likely to be significant upgrades required to the scheme water, such as water main extensions and increased storage at the existing tank site. Wastewater will require new pump stations to transfer increase waste flow to the proposed treatment plant and disposal plant site.

10.0 Gas

10.1 Existing Gas Reticulation Network

Currently the site is bounded to the east by Dampier to Bunbury Natural Gas Pipeline. This pipeline however does not provide gas service within town other than servicing the power station.

There is no reticulated gas service provided to Carnarvon and no plans to do so in the future. Thus the gas supply with in the town is supplied by bottled gas.

10.2 Proposed Infrastructure Requirement

Due to the close proximity of the Dampier to Bunbury pipeline to the eastern border of the development site, setback and easement consideration need to be allowed for in this District Plan. The gas line requires a 15m easement on both sides of its alignment and in addition, a further 150m setback zone. This buffer zone will prohibit development of infrastructure. However, detailed consultation with the DBP asset managers may allow for development of residential lots up to the easement boundaries.

Where proposed infrastructure requires crossing within the buffer zone, acceptable level of risk management will need to be considered and quantitative risk assessment will be required.

Minor landscaping earthworks including small non-structural retaining walls and footpaths through the easement may be allowed where the easements are vested with and managed by the Local Authorities.

Works within the pipeline easements cannot commence until an application made and approval received by the Pipeline Asset Owners and the Department of Regional Development &Lands.

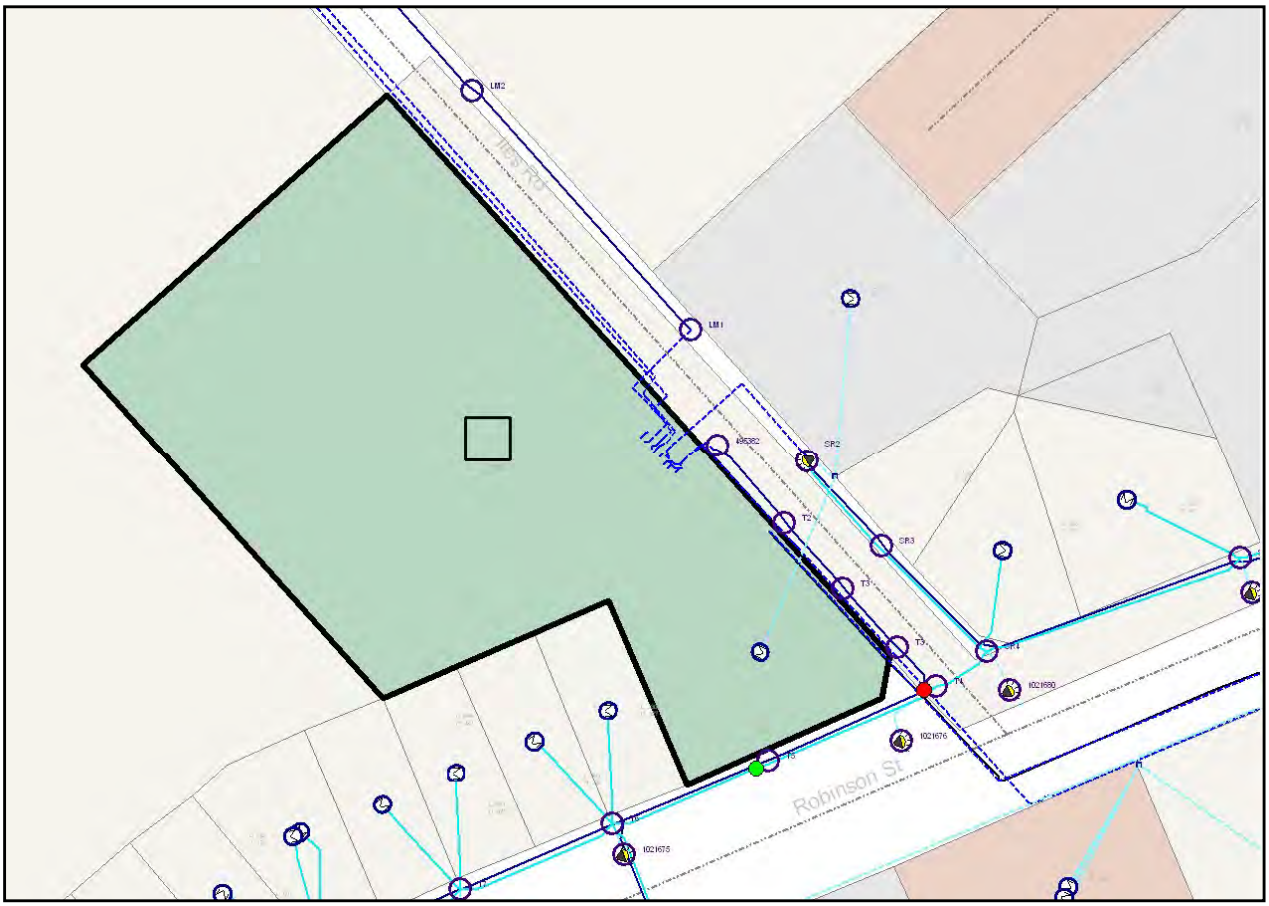
11.0 Disclaimer

JDSi have undertaken this assessment based on limited information and subsequently assumptions have been made which, if incorrect, have potential to change costs. Major cost implications exist through factors which cannot be assured at this time including upgrading and provision of utility services, WAPC conditions of development, Local Authority Scheme Requirements, ground conditions, timing of adjacent developments, etc.

While JDSi has taken all care in the preparation of the likely development requirements and has noted key assumptions, JDSi accepts no responsibility for the accuracy of this report and provides it only as an indicative summary of engineering requirements.

12.0 Appendix A

SNAPSHOT OF EXISTING POWER INFRASTRUCTURE


LM2
LM1
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SR2
SR3
SR4
T2
T3
T4
T5
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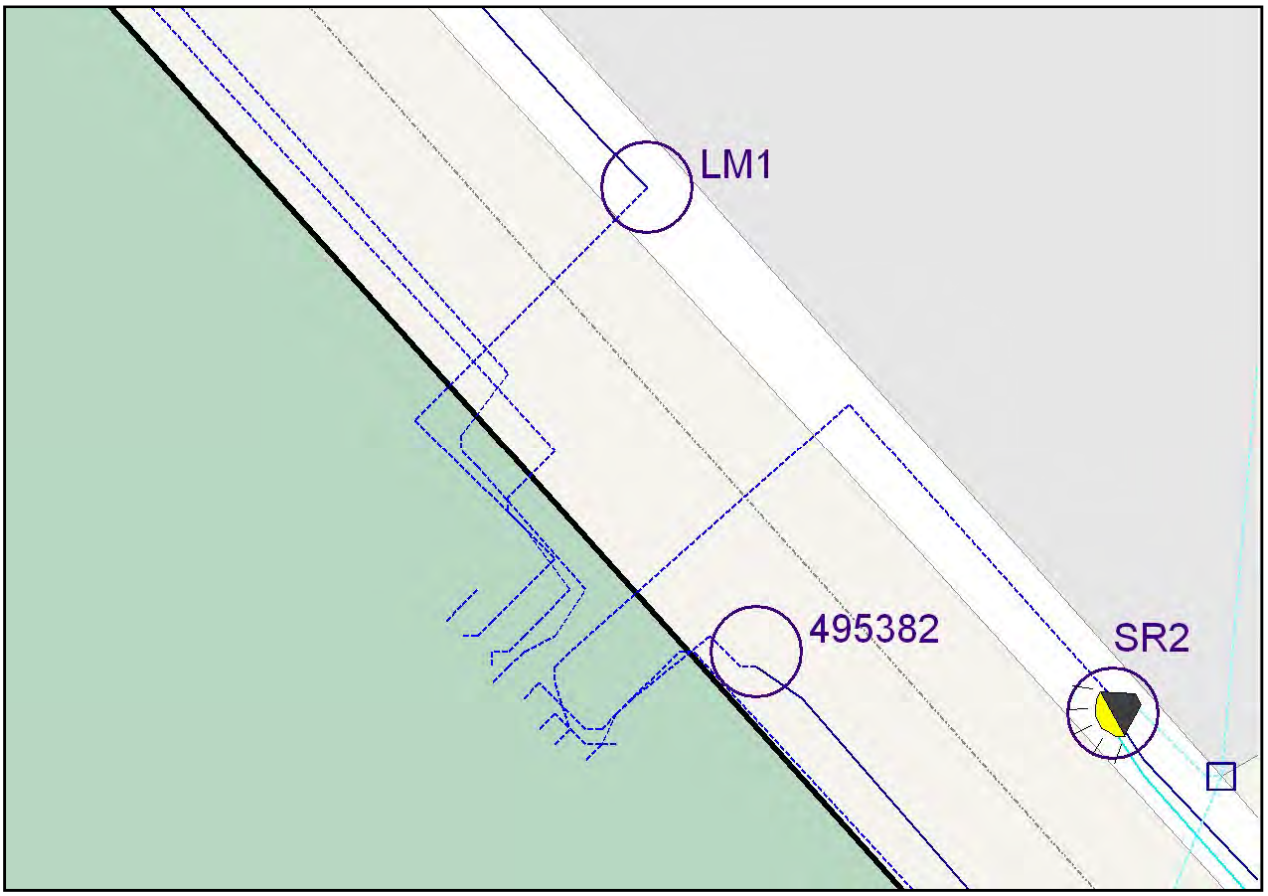
1021676
1021675
Robinson St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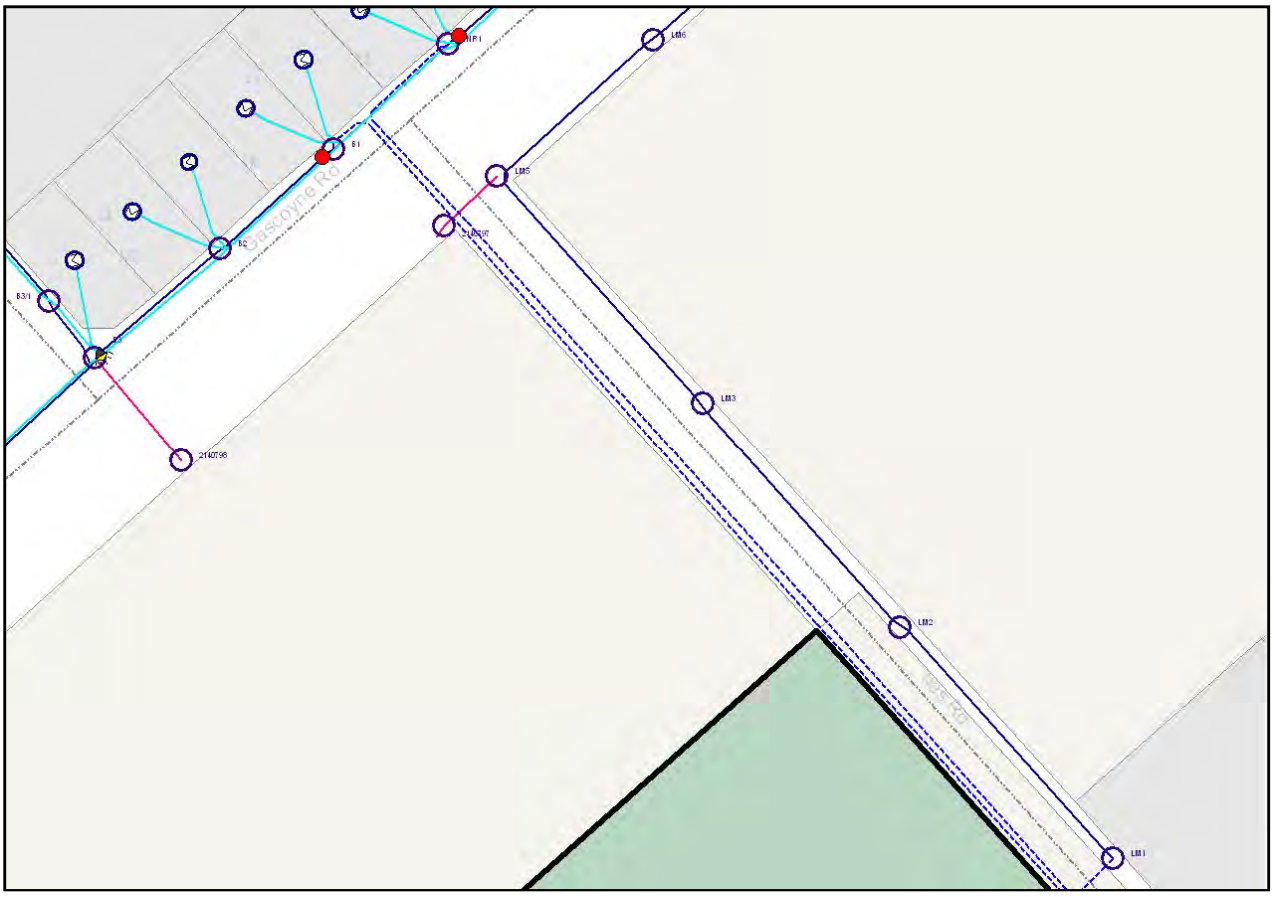

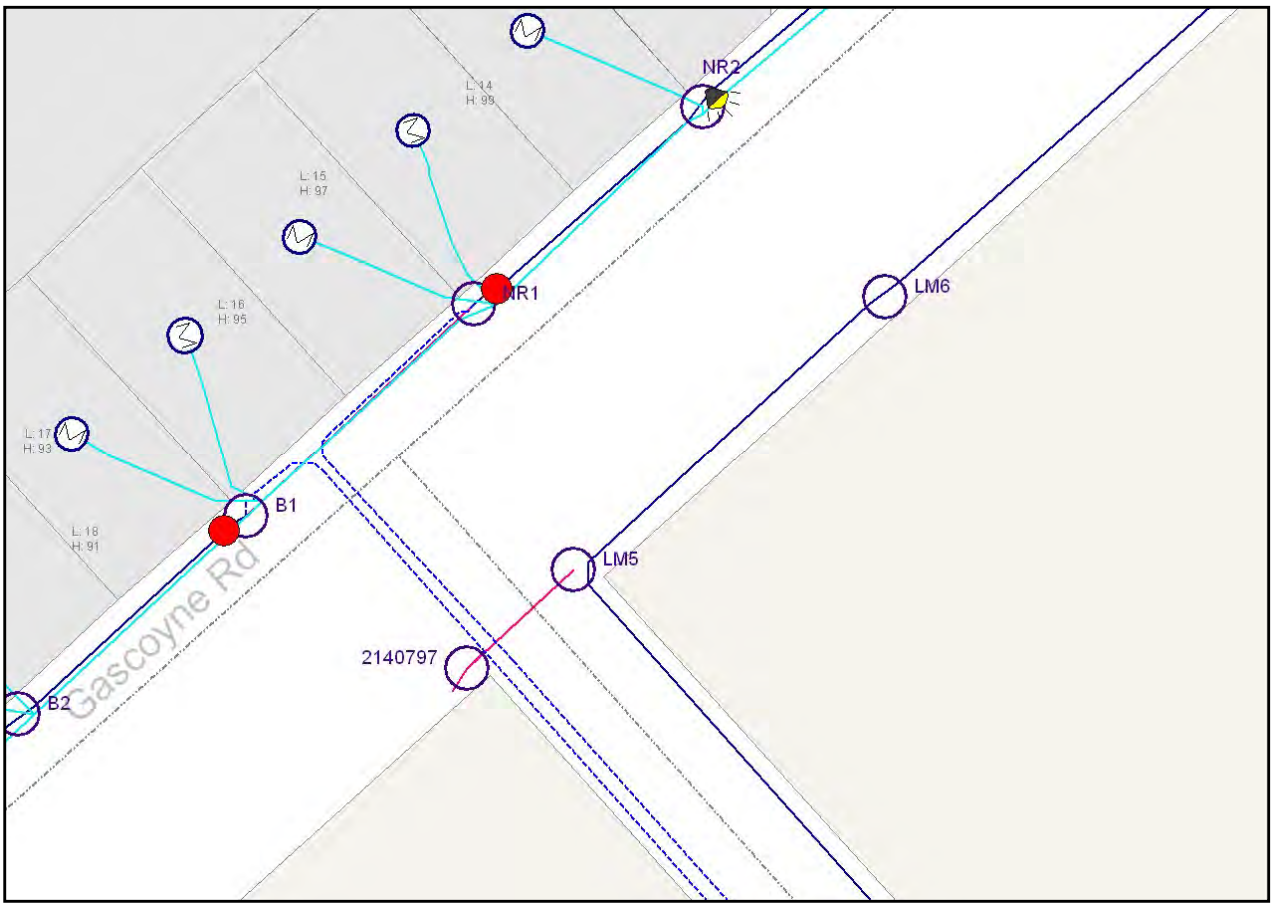
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L: 15
H: 97
NR1
LM6
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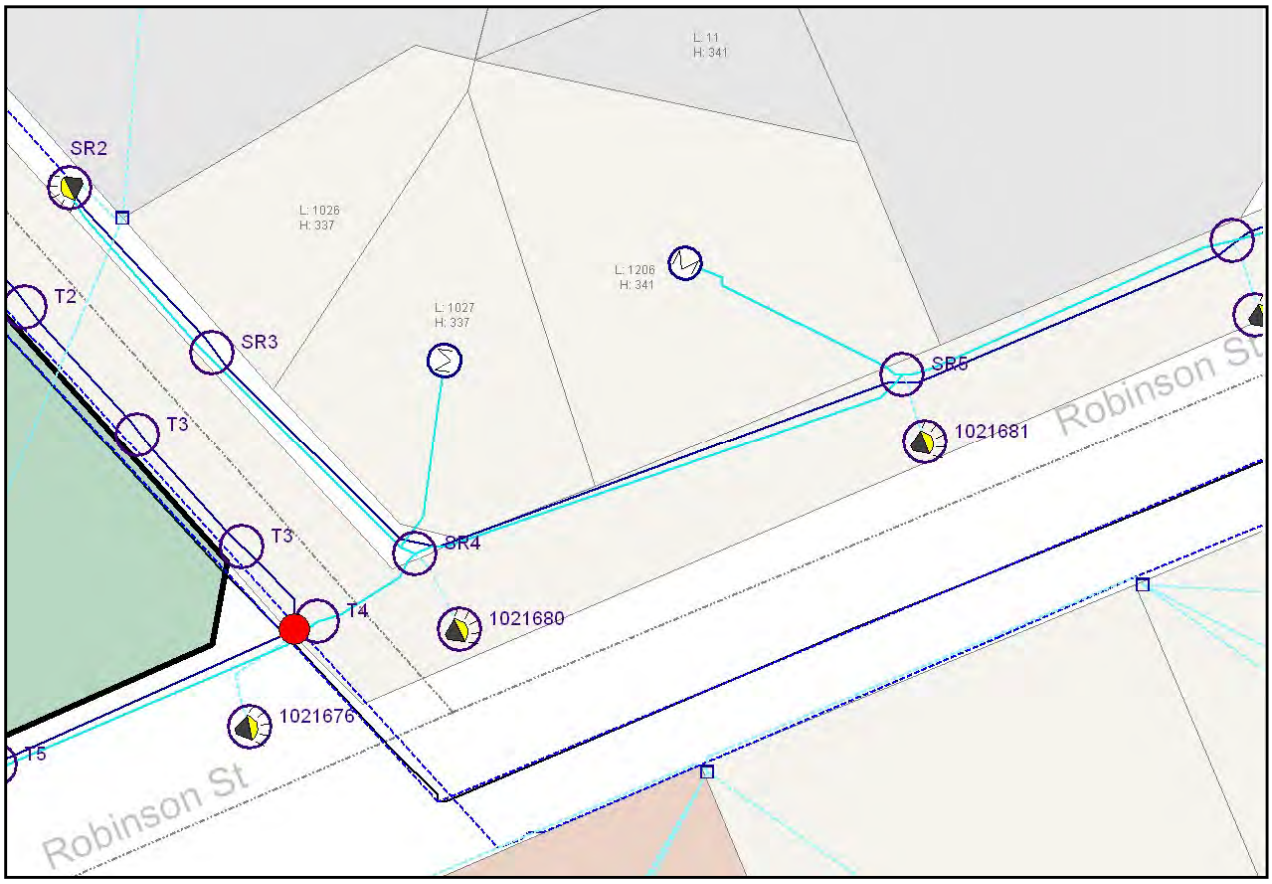
L: 17
H: 93
B1
L: 18
H: 91
LM5
2140797
B2
Gascoyne Rd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SR2
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L: 1027
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Robinson St
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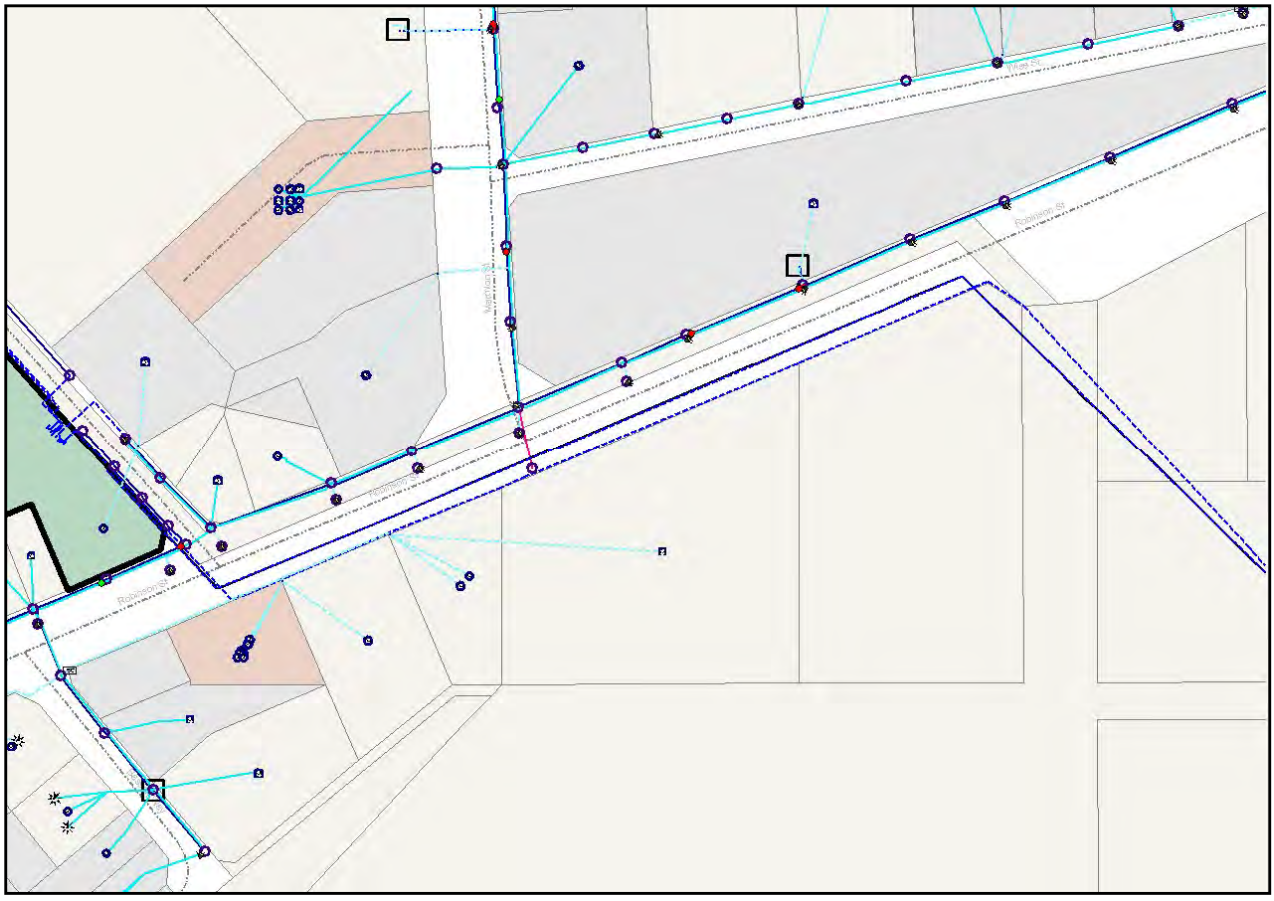
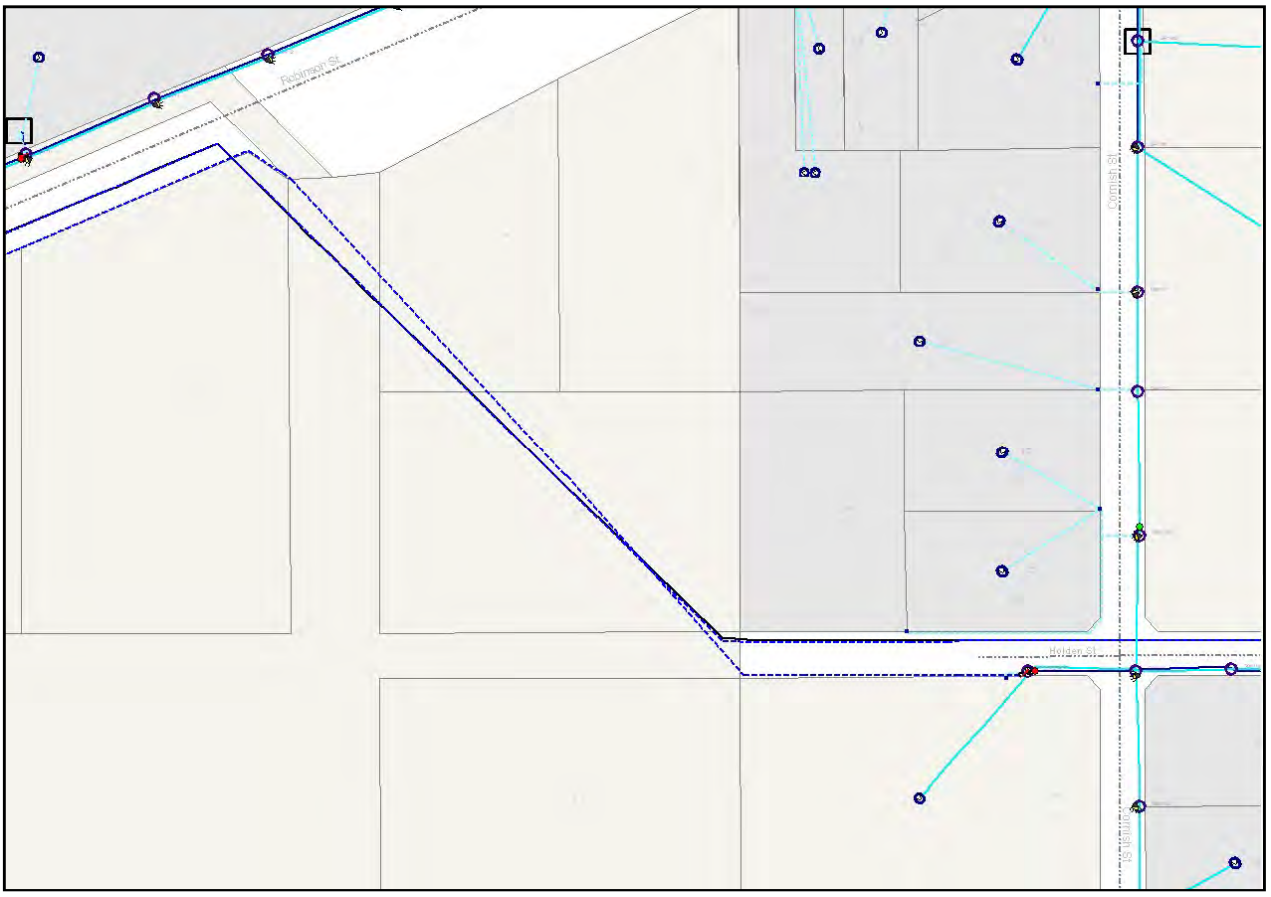
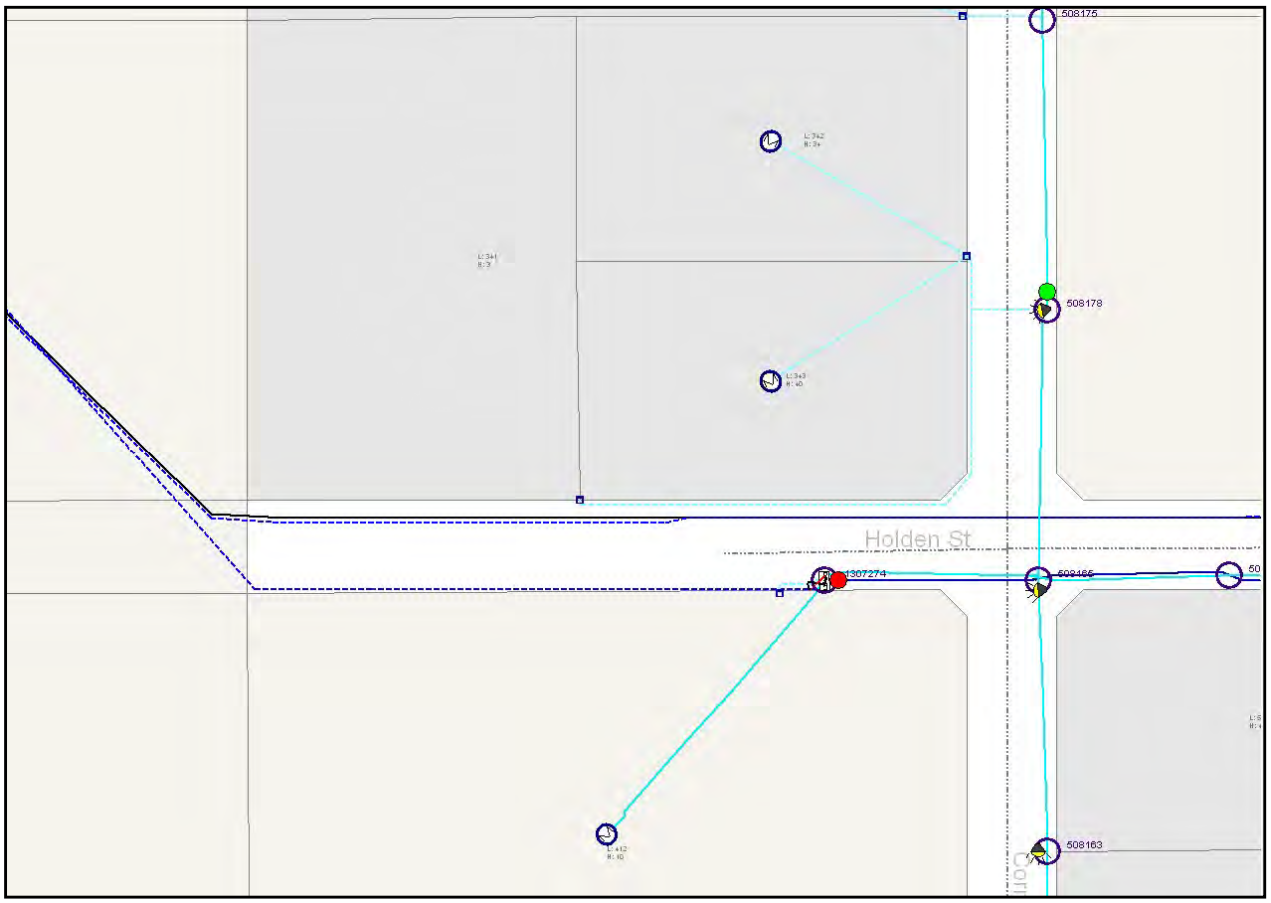
Robinson St




Holden St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509466
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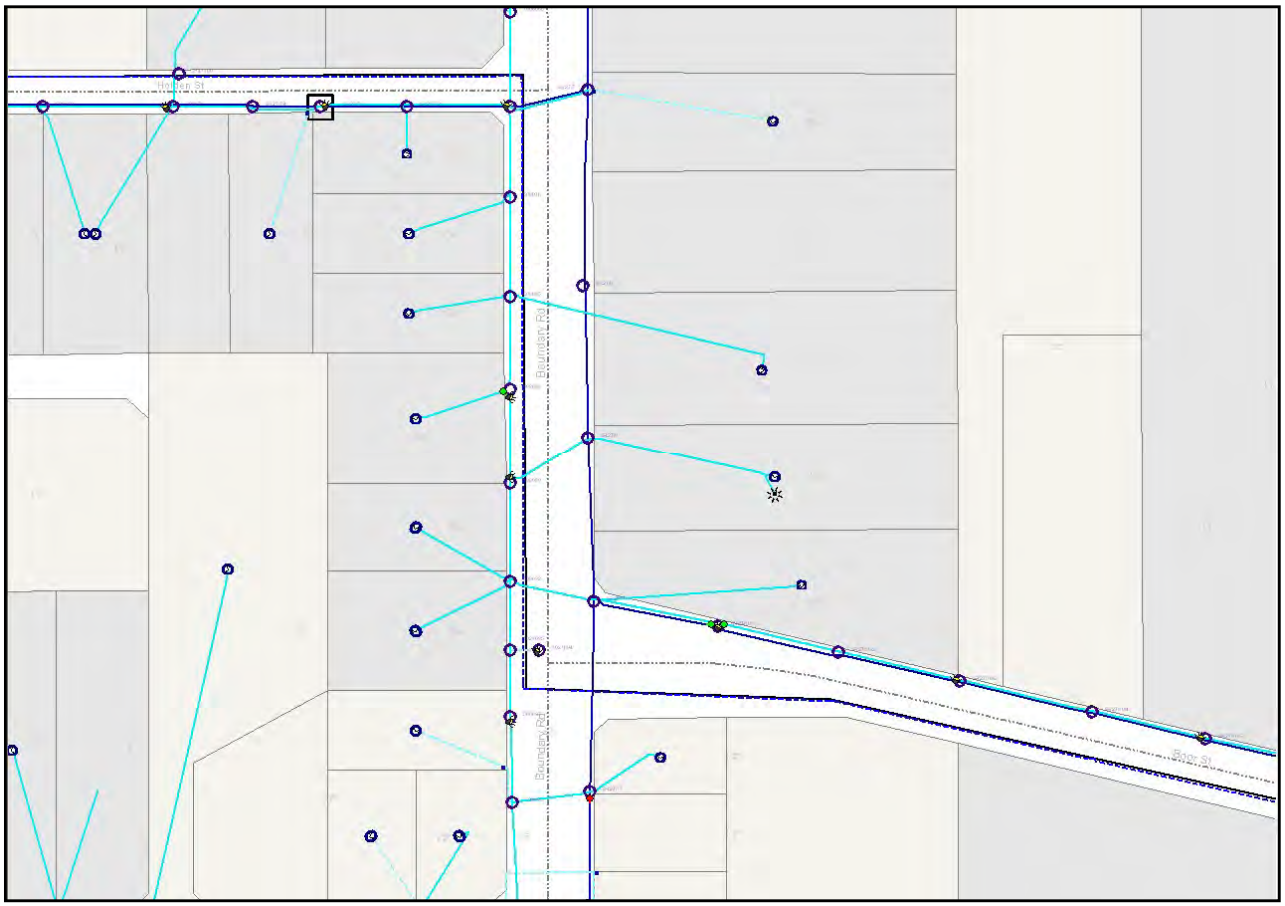

Boundary Rd
Boundary Rd
Brier St

WATER CORPORATION EXISTING INFRASTRUCTURE

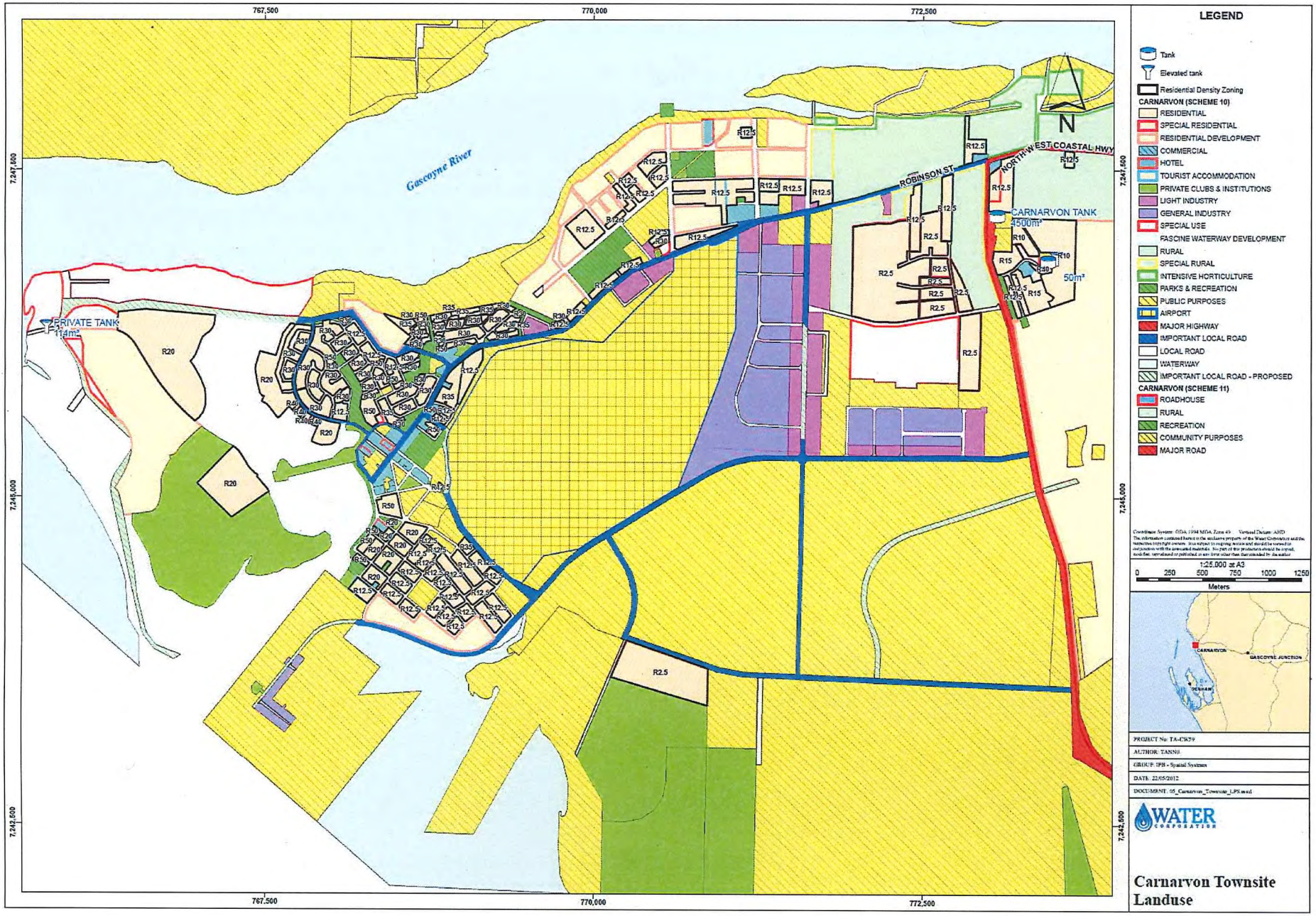
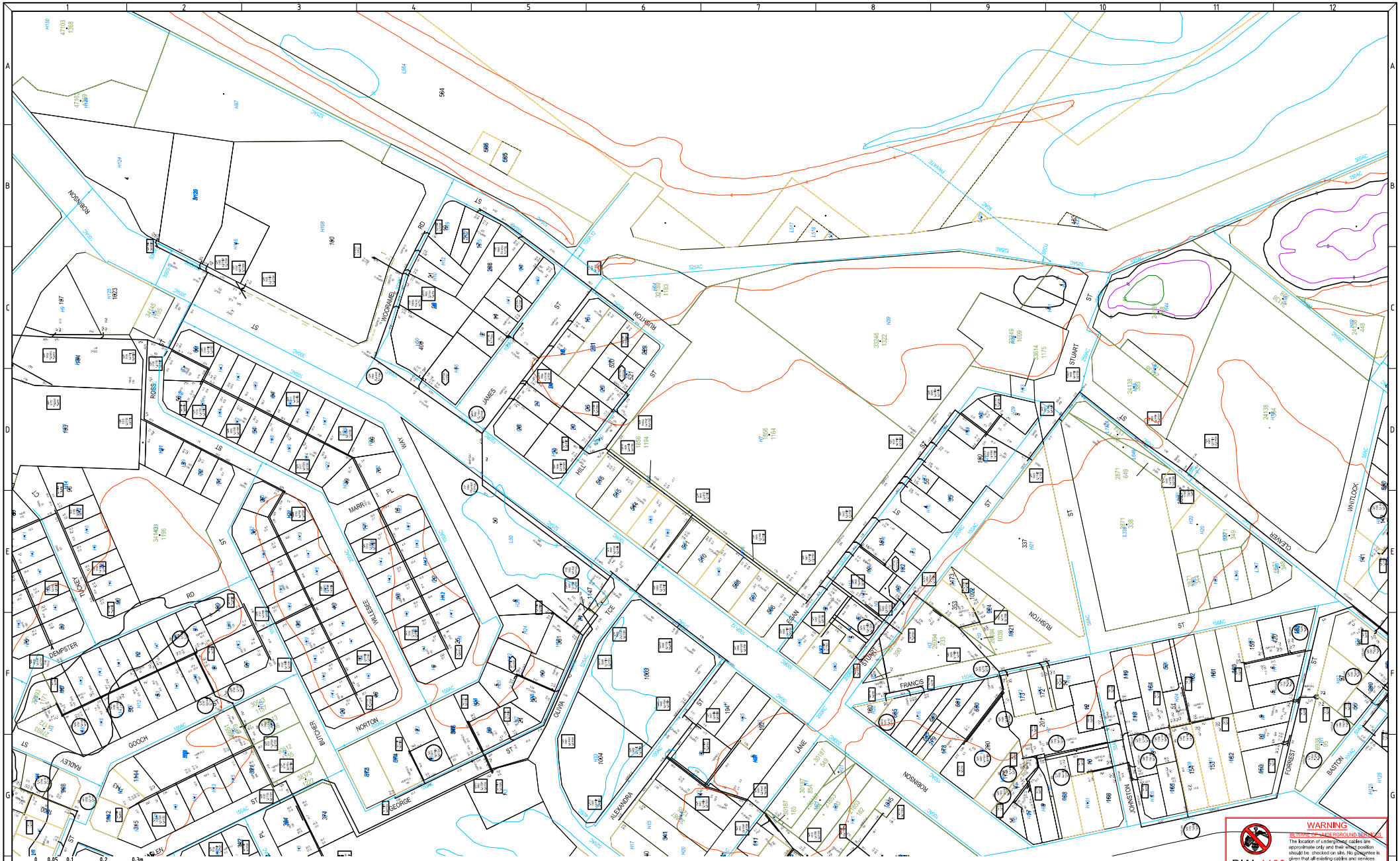


Fig 12 - Carnarvon Town Land Use Plan



WARNING
DAMAGE OF UNDERGROUND SERVICES
The location of underground cables are approximate only and their exact position should be checked on site. No guarantee is given that all existing cables and services are shown. Locate all underground cables and services before commencement of work. Refer to Worksafe Regulation 3.21.
DIAL 1100 BEFORE YOU DIG

REV	DATE	DRAWN	CHECKED	APPROVED	ISSUED FOR

NOTE
This drawing shall be preliminary only until it is issued for Construction.
Certified Quality System to ISO 9001

JDSi
CONSULTING ENGINEERS
Level 1, 59 Parry Street, Perth Western Australia 6000
P: (08) 9227 0595 F: (08) 9227 8617

CLIENT:

PROJECT:

DRAWING TITLE:

DRAWN	WAPC No.
DESIGNED	SCALE @ A1: AS SHOWN
PROJECT MANAGER	DATUM: AHD; CO-ORDS: NONE
JDSI PROJECT No.	DRAWING No. / REVISION

Plotted By: BLeslie Plot Date: 01/08/13 - 15:57 Cad File: C:\Users\bleslie\Desktop\kaval.dwg

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