South Hedland Town Centre Development Plan

Part 1 - Statutory Planning Provisions
Part 2 - Explanatory Report

(June 2014)

ENDORSEMENT PAGE

This structure plan is prepared under the provisions of the Town of Port Hedland
Local Planning Scheme No.7

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

19 MAY 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 2027**

TABLE OF MODIFICATIONS – DEVELOPMENT PLAN FOR SOUTH HEDLAND TOWN CENTRE, SOUTH HEDLAND

Modification No.	Description of Modification	Date Endorsed by Council	Date Endorsed by WAPC

PART 1 – STATUTORY PLANNING PROVISIONS

This document has been prepared for LandCorp and the Town of Port Hedland with the input of;

Halcyon Property
(Project Management)

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(Land Survey)

UDLA
(Landscape Architecture)

Porter Consulting
(Traffic, Transport and Parking)

PART 1 – CONTENTS

TABLES

1.0 DEVELOPMENT PLAN AREA

1.1 The Development Plan area relates to land generally compromising the South Hedland Town Centre, South Hedland as identified on the Development Plan map.

2.0 DEVELOPMENT PLAN CONTENT

2.1 The Development Plan comprises of the following sections:

- Part One – Statutory Section
- Part Two – Explanatory Information
- Appendices – Technical Reports

2.2 Part Two of the Development Plan provides justification and clarity to the provisions contained in Part One, and is to be used as a reference to guide for interpretation and implementation of Part One.

3.0 INTERPRETATIONS

The terms used in the Development Plan have the respective meaning given to them in the Town of Port Hedland Town Planning Scheme No. 5.

4.0 OPERATION DATE

4.1 The Development Plan will become operative following the endorsement of the Development Plan by the Town of Port Hedland and the adoption of the Development Plan by the Western Australian Planning Commission as provided for by Clause 5.1 and 5.2 of Town Planning Scheme No. 5. The operative date of the Development Plan is the later of the endorsement or adoption as identified on the Certification page.

5.0 RELATIONSHIP TO THE SCHEME

5.1 The provisions of this Development Plan are made pursuant to Clause 5.2, Clause 6.6 and Appendix 6 of the Town of Port Hedland Town Planning Scheme No. 5. The Development Plan is a policy statement and forms part of the Town of Port Hedland Local Planning Policy Manual.

5.2 Town Planning Scheme No. 5 provides that land use, development and subdivision of land within the Development Plan area shall be generally be in accordance with the Development Plan.

5.3 Land uses permitted within the Development Plan area shall be in accordance with the “Town Centre” and “Mixed Business” zones as identified within the Town of Port Hedland Town Planning Scheme No. 5.

5.4 An application for development approval must be made to the Town of Port Hedland for all land within the South Hedland Town Centre Development Plan.

6.0 DEVELOPMENT PLAN

6.1 General Town Centre Objectives

The South Hedland Town Centre will be an attractive, vibrant, mixed use locality for community services, shopping, recreation, work and residency that the community will want to visit, stay in and enjoy.

The Town of Port Hedland’s Town Planning Scheme No.5 provides the following objectives for the ‘South Hedland Town Centre’ precinct:

- reinforce the precinct as the primary regional activity centre for the local government area;
- provide an identifiable activity hub within the town centre in the form of a ‘main street’;
- improve pedestrian and vehicle connectivity between the South Hedland town centre and surrounding urban areas;
- facilitate residential and mixed use development within the town centre;
- introduce a greater permanent residential population through a variety of medium and higher density housing types;
- accommodate demand for short-stay and tourism within the accommodation, entertainment and related uses;
- provide high levels of visual amenity and points of interest, including key destinations landmarks and gateways.

7.0 RESIDENTIAL DENSITY

7.1 Residential development shall be provided in accordance with the densities as allocated on the R-Code Density Map. The densities are stipulated as either a minimum or maximum density requirement to ensure the objectives of the Development Plan are achieved.

7.2 The maximum permitted residential density for land within the Development Plan area with no density code allocated on the R-Code Density Map is R80.

7.3 Part Two of the Development Plan provides justification for the location and distribution of residential densities within the Development Plan area.

8.0 PREFERRED LAND USES

8.1 The preferred land uses for the Development Plan Precincts are detailed in Table 1 below. The objective of listing the preferred land uses is to assist in delivering the vision established by the master planning undertaken for the Town Centre which is outlined in Part Two.

When considering uses proposed that are not listed as 'preferred' (designated as 'P') in Table 1 yet permitted under the Town Planning Scheme No. 5 within the Town Centre Zone and Mixed Business Zone, consideration shall be given to the relationship of the site to surrounding activity, the Development Plan objectives and the explanatory text contained within Part Two.

Land use permissibility for use classes not identified in Table 1, but are listed in the Scheme are to be as per the Zoning Table of TPS 5.

	A	B	C	D	E
Precincts	**Main Street and Community Hub**	**Boulevard Retail**	**Health Services and Residential**	**Northern Commercial Gateway**	**Eastern Commercial Gateway**
Use Classes					
Residential					
Aged or Dependent Persons Dwelling			P		
Ancillary Accommodation			P		
Caretaker's Dwelling			P		
Grouped Dwelling			P	P	
Holiday Accommodation	P		P		
Home Business			P		
Home Office			P		
Hotel	P				P
Motel	P				P
Multiple Dwelling	P		P	P	
Residential Building			P		
Serviced Apartment					
Single House					
Industry					
Arts and Crafts Centre	P			P	P
Industry-Cottage					P
Commerce					
Dry Cleaning				P	P
Market	P	P			
Mobile Business				P	
Motor Vehicle and/or Marine Repair					
Motor Vehicle and/or Marine Sales or Hire					
Motor Vehicle and/or Marine Service Station					
Motor Vehicle Wash					

	A	B	C	D	E
Precincts	**Main Street and Community Hub**	**Boulevard Retail**	**Health Services and Residential**	**Northern Commercial Gateway**	**Eastern Commercial Gateway**
Use Classes					
Office	P	P	P	P	P
Outdoor Display				P	P
Reception Centre				P	P
Restaurant (includes café)	P	P		P	
Shop	P	P		P	P
Showroom		P		P	P
Take-away Food Outlet	P	P		P	
Health, Welfare & Community Services					
Carpark	P	P	P	P	P
Child Care Service		P	P	P	
Community Use	P	P	P	P	
Consulting Rooms		P	P	P	P
Emergency Services			P	P	P
Funeral Parlour				P	
Hospital			P		
Medical Centre			P	P	P
Nursing Home			P		
Place of Animal Care				P	P
Place of Public Meeting, Assembley or Worship	P			P	
Public Mall	P	P			
Entertainment, Recreation and Culture					
Entertainment Venue	P	P		P	
Private Recreation	P	P	P	P	P
Public Recreation	P	P	P	P	P

NOTE: For Use Classes listed as '~' under the TPS 5 Zoning Table, a Scheme Amendment and modification to the Development Plan would be required to enable them to be considered. The Scheme Amendment would need to demonstrate that the uses are consistent with the general objectives of the South Hedland Town Centre, as listed under Clause 5.3.9 of TPS 5. Such uses that may be considered suitable to be permissible in the Town Centre zone for example that are currently not permitted include Educational Establishment, Serviced Apartment and Short Stay Accommodation.

Table 1: Development Plan Preferred Land Uses

8.2 Purely residential land uses including aged or dependent persons dwellings, holiday accommodation, single houses, grouped dwellings, multiple dwellings and residential buildings are generally discouraged in the following precincts:

- Boulevard Retail (Precinct A)
- Main Street and Community Hub (Precinct B)
- Eastern Commercial Gateway (Precinct E)

Where residential land uses are proposed in the above precincts, it is preferred that they form part of a mixed-use development, with commercial functions at ground level.

9.0 DEVELOPMENT REQUIREMENTS

9.1 Part 5.2 of TPS 5 provides that development shall be generally consistent with the requirements of the Development Plan. The Scheme provides for departure from the Development Plan where the departure would not prejudice the orderly and proper development of the area. In making a decision on a departure from the Development Plan, the Council will have regard for the objectives listed under Clause 5.3.9 of TPS 5, the objectives listed under Part 1 of the Development Plan and the explanatory text of Part Two of the Development Plan.

9.2 The Town of Port Hedland Town Planning Scheme No. 5 contains specific provisions relating to development requirements, which include the following:

- Clause 6.12 Advertising: Approval is required for advertising signage, with Council taking into account the character and amenity of the locality in determining any particular application.
- Clause 6.13 Vehicles and Vehicle Areas: Adequate parking is required to be provided for all development. The minimum standard for car parking is set out at Appendix 7 of the Scheme. The Scheme also allows parking to be provided on-site or off-site.
- Clause 6.14 Landscaping, Screening and Fencing: Development proposals are to be prepared having regard to the requirements of the Scheme at this section – in particular, the need to screen any unsightly outdoor areas.
- Clause 6.16 Flood and Storm Surge Prone Land: In considered applications for planning approval, Council shall have regard to information about the land prone to 1:100 year flood and storm surge events. As part of this assessment Council shall consult with the relevant public authorities to obtain the most up-to-date information regarding the potential for the land to be affected by flood and storm surge events. In addition, Council may require applications to include an assessment of the impact of potential flood and storm surge events on the proposed development.

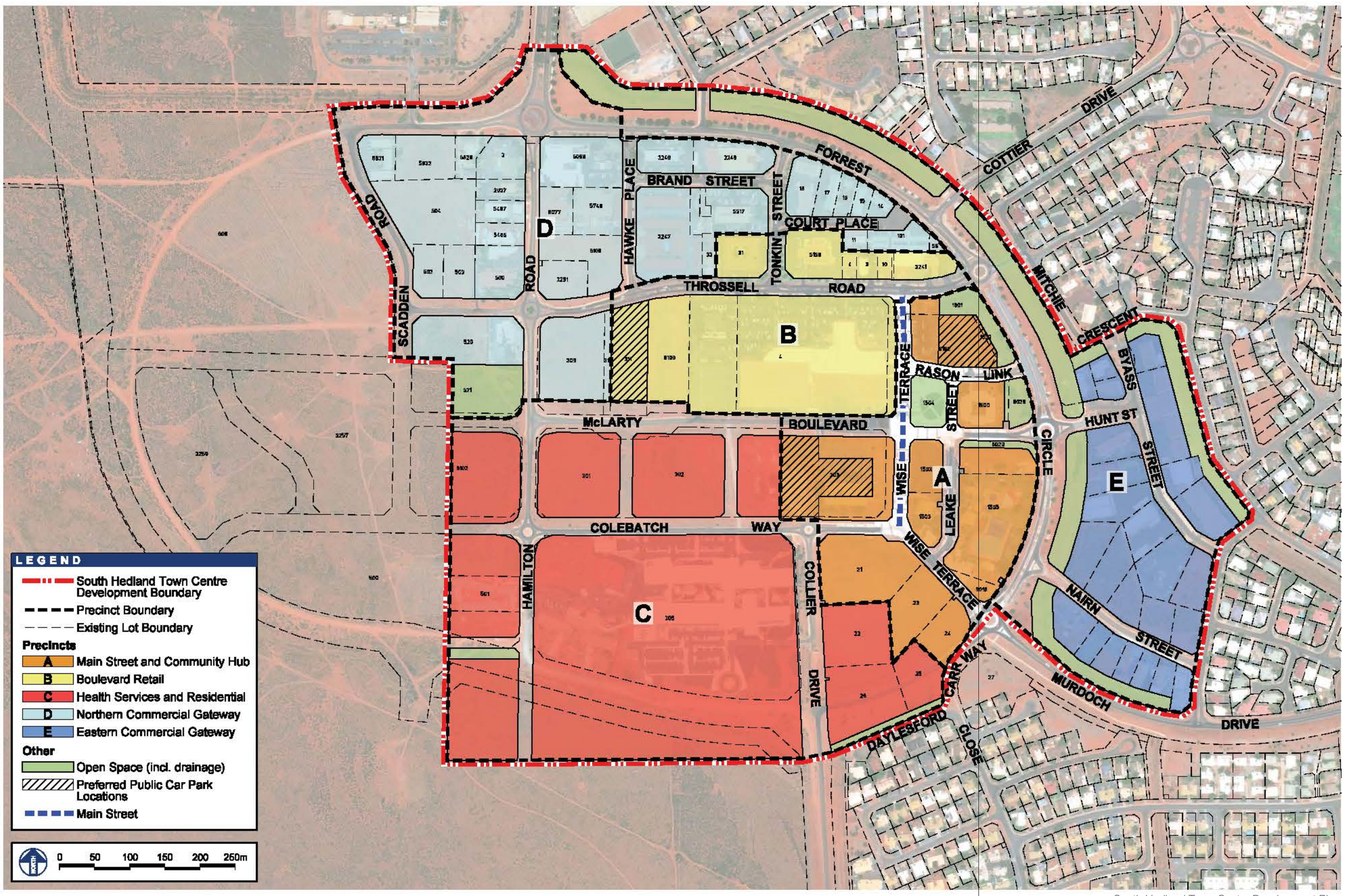
Applications for planning approval within the development plan area will need to have regard for these provisions in addition to any Detailed Area Plans or Design Guidelines relating to the land.

10.0 CAR PARKING

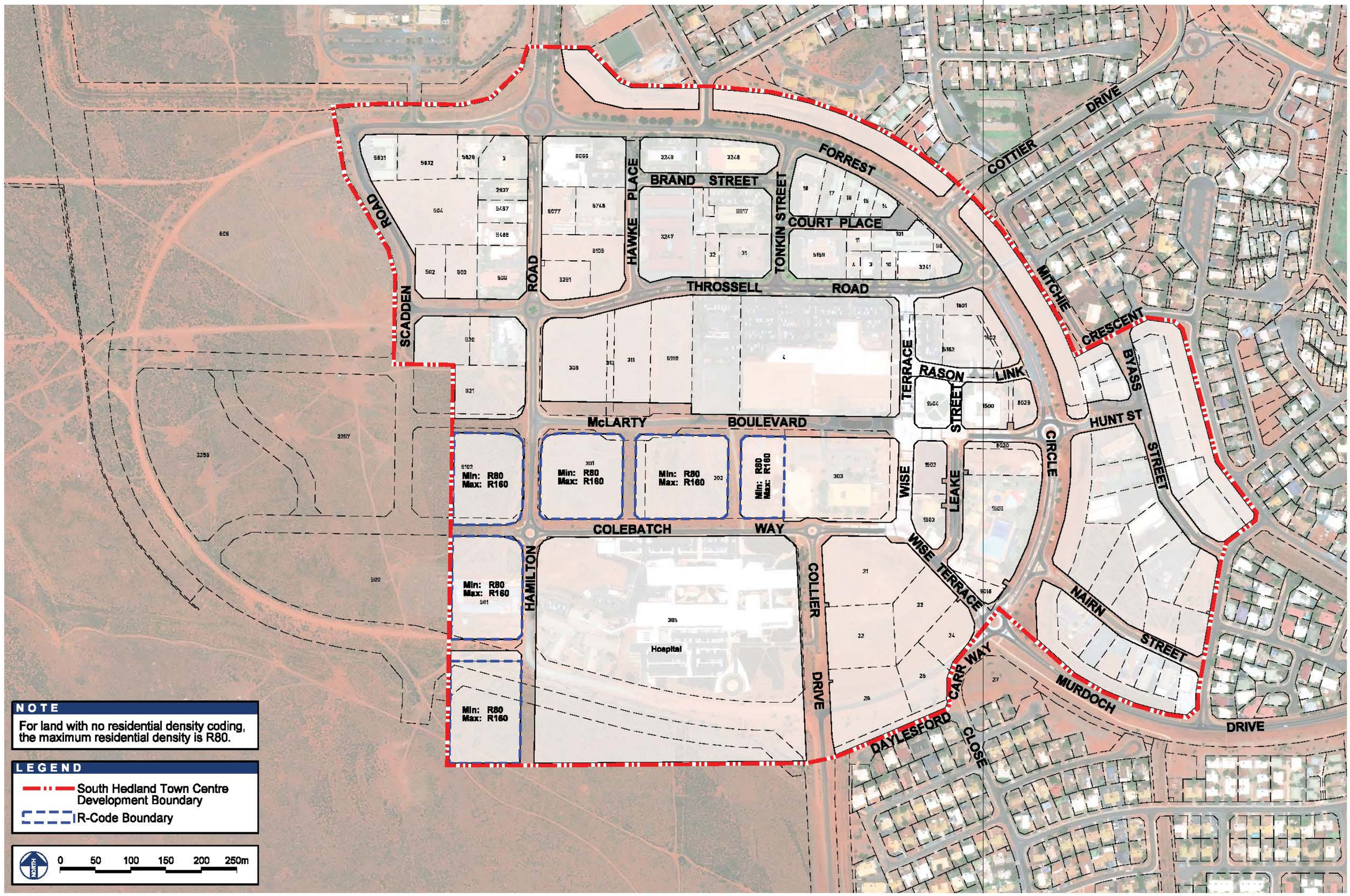
10.1 The Development Plan map illustrates the preferred location of public car parking facilities. The methodology to the calculation of the ultimate number of required public car parking bays is outlined in Section 3.9 of Part Two of the Development Plan report.

11.0 PUBLIC OPEN SPACE

11.1 Areas of Public Open Space (incl. Drainage) are illustrated on the Development Plan. The matter of Public Open Space is outlined in Part Two of the Development Plan report.



South Hedland Town Centre Development Plan



R-Code Density Map

PART 2 – EXPLANATORY REPORT

PART 2 – CONTENTS

1.0 PLANNING BACKGROUND

1.1 Introduction and Purpose

1.1.1 Planning for Growth – Overview

The Pilbara region of Western Australia is currently experiencing record population and economic growth, driven by a thriving resources industry which is forecast to remain strong and generate significant wealth for a number of decades. This extreme growth, however, has placed significant pressure on the towns and communities of the region, particularly on property markets, essential services and utilities infrastructure. Through the Pilbara Development Commission's Pilbara Cities project, the State Government has made a commitment to invest in and support the development of modern vibrant cities and regional centres in the Pilbara.

Port Hedland (comprising both Port and South Hedland) and Karratha have been identified as 'Pilbara Cities', each with target populations of 50,000 people by 2035. In the case of Port Hedland, this represents almost a tripling of the current population over the next 20 to 25 years, and poses considerable challenges for the City's future planning and development in terms of providing the required housing, retail/commercial services and essential utilities & community infrastructure.

Significant regional and city level planning has taken place since the Pilbara Cities project was launched, with the Pilbara Planning and Infrastructure Framework(PPIF) (WAPC, 2012) and Pilbara's Port City Growth Plan (ToPH, 2012) setting clear directions and priorities for future land use and infrastructure planning. At a more local level, however, further detailed planning is required for priority land release areas and to coordinate the delivery of high quality urban environments for people to enjoy.

1.1.2 The South Hedland Town Centre Development Plan: Meeting the Needs

As Port and South Hedland continue to develop, the South Hedland Town Centre (SHTC) will play an increasingly important role not only as the primary activity centre catering for the retail and service needs of a growing population, but also as a visual focal point and constant reminder of Hedland's modernisation and emergence as a "nationally significant, friendly City where people want to live and are proud to call home" (ToPH, 2011). In this sense, the development and revitalization of the SHTC has the potential to act as a catalyst for further development and growth, engendering business confidence as well as local community pride and ownership.

Figure 1: South Hedland Town Centre Development Plan: Meeting the Needs

This Development Plan provides, at the local level, a spatial planning and urban design framework for the Town Centre that seeks to facilitate development and meet the needs of a rapidly growing population. This includes:

- facilitating the orderly and timely release and development of SHTC land to meet the ongoing needs of a rapidly growing population;
- guiding development to ensure best practice, high quality built form and public space outcomes;
- identifying the required levels of community, retail and commercial use to facilitate local economic and community development and increase the services and facilities offered for residents and visitors;
- increasing housing supply and improve product choice and affordability;
- improving movement network efficiency, sustainability and attractiveness; and
- providing a level of certainty and confidence for the private and public sector to operate within by reflecting a clear vision of community expectation and aspiration.

South Hedland Town Centre Vision looking West from Forrest Circle (Source LandCorp /Last Pixel)

1.1.3 Background, Scope and Operation

The 2013 South Hedland Town Centre Development Plan (SHTCDP) replaces the draft 2008 South Hedland Town Centre Development Plan previously commissioned by LandCorp and the Town of Port Hedland (ToPH).

Since the time of the original Development Plan's adoption by Council in 2008, announcement of the Pilbara Cities and the PPIF there has been significant economic growth and investment in Port Hedland and the wider Pilbara region. This rapid growth, along with the commencement of the Pilbara Cities project and significant progress in the advancement of new regional and local planning frameworks, necessitated a review of the Town Centre Development Plan.

Like the Town Centre Development Plan before it, it is intended that the 2013 South Hedland Town Centre Development Plan be adopted by the ToPH under Part 5 of Town Planning Scheme No.5, thereby having statutory effect under the ToPH's local planning framework. Accordingly, this Development Plan has been prepared in accordance with the requirements of Town Planning Scheme No.5 and is consistent with the provisions of applicable state, regional and local planning strategies and policies (including the Pilbara Planning and Infrastructure Framework and Pilbara's Port City Growth Plan).

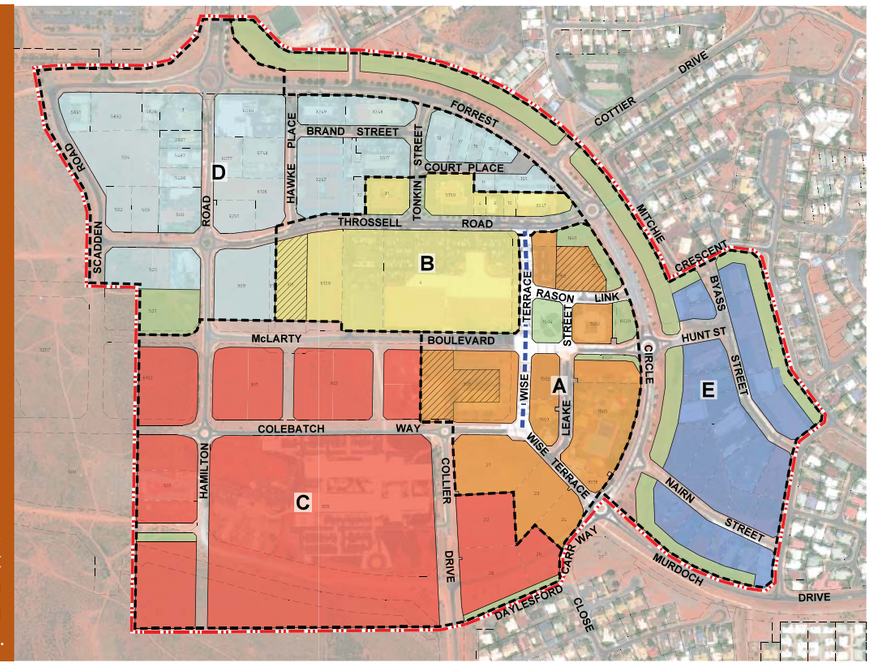
As well as forming a key element of the local planning framework for South Hedland, the SHTCDP also plays a crucial role as a bridging interface between the aspirations of the public sector, the community and the commercial needs and interests of the private sector. In this regard, the SHTCDP serves the following key purposes:

1. To provide an overarching vision for the Town Centre
2. To provide a local level statutory planning instrument to regulate development consistent with wider statutory and strategic planning frameworks; and
3. To facilitate the timely and orderly release of land to the private sector for development.

The Development Plan is made up of two key components:

Part One Statutory Planning Provisions:

Part One sets out the statutory planning provisions that guide the Town of Port Hedland in determining applications for planning approval.



Part Two Explanatory Report:

Part Two provides the explanatory material including vision and objectives. Part Two also sets out the spatial arrangements of the various elements, namely the movement network, activities, built form, public realm, car parking and water management.

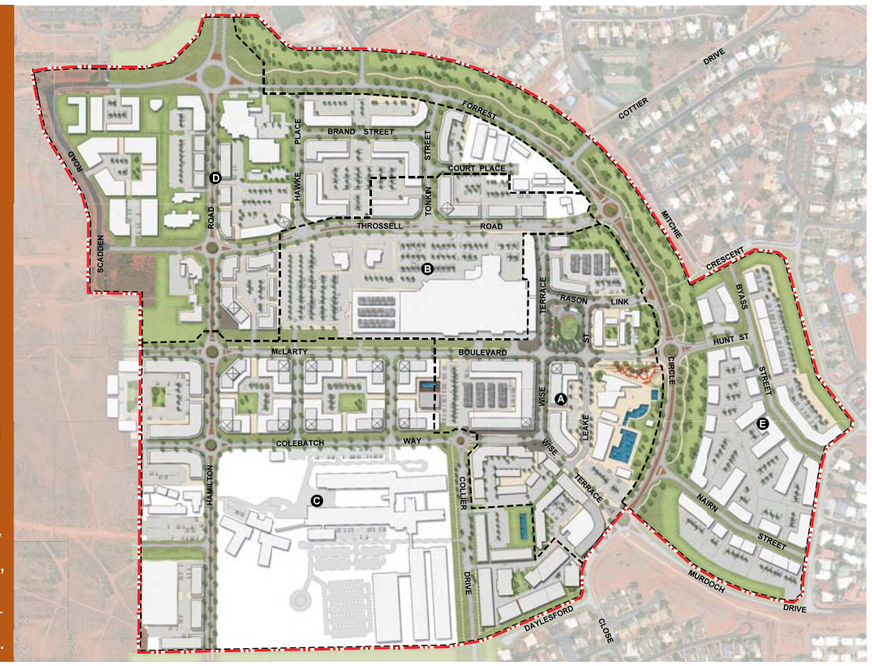


Figure 2: Development Plan Components

The preparation of the Development Plan has been influenced by a philosophy, centred on the creation of a vibrant Town Centre, reflective of the Pilbara and the South Hedland community. Key objectives comprise:

- Sustainability and Environment Design
- Urban Design/Built Form Excellence
- Development Flexibility
- Community Safety; and
- Private / Public collaboration.

1.1.3.1 Environmental Design and Sustainability

A commitment to sustainable development must underpin all planning and implementation decisions for the South Hedland Town Centre. The Town will grow to become the major centre for Pilbara's Port City, and considerations of services, amenity, local economy and community are embodied in the master planning that has ben undertaken to inform the preparation of the Development Plan. Further, elements of environmental design including solar design, ventilation, thermal efficiency and lighting should be considered at the development stage and, where possible, reflected within Town Centre Design Guidelines.

1.1.3.2 Urban Design / Built Form Excellence

Development of the Town Centre provides an opportunity to improve quality and vitality of the public environment. This demands a commitment to long-term decision making and design excellence in both public and private domains. This is a core attitude that has driven process and must remain a priority throughout the implementation of the Development Plan. Built form that reflects the unique character of the Pilbara and enlivens the Town Centre through form, materials and relationship to climate and culture must be evident.

1.1.3.3 Development Flexibility

The cyclical nature of the mining industry, which can lead to uneven growth and often urgent infrastructure and housing need, is a significant challenge that requires a suitable design response and approach to development. Where the ground floor of a building in the Town Centre is ultimately intended for commercial use, housing may be approved as an interim use, provided the space is designed for low cost conversion. In these cases, an appropriate timeframe for conversion of the ground floor to commercial uses should be determined as a condition of development approval.

Elements of the Development Plan	
Movement Network	Encourage a highly connected path and road network within and into the Town Centre, through key entry locations, strong pedestrian spaces and multiple parking locations;
	Encourage the integration of land uses with Wise Terrace as the Town Centre 'Main Street';
	Require road design standards that reflect the objectives of the Development Plan and Precinct objectives within Part Two including controlling traffic behaviour and speed in areas of higher pedestrian activity or movement;
Land Use & Activities	Encourage diversity of land use across the Town Centre that reflects the identified Precinct objectives described in Part Two;
	Facilitate land use of high intensity that promotes activity, interaction and diversity within the Town Centre;
	Provide for higher density mixed use residential development within the Town Centre that will bring a greater immediate population base to sustain local business growth and investment;
Built Form	Facilitate strong Town Centre entry points through the use of prominent architectural design solutions and interesting facades that reflect an urban Town Centre environment;
	Encourage reflection of the Pilbara and Port Hedland environs through the appropriate use of materials and finishes;
	Encourage building design to address street frontages and public spaces, increasing opportunities for passive surveillance and street-side activity through well located entry points, and use of street front windows and openings;
Public Realm	Facilitate a strong, legible and safe Town Centre identity through the use of landmarks, gateway location, local artwork, celebration of heritage and culture and attractive landscaping, lighting and shade elements;
	Encourage the application of Crime Prevention Through Environmental Design (CPTED);
	Integrate delivery of the public realm with site developments through the application of Design Guidelines for the Town Centre and the coordinated assessment of private development;
Car Parking	Provide parking areas in locations that encourage multi-purpose trips and strong pedestrian connectivity while minimising the visual impact on the streetscape;
	Facilitate the coordinated provision of parking through the application of both public and private (on-site) parking provision in accordance with the Parking Strategy appended to Part Two of the Development Plan (or as amended);
	Demonstrate adequate provision of parking supply for proposed development in accordance with TPS5, the Parking Strategy appended to Part Two of the Development Plan (or as amended) and any adopted Council Parking Policy requirements;
Water Management	Facilitate coordinated water management through the use of attractive and appropriately designed swales and flood storage areas;
	Ensure the appropriate on-site management of stormwater requirements having regard to the wider Town Centre Local Water Management Strategy;

Table 1: Elements of the Master Plan

1.1.3.4 Place Making

Place-making and creating a place and activities that will bind the people of South Hedland together as a community has been at the core of the Town Centre Development Plan. Achieving this goal starts with creating comfortable, safe streets and public spaces that will encourage social interaction and enhance a sense of security in the Town Centre.

The principles of Crime Prevention Through Environmental Design (CPTED) have been considered in all scales of the planning and design of the Town Centre, from overall concepts governing the mix of uses and density of development, to detailed design recommendations on building orientation and surveillance opportunities.

1.1.3.5 Private / Public Collaboration

Creating a sense of community pride and ownership of the South Hedland Town Centre is paramount to the ongoing success of South Hedland. By working in collaboration with the public to develop a strategic outcome for the Town Centre, it will build a sense of ownership, creating a celebrated and vibrant Town Centre.

1.1.4 Town Centre Elements

The provisions of Table 1 apply to the six elements of the development plan described in Part Two.

1.2 **Land Description**

1.2.1 Master Plan Area

The SHTCDP area is illustrated in Figure 3 and comprises an area of approximately 85 hectares.

In conducting a review of the 2008 Plan, the area of the SHTCDP has been extended to include that area of Mixed Business zoned land to the east of Forrest Circle, recognising the relationship of existing and potential activity in this precinct to the balance of the Town Centre. This also ensures consistency with the spatial strategy elements of the Pilbara's Port City Growth Plan, which was advertised for public comment during October 2011 and endorsed by the Town of Port Hedland in May 2012. It was endorsed by the Pilbara Regional Planning Committee of the Western Australian Planning Commission (WAPC) in June 2012.

The western extent of the SHTCDP area has also been rationalised to exclude that area west of Scadden Road

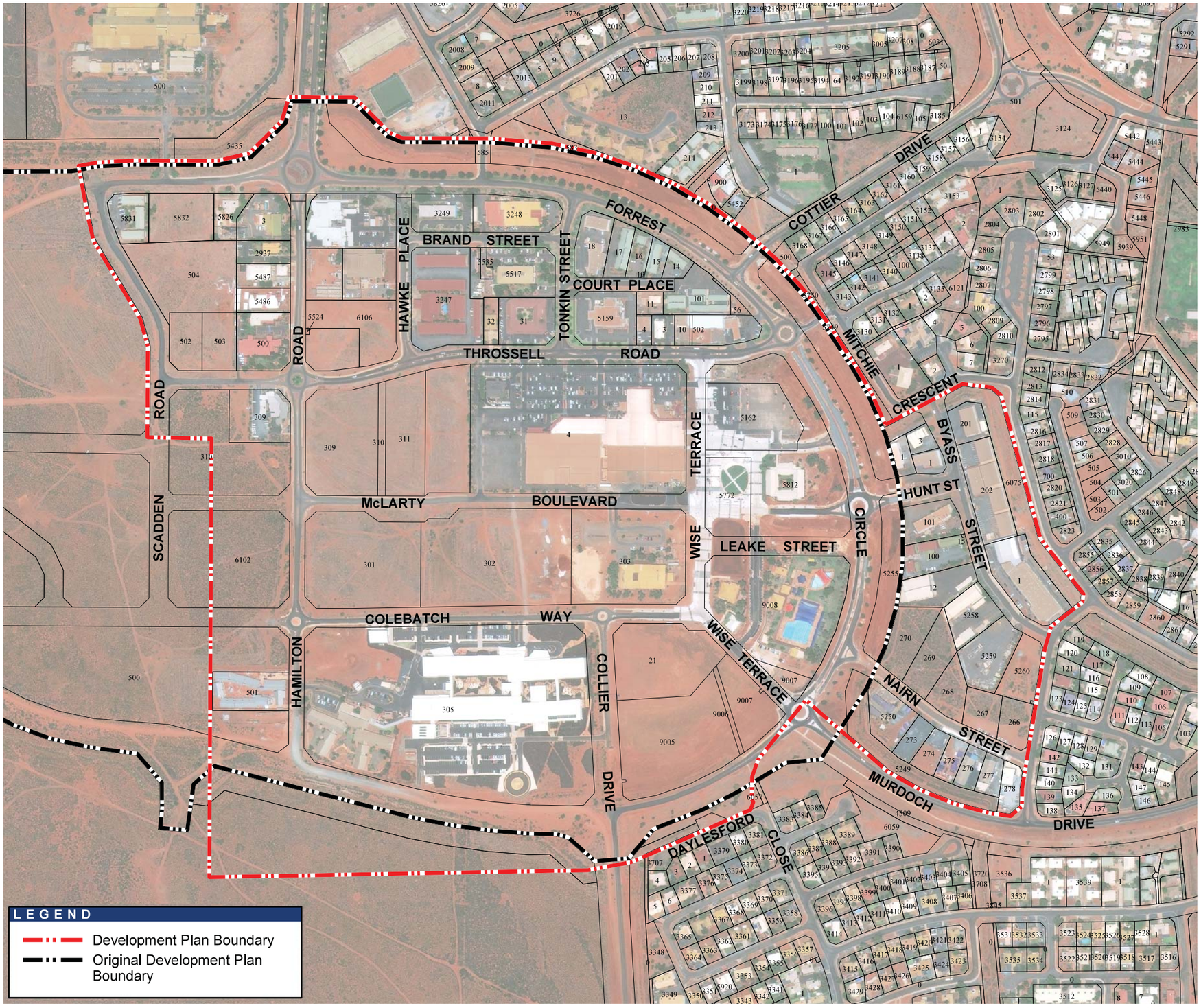


Figure 3: South Hedland Town Centre Development Plan Area

1.2.2 Land Ownership

While a range of properties in the northern and eastern areas of the Town Centre are in private ownership, the majority of land within the SHTCDP area is under the control of the Crown / State Government, presenting significant opportunities for the effective coordination and release of land for development.

Figure 4 identifies land ownership within the SHTCDP area. The following matters of particular relevance are also noted:

- Potential development areas are primarily owned / controlled by the State of Western Australia or State Government agencies, thereby presenting opportunities for a highly coordinated approach to land release and project implementation.
- The recent Native Title agreement between the Kariyarra people and the State Government will see approximately 5,000 hectares of land transferred to the Kariyarra people in exchange for their consent to the release of land in and around the South Hedland townsite (including the Town Centre area). This completes a significant step in the release of Crown Land to the private sector as freehold/green title properties. Figure 5 illustrates the Native Title agreement area as shown in Pilbara's Port City Growth Plan.
- Perpetual Trustees Australia Pty Ltd is the owner of the South Hedland Shopping Centre and adjoining car park land. As a major private landowner within the SHTCDP area, effective consultation and engagement with this stakeholder is essential to realising the project vision and objectives for the Development Plan
- The Town of Port Hedland retains vesting orders over local reserves lying between Colebatch Way and Forrest Circle, developed for a range of uses including the South Hedland Aquatic Centre and town library. The ongoing upgrade and development of facilities in this location forms a key part of the Town Centre vision.

1.2.3 Land Use & Development

Much of the Town Centre land remains vacant and undeveloped, namely those areas immediately north/north west and east of the Hospital site. These undeveloped areas are primarily under State Government/Crown control (and now clear of native title). They therefore present significant development opportunities. Figure 6 illustrates the extent of vacant land and the concentration of existing development in the north and east of the Town Centre, as well as the Karlarra House aged facility and new South Hedland Regional Hospital.

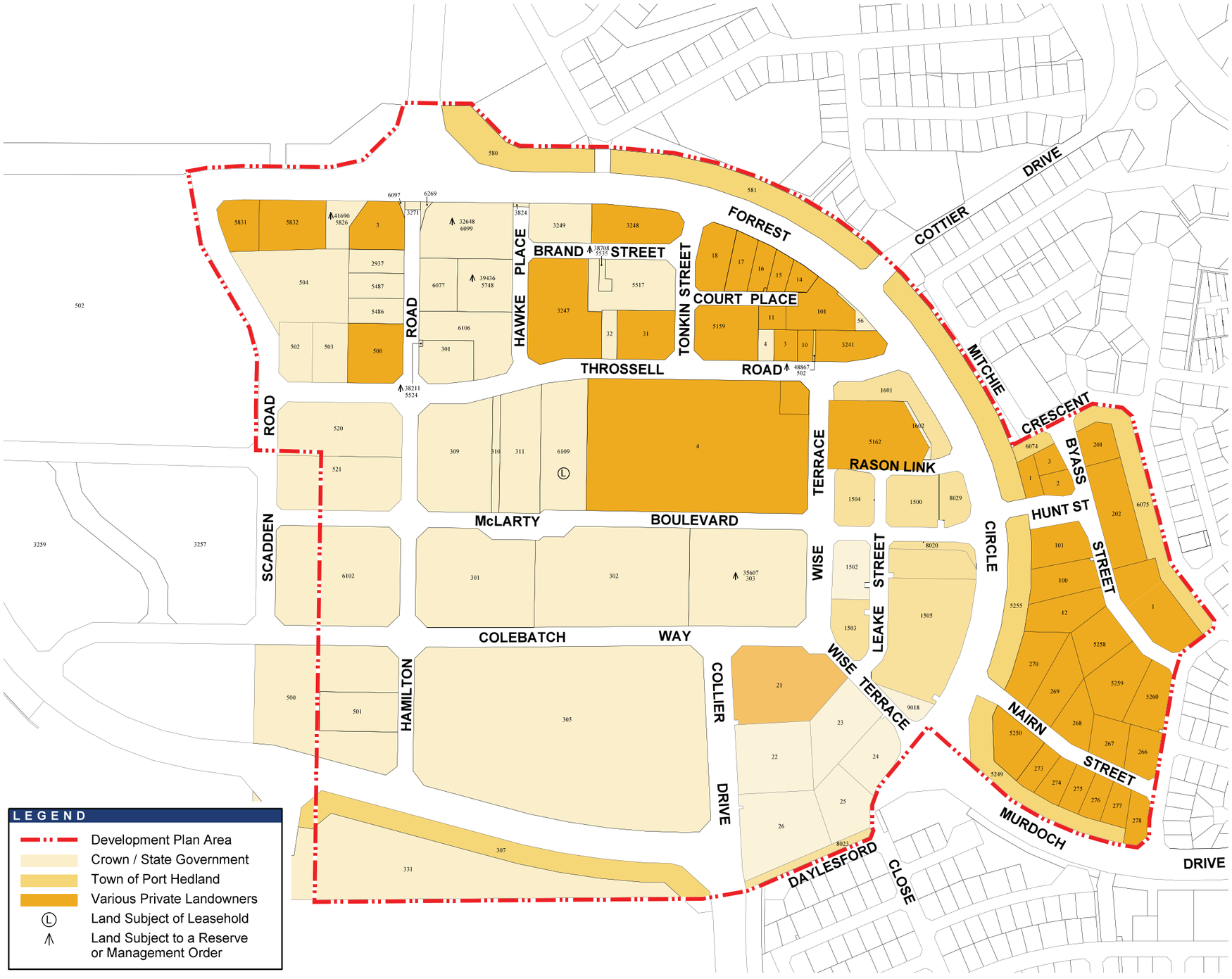


Figure 4: Land Ownership

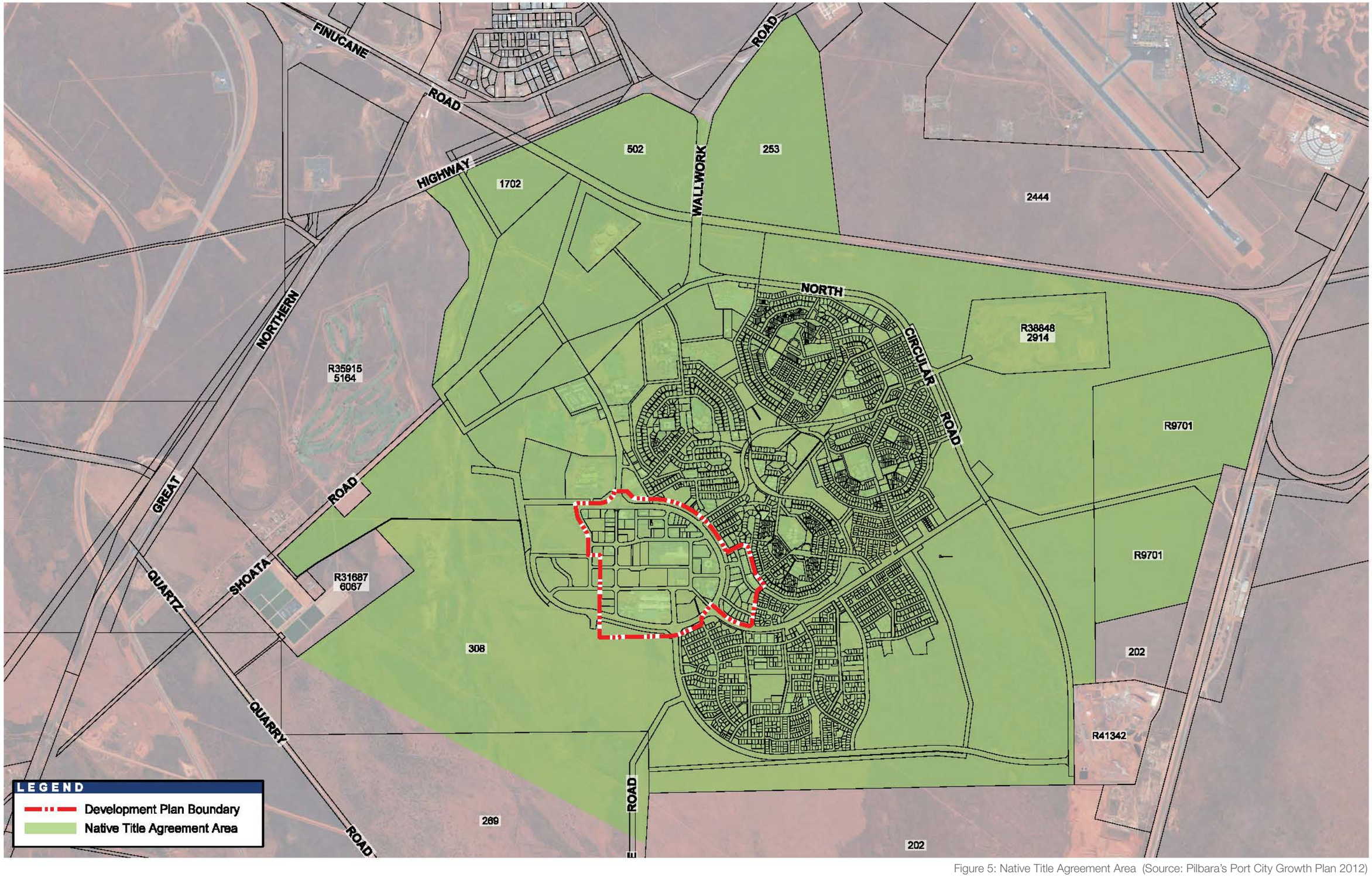


Figure 5: Native Title Agreement Area (Source: Pilbara's Port City Growth Plan 2012)

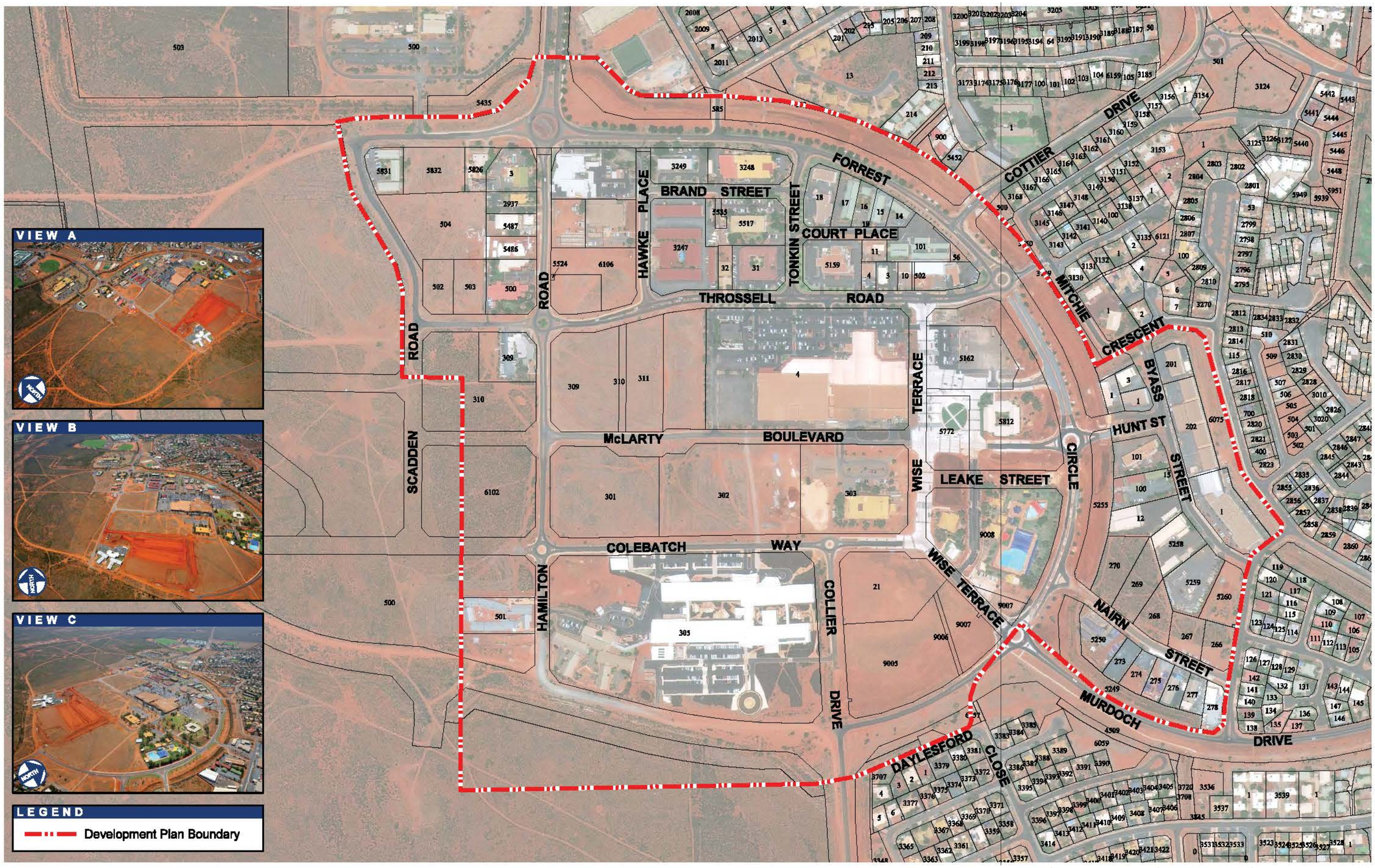


Figure 6: Aerial view of South Hedland Town Centre, May 2010 (Source: Landgate, 2011)

1.3 Statutory and Strategic Planning Framework

The South Hedland Town Centre forms a key element of the wider Statutory and Strategic Planning Framework for the area. Figure 7 provides a snapshot of the key planning documents and mechanisms ranging from the regional (Pilbara) level down to the site development level.

PILBARA PLANNING AND INFRASTRUCTURE FRAMEWORK

PILBARA'S PORT CITY GROWTH PLAN

SOUTH HEDLAND TOWN CENTRE DEVELOPMENT PLAN

ARCHITECTURAL DESIGN GUIDELINES

SITE SPECIFIC DEVELOPMENTS

DELIVERING THE VISION. MEETING THE NEEDS

Figure 7: Planning Framework

1.3.1 Town Planning Scheme No.5

Town Planning Scheme No.5 (TPS5) was originally gazetted in 2001 (since amended) and remains the statutory Town Planning Scheme for the area. TPS5 identifies the SHTCDP area as zoned predominantly 'Town Centre' zone, with the exception of land to the east of Forrest Circle which is zoned 'Mixed Business' .(refer Figure 8).

TPS5 also identifies the land zoned 'Town Centre' and 'Mixed Business' as being part of the 'South Hedland Town Centre Development Plan Area'. This requires all development to be in accordance with the provisions of an approved Development Plan.

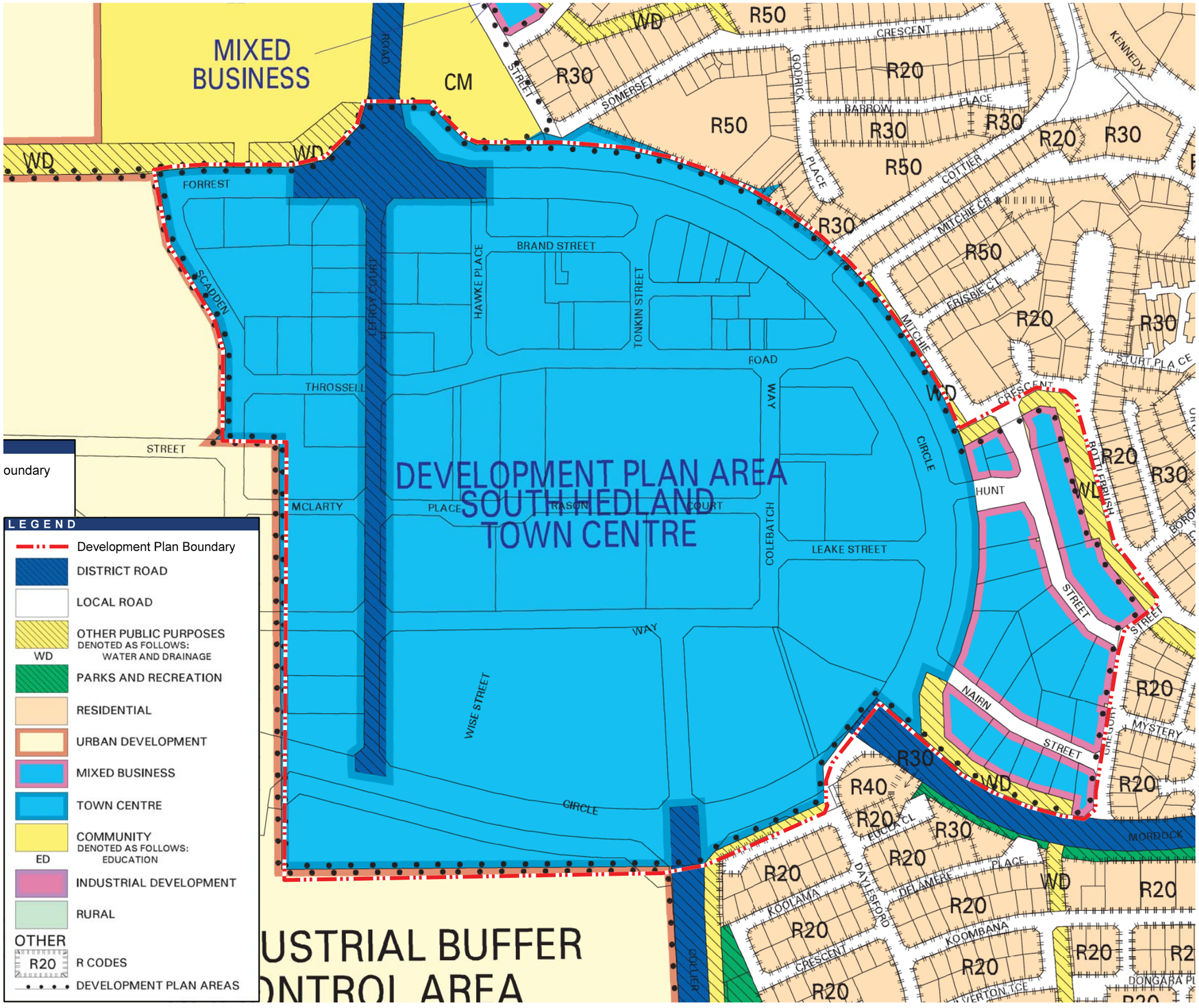


Figure 8: Town Planning Scheme No 5: Existing Zoning Plan (Extract)

1.3.2 Pilbara Planning and Infrastructure Framework

The Pilbara Planning and Infrastructure Framework (PPIF) was released in its final form in January 2012 by the WA Planning Commission (WAPC). It defines a strategic direction for the future development of the Pilbara region over the next 25 years. It seeks to ensure that development and change in the Pilbara is achieved in a way that improves people's lives and enhances the character and environment of the region.

In summary, the PPIF:

- Addresses the scale and distribution of future population growth and housing development, as well as identifying strategies for economic growth, environmental issues, transport, infrastructure, water resources, tourism and the emerging impacts of climate change.
- Sets out regional planning principles, together with goals, objectives and actions to achieve these. It represents an agreed 'whole of government' position on the broad future planning direction for the Pilbara, and will guide the preparation of local planning strategies and local planning schemes.
- Informs government on infrastructure priorities across the Pilbara and gives the private sector more confidence to invest in the region. The infrastructure priorities identified in the Framework have been determined following extensive liaison with State Government agencies, local government and other key stakeholders.

The SHTCDP, and the identified role and function of South Hedland Town Centre are consistent with the PPIF.

1.3.3 Pilbara's Port City Growth Plan

The Growth Plan provides a strategic blueprint for the sustained growth of Port Hedland, building on its relative competitive advantages and an enviable platform of strong and sustained projected economic growth into the future. In addition to this strategic blueprint, a companion 'implementation plan' also details and prioritises actions for precinct development, including delivery timeframes and responsibilities.

A number of the key challenges and opportunities addressed by the Growth Plan include:

- How to provide for significant population growth, create local employment and investment and diversify the economy, against a backdrop of significant housing market pressures and a mono-economy driven by the mining and resources industry;
- How the city will reflect cultural and landscape values through development of community and sense of place;
- Appropriate locations for urban and industrial growth, and the nature of transport, utilities and community infrastructure required to support this growth;
- Celebrating and protecting natural environmental assets and responding to the challenges of climate change;
- Identifying the required levels of retail and commercial floor space to facilitate local economic development and offering of services and facilities for residents and visitors; and
- Improving movement network efficiency, sustainability and attractiveness.

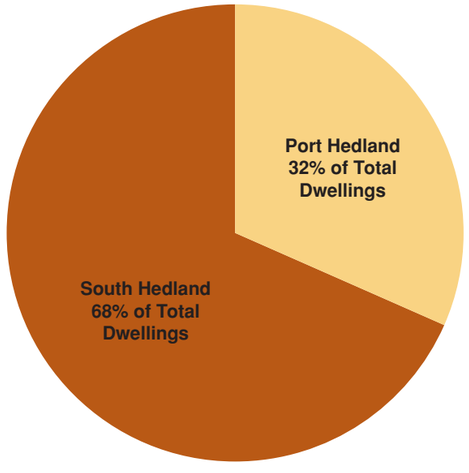


Figure 9: Forecast Distribution of Dwellings, 2031
(Source: Pilbara's Port City Growth Plan, 2012)

The Growth Plan advocates an urban development scenario whereby approximately two-thirds of new urban development over the next 20 years is provided in the existing South Hedland Town Centre and immediate surrounds (with the remaining one-third provided mainly in the East End of Port Hedland). In line with this spatial distribution pattern, the Growth Plan presents an activity centres framework which identifies South Hedland as the primary 'City Centre' for the region, supporting a concentration of significant retail offerings, commercial office space (potentially accommodating a range of public sector agency and local civic/administrative activities), major health facilities and personal services.

The SHTCDP area comprises Growth Plan Precinct 11 (See Figure 10). The Growth Plan's vision for the Town Centre is that of:

"a dynamic, accessible and inclusive place that is the heart of the South Hedland community and the major regional centre of our City of 50,000 people. It is an exciting destination for visitors, business people and residents. It has great public spaces, friendly streets, landmark buildings and architecture. There are many influences through public art and space of our strong association with indigenous heritage and natural landscape. Like many destinations throughout Pilbara's Port City, culture and social destinations are woven into our City Centre".

Key 'City Centre' recommendations and issues identified by the Growth Plan include:

- The identification of discrete precincts within the 'City Centre' aligned with functional roles, such as civic/justice, indigenous culture, commercial/office, Main Street, retail/shopping and health (including provision for Hospital expansion).
- High/Medium residential densities in (and close to) the 'City Centre'.
- Provision of open space 'green links' between the 'City Centre' and South Creek.
- Acknowledgement of the Town Centre Revitalisation Project and associated works currently under way, and the need to review/refine the existing 'South Hedland Town Centre Development Plan'.
- Key urban design objectives consistent with the 'South Hedland Town Centre Development Plan', including view corridors & landmarks, way finding, parking, bulk & scale, entry and shading etc.

The Growth Plan was advertised for public comment during October 2011, adopted by the Town of Port Hedland in May 2012, and endorsed by the Pilbara Regional Planning Committee of the WAPC in June 2012. The document will act as Council's Local Planning Strategy and form the basis for subsequent TPS 5 review.

The SHTCDP, and the identified role and function of South Hedland Town Centre are consistent with the Growth Plan.

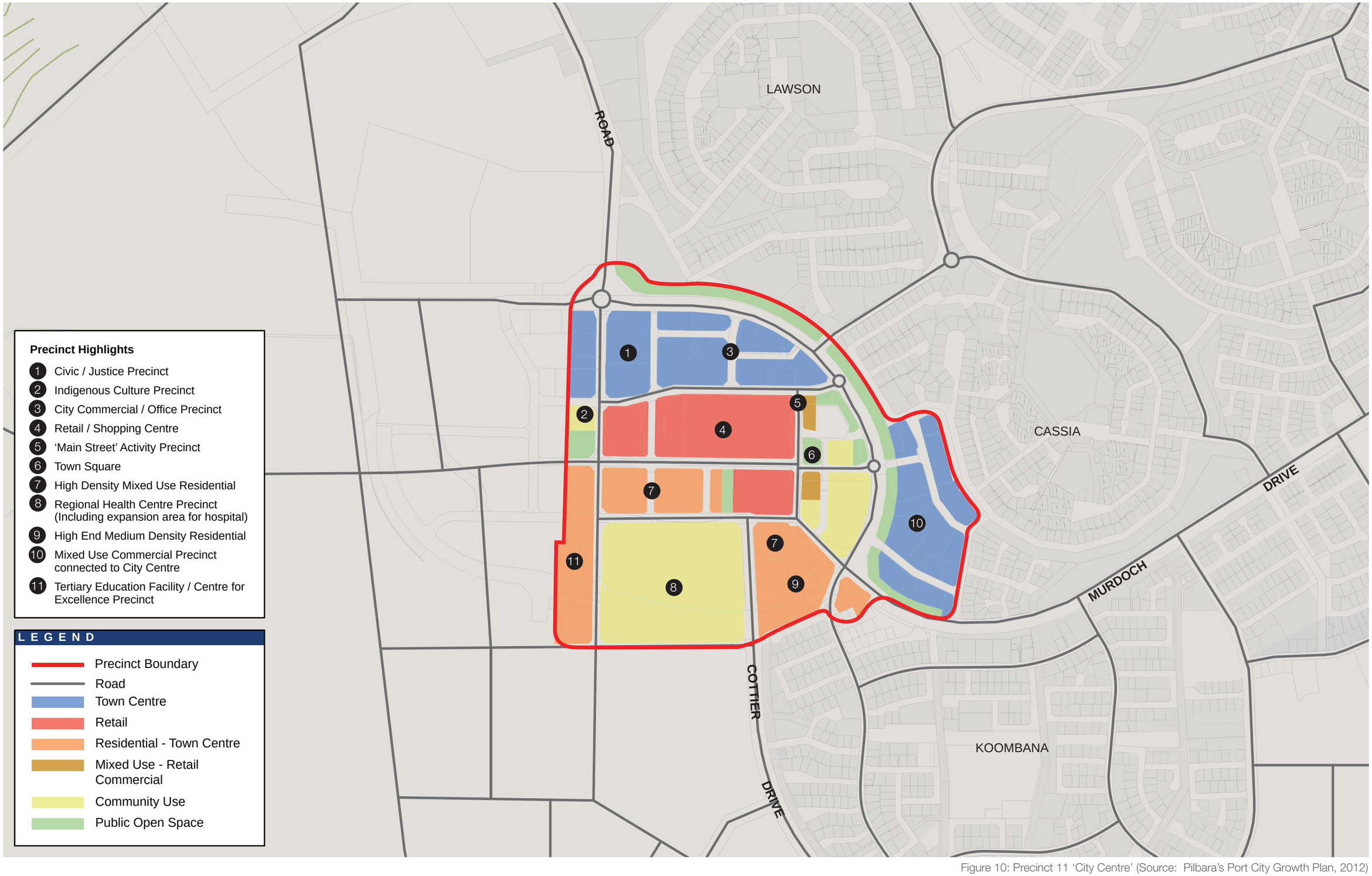


Figure 10: Precinct 11 'City Centre' (Source: Pilbara's Port City Growth Plan, 2012)

1.3.4 Other Approvals and Decisions

(a) WAPC/ToPH: South Hedland Town Centre Development Plan

This 2013 SHTCDP replaces the preceding SHTC Development Plan. The earlier document was advertised and approved as follows:

- Adopted by the Town of Port Hedland for advertising on 26 March 2008 and subsequently advertised for a period of 30 days between 26 March and 25 April 2008 during which time surveys were sent to South Hedland residents;
- Endorsed by the Town of Port Hedland on 28 May 2008, with modifications, and ultimately forwarded to the WA Planning Commission on 25 February 2009; and
- Endorsed by the WA Planning Commission on 10 November 2009, subject to:

i. A Traffic Impact Assessment in accordance with the Western Australian Planning Commission's Transport Assessment Guidelines for Developments 2006; and

ii. A Local Water Management Strategy (incorporating the key elements of the State Water Strategy for Western Australia 2003) in accordance with the Western Australian Planning Commission's Better Urban Water Management 2008.

(b) WAPC: Subdivision Approvals (Various)

Following the approval of the SHTC Development Plan both Traffic Impact Assessment and Local Water Management work was undertaken and subsequently formed the basis for approval to a variety of applications for subdivision that sought to implement the Development Plan. The following applications were supported by the Town of Port Hedland and approved by the WAPC:

WAPC Reference	Description	Approval Date
139090	Stage 1	1 October 2009
141694	Main Street & Town Square	20 May 2010
141695	Land Rationalisation	27 July 2010
142234	Stage 1C	13 Dec 2010
142255	Stage 1 (Lot 23)	25 August 2010

Table 2: Summary of Subdivision Approvals – South Hedland Town Centre

In addition to the above, a variety of associated road and reservation closures and revisions have been progressed by the Town of Port Hedland and Department of Regional Development and Lands as part of the implementation process, primarily in and around Wise Terrace.

(c) Town of Port Hedland: Library and Community Facilities in South Hedland Town Centre

The Town of Port Hedland Council at its Ordinary Meeting of 25 July 2012 endorsed a completed feasibility study into options for the provision of a range of community facilities, including South Hedland Library, Hedland Well Women's Centre and Lotteries House, within the South Hedland Town Centre. The study is to be used by Council as a guiding document for the strategic planning of these community facilities.

The aims of the feasibility study were to:

- Examine the options for co-location of the community facilities detailed;
- Determine the mix of co-located community facilities, as agreed by the groups;
- Provide conceptual designs for the agreed locations

Council resolved to adopt a resolution which included endorsement of the nominated plans as follows:

- Co-located Lotteries House and Hedland Well Women's Centre, with Lotteries House undergoing significant expansion and renovation to both increase its size , configuration and allow for Hedland Well Women's Centre to occupy a newly-added wing to the North-East;
- South Hedland Library to be relocated to a new facility constructed to the north of the existing South Hedland Aquatic Centre (SHAC), and co-located with the proposed youth space/skate park facilities.

This SHTCDP continues to reflect the initiative of the Town of Port Hedland with respect to land use, site identification and vision intent.

Future Community facilities concept - South Hedland Town Centre (Source LandCorp/Last Pixel)

2.0 SITE CONDITIONS & CONSTRAINTS

2.1 Role of the South Hedland Town Centre

South Hedland's Town Centre was originally developed in the 1970s as part of the wider South Hedland Town Site, and was planned to occupy a central location between four large residential areas designed to accommodate some 30,000 - 40,000 people. The design was prepared by the WA State Government in accordance with 'Radburn' design principles, characterised by a network of local pathways and centralised local facilities and open space. This vision however, was not ultimately achieved as the disconnected nature of the plan and shortcomings in design principles were recognised and ultimately abandoned.

The abandonment of the original design approach and the lack of subsequent expansion to the west and southwest of the centre have resulted in the present day situation where the Town Centre is somewhat removed and peripheral to its core catchment area.

Today, South Hedland's Town Centre plays an important local service/activity centre for the population of South Hedland, and to an extent, the wider Port Hedland City Region and East Pilbara Region. The lack of other local retail offerings in South Hedland reinforces this role, with the Town Centre effectively providing the only retail option for local residents and visitors (the only other retail offering being in Port Hedland itself, some 14 kilometres to the north). In addition to this local shopping role, the Town Centre currently accommodates a number of civic/ administrative organisations, business office space, cultural attractions, local recreational & community facilities (library, aquatic centre etc) and health services (including the regional hospital).

As previously noted, the future growth of Port and South Hedland into a City of 50,000 people will see significant additional development in and around the existing South Hedland town site. The constrained nature of the Port Hedland town site, due to the primacy of current and future Port operations and land availability constraints, means that the majority of the City's residential population (approximately two-thirds by 2031, and increasing thereafter) will live in and around South Hedland, including those areas immediately west and south of the existing Town Centre which could potentially be delivered in the immediate to short term. Pilbara's Port City Growth Plan recognises and responds to this growth by identifying South Hedland as the primary Centre in the hierarchy of activity centres (Figure 14), with other centres fulfilling a more local retail/commercial role or specialised function (for example, the West End of Port Hedland acting as a civic/cultural hub building on its historic/heritage significance and connections to the coast).

As the primary activity centre, the South Hedland Town Centre will continue to grow in terms of retail/commercial floor space and variety of retail products offered (particularly in terms of cafes, groceries and shops). It also has the capacity to serve a significant regional administrative function and accommodate a range of local and state/regional public sector organisations. The expansion and upgrade of the regional health campus will further strengthen the Town Centre's role as the primary hub for Pilbara regional health services, and further development of local civic and recreational spaces will help to establish the Town Centre as a destination in its own right and provide a range of leisure options and activities for local residents and visitors.

Generally speaking, existing land use and development within the Town Centre has evolved in the following main areas comprising:

- Community and civic uses to the east between Wise Terrace (formerly Colebatch Way) and Forrest Circle;
- Regional health services south of Colebatch Way between Hamilton Road and Collier Drive;
- Office and commercial generally north of Throssell Road including a range of Commonwealth and State Government Department premises;
- Throssell Road being the area of greatest activity (albeit vehicular activity), onto which the shopping centre fronts and some take-away outlets operate; and
- Bulky goods/mixed business style development east of Forrest Circle.

Figure 11: South Hedland in 1978 (Source: State Library of Western Australia)

Figure 12: South Hedland in 1982 (Source: State Library of Western Australia)

Figure 13: South Hedland Town Centre, 2007

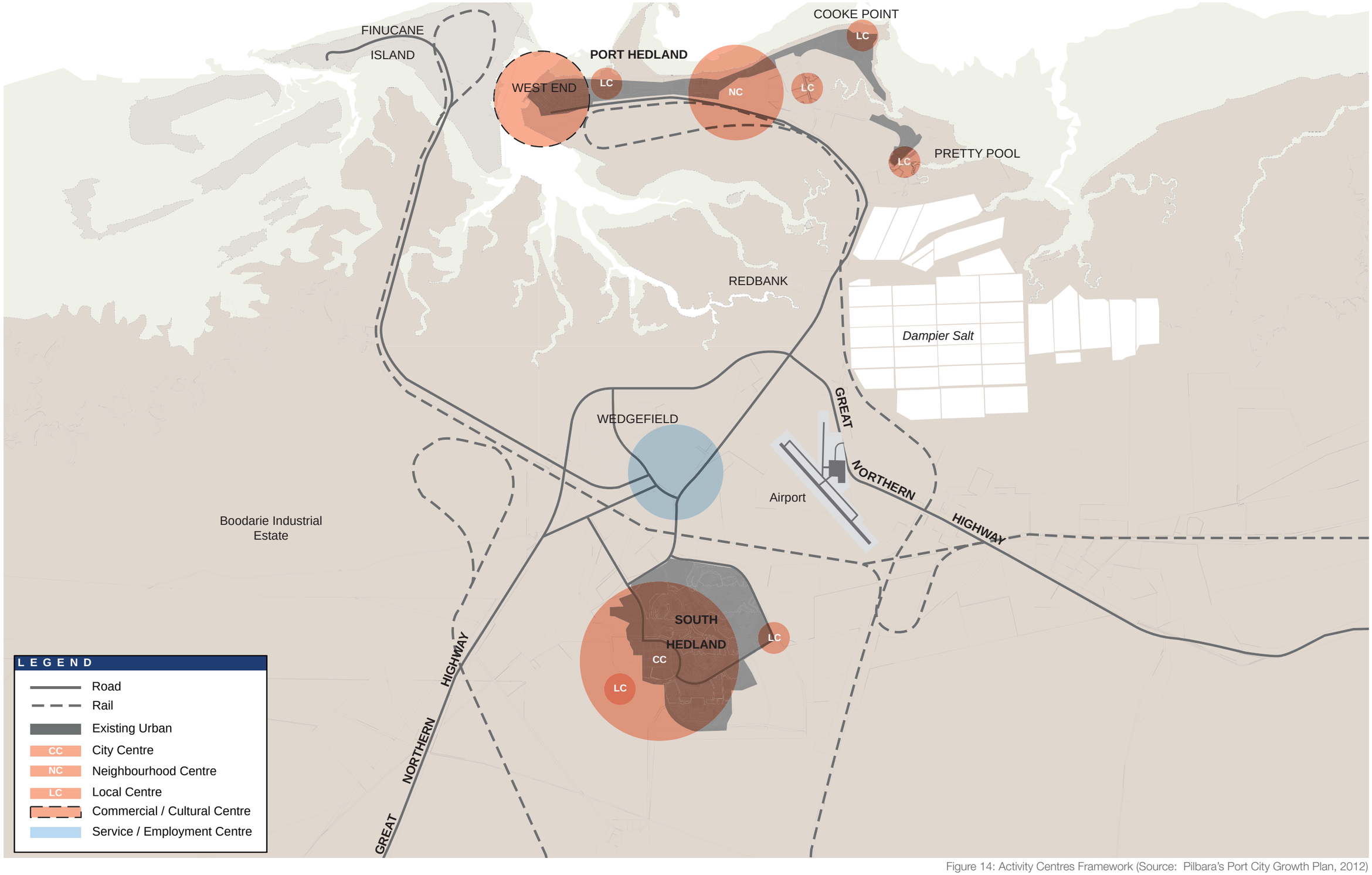


Figure 14: Activity Centres Framework (Source: Pilbara's Port City Growth Plan, 2012)

2.2 Natural Features

2.2.1 Topography

The South Hedland Town Centre is generally flat, with elevations of between 12m and 13m AHD. The land generally falls to the west towards South Creek (locally named 'Two Mile'), and to the north towards the coast. South Creek acts as a natural drainage corridor for South Hedland, directing run-off north past Wedgefield and towards the coast.

Figure 15 illustrates the existing topography of the Town Centre (at January 2010).

2.2.2 Geology and Soils

The soils within the Town Centre are described as red sandy loam, generally referred to as Pindan Sand. These soils generally extend to a depth of at least 4m, have a small clay component with fine to medium grained sands, and can become hard when dry and waterlogged during heavy rainfall. This low level of permeability suggests that infiltration drainage measures such as soakwells are largely inappropriate in this area.

The study area is mapped as having low risk of encountering Acid Sulphate Soils (ASS) occurring less than 3m from the surface.

2.2.3 Groundwater

Groundwater generally occurs at depths greater than 4m to 5m (less than 7m to 8m AHD) in April, with higher levels in the wet season (although these remain lower than 9m AHD – the minimum level of the Forrest Circle north drain). Little groundwater quality data exists, however nearby bores to the north of the Town Centre indicated salinity greater than 4,000 mg/L.

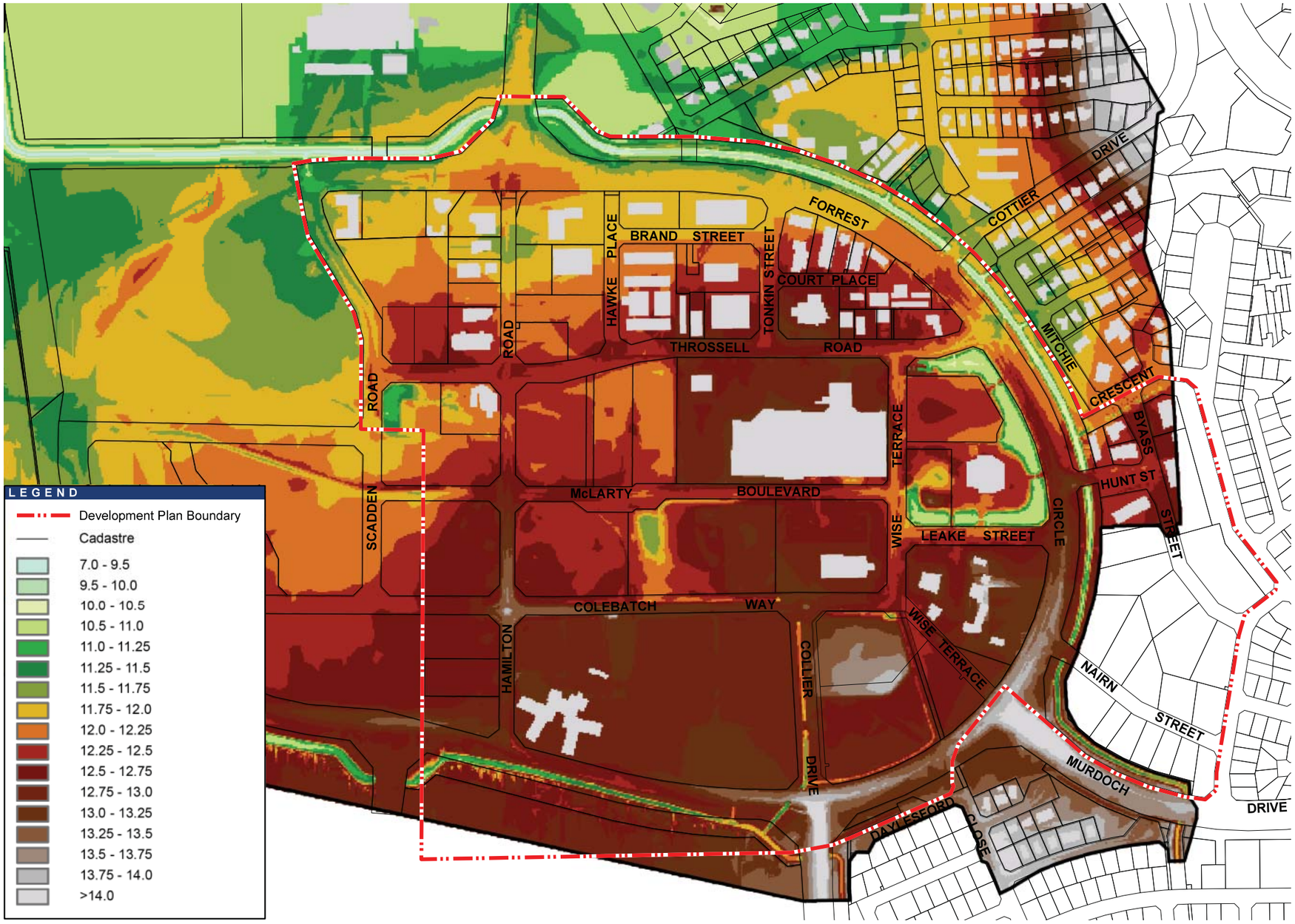


Figure 15: Existing Topography (Source: JDA, 2011)

2.2.4 Surface Water Drainage

There are two prominent drainage channels to the north and south of the Town Centre, which direct surface water flows from the Town Centre and residential areas to the west into South Creek. These are referred to as the Forrest Circle north drain (north of Town Centre) and Forrest Circle south drain (south of the Town Centre). Anecdotal evidence indicates that there has been no overtopping of the Forrest Circle north drain in the last 20 years . While these drainage channels provide an important function, they form a distinct physical boundary, segregating the Town Centre from surrounding residential cells.

There is an existing flood storage area located in the eastern section of the Town Centre around Lotteries House, which discharges into the Forrest Circle north drain via an outlet adjacent to the roundabout. A temporary flood storage area is located to the north of the hospital site between McLarty Boulevard (formerly Rason Court) and Colebatch Way. This caters for local runoff and discharges into the Forrest Circle south drain via swales and culverts eastward along Colebatch Way and south along Collier Drive.

In developed areas, runoff from impervious surfaces is directed into flood storage areas and drainage channels partly by formal pit and pipe drainage and partly by overland flows along road surfaces. In undeveloped areas there are few defined drainages routes, with runoff generally occurring by overland flow. Given the low slope gradients, there is an increased likelihood of depression storage within the Town Centre catchment area.

Regional and local stormwater management is further considered by the Local Water Management Strategy (LWMS) comprising Appendix 1. The LWMS provides guidance on appropriate development levels and stormwater design parameters, which are further described in Section 3.10 of this report.

2.2.5 Climate & Solar Orientation

2.2.5.1 Climate

South Hedland's climate can be described as arid sub-tropical. Between May and September, South Hedland enjoys consistent mild temperatures of 23-27C, including extended warm dry periods with cooler nights. In contrast, the summer months, October to April, consist of unsettled hot humid periods.

Unrelenting tropical storm build-ups can lead into short, strong wet periods with occasional cyclone activity, where there is often rapid overland run-off and flooding that may only last a few hours. Within this time of year extended hot periods of temperatures over 40C is not uncommon.

Average Annual Rainfall	313.5mm (with the majority of rain occurring between January and March)
Average Daily Maximum Temp	33.2'C;
Average Daily Minimum Temp:	19.3'C; and
Average 3PM Air Temp:	31.2'C.
Stage 1 (Lot 23)	25 August 2010

Table 3: South Hedland Average Rainfall and Temperature Data

Predominate winds are north westerlies (refer Figure 16), providing cooling breezes from across the coast. During the summer months, however, hot dry easterly winds can add to discomfort.

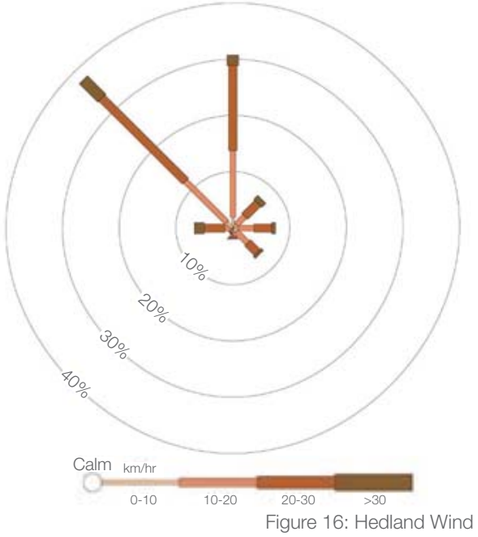


Figure 16: Hedland Wind Rose

2.2.5.2 Solar Orientation

Solar orientation during summer is close to Azimuth ~860 (refer Figure 17). In contrast to southern Australia, which experiences lower sun angles and cooler conditions, the northern orientation of the more overhead sun angle is not a strong climatic factor for individual lot solar orientation.

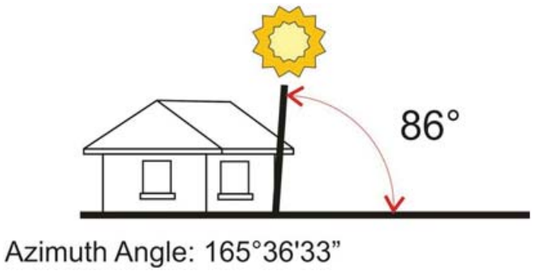


Figure 17: Summer Solstice Sun Angle
(In Northern Australia aim to avoid affect of peak sunlight.]

While taking into account views and landscape ecology, the allowance of shaded outdoor spaces and the collection of cooling breezes are of major importance within all northern Australian built environments and should be considered the primary climatic design influence.

In South Hedland, this aspect of climate sensitive design is deemed even more important and the amenity of shade and built form orientation to utilise cross flow ventilation cannot be over emphasised (Figure 18).

As illustrated below, lot orientation that favours an east-west alignment will reduce solar exposure and therefore heat gain to a dwelling's large external walls. In addition the east-west alignment encourages cross-flow and the potential to capture the cooling north-westerly breezes.

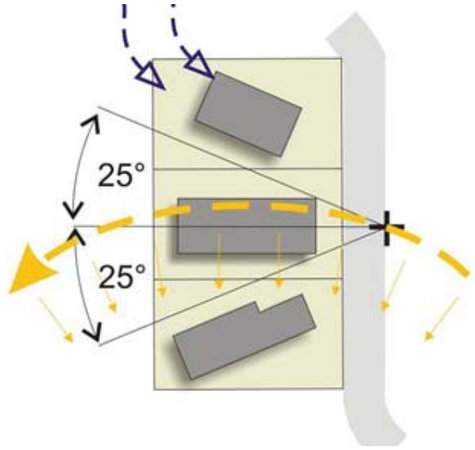


Figure 18: Hedland Lot Orientation

Source: Town of Port Hedland

2.3 **Economic Opportunities**

Increased mining and mineral processing activity in both the Port Hedland LGA and the wider Pilbara region have driven robust economic growth over the last 5 years, accelerating residential population growth at a much higher rate than the preceding decade. The local economy is dominated by the mining sector, which directly accounts for almost three quarters of production value in the LGA, and indirectly contributes even more through flow-on benefits to the construction, transport and service sectors (AECgroup, 2011).

Future forecasts for mining projects and international resources demand indicate strong and robust growth, however, there is a strong case to diversify the local economy and provide further employment opportunities in other sectors, particularly the population servicing/retail sector which can also help to improve the attractiveness of the City for new residents and visitors. Whilst the City's competitive advantages and strategic assets will no doubt remain strongly tied to mining activity and bulk exports through the Port, there are numerous opportunities to diversify the local economic and employment base, including:

- Increased local retail/service sector activity supported by a larger service population base;
- Increased tourism activity, capitalizing on local strategic assets and the City's role as a gateway to the wider Pilbara region.
- Capturing greater levels of supply chain and import replacement activity;
- Development of common user port infrastructure (potentially at Lumsden Point) for marine logistics and mining/exploration support industries;
- Further development of heavy/strategic industry (linked to the Boodarie Strategic Industrial Area); and
- Potential Defence Force presence (as an outcome of the Defence Force Posture Review);

The Pilbara's Port City Growth Plan recognises these opportunities and recommends a number of activities to take advantage of them. Importantly, it is highlighted that before economic development can be achieved, improved housing availability and affordability, along with provision of retail and commercial space must be achieved. Recommended initiatives to prepare for, and deliver, economic growth include:

- Immediately address housing shortages through the use of Council held land, modular construction techniques, and the provision of incentives and other forms of inducement;
- Ensure future provision of retail, commercial and industrial lands through a progressive property strategy and efficient facilitation of development approvals; and
- Establish proactive incentives schemes to facilitate development and create revenues.
- Encourage entrepreneurship through local programs, including business incubation, business advisory, local investment funds and other programs geared toward generating new products, services and businesses;
- Support local clusters to grow and diversify by providing a platform, together with partners, for interaction, innovation and the transfer of ideas as well as opportunities to connect businesses;
- Develop innovation and R&D capabilities including exploring options to develop a local mining research centre of excellence together with major universities and mining companies as well as specific education and training programs leveraging the unique assets of the Town of Port Hedland (i.e. Port, access to mines and major facilities/infrastructure); and
- Improved public sector engagement with, and support for, local businesses of all sizes in order to stay abreast of key issues, industry trends, opportunities and needs.
- Increased marketing activity to promote the City and attract new investment (e.g. market research, preparation of business cases, marketing information and other material).

The long-term economic sustainability of the City is dependent on its ability to reduce reliance on the mining sector through the development of other opportunities. By expanding innovation locally, increasing retail offering and ensuring there is sufficient land for future development, the Town of Port Hedland will be able to facilitate future economic development outcomes (AECgroup, 2011). The revitalisation and development of South Hedland City Centre presents a significant platform to pursue these goals, particularly the provision of additional retail/commercial floor space and residential dwellings, along with opportunities to support the growth of economic clusters and development of innovation/R&D capabilities.

Through preparation of the previous Town Centre Development Plan, market and economic consultancy Taktics4 were engaged to explore the nature and value of consumer markets on the economic performance and sustainability of the South Hedland Town Centre. The findings of this earlier work are summarised below:

- Residents in Hedland have a higher level of discretionary spending for retail goods, however this does not necessarily translate to a high level of retail spending in South Hedland. Outside of food and convenience spending, a lot of other retail spending is directed to retailers outside the region.
- The non food retail offering is limited because these retailers generally need larger markets than convenience based markets to sustain the necessary sales.
- Local residents are responsible for 90% of retail sales in the centre.
- A second smaller supermarket may be sustainable in South Hedland as population increases. This operator may be capable of attracting even more food & grocery specialty retailers.
- A second smaller Discount Department Store (DDS) may be sustained in South Hedland but would need to be developed in conjunction with a reduction of the current DDS (Kmart) operators store size.
- The introduction of a second DDS may result in the attraction of additional non food retailers and be responsible for a greater retention of non food spending in the region.

Sound Shell-South Hedland Town Centre (Source: Town of Port Hedland)

2.4 **The Community of South Hedland**

2.4.1 Population and Household Characteristics

Based on projections developed by AECgroup, and as illustrated in Figure 19 South Hedland's total service population is expected to increase from 13,058 to 32,797 between 2011 and 2031. This is in line with the 50,000 population target for the Port Hedland LGA within the Pilbara's Port City Growth Plan and represents an average annual population growth rate of 4.7%.

By far the largest contributor to South Hedland's service population will be its resident population, which is expected to increase at an average annual rate of 4.4% from 11,600 to 27,240 over the period – an increase of 15,640. However, the number of FIFO workers is expected to experience the fastest annual rate of growth of 10.2%, increasing to 4,239 (but from a much smaller base of 603). This reflects the importance of this form of population to local industry, particularly in the short-to-medium term. Visitor numbers are also expected to increase, but only at an average annual rate of 2.2% from 856 to 1,317 visitors per night over the period.

Analysis by AECgroup of recent Census data and current residential population estimates project that the average household size in South Hedland will gradually decline over the period from 2.72 in 2011 to 2.22 in 2031. This is illustrated in the figure below. The ageing of the local (and broader WA) community, and the increasing affluence of the local population (increasing per resident housing demand) are expected to drive this trend over the period.

Hedland has a relatively young population, with an average age of 31.2 years across the municipality – well below the average of Perth and regional WA (but also higher than the average age profile for the remainder of the Pilbara). This relatively young population is characterised by a high proportion of children under the age of 15 years and working aged persons between 25 and 34 years – which is representative of the number of young working families that are located in Port Hedland. Given the greater number of community facilities in South Hedland, the population tends to be more settled and have a higher proportion of families in comparison to Port Hedland.

Growing proportions of families and increasing birth rates in Hedland will continue to place stress on local child services and the associated infrastructure required to support the local population. This is a key consideration for the future planning and development requirements of South Hedland Town Centre.

Over 80% of Hedland's population is Australian born, which is in line with the cultural heritage trends of the broader Pilbara and regional WA. Of those residents born overseas, the top three countries of origin are the UK, New Zealand and South Africa . Hedland also has a significant level of indigenous Australian presence in the area (estimated at over 2,000 people), with levels higher than in Roebourne and the wider Pilbara region. This highlights the importance of indigenous Australians as a significant group of people for consideration in the planning and development of South Hedland, where they comprise approximately 20% of the population.

As the Hedland community grows it is experiencing an increasing diversity in cultural influences and values. In 2004, Hedland had the largest population of Muslim residents outside any capital city in Australia. This influence, however, is not clearly evident in the current offering of commercial amenities and community services.

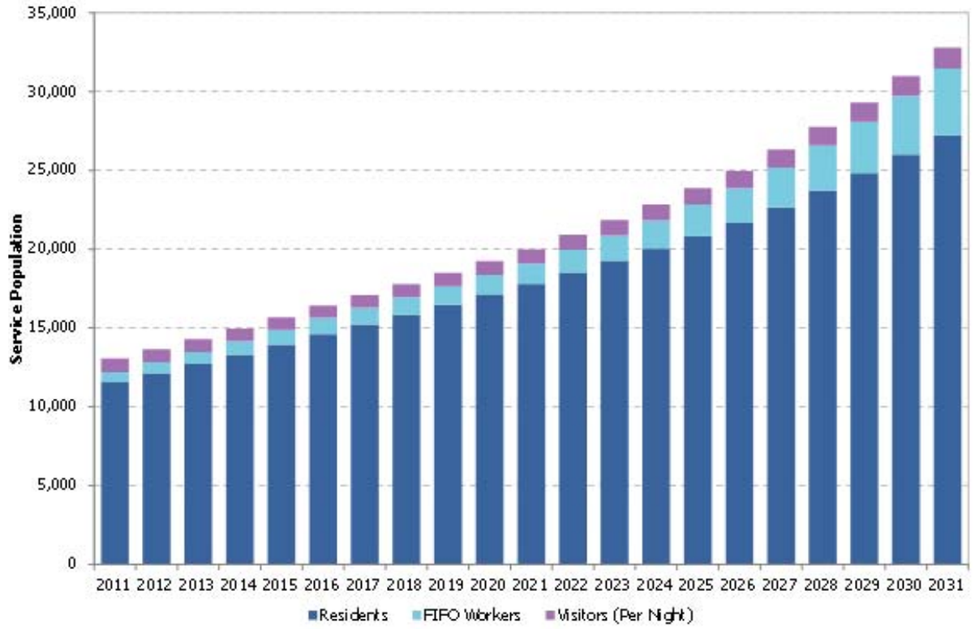


Figure 19: Service Population, by Segments, South Hedland Region, 2011 to 2031 (Source: AECgroup, 2011)

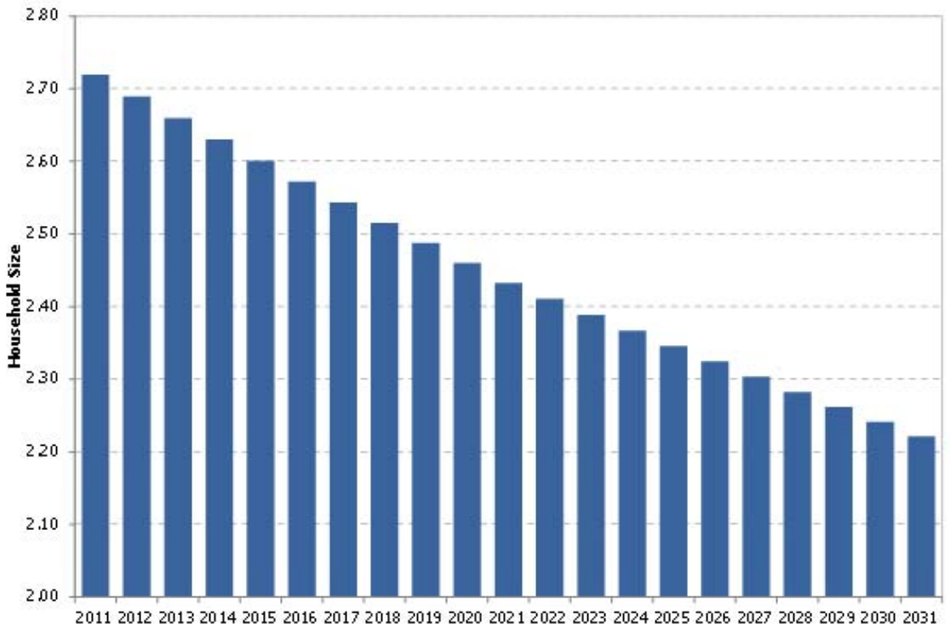


Figure 20: Average Household Size, Port Hedland LGA, 2011 to 2031
(Source: ABS Census of Population and Housing, 2007 and AECgroup, 2011)

2.4.2 Market Activity

2.4.2.1 Employment and Housing Market Activity

Port Hedland has a mono-economy, with almost three quarters of production value (73% of the total $3.3b Gross Regional Product) and 46% of total employment directly resulting from activity in the mining industry. Additionally, economic activity in the construction and transport sectors is strongly linked to the mining industry, through the dominance of civil engineering projects, mineral resource exports through the Port Hedland Port and the prominence of business related visitors. Employment is forecast to increase strongly between 2011 and 2016 (by 7.0% or almost 3500 jobs), and then less rapidly over the period 2016 to 2031. This is a reflection of expected GRP growth over the same period.

Outside mining and closely associated industries (e.g. transport and logistics, construction etc), population servicing industries (retail, hospitality etc) is the only other significant employment generating activities in Hedland. Considerable scope exists to increase the amount of employment activity in the professional and commercial service sectors and reduce the dependency upon the mining sector/associated industries.

Average incomes of Port Hedland residents are well above the Perth and Regional WA averages. This is due to the strong resource and industrial focus for the economy, with these sectors generally offering higher wages to secure specialist and high demand skilled workers. The proportion of the population earning high wage levels has increased dramatically over the last four years, with almost 20% of the population earning over $104,000 a year in 2008.

On the back of strong economic activity and population growth, coupled with a general undersupply of residential and non-residential properties, median property and rental prices in Port Hedland have risen dramatically in recent years. Residential sales and rental prices have both increased by an average of 14% between 2008-2010, with average house prices of $1.12m (triple that of Perth) and average rental prices of $1,772 / week (four times higher than Perth) at present. Relative to Perth, housing in South Hedland remains expensive and in short supply.

An analysis of the current housing supply and projected future demand for housing in the South Hedland Town Centre is included at Appendix 2 – South Hedland Town Centre Urban Development Opportunities. The key findings of this 'Urban Economic Review' report confirm the strong demand for apartment style residential development in the broader South Hedland Township and the SHTC is ideally positioned to accommodate this demand. The ability for quality retail and community services, employment accommodation and amenity and accessibility-related infrastructure to be delivered in the precinct further enhances the attractiveness of SHTC as a residential apartment location. This would support approximately 400 apartments in the short-term and up to 1,450 apartments in the long-term.

Current short-stay accommodation supply has the capacity to accommodate short-term demand from visitors if occupancy rates continue to operate at or around 100%. Over time however, the normalisation of the hotel market will see this occupancy rate fall closer to annual industry averages of 70-75%. Assuming the market currently operated at such occupancy rates now, there is a shortfall of supply of between 160 and 230 rooms in SHTC in 2011. Regardless of the occupancy rate, additional supply is required over the long-term, in light of increased role and function of SHCC in the Port Hedland accommodation market and strong visitor numbers growth.

2.4.2.2 Retail Market Activity

Retail demand is expected to grow strongly in the Town of Port Hedland over the next two decades, with SHTC positioned to play a central role in meeting this demand. SHTC is currently the largest concentration of retail floorspace in the LGA, and possesses the greatest capacity for floorspace expansion to meet future demand growth in its Primary and Secondary Catchments.

Meeting demand will require an effective tripling in the amount of retail floorspace in the Town Centre by 2031, with an increased diversification away from core Groceries and Specialty Foods to increased supply of café and restaurant, specialty stores, Discount Department Stores (DDS) and full Department Stores. There is also a requirement for some larger format retail offerings, to supplement Main Street, Shopping Centre and Mixed Use formats that traditionally define Town Centre offerings.

Primary Catchment households are forecast to expand from the 4,265 in 2011 to 12,264 by 2031. Similarly, Secondary Catchment households are forecast to expand from 1,173 to 5,510 over the same period. Visitor numbers are expected to increase to 1,317 visitors per day by 2031, while FIFO worker numbers increasing from 603 in 2011 to 4,239 over the period. These projections form core inputs into the assessment of future retail floorspace demand for SHCC.

Totalling the contributions from Primary and Secondary Catchments along with visitors, the retail spending in the Town Centre is expected to increase from $133.7 million in 2011 to $506.8 million by 2031. The contribution made to this expenditure by Primary Catchment residents is forecast to rise to $361.3 million (71.3%), constituting a slightly smaller share of the Primary Catchment's retail expenditure than occurred in 2011 ($103.0 million or 77.0% of the initial $133.7 million). This highlights the fact that the residential population in the Secondary Catchment is projected to reach a critical mass during this period), providing other Precincts with greater capacity to locally capture some expenditure.

There is currently demand for a total of 20,234 sqm of retail floorspace in the Town Centre, with 25,745 sqm of floorspace being currently supplied. This results in an apparent supply surplus (supply exceeding demand) of 5,511 sqm of floorspace in 2011. However, this does not suggest that current retail in South Hedland is either oversupplied or underperforming. Instead it reflects the fact that retail in the SHTC currently has higher market shares in its primary and/or secondary catchment than assumed in this long-term assessment. It is expected that these market shares will decline slightly in the future, namely in the secondary catchment, as further retail offering becomes available in other Precincts over time.

By 2016, the forecasted expansion in demand for retail floorspace in the region to 28,016 sqm will cause this demand gap to change to a supply gap of 2,271 relative to current supply. And by 2031, further expansion in demand to 77,461 sqm will correspondingly increase this supply gap to 51,716 sqm. This transition to, and growth of, the supply gap in the Town Centre is illustrated in Figure 22.

Further details of the expenditure pool, captured spending growth and projected floor space demands are included at Appendix 2 – South Hedland Town Centre Urban Development Opportunities.

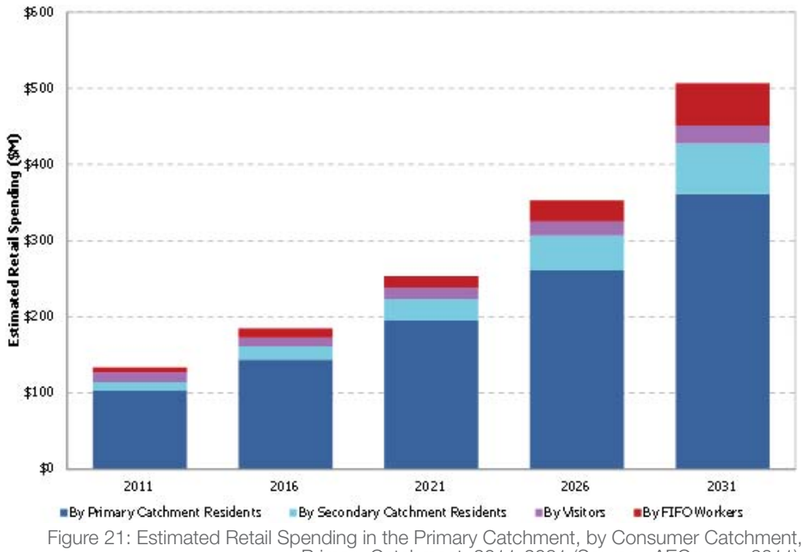


Figure 21: Estimated Retail Spending in the Primary Catchment, by Consumer Catchment, Primary Catchment, 2011-2031 (Source: AECgroup, 2011)

2.4.2.3 Commercial Market Activity

The commercial office market in the Town Centre will grow over the next 20 years, in response to a critical mass of local labour force and collocation with major medical facilities generating health-based floorspace demand. While it is expected that the West End will play an increasingly important role in the Town of Port Hedland as a primary concentration of premium and A Grade office floorspace (fulfilling its role as a Commercial and Cultural Precinct), SHTC has a critical role to play in maintaining and increasing the diversity of office accommodation locations and availability across the LGA. This will assist in providing a "release valve" for future potential pressures in office space demand.

The assessment included at included at Appendix 2 suggests that the current market is in a slight oversupply position. However, this reflects the SHTC having particularly strong market share in the commercial office market at present, relative to its local labour force dynamics. As the market normalises, local labour-based floorspace demand will play a greater role in underpinning overall accommodation supply in the medium to long-term.

2.4.3 Community Facilities

Existing community facilities and amenities attract a high proportion of families to South Hedland, with children under 15 years of age making up approximately 26% of the population.

At present South Hedland Town Centre provides the following community facilities and services:

- Lotteries House (providing not-for profit office accommodation in addition to a Day Care Centre)
- Government agency offices (including Police and Justice);
- Library;
- Post Office;
- Aquatic Centre (soon to be upgraded);
- Skate Park (to be redeveloped as the South Hedland Youth Space and Skate Park);
- Wangka Maya Pilbara Aboriginal Language Centre.
- Well Women's Centre;
- Bunara Maya Hostel (Indigenous Aged Care);
- Hedland Health Campus (including the new Regional Hospital and residential aged care services);
- Indoor shopping centre

Immediately to the north of the Town Centre is the Hedland College of TAFE and Multi-Purpose Sports Complex (including an indoor sports centre).

Existing facilities in the wider South Hedland suburban cells include a community centre, Hedland Senior High School (est. 1971), South Hedland primary school (est. 1972) and other sports facilities at Lawson. Two day-care centres and a Primary School (est. 1981) are in Cassia and Shellborough contains the Baler Primary School (est. 1975) and an Islamic mosque. Walnut Grove contains sports facilities and a Police and Citizens' Youth Club.

2.5 Servicing and Infrastructure

Following is a summary of servicing and infrastructure provision within the South Hedland Town Centre area. Appendix 3 incorporates the full Servicing and Infrastructure Report for the SHTCDP area undertaken by Cossill & Webley.

It should be noted that the focus of servicing and infrastructure review has been with respect to those areas of new development and land release, rather than to re-assess the established development areas around Hunt Street and Tonkin Street.

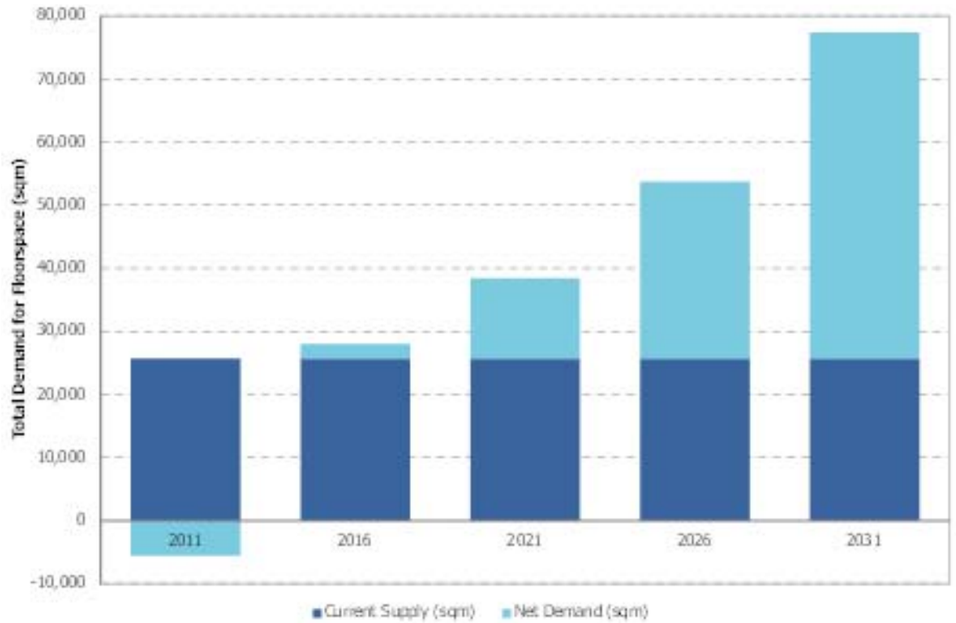


Figure 22: Forecasted Demand for Retail Floor Space, by Current Supply and Forecasted Net Demand, SHTC, 2011 to 2031 (Source: AECgroup, 2011)

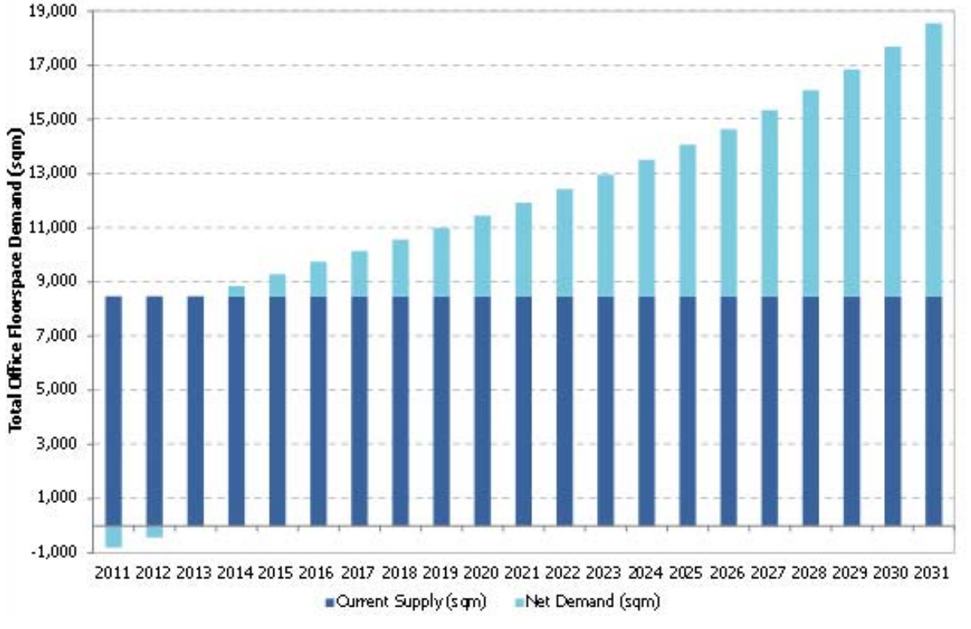


Figure 23: Total Office Floorspace Demand, by Current Supply and Forecasted Net Demand, South Hedland, 2011 to 2031 (Source: AECgroup, 2011)

2.5.1 Drainage

The previous drainage concept for the area (developed by the PWD in 1976) comprised a number of storage detention basins that were located around Lotteries House, the Hospital Site and south of McLarty Boulevard (formerly Rason Court) near Hamilton Road. A revised drainage strategy developed as part of the Town Centre Development Plan (2008) was prepared to accommodate the desired new "Main Street" focus and planned residential development. Where possible the larger detention areas were redirected to a widened Forrest Circle drain and planned linear drainage path along the north side of McLarty Boulevard. Inherent in this system however is a requirement for some onsite detention within each of the development sites. Part of the redirection of runoff was the need to upgrade a number of the existing culverts on the Forrest Circle drain.

The road drainage system in the northern established part of the Town Centre area compromises a pipe drain network with a depressed road system and some direct access to the existing open drain along Forrest Circle. Stormwater runoff from lots is in some areas detained onsite with runoff to roads and some locations appear to overflow to the adjoining Forrest Circle drain. Should redevelopment be proposed in this area, further assessment of site levels and drainage may need to be considered.

In the area east of Forrest Circle, surface water runoff for a large proportion of the developed areas is directed into depressed car park areas that then overflow onto the road network. This comprises a pipe network with depressed road system that directs surface flows to the outer Forrest Circle drain. Some of the lots that directly abut Forrest Circle drain overflow into this drain.

The immediate area around Hunt Street is low lying and prone to flooding. Should redevelopment be proposed, further assessment of the site levels with respect to forecast flood levels and site drainage should be considered.

2.5.2 Sewerage

A new gravity sewer reticulation system has been established in the Town Centre area with much of the old gravity network removed. Whilst some of these works have been completed as part of the Stage 1 (Wise Terrace) and Stage 2 Town Centre Development, future works will see the gravity flows for the majority of this area redirected west along McLarty Boulevard to a proposed pump station to be located near the North West corner of Hamilton Road and McLarty Boulevard.

The new pump station will service the central area of the Town Centre, land to the west of Hamilton Road and planned future residential land south of the Central Area. It will also receive flows from other areas of the existing South Hedland network. It is anticipated that this pump station be completed by the end of 2013 calendar year, thereby enabling planned building development to connect to this service prior to completion of the building phase.

In the northernmost (north of Throssell Road) and easternmost (east of Forrest Circle) areas of the Town Centre, there is an existing gravity sewer reticulation system that services existing lots. The Water Corporation has identified some limitations on the existing system (flat grades and pump station capacity), with some flow redirection works (pumped and gravity) being planned.

2.5.3 Water

A new water reticulation network has been established within the Town Centre as part of the Stage 1 and Stage 2 Town Centre Development works, and has been designed to meet demand based on the previous Town Centre Development Plan. Future works will include expansion and realignment of the reticulation network along McLarty Boulevard and Hamilton Road.

Water source upgrades have been planned by the Water Corporation to ensure water supply is sufficient to meet planned Town Centre growth demands.

2.5.4 Power

A new underground power network is being established within the Town Centre to replace the existing network. Provision has also been made for the expansion of the civic facilities, Aquatic Centre, Hotel sites and high density residential sites. Future planned sites will be served through extension of the underground network with cabling linking around the Central road network.

A new High Voltage (HV) feeder has been brought along Murdoch Drive from the Murdoch Zone substation to feed the Hospital and links to another feeder that extends down Hamilton Road. It is anticipated that an additional feeder will be required from the "Murdoch Zone" substation, to extend down Murdoch Drive and up Collier Drive to service development within the western area around Hamilton Road.

Existing development within the northernmost and easternmost areas of the Town Centre is serviced by an overhead power supply system comprising a High Voltage (HV) and Low Voltage (LV) circuit. The Pilbara Underground Power (PUP) project is scheduled to take place during 2012 and 2013, and will provide for the undergrounding of the existing overhead network.

2.5.5 Telecommunications

Works within the Stage 1 and Stage 2 Town Centre Development have required the relocation of existing Telstra cable and optic fibre network to the new realigned roadways. With the arrival National Broadband Network Company (NBN Co) and changes to the provision of telecommunication services, future development sites with be served under the NBN Co regime.

As part of future redevelopment in the Central precinct ducting and pits will be provided to meet the NBN Co requirements.

There is an existing Telstra network comprising cable and optic fibre servicing existing developments within the northernmost and easternmost areas of the Town Centre. Further liaison with NBN Co. and Telstra will be required to assess the impact of any redevelopment on these networks.

Conceptual pedestrian Bridge - South Hedland Town Centre
(Source LandCorp/Last Pixel)

2.6 **Stakeholder Engagement**

2.6.1 Working Group

As part of the ongoing delivery of key Pilbara Cities initiatives, the Town of Port Hedland and LandCorp meet regularly to consider progress and implementation of the South Hedland Town Centre revitalisation. Key staff from both organisations continue to oversee project delivery.

2.6.2 LandCorp / ToPH Workshop

Following release of a working draft of the SHTCDP in late 2011, informal workshops were held between the Town of Port Hedland and LandCorp on 23 March 2012 and again on 10 October 2012. Chaired jointly by staff from the Town and RPS, the meeting provided a forum to discuss the SHTCDP update, together with key initiatives the Town is undertaking in respect to community and commercial facilities planning. Discussion outcomes from these sessions and subsequent dialogue are reflected in the Development Plan.

2.6.3 South Hedland Youth Space

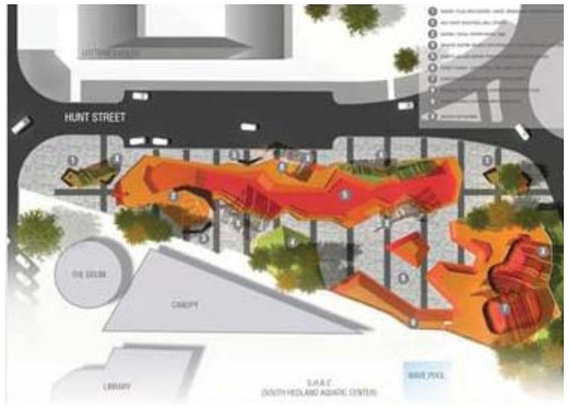
During 2010 and 2011 a range of consultation was undertaken, initially by part of the LandCorp consultant team, and ultimately by Convic Design on behalf of the Town of Port Hedland in regard to the existing South Hedland skate park and youth space.

Workshops were held at the South Hedland skate park, the South Hedland primary schools and Lawson Street Centre seeking feedback and ideas on the future of the skate park and how it relates to the wider changes to the town square and main street developments. This consultation generated the discussion themes, ideas and concerns relating either directly or indirectly to the skate facilities:

- Various improvements needed to skate equipment (rails, stairs, different features);
- Improvements in lighting, shading, fencing, seating etc;
- Opportunities for art features (mural wall, sculpture etc)
- Greater provision of other necessary facilities/ features – e.g. bins, security cameras, toilets, other recreational equipment (playground, basketball etc), bike racks.

The progression of a Skate Park within the integrated community facilities planned area of the SHCC adjoining the Aquatic Centre and Wise Terrace (main street) remains a key element of the Town of Port Hedland's strategic facilities planning and this Development Plan.

The document 'Investing in our future!' prepared for the Town of Port Hedland records the significant community engagement conducted by the Town provides a schematic layout and also a preliminary cost estimate for delivery. The design and location are further discussed in the 'Land Use and Activities' section of Part Two.



Proposed South Hedland Skatepark Design
Source: Town of Port Hedland

2.6.4 Consultation on the 2008 South Hedland Town Centre Development Plan

Through the preparation of the South Hedland Town Centre Development Plan in 2007/8, and subsequent 'Town Park' and 'Main Street' projects, a wide variety of government and business stakeholders, landowners and community interest groups were consulted and engaged with to determine the full range of Town Centre development opportunities and detailed design outcomes.

As an outcome of this consultation and engagement, a number of opportunities and themes were highlighted by nearly all the groups who participated. These issues and opportunities generally fall into the following categories:

- Social and cultural issues – the requirement for greater local cultural attractions (e.g. live theatre, connection to country, cultural art, cultural walks/ interpretation, etc.).
- Parks, Sport and Recreation – the requirement for green spaces (trees and grassed areas) and passive/active recreation areas.
- Housing and Commercial – greater need for medium density housing types, requirement for enhanced retail and commercial offering.
- Street features and facilities – greater provision of pedestrian walkways, signage, bus stops, shaded areas etc. The community generally expressed the need for continuing consultation on the design and development of the town centre and streetscape spaces (e.g. community consultation around the detailed design of the square).
- Other specific issues and opportunities - highlighting issues such as the need for parent's rooms etc.

2.6.4.1 Main Street Location

This 2013 SHTCDP is a refinement of the originally endorsed 2008 Development Plan. As context, and evidence of the original stakeholder consultation, Appendix 4 documents the 'Main Street' options originally contemplated.

A recurring theme throughout the original 2007/8 Development Plan process and stakeholder consultation was a strong desire to develop an area of the Town Centre with a "central focus". The community were clear in their view that this be an important objective for the Centre's growth and for it to generate a sense of ownership by local residents.

Following comprehensive review and discussion of the five options with key stakeholders (including the Town of Port Hedland, LandCorp, community groups and Macquarie Bank), Option 1: Colebatch Way was ultimately determined to have the best potential for success. This option was used as the basis for finalising the 2008 Master Plan layout. Design elements from other options, including Throssell Road, Rason Court and Hamilton Road were also further considered for inclusion.

In addition to the informal consultation carried out through 2007 for the SHTC Development Plan, further targeted community and stakeholder consultation has since been carried out by the Town of Port Hedland, LandCorp and UDLA, considering the public realm elements in further detail.

Since the SHTC Development was released in 2008, significant construction work has been carried out in line with the preferred option, with the Main Street now largely complete (Stage 1). This Development Plan builds upon this success and further reinforces the role and function of the Main Street in the wider Town Centre area.

2.6.4.2 Town Square

The 2008 SHTC Development Plan identified an opportunity to establish the then named 'Centennial Park' as a contemporary town and community square. In late 2009, a series of workshops were held with the South Hedland Town Centre Community Design Reference Group to develop a concept plan for a new Town Square.

The following were key requirements/wishes for the South Hedland Town Centre and are quoted directly from the final feedback minutes on the community design facilitation process:

1. Water - whether recycled, referenced or implied including misters, jets and water play;
2. Lighting - security and CPTED principles, evening activity;
3. Seating - variety of seating / gathering spaces; informal, benches, grass mounding, terrace steps and urban edges;
4. Event Space/Recreation - multi-use and flexible event space, seating and viewing, market space, improved toilets / parenting rooms, evening events and activity;
5. Art - recognising cultural and social diversity and heritage through local art and interpretation opportunities interactive, unique to the Hedland environment and cultural context, integrated with open space amenity shade structures, arbours, water, seating, paving, walls, ephemeral;
6. Shade - combination of trees, shade structures and built form, adaptable to seasonal variation;
7. Materiality - light coloured materials to minimise the heat sink effect, light coloured gravels as a practical contrast to lawn, earthy materials to respond to the Pilbara Landscape, use of soft organic shapes within the urban context;
8. Climate - use of traditional cooling methods such as allowing for breezes and bough shelter structures, limit use of dark colours and heavy heat sink materials.

Responding to these elements, a number of design options were developed and a preferred concept subsequently chosen. Ultimately, LandCorp, the Town of Port Hedland and the Pilbara Cities office have overseen what is now a new Town Park.

2.6.4.3 Streetscape Improvements

Community stakeholders considered a range of opportunities to improve Town Centre streetscapes, particularly along the new Main Street (formerly Colebatch Way, now Wise Terrace) and approaches, making them more user friendly and pleasant to view. This work, coordinated through UDLA as the project's Landscape Architect's discussed a range of priorities for improvement:

- More sitting areas, particularly in shaded locations;
- Generally more shade cover in public spaces and at bus stops;
- Opportunities for public art, murals on public buildings etc;
- Signage improvements (themes, banners etc)
- Improved lighting in public spaces;
- Greater provision of cycle ways, and better conceived footpaths routes.

2.6.4.4 Community and Public Art

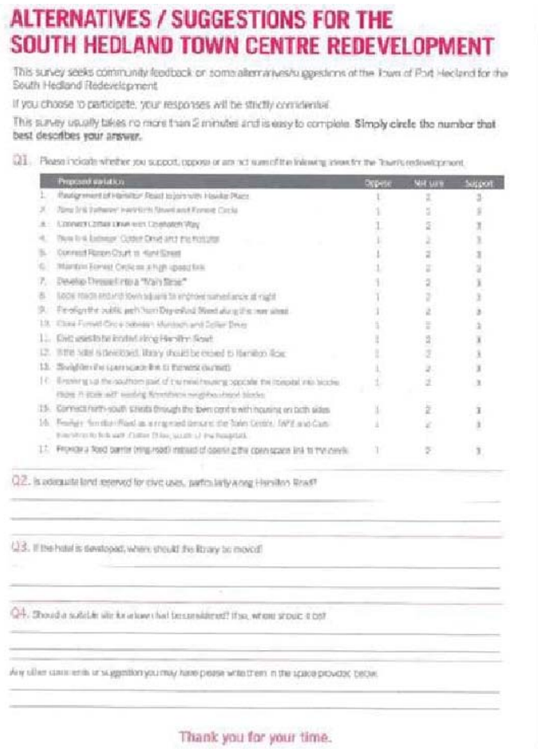
As part of the South Hedland Town Centre Community Art Programme, UDLA and LandCorp invited a range of community organisations, artists and teachers to attend a series of workshops and forums aimed at developing ideas for local artworks. This ultimately led to a range of initiatives including the use of local artist designs in detailed shade elements along the new Wise Terrace. This is further discussed in the 'Public Realm' section of Part Two.

2.6.5 Formal 2008 Community Consultation

The Town of Port Hedland adopted the South Hedland Town Centre Development Plan for formal advertising in accordance with TPS5 at its meeting of 26 March 2008 for a period of 30 days.

Following this, the following formal community consultation process was undertaken:

- 7-8 April 2008: All owners and tenants of land and/or shops were written to and provided with a copy of the proposed Development Plan and possible amendments, along with an invitation to the 10 April workshops and shopping centre display;
- 15-19 April 2008 – letter box deliveries to all South Hedland residents (see extract below);



ALTERNATIVES / SUGGESTIONS FOR THE SOUTH HEDLAND TOWN CENTRE REDEVELOPMENT

This survey seeks community feedback on some alternatives/suggestions of the Town of Port Hedland for the South Hedland Redevelopment.

If you choose to participate, your responses will be strictly confidential.

This survey usually takes no more than 2 minutes and is easy to complete. **Simply circle the number that best describes your answer.**

Q1. Please indicate whether you support, oppose or are not sure of the following ideas for the Town's redevelopment.

Proposed initiative	Oppose	Not sure	Support
1. Realignment of Hamilton Road to join with Hawke Place	1	2	3
2. New link between Hamilton Street and Forrest Circle	1	2	3
3. Connect Cottan Drive with Colebatch Way	1	2	3
4. New link between Cotton Drive and the Hospital	1	2	3
5. Connect Rippon Court to Hunt Street	1	2	3
6. Maintain Forrest Circle as a high speed link	1	2	3
7. Develop Throssell into a "Main Street"	1	2	3
8. Block roads around town square to improve safety at night	1	2	3
9. Realign the public path from Dagmar Road along the new street	1	2	3
10. Close Forrest Circle between Murdoch and Cotton Drive	1	2	3
11. Civic uses to be located along Hamilton Street	1	2	3
12. If the hotel is developed, library should be moved to Hamilton Road	1	2	3
13. Realign the open space link to the west (curved)	1	2	3
14. Rezoning up the southern part of the west housing opposite the hospital into blocks more in scale with existing Kimberley neighbourhood blocks	1	2	3
15. Connect north-south streets through the town centre with housing on both sides	1	2	3
16. Realign Tambrey Road as a ring road between the Town Centre, TAFE and Civic precincts to link with Cotton Drive, south of the hospital	1	2	3
17. Provide a flood barrier (ring road) instead of open space link to the creek	1	2	3

Q2. Is adequate land reserved for civic uses, particularly along Hamilton Road?

Q3. If the hotel is developed, where should the library be moved?

Q4. Should a suitable site for a town hall be considered? If so, where should it be?

Any other comments or suggestion you may have please write them in the space provided below.

Thank you for your time.

- 8 May 2008 – Community workshops with staff in attendance from both LandCorp and Town of Port Hedland;
- 13 May 2008 – Discussions with Care for Hedland Environmental Association inc.

19 submissions were ultimately received during the advertising period. From this, along with general workshop feedback, Town of Port Hedland staff confirmed the community were supportive of the plans for the Town Centre.

At its meeting of 28 May 2008, the Town of Port Hedland Council resolved to adopt the SHTC Development Plan for final approval.

This revision to the Town Centre Development Plan reflects subsequent wider consultation with the Port and South Hedland Community through the strategic 'Pilbara's Port City Growth Plan' process. The document's content has been refined with this in mind, and on the basis that formal advertising of the plan will again be undertaken prior to final adoption.

3.0 SHTC DEVELOPMENT PLAN REQUIREMENTS

3.1 Vision and Objectives

The SHTCDP area aligns with the Pilbara's Port City Growth Plan Precinct 11 ('City Centre'). The Growth Plan's vision for the Town Centre is that of:

"a dynamic, accessible and inclusive place that is the heart of the South Hedland community and the major regional centre of our City of 50,000 people. It is an exciting destination for visitors, business people and residents. It has great public spaces, friendly streets, landmark buildings and architecture. There are many influences through public art and space of our strong association with indigenous heritage and natural landscape. Like many destinations throughout Pilbara's Port City, culture and social destinations are woven into our City Centre".

This vision has been adopted in preparing the SHTCDP and is reflective of the aspirations of the community for a major regional centre that is accessible to all, providing a range of services and amenities consummate for a regional population of 50,000 people.

The key objectives for the SHTCDP relate to ultimately facilitating positive experiences for greater numbers of visitors and permanent residents by:

1. Providing a tangible Town Centre focal point or 'hub' of activity where people can meet and interact on an organised or chance basis and which supports a variety of services and functions;
2. Providing stronger pedestrian / cyclist and vehicular connections into the Town Centre making the task of travel to/from more convenient;
3. Providing shaded pedestrian walkways and open areas in an attractive setting within the Town Centre that encourage people to remain and spend time;
4. Introducing a greater permanent residential population through the release of a variety of medium and higher density housing types reflective of a Town Centre location;
5. Providing a logical program for the redevelopment of available existing land the future release of vacant land with an overall vision of a more vibrant place to live, work and recreate;
6. Recognising demands for short-stay and tourism with the release of land for accommodation, entertainment and related uses.

3.2 Planning Principles

A number of guiding urban design and planning principles have been developed in line with the view of creating a dynamic, accessible and inclusive regional centre, including:

- Improved connections to the suburban and natural surroundings of South Hedland;
- Improved walk-ability within and to the Town Centre core;
- A rich and diverse set of public areas, both active streetscapes and walkways;
- A strong mix of residential, retail and offices;
- Places for recreational activity in civic spaces and new open space areas;
- Housing choice for a variety of incomes and ages;
- High degree of legibility building on the existing street network;
- High levels of passive surveillance of public areas through buildings addressing the street;
- Recognition of the existing linkages to the landscape;
- Strengthen the medical precinct by promoting mixed use development adjacent to the hospital;
- Increased residential densities close to the Town Centre encouraging pedestrian movement.

3.3 SHTCDP Elements

The SHTCDP represents a compilation of the essential elements that comprise a Town Centre. These elements have been considered across the Town Centre as a whole and within five identified precincts that make up the spatial extent of the Town Centre.

The plan provides the coordination of these elements so as to achieve the plan vision and objectives.

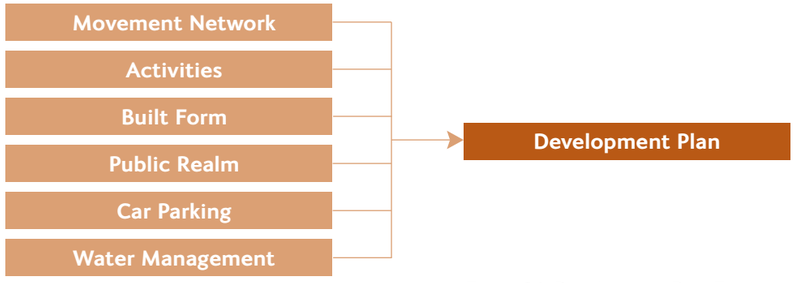


Figure 24: Development Plan Elements

In broad terms, the SHTCDP provides for the coordination of elements including:

Movement Network: setting out the functional arrangements for the street system, public transport options, pedestrian movement areas and cycling routes.

Land Use & Activities: identification of the optimal land uses and associated development opportunities.

Built Form: preferred design standards for development addressing aspects such as gateway entry statements, iconic sites, active edge/building setbacks, integration with public spaces, height and intensity.

Public Realm: location of key public places for recreation, informal meeting or gathering offering amenity and identity, and fostering a sense of local community.

Car Parking: arrangements for the provision of public and private parking facilities ensuring a functional Town Centre.

Water Management: providing for safe stormwater run-off from hard stand and built areas, making provision for overland flow paths.

3.4 **Development Plan Precincts**

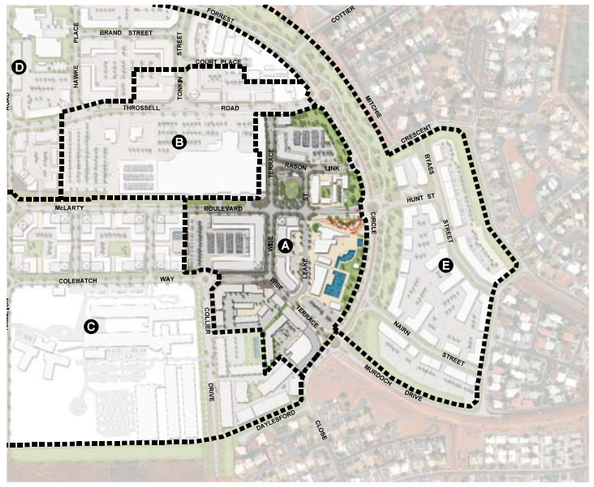
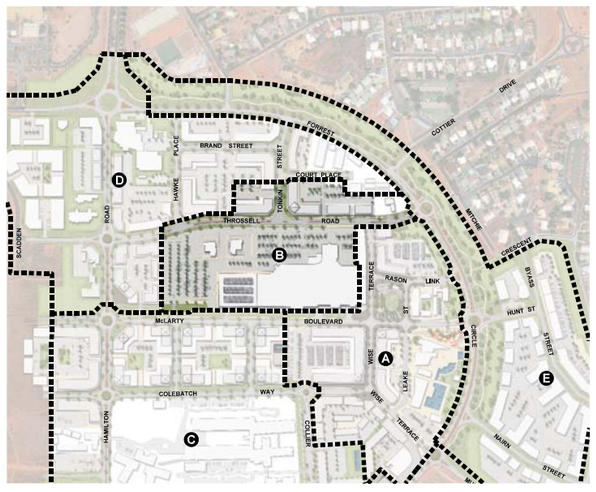
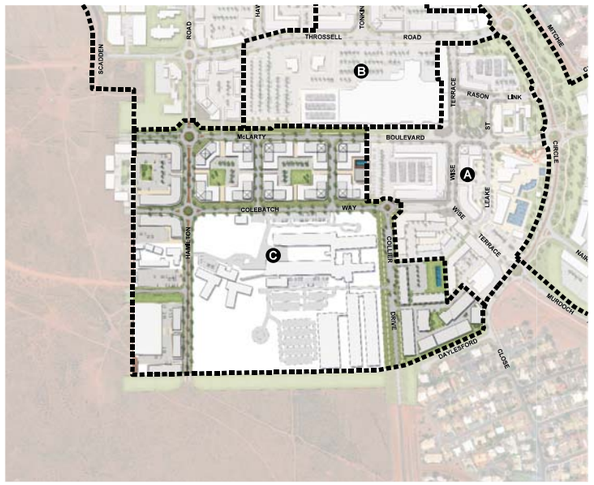
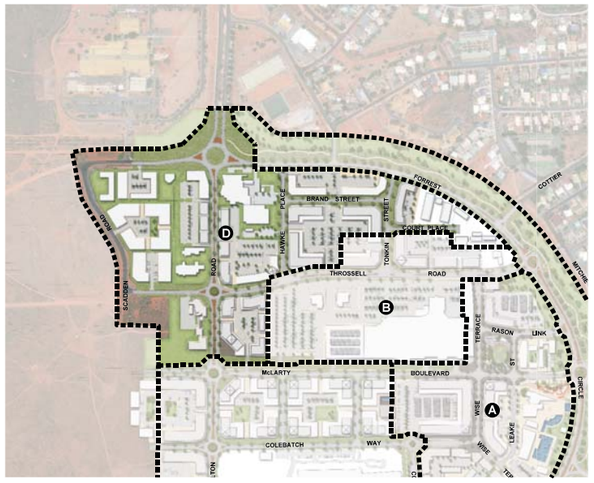
The SHTCDP comprises five precincts. These precincts assist in spatially communicating the Town Centre vision. The establishment of the precincts evolved from a review of land use, activity and the previous 2008 Development Plan and is further explained in Section 3.6.

The five precincts recognise key areas of existing and proposed activity, and highlight areas of focus within the SHTCDP area:

The relationship between the “elements” of the SHTCDP and the “precincts” of the SHTCDP is summarised in Table 3:

An illustration of the Town Centre vision incorporating these elements is included at Figure 25.

The arrangements of the SHTCDP are designed to guide decisions on the design and implementation of public works, assist the preparation of development proposals for individual sites and guide the decisions of the Town of Port Hedland in approving applications.

Precinct A – ‘Main Street & Community Hub’	Precinct A is the main street centre and community hub of the South Hedland Town Centre. The principal objectives are to create an active north-south main street which integrates the shopping centre and enhanced town park; and to facilitate the delivery of entertainment and community facilities including skate park, aquatic centre and library – all ensuring a vibrant, highly active place.	
Precinct B – ‘Boulevard Retail’	Precinct B is a retail mixed use environment, reflecting both existing development and providing for further reuse and intensification. Office, commercial and residential uses are encouraged in addition to the primary retail. As Throssell Road still serves a strong east-west movement role, the precinct signifies a change in environment from higher volume roads such Hamilton Road or Forrest Circle, while stopping short of the reduced setbacks and pedestrian based Wise Terrace environment.	
Precinct C – ‘Health Services & Residential’	Precinct C is located at the southern edge of the SHTC and encompasses the existing regional hospital and surrounds. The precinct’s primary objective is to deliver higher density mixed use development within the SHTC that draws on its location in proximity to the hospital (health services) and demand for ground floor office/ commercial.	
Precinct D – ‘Northern Commercial Gateway’	Precinct D is located at the northern entry to the SHTC and comprises the commercial gateway either via Hamilton Road (primary) or via the locally used Tonkin Street. The precinct allows for office / commercial and similar uses while encouraging mixed use residential. The precinct provides a focus area for business investment and expansion, together with Precinct C.	
Precinct E – ‘Eastern Commercial Gateway’	Precinct E is located to the east of Forrest Circle and has been incorporated into the SHTC in reflection of its similar pattern of land use and future redevelopment potential. The precinct forms the eastern commercial gateway with showrooms and commercial uses encouraged.	

South Hedland Town Centre Development Plan Precincts	South Hedland Centre Development Plan Elements					
	Movement Network:	Land Use & Activities:	Built Form:	Public Realm:	Car Parking:	Water Mgt:
Precinct A – ‘Main Street & Community Hub’	Highly pedestrian oriented safe walking environment, with reduced traffic speeds.	Key community, entertainment and pedestrian based retail activities for the Town Centre. Supports community events and is the primary ‘hub’ of activity.	Primary consideration as demonstration of scale, materials usage, street activation.	Primary consideration as public ‘face’ of the Town Centre. Incorporate elements of shade, art, local materials, seating, lighting and the like. Private and public development should reflect.	As a highly active precinct a mix of on and off-street parking as well as taxi, motorcycle and varied term bays to be available.	Areas allocated to both provide attractive setting and provide significant stormwater management function
Precinct B – ‘Boulevard Retail ’	Strong east-west traffic link retained, with safe pedestrian crossings and public transport route provision.	Car based retail offerings reflecting both the existing pattern of development and potential redevelopment.	Important consideration, acknowledging more car-based development pattern.	Important consideration for the continued activation and safe use of Throsselll Road.	Strong off-street parking provision through public parking or on-site provided.	East-West linear connection provided on southern edge of precinct
Precinct C – ‘Health Services & Residential’	Incorporates potential longer term western entry and continuation of north-south Hamilton link. Introduces new north-south link roads to improve Town Centre permeability.	Main strategic high density mixed use development in proximity to activity drivers of Hospital, Main Street and Shopping Centre. Significant opportunity for ground floor activation via cafe/restaurant/ retail, medical suites/services and commercial/ office uses.	Primary consideration to ensure street level activation and future proofing of ground floor uses.	Primary consideration as an extension of Main Street themes and safe and interesting street level environs on established McLarty and Colebatch as well as cross streets. Private development should reflect.	Strong on-street parking provision where appropriate to support ground floor street activation, business investment and visitor use.	Key East-West linkages provided in Mclarty and Colebatch to assist westerly flow paths
Precinct D – ‘Northern Commercial Gateway’	Northern Gateway into Town Centre from Hamilton and Forrest/Tonkin.	Landmark commercial / office or civic development sites at Hamilton / Throssell offer opportunity to ‘gateway’ northern entry.	Important consideration in potential landmark gateway development sites	Car oriented public environment, should reflect gateway role and therefore sense of entry to Town Centre.	Primarily on-site parking.	Accommodated on-site within existing use. Overland link provided west of Hamilton
Precinct E – ‘Eastern Commercial Gateway’	Eastern link to Town Centre is highly accessible from residential road network and serviced by bus route. Primarily on-site parking. Access improved via new Hunt Street connection.	Opportunity for redevelopment of established commercial/retail uses as part of integrated Town Centre plan. Offer larger footprint bulky goods uses as periphery retail.	Consider as part of development with respect to safety and surveillance	Streetscape and public spaces should integrate the precinct with the wider Town Centre and the Forrest Circle landscape corridor.	Primarily on-site parking.	Accommodated on-site within existing use. Upgrades with Hunt link and adjoining Forrest Circle rework

Table 4: Development Plan Elements Analysis by Precinct

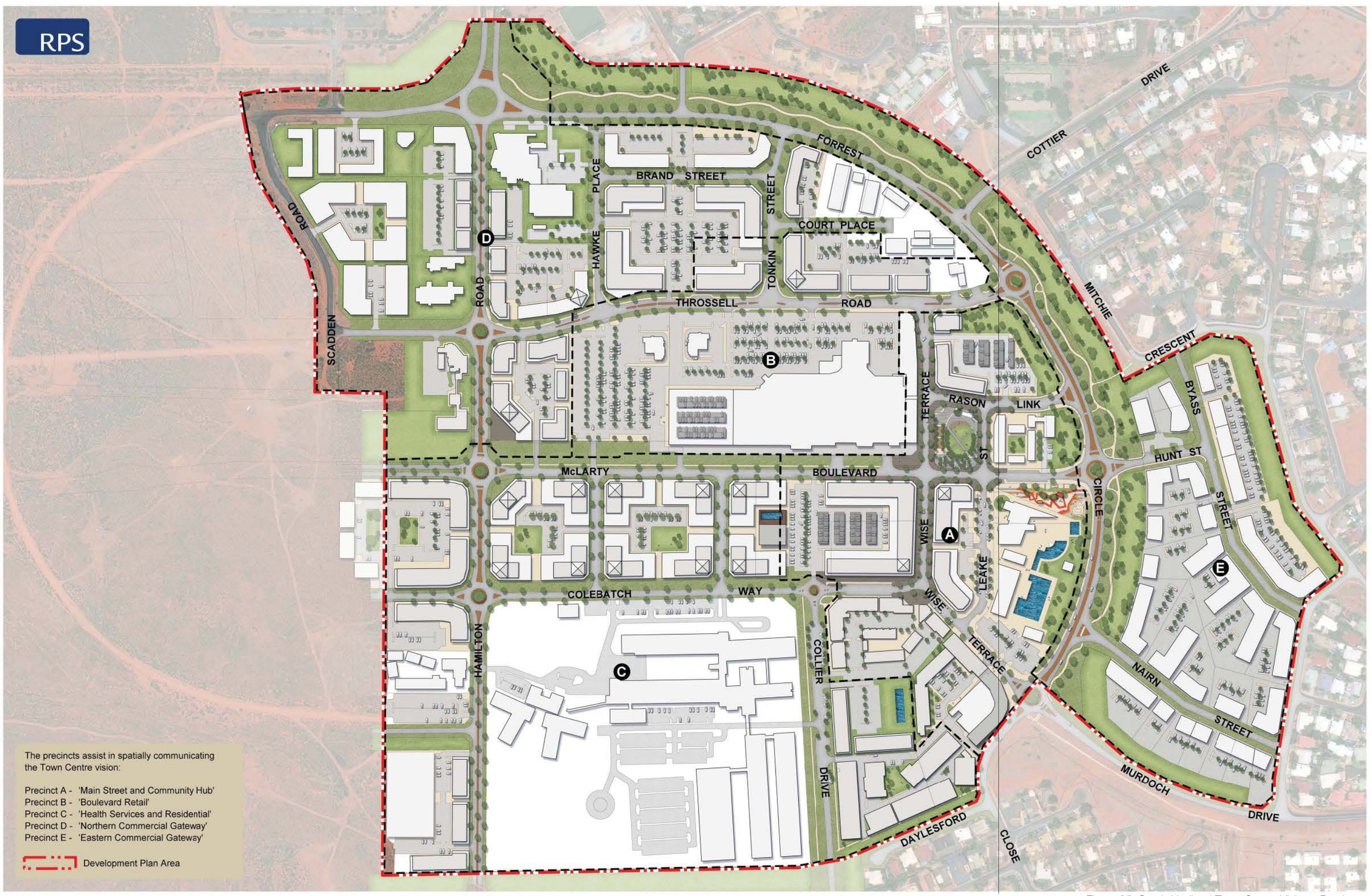


Figure 25: South Hedland Town Centre Vision - Precincts

3.5 **Movement Network**

3.5.1 Summary

The road network for the Town Centre is designed to achieve a high level of permeability of traffic flow as well as encouraging pedestrian movement and activities in front of and between adjoining developments. This includes improving the connectivity between the adjoining residential area and the Town Centre.

Underpinning the design of the road network is a requirement to achieve a high level of serviceability - that is, minimal delays in traffic movements due to volumes of traffic. The design also ensures intersections operate safely without any significant delays or queuing. The movement network draws on a separate study completed by Porter Consulting (2012) Appendix 5.

In preparing a traffic model for the Town Centre, the locations for property access from Hamilton Road are assumed to be restricted or minimised. The model also anticipates future development to the western and southern sections of the Town Centre to largely circulate around the Town Centre, though the role of Hamilton Road will naturally increase.

Pedestrian movements are encouraged through pathways utilising the permeable road network. This is supported by a parking strategy providing centralised parking facilities.

3.5.2 Key Elements

3.5.2.1 Road Network

The SHTCDP incorporates a hierarchy of road categories reflective of the Porter Consulting Transport Assessment. All roads provide for two-way vehicle movements. The road network, road hierarchy and recommended reserve widths are identified in Figure 26.

Figure 26: Road Hierarchy and Recommended Reserve Widths (Source: Porter Consulting 2012)

To provide a street environment that reflects the intensity of development anticipated by the SHTCDP and is conducive to pedestrian use, restricted speeds down to 40 km/h are recommended. The speed zone areas are depicted in Figure 27.

The basis of the traffic modelling and proposed road network changes is included at Appendix 5 - South Hedland Town Centre Transport Assessment. The report identifies recommended cross sections depicting, as appropriate, verge requirements (including drainage swales), parking embayments, carriageway widths and median requirements. Recommended intersection controls are also stipulated.

3.5.2.2 Path Network

Pedestrian and cyclist movements are encouraged through a combination of shared use paths and pedestrian links that take advantage of the permeable road network. The network is depicted at Figure 28. Share paths are typically 2.5m wide whereas pedestrian paths are generally 2.0m wide in areas of higher pedestrian use.

In the Town Centre, it is more practical to fully pave verge areas as this offers greater opportunity for pedestrian interaction between the street and property related activity. These areas can be complemented with street landscaping, providing shade and amenity.

The SHTCDP anticipates that landscaping and street furniture will incorporate opportunities for both pedestrian and cyclists including bicycle parking to encourage greater use.

Figure 27: Speed zones (Source: Porter Consulting 2012)

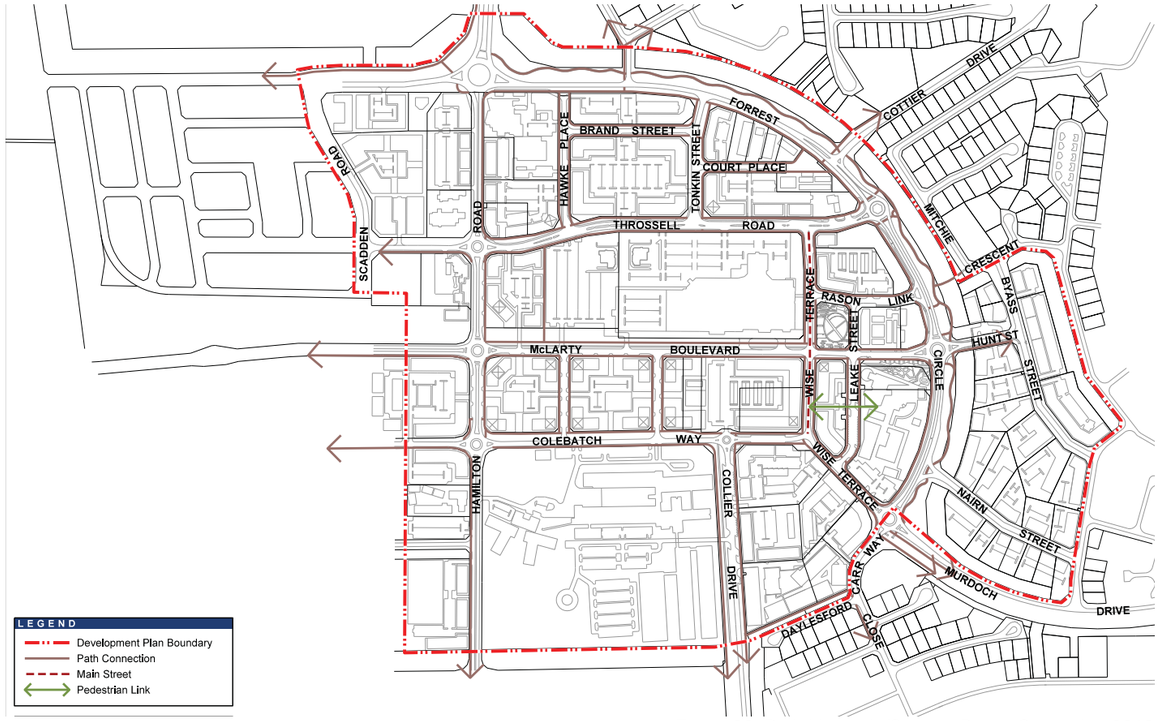


Figure 28: Path Network (Source: Porter Consulting 2012

Figure 29: Town Centre Bus Routes (Source: Porter Consulting 2012)

3.5.2.3 Public Transport

With the construction of new roads and increased development within the SHTC as proposed by the SHTCDP the level of service offered by existing bus routes can be enhanced. A suggested medium term expansion to the existing route is shown at Figure 29.

In the longer term, further changes to bus routes will be required as residential land development extends further south and south-west from the Town Centre. Taking account of this future development, a long term bus route is also identified. Full details are contained within the Porter Consulting report comprising Appendix 5.

3.6 **Land Use & Activities**

3.6.1 Summary

Increasing diversity and vibrancy will enable the transition of the existing centre into an attractive, functional and efficient Town Centre. This requires the introduction of activities, land uses and built form that provide street based pedestrian activity and create an interesting sense of place.

Analysis of the existing patterns of land use, and a detailed review of the 2008 Development Plan was undertaken in developing this document. Currently, the Town Centre is dominated by vehicular based movement and land use (e.g. existing shopping centre) and continues to suffer from a lack of people and pedestrian activity. Climatic conditions can contribute towards a preference in travel and land use, so it is a both challenge and an opportunity for the Town Centre to create a pattern of land use and public realm that responds to climate, and is both interesting and reflective of its community.

Leveraging off major existing land uses, through the identification of “Precincts” assists in establishing a rationale for the inclusion of a greater variety of land use, residential density and built form outcomes. It also provides a simple basis upon which to communicate the vision. The Precincts contained within the Development Plan are described in the following section and were borne out of a review of what the Town Centre’s “framework” might comprise. Figure 30 shows the Framework Sketch used to review and define general areas of activity and potential use – ultimately leading to the setting of the Development Plan Precincts discussed earlier in Section 3.4.

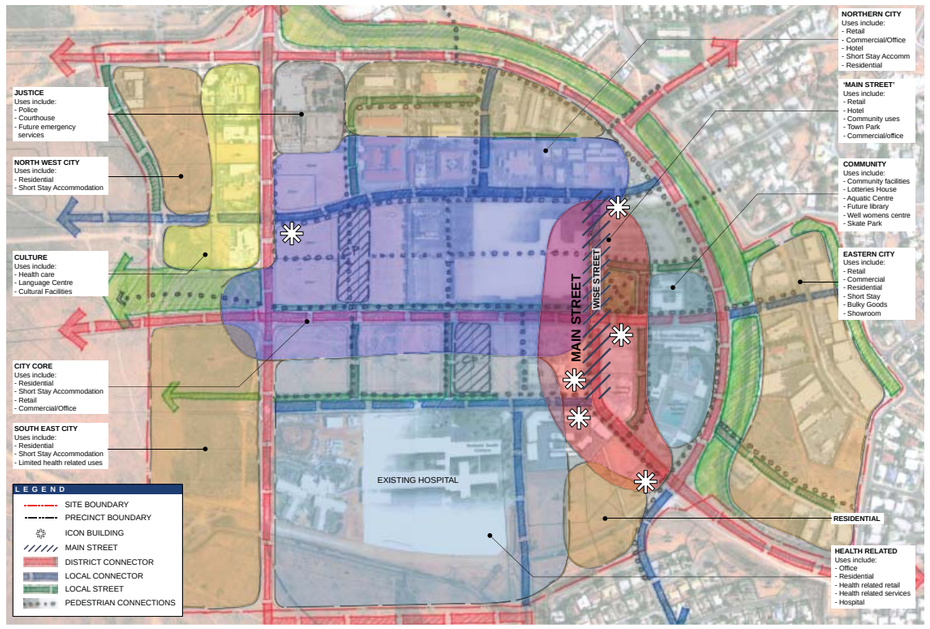


Figure 30: Indicative Framework Plan

3.6.2 Precinct A – 'Main Street & Community Hub'

Precinct A comprises the main street centre and community hub of the South Hedland Town Centre. The principal objectives are to create an active north-south main street which integrates the shopping centre and enhanced town park; and to facilitate the delivery of an associated community hub of facilities.

Implementation of Precinct A formed the focus of public works undertaken since the 2008 Development Plan and has seen significant construction in and around Wise Terrace and the new Town Square. The subsequent phases of work in this precinct are planned to now include investment by the Town of Port Hedland in facilities and services that will support the community, following Council's endorsement of plans to:

- Stage 1: Upgrade of South Hedland Aquatic Centre (SHAC);
- Stage 2: Develop the South Hedland Youth Space (including Skate Park)
- Stage 3: Upgrade Lotteries House and co-locate the Hedland Well Women's Centre (HWWC)
- Stage 4: Develop Main Building Facilities as part of the

It is important to note that, consistent with the intent of this Development Plan, Council's Library & Community Facilities Feasibility Business Plan (2012) suggests:

"Analysis and research as part of this project has revealed the opportunity to create a strong "Community Hub" in South Hedland Town Centre. A Community Hub has been defined as:

A conveniently located public place that is recognised and valued in the local community as a safe gathering place for people and an access point for a wide range of community activities, programs and events.

A Community Hub can be either contained in one multi-purpose facility or in a cluster of facilities. In the case of South Hedland, the Library, Lotteries House, HWWC, Town Centre Park and youth space/skate park and SHAC will form a cluster of facilities which will satisfy the above definition." (p16, 2012)

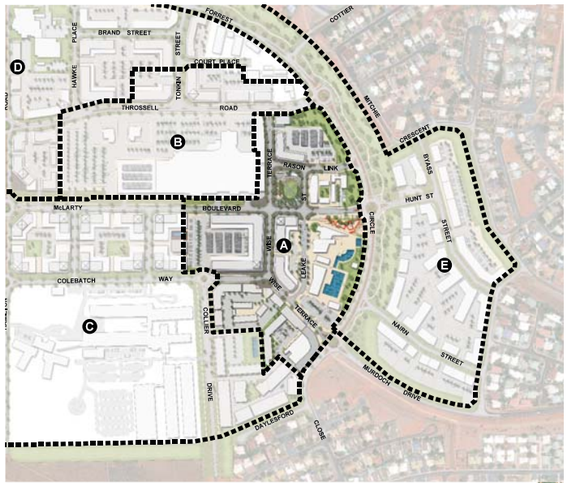


Figure 31: Precinct A – 'Main Street & Community Hub'

Key land use and development considerations within Precinct A comprise:

(a) Main Street: The Wise Terrace Main Street comprises two street sections north and south of Colebatch Way of 320m and 150m in length respectively. As a heavily pedestrian based environment parking along the main street is limited to 8 parallel taxi bays and 12 parallel limited (2 hour) parking bays.

The main street cross-section encompasses a tightening of the urban space to improve the pedestrian environment, slow traffic and integrate development with the street. Street planting and shade structures have also been constructed.

(b) External Shopping Centre Tenancies: Design of the new Main Street under the Development Plan provided for the sleeving of new Main Street retail tenancies as a key element to bring people and activity to Wise Terrace. Development south of the shopping centre on both sides of Wise Terrace should be encouraged to follow a similar pattern of active uses and built form that relates to the street.

(c) Eastern Main Street Development Site: A landmark area east Main Street and opposite the Town Park is identified within the Master Plan. The site is recognised as providing much-needed accommodation, together with additional main street retail and commercial uses. The introduction of a hotel or short-stay accommodation and the introduction of additional people in this location is considered an important outcome for the precinct.

(d) Pilbara Health Site: The Development Plan proposes the ultimate relocation and redevelopment of the Pilbara Health site at the key intersection of Colebatch Way and Wise Terrace. Potentially delivering a prominent landmark development addressing the Main Street, this site is also earmarked to provide one of three areas of public parking under the Development Plan. With opportunities to promote retail, mixed use and entertainment uses in this location, the integrated development of the land with Wise Terrace and public parking provision will serve the Town Centre and Precinct A particularly.

3.6.3 Precinct B – 'Boulevard Retail'

Precinct B is a retail mixed use environment, reflecting both existing development and providing for further reuse and intensification. Office, commercial and residential uses are encouraged in addition to primary retail. As Throssell Road still serves a strong east-west movement, the precinct signifies a change in environment from higher volume roads such Hamilton Road or Forrest Circle, while stopping short of the reduced setbacks and pedestrian based Wise Terrace environment.

Key land use and development considerations within Precinct B comprise:

(a) Shopping Centre: redevelopment or expansion of this key land use within the Town Centre should be encourage to provide a stronger relationship to Throssell Road through prominent centre entry points and increasing external shopfronts where possible. Opportunities for mixed use development that will increase activity as well as safety and surveillance should be encouraged. Provision of parking, as a key Town Centre use, should remain in line with TPS5 and Council Parking Policy requirements;

(b) Public Parking: the Development Plan recognises the findings of the Parking Strategy (Appendix 5) in identifying a future public parking area within the precinct. The timing of partial or complete at grade construction of bays should reflect the recommendations of the Parking Strategy with regard to demand, larger development triggers, and the ongoing review of parking supply;

(c) North of Throssell Road: opportunities for upgrade or redevelopment of individual sites on the northern frontage to Throssell Road should be encouraged to provide a high standard or street front presence with strong landscape elements, integrated signage, shading and lighting that continue the Main Street features and character into the wider Town Centre area.

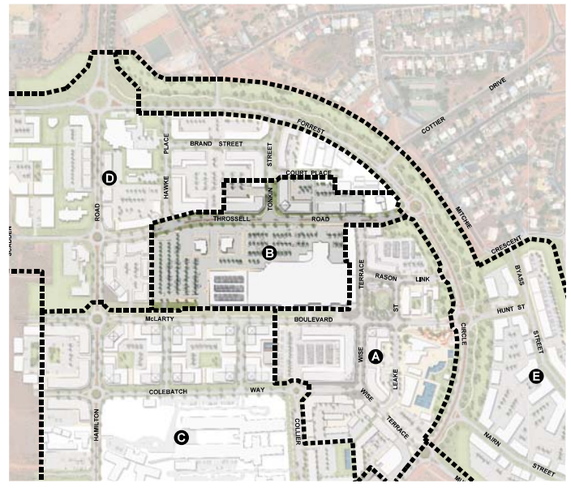


Figure 32: Precinct B – 'Boulevard Retail'

3.6.4 Precinct C – 'Health Services & Residential'

Precinct C is located at the southern edge of the SHTC and encompasses the existing regional hospital and surrounds. The precinct's primary objective is to deliver higher density mixed use development within the SHTC that draws on its location in proximity to the hospital (health services) and demand for ground floor office/ commercial.

Ultimately as the Town Centre matures, it is this precinct that will offer additional ground floor activity beyond the established Main Street environs. The design and development of land within the precinct should therefore be 'future proof' with respect to ground floor use.

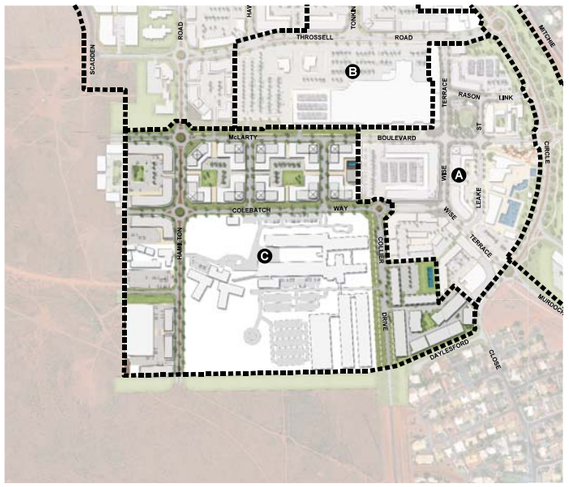


Figure 33: Precinct C – 'Health Services & Residential'

Key land use and development considerations within Precinct C comprise:

(a) Colebatch Way Mixed Use Development Site: The land parcels bounded by Hamilton Road, McLarty Boulevard, the former Pilbara Health Site, and Colebatch Way comprise the most strategic sites within the SHTC along with the former Pilbara Health site. They are well located relative to the Shopping Centre, Hospital and Main Street and highly accessible.

An urban economics review of the development opportunity for this location suggests:

- An ideal location for flexible ground-floor based commercial business floorspace. The majority of demand for additional commercial floorspace within the SHTC over the next decade and beyond should be accommodated on these sites;
- Proximity to health facilities will drive demand for medical suites, over and above normal commercial office floorspace. The delivery of medical suites on the Colebatch Way frontages particularly will enhance the viability of core commercial office uses by providing an anchor tenant.
- The introduction of higher density residential development in these locations will increase Town Centre activity and help support cafe and convenience retail offering in the medium term. This should be considered to the west where relative distance from the Main Street is achieved.
- The concentration of office based employment and proximity to health facilities would support the inclusion in time of a 60-80 room short-stay hotel, oriented to servicing business. Considerations of central location and walkability for visitors need to be taken into account.
- In addition to upper levels of residential development in any mixed use proposal, ground floor residential uses would be suited to the internal cross-streets between McLarty Boulevard and Colebatch Way where active street fronts are a lesser expectation.

(b) Tertiary Facility: An opportunity exists to accommodate a Tertiary Facility within the Town Centre, should the opportunity be taken up by a University or other institution. The location west of Hamilton between McLarty Boulevard and Colebatch Way is seen as well suited. In close proximity to the active uses of the Town Centre, Pilbara Tafe and the opportunity of support residential and short-stay accommodation such as use would add to the active Town Centre.

(c) Hospital: The South Hedland Hospital site is recognised within the Development Plan, together with the opportunity for southern expansion and realignment of existing drain and road reservations. The extent of this southern expansion area is consistent with planning being undertaken for the wider "Western Edge" area to the south and west of the Hospital site.

(d) Open Space: Corridors within the precinct are identified within the Development Plan that, once formally constructed, will play a pedestrian connectivity/ landscape amenity role as well as form part of the wider Water Management planning recommendations of the Local Water Management Strategy (Appendix 1).

(e) Collier Drive and Hamilton Road Development Sites: Identified as Mixed Use – Residential / Commercial these sites are recognised as playing an important role in delivering permanent residential accommodation within the Town Centre in proximity to the Main Street activity and Hospital. The sites are recognised as potentially accommodating commercial elements, while forming the transition between the Town Centre proper and the adjoining residential areas.

(f) Hamilton Road: The role of Hamilton as a key north-south connection, gateway to the Town, and ultimately western edge of activity is recognised in the planning for this street. The design and function of Hamilton Road is reflected in road widening and intersection land requirements reflected in the Development Plan. Where appropriate some on-street parking is provided for as part of the road reservation planning.

3.6.5 Precinct D – 'Northern Commercial Gateway'

Precinct D is located at the northern entry to the SHTC and comprises the commercial gateway either via Hamilton Road (primary) or via the locally used Tonkin Street. The precinct is recognised as having an established pattern of development, while the Development Plan is flexible in allowing for redevelopment. The precinct provides a focus area for medium term business investment and expansion, together with Precinct C.

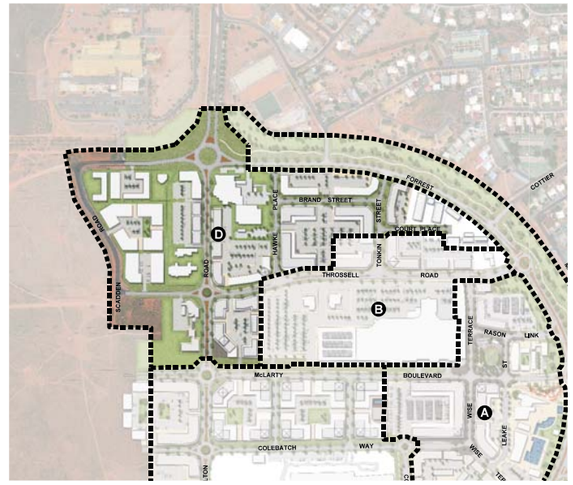


Figure 34: Precinct D – 'Northern Commercial Gateway'

Key land use and development considerations within Precinct D comprise:

(a) Justice Precinct and adjoining land: Land at the entry to South Hedland bounded by Forrest Circle, Hamilton Road, Throssell Road and Hawke Place is currently developed with the Police facilities and Courthouse. The Development Plan recognises the opportunity that exists to deliver a landmark development adjoining these uses at the entry to the Town Centre, fronting Throssell Road. The location should accommodate a development of high quality built form that address the adjoining prominent Hamilton Road intersection.

(b) Wangka Maya: The Pilbara Aboriginal Language Centre at the intersection of Hamilton Road and Throssell Road is important as a catalyst for further adjoining use and development. The Centre's prominent architectural style evokes the Pilbara and is important in reflecting local character within the Town Centre. As an important place of learning and research the Centre provides a tangible Town Centre link to Cultural Heritage. Opportunities to further develop the Town's links to its Cultural Heritage in this location should be encouraged.

(c) Scadden Road Residential: This location is recognised as providing a fringing residential role, able to support medium density residential development on the edge of the Town Centre and as a transition to the planned residential areas to the west.

(d) Existing Commercial: The established pattern of development on Tonkin, Brand, and Court streets is recognised by the Development Plan. While the Master Plan provides a conceptual model of redevelopment within this area, it is acknowledged that the land holdings will ultimately redevelop at the discretion of private landowners. Nevertheless, opportunities for coordinated redevelopment, and through this process, the introduction of mixed use development reflecting the Town Centre objectives should be encouraged.

3.6.6 Precinct E – 'Eastern Commercial Gateway'

Precinct E is located to the east of Forrest Circle and has been incorporated into the SHTC in reflection of its similar pattern of land use and future redevelopment potential. An important outcome of the Pilbara's Port City Growth Plan process, this area was recognised as forming part of what should be planned as the wider Town Centre. The precinct forms the eastern commercial gateway to the Town Centre with showrooms and commercial uses encouraged. Connectivity to the Main Street and Community Hub has been strengthened through the 2008 Development Plan work resulting in the direct connection of Hunt Street now constructed.

Key land use and development considerations within Precinct D comprise:

(a) Existing Commercial: The established pattern of development on Hunt, Byass and Nairn Street is recognised by the Development Plan. While the Development Plan provides a conceptual model of redevelopment within this area, it is acknowledged that the land holdings will ultimately redevelop at the discretion of private landowners. Nevertheless, opportunities for coordinated redevelopment, and through this process, the introduction of mixed use development reflecting the Town Centre objectives should be encouraged.

Figure 35: Precinct E – 'Eastern Commercial Gateway'

3.6.7 Residential Density and Mixed Use Development

The SHTCDP advocates significant medium and high density residential development throughout the Town Centre, together with areas of mixed used that will add to the revitalisation of South Hedland by bringing significant numbers of people into the core.

The inclusion of strong residential components also facilitates housing alternatives in areas of high amenity. Residential density codings within Precinct C of the SHTCDP is shown as a minimum (R80) and maximum (R160) to ensure the underdevelopment of sites for the longer term is avoided and the sustainable growth of the Town Centre through the introduction of local residents is achieved. Similarly, to provide appropriate scale and ratio of development, a maximum density code of R80 is shown for the balance of the SHTCDP area.

At the southern end of Wise Terrace is a mixed use development which draws on the land's location at the end of the main street, and opposite the hospital, it will encourage ground level retail and office within R80 type development. Typical R80 development of 4 storeys is envisaged at key nodes (end of Main Street) reducing to an average of R50 development adjoining the established residential neighbourhood.


Figure 36: Example of Mixed Use Development

Figure 37: Detail of Mixed Use Residential / Commercial

3.7 **Built Form**

3.7.1 Summary

The Development Plan aims to provide a framework for the transformation from a fragmented car-dominated urban form to a pedestrian-based, integrated Town Centre with a distinct identity. This can be achieved through a number of built form related mechanisms, including the identification of a central space for public interaction, promotion of 'main-street' style development (i.e. active edges), strengthening of existing gateways into the Town Centre and through the development of icon sites. These built form principles are commented upon below and will be reflected in the Town Centre Design Guidelines, which will be lodged separately with the Town of Port Hedland for adoption as a Local Planning Policy.

- Main Street / Central Meeting Place: A Town Centre provides a range of roles and functions, one of which being a primary meeting and gathering space – a community hub. This requires the development of a recognisable space that is accessible, includes a variety of community uses, has linkages with other precincts and is identifiable to members of the community and visitors alike. This will require a built form that is open and interactive with the public realm.
- Gateways: Gateways assist in creating an identifiable point of introduction to the Town Centre environment, often acting as a visual cue for arrival at the Town Centre. These gateways can be created through a number of architectural and landscaping treatments, including increased elevations, design features and use of materials, limited or nil street setbacks, themed lighting or landscape design.
- Icon Site: Icon sites with the Town Centre environment, similar to Gateways, assist in the legibility of a centre. Icon sites should be co-located with community areas / communal spaces and are encouraged in areas where there is significant development potential and where key vistas terminate. Built form on such icon sites should address the predominate view line through the use of building facades and openings which focus the attention of sight lines. Contemporary and innovating architectural design should also be implemented on these sites, effectively creating points of reference across the Town Centre, assisting with orientation and legibility.
- Active Edges: Active edges are characterised by limited or nil street setbacks and the inclusion of active land uses on the ground floor that promote interaction and surveillance. The principle of 'active edges' should particularly be encouraged along the primary entry and access roads within the Town Centre. They are important in creating gateways to the Town Centre and are also vital in creating pedestrian friendly streets through the provision of continuous awnings (i.e. shading / shelter), for example.

3.8 **Public Realm, Open Space and Public Art**

Providing people with a rich and diverse set of public areas to enjoy and spend time in is crucial to the success of any Town Centre. The public spaces in which people move and travel, relax in and meet friends and family all play in an important role in shaping the way residents and visitors alike experience the Town Centre.

In line with the Development Plan vision, the South Hedland Town Centre is to become a place that is dynamic, accessible and inclusive, forming the heart of South Hedland and offering an exciting destination for visitors, business people and residents. It will have attractive and functional public spaces and friendly streets, public art and a strong association with the cultural heritage and the natural landscape.

3.8.1 Public Realm

As identified through public consultation and stakeholder engagement, the South Hedland Town Centre has historically suffered from a lack of vitality and activity in the public realm, providing little in the way of high amenity public destinations and spaces for people to spend time in and enjoy. Through the identification and redevelopment of a new main street, Town Square improvements, skate park upgrades, public art projects and streetscape and landscaping works, significant improvement in the public realm of South Hedland Town Centre has been achieved to date.

Through a mixture of continued public works projects and private sector redevelopment, further improvements to the public realm will be achieved in line with the following planning and design principles:

- Clear definition of public spaces, with each having a unique character and sense of place, and surrounding built form interacting positively for ease of site identification and recognition.
- Functionality and usability of public spaces for a wide range of people, with appropriate levels of landscaping and public facilities to encourage activity.
- High levels of visual amenity and points of interest, including key destinations, landmarks and gateways.
- Ensuring that streets not only serve to provide for safe, efficient movement of vehicles, but also for the movement of pedestrians and cyclists, and act as dynamic, interesting public spaces in their own right.
- Celebration of community heritage through the use of public art and landscaping to tell the story of the place and its people.
- Adequate levels of lighting, activity and passive surveillance to improve the safety of public spaces. \

These planning and design principles have been used in the design of the Development Plan.

3.8.2 Open Space

Public open space amenity and provision within the South Hedland requires a robust response to address local ecological, climatic, social and cultural context, in turn responding to the West Pilbara's unique landscape and community context.

3.8.2.1 Context

The Town of Port Hedland's endorsed local planning strategy, the Pilbara's Port City Growth Plan, was prepared having regard to the recommendations of the Active Open Space Strategy (ToPH 2011). The Growth Plan advocates the implementation of the Active Open Space Strategy in order to create attractive and vibrant CBD areas.

In April 2012, the Town of Port Hedland Council endorsed the recommendation of the Active Open Space Strategy

Figure 38: Aerial 3D Concept of the Main Street Precinct (Source: LandCorp / Last Pixel)

Figure 39: Example of Town Centre Built Form on Main Street from southern end (intersection with Colebatch) (Source: LandCorp / Last Pixel)

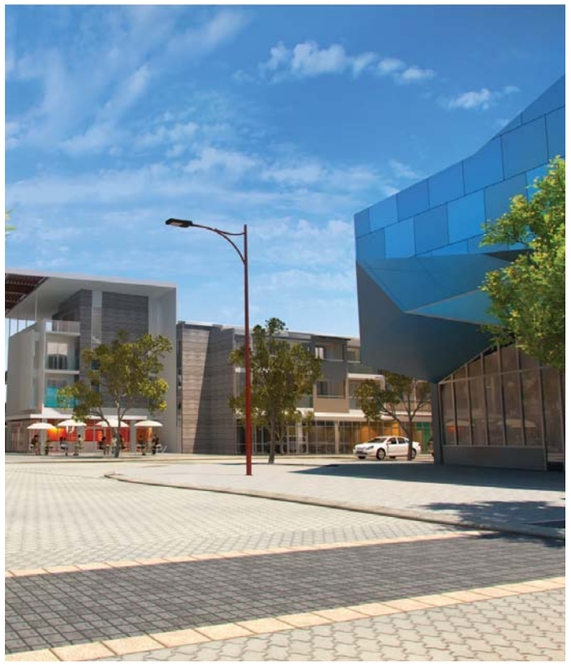


Figure 40: Example of Town Centre Built Form at south end of Main Street (intersection with Colebatch) (Source: LandCorp / Last Pixel)

Figure 41: Open Spaces

as a guide to future planning and decision making. The strategy report provides the Town of Port Hedland with an active open space strategy that addresses a future population of 50,000 residents, and accordingly, the report:

- Details the required size and location of active open space (recreational) for a predicted population of 50,000 residents;
- Provides a plan for the development of recreational facilities within that active open space; and
- Addresses accommodation and servicing issues affecting sport and recreation groups in Hedland that have arisen since the adoption of the Recreational Facilities Audit in 2006.

The underlying philosophy adopted in the Active Open Space Strategy is for the creation of fewer, albeit larger public open spaces that combine sporting areas with recreation and bush land.

In close proximity to the South Hedland Town Centre, the Active Open Space Strategy identifies a future district sporting facility, immediately south of the Hospital Site. The strategy states that this site will follow the 'district playing fields model' and may ultimately accommodate a new tennis, bowls and sportman's club. The upgrade and redevelopment of the existing Marie Marland Reserve and Hedland Senior High School Oval is also identified under the Active Open Space Strategy to assist in meeting future demand for recreational facilities.

The strategy advocates that 60% of the public open space provided should be suitable for active open space development. The strategy also includes cost estimates for the development of the various active open spaces identified, however no allowance has been made for land acquisition on the basis that active open space should be provided as part of the 10% public open space requirement for future residential land release.

The strategy recommends that 5,000m^2 should be a minimum park size where possible for all future parks. This reflects the environment conditions and the cost of maintenance of multiple small parks as opposed to fewer, slightly larger, more developed and better maintained parks.

Complementary to the Active Open Space Strategy, the Town of Port Hedland's Trails Master Plan seeks to provide a network of trails across Port Hedland, Finucane Island and South Hedland to provide passive recreation opportunities throughout some of Port Hedland's more unique landscapes. The objectives of the Trail Master Plan are to take into account cultural, ecological and historical appreciation of the proposed sites, increase opportunities for social interaction and passive recreation in an informal setting, increase appreciation of the local environment, and allow for growth of tourism based activities in natural settings.

Relevant to the South Hedland Town Centre, the Trails Master Plan identifies a future trail referred to as the 'South Hedland Recreational Loop'. The Master Plan describes the loop as follows:

> *"Figure 10 shows the proposed South Hedland Recreational Loop, which circumnavigates South Hedland to create a 10km loop, beginning and terminating at the Wanangkura Stadium, designed to be used by local residents and accessed from various points throughout the loop.*
>
> *Beginning at Wanangkura Stadium, the trail crosses Hamilton Rd and enters the boundary of the South Hedland Senior High School, which is referred to in the Active Open Space Strategy as being earmarked for upgrading to a community event space and higher quality facility. The trail loop then continues around South Hedland in a clockwise fashion, between North Circular Rd and the residential properties and sub-divisions, until reaching Murdoch Road, where the trail would join in with the new Osprey subdivision and proposed Open Space Strategy.*
>
> *The trail would then continue south along the boundary of the sub division, and then head West and North West back to the outskirts of the proposed Western Edge Landcorp subdivision, before turning back to Collier Drive and Hamilton Drive, heading past the South Hedland Hospital and Wanka Maya Centre to return to Wanangkura Stadium."*

The Master Plan describes the theme of the South Hedland Recreational Loop as follows:

"… the South Hedland Loop would be as an active exercise theme, to tie into the proposed Active Open Space Strategy, and provide exercise and passive recreation options for local residents who would like other alternatives outside of organized team sports, which are well catered for at the Sports Centre.

The linking of the masterplanned sports precincts (as identified by the Active Open Space Strategy) also allows for cycle commuting on segregated paths for users in the future, and encourages use of the paths for passive recreation in the interim."

The alignment of the proposed South Hedland Recreational Loop through the Town Centre will provide opportunities for residents and visitors in the Town Centre to access this trail, providing alternative transport methods to nearby recreational facilities.

3.8.2.2 Demand for Open Space in the SHTC

The Development Plan provides for the incorporation of residential uses through both the identification of suitable Precincts and land use preferences and also through the inclusion of residential density codings. As such, the South Hedland Town Centre is anticipated to include a resident population based on the future demand for apartment-style residential dwellings being 1,186 attached dwellings by 2031 (refer Appendix 2 – Urban Development Opportunities).

It is recognised that the future resident population within the Town Centre will generate a demand for public open space. The role and function of the Town Centre however means that this demand, particularly as it relates to active recreational pursuits, will need to be met largely by existing and future planned facilities outside of the SHTCDP area. Importantly however, the structure of the Town Centre provides for improved connections to these active open space areas, that are in close proximity to the Town Centre.

3.8.2.3 Open Space in the SHTC

Through significant and considered planning with key stakeholders and the community, the amount and type of public open space within the Town Centre has been established.

The objectives of the Development Plan are to facilitate positive experiences for the anticipated increase in both permanent resident population and visitors to the Town Centre, and particularly:

- Providing a Town Centre focal point or 'hub' of activity where people can meet and interact on an organised or chance basis and which supports a variety of services and function;
- Providing shaded pedestrian walkways and open areas in an attractive setting within the Town Centre that encourage people to remain and spend time.

In response and central to achieving these objectives has been the development of the Town Square. The Town Square, which provides a focal point of the Town Centre, is located immediately east of the Main Street (Wise Terrace). In addition, the landscape design of the new Main Street, upgraded Forrest Circle path network and future linear drainage systems provides for shaded pedestrian linkages and opportunities for 'linear' recreational pursuits.

A breakdown of the open space areas (incl. drainage) is provided in Table 5:

Open Space in the SHTC			
Map Ref	Description	Purpose	Area (ha)
1	Central linear swale to Western Edge	Linear parkway / drainage	0.7448 ha
2	Southern linear swale to Western Edge	Linear pedestrian link / drainage	0.1980 ha
3	Forrest Circle Drainage Reserve	Linear parkway / drainage	4.0962 ha
4	Town Square	Meeting Place / Passive	0.3544 ha
5	Lot 1601 (Throssell Road Drainage Reserve)	Landscaped drainage swale	0.5014 ha
6	Lot 8029 (Drainage Reserve adjoining library)	Landscaped drainage swale	0.2036 ha
7	Lot 8020 (McLarty Drainage Reserve)	Drainage	0.1176 ha
8	Pt Lot 8023 (Daylesford Drainage Reserve)	Drainage	0.1650 ha
9	Lots 6074 & 6075 (Mixed Business Drainage)	Drainage	0.8925 ha
	Total		7.2735 ha

Table 5 Open Space in the SHTC

The areas of open space (incl. drainage) total approximately 7.2735 hectares. Where possible, drainage areas, particularly the Forrest Circle Drainage Reserve (map ref: 3) and the central linear swale to Western Edge (map ref: 1) also provide opportunities for linear recreational opportunities. The upgrade of Forrest Circle and the adjacent drainage reserve has demonstrated how this can be achieved, creating an attractive, purposeful and functional space where people can recreate in, and connect to other recreational facilities in the surrounding locality.

Whilst not forming a dedicated area of land, the future landscaped linear pedestrian linkages along McLarty Boulevard and Colebatch Way identified on Figure 41, will also provide connection to both existing and future open spaces beyond the boundaries of the Town Centre.

The community facilities identified on Figure 41 also contribute to community development, assisting in meeting needs and expectations of the future residents within the Town Centre. The total land area of these community facilities is 2.50ha.

Upon the request of the local government, the WAPC may accept a community purpose site(s) being included in the 10 per cent public open space contribution (E4, R27, 28, 29 of Liveable Neighbourhoods).

3.8.3 Delivery of Open Space in the SHTC

To date, the ceding of land for public open space (incl. drainage) within the Town Centre has occurred through prior subdivision. For where open space areas (incl. drainage) have not yet been ceded, then the future subdivision of the existing land parcels for where open space (incl. drainage) has been identified on the Development Plan, will be required to cede this land accordingly.

The WAPC's operational policy, Liveable Neighbourhoods, acknowledges that a contribution towards public open space for mixed uses requires consideration, having regard to the following:

- The amount of mixed uses proposed and the potential number of residents;
- The amount of public open space available in 300m of the mixed use area;
- The proportion of the mixed use area likely to be used for non-residential purposes; and
- The level of innovation and quality of the resultant urban form in neighbourhood and town centres.

Areas of the Town Centre will require further subdivision to facilitate the continued redevelopment and revitalisation of the Town Centre. Subdivision will result in the creation of land parcels potentially suitable for mixed use development and in this regard the requirement for a public open space contribution will be determined by the WAPC at the time of subdivision having regard to the nature of the proposal, the considerations outlined by Liveable Neighbourhoods and the comments of the Town of Port Hedland.

The physical area of public open space within the Town Centre has been identified by the Development Plan and adopted by the Town of Port Hedland as being sufficient to meet the needs of the currently anticipated resident population, noting the amount of open space within the vicinity of the Town Centre. Public open space contributions from future subdivisions within the town centre would therefore need to consider the need to develop public open space within South Hedland outside the Development Plan area.

3.8.4 Public Art and Cultural Heritage

The public realm offers an opportunity to celebrate a community's heritage and tell the stories of a place and its people, through public art and landscape. These elements help to make an area unique and specific to its regional context, and provide ways to involve the residents of South Hedland in the development and maintenance of their town.

Through the application of the South Hedland Town Centre Design Guidelines, the Town of Port Hedland and LandCorp are seeking to create a stimulating, provocative and culturally significant public environment. Specifically, the design guidelines promote:

- The integration of public art into the initial design and construction of buildings and open spaces;
- Celebration of diversity and cultural expression, recognising both the indigenous and non-indigenous heritage of South Hedland;
- Engagement with local artists, school children or other community groups when possible in the design and production of public art elements;
- Interactive and changeable installations that encourage people to engage creatively with the environment and offer continuing variety and interest in the public realm; and
- The use of durable materials and finishes, considering the on-going maintenance requirements associated with public art components.

3.9 Car Parking

3.9.1 Overview

A successful Town Centre will be serviced by an adequate number of car parking bays to service resident, commercial and visitor needs. This means that the number of car parking bays provided achieves a balance between under-supply that would constrain accessibility to the Centre, and over-supply that would serve to under utilise land.

Some car parking bays are required for exclusive use, such as residential parking. Commercial activity however

Table 6 Summary of public car parking bay provision

Total Number of Required Car Parking Bays Estimated by Porter Consulting Engineers Transport Assessment	**5,896[1]**
Less	
- Number of bays estimated for future residential development	3,485
- Community Facility Parking in Porters Traffic Assessment	279
Sub-Total	**2,132**
Less	
- 20% Shared Use Factor	426
Revised Number of Required Car Parking Bays Estimated for Non-Residential Uses	**1,706**
Estimated Parking Requirement Calculations	
80% On-site Car Parking Requirement (1706) - 1,365 on-site parking bays required - **342** off-site parking bays required	
No. of Dedicated Public Car Parking Bays identified in Porters Transport Assessment	**969[2]**
Surplus	**627**
Community Facility Parking Requirement	
No. of car parking bays estimated to be required (Porter Community Facility Parking Strategy)	**365**
- Less 20% shared use factor	292
- No. of on-site car parking bays proposed	115
Shortfall of Assessed Car Parking Bays	**-177**
Number of Off-site Car Parking Bays identified by Porter Consulting Engineers in the preferred area for Community Facilities	**142**
Shortfall	**-35**
Revised Number of Public Car Parking Bays identified (969+35)	**1,004**
Revised Public Car Parking Bay Requirement Calculation	
Public Parking Bays illustrated on Development Plan / Figure 42	**1,004[3]**
Total Surplus / Shortfall in Public Car Parking Bays (incl. On-street bays)	**485 (Surplus)**

NOTES:

[1]The total number of car parking bays (incl. on-street bays) estimated to be required by the Transport Assessment prepared by Porter Consulting Engineers is an estimate only, and is based on assumed land uses, floor areas, etc. The Transport Assessment prepared by Porter Consulting Engineers does not cover the full extent of the South Hedland Town Centre Development Plan area. For areas outside of the Transport Assessment area, the total number of required car parking bays is to be assessed in accordance with the standard provisions of the Town of Port Hedland Town Planning Scheme No. 5.

[2]The total number of dedicated public car parking bays identified in the Transport Assessment prepared by Porter Consulting Engineers includes the 88 bays that are required by South Hedland Aquatic Centre, and therefore the number stated in the Transport Assessment (1,057) is reduced to 969.

[3]The total number of dedicated public car parking bays (incl. on-street bays) identified in Figure 42 of the South Hedland Town Centre Development Plan report ultimately required is subject to monitoring and review as new development progresses.

requires car parking bays to be publicly available to customers. It is recognised that visitors to the Town Centre may attend a number of properties in one visit. This means that some car parking bays are effectively shared between different development sites. In this circumstance, it is appropriate to discount the number of car parking bays required by individual developments, and for some car parking bays to be on public land to allow effective sharing of car parking bays.

The Development Plan acknowledges the ability of the Town of Port Hedland to discount parking calculations where reciprocal arrangements can be demonstrated. The plan also acknowledges the capacity for cash-in-lieu of car parking bays on individual development sites. The Development Plan is supported by an accompanying Parking Strategy prepared by Porter Consulting and incorporated within the Transport Assessment contained within Appendix 5.

3.9.2 Parking Provision for New Development

3.9.2.1 Residential Parking

Proposed residential developments (i.e. grouped dwellings and multiple dwellings), shall provide all required car parking bays on-site. The adequate provision of car parking bays for residential uses in the Town Centre is considered to be fundamental to the success of the Development Plan and ultimately the amenity for future residents. Together with other relevant development requirements under the R-Codes, the requirement for on-site car parking bays also assists in ensuring residential density is appropriately controlled.

3.9.2.2 Non-Residential Parking

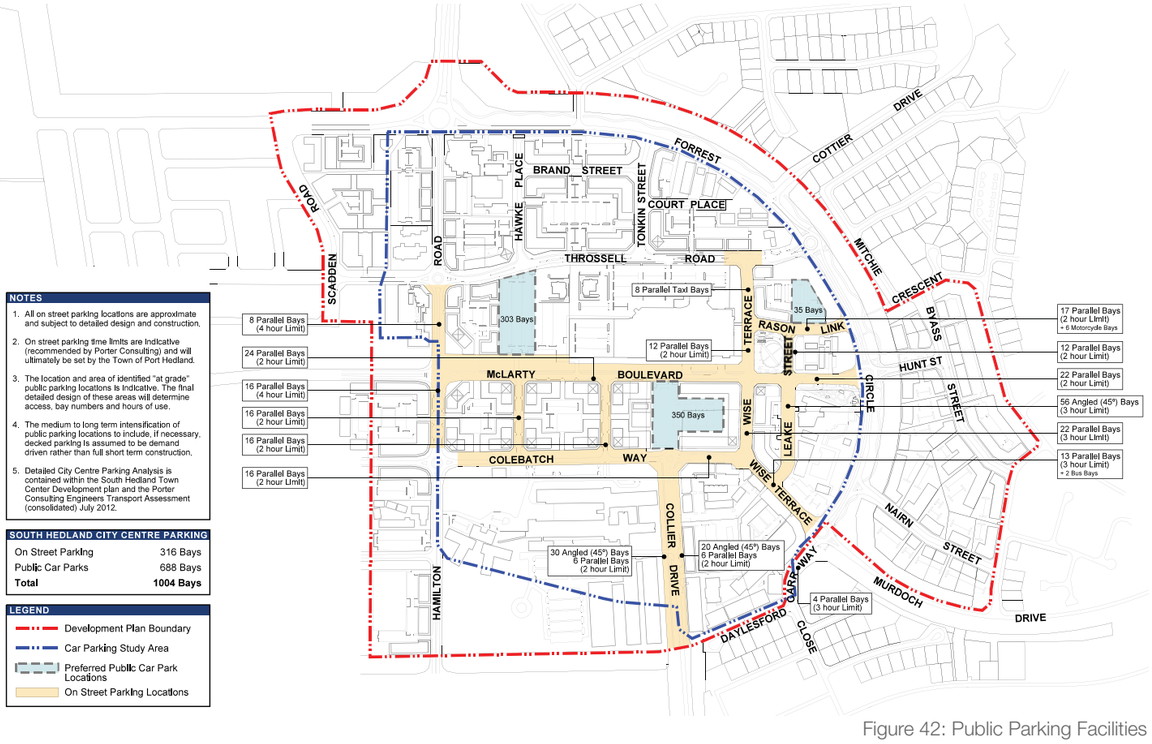


Figure 42: Public Parking Facilities

Proposed non-residential developments (including the portion of commercial within mixed uses developments), shall identify the number of required car parking bays required by the development. The determination shall be made either using the minimum car parking requirements contained within Appendix 8 of the Town Planning Scheme, or where suitable justification is provide by a Traffic Statement / Report.

Once the amount of car parking bays required for a non-residential development is determined, a 20% shared use reduction shall be applied to that number of car parking bays, to determine the final amount of car parking bays required by the development.

With the inclusion of the 20% shared use reduction applied, all non-residential developments shall provide a minimum of 80% of the final required car parking bays on-site.

3.9.3 Car Parking Calculations

The supporting Transport Assessment contained within Appendix 5, identifies a total number of required car parking bays to be 5,896 bays.

On the basis of all proposed residential developments (i.e. grouped dwellings and multiple dwellings) providing all required car parking bays on-site, the total future demand of car parking bays as listed in the Transport Assessment should be revised to 2,411, being the number of car parking bays estimated for future non-residential land uses only.

Further, and noting the findings of the Community Facilities Parking Strategy, also prepared by Porter Consulting Engineers, the estimated number of car parking bays required for these facilities outlined in the Transport Assessment table (being 279) should be subtracted from the overall estimated future demand figure and be included as a separate component to the overall parking demand calculations. This results in the overall estimated future demand for non-residential uses as being 2,132.

As supported by the Transport Assessment, including the literature cited within the report (refer Appendix 5), a shared use reduction of 20% is considered appropriate. The application of this shared use reduction factor has been applied acknowledging the Town Centre context, and specifically the cross-visitation and reciprocal use of car parking bays across non-residential development within the Town Centre. Further, cross-visitation within the Town Centre will be promoted through the increased level of 'walkability', implemented both through the recently completed Town Centre upgrades and the use of Design Guidelines which promote pedestrian-friendly streets (i.e. standards relating to active frontages, awnings, setbacks).

Accordingly, the following is calculated:

- Estimated Future Demand (Non-Residential) = 2,132
- Less the 20% shared use factor = 1,706

Based on the future non-residential forecasted demand of 1,706, the following calculations are provided:

- 80% on-site parking provided for future development = 1,365 on-site car parking bays, leaving 342 off-site parking bays being required.

The current number of dedicated public car parking bays proposed by Porter's Transport Assessment is 969 (this excludes the 88 car parking bays identified in Porter's Transport Assessment that are wholly required for the South Hedland Aquatic Centre).

On the basis of future non-residential developments providing a minimum of 80% of the assessed car parking bay requirement on-site, there is a surplus of 627 public car parking bays.

The above figures however do not account for the car parking bay numbers outlined in the Community Facilities Parking Strategy. We understand that the redevelopment of the Community Facilities requires a total of 365 car

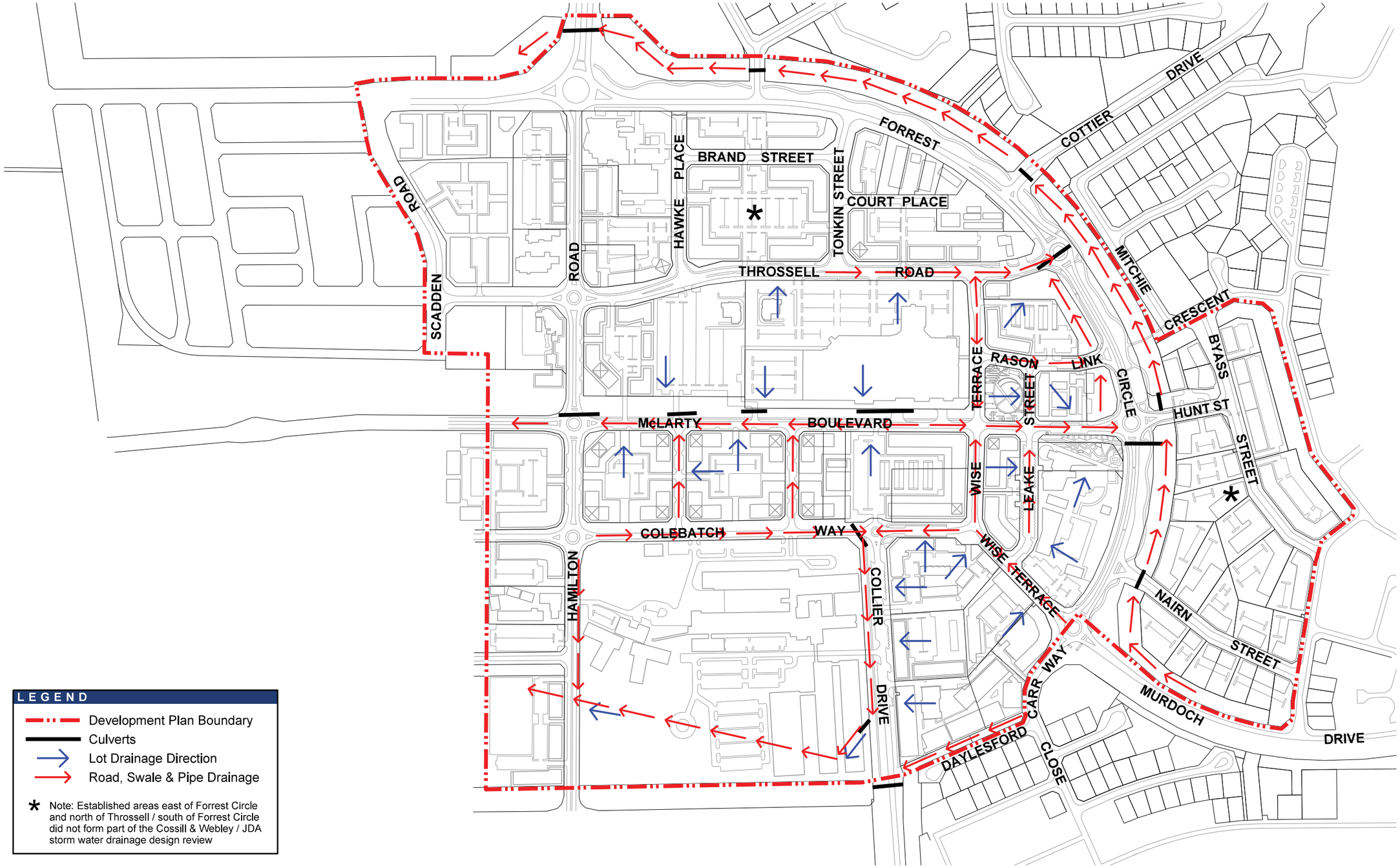


Figure 43: Storm Water Drainage Design

parking bays. Application of the 20% shared use reduction factor, brings this total requirement down to 292. With a total number of proposed on-site car parking bays being 115, this leaves a shortfall of 177 car parking bays.

Despite the number of on-site car parking bays being less than the 80% target, the Town is prepared to support the resulting shortfall being provided off-site, subject to adequate provision being made within close proximity, being the general area bound by Wise Terrace (west and south), Throssell Road (north) and Forrest Circle (east). The current Transport Assessment identifies 142 public parking car parking bays (incl. on-street bays) within this area, leaving a shortfall of 35 car parking bays.

Incorporating this shortfall, the total number of public car parking bays proposed with the South Hedland Car Parking Study Area is now proposed to be 1,004.

On the basis of future non-residential developments providing a minimum of 80% of the assessed car parking requirement on-site, and the considerations as outlined above, there is a calculated surplus of 485 public car parking bays.

The purpose of these calculations is to demonstrate that the Development Plan identifies areas for appropriately located public parking, and that should non-residential development not be able to achieve 80% of the assessed parking on-site, then there is sufficient scope to entertain an increase in the amount of off-site bays permitted (via cash-in-lieu).

A reduction to the minimum 80% on-site parking requirement target should be assessed on the merit of each individual development proposal, including its overall contribution to the objectives of the South Hedland Town Centre Development Plan and the availability of off-site parking.

3.9.4 Variations

The preferred location and distribution of the public parking areas are illustrated on both the Development Plan map and Figure 42. These locations have been deliberately annotated as 'preferred', acknowledging the variables associated with development timing and availability of land for public parking.

The methodology and/or requirement for the provision of on-site parking does not bind the Council in respect of any application for planning approval proposing a variation to the required number of car parking bays. As per Clause 6.13.5 of the Town Planning Scheme No. 5, where the Council is satisfied that the circumstances of a development justify such action and there will not be any resultant lowering of safety standards, a reduction in the number of car parking spaced required may be permitted.

The number of required public parking bays (i.e. off-site parking) is to be subject to regular review and monitoring as new developments are approved / constructed.

3.10 **Water Management**

3.10.1 Principles

The key feature of water management within the context of South Hedland is the control of local flood potential and the protection of properties from water logging. The stormwater drainage system is based on a major/minor approach. The minor drainage system is defined as a swale and road drainage system designed to carry runoff generated by low frequency storms, less than 5 year average recurrence incidence. In some areas pipework will be required to provide for this. The major drainage system is defined as the arrangement of roads and drainage reserves to provide safe passage of stormwater runoff from extreme events which exceeds the capacity of the minor system.

The swale drains and flood storage areas are to accommodate a relatively high runoff coefficient of 80% given the limited infiltration capacity. All stormwater swale areas are proposed to be ephemeral and no open water body lakes are proposed.

In the context of a Town Centre, the swales and flood storage areas are intended to be attractive, and complementary to the Town Centre environment.

3.10.2 Plan Provisions

A Local Water Management Strategy (LWMS) has been prepared to support the development and redevelopment initiatives proposed by the SHTCDP. The strategy, prepared in accordance with the Better Urban Water Management guidelines of the WA Planning Commission is included at Appendix 1.

Key elements of the Local Water Management Strategy that are incorporated into the SHTCDP Plan include:

- Proposed drainage swales located in the road reserve along Rason Court;
- Modification of the existing eastern flood storage area into three separate areas, with an additional connection to the Forrest Circle north drain;
- Upgrade of the Forrest Circle north drain between Nairn Street and Cottier Drive to increase capacity; and
- Maintenance of the existing key discharge points from the Study Area to the receiving environment.

These features are identified at Figure 43. Further details in respect to the surface and ground water hydrology and conceptual stormwater system design are set out at Appendix 1.

It is to be noted that the LWMS does not cover the entire SHTCDP area, instead focussing primarily on the central area south of Throssell Road, east of Hamilton Road and west of Forrest Circle. The same urban water management principles should also apply to any further development or redevelopment of established areas in the northernmost and easternmost portions of the Town Centre.

4.0 DELIVERY

The SHTCDP is about delivering on the vision set out in strategic plans, namely the Pilbara Regional Planning and Infrastructure Framework and the Port City Growth Plan. The SHTCDP is also about facilitating works on the ground, be it servicing infrastructure, public amenities or private construction projects. The SHTCDP therefore serves dual purposes of 'Delivering the Vision' and 'Meeting the Needs' as illustrated in the following figure.

Implementation of the SHTCDP relies on three key considerations:

1. Governance: an effective means to guide investment decisions and approvals processes.
2. Private Works: development initiatives that are in line with the overall direction of the Town.
3. Public Works: providing the infrastructure and amenity expected of an attractive and active Town Centre.

The mechanisms necessary to facilitate public and private works are addressed in the following sections.

4.1 SHTCDP Arrangements

While the SHTCDP provides the framework for the Town Centre, there are further documents that set out the design standards for on-site developments. These include Design Guidelines and Town Planning Scheme Text provisions. When preparing an application for planning approval to develop or redevelop a site, a landowner will have regard for the terms of the SHTCDP along with the design standards as illustrated in the following figure:

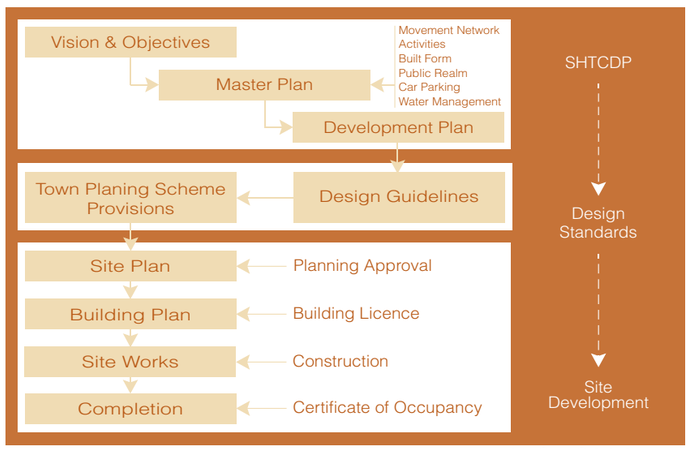


Figure 44: SHTCDP Delivery

4.2 Staging and Delivery

In 2013 LandCorp is looking to service and put to the market Town Centre lots on the north eastern corner of Throssell Road and Hamilton Road.

- Lot 301 3678 sqm Zoned Town Centre
- Lot 6106 6530 sqm Zoned Town Centre
- Lot 6077 3239 sqm Zoned Town Centre

Following these lots will be the lots to the north of the hospital between McLarty and Colebatch which will be put to the market prior to construction to be informed by the market demand as to what configuration is best to construct initially.

The remaining lots between McLarty and Throssell will be developed as demand is demonstrated. It is proposed to put these lots to the market prior to construction in order to gauge the market demand and the configuration to be constructed.

RPS

LEGEND

1. Wise Terrace 'Main Street'
2. Town Park and Event Space
3. Lotteries House
4. Hedland Well Women's Centre
5. Youth Space / Skate Park
6. Library and facilities
7. South Hedland Aquatic Centre (SHAC)
8. Public Parking
9. Hotel Site
10. Mixed Use Development (Ground floor Commercial / Retail with short-stay or permanent residential over)
11. Landscaped pedestrian connection, drainage corridor and recreation space
12. Road Connection to Daylesford Close and surrounding residential area
13. Eastern Gateway to City Centre supporting Mixed Use Development
14. Shopping Centre expansion with external tenancies to front Wise Terrace
15. Possible western shopping centre expansion as City Centre demand warrants
16. Mixed Use Development in landmark location (with possible entertainment, restaurant / cafe and retail) integrated with adjoining public parking
17. Regional Hospital Campus and southern expansion
18. Possible Tertiary Education facility
19. Fringing City Centre residential as transition to surrounding residential
20. Upgraded Hamilton Road (with on-street parking)
21. Landscaped drainage link

Plan Area

Note: Pattern of Development shown is indicative only. Individual landowners will ultimately consider the merit or otherwise of redevelopment having regard to the SHTC Development Plan objectives.

SHTCDP Vision: Key Features

APPENDIX I

South Hedland Town Centre
Local Water Management Strategy

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JDA CONSULTANT HYDROLOGISTS

Your Ref:
Our Ref: J5169d

15 November 2012

Rod Dixon
RPS
PO Box 465
Subiaco WA 6904

Dear Rod,

SOUTH HEDLAND TOWN CENTRE REVITALISATION – EAST PRECINCT: LWMS

The Local Water Management Strategy (LWMS) prepared by JDA (dated 26 August 2011) for South Hedland Town Centre was approved by Department of Water (DoW) on 30 August 2011. This document remains the current approved version for South Hedland Town Centre.

While there have been minor modifications to the Development Plan contained within the LWMS, these have not changed any of the concepts or strategy presented in the LWMS.

Any modifications to water management due to the ongoing implementation of the Development Plan will be detailed within the appropriate Urban Water Management Plans (UWMPs).

If you have any queries, please do not hesitate to contact Alex Rogers

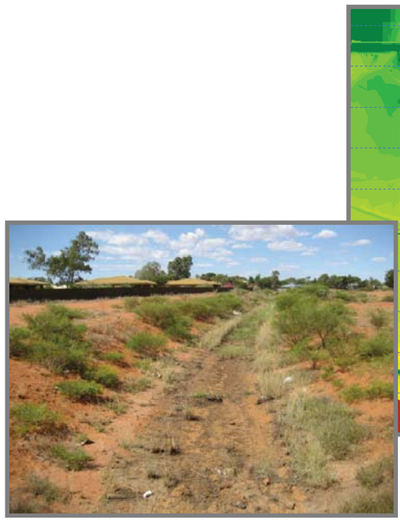
Yours sincerely,

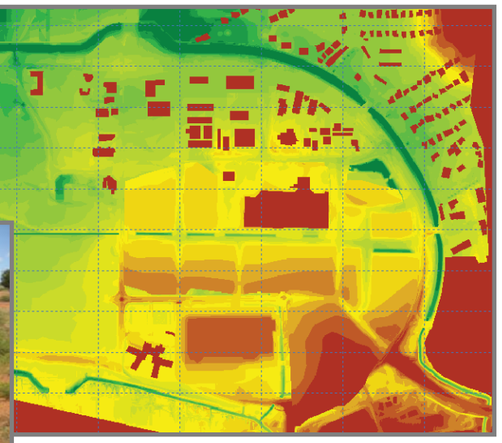
JDA Consultant Hydrologists

Landcorp

South Hedland Town Centre Revitalisation – East Precinct

Local Water Management Strategy (LWMS)





August 2011

JDA Consultant Hydrologists

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1. INTRODUCTION

This Local Water Management Strategy (LWMS) has been prepared to support the revitalisation of the South Hedland Town Centre (East Precinct) in the Town of Port Hedland, in accordance with Better Urban Water Management (WAPC, 2008). The Study Area is presented in Figures 1 and 2.

1.1 Background

This document has been prepared to support a Development Plan by RPS for the above property within the Town of Port Hedland. The LWMS has been developed by JDA Consultant Hydrologists on behalf of Landcorp. The relationship of this document to the planning process is shown in Table 1. The compilation of this document has included a range of expertise and guidelines from leading authorities including the Department of Water (DoW), Water Corporation (WC) and Town of Port Hedland (ToPH) to assist in achieving the implementation of best practice in water management and sustainable development within the context of the Pilbara region.

To manage and protect Western Australia's water resources, DoW and the Department of Planning and Infrastructure (DPI) produced a key document *Better Urban Water Management (BUWM)* (WAPC, 2008) to guide urban development in Western Australia.

Discussions with DoW, Perth on 1 June 2010 (and subsequent follow up emails) guide the approach required for the preparation of the South Hedland Town Centre LWMS. The guidance requirements are detailed in section 1.3.

In Port Hedland, surface runoff issues are erosion and sedimentation. Peak flow rates do not need to be detained to pre development peak flow, but the velocity of the post development flow should to be minimised. Geotechnical investigation indicates no groundwater encountered to a depth of 2.5 m.

An LWMS Checklist has been included as Appendix A to assist ToPH and DoW in review of this document.

TABLE 1: INTEGRATED PLANNING AND URBAN WATER MANAGEMENT PROCESS

Planning Phase	Planning Document	Water Management Document and Status
District	Pt Hedland Land Use Master Plan (LUMP); also Pt Hedland Planning Study Ultimate Development Plan (UDP)	Flood studies detailed in section 1.2 **- EXISTING**.
Local – Town Planning	South Hedland Town Centre Development Plan RPS (2010)	South Hedland Town Centre Revitalisation (East Precinct), Local Water Management Strategy (LWMS) **- THIS DOCUMENT**.
Subdivision	Subdivision Application	Urban Water Management Plan (required for individual stages of development) - **FUTURE PREPARATION**

1.2 Previous Studies

This LWMS considers the following key documents:

1.2.1 Town Planning Flood Study for South Hedland (Wyche, 1975)

This flood study by Wyche (1975) for South and South West Creeks provided flood level estimates for each channel for the 10, 20, 50 and 100 year ARI events, upstream of Great Northern Highway. Greater detail regarding this study is provided in Appendix B.

1.2.2 South Hedland Town Centre Drainage Design (PWD, 1976)

This study examined drainage from the Town Centre and surrounding areas. Two drainage channels, one to north of Forrest Circle and the other to the south were proposed to discharge stormwater runoff. The drainage channels were designed for the 5 year ARI flood event, consistent with the PWD Manual of Standards (Urban Drainage) (PWD, 1980). Greater detail regarding this study is provided in Appendix B and Section 2.6.1 below.

1.2.3 State Planning Policy 2.9 - Water Resources

The LWMS has been developed in accordance with regional and local principles and objectives of Integrated Urban Water Management (IUWM).

The Western Australian Planning Commission (2005) defines IUWM (also known as total water cycle management) as promoting

> "*management of the urban water cycle as a single system in which all urban water flows are recognised as a potential resource and where the interconnectedness of water supply, stormwater, wastewater, flooding, water quality, waterways, estuaries and coastal waters is recognised*".

IUWM promotes water conservation measures, reuse and recycling of water and best practice in stormwater management (Western Australian Planning Commission 2005).

1.2.4 Stormwater Management Manual for WA

The Stormwater Management Manual for Western Australia was first published by the Waters and Rivers Commission in 1998 to define and describe in practical terms Best Management Practices (BMP's) to reduce pollutant and nutrient inputs to stormwater drainage systems as well as guidelines for the incorporation of water sensitive urban design principles. A major review of the Stormwater Management Manual was undertaken by the DoW, with additional input by other State and Local Government Authorities and sectors of the urban development industry. This revised version of the Stormwater Management Manual was officially launched in 2007, though some chapters were published in 2004.

DoW's current position on Urban Stormwater Management in Western Australia is outlined in Chapter 2: Understanding the Context of the Stormwater Management Manual for Western Australia (DoW, 2007), which details the management objectives, principles, and a stormwater delivery approach for WA. Principle objectives for managing urban water in WA are:

- Water Quality: To maintain or improve the surface and groundwater quality within development areas relative to pre-development conditions.

- Water Quantity: To maintain the total water cycle balance within development areas relative to the pre-development conditions.
- Water Conservation: To maximise the reuse of stormwater.
- Ecosystem Health: To retain natural drainage systems and protect ecosystem health.
- Economic Viability: To implement stormwater systems that are economically viable in the long term.
- Public Health: To minimise the public risk, including risk of injury or loss of life to the community.
- Protection of Property: To protect the built environment from flooding and waterlogging.
- Social Values: To ensure that social aesthetic and cultural values are recognised and maintained when managing stormwater.
- Development: To ensure the delivery of best practice stormwater management through planning and development of high quality developed areas in accordance with sustainability and precautionary principles.

DoW released the Decision Process for Stormwater Management in WA in August 2009 to provide a decision framework for the planning and design of stormwater management systems and assist in meeting the objectives specified above.

1.3 Key Design Principles and Objectives

A meeting was held at DoW, Perth on 1 June 2010 to discuss the approach required for the South Hedland Town Centre, as the Department has not published any guidelines to assist with the preparation of LWMS specifically for sites in the Pilbara Region of Western Australia.

The minutes of the meeting are summarised below:

- Towns in the Pilbara have been developed using open drains rather than piped drainage and this is appropriate due to the high rainfall intensities and runoff rates compared with the South West of WA. The nature of the Town Centre urbanisation is such that some piped drainage will be required.
- Need to ensure that existing creeks and drains are retained as far as possible - working with the existing drainage system, rather than against it.
- Flood risk is the main issue from surface water, however groundwater levels also need to be checked.
- Management of erosion and sedimentation is important.
- Other water quality issues such as nutrient concentrations are of lower priority in the Pilbara.
- DoW has not prepared any flood mapping for Port Hedland.
- DoW accepts there will not be 2 years of pre development groundwater monitoring data. DoW will expect some monitoring bores to be installed to show the elevation of the water table relative to ground level to indicate whether imported fill will be required.
- DoW will not require any ongoing post development surface water or groundwater quantity or quality monitoring.
- The LWMS checklist contained in BUWM (WAPC, 2008) should still be used.

Summary of the key principles and objectives applicable to this LWMS for the Study Area in the Pilbara region is based on agreement with DoW.

TABLE 2: LWMS KEY PRINCIPLES AND OBJECTIVES

Key WSUD Guiding Principles		
• Facilitate implementation of sustainable best practice in water management in the Pilbara region • Provide integration with planning processes and clarity for agencies involved with implementation • To minimise public risk, including risk of injury or loss of life • Protection of infrastructure from flooding and waterlogging • Encourage environmentally responsible development		
Category	**Principles**	**Design Objectives**
Water Supply and Conservation	• Consider all potential water sources in water supply planning. • Integration of water and land use planning • Sustainable and equitable use of all water sources having consideration of the needs of all users, including community, industry and environment • Maximise the reuse of stormwater	• Minimise the use of potable water where drinking water quality is not essential, particularly ex-building use. • Apply waterwise landscaping measures to swales in road reserve to reduce/avoid irrigation.
Surface Water Flows and velocity	• Protect development from flooding and waterlogging • Implement economically viable stormwater systems • Retain natural drainage systems and protect and/or improve ecosystem health – For the Pilbara, reduce the stormwater velocity to prevent export of sediments. • Ensure that stormwater management recognises and maintains social, aesthetic, and cultural values • Where there are identified impacts on significant ecosystems, maintain or restore desirable environmental flows and/or hydrological cycles consistent with DoW's requirements.	• Use swales through the development to disperse flow throughout the development with the aim to minimise velocity. Swales sized to minimum 10yr ARI, with larger events flowing along road reserve. • For flood management, lot levels have minimum 100 yr ARI protection, with 0.3 m freeboard above kerb height.
Groundwater Levels	• Protect development from waterlogging	• Protect development from waterlogging
Water Quality	• Where development is associated with an ecosystem dependent upon a particular hydrologic regime, minimise discharge or pollutants to shallow groundwater and receiving waterway and maintain water quality in specified environment	• No sensitive ecosystems in vicinity. The receiving environment is South Creek which discharges to the intratidal zone prior to discharging to the ocean. (Note nutrients are not a problem in the Pilbara).

2. PRE-DEVELOPMENT ENVIRONMENT

The environmental conditions of the pre development Study Area provide an important context for planning future water management strategies. This section describes the pre development details.

2.1 Location and Existing Land Use

The South Hedland Town Centre is located to the south west of the South Hedland town site within the Town of Port Hedland (Figure 1). The Study Area is located within the eastern section of the Town Centre, bordered by Hamilton Road to the west and Forrest Circle to the north, south and east.

The land use of the site (Figure 2) is existing commercial and retail, with areas of public purpose (hospital and police station), as well as vacant cleared land within the southern section of the Study Area. Examples of land use are shown in Figure 3.

2.2 Topography

A topographic survey of the Study Area and surrounds conducted by MAPS is presented in Figure 4. The topography of the Study Area is mostly flat, with elevations of between 12 and 13 m AHD within the Town Centre. The land generally falls to the west towards South Creek and to the north towards the coast.

2.3 Climate

South Hedland's climate can be described as being arid sub tropical with warm, dry winters and hot humid summers.

The long term average rainfall for Port Hedland Airport (station no. 004032) is 313 mm (1943 – 2009). Annual and monthly rainfall data in Figure 5 shows many years without significant rainfall occur, (BoM, 2010). Most of the rain comes in summer months January to March from approximately 15 to 20 scattered thunderstorms and the occasional tropical cyclone (BoM, 2010). A secondary small peak in the monthly rainfall occurs in May as a result of rainfall caused by tropical cloud bands which intermittently affect the area mostly in May and June (BOM, 2010).

The coast from Port Hedland to Exmouth Gulf is the most cyclone prone area in Australia, with 49 cyclones since 1910 recorded, averaging one every two years (BoM, 2010). The cyclone season runs from mid December to April peaking in February.

The average annual pan evaporation for Port Hedland is approximately 3590 mm, with monthly averages shown on Figure 5 (Luke et al, 1988).

2.4 Geology and Soils

The soil within the Study Area can be described as a red sandy loam (GSWA, 1983), generally referred to as Pindan Sand (Figure 6). The soil has a small clay component, and sands are generally fine to medium grained, sub-angular to sub-rounded quartz. This can become hard when dry, and waterlogged during heavy rainfall. Onsite inspection indicated that these soils extended to a depth of at least 4 m.

2.5 Geotechnical Investigation

A geotechnical investigation was completed for the undeveloped sections of the eastern section of the South Hedland Town Centre (Coffey, 2010) during September and October 2009. A total of 26 test pits were completed to depths between 1.05 m and 2.5 m (majority 2 to 2.5 m).

The investigation described the soils as being silty sand at the surface (topsoil to 0.2 m depth) and silty/clayey sand below that to the maximum depth of investigation. The soil was described as being dense to very dense, fine to medium grained with low to medium plasticity fines, generally red brown in colour. Particle size distribution indicated that 20 to 40% of the soil matter was silt or clay. It was concluded that the soils were Pindan Sands (in agreement with regional soil mapping – see Section 2.4).

Groundwater was not encountered in any of the test pits. Test pit base elevations were between 9.8 and 11 m AHD.

Coffey (2010) also concluded that soakwells were not considered effective for disposal of stormwater runoff due to the high percentage of fines in the sand and the high rainfall intensities during the wet season.

2.6 Surface Water Hydrology

2.6.1 Existing Surface Drainage

Two of the most prominent drainage features within the Study Area are the drainage channels to the north and south of the Town Centre (Figure 7). These take flow from the Town Centre and residential areas and discharge runoff to the west into South Creek. These have been referred to as the Forrest Circle north drain (north of Town Centre) and Forrest Circle south drain (south of Town Centre). Figure 8 shows photos of culverts and channels along these drainage channels.

These drains were designed by Public Works Department (PWD) in 1976. The drains were designed to contain the 5 year ARI flood event, with culverts designed for the 5 year ARI with 50% surcharge. Drainage design was consistent with PWD's Manual of Standards for Urban Drainage (PWD, 1980). The hydrology component of the design used the Rational Method to estimate runoff. The PWD standards indicate that a design recurrence interval of 5 years is suitable for low to high density residential areas not adjacent to major rivers or with upstream catchments greater than 25 km^2. The manual states that cost is an important criteria for design and that the drainage should be designed to convey the design flow for the least cost. Anecdotal evidence (see Section 4.4 of Appendix B) indicates that there has been no overtopping of the Forrest Circle north drain in the last 20 years.

There is an existing flood storage area located in the eastern section of the Study Area bordering Forrest Circle, Leake Street and Throssell Road. This area is divided into sections by walkways, connected by culverts. There is an outlet located on the northern boundary which allows discharge into the Forrest Circle north drain adjacent to the roundabout. This flood storage area is one of the three basins provided for in the PWD (1976) design.

There is also a temporary flood storage area located to the north of the hospital site, between Rason Court and Colebatch Way. This takes runoff from the local area. There is a discharge path via swales and culverts eastwards along Colebatch Way and then south along Collier Drive, draining into the Forrest Circle south drain.

Runoff from the residential and commercial areas is mostly from impervious surfaces. Runoff is drained partly by formal pipe drainage and partly by flow along road surfaces into drainage channels.

In the undeveloped areas, particularly to the south of the Town Centre, there is little evidence of defined runoff routes, with runoff likely to occur by overland flow. The low slope gradients may result in increased depression storage within the catchment.

2.6.2 Surface Water Quality

There is no surface water quality data available.

2.7 Groundwater Hydrology

2.7.1 Groundwater Levels

There are no long term groundwater monitoring bores within the South Hedland / Port Hedland Area. All mapped bores from the Department of Water WIN database are shown in Figure 9. Few bores are located close to the Study Area. Most bores are owned by mining companies, or are used for livestock watering. Therefore there is no data record to indicate seasonal variability.

Groundwater was not encountered during site inspection in April 2010. There was no evidence of groundwater in any of the surface drainage systems. At the two lowest points of elevation (Figure 10) groundwater was not observed.

The first was a stormwater sump located on the southern boundary of the hospital site. At this location the natural surface elevation was estimated to be 12.5 m AHD. The sump was approximately 4 m deep, indicating a base invert of 8.5 m AHD. The base of the sump did not show any wetting that might result from groundwater table or its capillary fringe. Groundwater level was therefore estimated to be below 8 m AHD.

The second location was within South Creek adjacent to where the Forrest Circle north drain connects. At this point the invert of South Creek is approximately 7.2 m AHD. Again groundwater was not observed, indicating that groundwater was less than 7 m AHD at this point.

Therefore it is likely that groundwater occurs at depths greater than 4 to 5 m (less than 7 to 8 m AHD) in April. Higher groundwater levels may occur during the wet season. However, it has been observed (J. Voitkevich, Town of Port Hedland, 2010, pers. comm.) that the Forrest Circle drainage channels remain dry throughout the year (except during and following rainfall events), so groundwater does not intersect the drainage channels. The channel invert for the Forrest Circle north drain is between 9 and 10 m AHD and the invert for the south drain is between 11 and 11.5 m AHD. Groundwater levels are therefore lower than these levels even during the wet season.

2.7.2 Permeability

The geotechnical investigation performed in 2009 (Coffey, 2010) did not include infiltration / permeability testing as part of the study. However the report concluded that infiltration measures such as soakwells would not be appropriate due to the high percentage of fines in the soil, indicating that vertical soil permeability (hydraulic conductivity) would be expected to be low (as would be expected for a clayey sand.

Nearby infiltration testing at Wedgefield Industrial Estate approximately 2 km north of South Hedland Town Centre was performed in Pindan Sands, similar to those found at the Town Centre. Testing of the soils at 0.5 m below surface was conducted by GHD (2009) as part of the Geotechnical Investigation. Permeability measurements of 3 to 4 m/day were recorded, but permeability for design purposes was estimated at 1 m/day “based on correlation of the material classification with published data” (GHD, 2009).

Based on anecdotal evidence, a permeability of 1 m/d may be considered high, ponding on the soil surface occurs as rainfall commences.

It has been assumed that the soil has little to no capacity for infiltration and that 80% of rainfall failing on the post development Town Centre becomes runoff.

2.7.3 Groundwater Quality

Little data is available for groundwater quality. Nearby groundwater bores to the north of the Town Centre (one a garden irrigation bore and the other for livestock) indicated salinity greater than 4,000 mg/L.

2.8 Wetlands

No Environmental Protection Policy (EPP) or Conservation Category wetlands are located within or near the Study Area. No sensitive receiving environments are downstream of the Study Area.

2.9 Acid Sulphate Soils

According to mapping published by the Department of Environment and Conservation (2008), the Study Area is mapped as having low risk of having Acid Sulphate Soils (ASS) occurring less than 3 m from surface (DoEC, 2008). Regional Acid Sulphate Soil mapping is shown in Figure 11.

2.10 Water Resources

Opportunities for water extraction from the superficial formation are limited and groundwater is of poor quality due to salinity.

The DeGray River wellfield and Yule River wellfields supply water to the Port Hedland region, operated by the Water Corporation, and protected by a Water Source Protection Plan (WRC, 2000). The development area is greater than 75 km from the DeGray River Wellfield and 50 km from the Yule River Wellfield.

The water supply will be from the existing mains pipe network.

3. PROPOSED DEVELOPMENT

The proposed development plan (RPS et al, 2008) for the Study Area is shown in Figure 12. The development plan covers the whole of the South Hedland Town Centre (both Eastern and Western Precincts) and shows that land use in the proposed development will consist of:

- The existing Town Centre commercial area (between Throssell Road and Forrest Circle);
- Retail areas between and bordering Rason Court, Throssell Road and Colebatch Way;
- Public purpose areas (hospital and police station);
- Residential areas within the southern section on the Eastern Precinct and in the Western Precinct;
- Community areas within the eastern section.

Key elements of the structure plan relating to water management include:

- Proposed drainage swales located in the road reserves along Rason Court;
- Modification of the existing eastern flood storage area into three separate areas, with an additional connection to the Forrest Circle north drain;
- Upgrade of the Forrest Circle north drain between Nairn Street and Cottier Drive to increase capacity;
- Maintenance of the existing key discharge points from the Study Area to the receiving environment.

Figure 13 shows the topography of the existing and the modified flood storage areas. It can be seen that due to the realignment of Hunt St and removal of Leake St and the additional east-west road, that the flood storage area has been reduced in size. While this change has reduced the storage capacity of the flood storage area compared to the existing area, the upgrade to the Forrest Circle north drain results in greater storage within the drain. Overall, the proposed changes result in an increase in storage of approximately 3,000 m^3.

4. LOCAL WATER MANAGEMENT STRATEGY

The proposed Local Water Management Strategy for the Study Area is outlined in this chapter. It includes discussions regarding water use and conservation, and details key elements of groundwater, surface water and water quality management with respect to demonstrated best management practice in water sensitive design.

Issues related to implementation are discussed in Chapter 5.

4.1 Water Use & Sustainability Initiatives

The supply and sustainable use of water within the proposed development are key components of the management strategy.

4.1.1 Water Sources

Scheme water is proposed to service the Town Centre. A development scale water reuse scheme is not planned for the Study Area.

4.1.2 Water Conservation

Development of the Study Area will lead to an increased demand for water. Potential water conservation measures can be implemented to reduce scheme water consumption within the development, consistent with Water Corporation's "Waterwise" land development criteria, and include:

- Promotion of use of waterwise practices including water efficient fixtures and fitting (taps, toilets and appliances, waterwise landscaping).
- Use of native vegetation requiring no/less irrigation in proposed drainage swales.
- Recharge of the groundwater to improve salinity concentration by on site infiltration of fresh stormwater in drainage swales. While infiltration is expected to be low due to low permeability of the soil strata, there may be some periods when inundation to some degree may exist for several days. This minor infiltration of low salinity water will provide some dilution of the existing groundwater salinity.
- Rainwater tanks as one method of collecting roof stormwater for possible reuse. However given the low rainfall pattern of the region, viability will need to be assess prior to implementation.

Specific measures to achieve water conservation and will be detailed in the UWMP.

4.1.3 Non Potable Water Supply & Water Balance

A water balance at the LWMS stage is generally requested to support the identification of excess water generated by the development for potential use as a non potable water supply scheme.

Post development groundwater levels in the Study Area are unlikely to rise as there will be an increase in impermeable areas. The northern section of the Study Area is already developed, and so the water balance will not change from existing. In the southern section, areas which are currently vacant land will

be developed into residential land between R40 and R80 densities. It is expected that runoff will increase from these areas. Infiltration from the temporary flood storage area between Rason Court and Colebatch Way will be maintained via the proposed swales along Rason Court.

As such, rainwater tanks have been identified as a non-potable source to be integrated as part of the water supply scheme to assist in reducing excess stormwater generation and minimise scheme water importation. Sizing of rainwater tanks will be provided at UWMP stage, commensurate with requirements of building design and DoW (2007).

4.2 Surface Water Management

Management of the surface water in the study area following development involves mitigating the impacts from flooding and designing a suitable stormwater system.

4.2.1 Regional Flood Management

A flood study was performed for the Town Centre area, and has been included in Appendix B. This study details the development of a MIKEFLOOD model which simulates runoff of rainfall during storm events.

The MIKEFLOOD model provides estimates of flood levels within the Forrest Circle drainage channels and flood storage areas, and allows the impact of development to be quantified.

With the proposed upgrades to drainage infrastructure (discussed below), it was found that the proposed development and upgrades resulted in a lower flood risk to the existing residents located to the north east of the Town Centre.

The study also allowed for the setting of lot levels within the Town Centre.

The area west of Hamilton Rd is likely to be developed in future stages of development. The MIKEFLOOD model has used a runoff coefficient of 80% for the whole of the Town Centre area to allow for future development of this area. This has allowed the capacity of the drainage system to be assessed to discharge this area.

4.2.2 Local Flood Management

Local stormwater management is proposed to be undertaken consistent with water sensitive design practices and meet key objectives and criteria as detailed in Table 1.

The stormwater drainage system will be designed using a major/minor approach. The minor drainage system is defined as a swale and road drainage system designed to carry runoff generated by low frequency ARI storms, less than 5 year ARI. In some areas pipework will be required – this is discussed in the next section. The major drainage system is defined as the arrangement of roads and drainage reserves to provide safe passage of stormwater runoff from extreme events which exceeds the capacity of the minor system.

Stormwater runoff generated by the lots and impervious areas of the road reserve will be collected in swale system or flood storage areas.

Opportunities for infiltration are limited due to the low permeability of the soil strata. Infiltration options such as soakwells and bottomless manholes are not appropriate in this hydrogeological setting and are not proposed here. Some areas on lots will be used to provide local attenuation of flow prior to discharge to the stormwater conveyance system. Up to the first 16 mm of rainfall will be stored and released at low flow rates.

Given the nature of the existing environment and the limited infiltration capacity, it has been assumed that the existing runoff coefficient is 80%. A similar value has been used for the post development environment, though with a reduced roughness coefficient for the impermeable surfaces.

All stormwater swales areas are proposed to be ephemeral and no open water body lakes are proposed, consistent with the DoW's current policy.

4.2.3 Conceptual Stormwater System Design

The proposed water management system is shown in Figure 14.

The main components to the management system:

- Swale system along Rason Court;
- Modification of the existing flood storage area in eastern section;
- Upgrade of Forrest Circle North Drain between Nairn St and Cottier Dr;
- Pipework system to control road gutter flows.

A swale system along Rason Court is proposed. This will drain westwards towards Hamilton Road. This will be a shallow roadside drain, joined by culverts at road crossings. The area west of Hamilton will be developed as POS, incorporating drainage. Until this occurs, a temporary drainage channel will be required to allow discharge of stormwater to South Creek (Figure 14). This will be designed as a swale drain, with 1 in 6 side slopes.

The existing flood storage area adjacent to Leake Street will be modified due to the realignment of roads, including the extension of Hunt Street through the existing storage area. The existing outlet to Forrest Circle North Drain will be retained, and a second added to the isolated southern storage area to allow it to drain.

To improve drainage from these flood storage areas, it was proposed that a section of the Forrest Circle North Drain be upgraded to provide greater storage and flow capacity, and several sets of culverts under road crossings be upgraded to provide greater flow capacity. Figure 15 shows a schematic of the proposed cross section of the modified drainage channel. It can be seen that the proposed channel has two levels, which has the result of opening out the channel compared to the existing channel. The culverts under Hunt St and Cottier Dr are proposed to be upgraded, with an increase in the number of culverts. Details are provided in the Flood Study in Appendix B. Figure 16 shows a conceptual cross section for the proposed flood storage area and swale drain along Rason Court.

Event plans for the 1, 5 and 100 year ARI storm events are shown in Figure 17.

The Forrest Circle North Drain provides storage within the channel itself, as several of the culverts under road crossings are higher than the channel invert, requiring water to pond before further flow can occur.

A pipework system will be required to drain trapped lows in the road system where constraints of existing infrastructure prevent grading to swale drainage systems. These pipework systems will discharge to the proposed swales and flood storage areas.

4.3 Groundwater Management

As discussed in Section 2.6, there is little groundwater data available. However observational evidence indicates that maximum groundwater levels are less than 11 m AHD on the southern boundary of the Town Centre and less than 9 m AHD on the northern boundary. As minimum road levels in the southern sector are approximately 12.7 m AHD and lot levels are 13.0 m AHD, there is at least 2 m of clearance from lot levels to groundwater. Lot and road levels are similar in the northern section so therefore clearance to groundwater is greater. The geotechnical investigation (Coffey, 2010) did not encounter groundwater to a depth of 2.5 m below natural surface. As there is at least 2 m of clearance to groundwater from lot levels, subsoil drainage is not required.

Department of Water have set a requirement that if the depth to groundwater is less than 4 m, monitoring bores should be installed to establish groundwater levels. As available data only extends to a depth of 2.5 m, monitoring bores will be installed and results reported in the UWMP.

The geotechnical report (Coffey, 2010) suggests that soakwells would not be effective for disposal of stormwater runoff due to the high percentage of fines in the soil, limiting its infiltration capacity.

While this LWMS establishes criteria and the general approach for setting development levels, finished lot levels and fill requirements are a detailed design issue and will addressed during preparation of Urban Water Management Plans (UWMP's) and submitted for council approval at this stage.

4.4 Erosion & Sedimentation Management

The erosion potential in channels and overland flow paths can be estimated based on the velocity of flow during storm events. Flow velocity can therefore be used to identify areas where stabilization of channels will be required.

The geotechnical investigation of the Study Area (Coffey, 2010) found that the soils are classed as silty sands (topsoil), overlying silty/clayey sands, with between 20 to 40% fine material (silt and clay). French (1985) indicates that for these soil types, erosion will start to commence at velocities greater than 0.8 to 1.1 m/s.

Figure 18 shows maximum flow velocities for the critical 5 year ARI event. It can be seen that across the majority of the Study Area, flow velocities are less than 0.2 m/s. In some areas, usually road reserve areas, flow velocities are higher, but still less than 0.5 m/s. In a few areas maximum flow velocities of up to 1.0 m/s occur, but are very localised.

Outside of the Study Area, flow velocities are mostly less than 0.2 m/s. Higher velocities are generally seen in the Forrest Circle Drainage Channel or the proposed central outlet channel west of Hamilton Rd. Again, flow velocities are generally less than 1.0 m/s.

There are several areas which have higher flow velocities, primarily around culvert structures, as would be expected. These are areas where bank and channel stabilisation works, such as concrete wing walls and rock / concrete bedding, would be incorporated to minimise erosion and scour.

Erosion control measures suggested by AgWA (2001) include:

- Drop structures;
- Sediment traps;
- Vegetation stabilisation;
- Mulching;
- Geomat® type products;
- Geocell® type products;
- Rip-Rap type drain lining;
- Reno Mattresses;
- Revetment mattresses; and
- Rock Gabions.

These may be used in the Forrest Circle drainage channel to protect drain batter slopes against steep flow into the channel and from flows in the channel.

4.5 Wetland Management

As previously discussed in Section 2.7, there are no EPP or Conservation Category Wetlands located within or downstream of the Study Area. No specific strategy for protection of wetlands is therefore required for this development.

4.6 Water Quality Management

With respect to water quality management the LWMS proposes that the use of swales is appropriate treatment for minor events in the Pilbara region.

- **Non Structural Controls**
  Planning practices (wide road reserves to accommodate dedicated drainage swales)
  Construction practices (construction management, use of appropriate native plantings)
  Maintenance practices (of the swale systems)

- **Structural Controls**
  Infiltration of frequent events where possible (swales)
  Use of vegetated swales

Other water quality parameters such as oils, grease and hydrocarbons are considered to be treated by structural controls as specified by the Town of Port Hedland.

The current land use is some existing urban / commercial areas and vacant land with sparse vegetation. Vacant areas are unfertilised. Some grass verges on commercial lots may be fertilised. The change in land use will result in urbanisation of the remaining vacant lots with mostly impermeable surfaces, so there is likely to be little change in land use.

Existing POS are expected to remain the same or be reduced slightly, so there should be little change in nutrient loading for these areas.

It is therefore predicted that there will be little change in current nutrient loading within the Study Area.

4.7 Construction Management

The presence of groundwater and acid sulphate soils will require management during construction of the proposed development.

4.7.1 Dewatering

Dewatering is unlikely to be required for subdivision construction. Given the depth of construction (maximum depth of RL 8.8 m AHD), any dewatering will be minimal and only be in the surface groundwater. As the volume of any dewatering is likely to be minor, and this water is to be infiltrated back into the surface groundwater, the overall impact on the aquifer will be minimal.

Drawdown will occur at the dewatering site, and mounding where the water is infiltrated. It should be noted that there will be zero net loss of groundwater, as all water abstracted will be infiltrated (except for minor losses to evaporation).

JDA understand that prior to the commencement of any dewatering, the construction contractor will apply for and obtain from DoW a "Licence to Take Water". All dewatering will be carried out in accordance with the conditions of this licence.

Where possible, construction will be timed to minimise impacts on groundwater and any dewatering requirements.

4.7.2 Acid Sulphate Soils

As previously discussed in Section 2.7, there is low risk of ASS being present within the Study Area.

4.8 Water Management Strategy Summary

Table 3 provides an overall summary of key elements of the proposed water management strategy for the Study Area, with an assessment of the strategy in relation to DoW (2007) principle objectives for stormwater management in Western Australia (Section 1.2.4).

TABLE 3: SUMMARY OF PROPOSED LOCAL WATER MANAGEMENT STRATEGY

Principle	Key LWMS Elements
Water Quantity To maintain the total water cycle balance within development areas relative to the pre-development conditions.	• Maintain flow paths for existing catchments • Maintain or reduce 100 year ARI peak flood levels from the Study Area
Water Quality To maintain or improve the surface and groundwater quality within development areas relative to pre-development conditions.	• Change in land use and WSUD to reduce nutrient input in the Study Area. • Maintain 1 in 1 year ARI event post development discharge volume and peak flow rates relative to pre-development conditions • Application of source controls – including street sweeping, native plantings. • Application of structural controls – retention/detention areas, swales.
Water Conservation To maximise the reuse of stormwater	• Encourage implementation of water efficiency and demand management measures in and ex-building. • Use of native plantings in swale and drainage areas to minimise irrigation
Ecosystem Health To retain natural drainage systems and protect ecosystem health	
Economic Viability To implement stormwater systems that are economically viable in the long term	• Use of proven structural WSUD technology • Use of source control techniques to minimise cost of nutrient management
Public Health To minimise the public risk, including risk of injury or loss of life to the community	• Design in accordance with relevant design standards, best management practices, council regulations and government agency requirements.
Protection of Property To protect the built environment from flooding and waterlogging	• Identification of 100 year ARI flood levels for Study Area • Protection of downstream areas by restricting stormwater discharge to existing levels for storm events up to 100 year ARI
Social Values To ensure that social aesthetic and cultural values are recognised and maintained when managing stormwater	• Use of swales within public areas for stormwater conveyance • Integration of drainage and POS functions
Development To ensure the delivery of best practice stormwater management through planning and development of high quality developed areas in accordance with sustainability and precautionary principles.	• Urban water management in accordance with Better Urban Water Management (WAPC, 2008) • Development of the LWMS in accordance with government agency guidelines and best management practice recommendations

5. IMPLEMENTATION

Implementation of the Local Water Management Strategy involves defining the roles and responsibilities of the developer and local authority, outlining further documentation required to support the development and defining operation, monitoring and maintenance of the stormwater system.

5.1 Roles and Responsibilities

Table 4 details the roles and responsibilities to undertake the implementation plan.

The operation and maintenance of the stormwater management system will be the responsibility of the developer within the Study Area and the parties responsible for the existing rural swale outside of the Study Area initially. Responsibility for all areas will ultimately be reverted to the local authority. Preparation of the UWMP will be the responsibility of the developer.

TABLE 4: IMPLEMENTATION RESPONSIBILITIES

IMPLEMENTATION		RESPONSIBILITY	
LWMS Section	**Action**	**Developer**	**Town of Port Hedland**
5.2	Preparation of an Urban Water Management Plan to support subdivision	✓	
5.3	Construction of stormwater system	✓	
5.3	Stormwater system operation and maintenance		✓

5.2 Subdivision Process

A UWMP for the Study Area may be required by the Department of Water. If so, then a UWMP will be submitted by the Developer to the Department of Water and the Town of Port Hedland as required under relevant conditions of subdivision. Preparation of the UWMP will take into consideration *Urban Water Management Plans: Guidelines for preparing plans and complying with subdivision conditions* (DoW 2008). The UWMP will address:

- Detailed stormwater management design including the size, location and design of swales, integrating major and minor flood management capability, landscape plants for the swales as related to stormwater function, specific details of local geotechnical investigations and their impact on stormwater design;
- Detail measures to reduce velocity of stormwater discharge to prevent erosion and sediment transportation.
- Management of groundwater levels, and if any proposed dewatering is necessary;
- Agreed/approved measures to achieve water conservation and efficiencies of use including sources of water for non-potable uses and detailed designs, controls, management and operation of any proposed system;
- Management of sub-divisional works (management of soil/sediment including dust);

5.3 Stormwater System Operation and Maintenance

Operation and maintenance of the drainage system will be the responsibility of the Town of Port Hedland. The surface drainage system will require routine maintenance to ensure its efficient operation. It is considered the following operating and maintenance practices will be implemented periodically:

- removal of debris to prevent blockage of culverts;
- cleaning of sediment build up and litter layer on the bottom of swales;

A summary of the proposed maintenance schedule is presented in Table 5 below.

TABLE 5: MAINTENANCE SCHEDULE FOR DRAINAGE INFRASTRUCTURE

Item	Maintenance Interval	
	Biannually	**As required**
Swales		
Inspect for erosion + sediment accumulation	✓	
Assess health of vegetation. Remove dead plants and replace where necessary.	✓	
Removal of sediment and leaf litter layer build up.		✓

5.4 Monitoring Program

The stormwater management system outlined in this LWMS focuses on implementation of current known best management practice without the requirement of a post development monitoring program.

6. REFERENCES

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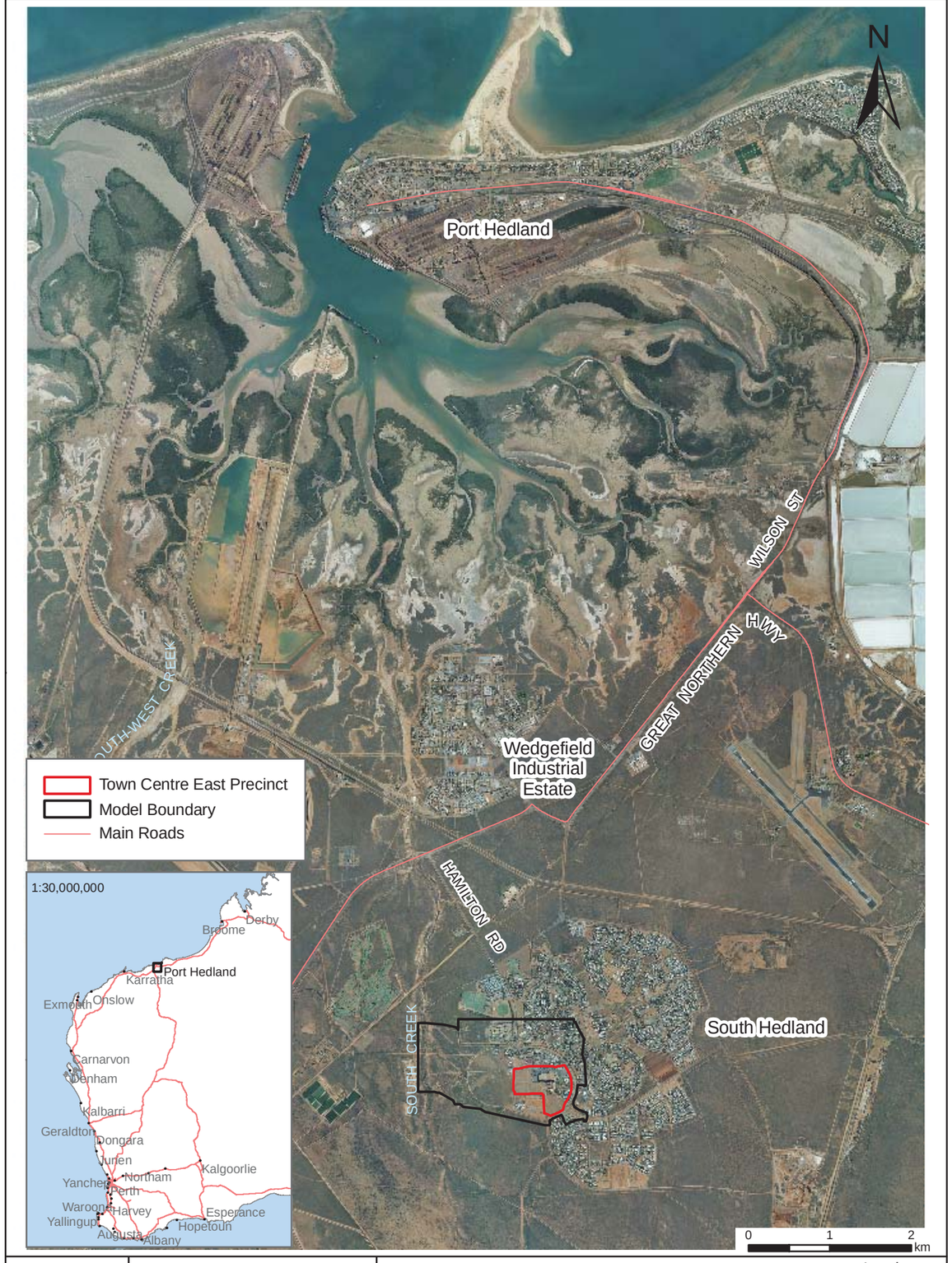
FIGURES



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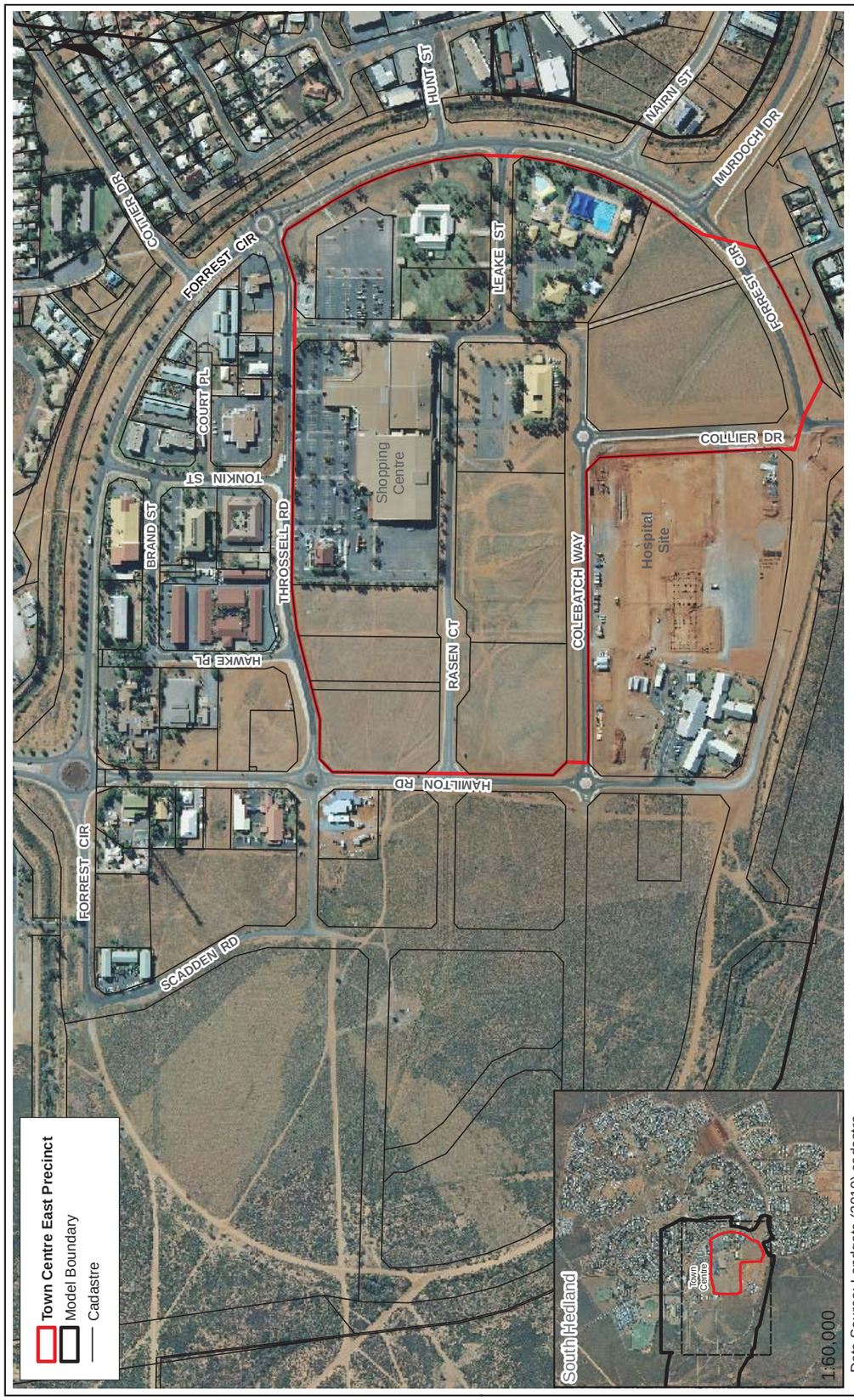
South Hedland Centre Revitalisation: Flood Modelling

Figure 1: Location Plan



Data Source: Landgate (2010) cadastre

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Figure 2: Study Area

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Scale:1:6,000

0 100 200 300 400 Meters

1 Example of fringing vegetation along Forrest Circle Drainage Channel

2 Looking south-east (Existing Native Vegetation).

3 Looking westwards down Brand St (existing commercial).

4 Eastern detention basin from Leake St.

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Job No. J4381
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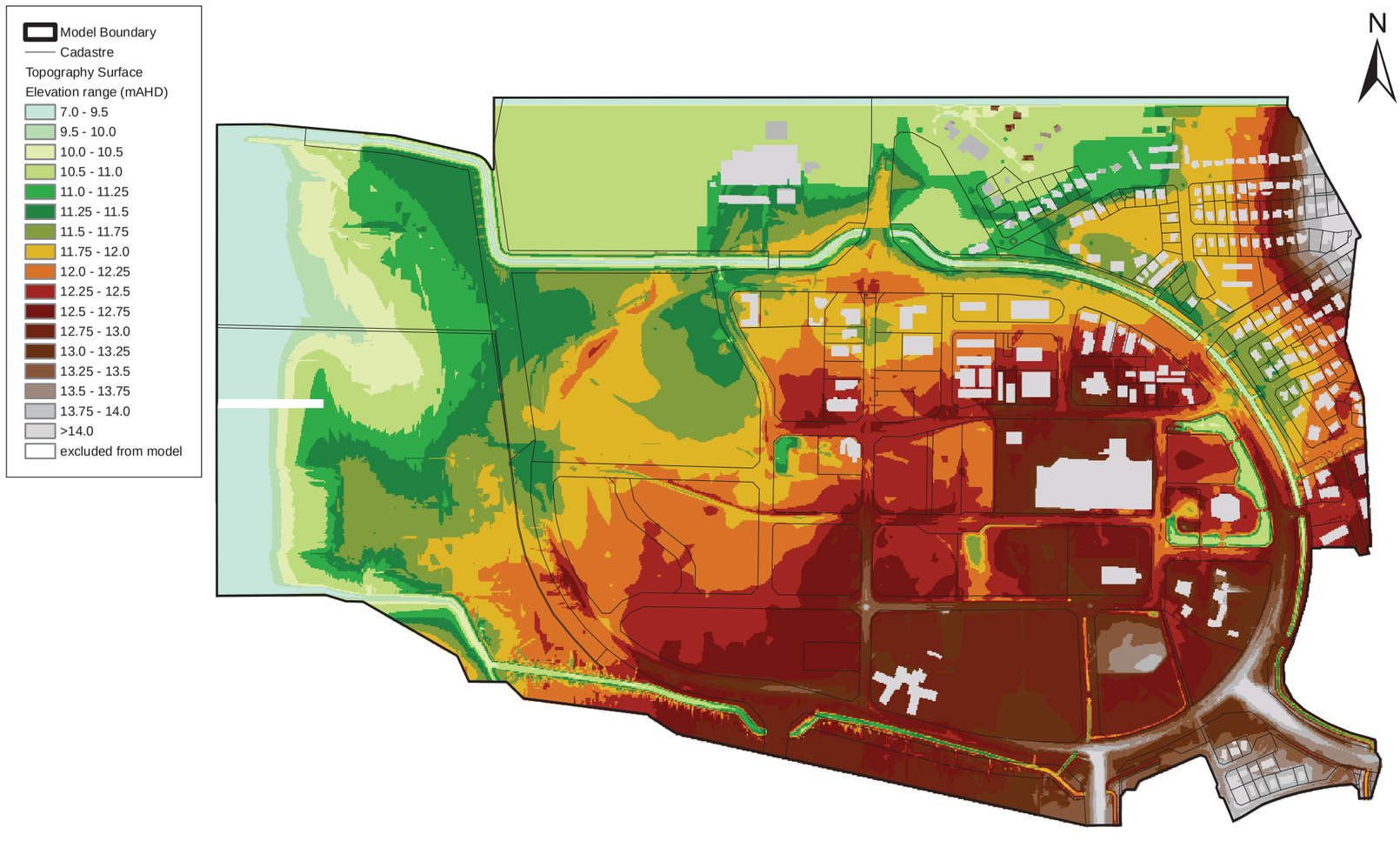
0 100 200 300 400 Meters

Lancorp
South Hedland Town Centre Revitalisation: Flood Modelling
Figure 11: Examples of Land Uses



Data Source: Derived from Topographic Survey (MAPS, 2010)

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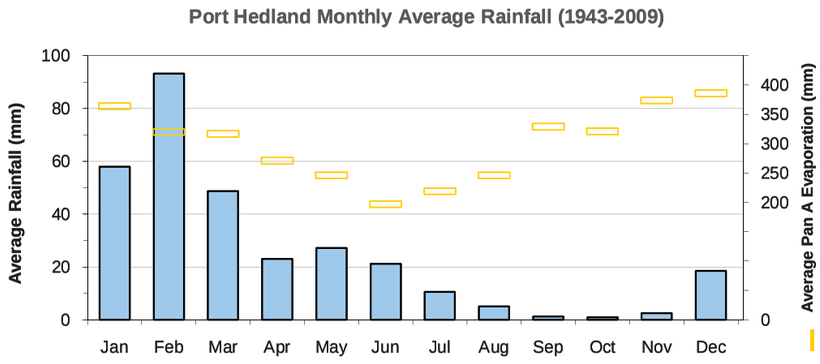
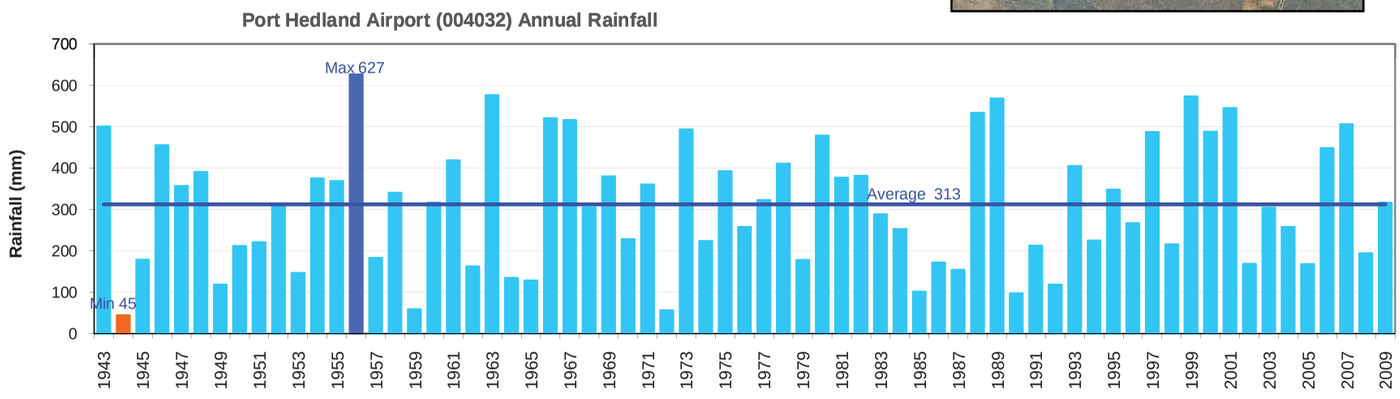
0 100 200 300 400 Meters

Land Corp
South Hedland Town Centre Revitalisation: Flood Modelling
Figure 12: Topographic Grid (Existing)





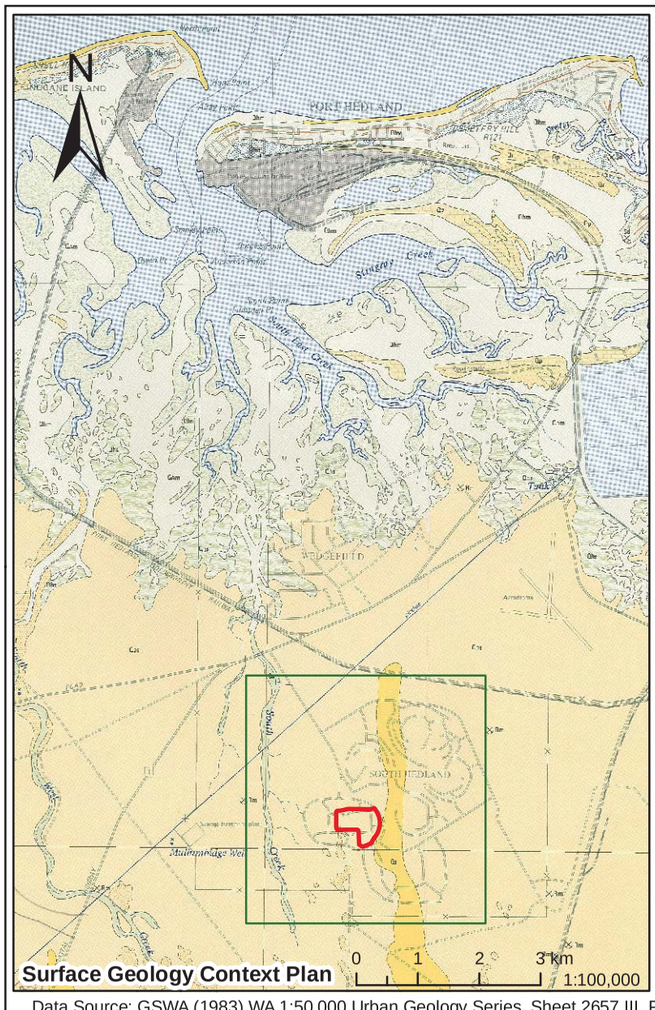
Data Source: Bureau of Meterorology (2010) Climate Data Online. Luke et al (2003) Average monthly Pan A Evaporaiton.

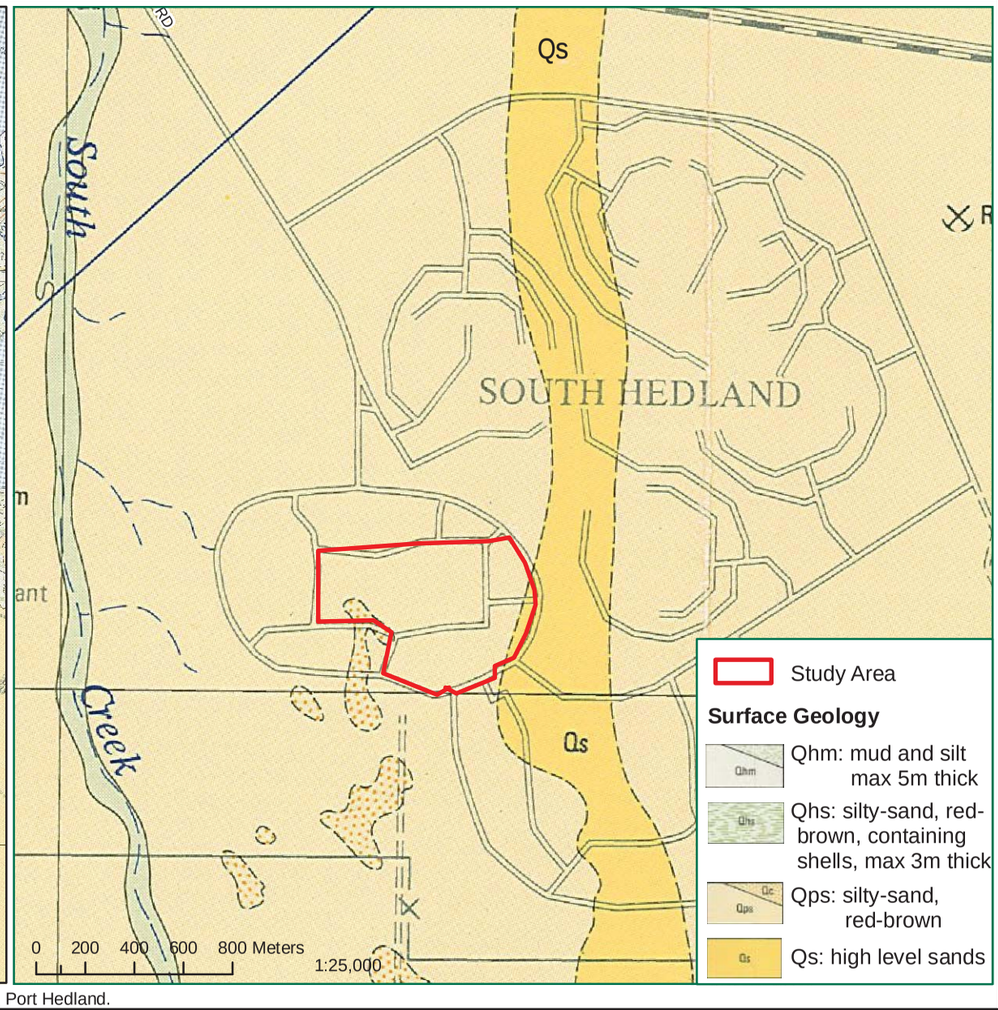
Job No. J4723

Landcorp

Sout Hedland Town Centre Revitalisation East Precinct: LWMS

Figure 5: Port Hedland Airport Rainfall Data





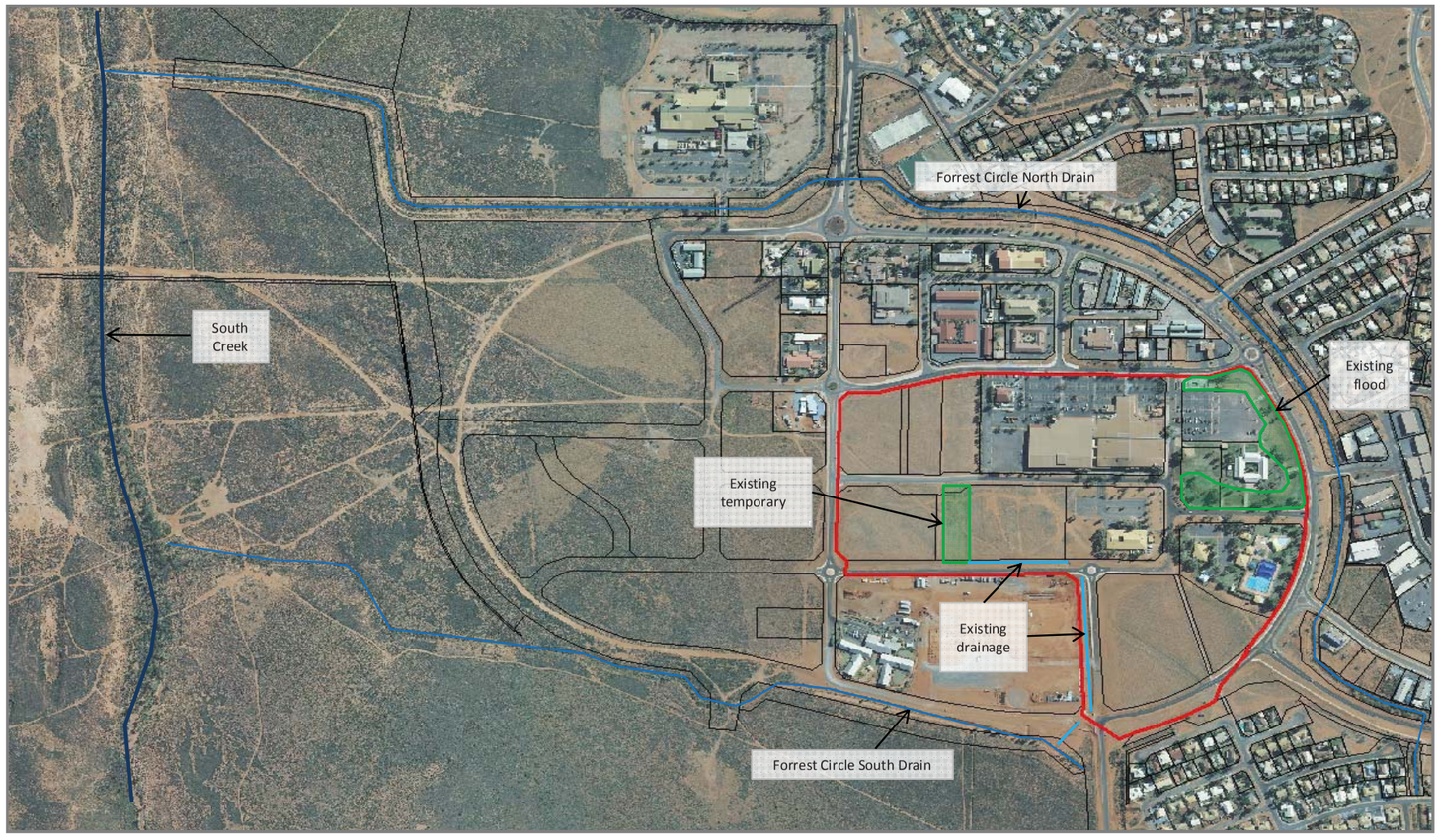
Data Source: GSWA (1983) WA 1:50,000 Urban Geology Series, Sheet 2657 III, Port Hedland.

Job No. J4723

Landcorp

South Hedland Town Centre Revitalisation - East Precinct: LWMS

Figure 6: Surface Geology



Job No. J4723
Scale

N

LandCorp
South Hedland Town Centre Revitalisation - East Precinct: LWMS
Figure 7: Existing Local Surface Drainage

1 Looking west at Hamilton Rd, upstream of culvert.

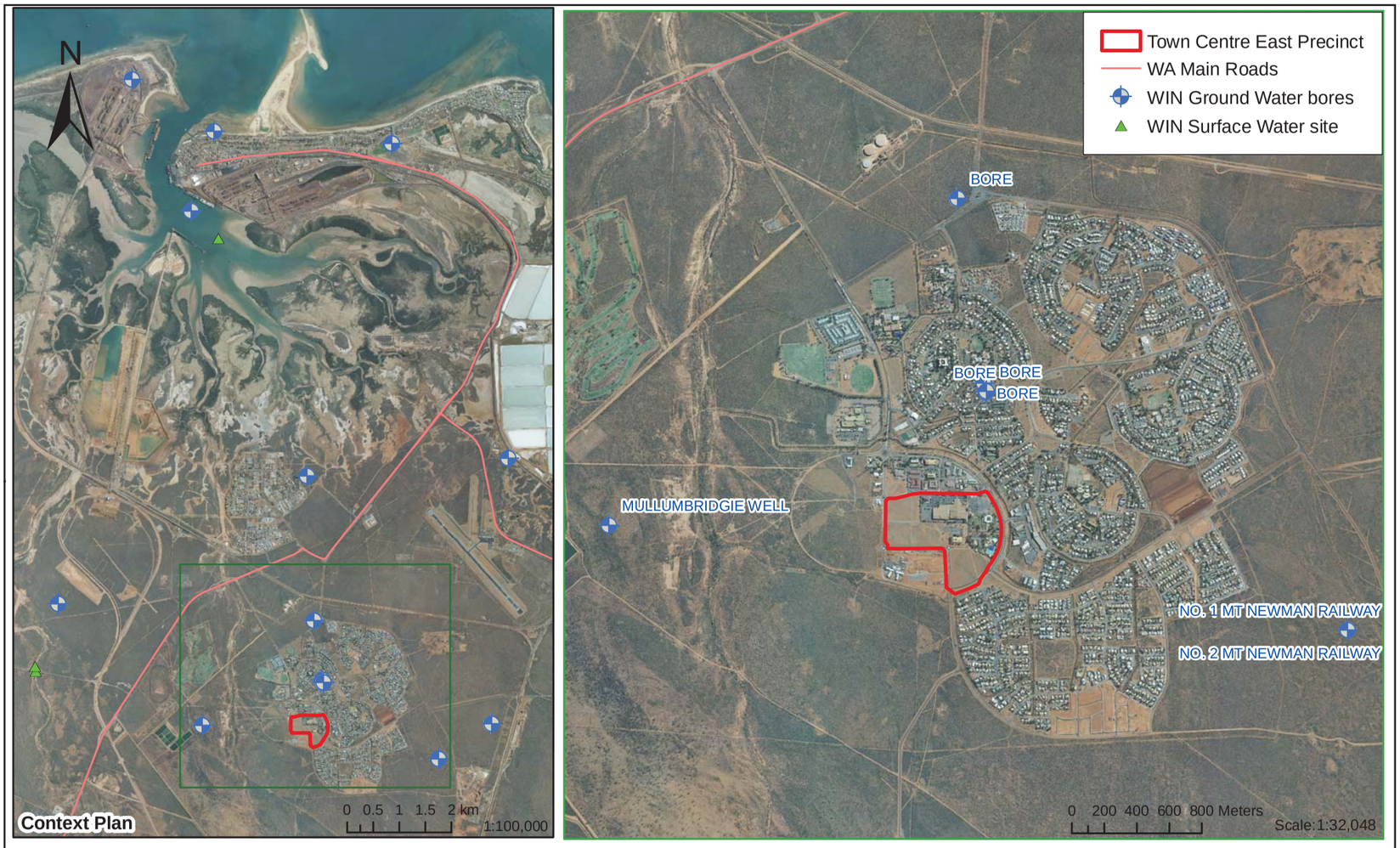
2 Looking north-west at track crossing, upstream of culvert.

3 Looking south-west towards Forrest Circle (South) culvert.

4 Looking south-east at Hunt St culvert, downstream end.

Job No. J4381
Scale: 1:12,250
0 100 200 300 400 Meters

Landcorp
South Hedland Town Centre Revitalisation: Flood Modelling
Figure 14: MIKE11 Structure Locations and Photos



Data Source: DoW (2010) WIN Database

Job No. J4723

Landcorp
South Hedland Town Centre Revitalisation - East Precinct: LWMS
Figure 9: Groundwater Bores

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Scale

N

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South Hedland Town Centre Revitalisation - East Precinct: LWMS
Figure 10: Location of Low Surface Elevation

Data Source: DEC (2008) ASS Risk Mapping - Pilbra

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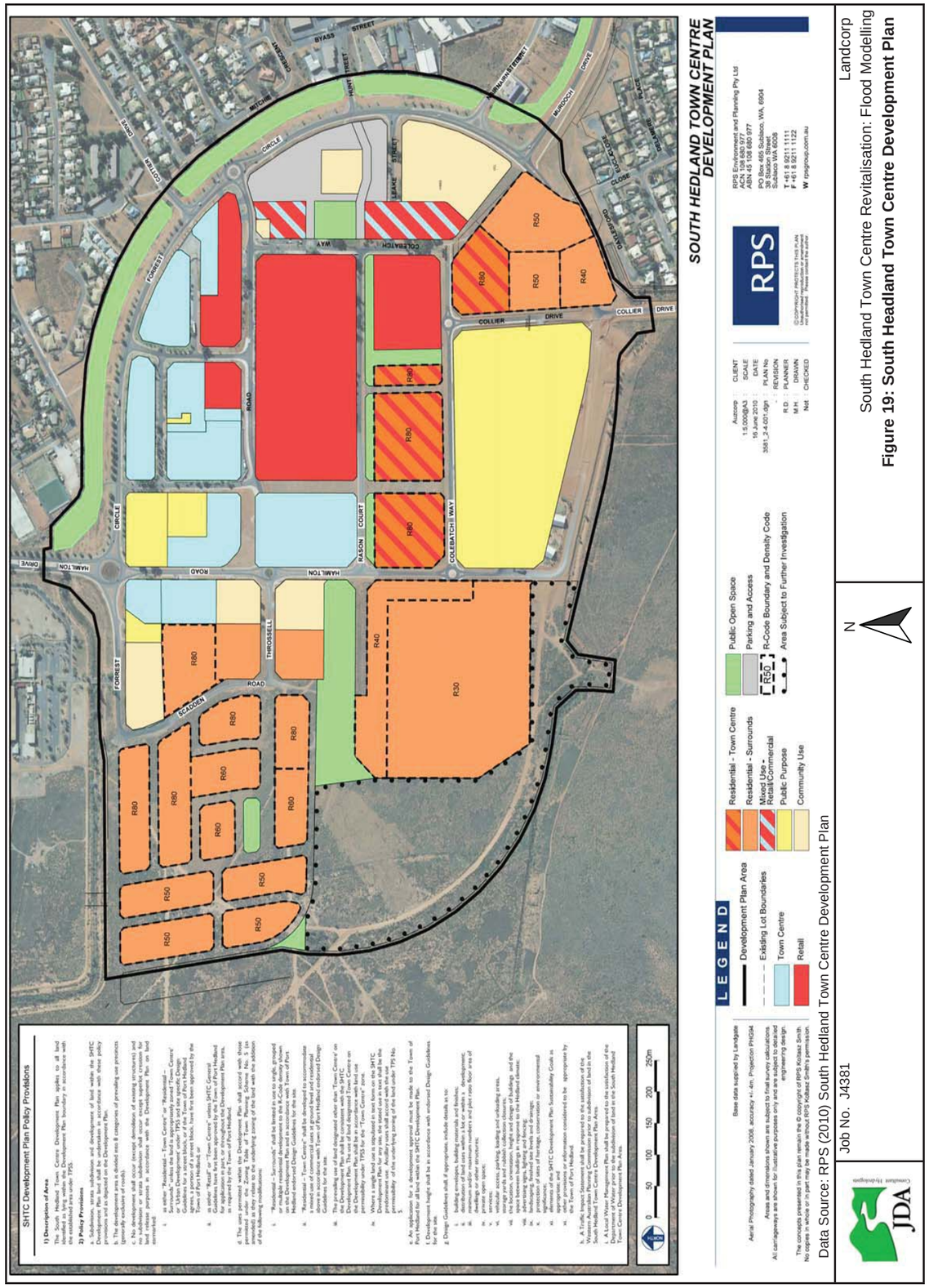
Scale 1:60,000

Landcorp
South Hedland Town Centre Revitalisation - East Precinct: LWMS

Figure 11: Acid Sulfate Soil Mapping



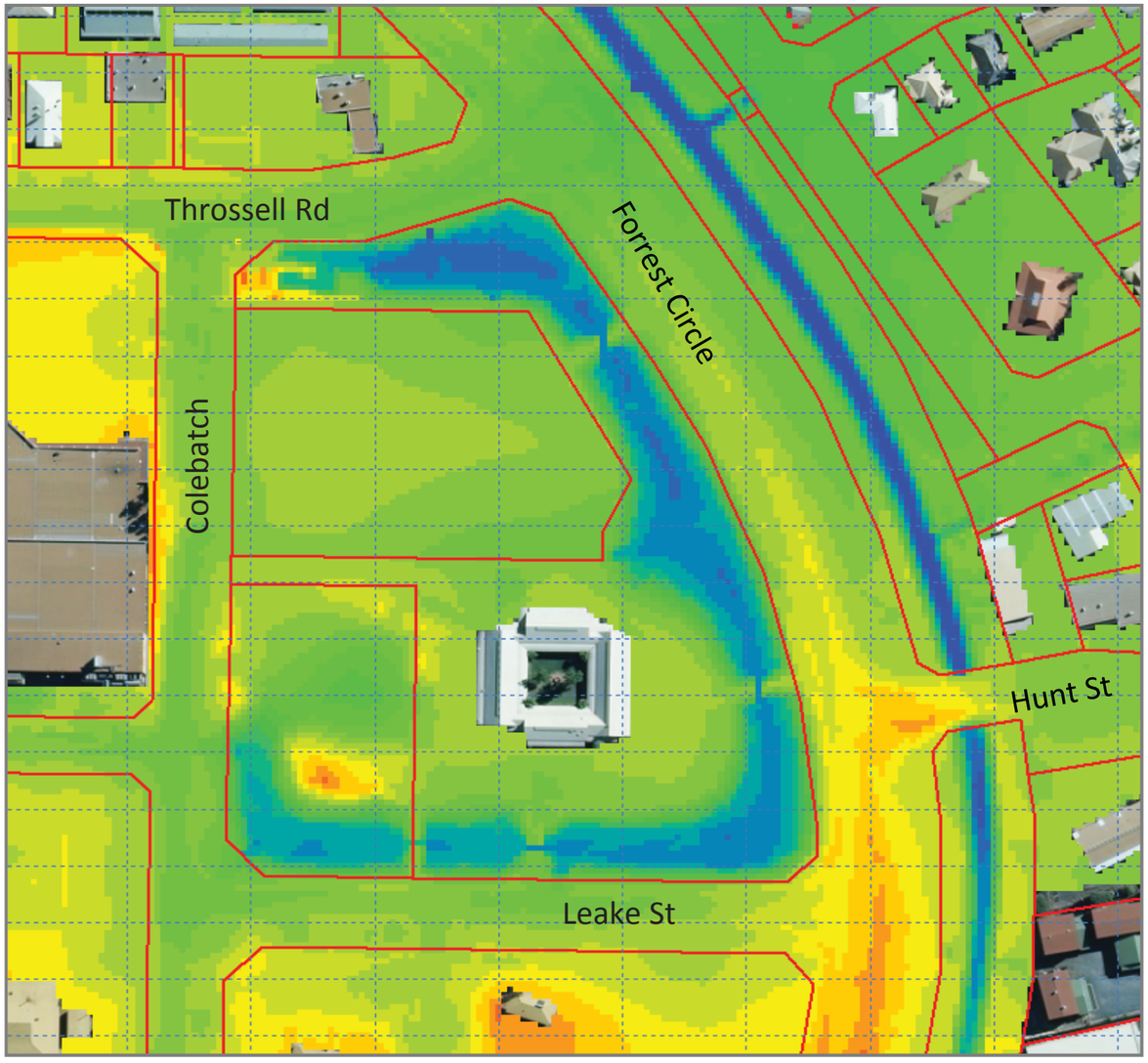
Landcorp
South Hedland Town Centre Revitalisation: Flood Modelling

Figure 19: South Headland Town Centre Development Plan

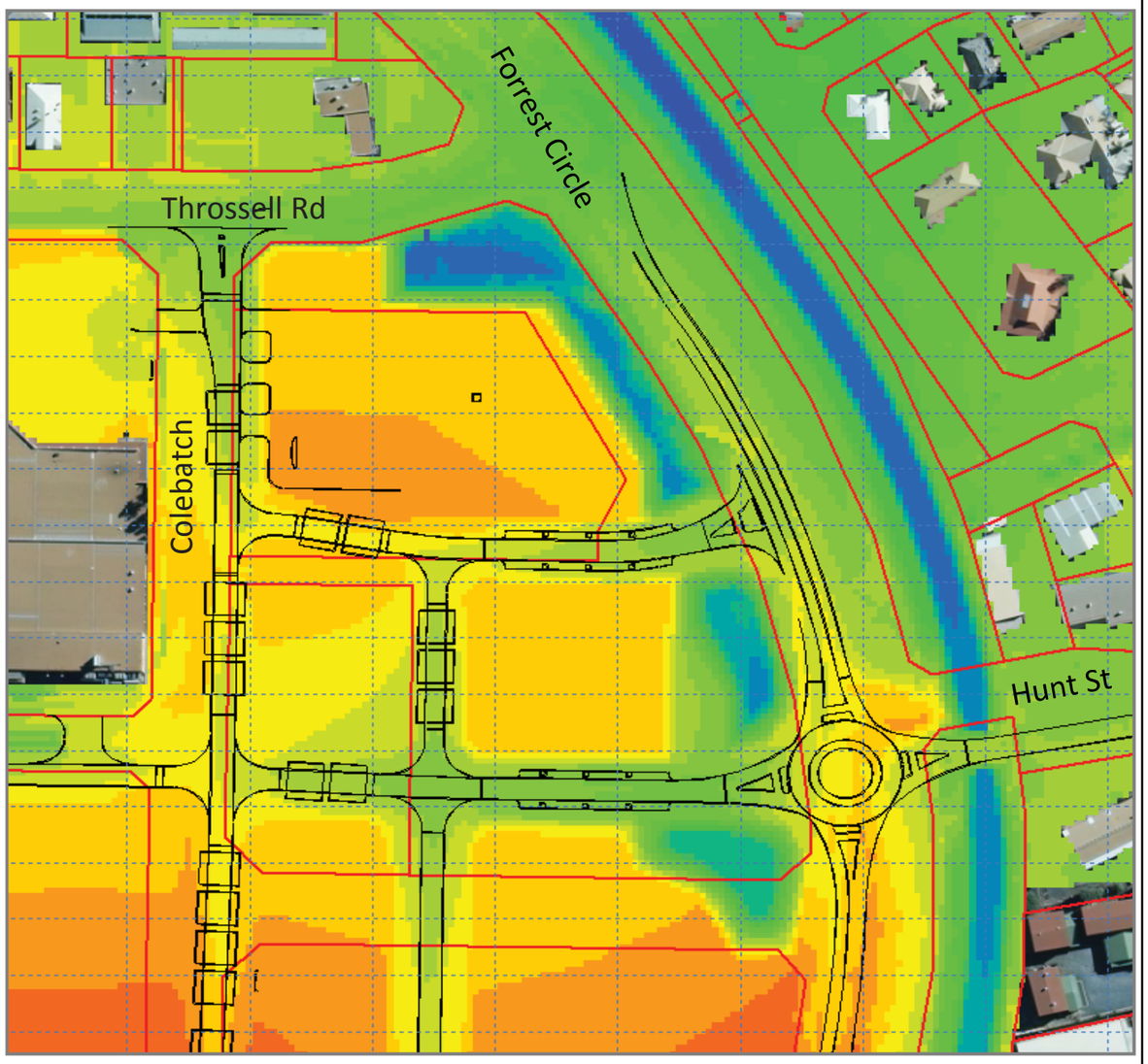
Data Source: RPS (2010) South Hedland Town Centre Development Plan

Job No. J4381

Existing Basin



Proposed Basin



Topographic Elevation (mAHD)

Above 13.8	11.8 - 12.0	9.8 - 10.0
13.6 - 13.8	11.6 - 11.8	9.6 - 9.8
13.4 - 13.6	11.4 - 11.6	9.4 - 9.6
13.2 - 13.4	11.2 - 11.4	9.2 - 9.4
13.0 - 13.2	11.0 - 11.2	9.0 - 9.2
12.8 - 13.0	10.8 - 11.0	Below 9.0
12.6 - 12.8	10.6 - 10.8	Undefined Value
12.4 - 12.6	10.4 - 10.6	
12.2 - 12.4	10.2 - 10.4	
12.0 - 12.2	10.0 - 10.2	

Legend

- Existing Cadastral Boundaries
- Proposed Road Alignments

JDA Consultant Hydrologists

Job No. J4723
Not to Scale

LandCorp
South Hedland Town Centre Revitalisation - East Precinct: LWMS

Figure 13: Comparison of Existing and Proposed Flood Storage Area

Data Source: RPS (2010) South Hedland Town Centre Development Plan

Job No. J4381

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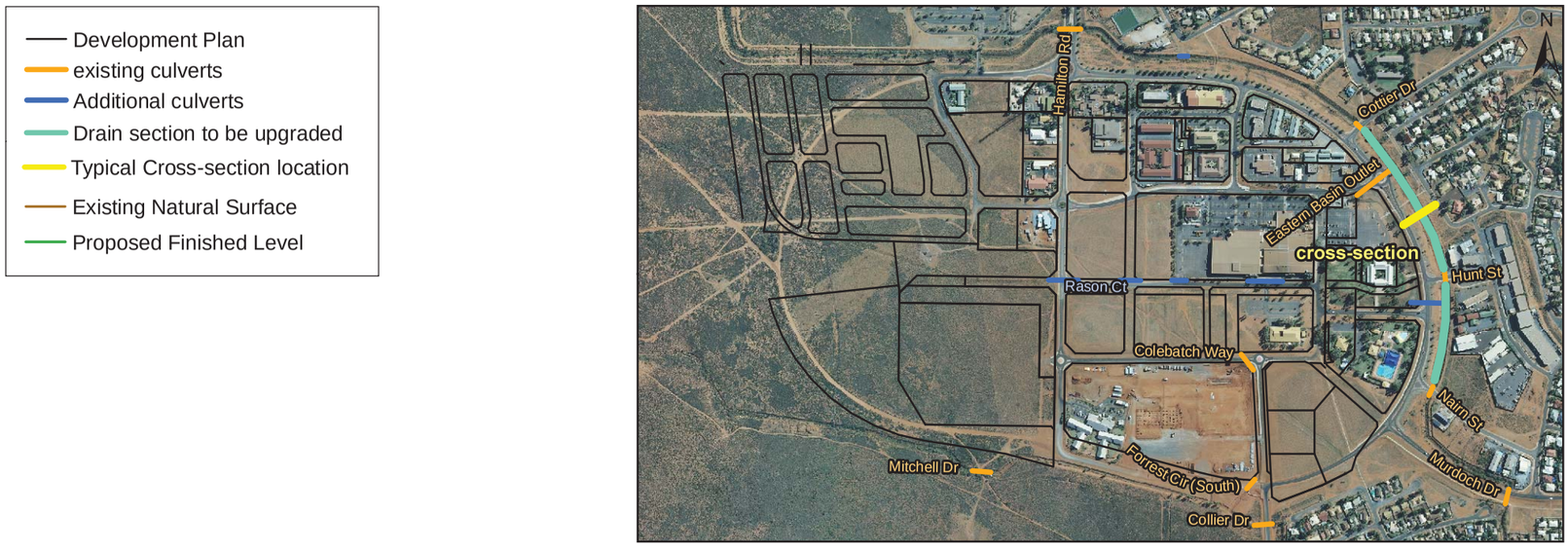
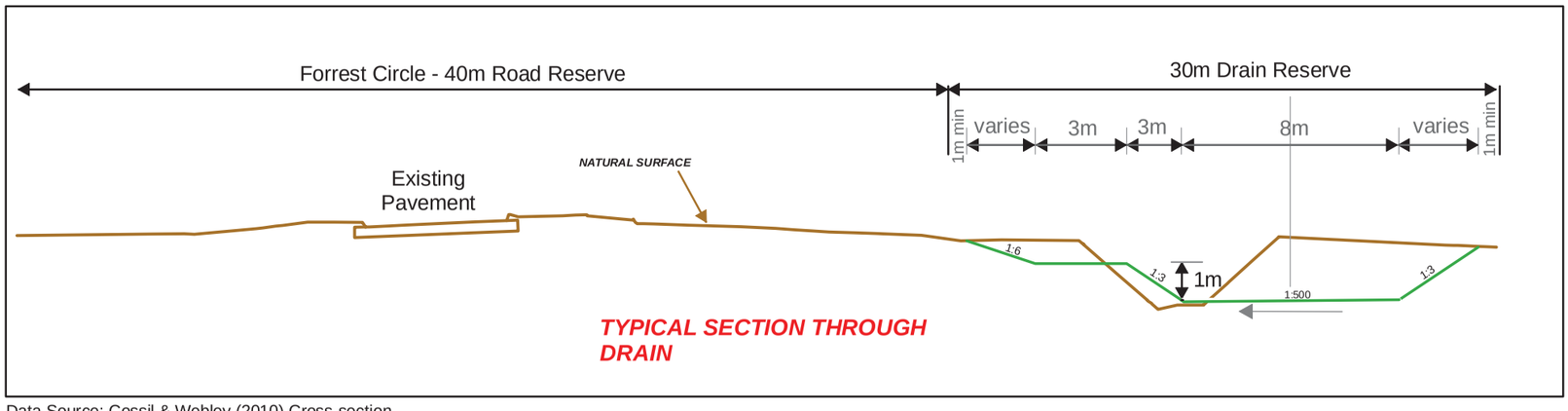
Landcorp

South Hedland Town Centre Revitalisation: Flood Modelling

Figure 19: S14h He5adland Town Centre Development Plan





Data Source: Cossil & Webley (2010) Cross-section

Job No. J4723

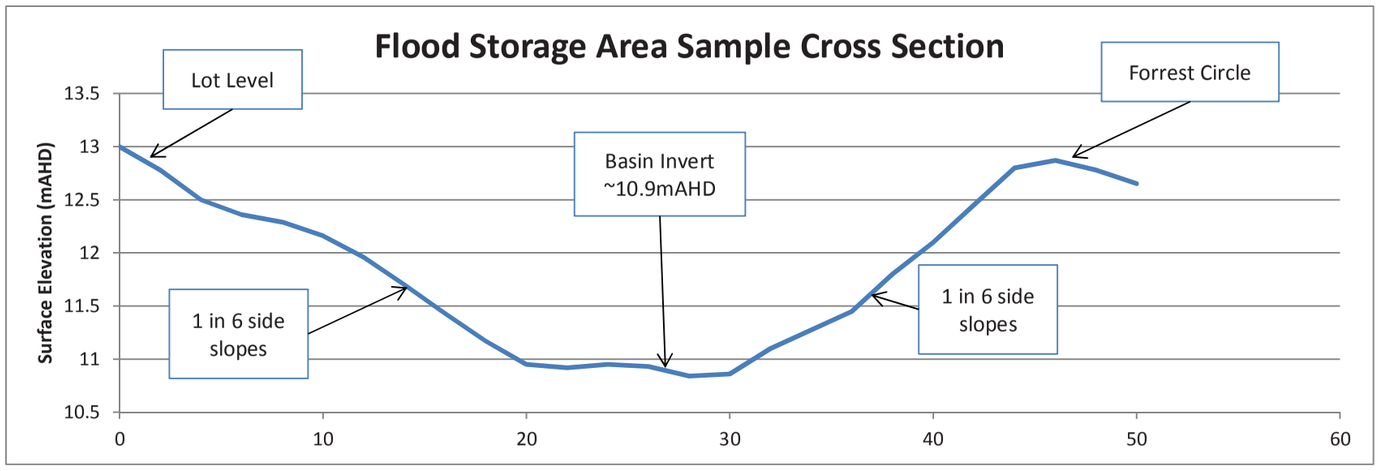
Scale: 1:12,000

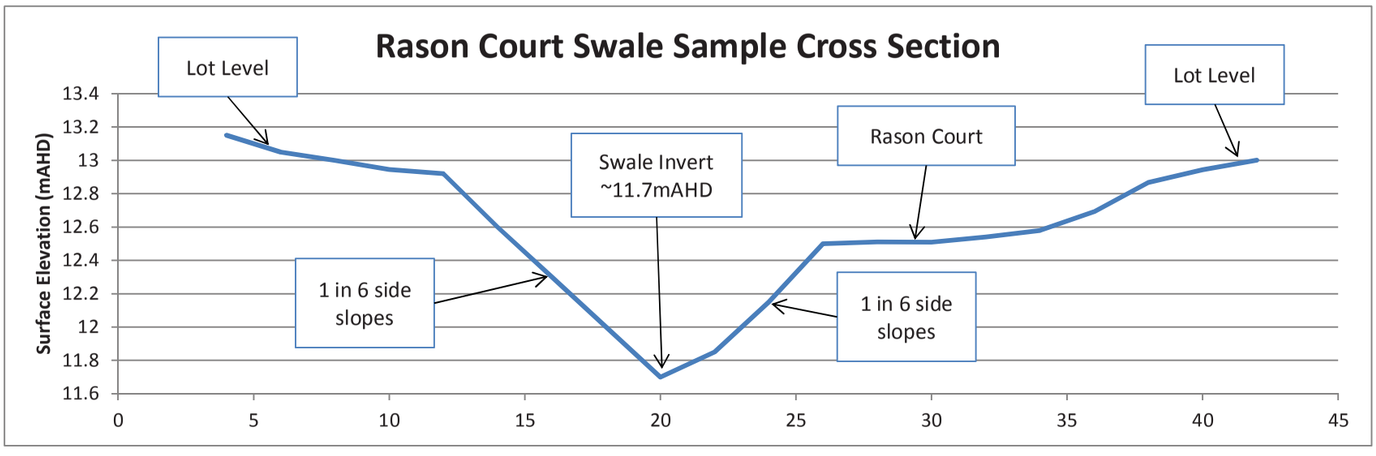
0 100 200 300 400 Meters

Landcorp

South Hedland Town Centre Revitalisation - East Precinct: LWMS

Figure 15: Schematic Cross Section of Proposed Upgrade to Forrest Circle Northern Drainage Channel

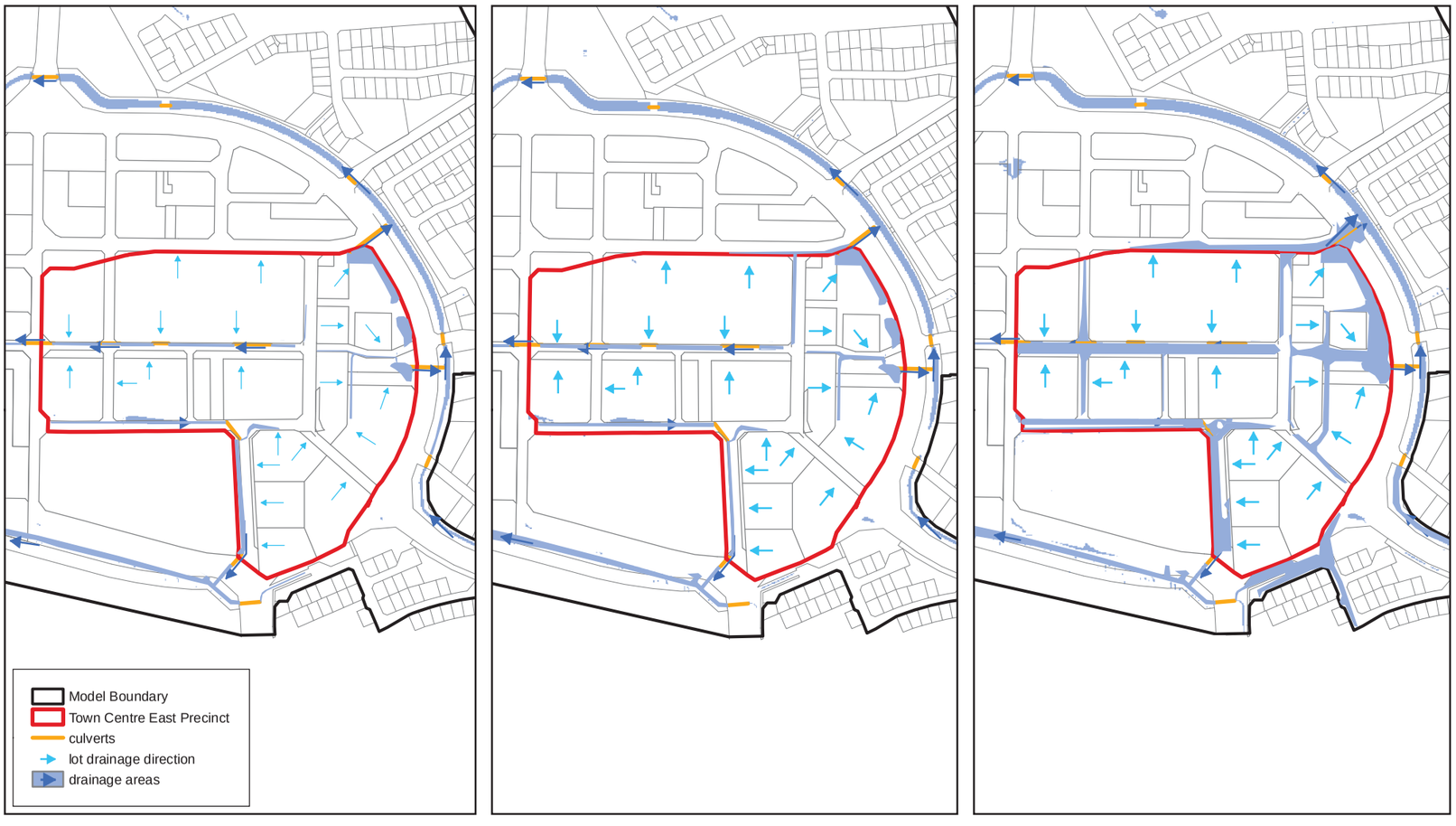




LandCorp

South Hedland Town Centre Revitalisation - East Precinct: LWMS

Figure 16: Flood Storage Area and Rason Court Swale Conceptual Cross Sections



1yr ARI Event Plan *5yr ARI Event Plan* *100yr ARI Event Plan*

N

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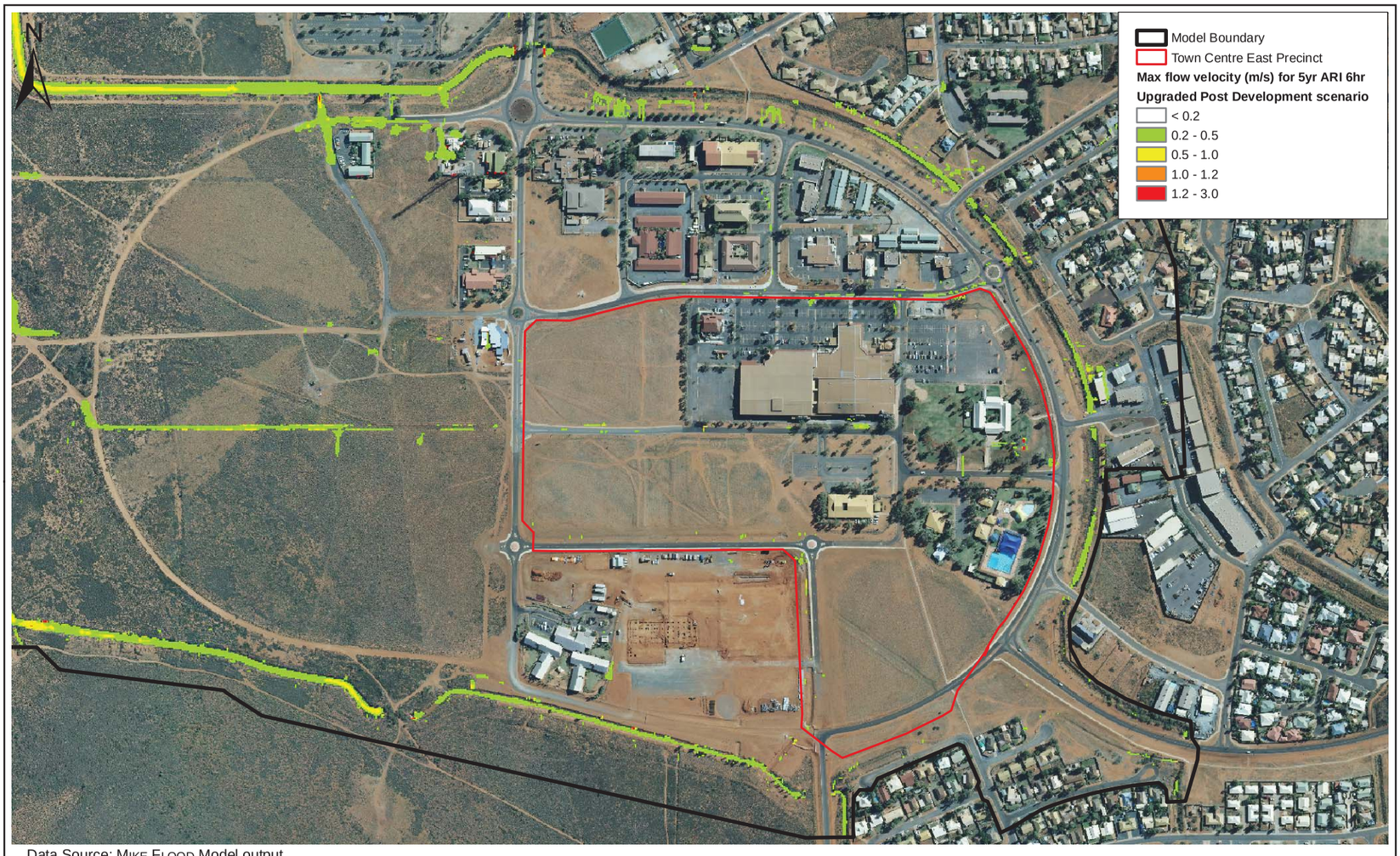
South Hedland Town Centre Revitalisation - East Precinct: LWMS

Figure 17: 1yr, 5yr and 100 Year ARI Event Plans



Data Source: MIKE FLOOD Model output

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Job No. J4723
Scale:1:7,000

0 100 200 300 400 Meters

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South Hedland Town Centre Revitalisation - East Precinct: LWMS
Figure 18: 5 Year ARI 6 hour Event (Upgraded Post Development) Flow Velocities

APPENDIX A

Local Water Management Strategy Checklist for Developers

LOCAL WATER MANAGEMENT STRATEGY: CHECKLIST (WAPC, 2008)

The following checklist provides a guide to items which should be addressed by developers in the preparation of Local Water Management Strategies for assessment by the local authority when an application for a structure plan is lodged.

1. Tick the status column for items for which information is provided
2. Enter N/A in the status column if the item is not appropriate and enter the reason in the comments column
3. Provide brief comments on any relevant issues
4. Provide brief descriptions of any proposed best management practices, e.g. multi-use corridors, community based-social marketing, water re-use proposals

Applicant: Landcorp	Date: November 2010
Name of Structure Plan: South Hedland Town Centre Revitalisation - East Precinct	
Contact: Alex Rogers, JDA Consultant Hydrologists	
Address: Suite 1, 27 York St Subiaco WA 6008	
Telephone: 9388 2436	Email: alex@jdahydro.com.au

Local Water Management Strategy Item	Required Deliverable	Deliverable		☐	Comment
		LWMS Reference	Comment		
Executive Summary					
Summary of the development design strategy, outlining how the design objectives are proposed to be met	Table 1: Design elements and requirements for BMPs and critical control points	Section 4.7 Table 3		☐	
Introduction					
Total water cycle management – principles & objectives Planning background Previous studies		Section 1.3 Section 1.1 Section 1.2		☐	
Proposed Development					
Structure plan, zoning and land use. Key landscape features Previous land use	Site context plan Structure plan	Section 3, Figure 12 Section 3, Figure 12 Section 2.1		☐ ☐	
Landscape - proposed POS areas, POS credits, water source, bore(s), lake details (if applicable), irrigation areas	Landscape Plan	Section 3, Section 4.1 Figure 10		☐	

Local Water Management Strategy Item	Required Deliverable	Deliverable		☐	Comment
		LWMS Reference	Comment		
Design Criteria					
Agreed design objectives and source of objective		Sections 1.2, 1.3		☐	
Pre-development Environment					
Existing information and more detailed assessments (monitoring). How do the site characteristics affect the design?		Section 2		☐	
Site Conditions - existing topography / contours, aerial photo underlay, major physical features	Site Condition Plan	Section 2.2, Figure 2, 4		☐	
Geotechnical - topography, soils including acid sulfate soils and infiltration capacity, test pit locations	Geotechnical Plan	Sections 2.5, 2.9, Figures 6, 11		☐	
Environmental - areas of significant flora and fauna, wetlands and buffers, waterways and buffers, contaminated sites	Environmental Plan plus supporting datasets where appropriate	Section 2.8		☐	
Surface Water – topography, 100 year floodways and flood fringe areas, water quality of flows entering and leaving (if applicable)	Surface Water Plan	Section 2.6, Figure 7		☐	
Groundwater – topography, pre development groundwater levels and water quality, test bore locations	Groundwater Plan plus details of groundwater monitoring and testing	Section 2.7, Figure 9		☐	
Water Use Sustainability Initiatives					
Water efficiency measures – private and public open spaces including method of enforcement		Section 4.1		☐	
Water supply (fit-for-purpose strategy), agreed actions and implementation. If non-potable supply, support with water balance		Section 4.1		☐	
Wastewater management		Section 4.1		☐	
Stormwater Management Strategy					
Flood protection - peak flow rates, volumes and top water levels at control points,100 year flow paths and 100 year detentions storage areas	100yr event Plan Long section of critical points	Section 4.2, Figures 13, 14, 15 Appendix B		☐ ☐	
Manage serviceability - storage and retention required for the critical 5 year ARI storm events Minor roads should be passable in the 5 year ARI event	5yr event Plan	Section 4.2, Figures 13, 14, 15 Appendix B		☐	

Local Water Management Strategy Item	Required Deliverable	Deliverable		☐	Comment
		LWMS Reference	Comment		
Stormwater Management Strategy (cont)					
Protect ecology – detention areas for the 1 yr 1 hr ARI event, areas for water quality treatment and types of (including indicative locations for) agreed structural and non-structural best management practices and treatment trains. Protection of waterways, wetlands (and their buffers), remnant vegetation and ecological linkages	1yr event plan Typical cross sections	Section 4.2, Figures 13, 14, 15 Appendix B		☐ ☐	
Groundwater Management Strategy					
Post development groundwater levels, fill requirements (including existing and likely final surface levels), outlet controls, and subsoils areas/exclusion zones	Groundwater/subsoil Plan	Section 4.3		☐	
Actions to address acid sulfate soils or contamination		Section 4.6.2		☐	
The Next Stage - Subdivision and Urban Water Management Plans					
Content and coverage of future urban water management plans to be completed at subdivision. Include areas where further investigations are required prior to detailed design.		Section 5.2		☐	
Monitoring					
Recommended future monitoring plan including timing, frequency, locations and parameters, together with arrangements for ongoing actions		Section 5.4		☐	
Implementation					
Developer commitments		Section 5.1		☐	
Roles, responsibilities, funding for implementation		Section 5.1		☐	
Review		Section 5.1		☐	

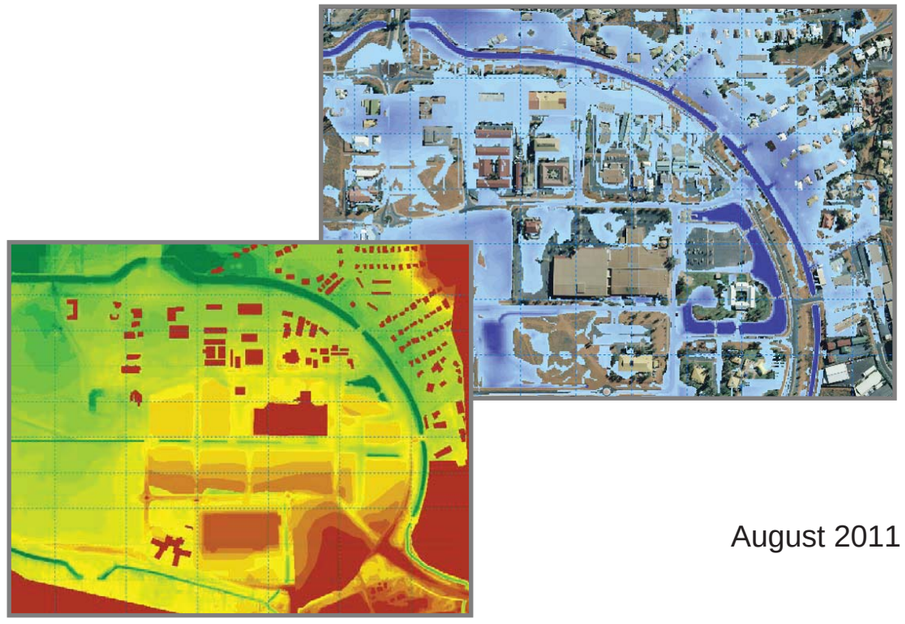
APPENDIX B

JDA (2011)
South Hedland Town Centre Revitalisation: Flood Modelling

LandCorp

South Hedland Town Centre Revitalisation

Flood Modelling



August 2011

Consultant Hydrologists

JDA

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LIST OF APPENDICIES

1. INTRODUCTION

1.1 Objectives

The South Hedland Town Centre is located on the south western boundary of the South Hedland Town Site (Figure 1). As part of the revitalisation of the Town Centre, a Subdivision Plan has been submitted. The proposed Subdivision incorporates realignment of roads, filling of lots and changes to drainage within the Town Centre.

This report details the drainage flood modelling performed to assess the impact of the proposed changes on flood levels in and adjacent to the Town Centre, and the performance of flood storage and swale capacities within the Town Centre.

1.2 Study Area

The Study Area covers the South Hedland Town Centre and adjacent residential and commercial areas (Figure 2).

Significant drainage features within the Study Area include South Creek to the west, the drainage channels to the north and south of Forrest Circle and the existing basin at the eastern extent of the Town Centre.

1.3 Methodology

Detailed two-dimensional numerical modelling of the Study Area was undertaken using MIKE FLOOD, incorporating a 2-D (MIKE21) representation of channel conveyance and runoff areas, and a 1-D (MIKE11) representation of major hydraulic structures (culverts and bridges) which have an impact on flow behaviour. Fully dynamic, rather than steady flow, modelling was deemed necessary to understand the impacts of the above factors, and also to predict impacts from the proposed development. Rainfall was applied to the Study Area allowing flow paths to be determined for runoff and an assessment of storages made.

The “Existing Case” was developed to represent the current state of the Study Area and allow model validation using historical events. Various “Developed Cases” were assessed to determine the impacts of development and modifications to the drainage system to reduce flood levels.

2. CATCHMENT DESCRIPTION

2.1 Climate and Rainfall

South Hedland's climate can be described as being arid sub tropical with warm, dry winters and hot humid summers.

The majority of rainfall occurs in January, February and March, with an average annual rainfall of 313 mm. In the summer months between October and April, cyclonic activity can result in short periods of high rainfall. Wind direction is predominantly north westerly across the coast.

The closest Bureau of Meteorology station is located at Port Hedland Airport (station no. 004032), approximately 5 km north east of the South Hedland Town Centre. Records have been kept since 1942. Rainfall data is shown in Figure 3.

2.2 Topography

The topography of the Study Area is mostly flat, with elevations of between 12 and 13 m AHD within the Town Centre. The land generally falls to the west towards South Creek and to the north towards the coast.

A more detailed description of site topography is given below in Section 3.2.

2.3 Surface Drainage

Two of the most prominent drainage features within the Study Area are the drainage channels to the north and south of the Town Centre. These take flow from the Town Centre and residential areas and discharge runoff to the west into South Creek.

Runoff from the residential and commercial areas is mostly from impervious surfaces. Runoff is drained partly by formal pipe drainage and partly by flow along road surfaces into drainage channels.

In the undeveloped areas, particularly to the south of the Town Centre, there is little evidence of defined runoff routes, with runoff likely to occur by overland flow. The low slope gradients will impede runoff and promote infiltration.

2.4 Soils

The soil within the Study Area can be described as a red sandy loam (GSWA, 1983), generally referred to as Pindan Sand. The soil has a small clay component, and sands are generally fine to medium grained, sub-angular to sub-rounded quartz. This can become hard when dry, and waterlogged during heavy rainfall. Onsite inspection indicated that these soils extended to a depth of at least 4 m.

Nearby infiltration testing yielded hydraulic conductivities of 3 to 4 m/d, although values of 1 m/d are more usual for this soil type. These range of values will allow infiltration of runoff particularly where water ponds.

2.5 Groundwater

Groundwater was not encountered during site inspection (in April 2010) and is likely to occur at depths greater than 4 m (less than 8 m AHD). Higher groundwater levels may occur during the wet season.

2.6 Landuse & Vegetation

Land use in the Study Area contains a mixture of existing residential and commercial areas, predominantly in the eastern section of the Study Area, and native vegetation in the western section (Figure 2).

The majority of the residential and commercial has been cleared of vegetation. The Reserves for the Forrest Circle drainage channels (FCdc) are generally bare earth with the channels themselves bordered and / or populated with low trees and shrubs.

The areas of native vegetation have a shrub steppe landscape typology. The principal flora is *spinifex sp.* and *Acacia sp.* with scattered Desert Walnut, Coolibah and River Gums, particularly within the channels and creek systems where water tables are shallower (RPS et al, 2008).

3. DATA SUMMARY

The following is a brief summary of data used in the Study.

3.1 Previous Studies

3.1.1 Wyche (1975)

In 1975, Main Roads WA conducted a flood study for town planning purposes for South Hedland.

This study estimated design flood flows from the South West Creek and South Creek catchments south of the South Hedland town site. From these flow rates, flood levels for the 10, 20, 50 and 100 year ARI events were estimated, based on six cross sections across the two creek systems.

Scenarios were investigated to provide flood protection for the town site and additional land availability between the two creek systems. A design line along the eastern bank of South Creek was calculated, to provide a limit of development westwards from the town site.

A long section of the system depicting design flood levels allows estimates of flood levels along channel, including adjacent to the South Hedland Town Centre.

3.1.2 PWD (1976)

In 1976 the PWD performed runoff calculations for the Town Centre (Forrest Circle) drainage channels. JDA obtained PWD drawings from Ric Bretnall/Simon Rodgers (DoW) and Water Corporation Reprographics Section Perth.

These drawings show an external catchment (outside Town Centre) of approximately 180 ha (subcatchments 1 to 16, Figure 4) and a 97 ha Town Centre internal catchment within the Forrest Circle, totalling 277 ha.

Based on the prevailing road layout and with regard for the existing topography, it is apparent that the PWD proposed development levels and a drainage strategy for the Town Centre (Figure 5).

Trapezoidal drains called Sub B and Sub B8 were designed by PWD to both the north and south of the Town Centre to convey the 5 yr average recurrence interval (ARI) runoff from the external and internal Town Centre catchments. These are the existing drainage features to the north and south of Forrest Circle. Figure 5 shows drain “Sub B” (FCdc North) along the north side and “Sub B8” (FCdc South) on south side.

Design of the drainage system was performed in accordance with the PWD Manual of Standards (Urban Drainage (PWD, 1980). The PWD standards indicate that a design recurrence interval of 5 years is suitable for low to high density residential areas not adjacent to major rivers or with upstream catchments greater than 25 km^2. Drainage channels were designed to convey the 5 year ARI event, with structures (culverts) designed to discharge the 5 year ARI event with 50% surcharge. Drainage channels would have been designed to meet maximum flow velocities as described in the Manual. The hydrology component of the design used the Rational Method to estimate runoff. Anecdotal evidence (see Section 4.4) indicates that there has been no overtopping of the Forrest Circle north drain in the last 20 years.

A tail-water condition of 10.7 m AHD in South Creek was assumed, being 0.3 m below the 100 yr ARI water level estimate of 11.0 m AHD from Wyche (1975). This lower level is thought to be the 10 year ARI level.

PWD design drawings show three stormwater detention basins within the Town Centre (Figure 6). The purpose of these basins was to reduce the runoff rate from the future developed Town Centre to an acceptably low flow rate before discharge through pipes to the Forrest Circle drainage channels. Of these 3 basins, the easterly one was constructed. This basin has a storage of approximately 11,000 m^3 between 10.5 and 12 m AHD.

The partly constructed basin to the north of the new hospital site is also shown as one of the three PWD (1976) stormwater detention basins, at the site of DB3.

A total of four drop structures to reduce velocity were designed in the perimeter drain Sub B. These drops were 0.4 m at Nairn Street, 0.92 m at Hunt Street, 0.33 m at Hamilton Street and 1.15 m drop downstream of the drain approximately 200 m upstream of South Creek.

3.1.3 JDA (2009)

A report for Wedgefield Industrial Estate by JDA in 2009 reviewed available literature for flood levels in the Port Hedland / South Hedland area, looking at storm surge from the ocean and flood levels from South Creek and South West Creek.

As well as reviewing the previous two references, the report detailed a storm surge study by GEMS (2000), which included flood flow from the two creeks, and the associated CD which plotted flood levels for the 50 and 100 year ARI events (Flood Map v3.1, WAPC, 2008?). Other literature referred to in JDA (2009) primarily address storm surge rather than freshwater flooding and so are not detailed here.

The methodology used by GEMS, referred to as the Revised Index Flood Method, appears to provide flood estimates between those values given by the Runoff Routing Method and the Index Flood Method (from Australian Rainfall & Runoff (Institution of Engineers, Australia, 1987)). The Revised Index Flood Method is not fully explained in GEMS (2000).

Flood levels given by Flood Map indicate 100 year ARI levels lower than Wyche (1975) on South Creek near the Study Area. At the outlet of the northern Forrest Circle drainage channel, Flood Map predicts a 100 year ARI flood level of 9.8 m AHD, compared to 11.2 m AHD from Wyche (1975).

3.2 Survey and Site Inspection

The topographic elevation model was based on available survey data of the Study Area and surrounding areas. No aerial mapping data was available, with all data based on spot height ground survey.

Within most of the Town Centre (including the Forrest Circle drainage channels), natural surface elevation survey was available at a spacing of approximately 15 m, with vertical accuracy ± 0.1 m (Figure 7). This excluded the new hospital site and the existing commercial area bounded by Hamilton Road to the west, Forrest Circle to the north and east, and Throssell Road to the south.

Levels for the Hospital site were based on finished earthwork data. Level data for Lot 21 (corner of Colebatch Way and Collier Drive) was based on design / as constructed earthwork levels for the site.

Additional survey was required for the areas outside of the town centre and Forrest Circle drainage channel areas. This included the undeveloped area between the Town Centre and South Creek, the undeveloped area to the south of the Town Centre, the area west of the TAFE and the residential and commercial areas to the north and east of the Town Centre. Some of this data was provided by existing Water Corporation natural surface contours, however most of the data was provided by MAPS spot height elevations along the roads and tracks through the required areas. While most of the spacing of this data was between 50 to 100 m, with vertical accuracy ± 0.25 m, this was considered adequate due to the flatness of the topography through most of this area.

It can be seen from Figure 7 that survey of the two Forrest Circle drainage channels did not extend completely westward to South Creek. Therefore it was necessary to estimate a cross section for the two channels and generate interpolated channel topography between the existing data and South Creek.

All survey data collected as part of this investigation was then merged into a single digital elevation model DEM (Figure 8). Channels and basins are clearly visible as features in the DEM, as are areas where data was not available (white areas in Figure 8).

In view of the level of survey data available, the level of accuracy of the DEM is estimated to be ± 0.25 m, and there are likely to be some areas where the DEM differs significantly from actual levels. This may result in flood water levels being under or over estimated. This may be tempered by the flat nature of the Study Area topography. In conclusion, difference maps between different scenarios may be more accurate than absolute flood levels.

A site inspection was conducted to ensure that all significant hydraulic features were accounted for in the modelling. All drainage culverts of the Forrest Circle drainage channels were photographed and measured, with inverts estimated from DEM data where not surveyed.

3.3 Rainfall IFD

Rainfall intensity frequency duration (IFD) data for Port Hedland Airport (Figure 9) was used for the application of rainfall to the model and for the generation of runoff hydrographs for the external catchments. Table 1 gives the rainfall intensities and Table 2 the total rainfall depths for the 5, 10, 20 and 100 year ARI events.

TABLE 1: PORT HEDLAND AIRPORT RAINFALL INTENSITY (mm/hr)

Duration	5 Year ARI	10 Year ARI	20 Year ARI	100 Year ARI
0.5 hr	78.4	95.6	117	172
1 hr	53.4	65.7	81.3	121
3 hr	25.6	32.2	40.4	61.9
6 hr	15.6	19.8	25.2	39.4
12 hr	9.57	12.3	15.8	25.2
24 hr	6.03	7.80	10.0	16.2
48 hr	3.75	4.87	6.28	10.2
72 hr	2.72	3.54	4.59	7.46

TABLE 2: PORT HEDLAND AIRPORT TOTAL RAINFALL DEPTH (mm)

Duration	5 Year ARI	10 Year ARI	20 Year ARI	100 Year ARI
0.5 hr	39.2	47.8	58.5	86.0
1 hr	53.4	65.7	81.3	121
3 hr	76.8	96.6	121.2	185.7
6 hr	93.6	118.8	151.2	236.4
12 hr	114.8	147.6	189.6	302.4
24 hr	144.7	187.2	240.0	388.8
48 hr	180.0	233.8	301.4	489.6
72 hr	195.8	254.9	330.5	537.1

3.4 Model Boundary Conditions

External subcatchments to the south and east of the Town Centre (Figure 4), which contribute flow to the Forrest Circle drainage channels, were included as point sources. Catchment areas and topographic slopes from PWD (1976) were used to generate hydrographs for each subcatchment for 5, 10, 20 and 100 year ARI rainfall events using XP-STORM. This data is summarised in Table 3.

TABLE 3: EXTERNAL CATCHMENT DATA

Sub Catchment	Area (ha)	Slope (m/m)	Catchment Description
1	32.592	0.0012	Developed
2	5.680	0.0024	Developed
3	10.516	0.0029	Developed
4	10.787	0.0063	Developed
9	15.295	0.0020	Developed
10	22.090	0.0022	Undeveloped
11	30.748	0.0012	Undeveloped
12	40.000	0.0012	Undeveloped

There are three downstream boundary conditions (BC1 to 3) in the MIKE FLOOD modelling (Figure 10):

- The first is the water level in South Creek where the southern Forrest Circle drainage channel discharges.
- The second is the water level in South Creek where the northern Forrest Circle drainage channel discharges.
- The third is a water level along the northern section of the model.

The two water level boundary conditions in South Creek were based on data from Wyche (1975). Wyche (1975) was used rather than GEMS (2000) and Flood Map (WAPC (2008?) as flood levels were higher, and therefore more conservative. Additionally the method of flood estimation used by GEMS (2000) is not consistent with IEA (1987) and not detailed sufficiently.

Peak levels in South Creek were estimated to occur at greater than two days for recurrence intervals 10 year to 100 year (Wyche, 1975). However, the Town Centre catchment was predicted to peak much more quickly, generally within 3 hours, due to the mostly impervious nature of the catchment.

As the prevailing weather conditions, particularly cyclonic activity, are north-north-westerly from the coast, rainfall events will occur over the South Hedland Town Centre before falling over the bulk of the South Creek catchment. Therefore it is likely that the majority of runoff from the Town Centre will discharge to South Creek before levels in South Creek rise due to flood flow. For the two catchments to peak simultaneously, the rainfall events falling on each catchment will be (mostly) independent of each other. Assuming two independent events, the joint probabilities involved indicate that a 100 year ARI flow from the Town Centre and a 100 year peak level in South Creek equates to a joint probability rarer than a 10,000 year ARI event.

It is therefore appropriate to assume a tailwater level in South Creek lower than the 100 year level (11.0 m AHD) from Wyche (1975) or that used in PWD (1976) (10.7 m AHD). A level of 9.5 m AHD has been assumed in South Creek where the northern Forrest Circle drainage channel discharges to the creek. This compares to the South Creek invert of 7.17 m AHD at this location. A level of 10.0 m AHD has been assumed in South Creek where the southern Forrest Circle drainage channel discharges into the creek. These levels may be closer to peak levels for between 2 to 5 year ARI event.

A sensitivity analysis of flood levels to the South Creek boundary condition levels is investigated in Section 4.3 below.

The third water level boundary condition, along the northern boundary of the model, was required as the topography slopes in a northward direction, and the areas north of the northern Forrest Circle drainage channel will drain in this direction, as will any overflow from the northern Forrest Circle drainage channel. It is therefore necessary to allow drainage through the northern boundary of the model. A water level of 10 m AHD has been assumed, as this is slightly lower than the natural surface elevation adjoining the boundary.

3.5 Model Background Layers

The following background information was used as input to the modelling or presentation of results:

- Rectified Aerial Photo covering the Study Area (Figure 1) and additional areas further south (*source: RPS*).
- Cadastre and Land Use Polygon Data (Figure 11).

All data was supplied in MGA-50 projected coordinates.

4. MIKE FLOOD MODEL DEVELOPMENT

MIKE FLOOD is a dynamic coupling of a MIKE21 model (in this case a 2D representation of the Study Area) and a MIKE11 model (predominantly used to represent 1D structures). The following sections detail the different components of the model and how it was applied to simulate flooding characteristics of the South Hedland Town Centre and Forrest Circle drainage channels.

4.1 MIKE21 Model

The MIKE21 model comprises a bathymetry file (topography), a roughness coefficient (resistance), boundary conditions (inflows and water levels), initial water levels and secondary model parameters (simulation parameters, eddy viscosity and wetting/drying parameters).

4.1.1 Topography

Using the merged DEM (as described in Section 3.2), a rectangular topographic grid was developed with a 2 m resolution (Figure 12). A 2 m grid was selected as optimal to describe drainage features and rainfall runoff within the Study Area.

Sections of the bathymetry not affected by flooding, or where topography data was not available, were excluded from the computation using the “Land” setting in the model.

4.1.2 Roughness

Using the land use mapping, aerial photography and observations of vegetation type during site inspection, a roughness map was developed covering the same area as the topographic grid. MIKE21 uses values of Manning’s M (1/n) in its resistance formulation. A roughness value of 25 (0.04) was assigned across the grid. Sensitivity to roughness value (particularly within the Forrest Circle drainage channels) was investigated in Section 4.3 below.

4.1.3 Inflow Time Series, Precipitation and Initial Conditions

Hydrographs for the eight external subcatchments to the south, east and northeast of the Town Centre are shown in Figure 13 for the 100 year ARI event for existing land use. It can be seen that peak flows for the critical durations vary between 0.57 and 1.78 m^3/s. These flows are applied directly into the Forrest Circle drainage channels to simulate the runoff from these subcatchments.

Precipitation was applied uniformly across the Study Area, based on IFD design storm temporal distributions. A rainfall runoff coefficient of 80% was assumed based on the nature of catchment and the soil types present.

An initial condition map was developed to match the static water level applied at the boundary. This assumed an initial condition set to topographic elevation, except where elevations were less than assumed levels in South Creek or on the northern boundary. In these cases the initial condition map was adjusted to match these levels. Revised initial condition maps were developed where topographic elevation was adjusted (in the case of the post development simulations) or where the boundary condition levels were adjusted (in the case of the sensitivity investigations).

4.1.4 Additional Model Parameters

The following secondary model parameters were adopted:

- Drying depth (0.001 m)
- Flooding Depth (0.002 m)
- 0.2 second time step, yielding a Courant number of 0.63
- Uniform eddy viscosity value of 0.2 (higher local values around couples)

Flooding and drying depths affect the rate of propagation of a flood wave across a floodplain, but do not impact significantly on the absolute flood levels, and eddy viscosity was selected from appropriate range of values based on a grid size of 2 m. The Courant number calculated by MIKE21 prior to run time satisfies stability conditions (generally for MIKE FLOOD, a value less than 1 is recommended).

4.2 Treatment of Structures (MIKE11)

A total of 10 existing drainage structures in the floodplain were considered important in the context of conveyance of runoff (Figure 14). The pipe drainage within the existing commercial area in the north eastern area of the Town Centre was excluded.

The purpose of including structures in the model was to allow flows to pass through embankments which are closed in the topographic grid or where long conduits exist (for example the outlet to the existing basin in the eastern section of the Town Centre).

A summary of structure geometry as represented in MIKE11 is presented in Table 4. In MIKE11 and MIKE FLOOD there are several ways of defining and coupling culverts (implicit, explicit, structure routine or as a long conduit). Dimensions of structures are based on detailed survey in most cases, particularly for structures along the northern arm of the Forrest Circle drainage channel. In other cases, dimensions are based on measurements taken in the field and invert levels are approximate, based on site inspections and levels in the topographic grid.

All concrete culverts were assigned a Manning ‘n’ value of 0.02 reflecting aged concrete.

TABLE 4: HYDRAULIC STRUCTURE SUMMARY

ID	Location	Size	U/S Invert (mAHD)	D/S Invert (mAHD)	Length (m)	Model Definition	
						MIKE11	MIKE FLOOD
1	Hamilton Rd (FCdc North)	4 x 1200 mm x 900 mm Box Culverts	10.25	10.10	42	Culvert	Explicit
2	Cottier Dr (FCdc North)	2 x 1200 mm x 750 mm Box Culverts	10.22	10.10	20	Culvert	Explicit
3	Hunt St (FCdc North)	2 x 1200 mm x 750 mm Box Culverts	10.72	10.64	20	Culvert	Explicit
4	Nairn St (FCdc North)	2 x 900 mm Pipe Culverts	11.91	11.80	20	Culvert	Explicit
5	Murdoch Dr (FCdc North)	2 x 1200 mm x 750 mm Box Culverts	11.70	11.65	30	Culvert	Explicit
6	Mitchell Dr (FCdc South)	4 x 900 mm Pipe Culverts	11.25	11.10	40	Culvert	Explicit
7	Collier Dr (FCdc South)	2 x 900 mm Pipe Culverts	11.50	11.42	38	Culvert	Explicit
8	Forrest Cir (south) (FCdc South)	2 x 600 mm Pipe Culverts	11.25	11.15	28	Culvert	Explicit
9	Colebatch Wy (Hospital)	3 x 450 mm Pipe Culverts	12.05	12.00	40	Culvert	Explicit
10	Eastern Basin (Existing)	600 mm Pipe Culvert	10.40	10.19	90	Conduit	Explicit

4.3 Sensitivity Analysis

In the absence of calibration data, particularly for recent flood events of any magnitude, sensitivity testing can be used to assess the validity of adopted model parameters. Additionally, impacts of modelling assumptions (like treatment of tailwater levels) on the results can be quantified. Sensitivity analysis can also be used to determine the range of variability inherent in the model results.

4.3.1 South Creek Levels

With respect to adopted tailwater condition, the 100 Year ARI model results were compared for a tailwater levels in South Creek of 10.7 m AHD [PWD (1976) level] and 11.0 m AHD [Wyche (1975) 100 year level]. Difference maps are shown in Figure 15.

The analysis showed that flood levels east of Hamilton Rd were very insensitive to tailwater condition, with increases predicted to be less than 0.1 m in all cases and less than 0.01 m in most areas.

4.3.2 Model Hydraulic Roughness

Adopted Study Area hydraulic resistance (roughness Manning's n) values were based on site visit and land use and are within accepted ranges. It is noted that the density of vegetation within the Forrest Circle Drainage Channels can vary depending on maintenance and clearing activities. Sensitivity testing of roughness values was undertaken to assess the possible variability in results due to hydraulic roughness increasing as a result of dense vegetation within the Forrest Circle Drainage Channels. Figure 16 shows the impact of decreasing the Mannings M to a value of 17 (Mannings n of 0.06).

Hydraulic roughness has greatest influence within the Forrest Circle Drainage Channels itself. It can be seen that increasing the roughness increases levels within both branches of the Forrest Circle Drainage Channels by approximately 0.1 m. Impact on areas outside the Forrest Circle Drainage Channels is less than 0.05 m and generally less than 0.02 m.

4.4 Model Calibration

There is little data available for calibration of the model. There are no gauging stations or staff gauges within the Study Area. While the PWD (1976) study looked at flood levels within the Sub B (Forrest Circle North Channel), this was based on the Sub B8 (Forrest Circle South Channel) discharging to it, whereas it was actually constructed so that it discharges directly to South Creek.

Anecdotal evidence from local long term residents is available, several of whom have stated that the Forrest Circle drainage channels have not overtopped their banks within the last 20 years (Pip Jarkiewicz, Town of Port Hedland and residents via Ken Ash, Surveyor). Only flooding on Hunt St at a low point adjacent to the liquor store was observed.

Table 5 below shows the rainfall from major events since 1976, for 1, 2 and 3 day durations, based on daily rainfall readings.

TABLE 5: MAJOR RAINFALL EVENT DATA (1976 TO 2010)

Date	1 Day Duration			2 Day Duration			3 Day Duration		
	Rainfall (mm)	Rainfall (mm/hr)	ARI (yr)	Rainfall (mm)	Rainfall (mm/hr)	ARI (yr)	Rainfall (mm)	Rainfall (mm/hr)	ARI (yr)
Mar 77	152.4	6.35	~7yr	152.4	3.18	2-5yr	152.4	2.12	2-5yr
Feb 80	87.6	3.65	~2yr	124.8	2.60	2-5yr	124.8	1.73	~2yr
Feb 81	64.2	2.68	~1yr	97.6	2.03	1-2yr	115.4	1.60	2yr
Jan 83	50.4	2.10	<1yr	100.2	2.09	1-2yr	113.8	1.58	2yr
Apr 83	104.6	4.36	2-5yr	105.0	2.19	2yr	105.2	1.46	1-2yr
Mar 84	98.2	4.09	~3yr	140.2	2.92	2-5yr	156.2	2.17	2-5yr
Mar 88	156.8	6.53	~7yr	193.6	4.03	~6yr	198.6	2.76	~5yr
Dec 88	67.4	2.81	1-2yr	118.6	2.47	2yr	124.2	1.73	2yr
Feb 89	234	9.75	~ 20yr	311.6	6.49	~ 23yr	327.8	4.55	~ 20yr
Feb 97	88.6	3.69	2-5yr	88.8	1.85	1-2yr	88.8	1.23	1-2yr
Jan 01	177.4	7.39	~ 9yr	253.4	5.28	~ 13yr	270	3.75	~ 12yr
Mar 07	114	4.75	2-5yr	133.4	2.78	2-5yr	133.4	1.85	2-5yr

It can be seen that the largest rainfall event within the last 35 years was in January 1989, when 311.6 mm of rainfall fell over 2 days. This equates to an estimate rainfall ARI of 23 years for a 2 day duration. The drainage channels were apparently designed for a 5 year ARI capacity. However this shows that actual capacity is greater than 5 year ARI although the Town Centre has not yet been fully developed.

5. EXISTING SIMULATION RESULTS

The Existing Case as adopted in this investigation relates to the state of the Study Area in its current state. This case provides an estimate of flood levels and flood extent with which to compare proposed changes to topography and drainage system design.

Figure 17 shows the flood depths for the 5 year ARI 24 hour duration storm event. It can be seen that there is shallow ponding of water (<0.2 m) in many areas of the model area, particularly in the western section of the Town Centre. Similar levels of flooding in developed areas are likely to be confined to road areas as road runoff. The eastern detention basin has between 1.0 and 1.5 m of water depth, while the temporary basin north of the hospital site has 0.5 to 1.0 m of water depth.

For the 100 year ARI design storm event, the model was run to simulate the 0.5, 1, 3, 6, 12, 24, 48 and 72 hour durations. It was found that the 3 hour duration was critical for this ARI event. Figure 18 shows flood depths for the 100 year ARI 3 hour duration storm event. It can be seen that flood depths are greater, and flood extent has expanded. The northern branch of the Forrest Circle drainage channel breaks out at Cottier Dr, due to the inability of the culverts to discharge flow, resulting in flow overtopping the road and flowing back into the channel downstream. Flooding of the residential area north east of the Town Centre shows up to 1 m of flooding in some locations.

Peak flood levels within the Forrest Circle North & South Drains are shown in Figure 18 at several locations. These represent locations which will allow comparison between existing and proposed development simulations to assess impact of development.

6. DEVELOPED SIMULATIONS RESULTS

As part of the South Hedland Town Centre Revitalisation, changes have been proposed to some road layouts, detention basin locations and lot elevations. The proposed Structure Plan is shown in Figure 19. Additionally, although it is not part of the Structure Plan, an additional crossing of the Forrest Circle North Drain is proposed (by others) between Hamilton Rd and Cottier Dve. The impact of this additional crossing will be examined first, in separation to the changes proposed by the Structure Plan.

For all 100 year ARI simulations, durations of between 0.5 and 72 hours were modelled, and the 3 hour duration was found to be critical.

6.1 Hedditch St Crossing

This is referred to as the “Hedditch St” simulation.

The proposed crossing connects Hedditch St on the north side of the Forrest Circle North Drain with Forrest Circle (Figure 20). It is proposed to replicate the Hamilton Road crossing structure (ie. four 1200mm x 900mm box culverts) with the culverts set to the existing channel invert.

This proposed structure was incorporated into the MIKE FLOOD model, including road centreline elevations.

Figure 21 shows the flood depths for the 100 year ARI 3 hour duration event, with Figure 22 showing the difference in flood levels compared to the “Existing” simulation.

It can be seen that the proposed structure results in increased flood levels upstream of the crossing and in the residential area north of Forrest Circle. This is a result of the reduced flow capacity of the crossing culverts, causing an afflux across the structure. As flood waters cannot discharge through the culverts quickly enough, water levels on the downstream side are lower than on the upstream side. Therefore the capacity of the channel between Hamilton Road and the proposed Hedditch St extension is not fully utilised (compared to the “Existing” scenario). This results in increased water levels upstream and greater discharge of water into the residential area.

6.2 Details of Structure Plan

The revised Town Centre elevation mapping was based on engineering design drawings (Cossill & Webley), which were projected onto a 2 m grid, and then imported into the MIKE FLOOD model. The revised topographic grid incorporating the proposed design surface is shown in Figure 23.

The development levels provided by Cossill & Webley are the finished site levels for the proposed roads and development sites within the Study Area. The levels of the existing shopping centre site remain unchanged. The ultimate levels on each site will be dependent on development of the site, which may locally impact on direction of flows (eg roof lines, carpark orientation, etc).

As part of the proposed changes to the drainage, there are a series of swales drains proposed along Rason Court. These are connected by culverts, details of which are shown on Figure 24. These swales drain to the west. An outlet channel has been assumed to provide a flow path from Hamilton Road westward to South Creek (Figure 23). These culvert sizes are preliminary only and subject to further analyses for catchments to the south, basin location to the west of Hamilton Rd and finished road levels.

In addition the existing detention basin in the eastern section has been modified, being split into two areas. The southern section of the existing basin has been moved southward, and a separate pipe connection to the main drainage channel provided (Figure 24).

6.3 Impact of Proposed Changes on Flood Levels

This is referred to as the “Post Development” simulation.

Figure 25 shows the flood depths for the 100 year ARI 3 hour duration storm event. Figure 26 shows the difference in flood levels compared to those from the existing topography for the same storm event.

It can be seen that the proposed changes result in increased water levels within the Forrest Circle Drainage Channel, with the greatest increase occurring between Hunt and Nairn.

In the eastern section of Rason Court, there is a trapped low point that will need to be drained to the modified flood storage area. In order to achieve drainage of this area, it is required that peak water levels within the basin be minimised. As the basin discharges to the Forrest Circle north drain, reducing levels within the drain would aid in increasing discharge from the basin.

6.4 Proposed Upgrade to Drainage Infrastructure

It was proposed that a section of the Forrest Circle north drain be upgraded to provide greater storage and flow capacity, and several sets of culverts under road crossings be upgraded to provide greater flow capacity.

Figure 27 shows a schematic of the proposed cross section of the modified drainage channel. It can be seen that the proposed channel has two levels, which has the result of opening out the channel compared to the existing channel.

The culverts under Hunt St, Cottier Dr and Forrest Circle (South) are proposed to be upgraded, with an increase in the number of culverts. Details are shown in Figure 28.

6.5 Impact of Upgrades on Flood Levels

This is referred to as the “Upgraded Post Development” simulation.

The results of modelling the proposed upgrades are shown in Figures 29 and 30 for water levels and difference with the existing case respectively. It can be seen that the proposed upgrades have the result of lowering flood levels within the Forrest Circle north drain. Flood levels within the existing residential areas to the north east of the Town Centre are also reduced compared to existing flood levels.

Peak flood levels for the 5, 10 and 100 year ARI events are shown in Figure 31 for several locations for the critical durations.

6.6 Erosion Potential

The erosion potential in channels and overland flow paths can be estimated based on the velocity of flow during storm events. Flow velocity can therefore be used to identify areas where stabilization of channels will be required.

The geotechnical investigation of the Study Area (Coffey, 2010) found that the soils are classed as silty sands (topsoil), overlying silty/clayey sands, with between 15 to 40% fine material (silt and clay). French (1986) indicates that for these soil types, erosion will start to commence at velocities greater than 0.8 to 1.1 m/s.

Figure 32 shows maximum flow velocities for the critical 5 year ARI event. It can be seen that across the majority of the Study Area, flow velocities are less than 0.8 m/s. There are several areas which have higher flow velocities, such as around culvert structures, where they would be expected. These are also areas where bank and channel stabilisation works, such as concrete wing walls, would be incorporated to minimise erosion. Most of these areas occur outside of the Development Plan area, within the Forrest Circle Drainage Channel. The proposed outlet channel west of Hamilton Rd has flows generally less than 0.5 m/s, indicating low erosion potential.

Figure 33 shows the maximum flow velocities for the critical 100 year ARI event. While it is not proposed to provide erosion protection for the 100 year event, it can be seen that flow velocities are not significantly higher than the 5 year event.

7. SUMMARY & RECOMMENDATIONS

The drainage channels proposed by PWD in 1976 were constructed and are still largely intact.

There is not much history of flooding within the South Hedland Town Centre. The drainage channels have not been overtopped within the last 20 years. Localised flooding adjacent to the liquor store on Hunt St has occurred during the last 10 years.

A MIKE FLOOD model was successfully created to model overland stormwater runoff from the South Hedland Town Centre, based on realistic parameters of surface roughness and runoff coefficients.

As LIDAR survey data was not available for the Study Area, a digital elevation model was based on groundwater survey. Data density was greatest within the Town Centre area and lowest in the undeveloped area to the west of the Town Centre.

The model was used to estimate the 100 year ARI flood levels within and adjacent to the Town Centre for the existing land use. The critical duration was the 3 hour storm event.

The proposed changes to the Town Centre were incorporated into the model. The drainage system was revised, with the Forrest Circle drainage channel (between Hunt St and Cottier Dr) being upgraded to a widened, tiered channel. This revised drainage system resulted in reduced flood levels in the existing residential areas to the north east of the Town Centre, and a reduction in the required storage capacity of the existing detention basin in the eastern section of the Town Centre.

It is recommended that the Town of Port Hedland keep the proposed channel upgrade free of weeds to maintain the hydraulic efficiency. In the meantime (prior to reconstruction of the channel), the drainage channels should be cleared out.

It is recommended that any further landuse change be included in the flood model.

It is recommended that the modelling could be improved if the area is flown and LIDAR survey data becomes available.

It is recommended that finished floor levels be 0.3 m above the road kerb level and 0.5 m above flood levels in South Creek.

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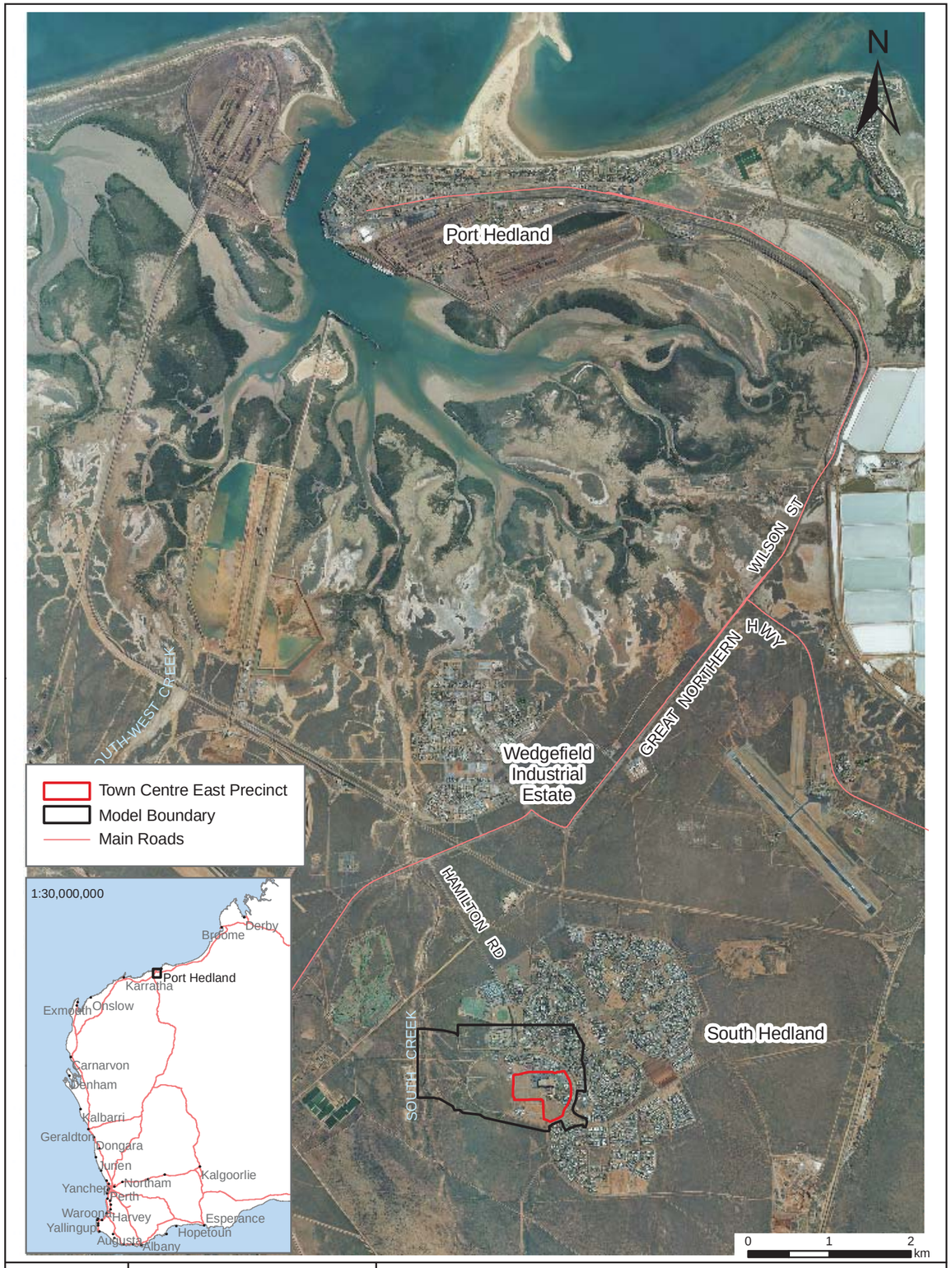
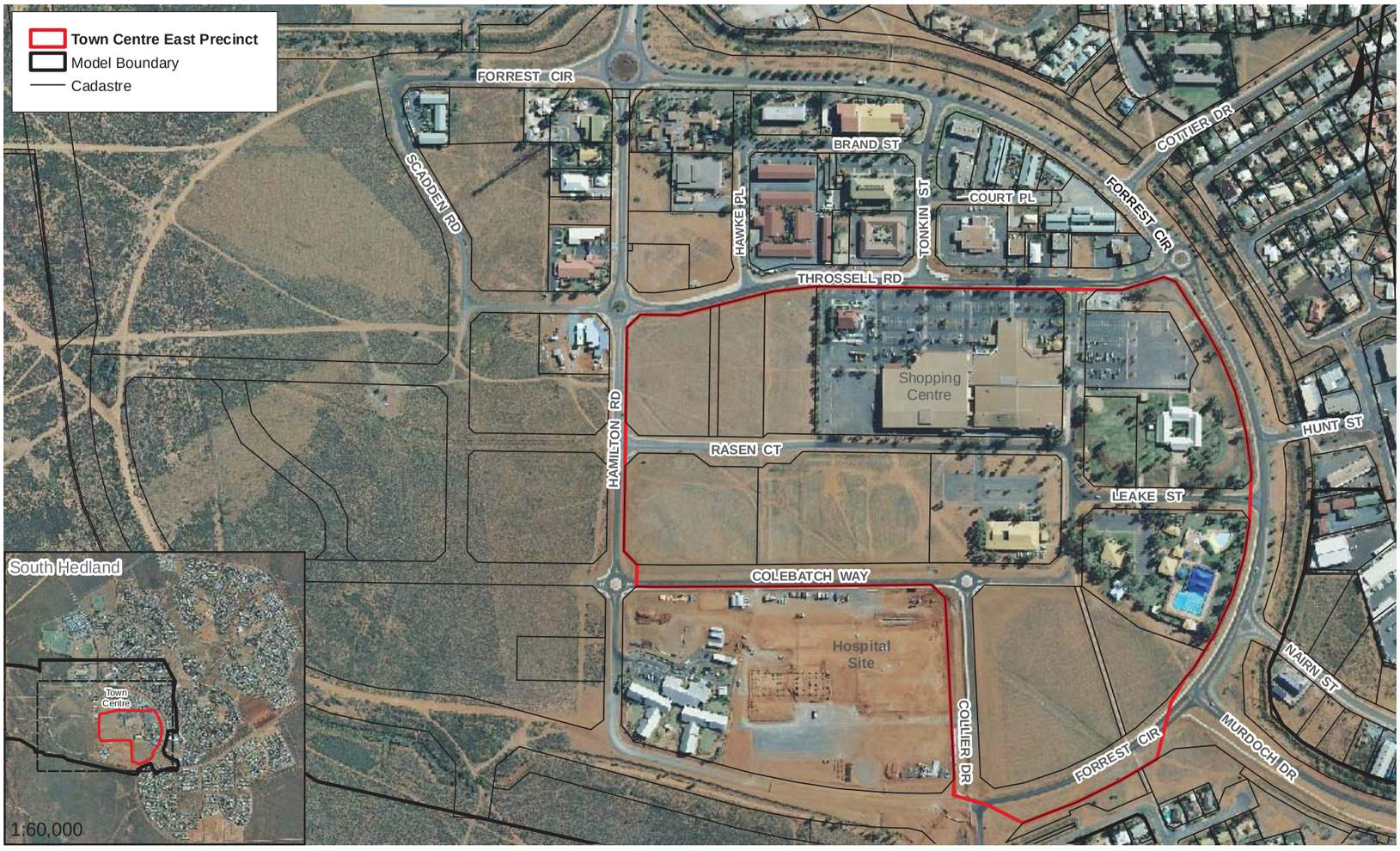
FIGURES



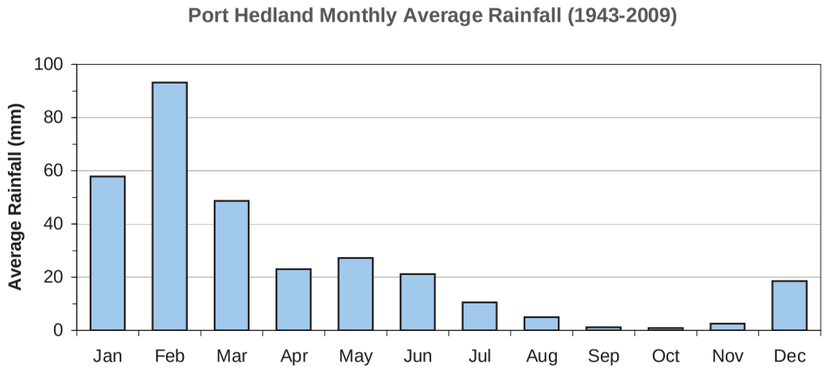
JDA Consultant Hydrologists	Job No. J4381 Scale 1:62,000 © COPYRIGHT JIM DAVIES & ASSOCIATES PTY. LTD. 2010	Landcorp South Hedland Centre Revitalisation: Flood Modelling **Figure 1: Location Plan**

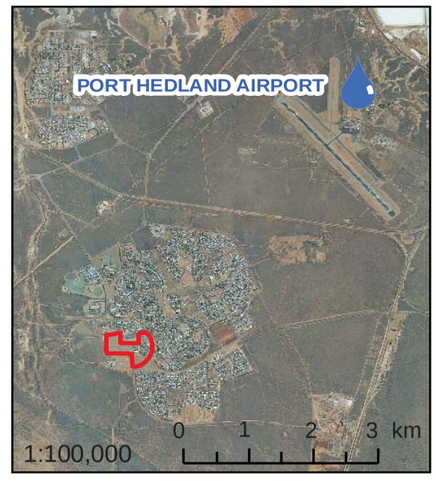


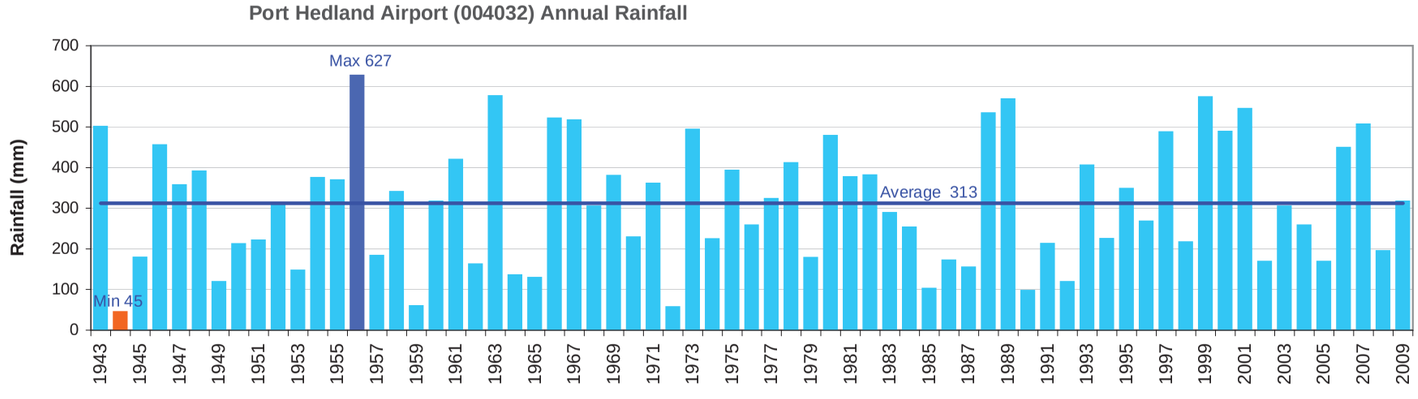
Data Source: Landgate (2010) cadastre

Job No. J4381
Scale:1:6,000
0 100 200 300 400 Meters

Landcorp
South Hedland Town Centre Revitalisation: Flood Modelling
Figure 2: Study Area







Data Source: Bureau of Meterorology (2010) Climate Data Online.

Job No. J4381

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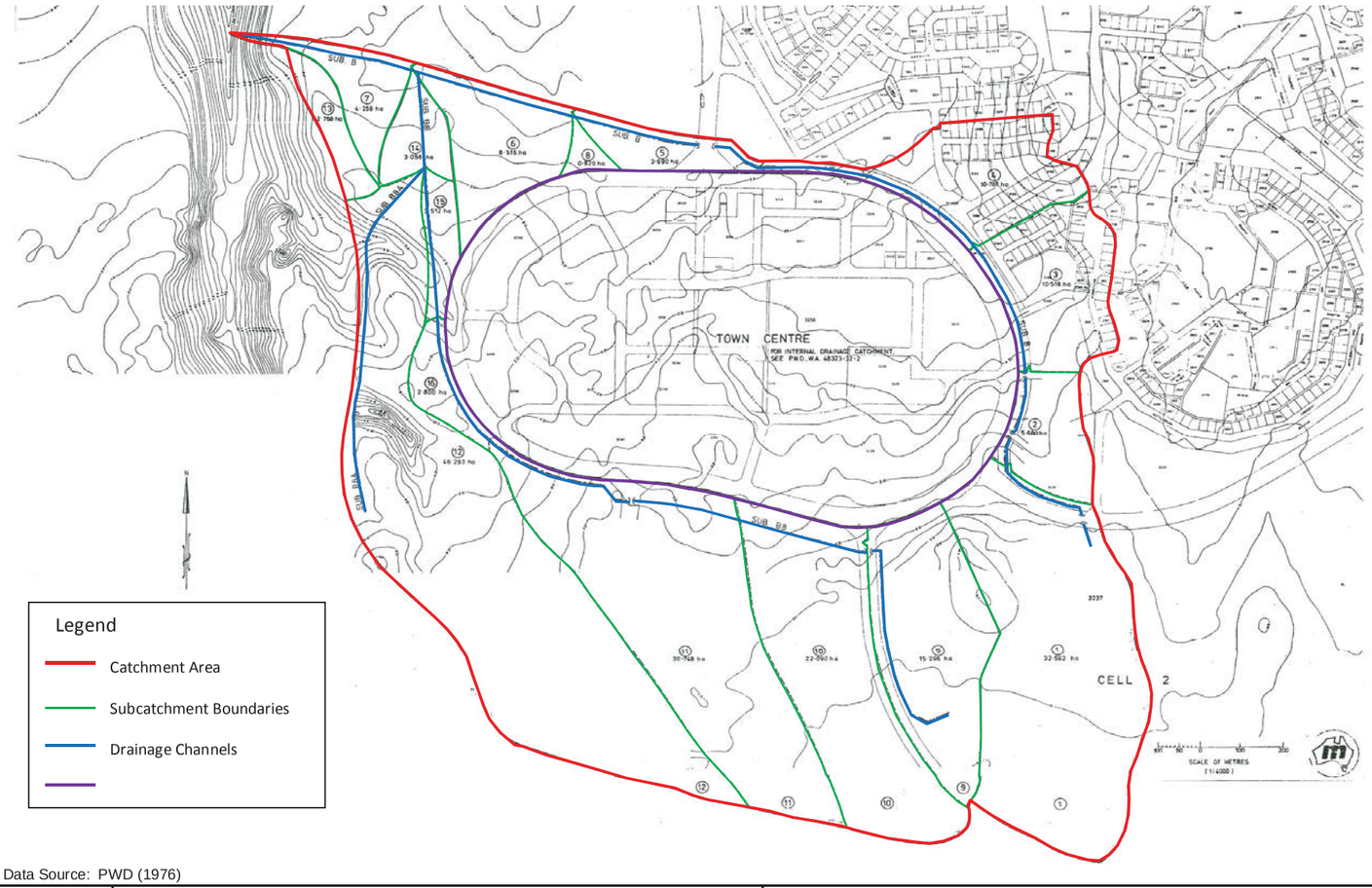
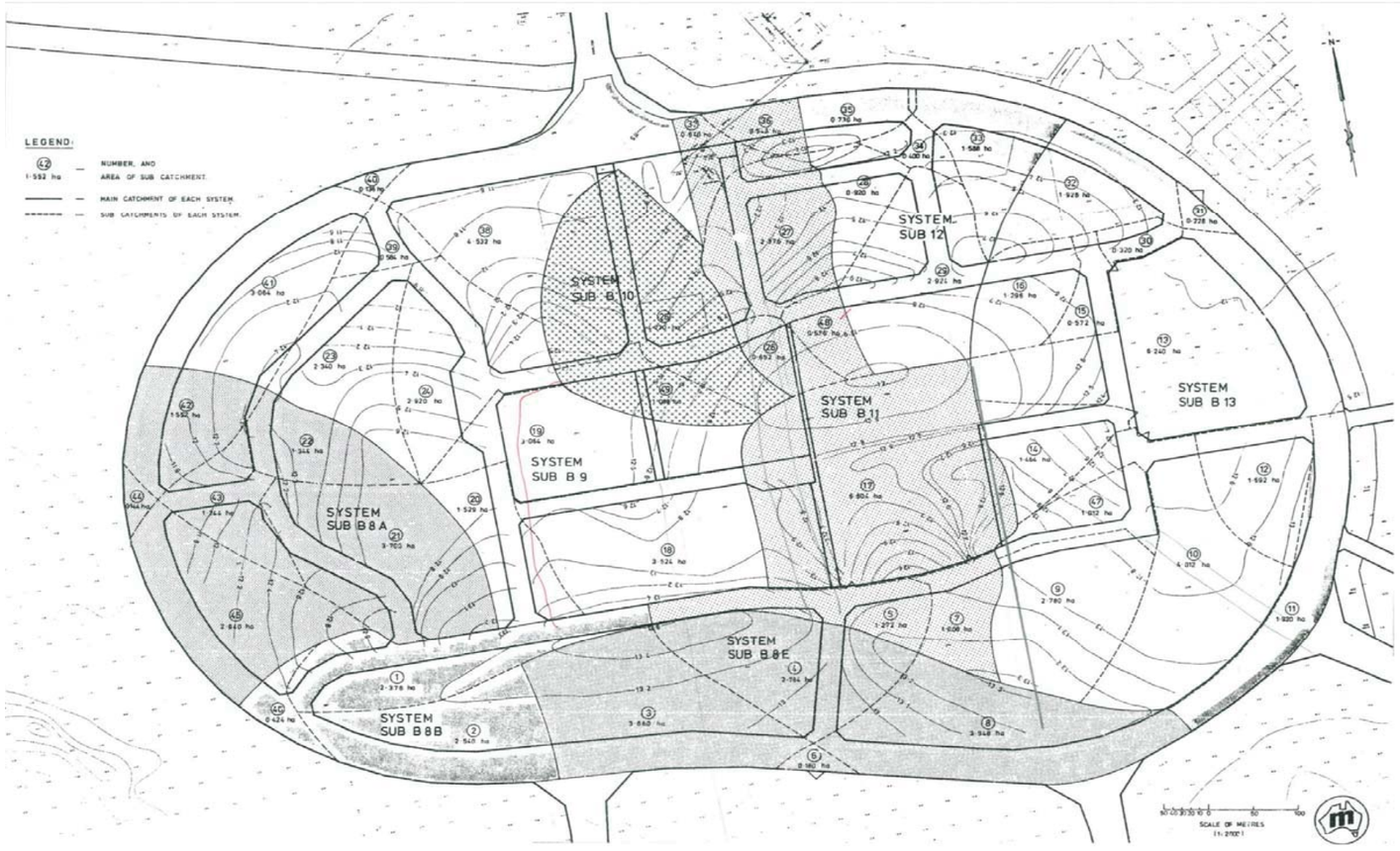
Landcorp
South Hedland Town Centre Revitalisation: Flood Modelling
Figure 3: Port Headland Airport Rainfall Data



Data Source: PWD (1976)

Job No. J4381
Scale ~ 1 : 13,450

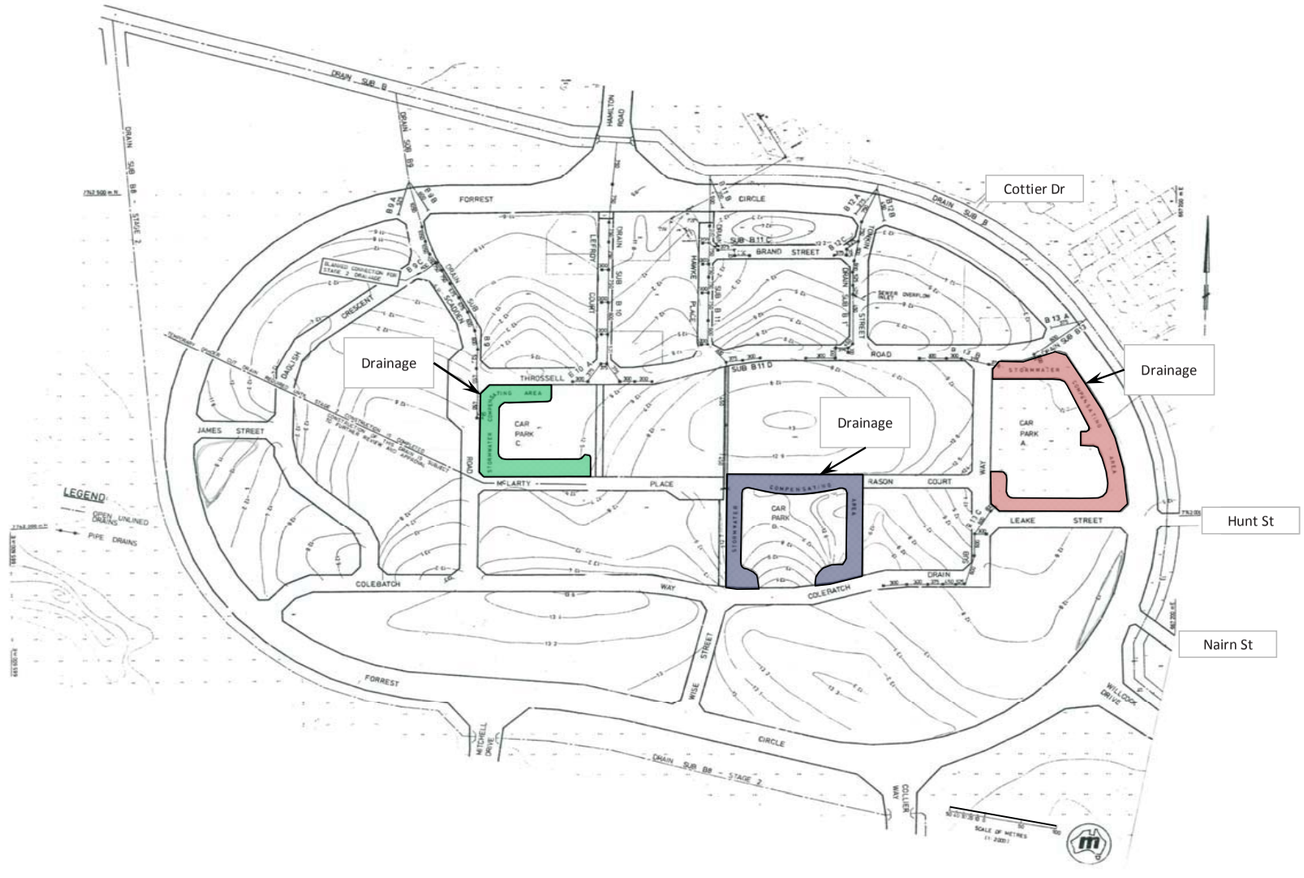
Landcorp
South Hedland Town Centre Revitalisation: Flood Modelling
Figure 4: PWD (1976) Catchment Plan



Data Source: PWD (1976)

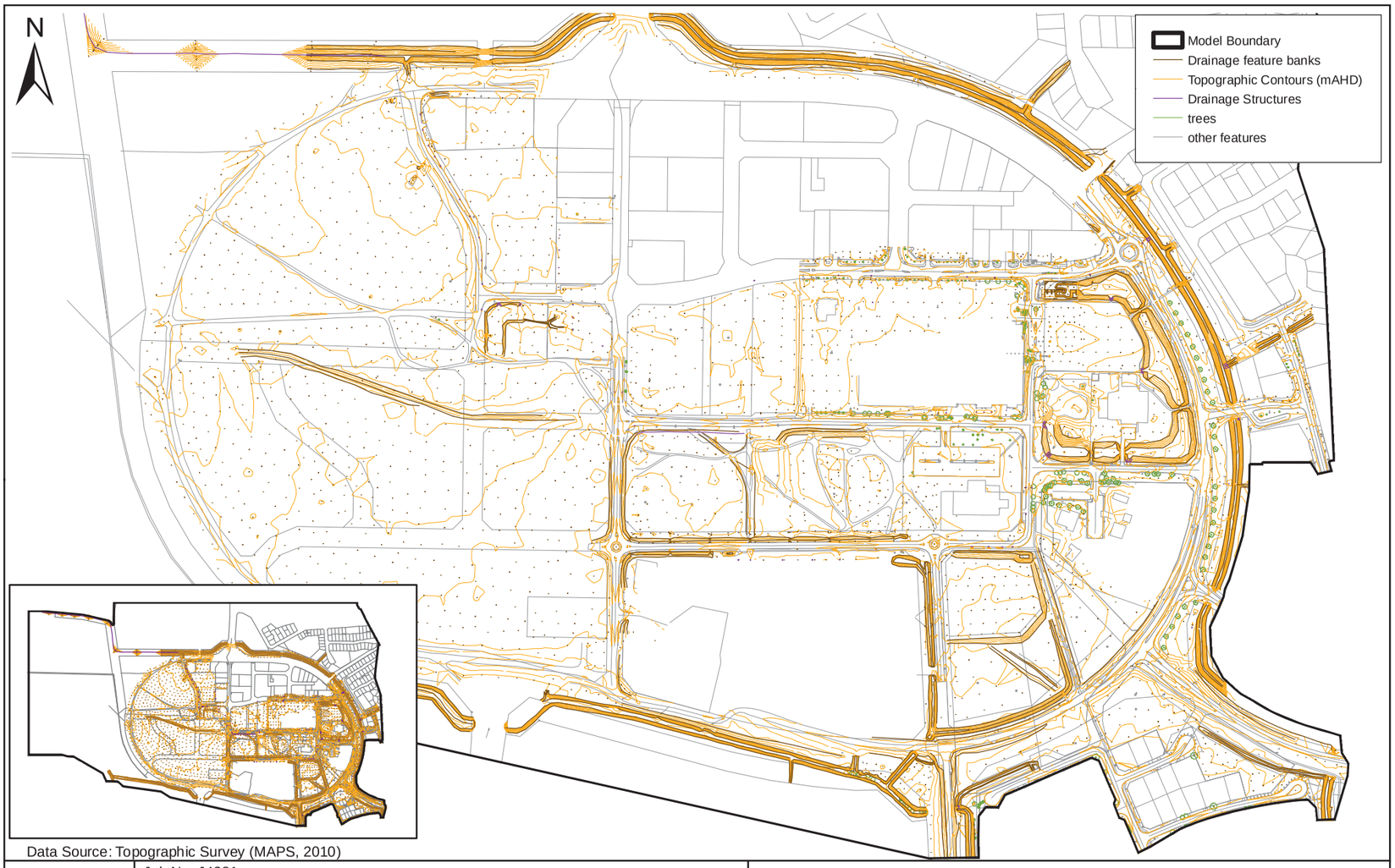
Job No. J4381
Scale ~ 1 : 6,360

Landcorp
South Hedland Town Centre Revitalisation: Flood Modelling
Figure 5: PWD (1976) Town Centre Drainage



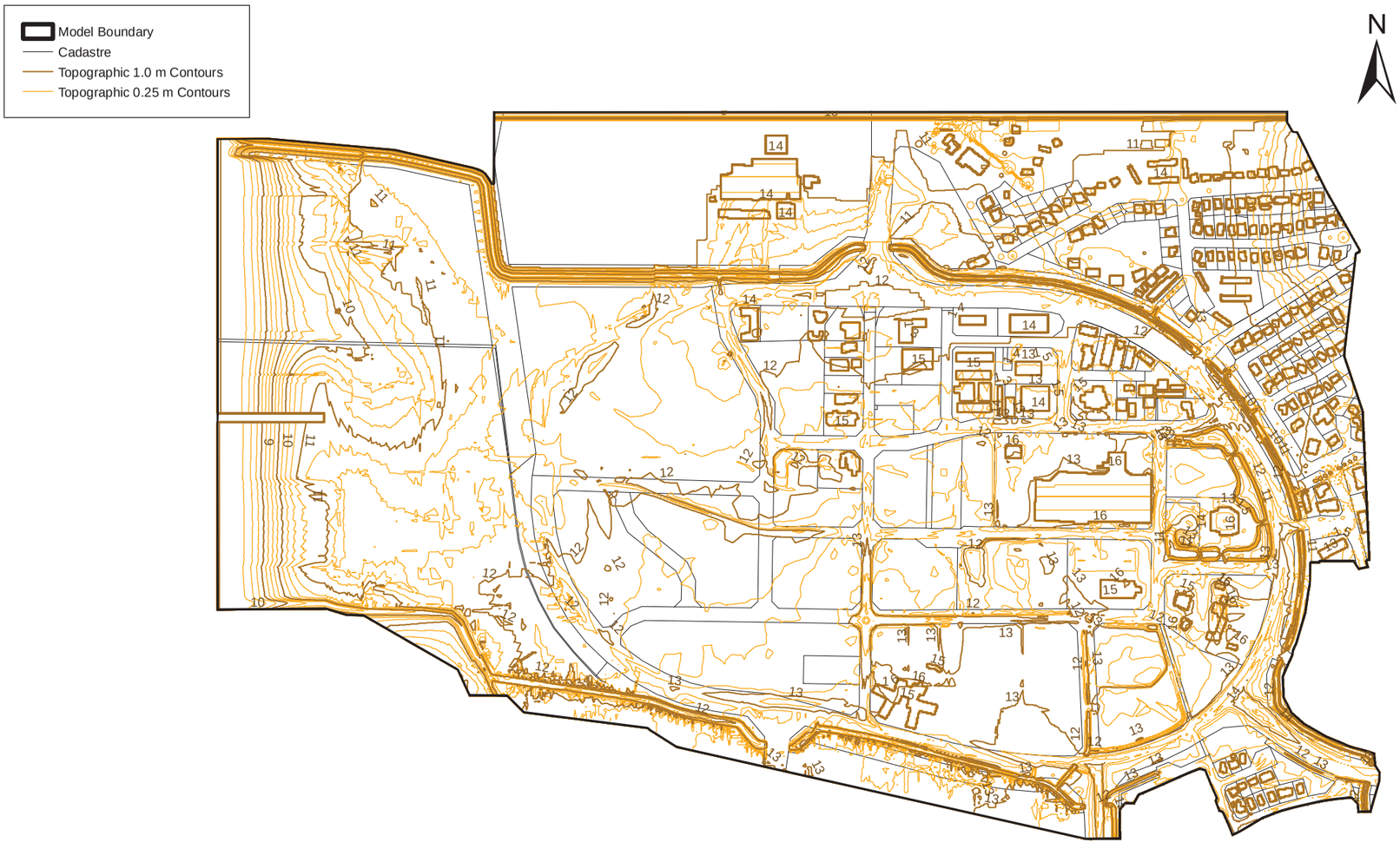
Data Source: PWD (1976)

JDA Consultant Hydrologists	Job No. J4381 Scale ~ 1 : 8,000	Landcorp South Hedland Town Centre Revitalisation: Flood Modelling **Figure 6: PWD (1976) Town Centre Proposed Drainage Basins**



Data Source: Topographic Survey (MAPS, 2010)

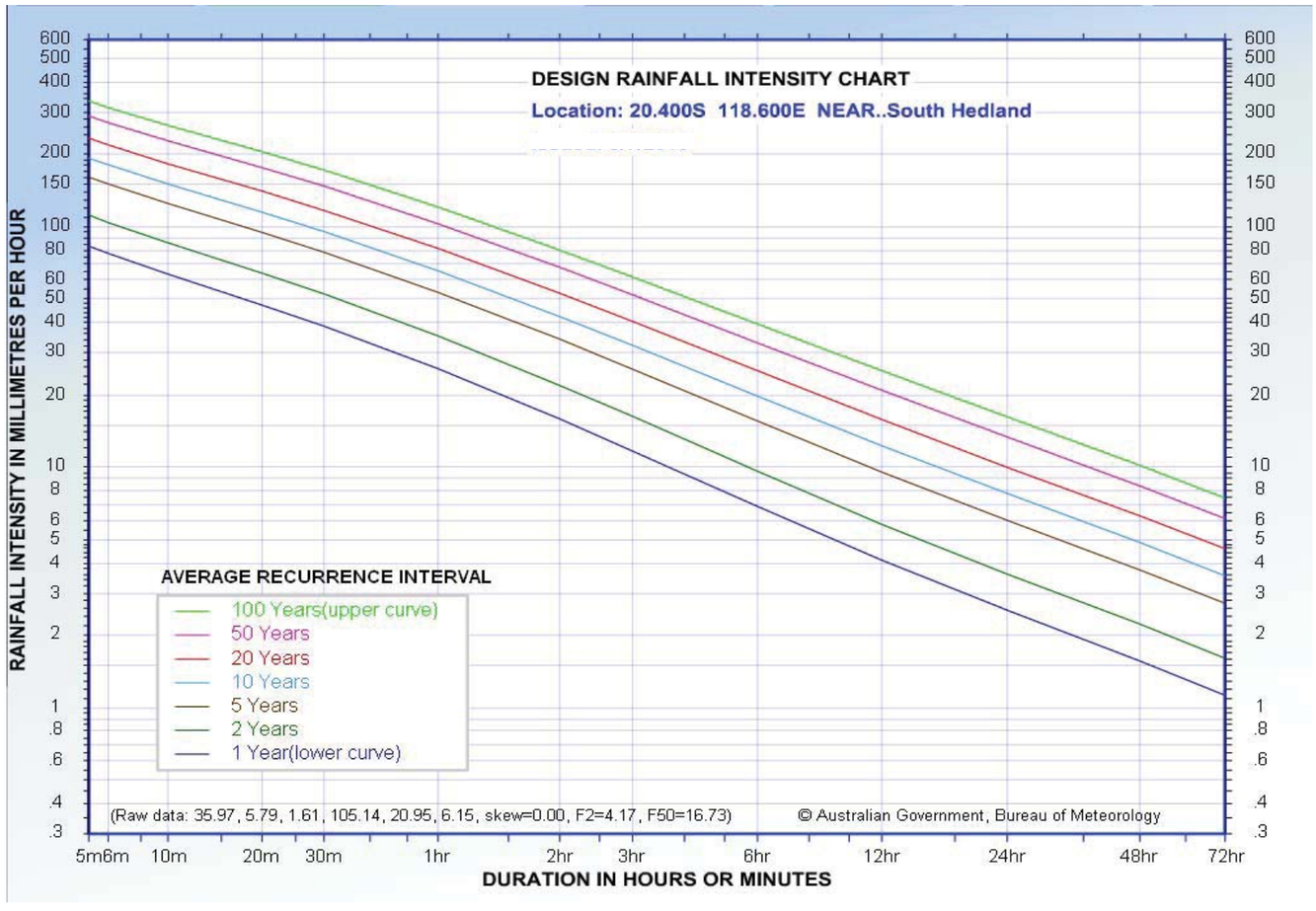
JDA Consultant Hydrologists	Job No. J4381 Scale:1:6,500 0 100 200 300 400 Meters	Landcorp South Hedland Town Centre Revitalisation: Flood Modelling **Figure 7: Town Cetnre Survey Data**



Data Source: Derived from Topographic Survey (MAPS, 2010)

Job No. J4381
Scale: 1:9,500
0 100 200 300 400 Meters

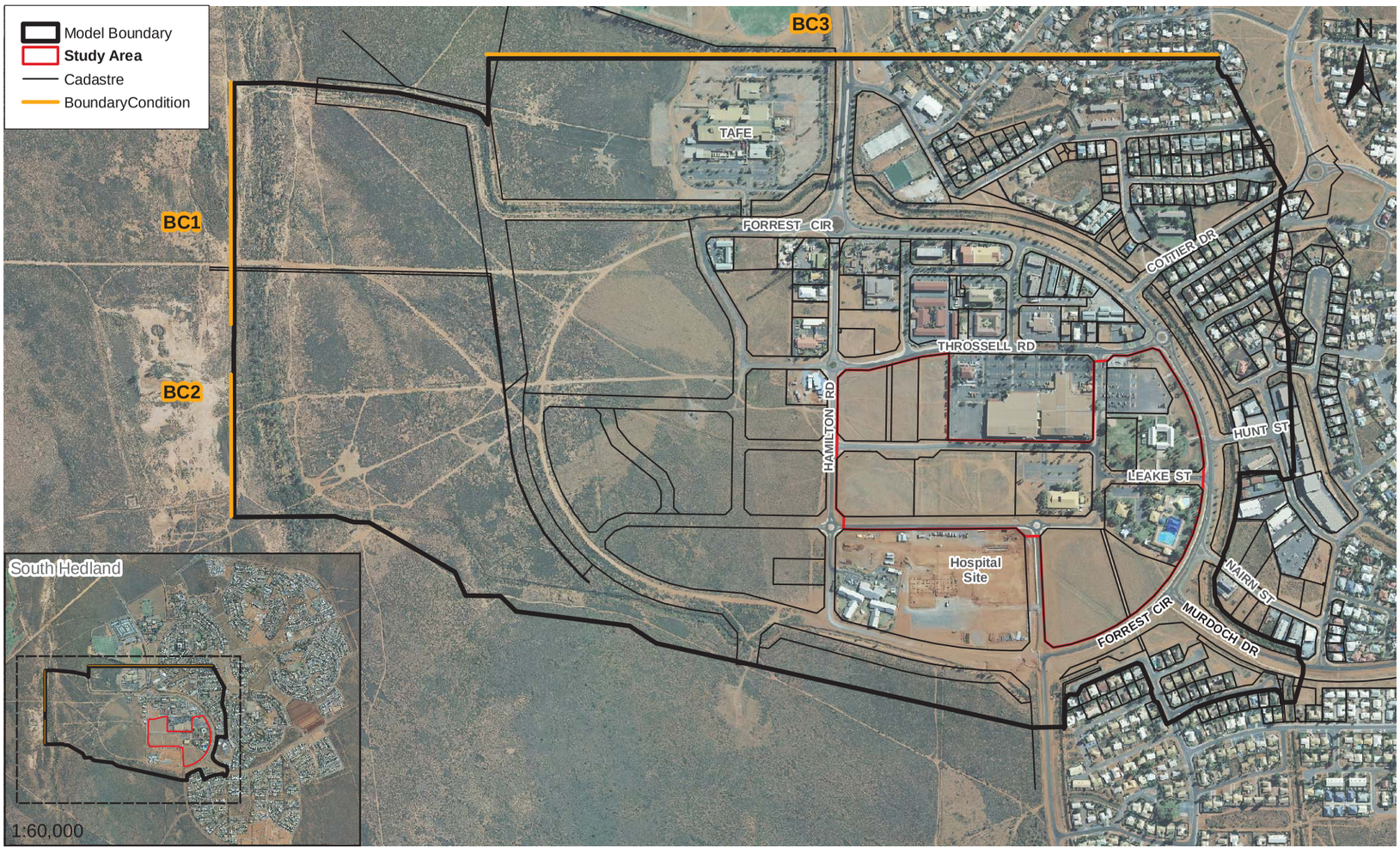
Landcorp
South Hedland Town Centre Revitalisation: Flood Modelling
Figure 8: Raw DEM



Data Source: Bureau of Meterorology (2010) IFD Generator

Job No. J4381

Landcorp
South Hedland Town Centre Revitalisation: Flood Modelling
Figure 9: South Hedland IFD



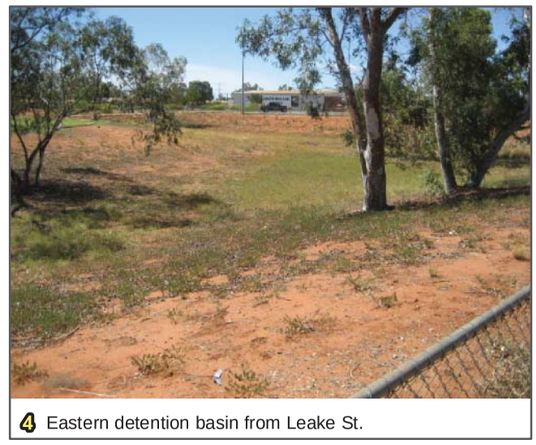
Job No. J4381
Scale: 1:10,238
0 100 200 300 400 Meters

Land Corp
South Hedland Town Centre Revitalisation: Flood Modelling
Figure 10: Model Boundary

1 Example of fringing vegetation along Forrest Circle Drainage Channel

2 Looking south-east (Existing Native Vegetation).

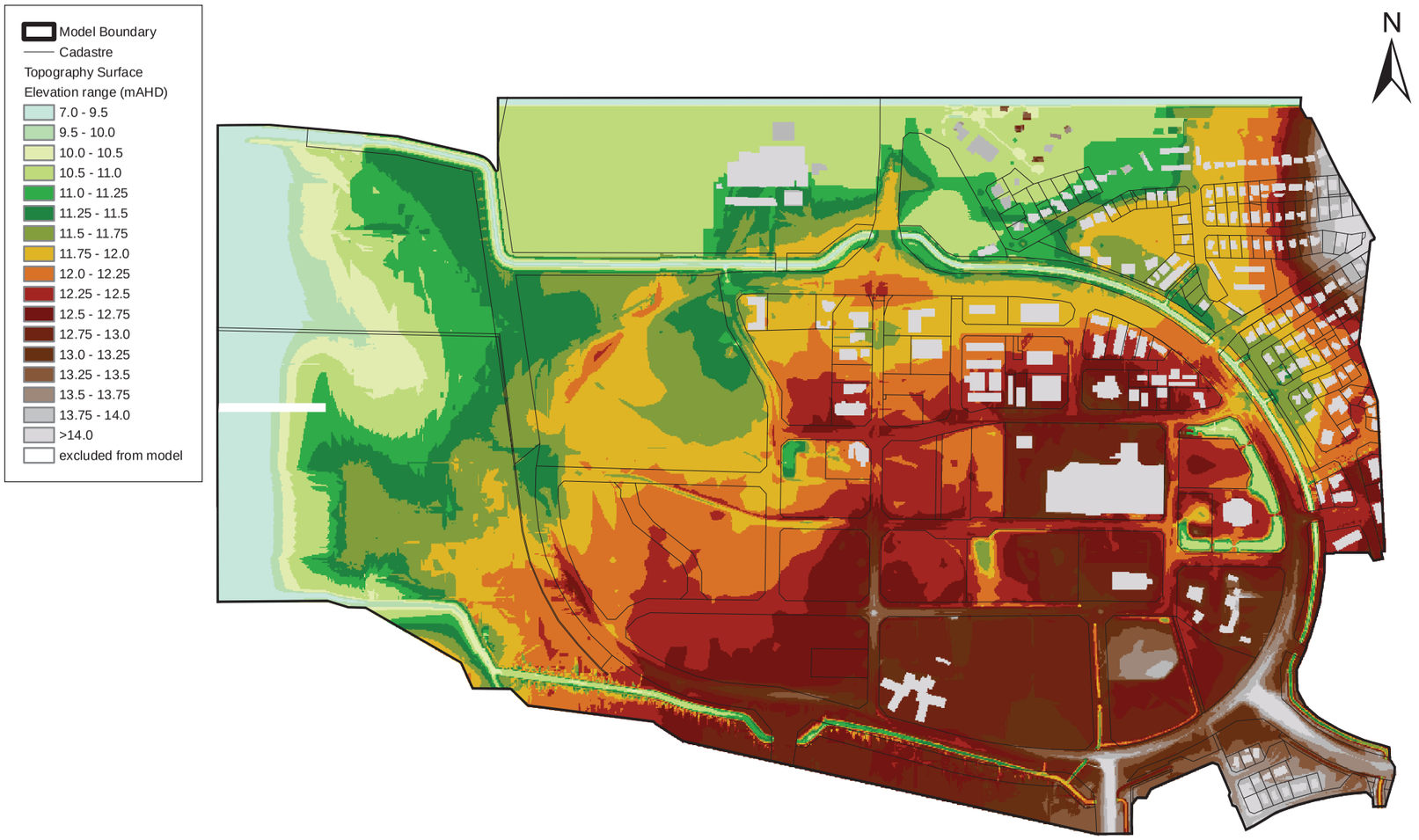
3 Looking westwards down Brand St (existing commercial).



4 Eastern detention basin from Leake St.

Job No. J4381
Scale: 1:12,250
0 100 200 300 400 Meters

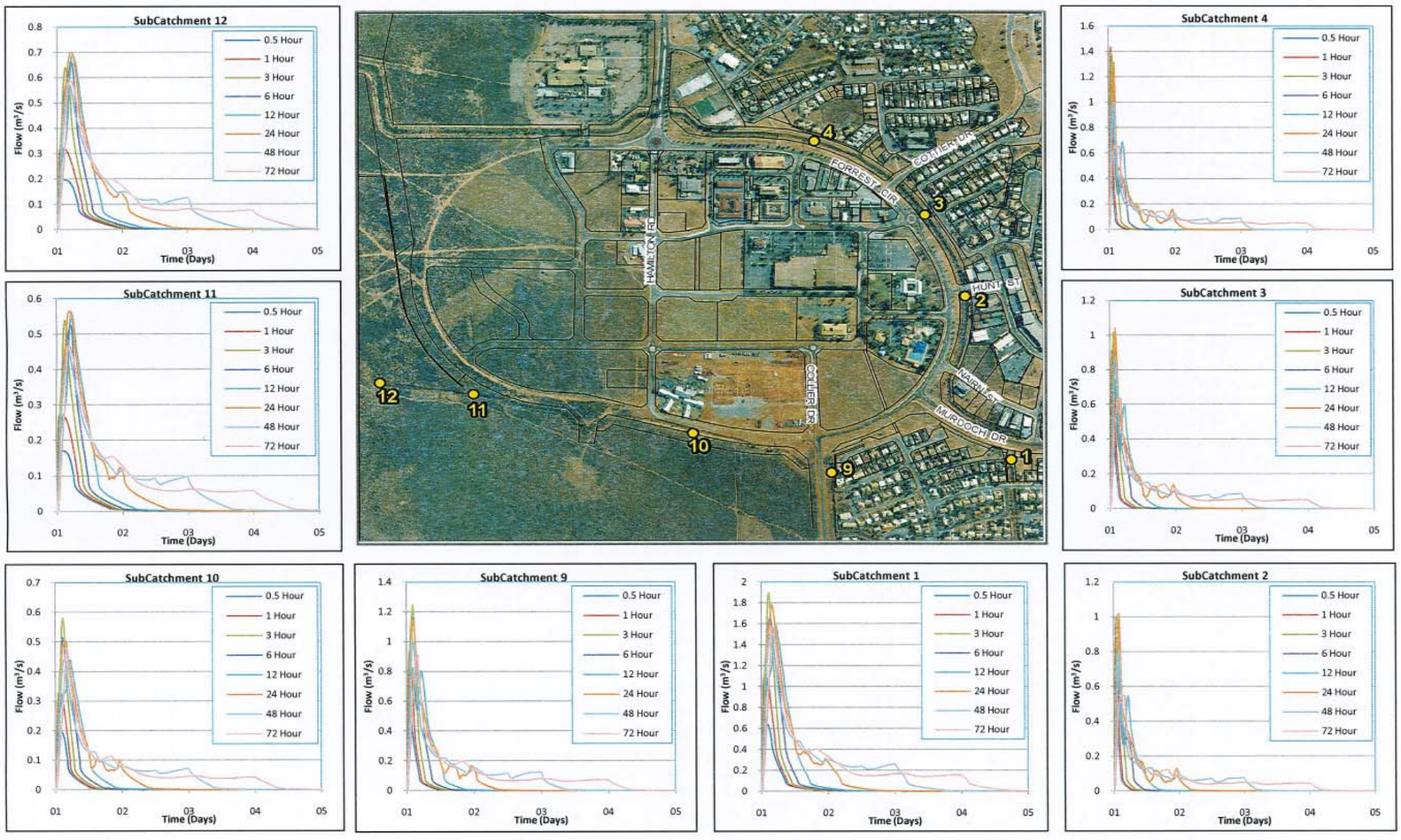
Lancorp
South Hedland Town Centre Revitalisation: Flood Modelling
Figure 11: Examples of Land Uses



Data Source: Derived from Topographic Survey (MAPS, 2010)

Job No. J4381
Scale: 1:9,500
0 100 200 300 400 Meters

Land Corp
South Hedland Town Centre Revitalisation: Flood Modelling
Figure 12: Topographic Grid (Existing)



Job No. J4381

LandCorp
South Hedland Town Centre Revitalisation: Flood Modelling
Figure 13: External Subcatchment Inflow Hydrographs

1 Looking west at Hamilton Rd, upstream of culvert.

2 Looking north-west at track crossing, upstream of culvert.

3 Looking south-west towards Forrest Circle (South) culvert.

4 Looking south-east at Hunt St culvert, downstream end.

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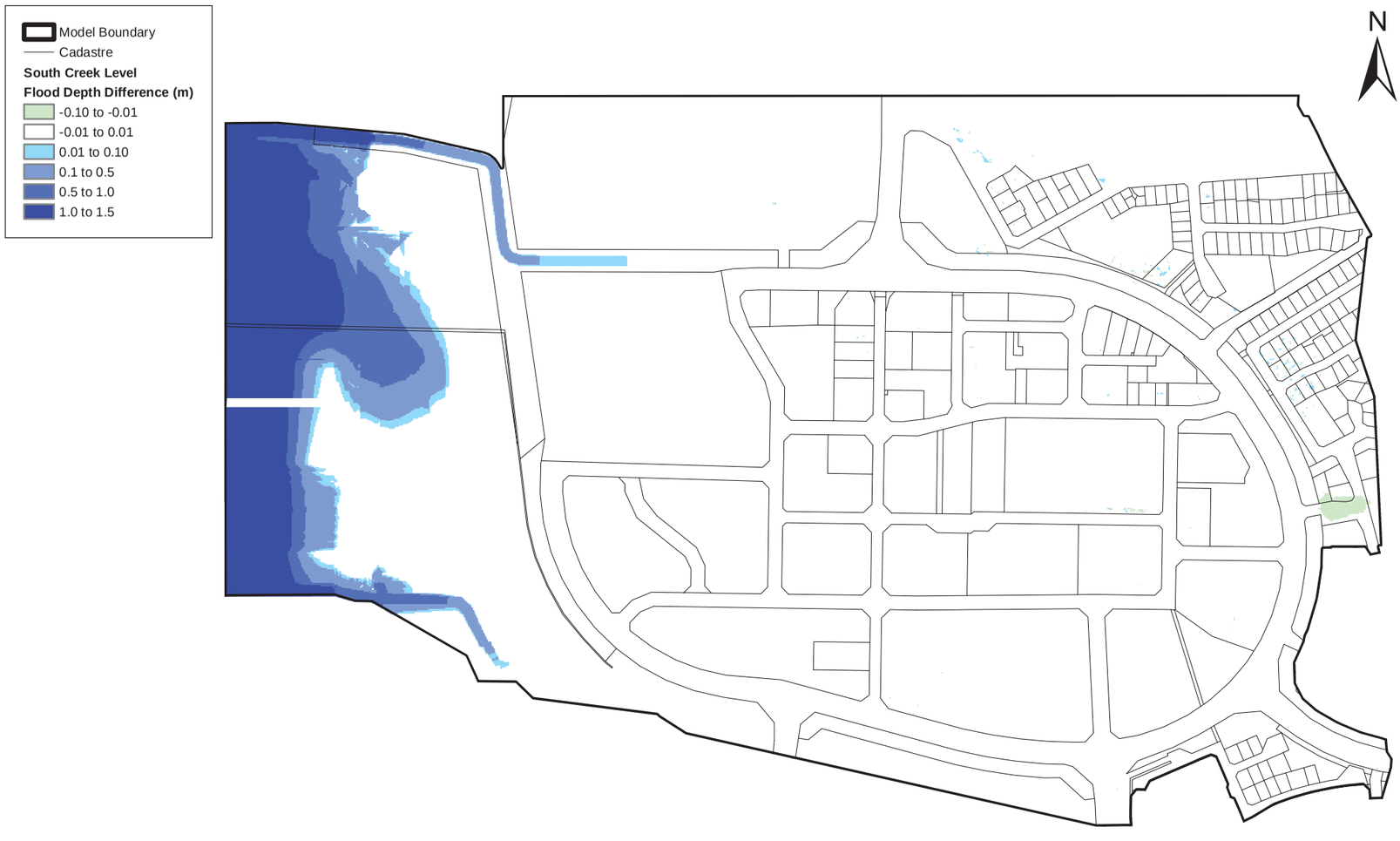
Job No. J4381
Scale: 1:12,250
0 100 200 300 400 Meters

Landcorp
South Hedland Town Centre Revitalisation: Flood Modelling
Figure 14: MIKE11 Structure Locations and Photos



Data Source: MIKE FLOOD Model output

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Job No. J4381
Scale: 1:9,500
0 100 200 300 400 Meters

Landcorp
South Hedland Town Centre Revitalisation: Flood Modelling
Figure 15: South Creek Level Sensitivity Map (100yr ARI)

Data Source: MIKE FLOOD Model output

Job No. J4381
Scale: 1:9,500
0 100 200 300 400 Meters

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South Hedland Town Centre Revitalisation: Flood Modelling
Figure 16: Roughness Sensitivity Map (100 Year ARI)

Data Source: MIKE FLOOD Model output

Job No. J4381
Scale: 1:7,000
0 100 200 300 400 Meters

Landcorp
South Hedland Town Centre Revitalisation: Flood Modelling
Figure 17: 5 Year 24 hour Event Flood Extent (Existing)

Data Source: MIKE FLOOD Model output

Job No. J4381
Scale:1:7,000
0 100 200 300 400 Meters

Landcorp
South Hedland Town Centre Revitalisation: Flood Modelling
Figure 18: 100 Year ARI 3 hour Event Flood Extent (Existing)

Data Source: RPS (2010) South Hedland Town Centre Development Plan

Job No. J4381

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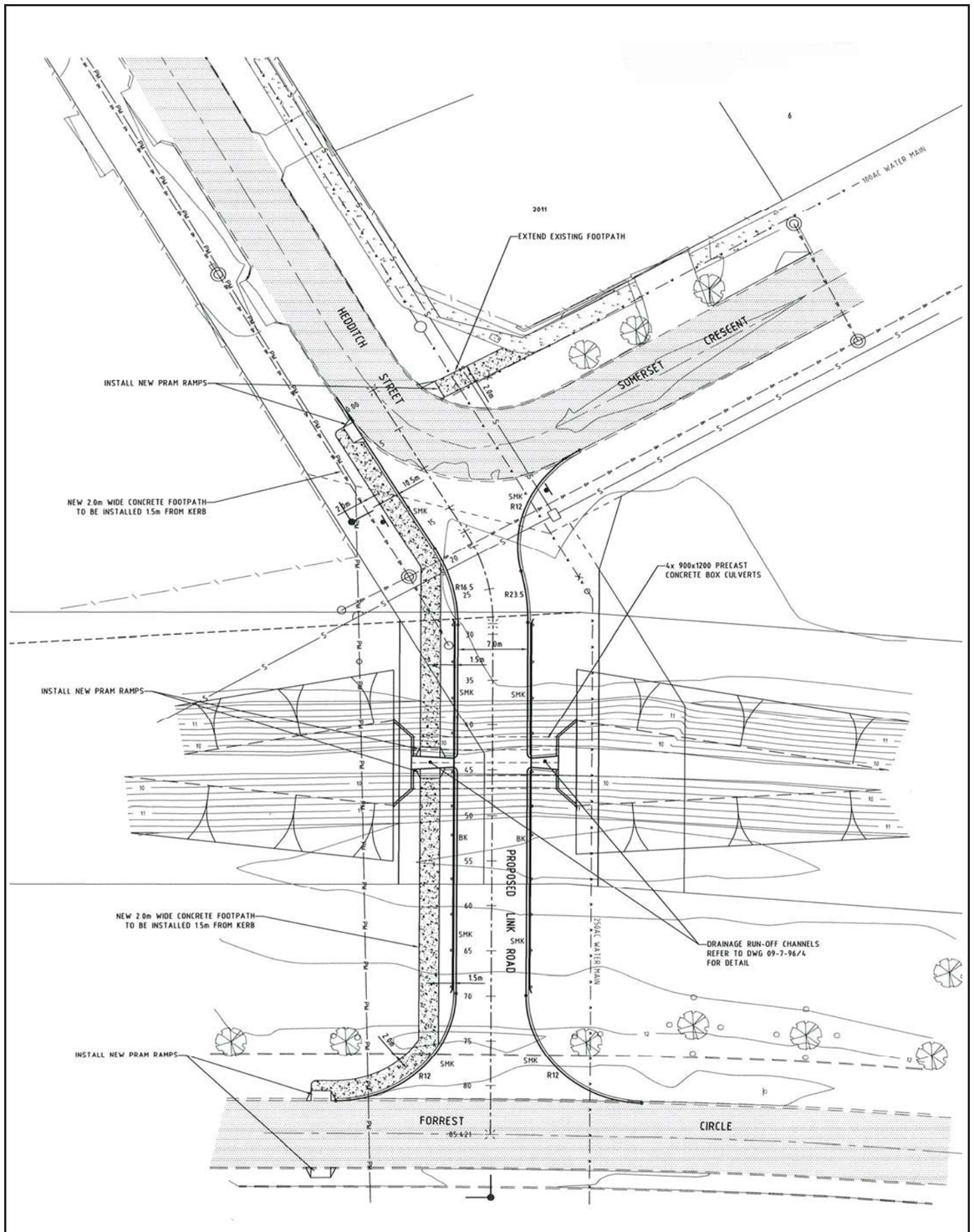
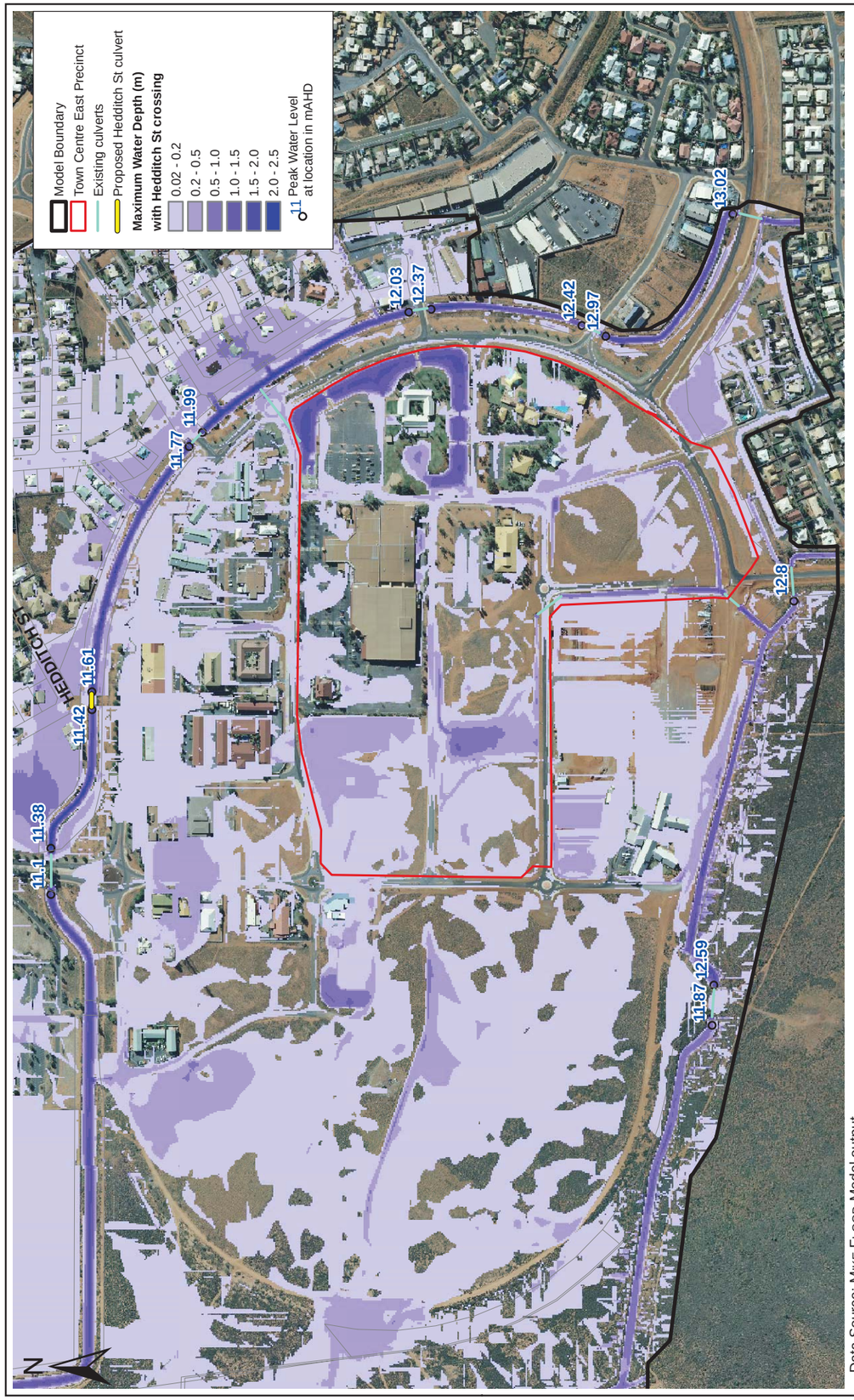
Landcorp
South Hedland Town Centre Revitalisation: Flood Modelling
Figure 19: South Headland Town Centre Development Plan



Data Source: Porter Consulting Engineers (2010)

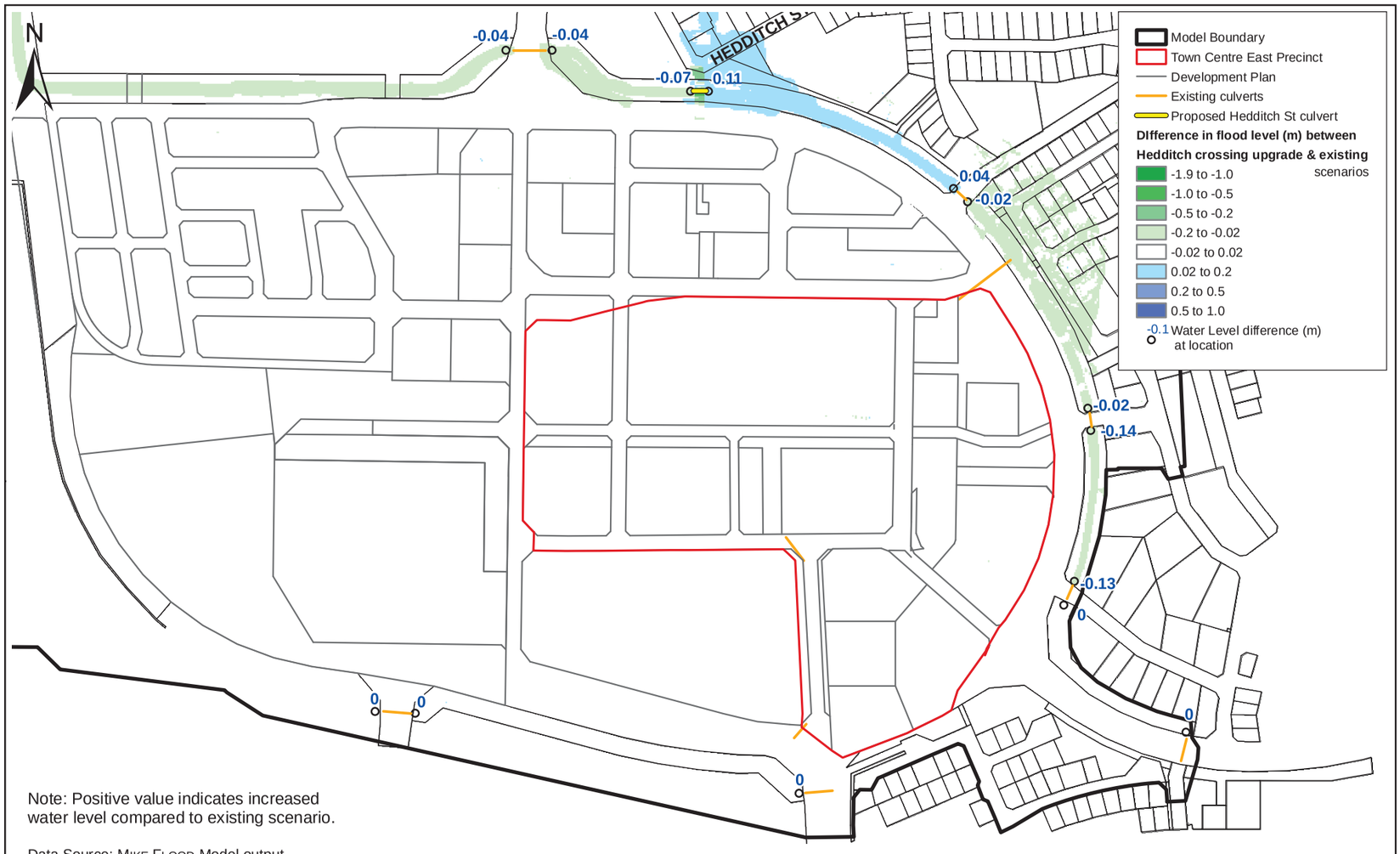
JDA Consultant Hydrologists	Job No. J4381 Scale ~1 : 570	Landcorp South Hedland Town Centre Revitalisation: Flood Modelling **Figure 20: Proposed Hedditch St Crossing**



Data Source: MIKE FLOOD Model output

JDA Consultant Hydrologists	Landcorp South Hedland Town Centre Revitalisation: Flood Modelling **Figure 21: 100yr ARI 3 Hour Event Flood Extent (Hedditch St crossing Simulation)**

Job No. J4381
Scale:1:7,000

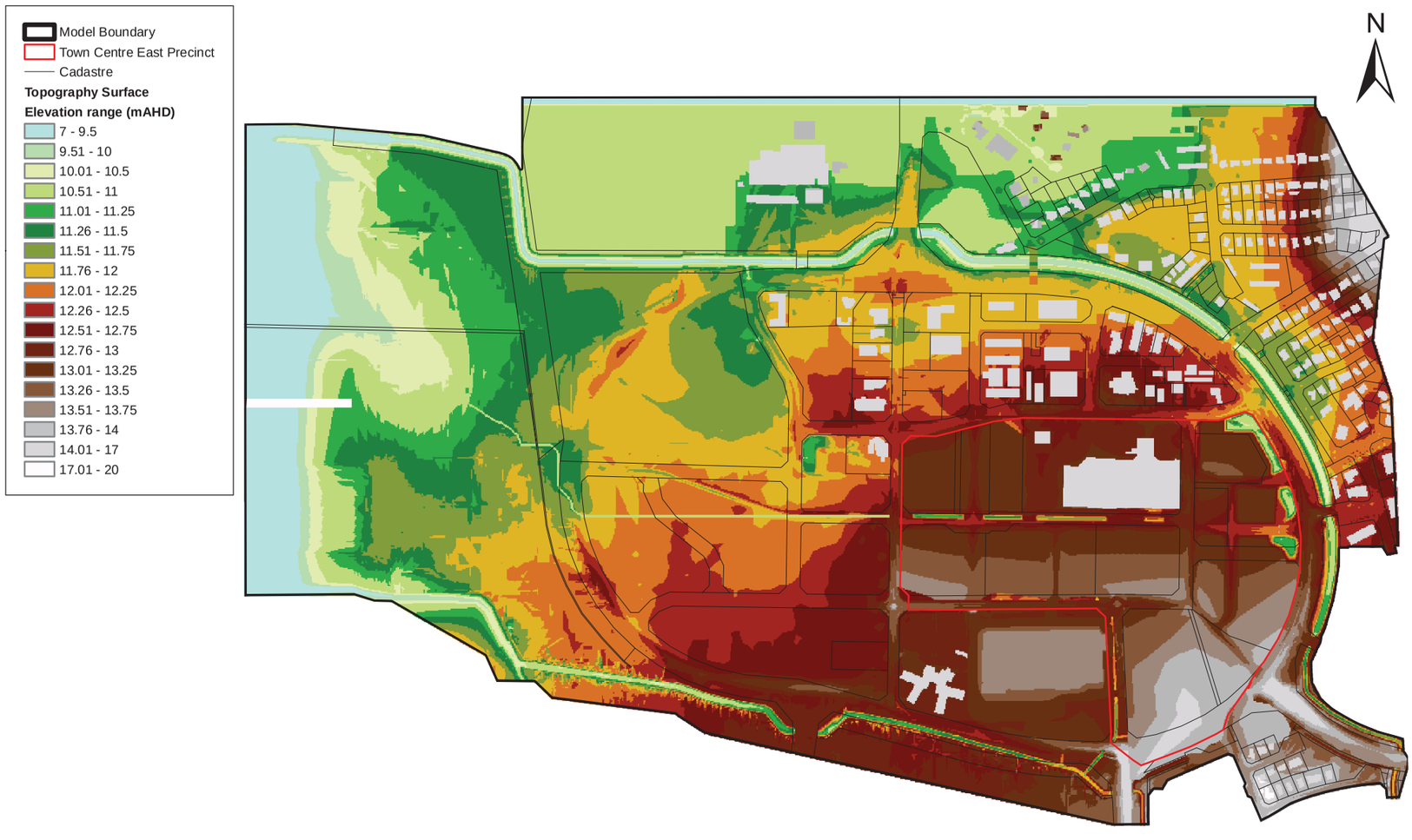


Note: Positive value indicates increased water level compared to existing scenario.

Data Source: MIKE FLOOD Model output

Job No. J4381
Scale:1:7,000
0 100 200 300 400 Meters

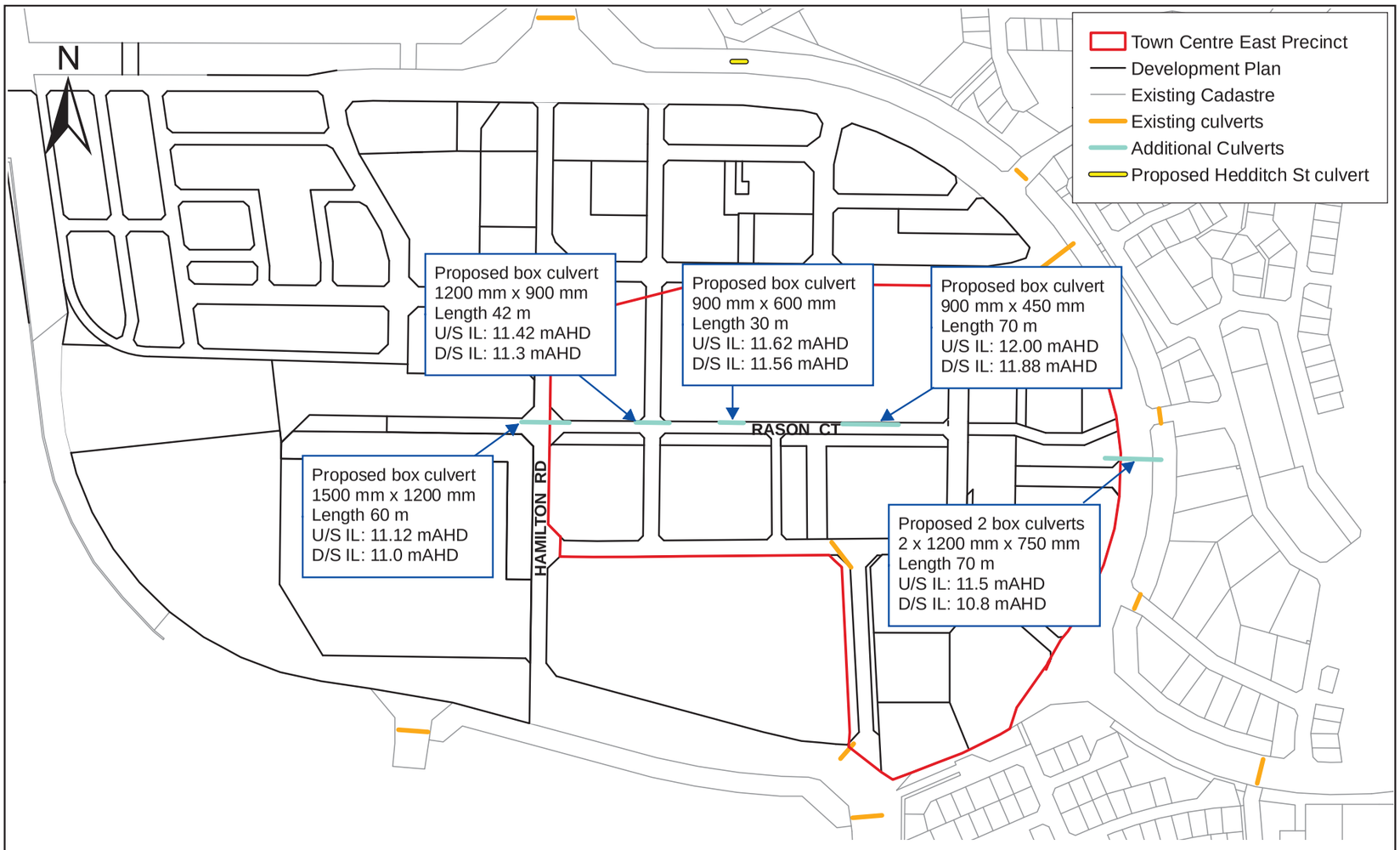
Landcorp
South Hedland Town Centre Revitalisation: Flood Modelling
Figure 22: Difference in Flood Levels between Hedditch St and Existing Simulations



Data Source: Derived from Topographic Survey (MAPS, 2010) with modifications to proposed development area

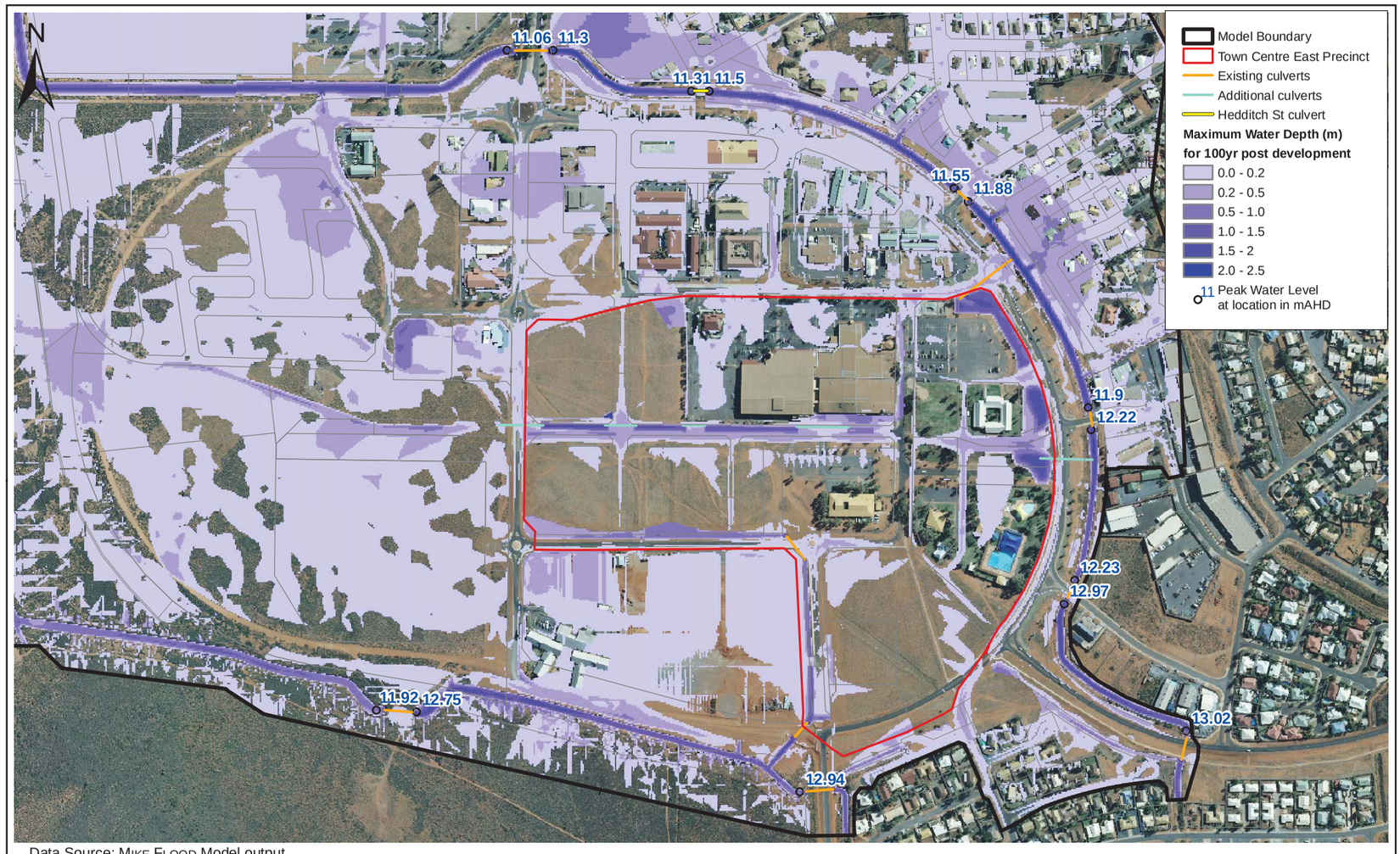
Job No. J4381
Scale:1:9,500
0 100 200 300 400 Meters

Landcorp
South Hedland Town Centre Revitalisation: Flood Modelling
Figure 23: Topographic Grid incorporating proposed design surface



Job No. J4381
Scale:1:6,500
0 100 200 300 400 Meters

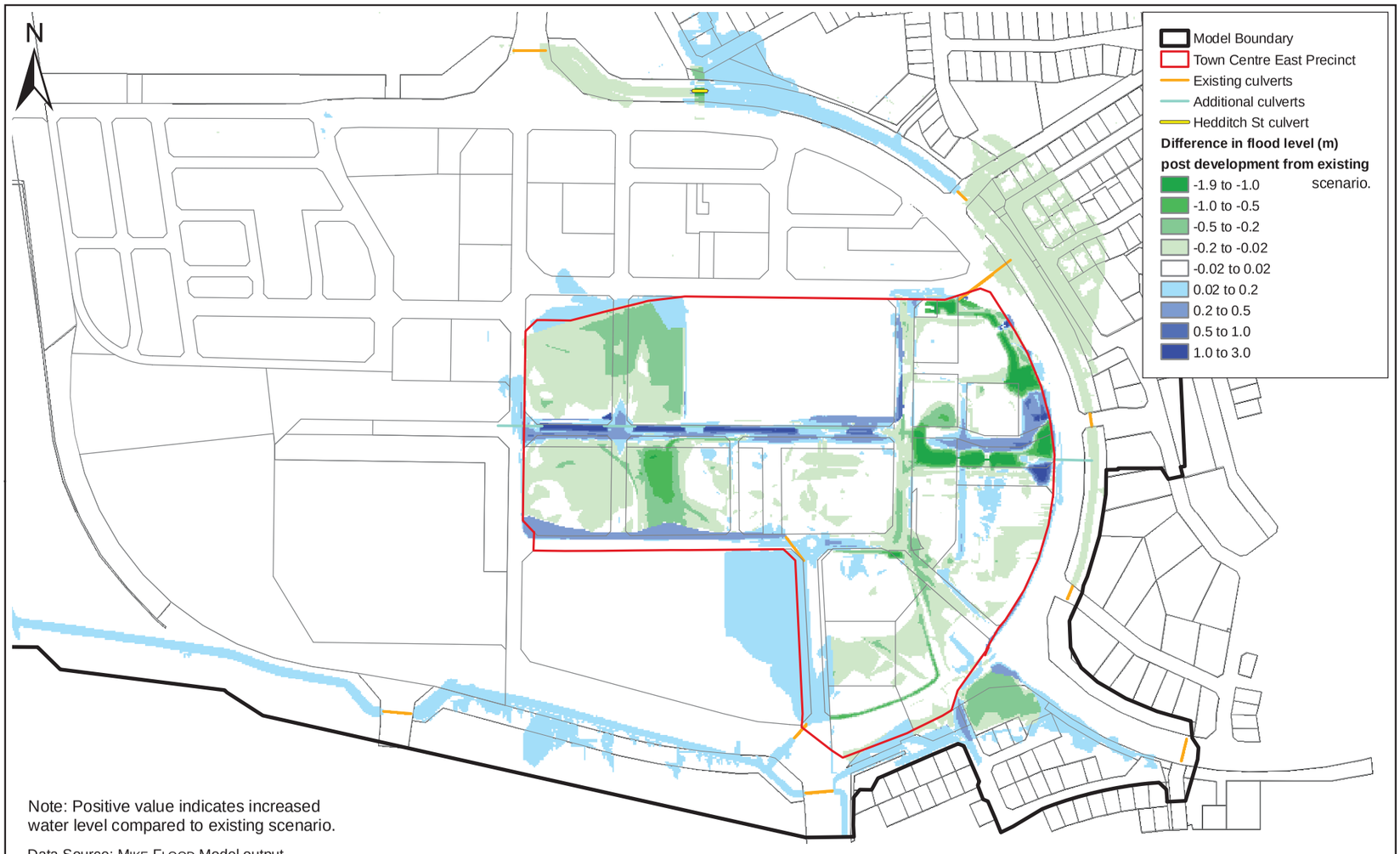
Landcorp
South Hedland Town Centre Revitalisation: Flood Modelling
Figure 24: Details of Additional Culverts



Data Source: MIKE FLOOD Model output

Job No. J4381
Scale:1:7,000
0 100 200 300 400 Meters

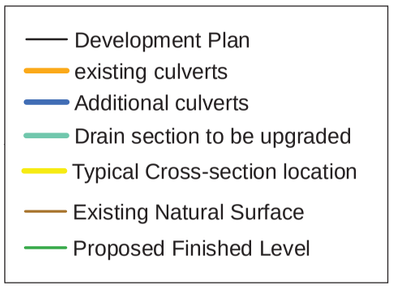
Landcorp
South Hedland Town Centre Revitalisation: Flood Modelling
Figure 25: 100 Year ARI 3 hour Event Flood Extent (Post Development Scenario)

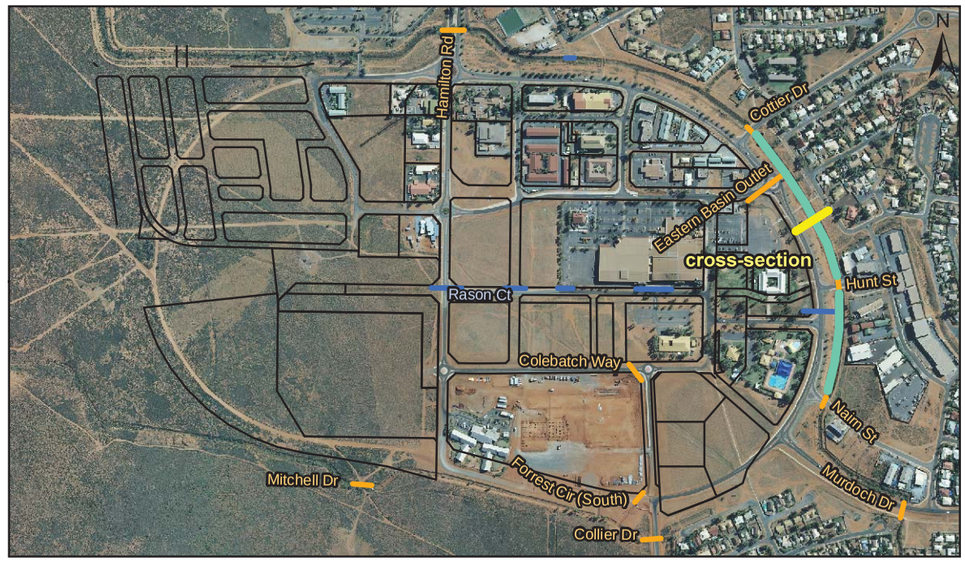


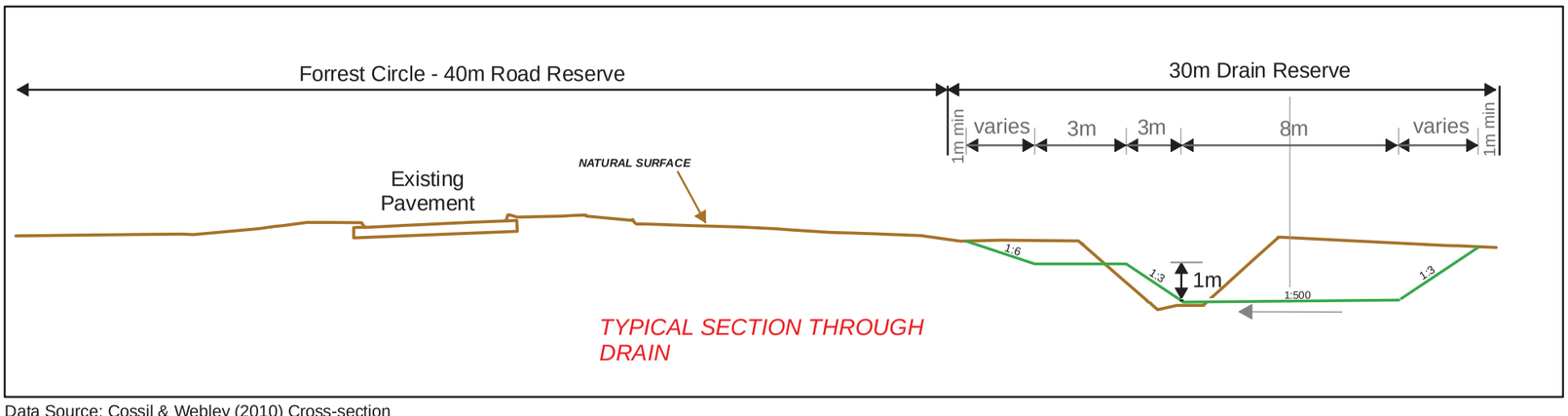
Data Source: MIKE FLOOD Model output

Job No. J4381
Scale: 1:7,000
0 100 200 300 400 Meters

Landcorp
South Hedland Town Centre Revitalisation: Flood Modelling
Figure 26: Difference in Flood Levels (100 year ARI 3 hour Duration) between Post Development and Existing



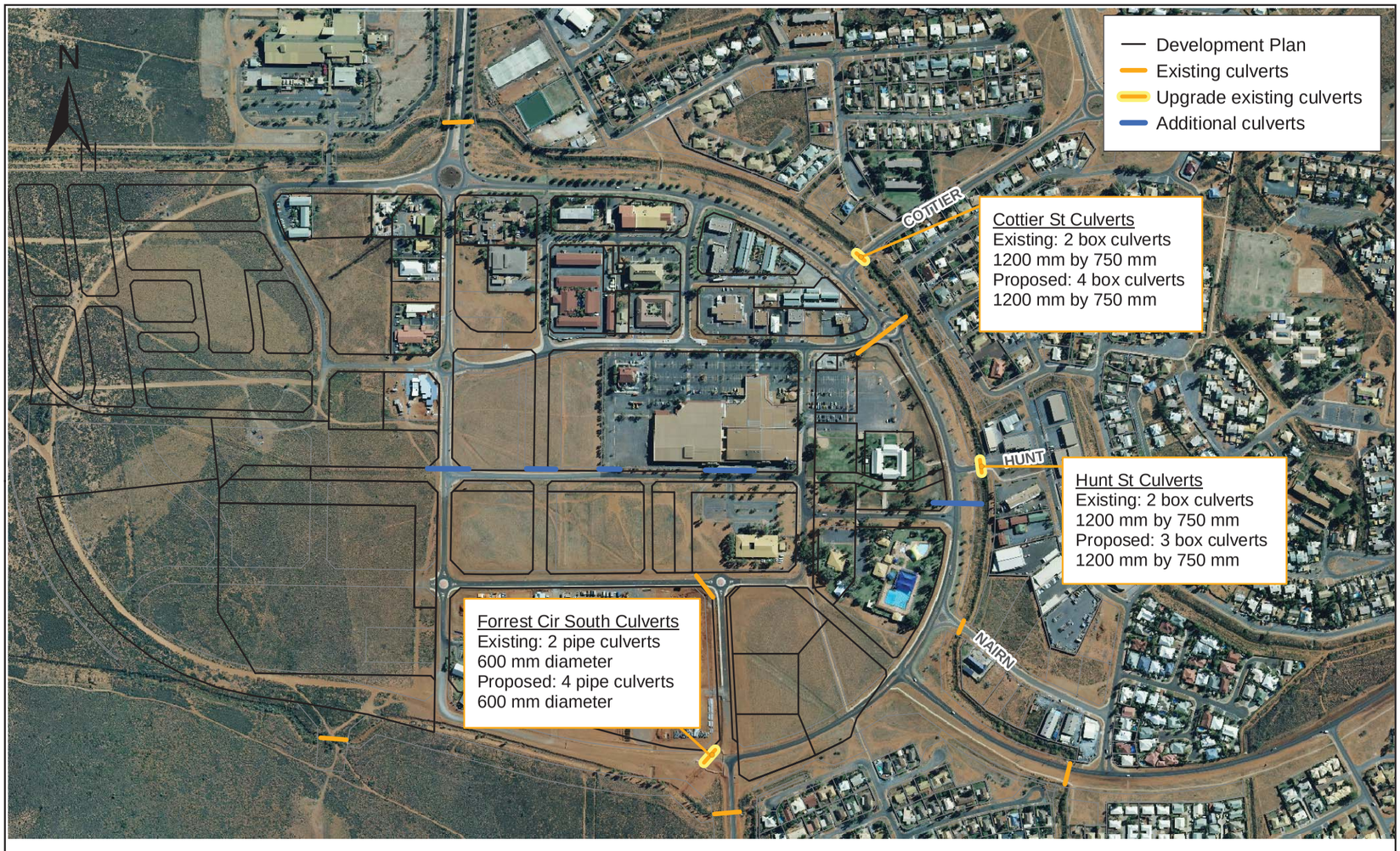




Data Source: Cossil & Webley (2010) Cross-section

Job No. J4381
Scale: 1:12,000
0 100 200 300 400 Meters

Landcorp
South Hedland Town Centre Revitalisation: Flood Modelling
Figure 27: Schematic Cross Section of Proposed Upgrade to Forrest Circle Northern Drainage Channel



Job No. J4381
Scale:1:7,500
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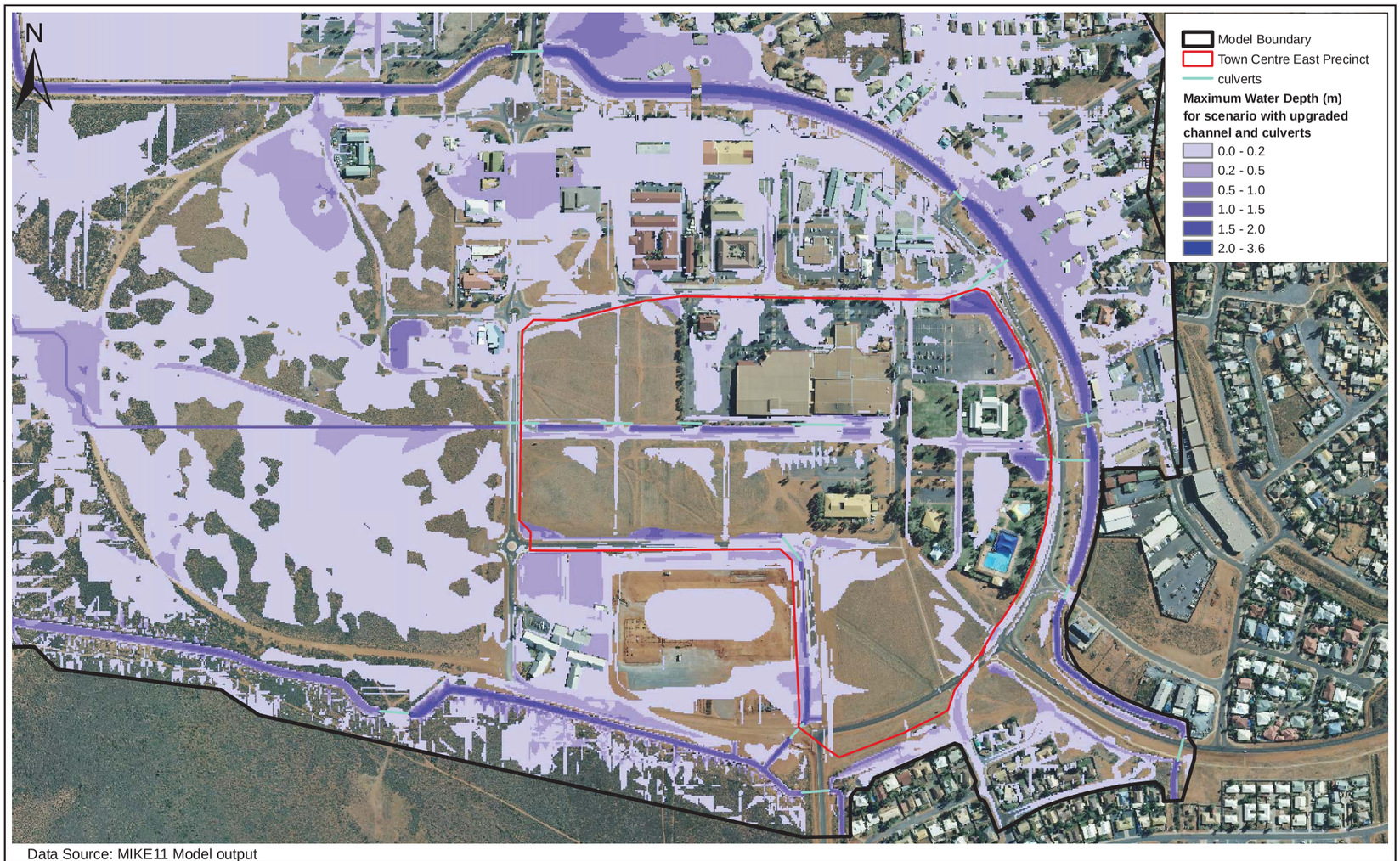
Landcorp
South Hedland Town Centre Revitalisation: Flood Modelling
Figure 28: Details of Proposed Upgrade of Culverts



Data Source: MIKE11 Model output

Job No. J4381
Scale:1:7,000
0 100 200 300 400 Meters

Landcorp
South Hedland Town Centre Revitalisation: Flood Modelling
Figure 29: 100 Year ARI 3 hour Event Flood Extent (Upgraded Post Development compared to existing)

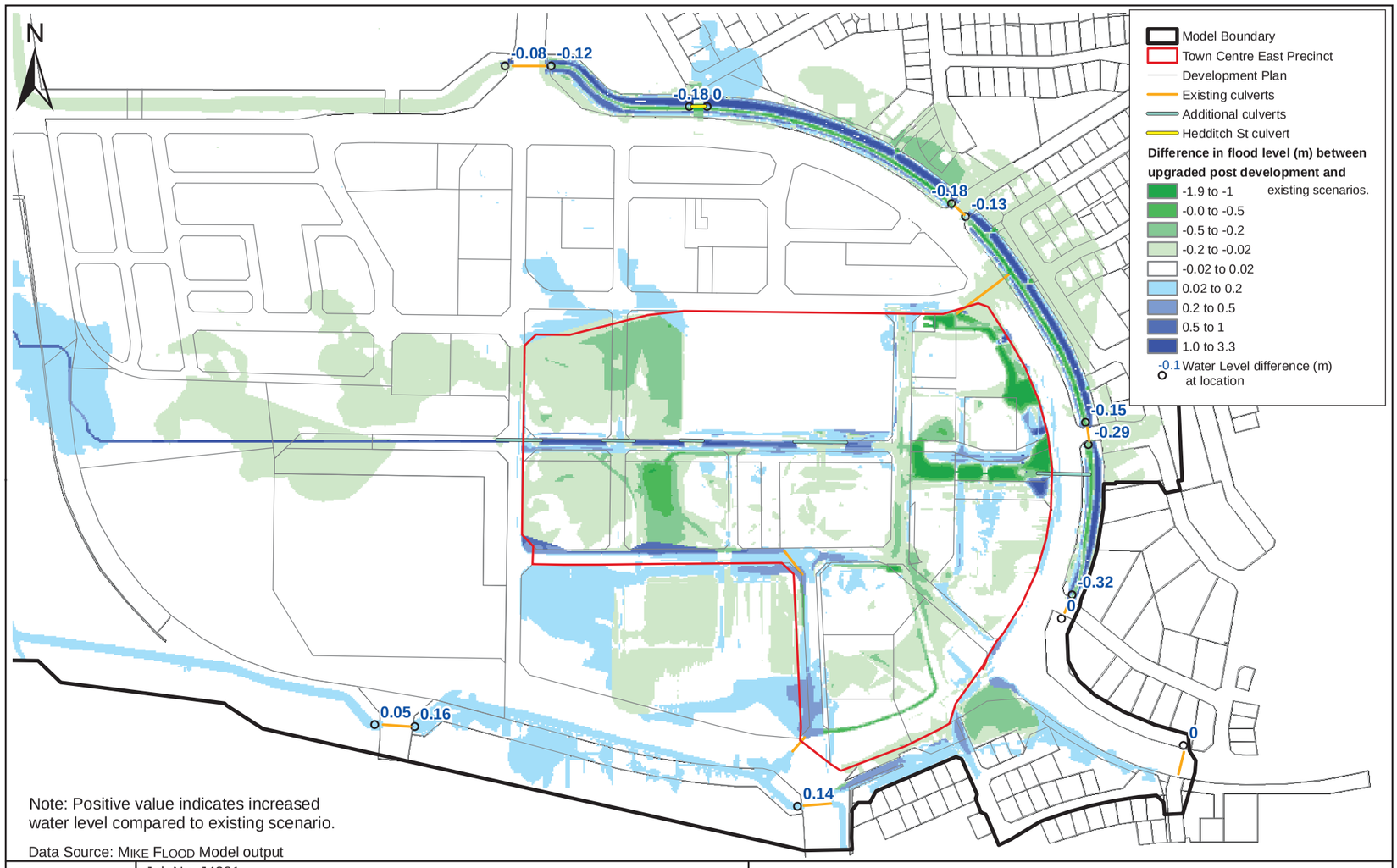


Figure 30: Difference in Flood Levels (Upgraded Post Development compared to Existing)

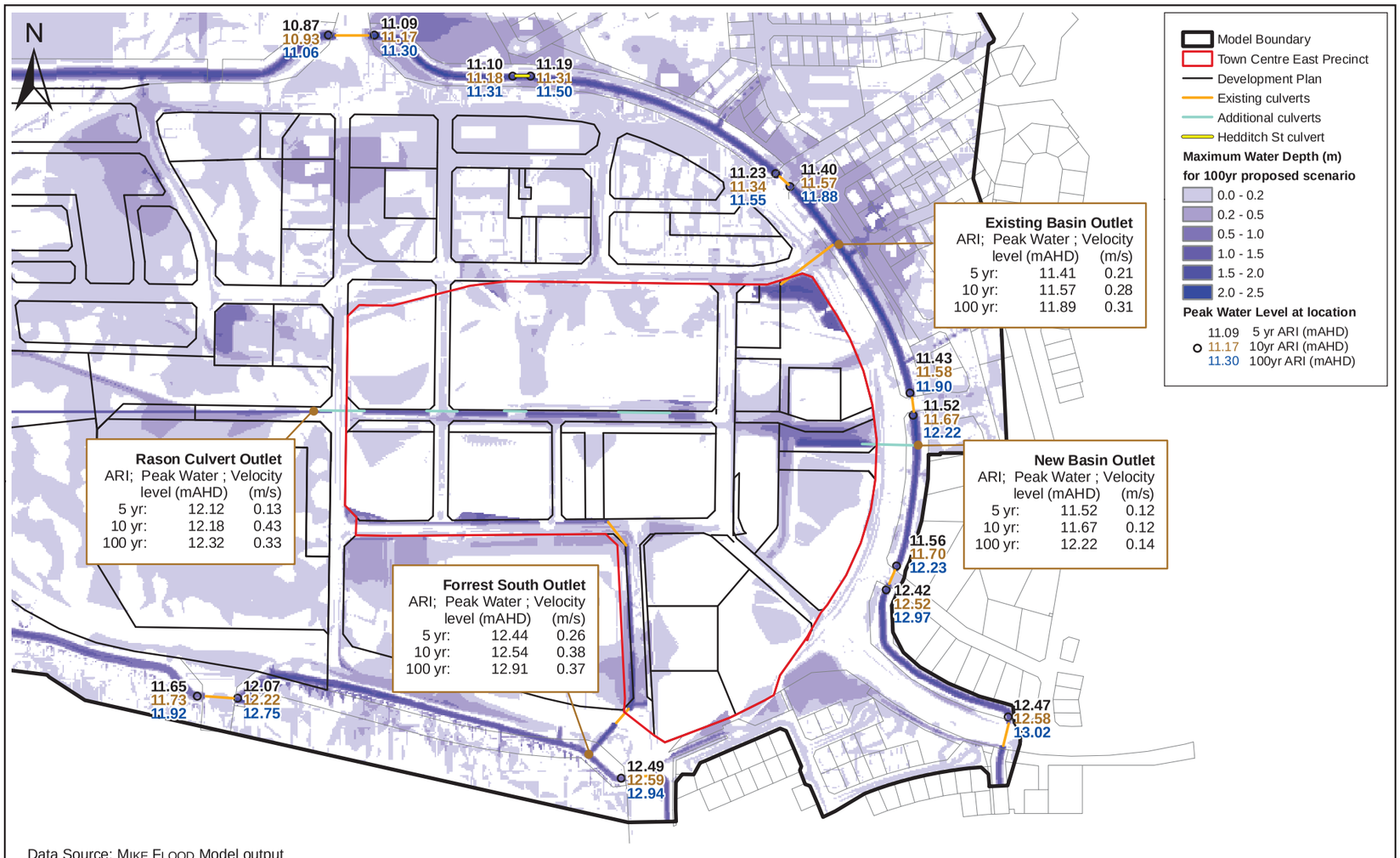
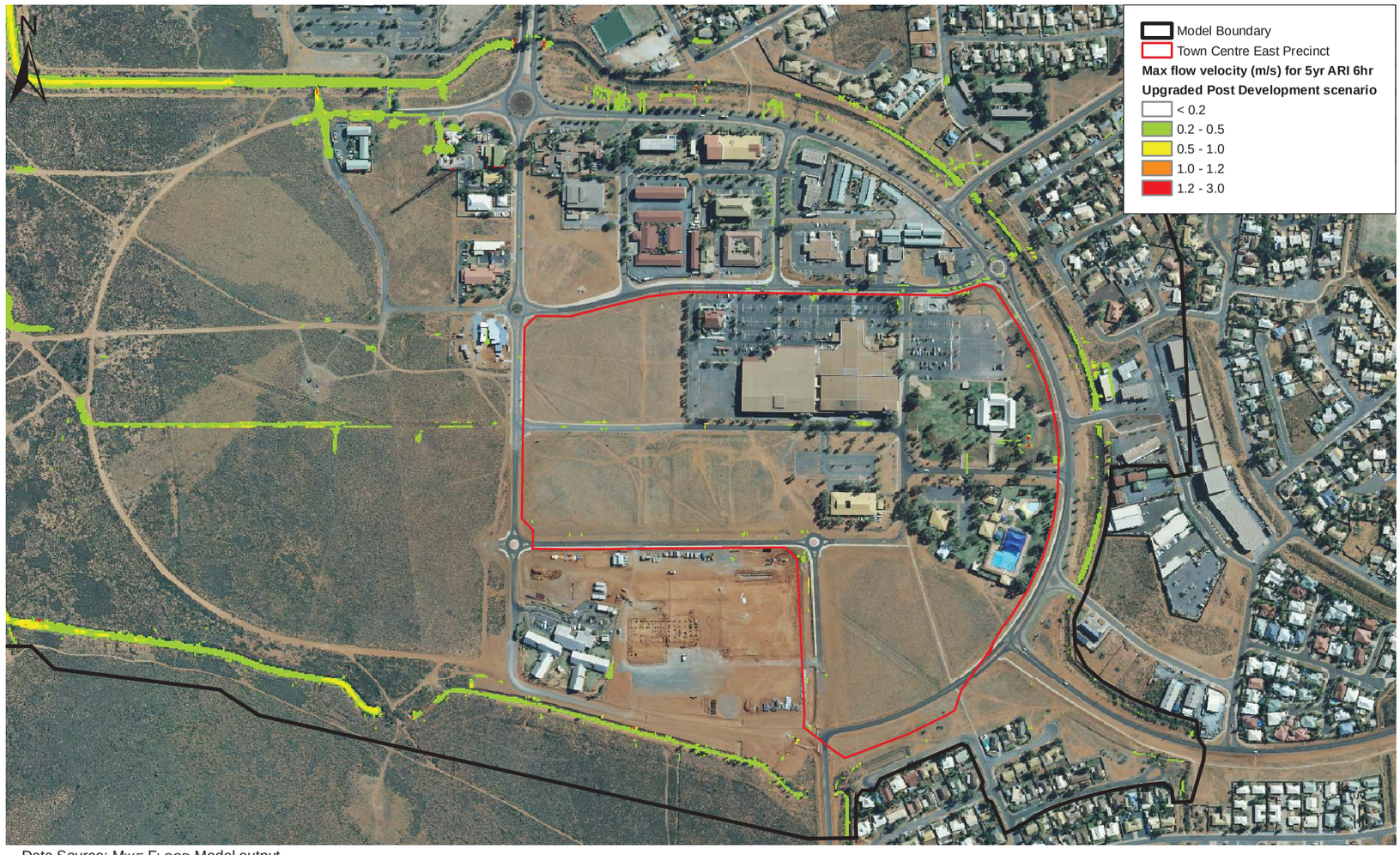


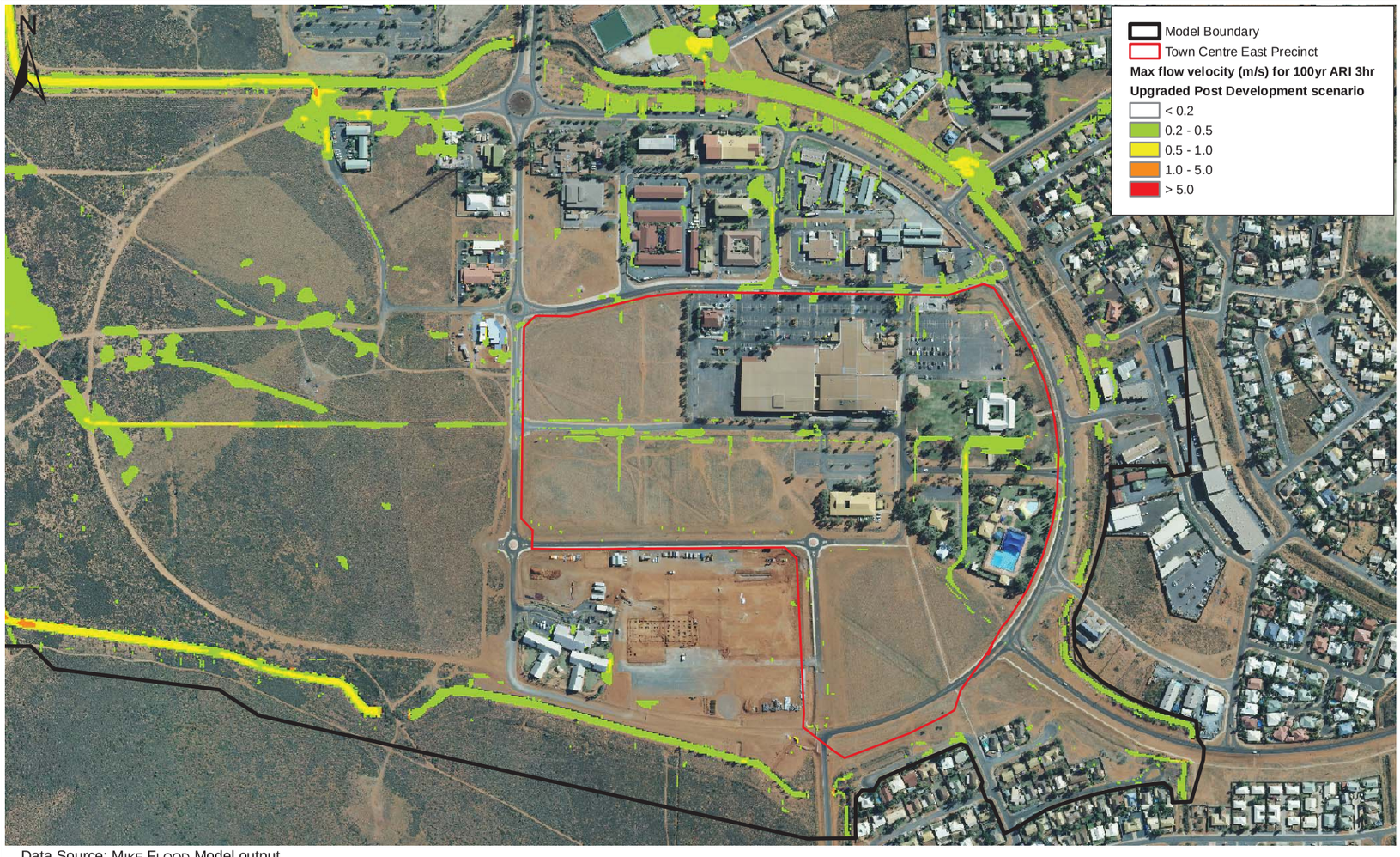
Figure 31: Peak Flood Levels for 5, 10 and 100 Year ARI Events



Data Source: MIKE FLOOD Model output

Job No. J4381
Scale: 1:7,000
0 100 200 300 400 Meters

Landcorp
South Hedland Town Centre Revitalisation: Flood Modelling
Figure 32: 5 Year ARI 6 hour Event (Upgraded Post Development) Flow Velocities



Data Source: MIKE FLOOD Model output

Job No. J4381
Scale: 1:7,000
0 100 200 300 400 Meters

Landcorp
South Hedland Town Centre Revitalisation: Flood Modelling
Figure 33: 100 Year ARI 3 hour Event (Upgraded Post Development) Flow Velocities

APPENDIX A

JDA (2009)
Wedgefield Industrial Estate, Port Hedland: Flood Levels
Report to LandCorp, October 2009
(Ref J4485a)

Landcorp

Wedgefield Industrial Estate, Port Hedland – Flood Levels

October 2009

JDA Consultant Hydrologists

CONTENTS

LIST OF FIGURES

APPENDIX

1. INTRODUCTION

This report was commissioned by Paul Schneider Landcorp as a desktop review of previous studies of likely storm surge levels and rainfall runoff flood levels which may affect Wedgefield Industrial estate Port Hedland.

The report describes previous studies, expected water levels (mAHD) and the accuracy of the assessments.

The report makes recommendations for future studies.

2. PUBLISHED FLOOD STUDIES

The 100 yr ARI flood estimates from the following studies are all shown on Figure 1.

2.1 Town Planning Flood Study for South Hedland (Wyche, 1975)

This study was carried out to determine the constraints upon the development of South Hedland from flooding of South Creek and South West Creek systems, and to design flood protection to increase land use in the flood prone area. The design flood was taken as the 100 yr average recurrence interval (ARI) event, estimated in the 2 creeks combined as 1415 m^3/s. The study assumed a sea level of 5 mAHD. Using Mannings equation, and available topographic data to compile cross-sections, 100 yr ARI flood levels were estimated as shown on Figure 1 ranging between 7.5 mAHD just upstream of Great Northern Highway over South Creek, to 13.5 mAHD, at a distance of 4 km south (upstream) of the Highway.

No flood level estimates were made north (downstream) of the Highway.

2.2 South Hedland Town Centre Stormwater Drainage (PWD, 1976)

JDA has obtained from Water Corporation Reprographic Section a copy of PWD Drainage Drawings for South Hedland Town Centre are referred to collectively here as PWD (1976). These drawings show that the drainage for the Town Centre of South Hedland was designed assuming a water level of 10.7 mAHD in South Creek at a distance of 2.5 km upstream of Great Northern Highway. This level was derived from Wyche (1975) 100 yr ARI estimate of 11.2 mAHD, less 0.5 m. No recommended finished surface levels for the Town Centre are shown on these drawings.

No flood level estimates were made north (downstream) of the Highway.

2.3 Port Hedland Storm Surge Inundation Study Preliminary Report (Smith & Hubbert, 1993)

The report estimates 100 yr ARI storm surge levels at the harbour entrance of 6.2 mAHD. This level is referred to as a stillwater level on the coast, defined as tide plus storm surge. As the sea water passes through the harbour entrance, water levels are predicted to rise due to wave setup up to 7.4 mAHD within the harbour. Hence at Wedgefield, this report predicts 100 yr ARI flood level due to tide, surge and wave setup (but neglecting rainfall run-off) of 7.4 mAHD. This water level (7.4 mAHD) is close to the 7.5 mAHD estimated by Wyche (1975) at South Creek Great Northern Highway bridge using rainfall run-off modelling. This similarity is apparently coincidental.

2.4 Boodarie Resource Processing Estate Drainage and Flood Management (JDA, 1995)

This report describes a 1D model of South West Creek over the Boodarie Estate, north of Great Northern Highway. The report does not extend as far east as South Creek, but extrapolating the flood maps indicates a 100 yr ARI flood level on South Creek at Great Northern Highway of between 7 and 8 mAHD. Hence this study did not specifically cover Wedgefield on South Creek, but the results provide a range (7 to 8 mAHD) which is consistent with the previous studies referred to above. The results of this study are not shown on Figure 1.

2.5 Port Hedland Stormwater Level Study (Egis, 1999)

This report was a review of stormwater levels for planning purposes. The report concluded that the Smith & Hubbert (1993) report referred to above was reliable. Subsequent 1994 and 1995 studies by the Bureau of Meteorology were not considered as reliable as they assumed mean sea level combined with a storm surge, whereas a higher sea level combined with storm surge was considered appropriate by Egis (1999).

The report recommended that inundation modelling should be performed, similar to that already performed by the Bureau of Meteorology in other studies.

2.6 Greater Port Hedland Storm Surge Study (Gems, 2000)

Following the recommendation by Egis (1999) above, this reports shows the results of inundation modelling for South West Creek, South Creek, Beebingarra (Twelve Mile) Creek and Turner River to define the flooding potential for the residential areas of South Hedland, Wedgefield and Twelve Mile (Tjalkuwarra) Aboriginal Community. The modelling was performed as a guide to identify land unsuitable for development as proposed in the (then) Draft Port Hedland Town Site Structure Plan. A second objective of the report was to determine safe storm surge levels for the Port Hedland Town Site for Town Planning purposes.

The report describes inundation modelling using both ocean storm surge and land rainfall run-off processes. The combined flow of South West Creek and South Creek adopted for the study was 2300 m^3/s.

The report notes that the worst historic flooding in 1939 was a result of storm surge reaching a maximum of 5.7 mAHD along the coast.

The report further notes that more recent flooding has been inland, not coastal, and associated with South West Creek and South Creek in March 1988 and March 1989.

The reports identifies the 100 yr ARI cyclone as the cyclone with central pressure 920 hPa and radius of maximum winds over Port Hedland, as resulting in 6.2 mAHD sea level at the coast.

The report argues that peak storm surge levels generally occur well before any associated rainfall run-off peak water levels. As such, peak storm surge levels were assumed to not occur simultaneously with peak rainfall run-off events. Consequently the modelling of rainfall run-off floods, which tend to dominate the flood processes inland, assumed a spring high tide sea level rather than a higher level associated with storm surge.

The report states that storm surge and rainfall run-off were treated as “quasi-independent” events. The report (Page 41) states that while there is no explicitly “correct” method for aggregating the results of the two approaches, by overlaying the datasets from the two approaches a single map showing the 50 and 100 yr ARI flood regions were obtained. These maps show the regions which can be expected to flood at least once every 50 yrs and at least once every 100 yrs respectively, either as a result of storm surge or rainfall run-off flooding, or a combination of the two processes.

The hydrology study of rainfall run-off was performed by Consultant David Flavell as a sub-consultant with GEMS.

The methodology used to estimate flood hydrographs was different to that in the national publication by the Institution of Engineers Australia titled “Australian Rainfall and Run-off – A Guide to Flood Estimation” (IEA, 1987).

The methodology used by GEMS, referred to as the Revised Index Flood Method (RIFM) appears to provide flood estimates intermediate between those which would be produced by applying the two methods recommended in IEA (1987) namely the Runoff Routing Method and the Index Flood Method.

The RIFM method is not fully explained in GEMS (2000), so it is not possible to review its suitability.

In reality there is very little hydrological data for South West Creek or South Creek with which to calibrate any hydrological model to estimate the rainfall run-off process reliably.

The report (page 5) refers to a computer program “Floodmap” which allows a user to identify the 50 and 100 yr ARI flood levels for any particular location within the study region.

Specific flood levels from this program are not presented in the report so that the Wedgefield predicted flood levels are not readily available from the report.

The report notes that portions of Wedgefield Townsite are subject to storm surge and flood risk, and lower lying parts of this Townsite are within the 50 yr ARI flood zone and that a slightly larger area falls within the 100 yr ARI flood zone.

2.7 Pilbara Iron Ore and Infrastructure Project – Flood Study Overview Anderson Point to White Hills (FMG, 2004)

This study summarises the investigations by FMG of the potential flood impacts of the Project on existing communities at Wedgefield and South Hedland.

The flood study was broken into two units, north and south of the artificial barrier caused by the BHP Billiton Iron Ore (BHPBIO) Railway Line.

The project development in the Port Hedland area includes:

- A railway approaching the Port Hedland area from the south located to the west of the White Hill Rural Estate and following the rise to cross the North West Coastal Highway within 500 m west of the road bridge over the South West Creek;
- From there the railway turns into a marshalling yard between the Highway and the BHPBIO Railway Line to Finucane Island;
- A screening plant and stockpile to be constructed on reclaimed tidal flats.

The northern study was conducted using EFBC modelling software and is a 2 dimensional approach similar to that used by GEMS (2000). This northern study showed that there would be no measurable increase in flood level at Wedgefield due to the proposed works north of the BHPBIO Railway Line.

The southern area study used 1 dimensional models (Culvert W and HECRAS) together with flood hydrographs from GEMS (2000). The railway alignment (as shown on Figure 2) lies between South West Creek and South Creek to the north of the NWCH, and crosses South West Creek near the Highway crossing. To the south the projects’ railway embankment divides the catchment for South West Creek such that approximately 25% is to the west of the embankment and 75% to the east of it. The flow rejoins South West Creek just south of the NWCH bridge via the series of culverts. The report concludes that these culverts will act as flow regulators thus delaying the flood waters and reducing the peak flood level at the Bridge. It is stated that the reduced peak flood level reduces the potential of South West Creek overflowing into South Creek and its consequential impacts on south Hedland and Wedgefield, until the railway embankment is overtopped in larger floods.

The report draws attention to the proposed Hope Downs Railway alignment and concludes that if it is on the same alignment as the FMG railway line it also will reduce the potential for increased flooding issues in South Hedland and Wedgefield.

2.8 Flood Map Version 3.1 (2008?)

This CD, as referred to in GEMS (2000), allows the user to click on the screen to plot natural surface and 50 yr and 100 yr ARI flood levels (mAHD) resulting from the combined effects of storm surge and rainfall run-off.

It is evident using the CD that there are anomalous values particularly south (upstream) of the Highway where large differences in flood levels occur over short distances, suggesting model numerical instability.

Downstream (north) of the Highway flood levels are consistent in the vicinity of Wedgefield, suggesting model numerical instability.

2.9 MPR Submission to Landcorp 5/2/09 (Appendix 1)

MPR submission to Landcorp 5/2/09, attached as Appendix 1, recommends the development of level at Wedgefield of 6.3 mAHD, based on 50 yr ARI stillwater level of 5.3 mAHD, +0.3 m near shore setup, +0.2 m sea level rise over the next 50 years, +0.5 m freeboard.

This stillwater level is taken from Floodmap V3.1 presumably, and setup estimated by MPR.

MPR take the view that an industrial site, being non-residential, should have a lower level flood risk security than residential – a view which JDA shares.

The official IPCC position on sea level rise is still 0.4 m to 2100, although this may be varied upwards by “Copenhagen Meeting” later this year.

For a 50 yr land use horizon and associated sea level rise, JDA agrees with MPR’s submission.

3. REVIEW

Various studies have been conducted into 100 yr ARI flood levels between the coast at Port Hedland inland to South Hedland Townsite since 1975. The methods used the best available techniques at the time.

The most recent, namely Flood Map V3.1, is based on GEMS (2000).

If a flood study was to be conducted today it would probably use an internationally accepted hydraulic modelling package such as MIKE 21 developed by Danish Hydraulic Institute (DHI).

This model has been used for several flood studies in Western Australia in recent years including Exmouth, Boddington and, currently, Murray River.

This model is particularly suited to mapping the flood water surface elevation where rivers overtop their banks and converge with other rivers, as occurs with the South West Creek and South Creek at Port Hedland.

However, whichever hydraulic model is used there would still be uncertainty combining the effects of storm surge on sea level, together with rainfall run-off from the land catchment.

Any such model would need to be calibrated to the observed flood events and particularly records of flood levels which have occurred in the flood study area. To our knowledge Main Road Western Australia do record flood levels on the Great Northern Highway at South Creek and South West Creek and these were previously analysed by JDA (1995).

Without calibration to such historic events, any prediction of the 100 yr ARI flood levels would not be reliable.

Our estimate of the accuracy of the most current flood study results (GEMS, 2000 and Floodmap V3.1) based on our experience of such studies would be +/- 0.5 m in the vicinity of Wedgefield. Floodmap V3.1 also states “error 0.5m”, which we assume to be accuracy statement of program authors.

Given the high rainfall in March 2009 there may be flood debris levels (leaves/twigs left suspended in trees etc) still visible in the field which could be surveyed to check against the estimated 100 yr ARI flow levels in Figure 1. This would be a useful check that the Figure 1 flood levels are at least higher than the flood levels which have occurred earlier this year. The survey data would also be useful to calibrate any future model.

The FMG (2004) flood study used a 1D model to assess the impact of the proposed (now built) Railway on flood levels. As the Railway has significant embankment and affect the flow between South Creek and South West Creek, a 2D model would give a more reliable result. As such, it cannot be reliably said that the Railway does not increase the flood risk to Wedgefield and South Hedland above that shown on Floodmap V3.1.

JDA agrees with the submission by MPR (2009) with respect to suitable design flood level for Wedgefield based on current understanding.

4. CONCLUSIONS

- Various methods have been used to estimate 100 yr ARI flood levels at Port Hedland, including at Wedgefield. The most up to date method would involve a 2 dimensional hydraulic model such as MIKE 21 developed by Danish Hydraulic Institute (DHI).
- It is likely that the state Government Department responsible for flood plain management namely Department of Water, has not initiated such a study for Port Hedland due to the lack flood events and associated damages in recent years. Discussions with Ric Bretnall (Department of Water) suggests that Port Hedland is not a priority for floodplain mapping section of the Department at present.
- The likely accuracy of the most recent flood levels (Floodmap V3.1), in JDA’s estimation is +/- 0.5 mAHD.
- The fact that the most recent study (GEMS, 2000) did not use the published methodology for estimating rainfall run-off from the catchment is of some concern and it would be worthwhile reviewing this in more detail to see if this would affect flood levels at Wedgefield.
- There may be flood debris left from the storms of March 2009 which could be surveyed (mAHD) to provide some measure of confidence in the published Floodmap V3.1 and for calibration of any future flood modelling.
- The FMG (2004) flood study conclusion that the recently built Railway does not worsen flood levels in Wedgefield and South Hedland may not be valid.
- JDA agrees with the submission by MPR (2009) regarding suitable design flood levels for Wedgefield, given current understanding.

5. RECOMMENDATIONS

- JDA recommends a review of the GEMS (2000) Flood Study component, possibly involving discussions with the author of the hydrology chapter namely David Flavell Private Consultant resident in Perth to better understand the methodology.
- JDA recommends the adoption of the Floodmap V3.1 flood level estimates and MPR (2009) interpretation of design levels for Wedgefield.
- JDA recommends sending this report to Department of Water, Attention Ric Bretnall for comment and endorsement.
- JDA recommends that given the significant infrastructure present and proposed for the Port Hedland District, the most reliable method of flood estimation should be used namely a 2D hydraulic model such as MIKE 21 by DHI as its currently been used for other locations in Western Australia.
- JDA recommends survey of flood debris levels from March 2009 to check against Floodmap V3.1 for calibration of any future model.

6. REFERENCES

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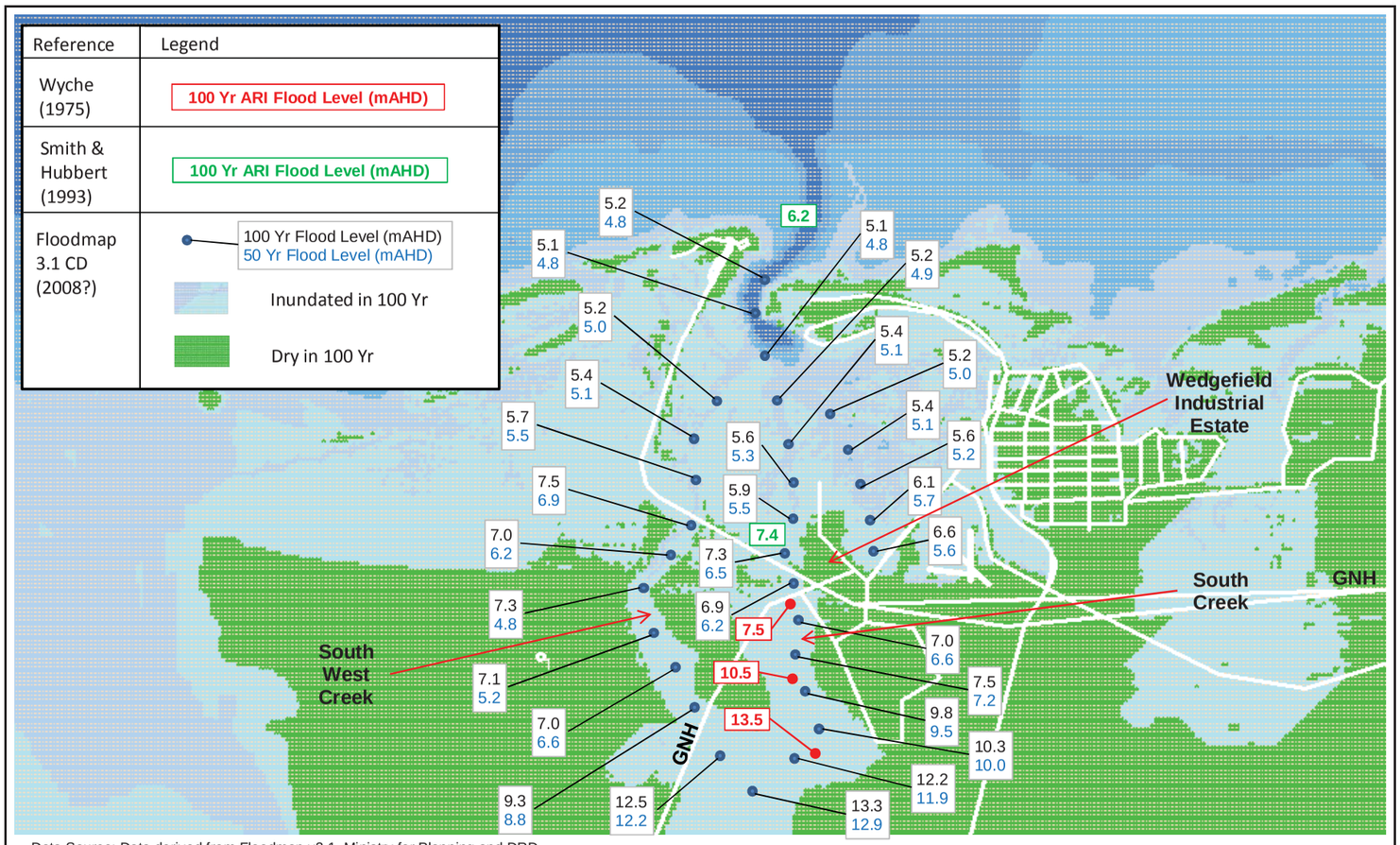


Data Source: Data derived from Floodmap v3.1, Ministry for Planning and DRD

JDA Consultant Hydrologists

Job No. J4485

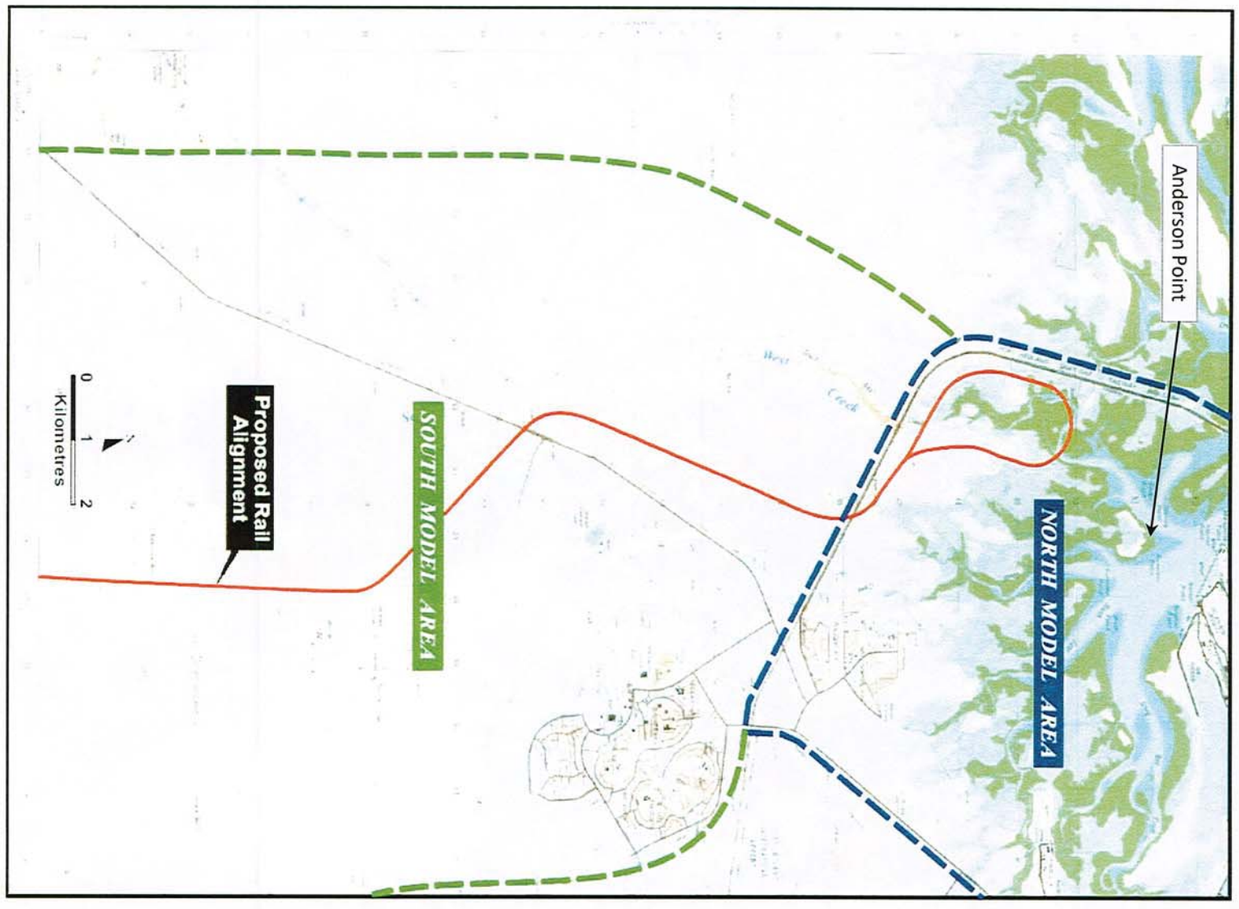
Scale: 1 : 155,000 (approx.) 0 4km

N

Landcorp

Wedgefield Industrial Estate - Flood Risk

Figure 1: Flood Levels in Port Hedland Estuary, South Creek and South West Creek



Data Source: Fortescue Metals Group Ltd (2004)

JDA Consultant Hydrologists

Job No. J4485

Landcorp

Wedgefield Industrial Estate - Flood Risk

Figure 2: Pilbara Iron Ore & Infrastructure Project Flood Study (FMG, 2004)

APPENDIX 1

Jim Davies

From: Clinton Doak [c.doak@coastsandports.com.au]
Sent: 05 February 2009 16:08
To: Paul Schneider
Cc: 'Justin Zelones (WGE)'
Subject: Wedgefield Storm Surge & Development Levels
Attachments: Preliminary Storm Surge & Development Levels for Wedgefield.pdf

Email reference: 186/09, Job number: J741

Dear Paul

Please find attached our preliminary estimates of the water levels and associated minimum development levels for the Wedgefield area. Included are estimates of the levels for the 25, 50 and 100 year return period events.

Please note that MRA's recommendation would be that the 50 yr ARI event be used as the basis for the development of Wedgefield since it would be an industrial development with no provision for onsite accommodation. Further, it is considered that the consequences of inundation of this area would be significantly less than that of a residential area so the requirement for the development need not adhere to the same guidelines. Essentially, this is as we have previously discussed.

Please note that these levels would be subject to refinement at the detailed design stage and should be used as a guide only, however, having said that they should be reasonably accurate.

Please call should you wish to discuss any of this further.

Kind regards
Clinton Doak
for and on behalf of

m p rogers & associates pl ABN 14 062 681 252
consulting engineers specialising in coastal, port & marine projects

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boat harbours canals breakwaters seawalls jetties submarine pipelines dredging reclamation
waves currents tides flood levels water quality siltation erosion rivers beaches estuaries climate change

J741 - Wedgefield Storm Surge Investigations

MRA approximation of return period flood levels and associated development levels

	Return Period		
	25 years	50 years	100 years
Still Water Level (mAHD)	4.4	5.3	6.3
Nearshore setup (m)	0.2	0.3	0.3
Peak Steady Water Level (m AHD)	**4.6**	**5.6**	**6.6**
Allowance for climate change induced sea leve rise (m)	0.1	0.2	0.4
Freeboard / Factor of Safety (m)	0.5	0.5	0.5
Development Level (mAHD)	**5.6**	**6.3**	**7.5**

Note: Levels are preliminary estimates only and would be subject to further investigation

APPENDIX 2

South Hedland City Centre Urban Development Opportunities

South Hedland City Centre: Urban Development Opportunities

LandCorp

DRAFT Version 1.0

December, 2011

Economics, Planning & Development
Business Strategy & Finance
Community Research & Strategy
Design, Marketing & Advertising
Information & Knowledge Management

Document Control

Job ID:	16118
Job Name:	South Hedland City Centre Economic Development Assessment
Project Director:	Simon Smith
Project Manager:	Mark Wallace
Company:	LandCorp
Job Contact:	Rod Dixon
Document Name:	AECgroup - SHCC Economic Development Assessment DRAFT v1.0
Last Saved:	22/12/2011 2:01 PM

Version	Date	Reviewed PM	Approved PD
Working Draft v1.0	23/11/2011	MW	
Draft v1.0	7/12/2011	MW	AJP
Final v1.0			

Executive Summary

Introduction

AEC*group* has been engaged by LandCorp to undertake an assessment of the property and urban economic development opportunities of the South Hedland City Centre (SHCC) over the next 20 years. This builds upon recent analysis undertaken by AEC*group* as part of the preparation of the ***Draft Port Hedland City Growth Plan***. The results of this assessment are to inform the preparation of the South Hedland City Centre Development Plan and includes analysis of the growth prospects for a range of property markets (including residential, commercial office, retail and short-stay accommodation) as well as advice regarding the timing and staging of development and the role and function of activity clusters within the Precinct.

Results

Based on an assessment of the current and future demand for property floorspace, the following urban development opportunities have been identified for South Hedland City Centre.

Table ES.1: Total Demand Levels, South Hedland City Centre, 2011 to 2031

Activity	2011	2016	2021	2026	2031	Growth (no)	Growth (%)
Residential Dwellings	**413**	**549**	**708**	**901**	**1,186**	**773**	**187%**
- Attached	413	549	708	901	1,186	773	187%
- Detached	0	0	0	0	0	0	0%
Short Stay Accommodation (No. of rooms)	**667**	**602**	**714**	**856**	**1,027**	**360**	**54%**
Commercial Office Floorspace (sqm)	**7,667**	**9,742**	**11,929**	**14,646**	**18,553**	**10,886**	**142%**
- Core Office Floorspace	6,517	8,281	10,139	12,449	15,770	9,253	142%
- Ancillary Office Floorspace	1,150	1,461	1,789	2,197	2,783	1,633	142%
Retail Floorspace (sqm)	**20,234**	**28,016**	**38,503**	**53,824**	**77,461**	**57,227**	**283%**
- Groceries & Specialty Food	6,897	9,571	13,062	17,753	24,820	17,923	260%
- Food and Liquor Catering	4,123	5,548	7,403	10,583	16,084	11,961	290%
- Clothing & Accessories	2,507	3,474	4,791	6,854	10,119	7,612	304%
- Furniture, Houseware & Appliances	1,965	2,770	3,918	5,542	7,868	5,903	300%
- Recreation & Entertainment Equipment	2,332	3,290	4,658	6,584	9,331	6,999	300%
- Garden & Hardware Goods	736	1,022	1,428	2,042	2,976	2,240	304%
- Other Goods & Personal Services	1,675	2,342	3,243	4,467	6,262	4,587	274%

Source: AEC*group*

The fastest growth in demand is expected in Clothing & Accessories and Garden & Hardware Goods retail categories (304% growth), followed by other retail categories (varying from 260% growth in Groceries & Specialty Food demand to 300% growth in Furniture, Houseware & Appliances and Recreation & Entertainment Equipment). The growth in retail floorspace reflects a strong exposure to population growth in South Hedland and the broader Port Hedland LGA, as well as strong income levels and growth expected over the next 20 years. This is followed by the growth in demand for Residential dwellings (187%). However, this growth rate understates actual development potential as all of the demand as at 2011 is currently unmet. The slowest growth is expected in short-stay accommodation rooms. This reflects the fact that of all the components of the service population of South Hedland, visitor numbers are expected to experience the slowest growth rate.

Conclusions

South Hedland City Centre is ideally located to support Port Hedland's growth into a City. It is centrally positioned within the largest current and future residential population catchment in the Town of Port Hedland. This central location underpins demand for community facilities, health and education services and quality retail offering. The activity created by these ancillary pursuits, in combination with continued urban amenity enhancements, will support development and take up of apartment-style residential living, increased short-stay accommodation supply and commercial office to accommodate local white collar workers.

Retail floorspace is expected to experience the strongest growth in demand in South Hedland City Centre over the next 20 years. This growth is reflected in all service population cohorts (resident, visitor and FIFO workers) in both primary and secondary catchments and above average income levels. Even when adjusted for higher than average retail turnover densities among current and future retailers (to reflect higher capital and operational costs), SHCC will experience an increase in retail demand in the order of 280% to 2031. This is stronger growth than any other floorspace type.

This retail offering, particularly increased café and restaurant provision, will support the development of residential apartments in the SHCC. Such a local in-centre population will have significant benefits for SHCC by providing local expenditure levels which support24 hour activation. The take-up of residential dwellings in the SHCC is dependent on the creation and maintenance of high levels of public and service-based amenity, reflecting strong competition from the East End with its coastal location.

Commercial office floorspace in the precinct will more than double over the next two decades. Driving this demand for dedicated business accommodation is a combination of a strong local labour force catchment, increased land costs in Port Hedland township (West and East End) and ancillary demand associated with medical and allied health services (given the collocation of the SHCC with the Port Hedland Hospital).

The South Hedland City Centre has strong future development potential. It has the potential to support the long-term growth of Port Hedland as a Pilbara City of 50,000 people. Effective land use planning, urban design and infrastructure investment is therefore critical to support and facilitate this growth in the realisation of the potential of the SHCC precinct, but also to mitigate against future economic and market volatility.

Table of Contents

1. Introduction

1.1 Background

The Town of Port Hedland has recently prepared the Port Hedland Port City Growth Plan. This Growth Plan seeks to implement the State Government's Pilbara Cities Initiative with the objective of increasing the population critical mass of the main Pilbara towns of Karratha and Port Hedland to 50,000 by 2031.

As part of the City Growth Plan development, South Hedland City Centre was identified as the likely principal concentration of economic, employment and business activity in the Town of Port Hedland over the next twenty years, accommodating much of expected growth in demand for retail, commercial office and short-stay accommodation. It is also expected to play an important role in the provision of housing supply and diversity, both within the City Centre itself and in the surrounding South Hedland area.

1.2 Project Scope

AEC*group* has been engaged by LandCorp to undertake an assessment of the property and urban economic development opportunities of the South Hedland City Centre over the next 20 years. The results of this assessment are to inform the preparation of the South Hedland City Centre Development Plan and includes analysis of the growth prospects for a range of property markets (including residential, commercial office, retail and short-stay accommodation) as well as advice regarding the timing and staging of development and the role and function of activity clusters within the Precinct.

1.3 Report Structure

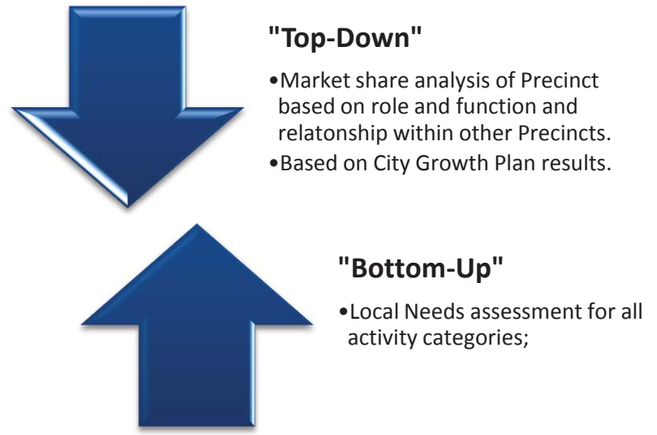
This report is comprised of the following key chapters:

- ***Economic Role and Function Analysis*** – analysis of the role and function of the South Hedland City Centre (SHCC) precinct including identification of key drivers and relationships with other precincts. Includes a "top-down" analysis of potential floorspace demand, based on apportionment of whole-of-LGA demand projections.
- ***Housing Market Assessment*** – assessment of the residential and short-stay accommodation markets in the SHCC. Analysis based on projection of population and households at the local level, assuming the achievement of the 50,000 population target by 2031.
- ***Retail Market Assessment*** – high level retail market assessment comparing current supply levels, across all retail types, with current and projected future demand levels for the SHCC. Consideration of the role and function of the Centre and its relationship with other centres (particularly the East End) form inputs into retail market analysis.
- ***Commercial Market Assessment –*** assessment of commercial office market in SHCC including labour-force and employment self-sufficiency based office floorspace demand projections. Analysis of core and ancillary office markets.
- ***Timing and Staging*** – summary of the timing and staging of required development across all property markets, to inform the preparation of the Development Plan.
- ***Sub-Precinct Analysis –*** summary of the role and function of sub-precincts within the SHCC including indicative land use/activity mixes and development levels.
- ***Conclusions*** – summary of key findings and conclusions from the analysis and reporting.

1.4 Approach

As part of the ***Port Hedland City Growth Plan,*** high level floorspace needs analysis for each floorspace type was undertaken for the whole of Port Hedland LGA. Precinct level floorspace estimates was derived from these whole-of-LGA numbers through the application of Precinct-specific market shares. This "top-down" approach and its relationship with Precinct-level market assessments ("bottom-up") undertaken in chapters 3 to 5, is illustrated in the following figure.

Figure 1.1: "Top-Down" and "Bottom-Up" Approaches to Precinct-Level Floorspace and Activity Analysis



Source: AEC*group*

The results of the distribution-based analysis are compared with the detailed local-specific needs assessments to provide rigorous and robust information regarding supportable levels of residential/ accommodation, retail and commercial office activity in the SHCC.

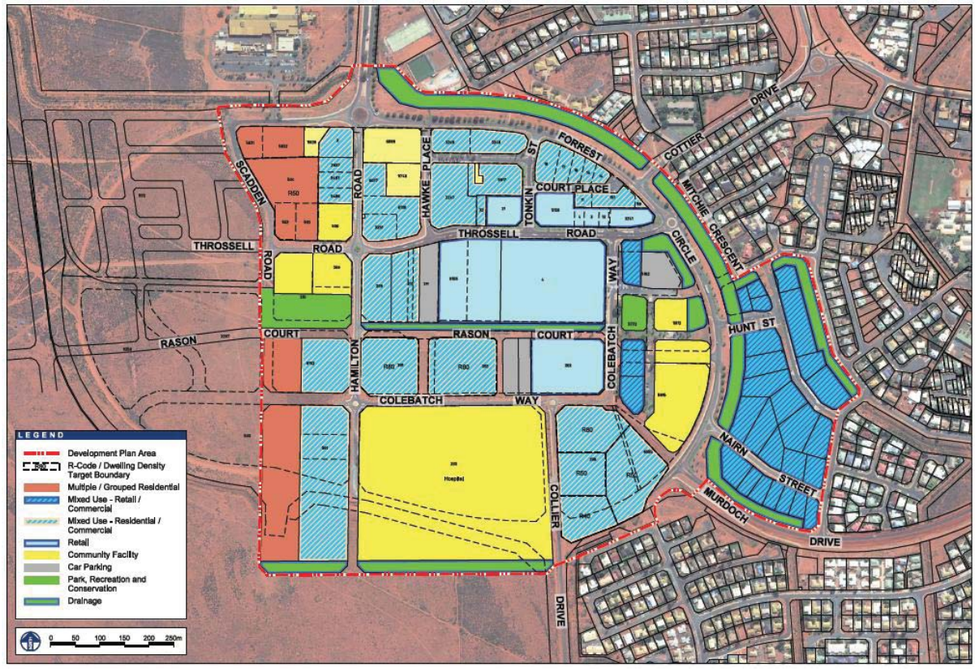
1.5 Geography

In this report, several geographies form the basis of analysis. These include:

- South Hedland City Centre (defined as Precinct 11 under the City Growth Plan);
- South Hedland Township (defined as Precinct 10-13 of the City Growth Plan);
- East End as the secondary catchment in the retail market assessment (defined as Precinct 2 in the City Growth Plan); and
- Town of Port Hedland.

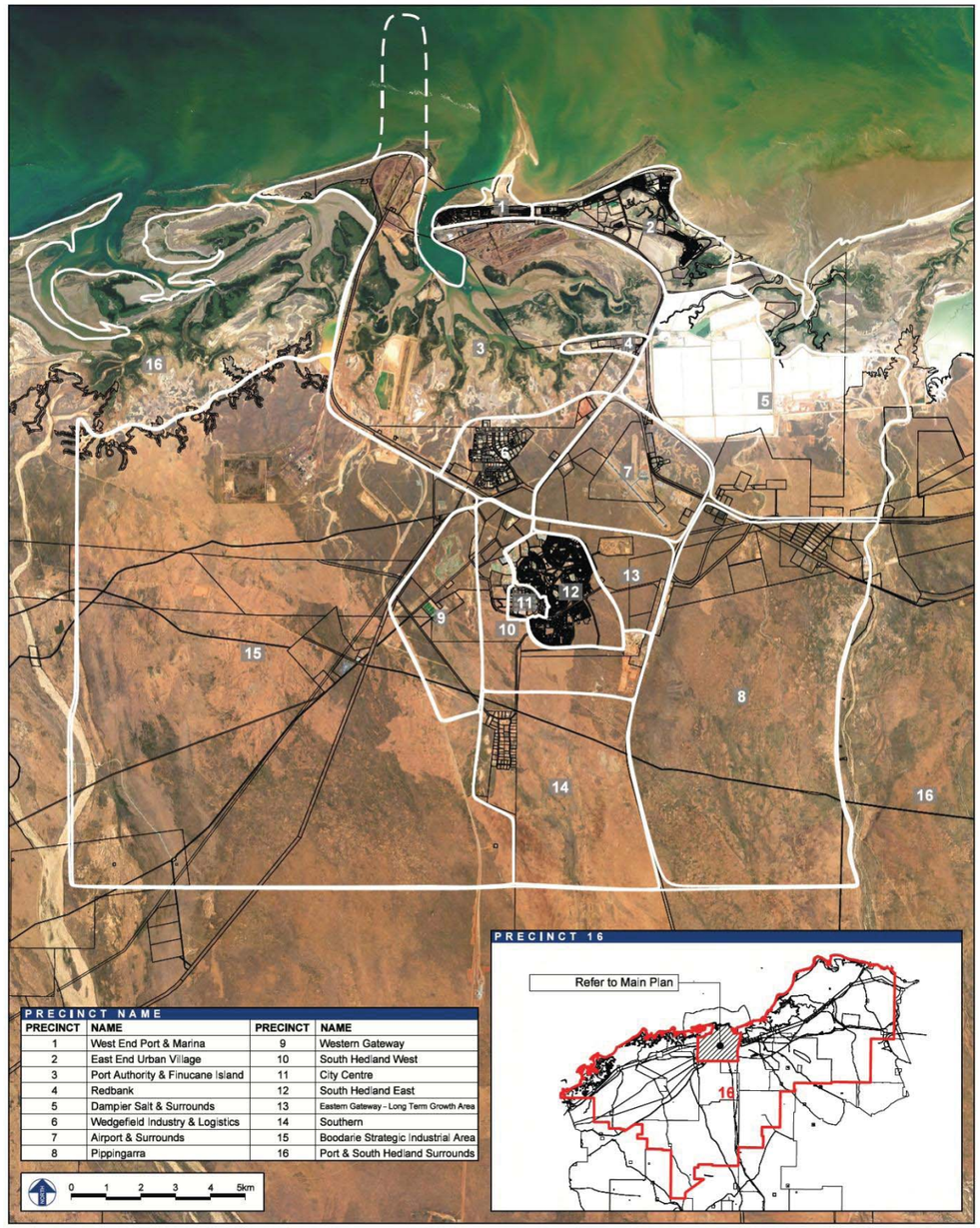
These geographies are illustrated in the figures below.

Figure 1.2: South Hedland City Centre



Source: RPS (2011)

Figure 1.3: Port Hedland City Growth Plan Precincts



Source: RPS (2011)

2. Economic Role and Function Analysis

This chapter analyses the role and function of the SHCC Precinct within the broader Port Hedland LGA. It identifies and examines key drivers of investment and economic activity in the SHCC and the precinct's relationships with other precincts in the LGA. This role and function analysis forms the basis of high level 'top-down' estimates of potential activity in SHCC, based on industry specific market shares.

2.1 Key Economic Drivers

The economic role and function of the South Hedland City Centre is ultimately defined by the key socio-economic drivers of the location. These drivers include:

- **Larger population catchment** – based on a more traditional residential settlement pattern and the availability of future residential land;
- **Residential Development on western edge** – providing a secondary front for activity in the Precinct and creating genuine 360 degree catchment around the city centre;
- **Supply of large vacant development sites –** providing greater opportunities for large scale, low and high density development in residential, retail, commercial and community markets;
- **Location Hedland Health Campus** – representing a major attractor of activity in the City Centre and broader LGA and presenting co-location and precinct opportunities;
- **Concentration of community facilities** – including core justice, sport and recreational, youth and indigenous facilities;
- **Comparable affordability** – in terms of land values and house prices, compared to Port Hedland;
- **Main Street development** – providing genuine retail-based amenity particularly in the form of café and restaurant offering;
- **Less constrained development opportunities** – particularly compared to the West End (relating to issues of dust); and
- **Existing concentration of shop retail** – with opportunity for significant expansion over time.

2.2 Role and Function Characteristics

These drivers and relationship characteristics may result in South Hedland City Centre fulfilling the following role and function:

- Large scale, mixed-use city centre precinct encompassing the full range of activities expected for the centre of a 50,000 population city;
- Primary concentration of community facilities and Government services in the LGA;
- Primary concentration of shop retail in the LGA, delivered in an externalised shopping centre format and complimented by an active Main Street environment with cafés and restaurants, banking, real estate and services tenants;
- Major mixed-use health precinct developed in line with Health-Oriented Development (HOD) principles;
- Secondary short-stay/hotel location in LGA (after the West End), providing affordable choice across all accommodation types (hotels, serviced apartments, etc.);
- Secondary high density residential location in the LGA (after the East End), providing affordable choice;
- Secondary service commercial node in the LGA, providing a range of larger format, service-based offerings including motor vehicle repairs and parts sales and smaller bulky goods (e.g. carpets/tiles sales, car hire, household storage, motor vehicle/boat sales, office furniture, equipment hire, etc.).

2.3 'Top Down' Activity Estimates

Based on analysis in the City Growth Plan, current floorspace/activity levels in the South Hedland City Centre Precinct are outlined in the table below. It reveals that currently, SHCC accounts for approximately one-quarter of short-stay accommodation rooms, almost two-thirds of retail floorspace and almost three-fifths of commercial office floorspace.

Table 2.1: Current Floorspace/Activity Supply, South Hedland City Centre (SHCC) and Town of Port Hedland (ToPH)

Activity	SHCC	ToPH	Current SHCC Market Share
Residential Dwellings (no.)	0	5,392	0.0%
Short Stay Accommodation (rooms)	239	1,026	23.3%
Retail Floorspace (sqm)	25,745	41,138	62.6%
Commercial Office Floorspace (sqm)	8,471	14,597	58.0%

Source: Town of Port Hedland (Unpublished 2011) and AEC*group*

Given the role and function of the South Hedland City Centre, and assuming the achievement of the 50,000 population target for Port Hedland by 2031, the Precinct will likely have the following shares of net additional activity demand in the Town of Port Hedland. These market shares are broadly similar to those estimated in the Growth Plan, with minor changes reflecting more detailed, Precinct-specific analysis.

Table 2.2: SHCC Market Shares of Net Additional Demand, based on 50,000 Population Target, to 2031

Net Additional Demand (to 2031)	SHCC Market Share
Residential Dwellings (no.)	8%
Short Stay Accommodation (rooms)	20%
Retail Floorspace (sqm)	45%
Commercial Office Floorspace (sqm)	35%

Source: AEC*group*

Note: Market shares for future growth in residential dwellings, retail floorspace and commercial office floorspace are different than current market shares, reflecting changes in the role and function of the City Centre Precinct over time.

Applying these market shares to the net additional floorspace/activity demand projected for the Town of Port Hedland to 2031, the following estimates for the South Hedland City Centre Precinct were developed. This represents the results of the "Top-Down" analysis. These floorspace/activity levels are *in addition to* current supply.

Table 2.3: Net Additional Demand, SHCC and ToPH, based on 50,000 Population Target, to 2031

Net Additional Demand (to 2031)	SHCC	ToPH
Residential Dwellings (no.)	1,251	15,635
Short Stay Accommodation (rooms)	393	1,963
Retail Floorspace (sqm)	42,470	94,378
Commercial Office Floorspace (sqm)	10,500	29,999

Source: Town of Port Hedland (Unpublished 2011) and AEC*group*

The 50,000 population target for the Town of Port Hedland established by the Pilbara Cities initiative is regarded as bullish based on currently known socio-demographic and economic drivers. Population projections developed for the Growth Plan suggested a service population of between 40,000 and 45,000 is more likely by 2031, based on known economic, population, demographic and socio-economic drivers.

Based on these considerations, the following low and high scenarios for floorspace will be ustilised in comparison with detailed market assessments in chapters below.

Table 2.4: Net Additional Demand, Top-Down Analysis Activity Scenarios, SHCC, 2031

Net Additional Demand (to 2031)	Low	High
Residential Dwellings (no.)	700	1,400
Short Stay Accommodation (rooms)	300	500
Retail Floorspace (sqm)	35,000	50,000
Commercial Office Floorspace (sqm)	7,500	12,000

Source: AEC*group*

2.4 Key Findings

The SHCC's role and function in the Port Hedland centres network will elevate over the next 20 years, with a greater concentration of population in South Hedland supporting increased critical mass and diversity of floorspace and activity. The introduction of apartment style residential development will supplement increased supply of short-stay accommodation, providing local and regional accommodation diversity. Similarly, strong demand for retail and office floorspace will supplement existing and proposed community and government facilities and services, supporting a genuine commercial character for the precinct (with associated investment and activity generation). The "Top-Down" analysis undertaken in this section forms a baseline against which local-specific market assessments ("Bottom-Up" analysis) will be compared and contrasted, allowing for more detailed and informed interpretation.

3. Housing Market Assessment

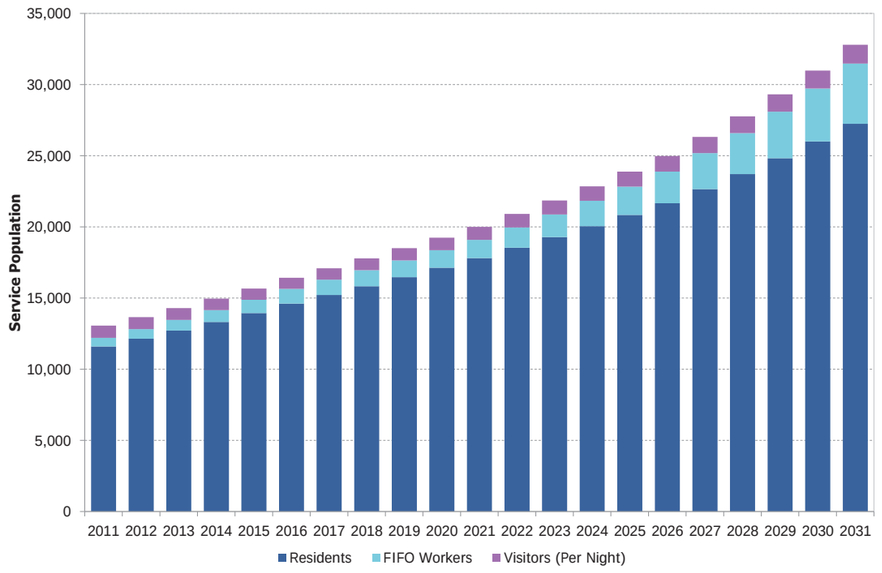
This chapter assesses the supply and demand for different residential products (detached and attached housing, short-stay accommodation) in the SHCC Precinct. It includes consideration of population type and growth, household size and dwelling diversity factors as part of the assessment.

3.1 Population and Household Characteristics

South Hedland's total service population is expected to increase from 13,058 to 32,797 between 2011 and 2031. This is in line with the 50,000 population target for the Port Hedland LGA within the Pilbara Cities Growth Plan and represents an average annual population growth rate of 4.7%.

By far the largest contributor to South Hedland's service population will be its resident population, which is expected to increase at an average annual rate of 4.4% from 11,600 to 27,240 over the period – an increase of 15,640. However, the number of FIFO workers is expected to experience the fastest rate of growth of 10.2% per annum, increasing to 4,239 (but from a much smaller base of 603). This reflects the importance of this form of employment to local industry, particularly in the short-to-medium term. Visitor numbers are also expected to increase, but only at an average annual rate of 2.2% from 856 to 1,317 visitors per night over the period.

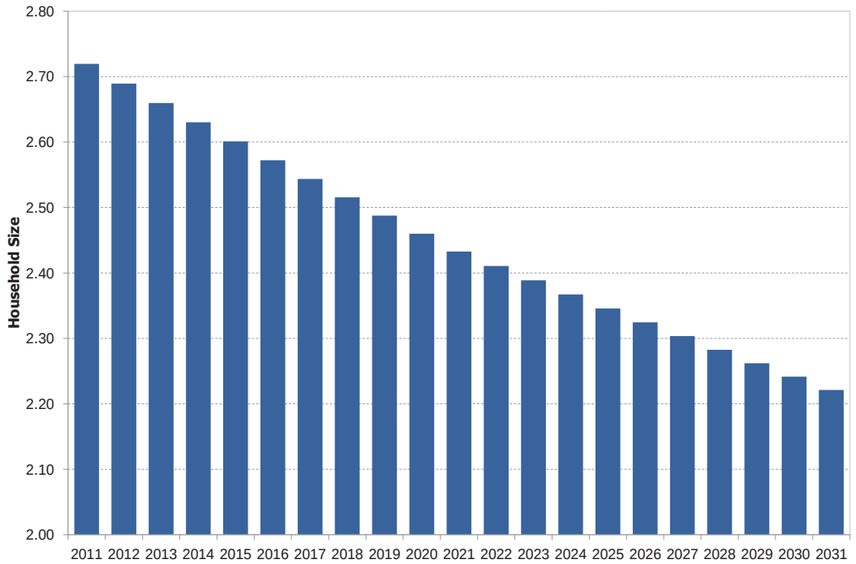
Figure 3.1: Service Population, by Segments, South Hedland Region, 2011 to 2031



Source: AEC*group*

The average household size in South Hedland is expected to gradually decline from 2.72 in 2011 to 2.22 in 2031 (**Error! Reference source not found.**). The ageing of the local (and broader WA) community, and the increasing affluence of the local population (increasing per resident housing demand) are expected to drive this trend over the period.

Figure 3.2: Average Household Size, Port Hedland LGA, 2011 to 2031



Source: ABS Census of Population and Housing (2007), and AEC*group*

3.2 Residential Housing in SHCC

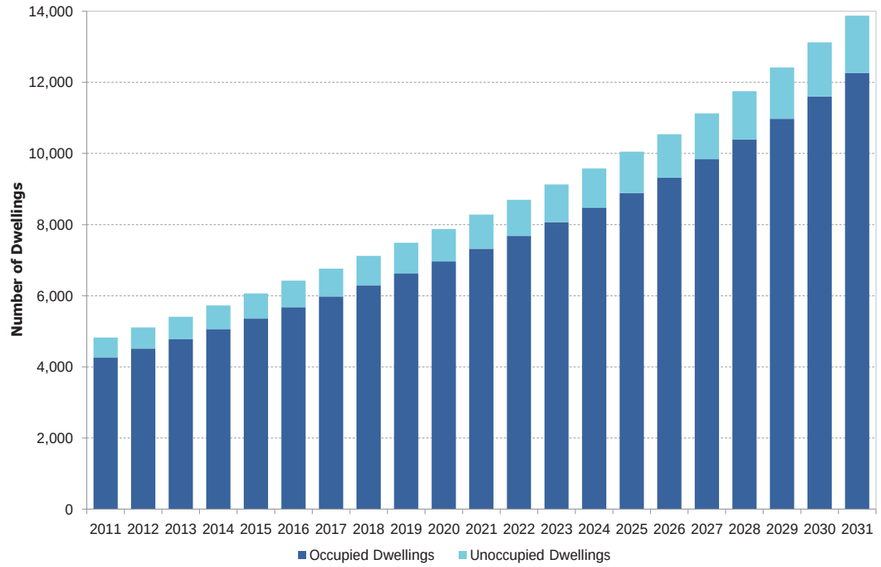
3.2.1 Current Supply

Estimates indicate a current housing supply in the South Hedland region of 3,508 (WAPC 2011). Of these dwellings, none are currently located in SHCC. These figures are used in subsequent analysis to identify any gaps in meeting future housing demand in the precinct.

3.2.2 Current and Projected Future Demand

Dividing the South Hedland residential population projections by forecast household sizes and applying the current occupancy rate of (88.4%) identifies total dwelling demand to 2031. Total residential dwelling need in the broader South Hedland region is expected to increase from 4,825 in 2011 (4,265 of which are occupied and 559 unoccupied) to be 13,872 in South Hedland by 2031 (12,264 of which would be occupied and 1,608 unoccupied).

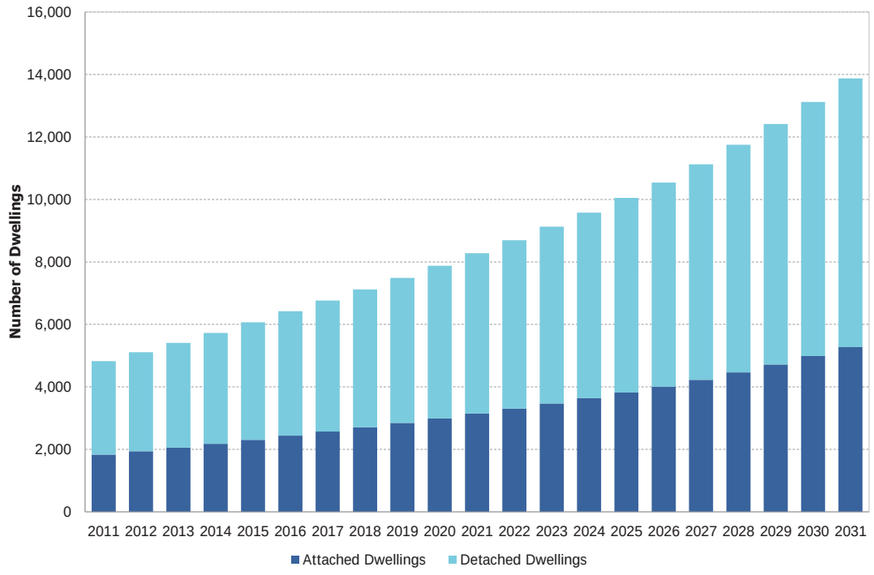
Figure 3.3: Private Dwellings, by Occupancy Status, South Hedland, 2011 to 2031



Source: ABS Census of Population and Housing (2007), and AEC*group*

The total number of attached and detached dwellings in the region is expected to rise from 1,833 and 2,991 respectively in 2011, to 5,271 and 8,601 respectively in 2031. This is based on assumed market shares of 38% and 62%, respectively and is reflected in the figure below.

Figure 3.4: Private Dwellings, by Type, South Hedland, 2011 to 2031



Source: AEC*group*

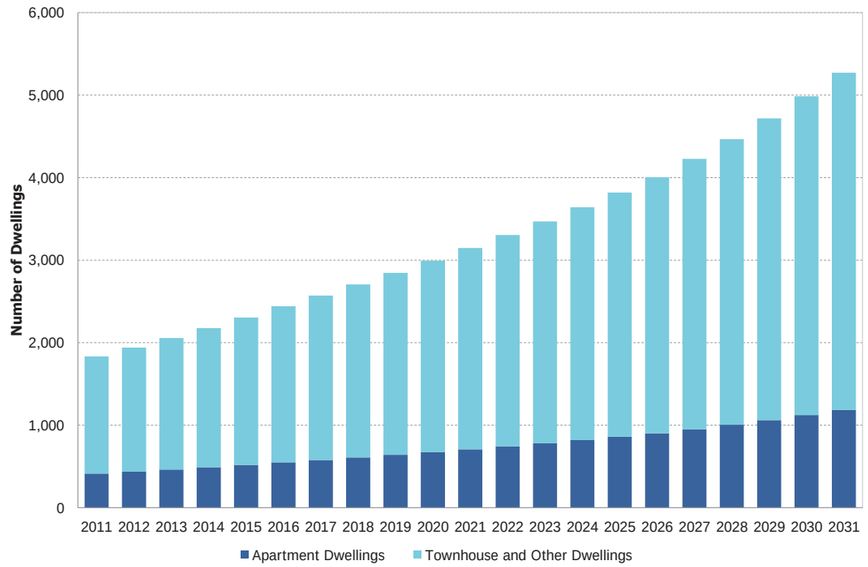
South Hedland may have more than 62% of its dwellings as detached. The figures of 38% and 62% refer to the whole-of-Port Hedland LGA region, which includes areas that

are restricted in terms of land availability. South Hedland, however, has more land available and therefore, more detached and lower density dwellings. This would warrant a lower share for attached dwellings within the South Hedland Township.

Not all dwellings required for the broader South Hedland region will be located in the South Hedland City Centre. The nature of the built form and mix of uses in the Centre would support a concentration of attached dwellings. The proportion of attached dwellings in the Town of Port Hedland that are classified as "Apartments" was 27.5% in 2006, with the remainder (72.5%) being "Townhouses and other" dwellings. A lower proportion of future growth of 22.5% has been assumed, reflecting the release of residential land surrounding the SHCC would likely accelerate the growth of townhouse products at a slightly faster rate than apartments over the period.

Applying this breakdown to estimated attached dwelling demand in the South Hedland region over time, the number of "Apartments" is estimated to rise from 413 in 2011 to 1,186 in 2031, compared to "Townhouses and other" dwelling growth from 1,421 to 4,085.

Figure 3.5: Attached Dwellings, by Style, South Hedland, 2011 to 2031



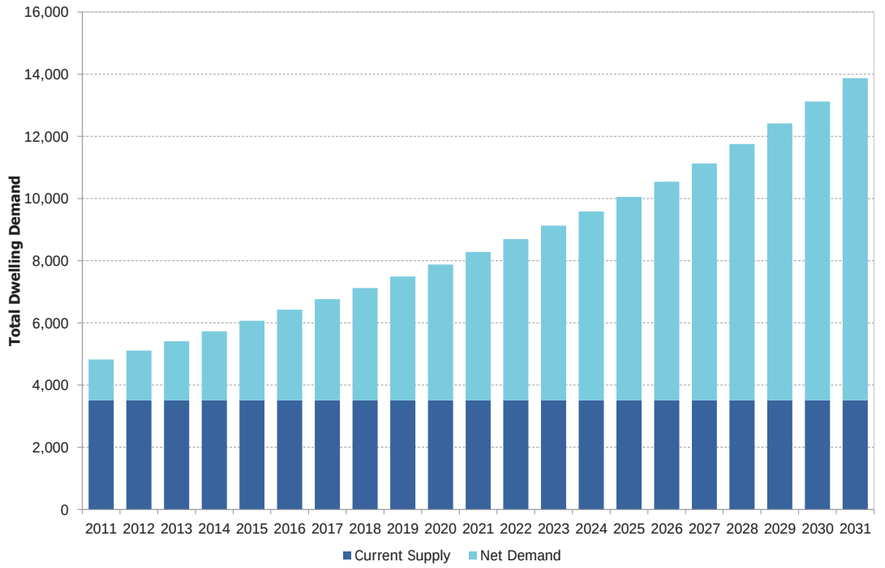
Source: AEC*group*

South Hedland City Centre will absorb the construction of all the apartment-style dwellings needs for the broader South Hedland region (townhouse and other dwellings will be constructed where land availability is less of a constraint). This results in total dwelling demand in the South Hedland City Centre increasing from 413 in 2011 to 1,186 in 2031.

3.2.3 Supply Gap

Based on the above analysis, the figure below identifies current demand for 4,825 private dwellings in the South Hedland region. There are 3,508 dwellings currently supplied, which leaves a current supply gap of 1,317 dwellings. By 2031, it is expected the large expansion in demand for housing in the region to 13,872 dwellings will create a gap of 10,364 relative to current supply.

Figure 3.6: Total Private Dwelling Demand, by Current Supply and Forecasted Net Demand, South Hedland, 2011 to 2031



Source: AEC*group*

None of current supply is located within the SHCC. This means that total current and future demand for apartment-style residential dwellings in the City Centre (413 in 2011 rising to 1,186 in 2031) also represents the supply gap.

3.3 Short-Stay Accommodation in SHCC

3.3.1 Current Supply

Current short-stay accommodation supply in the South Hedland region is identified at be 439 rooms (WAPC 2011). This will be used to compare current and future short-stay accommodation demand in the precinct, so as to assess any supply gaps.

3.3.2 Current Demand

The South Hedland region is expected to have 856 visitors per night for the year of 2011 (refer to section 3.1) or a total of 312,349 visitor nights in the region per year. However, only 60% of these visitors desire to stay in short-stay accommodation facilities (TRA 2011). The remaining 40%: stay with family and/or friends; stay in residential facilities under short-term rental contracts; or are longer-stay visitors staying in self-contained rentals. Based on this accommodation share, only 187,409 of these visitor nights (514 visitors per night) will require short stay accommodation.

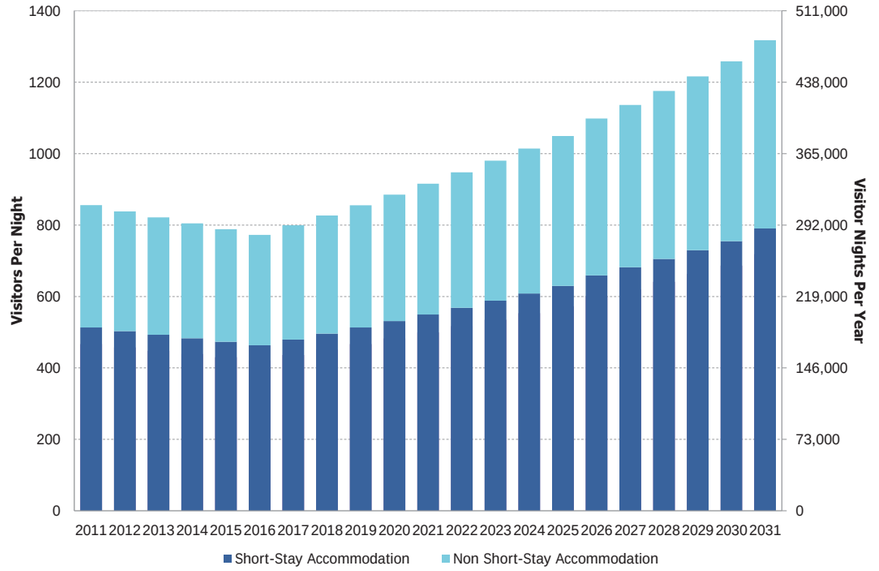
Applying an average guest per room levels of 1.1 for the Pilbara region (ABS 2011), current demand for room nights in South Hedland is estimated at 170,372 per year. Assuming the Port Hedland market normalises in line with the goals of the Draft City Growth Plan, an average annual occupancy rate of 70% [1] has been applied. This means a further 73,017 room nights will remain unoccupied during the year resulting in a total of 243,389 room nights available in 2011 in South Hedland or 667 available rooms per night.

[1] This occupancy rate is slightly above the 65% rate assumed for more metropolitan locations such as Perth, due to Port Hedland having much stronger business-related drivers of short-stay accommodation demand. Furthermore, costs of hotel operation are much higher in this region, meaning the profit incentive that would ordinarily encourage further accommodation development requires a slightly higher occupancy rate.

3.3.3 Projected Future Demand

According visitor projections outlined in section 3.1, the number of visitors per night to the region is expected to fall from its above 850 to approximately 775 in the five years to 2016. This reflects a reallocation of visitors to other precincts with the release of new accommodation product. Following this, a recovery to approximately 1,317 by 2031 could be expected. This is illustrated in the figure below.

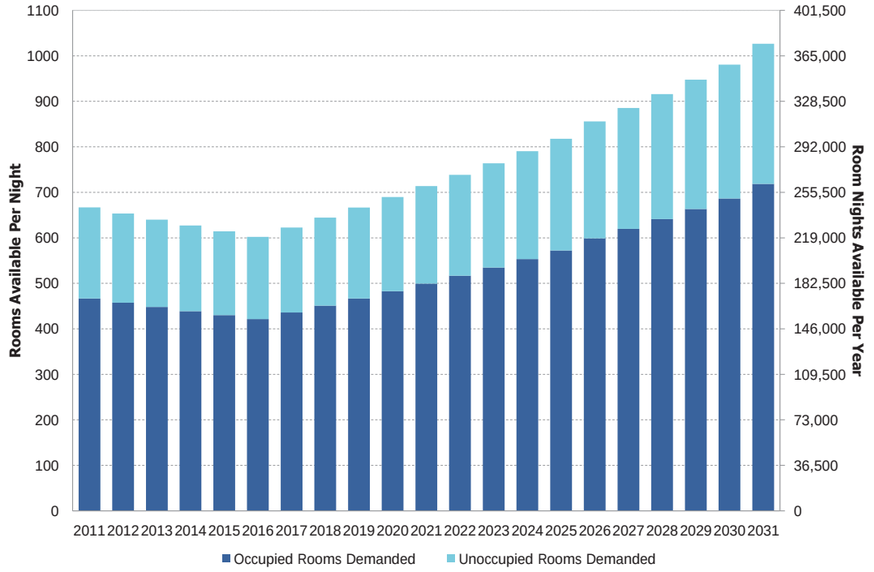
Figure 3.7: Forecasted Visitors per Night and Visitor Nights per Year, by Type of Accommodation, South Hedland, 2011 to 2031



Source: AEC*group*

Applying similar assumptions as outlined in section 3.3.2, projected demand for available rooms per night falls from the initial 667 rooms to 602 rooms in the trough of 2016, before recovering to 1,027 rooms by 2031. The corresponding demand for room nights available per year equate to a drop from the initial 243,389 to 219,714 in 2016, and a recovery to 374,715 by 2031.

Figure 3.8: Forecasted Demand for Rooms Available per Night and Room Nights Available per Year, by Occupancy Status, South Hedland, 2011 to 2031



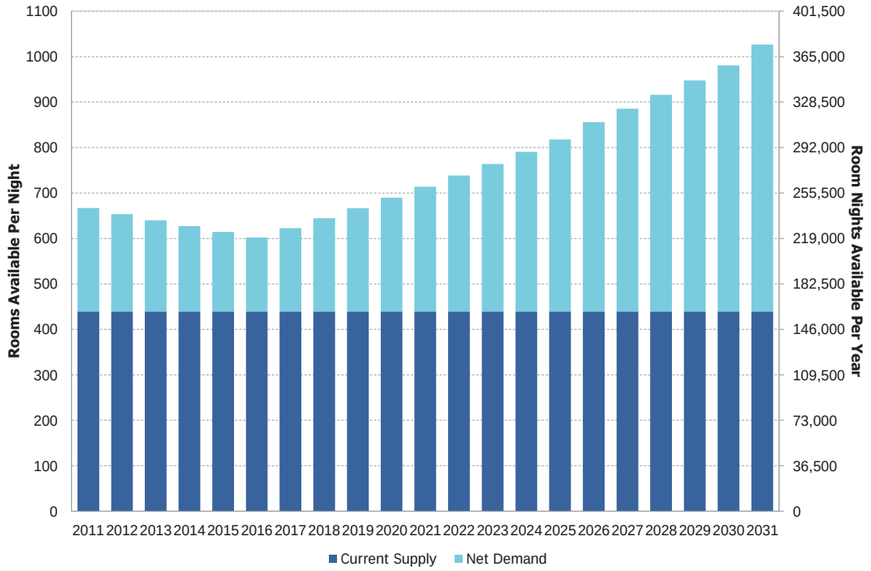
Source: AEC*group*

Note the fall in demand over the next 5 years assumes that currently proposed short-stay accommodation developments in the West and East End of Port Hedland are built and constructed. The Port Hedland Township, with its coastal location, has a natural competitive advantage over SHCC in short-stay accommodation. However, these locations are also constrained to a greater extent in terms of future demand than South Hedland generally meaning the future demand profile will naturally shift to the SHCC over time.

3.3.4 Supply Gap

There is currently demand for a total of 667 available rooms per night in the SHCC, with 439 of these rooms currently being supplied. This has resulted in a current supply gap of 228 rooms. However that short-stay accommodation is assumed to operate at only a 70% occupancy rate, in line with sustainable industry standards in a normalised market. Were this rate to be 90%, the demand for available rooms per night would be 519 in 2011. Thus, at the effective full occupancy rate, the supply gap would be only 80 rooms per night.

Figure 3.9: Current Supply and Forecasted Net Demand for Rooms Available, by, 70% Occupancy Rate, South Hedland



Source: AEC*group*

By 2016, demand for available rooms per night falls to 602, causing the supply gap to similarly narrow to 163 rooms per night. However, by 2031 the projected expansion in demand for short-stay accommodation in the region to 1,027 available rooms per night will create a gap of 588 available rooms per night relative to current supply.

3.4 Key Findings

There is strong demand for apartment style residential development in the broader South Hedland Township and the SHCC is ideally positioned to accommodate this demand. The ability for quality retail and community services, employment accommodation and amenity and accessibility-related infrastructure to be delivered in the precinct further enhances the attractiveness of SHCC as a residential apartment location. This would support approximately 400 apartments in the short-term and up to 1,450 apartments in the long-term.

Current short-stay accommodation supply does not have the capacity to accommodate demand from visitors if the hotel market operated closer to national annual industry averages of 70-75% occupancy rates. Regardless of the occupancy rate, additional supply is required over the long-term, in light of the increased role and function of SHCC in the Port Hedland accommodation market and strong visitor numbers growth.

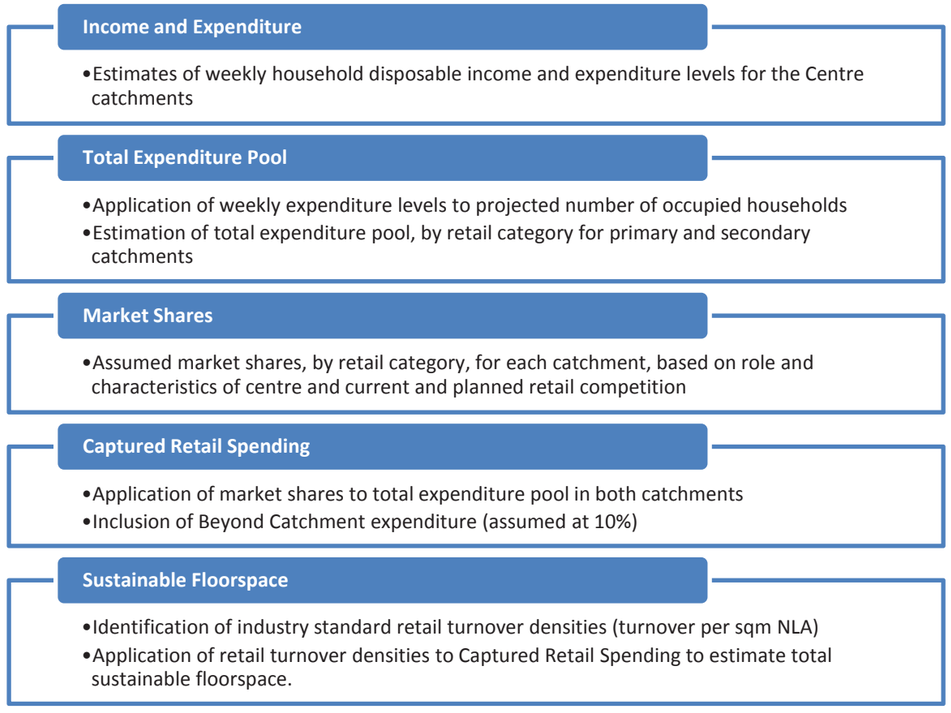
4. Retail Market Assessment

This chapter assesses the retail market in the SHCC, with consideration of local and extended population and expenditure catchments, household income and growth and retail turnover densities. Demand and supply for different categories of retail are estimated, to provide guidance on the required retail formats in the SHCC.

4.1 Methodology

In this assessment, current floorspace supply levels are compared with estimated current and future floorspace demand over the next 20 years. The methodology utilised in this assessment for projecting retail floorspace demand is comprised of the following steps.

Figure 4.1: Retail Demand Methodology



Source: AEC*group*

4.2 Current and Future Supply

Current retail floorspace supply in South Hedland of 25,745 sqm (ToPH 2011). This figure is used in subsequent analysis to identify any gaps in meeting future retail demand in the precinct.

4.3 Current Demand

4.3.1 Population/Household Catchment

AEC*group* has identified the following catchments for SHCC the purpose of this assessment:

- Primary – South Hedland Township (Precincts 10-13);
- Secondary – East End (Precinct 2);
- Beyond – FIFO and Visitor Populations.

AEC*group* takes into account retail expenditure in the SHCC undertaken not only by Primary Catchment residents (i.e. locals), but also by visitors, FIFO workers and Secondary Catchment residents.

The number of occupied residential households in SHCC in 2011 is estimated at 4,265, while that of the Secondary Catchment is estimated at 1,173. Furthermore, there are expected to be 856 short-term visitors per day to the Primary Catchment in 2011, as well as a FIFO workforce of 603.

Due to uncertainty relating to future residential and population growth in the West End (due to issues of dust), and the subsequent impact of this uncertainty on expenditure profiles, this analysis assumes a closed expenditure. This means all expenditure by the West End residents is completely localised.

However, the ability of the West End to supply retail floorspace and amenities to the wider Port Hedland community has been accounted for. This is reflected in inter-precinct retail market shares calculated including the significant amount of current and potential future restaurant and café development that has occurred/could occur around the proposed Spoil Bank marina.

4.3.2 Expenditure Pool and Captured Spending

4.3.2.1 Primary Catchment

The estimated retail expenditure level for Primary and Secondary Catchment households is $800 per week (ABS Household Expenditure Survey 2011)[2].

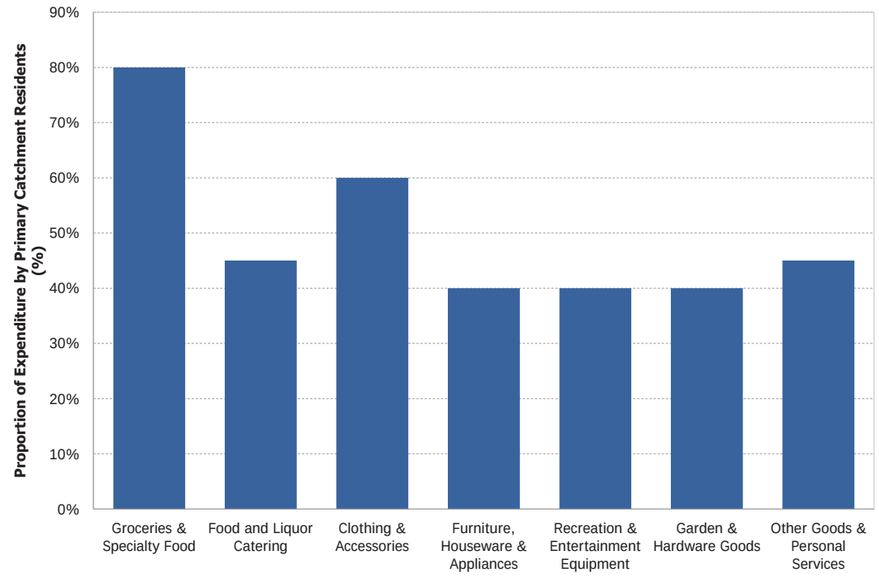
Combining this with the estimated number of households in the Primary Catchment, the size of the retail expenditure pool in the Primary Catchment in 2011 is estimated at $177.5 million. This consists of:

- $65.5 million on Groceries and Specialty Food;
- $30.8 million on Food and Liquor Catering;
- $16.0 million on Clothing and Accessories;
- $18.2 million on Furniture, Houseware and Appliances;
- $21.8 million on Recreation and Entertainment Equipment;
- $4.7 million on Garden and Hardware Goods; and
- $20.6 million on Other Goods and Personal Services.

Not all of this expenditure will occur in South Hedland. The proposed role and function SHCC, outlined in section 2.2, as well as competition from other Precincts in the Port Hedland LGA, have been taken into consideration in the development of a set of category specific market shares. These market shares are illustrated below.

[2] Adjusted for local income levels and distributions.

Figure 4.2: Market Shares, by Retail Category, Primary Catchment, 2011-2031



Source: AEC*group*

Applying these proportions to the expenditure pool of the above categories, Primary Catchment residents are expected to account for $103.0 million worth of retail expenditure in SHCC – over half of their total retail expenditure pool.

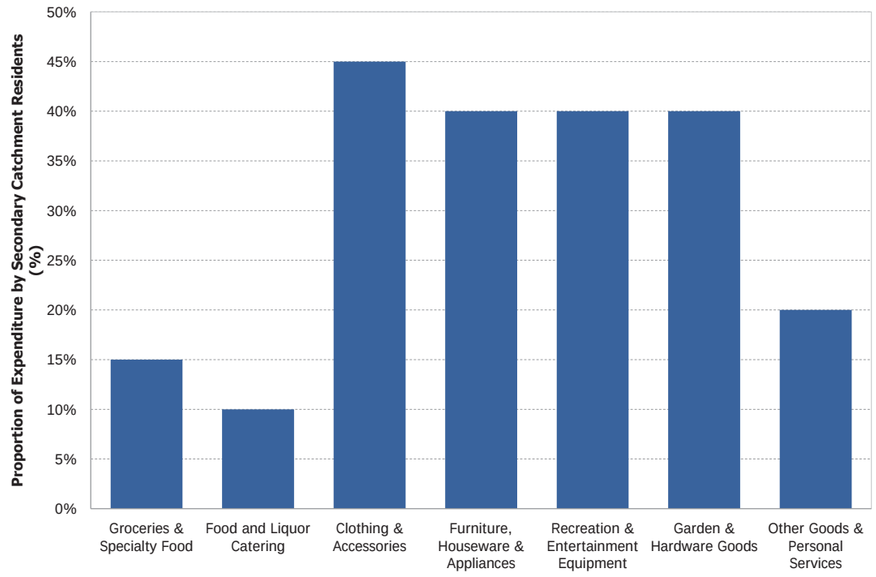
4.3.2.2 Secondary Catchment

Applying the assumed weekly household expenditure levels, Secondary Catchment residents are estimated to undertake $48.8 million worth of retail expenditure in 2011. This consists of:

- $18.0 million on Groceries and Specialty Food;
- $8.5 million on Food and Liquor Catering;
- $4.4 million on Clothing and Accessories;
- $5.0 million on Furniture, Houseware and Appliances;
- $6.0 million on Recreation and Entertainment Equipment;
- $1.3 million on Garden and Hardware Goods; and
- $5.7 million on Other Goods and Personal Services.

A significant share of expenditure from the Secondary Catchment is expected to be captured by South Hedland. This reflects the interrelationship between the Primary and Secondary catchments and their respective role and functions within the broader retail market. The assumed market shares are outlined in the figure below.

Figure 4.3: Market Shares, by Retail Category, Secondary Catchment, 2011-2031



Source: AEC*group*

Applying these proportions to the expenditure levels, Secondary Catchment residents are expected to account for $11.6 million worth of retail expenditure in South Hedland – representing 23.7% of the total retail expenditure pool from the Secondary Catchment.

4.3.2.3 Visitors

Applying the visitor numbers of 856 per day, and a total retail expenditure level of $40.72 per visitor night (TRA 2011), visitors staying in SHCC are estimated to undertake $12.7 million worth of retail expenditure in 2011. It is assumed that this expenditure will be wholly captured within SHCC with no leakage to outside catchment. While this is unlikely to occur in reality, similar leakage is likely to occur from visitors to other precincts to South Hedland. As such, it is assumed that the net impact of this inter-precinct visitor expenditure flow is zero.

Visitor expenditure in the Primary Catchment in 2011 is estimated to include:

- $2.8 million on Groceries and Specialty Food;
- $6.4 million on Food and Liquor Catering;
- $2.1 million on Clothing and Accessories;
- $0.4 million on Furniture, Houseware and Appliances;
- $0.4 million on Recreation and Entertainment Equipment;
- $0.4 million on Garden and Hardware Goods; and
- $0.4 million on Other Goods and Personal Services.

4.3.2.4 FIFO Workers

There is expected to be a FIFO workforce in the Primary Catchment of 603 in 2011. The following breakdown of daily retail expenditure (based on the adjusted levels for business travellers) is assumed:

- $4.25 on Groceries;
- $27.36 on Takeaway and restaurant meals;
- $7.21 on Alcohol and drinks (not elsewhere included);
- $11.20 on Shopping, gifts and souvenirs; and
- $5.00 (per week) on Services.

This budget has been weighted by an assumed 60-80% (depending on the expenditure category) to obtain the level of this business traveller expenditure that is attributable solely to FIFO workers, and then multiplied by the 603 FIFO workers and the 365 days in a year (or 52 weeks in the year, as with the $5.00 per week on Services). Based on this it is estimated that FIFO workers undertook an estimated $6.4 million worth of retail expenditure in 2011 directly attributable to the SHCC.

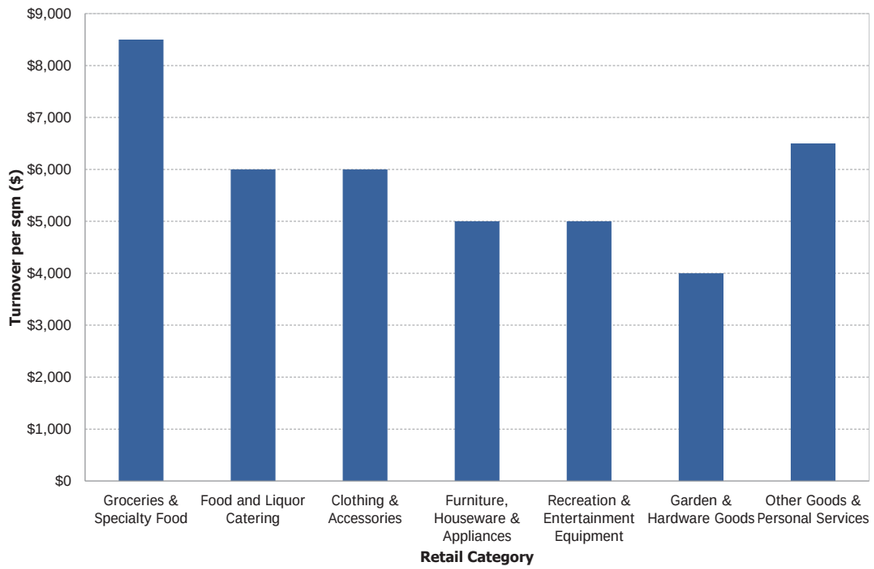
4.3.3 Total Captured Spending

There was a total of $133.7 million worth of retail spending in the SHCC in 2011. Primary catchment households account for the bulk of this expenditure with $103.0 million (77.0%) with Secondary Catchment households accounting for $11.6 million (8.7%) of this retail expenditure. Groceries and Specialty Food is expected to account for the largest proportion of this expenditure, at $58.6 million (43.8%) of the total $133.7 million. Food and Liquor Catering is second with $24.7 million (18.5%).

4.3.4 Current Floorspace Demand

The following turnovers per square metre of retail floorspace (i.e. retail turnover density) has been assumed. These are the rates required to maintain the sustainability of each particular retail category in a normalised market. This is illustrated in the figure below.

Figure 4.4: Assumed Turnover per Square Metre, by Retail Category, Primary Catchment, 2011-2031



Overall, the estimates for normalised retail turnover densities in Port Hedland have been assumed to be higher than the industry averages across the country. This reflects a higher capital and operational cost base, and therefore a need for a turnover level to compensate. These higher retail turnover densities have the effect of decreasing the amount of floorspace required to meet the current expenditure pool in South Hedland than would otherwise be the case outside Port Hedland, making the results inherently conservative and therefore defensible.

Based on the retail turnover densities for the Groceries and Specialty Food category of $8,500, there is a current demand/requirement for 6,897 sqm of floorspace for this category in 2011 in South Hedland.

Demand for other retail floorspace categories is currently estimated at:

- 4,123 sqm for Food and Liquor Catering;
- 2,507 sqm for Clothing and Accessories;
- 1,965 sqm for Furniture, Houseware and Appliances;
- 2,332 sqm for Recreation and Entertainment Equipment;
- 736 sqm for Garden and Hardware Goods; and
- 1,675 sqm for Other Goods and Personal Services.

This represents a total demand for 20,234 sqm of retail floorspace in the SHCC in 2011.

4.4 Projected Future Demand

4.4.1 Catchment Growth

The number of Primary Catchment households is projected to grow from the 4,265 in 2011 to 12,264 by 2031. Similarly, Secondary Catchment households are projected to grow from 1,173 to 5,510 over the same period. Visitor numbers are expected to increase to 1,317 visitors per day by 2031, while FIFO worker numbers increasing from 603 in 2011 to 4,239 over the period. These projections form core inputs into the assessment of future retail floorspace demand for SHCC.

4.4.2 Expenditure Pool and Captured Spending Growth

4.4.2.1 Primary Catchment

Household retail expenditure for Primary and Secondary Catchment households is expected to increase from the above $800 per week in 2011 to $976.74 per week by 2031. This is assuming a 1.0% per annum real growth rate in household expenditure over the period.

This, combined with the above population growth (adjusted to households), allows us to estimate that retail spending by Primary Catchment households shall increase from the above $177.5 million in 2011 to $622.9 million by 2031. This spending will consist of:

- $229.8 million on Groceries and Specialty Food;
- $107.9 million on Food and Liquor Catering;
- $56.0 million on Clothing and Accessories;
- $63.8 million on Furniture, Houseware and Appliances;
- $76.4 million on Recreation and Entertainment Equipment;
- $16.5 million on Garden and Hardware Goods; and
- $72.4 million on Other Goods and Personal Services.

Applying the same market shares as were used for 2011, Primary Catchment households are expected to spend $361.3 million worth of retail expenditure in SHCC in 2031 – still over half of their total expenditure pool.

4.4.2.2 Secondary Catchment

The retail expenditure pool of the Secondary Catchment is estimated to increase to $279.9 million in 2031. This expenditure pool will consist of:

- $103.3 million on Groceries and Specialty Food;
- $48.5 million on Food and Liquor Catering;
- $25.2 million on Clothing and Accessories;
- $28.7 million on Furniture, Houseware and Appliances;
- $34.3 million on Recreation and Entertainment Equipment;
- $7.4 million on Garden and Hardware Goods; and
- $32.5 million on Other Goods and Personal Services.

Applying previously identified market shares, the Secondary Catchment will account for $66.3 million worth of retail spending in the SHCC in 2031.

4.4.2.3 Visitors

Retail expenditure of $40.72 per visitor night in 2011 is projected to rise to $49.68 by 2031, based on a 1.0% per annum growth rate in real expenditure.

Combining this with the growth in visitor numbers, visitor retail expenditure directly attributable to the SHCC is estimated to rise from the $12.7 million in 2011 to $23.9 million by 2031. This is expected to consists of:

- $5.2 million on Groceries and Specialty Food;
- $12.1 million on Food and Liquor Catering;
- $4.0 million on Clothing and Accessories;
- $0.7 million on Furniture, Houseware and Appliances;
- $0.7 million on Recreation and Entertainment Equipment;
- $0.7 million on Garden and Hardware Goods; and
- $0.7 million on Other Goods and Personal Services.

4.4.2.4 FIFO Workers

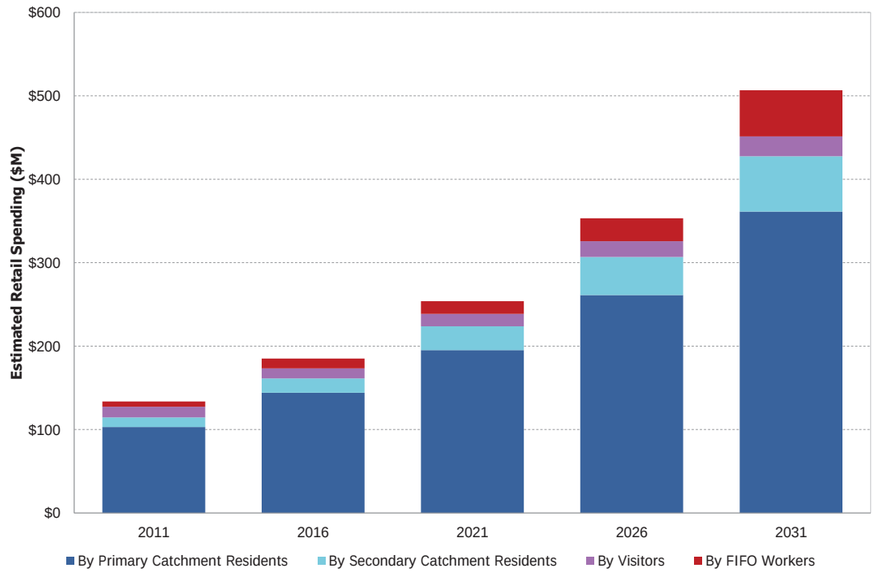
Applying the assumed FIFO expenditure profile outlined in section 4.3.2.4 (adjusted for a 1.0% annual growth rate), FIFO worker retail expenditure directly attributable to SHCC is projected to increase from the $6.4 million in 2011 to $55.3 million by 2031. This is estimated to consist of:

- $6.4 million on Groceries and Specialty Food;
- $31.0 million on Food and Liquor Catering;
- $11.8 million on Clothing and Accessories;
- $1.7 million on Furniture, Houseware and Appliances;
- $1.7 million on Recreation and Entertainment Equipment;
- $1.7 million on Garden and Hardware Goods; and
- $0.9 million on Other Goods and Personal Services.

4.4.3 Total Captured Spending

Total retail spending captured by SHCC is expected to increase from $133.7 million in 2011 to $506.8 million by 2031. The expenditure by Primary Catchment residents is forecast to rise to $361.3 million (71.3%).

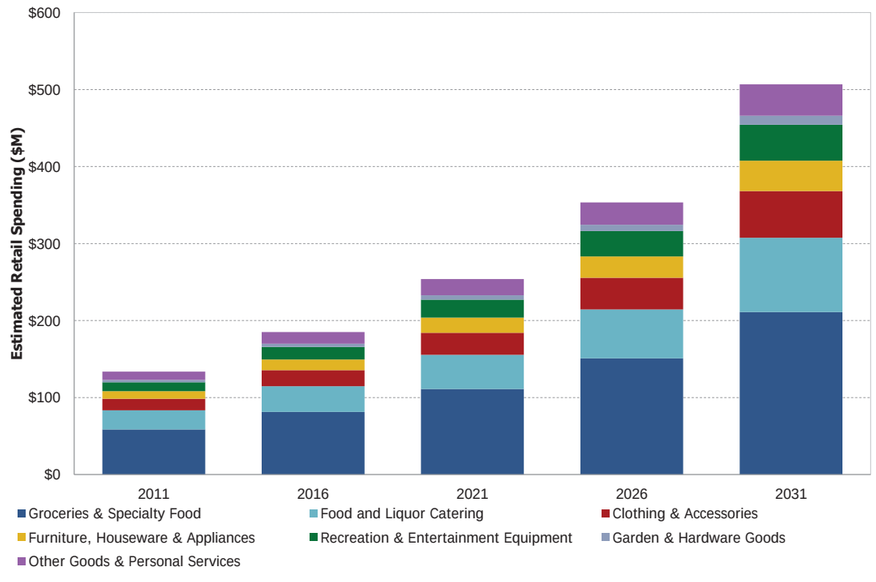
Figure 4.5: Estimated Retail Spending in the Primary Catchment, by Consumer Catchment, Primary Catchment, 2011-2031



Source: AEC*group*

Groceries and Specialty Food's share of this expenditure will remain the largest share, accounting for 40% of total captured expenditure in 2031. Food and Liquor Catering is second with 19.0% of total expenditure, as illustrated in the figure below.

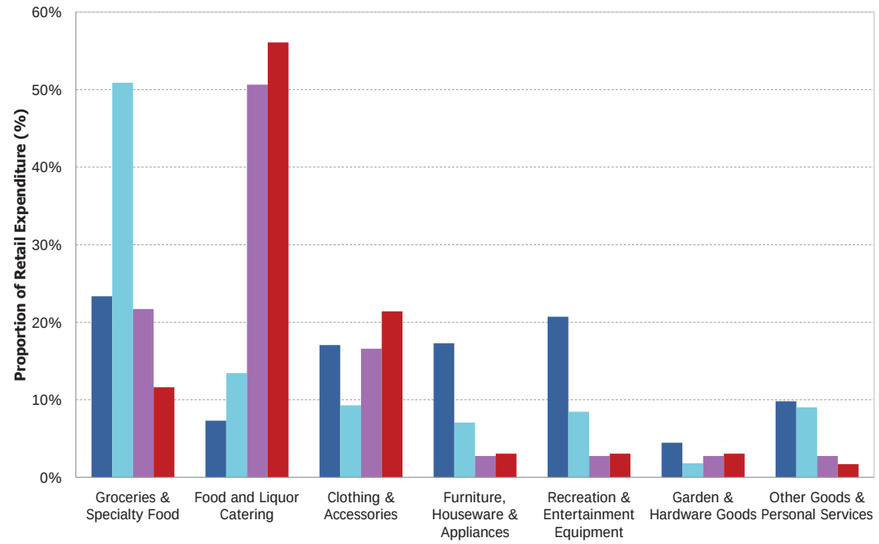
Figure 4.6: Estimated Retail Spending in South Hedland, by Retail Category, 2011-2031



Source: AEC*group*

The breakdown of expenditure by category varies between the different sources of expenditure. This reflects different relationships between the catchments and the SHCC and variations in how consumers will likely utilise retail offering in the Centre. As expected, Groceries and Specialty Food retail shopping is expected to be the primary expenditure category for households in the Secondary catchment. Conversely, Food and Liquor Catering is the primary expenditure category for Visitors and FIFO workers.

Figure 4.7: Share of Retail Spending in South Hedland, by Catchment and Retail Category, 2011-2031



Source: AEC*group*

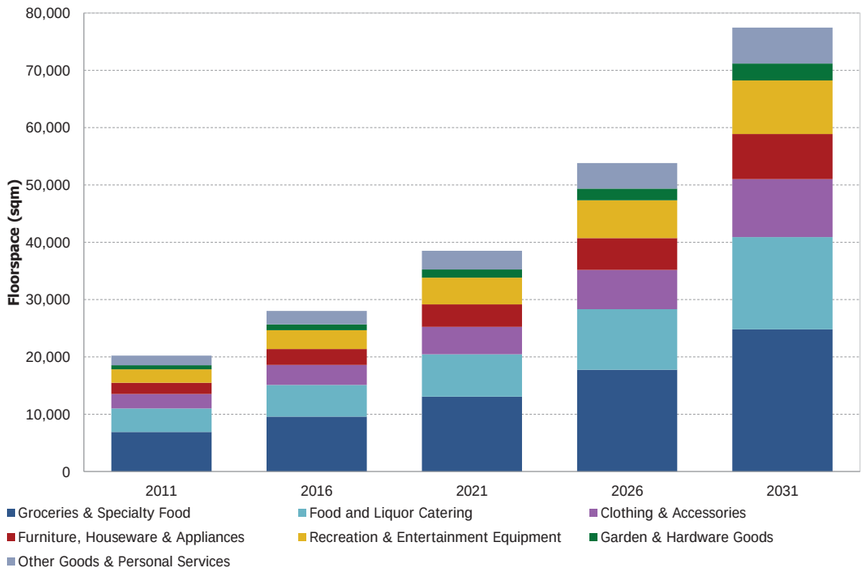
4.4.4 Projected Floorspace Demand

Applying the retail turnover densities assumptions in section 4.3.2.2 retail floorspace demand is expected to increase for each category by the following:

- Groceries and Specialty Food floorspace demand expected to increase from the 6,897 sqm to 24,820 sqm;
- Food and Liquor Catering from 4,123 sqm to 16,084 sqm;
- Clothing and Accessories from 2,507 sqm to 10,119 sqm;
- Furniture, Houseware and Appliances from 1,965 sqm to 7,868 sqm;
- Recreation and Entertainment Equipment from 2,332 sqm to 9,331 sqm;
- Garden and Hardware Goods from 736 sqm to 2,976 sqm; and
- Other Goods and Personal Services from 1,675 sqm to 6,262 sqm.

This represents an increase in total demand for retail floorspace in South Hedland from 20,234 sqm in 2011 to 77,461 sqm by 2031. This is illustrated below.

Figure 4.8: Total Demand for Retail Floorspace, by Retail Category, SHCC, 2011-2031



Source: AEC*group*

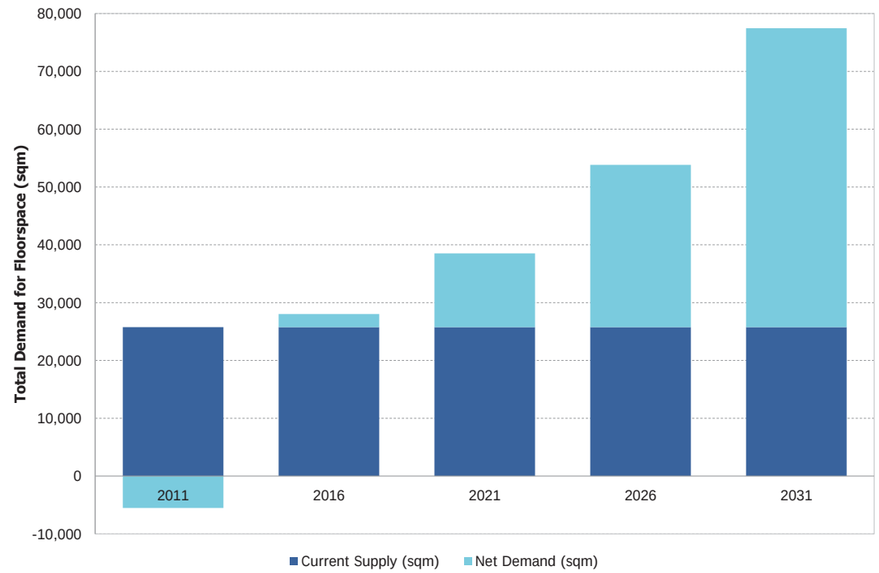
4.5 Supply Gap

There is currently demand for a total of 20,234 sqm of retail floorspace in the SHCC, with 25,745 sqm of floorspace being currently supplied. This results in an apparent *supply suprlus* (demand exceeding supply) of 5,511 sqm of floorspace in 2011.

However, this does not suggest that current retail in South Hedland is either oversupplied or underperforming. Instead it reflects the fact that retail in the SHCC currently has higher market shares in its primary and/or secondary catchment than assumed in this long-term sustainability assessment. It is expected that these market shares will decline slightly in the future, namely in the secondary catchment, as further retail offering becomes available in other Precincts over time.

By 2016, the forecasted expansion in demand for retail floorspace in the region to 28,016 sqm will cause this demand gap to change to a supply gap of 2,271 relative to current supply. And by 2031, further expansion in demand to 77,461 sqm will correspondingly increase this supply gap to 51,716 sqm. This transition to, and growth of, the supply gap in the SHCC is illustrated below.

Figure 4.9: Forecasted Demand for Retail Floorspace, by Current Supply and Forecasted Net Demand, SHCC, 2011 to 2031



Source: AEC*group*

4.6 Key Findings

Retail demand is expected to grow strongly in the Town of Port Hedland over the next two decades, with SHCC positioned to play a central role in meeting this demand. SHCC is currently the largest concentration of retail floorspace in the LGA, and possesses the greatest capacity for floorspace expansion to meet future demand growth in its Primary and Secondary Catchments.

Meeting demand will require a tripling in the amount of retail floorspace in the City Centre by 2031, with an increased diversification away from core Groceries and Specialty Foods offering to increased supply of café and restaurant, specialty stores, Discount Department Stores (DDS) and full Department Stores. There is also a requirement for some larger format retail offerings, to supplement Main Street, Shopping Centre and Mixed Use formats that traditionally define City Centre offerings.

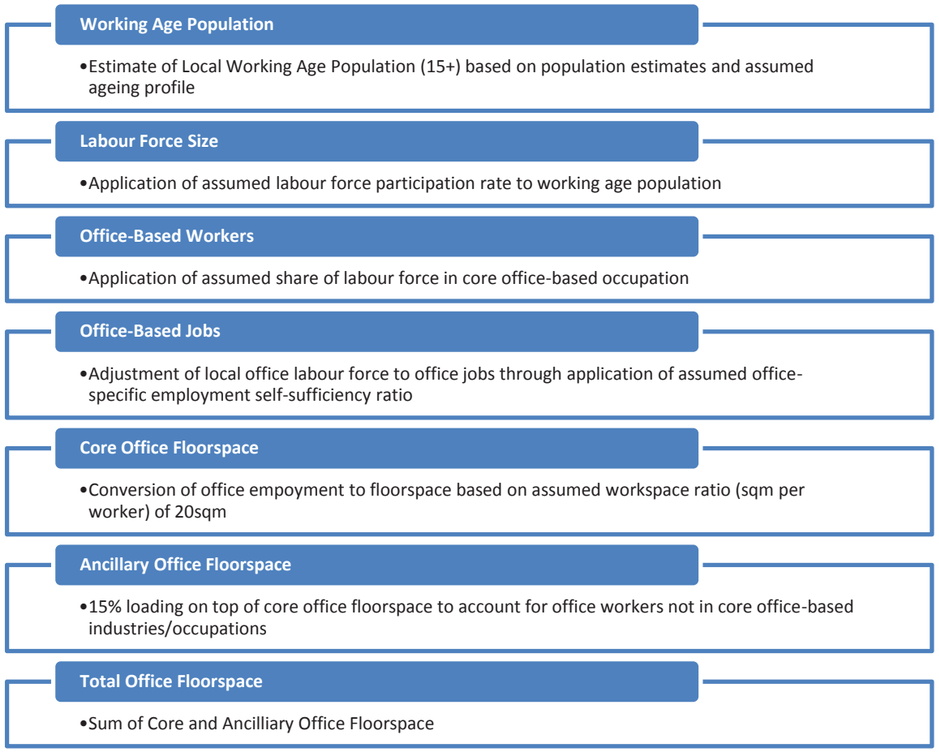
5. Commercial Office Market Assessment

This chapter assesses the market for commercial office floorspace in SHCC over the next 20 years. It uses a labour force-based methodology to estimate the amount of commercial office floorspace required to accommodate current and future office workers.

5.1 Methodology

In this assessment, current floorspace supply levels are compared with estimated current and future floorspace demand over the next 20 years. The methodology utilised in this assessment for projecting commercial floorspace demand is comprised of the following steps.

Figure 5.1: Commercial Office Demand Methodology



Source: AEC*group*

Note that this methodology applies only to *commercial* office floorspace and does not take into consideration office demand for Government tenants. Also note that for this assessment, it is assumed that all commercial office floorspace demand will be met by supply in the SHCC only.

5.2 Current Supply

A current commercial office space supply in South Hedland of 8,471 sqm was identified as part of the Growth Plan. This figure is used in subsequent analysis to identify any gaps in meeting future retail demand in the precinct.

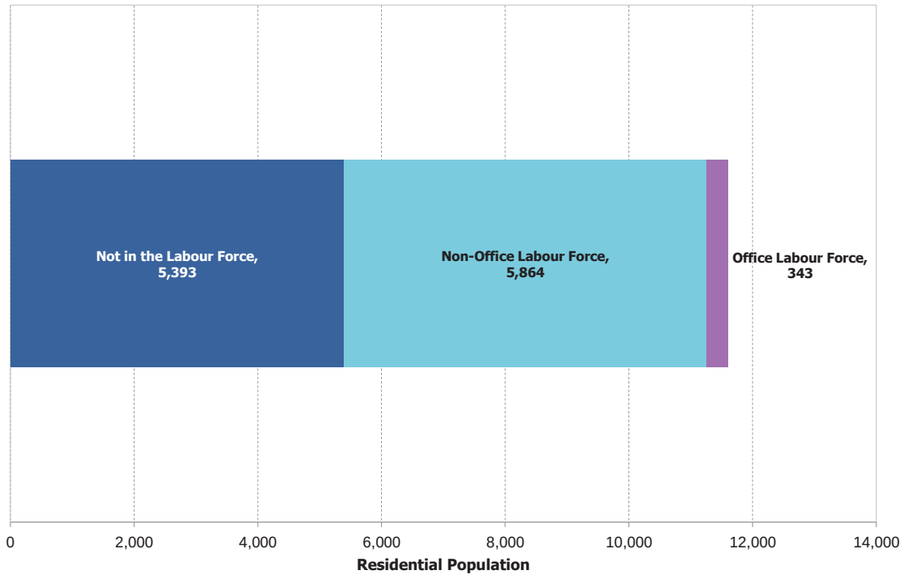
5.3 Current Demand

5.3.1 Office-Based Labour Force

As estimated in section 3.1, South Hedland's residential population is currently 11,600. Approximately 76% of the Port Hedland population currently is aged 15 years and over (ABS 2011), representing the total working age population in the township. This equates to 8,867 people in 2011. Of this working age population, approximately 6,207 people are estimated in be in labour force, based on an assumed participation rate of 70% (ABS 2011).

Currently, only 5.5% of the LGA's labour force is in core office industries and occupations. This is a small component of the labour market relative to metropolitan area, reflecting a greater concentration of trade and service workers in the Town of Port Hedland. Currently there are 343 office workers in South Hedland's resident population of 11,600. This is illustrated in the figure below.

Figure 5.2: Commercial Office Demand Methodology



Source: AEC*group*

5.3.2 Workspace Ratios

Not all of these office workers work in SHCC. Worker mobility means that many of these workers travel to Port Hedland township for work, just as workers from outside South Hedland travel to SHCC to work. For this assessment, an employment self-sufficiency rate (number of people that work in a location divided by the number of workers that live there) for office workers of 95% has been assumed. This means that the total office labour force that needs to be accommodated in offices within the precinct is equal to 95% of the resident office labour force[3]. This currently represents 326 core office jobs.

Assuming an average workspace ratio for commercial office workers in a regional centre of 20 sqm, core office demand for floorspace in SHCC will is currently 6,517sqm. This accounts for all office workers in occupations and industries most commonly associated with office accommodation (i.e. core office workers).

[3] Note that South Hedland may have both an inflow and outflow of office workers, but on a net basis, 95% of their resident office labour force works within the precinct – the remainder work elsewhere.

5.3.3 Current Floorspace Demand

Commercial office floorspace accommodates workers from a wide range of industries and occupations to accommodation. Over the past two decades, the share of floorspace in Australian capital cities accounted for by ***ancillary office workers*** (i.e. those not in core office worker industries and accommodations) has ranged from 10-15% (PCA 2011). In this assessment, a 15% weighting has been assumed as Port Hedland is a regional market and a general lack of business accommodation diversity means the burden on office accommodation is likely greater than more metropolitan areas. It also reflects the collocation of major health facilities and services in the SHCC and the demand for office floorspace generated through medical suites and allied health service delivery.

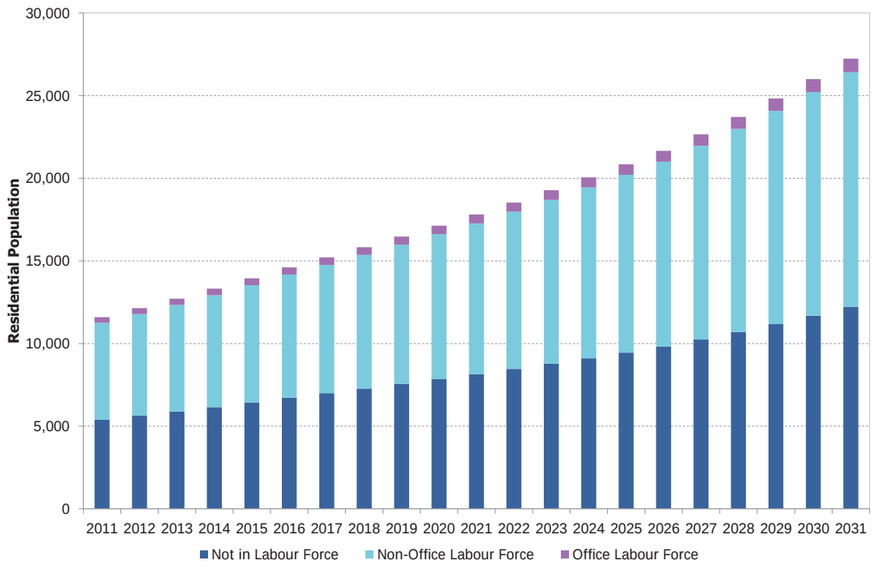
Currently ancillary office floorspace demand equates to an additional 1,150 sqm in SHCC. Together, core and ancillary office demand equates to total floorspace requirement of 7,667sqm in 2011.

5.4 Projected Future Demand

5.4.1 Labour Force Growth

According to section 3.1, South Hedland's resident population is expected to increase to 27,240 by 2031. However, the Department of Health and Ageing project the proportion of Port Hedland's population that is aged 15 years and over will grow to 78.8% by 2031. This reflects the general ageing of the population expected over the next 10 to 20 years meaning the share of residential population in the working age population and labour force will increase over time.

Figure 5.3: Resident Population, by Labour Force Participation and Office/Non-Office Labour Force, South Hedland, 2011 to 2031



Source: AEC*group*

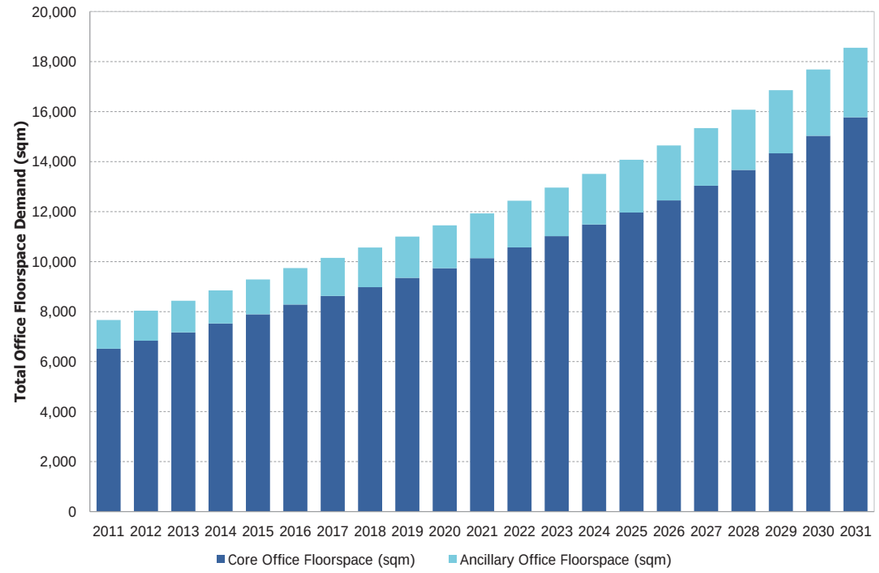
As illustrated in the figure above, the local labour force in SHCC will growth to 15,020 workers by 2031. Assuming the current share of office-based workers remains constant over this period, the number of core commercial office workers is expected to also increase to 830 over the next two decades.

5.4.2 Future Floorspace Demand

Applying the assumed employment self-sufficiency rate for office workers identified in section 5.3.3, the total number of core commercial office jobs in SHCC in 2031 is projected to be 789. With the 20sqm per workers workspace ratio, this equates to demand for 15,770sqm of commercial office floorspace from core office workers.

With ancillary office floorspace demand estimated at a further 2,783sqm, total commercial floorspace requirement for SHCC in 2031 is projected to be 18,553sqm. This total and composition is outlined in the figure below.

Figure 5.4: Total Office Floorspace Demand, by Core and Ancillary Use, SHCC, 2011 to 2031

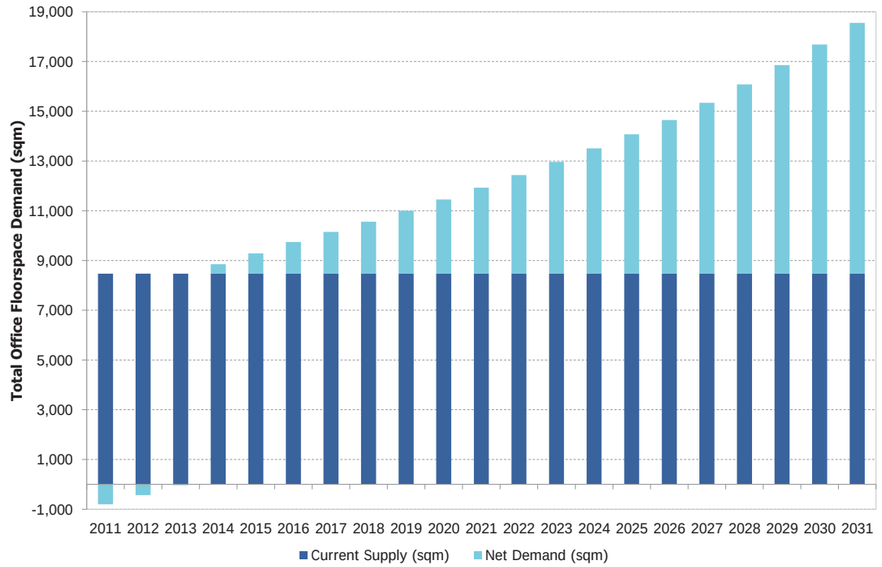


Source: AEC*group*

5.5 Supply Gap

There is currently demand for a total of 7,667 sqm of total office floorspace in South Hedland, with 8,471 sqm being currently supplied. This appears to indicate a current supply surplus of 804 sqm. In reality, the market in Port Hedland is currently experiencing shortages in all forms of business accommodation. Retail and residential space is regularly being occupied by commercial office businesses, which is having the effect of distorting supply and demand. Development constraints in East and West End in recent years have seen South Hedland capture a greater market share than would be expected. Going forward, the normalisation of the commercial office market will see South Hedland revert to a more traditional labour force-driven dynamic in line with its role and function as a population- and service-driven city centre.

Figure 5.5: Total Office Floorspace Demand, by Current Supply and Forecasted Net Demand, South Hedland, 2011 to 2031



Source: AEC*group*

5.6 Key Findings

The commercial office market in SHCC will grow over the next 20 years, in response to a critical mass of local labour force and collocation with major medical facilities generating health-based floorspace demand. While it is expected that the West End will play a critical role in the Town of Port Hedland as a primary concentration of premium and A Grade office floorspace (fulfilling its role as a Commercial and Cultural Precinct), SHCC has an increasingly role to play in maintaining and increasing the diversity of office accommodation locations and availability across the LGA. This will assist in providing a "release valve" for future potential pressures in office space demand.

The assessment suggests that the current market is in a slight oversupply position. However, this reflects the SHCC having particularly strong market share in the commercial office market at present, relative to its local labour force dynamics. As the market normalises, local labour-based floorspace demand will play a greater role in underpinning overall accommodation supply in the medium to long-term.

6. Timing and Staging

This chapter provides a summary of the total floorspace/activity levels projected for the SHCC over the next 20 years and commentary on the relative timing and staging of when new supply and investment should be encouraged and facilitated.

6.1 Total Activity Demand

A summary of all activity demand levels (accommodation, office and retail) is outlined in in the following table.

Table 6.1: Total Demand Levels, South Hedland City Centre, 2011 to 2031

Activity	2011	2016	2021	2026	2031	Growth (no)	Growth (%)
Residential Dwellings	**413**	**549**	**708**	**901**	**1,186**	**773**	**187%**
- Attached	413	549	708	901	1,186	773	187%
- Detached	0	0	0	0	0	0	0%
Short Stay Accommodation (No. of rooms)	**667**	**602**	**714**	**856**	**1,027**	**360**	**54%**
Commercial Office Floorspace (sqm)	**7,667**	**9,742**	**11,929**	**14,646**	**18,553**	**10,886**	**142%**
- Core Office Floorspace	6,517	8,281	10,139	12,449	15,770	9,253	142%
- Ancillary Office Floorspace	1,150	1,461	1,789	2,197	2,783	1,633	142%
Retail Floorspace (sqm)	**20,234**	**28,016**	**38,503**	**53,824**	**77,461**	**57,227**	**283%**
- Groceries & Specialty Food	6,897	9,571	13,062	17,753	24,820	17,923	260%
- Food and Liquor Catering	4,123	5,548	7,403	10,583	16,084	11,961	290%
- Clothing & Accessories	2,507	3,474	4,791	6,854	10,119	7,612	304%
- Furniture, Houseware & Appliances	1,965	2,770	3,918	5,542	7,868	5,903	300%
- Recreation & Entertainment Equipment	2,332	3,290	4,658	6,584	9,331	6,999	300%
- Garden & Hardware Goods	736	1,022	1,428	2,042	2,976	2,240	304%
- Other Goods & Personal Services	1,675	2,342	3,243	4,467	6,262	4,587	274%

Source: AEC*group*
Note: Growth (no) is based on the difference between 2011 and 2031. It does not represent the supply gap (total demand minus currently supply).

The fastest growth in demand is expected in Clothing & Accessories and Garden & Hardware Goods retail categories (304% growth), followed by other retail categories (varying from 260% growth in Groceries & Specialty Food demand to 300% growth in Furniture, Houseware & Appliances and Recreation & Entertainment Equipment). This retail floorspace demand reflects a strong exposure to population growth in South Hedland and the broader Port Hedland LGA, as well as strong income levels and growth expected over the next 20 years.

This is followed by the growth in demand for Residential dwellings (187%). However, this growth rate understates actual development potential as all of the demand as at 2011 is currently unmet.

The slowest growth is expected in short-stay accommodation rooms. This reflects the fact that of all the components of the service population of South Hedland, visitor numbers are expected to experience the slowest growth rate.

6.2 Comparison with Top-Down Analysis

Adjusting for current supply, the supply gap generated as part of the "bottom-up" analysis has been compared with the "top-down" scenarios. This analysis reveals divergent results across all categories.

Table 6.2: Supply Gap, "Top-Down" and "Bottom-Up" Analysis, SHCC, 2011-2031

Activity	"Top-Down"		"Bottom-Up"
	Low	High	
Residential Dwellings (no.)	700	1,400	1,186
Short Stay Accommodation (rooms)	300	500	588
Commercial Office Floorspace (sqm)	7,500	12,000	10,082
Retail Floorspace (sqm)	35,000	50,000	51,716

Source: AEC*group*

The results of the "bottom-up" assessments for Short-Stay Accommodation and Retail floorspace produced supply gap estimates above the "top-down" analysis in chapter 2. For Short-Stay Accommodation, this appears to be based on the current shortfall in local supply rather than future demand growth (which is expected to be slower than other activity types - refer to Table 6.1). For Retail, more detailed analysis of local factors in this assessment appears to be driving a more bullish outcome.

In contrast, net demand for residential dwellings and commercial office floorspace under the market assessments sit between the low/high scenarios of "top-down" analysis. Interestingly, both estimates are located closer to the High scenario, suggesting that the results these local assessments were also more bullish, just not the extent of retail and short-stay accommodation.

6.3 Key Findings

The results of the market assessments revealed strong demand for retail floorspace and residential dwellings, along with moderate demand for commercial office and short-stay accommodation in SHCC over the next 20 years. These results appear to be bullish compared to the outputs of the "Top-Down" analysis is chapter 2, reflecting more detailed consideration of local drivers under this analysis. This reinforces the notion of SHCC having a strong forward growth profile for demand across all economic activities, which will support its development as the city centre of Port Hedland.

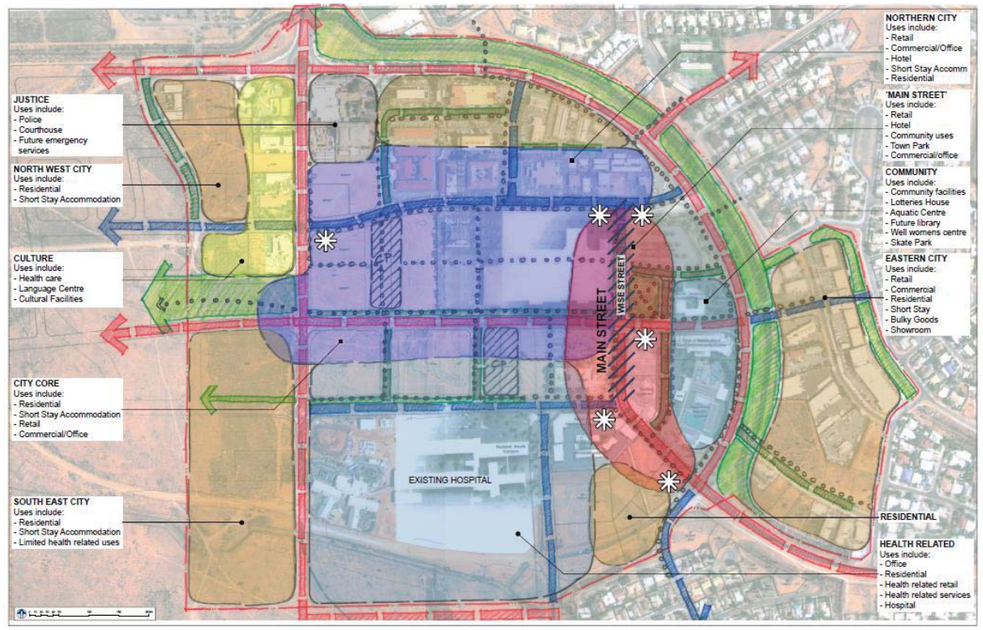
7. Activity Clusters Analysis

This chapter provides high level advice on the potential role and function and character of different Activity Clusters in the South Hedland City Centre.

7.1 Activity Cluster Role and Function

A range of activity clusters were identified in the preparation of the South Hedland City Centre Development Plan. These clusters are characterised by either specific location characteristics (same portion of SHCC) or share a common thematic driver (health, retail, residential etc). These clusters are illustrated in the figure below.

Figure 7.1: Activity Clusters, SHCC



Source: RPS (2011)

The table below reviews these activity clusters in terms of their drivers, role and function in the overall Precinct, mix of potential uses and cluster interrelationships.

Table 7.1: Role and Function of Activity Clusters, South Hedland City Centre,

Cluster No.	Activity Clusters	Drivers	Role and Function	Mix of Uses	Related Clusters
1	Justice/Culture	• Proximity to future western population catchment • Co-location of civic and cultural uses • Proximity to City Centre Core	• Civic and cultural precinct	• Civic and cultural uses • Local café and restaurant offering servicing local workers	2,3
2	North West City	• Residential area in close proximity to City Centre • Attractive for medium density development	• Medium density residential precinct	• Residential	

Cluster No.	Activity Clusters	Drivers	Role and Function	Mix of Uses	Related Clusters
3	City Core	• Primary core of commercial activity in South Hedland catchment and broader LGA • Existing travel destination within catchment • Established retail offering • Recent investment and revitalization • Central location within broader city centre	• Commercial and retail CBD of South Hedland and LGA	• Retail (externalized box) • Café and restaurants • Commercial office • Short-stay accommodation • High density residential (limited to allow revitalisation)	All
4	South East City	• Residential area in close proximity to City Centre • Adjacent to Health Campus • Attractive for medium density development • Attractive location for retirement/aged care.	• Medium density residential precinct with potential retirement/Aged Care offering	• Residential • Retirement/Aged Care	9
5	Northern City	• Established area • Bordered by city core to the south, Justice/Culture node to west and open space amenity to north and east • Redevelopment opportunities	• Mixed-use precinct with strong residential/accommodation activities and secondary retail, café and office offering.	• Residential • Short-stay accommodation • Retail • Café/restaurant • Commercial office	1,3
6	"Main Street"	• Newly established sub-precinct • Enhanced urban amenity • Supports café and restaurant and retail services • Links core with community node	• "Main-Street"	• Retail services (banks, post office) • Café and restaurant	3,7
7	Community	• Concentration of community facilities and uses • Proximity to existing population catchment • Strong pedestrian link between City Core, through Main Street.	• Community Hub with social and community facilities and services	• Sport and recreational facilities • Youth facilities • Not-for-profit organisations • Community organisations	3,6
8	Eastern City	• Large lots • Strong development/redevelopment potential • Existing service commercial activity	• Service Commercial Node	• Motor vehicle mechanics • Small floor plate bulky goods (carpets/tiles, automotive parts, outdoor/sport) • Boat sales and chandlery • Bulky chemist, alcohol and other consumable goods (i.e. not white goods/hardware)	NA
9	Health	• Existing hospital • Extensive land for development • Strong connections to City Core • Ability for mix of uses to be provided • Ideal HOD	• Mixed-use health-oriented precinct anchored by public health, supporting private health care, social service, high density residential, retirement/aged care and commercial office floorspace	• Hospital • Medical suites • Commercial office • Convenience retail • High density residential • Retirement/aged care	3,4,6

Source: AEC*group*

7.2 Key Findings

The size of SHCC (in terms of both land area and future growth prospects) and the diversity of anchors and associated drivers will support a range of activity clusters within the Precinct. These clusters will invariably perform a different function within the SHCC, while possessing strong inter-relationships that create a network of activity anchors.

Major drivers of activity in clusters include health facilities, existing and new retail offerings and community facilities, which have the potential to support and induce investment in residential, commercial office and short-stay accommodation supply. Effective urban design that maximises effective and pedestrian oriented linkages between the clusters will maximise the economic development of the Precinct, enhance investor/developer returns and reinforce the Precinct's role as the principal city centre of the Town of Port Hedland.

8. Conclusions

South Hedland City Centre is ideally located to support Port Hedland's growth into a City. It is centrally positioned within the largest current and future residential population catchment in the Town of Port Hedland. This central location underpins demand for community facilities, health and education services and quality retail offering. The activity created by these ancillary pursuits, in combination with continued urban amenity enhancements, will support development and take up of apartment-style residential living, increased short-stay accommodation supply and commercial office to accommodate local white collar workers.

Retail floorspace is expected to experience the strongest growth in demand in South Hedland City Centre over the next 20 years. This growth is reflected in all service population cohorts (resident, visitor and FIFO workers) in both primary and secondary catchments and above average income levels. Even when adjusted for higher than average retail turnover densities among current and future retailers (to reflect higher capital and operational costs), SHCC will experience an increase in retail demand in the order of 280% to 2031. This is stronger growth than any other floorspace type.

This retail offering, particularly increased café and restaurant provision, will support the development of residential apartments in the SHCC. Such a local in-centre population will have significant benefits for SHCC by providing local expenditure levels which support24 hour activation. The take-up of residential dwellings in the SHCC is dependent on the creation and maintenance of high levels of public and service-based amenity, reflecting strong competition from the East End with its coastal location.

Commercial office floorspace in the precinct will more than double over the next two decades. Driving this demand for dedicated business accommodation is a combination of a strong local labour force catchment, increased land costs in Port Hedland township (West and East End) and ancillary demand associated with medical and allied health services (given the collocation of the SHCC with the Port Hedland Hospital).

The South Hedland City Centre has strong future development potential. It has the potential to support the long-term growth of Port Hedland as a Pilbara City of 50,000 people. Effective land use planning, urban design and infrastructure investment is therefore critical to support and facilitate this growth in the realisation of the potential of the SHCC precinct, but also to mitigate against future economic and market volatility.

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APPENDIX 3

South Hedland City Centre
Servicing and Infrastructure Report

SOUTH HEDLAND

CITY CENTRE MASTERPLAN

SERVICING & INFRASTRUCTURE REPORT

REPORT 6020-SI- REV2

NOVEMBER 2012

DRAFT

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2. Figure 6: PWD (1976) Town Centre Proposed Drainage Basins (from JDA)
3. Water Corporation – Wastewater Scheme Planning: South Hedland – Long Term Scheme

1.0. INTRODUCTION

This Servicing Report has been prepared by Cossill & Webley (CW) for LandCorp to provide a summary of the existing service infrastructure and comment on its capacity following partial completion of the redevelopment within the *South Hedland City Centre*.

The workshop held at RPS offices on 3 October 2011 provided a background of the planning and other investigations undertaken to date and defined a number of precincts of the *South Hedland City Centre* as indicated on the "*Draft Master Plan*" (refer Appendix 1).

Within a large portion of the proposed City Centre, under the LandCorp *South Hedland Town Centre Development*, there are service infrastructure works that have been installed (Stage 1 and Stage 2), under way (Stage 1C) and other stages planned for implementation. Additionally there are other areas where there is existing development and the nature of the existing service infrastructure has not been investigated in detail. Based on the RPS "*Draft Master Plan*" the following five Precincts have been defined and this forms the basis for the descriptions outlined in this report >

- Precinct A – *City Core, Main Street and Community Hub*
- Precinct B – *Throssell Road Boulevard Retail and Mixed Use*
- Precinct C – *Colebatch Way Health Services and Mixed Use Residential*
- Precinct D – *Hamilton Road Northern Commercial Gateway*
- Precinct E – *Hunt Street Eastern Commercial Gateway*

2.0. ROADS & PEDESTRIAN NETWORK

2.1. Precinct A

The City Core has undergone a major upgrade of its road network including realignment of roads and reconstruction of existing roads. These works include the upgrading of Forrest Circle between Murdoch Drive and Throssell Road, realignment of the existing Colebatch Way into a brick paved Main Street(now Wise Terrace), removal of the existing Leake Street, re-alignment of Rason Court to become McLarty Boulevard and construction of a new east west road(Rason Link). Additionally there is revision of on street parking throughout the City Corel area. Current works include the removal of Forrest Circle between Murdoch Drive and Collier Drive and the addition of a link road between Daylesford Close and Forrest Circle to improve the access into the Koombana area.

The City Core/Main Street area comprises paved verges along Wise Terrace and footpaths on the other roadways. There will be a high level of connectivity for the pedestrian movement in this area. A major pedestrian spine has been planned along the landscaped upgrade of the Forrest Circle drain providing a pedestrian and bicycle link along this route. Additionally a landscaped linear parkway is proposed on the north side of McLarty Boulevard.

2.2. Precinct B

There is an existing road network generally comprising sealed, kerbed and drained roads. There has been no detailed geotechnical investigation of the pavements or their structure and subject to planned development within these precincts the existing road network may suffice. However, should any significant high density development be considered then some assessment of the existing network and pavement structure may be warranted. Additionally the capacity of the road network (lane widths, intersection treatments, etc) and provision for parking may need to be reviewed.

The Pedestrian Network throughout this area consists of concrete footpaths generally on both sides of the existing roads. Throssell Road has a number of paved medians which contain a pedestrian refuge to allow for safe passage across the street.

2.3. Precinct C

Within Precinct C Colebatch Way and the northern section of Collier Drive were constructed several years ago during the hospital works. As part of the works currently being constructed a small section of Collier Drive will be completed and link the existing section of Collier Drive to the south to the town centre, it is envisaged this will form a major conduit for trips to and from the Koombana area and further to the south-eastern areas of the town. Planning has commenced for upgrades of Hamilton Road through Precinct C to form either a wider pavement road or a Boulevard cross section to enable Hamilton Road to sustain higher traffic volumes predicted as part of the expansion of South Hedland. New roads are also planned to link Colebatch Way and McLarty Boulevard to provide connectivity between the main health services and the retail areas.

The pedestrian network throughout Precinct C will consist of footpaths on one side of each road which over time will increase to both sides of the roads as building construction works advance. The connectivity of the path network between the main shopping precinct, community precinct and health services precinct once the current and future construction is completed is expected to be good.

2.4. Precinct D

The road network within the Precinct D area is generally established and has been developed over a number of years preceding this report. The notable areas of planned modifications is the upgrade of Hamilton Road generally south of Throssell Road to a Boulevard style road as discussed under Precinct C to provide for higher anticipated future traffic volumes.

A path network exists within Precinct D which provides pedestrian connectivity alongside the road network.

2.5 Precinct E

The road network within Precinct E is already well established. As part of the Stage 2 works parts of the roads leading into Precinct E from the Town Centre have been upgraded and resurfaced and no further works are planned within the area at the current time.

A path network exists generally on one side of the road within Precinct E. The stage 2 works have renewed the pedestrian linkages from the town centre into this area which is generally characterised by light commercial properties where the majority of visits to the area appear to be by motor vehicle.

3.0. DRAINAGE

3.1. Precinct A

The previous drainage concept for the area (developed by the PWD in 1976) comprised a number of storage detention basins that were located around Lotteries House, the Hospital Site and south of Rason Court (now McLarty Boulevard) near Hamilton Road (refer JDA Report – South Hedland Town Centre Revitalisation – Flood Modelling, August 2011 included in Appendix B in the LWMS- August 2011). A copy of Figure 6 showing the proposed drainage basin is presented in Appendix 2.

The revised drainage strategy was prepared to accommodate the desired "Main Street" focus and planned residential development. Where possible the larger detention areas were redirected to a widened Forrest Circle drain and planned linear drainage path along the north side of Rason Court (now McLarty Boulevard). Inherent in this system however is a requirement for some onsite detention within each of the development sites. Part of the redirection of runoff was the need to upgrade a number of the existing culverts on the Forrest Circle drain. In addition, pending further development it may be necessary to upgrade the open drain downstream of Hamilton Road to South Creek.

The development sites are required to be filled above the forecast 1:100 year flood levels and will be elevated above the road verge. Some existing sites where civic facilities are being retained will need to be filled upon demolition and redevelopment of the sites. In the interim period some localised ponding and flooding may occur.

3.2. Precinct B

Similar to Precinct A lot runoff for a large proportion of the developed areas comprises depressed carpark areas that would overflow onto the road network. The road network comprises a pipe network with depressed road system that directs surface flows to the outer Forrest Circle drain.

3.3. Precinct C

The drainage strategy for the health services precinct was established during the hospital construction, the majority of the stormwater flows within the area exits the site via on open drain on Collier Drive and/or a major drainage path adjacent to the southern boundary of the hospital site, this drain also receives flows from the Koombana area. Any flows to the west of Hamilton Road currently flow overland or via minor surface channels toward south creek. It is envisaged these flow paths will be formalised in the future with major surface drains extending westwards from McLarty Boulevard and a secondary outlet near the renal accommodation unit.

3.4. Precinct D

The drainage network within precinct D is already well established, it consists of a piped drainage network and utilises the existing road network to provide an overland flow path towards the main drain on Forrest Circle. The Forrest drain adjacent to Precinct D and east of Hamilton Road has been upgraded as part of the town centre works, further upgrades to the Forrest Circle drain west of Hamilton Road may be required in the future to ensure the adequacy of the network.

Should redevelopment be proposed in the precinct, assessment of site levels and drainage may need to be considered.

3.5. Precinct E

The road drainage system compromises a pipe drain network with a depressed road system and some direct access to the existing open drain along Forrest Circle. Stormwater runoff from lots is in some areas detained onsite with runoff to roads and some locations appear to overflow to the adjoining Forrest Circle drain.

From the flood study work carried out by JDA it is noted that the area of Precinct E around Hunt Street is low lying and prone to flooding. Should redevelopment be proposed for these areas (or other areas in the precinct) an assessment of the site levels with respect to forecast flood levels and site drainage should be considered.

4.0. SEWERAGE

4.1. Precinct A

A new gravity sewer reticulation system has been established with much of the old gravity network removed. Whilst some of these works have been completed as part of the Stage 1 and Stage 2 Town Centre Development, future works will see the gravity flows for the majority of this area redirected west along McLarty Boulevard to a proposed Type 180 pump station to be located near the North West corner of Scadden and McLarty Boulevard (south Hedland Pump Station "D" – refer Appendix 3).

The Type 180 pump station will service the central area, land to the west of Hamilton Road and planned future residential land south and west of the Precinct C. The Type 180 pump station will also receive flows from other areas of the existing South Hedland network which may include graded out pump stations and redirected pump flows from other pump stations. In discussions with the Water Corporation and as part of the South Hedland Town Centre Development it is proposed that this pump station be completed by the end of 2014 calendar year. This is later than the original timeframe and may result in some buildings being completed prior to the pump station being commissioned.

4.2. Precinct B & D

There is an existing gravity sewer reticulation system that services the lots within these Precincts. In discussion with the Water Corporation it is understood that there are some limitations on the existing system (flat grades and pump station capacity) and some redirection of flow (pumped and gravity) is planned.

Within Precinct B there is an existing pump station (South Hedland Number 8) that is understood to have capacity problems and is planned to be removed and the system "graded out" to a proposed Type 180 pump station in the City Central area. The Type 180 pump station is planned to be constructed by the Water Corporation and completed by end of 2014.

4.3. Precinct C

The existing sewer infrastructure with Precinct C directs flows towards and existing pump station Number 8 referred to in section 4.2. This flow is anticipated to be directed towards the Type 180 pump station referred to under precinct A in the longer term. Also existing in the precinct is private sewer infrastructure, it is envisaged that this and any future development will also be directed towards the proposed type 180 pump station. Future

building development within Precinct C will be constrained until the commissioning of the Type 180 Pump Station.

4.4 Precinct E
Within Precinct E some of the flows are directed to the City Central area and those lots on Byass and Hunt Street discharge to a pump station further to the north. No modifications to the sewer network within Precinct E are envisaged.

5.0. WATER

5.1. Precinct A
A new water reticulation network has been established within the City Central area as part of the Stage 1 and Stage 2 Town Centre Development works. The system has been designed to meet the demand based on the original Town Centre densities.

In discussion with the Water Corporation it is understood that their water source upgrades have been planned to provide for the water supply to meet the current Town Centre growth demands (based on the "original" building densities). Should there be any significant changes to those densities previously defined then the Water Corporation should be consulted to ensure that the supply can meet the demand.

5.2. Precinct B, D & E
The existing developments within this precinct are serviced by an existing piped water reticulation network. It is understood that the supply currently meets the existing demand. Subject to any planned development and any significant increase in demand the existing network may be required to be upgraded. The Water Corporation should be consulted when development plans are known for this area to confirm whether any upgrade of the reticulation network is required.

5.3 Precinct C
Precinct C is already served by an existing pipe network. Future works will include expansion and realignment of the reticulation network along Rason Court and Hamilton Road to interconnect the network with Precinct B and D.

6.0. POWER SUPPLY

6.1. Precinct A
A new underground power network is being established within the City Core area that replaces the existing network. Provision has also been made for the expansion of the civic facilities, Aquatic Centre, Hotel sites and high density residential sites. Future planned sites will be served through extension of the underground network with cabling linking around the City Central road network. The planned sites within the Main Street and Community Hub have been provided with access to a power supply with some surplus capacity pending the intensity of development. Should more significant levels of power be required provisional of additional cables, switchgears and transformers may be necessary.

6.2. Precinct B, D & E
Existing development within the Precinct is serviced by an underground power supply system comprising a High Voltage (HV) and Low Voltage (LV) circuit with transformers and switchgear sites located in key locations. Any significant change in demand as a result of any planned redevelopment may require upgrade or provision of additional transformers and switchgear.

6.3 Precinct C
The existing development within the precinct is serviced by an underground power supply. A new HV feeder was brought along Murdoch Drive from the Murdoch Zone substation to feed the Hospital and links to another feeder that extends down Hamilton Road. Based on the original planned densities for the City Central Precinct an additional feeder will be required from the "Murdoch Zone" substation that will need to extend down Murdoch Drive and up Collier Drive to service development within the western area around Hamilton Road.

7.0. TELECOMMUNCATIONS

7.1. Precinct A
Works within the Stage 1 and Stage 2 Town Centre Development have required the relocation of existing Telstra cable and optic fibre network to the new realigned roadways. With the arrival NBN Co and changes to the provision of telecommunication services, future development sites with be served under the NBN Co regime. As part of the redevelopment in the southern areas of Precinct A ducting and pits have been provided to meet the NBN Co requirements.

7.2. Precinct B, D & E
There is an existing Telstra network comprising cable and optic fibre that services existing developments within these precincts. No discussions have been held with Telstra at this stage in regard to the impact of any redevelopment of these precincts and any such change may require liaison with NBN Co.

7.3 Precinct C
The existing developed lots within Precinct C have access to the Telstra network, some of which is being relocated as part of the stage 1C works program. In addition NBN services are to be installed to serve all new lots being created within the Precinct C area.

Figure 1

Draft Master Plan (RPS – September 2012)

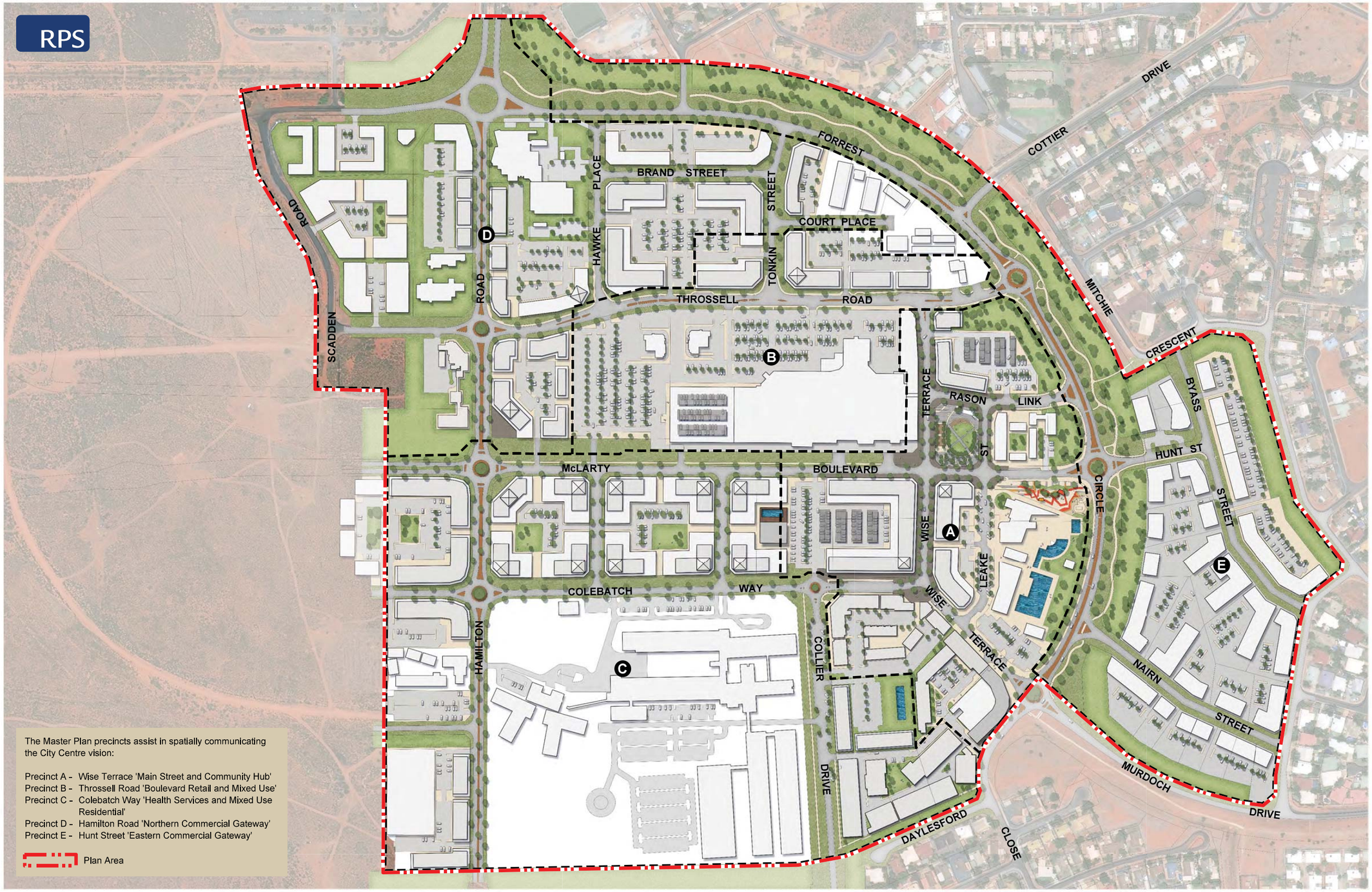
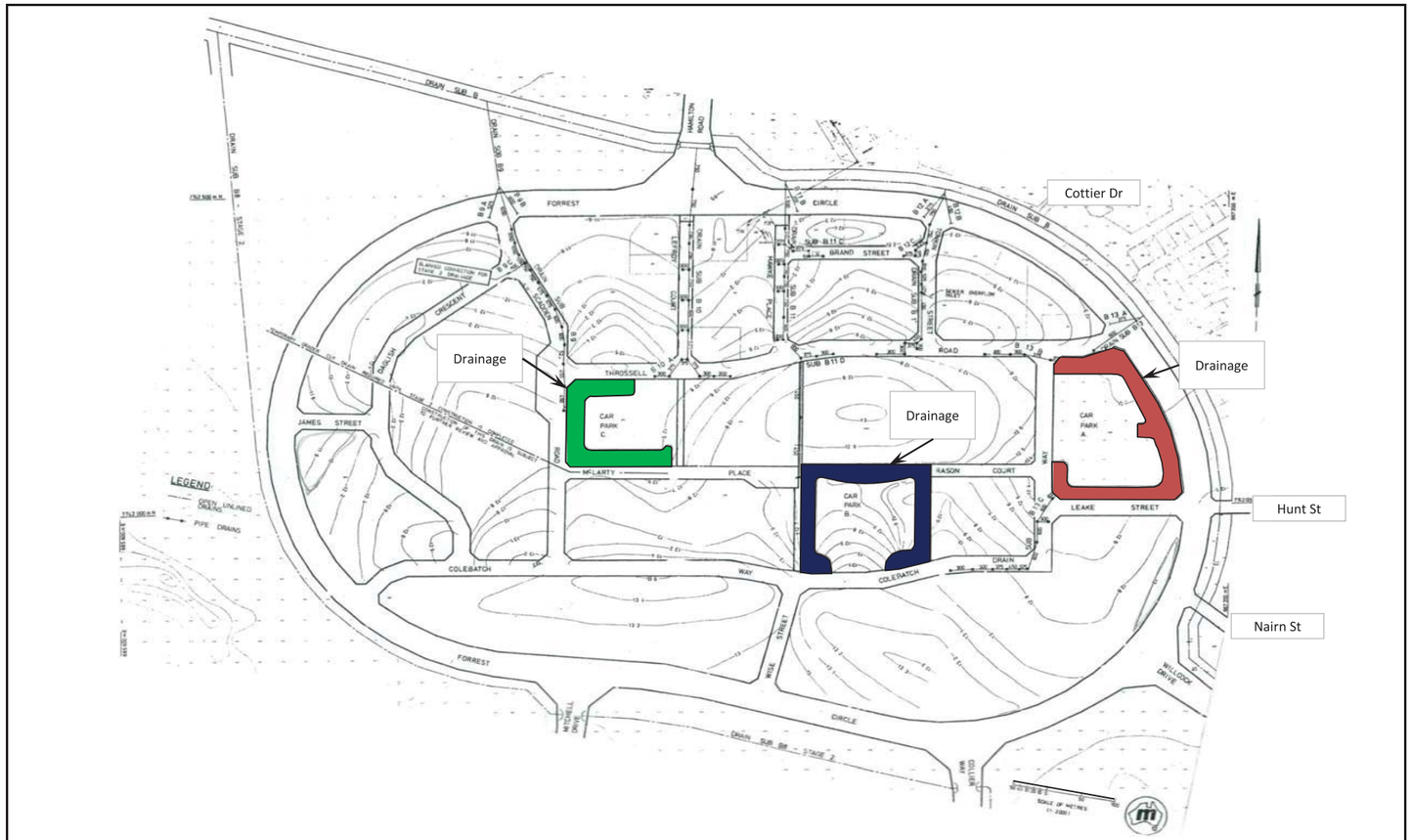


Figure 2

Figure 6: PWD (1976) Town Centre Proposed Drainage Basins (from JDA)

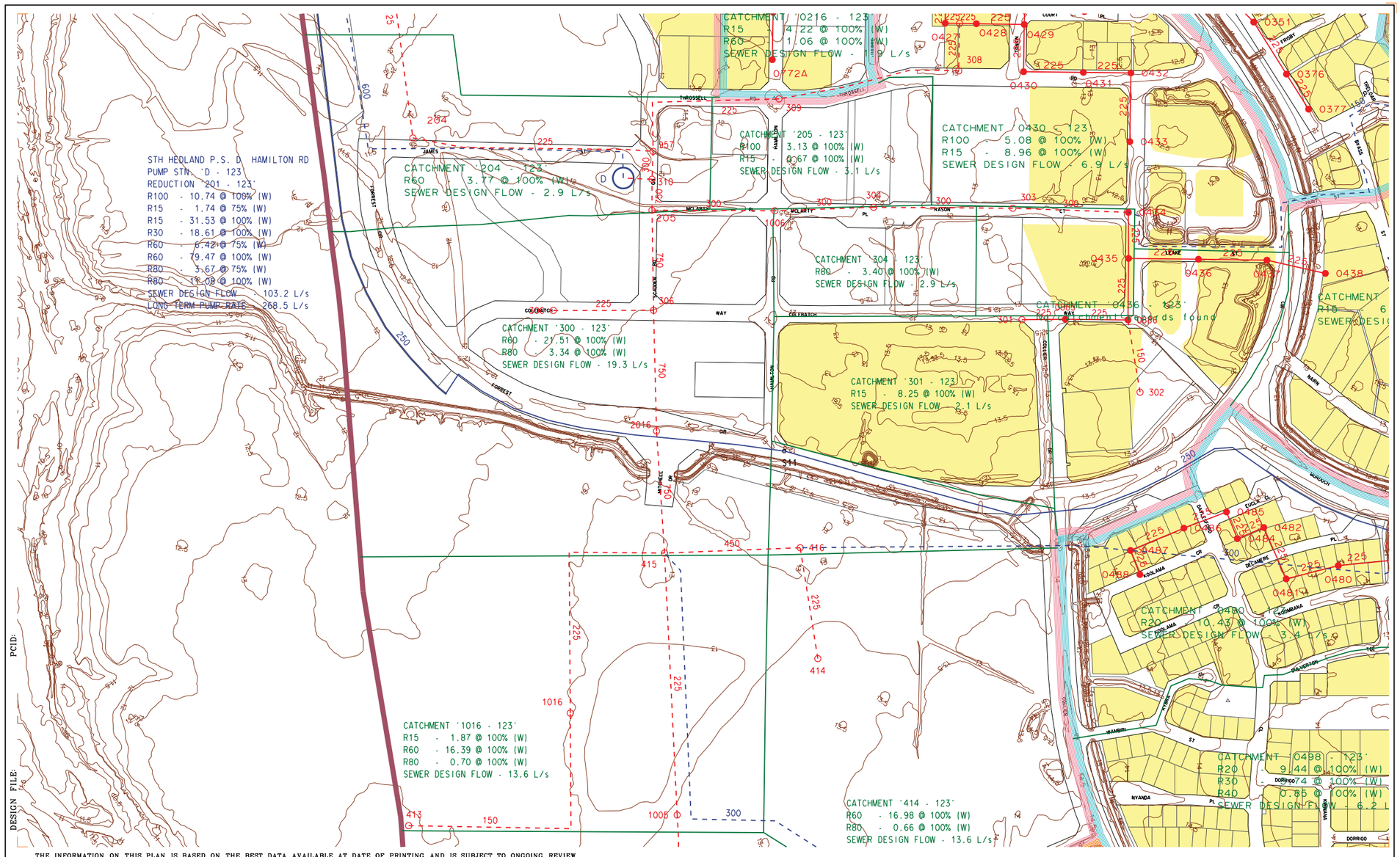


Data Source: PWD (1976)

JDA Consultant Hydrologists	Job No. J4381 Scale ~ 1 : 8,000	Landcorp South Hedland Town Centre Revitalisation: Flood Modelling **Figure 6: PWD (1976) Town Centre Proposed Drainage Basins**

Figure 3

Water Corporation – Wastewater Scheme Planning: South Hedland – Long Term Scheme



THE INFORMATION ON THIS PLAN IS BASED ON THE BEST DATA AVAILABLE AT DATE OF PRINTING AND IS SUBJECT TO ONGOING REVIEW AND AMENDMENT. NO RESPONSIBILITY IS ACCEPTED BY THE WATER CORPORATION FOR ACCURACY OF DATA SUPPLIED BY EXTERNAL AGENCIES.

LEGEND

- EXISTING PUMPING STATION
- EXISTING PRESSURE MAIN
- EXISTING GRAVITY SEWER
- PROPOSED PUMPING STATION
- PROPOSED PRESSURE MAIN
- PROPOSED GRAVITY SEWER
- PARKS AND PUBLIC OPEN SPACE
- EXISTING SEWERED AREAS
- SEWERED BY PRIVATE PS
- NODE CATCHMENT
- PS AND SEWER CATCHMENTS
- SEWER DISTRICT CATCHMENT
- WWTP CATCHMENT

NOTATION

SEWER DISTRICT NUMBER
CATCHMENT NODE
CATCHMENT '7001 - 121'
R15 - 108.4 @75% (W)
GROSS AREA (ha)
'R' CODE ZONING
% OF LAND DEVELOPMENT
(W) - WET CONDITIONS
(D) - DRY CONDITIONS

SEWER DESIGN FLOW = 1.5 x AVERAGE DAILY FLOW RATE

WATER CORPORATION
ISSUED WITH THE AUTHORITY OF THE MANAGER
INFRASTRUCTURE PLANNING BRANCH
629 NEWCASTLE STREET, LEEDERVILLE 6007
WESTERN AUSTRALIA.
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WASTEWATER SCHEME PLANNING SERIES

SOUTH HEDLAND - SD123
CONCEPTUAL PLANNING
LONG TERM SCHEME

PLANNING BY	COMPILED BY	ACCEPTED BY
R. APPOLONI	L. GABRIEL	
SCALE 1:5000	VERSION	FILE NO. A3

APPENDIX 4

Creating a Sense of Place: The South Hedland Town Centre ‘Main Street’ Community Consultation

Creating a Sense of Place: The South Hedland Town Centre 'Main Street' Community Consultation

This 2013 SHTCDP is a refinement of the originally endorsed 2008 Development Plan. As context, and evidence of the original stakeholder consultation, the following documentation of 'Main Street' options is retained in this 2013 document.

A recurring theme throughout the original 2007/8 Master Plan process and stakeholder consultation was a strong desire to develop an area of the Town Centre with a "central focus". The community were clear in their view that this be an important objective for the Centre's growth and for it to generate a sense of ownership by local residents.

Aim: The South Hedland 'Main Street' would serve to attract a wide range of people of all ages, provide an area for activity and reinforce/strengthen local identity. It would be a meeting place, and a location for events and attractions. In responding to this issue, a range of options for the potential town centre focus were considered in consultation with the local community, with five primary candidates emerging.

Option 1: Colebatch Way (Now Wise Terrace)

This option assumed a hub of activity taking place along Colebatch Way, drawing on the established Throssell Road and taking advantage of vacant land potential to the south. It also responded to an opportunity to build upon the existing pattern of development within the Town Centre at its eastern end, and to create a hub of activity in relatively close proximity to existing residential areas.

Stakeholder and community groups responded positively to the immediate development potential of this option, and its recognition of key existing facilities and community services.

Figure 45: Development Considerations within SHTCDP Area

Option 2: Throssell Road

The Throssell Road option assumed that the hub of activity would take place along Throssell which, in many ways, already occurs albeit at a 'traffic activity' level. Option 2 was selected for consideration as it reflected an established pattern of Town Centre use and activity, whereby the main shopping centre and a number of regularly visited uses (e.g. Post Office) are located here.

During consultation, stakeholder and community groups saw the existing role played by Throssell as complimenting the activation of Colebatch Way (now Wise Terrace) under option 1. In this circumstance, new development proposed along Throssell Road, such as shopping centre expansion or tavern redevelopment, could be encouraged to adopt similar design principles. They would then be complimenting Colebatch Way (now Wise Terrace).

Figure i: Main Street Option 1: Colebatch Way

Option 3: Tonkin Street (extended)

The Tonkin Street option envisages a new 'north-south' link being created which draws on the existing access used from Forrest Circle into Tonkin Street. This option was considered as it reflected an opportunity to create an entirely new focus relatively close to existing residential areas and would be directly accessible from Forrest Circle. This option also provides for easy access to the new hospital, which would be at the end of the active street area.

Macquarie, as the shopping centre owners, highlighted that wholesale demolition and redevelopment of the commercial floorspace as proposed was unlikely to be achievable. Aside from significant costs, issues of development staging and impact to tenants, patrons and the broader public would be factors. Other stakeholder feedback suggested that the activation of Colebatch Way (now Wise Terrace) under option 1 better achieved the north-south link in a manner which drew upon road connection and reflected the community's desire for an upgraded "Town Park".

Figure ii: Main Street Option 2: Throssell Road

Option 4: Hamilton Road

This option was included for further review and discussion as it recognised Hamilton Road as the main regional entry to the Town Centre from Port Hedland, Wedgefield and the airport. Option 4 presented a largely 'clean slate' from which new development can be planned and designed. This potentially allows a new image of South Hedland to be shown to visitors upon arriving to the SHTC.

The Hamilton Road option failed, however, to adequately serve the existing established residential areas. With a number of established developments on Hamilton Street's west side between Forrest Circle and Throsell Road, the ability to create a new development pattern would be undermined. Furthermore, the shopping centre owners highlighted that complete shopping centre relocation was unlikely to be achievable.

In a more positive sense, stakeholders liked the potential 'sense of arrival' created by virtue of its regional entry. It was acknowledged that the final plan should seek to address this issue in particular.

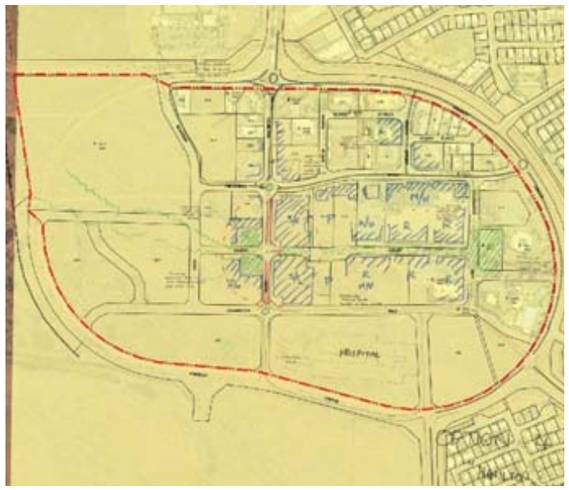


Figure iii: Main Street Option 3: Tonkin Street

Option 5: Rason Court (now McLarty Boulevard)

The Rason Court option provided a new east-west focus centrally within the SHTC and avoided the existing pattern of car dominated development along Throssell Road. It provided a strong landscape link and recognises the existing Town Park area and surrounds.

This option received positive stakeholder feedback for its ability to maintain links to the existing community uses and park, however, is less achievable due to the need to relocate the shopping centre. Throssell Road would be undermined in its current capacity as a heavily developed and used part of the Town Centre. Given the relocation of many of these uses would only occur over a lengthy time period, this option does not allow for the same level of immediate impact as other options.

Figure iv: Main Street Option 4: Hamilton Road

Outcome: Preferred Option

Following comprehensive review and discussion of the five options with key stakeholders (including the Town of Port Hedland, LandCorp, community groups and Charter Hall as shopping centre owners), Option 1: Colebatch Way was ultimately determined to have the best potential for success.

This option was used as the basis for finalising the 2008 Development Plan layout for the purposes of further public advertising, and ultimately final endorsement. Design elements from other options, including Throssell Road, Rason Court and Hamilton Road were also further considered for inclusion.

In addition to the informal consultation carried out through 2007 for the Development Plan, further targeted community and stakeholder consultation has since been carried out by the Town of Port Hedland, LandCorp and UDLA, considering the following public realm elements in further detail.

Since the Development Plan was released in 2008, significant construction work has been carried out in line with the preferred option, with the Main Street now largely complete. This 2013 Development Plan builds upon this success and further reinforces the role and function of the Main Street in the wider Town Centre area. Key developments are now taking shape as a result of this subsequent design and detailed delivery of the 'Main Street' on what is now called Wise Terrace.

The first community event on Wise Terrace and the main park was also recently held (June 2012) by the Town of Port Hedland with great success, and some 4000 people attending.

APPENDIX 5

South Hedland Town Centre Transport Assessment

CONTENTS

1.0 SUMMARY

Significant enhancement and expansion of the South Hedland Town Centre is proposed by LandCorp in accordance with the intentions of the South Hedland Town Centre Development Plan (SHTCDP).

Included in the proposals are modification to existing roads and the construction of new road links to improve permeability of traffic flow and encourage pedestrian movement and activities in front of and between adjacent developments.

Summary of proposed road network changes are as follows:

- Create a new north-south link road between Murdoch Drive and Hunt Street extension.
- Create a new north-south and an east-west road links in land bounded by Throssell Road, Colebatch Way, Hunt Street extension and Forrest Circle.
- Create two new north-south link roads from Colebatch Way to McLarty Boulevard (formerly Rason Court) between Collier Drive and Hamilton Road.
- Realign McLarty Boulevard to link with a realigned Hunt Street to create a new eastern entry.
- Extend Murdoch Drive to create a new south-eastern entry.
- Removal of Forrest Circle between Murdoch Drive and Collier Drive and connect Forrest Circle with Daylesford Close.
- Cottier Drive extension to Colebatch Way.
- Provide intersection controls.

Estimated traffic flows for the South Hedland Town Centre and surrounding area have been modelled with TrafikPlan v4 network modelling software to identify anticipated changes to the modified road network and associated trip generation and traffic movements.

SIDRA analysis for each of the affected intersections indicates Levels of Service A and B are predicted for operation of each intersection. This indicates that all intersections are anticipated to operate without any significant delays or queuing. The SIDRA analysis also predicts that all intersections will continue to function with high Levels of Service and be well within their capacity. This indicates that staging of construction for short and long-term traffic generation at these intersections is not required.

In preparing the traffic model to predict estimated traffic flows for future development of the South Hedland Town Centre (SHTC) the locations for property access from abutting roads into future developments have been positioned to maintain road safety and minimise impact on intersections and the main traffic flows. This is considered good traffic design practice. Authorities approving future developments must ensure that vehicle access to developments will also follow this practice. On that basis it is recommended that direct property access onto Hamilton Road will be restricted or minimised as Hamilton Road is expected to carry significant traffic flows at the assumed full development of the Town Centre by the year 2030. However, it should be noted that this assumption is dependant on the proposed residential development south of the SHTC taking place in the short term and that at the same time a new north-south circulation road is constructed west of the Town to minimise the through traffic load onto Hamilton Road from the residential development.

Staging of construction of future extension of Hamilton Road and interconnection of new road links and land development will determine the short and long term traffic flows experienced. The future extension of the western section of Forrest Circle will permit traffic from future land development on the western and southern sections of the SHTC to bypass the Town Centre. If this western section of Forrest Circle is not constructed at the same time as these areas of land are developed then the main north-south traffic route will be provided by Hamilton Road. In that instance traffic volumes can be expected to exceed predicted flows.

This analysis has had to make a number of assumptions in relation to the rate and intensity of land development for South Hedland. If the assumptions made are substantially correct, then in 3.7 years the traffic volume of Murdoch Drive east of Forrest Circle will reach 7,000 veh/day and in accordance with Liveable Neighbourhoods and Austroads Guidelines the road cross-section should be of a median-divided type.

Similarly it may be concluded that it would take development of 1,850 lots to reach a traffic volume of 15,000 veh/day. At this point a further change in the cross-section of Murdoch Drive would be desirable. At a development rate of 100 lots per year this point may be reached in 18.5 years.

Extension of McLarty Boulevard (formerly Rason Court) west from Hamilton Road to connect with Great Northern Highway is proposed for future consideration. Although a specific alignment has not been determined there is support for such a road to link activities to the west and the residential area to the east and provide improved direct access to the SHTC.

Forrest Circle is a District Distributor road carrying traffic past and into the Town Centre from connecting Local Distributor and Local roads. In the future Forrest Circle traffic flows will continue to increase as the Town Centre and surrounding development proceeds. The predicted future traffic volume for 2030 indicates that single-lane median-separated carriageways will be required with single lane right turn pockets (3.5m wide) at intersections and dual-lanes at roundabouts may be required to accommodate turning flows and minimise queuing.

As Town Centre development progresses and pedestrian and parking movements increase with changes to street cross-section, it is recommended that the Town Centre become a 40km/h Precinct to encourage this integration by presenting a safer street environment for the interaction between pedestrian and vehicle activities.

There is potential to encourage walking by providing centralised parking facilities surrounded by the attractors and activities located within easy walking distance. This must be supported by a pedestrian friendly walking environment. This report suggests the type and location of paths to support the SHTC Design Guidelines.

2.0 INTRODUCTION

Porter Consulting Engineers has been engaged by LandCorp to provide traffic engineering guidance for the development of the South Hedland Town Centre. The proposed South Hedland Town Centre Development Masterplan is included in Appendix 1.

This report seeks to assist the environmental adaptation of the existing town centre to a more diverse, liveable and active centre by providing a road system which provides an acceptable balance between the diverse interests of town centre stakeholders.

The report seeks to balance the conflict in function between the road network as a traffic route for vehicles and pedestrians, and as a place for retail, commerce, high density residential and community activities.

The report acknowledges conventional town centre and community guidelines, such as the West Australian Planning Commission Liveable Neighbourhoods, but seeks to adapt those to reflect the local environment and community function of South Hedland.

The climate is not conducive to long walking trips and once beyond the town centre environs a large robust motor vehicle is preferred by the majority of the population.

The function and purpose of the streetscape is to be conveyed through the geometry, scale and landscaping to create a cognitive awareness of the perceptible environment and behaviour required. The traffic interventions attempt to manage some of these through defining the:

- Geometry for movement circulation;
- Extent of access to frontage activities;
- Travel speed permitted;
- Distribution of on-street parking; and
- Resolution of conflict at important junctions through spatial allocation of priority.

The standards recommended should be adopted when implementing the town centre expansion.

In order to understand the impacts on the town centre of an expanding residential component in South Hedland, the traffic assessment has extended into the surrounding areas to review likely traffic demand and capacity of the primary routes servicing the town centre. Full details of the overall town area are presented in the South Hedland Town Centre Development Plan (September 2008) prepared by RPS Koltasz Smith and others on behalf of LandCorp for the Town of Port Hedland.

The proposal modifies the existing road network layout by introducing two new north-south interconnecting link roads for greater internal Town Centre road network permeability and providing new permeable links to improve accessibility from the surrounding residential area. This report presents the results of traffic model forecasting and related assessments of the proposals.

3.0 SCOPE OF REPORT

The scope of this report is primarily to address the following matters;

- Forecast anticipated traffic generation on the proposed road network.
- Assess traffic impacts on the surrounding environment.
- Assess impact on the existing road network traffic safety and efficiency.
- Define the type of road layout and intersection control needed in medium and long terms.
- Establish the standards to guide ongoing development.

4.0 PREVIOUS REPORTS

Previous traffic and transport assessment reports relevant to the South Hedland Town Centre Land Rationalisation and Subdivision have been prepared by Porter Consulting Engineers on behalf of LandCorp. Those reports are:

- Traffic Assessment - Lots 306 and 6055 Forrest Circle, South Hedland (September 2009). Assessment of proposed subdivision.
- Parking Assessment - South Hedland Town Centre (January 2010 and revised July 2011). Assessment of existing and future development parking provision.
- Traffic Assessment - South Hedland Town Centre Land Subdivision Stage 1A-1C (February 2010). Assessment of proposed subdivision and rezoning.
- Traffic Assessment – South Hedland Town Centre “Mainstreet” and Land Rationalisation (March 2010). Assessment of proposed subdivision, rezoning and road network modifications.

5.0 EXISTING DEVELOPMENT

The subject land is centrally located within the South Hedland Town Centre and is generally bounded by the roads of Hamilton Road, Colebatch Way and Forrest Circle.

The land is zoned ‘Town Centre’ under the Town of Port Hedland Town Planning Scheme No.5 and is located within the South Hedland Town Centre Development Plan (SHTCDP).

Surrounding the Town Centre are residential dwellings to the east, south-east and north-east. To the north of the Town are the South Hedland Sporting Complex and the educational facilities of Hedland College, Hedland Senior High School and Pundulmurra Aboriginal College.

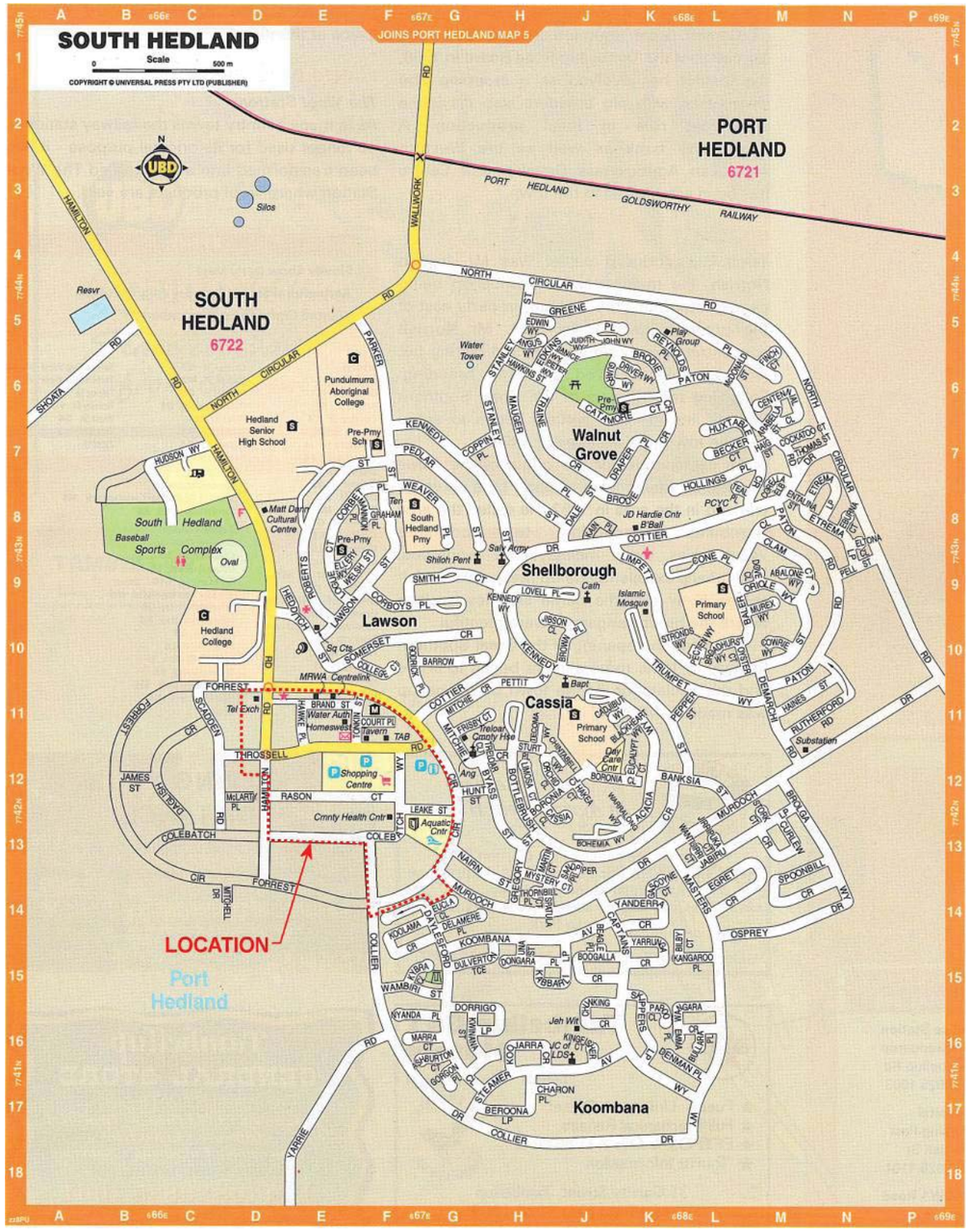


Figure 1. Location of Land Rationalisation and Subdivision (UBD)

6.0 PROPOSED LAND SUBDIVISION

Town Planning Scheme No.5 is the prevailing statutory zoning scheme for the Port Hedland Local Authority, including South Hedland. The Town Planning Scheme Maps show the South Hedland Town Centre as zoned predominantly 'Town Centre' zone, with the exception of land to the west of Scadden Road which remains 'Rural' zone. The Town Centre zone provides for a range of land uses commensurate with an urban centre. While hotels, motels and commercial uses including shops, showrooms and take-away outlets can be approved within the Town Centre zone, so too can residential development of varying type and density up to R50.

7.0 EXISTING TOWN CENTRE TRANSPORT NETWORK

7.1 Road Network

The existing road network layout of the area that is the subject of this evaluation is indicated in the following aerial image.

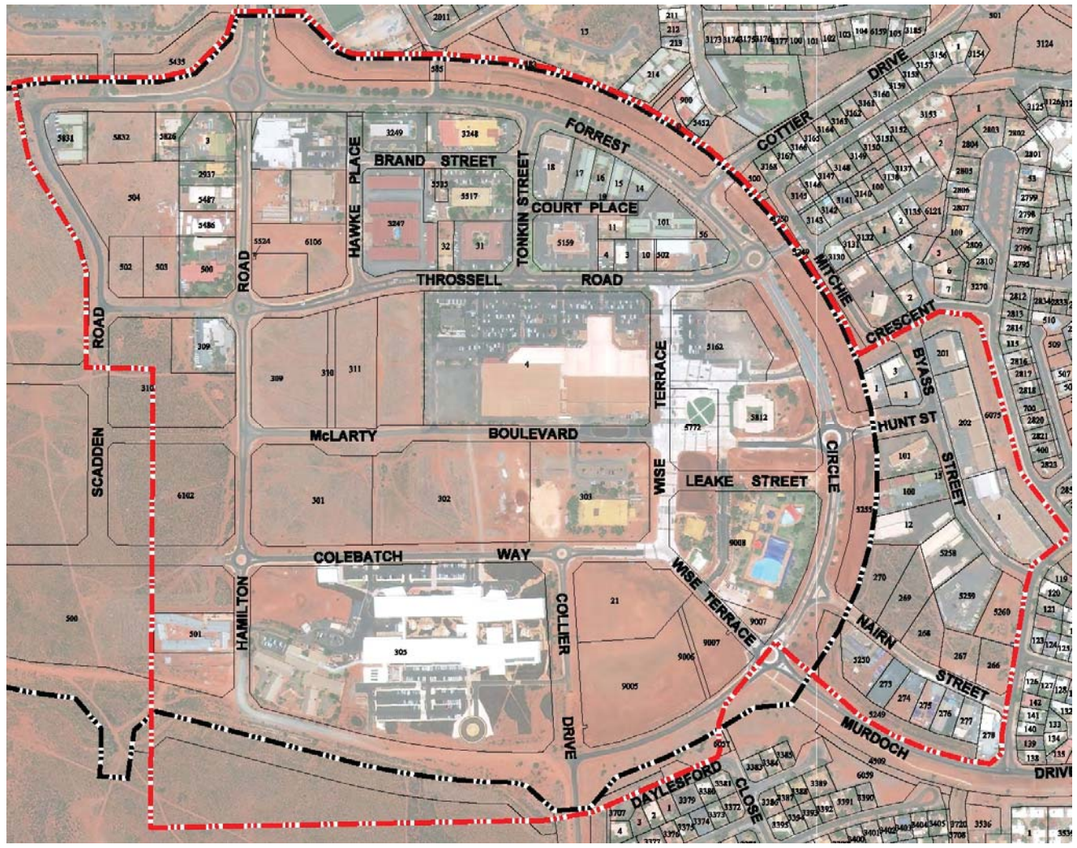


Figure 2. Aerial Image over SHTC (courtesy RPS)

7.2 Road Classification

Functional Road Hierarchy details for the roads within the Town Centre assessment area are listed in the following table. This includes the main traffic carrying roads, lower order integrator roads and the abutting access roads providing the necessary direct connection with developments.

Table 1. Current Town Centre Road Classifications

Road	Classification
Forrest Circle	Integrator Arterial
Hamilton Road	Integrator Arterial
Collier Drive	Integrator Arterial
Murdoch Drive	Integrator Arterial
Colebatch Way	Neighbourhood Connector
McLarty Boulevard	Neighbourhood Connector
Throssell Road	Neighbourhood Connector

7.3 Roads and Land Use Relationship

Existing land uses in the South Hedland Town Centre area include:

- South Hedland Shopping Centre
- South Hedland Regional Hospital
- Pilbarra Health Service
- Karlarra House Aged Retirement
- Aquatic Centre
- Police
- Justice
- Centennial Park
- Community Centres (Library)
- Retail and Commercial
- Government Authorities

The abutting and connecting roads to these land uses are intended to be suitably commensurate and provide functional transport for all legitimate road use to enable safe and efficient transportation.

With proposed changes to the Town Centre, intended to encourage development which will generate a higher intensity of use and to change the mainly car based trips within the Town to a greater proportion of pedestrian based trip movements, the road network needs to change in support.

7.4 Road Type and Capacity

The following table lists the desirable maximum traffic volumes for the various classes of roads.

Table 2. Desirable Maximum Traffic Volume

Road Category	Street	Desirable Maximum Volume ADT (veh/day)
Primary Distributor	None in study area	35,000-50,000
Integrator Arterial A	None in study area	15,000-35,000
Integrator Arterial B	Forrest Circle Murdoch Drive Hamilton Road Collier Drive	7,000-15,000
Neighbourhood Connector	Colebatch Way McLarty Boulevard Throssell Road Tonkin Street	3,000-7,000
Access Road	Hawke Place Brand Street	1,000 – 3,000
Laneway	None in study area	300

The most recent traffic counts available from the Town of Port Hedland and Main Roads Western Australia on streets in the surrounding road network to the land rationalisation and subdivision development are:

Table 3. Recorded Traffic Volume

Road	Location	Volume (AWT) Veh/day
Hamilton Road	N of Forrest Circle	7,270 (Aug. 2004)
Hamilton Road	N of Throssell Road	4,560 (Feb. 2011)
Hamilton Road	S of Throssell Road	1,660 (Feb. 2011)
Forrest Circle	E of Hamilton Road	4,570 (Feb. 2011)
Forrest Circle	S of Murdoch Drive	2,680 (Feb. 2011)
Throssell Road	W of Forrest Circle	8,020 (Feb. 2011)
Throssell Road	E of Hamilton Road	4,390 (Feb. 2011)
Murdoch Drive	E of Forrest Circle	3,610 (Dec. 2010)
Daylesford Close	N of Wambiri Street	1,090 (Feb. 2011)
Hunt Street	E of Forrest Circle	3,040 (Feb. 2011)
Hedditch Street	N of Forrest Circle	2,850 (Feb. 2011)

Analysis of the road network using the recorded traffic counts and trip generation rates with land uses allows for estimation of traffic flows on other roads contained within the road network. The results of the modelling estimates current traffic flows on existing roads and are shown in the following table.

Table 4. Current Traffic Volume (Modelled)

Road	Section	Volume (veh/day)
Forrest Circle	N of Throssell Road	8,000
Hamilton Road	Throssell Rd to McLarty Bvd	1,800
Hamilton Road	McLarty Bvd to Colebatch Wy	890
Throssell Road	Wise Tce to Hamilton Rd	8,030
McLarty Boulevard	Wise Tce to Hamilton Rd	1,100
Colebatch Way	Collier Dr to Hamilton Rd	790
Wise Terrace	Leake St to Colebatch Wy	830

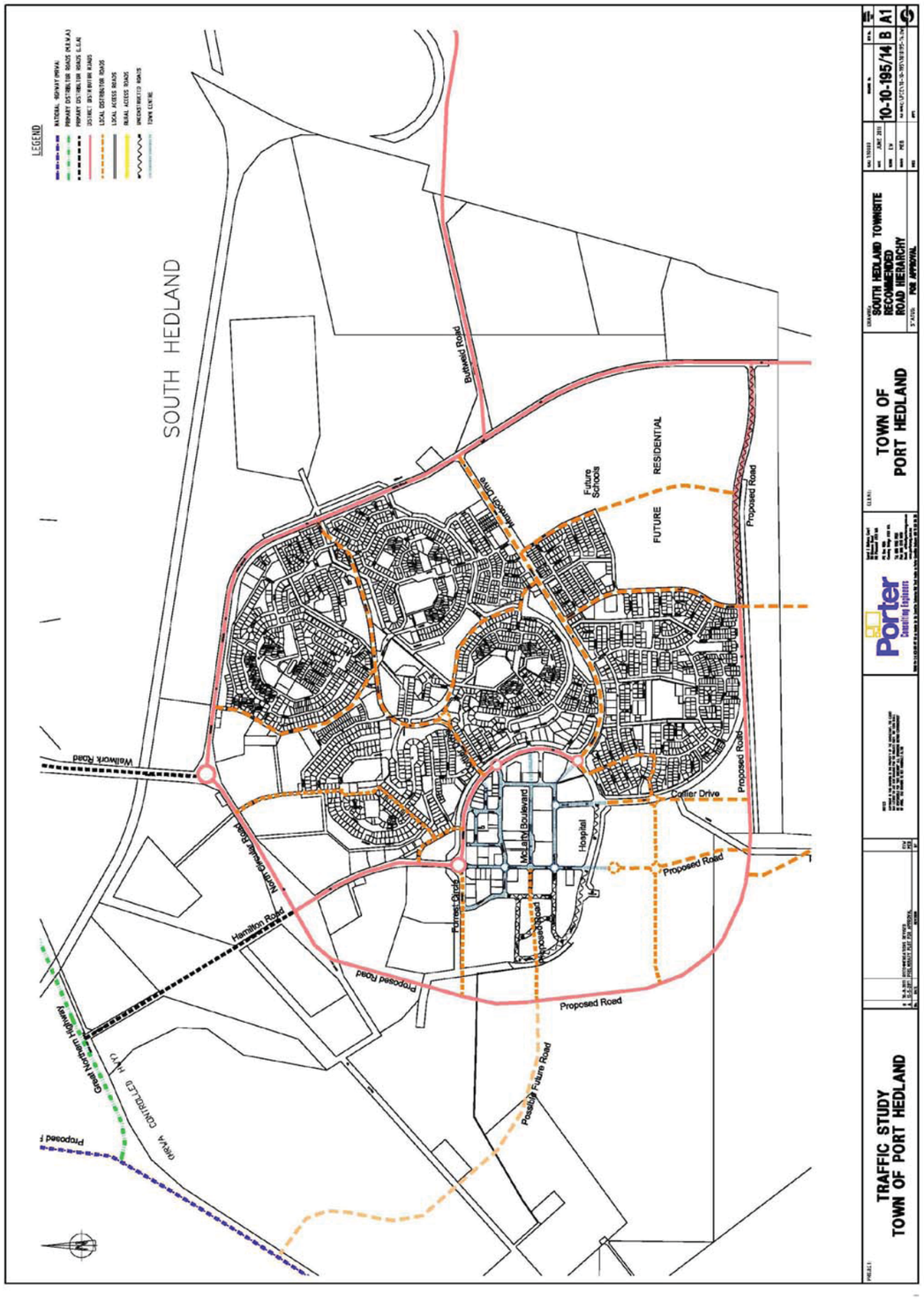
The modelling predicts that currently all roads in the assessment area are operating with traffic volumes within their respective desirable maximum except for the section of Throssell Road west of Forrest Circle where access to the public car park and the shopping centre car park for direct entry to the shopping centre would appear to be attracting a higher than expected intensity of traffic flows.

8.0 TRAFFIC GENERATION

8.1 Regional Context

The realignment of McLarty Boulevard and Hunt Street to connect with Forrest Circle is part of a future intention to potentially also extend McLarty Boulevard westward to connect with Great Northern Highway. In the future, a proposal has been made for McLarty Boulevard to become an east-west link route connecting eastern and western South Hedland regions direct to the South Hedland Town Centre.

The following concept indicates a potential interconnecting linking route for this future possibility. It should be noted there are currently no plans to implement this link and it is considered to be a potential long-term strategy only.



8.2 Land Use

The proposed town centre land subdivisions will create new lots and the introduction of new road links as identified in the SHTCDP.

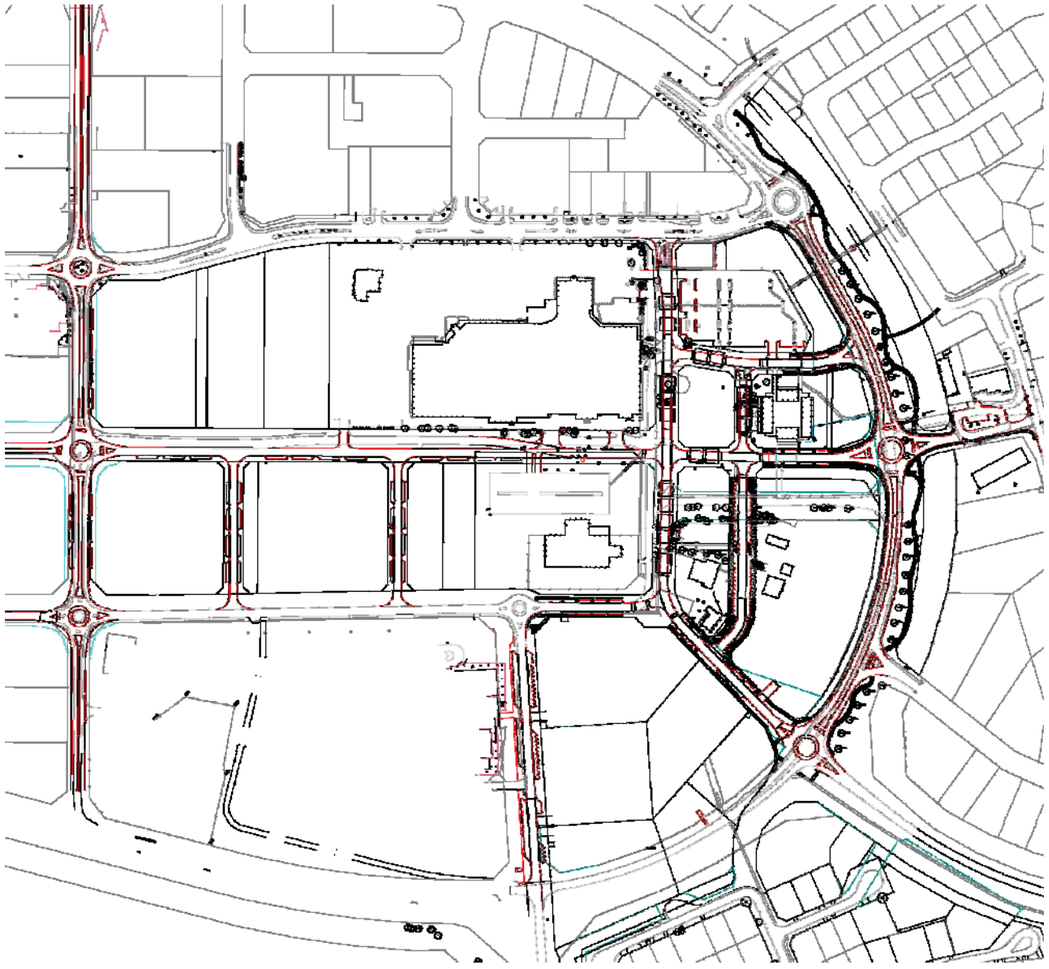


Figure 3. Proposed Land Subdivision and Roads Layout

8.3 Attractors and Generators

The proposed Town Centre development with a mix of retail, business, government, community and residential development is intended to be a focus for the immediate surrounding South Hedland area.

9.0 EXISTING TRAFFIC

9.1 Land Use and Access

Identified land uses (existing and proposed) in the South Hedland Town Centre Development Plan are:

- South Hedland Shopping Centre
- South Hedland Regional Hospital
- Pilbarra Health Service
- Karlarra House Aged Retirement
- Aquatic Centre and Centennial Park
- Police and Justice
- Hotel
- Offices
- Residential

9.2 Internal and External Roads

The current roads surrounding the land development area that provide access to the proposed development lots are listed in the following table.

Table 5. Roads Surrounding Development Areas

Road	Speed Zone	Geometry
Forrest Circle	60kmh	median-divided single carriageway
Hamilton Road	50kmh	undivided single carriageway
Colebatch Way	50kmh	undivided single carriageway
Wise Terrace	40kmh	undivided single carriageway
Collier Drive	50kmh	undivided single carriageway
Leake Street (removed)	40kmh	undivided single carriageway
Murdoch Drive	60kmh	undivided single carriageway
Hunt Street	50kmh	undivided single carriageway
McLarty Boulevard	40kmh	undivided single carriageway
Throssell Road	50kmh	median-divided single carriageway

9.3 Pedestrians and Cyclists

There are no dedicated on-road and limited off-road cycling facilities in the South Hedland Town Centre. None of the pedestrian paths are designated as dual-use as they are generally not of sufficient width to be designated as such under current standards.

The east-west section of Colebatch Way has a 1.5m concrete path on the southern side at the back of kerb. Collier Drive south of Colebatch Way has a 1.5m concrete path located on the western side at the back of kerb. Hamilton Road has a 2.0m footpath on each side along the back of kerb from McLarty Boulevard to Forrest Circle. McLarty Boulevard has a 2.0m footpath on the northern side along the back of kerb from Hamilton Road to the eastern edge of the Shopping Centre car park.

Care must be taken in design of the layout and form of buildings, roadways and pedestrian paths to ensure security of pedestrian movement is not compromised. In that respect it is particularly important to:

- Maximise natural surveillance by overlooking from nearby building and activity areas.
- Avoid narrow paths between fences, the sides of buildings or through tall, dense landscaping.
- Pedestrians can see and be seen clearly in the surrounding area.
- Design should not create recessed areas and hiding places.
- Provide pedestrians with the maximum number of route choices.
- Provision of adequate lighting.
- Provide an environment that is cared for, e.g. promptly repair any damage or graffiti.

These are being addressed in the Civic Design Guidelines currently being prepared.

9.4 Public Transport

There are currently two bus routes through the Town Centre operating as follows:

Table 6. Bus Routes

Route No.	Route Description	Frequency	
		Weekdays	Saturday
301	South Hedland (clockwise)	Every 2 to 3 hours (8.15am to 5.00pm)	Every 3 to 4 hours (8.15am to 4.05pm)
401	South Hedland (anticlockwise)	Every 2 to 3 hours (9.10am to 5.55pm)	2 services (10.05am and 2.05pm)

Associated with the bus routes, there are two bus stops in the Town Centre located on:

- Throssell Road - Bus shelter on the northern side opposite Colebatch Way.
- McLarty Boulevard - On road stops designated by bus stop posts on the northern and southern sides of the road west of Wise Terrace.

Current bus routes through the South Hedland road network area are shown in Figure 4.

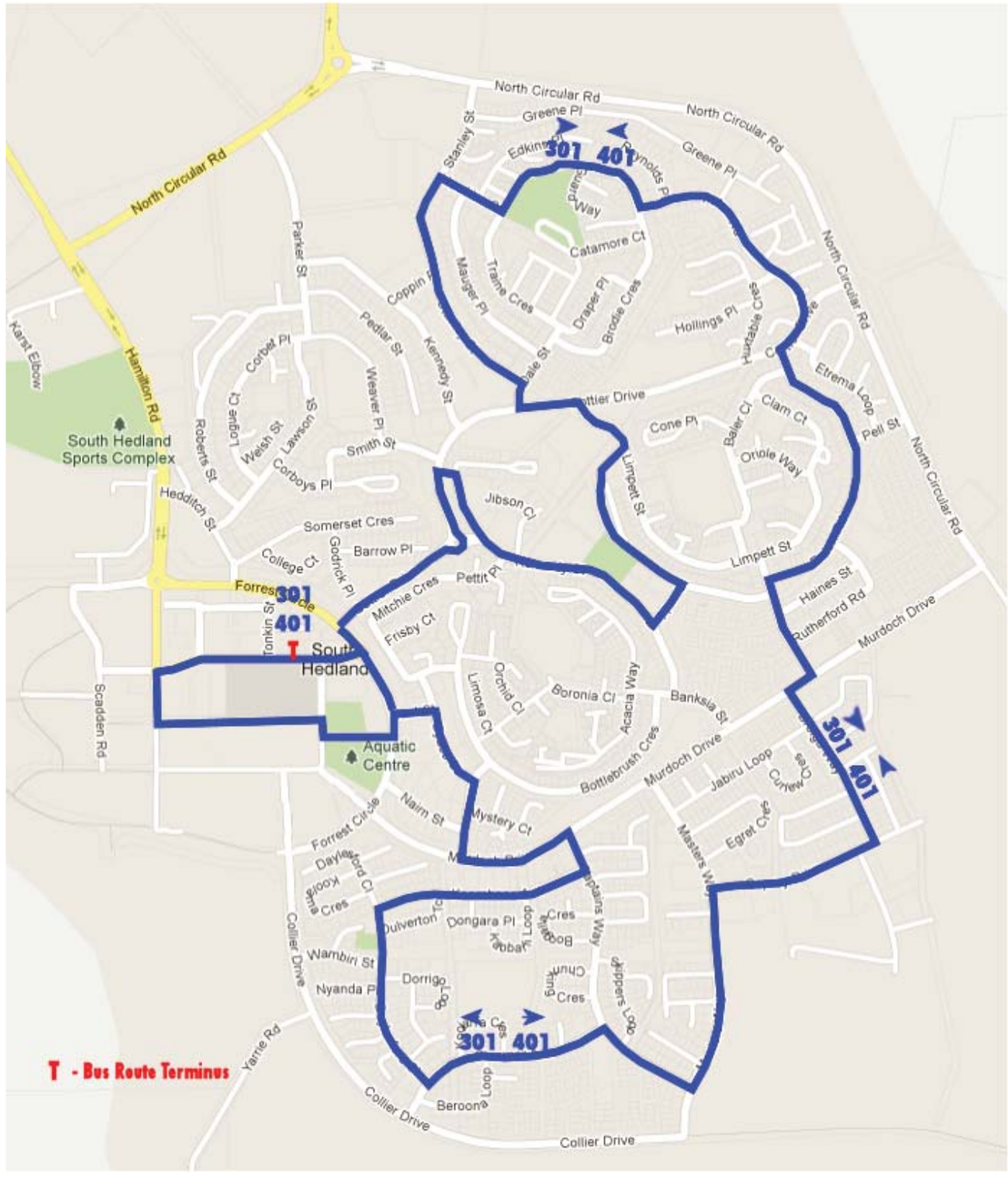


Figure 4. Current Bus Routes

9.5 Intersection Controls

The existing road network intersection controls are described in the following table.

Table 7. Existing Intersection Controls

Intersecting Roads	Existing Control
Forrest Circle / Leake Street (removed)	Unsigned T-junction
Forrest Circle / Nairn Street	Give Way, Left-in/out Only T-Junction
Forrest Circle / Murdoch Drive / Wise Terrace	Roundabout
Forrest Circle / Collier Drive (removed)	Unsigned T-junction
Forrest Circle / Throssell Road	Roundabout 3-way
Forrest Circle / Cottier Drive	Unsigned T-junction
Forrest Circle / Tonkin Street	Unsigned T-junction
Forrest Circle / Hedditch Street	Unsigned T-junction
Forrest Circle / Hamilton Road	Roundabout 4-way
Hamilton Road / Throssell Road	Roundabout 4-way
Hamilton Road / McLarty Boulevard	Give Way T-junction
Hamilton Road / Colebatch Way	Roundabout 4-way
Wise Terrace / Throssell Road	Unsigned T-junction
Wise Terrace / McLarty Boulevard	Give Way 4-way
Wise Terrace / Leake Street (removed)	Unsigned T-junction
Wise Terrace / Colebatch Way	Give Way T-junction
Colebatch Way / Collier Drive	Roundabout 3-way
Throssell Road / Tonkin Street	Unsigned T-Junction

The safe and efficient operation of an intersection relies on good legibility for the motorist of traffic priority with associated minimal queuing and delays. Current operation of the road network and intersections show no undue delays occurring with the present traffic flows.

10.0 PROPOSED ROAD NETWORK CHANGES

10.1 Base Road Network

Considered in the design and development of the SHTCDP is the need to improve connectivity between the adjoining residential area and the Town Centre. The review of traffic movements recognised the need to improve connectivity both for local trips and for wider travel to the airport, Wedgefield and beyond.

The street network in Figure 5 has the following hierarchy:

- Primary Distributor
  - Hamilton Road
  - Future western ring road

- Integrator Arterial
  - Forrest Circle around the eastern edge
  - Hamilton Road south to Forrest Circle and Forrest Circle to Collier Drive
  - In the short-term, extension of Collier Drive to Colebatch Way linking west to Hamilton Road
  - Cottier Drive
  - Murdoch Drive
  - Collier Drive

- SHTC Main Street
  - Colebatch Way between Forrest Circle and Throssell Road

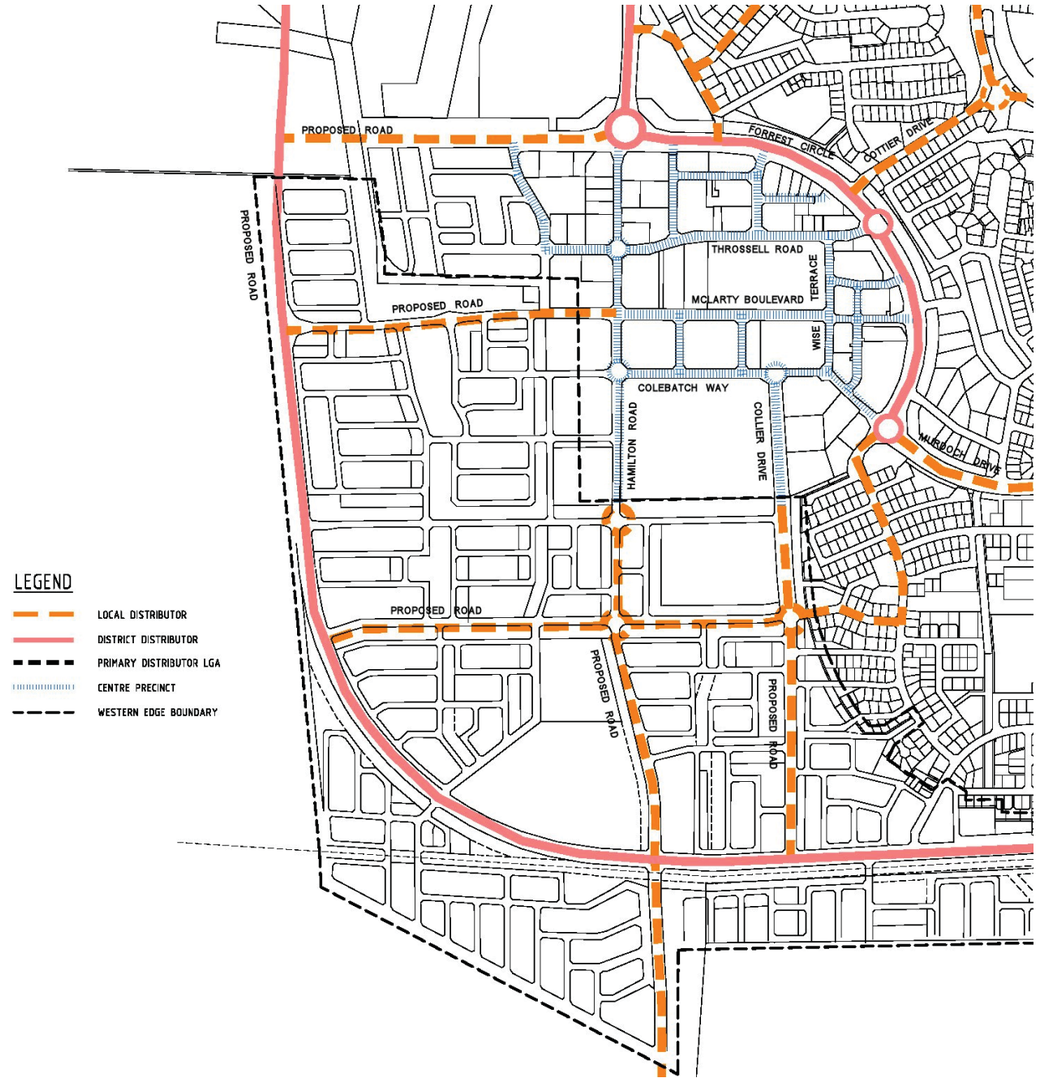


Figure 5. Road Network Hierarchy Connectivity

10.2 Land Use of Surrounding Area

The following table presents the current building type land uses with building areas and area of parking used on the site in terms of parking bays supply. Figure 6 shows the location of each of the land zones described in Table 8.

Table 8. Current Land Use

Zones	Building Usage	Approximate Building Area (m^2)	Number of Parking Bays Provided
A	Retail	20000	700
B	Retail	2300	180
C	Retail	2000	48
D	Retail/Medical Consulting	1750	125
E	Car Park	Nil	342
F	Community - Lotteries House	1700	Uses E
G	Community – Swimming Pool	1400	36
H	Aged Care Health Campus	3400 10800	46 296
I	Community - Library	570	34
J	Community - Justice	1750	30
K	Community - Police	1150	34
L	Government - Telstra	1900	37
M	Motel/Short Term Accommodation	1600	28
N	Community – Aboriginal Language Centre	3000	75
O	Motel/Short Term Accommodation	1800	32
P	Hotel	4900	128
Q	Offices	3500	80
R	Hotel/Motel	4300	81
		Total	2,336

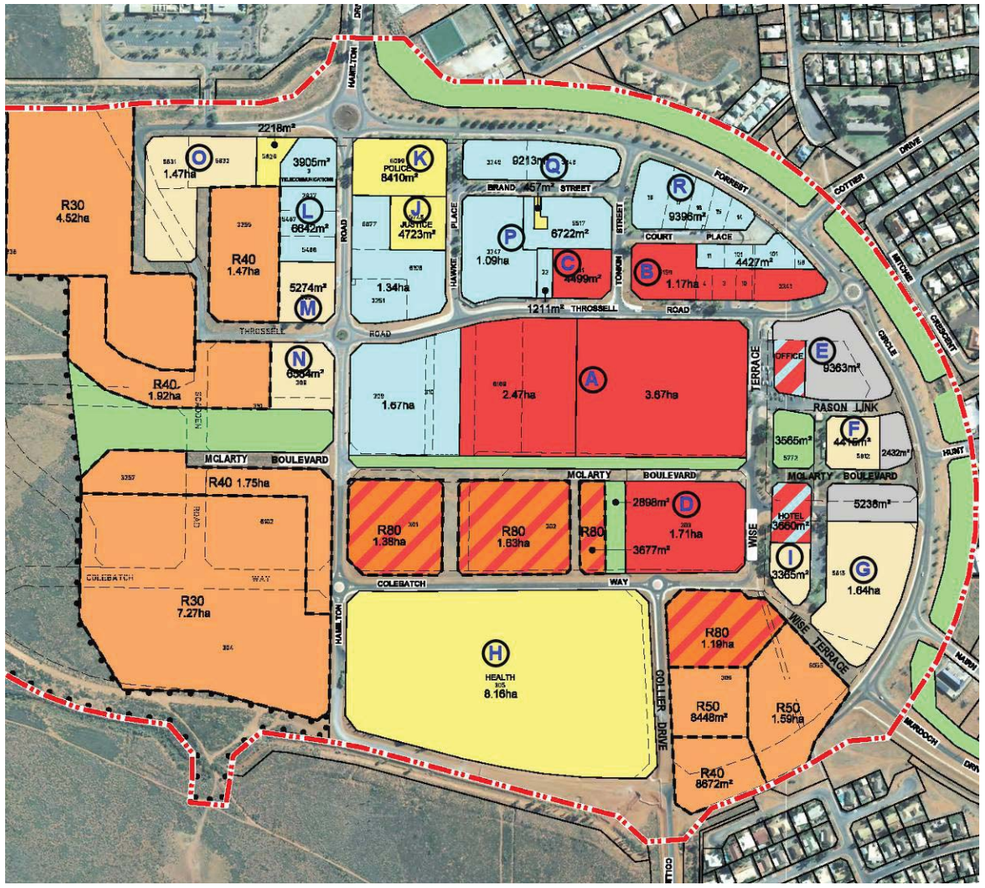


Figure 6. Landuse Zones

The identified total off-street parking supply is 2,336 bays. Compared to the overall Town Planning Scheme parking requirements combined total of 2,186 bays. It should be noted that (excluding the Health Campus) 45% of the Town's parking is supplied at two locations which are in close proximity. The South Hedland Shopping Centre (Zone A) contains 700 parking spaces and the public car park (Zone E) contains 342 spaces. These are both unconstrained parking areas and can effectively be considered to be operating as public shared use parking. Best practice suggests that where 50% of the available parking supply can be managed by a single authority, this permits effective management of parking in terms of allocation, changing demand, market pricing (if paid parking) and allows parking times to be imposed and enforced with greater efficiency. Parking currently provided in the Town Centre is nearly exclusively parking provided on private land adjacent to the commercial/community buildings. Town centre parking is analysed further later in this report.

10.3 Internal Road Network

The proposed internal road network geometry and suggested speed zones are described in the following table. The new road layouts are shown in Appendix 4.

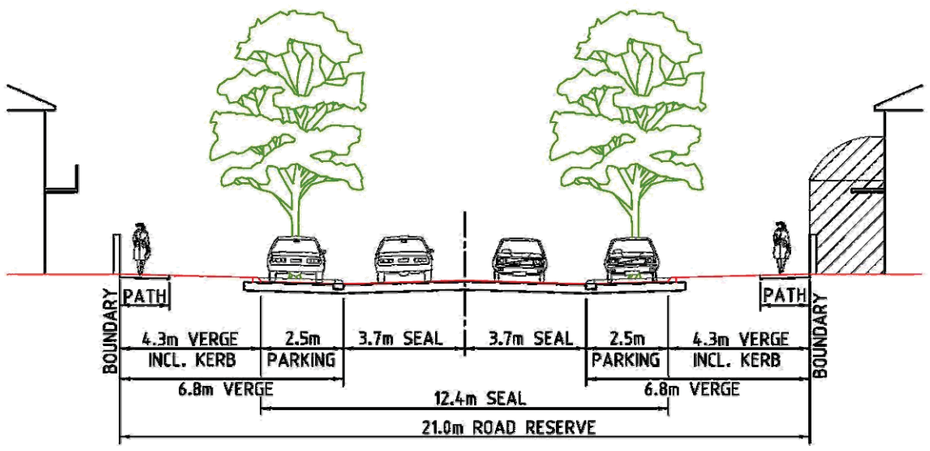
Table 9. New Internal Roads

Road	Speed Zone	Geometry
Wise Terrace "Main Street"	40kmh	undivided single carriageway with embayed on-street parking
Wise Terrace (Murdoch Drive extension)	40kmh	undivided single carriageway with embayed on-street parking
McLarty Boulevard (Hunt Street extension)	40kmh	undivided single carriageway with embayed on-street parking
Rason Link (new road Wise Tce to Forrest Ci)	40kmh	undivided single carriageway with embayed on-street parking
Leake Street (new road north of Wise Terrace)	40kmh	undivided single carriageway with embayed on-street parking
New north-south Road (west) – McLarty to Colebatch	40kmh	undivided two-way single carriageway
New north-south Road (east) – McLarty to Colebatch	40kmh	undivided two-way single carriageway

10.4 Road Types Proposed

10.4.1 Wise Terrace (Main Street)

The existing Colebatch Way (north-south) is a two-way undivided and kerbed single carriageway of nominal lanes 2 x 3.5 metres. It is renamed Wise Terrace and the proposed carriageway is to be kerbed at 7.4 metres in width comprising 2 x 3.7 metre lanes and will be an undivided two-way single carriageway with on-street embayed parallel parking.

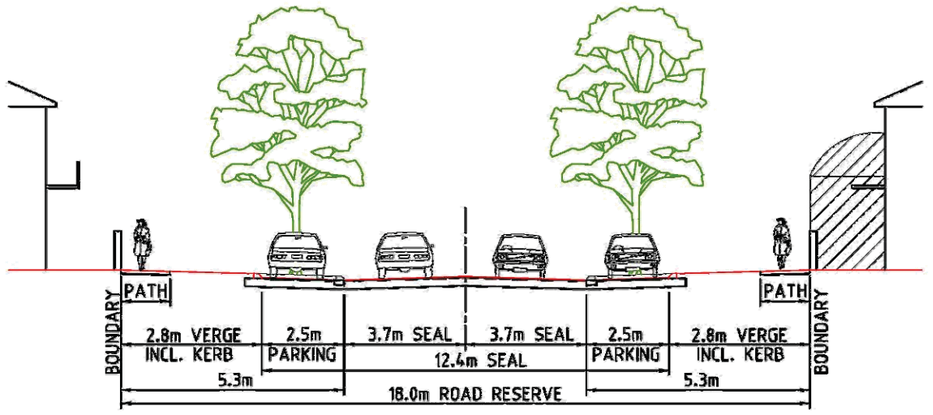


The design and operating speeds for a Neighbourhood Connector type road is 50 km/h with an indicative road pavement width of 11.2 metres including embayed parallel parking on both sides and a shared path on one verge. The proposed 12.4m pavement is consistent with that intent.

Leake Street and McLarty Boulevard are currently speed zoned at 40km/h while Colebatch Way and Throssell Road are speed zoned at 50km/h. It is recommended that Town Centre internal roads should be speed zoned at 40km/h and designed so as to be consistent with a Town Centre and to maintain a speed environment of not higher than 40km/h.

10.4.2 McLarty Boulevard

The existing Hunt Street and McLarty Boulevard are two-way undivided and kerbed single carriageway of nominal lanes 2 x 3.5 metres localised widening and kerbing at the intersection approaches. The proposed carriageway extension to Hunt Street is to be named McLarty Boulevard and kerbed at 7.4 metres in width comprising 2 x 3.7 metre lanes and will be an undivided two-way single carriageway with embayed on-street parallel parking in an 18 metre wide road reserve.

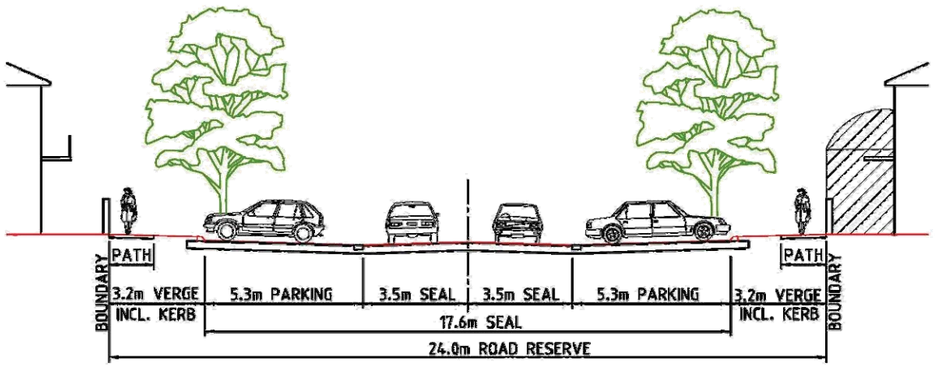


The design and operating speeds for a Neighbourhood Connector type road is 50 km/h with an indicative road pavement width of 11.2 metres including embayed parallel parking on both sides and a shared path on one verge. The proposal is consistent with that intent.

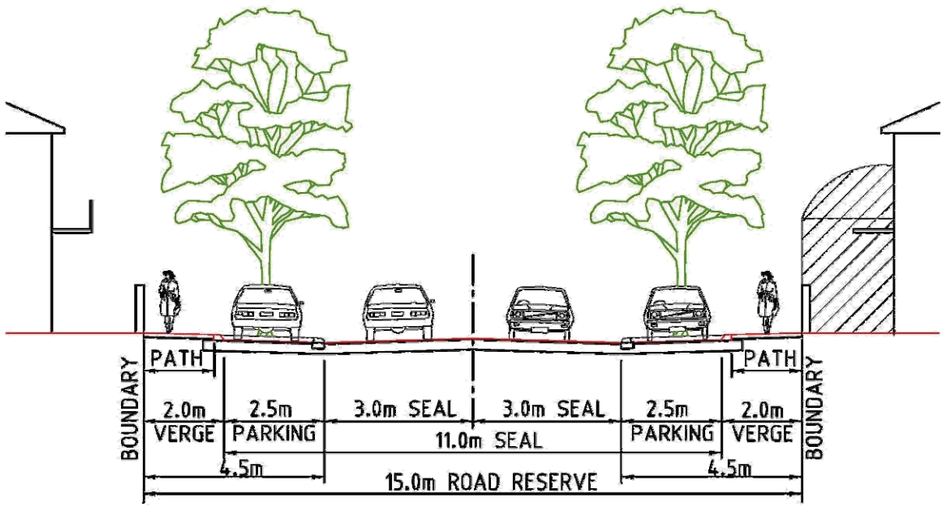
Leake Street and McLarty Boulevard are currently speed zoned at 40km/h. It is recommended that the extension of Hunt Street from Forrest Circle to Colebatch Way Murdoch Drive should be speed zoned at 40km/h and designed so as to be consistent with a Town Centre and to maintain a speed environment of not higher than 40km/h.

10.4.3 New Leake Street

This new north-south link road will be named Leake Street and is proposed to have different configurations. From north of Wise Terrace to McLarty Boulevard it is proposed to be a 7.0m carriageway with 45 degree embayed parking on each side within a 24m road reserve.

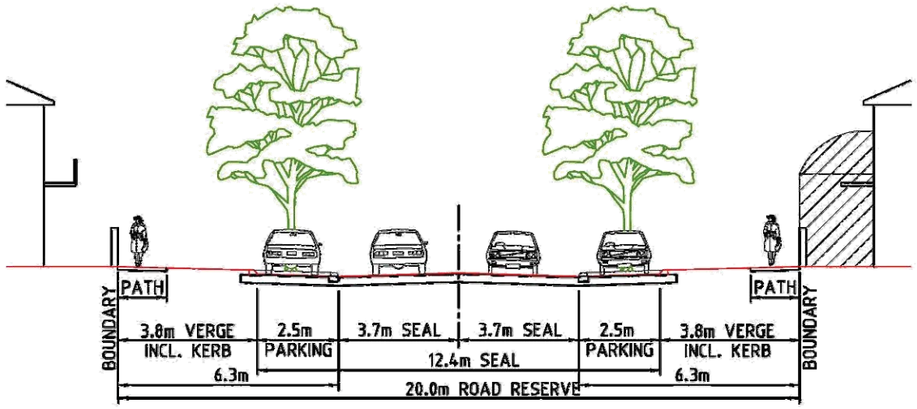


The section north of McLarty Boulevard to Rason Link is proposed to be a single carriageway with parallel embayed parking on both sides within a 15m road reserve.



10.4.4 Rason Link

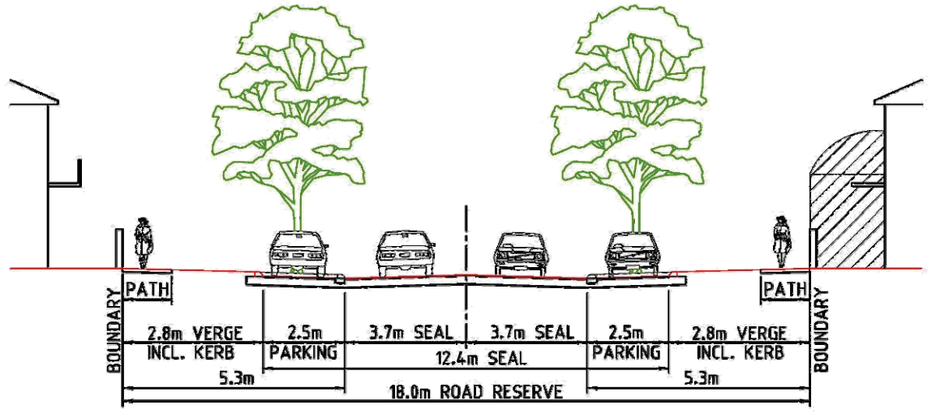
The proposed new link road from Forrest Circle to Wise Terrace is to be kerbed at 7.4 metres in width comprising 2 x 3.7 metre lanes and will be an undivided two-way single carriageway with embayed on-street parallel parking in a 20m road reserve.



10.4.5 New North-south Road (west) – Colebatch Way to McLarty Boulevard

The proposed new link road carriageways are to be kerbed at 7.4 metres in width comprising 2 x 3.7 metre lanes and will be an undivided two-way single carriageway with the option of occasional embayed on-street parallel parking in an 18m road reserve.

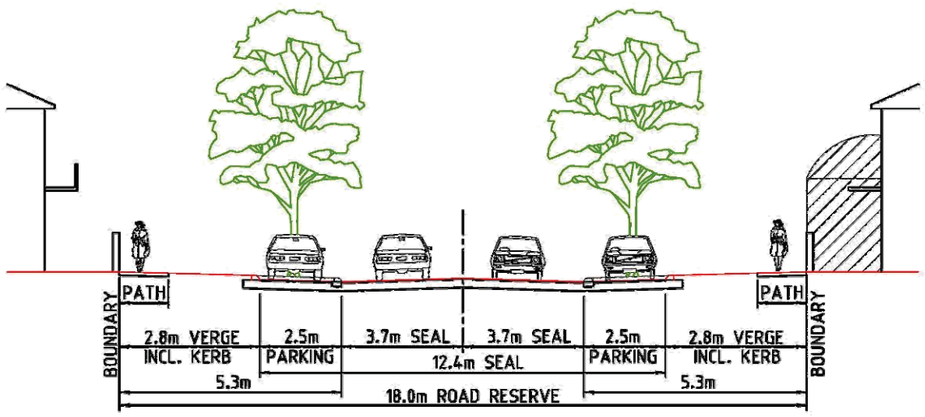
A 7.4m pavement is required for the two way travel of larger vehicles including buses and service vehicle trucks necessary for the servicing of abutting commercial development land. These streets provide for commercial generated traffic movement and access to development within the Town Centre.



10.4.6 New North-south Road (east) – Colebatch Way to McLarty Boulevard

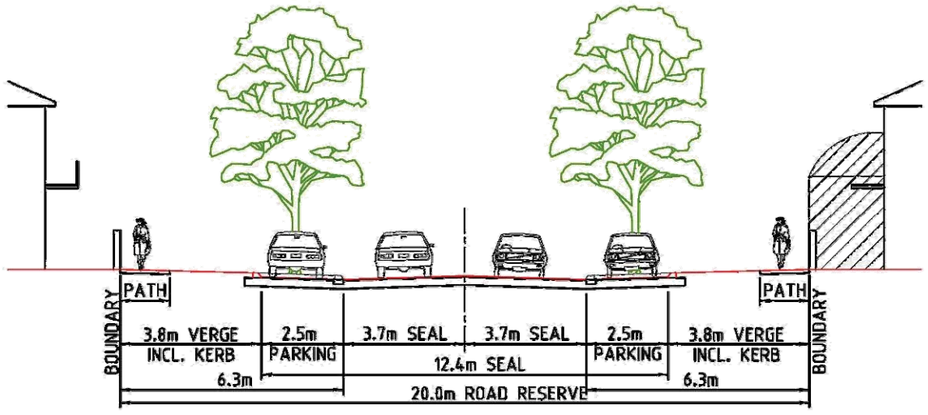
The proposed new link road carriageways are to be kerbed at 7.4 metres in width comprising 2 x 3.7 metre lanes and will be an undivided two-way single carriageway with the option of occasional embayed on-street parallel parking in an 18m road reserve.

A 7.4m pavement is required for the two way travel of larger vehicles including buses and service vehicle trucks necessary for the servicing of abutting commercial development land. These streets provide for commercial generated traffic movement and access to development within the Town Centre.



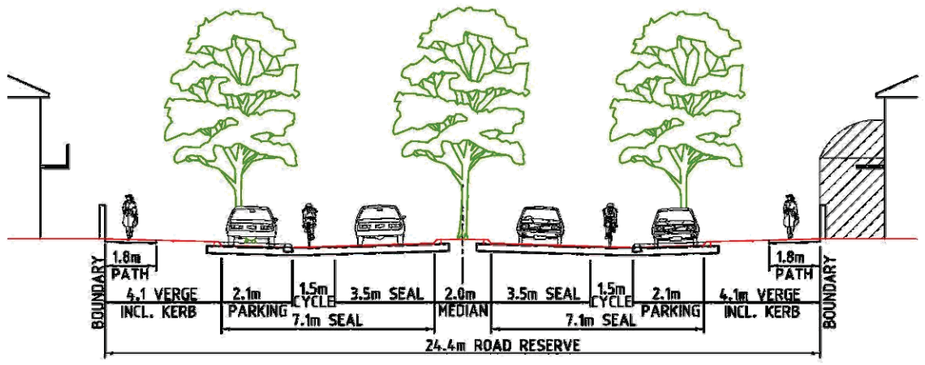
10.4.7 Wise Terrace (Murdoch Drive extension)

The proposed Murdoch Drive extension has previously been discussed in the Subdivision Stage 1A-1C Traffic Assessment report. This extension will be named Wise Terrace and the proposed carriageway extension is to be kerbed at 7.4 metres in width comprising 2 x 3.7metre lanes with embayed parallel parking on both sides at strategic locations.

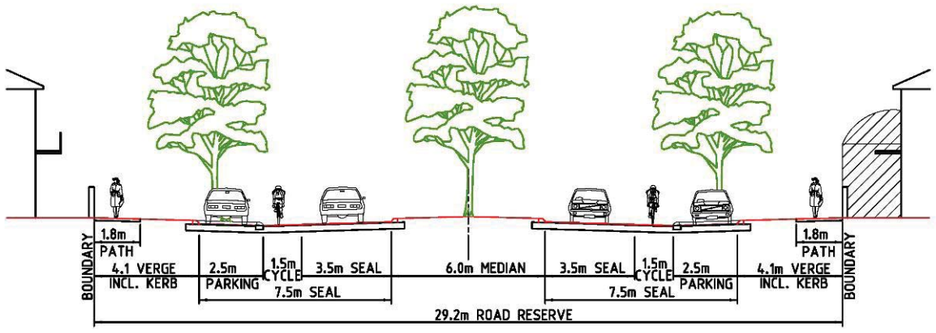


The existing Murdoch Drive is presently speed zoned at 70kmh and is of a generally unkerbed cross-section with narrow sealed shoulders except around intersections where it is kerbed. Austroads Guide to Traffic Management Part 3: Traffic Studies and Analysis suggests that two lane two-way urban arterial roads with interrupted flow and no on-street parking will have a maximum mid block capacity of up to 2,000 veh/h. Assuming this to be the maximum peak hour volume at 10% of daily flow, the maximum daily flow capacity is 20,000 veh/day. This is the maximum mid-block capacity not taking into account intersection management measures and approach treatments. Intersections would need to be widely separated at not less than 500 metres and limited roadside development for this level of capacity to be achieved. The existing Murdoch Drive meets some of these criteria. There is limited abutting development within the wide road reserve, however intersections are more closely spaced at 100 to 300 metres intervals although these are T-junctions and unsignalised which offer minimal restriction to free flow provided passing of right turning vehicles is provided. Murdoch Drive does not have passing lanes or right-turn pockets.

The current range in traffic volume on Murdoch Drive is 3,300 veh/day up to the highest volume east of Forrest Circle at 4,970 veh/day. Irrespective of mid-block capacity, it has become practice for opposing carriageways to be median separated where traffic volumes exceed 3,000 veh/day. This serves to improve road safety by reducing opportunity for vehicle collision conflicts and provides pedestrians with improved safety when crossing. With the current volume of traffic on Murdoch Drive greater than 3,000 veh/day it may be argued that median separation could be introduced.



The above cross section is considered to be applicable to roads with traffic volumes from 3,000 to 7,000 veh/day. Where traffic volumes exceed 7,000 veh/day then it is considered that the cross section for up to 15,000 veh/day traffic flows be as shown in the following diagram.



Taking the change point as being 7,000 veh/day to upgrade the road from undivided to median-divided, a conclusion can be drawn as to when this might occur if generalised assumptions are made. It should be noted that the following assumptions are an assessment of what might occur. They do not reflect any measured data.

To reach 7,000 veh/day on Murdoch Drive east of Forrest Circle an increase of 2,000 veh/day is required to occur. Assuming that:

- all of the 2,000 veh/day traffic is generated from development of land to the east of South Hedland.
- all Lots generate an average of 9 trips/day/lot
- 60% of traffic generated by the Lots travel west along Murdoch Drive to the Town Centre or Forrest Circle.
- A development rate of 100 lots/year

If the assumptions are correct, in 3 to 4 years the traffic volume on Murdoch Drive east of Forrest Circle will increase to around 7,000 veh/day and the road cross-section should be median-divided. As 3 to 4 years can be considered a relatively short timeframe consideration should be given to inclusion of this upgrade in the short term.

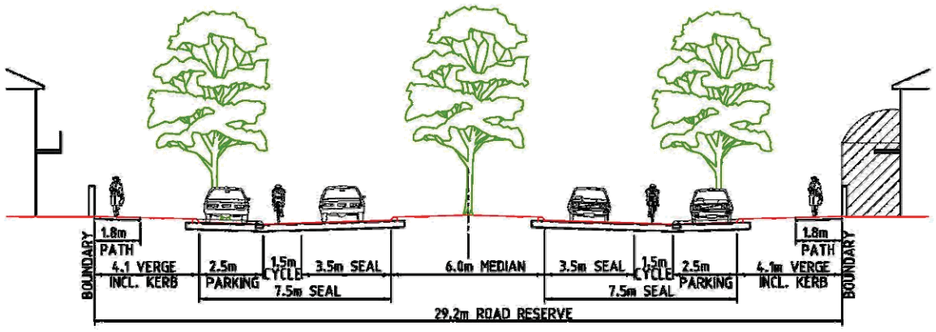
Similarly, using the same data we can also conclude that it would take development of 1,850 lots to reach a traffic volume of 15,000 veh/day. At this point a further change in the cross-section of Murdoch Drive would be desirable under Liveable Neighbourhoods. At a development rate of 100 lots per year this point could be reached in 18.5 years.

10.4.8 Hamilton Road

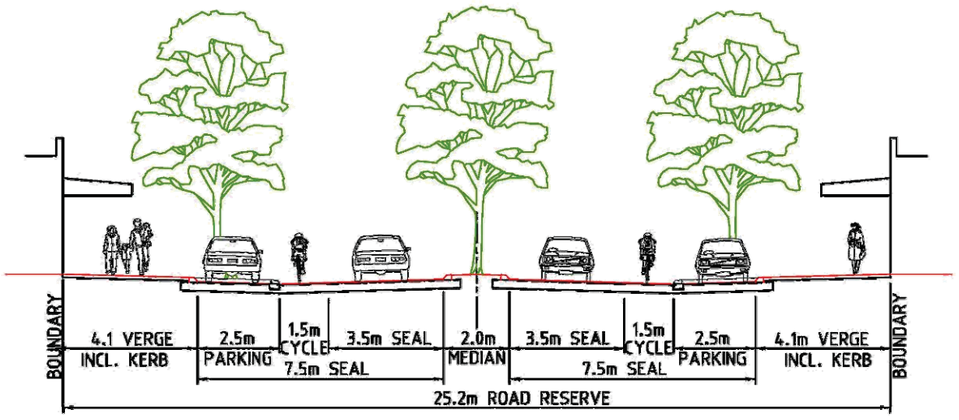
Hamilton Road is designated an Integrator Arterial B road with a desirable traffic volume range of 7,000 to 15,000 vehicles per day. The following table indicates existing traffic flows and compares those with predicted traffic flows for the year 2030.

Road Section	Existing Reserve Width(m)	Existing Carriageway	Existing Traffic Volume AWT	Predicted Volume (2030) AWT
Hedditch Street to Forrest Circle	40	Two-way Median-divided 2 x 3.5m lanes each direction	7,270 (Aug. 2004)	10,160
Forrest Circle to Throssell Road	20	Two-way undivided 8m carriageway	5,400 (model)	8,980
Throssell Road to McLarty Boulevard	20	Two-way undivided 8m carriageway	1,800 (model)	5,930
McLarty Boulevard to Colebatch Way	20	Two-way undivided 7m carriageway	900 (model)	4,750
Colebatch Way to Forrest Circle	20	Two-way undivided 7m carriageway	100 (model)	3,170

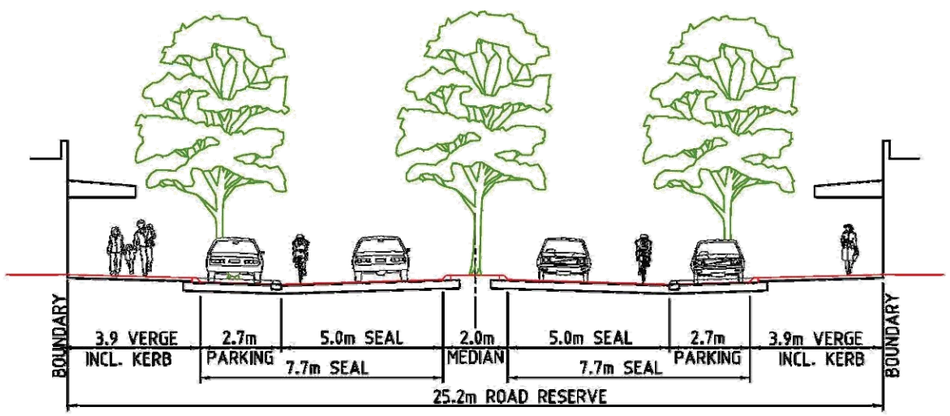
Hamilton Road north of Forrest Circle has a 40 metre wide road reserve while south of Forrest Circle it reduces to20 metres. An Integrator Arterial A road should have a reserve width of 29.2m outside centres and a 25.2m reserve within centres.



Hamilton Road north of Forrest Circle is outside of the South Hedland Town Centre and the 40m road reserve with existing road profile of a median-divided dual-carriageway adequately provides for existing and future traffic flows.



South of Forrest Circle the road reserve narrows to 20 metres and the described road profile within the Town Centre is not able to be provided. The options are to take land from abutting property to widen the road reserve to 25.2 metres or, revise the future road profile to retain the existing 20 metre reserve. A road profile to fit within the 20 metre road reserve and maintain free traffic flow can be achieved with deletion of on-street parking. A suggested profile is shown below. Not including on-street parking on Hamilton Street is justifiable on the basis that the east-west roads connecting with Hamilton Road are intended as the “active frontage” streets to the abutting land development proposals while Hamilton Road functions mainly as a north-south traffic carrying route. In the Town Centre there are five intersections along Hamilton Street. Short distances between intersections on a busy road limits opportunity for on-street parking as bays must not be so close to an intersection that entry and exit hinders free traffic flow or creates unsafe conditions for vehicle traffic and pedestrians. Notwithstanding this, if the opportunity exists to readily take land to provide a continuous 25.2m road reserve within the Town Centre then it should be considered. Widening the Hamilton Road reserve to 25.2m will allow greater flexibility in a future road layout should a cross-section other than those proposed here be more desirable to suit future land development and changes to the road network.



Staging of construction of future extension of Hamilton Road and interconnection of new road links and land development will determine the short and long term traffic flows experienced. The future extension of the western section of Forrest Circle will permit traffic from future land development on the western section of the South Hedland Town Centre and also south of the Town Centre will allow traffic generated in these areas to bypass the Town Centre. If this western section of Forrest Circle is not constructed within a similar timeframe as these areas of land are developed then the main north-south traffic route will be provided by Hamilton Road. In that instance traffic volumes may exceed the predicted flows. The following table lists the current and proposed intersections by 2030.

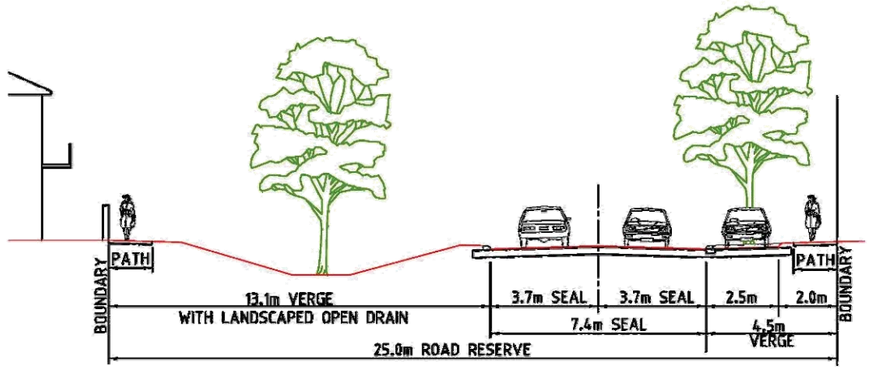
Intersection with	Existing Geometry	Existing Control	Proposed Geometry	Proposed Control
Forrest Circle (North)	4-way	Large single-lane roundabout	4-way	unchanged
Throssell Road	4-way	single-lane roundabout	4-way	unchanged
McLarty Boulevard	3-way	Give Way	4-way	Single-lane roundabout
Colebatch Way	3-way	single-lane roundabout	3-way	unchanged
Forrest Circle (South)	bend	none	4-way	Give Way on Forrest Circle

Operation of the existing Hamilton Road intersections and the proposed future new road connections with predicted resulting geometry have been analysed using SIDRA intersection modelling software. SIDRA modelling suggests that satisfactory performance will be maintained. In consideration of good planning allocation for possible future change it is considered that the Hamilton Road reserve should be increased to at least 25.2 metres between Forrest Circle.

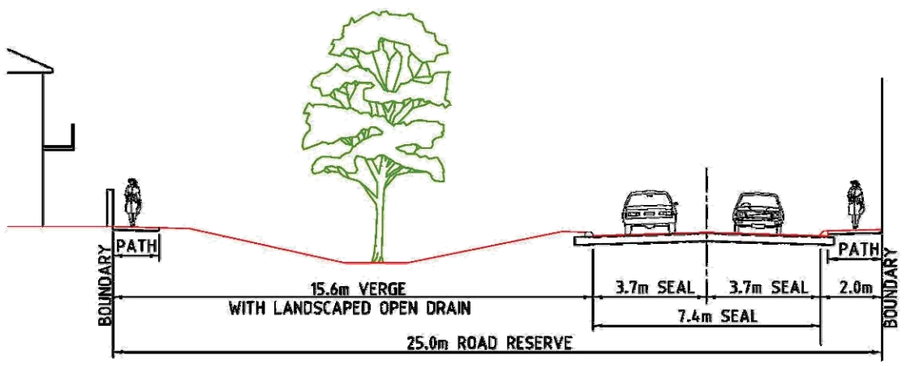
Intersection	Average Level of Service	Lowest Level of Service	Degree of Saturation (v/c)
Hamilton Road / Forrest Circle (north)	A	B	0.342
Hamilton Road / Throssell Road	A	B	0.343
Hamilton Road / McLarty Boulevard	A	B	0.228
Hamilton Road / Colebatch Way	A	B	0.143
Hamilton Road / Forrest Circle (south)	A	A	0.151

10.4.9 Colebatch Way

Colebatch Way from Wise Street to Hamilton Road abuts the South Hedland Health Regional Resource Centre. The provision of on-street parking along the southern side of this road will enhance the street environment and as a minimum encourage walking from cars to the Resource Centre and potentially also to development on the north side of Colebatch Way. It is estimated that up to 40 on-street parallel parking bays could be provided along this section of road. To prevent this parking from being used all day by Health Centre staff and encourage turn-over, a timed parking limit is recommended of 2 hours. Where unit development occurs on the Lots on the northern side of Colebatch way, this parking would mostly be of benefit and consequently utilised by persons attending the Health Centre. Dependant on the type of development occurring and the supply of on-site parking, the street parking could remain as mainly utilised for Health Centre patronage.



The northern side of Colebatch Way will abut a new drainage reserve that is intended to be created in such a manner that it will provide the intended stormwater drainage function while also providing an area of visually aesthetic landscaping for public use and a pedestrian link route within and through the Town Centre. If it is required to maximise the available width of reserve for the open drain then street parking may not be able to be included. In which case the road cross section may need to be reduced as follows.

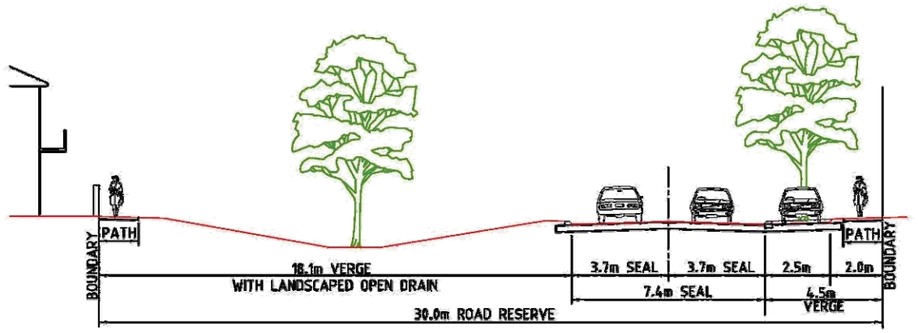


10.4.10 McLarty Boulevard

McLarty Boulevard (formerly Rason Court) currently has no direct fronting development and its use is limited to providing for through traffic movements and access for service vehicles to the Shopping Centre loading area. A change in the character of this road to encourage other use will require that suitable development occurs with direct frontage to this road.

The SHTC Design Guidelines identify McLarty Boulevard (Rason Court) as a Primary Street of the Town Centre where development fronting the street must directly access the public environment with its primary façade and main entry. The Design Guidelines suggest there should be on-street parallel parking on the southern side of the street with zero building setback in Precincts 1 and 4.

The northern side of McLarty Boulevard will abut a new drainage reserve that is intended to be created in such a manner that it will provide the intended stormwater drainage function while also providing an area of visually aesthetic landscaping for public use and a pedestrian link route within and through the Town Centre.



Extension of McLarty Boulevard west from Hamilton Road to connect with Great Northern Highway is proposed for future consideration. Although a specific alignment has not been determined there is support for such a road link to improve synthesis between activities to the west and the residential area to the east with the focus of integration being the South Hedland Town Centre between.

10.4.11 Throssell Road

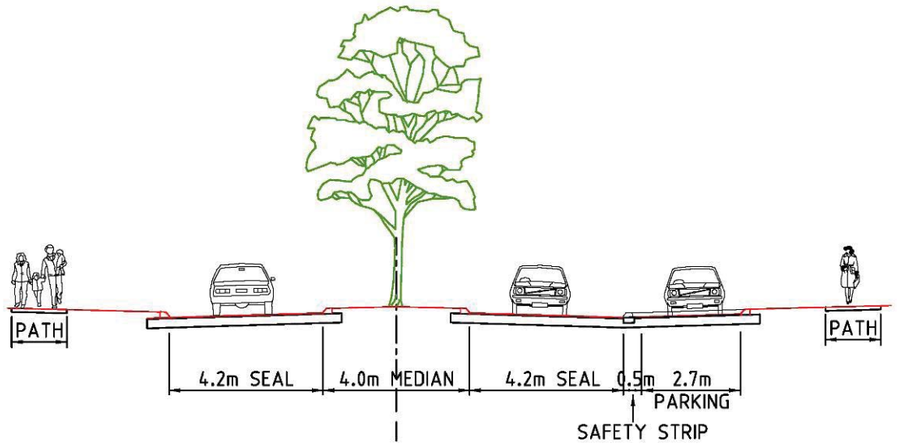
This road is currently the principal Town Centre road. It is median divided with a landscaped planted median and carries the majority of traffic through and within the Town due to it currently having the large majority of fronting development. The types of developments fronting this road are generally retail and those with high turnover of vehicle movements and activity.

The function of this road will alter as the proposed Wise Terrace “Main Street” becomes attractive. It will remain one of the principal traffic routes and could maintain a speed limit of 50km/h, however for consistency of awareness to motorists the operation of this road should not differ from other Town Centre roads and accordingly 40km/h is recommended.

10.4.12 Forrest Circle

This is a District Distributor road carrying traffic past and into the Town Centre via the connecting Local Distributor and Local roads. In the future Forrest Circle flows will continue to increase as the Town Centre and surrounding development proceeds. The predicted future traffic volume for 2030 indicates that single-lane median-separated carriageways will be required with right turn pockets at intersections and potentially dual-lanes at roundabouts to accommodate turning flows with minimal delays and queuing.

The desired profile is a 6.0m wide median with a single traffic lane and cycle lane in each direction. With the emphasis on through traffic movements and the development of open space areas on the east side a more appropriate profile is 4.2 metre wide carriageways with a 4.0 metre wide median. The path and cycle lanes can be included within the open space area.



10.5 Pedestrian Network

The Master Plan recognises that despite the hot climate, it remains a comfortable walking environment in summer evenings and for much of the remainder of the year. In addition, with some visitors and residents not having access to a vehicle, many have no choice but to walk or cycle.

The Town of Port Hedland has established over time a network of shared use pathways. The Master Plan aims to build on the network by:

- Improving current links to the Town Centre with improvements that may include adding missing links, landscaping to add shading or route realignment for better surveillance.
- Providing additional path routes within and around the SHTC both as part of new roads, and separately where only a shared use path is required.

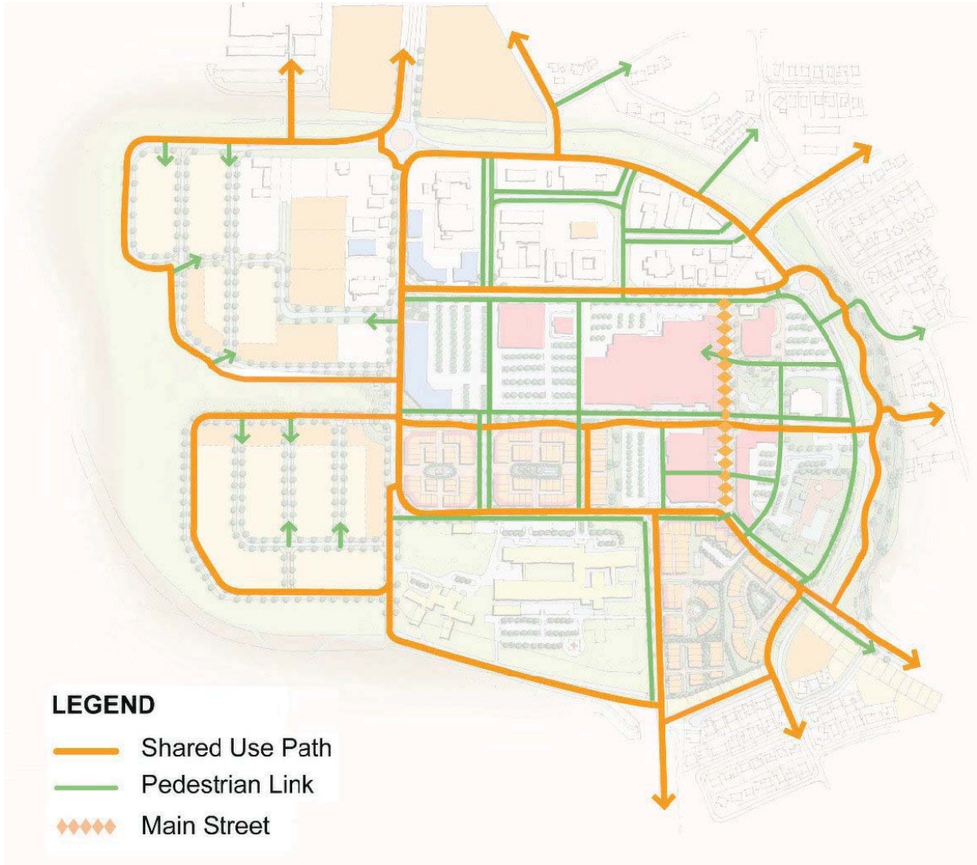


Figure 7. Pedestrian Path Network (source RPS Koltasz Smith SHTC Master Plan)

The previous figure provides a layout for the existing and proposed path network. Existing paths are not classified as shared paths or footpaths. A recommendation of the Master Plan is that the network be reviewed to confirm path width requirements. Shared paths are typically a minimum width of 2.5m and pedestrians paths are typically 2.0m width in areas of higher pedestrian use.

However, in the Town Centre abutting major activity centres it is more practical to fully pave verge areas as this offers greater opportunity for pedestrian interaction between the street and development generated uses. With the addition of street landscaping in the verge, pedestrian areas can be enticing to attract pedestrian activity.

The Master Plan anticipates that landscaping and street furniture will incorporate opportunities for both pedestrians and cyclists including bicycle parking to encourage greater use.

10.6 New Road Links

Included in the South Hedland Town Centre Development Plan are new internal link roads to increase permeability of the road network and provide direct access to new land development. The configuration and anticipated function of these new road links is indicated below.

Table 10. New Internal Roads

Road	Speed Zone	Predicted Traffic Volume veh/day AWT	Road Classification	Geometry
McLarty Boulevard (Hunt Street ext.)	40kmh	2,140	Access Road	undivided single carriageway with embayed on-street parking. Pedestrian paths on both sides.
Rason Link	40kmh	1,160	Access Road	undivided single carriageway with embayed on-street parking. Pedestrian paths on both sides.
Leake Street (New)	40kmh	400	Access Road	undivided single carriageway with embayed on-street parking. Pedestrian paths on both sides.
Wise Terrace (Murdoch Dr ext.)	40kmh	3,820	Access Road	undivided single carriageway with embayed on-street parking. Pedestrian paths on both sides.
New north-south Road (west) McLarty to Colebatch	40kmh	390	Access Road	undivided single carriageway with embayed on-street parking. Pedestrian paths on both sides.
New north-south Road (east) McLarty to Colebatch	40kmh	340	Access Road	undivided single carriageway with embayed on-street parking. Pedestrian paths on both sides.

11.0 SOUTH HEDLAND TRAFFIC MODEL

11.1 Traffic Generation and Assignment

Road network traffic modelling has been prepared covering the South Hedland Town Centre and surrounding residential locality of South Hedland to produce predicted travel demand for proposed road links to and within the Town Centre. As well as predicting traffic generation the modelling serves to assist with identifying potential traffic impacts on intersections and the subsequent assessments required to analyse changes in the efficiency and safety of operation.

The assessment modelling has been undertaken using TrafikPlan v4 with trip generation rates determined for the traffic generated by particular development land use types described in:

- Land Use Traffic Generating Guidelines, Director General of Transport, South Australia, 1986
- Guide to Traffic Generating Developments, Roads and Traffic Authority, NSW, 2002
- Trip Generation 7th Edition, 2003 – Institute of Transportation Engineers, Washington, USA

Details regarding modelling assumptions and traffic flow predictions are provided in the following sections of this report.

The base road network compiled in the modelling includes all Collector Roads and the main Local Roads feeding Collectors. The layout of roads in the model's diagrams displays the road network diagrammatically as it is only required to represent the layout in such a manner that distances, connections and intersections are correct.

No count data is available for recently constructed road sections within the Town Centre and also no data is available on numbers of vehicles that traverse unconstructed informal tracks linking between constructed roads. Completion of the South Hedland Health Campus will also have impact on trip generation within the Town Centre.

Calibration of the model was done by comparison of recently recorded (2010/11) traffic counts on the current road network taken by the Town of Port Hedland. The comparison suggests the modelling results are generally consistent with the individual road network counts taken at specific locations and overall the model should provide a good approximation.

The modelling process is based on AM Peak Hour traffic flows and presented as Average Weekday Traffic Flow for road lengths and peak hour at intersections. This methodology is considered appropriate for the assessment of this review at street and intersection level.

11.2 Town Centre Roads Traffic

Results from the traffic modelling predict traffic flows on Town Centre roads in the study area at full development in the year 2030 are shown in the following table. The full modelled South Hedland area predicted traffic flows are attached in Appendix 2.

Table 11. Predicted 2030 Traffic Volume

Road	Location	Volume (veh/day)
Forrest Circle	Throssell Rd to Cottier Dr	9,050
Forrest Circle	Throssell Rd to Hunt St	4,580
Forrest Circle	Hunt St to Murdoch Dr	3,660
Hamilton Road	Forrest Circle to Throssell Road	8,990
Hamilton Road	Throssell Road to McLarty Boulevard	5,750
Hamilton Road	McLarty Boulevard to Colebatch Way	4,750
Murdoch Drive	East of Forrest Circle	4,950
Throssell Road	Wise Terrace to Forrest Circle	9,110
Wise Terrace	Throssell Rd to Rason Link	3,820
Wise Terrace	Rason Link to McLarty Boulevard	3,950
McLarty Boulevard	West of Wise Terrace	2,250
McLarty Boulevard	Wise Terrace to Leake Street	2,140
Hunt Street	East of Forrest Circle	3,320
Rason Link	Leake Street to Forrest Circle	1,160
Leake Street	Wise Terrace to Rason Link	400
New north-south Road (west)	McLarty Boulevard to Colebatch Way	390
New north-south Road (east)	McLarty Boulevard to Colebatch Way	340

11.3 Town Centre Intersections Traffic

The traffic modelling software TrafikPlan used for this analysis also provides predicted turning movement flows for the modelled intersections. These intersection flows have been further analysed using SIDRA intersection modelling software to assess anticipated Level of Service, delay and queuing.

The results indicate that the Levels of Service will not exceed Level of Service B. This indicates that all intersections will operate satisfactorily for the proposed intersection layout and controls.

11.4 Public Transport New Routes

Current bus routes through the South Hedland road network area are shown in Figure 4. With proposed future development of the Town Centre that includes new roads and major activity centres, these could be better serviced by Public Transport.

A suggested medium term alteration to the existing route is shown in the following figure. The new route should be provided along with additional bus stops located within a walking distance of less than 200 metres.

The suggested route requires construction of new link roads within the Town Centre that include the extension of Hunt Street and realignment to connect with McLarty Boulevard. In the longer term further change to bus routes will be required as residential land development extends south from the Town Centre.

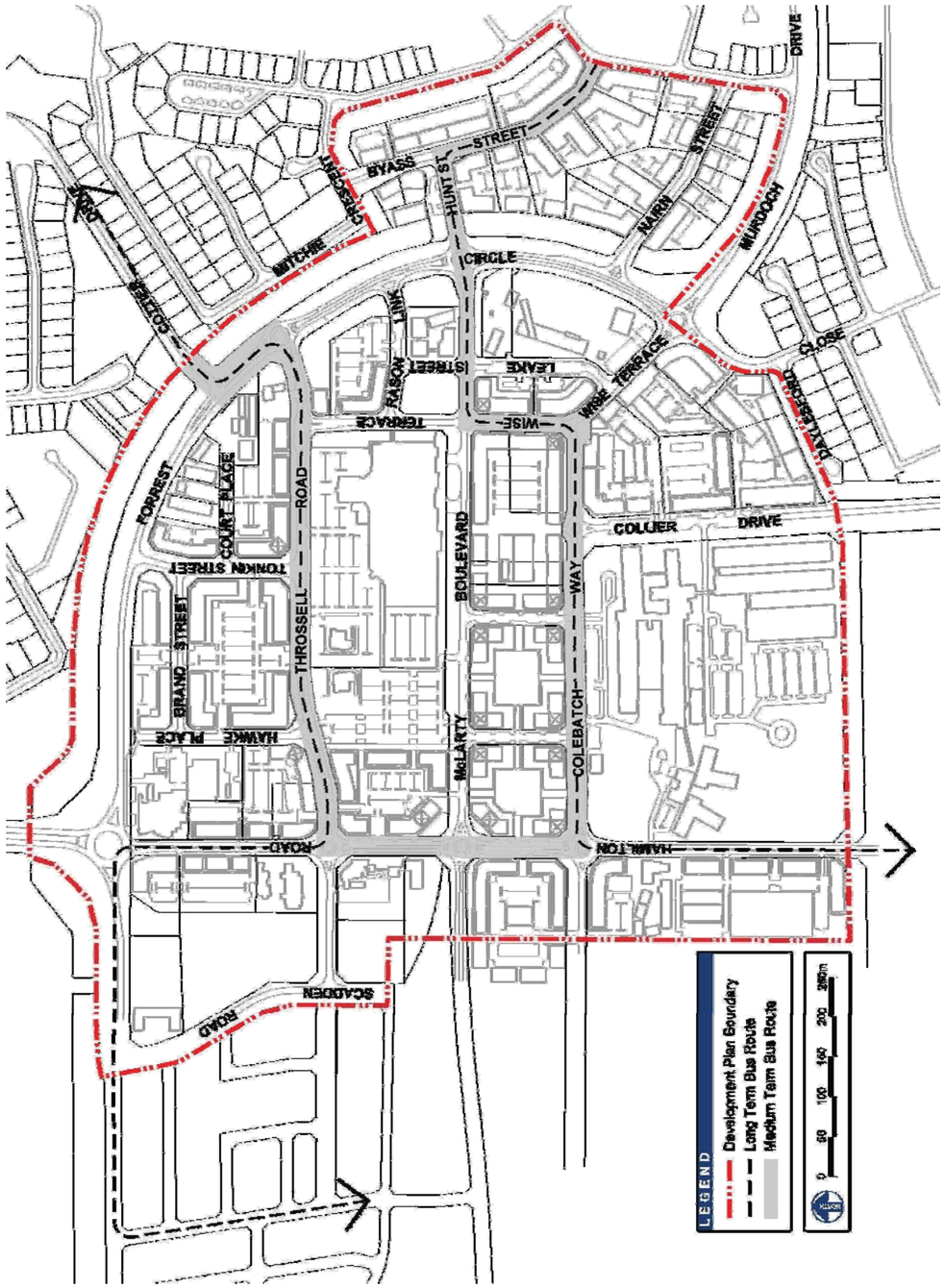


Figure 8. Proposed Route Change (short and long term)

11.5 Capacity Analysis of Town Centre Roads

The following table presents the predicted traffic model flows at full and partial development and compares them with Liveable Neighbourhoods desirable maximum volumes for each road within its classification. All roads are indicated as not exceeding their intended functional capacity within the next 20 years.

Table 12. Desirable Maximum Traffic Volume

Road Category	Street	Predicted Volume ADT (veh/day) 2020	Predicted Volume ADT (veh/day) 2030	Desirable Maximum Volume ADT (veh/day)
Integrator Arterial B	Forrest Circle Murdoch Drive Hamilton Road	9,050 4,950 7,900	9,050 4,950 8,980	7,000-15,000
Neighbourhood Connector	Wise Terrace Colebatch Way	3,590 1,550	3,950 1,880	3,000-7,000
Access Road	Hunt Street McLarty Boulevard Throssell Road Rason Link Leake Street (new) New North-south Road (east) New North-south Road (west)	1,200 1,900 2,880 800 280 390 340	1,280 2,250 3,200 1,160 400 390 340	1,000 – 3,000

Traffic volumes presented for the year 2020 have been predicted based on the population growth forecasts prepared by Pilbara Industry's Consultative Council (2007). Rather than WA Planning Commission census data. The latter predicts a low constant rate of growth at around 1.5% per annum. The PICC data predicts a high rate of growth in the first decade and a reduced rate of growth in the second decade. This results in around 70% of the growth occurring in the first decade.

11.6 Capacity Analysis of Main Intersections

The main traffic route roads and their connecting intersections have been analysed using SIDRA intersection modelling software to predict operating Levels of Service and Capacity at anticipated full development by the year 2030.

Table 13. Intersection Capacity

Intersection	Average Level of Service	Lowest Level of Service	Degree of Saturation (v/c)
Forrest Circle / Cottier Drive	A	B	0.149
Forrest Circle / Throssell Road	A	B	0.209
Throssell Road / Wise Terrace	A	B	0.246
McLarty Boulevard / Wise Terrace	A	B	0.223
Wise Terrace / Rason Link	A	B	0.114
Forrest Circle / Rason Link	A	A	0.115
Forrest Circle / McLarty Boulevard	A	B	0.160
Wise Terrace / Colebatch Way	A	B	0.118
Murdoch Drive/Forrest Circle/Wise Bvd	A	B	0.216
Hamilton Road / Forrest Circle	A	B	0.342
Hamilton Road / Throssell Road	A	B	0.343
Hamilton Road / McLarty Boulevard	A	B	0.228
Hamilton Road / Colebatch Way	A	B	0.143

The SIDRA analysis predicts that all intersections will continue to function with high Levels of Service and be well within their capacity. This indicates that staging of construction for short and long-term traffic generation at these intersections is not required.

11.7 Intersection Traffic Control

The following table describes the proposed intersections controls that have been used in this analysis.

Table 14. Intersection Controls

Intersecting Roads	Existing Control	Proposed Control
Leake Street / Forrest Circle	Unsigned T-junction	Intersection removed
Leake Street / Colebatch Way	Unsigned T-junction	Intersection removed
Forrest Circle / Nairn Street	Give Way, Left-in/Out Only T-Junction	No change
Forrest Circle / Murdoch Drive	Unsigned T-junction	4-way Roundabout
Forrest Circle / Collier Drive	Unsigned T-junction	Intersection removed
Colebatch Way / Collier Drive	Roundabout	No change
Colebatch Way / Wise Terrace	90 degree bend	Give Way sign 3-way Brick-paved Intersection
Wise Terrace / Throssell Road	Unsigned T-junction	Give Way on Wise Terrace
McLarty Boulevard / Wise Terrace	Unsigned T-junction	4-way Give Way on McLarty Bvd
Hunt Street / Forrest Circle / McLarty Boulevard	n/a	4-way Roundabout
Leake Street (new) / Rason Link	n/a	3-way unsigned
Leake Street (new) /McLarty Boulevard	n/a	4-way Give Way on Leake Street
Leake Street (new) / Wise Terrace	n/a	3-way unsigned
Rason Link / Wise Terrace	n/a	3-way unsigned
Rason Link / Forrest Circle	n/a	3-way Give Way on Rason Link with left-in/left-out only permitted.
New North-south Road (east) / Colebatch way	n/a	3-way Give Way on new north-south road
New North-south Road (east) / McLarty Boulevard	n/a	3-way Give Way on new north-south road
New north-south Road (west) / Colebatch Way	n/a	3-way Give Way on new north-south road
New north-south Road (west) / McLarty Boulevard	n/a	3-way Give Way on new north-south road
Hamilton Road / Colebatch Way	Roundabout	No change
Hamilton Road / McLarty Boulevard	Give Way T-junction	4-way Roundabout
Hamilton Road / Throssell Road	Roundabout	No change
Hamilton Road / Forrest Circle	Roundabout	Dual-lane roundabout (when volumes warrant)

11.8 Development Access

In preparing the traffic model to predict estimated traffic flows for future development of the Town Centre, the locations for property access from abutting roads into future developments have been positioned to maintain road safety and minimise impact on intersections and the main traffic flows. This is considered good traffic design practice. It is assumed that appropriate authorities approving future developments can be expected to ensure that vehicle access to developments will also follow this practice. On that basis it is recommended that direct property access onto Hamilton Road will be restricted or minimised as Hamilton Road is anticipated to be required to carry significant traffic flows at the assumed full development of the Town Centre by the year 2030.

The South Hedland Town Centre Design Guidelines make specific recommendations where limitation on vehicle access should be imposed and specific locations where accesses may be permitted. The various recommendations in the Design Guidelines are not repeated in this report.

12.0 RECOMMENDED WORKS

12.1 Road Types

Road geometry, traffic lanes and speed zones have been analysed and the following geometries are recommended for proposed new roads and modified existing roads.

Table 15. New and Modified Roads

Road	Speed Zone	Traffic Lanes	Road Reserve	Geometry
Wise Terrace “Main Street”	40kmh	2 x 3.7m	21.0m	undivided single carriageway with embayed on-street parking
McLarty Boulevard (Hunt Street ext.)	40kmh	2 x 3.7m	18.0m	undivided single carriageway with embayed on-street parking
Rason Link	40kmh	2 x 3.7m	20m	undivided single carriageway with embayed on-street parking
Leake Street (new)	40kmh	2 x 3.5m 2 x 3.0m	24.0m 15.0m	undivided single carriageway with embayed on-street parking
Wise Terrace (Murdoch Dr ext.)	40kmh	2 x 3.7m	20.0m	undivided single carriageway with embayed on-street parking
McLarty Boulevard	40kmh	2 x 3.7m	30.0m	undivided single carriageway with drain swale on north side and embayed on-street parking (south)
New north-south Road (west) McLarty to Colebatch	40kmh	2 x 3.7m	18.0m	undivided single carriageway with embayed on-street parking
New north-south Road (east) McLarty to Colebatch	40kmh	2 x 3.7m	18.0m	undivided single carriageway with embayed on-street parking
Hamilton Road	50kmh	2 x 5.0m	25.2m	Divided single carriageway with some embayed on street parking
Colebatch Way Collier to Hamilton	40kmh	2 x 3.7m	25.0m	undivided single carriageway with drainage swale on north side
Forrest Circle	60kmh	2 x 4.2m	40.0m	Divided single carriageway with some embayed on street parking

12.2 Intersection Types

Intersection Capacity and Level of Service of operation have been modelled and results of the analysis indicate the following recommendations for changes to control and geometry for the proposed new and modified intersections.

Table 16. Intersection Geometry

Intersection	Control	Geometry
Forrest Circle / Nairn Street	Give Way sign on Nairn St	Existing T-Junction with seagull island on Nairn Street
Forrest Circle / Murdoch Drive	4-way Roundabout	There is potential for traffic volumes on Murdoch Dr and Forrest Circle to greatly increase. A single lane roundabout will operate satisfactorily to 2030, unless the south-east area of South is developed for large scale residential housing. At full development a two-lane roundabout may potentially be required depending on peak hour turning movements.
Colebatch Way / Collier Drive	3-way Roundabout	Unchanged T-junction with single-lane roundabout.
Colebatch Way / Wise Terrace	Give Way sign on Colebatch Way (west).	Y-junction with flush brick-paved pavement treatment.
McLarty Boulevard / Wise Terrace	Give Way sign on McLarty Boulevard	4-way T-junction.
Hunt Street / Forrest Circle / McLarty Boulevard	4-way Roundabout	There is potential for traffic volumes on Forrest Circle to greatly increase. A single lane roundabout will operate satisfactorily to 2030, unless the south-east area of South Hedland is developed for large scale residential housing. At full development, a two-lane roundabout is potentially required.
Leake Street / Rason Link	Unsigned	T-junction.
Leake Street / McLarty Boulevard	Give Way signs on north-south road	4-way cross intersection.
Leake Street / Wise Terrace	Unsigned	T-junction.
Rason Link / Wise Terrace	Unsigned	T-junction.
Rason Link / Forrest Circle	Give Way sign on Rason Link	T-junction with seagull island on Rason Link and to maintain left-in/left-out restriction a continuous solid median in Forrest Circle is also desirable across the intersection.
New North-south Road (east) / Colebatch Way	Give Way sign on new north-south road	T-junction with traffic islands on north-south road with pedestrian refuge to encourage safe walking.

New North-south Road (east) / McLarty Boulevard	Give Way sign on new north-south road	T-junction with traffic islands on north-south road with pedestrian refuge to encourage safe walking.
New north-south Road (west) / McLarty Boulevard	Give Way sign on new north-south road	T-junction with traffic islands on north-south road with pedestrian refuge to encourage safe walking.
New north-south Road (west) / Colebatch Way	Give Way sign on new north-south road	T-junction with traffic islands on north-south road with pedestrian refuge to encourage safe walking.
Hamilton Road / McLarty Boulevard	3-way Roundabout	If the proposed extension of McLarty Boulevard occurs to Great Northern Hwy, this intersection will change from 3-way to 4-way with increased traffic flow on McLarty Boulevard.

12.3 New Pedestrian Paths

Figure 9 provides a layout for the existing and proposed path network. Existing paths are not classified as shared paths or footpaths. A recommendation of the Master Plan is that the network be reviewed to confirm path width requirements. Shared paths are typically a minimum width of 2.5m and pedestrians paths are typically 2.0m width in areas of higher pedestrian use.

However, in the Town Centre abutting major activity centres it is more practical to fully pave verge areas as this offers greater opportunity for pedestrian interaction between the street and development generated uses. With the addition of street landscaping the verge pedestrians areas can be enticing to pedestrians.

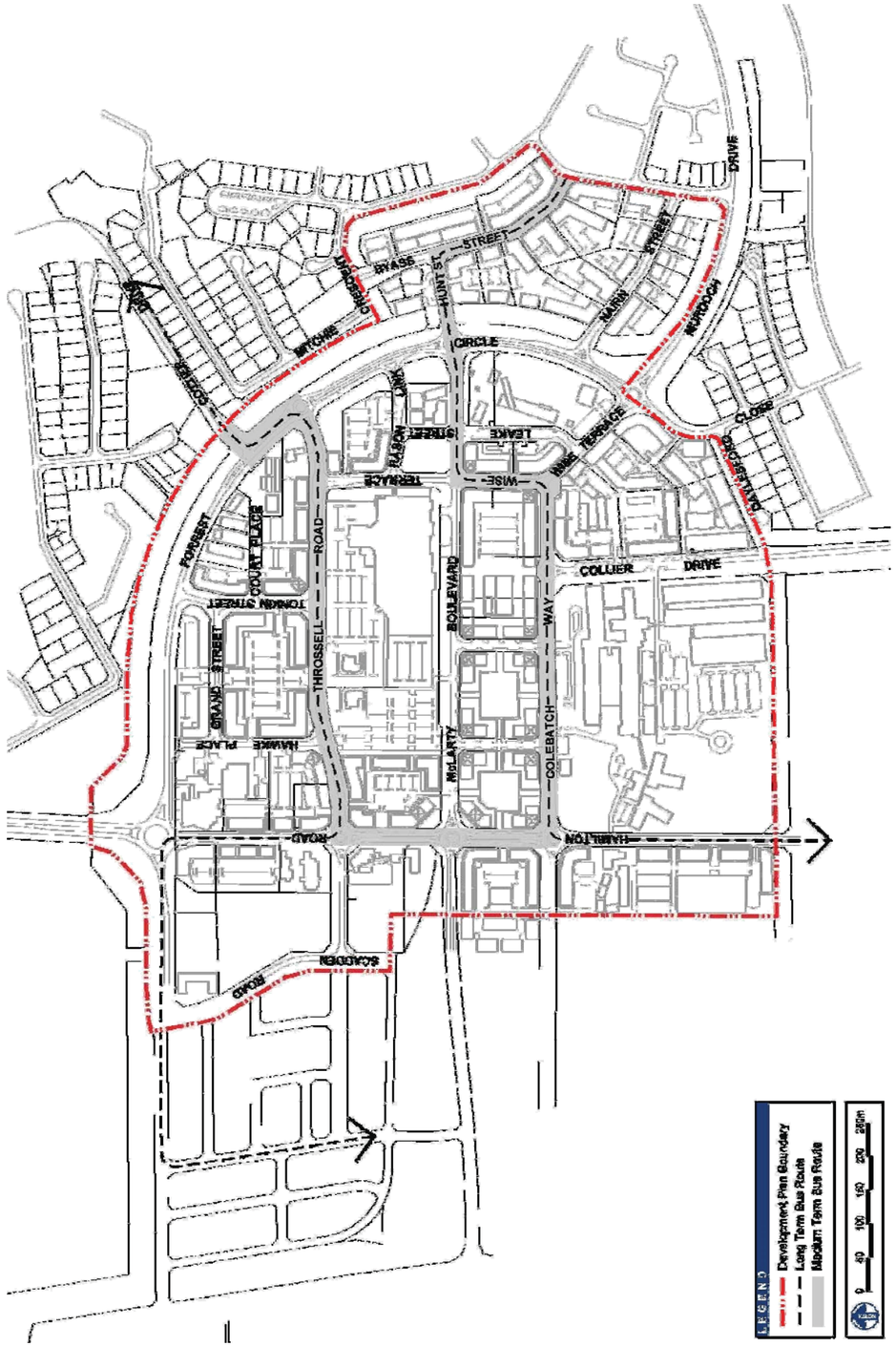


Figure 9. Pedestrian and Cycle Paths

12.4 Speed Zoning

The following map indicates suggested speed zones for the current and future road network to provide suitable street environments consistent with the function of the Town Centre and conducive for a co-existent pedestrian environment.

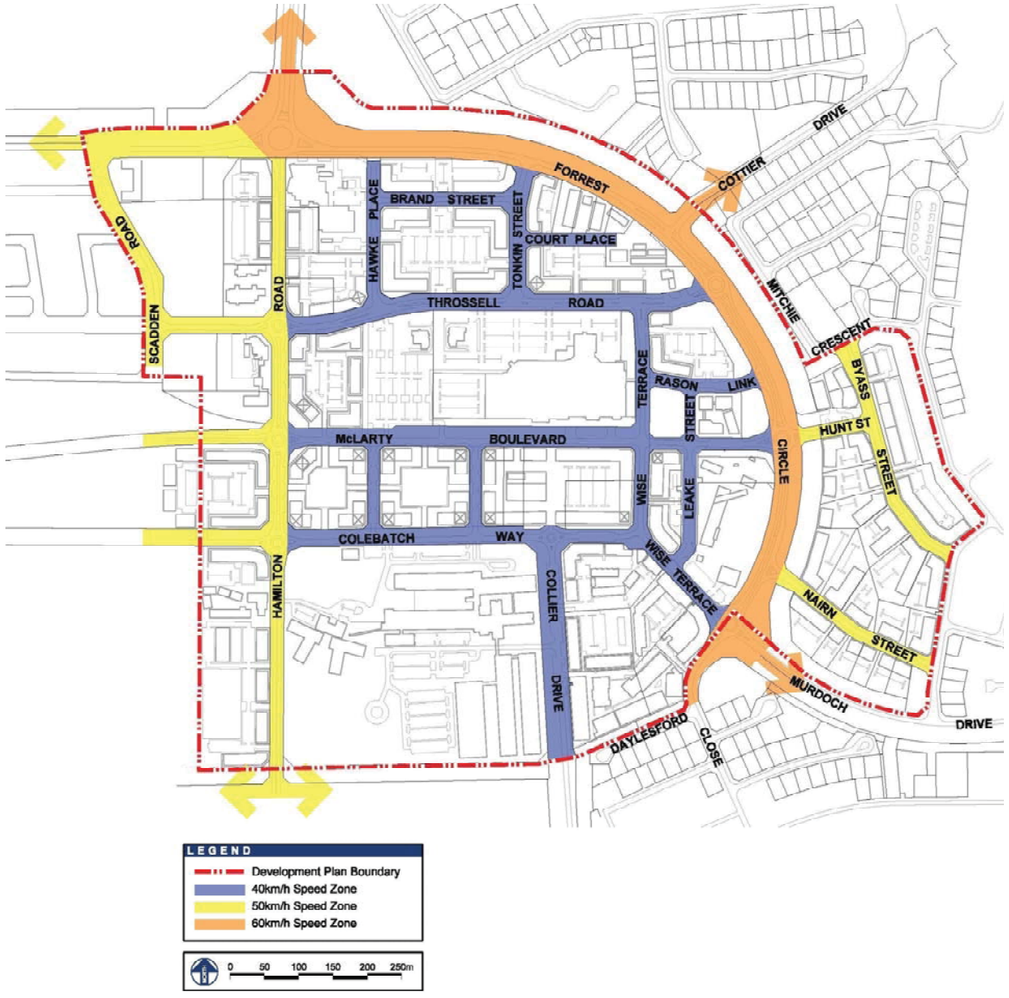


Figure 10. Speed Zoning

12.5 Traffic Management Control

The intersection control proposed for Colebatch Way/Wise Terrace is required to provide the needed functions of an entry statement and an introduction to pedestrian environment. The recommended treatment is a brick-paved road pavement with Wise Terrace "main street" speed zoned at 40km/h.

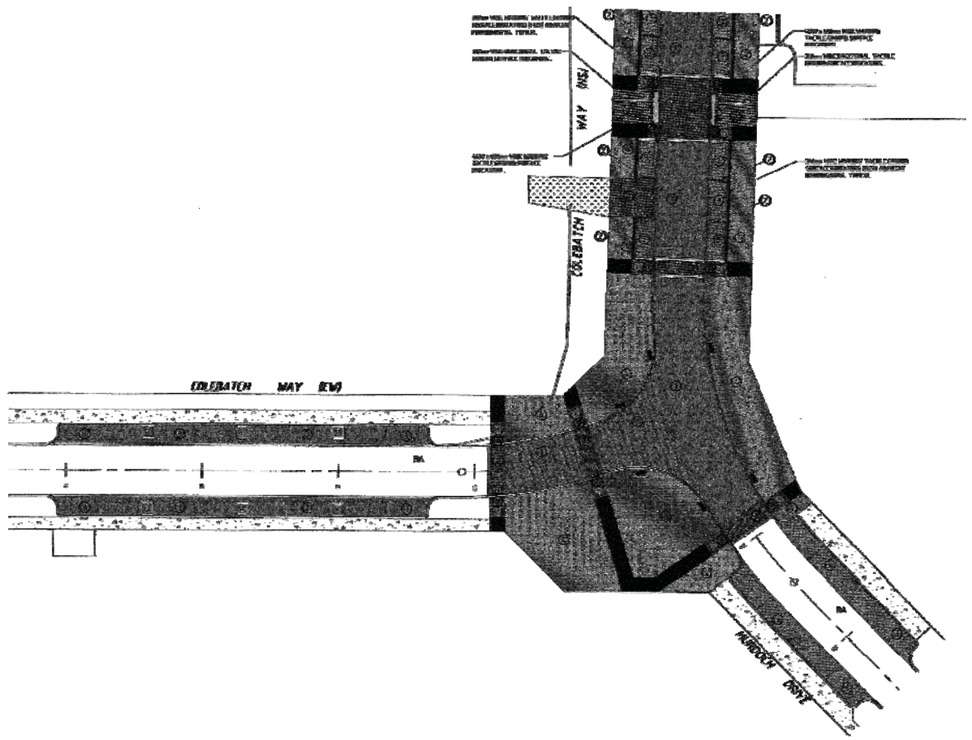


Figure 11. Intersection Geometry

All other roads and intersections in this section of the Town Centre are intended to perform similarly by providing an environment consistent with the 40 km/h speed limit that is intended to create opportunity for traffic movement in conjunction with parking and safe pedestrian accessibility. The road and intersection geometries proposed are intended to be consistent with this intent.

13.0 TOWN CENTRE PARKING

This section makes an assessment of existing and future development parking provisions within the South Hedland Town Centre. While the assessment mainly involves developing strategies for the future Town Centre scenario, existing conditions have also been reviewed for consideration of parking issues. The primary issues addressed within the scope of this report are:

- Current parking supply
- Estimated parking demand arising from future town centre development
- Estimate parking for the proposed Residential/Commercial zones within the future town centre

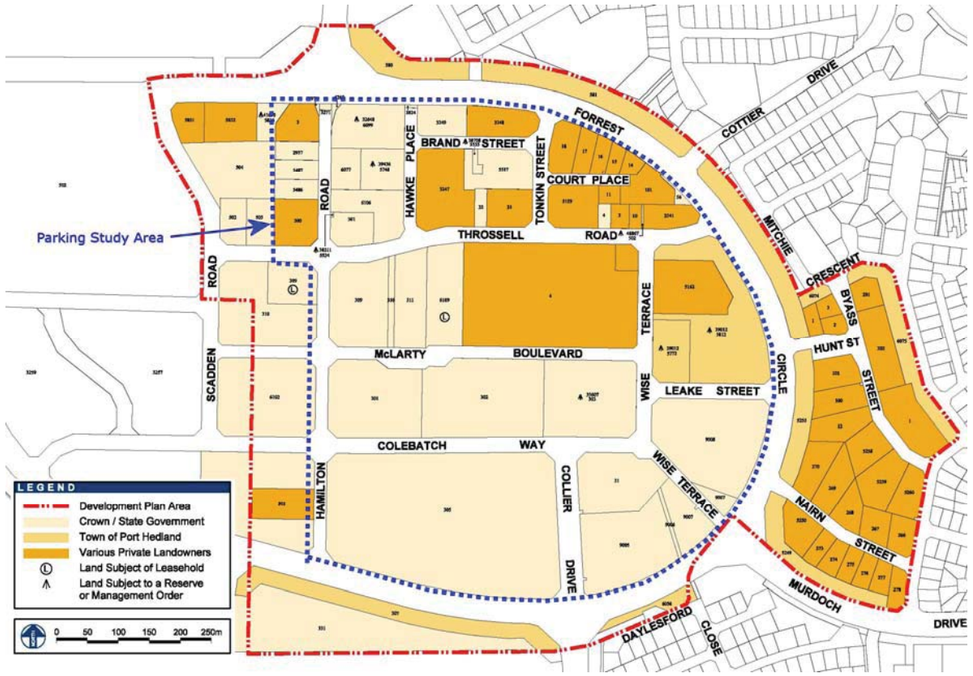


Figure 12. South Hedland Town Centre Parking Assessment Area

The Town of Port Hedland has been developing and defining a new vision for South Hedland to better identify and define Town Centre development. The South Hedland Town Centre Development Plan, September 2008 presents the guiding principles where increased density and pedestrian activity are desirable. This includes the framework on which public off-street parking areas and on-street parking are presented.

The aim is for parking to support the community's desire for economic activity by being adequate and in reasonable proximity, but not to the extent of surplus beyond the existing and potential need. The intent is to consider parking allocation, location, design, multi-use opportunities and operating efficiency in conjunction with necessary expansion.

13.1 Existing Developments Parking Provision

Examination has been undertaken of existing land usages and the parking provided within the Town of South Headland. The Town of Port Hedland requirements for the provision of parking facilities are dependant upon land usage and the environmental factors that affect the extent of a walking area. Calculation of parking demand is determined by the Town of Port Headland Town Planning Scheme Text No.5; Appendix 7 - Car Parking Standards. Also Appendix 8 of the Scheme Text indicates the requirements for minimum car parking specifications. This includes bay dimensions which are for most applications typically 2.7m wide x 5.4m in length. These dimensions have been used to determine the estimated approximate total car parking areas. When the Town of Port Hedland's Guidelines did not specify parking requirements the 'RTA New South Wales Guide to Traffic Generating Developments was consulted.

The counted parking supply within the South Hedland Town Centre varies slightly from the Town's parking requirements. In order to ascertain the required parking provision, assessment of buildings areas has been made using aerial photographs. A tabulated list showing the existing zones land usage, parking provided and parking required is presented in Table 8.

The process consisted of a two-part analysis. The first part of the analysis included a calculation of parking demand by block based on a building inventory and parking generation factors per $100m^2$ of gross floor space as presented in the Scheme Text.

The second part involved a comparison of the calculated parking requirement to the actual provision of off-street parking identifiable from aerial photography.

The identified total off-street parking supply is 2,336 bays. Compared to the overall Town Planning Scheme parking requirements combined total of 2,186 bays.

It should be noted that (excluding the Health Campus) 45% of the Town's parking is supplied at two locations which are in close proximity. The South Hedland Shopping Centre (Zone 12) contains 700 parking spaces and the public car park (Zone 17) contains 342 spaces.

These are both unconstrained parking areas and can effectively be considered to be operating as public shared use parking. Best practice suggests that where 50% of the available parking supply can be managed by a single authority, this permits effective management of parking in terms of allocation, changing demand, market pricing (if paid parking) and allows parking times to be imposed and enforced with greater efficiency.

Parking currently provided in the Town Centre is nearly exclusively parking provided on private land adjacent to the commercial/community buildings.

13.2 Strategic Development Plan Parking Provision

Strategic planning for the town centre development has identified 19 distinct property usages for future development of the town centre. Some of these distinct areas have mixed usage and the parking demands have been calculated according to proportional splits between these uses.

Figure 13. Development Zones

The estimated future parking demands are represented in the table in Appendix 3. It is possible that the parking demands will be in excess of actual demand where lower lot yields may occur. Parking demand ratios are used to calculate parking demand for each zone.

These ratios are assigned according to the type of use present in the buildings. The parking generation ratios are determined from Appendix 7 of the Town of Port Hedland Town Planning Scheme No.5 at a residential development ratio of 'high intensity R80'.

In determining the parking rate, firstly the area of building and its use must be determined. The anticipated building coverage for each development site has been estimated based on the Town of Port Hedland Planning documents and RPS Koltasz Smith South Hedland Town Centre preliminary planning reports. The WA Department of Planning, Multi Unit Housing Code has been used as the basis for estimation of residential parking.

Assumptions for the maximum building site coverage have been made. The purpose of site coverage in planning is an attempt to ensure that development is of an appropriate scale that is compatible with surrounding developments by limiting the maximum ground floor area permissible.

A standard of 90% of Gross Floor Area is assumed as the Lettable Area for all retail and commercial tenancies to determine the applicable building area for parking ratios.

13.3 Parking Supply

The current parking demand is 2,186 bays and the current available parking is 2,336 bays. This suggests there is a current surplus of 150 bays. The future parking requirement for the town centre is 5,896 bays. However, there may be a reduction in the parking required due to the ability for shared parking to be utilised for linked and multi-purpose trips.

The Urban Land Institute, Shared Parking, 2005 publication is a recognised source describing shared parking concepts and detailed procedures for analysing parking demand for shared parking facilities. Another recognised source is the TDM Encyclopaedia, Victoria Transport Policy Institute, 2004 which provides parking occupancy rates. Shared parking is limited by proximity of the destinations sharing available parking facilities. The TDM Encyclopaedia provides acceptable walking distances for various types of activities. Taking this into account, the following assessment is based on a combined overall reduction of 20%. It is worth noting that the Port Hedland climate may at times reduce opportunities available for shared trips due to disinclination for walking during very hot weather.

Sharing of parking (20% shared) will reduce the parking requirement to 4,717 bays. The resulting additional number of parking bays required is 3,660 when taking into account the development of planned public car parks and proposed on street parking. Appendix 3 gives details on the existing and future parking requirement for each zone.

It is generally accepted that up to 500 metres is a comfortable walking distance in a moderate climate. Environmental factors such as high daytime summer temperatures that occur in this Region may reduce the inclination for walking than could otherwise be experienced in a more temperate climate. Therefore a walking distance of 250m has been assumed. Zone 41 provides parking to the western zones and Zones 8/37/43 provide parking to the eastern zones.

In the future the anticipated major centres of parking will be Zones 12 and 5/43. Zone 12 includes the existing retail Shopping Centre which is one of the main attractors to South Hedland. Future expansion of the Shopping Centre could potentially include a multi-level parking facility with parking extra to that required to be provided by the Town's Planning Scheme.

It is possible for a multi-level car park to take up a reduced area of land compared to all parking at ground level only. This could permit a higher density of retail development on land not tied up for parking. Contribution by others toward the cost of a multi-level car park for the inclusion of shared extra public parking could also permit a higher density in abutting and surrounding developments.

In the vicinity of retail and other high intensity uses the car parking provided should be restricted to specific durations to ensure a high turnover thus increasing availability. The proposed locations and timed parking restrictions are as follows:

- Wise Terrace (Throssell to Rason): 8 parallel bays – taxis
- Wise Terrace (Rason to McLarty): 12 parallel bays – 2 hour limit
- Wise Terrace (McLarty to Colebatch): 22 parallel bays – 3 hour limit
- Wise Terrace (Colebatch to Forrest): 13 parallel bays – 3 hour limit
- Collier Drive (Colebatch to Forrest): 62 x 45° angle/parallel bays – 2 hour limit
- McLarty Boulevard (Forrest to Leake): 14 parallel bays – 2 hour limit
- McLarty Boulevard (Leake to Wise): 8 parallel bays – 2 hour limit
- McLarty Boulevard (Wise to Hamilton): 24 parallel bays – 2 hour limit
- Colebatch Way (Wise to Collier): 16 parallel bays – 2 hour limit
- Forrest Circle (Throssell to Wise): 18 parallel bays on east side – 3 hour limit
- New north-south Road (west) McLarty to Colebatch: 16 parallel bays – 2 hour limit
- New north-south Road (east) McLarty to Colebatch: 16 parallel bays – 2 hour limit
- Leake Street (Wise to McLarty): 56 x 45° angle/parallel bays – 3 hour limit
- Leake Street (McLarty to Rason): 12 parallel bays – 2 hour limit
- Rason Link (Forrest to Leake): 9 parallel bays – 2 hour limit
- Rason Link (Leake to Wise): 8 parallel bays – 2 hour limit
- Hamilton Road: (Throssell to Colebatch): 24 parallel bays – 4 hour limit

13.4 Redevelopment of Community Facilities

The Town of Port Hedland is proposing redevelopment of existing community facilities comprising the Library, Aquatic Centre, Well Women's Centre, Lotteries House and Skate Park. Detailed operation of the proposed facilities was not specified at the time of preparing this report therefore typical parking rates are derived from public resources to give an indication of the potential parking demand for each. The table in Appendix 3 suggests estimated potential parking demands.

Porter Consulting Engineers are engaged by the Town of Port Hedland to prepare a separate report on parking for these facilities and the details in this report should be read in conjunction with the South Hedland Community Facilities Parking Strategy report.

The combined Library, Aquatic Centre and Skate Park (Zones 19 and 34) are suggested as having demand for 160 shared parking bays. Zone 42 has the potential to accommodate parking for up to 88 bays leaving a shortfall of 72 bays. On-street parking along the fronting roads to the Library and Aquatic Centre provide 72 parking bays which is sufficient to cover the 72 bay shortfall provided no other concurrent demands occur to utilise this parking.

For security, skate parks need to be in well overlooked areas that are included in centres with other activities that can provide surveillance. Skate parks are most commonly attended by children who are not of driving age and will typically either arrive at the park as a result of a vehicle trip made for another purpose by an adult to a nearby destination, or will make their own way there by cycling, walking or public transport. For these reasons it is not typical practice to provide dedicated parking for a skate park.

Lotteries House and the Well Women's Centre (Zones 18 and 35) are suggested as having demand for 205 parking bays. An on-site car park for 27 bays will be required. On-street parking on the surrounding frontage roads provides a further 86 parking bays leaving a shortfall of 92 bays. Zones 7 and 17 abut and currently comprise a public car park facility with 184 bays. Utilisation of this public car park to provide the 92 bay shortfall is possible in the foreseeable future until such time as redevelopment of the carpark for other purposes is proposed, at which time an arrangement to provide shared parking on the site with the landholder/developer should be negotiated.

13.5 Town of Port Hedland Parking Policy

The Town of Port Hedland has a prepared a draft policy document under its Town Planning Scheme No.5 for Reciprocal Car Parking and Cash in Lieu of Car Parking. The intent of the policy is generally to allow for development which due to financial, physical and urban design constraints or through encouragement of very high density development are unable to provide sufficient self contained parking. Decisions to be made by the Local Authority when considering cash-in-lieu payments include, but are not limited to:

- Is the development consistent with the objectives of the Town Planning Scheme?
- Are the objectives of the Town Parking Strategy being met?
- Where is alternate parking to be provided and will a deficiency of parking on the development create parking issues in the immediate surrounding area?
- Ability of the development to provide the required number of parking bays on site.
- Can alternate parking be provided in time for the development, and if not, when?
- If alternate parking cannot be immediately provided, what are the consequences?
- Does the LGA have an interest in providing public parking facilities in the area?
- The number of parking bays to be permitted for cash-in-lieu payment.

The draft policy allows for:

- Not more than 50% of the TPS required car parking can be provided for by reciprocal car parking and/or cash-in-lieu.
- Up to 100% reciprocal (shared) parking.

The ToPH draft policy presents a number of examples for permitted shared use of parking which are based on different hours of development operation. However, once this arrangement is permitted any change in hours of operation without a change in use will not require further approval from the ToPH and consequently the parking supply will be affected to the extent that it may become insufficient to meet demand. Permitting shared use of parking based solely on the approved development use hours of operation can become unworkable under future scenarios. It is therefore imperative that permitting shared use is not based on easily changeable circumstances.

The density of development intended to be encouraged in the South Hedland Town Centre is high. High density development may require a high ratio of parking depending on the types of use. Allowing for 50% of the development parking to be provided off-site introduces the requirement for a large number of off-site parking bays to be available. With multiple high density development proposed for the Town Centre the off site parking requirement at an allowed 50% rate becomes several hundred parking bays. The provision of land and car parking infrastructure to meet demand at that rate cannot be fulfilled by ground level car parking without taking up an unacceptable area of the available land supply in the Town Centre. The alternative to using large areas of land for ground level parking is multi-level parking facilities. The cost for provision of multi-level parking facilities is at much higher orders of cost than for ground level parking. Consequently a more limited maximum ratio is suggested at up to 20% of development parking to be permitted to be provided off-site by cash-in-lieu. This ratio can be adjusted under the Town's Parking Policy at any time.

It is suggested that to initially encourage development, the Town should consider allowing up to a 20% maximum. Then as sufficient development occurs to provide the vibrant Town Centre sought, later development should not need the same level of encouragement and the amount of off-site parking permitted can be reduced to possibly a ratio of 10%, or none.

13.6 Public Car Parking Supply

The cash-in-lieu policy enables the ToPH to receive funds into a Reserve Account and set aside money from its own resources to construct and maintain public car parks. The number and locations for these public car parking bays to be provided in the Town Centre is critical to ensuring that parking is available where and when it is needed to fulfil demand. Based on the anticipated future development scenario proposed for South Hedland two locations have been selected to meet predicted demand based on 20% of development parking permitted to be provided by public parking. These locations and the number of parking bays suggested to be supplied are based on current predictions. With the rate and variability of development in South Hedland these predictions should be revisited in at least 5 years time to ascertain whether any significant change has taken place requiring change to the parking strategy.

Staging for construction of public parking supply is dependant on the demand that will be imposed as development proceeds. If initially small scale development with limited demand for parking occurs this will not trigger an immediate demand for public parking. If however, a single large scale development occurs requiring a large number of off-site parking bays then the requirement for the public car parking is immediate. How that is to be funded may be determined by the number of parking bays, the cash-in-lieu supplied and available funds set aside in a Parking Reserve Account, or other sources of funding as may be available to the ToPH.
It is recommended that any large scale development with an off-site parking demand for more than 50 parking bays should immediately trigger construction of the number of off-site parking bays. And, where a number of smaller scale developments have occurred and the number of off-site parking totals more than 50 bays then this should also trigger immediate construction of the required number of parking bays.

13.7 Street Parking Operation

Street parking in the Town Centre should not be used for long term parking. Instead the intent should be for it to cater for short to medium length of time parking to encourage turnover which in turn encourages street activity. Typically, short to medium times will range from 15 minutes to 3 hours.

Maximum times for the Town Centre street parking are suggested on the parking diagram in the Appendix. It is imperative that ongoing enforcement of parking times is undertaken by the ToPH to ensure compliance by motorists to maintain the intent of purpose for street parking.

13.8 Financial Implications

The provision of land and infrastructure to provide public parking to meet demand that is not otherwise supplied by parking supply within developments required under the development approval process can be complicated by various factors. Not the least of these is the manner in which the provision and ongoing operation of public parking will be financed.

Ground level car parking whether it is on-street or off-street is the most cost efficient manner in which to provide parking. Typical cost per bay in the metropolitan area can range from $2,800 to $3,000 for construction and $50 to $100 per bay per year for ongoing maintenance. The typical pavement life cycle for a ground-level car park is 15 to 20 years.

The WA Local Government Act has provision for Local Government Authorities to establish and maintain Reserve Accounts with money set aside for a purpose in a future financial year. This permits the Local Authority to set aside money from its own resources and/or from external resources to be used as and when required for specific a purpose such as funding the construction and maintenance of car parking and purchase of land on which to construct car parking. The Town of Port Hedland Reciprocal Car Parking and Cash in Lieu of Car Parking Policy allows the Town to accept payments for car parking as part of the land development process.

If the LGA approves parking concessions in order to relieve development from providing parking in accordance with the Town Planning Scheme requirements it also relieves the requirement to provide cash-in-lieu. The consequence of this is dilution of the effectiveness of a cash-in-lieu scheme and increases demand on the available parking supply. Parking concessions should not be made unless it can clearly be demonstrated that parking supply for the development site is excessive for current and future needs. Noting that future parking need is dependant upon the development use, hours of operation, etc not increasing to higher parking demand intensity.

Some Local Governments attempt to charge developments the full cost of provision of each parking bay. This can result in only a very small opportunity for developments to take up the offer. Typically relating to small infill projects which have no other alternative and are able to financially cover the cost in a high resale value development. The value of a parking bay which a development does not own or control is not the same as the cost of constructing a parking bay on the development's own land where full control is available. Therefore the cash-in-lieu rate is often set at a value less than 100% of the estimated cost of providing a new parking bay.

13.9 Recommendations

The purpose of this assessment is a comparison of the existing parking supply in the South Hedland Town Centre within the requirements of the Town of Port Hedland's Town Planning Scheme Text No.5 as it relates to existing and future potential development.

Actual usage of the currently available Town Centre car parking bays supply is not assessed. Such an assessment would take resourcing beyond the intent of this review. However, it can reasonably be assumed that the Town of Port Hedland in developing their Scheme Text has provided parking rates relevant to the specific requirements of this community. This also relates to the high car based trips preferred by residents and consequent limited use of public transport. The highest use of public transport is for school student pick-up and drop-off.

Further, as developments have been approved within the Town Centre, the Town of Port Hedland will have approved each new development's parking requirements in relation to surrounding development's parking availability to ensure under supply has not occurred. This assumption appears to be confirmed, as the total parking requirement under the Scheme provisions for the Town Centre is 2186 bays and the actual supply is greater than this at 2336 bays. Which is 150 parking bays or 7% more than required and there are no indications that the current overall parking supply is insufficient.

The centre of the existing Town development is encompassed within a radius of less than 500 metres. It is generally accepted that up to 500 metres is within a comfortable walking distance of most people. Although environmental factors such as high daytime summer temperatures that occur in this Region may reduce the inclination for walking than would otherwise be experienced in a more temperate climate. Therefore 250m has been assumed for this environment and the locations for two public parking facilities are suggested accordingly.

Redevelopment of the Town Centre proposes to introduce on-street parking and to encourage pedestrian activity within the street setting. This street parking should be of shorter duration than the off-street parking to encourage turnover and activity. The shortest parking times should front activity generators having the highest short time parking attraction to provide activity of pedestrian movement by parking turnover.

With respect to travel demand management, it is generally accepted that in order to reduce the potential volume of private vehicle trips to and from intense development during peak commuter periods, lower parking rates are imposed. The objective is to encourage commuting via public transport. In this instance, the provision of public transport is limited to two routes through South Hedland (Routes 301 and 401) and unlikely to increase to a level suitable for reduced parking rates.

However, the Town of Port Hedland in conjunction with the Public Transport Authority - Regional Town Bus Services and the local private bus service company, Hedland Bus Lines should be encouraged to evaluate opportunities for improvement and implement progressive upgrading of facilities to increase patronage.

End of trip facilities for bicycle users can further encourage non vehicle commuting and subsequently reduce parking requirements for developments. Cycling is most able to be encouraged where a moderate climate satisfies riders comforts and where suitable provision of off-road cycle paths and wide carriageway lanes or on-road bicycle lanes enable cycling to be undertaken safely. It must be noted that the Town has a high proportion of heavy vehicles which does not encourage cyclists to feel safe when travelling on-road unless well separated from heavy vehicles. Off-road paths are therefore the alternative. A high level of integration of off-road paths with protected road crossings is therefore recommended for cycling to be encouraged.

Consolidated parking areas within the Town Centre for general public use can effectively reduce the overall parking supply required to fulfil peak parking demand. The subsequent effect of providing consolidated parking is that the parking requirement for smaller individual developments can be reduced by the use of shared parking arrangements.

Parking rates in Planning Schemes may recognise that there are typically constraints associated with constructing developments within a Town Centre. High intensity developments may typically include multi-level car parking either above or below ground, which is a costly exercise that may impact on the feasibility of a project. As such, to facilitate higher intensity development, alternative public parking may be provided by on-street parking or off-street parking facilities shared by adjacent developments in lieu of providing some of the development's on-site parking.

This assessment includes a proposal for provision of two off-street public carparks able to service carparking demand by separating the demand into an eastern and a western area. A car park situated in Zone 41 comprising 303 (at-grade) bays can service new development on Zones 9, 10, 11 and 13 (western area). A car park situated in Zones 5/43 comprising 350 (at-grade) bays can service new development on Zones 1, 2, 5, 6 and 21 (eastern area).

With the two off-street car parks and on-street parking the total supply of public parking is 1,057 bays. This will permit up to 18% of the fully developed Town Centre's Development parking to be supplied external to developments. If it is assumed that 20% of trips are shared, then the ratio of development parking accepted by public car parking may increase to around 22%.

Depending on how quickly development of the available vacant land in South Hedland Town Centre occurs will determine when and how much public car parking is required. The eastern end of the Town is currently being re-developed first and this is likely to promote parking in that end of the Town to be developed first. Therefore the potential is that the suggested public carpark on Zones 5/43 comprising 350 (at-grade) bays will be required within the first 5 years of Town Centre development. And potentially in the following 5 to 10 years, the western car park of 303 (at-grade) bays will be required. However, should development in Zones 9, 10, 11 and 13 occur earlier that may initiate an earlier need depending on the intensity of development. The full area of each of these car parks does not need to be constructed at once. Staged construction to provide only immediate demand for parking bays as they arise from development activity is suggested.

Construction of public car parks may be needed early should sufficient intensity of development arise in South Hedland Town Centre. The Local Authority should make provision by creating a Parking Reserve Account for cash-in-lieu payments from development contributions toward public parking. It is unlikely that it will be possible to achieve a cash-in-lieu rate sufficient to cover the full cost for construction of parking. Too high a rate will deter development. Accordingly other sources of funding should be sought either at the time at which construction is required, or progressively set aside from each annual budget into a Parking Reserve Account.

Summary of South Hedland Town Centre Parking Provision

	No. Parking Bays 20% Shared Use	No. Parking Bays No Shared Use
Target Parking Supply		
Estimated Future Demand	5,896	5,896
20% Reciprocal Shared Use Reduction	1,179	0
Estimated Future Demand less 20% Shared Use Reduction	4,717	5,896
On-site Parking Supply (80% of Target) – Within Development site	3,773	4,717
Off-site Parking Supply (20% of Target) – On-street & Public Carparks	943	1,180
Developments Parking Supply		
Estimated Total Future Parking Provision (80% of Total Supply)	3,773	4,717
Less 80% of current Developments Parking Provision	1,869	1,869
Estimated Balance of Future Development Parking Supply Required	1,904	2,848
Public Parking Supply		
Estimated Street & Public Carpark Required	943	1,180
Less Public Parking built or provided through SHTC Master Plan		
- On-street Parking	316	316
- Public Carparks	741	741
- Total	1,057	1,057
Resulting Surplus or Shortfall in Public Parking	114 bay surplus	122 bay shortfall

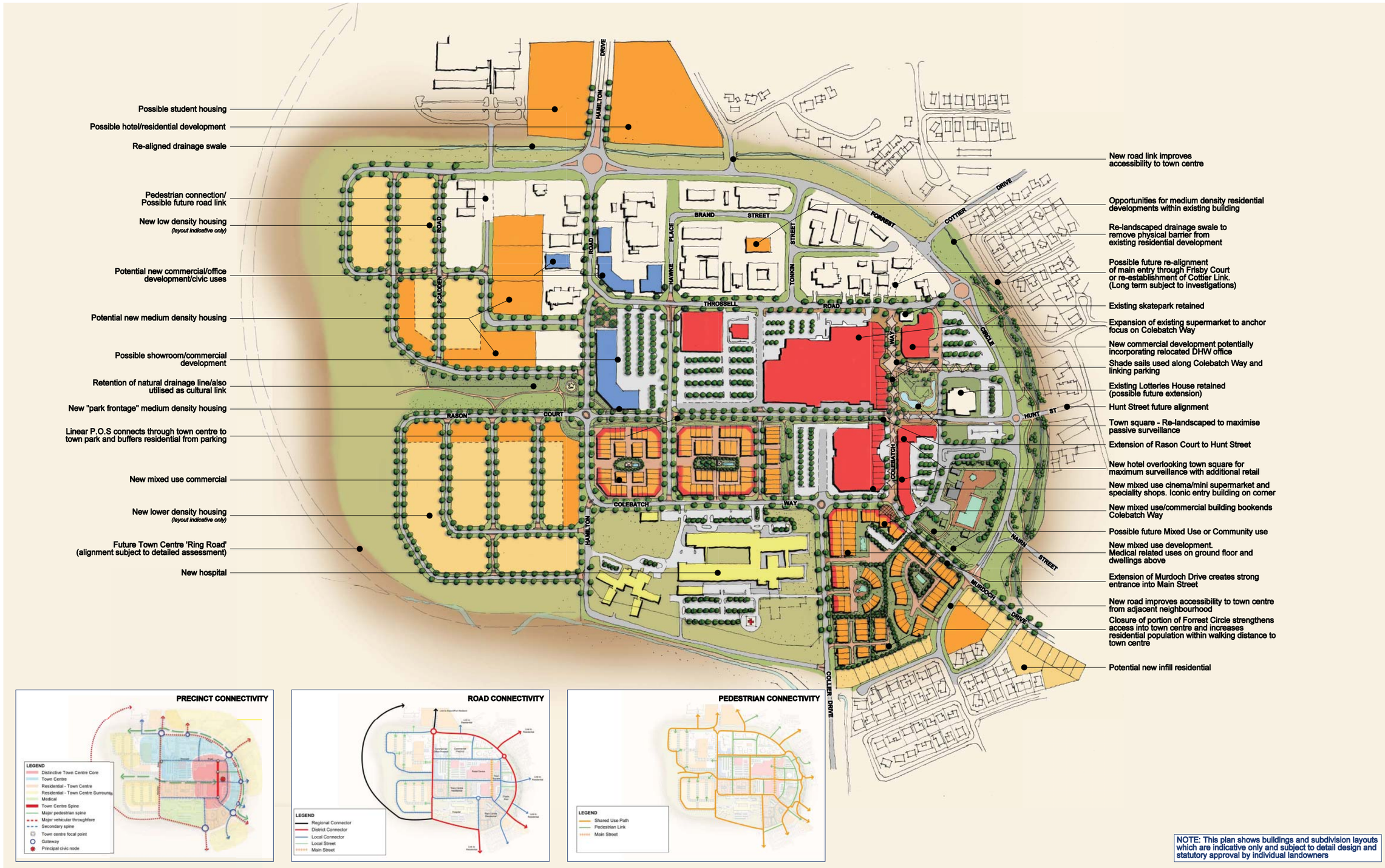
The above summary is based on the Town of Port Hedland requiring 80% of Development parking to be provided within the development and allowing 20% to be provided through public parking facilities consisting of on-street parking and dedicated off-street parking car parks. The summary then presents the optional cases of; assuming 20% of parking is shared within and between developments, and the alternate case of assuming no sharing of parking occurs within and between developments.

In the worst case if no sharing of parking occurs within private developments then there may be a shortfall in the public parking supply of up to 122 bays. The alternate assumption that 20% of parking is shared within and between developments results in a surplus of 114 bays. Irrespective of whether or not there is formal agreement between developments some shared parking use occurs naturally. Which indicate that even informally the estimated parking supply figures presented in the above predictions will result in a balance of demand and supply.

The following recommendations are presented for consideration by the Town of Port Hedland:

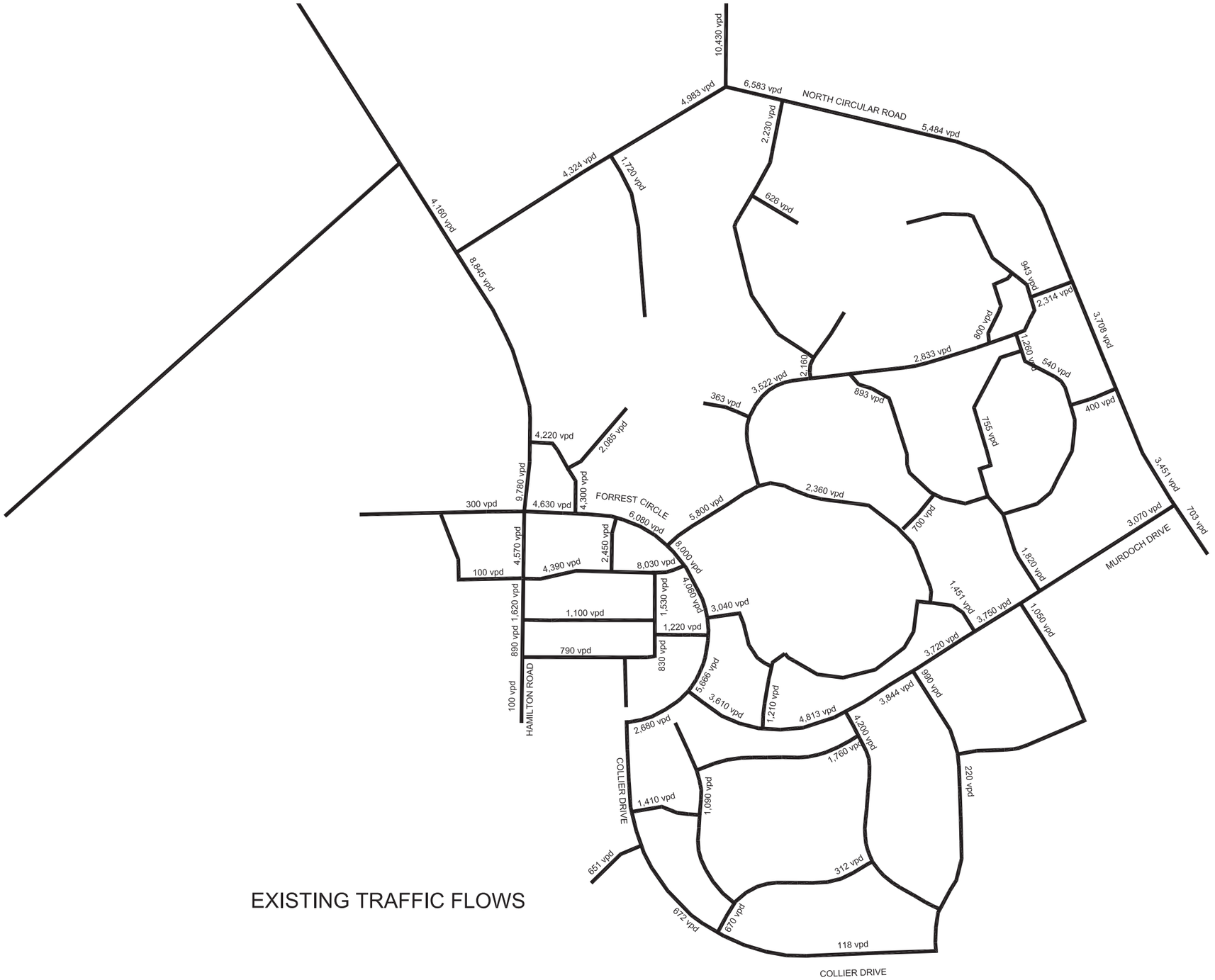
- Reduce the maximum permitted cash-in-lieu from 50% to 20% initially and consider further reduction to 10% following achievement of development initiatives.
- Set the cash-in-lieu rate at less than 100% of estimate construction cost with the ToPH to make up the difference.
- Shared parking not to be based on changeable circumstances such as operating hours.
- ToPH to create a Parking Reserve Account for cash-in-lieu and other contributions.
- ToPH to stage construction of public parking bays depending on demand and commence immediate construction whenever more than 50 public parking bays are required.
- Create and enforce timed on-street parking restrictions.
- Provide public car parking off-street and on-street in accordance with the suggested locations and number of bays. The number of bays required to be reviewed in 5 years.

APPENDIX 1
South Hedland Town Centre Masterplan

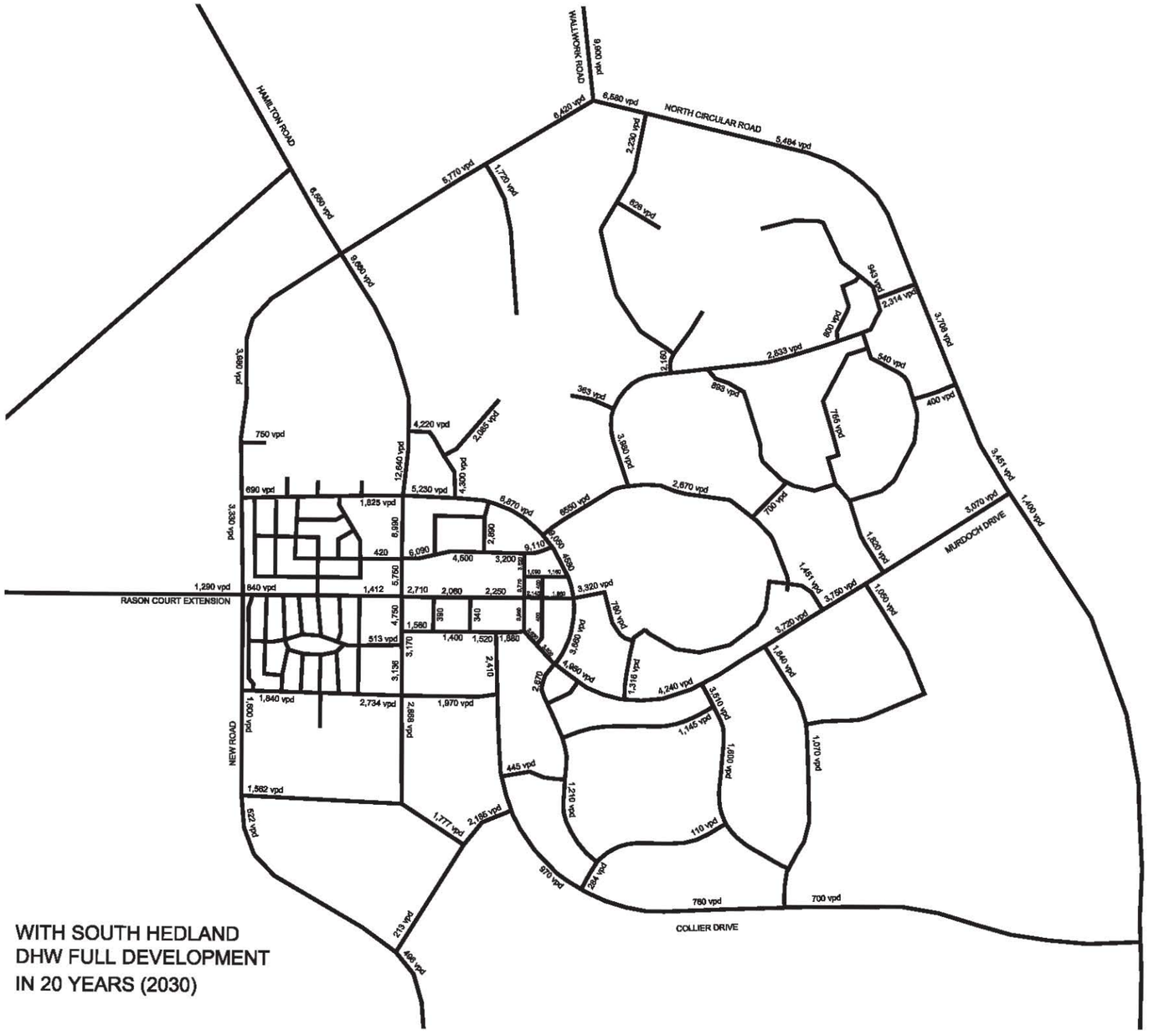


NOTE: This plan shows buildings and subdivision layouts which are indicative only and subject to detail design and statutory approval by individual landowners

APPENDIX 2
Road Network Traffic Models



EXISTING TRAFFIC FLOWS


HAMILTON ROAD
WALLWORK ROAD
NORTH CIRCULAR ROAD
NEW ROAD
RASON COURT EXTENSION
MURDOCH DRIVE
COLLIER DRIVE
9,000 vpd
6,580 vpd
6,420 vpd
5,770 vpd
1,720 vpd
2,230 vpd
5,484 vpd
628 vpd
943 vpd
2,314 vpd
3,708 vpd
850 vpd
2,833 vpd
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1,210 vpd
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780 vpd
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3,330 vpd
1,825 vpd
8,990
2,880
420
6,090
4,600
3,200
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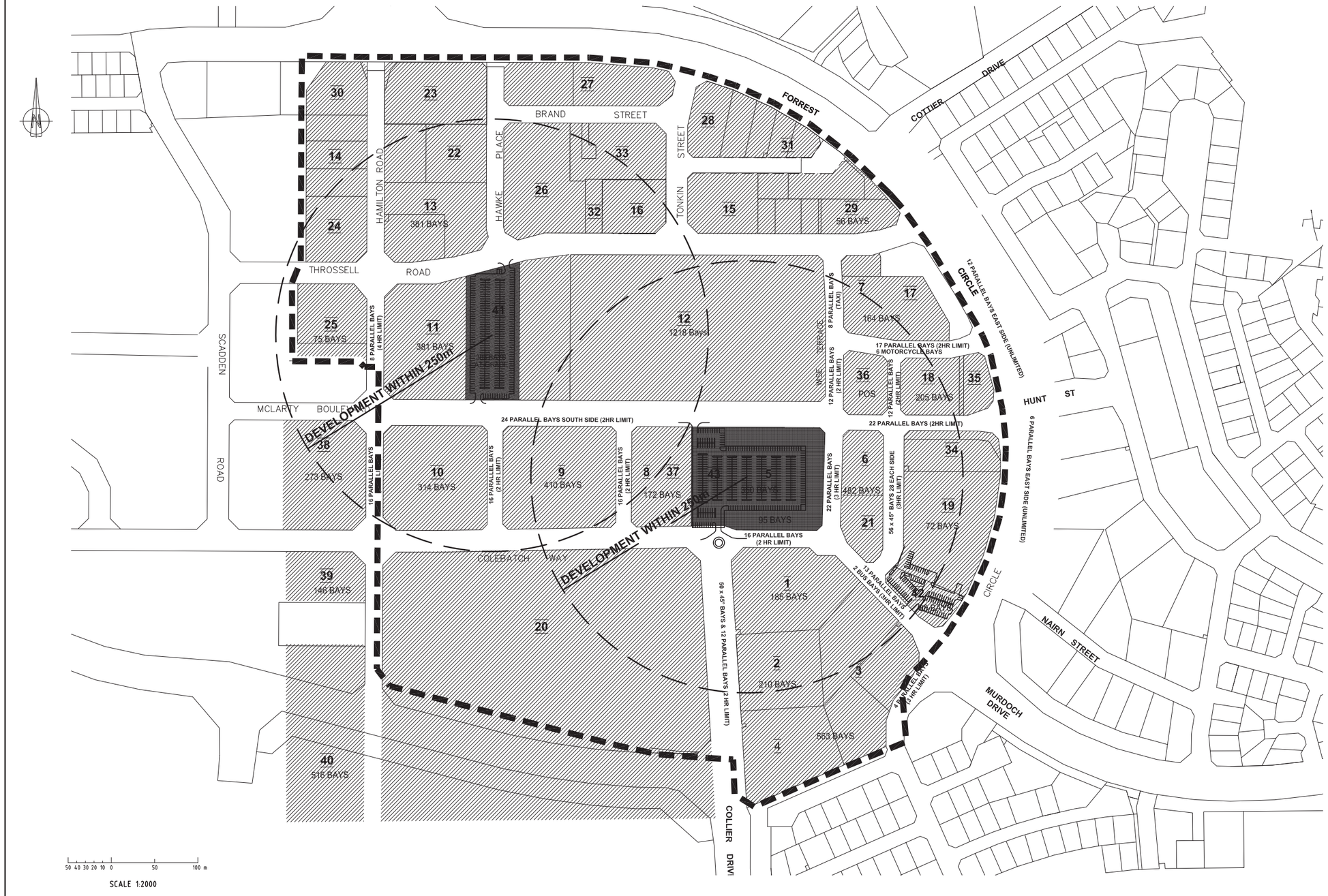
840 vpd
1,412
5,760
2,710
2,080
2,250
3,320 vpd
4,750
1,560
380
340
513 vpd
3,170
1,400
1,520
1,880
3,138
2,410
760 vpd
3,680 vpd
1,990 vpd
2,870
1,316 vpd
4,240 vpd
1,840 vpd
2,734 vpd
1,970 vpd
1,600 vpd
2,668 vpd
1,562 vpd
522 vpd
1,777 vpd
2,185 vpd
215 vpd
498 vpd
WITH SOUTH HEDLAND
DHW FULL DEVELOPMENT
IN 20 YEARS (2030)

APPENDIX 3
Parking Demand



PROJECT:	**PARKING STUDY SOUTH HEDLAND**		
E	17-8-2012	PUBLIC PARKING RELOCATED. STREET PARKING REVISED	ELW
D	24-5-2012	LOT BOUNDARIES REVISED.	MJV
C	9-5-2012	REVISED PUBLIC CAR PARKS PROVISION	ELW
B	1-5-2012	REVISED LOT LAYOUTS	MJV
A	1-7-2011	PRELIMINARY PLOT FOR APPROVAL	MAC
No.	DATE	REVISION	BY

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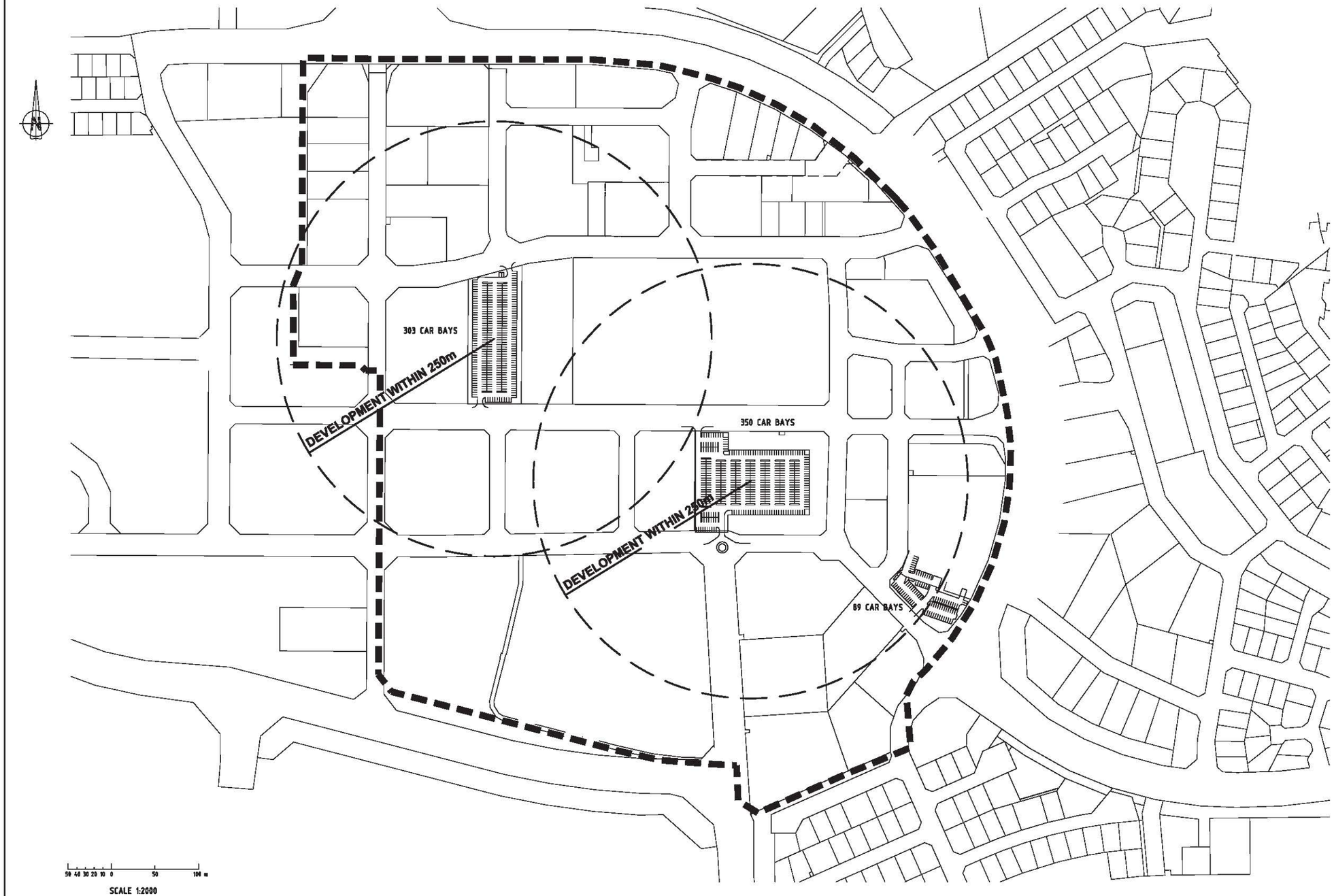
CLIENT:	**TOWN OF PORT HEDLAND**
DRAWING:	**FUTURE PARKING REQUIREMENTS**
STATUS:	**FOR APPROVAL**
SCALE	1:2000
DATE	MAY 2012
DESIGN	ELW
DRAWN	MJV
CHECK	
DRAWING No.	09-7-91/4
REV No.	E
ORIGINAL DRAWING SIZE	A1
FILE NAME	c:\pce\9-7-91\9791-4.dwg
APP'D	



PROJECT:
PARKING STUDY
SOUTH HEDLAND

No.	DATE	REVISION	BY
B	1-8-2012	REVISED CARPARK LAYOUT CENTRAL CARPARK.	MJV
A	29-5-2012	PRELIMINARY PLOT FOR APPROVAL	MAC

Porter Consulting Engineers
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CLIENT:
LANDCORP

DRAWING:
PROPOSED PUBLIC CARPARKS
CONCEPTUAL LAYOUTS

STATUS: **FOR APPROVAL**

SCALE	1:2000
DATE	AUG 2012
DRAWN	ELW
CHECK	MJV
DRAWING No.	09-7-91/7
REV. No.	B
PAPER SIZE	A1
FILE NAME	c:\pce\9-7-91\9791-7.dwg
APP'D	

Zone	Zoning	Proposed Use	Land Area (approx)	Existing Use	Development Scenario	Commercial/ Retail Parking	Residential Parking	Current Parking Available	Current Parking Required	Future Parking Required	Comment
1	Residential Town Centre	Residential, Medical/Consulting and Retail over 3 levels.	1.19ha	Undeveloped	Ground Floor Medical/Commercial/ Retail plus mulit-level residential			N/A	N/A	161	Plus uses 24 on-street bays
2	Residential Surrounds	Residential only	0.85ha	Undeveloped	Residential Units – R80		140 units 140*(1.25+0.25) = 210 bays	N/A	N/A	210	
3	Residential Surrounds (R40,plot ratio = .6)	Residential Grouped Dwelling/ Town House Development ,minimum 3 storey frontage	1.59ha	Undeveloped	Ground floor Residential and Commercial	1000 sqm retail with 1 bay per 20 sqm NFA = 50 bays	342 units 42*1.5 = 513 bays	N/A	N/A	563	Proposes 81 bays
4	Residential Surrounds (R40 plot ratio = .6)	Residential Grouped Dwelling / Town House Development, minimum 2 storey frontage	0.86ha	Undeveloped	Combined with Zone 3			N/A	N/A	N/A	
5	Mixed Use	Public Car Park with Retail and Apartments	1.71ha	1750sqm retail / medical consulting	R80 residential	2000 sqm with 1 bay per 40 sqm GFA = 50 bays	{(2,000 * 0.9)/60}*1.5= 45 bays	125	59	95	350 Bay Public Car Park in conjunction with Site 43.
6	Mixed Use	Hotel with Banquet Centre, Bistro, retail units and apartments	0.37ha	Aquatic Centre Parking	1800 sqm retail, 300 sqm bistro bar, 50 guest bedrooms, 1000 sqm banquet centre 3000 sqm residential	1800 sqm retail with 1 bay per 20 sqm NFA = 77bays, 300 sqm bistro with 1 bay per 4 seats = 52bays, 50 guest bedrooms with 1 bay per room and 1 per 5 rooms for visitors = 60 bays,1000 sqm banquet centre with 1 bay per 4 seats = 225 bays	{(3,000 * 0.9)/60}*1.5= 68 bays	41	See Site 19.	482	In conjunction with Zone 21
7	Mixed Use	Retail and apartments	0.27ha	342 bay Public Car Park	2714sqm ground floor retail 2714sqm residential	2714sqm ground floor retail with 1 bay per 20 sqm NFA = 115 bays	{(2714 * 0.9)/60}*1.5= 61 bays	342	N/A	164	In conjunction with Zone 17 for parking
8	Residential Town Centre (R80)	Mixed Use/ Commercial Development	0.37ha	Undeveloped	700 sqm commercial 3000 sqm residential	700 sqm with 1 bay per 40 sqm GFA = 18 bays	{(3,000 * 0.9)/60}*1.5= 68 bays	N/A	N/A	86	
9	Residential Town Centre (R80)	Mixed Use/ Commercial Development	1.83ha	Undeveloped	2000 sqm commercial 16000 sqm residential	2000 sqm with 1 bay per 40 sqm GFA = 50 bays	{(16,000 * 0.9)/60}*1.5= 360 bays	N/A	N/A	410	
10	Residential Town Centre (R80)	Mixed Use/ Commercial Development	1.38ha	Undeveloped	1,400 sqm commercial 12,400 sqm residential	1,400 sqm with 1 bay per 40 sqm GFA = 35 bays	{(12,400 * 0.9)/60}*1.5=279 bays	N/A	N/A	314	
11	Town Centre	Mixed Used Town Centre	1.67ha	Undeveloped	1,700 sqm commercial 15,000 sqm residential	1700 sqm commercial with 1 bay per 40 sqm NFA = 43 bays	{(15,000 * 0.9)/60}*1.5= 338 bays	N/A	N/A	381	
12	Mixed use	Major Shopping Centre. Residential over retail	2.47ha	20000sqm Retail	Addition of 4500 sqm retail 4500 sqm office 9000 sqm residential	4500 sqm with 1 bay per 20 sqm NFA = 191 bays 4500 sqm office space with 1 bay per 30 sqm NFA = 150 bays	{(9,000 * 0.9)/60}*1.5= 202 bays	700	675	1218	
13	Town Centre	Mixed Use	1.67ha	Undeveloped	1,700 sqm commercial 15,000 sqm residential	1700 sqm commercial with 1 bay per 40 sqm NFA = 43 bays	{(15,000 * 0.9)/60}*1.5= 338 bays	N/A	N/A	381	
14	Town Centre	N/A	0.66ha	Residential to the front and Office	N/A	N/A	N/A	17	22	N/A	5 bay shortfall

Zone	Zoning	Proposed Use	Land Area (approx)	Existing Use	Development Scenario	Commercial/ Retail Parking	Residential Parking (Bays)	Current Parking Available	Current Parking Required	Future Parking Required	Comment
15	Retail	N/A	1.17ha	2300sqm Retail	N/A	N/A	N/A	160	78	N/A	82 bay surplus
16	Retail	N/A	0.45ha	2000sqm	N/A	N/A	N/A	48	68	N/A	20 bay shortfall
17	Parking and Access	N/A	0.94ha	Skate Park and Public Car Park	N/A	N/A	N/A	See Site 7	-	N/A	In conjunction with Zone 7
18	Community Uses	N/A	0.44ha	Offices	Lotteries House and Well Womens Centre	Lotteries House: Staff-640m^2 @1/30m^2=22 plus 650m^2 @ 1 person/2m^2 @ 1 per 4 = 82 (Total 104) Well Womens: 7 staff bays plus 235m^2 @ 1 person/2m^2 @ 1 per 4 = 30 (Total 37)	N/A	Public Car Park	95	141	In conjunction with Zone 35
19	Community Uses	N/A	1.34ha	Community - 1400sqm Pool	Library, Aquatic Centre and Skate Park	Library; 8 staff bays plus 4 per 100m^2 = 48 Aquatic Centre; 10 staff bays plus 1 per 20m^2 of pool = 90. Fully shared parking.	N/A	36 + Site 7	47	138	In conjunction with Zone 34
20	Community Uses	N/A	8.16ha	3400 sqm aged care and 10800 sqm health campus Hospital	N/A	N/A	N/A	342	339	N/A	3 bay surplus
21	Community Uses	Hotel. With Site 6.	0.34ha	Community – 570sqm Library	N/A	N/A	N/A	34	11	N/A	In conjunction with Zone 6
22	Community Uses	N/A	0.47ha	Community - 1750sqm Justice -	N/A	N/A	N/A	30	35	N/A	5 bay shortfall
23	Community Uses	N/A	0.84ha	Community – Police 1150sqm	N/A	N/A	N/A	34	23	N/A	11 bay surplus
24	Community Uses	N/A	0.53ha	1600sqm Motel Short/Term Accommodation	N/A	N/A	N/A	28	32	N/A	4 bay shortfall
25	Community Uses	Community – Aboriginal Language Centre	0.66ha	Undeveloped	Estimated at 3000sqm	3000/40 = 75 bays	N/A	N/A	N/A	75	
26	Town Centre	N/A	1.09ha	4900sqm Hotel	N/A	N/A	N/A	128	98	N/A	30 bay surplus
27	Town Centre	N/A	0.92ha	6000 sqm Offices	N/A	N/A	N/A	80	180	N/A	100 bay shortfall
28	Town Centre	N/A	0.35ha	1140 sqm offices With bays provided and required	N/A	N/A	N/A	34	38	N/A	4 bay shortfall
29	Retail	Service Station with Retail	0.41ha	216 sqm Service Station with bays	Expansion of Existing Service Station to 250sqm and Construction of 5* 170sqm Shops and re-arrangement of parking to 43 bays	250sqm with 1 bay per 20 sqm LFA = 13 bays 5*(170sqm with 1 bay per 20 sqm LFA) = 43 bays	N/A	20	Not specified	56	13 bay shortfall

Zone	Zoning	Proposed Use	Land Area (approx)	Existing Use	Development Scenario	Commercial/ Retail Parking	Residential Parking (Bays)	Current Parking Available	Current Parking Required	Future Parking Required	Comment
30	Town Centre	N/A	0.39ha	Telstra Exchange	N/A	N/A	N/A	20	25	N/A	5 bay shortfall
31	Town Centre	N/A	0.82	5700 sqm South Hedland Motel	N/A	N/A	N/A	47	184	N/A	137 bay shortfall
32	Town Centre	N/A	0.12ha	Restaurant	N/A	N/A	N/A	10	52	N/A	42 bay shortfall
33	Town Centre	N/A	0.72ha	3750 sqm Offices	N/A	N/A	N/A	60	125	N/A	65 bay shortfall
34	Parking and Access	Skate park	0.46ha	Undeveloped	Skate Park	N/A	N/A	N/A	N/A	N/A	See Zone 19
35	Parking and Access	N/A	0.25ha	Undeveloped	N/A	N/A	N/A	N/A	N/A	N/A	See Zone 18
36	Public Open Space	N/A	0.43ha	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
37	Residential Town Centre (R80)	Mixed Use/ Commercial Development	0.37ha	N/A	700 sqm commercial 3000 sqm residential	700 sqm with 1 bay per 40 sqm GFA = 18 bays	{(3,000 * 0.9)/60}*1.5= 68 bays	N/A	N/A	86	
38	Mixed use	Mixed Used Town Centre	1.096ha	Undeveloped	Residential	-	182*1.5= 273 bays	N/A	N/A	273	
39	Mixed use	Mixed Used Town Centre	0.58ha	Undeveloped	Residential	-	97*1.5= 146 bays	N/A	N/A	146	
40	Mixed use	Mixed Used Town Centre	2.07ha	Undeveloped	Residential	-	344*1.5= 516 bays	N/A	N/A	516	
41	Public Car Park	Public Car Park	0.62ha	Undeveloped	Public Car Park	-	-	N/A	N/A	N/A	303 bays on ground. Future deck over when required.
42	Community Uses	Car Park for Community Centre	0.30ha	Aquatic Centre	Public Car Park	-	-	N/A	N/A	N/A	88 bays on ground
43	Public Car Park	Public Car Park		Undeveloped	Public Car Park	-	-	-	-	-	See Zone 5
On Street Parking	-	On Street Parking (as indicated on 09-07-091/4)	-	-	316 on street parking bays	-	-	-	-	-	316 on-street parking bays
							TOTALS	2,336	2,186	5,896	

Parking Totals:

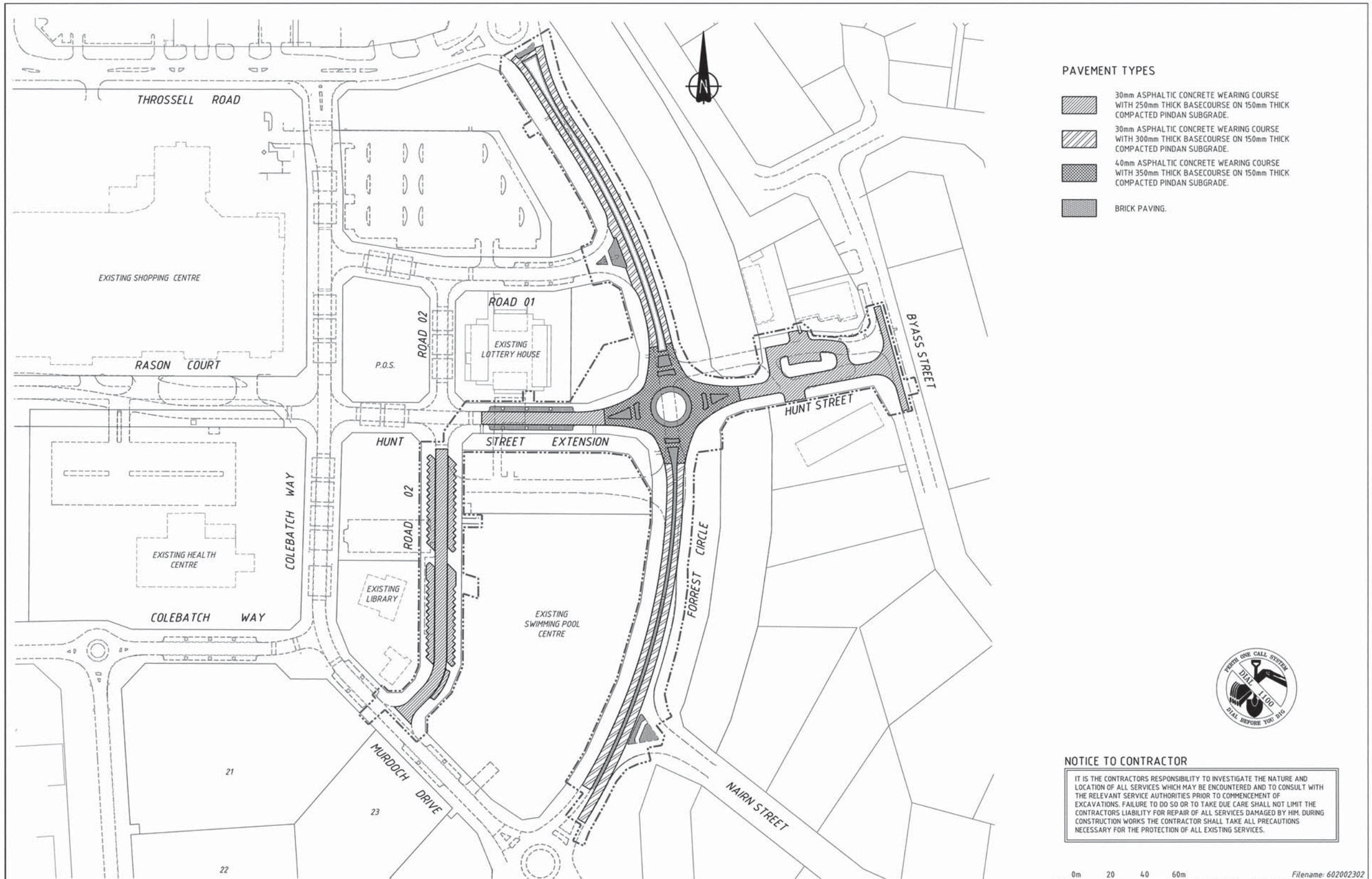
Current parking available:	2336 bays
Current parking required:	2186 bays
Current Surplus:	150 bays
Future Total SHTC Parking requirement:	5896 bays
Future Total SHTC Parking requirement taking Shared Parking into Account:	
Future:	5896 – 20% = 4717 bays
Current:	2336 – 80% = 467 bays
Planned public car parks and on street parking :	1,057 bays (303+350+88+316)

Ratio of development parking provided by public parking = 1,057/5896 = 0.18 (18%).
If 20% Shared Parking occurs then the ratio of development parking provided by public parking may increase to = 1,057/4,717 = 0.22 (22%).

Assumptions and Simplifications

1. Each Zone is fully developed
2. Each parking bay requires approximately 25sqm at ground.
3. Shared parking at 20% is acceptable
4. All residential buildings are assumed to have 10% open space and have 60sqm units. 60sqm was chosen as it is an area which can accommodate a 1 bedroom unit or a small two bedroom unit.

APPENDIX 4
Town Centre New Roads



NOTICE TO CONTRACTOR

IT IS THE CONTRACTORS RESPONSIBILITY TO INVESTIGATE THE NATURE AND LOCATION OF ALL SERVICES WHICH MAY BE ENCOUNTERED AND TO CONSULT WITH THE RELEVANT SERVICE AUTHORITIES PRIOR TO COMMENCEMENT OF EXCAVATIONS. FAILURE TO DO SO OR TO TAKE DUE CARE SHALL NOT LIMIT THE CONTRACTORS LIABILITY FOR REPAIR OF ALL SERVICES DAMAGED BY HIM. DURING CONSTRUCTION WORKS THE CONTRACTOR SHALL TAKE ALL PRECAUTIONS NECESSARY FOR THE PROTECTION OF ALL EXISTING SERVICES.

1:1000 0m 20 40 60m

Filename: 602002302

WAPC No. 139090, 141694, 141695

No.	DATE	DRAWN	CHECKED	AMENDMENT
0	11.08.11	GED	DCH	ISSUED FOR CONSTRUCTION
A	04.08.11	GED	RGS	ISSUED FOR APPROVAL

CLIENT: LANDCORP

DESIGNED: GED | CHECKED: DCH

DRAWN: GED | CHECKED: DCH

APPROVED: 17/8/11

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PROJECT: SOUTH HEDLAND TOWN CENTRE REDEVELOPMENT - STAGE 2 CIVIL

TITLE: ROAD PAVEMENT TYPES

SCALE: 1:1000 | DRAWING NUMBER: 6020-02-302 | ISSUE: 0

No.	DATE	DRAWN	CHECKED	AMENDMENT
B	29.03.12	GED	DCo	PARKING BAY LAYOUTS REVISED
A	16.09.11	GED	RGS	ISSUED FOR COMMENT

CLIENT: LANDCORP

DESIGNED	CHECKED	APPROVED
DRAWN: GED	CHECKED: DCo	27/3/12

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PROJECT: SOUTH HEDLAND TOWN CENTRE REDEVELOPMENT

TITLE: HAMILTON ROAD PROPOSED ROAD LAYOUT

SCALE	DRAWING NUMBER	ISSUE
1:1000	6020-00-SK12	B

South Hedland Town Centre

Development Plan

Part 1 - Statutory Planning Provisions
Part 2 - Explanatory Report

(June 2014)