Outline Development Plan Report

Lots 555 & 847 Nimitz Street, Lot 556 & Part Lot 500 Reid Street and Lot 960 Maley Street, Exmouth

Part 1 – Statutory Planning Provisions

Prepared by:

RPS AUSTRALIA EAST PTY LTD

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Report Number: 3777-4
Date: January 2014

Prepared for:

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ENDORSEMENT PAGE

This structure plan is prepared under the provisions of the Shire of Exmouth Local Planning Scheme No. 4

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

23 JULY 2012

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

Date of Expiry: **19 OCTOBER 2035**

Document Status

Version	Purpose of Document	Orig	Review	Review Date
Final	ODP Modification No. 1	LR	SD	25 June 2013

Table of Amendments – Outline Development Plan for Lots 555 & 847 Nimitz Street, Lot 556 & Part Lot 500 Reid Street and Lot 960 Maley Street, Exmouth

Amendment No.	Description of Amendment	Endorsed by Council	Endorsed by WAPC
Amendment No. 1	1. Extend Outline Development Plan boundary to include the existing Recreation and Open Space reserve located east of Reid Street, facilitating the proposed relocation of the linear drainage system. 2. Delete the 'Area Subject to Further Investigation, Including Rezoning' category from the Outline Development Plan; 3. Modify the 'Area reserved for Recreation and Open Space (TPS 3)' category to reflect Amendment No. 29 and the current TPS 3 Map; 4. Amend the general layout of the Outline Development Plan, including the proposed road network, the proposed residential areas and areas of public open space so as to reflect Amendment No. 29 and the proposed relocation of the linear drainage system.		

Contents

1.0 Outline Development Plan Area

1.1 The Outline Development Plan area relates to Lots 555 & 847 Nimitz Street, Lot 556 & Part Lot 500 Reid Street and Lot 960 Maley Street, Exmouth, as identified on the Outline Development Plan map.

2.0 Outline Development Plan Content

2.1 The Outline Development comprises the following sections:

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

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

3.0 Interpretations

3.1 The terms used in the Outline Development Plan have the respective meanings given to them in the Shire of Exmouth Town Planning Scheme No. 3.

4.0 Operation Date

4.1 The Outline Development Plan will become operative following adoption of the Plan by the Shire of Exmouth and endorsement of the Plan by the Western Australian Planning Commission, as provided for in Clause 5.2 of the Town Planning Scheme No. 3. The operative date of the Plan is the later of the endorsement or adoption dates identified on the Certification page.

5.0 Relationship to the Scheme

5.1 The provisions of this Outline Development Plan are made pursuant to Clause 5.2 of the Shire of Exmouth Town Planning Scheme No. 3. The Outline Development Plan is a Policy Statement and forms part of the Shire of Exmouth Local Planning Policy Manual.

5.2 Town Planning Scheme No. 3 provides that land use, development and subdivision of land within the Outline Development Plan area shall be generally be in accordance with the Outline Development Plan.

5.3 Land uses permitted within the Outline Development Plan area shall be in accordance with the Shire of Exmouth Town Planning Scheme No. 3 “Residential” Zone.

5.4 The use of “Holiday Accommodation” shall not be permitted with the Outline Development Plan area.

5.5 All development shall be in accordance with the requirements of the Residential Design Codes of Western Australia (unless otherwise varied by an adopted Detailed Area Plan or Council Policy), and statutory assessment / approval procedures within the Shire of Exmouth Town Planning Scheme No. 3.

6.0 Public Open Space Provision

6.1 The Outline Development Plan includes a total Public Open Space (POS) provision of approximately 3.5ha, representing approximately 10.0% of the gross subdivisible area.

7.0 Residential Density

7.1 The residential areas of the Outline Development Plan are coded R17.5, R20 and R30 as illustrated on the Outline Development Plan.

7.2 Subdivision is to be in accordance with the applicable minimum lot sizes listed under Table 1 of State Planning Policy 3.1 Residential Design Codes.

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

8.0 Development and Reporting Requirements

8.1 Prior to any subdivision or development being support, the Shire will require:

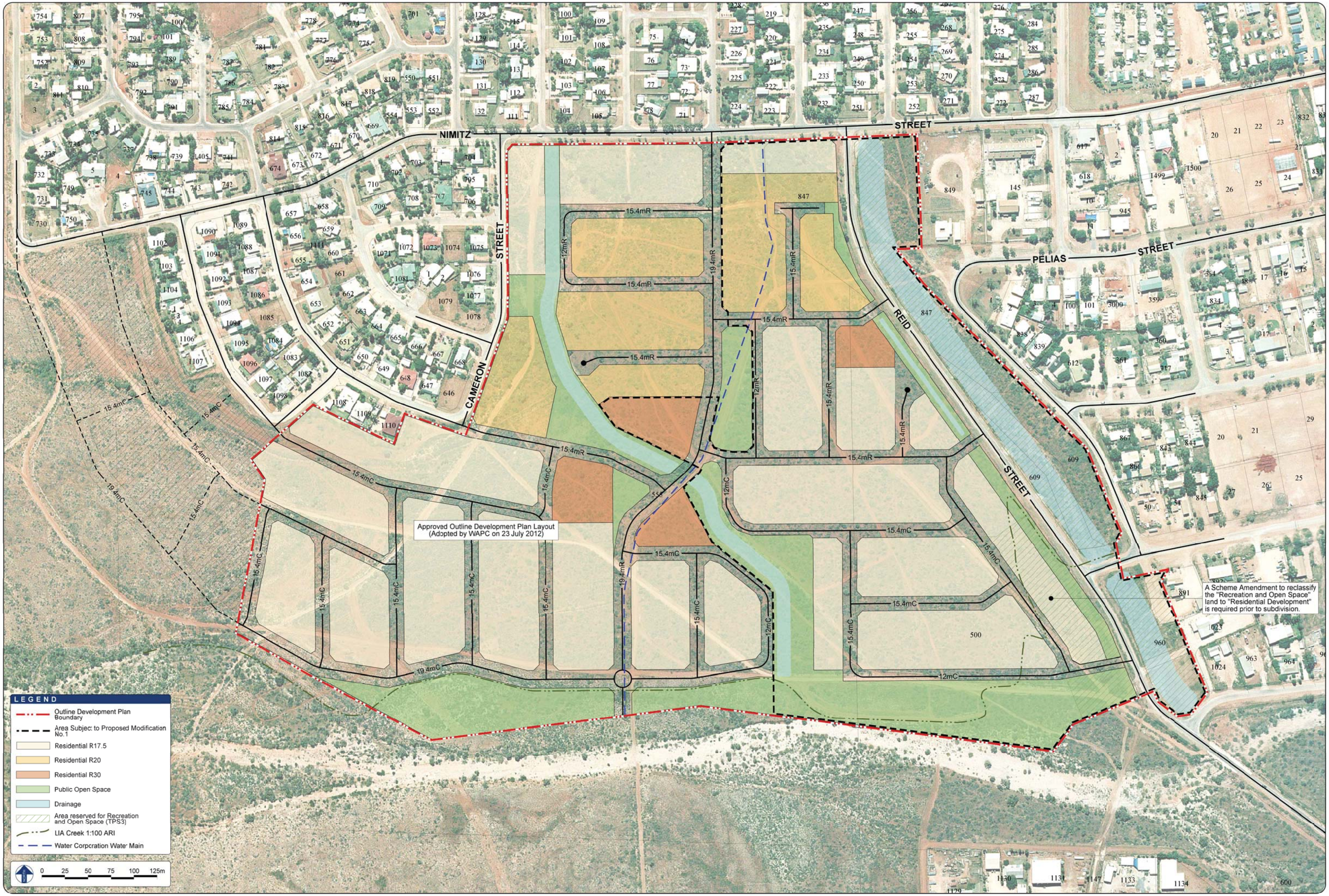
(a) a report accompanying any application that outlines the manner in which the findings and recommendations of the plans and strategies listed in Table A below have been incorporated into or addressed by the proposed subdivision or development or will be implemented in subsequent stages of development.

Table A – Reports, Surveys, Strategies and Plans

Documentation	Approval Stage	Approving Authority
Local Water Management Strategy	Concurrent with Outline Development Plan	Shire of Exmouth & Department of Water
Urban Water Management Plan	Prior to clearance of development and/or subdivision conditions	Shire of Exmouth & Department of Water
Geotechnical Report	Prior to clearance of development and/or subdivision conditions	Shire of Exmouth
Landscaping Plan	Prior to clearance of development and/or subdivision conditions	Shire of Exmouth

OUTLINE DEVELOPMENT PLAN

Lots 555 & 847 Nimitz Street, Lot 556 & Part Lot 500 Reid Street and Lot 960 Maley Street, Exmouth



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1:2,500@A2	SCALE
10 June 2014	DATE
3777_4-4-007c.dgn	PLAN No
G.K.	DRAWN

PROPOSED OUTLINE DEVELOPMENT PLAN

Lots 555 & 847 Nimitz Street, Lot 556 & Pt Lot 500 Reid Street and Lot 960 Maley Street, Exmouth

Outline Development Plan Report

Lots 555 & 847 Nimitz Street, Lot 556 & Part Lot 500 Reid Street and Lot 960 Maley Street, Exmouth

Part 2 – Explanatory Report

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Report Number: 3777-4
Date: January 2014

Document Status

Version	Purpose of Document	Orig	Review	Review Date
Draft A	Draft – Preliminary Lodgement	LR	FV	3.02.12
Draft B	Final Draft – Lodgement with Shire	FV	FV	21.02.12
Draft C	WAPC Referral – Modified following Council Adoption	LR	FV	15.06.12
Final	Endorsed Version	LR	SD	30.08.12
Mod 1	Modifications following WAPC Approval of Modification No. 1 to ODP	LR	SD	14.01.14

Disclaimer

Contents

Plans

Appendices

1.0 Planning Background

1.1 Introduction and Purpose

This Outline Development Plan (ODP) report has been prepared by RPS, on behalf of LandCorp, for the parcel of land commonly known as the Nimitz site in the Shire of Exmouth.

The proposed ODP has been designed having regard to environmentally sensitive design initiatives and the provision of a highly connected road network. It represents a logical and coordinated expansion of the existing residential areas of the Exmouth Townsite. Importantly, the proposed ODP has been prepared in accordance with the design requirements established by Liveable Neighbourhoods and will facilitate the future subdivision and development of the subject land.

The preparation of the ODP has been informed by technical input from a range of consultants, including:

- ***RPS*** – Environment
- ***JDA Hydro*** – Urban Water Management
- ***TABEC*** – Infrastructure and Servicing
- ***i3 consultants WA*** – Transport and Traffic

This ODP report includes the latest modifications proposed by LandCorp responding to the design changes undertaken to the previously adopted ODP following further investigations into stormwater management within the eastern portion of the site, including rezoning of a portion of the ODP area from Recreation and Open Space to Residential Development.

1.2 Land Description

1.2.1 Location

The subject land is generally bounded by Nimitz Street to the north, Carter Road to the east, Cameron Street to the west and the Light Industrial Area Creek to the south (**refer Plan 1**).

The subject land is located approximately 500m south of the existing Exmouth Town Centre, and can be accessed via Kennedy Street. The existing Exmouth Service Commercial / Service Industry area is located directly to the east of the subject land, separated by Reid Street and the existing open space / drainage corridor between Reid Street and Carter Road. The Welsh Street Light Industry Area is located to the south of the subject land.

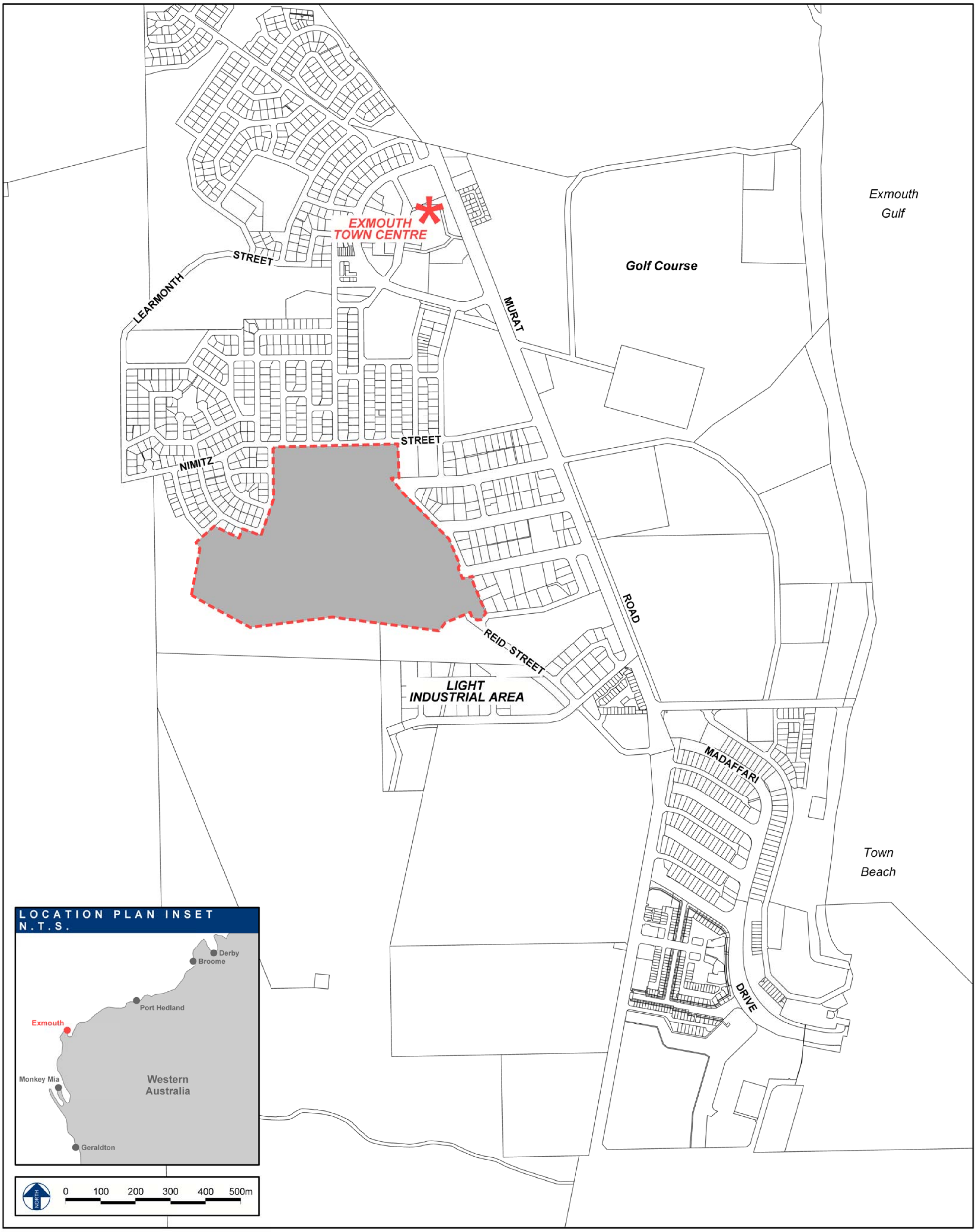
1.2.2 Area and Land Use

The ODP covers a total area of approximately 44 ha (**refer Plan 2**). The subject land is characterised by a moderate coverage of existing shrub vegetation, and contains numerous informal access tracks. The subject land is vacant and has not previously been used for any form of active land use.

1.3 Planning Framework

1.3.1 Zoning and Reservations

The subject land is zoned ‘Residential Development’ under the Shire of Exmouth Town Planning Scheme No. 3 (TPS 3), with a portion of the ODP area also reserved for ‘Recreation and Open Space’ under TPS 3 (**refer Plan 3**).



LOCATION PLAN

Lots 555 & 847 Nimitz Street, Lot 556 & Pt Lot 500 Reid Street and Lot 960 Maley Street, Exmouth

Base data supplied by Landgate.
Accuracy +/- 4m. Projection MGA Zone 50.

Areas and dimensions shown are subject to final survey calculations.
All carriageways are shown for illustrative purposes only and are subject to detailed engineering design.

LEGEND

Outline Development Plan Area

CLIENT	LandCorp
SCALE	1:12,500@A3
DATE	10 June 2014
PLAN No	3777_4-5-001c.dgn
REVISION	-
PLANNER	L.R.
DRAWN	G.K.
CHECKED	L.R.

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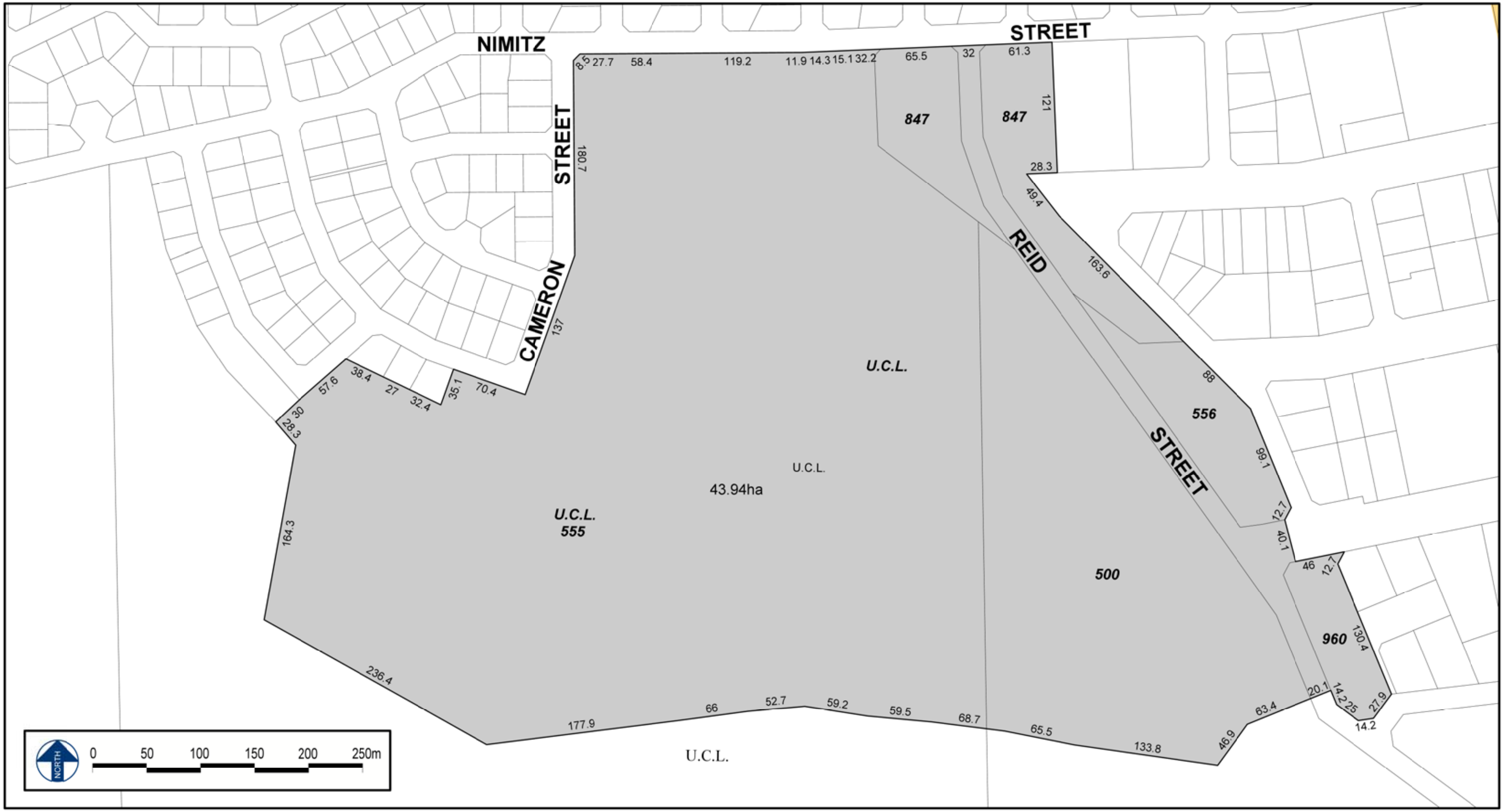
PLAN 1



SITE PLAN Lots 555 & 847 Nimitz Street, Lot 556 & Pt Lot 500 Reid Street and Lot 960 Maley Street, Exmouth

Base data supplied by the Western Australian Land Information Authority.

Accuracy +/- 4m.

Areas and dimensions shown are subject to final survey calculations.
All carriageways are shown for illustrative purposes only and are subject to detailed engineering design.

Subject Area

CLIENT	LandCorp
SCALE	1:5,000@A4
DATE	10 June 2014
PLAN No	3777-4-001c.dgn
REVISION	c
PLANNER	L.R.
DRAWN	G.K.
CHECKED	-

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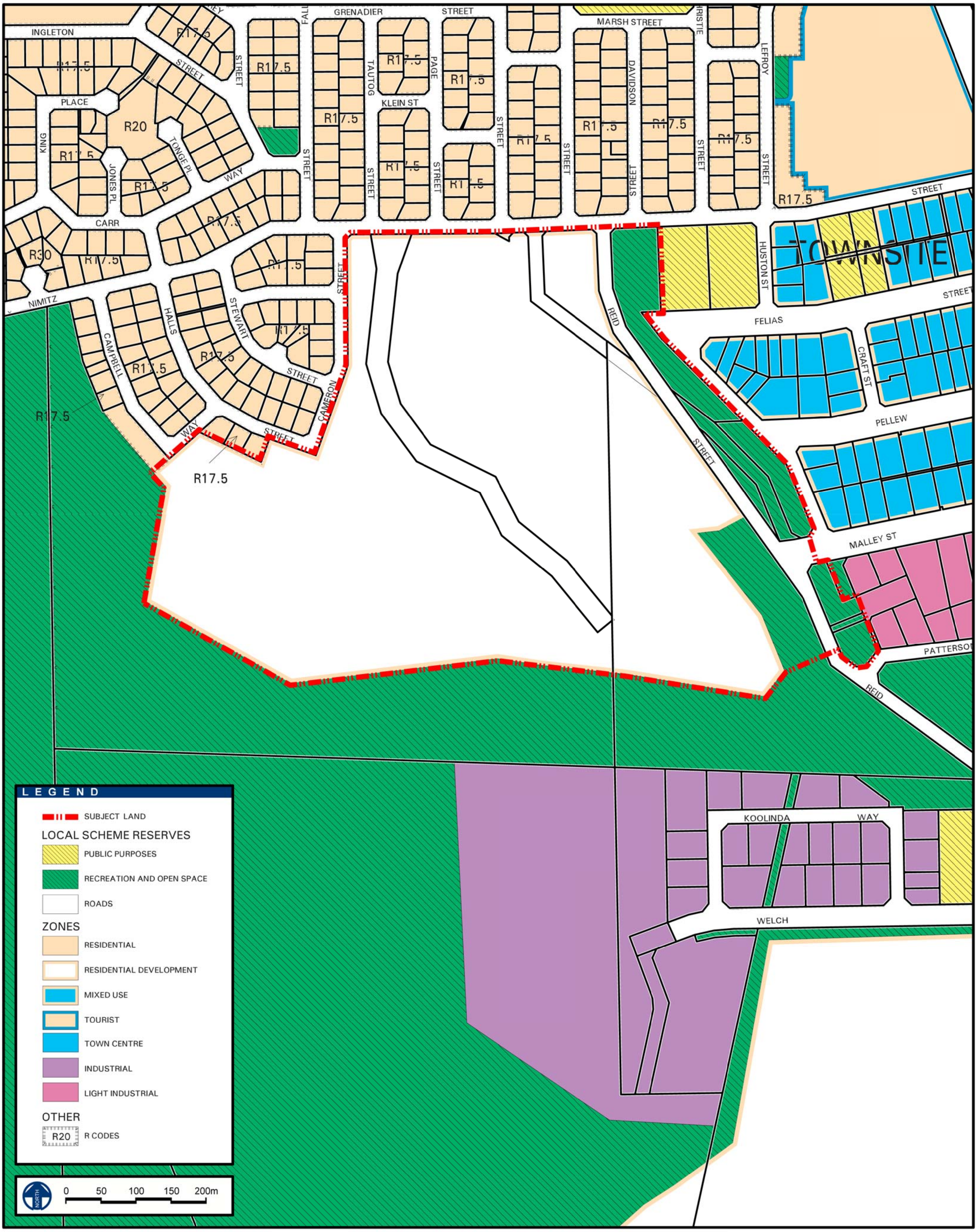
PLAN 2



ZONING MAP

Lots 555 & 847 Nimitz Street, Lot 556 & Pt Lot 500 Reid Street and Lot 960 Maley Street, Exmouth

Image supplied by WAPC.
Accuracy +/- 4m. Projection MGA Zone 50.

Areas and dimensions shown are subject to final survey calculations.
All carriageways are shown for illustrative purposes only and are subject to detailed engineering design.

LandCorp	:	CLIENT
1:5,000@A3	:	SCALE
10 June 2014	:	DATE
3777_4-5-002b.dgn	:	PLAN No
b	:	REVISION
L.R.	:	PLANNER
G.K.	:	DRAWN
L.R.	:	CHECKED

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PLAN 3

As outlined in TPS 3, the objectives of the 'Residential Development' zone are to:

a) *"Provide for residential development for expansion of Exmouth.*

b) *Provide for diversity of lifestyle choice with a range of residential densities.*

c) *Achieve a high standard of residential development having regard to the economic importance of tourism to the town.*

d) *Allow for the establishment of non-residential uses which are compatible with the predominant residential use and which will not adversely affect local amenities.*

e) *Promote development consistent with the planning objectives and recommendations of the Exmouth-Learmonth (North West Cape) Structure Plan."*

TPS 3 requires the preparation of an ODP for all land zoned 'Residential Development' in accordance with the provisions of Clause 5.2.3 of the Scheme.

The ODP has been prepared in accordance with provisions outlined in TPS 3.

The ODP encompasses land in the south-east corner currently reserved for 'drainage' purposes (**refer Plan 4**). Council has advised that a portion of this drainage reserve is surplus to its requirements and has expressed a willingness to modify the current Management Order to facilitate future development over the surplus portion.

Council is presently negotiating a transfer of the surplus portion with LandCorp.

Since the time the ODP was originally adopted, Amendment No. 29 to TPS 3 was prepared and has since been gazetted, facilitating the rezoning of a portion of land reserved for 'Recreation and Open Space' on the south-west corner of Reid Street and Nimitz Street.

1.3.2 Policy Framework

Liveable Neighbourhoods

Liveable Neighbourhoods is an adopted policy intended to guide the subdivision and development of land in Western Australia. The key principles of this policy include:

- Providing a variety of lots sizes and housing types to cater for the diverse housing needs of the community at a density that can ultimately support the provision of local services;
- To ensure cost-effective and resource efficient development to promote affordable housing; and
- To maximise land efficiency.

The proposed ODP not only acknowledges the objectives of Liveable Neighbourhoods in providing a greater diversity in housing types, but addresses the important objective of maximising land efficiency by rationalising development in an established and well serviced residential area. The proposed ODP will also facilitate the development of housing options that will directly target housing demand in Exmouth.

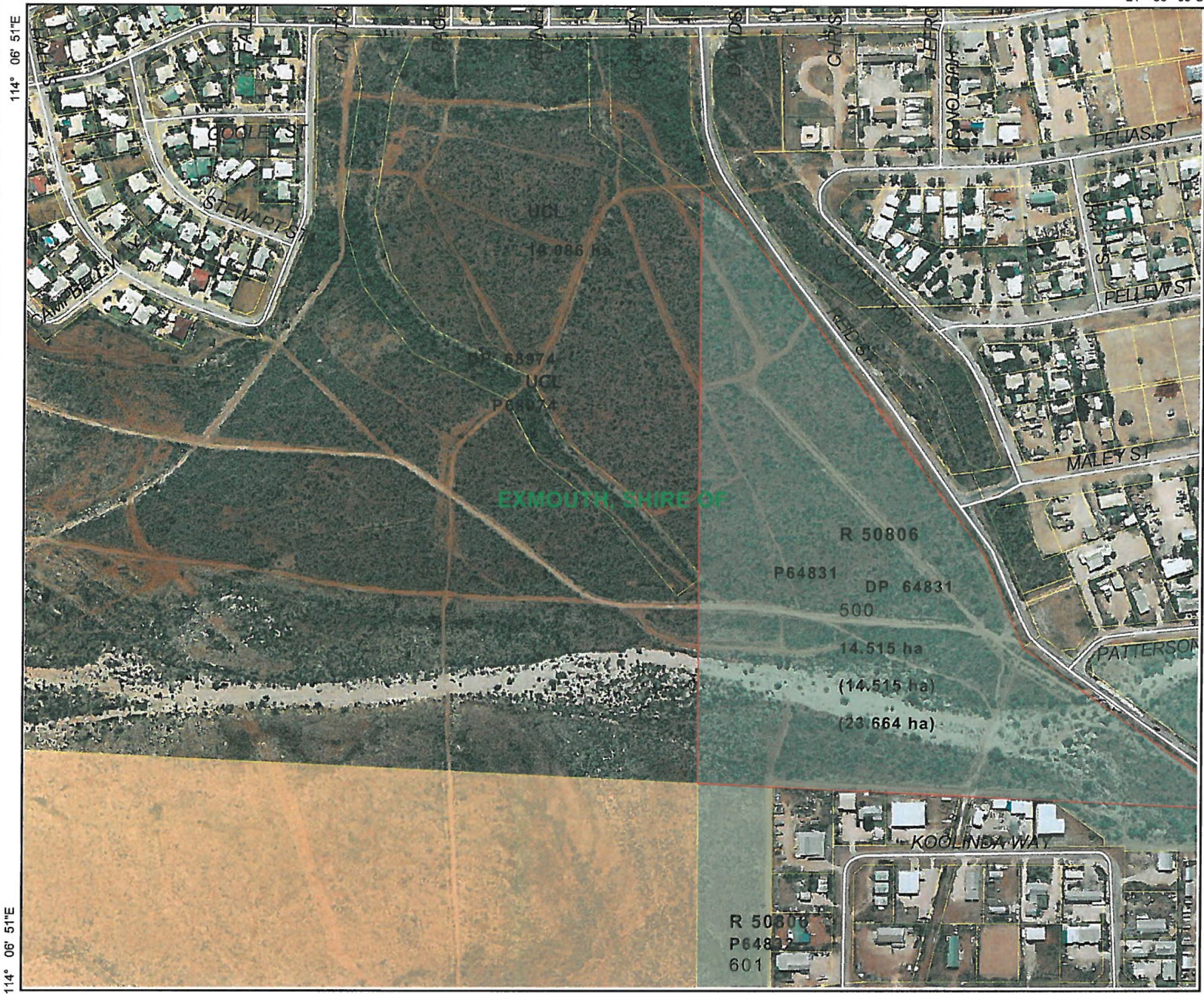
Exmouth Townsite Structure Plan

The Exmouth Townsite Structure Plan report focuses on the establishment of a land use framework for the Exmouth Townsite that will guide the preparation of a Local Planning Strategy, and in so doing assist the

Map Viewer

Created 16 Jan 2012

21° 56' 09"S
114° 06' 51"E



21° 56' 09"S
114° 07' 53"E

21° 56' 47"S
114° 06' 51"E

21° 56' 47"S
114° 07' 53"E

N

Scale: 1:6,000

Description

Map Projection: GDA 94 (Lat/Long)

Datum: Geocentric Datum of Australia 1994

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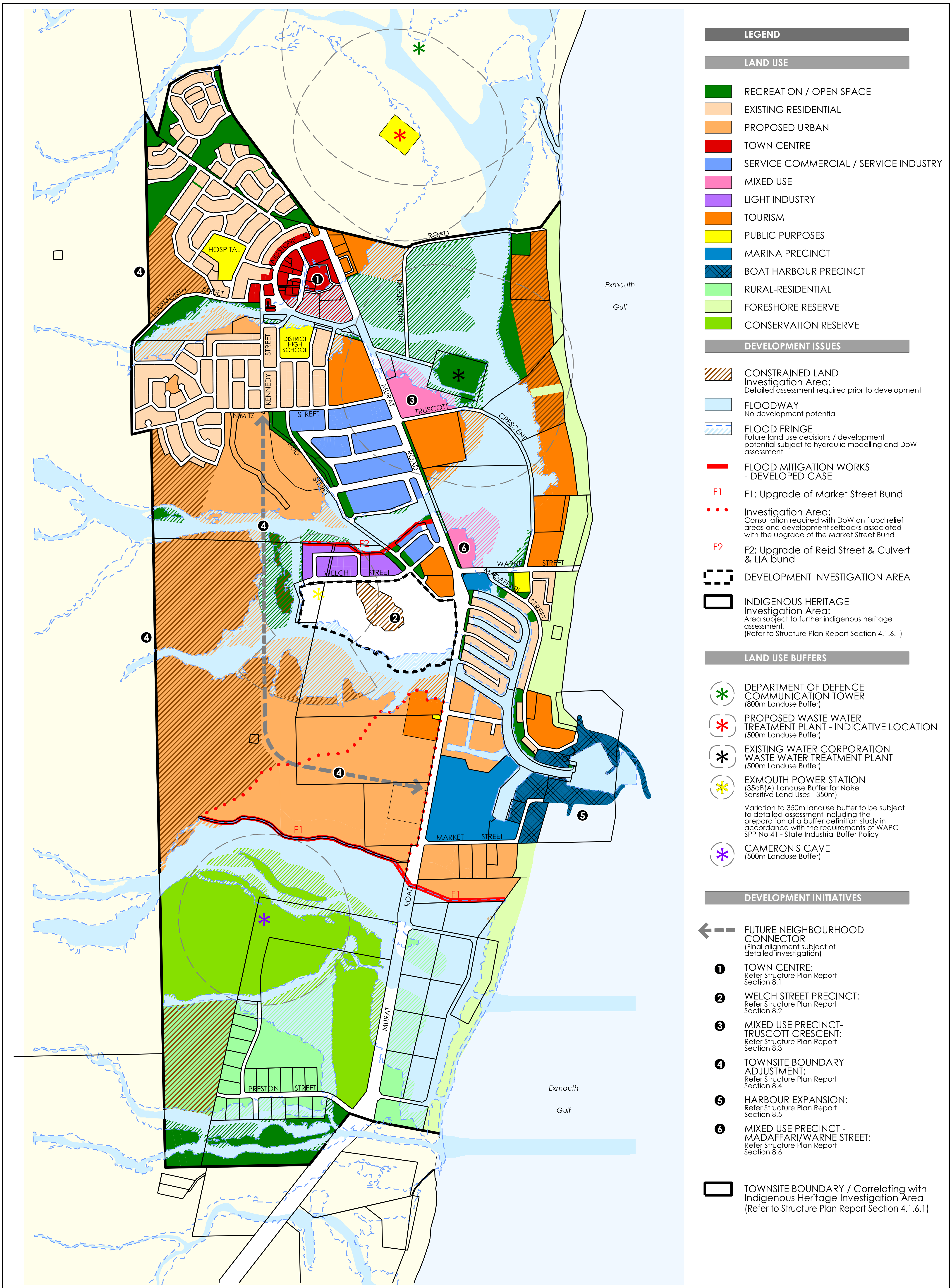
Landgate



Exmouth Townsite Structure Plan 2011

SHIRE OF EXMOUTH / DEPARTMENT FOR PLANNING AND INFRASTRUCTURE

plan:	designed:	scale:
08/024/001G	SB	1:20 000@A3
date: 29/08/2011	checked: WHB	0 200 400
projection: MGA94-Z50	drawn: NM	

N

Taylor Burrell Barnett Town Planning & Design
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implementation of development initiatives and land use decisions over time. The Structure Plan was adopted by the WA Planning Commission in September 2011.

The subject land is identified as “Proposed Urban” under the Structure Plan. The Structure Plan defines the classification of “Proposed Urban” as being:

“predominantly providing for residential development and a range of compatible associated uses including local employment, recreation and open space, local shopping, schools and other community facilities, with the requirement for comprehensive investigation and structure planning to define the appropriate distribution of land uses and to resolve any environmental and planning requirements relating to the development of land.”

The subject land is also identified as one of three residential infill areas within or adjacent to the existing residential areas of Exmouth. Referred to as “Nimitz Street south”, the Structure Plan states as follows:

“This land parcel is comprised of approximately 35 ha. Whilst the land is only partially affected by the flood fringe areas associated with LIA Creek, detailed engineering design would need to address local drainage constraints. Structure Planning should make provision for the alignment of the proposed neighbourhood connector to facilitate the Kennedy Street link. Native Title clearance has not yet been obtained.”

As discussed in section 3.0 of this report, the proposed ODP has been designed in accordance with the requirements of the Structure Plan.

1.4 Context Analysis

1.4.1 Surrounding Land Use and Development Pattern

The subject land is situated to the south of the existing development front and to the west of the existing industrial precinct.

The Exmouth Power Station is located approximately 400m to the south of the subject land. The Exmouth Power Station is a gas-fired power station comprising eight generators. Seven of the eight generators operate on duel fuel (compressed natural gas / liquefied petroleum gas) and one operates on diesel fuel. The main generators are chiefly fuelled by natural gas taken from the Dampier-to-Bunbury natural gas pipeline.

1.4.2 Economic Considerations

As part of its Urban Development Program, the WAPC prepares a series of regional hotspot reports on major resource centres. The Exmouth Regional Hotspots Land Supply Update 2008 identified that Exmouth’s greatest current challenges are land release and housing supply to keep pace with the local economic drivers of impending off shore oil and gas projects and tourism and fishing industries.

2.0 Site Conditions and Environment

2.1 Environmental Overview

An Environmental Assessment Report (EAR) has prepared by RPS Environment to support the proposed ODP (**refer Appendix 1**). The modifications undertaken to the ODP since the time the EAR was prepared has not generated a requirement to update the EAR, with the findings and recommendations remaining relevant and applicable. A summary of the EAR is provided below.

2.1.1 Climate

The Gascoyne region experiences a dry warm Mediterranean Climate characterised by cool, wet winters and hot, dry summers. More specifically, Exmouth frequently experiences seasonal extremes in weather from hot summer days when north easterly winds arrive from the interior of Western Australia to cold, wet, windy winter days as cold fronts from the Southern Ocean move through the region. Mean maximum temperatures of 38^{o}C have been recorded at Learmonth in January while the mean minimum temperature is 11.3^{o}C during July.

The long term average rainfall for Exmouth is approximately 267 mm per annum, which generally falls during either from January through to March or from May to July. Rainfall in summer is associated with thunderstorms and tropical lows, which can produce heavy localised falls over short periods of time. Most rain which occurs from May to July which is brought to the region by tropical cloud bands originating in the north west of the state.

Tropical cyclones causing strong winds, high seas and heavy rain affect the North West Cape about once every two years on average. Cyclones are most common in February and March.

2.1.2 Flora and Fauna

Flora & Vegetation

Coffey Environments identified that the vegetation condition for the majority of the subject land was considered to range from ‘Poor’ to ‘Very Poor’. The report also recorded that *Corchorus congener*, a Priority 3 species, was recorded in two locations upon the subject land.

The targeted flora searches undertaken by RPS in December 2011 did not record any additional *Corchorus congener* plants or any other species of Threatened or Priority Flora upon the subject land.

Priority 3 species are ‘Taxa’ that are known from collections or sight records from several localities not under imminent threat, or from few but widespread localities with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Taxa may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and known threatening processes exist that could affect them (Florabase 2011).

Kendrick and Mau (2002) identify that in general the flora of the Cape Range subregion is poorly known with limited intensive surveys being undertaken. Kendrick and Mau (2002) note only very small areas of the subregion have been examined in detail and these surveys are usually undertaken for specific development proposals.

A search of FloraBase was undertaken to locate other occurrences of this *Corchorus congener* in Western Australia. Sixteen locations were identified, 9 of which were located on the Exmouth Peninsula. One of these locations (was described as having up to 60 plants) is protected within the Cape Range National Park.

Given that there is a lack of existing information regarding the flora of the Cape Range sub-region as identified by Kendrick and Mau (2002) it is very unlikely that the removal of the *Corchorus congener* plants identified within the two locations within the proposed ODP will have a significant effect upon the remaining population of the species, given the large numbers of the species that are already protected within an Cape Range National Park.

Fauna

Future development of the subject land is not considered likely to have a significant impact on any fauna species identified in the desktop assessment or in the field survey.

2.1.3 Aboriginal Heritage and Native Title

A search of the Department of Indigenous Affairs (DIA) Aboriginal Heritage Inquiry System was undertaken in January 2011 and no Aboriginal sites were registered over the subject land or lands directly adjacent to the subject land.

A Heritage Survey of the Nimitz site has been undertaken and was completed in March 2012.

2.1.4 Exmouth Power Station

The Nimitz site was zoned for ‘Residential Development’ purposes in 1999 under TPS 3, which is prior to the selection of the power station site in 2003.

The Environmental Protection Authority in the document Guidance for the Assessment of Environmental Factors – Environmental Noise, specified that a maximum night time noise impact of 30-35 decibels (dB) is permitted on residential development in proximity to industry. Lloyd George Acoustic (2011) has provided ‘real time’ night time data that demonstrates that most of the Nimitz Street site is between the 30-35dB contour (refer Plan 6). Lots falling outside the 30-35dB contour will require a Notification on Title at subdivision.

Worley Parsons, the Power Station Operator, is committed to noise mitigation works that will reduce the dB level from 5-10dB. The modifications will be completed in October 2012 and new noise contours will be mapped that potentially will include the south of the site within the 30-35dB contour.

2.1.5 Hydrology

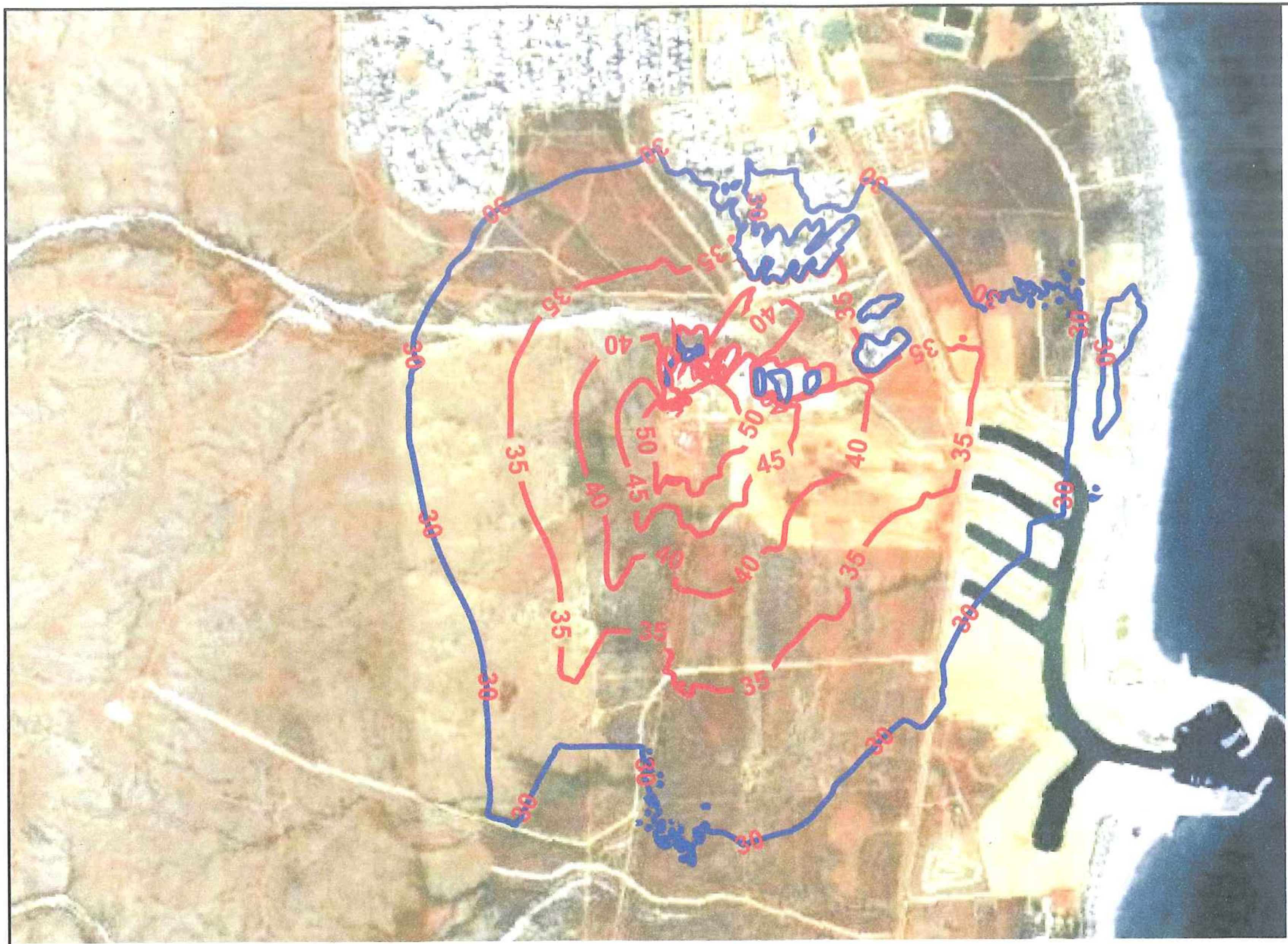
An ephemeral local watercourse lies approximately 30 m beyond the southern boundary of the subject land. The watercourse performs the hydrological function of a local flood plain which conveys and disperses the overland flow from the surrounding catchment area during high rainfall or less frequent extreme events, such as tropical cyclones.

SKM have prepared a floodplain management report for the Department of Water; *Exmouth Floodplain Management Strategy* which determines the 1 in 100 year Average Recurrence Interval (ARI) for the ephemeral local watercourse. SKM identifies that the southern boundary and south east corner of the subject land lie within the 1 in 100 year ARI level.

A drainage channel, which traverses the subject land from the north-west to the south-east, has been created from storm water runoff from the existing residential development to the north.

JDA Consultants have prepared a Local Water Management Strategy (LWMS) to support the ODP (refer ***Appendix 2***). This has been submitted to the Council and the Department of Water for review and endorsement. Further details on the LWMS are outlined in Section 3.5 of this report.

Figure 4.3



Exmouth Power Station - Existing Night Operating Conditions (4 Engines)
Predicted Noise Levels L_{A10} Noise Levels - Wind from All Directions

Lloyd George Acoustics
by Daniel Lloyd
daniel@lgacoustics.com.au
(08) 9300 4188

3.0 Proposed Outline Development Plan

The original ODP for the Nimitz site was adopted by the WAPC on 23 July 2012 and seeks to facilitate the orderly release of vacant Crown land for residential purposes, representing an expansion of the existing Exmouth townsite residential area. Since the time of the ODP being adopted by the WAPC, subdivision approval has since been granted for Stages 1 and 2 of the ODP area, which will facilitate the release of seventy (70) residential lots, including an area of public open space. To facilitate approval of the next stage of subdivision (Stage 3), the ODP has been modified. A summary of the modifications undertaken to the ODP are provided below:

1. Extension of the ODP boundary to include the existing Recreation and Open Space reserve located east of Reid Street, essentially facilitating the relocation of the previously proposed easternmost linear drainage system;

2. Deletion of the 'Area Subject to Further Investigation, Including Rezoning' category from the ODP;

3. Modification to the extent of the 'Area reserved for Recreation and Open Space (TPS3)' category to reflect Amendment No. 29 and the current TPS 3 Map; and

4. Amending the general layout of the ODP, including the proposed road network, the proposed residential areas and areas of public open space so as to reflect Amendment No. 29 and the relocation of the easternmost linear drainage system.

The project team, in consultation with the Shire of Exmouth, reviewed the original ODP layout and specifically how the area of land near the corner of Nimitz Street and Reid Street could be designed and developed for residential purposes following the rezoning of this area from 'Recreation and Open Space' to 'Residential Development'. The previously proposed linear drainage system, which ran through this portion of the ODP was an identified design constraint, and given the area is highly suitable for residential purposes and is the area of land located within closest proximity to existing infrastructure, including the Exmouth Town Centre, the objective was to ensure the land was designed and developed as efficiently as possible. This meant that an alternative drainage concept was necessary, with the area of land located on the eastern side of Reid Street being identified as being suitable to accommodate such a function, effectively removing the identified design constraint.

The design of this area as shown on the current ODP will now facilitate additional single residential lots, with those fronting Nimitz Street having a R17.5 density coding to provide for an appropriate interface with existing residential development to the north. The remaining portion of this area has been coded R20, which will facilitate single residential lots serviced via a new 15.4m wide cul-de-sac road. The layout of the originally adopted ODP has also, in part, been reviewed, resulting in the reorientation of some residential cells to facilitate greater frontage to the central public open space area, whilst also improving the climatic responsiveness of the design (i.e. increased east-west orientated residential cells).

The modifications to the ODP are considered to represent an improved and more efficient planning outcome, undertaken in consultation with the Shire of Exmouth and supported by necessary technical investigations (NOTE: The modifications to the ODP have not generated a requirement to modify the technical reports appended to this document, with the findings and recommendations remaining applicable).

The following sections of this report outline the design elements of the ODP, consistent with that required under the WAPC's Liveable Neighbourhoods policy.

3.1 Community Design

The ODP is intended to designate the broad land use over the extent of the subject land. The ODP uses environmentally sensitive design to facilitate the residential expansion of the Exmouth in a logical and coordinated manner.

The ODP is characterised by the provision of a linear strip of POS approximately 25m wide, which in addition to providing a passive recreation function for future residents will assist in the disposal of stormwater from the site, including the surrounding catchments.

The ODP has been designed taking into account the alignment of the proposed bund for Reid Street in the south-east corner of the subject land. Construction of this bund is due to commence shortly. Any off-site impacts associated with the construction of this bund, including storage or dumping of material will need to be discussed with LandCorp.

3.1.1 Integration with Surrounding Development

The ODP provides for appropriate connections and integration with surrounding residential and non-residential development.

3.2 Movement Network

A detailed Transport Assessment Report (TAR) has been prepared by i3 consultants WA (***refer Appendix 3***) to assess the impacts of the ODP on the adjacent road network. The following summarises these investigations:

- The development of Nimitz Street ODP is specific to the needs of Exmouth, consistent with the Exmouth Townsite Structure Plan and has been carried out in accordance with best practice sustainable planning principles and policies.
- There is a need for a Road Hierarchy consistent with Liveable Neighbourhoods to be developed and adopted for the Exmouth Townsite as soon as possible to assist with sustainable planning processes and procedures.
- There is plenty of mid-block capacity on all of the assessed roads with current usage between 2% and 17% of capacity.
- There is plenty of spare capacity within all of the assessed intersections (existing and proposed with the forecast volumes up to 2030) with all intersections formally assessed as “Good with minimal delays and plenty of spare capacity”.
- There is a ‘disconnect’ between the main Integrator (Arterial) Road (Murat Road) and the Town Centre. At present Murat Road tends to lead unfamiliar motorists past the turn off to the town centre (Maidstone Crescent). It is noted that the Shire of Exmouth is currently investigating ways of addressing this through the Town Centre Plan and recommendations within the Exmouth Townsite Structure Plan. This includes ‘reclassifying’ Kennedy Street as a Neighbourhood Connector Road and extending this through the *Nimitz Street ODP* area to connect to Murat Road south of the Marina Precinct. This will provide a more direct route to the Town Centre for local traffic.
- There are no public transport facilities or services within the Exmouth Townsite and no plans to provide these.
- The majority of residential roads have paths on at least one side and provide good connective pedestrian links to facilities through to the town centre.

An addendum to the Traffic Assessment Report was provided to capture the changes in the ODP that was originally endorsed. From a transport perspective, the layout is not expected to result in any greater impacts on streets and roads than assessed in the Transport Assessment Report for the original layout. It will, however, require Council to consider the following:

- That careful attention is given to the detailed design of Kennedy Street to ensure that operating speeds do not exceed 50 km/h.
- That the section of Learmonth Road east of the Kennedy Street extension is designed as a Neighbourhood Connector Road if it is intended to finally connect this to Reid Street.
- That the proposed road network in the Exmouth Town Centre Structure Plan is amended to reflect the above and assess the requirement, if any, to changes to other Neighbourhood Connector Roads shown in the Exmouth Town Centre Structure Plan.

The modifications to the ODP following its adoption maintain the general distribution of traffic on surrounding streets, with no impact on the capacity of existing of future intersections. Consistent with the originally adopted ODP and as required by the Shire of Exmouth, the modifications maintain the three (3) future road connections with Reid Street.

3.2.1 Intersection Spacing

All intersections are spaced so as to comply with the requirements of the Liveable Neighbourhoods. The proposed ODP will result in a safe environment for pedestrians, cyclists and motorists.

3.2.2 Traffic Speed

The local streets proposed by the ODP are designed to produce the target vehicle speeds as prescribed by Liveable Neighbourhoods. The proposed local streets are short in length and do not create opportunities for speeding.

3.2.3 Public Transport

There are currently no public transport services available in Exmouth.

3.2.4 Pedestrian Circulation and Amenity

The creation of integrated, highly connective, attractive and safe spaces for pedestrians, which respond to the local climate, have been considered having regard to the following urban design principles:

- Encouraging the upgrading of streets to serve as the primary pedestrian environment.
- Improving the amenity of streets for pedestrians, including provision of shading and shelter.
- Ensuring a highly connected and legible movement network to facilitate the most efficient and direct movement.
- Encouraging an active frontage to streets to maximise passive surveillance.
- Designing streets to ensure low speed environments for pedestrian safety.

The proposed path network will integrate and connect with the existing pedestrian and cycle system and will be developed in consultation with the Shire of Exmouth.

3.2.5 Streetscape

The proposed street network has been designed to convey to its user its primary function, character and identity and encourages appropriate drive behaviour. Development will be subject to specific design provisions, promoting a high standard of design and passive surveillance of public areas.

3.3 Lot Layout

3.3.1 Density and Diversity

The Outline Development Plan incorporates a mix of low and medium density lot sizes including Residential R17.5, R20 and R30 development sites. A summary of the potential lot yield and densities is outlined below:

Table 1: Lot Density and Diversity

DENSITY CODE	ESTIMATED LOTS	ESTIMATED DWELLING UNITS[1]
R17.5	298	298
R20	97	97
R30	4	50
Total	**399**	**445**

[1]Based on strict interpretation of the minimum average lot size requirements of the R-Codes

It should be noted that these numbers are based on the strict interpretation of the minimum average lot size requirements of the R-Codes, and are therefore higher than what is anticipated to be delivered through the eventual subdivision of the land. In this regard, it should be noted that LandCorp expects to create lots averaging approximately 700m^2 in the R17.5 zones and 600m^2 in the R20 zones.

The Residential R30 sites are predominately located adjacent to the main neighbourhood connector road and areas of POS. Opportunities exist for the R30 sites to be developed as a mix of grouped housing and conventional single residential dwellings.

The higher density opportunities will assist in delivering a balanced outcome of residential housing options, notwithstanding that prevailing market conditions in Exmouth will, for the foreseeable future, remain focussed on the provision of single house lots.

3.3.2 Lot Type and Shape

The R17.5 and R20 areas will predominantly include single residential lots, generally characterised by wider than normal frontages to enable cooling breezes to access the living areas of the dwellings.

3.3.3 Climatic Responsiveness

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. Lot orientation that favours an east-west alignment will reduce solar exposure and therefore reduce heat gain to otherwise large external walls.

The ODP has, where possible, endeavoured to provide for residential cells that will facilitate lots with an east-west alignment. However, given the configuration of the ODP area and the need for appropriate connections to both the existing and future residential areas, not all residential cells can achieve the optimum alignment. Nevertheless, it is anticipated that Design Guidelines will be prepared for the land which will, among other things, address housing responsiveness to climatic conditions (ie. shading devices, energy efficient materials, etc).

3.4 Public Open Space

The WAPC's Policy No. DC 2.3 'Public Open Space in Residential Areas' requires that for residential subdivision, 10% of the gross subdivisible area shall be given up free of cost by the subdivider for POS purposes. The aim of the policy is to ensure that the provision of POS allows for a reasonable distribution of land for active and passive recreation.

The total POS provision is approximately 10.0% of the gross subdividable area. The Schedule below provides a breakdown of the POS provision. In addition, **Plan 7** provides an illustration of the proposed POS areas.

Table 2: Public Open Space Schedule

Public Open Space Schedule		
Total Site Area	43.94 ha	
Total	**43.94 ha**	
Less		
Area reserved for Recreation and Open Space (TPS 3)	5.05 ha	
LIA Creek Floodway (1:100 yr ARI)	2.61 ha	
Net Site Area	**36.28 ha**	
Deductions		
Drainage - Drain A1 - Drain A2 - Drain B1	 0.62 ha 0.38 ha 0.09 ha	
Total	**1.09 ha**	
Gross Subdivisible Area		**35.19 ha**
Public Open Space Requirement (Standard 10%)		**3.52 ha**
Public Open Space Requirement (5% Regional Variation under LN)		**1.76 ha**
Provision of Public Open Space		
- POS A1 - POS A2 - POS A3 - POS A4 - POS B1 - POS B2 - POS C1	0.62 ha 0.15 ha 1.68 ha 0.48 ha 0.33 ha 0.11 ha 0.15 ha	
Total	**3.52 ha**	
Total Public Open Space		**3.52 ha (10.00%)**

The POS provided in the ODP comprises functional and practical areas of land. The ODP has deliberately avoided the creation of 'pocket parks' and other small, impractical areas of POS, given the longer term maintenance issues such areas present to Council.

3.4.1 Landscape

It is envisaged that the function of the proposed public open space area will be for passive recreation and urban water management. Final design requirements will be confirmed at the detailed design phase, in consultation with the Shire of Exmouth.

PUBLIC OPEN SPACE SCHEDULE -Proposed Modification to Nimitz Street ODP (June 2013)	
TOTAL SITE AREA	
Total	**43.94ha**
LESS	
Area reserved for Recreation and Open Space (TPS 3)	5.05ha
LIA Creak Floodway (1:100 yr ARI)	2.61ha
Net Site Area	**36.28ha**
DEDUCTIONS	
Drainage	
Drain A1	0.62ha
Drain A2	0.38ha
Drain B1	0.09ha
Total	**1.09ha**
Gross Subdivisible Area	**35.19ha**
Public Open Space Requirement (Standard 10%)	**3.52ha**
Public Open Space Requirement (5% Regional Variation available under LN)	**1.76ha**
PROVISION OF PUBLIC OPEN SPACE	
P.O.S. A1	0.62ha
P.O.S. A2	0.15ha
P.O.S. A3	1.68ha
P.O.S. A4	0.48ha
P.O.S. B1	0.11ha
P.O.S. B2	0.25ha
P.O.S. B3	0.11ha
P.O.S. C1	0.15ha
Total	**3.54ha**
Total Public Open Space	**3.54ha (10.06%)**

Future subdivision of areas subject to rezoning will need to demonstrate compliance with the level of Public Open Space proposed.

LEGEND

- Outline Development Plan Boundary
- 400m Catchment
- Public Open Space
- Drainage
- Area reserved for Recreation and Open Space (TPS3)
- LIA Creek 1:100 ARI
- Water Corpcration Water Main

NORTH 0 25 50 75 100 125m

RPS

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1:2,500@A2	SCALE
10 June 2014	DATE
3777_4-4-002d.dgn	PLAN No
G.K.	DRAWN

PLAN 7: PUBLIC OPEN SPACE PLAN

Lots 555 & 847 Nimitz Street, Lot 556 & Pt Lot 500 Reid Street and Lot 960 Maley Street, Exmouth

3.4.2 Parkland Frontage and Surveillance

The location, layout and design of future subdivision and development surrounding the POS should minimise potential problems relating to personal security, property security and poor visual amenity in relation to the park and its boundaries by providing high levels of passive surveillance through public road and direct lot frontage interface.

The ODP has endeavoured, where possible, to frame the areas of POS with streets, such that future dwellings will overlook the street and POS, consistent with the requirements of Liveable Neighbourhoods. Design provisions will be included in future DAPs for those lots which have direct frontage onto the public open space system, ensuring adequate surveillance and amenity is afforded.

3.5 Urban Water Management

A Local Water Management Strategy (LWMS) has been prepared by JDA in support of the ODP ***(refer Appendix 2).*** The LWMS has been submitted under separate cover with the Department of Water (DoW) and Shire of Exmouth for approval, consistent with the WA Planning Commission's *Better Urban Water Management Guidelines (WAPC October 2008).*

The LWMS establishes a Total Water Cycle Management approach to water management at the site, and has been developed based on detailed site-specific investigations, industry best-practice and relevant state and Shire of Exmouth policies relating to water management. The overall objective for the LWMS is to mimic the hydrological regime that currently exists prior to urban development of the site. Underpinning this is the requirement to protect life, property and the environment from intense rainfall events.

A summary of the key principles and objectives underpinning the ODP and LWMS for the Nimitz site are presented in Table 3 below.

Table 3: LWMS Key Principles and Objectives

Key WSUD Guiding Principles		
▪ Facilitate implementation of sustainable best practice in water management in the Exmouth 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 water-logging ▪ 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	▪ Minimise the use of potable water where drinking water quality is not essential, particularly ex-building use. ▪ Apply waterwise landscaping measures to streetscapes and POS areas to reduce/avoid irrigation.

Surface Water Flows and velocity	▪ Protect development from flooding. ▪ Implement open drains for safe conveyance of flood waters. ▪ Implement economically viable stormwater systems. ▪ Retain natural drainage systems and protect and/or improve ecosystem health ▪ Reduce the stormwater velocity to prevent export of sediments and manage erosion. ▪ Ensure that stormwater management recognises and maintains social, aesthetic, and cultural values	▪ For flood management, manage up to the 100yr ARI event within the development. ▪ Finished floor levels to be 0.5m above 100yr ARI flood level. ▪ Use open drainage swales through the development to disperse flow throughout the development with the aim to minimise velocity. Drainage swales sized to minimum 5yr ARI, with larger events flowing along road reserve. ▪ Where there are identified impacts on significant ecosystems, maintain or restore desirable environmental flows and/or hydrological cycles consistent with DoW's requirements.
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 immediate vicinity. The receiving environment is LIA Creek which discharges to the intertidal zone prior to discharging to the Exmouth Gulf. ▪ Nutrients not considered a priority in the North West.

Whilst the location of one of the drainage channels in the original ODP / LWMS has now been modified, the overall objectives for water management remain consistent and therefore the original LWMS is not required to be revised. JDA have undertaken investigations (incl. modelling) relating to the use of the area located east of Reid Street for drainage purposes. These investigations and findings are summarised in the below dot points:

- Stormwater modelling has been undertaken by JDA to assess the hydraulic performance and flood storage capacity to convey stormwater from the Nimitz development. Modelling performed with the existing topography of the area indicates that the only alterations required to safely convey up to the 100yr ARI rainfall event to LIA Creek are culverts under cross roads (Maley Street and Paterson Way) and construction of an approximately 0.8m high bund along the interface with Carter Road. Retention of the existing landform in this area with a larger flow width also maximises the opportunity for stormwater quality improvement through increased sedimentation due to decreased flow velocity.
- The investigations carried out by JDA have established that the use of this area to assist in the conveyance of stormwater to LIA Creek reduces the extent of the LIA Creek tailwater in the drainage channel, effectively reducing the volume of fill required for the future residential development.
- In addition to an improved and more efficient planning outcome (as outlined in section 3.0 of this report), the use of this area will reduce the Shire's future maintenance requirements by providing a single integrated area for drainage rather than separate drainage areas either side of Reid Street.

Further detailed engineering design of the stormwater drainage channel on the eastern side of Reid Street will be described in the future Urban Water Management Plan, required as part of the subdivision of the Nimitz Street site. The Shire of Exmouth, at its Ordinary Council Meeting on 1 August 2013 resolved to support the proposal to relocate the drainage channel to the east side of Reid Street, which also included a request to the Department of Lands to create a reservation on Lot 556 for the purposes of recreation and drainage and also to change the purpose of part reserve R31212 from recreation to recreation and drainage.

3.6 Utilities

The subject land is surrounded by existing development (to the north, west and east), which greatly facilitates new development in terms of availability of connection points for services and access to existing road infrastructure.

Water and Sewerage

A supply of reticulated water and connection to the reticulated sewerage scheme is available for the subject land. Any costs incurred in upgrading or relocating existing services will be Water Corporation/LandCorp responsibility.

There is an existing 150AC and 200AC water main running on a north-south alignment through the centre of the subject land. This infrastructure, will in part, be left 'in situ', within the future road reserves and areas of public open space. A portion of this existing infrastructure however is proposed to be removed so as to facilitate the creation of the future residential lots within the north-eastern portion of the ODP area.

Reticulated sewerage will grade generally from west to the east across the subject and will need to pass under Reid Street to a connection point on Huston Street.

Power

Currently, high voltage infrastructure traverses the adjoining road network and can be used to supply future developments within the ODP. The existing network may not require upgrading, however, Horizon Power will need know the number of lots proposed and the timing of future development.

It is expected that the Council will refer the proposed ODP to Horizon Power and other stakeholders for comment during the consultation period. Horizon Power can then provide additional feedback on any capacity issues or constraints associated with the timely provision of future services to the subject land.

3.7 Implementation and Staging

Following approval of the ODP by the Council and endorsement by the WA Planning Commission, on advice from the Department of Planning, subdivision applications, consistent with the approved ODP, can be submitted for approval. It is acknowledged that as part of the subdivision assessment, the Commission may require LandCorp to prepare a Detailed Area Plan/s (DAP) for a cross-section of the proposed development sites. The DAPs will be prepared in consultation with the Shire of Exmouth and will be used by the Council to assist in the assessment of relevant Development Applications.

Typically, design elements required to be addressed in a DAP include setback requirements, site coverage, location of garages, boat parking, fencing requirements etc.

LandCorp has advised that it will progress subdivision of the land on a staged basis taking into account, among other things, prevailing market conditions. At this stage, LandCorp anticipates the first stage of development will involve the creation of approximately 35 lots at the northern end of the subject land. Services in this location are readily available and development of this portion of the ODP in the first instance represents a logical and orderly extension of the existing development front north of Nimitz Street.

4.0 Conclusion

The ODP, prepared on behalf of LandCorp, illustrates the preferred long term development concept for the Nimitz Street site in Exmouth.

The ODP has been prepared in accordance with the design requirements established by Liveable Neighbourhoods, and will facilitate significant residential development opportunities which will assist in meeting a demand for housing in this region.

The ODP has been based on a number of best-practice design principles, including climatic responsiveness, legibility, diversity and connectivity. Development will also integrate with the existing urban structure and land use.

A mix of residential densities have been proposed, encouraging a variety of lot sizes to cater for a diversity in housing options for existing and future residents of Exmouth.

APPENDIX 1

RPS

ENVIRONMENTAL ASSESSMENT REPORT

**UCL Nimitz Street, Exmouth,
Outline Development Plan**





ENVIRONMENTAL ASSESSMENT REPORT

UCL Nimitz Street, Exmouth,
Outline Development Plan

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Disclaimer

SUMMARY

Background

Exmouth is a coastal town situated on the North West Cape of Western Australia. Its diversity of natural resources including beaches, gorges and the Ningaloo reef coupled with the town's proximity to commercial fisheries and impending resources projects, are the key drivers for Exmouth's growth. With further growth forecast for the Gascoyne region, there will be a strong local demand for residential subdivisions to provide affordable housing in the region's second largest town.

Environmental Assessment Report

RPS Environment and Planning Pty Ltd (RPS) was commissioned by the Western Australian Land Authority (trading as "LandCorp"), to provide an Environmental Assessment Report (EAR) for UCL Nimitz Street, Exmouth (the subject land). The subject land is comprised of two land parcels which form a total of 39.6 hectares (ha).

The subject land is currently identified as being subject to two zonings under the Shire of Exmouth's Town Planning Scheme No. 3 (TPS No. 3). The majority of the subject land (approximately 35.26 ha or 87%) is zoned "Residential Development" with a small portion of land (approximately 5.10 ha or 13%) enclosed within the subject land being zoned "Recreation and Open Space" (Shire of Exmouth 2006).

A Scheme Amendment has been proposed to rezone the northern portion of the subject land (approximately 3.68 ha or 9% of the subject land) that is currently zoned "Recreation and Open Space" to "Residential Development".

This EAR has been prepared to support the proposed Outline Development Plan (ODP) for the subject land.

To assist in fulfilling the scope of services required to assess the natural environment of the subject land; Coffey Environments were commissioned to undertake a Level 2 Terrestrial Flora and Vegetation survey and JDA Consulting Hydrologists were commissioned to undertake a Local Water Management Strategy (LWMS).

RPS undertook a Level 1 Terrestrial Fauna survey and Preliminary Site Investigation (PSI) for contamination for the entire extent of the subject land.

Additional targeted flora searches were undertaken by RPS for species of Threatened and Priority flora in the portion of the subject land that was not surveyed as part of the Coffey Environments (2011) investigations and over the entire extent of the subject land in order to determine the relative distribution of the Priority 3 species, *Corchorus congener* (P3).

Key Findings

Hydrology

The southern boundary and south-east corner of the subject land lie within the 1 in 100 year ARI level for the ephemeral local watercourse.

Flora and Vegetation

No flora species protected under the EPBC Act or *Wildlife Conservation Act 1950* were identified upon the subject land.

Six plants of a Priority 3 species, *Corchorus congener* (P3), were recorded in two locations (three plants in each location) upon the subject land, however:

- at a subregional scale these six plants represent less than 1% of the known population of *Corchorus congener* (P3).
- vegetation types associated with the occurrence of *Corchorus congener* (P3) are not restricted to the subject land.
- it is considered extremely unlikely that the subject land would be considered significant habitat upon which *Corchorus congener* (P3) is dependent upon for survival.

No Threatened Ecological Communities (TECs) or Priority Ecological Communities (PECs) were identified within the survey area by Coffey Environments (2011).

The vegetation condition for the majority of the subject land is considered to range from "Poor" to "Very Poor".

Fauna

Although the subject land may potentially contain habitat, which could potentially be utilised by the identified species of conservation significant fauna, it is unlikely to be considered significant habitat upon which any of these species are dependent upon for survival.

Contamination

The PSI determined that sources of on-site and off-site contamination existed. The PSI determined that although potential contaminants were identified for the subject land, the nature and extent of these contaminants is likely to be minor.

Management of Impacts

A summary of the management measures which will underpin the proposed ODP for UCL Nimitz Street, Exmouth is provided in Table 2. The implementation of these management measures will ensure that any potential impacts to key environmental factors are managed to ensure that the development of the subject land meets the objectives of the Environmental Protection Authority (EPA).

Conclusions

The proposed ODP for the UCL Nimitz Street, Exmouth achieves the following environmental outcomes:

- creation of Public Open Space (POS) reservation containing retained vegetation bordering the ephemeral watercourse

- creation of green linkages of POS, containing existing drainage systems, to be used for the purpose of drainage.

Through addressing the identified key environmental factors, this environmental assessment of the proposed ODP for UCL Nimitz Street, Exmouth concludes that the potential environmental impacts identified in this report can be managed in accordance with the objectives of the EPA to prevent significant impacts to the environmental values of the subject land.

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(compiled at rear of report)

APPENDICES

1.0 INTRODUCTION

1.1 Background

RPS Environment and Planning Pty Ltd (RPS) was commissioned by the Western Australian Land Authority (trading as "LandCorp"), to provide an Environmental Assessment Report (EAR) for UCL Nimitz Street, Exmouth, Outline Development Plan which is comprised of two land parcels. These land parcels (the subject land) form an approximate 40.36 hectare (ha) extent of land directly to the south of the Exmouth Central Business District.

This EAR has been prepared to support the proposed Outline Development Plan (ODP) for the subject land (Figures 1 and 2).

1.2 Objective

The objective in undertaking this EAR is to identify the potential impacts to the environment posed by the development of the subject land and, identify management actions aimed at facilitating development of the subject land in accordance with the Environmental Protection Authority's (EPA) objectives.

In order to deliver this report, RPS followed this approach:

- described the existing natural environment of the subject land
- identified the key environmental constraints to the development opportunities
- identified potential management actions required to facilitate the development opportunities.

1.3 Methodology and Scope

This EAR addresses the following key environmental factors:

- hydrology
- flora and vegetation
- fauna
- acid sulfate soils
- contamination
- heritage
- noise.

The identified environmental factors have been validated and refined through undertaking a site visit.

To assist in fulfilling the scope of services required to assess the natural environment of the subject land; Coffey Environments were commissioned to undertake a Level 2 Terrestrial Flora and Vegetation survey and JDA Consulting Hydrologists were commissioned to undertake a Local Water Management Strategy (LWMS).

RPS undertook a Level 1 Terrestrial Fauna survey and Preliminary Site Investigation (PSI) for the entire extent of the subject land.

Additional targeted flora searches were undertaken by RPS for species of Threatened and Priority flora in the portion of the subject land that was not surveyed as part of the Coffey Environments (2011) investigations and over the entire extent of the subject land in order to determine the relative distribution of the Priority 3 species, *Corchorus congener* (P3).

2.0 PLANNING CONTEXT

The proposed ODP for UCL Nimitz Street is subject to the direction provided by the following key strategic planning documents.

2.1 Strategic Planning

2.1.1 State Planning Strategy

The *State planning strategy* (Western Australian Planning Commission (WAPC) 1997) provides the basis for long-term state and regional land use planning and coordinates a whole of government approach to planning. The *State planning strategy* aims to shape and manage the direction and form of development where it is most achievable and where there is the strongest case for government action to protect strategic assets (Department of Planning 1997).

2.1.2 Exmouth-Learmonth (North West Cape) Structure Plan

The *Exmouth-Learmonth (North West Cape) structure plan* (WAPC 1998) provided a vision for the direction of Exmouth and the North West Cape over a 30 year planning horizon and represents a balanced approach to land use planning in the region.

The primary focus of the *Exmouth-Learmonth (North West Cape) structure plan* was to promote sustainable uses that enable diversification of the economy while protecting the fragile environment of the North West Cape.

2.1.3 Exmouth Regional Hotspots Land Supply Update

As part of its Urban Development Program, the WAPC prepares a series of regional hot spot reports on major resource centres. The *Exmouth regional hotspots land supply update* (WAPC 2008) identifies that Exmouth's greatest current challenges are land release and housing supply to keep pace with the local economic drivers of impending off shore oil and gas projects and tourism and fishing industries.

Additionally, the *Exmouth regional hotspots land supply update* outlines key economic, employment, population and housing demand considerations.

2.1.4 Gascoyne Regional Development Plan 2010–2020

The *Gascoyne regional development plan* (Gascoyne Regional Development Commission 2010) is designed to provide a strategic direction for the Gascoyne region from 2010 to 2020. The *Gascoyne regional development plan* lists a series of priorities which provide focal points for proposed actions and projects designed to achieve specific outcomes identified by the Gascoyne region over a medium to long-term time frame.

2.2 Statutory Planning

The proposed ODP for UCL Nimitz Street, Exmouth is regulated by the Shire of Exmouth's statutory planning instruments.

2.2.1 Shire of Exmouth Town Planning Scheme No. 3

The subject land is identified as being subject to two zonings under TPS No. 3. The majority of the subject land (approximately 35.26 ha or 87%) is zoned "Residential Development" with a small portion of land (approximately 5.10 ha or 13%) enclosed within the subject land being zoned "Recreation and Open Space" (Shire of Exmouth 2006) (Figure 3).

A Scheme Amendment has been proposed to rezone the northern portion of the subject land (approximately 3.68 ha or 9%) that is currently zoned "Recreation and Open Space" to "Residential Development".

3.0 EXISTING ENVIRONMENT

3.1 Location

The subject land is located within the Shire of Exmouth, approximately 1 km south of the Exmouth Central Business District (Figure 1). Exmouth is situated in the Gascoyne region of Western Australia and is located about 1270 km north of Perth.

The Gascoyne region has a balanced economy which is supported by a strong network of retail, administrative and trade services. The major industries are predominantly built around tourism, retail, horticulture, mining, fishing, and pastoralism (Gascoyne Development Commission 2012).

The subject land is comprised of multiple parcels of land and has an area of 39.6 ha. The subject land is separated from existing urban development of the town site to the west by Cameron Street, to the north by Nimitz Street and to the east by Reid Street. To the south and south-west, the subject land is bordered by land reserved for “Recreation and Open Space”. The southern boundary of the subject land is bordered by an ephemeral watercourse.

3.2 Climate and Weather

The Gascoyne region experiences a dry warm Mediterranean climate characterised by cool, wet winters and hot, dry summers. More specifically, Exmouth frequently experiences seasonal extremes in weather from hot summer days when north-easterly winds arrive from the interior of Western Australia to cold, wet, windy winter days as cold fronts from the Southern Ocean move through the region. Mean maximum temperatures of 38 °C have been recorded at Learmonth in January while the mean minimum temperature is 11.3 °C during July (Bureau of Meteorology 2011).

The long-term average rainfall for Exmouth is approximately 267 mm per annum, which generally falls during either from January through to March or from May to July. Rainfall in summer is associated with thunderstorms and tropical lows, which can produce heavy localised falls over short periods of time. Most rain occurs from May to July and is brought to the region by tropical cloud bands originating in the north-west of the state (Bureau of Meteorology 2011).

Tropical cyclones causing strong winds, high seas and heavy rain affect the North West Cape about once every two years on average. Cyclones are most common in February and March (Bureau of Meteorology 2011).

3.3 Land Uses

3.3.1 Historic Land Uses

The historic land uses for the subject land have been identified from analysis of historical imagery obtained from the Landgate Map viewer dating back to the year 2001. Based on the historical aerials, there have been no previous land uses on the site and it remains vegetated by native vegetation. Based on the aerial photographs available from Landgate, there were no major changes identified in land use between 2001 and 2011, with native vegetation remaining at the same extent.

Minor changes that are observable from the 2001 image through to 2010 image include the increased dissection the subject land by vehicular tracks (this dissection is most evident when comparing the 2004 and 2007 images) and the fluctuation in vegetation coverage, with the amount of bare earth visible from the images appearing to have increased over time.

3.3.2 Existing Land Uses

RPS undertook a site visit on 6 and 7 December 2011, which identified that present land uses of the subject land are predominantly for native vegetation, vehicle access, water conveyance and maintaining hydrological function.

3.3.3 Surrounding Land Uses

To the north and west of the subject land lies the existing of residential development and to the east is an existing industrial precinct.

The Exmouth Power Station is located approximately 400 m to the south of the subject land. The Exmouth Power Station a gas-fired power station which includes eight generators. Seven of the eight generators operate on duel fuel (compressed natural gas / liquified petroleum gas) and one operates on diesel fuel. The main generators are chiefly fuelled by natural gas taken from the Dampier to Bunbury natural gas pipeline (Applicon Australia 2009).

3.4 Topography and Landform

The subject land is located on the North West Cape which is a northerly trending peninsula approximately 80 km long and 20 km wide. It has a rugged topography, reaching a maximum elevation of 314 m. The peninsula is bordered on the west by the Indian Ocean and to the east by the shallow Exmouth Gulf.

Topography of the subject land ranges from approximately 12 to 20 m Australian Height Datum (m AHD) and slopes in a westerly direction.

3.5 Geology and Soils

The subject land is situated within the Cape Giralia Coastal Zone of the Exmouth Province. The soils of the Cape Giralia Coastal Zone are described as consisting of deep red sands and red loamy earths with some shallow calcareous loams, red-brown non-cracking clays and stoney soils (Tille 2006).

The natural geology of the subject land can be described as consisting of alluvial, shoreline and eolian deposits (DoIR 2006) (Figure 5).

3.6 Hydrology

3.6.1 Surface Water and Wetlands

An ephemeral local watercourse lies approximately 30 m beyond the southern boundary of the subject land. The watercourse performs the hydrological function of a local flood plain which conveys and disperses the overland flow from the surrounding catchment area during high rainfall or less frequent extreme events, such as tropical cyclones.

SKM have prepared a flood plain management report for the Department of Water; *Exmouth flood plain management strategy* (SKM 2007) which determines the 1 in 100 year Average Recurrence Interval (ARI) for the ephemeral local watercourse. SKM (2007) identifies that the southern boundary and south-east corner of the subject land lie within the 1 in 100 year ARI level (Figure 2).

A drainage channel, which traverses the subject land from the north-west to the south-east, has been created from storm water run-off from the existing residential development to the north.

3.6.2 Groundwater

The subject land lies within the Gascoyne Groundwater Area and the Exmouth Groundwater Sub-area which comprises both an unconfined aquifer, Cape Range Group, and confined aquifer, Birdrong Sandstone (Water and Rivers Commission 1999). The Cape Range Group aquifer is a thin lens of freshwater, underlain by the Birdrong Sandstone which exceeds a depth of 1000 m in the Exmouth and has a salinity of over 12,000 mg/L Total Dissolved Solids (Water and Rivers Commission 1999).

A search of the Department of Water's groundwater bore database was undertaken by RPS in January 2012. The closest bores to the subject land were less than one kilometre to the west, with bore 7342 having a depth of 0.5 m AHD and bore 7341 having an average depth of 0.6 m AHD.

3.7 Flora and Vegetation

3.7.1 Regional Vegetation

The subject land lies within the Interim Biogeographical Regionalisation of Australia (IBRA) region of Carnarvon (EPA 2004a). It is within the costal subregion of Cape Range (Kendrick and Mau 2002).

The Carnarvon bioregion is composed of quaternary alluvial, aeolian and marine sediments overlying Cretaceous strata. A mosaic of saline alluvial plains with samphire and saltbush low shrublands, Bowgada low woodland on sandy ridges and plains, Snakewood scrub on clay flats, and tree to shrub steppe over hummock grasslands on and between red sand dune fields (Kendrick and Mau 2002).

The subject land is located over Beard Vegetation Association 663 which is described as Hummock grasslands, shrub steppe; waterwood over soft spinifex. Kendrick and Mau (2002) identifies that approximately 8511.2 ha of this vegetation association is already reserved in the Cape Range subregion. Beard Vegetation Association 663 has the third highest area of vegetation reserved of 39 Beard Vegetation Associations described within the Cape Range subregion and correspondingly the reservation priority for conservation of this association is low (Kendrick and Mau 2002).

3.7.2 Level 2 Flora and Vegetation Survey

Coffey Environments undertook a Level 2 Flora and Vegetation survey within the subject land in line with EPA Guidance Statement No. 51 – *Terrestrial flora and vegetation surveys for environmental impact assessment in Western Australia* (EPA 2004a).

Coffey Environments undertook a:

- desktop assessment
- field surveys on 4 to 6 October 2010 and 6 to 7 April 2011.

The report; *Flora and vegetation assessment, Lot 5000 Learmonth Street and UCL (Nimitz Street), Exmouth* (Coffey Environments 2011) is provided in Appendix 1.

RPS undertook a targeted search for species of Threatened and Priority flora in the portion of the subject land that was not surveyed as part of the Coffey Environments (2011) investigations on 6 and 7 December 2011. The targeted search was undertaken specifically for the Priority 3 species, *Corchorus congener* (P3), and other species of Threatened and Priority flora identified in Coffey Environments (2011).

Additionally a targeted search was undertaken by RPS specifically to determine the relative distribution of the Priority 3 species, *Corchorus congener* (P3) over the entire extent of the subject land.

Vegetation Types

Coffey Environments (2011) identified that nine vegetation types were defined within the survey area. Coffey Environments (2011) summarises these vegetation types as:

1. *TOSAsAb* – tall open shrubland of *Acacia synchronicia* and *Acacia bivenosa* to 3.5 m over shrubland of *Eremophila longifolia* and *Senna artemisiodes* subsp. *Oligophylla* to 1.8 m over hummock grassland of *Triodia wiseana* and *Triodia epactia* to 0.4 m.

2. *LOWChAs* – low open woodland to scattered low trees of *Corymbia hamersleyana* and *Acacia sericophylla* to 8m over tall open shrubland of *Acacia tetragonophylla, Acacia bivenosa* and *Acacia pyrifolia var. pyrifolia* to 3 m over tussock grassland of *Cenchrus ciliaris* to 0.5 m.

3. *TOSAoAs* – tall open shrubland of *Alectryon oleifolius* and *Acacia synchronicia* to 3.5 m *over* open tussock grassland of *Cenchrus ciliaris* to 0.3 m.

4. *LWEcAsAb* – low open woodland to scattered low trees of *Eucalyptus camaldulensis subsp. obtuse* to 6m over *Acacia synchronicia* and *Acacia bivenosa* to 4 m over open shrubland of *Senna artemisiodes subs. oligophylla* to 1.6 m over tussock grassland of *Cenchrus ciliaris* and *Chrysopogon fallax* to 1.3 m over low open shrubland of *Scaevola spinescens* to 0.6 m.

5. *SLTCh* – scattered low trees of *Corymbia hamersleyana* to 6 m over tall shrubland of *Acacia pyrifolia subsp. Pyrifolia* to 3.5 m over open shrubland of *Acacia bivenosa* and *Senna artemisoides subs. Oligophylla* to 2 m over hummock grassland of *Triodia epactia* to 0.8 m.

6. *SMcAb* – shrubland of *Melaleuca cardiophylla and Acacia bivenosa* to 1.5 m over *hummock* grassland of *Triodia epactia* and *Triodia wiseana* to 0.8 m.

7. *TSApAs* – tall shrubland of *Acacia pyrifolia* and *Acacia synchronicia to* 4 m over open tussock *grassland* of *Cenchrus ciliaris* to 0.4 m.

8. *TOSAs* – tall open shrubland of *Acacia synchronicia* to 3.5 m over shrubland of *Acacia bivenosa* to 1.8 m over dense *hummock grassland* of *Triodia epactia* and *Triodia wiseana* to 0.5 m.

9. *SAb* – shrubland of *Acacia bivenosa* to 1.5 m over hummock grassland of *Triodia epactia and Triodia wiseana* to 0.5 m.

Coffey Environments (2011) does not identify the vegetation types contained within the portion of the subject land that has been zoned for the purpose of "Recreation and Open Space". However Figure 3a contained within Coffey Environments (2011) shows that Quadrat 3 was placed within this area. Coffey Environments (2011) identifies that the vegetation type contained within Quadrat 3 is *LWEcAsAb* (which is described above).

This vegetation type is consistent with the vegetation type that occurs directly adjacent to the west of Quadrat 3. Given this fact, an indication of the vegetation type that occurs within the remainder of this area can be provided by the vegetation type that occurs directly adjacent to the west of the area. Therefore this area can be indicatively considered to be comprised of the following vegetation types:

1. *TOSAoAs* – tall open shrubland of *Alectryon oleifolius* and *Acacia synchronicia* to 3.5 m over open tussock grassland of *Cenchrus ciliaris* to 0.3 m.

2. *LWEcAsAb* – low open woodland to scattered low trees of *Eucalyptus camaldulensis subsp. obtuse* to 6m over *Acacia synchronicia* and *Acacia bivenosa* to 4 m over open shrubland of *Senna artemisiodes subs. oligophylla* to 1.6 m over tussock grassland of *Cenchrus ciliaris* and *Chrysopogon fallax* to 1.3 m over low open shrubland of *Scaevola spinescens* to 0.6 m.

3. *SLTCh* – scattered low trees of *Corymbia hamersleyana* to 6 m over tall shrubland of *Acacia pyrifolia subsp. Pyrifolia* to 3.5 m over open shrubland of *Acacia bivenosa* and *Senna artemisoides subs. Oligophylla* to 2 m over hummock grassland of *Triodia epactia* to 0.8 m.

4. *TSApAs* – tall shrubland of *Acacia pyrifolia* and *Acacia synchronicia to* 4 m over open tussock grassland of *Cenchrus ciliaris* to 0.4 m.

Vegetation Condition

Coffey Environments (2011) identifies that vegetation condition within the survey area ranged from “Very Good” to “Degraded”. The majority of vegetation within the survey area was considered to be in “Poor” to “Very Poor” condition due to weed invasion.

Coffey Environments (2011) does not identify the vegetation condition contained within the portion of the subject land that has been zoned for the purpose of “Recreation and Open Space”. However Figure 3a contained within Coffey Environments (2011) shows that Quadrat 3 was placed within this area. Coffey Environments (2011) identifies that the vegetation condition contained within Quadrat 3 is identified as “Poor”.

The condition of the vegetation across the subject land appears to trend from “Very Good” in the west to “Very Poor” in the east.

Given the size of the subject land, the west to east trend in the vegetation condition and the area of the subject land described by Coffey Environments (2011) as being in “Poor” to “Very Poor” condition, the condition of the majority of the vegetation contained within the subject land can, indicatively, be considered to range from “Poor” to “Very Poor”.

Threatened and Priority Flora

No flora species protected under the EPBC Act or *Wildlife Conservation Act 1950* were identified within the survey area by Coffey Environments (2011) or by RPS during the targeted searches.

Six plants of the Priority 3 species, *Corchorus congener* (P3), were recorded in two separate locations within the study area by Coffey Environments (2011) (Figure 6). Coffey Environments (2011) identified that three plants were recorded in each location.

The targeted flora searches undertaken by RPS in December 2011 did not record any additional *Corchorus* congener (P3) plants or any other species of Threatened or Priority Flora upon the subject land.

Priority 3 species are “taxa that are known from collections or sight records from several localities not under imminent threat, or from few but widespread localities with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Taxa may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and known threatening processes exist that could affect them.” (Florabase 2011).

Kendrick and Mau (2002) identify that, in general, the flora of the Cape Range subregion is poorly known with limited intensive surveys being undertaken. Kendrick and Mau (2002) note only very small areas of the subregion have been examined in detail and these surveys are usually undertaken for specific development proposals.

FloraBase identifies that *Corchorus congener* (P3) is known to occur over the Carnarvon and Pilbara IBRA regions and more specifically within the Cape Range and Hamersley IBRA subregions. A search of FloraBase was undertaken to locate the known occurrences of *Corchorus congener* (P3) in Western Australia.

Sixteen locations were identified, nine of which were located on the North West Cape.

The records indicate that this species is wide spread in the Cape Range subregion and also has been recorded on several off-shore islands (Barrow Island). The largest population referenced in the collection records is 1000+ plants and was recorded in the Cape Range National Park.

Given that there is a known lack of existing information regarding the flora of the Cape Range subregion (Kendrick and Mau (2002), that there is large amount of area containing potential habitat for *Corchorus congener* (P3) already reserved within the Cape Range subregion and that there are 1000+ plants recorded for one population it is extremely unlikely that the removal of the six *Corchorus congener* (P3) plants, which represents less than 1% of its known population, will have a significant impact upon the remaining population of the species within Cape Range subregion.

Vegetation Communities

Coffey Environments (2011) identifies that no TECs or Priority Ecological Communities (PECs) were recorded within the survey area.

3.7.3 Conclusions

The results of the investigations undertaken Coffey Environments and RPS identifies that:

- no flora species protected under the EPBC Act or *Wildlife Conservation Act 1950* were identified upon the subject land.
- at a subregional scale the six plants *Corchorus congener* (P3) represent less than 1% of the known population of *Corchorus congener* (P3).
- vegetation types associated with the occurrence of *Corchorus congener* (P3) are not restricted to the subject land.
- it is considered extremely unlikely that the subject land would be considered significant habitat upon which *Corchorus congener* (P3) is dependent upon for survival.
- no TECs or PECs were recorded within the survey area.
- vegetation condition for the majority of the subject land was considered to range from "Poor" to "Very Poor".

3.8 Fauna

3.8.1 Level 1 Fauna Survey

RPS undertook a Level 1 Terrestrial Fauna Survey in line with the objectives of EPA Guidance Statement No. 56 – *Terrestrial fauna survey for environmental impact assessment in Western Australia* (EPA 2004b) for the subject land. The Level 1 Terrestrial Fauna Survey included a desktop assessment and a field survey of the subject land, which was undertaken on 6 and 7 December 2011.

The key objectives of the survey were to determine the fauna values of the subject land and the potential impacts of the proposed residential development. The report; *Level 1 Fauna Survey Report – UCL Nimitz Street, Exmouth* (RPS 2012a) is provided in Appendix 3.

Desktop Assessment

A desktop search was undertaken using the DEC's *Threatened fauna* database to search for species which are declared as "Rare or likely to become extinct", "Birds protected under international agreement" and "Other specially protected fauna" identified as occurring within a 10 km radius of the subject land.

A search of the NatureMap database and EPBC Protected Matters Search Tool were undertaken by RPS in December 2011 and November 2011, respectively (Appendix 2). Species that potentially occur in the area and that are identified as protected under the *Wildlife Conservation Act 1950* and / or under the EPBC Act are listed in Table 1.

Table 1: Conservation Significant Fauna Species Potentially Occurring within the Subject Land

Species	Conservation Status (State)	Conservation Status (EPBC)	Occurrence on Subject Land
Birds			
Apus pacificus (fork-tailed swift)		Migratory	The fork-tailed swift breeds in Siberia and the Himalayas and migrates to Australia in October, before returning to the breeding grounds by May or June. Movements within Australia are in response to weather patterns, with this species often following thunderstorms. When in Australia, the fork-tailed swift is common and prominent in both natural and developed environments. It is unlikely this species occurs within the subject land, except as a mobile species flying over the subject land, and as such is highly unlikely to be impacted by development.
Ardea alba (great egret)		Migratory	The great egret is widespread in southern and eastern Asia and Australasia and is highly mobile, rendering them less susceptible to population fragmentation. In Western Australia breeding colonies nest predominantly in *Melaleuca* swamps in November and December although breeding is dependent to some extent on rainfall As waterbird species, it is unlikely to inhabit the subject land for most of the year, though they may interact with it in a transitory capacity during the wetter months due to the drainage line present on the subject land. However, it is considered unlikely that these species will be impacted by development.
Ardea ibis (cattle egret)		Migratory	The cattle egret is widespread in southern and eastern Asia and Australasia and is highly mobile, rendering them less susceptible to population fragmentation. In Western Australia breeding colonies nest predominantly in *Melaleuca* swamps in November and December although breeding is dependent to some extent on rainfall. As waterbird species, it is unlikely to inhabit the subject land for most of the year, though they may interact with it in a transitory capacity during the wetter months due to the drainage line present on the subject land. However, it is considered unlikely that these species will be impacted by development.
Ardeotis australis (Australian bustard)	P4		The Australian bustard inhabits dry plains, grassland and open woodland. They are omnivores, eating leaves, flowers, seeds, frogs, lizards, invertebrates, etc. There is suitable habitat for this species on the subject land. However this species was not identified on subject land by the survey and as there is more suitable habitat not impacted by development in the area. It is not considered likely that this species will be impacted by the proposed development.
Charadrius veredus (oriental plover)		Migratory	The oriental plover is a non-breeding visitor to Australia where it occurs in both coastal and inland areas; however it is mostly recorded along the north-western coast. When inland, the oriental plover generally inhabits flat, open, semi-arid or arid grasslands where areas of bare ground are prevalent. The oriental plover is considered unlikely to frequent the subject land and is therefore unlikely to be adversely impacted by development of the subject land, which covers only a small area of the extensive distribution of the species

Species	Conservation Status (State)	Conservation Status (EPBC)	Occurrence on Subject Land
Falco peregrinus (peregrine falcon)	S		The peregrine falcon is found across Australia but is not common anywhere and is found in most habitats. Breeding pairs maintain a home range of 20 to 30 km throughout the year and breed in recesses of cliff faces, hollow logs and large abandoned bird nests. There is potential habitat for the peregrine falcon on the subject land. However as this species is so widespread and there is similar habitat present nearby. The proposed development is unlikely to impact on this species.
Glareola maldivarum (oriental pratincole)		Migratory	The oriental pratincole is a medium-sized shorebird that occurs in small to very large flocks of thousands to millions of individuals. It is widespread in the northern extent of Australia, particularly along the coastlines of Western Australia's Pilbara and Kimberley regions. The breeding season is spent in southern, south-eastern and eastern Asia, with the non-breeding season spent largely in Australia. During this time, the oriental pratincole preferably inhabits beaches, mudflats, islands, open plains, floodplains or short grassland, often with extensive areas of bare ground. As this species frequents shorelines, there is not considered suitable habitat on the subject land and as such, it is unlikely to be adversely impacted by development of the subject land.
Haliaeetus leucogaster (white-bellied sea eagle)		Migratory	The white-bellied sea eagle is not globally threatened, but has been subject to population decline within Australia and South East Asia. In Australia, it is distributed along the coastline, and is restricted to a narrow band of coastline in south-western Australia. The population residing within Australia is estimated at 500 mating pairs. The white-bellied sea eagle is found in coastal habitats and tends to occupy dunes, tidal flats, woodlands, forests and grasslands (generally in areas associated with large bodies of water). When not migrating, the home range of the white-bellied sea eagle can be up to 100 square km, although breeding adult birds are generally sedentary (breeding season runs from June to January). The nests of these birds are large and conspicuous, generally constructed in large trees, cliffs, rocky outcrops, mangroves, caves or on artificial structures. This species was not identified on the subject land and is considered unlikely to frequent any habitat present on the subject land. Therefore, development of the subject land is not considered likely to impact this species.
Hirundo rustica (barn swallow)		Migratory	The barn swallow occurs in open land, such as agricultural pasture and plains, roosting or nesting in dead trees, banks, cliff cavities and rock shelves. It is a regular non-breeding summer migrant to northern Australia, where its range extends from the Kimberley region to north-eastern and south-eastern Queensland. There is potential habitat present on the subject land for this species, however as the subject land only occupies a small area of the extensive distribution of this species. It is unlikely to be impacted by this development proposal.
Macronectes giganteus (southern giant petrel)		Endangered	The southern giant petrel breeds on subantarctic and Antarctic islands within the Australian territory. There is not considered to be any breeding or feeding habitat present for this species on the subject land. Consequently, development of the subject land will not impact the southern giant petrel.

Species	Conservation Status (State)	Conservation Status (EPBC)	Occurrence on Subject Land
*Merops ornatus (*rainbow bee-eater)		Migratory	The population size of this species within Australia is not known, but it is assumed to be quite large. It is known to occur across the majority of the mainland. It migrates between Australia, Eastern Indonesia and Japan, and has formed a colony on Rottnest Island. The rainbow bee-eater tends to occupy open forests and woodlands, including cleared or semi-cleared areas and farmland, and prefers timbered landscapes. Their nests consist of an enlarged chamber at the end of a long burrow that is excavated by both the female and male bird from flat or sloping ground, cliff faces or mounds of gravel. A number of individuals were identified feeding on subject land. However, as no nesting burrows were identified on subject land and the rainbow bee-eater is widespread in the region, it is considered unlikely that the proposed development will impact this species.
Mammals			
*Dasycercus cristicauda (*crest-tailed mulgara)		Vulnerable	The crest-tailed mulgara can tolerate moderate local reduction in land cover, however a more severe reduction will lead to population decline. The main threat to this species is predation from introduced species and habitat reduction through agriculture and mining. Crest-tailed mulgara predominantly occur in hummock grasslands and shrublands on sandy soils, burrowing in flat areas between sand dunes or on the low side of sand dunes. They are predominantly nocturnal, emerging from their burrows at night to feed on insects and small reptiles. Based on the vegetation present on the subject land, it is considered likely that the subject land contains habitat suitable for the crest-tailed mulgara, although no individuals were identified during the survey. However, due to the amount of similar habitat available nearby, the proposed development is not considered likely to have an impact on the crest-tailed mulgara.
*Petrogale lateralis subs. Lateralis (*black-flanked rock wallaby)	T	Vulnerable	The habitat of the black-flanked rock wallaby varies between colonies, however always involves proximity to some form of cliff, rock pile, escarpment or talus for refuge in areas of hummock grassland. They feed on grasses, herbs leaves and fruits and do not require close proximity to water as they conserve water through sheltering from warm temperatures in caves or rock overhangs. Consequently there is not considered suitable habitat on the subject land for the black-flanked rock wallaby and no signs of this species were seen during the survey. Therefore, the proposed development is not considered likely to impact this species.
Reptiles			
Aprasia rostrata	T	Vulnerable	This species occurs on Hermite Island in habitats consisting of calcareous sandstone, dried mud flats and hummock grassland. It is considered highly unlikely that this species occurs within vicinity of the subject land.
Diptodactylus sp "Cape Range" (Cape Range diplodactylus)	P2		There is very little information available on this species; however similar species in Exmouth are known to inhabit hard rocky substrates and hummock grassland. Consequently there is potential for this species to occur on subject land, however it was not identified during the survey and as there is similar habitat in better condition and better protected elsewhere in the area, therefore proposed development on the subject land is not considered likely to impact this species.

Field Survey

The findings of the field survey are summarised below:

- a number of rainbow bee-eaters, a Migratory species, were observed upon the subject land
- any proposed development of the subject land is not considered likely to have a significant impact on any species listed in the desktop assessment or identified in the field survey
- large trees, such as *Corymbia hamersleyana* and *Eucalyptus camaldulensis* were noted for their utilisation by bird species on the subject land; in particular, feeding by honeyeater species and perching for feeding rainbow bee-eater. Trees with structural complexity provide essential roosting habitat for many bird species.
- drainage line contains a number of mature trees and provides important habitat for fauna species.
- a total of 137 bird species have been historically recorded within or in close proximity to the subject land. Of these, seven species are of conservation significance, which may potentially occur within the subject land or be adversely impacted by the proposed development. Fourteen bird species were recorded on the subject land during the field survey, none of these were of conservation significance
- a total of five mammal species were historically recorded within vicinity of the subject land, and of these, the red fox is introduced. This list also includes two species of conservation significance, neither of which are considered likely to be impacted by any development on the site. No mammal species were identified during the survey, however kangaroo tracks and scats were present across the subject land
- forty reptile species have been historically recorded within and surrounding the subject land. Of these, two are of conservation significance. Only one reptile species was identified on subject land, *Amphibolurus longirostris,* and this species is common throughout the Exmouth area
- two species of amphibian were identified as potentially occurring within or adjacent to the subject land. Neither of these species are of conservation significance and were not identified on the subject land.

3.8.2 Conclusions

RPS (2012a) identifies that:

- a number of rainbow bee-eaters, a Migratory species, were observed upon the subject land
- any proposed development of the subject land is not considered likely to have a significant impact on any species identified in the desktop assessment or identified in the field survey.

3.9 Acid Sulfate Soils

Acid Sulfate Soils (ASS) are naturally occurring soils, sediments and peats that contain fine-grained metal sulfides, typically pyrite, which are formed under saturated, anoxic/ reducing conditions (MPL Laboratories 2010). In an undisturbed state below the water table, these soils are benign and non-acidic. However, if the soils are exposed to the atmosphere by drainage, excavation or lowering of the water table, the sulfides may react with oxygen to form sulfuric acid. Where these materials have oxidised, they commonly have a mottled appearance (orange / red or buttery yellow discolouration) due to the presence of oxidised iron minerals (MPL Laboratories 2010).

The subject land is mapped by the DEC as being of no known risk of encountering ASS within 3 m of the soil's natural surface, however the ephemeral watercourse to the south of the subject land is mapped by the DEC as being moderate to low risk of encountering ASS within 3 m of the soil's natural surface.

The proposed design of the ODP indicates that no ground disturbing activities are being undertaken in areas in close proximity to the ephemeral watercourse. However, if any ground disturbing activities below 3 m are being undertaken on the site, preliminary ASS investigations may need to be undertaken.

3.10 Contamination

The contaminated sites legislation in Western Australia has been formulated to protect the health of the local population and safe guard the natural environment from serious harm. Under the *Contaminated Sites Act 2003*, contaminated sites may need to be investigated and ameliorated, if required, to protect the interests of the owners and occupiers of the specific landholding (DEC 2011).

A search of the DEC's *Contaminated sites database* was undertaken on 18 January 2012, no contaminated sites have been registered over the subject land and no matches were recorded for the subject land. However, the following properties have been classified as "Contamination – remediation required" for the surrounding area (Figure 7):

- Lots 849, 145 Pelias Street, Exmouth – Previous diesel fired power station on the site which has resulted in hydrocarbon contamination of the soil and groundwater.

- Lots 618, 10 and 11 Huston Street and Lot 24 Nimitz Street Exmouth – Groundwater contamination extends to the east and south from the site of the previous power station, contaminating groundwater under these lots.

As the subject land lies only approximately 0.2 km west from the source of contamination, there is potential for groundwater contamination.

A Preliminary Site Investigation (PSI) was undertaken for the subject land by RPS in March 2012 (RSP 2012b) and determined that sources of on-site and off-site contamination existed. The PSI recommended that additional information is required to be sourced in order to assess the presence or absence of potential impacts from the off-site contamination source upon the subject land. The PSI concluded that although potential contaminants were identified as existing for the subject land, the nature and extent of the potential contaminants is likely to be minor.

3.11 Heritage

3.11.1 Aboriginal Heritage

The *Aboriginal Heritage Act 1972* defines Aboriginal Heritage Sites and provides for the preservation of places and objects customarily used by or traditionally important to Aboriginals, and prohibits the concealment, destruction or alteration of any Aboriginal Heritage Sites. An Aboriginal site may:

- exist in any area of Western Australia
- not have been recorded in the register of Aboriginal Sites or elsewhere
- not have been identified in previous heritage surveys or reports on that area but remains fully protected under the Act.

A search of the Department of Indigenous Affair's (DIA) Aboriginal Heritage Inquiry System was undertaken on 18 January 2011 and no Aboriginal sites were registered for the subject land or lands directly adjacent to the subject land.

Although no heritage sites have been identified in the desktop searches, there is a native title claim over the subject land, registered as Gnulli (WAD 6161/1998). This claim covers approximately 87,876 km^2 within the Shires of Ashburton, Carnarvon, Exmouth, Shark Bay and Upper Gascoyne (DoW 2011). Discussions are underway with Aboriginal people regarding this, and it is not considered likely to pose a constraint on development.

3.11.2 European Heritage

A search of the Heritage Council of Western Australia's *Places database* was undertaken on 18 January 2012 and no matches were found for the subject land. The *Places database* allows members of the general public to search for places or sites listed on the *State register of heritage places*. The *State register of heritage places* is managed by the Heritage Council of Western Australia (Government of Western Australia 2010).

3.12 Noise

The Exmouth Power Station, operated by Worley Parsons, is located approximately 400 m to the south of the subject land. Noise emissions from the Exmouth Power Station may potentially impact the proposed residential land uses.

EPA Guidance Statement No. 8: *Environmental Noise* (draft) (EPA 2007) specified that a maximum night time noise impact of 30–35 decibels (dB) is permitted on residential development in proximity to industry.

Lloyd George Acoustics (2011) has provided "real time" night time data that demonstrates the majority of the subject land is between the 30–35 dB contour. Worley Parsons (the power station operator) is committed to undertaking noise mitigation works that will reduce the noise db level from 5 to 10 dB. The modifications will be completed in October 2012 and new noise contours will be mapped that potentially could include the south of the subject land within the 30–35 dB contour.

4.0 OUTLINE DEVELOPMENT PLAN

The subject land is identified as being subject to two zonings under TPS No. 3. The majority of the subject land (approximately 35.26 ha or 87%) is zoned "Residential Development" with a small portion of land (approximately 5.10 ha or 13%) enclosed within the subject land being zoned "Recreation and Open Space" (Shire of Exmouth 2006) (Figure 3).

A Scheme Amendment has been proposed to rezone the northern portion of the subject land (approximately 3.68 ha or 9%) that is currently zoned "Recreation and Open Space" to "Residential Development".

The proposed ODP is intended to designate the broad land use over the extent of the subject land. The proposed ODP uses environmentally sensitive design to facilitate the residential expansion of the Exmouth in a logical and coordinated manner. The proposed ODP is subject to future approval and endorsement by the Shire of Exmouth and WAPC.

The proposed ODP was designed to effectively manage stormwater and contains approximately 8.82 ha (or 21% of the subject land) in Public Open Space (POS). The provision of two linear green linkages of POS, to be used for the purposes of drainage, to the retained vegetation in the POS reservation bordering the ephemeral watercourse was central to the design of the proposed ODP. The POS reservation which borders the ephemeral watercourse acts as a setback for urban land uses from the watercourse during times of peak flow as it contains the 1 in 100 year ARI flood level.

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5.0 POTENTIAL ENVIRONMENTAL IMPACTS AND MANAGEMENT MEASURES

In response to the existing environmental values of the subject land, this section outlines the likely impacts and subsequent management measures to minimise and mitigate any impacts to the environment resulting from development of the subject land.

5.1 Hydrology

5.1.1 EPA Objective

To maintain the quantity and quality of water so that existing and potential environmental values, including ecosystem maintenance, are protected.

5.1.2 Potential Impacts

Surface water in the ephemeral watercourse and groundwater of the subject land have the potential to be impacted by a variety of activities including:

- groundwater level changes that occur as a result of a change in land use
- removal of vegetation and installation of impervious surfaces that lead to an increase in run-off during rainfall events
- urbanisation will result in an increase in the potential for urban generated pollutants, such as nutrients, hydrocarbons, metals and sediment, being discharged, via run-off and influencing the soil profile and ultimately, into the groundwater
- nutrient loading to the surface water and groundwater
- stormwater drainage which facilitates the transportation of nutrients (through surface run-off) and potential contaminants (e.g. litter) through the subject land.

5.1.3 Management Measures

To ensure that the quantity and quality of surface water is maintained in order to protect vegetation within the subject land a LWMS is being prepared by JDA Consulting Hydrologists which includes a variety of measures to ensure that the quantity and quality of surface water and groundwater is maintained.

The proposed ODP features:

- a green linkage of POS, which traverses the centre of the subject land, be used for the purposes of drainage

- a linear green linkage along the eastern boundary of the subject land, which will be used for the purposes of drainage

- integration of sections of the subject land that do occur within the identified 1 in 100 year ARI flood level of the ephemeral watercourse into POS

- internal road network which allows for maximum drainage efficiency.

5.2 Flora and Vegetation

5.2.1 EPA Objective

To maintain the abundance, diversity, geographic distribution and productivity of flora at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.

5.2.2 Potential Impacts

The potential impacts to native vegetation within the subject land from the proposed ODP include:

- removal of vegetation within the subject land with the exception of those areas proposed to be retained

- degradation of retained vegetation through uncontrolled public access and weed invasion

- disturbance to vegetation from fire.

5.2.3 Management Measures

5.2.3.1 Vegetation Retention

Vegetation retention is proposed to be incorporated into:

- POS reservation which borders the ephemeral watercourse
- drainage reserves.

5.2.3.2 Construction Management

Pre-construction management activities include:

- flagging of areas not designated for clearing during the construction and development phases upon the subject land to prevent accidental clearing.

Management activities undertaken during construction include:

- minimise soil disturbance during clearing and practice standard vehicle hygiene to ensure exotic species do not become established within the subject land whist undertaking construction activities.

5.3 Fauna

5.3.1 EPA Objective

To maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.

5.3.2 Potential Impacts

The threatening process in general to fauna and habitat which are relevant to the subject land include:

- loss of habitat through clearing
- habitat fragmentation
- land clearing and vehicle movement may result in death or injury of fauna as a result of collisions
- habitat degradation due to weed invasion
- species interactions, including predation and competition
- disturbance of fauna from light spill, noise and human disturbance
- changes in fire regime.

5.3.3 Management Measures

In response to the proposed removal of vegetation which will result from the implementation of a Development Plan the following management measures should be considered:

- retention of the existing drainage systems in the ODP
- staging of any proposed vegetation clearing works and implementation of clearing methods designed to maximise the survival of fauna individuals on the subject land during construction.

5.4 Contamination

5.4.1 EPA Objective

To ensure previous land uses within and surrounding the subject land, do not impact on proposed development of the subject land.

5.4.2 Potential Impacts

Development of the subject land for residential purposes may potentially result in the unearthing of groundwater contaminants.

5.4.3 Management Measures

In accordance with DEC guidelines for the management of potentially contaminated sites additional information is required to be sourced in order to assess the presence or absence of potential impacts from the off-site contamination source upon the subject land.

The on-site contamination identified by the PSI will be removed prior to the commencement of development activities being undertaken.

5.5 Heritage

5.5.1 EPA Objective

To ensure that changes to the biophysical environment do not adversely affect historical and cultural associations and comply with relevant heritage legislation.

5.5.2 Potential Impacts

It is considered that there is a very low risk that Aboriginal objects maybe either identified or unearthed during development activities.

5.5.3 Management Measures

Should any Aboriginal objects be identified or unearthed during development activities then under the *Aboriginal Heritage Act 1972* the findings must be reported to the DIA and development activities should be stopped.

5.6 Noise

5.6.1 EPA Objective

To protect the amenity of the community from noise and vibration impacts with associated land use by ensuring that statutory requirements and acceptable standards are met.

5.6.2 Potential Impacts

Noise emissions from the Exmouth Power Station may potentially impact the proposed residential land uses.

5.6.3 Management Measures

Worley Parsons (the power station operator) is committed to undertaking noise mitigation works that will reduce the noise db level from 5 to 10 dB. The modifications will be completed in October 2012 and new noise contours will be mapped that potentially could include the south of the subject land within the 30-35 dB contour.

Lots falling outside the 30–35 db contour will require a notification on title at subdivision.

5.7 Environmental Management Summary

Table 2 summarises the management measures that will be undertaken to manage the environmental values of the subject land in accordance with the objectives of the EPA.

Table 2: Potential Constraints and Management Recommendations

Environmental Factors	EPA Objective	Potential Impact	Management Recommendations
Hydrology	To maintain the quantity and quality of water so that existing and potential environmental values, including ecosystem maintenance, are protected.	▪ Groundwater level changes that occur as a result of a change in land use. ▪ Removal of vegetation and installation of impervious surfaces that lead to an increase in run-off during rainfall events. ▪ Urbanisation will result in an increase in the potential for urban generated pollutants, such as nutrients, hydrocarbons, metals and sediment, being discharged, via run-off and influencing the soil profile and ultimately, into the groundwater. ▪ Nutrient loading to the surface water and groundwater. ▪ Stormwater drainage which facilitates the transportation of nutrients (through surface run-off) and potential contaminants (e.g. litter) through the subject land.	Implementation of LWMS.
Flora and Vegetation	To maintain the abundance, diversity, geographic distribution and productivity of flora at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.	▪ Removal of vegetation within the subject land with the exception of those areas proposed to be retained. ▪ Degradation of retained vegetation through uncontrolled public access and weed invasion. ▪ Disturbance to vegetation from fire.	▪ Vegetation retention. ▪ Employ construction management actions.
Fauna and Habitat	*To maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.*	▪ Loss of habitat through clearing. ▪ Habitat fragmentation. ▪ Land clearing and vehicle movement may result in death or injury of fauna as a result of collisions. ▪ Habitat degradation due to weed invasion. ▪ Species interactions, including predation and competition. ▪ Disturbance of fauna from light spill, noise and human disturbance. ▪ Changes in fire regime.	▪ Retention of the existing drainage systems. ▪ Employ construction management actions.
Contamination	To ensure previous land uses within and surrounding the subject land, do not impact on proposed development of the subject land.	▪ Potential unearthing of groundwater contaminants.	▪ Assessment of the potential impact of the off-site contamination source. ▪ Removal of on-site contamination.
Heritage	To ensure that changes to the biophysical environment do not adversely affect historical and cultural associations and comply with relevant heritage legislation.	▪ Aboriginal objects are either identified or unearthed during development activities.	Report findings to the DIA and stop development activities.
Noise	To protect the amenity of the community from noise and vibration impacts with associated land use by ensuring that statutory requirements and acceptable standards are met.	▪ Noise emissions from the Exmouth Power Station may potentially impact the proposed residential land uses.	▪ Worley Parsons to undertake noise reduction works upon the Exmouth Power Station. ▪ Notification on title at subdivision, if required.

6.0 CONCLUSION

The proposed ODP for the UCL Nimitz Street, Exmouth achieves the following environmental outcomes:

- creation of POS reservation containing retained vegetation bordering the ephemeral watercourse
- creation of green linkages of POS, containing existing drainage systems, to be used for the purpose of drainage.

Through addressing the identified key environmental factors, this environmental assessment of the proposed ODP for UCL Nimitz Street, Exmouth concludes that the potential environmental impacts identified in this report can be managed in accordance with the objectives of the EPA to prevent significant impacts to the environmental values of the subject land.

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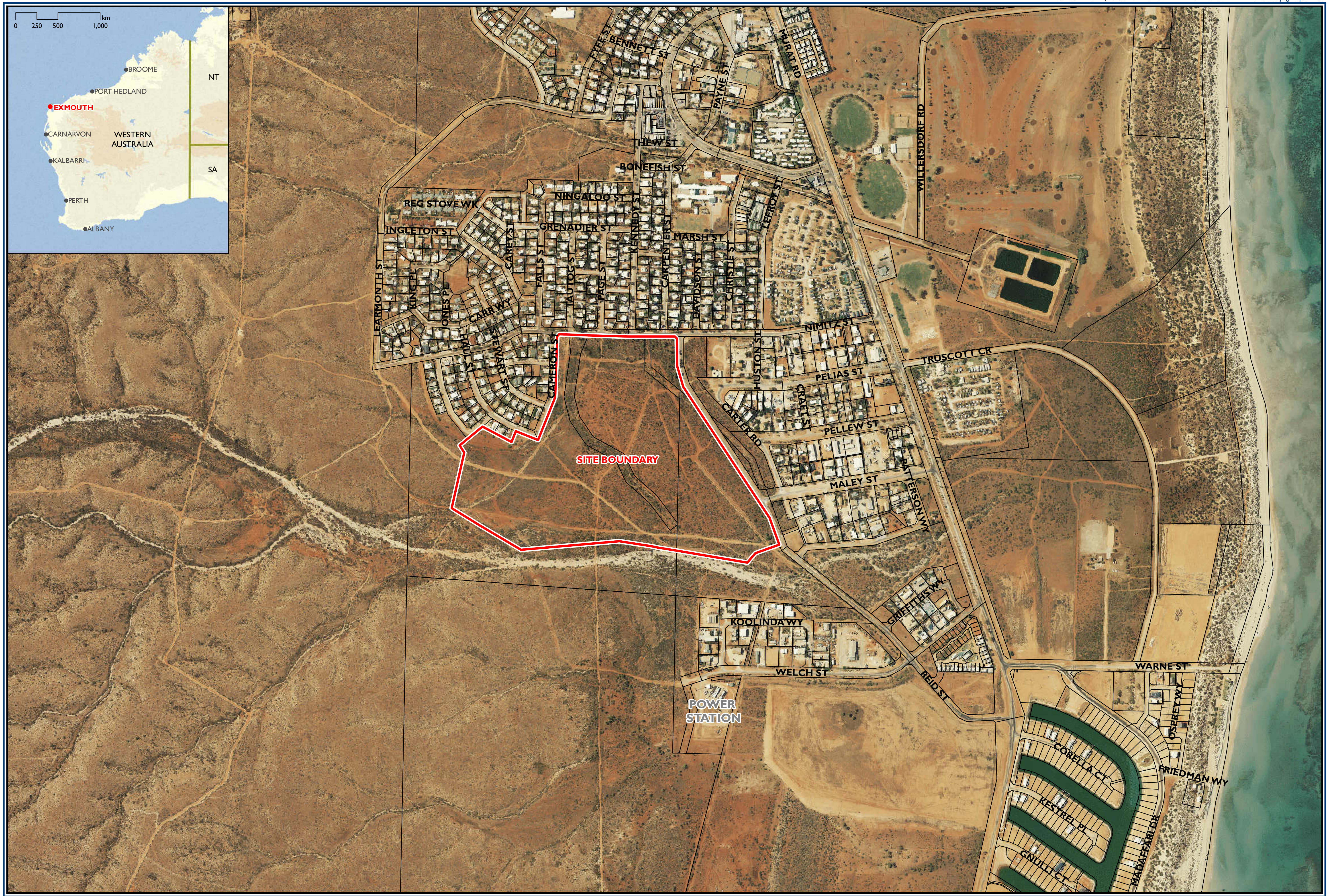
FIGURES



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Version: 0
Drafted by: HT
Source: Cadastre - Landgate, 2011 Orthophoto - Landgate, 2010

Figure 1

Site Location

LOT YIELD		
Residential R17.5	271 Lots	271 Du's
Residential R20	74 Lots	74 Du's
Residential R30	4 Lots	41 Du's
TOTAL	**349 Lots**	**386 Du's**

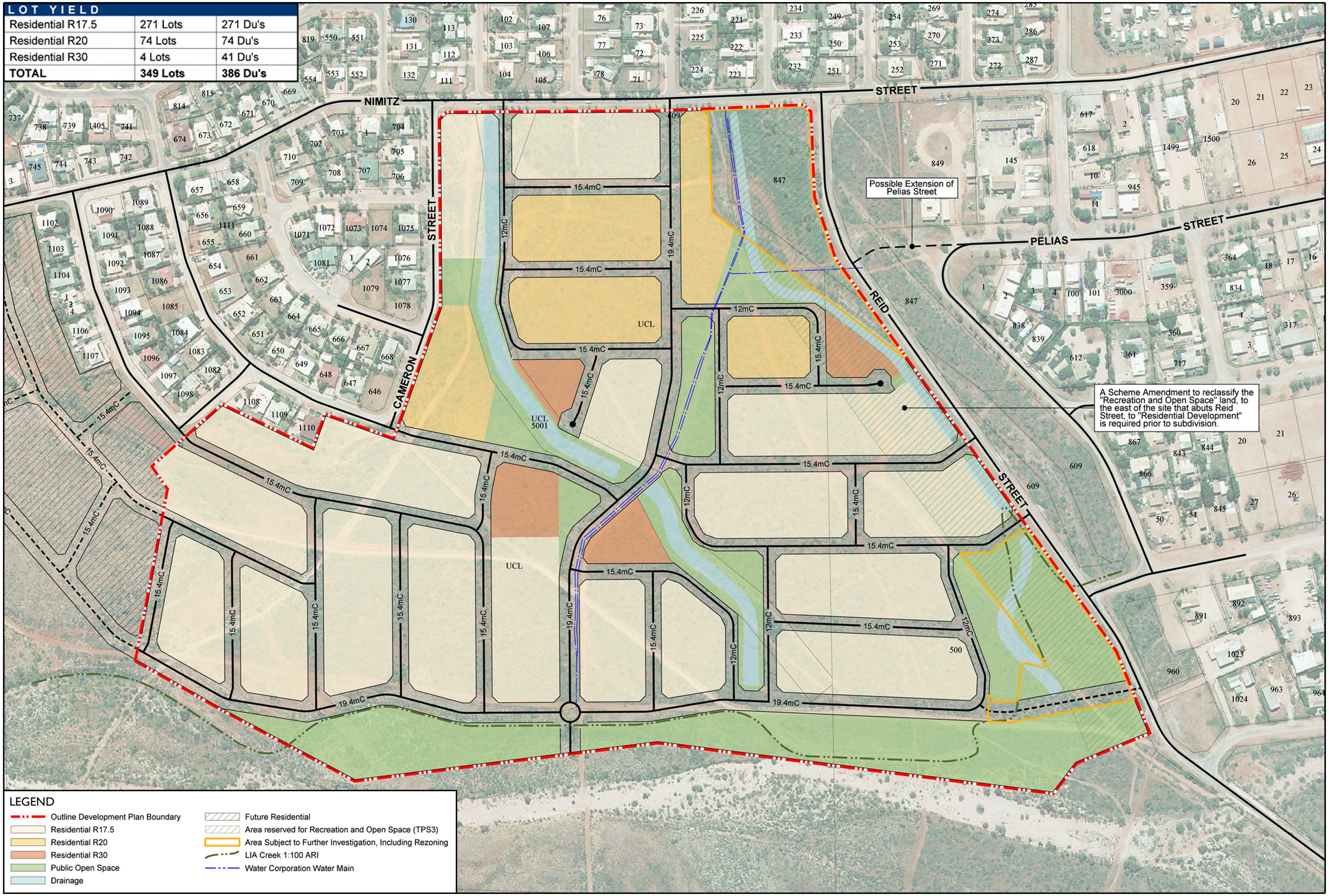

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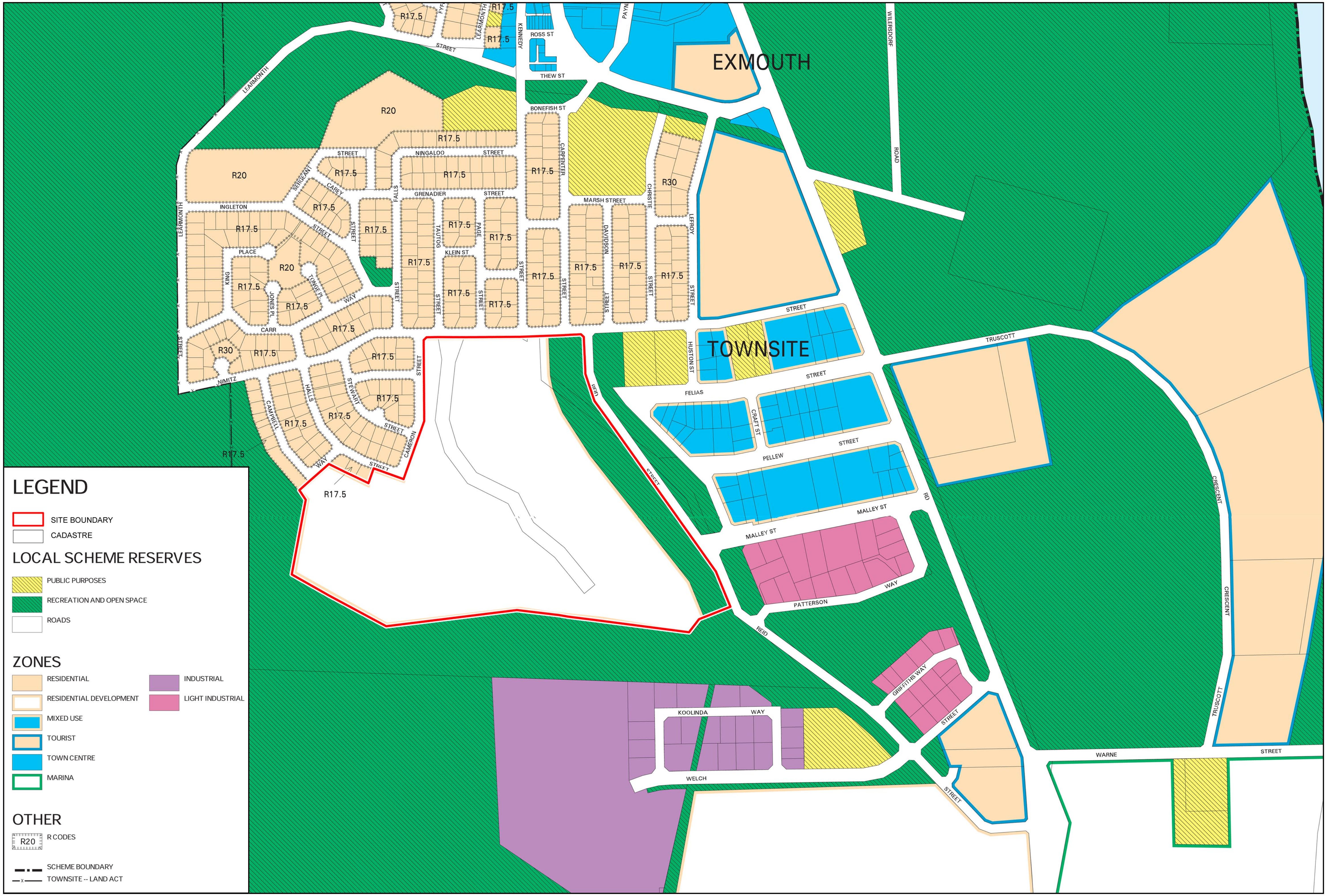
Figure 2

Outline Development Plan



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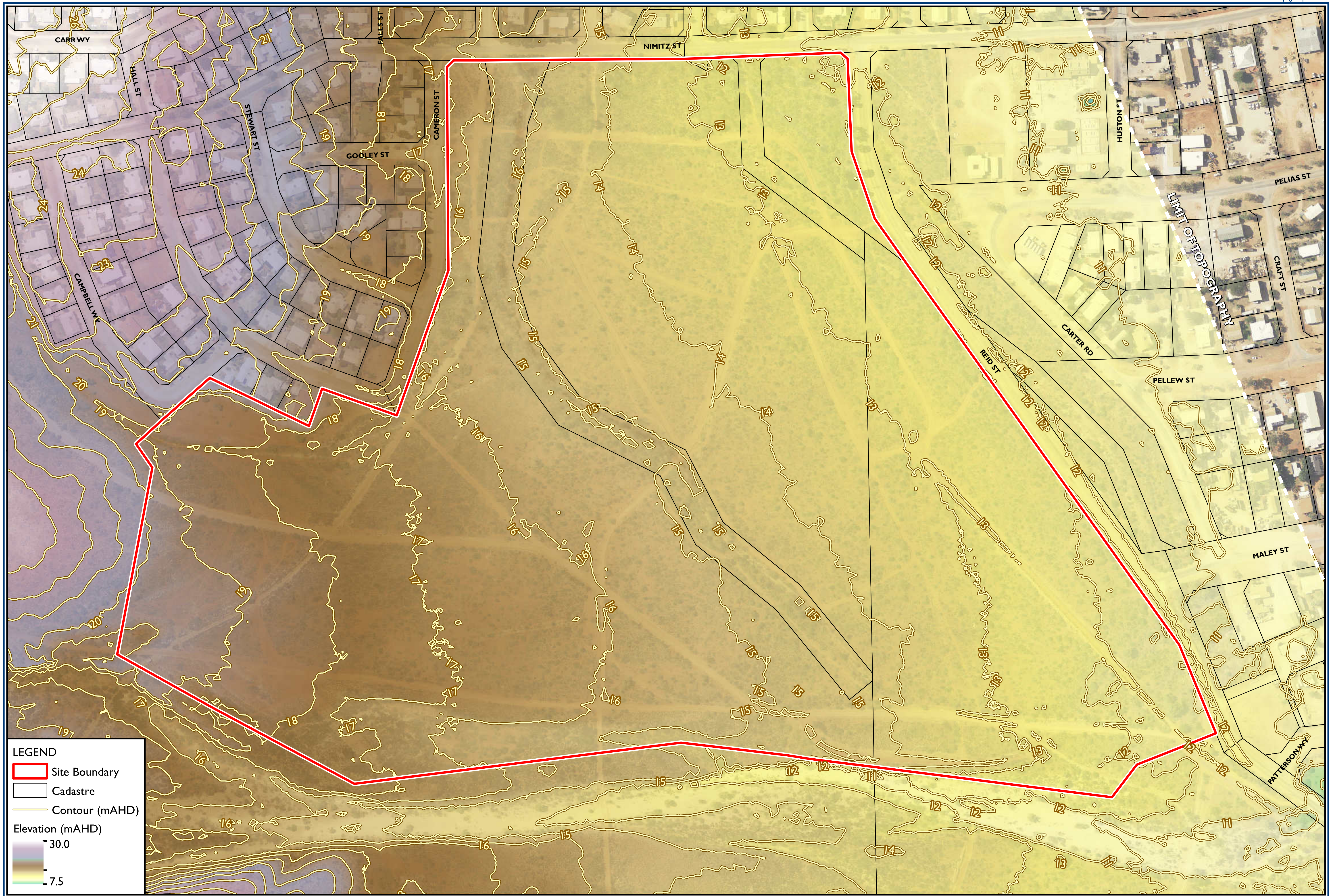
RPS

Figure 3

Zoning



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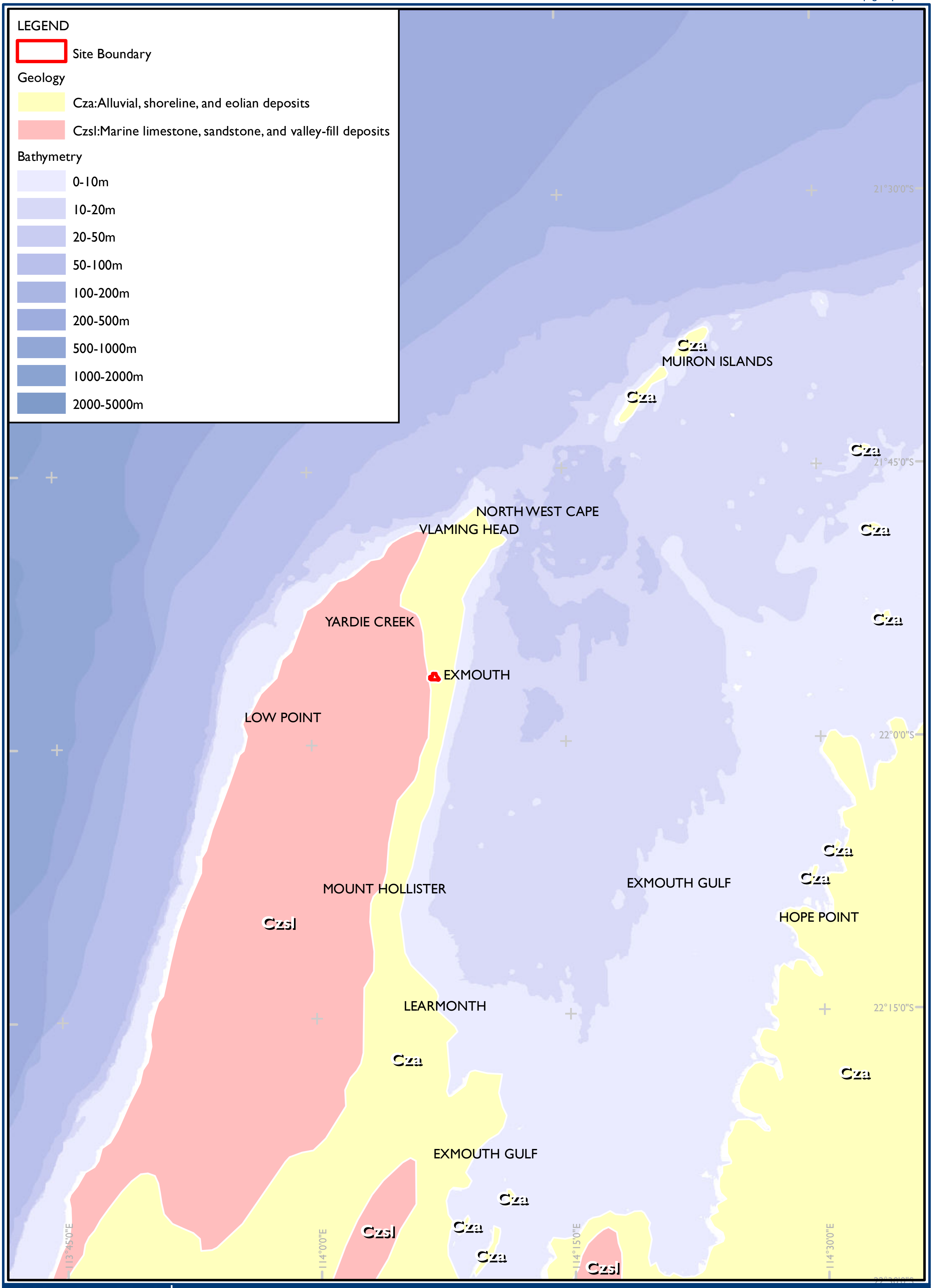
Version: A
Drafted by: HT
Source: Cadastre (2011), Orthophoto (2010) - Landgate.

0 25 50 100 150 200 metres

Figure 4

Topography

38 Station Street, Subiaco | T +61 8 9211 1111 | F +61 8 9211 1122 | www.rpsgroup.com.au



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Version: A
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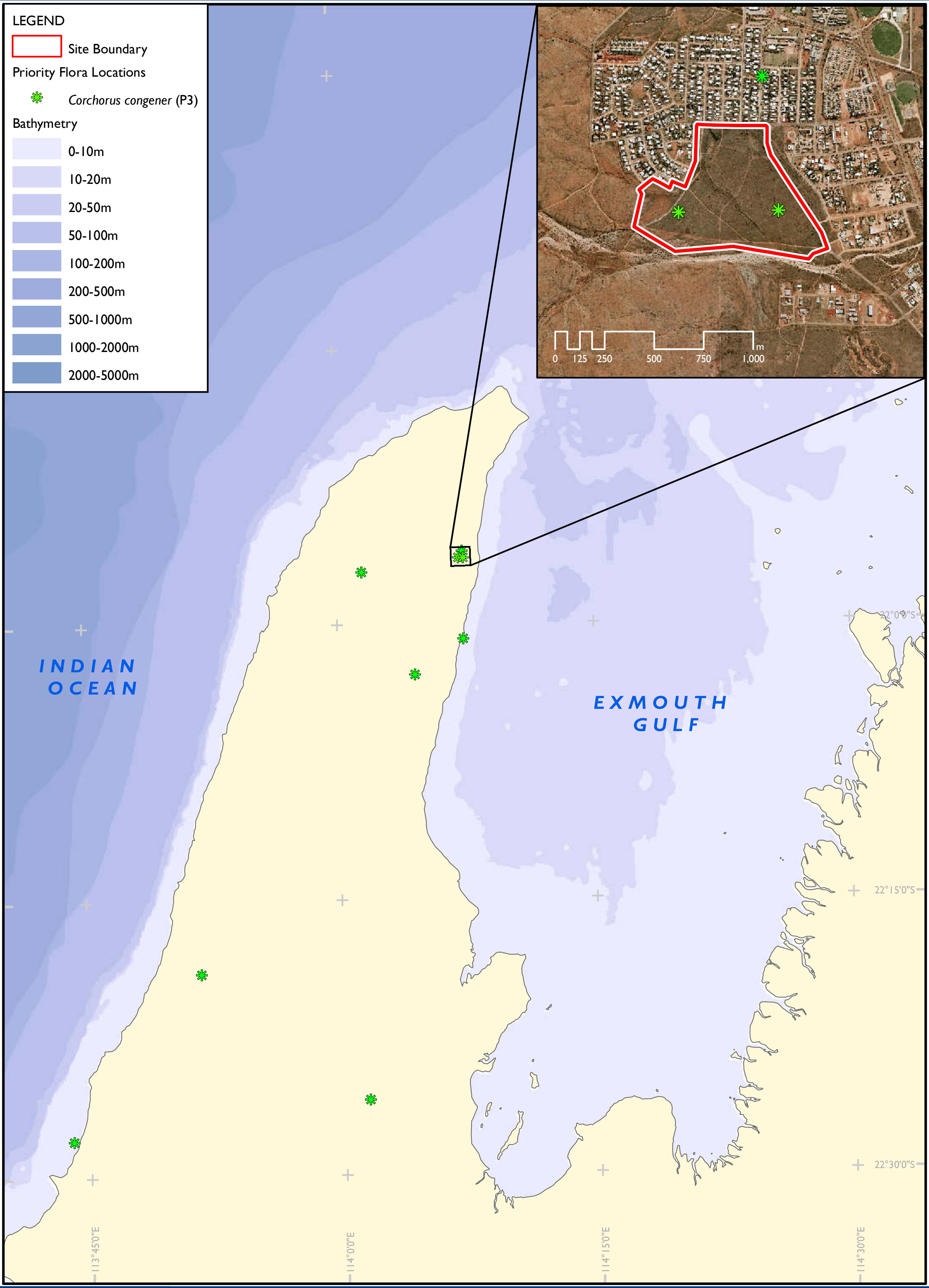
Drafted by: SC
Source: Geology - DoIR

Figure 5

Geology



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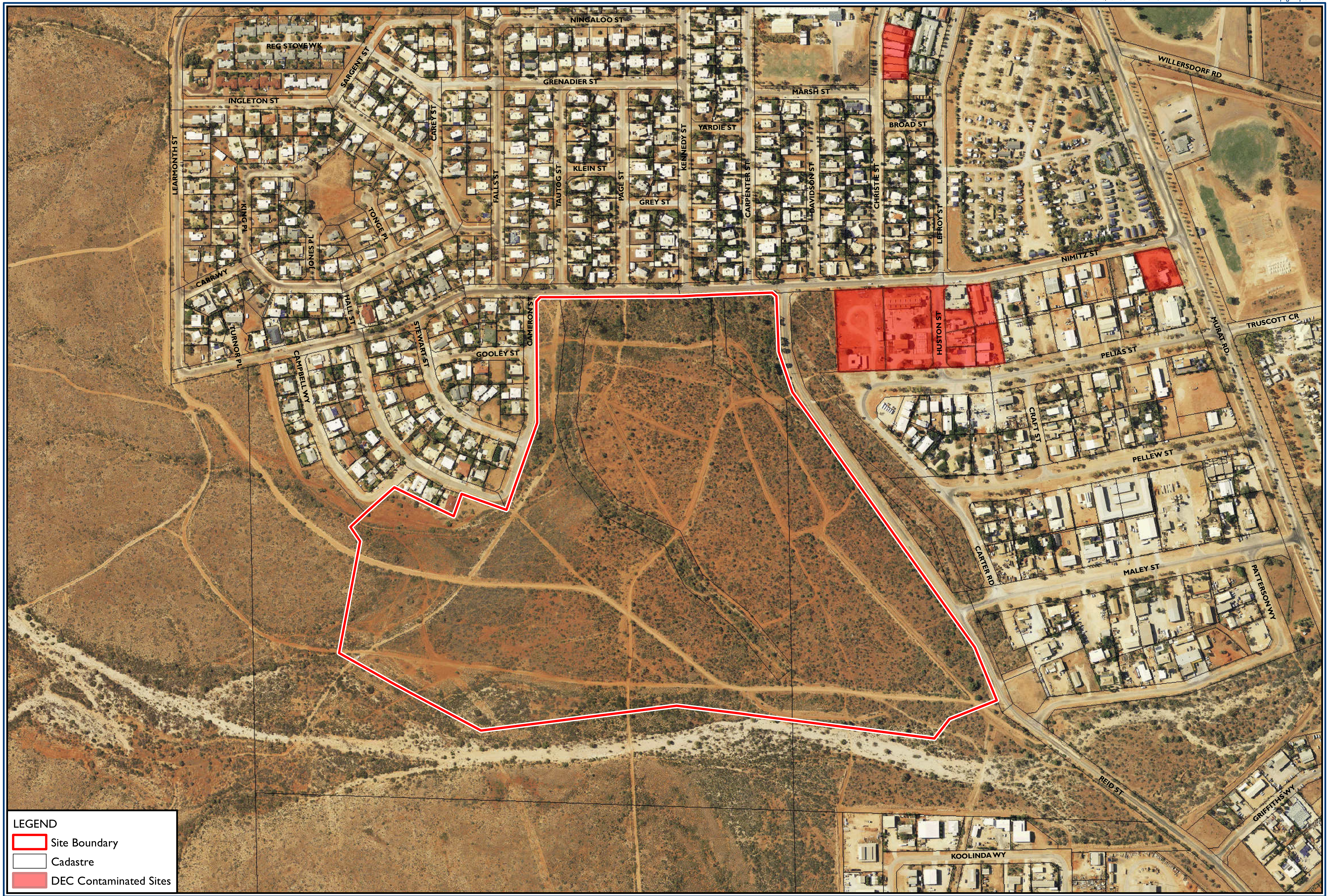
Version: A
Scale: 1:500,000, Close up 1:25000 @ A4.
Drafted by: HT
Source: Flora - Coffey 2011, Florabase 2012.

0 2.5 5 10 15 20 km

Figure 6

Significant Flora Locations



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Version: A
Drafted by: HT
Source: Cadastre (2011), Orthophoto (2010) - Landgate. Contam Sites - DEC 2012.

Figure 7

Contaminated Sites

APPENDIX 1

Flora and Vegetation Assessment, Lot 5000 Learmonth Street and UCL (Nimitz Street), Exmouth

coffey environments
SPECIALISTS IN ENVIRONMENTAL, SOCIAL AND SAFETY PERFORMANCE

FLORA AND VEGETATION ASSESSMENT, LOT 5000 LEARMONTH STREET AND UCL (NIMITZ STREET), EXMONUTH

EP2010/208, V3

JUNE 2011

coffey environments
SPECIALISTS IN ENVIRONMENTAL, SOCIAL AND SAFETY PERFORMANCE

FLORA AND VEGETATION ASSESSMENT, LOT 5000 LEARMONTH STREET AND UCL (NIMITZ STREET), EXMOUTH

Prepared for:

Landcorp
Level 3 Wesfarmers House
40 The Esplanade
PERTH WA 6000

Report Date: 16 June 2011
Report Ref: EP2010/208 V3
Project Ref: ENAUPERT02225AA

Written/Submitted by:	Reviewed/Approved by:
Cassyanna Gray	Martine Scheltema
Team Leader - Ecological Services	Principal Environmental Consultant

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coffey environments
SPECIALISTS IN ENVIRONMENTAL,
SOCIAL AND SAFETY PERFORMANCE

16 June 2011

Landcorp
Level 3 Wesfarmers House
40 The Esplanade
PERTH WA 6000

Attention: Kylie Coman

Dear Kylie

RE: Flora and Vegetation Assessment, Lot 5000 Learmonth Street and UCL (Nimitz Street), Exmouth

Please find attached one (1) hardcopy of the amended Flora and Vegetation Assessment Lot 5000 Learmonth Street and UCL (Nimitz Street) Exmouth Report, Version 3 (Report No. EP2010/208 V3).

For and on behalf of Coffey Environments Pty Ltd

Cassyanna Gray
Team Leader - Ecological Services

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1	ENVAUPERT02225AA_Flora and Vegetation Assessment_001_clg_V1	V1	26 November 2010	Landcorp	CLG
1	ENVAUPERT02225AA_Flora and Vegetation Assessment_001_clg_V1	V1	26 November 2010	Coffey Environments	CLG
1	ENVAUPERT02225AA_Flora and Vegetation Assessment_001_clg_V2	V2	17 December 2010	Landcorp	CLG
1	ENVAUPERT02225AA_Flora and Vegetation Assessment_001_clg_V2	V2	17 December 2010	Coffey Environments	CLG
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1	ENVAUPERT02225AA_Flora and Vegetation Assessment_001_clg_V3	V3	16 June 2011	Coffey Environments	CLG

CONTENTS

CONTENTS

LIST OF ATTACHMENTS

ABBREVIATIONS

BOM	Bureau of Meteorology
DEC	Department of Environment and Conservation
DSEWPC	The Department of Sustainability, Environment, Water, Population and Communities
DRF	Declared Rare Flora
EPA	Environmental Protection Authority
EPBC	Environmental Protection and Biodiversity Conservation
Ha	Hectares
IBRA	Interim Biogeographic Regionalisation for Australia
Km	Kilometres
PEC	Priority Ecological Community
SLIP	Shared Land Information Platform
TEC	Threatened Ecological Community
WAHERB	Western Australian Herbarium
WGS84	World Geodetic System 1984

1 INTRODUCTION

1.1 Background

Coffey Environments were engaged by Landcorp to undertake a Level 2 flora and vegetation assessment within Lot 5000 Learmonth Street (EXM05) and UCL (Nimitz Street) (EXM18), Exmouth. The assessment was required as part of preliminary investigations to determine the suitability of the sites for residential development. Lot 5000 is approximately 11ha in size, while UCL (Nimitz Street) is approximately 35ha in size.

1.2 Scope of Works

The scope of the flora and vegetation assessment was to provide the following information:

- Results of a search of the DEC's Declared Rare and Priority Flora Species database to identify potential significant flora species occurring within the study area;
- Results of a search of the DEC's Threatened and Priority Ecological Communities database to identify any significant ecological communities occurring within the study area;
- Results from a search of the Department of Sustainability, Environment, Water, Population and Communities (DSEWPC's) on-line database to identify significant flora species or ecological communities of national environmental significance that are protected under the *Environment Protection and Biodiversity Conservation Act 1999* potentially occurring in the area;
- Mapping and description of vegetation types using a combination of recent aerial photography and field survey results;
- Mapping of vegetation condition using the vegetation condition criteria as classified in Bush Forever (Government of Western Australia, 2000);
- A list of all native and non-native plant species occurring within the study area as recorded during two survey seasons from semi-permanent 20m x 20m quadrats located in representative vegetation types and any other species not found within quadrats;
- Identification, location (GPS point) and mapping of any significant plant species or ecological communities recorded on the DECs threatened species (i.e. Declared Rare Flora (DRF) and Priority Flora), TEC and PEC databases, including a list of significant species recorded on the database as having been previously recorded within the vicinity of the study area;
- Discussion of the conservation significance of the flora and vegetation identified within the study area from a local and regional context; and
- Discussion of the potential flora and vegetation constraints (including wetlands) associated with the clearing of vegetation for development with reference to State and Federal legislation, including implications of the Commonwealth's *EPBC Act 1999.*

2 EXISTING ENVIRONMENT

2.1 Climate

The study area is characterised by a semi-arid bixeric (receives rain in both summer and winter) climate with an annual precipitation 200 to 250mm (Beard, 1990). Mean maximum daily temperatures recorded at Learmonth Airport weather station vary from 38°C in January to 24.2°C in July, and mean minimum daily temperatures vary from 22.9°C in January to 11.4°C in July (BoM, 2010).

Average annual rainfall (1968-2009) recorded from Exmouth Town weather station is approximately 284mm. The highest rainfall is generally received in May and June (BoM, 2010). Chart 1 below shows the rainfall in the months preceding the flora and vegetation assessment undertaken in October 2010, compared with average annual rainfall. The chart shows that the rainfall between January and May 2010 was below average, however 125.5mm of rainfall was received in June 2010, which is significantly above average.

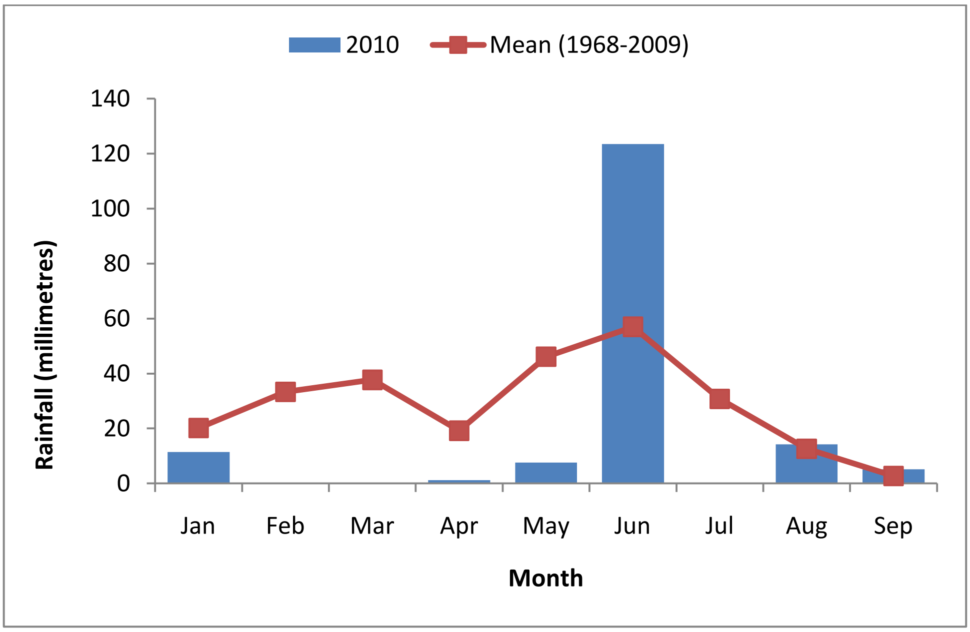


Chart 1:

Monthly rainfall for nine months preceding flora survey and mean rainfall (1968-2009) for Exmouth Town weather station

2.2 Geology and Landforms

The study area is located within the Carnarvon region which coincides broadly with the geological Carnarvon Basin and is thus situated upon sedimentary rocks to the west of the Western Shield. The topography includes low plateaux, coastal plains, occasional tabular hills and some low folded ranges (Beard, 1990).

Topography within the study area was predominantly relatively flat to gently undulating, with some low rises.

2.3 Surface Hydrology

A major drainage line abuts the southern perimeter of the Nimitz Street study area. In addition, a minor to moderate sized drainage line dissects diagonally through the centre of the Nimitz Street study area.

A moderately sized drainage line is located within the southern half of the Learmonth Street study area, and within a small area in the north-west corner.

2.4 Soils

According to the Geoscience Australia portal (Geoscience Australia, 2010), the soils in the vicinity of Exmouth are comprised of colluvium – poorly sorted clay, silt, sand and gravel, formed on plains and slopes by sheet flood and deflation.

2.5 Biological Context of Study Area

2.5.1 Bioregional Context

The study area occurs in the Carnarvon 1 (CAR1 – Cape Range) subregion of the Carnarvon Bioregion (Environment Australia, 2000). The Cape Range subregion is composed of rugged tertiary limestone ranges and extensive areas of red aeolian dunefield, Quarternary coastal beach dunes and mud flats. The vegetation consists typically of *Acacia* shrublands (*Acacia stuartii* or *A. bivenosa)* over *Triodia* on limestone and red dunefields, and *Triodia* hummock grasslands with sparse *Eucalyptus* trees and shrubs on the Cape Range (Kendrick and Mau, 2002).

2.5.2 Beard's Vegetation Mapping

The study area lies entirely within the Carnarvon Botanical District of the Eremaean Botanical Province as defined by Beard (1975). The vegetation of the Carnarvon Botanical District is very varied, and is generally *Acacia* dominated in the south, changing to *Triodia* dominated in the north.

The Natural Resources Management, Shared Land Information Platform (SLIP) (Department of Agriculture and Food, 2010) provides State-wide coverage of the Pre-European extent of vegetation within Western Australian at the scale of 1:250,000. This dataset is based on the work of J. S. Beard, supplemented where necessary to give a uniform standard of mapping detail.

According to the Department of Agriculture and Food (2010) database, the study area is comprised of the Cape Range (663) Beard mapping unit. The Cape Range mapping unit is described as hummock grasslands, shrub steppe; waterwood over soft spinifex: According to Beeston *et al.,* (2002), a total of 95.65% (29,016ha) of the pre-European extent of the Cape Range mapping unit currently remains in Western Australia.

3 METHODOLOGY

3.1 Flora and Vegetation Survey Methodology

A flora and vegetation assessment of the study area was undertaken from 4 to 6 October 2010 by experienced botanists Cassyanna Gray and Bethea Loudon. An additional follow up survey was undertaken within the study area from 6 to 7 April 2011 by experienced botanists Cassyanna Gray and Clinton Van Den Bergh. The follow-up survey was undertaken to record any additional annual/ephemeral flora species not present during the initial flora survey and involve a targeted search for significant flora species that may not have been identifiable during the initial survey.

The time spent surveying the study area is considered appropriate considering the size and ease of the access to the study area. The surveys were undertaken to provide a description of the dominant vegetation types, vegetation condition and provide a list of the flora species present at the time of the survey. Additionally, the survey also determined whether any of the significant flora species identified on the DEC Declared Rare and Priority Flora list for the area actually occur or are likely to occur within the study area. This was based on a combination of sampling within nine semi- permanent quadrats of 20m x 20m dimensions and one relevé, located in representative vegetation types, as well as traversing the site to opportunistically record all plant species that were not recorded from the quadrats.

Vegetation types were described according to the vegetation structural classes adapted from Muir (1977) and Aplin (1979), which is a modification of the vegetation classification system of Specht (1970). This classification is outlined in Table 1 below.

Table 1
Vegetation Structural Classes

Stratum	Canopy Cover				
	70%-100%	30%-70%	10%-30%	2%-10%	<2%
Trees over 30m	Tall Closed Forest	Tall Open Forest	Tall Woodland	Tall Open Woodland	Scattered Tall Trees
Trees 10-30m	Closed Forest	Open Forest	Woodland	Open Woodland	Scattered Trees
Trees under 10m	Low Closed Forest	Low Open Forest	Low Woodland	Low Open Woodland	Scattered Low Trees
Shrubs over 2m	Tall Closed Scrub	Tall Open Scrub	Tall Shrubland	Tall Open Shrubland	Scattered Tall Shrubs
Shrubs 1-2m	Closed Heath	Open Heath	Shrubland	Open Shrubland	Scattered Shrubs
Shrubs under 1m	Low Closed Heath	Low Open Heath	Low Shrubland	Low Open Shrubland	Scattered Low Shrubs
Hummock Grasses	Closed Hummock Grassland	Mid-dense Hummock Grassland	Hummock Grassland	Open Hummock Grassland	Scattered Hummock Grasses

Table 1
Vegetation Structural Classes (Cont'd)

Stratum	Canopy Cover				
	70%-100%	30%-70%	10%-30%	2%-10%	<2%
Grasses, Sedges and Herbs	Closed Tussock Grassland/ Sedgeland/ Herbland	Tussock Grassland/ Sedgeland/ Herbland	Open Tussock Grassland/ Sedgeland/ Herbland	Very Open Tussock Grassland/ Sedgeland/ Herbland	Scattered Tussock Grasses/ Sedges/ Herbs

A vegetation condition rating scale that was developed based on a rating scale devised by M.E. Trudgen was used to assess the vegetation condition. This rating scale is outlined in Table 2 below.

Table 2
Vegetation Condition Rating Scale

E=Excellent Pristine or nearly so; no obvious signs of damage caused by activities of European man.
VG= Very Good Some relatively slight signs of damage caused by activities of European man. For example, some signs of damage to tree trunks caused by repeated fire, the presence of some relatively non-aggressive weeds such as **Ursinia anthemoides* or **Briza* spp., or occasional vehicle tracks
G=Good More obvious signs of damage caused by activities of European man, including some obvious signs of impact on the vegetation structure such as that caused by low levels of grazing or by selective logging. Weeds as above, possibly plus some more aggressive ones such as **Ehrharta* spp.
P=Poor Still retains basic vegetation structure or ability to regenerate to it after very obvious activities of European man, such as grazing, partial clearing (chaining) or frequent fires. Weeds as above, probably plus some aggressive ones such as **Ehrharta* spp.
VP=Very Poor Severely impacted by grazing, very frequent fires, clearing or a combination of these activities. Scope for some regeneration but not to a state approaching good condition without intensive management. Usually with a number of weed species including very aggressive species.
D=Degraded Areas that completely or almost completely without native species in the structure of their vegetation ; i.e. areas that are cleared or 'parkland cleared' with their flora comprising weed or crop species with isolated native trees or shrubs

* denotes weed species

The survey methodology complies with Coffey Environments interpretation of the EPA's guidelines for flora surveys as outlined in Guidance Statement No. 51: *Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia* (EPA, 2004) and Position Statement No. 3: *Terrestrial Biological Surveys as an Element of Biodiversity Protection* (EPA, 2002).

The optimal time for conducting flora and vegetation surveys within the Gascoyne region is after the main rainfall period (usually March – May), however this can vary due to the sporadic rainfall patterns in the region. Two surveys were undertaken within the study area (October 2010 and April 2011) and the timing of these surveys are considered to be adequate for the identification of the majority of the annual and ephemeral species, including any DRF or Priority flora species that may potentially be present within the study area.

Common species that were well known to the survey botanists were identified in the field, while the specimens of all the other species were collected, assigned a unique number to facilitate tracking and pressed during that day. These specimens were then identified by comparing them against specimens at the Western Australian Herbarium (WAHERB) and using taxonomic keys.

Quadrat dimensions are dependent on the region in which the survey is being undertaken. For the Gascoyne region it was appropriate to use quadrats of 20m x 20m (EPA, 2004). The following information was recorded for each of the nine 20m x 20m quadrats:

- **Location** - MGA coordinates (equivalent of WGS84) were taken from the north-west corner of the 20m x 20m quadrat using a handheld Magellan GPS to an accuracy of 2m;
- **Vegetation Description -** The vegetation types were described and mapped using the vegetation structural classes adapted from Muir (1977) and Aplin (1979);
- **Disturbance Details -** Vegetation condition was assessed using the condition rating scale devised by M.E. Trudgen;
- **Percentage Foliage Cover and Height -** Cover and height was estimated visually for each species recorded within each quadrat. Estimates were made to the nearest percentage and tenth of a metre (i.e. 0.1m) where possible;
- **Habitat -** Habitat was described based on aspect and slope within and around the surrounding area of the quadrat; and
- **Soil -** Colour and soil texture within each quadrat was recorded.

3.2 Database Searches

3.2.1 Vegetation

A search of the DEC's Threatened and Priority Ecological Community database identified one Threatened Ecological Community (TEC), the 'Critically Endangered' *Camerons Cave Troglobitic Community*, as occurring within the vicinity of the study area.

No Priority Ecological Communities (PECs) were identified from the database search as occurring within the vicinity of the study area.

3.2.2 Flora

A search of the DEC's Declared Rare and Priority Flora database was undertaken in October 2010 to identify significant flora that could potentially occur in the survey area. This investigation encompassed a review of the following databases:

- DEC's 'Threatened (Declared Rare) Flora' database; and

- DEC's 'Declared Rare and Priority Flora List' which contain species that are Declared Rare (Conservation code R or X for those presumed to be extinct) poorly known (Conservation codes 1, 2 or 3) or require monitoring (Conservation Code 4).

The results of the DEC database search are presented below in Table 3. A total of 19 Priority species have been previously recorded in the vicinity of the study area. No DRF species were identified as occurring within the vicinity of the study area.

Table 3
DEC Listed DRF and Priority Listed Taxa Previously Recorded From Vicinity of The Study Area

Species	Conservation Status	Preferred Habitat	Flowering Period
Abutilon sp. Cape Range (A.S George 1312)	P2	Calcareous loam. Limestone gullies	May-Jun
Abutilon sp. Quobba (H. Demarz 3858)	P2	Sand	Jul-Sep
Acacia alexandri	P3	Limestone. Stony creeks, steep rocky slopes	Jun-Sep
Acacia startii	P3	Calcareous loam with limestone pebbles. Stony hills & watercourses	Jul-Aug
Acanthocarpus rupestris	P2	Red sand, limestone	May-Jun
Brachychiton obtusilobus	P4	Skeletal soils. Rocky limestone ranges, gorges, occasionally sandplains	Aug-Sep
Corchorus congener	P3	Sand, red sandy loam with limestone. Sand dunes, plains	Apr-Nov
Crinum flaccidum	P2	Loam, clay, sandstone. Swamps, creeks	Oct-Jan/May
Daviesia pleurophylla	P2	Sand dunes	-
Eremophila forrestii subsp. *capensis*	P3	Brown rocky soils, limestone. Ridges	Jun-Jul
Eremophila occidens	P2	Orange/brown sand. Limestone ranges, dunes	Aug-Sep
Eremophila youngii subsp. *lepidota*	P4	Stony red sandy loam. Flats plains, floodplains, sometimes semi-saline, clay flats	Jan–Mar/ Jun–Sep
Grevillea calcicola	P3	Limestone hilltops	May-Aug

Table 3
DEC Listed DRF and Priority Listed Taxa Previously Recorded From Vicinity of The Study Area (Cont'd)

Species	Conservation Status	Preferred Habitat	Flowering Period
Harnieria kempeana subsp. *rhadinophylla*	P2	Calcareous loam. Amongst limestone rocks, creek banks	May-Sep
Livistona alfredii	P4	Edges of permanent pools	Jul-Sep
Rhynchosia bungarensis	P4	Banks of flow line in the mouth of a gully in a valley wall	-
Stackhousia umbellata	P3	Sandy soils on limestone	May-Aug
Tinospora esiangkara	P2	Pebbly orange-brown calcareous loam. Limestone outcrops or ridges, near creek bank	Jul
Verticordia serotina	P2	Red sand. Sand dunes	Aug-Sep

Note:

DRF Declared Rare Flora, which have not been collected, or otherwise verified, over the past 50 years despite thorough searching, or of which all known wild populations have been destroyed more recently, and have been gazetted.

P1 Priority One - Poorly known taxa, which are known from 1 to <5 populations that are under threat, or on lands under immediate threat (i.e. road verges, farmland, or urban areas). Such taxa are under consideration for declaration as 'rare flora', but are in urgent need for further survey.

P2 Priority Two - Poorly known taxa, which are known for 1 to <5 populations, at least some of which are not to be believed to be under threat (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but are not in urgent need for further survey.

P3 Priority Three - Poorly known taxa, which are known from several populations, at least one of which are not believed to be under immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but are in need of further survey.

P4 Priority Four - Rare taxa, which are considered to have been adequately surveyed, and which, whilst being rare, are not currently threatened by any identifiable factors. These taxa require monitoring every 5-10 years.

Information on each of the Priority flora, including habit and preferred habitat, was obtained from the Western Australian Herbarium (2010) and other appropriate literature.

3.3 Survey Limitations

The potential limitations of the October 2010 and April 2011 flora and vegetation surveys within the study area are presented in Table 4.

Table 4
Statement of Botanical Limitations

Potential Limitations	Constraints (Yes/No); Significant/Moderate/ Negligible	Comment
Competency/experience of the consultant conducting the survey	No constraints	Botanist with extensive survey experience and taxonomic skills.
Proportion of the flora identified	No constraints	Initial survey conducted in October 2010 with follow up survey in Apri 2011. A reasonable number of annual and ephemeral species recorded. Five days spent on site.
Sources of information (historic/recent or new data)	No constraints	Region is well documented.
Proportion of the task achieved and further work that may need to be undertaken	Minor constraint	An intensive targeted grid-search was not undertaken throughout the entire study area for the Priority 3 species, *Corchorus congener*.
Timing/weather/season/cycle	No constraints	Initial survey conducted in October 2010 with follow up survey in Apri 2011
Intensity of survey (i.e. In retrospect was the intensity adequate)	No constraints	The study area was mapped and searched comprehensively, with the study area traversed by foot. Ten quadrats were sampled in October 2010
Completeness (i.e. was relevant area fully surveyed)	No constraints	
Resources (i.e. degree of expertise available for plant identification)	No constraints	Experienced botanist undertook plant identifications in field and at the Western Australian Herbarium.
Remoteness and/or access problems	No constraints	The site was accessible by numerous vehicle tracks and on foot.
Availability of contextual (i.e. bioregional) information for the survey area	No constraints	Flora and vegetation of the Exmouth region have been well documented.

Fungi and nonvascular flora (i.e. algae, mosses and liverworts) were not specifically surveyed for during the surveys.

No numerical analysis (i.e. PATN) of the floristic sample data collected from the surveys was conducted for this study.

4 RESULTS OF VEGETATION SURVEY

4.1 Vegetation Types

A total of 12 relatively discrete vegetation types were recorded within the study area during the October 2010 and April 2011 flora and vegetation surveys. The 12 vegetation types are described below along with the corresponding quadrats from Appendix A. The quadrat locations and vegetation mapping are shown on Figures 2, 3a and 3b.

4.1.1 Learmonth Street

A total of three vegetation types were recorded within the Lot 5000 Learmonth Street study area.

SLTCh

Scattered Low Trees of *Corymbia hamersleyana* to 6m over Tall Open Scrub of *Gossypium robinsonii* and *Acacia bivenosa* to 3m over Shrubland of *Acacia arida* and *Acacia pyrifolia* to 1.8m over Low Open Shrubland of *Indigofera monophylla* to 0.6m over Open Hummock Grassland of *Triodia wiseana* to 0.4m over Very Open Tussock Grassland of *Cenchrus ciliaris* to 0.3m. This vegetation type was located along the drainage line in the southern portion of the study area (Quadrat 8).

SAbElSg

Shrubland of *Acacia bivenosa, Eremophila longifolia, Senna glutinosa* subsp. *pruinosa* and *Stylobasium spathulatum* to 1.5m over Hummock Grassland of *Triodia wiseana* to 0.4m. This vegetation type was mainly located in the central and northern portion of the study area (Quadrat 9).

LOWCh

Low Open Woodland of *Corymbia hamersleyana* to 4m over Tall Open Shrubland of *Acacia bivenosa, Gossypium robinsonii, Eremophila longifolia, Acacia arida* and *Acacia pyrifolia* to 2.5m over Open Hummock Grassland of *Triodia wiseana* and *Triodia epactia* to 0.5m. This vegetation type was located on the edge of the drainage line in the north-western portion of the study area (Quadrat 10).

4.1.2 Nimitz Street

A total of nine vegetation types were recorded within the UCL Nimitz Street study area.

TOSAsAb

Tall Open Shrubland of *Acacia synchronicia* and *Acacia bivenosa* to 3.5m over Shrubland of *Eremophila longifolia* and *Senna artemisioides* subsp. *oligophylla* to 1.8m over Hummock Grassland of *Triodia wiseana* and *Triodia epactia* to 0.4m. This vegetation types was located within the south-western portion of the study area (Quadrat 1)

LOWChAs

Low Open Woodland to Scattered Low Trees of *Corymbia hamersleyana* and *Acacia sericophylla* to 8m over Tall Open Shrubland of *Acacia tetragonophylla, Acacia bivenosa* and *Acacia pyrifolia* var. *pyrifolia* to 3m over Tussock Grassland of *Cenchrus ciliaris* to 0.5m. This vegetation type was located within the drainage line traversing through the centre of the study area (Relevé 1).

TOSAoAs

Tall Open Shrubland of *Alectryon oleifolius* subsp. *oleifolius* and *Acacia synchronicia* to 3.5m over Open Tussock Grassland of *Cenchrus ciliaris* to 0.3m. This vegetation was located in the central portion of the study area (Quadrat 2).

LWEcAsAb

Low Open Woodland to Scattered Low Trees of *Eucalyptus camaldulensis* subsp. *obtusa* to 6m over *Acacia synchronicia* and *Acacia bivenosa* to 4m over Open Shrubland of *Senna artemisioides* subsp. *oligophylla* to 1.6m over Tussock Grassland of *Cenchrus ciliaris* and *Chrysopogon fallax* to 1.3m over Low Open Shrubland of *Scaevola spinescens* to 0.6m. This vegetation type was located in the northern portion of the study area (Quadrat 3).

SLTCh

Scattered Low Trees of *Corymbia hamersleyana* to 6m over Tall Shrubland of *Acacia pyrifolia* subsp. *pyrifolia* to 3.5m over Open Shrubland of *Acacia bivenosa* and *Senna artemisioides* subsp. *oligophylla* to 2m over Hummock Grassland of *Triodia epactia* to 0.8m. This vegetation type was located north of the major drainage line in the southern portion of the study area (Quadrat 4).

SMcAb

Shrubland of *Melaleuca cardiophylla* and *Acacia bivenosa* to 1.5m over Hummock Grassland of *Triodia epactia* and *Triodia wiseana* to 0.8m. This vegetation type was located in on a low rise near the western perimeter of the study area (Quadrat 5).

TSApAs

Tall Shrubland of *Acacia pyrifolia* and *Acacia synchronicia* to 4m over Open Tussock Grassland of *Cenchrus ciliaris* to 0.4m. This vegetation type was located in the south-eastern portion of the study area (Quadrat 6).

TOSAs

Tall Open Shrubland of *Acacia synchronicia* to 3.5m over Shrubland of *Acacia bivenosa* to 1.8m over Mid-dense Hummock Grassland of *Triodia epactia* and *Triodia wiseana* to 0.5m. This vegetation type was located near the centre of the southern portion of the study area (Quadrat 7).

SAb

Shrubland of *Acacia bivenosa* to 1.5m over Hummock Grassland of *Triodia epactia* and *Triodia wiseana* to 0.5m. This vegetation type was located in the western portion of the study area.

4.2 Vegetation Condition

The vegetation condition within the study area was rated according to the Condition Rating Scale devised by M.E Trudgen (see Section 3.1). The Condition Scale provides a gradational scale that rates vegetation from Excellent to Degraded. The vegetation condition ratings within the study area are described below and mapped in Figures 2, 3a and 3b.

4.2.1 Learmonth Street

The vegetation condition in the Lot 5000 Learmonth Street study area ranged from Very Good to Degraded (Figure 2). The majority of vegetation within the study area was considered to be in Good condition due to a low weed density. Portions of vegetation associated with drainage lines were considered to be in Poor condition due to a moderate weed density. Cleared tracks were considered to be in Degraded condition due to being devoid of native vegetation.

4.2.2 Nimitz Street

The vegetation condition in the UCL Nimitz Street study area ranged from Very Good to Degraded (Figures 3a and 3b). The majority of vegetation within the study area was considered to be in Poor to Very Poor condition due to a moderate to high weed density. Some portions of vegetation in the south-western portion of the study area were considered to be in Very Good to Good condition due to a low weed density. Cleared tracks were considered to be in Degraded condition due to being devoid of native vegetation.

4.3 Conservation Significance of Vegetation

4.3.1 Threatened Ecological Communities

The Critically Endangered TEC, *Camerons Cave Troglobitic Community,* which was identified on the DEC Threatened and Priority Ecological Communities database as occurring within the vicinity of the study area, was not recorded during flora and vegetation survey. No other TECs were recorded during the survey.

No TECs protected under the *Environment Protection and Biodiversity Conservation Act 1999* were identified from the DSEWPC's database search as having the potential to occur within the study area. No TECs listed on DSEWPC's database were identified during the flora and vegetation survey.

4.3.2 Priority Ecological Communities

No PECs were identified on the DEC Threatened and Priority Ecological Communities database as occurring within the vicinity of the study area.

5 TERRESTRIAL FLORA

5.1 Flora

A total of 130 species were recorded within the study area (Appendix B). The dominant plant families were Asteraceae (Daisy family) with 14 taxa, Papilionaceae (Pea family) with 12 taxa, and Mimosaceae (Wattle family) with nine taxa.

A total of seven weed species were recorded within the study area, some of which are considered invasive, such as *Cenchrus ciliaris* (Buffel Grass).

5.2 Conservation Significant Flora

A search of DEC's Threatened (Declared Rare) and Priority Flora databases and the Western Australian Herbarium Specimen database was conducted for the vicinity of the study area. A total of 19 Priority species have been previously recorded in the vicinity of the study area. No DRF species were identified in the database search or during the site visit as occurring within the vicinity of the study area.

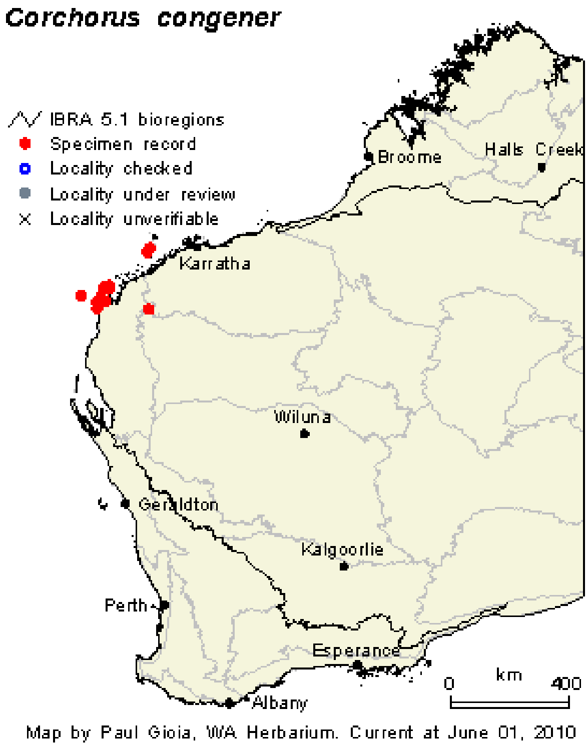
No Declared Rare Flora species were recorded from the study area during the October 2010 flora survey.

One Priority 3 flora species, *Corchorus congener* (P3) was identified as occurring within the UCL Nimitz Street study area during the October 2010 and April 2011 flora surveys. *Corchorus congener* (P3) is a spreading shrub to 0.6 m high, with yellow flowers between April and November. A total of six individuals of this species were recorded at two locations within the study area as shown on Figure 3a.

Reference: Photography by J. English. Image used with the permission of the Western Australian Herbarium, Department of Environment and Conservation http://florabase.dec.wa.gov.au/help/copyright. accessed on Friday, 12 November 2010.

According to the Western Australian Herbarium Specimen database search conducted for the vicinity of the study area, four occurences of *Corchorus congener* (P3) have previously been recorded within 25km of the study area. It is also likely that there are further occurrences of *Corchorus congener* (P3) within the vicinity of Exmouth, therefore the occurrence of *Corchorus congener* (P3) within the study area is not considered to be of high local significance.

Occurences of *Corchorus congener* (P3) have also previously been recorded in the vicinity of Cape Range National Park, Ningaloo Station and Barrow Island (Western Australian Herbarium, 2010). The map below shows the locations of previous records of *Corchorus congener* (P3) within Western Australia.



Reference: Map by P. Gioia. Image used with the permission of the Western Australian Herbarium, Department of Environment and Conservation (http://florabase.dec.wa.gov.au/help/copyright. accessed on Thursday, 16 December 2010.

Based on preferred habitat, soils and vegetation, it is considered that all Priority flora species likely to potentially occur within the study area based on the DEC database search would have been identifiable during the October 2010 and April 2011 flora surveys.

5.3 Environmental Weeds

A total of six weed species were recorded within the study area during the October 2010 flora survey, none of which are listed as a Declared Plant under the *Agriculture and Related Resources Protection Act 1999* (Agwest, 2009). These included *Aerva javanica, Bidens bipinnata, Cenchrus ciliaris, Lantana camara, Leucaena leucocephala* subsp. *leucocephala* and *Sonchus asper.*

The Environmental Weeds Strategy for Western Australia (CALM, 1999) included criteria for the assessment and rating of introduced flora species in terms of their environmental impact on biodiversity.

The criteria included:

- **Invasiveness –** ability to invade bushland in good to excellent condition or ability to invade waterways (score of yes or no);
- **Distribution –** wide current or potential distribution including consideration of known history of widespread distribution elsewhere in the world (scored as yes or no); and
- **Environmental Impacts** – ability to change the structure, composition and function of ecosystems, in particular an ability to form a monoculture in a vegetation community (scored as a yes or no).

The rating of each introduced flora species was determined based on these criteria by using the following scoring system:

High - an introduced flora species that scores yes to all three criteria. An introduced flora species with a rating of High would indicate prioritising this weed for control and/or research.

Moderate - An introduced flora species that scores yes to two of the criteria. Rating an introduced flora species as Moderate would indicate that control or research effort should be directed if funds are available, however it should be monitored.

Mild – An introduced flora species that scores yes to one of the criteria. A Mild rating would indicate that monitoring and control of the introduced flora species is necessary where appropriate.

Low – an introduced flora species that score no to all of the criteria. A Low rating would mean that this species would require a low level of monitoring.

Aerva javanica and *Cenchrus ciliaris* are classified as having High ratings due to their high impact on biodiversity. *Lantana camara, Leucaena leucocephala* subsp. *leucocephala* and *Sonchus oleraceus* are classified as having Moderate ratings due their moderate impact on biodiversity (CALM, 1999). None of the other introduced flora species recorded from the study area were listed in the Environmental Weeds Strategy. *Cenchrus ciliaris* is listed on DSEWPC's on-line database as a species identified as posing a significant threat to biodiversity.

6 POTENTIAL IMPACTS OF PROPOSED DEVELOPMENT

6.1 Conservation Significant Species

One Priority 3 Flora species, *Corchorus congener*, was recorded as occurring within UCL (Nimitiz Street). The species was recorded at two locations within the study area. It is recommended that a follow-up targeted flora survey be undertaken to record the numbers and distribution of *Corchorus congener* (P3) within the study area prior to any clearing of vegetation.

While there is no statutory obligation for Landcorp to protect Priority 3 listed flora, wherever possible Landcorp should endeavour to ensure impacts on these species are minimised or avoided, as they are considered by the DEC to be rare or threatened, however there is insufficient information to properly evaluate their conservation significance.

6.2 Clearing Vegetation

6.2.1 Beard Vegetation

The study area is comprised of the Cape Range (663) Beard mapping unit Department of Agriculture and Food (2010). The Cape Range mapping unit is described as hummock grasslands, shrub steppe; waterwood over soft spinifex: According to Beeston *et al.,* (2002), a total of 95.65% (29,016ha) of the pre-European extent (30,334ha) of the Cape Range mapping unit currently remains in Western Australia.

The proposed development within the study area could potentially result in the clearing of approximately 44ha of native vegetation, which comprises approximately 0.15% of the current extent of the Cape Range Beard Mapping unit.

The national objectives and targets for biodiversity conservation in Australia has a target to prevent clearance of ecological communities below 30% of the pre-European (pre-1750) extent. Below this level species loss appears to accelerate exponentially at an ecosystem level (Commonwealth of Australia, 2001). The extent of the Cape Range Beard mapping unit currently remaining (as at 2002) is well above the 30% threshold level for retention.

As a result, it is considered that clearing of native vegetation within the study area will not have a significant impact on the conservation of the Cape Range Beard mapping unit.

6.2.2 Assessment against the Ten Clearing Principles

The impacts associated with the clearing of the vegetation within the study area has been assessed against the ten clearing principles listed in Schedule 5 of the *Environmental Protection Act 1986* and described in Table 5.

The project may be at variance with one of the ten clearing principles. The project may potentially be at variance with principle (f): *native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland*.

Table 5

Assessment against the Ten Principles for Clearing Native Vegetation

Native vegetation should not be cleared if:	Assessment
a) It comprises a high level of biological diversity.	The study area is comprised of the Cape Range Beard Mapping unit of which there is currently 95.65% of the pre-European extent remaining. The study area does not comprise any TECs, PECs or DRF species, and is not likely to provide critical habitat for any significant fauna species.
b) It comprises the whole or part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.	The fauna habitat within the study area is predominantly in a degraded condition and is not considered to be unique within the local region. The retention of the vegetation within the study area is not considered to be necessary for the maintenance of significant habitat for fauna indigenous to Western Australia.
c) It includes or is necessary for the continued existence of rare flora.	No Declared Rare Flora were identified as occurring within the study area on the DEC database or during the October 2010 and April 2011 flora surveys.
d) It comprises the whole or part of, or is necessary for the maintenance of, a threatened ecological community.	No TECs or PECs were identified as occurring within the study area during the October 2010 and April 2011 flora surveys.
e) It is significant as a remnant of native vegetation in an area that has been extensively cleared.	The study area is comprised of the Cape Range Beard Mapping unit of which there is currently 95.65% of the pre-European extent remaining, this is well above the 30% threshold for retention as defined by the Commonwealth of Australia (2001). The vegetation types recorded within the study area are considered to be common within the region.
f) It is growing in, or in association with, an environment associated with a watercourse or wetland.	Portions of three minor to moderately sized drainage lines occur within the study area, and one major drainage line is located to the south of the Nimitz Street study area. The vegetation types SLTCh, LOWCh and LOWChAs were identified as occurring within the drainage lines during the October 2010 and April 2011 flora surveys. These vegetation types are considered to be common within the region.
g) The clearing of vegetation is likely to cause appreciable land degradation.	The study area is predominantly comprised of clayey loam soils, which is not considered to be at a high risk of erosion. Land degradation within the study area is not considered to be a concern.
h) The clearing of vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.	There are no conservation areas located adjacent to study area. Clearing within the study area will not impact on any conservation areas in the vicinity.
i) The clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.	Clearing for residential purposes will not cause deterioration to the quality of the surface or underground water providing appropriate design and engineering management methods are implemented.
j) The clearing of the vegetation is likely to cause or exacerbate the incidence or intensity of flooding.	The study area is subject to flooding, however it is unlikely that clearing of vegetation would significantly impact on peak flood height or duration. Appropriate drainage design will be required for any proposed residential development to mitigate potential flooding.

7 SUMMARY AND CONCLUSIONS

The flora and vegetation assessment of Lot 5000 Learmonth Road and UCL (Nimitz Street), Exmouth resulted in the following findings:

- A total of 12 vegetation types were recorded within the study area.
- No TECs as defined by the *EPBC Act 1999* or the DEC were recorded from the study area.
- No PECs as defined by DEC were recorded from the study area.
- The study area is comprised of the Cape Range (663) Beard mapping unit.: According to Beeston *et al.,* 2002), a total of 95.65% (29,016ha) of the pre-European extent of the Cape Range Beard mapping unit currently remains in Western Australia.
- The condition of vegetation in the study area ranged from Very Good to Degraded.
- A total of 130 flora species were recorded in the study area, of which seven were introduced (weed) species.
- No DRF species were identified as potentially occurring within the study area based on DEC database search results. No DRF species were recorded within the study area during the October 2010 and April 2011 flora surveys.
- One Priority 3 Flora species, *Corchorus congener*, was recorded at two locations within the study area during the October 2010 and April 2011 surveys. Based on the Western Australian Herbarium Specimen database, four records of *Corchorus congener* (P3) have previously been recorded within 25km of the study area. It is also likely that there are further occurrences of *Corchorus congener* (P3) within the vicinity of Exmouth, therefore the occurrence of *Corchorus congener* (P3) within the study area is not considered to be of high local significance.
- While there is no statutory obligation for Landcorp to protect Priority 3 listed flora, wherever possible Landcorp should endeavour to ensure impacts on these species are minimised or avoided, as they are considered by the DEC to be rare or threatened, however there is insufficient information to properly evaluate their conservation significance. Therefore, it is recommended that an intensive targeted flora survey be undertaken to ascertain the numbers and distribution of *Corchorus congener* (P3) within UCL (Nimitz Street), Exmouth prior to any clearing of vegetation.
- Based on preferred habitat, soils and vegetation, it is considered that all of the Priority flora species likely to potentially occur within the study area based on the DEC database search would have been identifiable during the October 2010 and April 2011 flora surveys.
- The project may be at variance with one of the ten clearing principles. The project may potentially be at variance with principle (f): *native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland*. The vegetation types identified as occurring within the drainage lines during the flora surveys are considered to be common within the region.

8 REFERENCES

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Figures

Flora and Vegetation Assessment, Lot 5000 Learmonth Street and UCL (Nimitz Street), Exmouth

AERIALPHOTOGRAPH SOURCE: Landgate, flown August 2007
BASE SOURCE: Landgate StreetExpress Travellers Atlas of WA, 2006.

Drawn:	C. Reeves
Checked:	C. Gray
Date:	23 Nov 2010
Projection:	MGA zn50
Scale:	1 : 1 250 000 at A4

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FLORA AND VEGETATION ASSESSMENT, LOT 5000 LEARMONTH STREET AND UCL (NIMITZ STREET), EXMOUTH

REGIONAL LOCATION

Figure 1

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VEGTETATION TYPES

SLTCh
Scattered Low Trees of *Corymbia hamersleyana* to 6m over Tall Open Scrub of *Gossypium robinsonii* and *Acacia bivenosa* to 3m over Shrubland of *Acacia arida* and *Acacia pyrifolia* to 1.8m over Low Open Shrubland of *Indigofera monophylla* to 0.6m over Open Hummock Grassland of *Triodia wiseana* to 0.4m over Very Open Tussock Grassland of *Cenchrus ciliaris* to 0.3m.

SAbEISg
Shrubland of *Acacia bivenosa, Eremophila longifolia, Senna glutinosa* subsp. *pruinosa* and *Stylobasium spathulatum* to 1.5m over Hummock Grassland of *Triodia wiseana* to 0.4m.

LOWCh
Low Open Woodland of *Corymbia hamersleyana* to 4m over Tall Open Shrubland of *Acacia bivenosa, Gossypium robinsonii, Eremophila longifolia, Acacia arida* and *Acacia pyrifolia* to 2.5m over Open Hummock Grassland of *Triodia wiseana* and *Triodia epactia* to 0.5m.

VEGETATION CONDITION

E - Excellent
Pristine or nearly so; no obvious signs of damage caused by activities of European man.

VG - Very Good
Some relatively slight signs of damage caused by activities of European man. For example, some signs of damage to tree trunks caused by repeated fire, the presence of some relatively non-aggressive weeds such as **Salvia verbenaca* or occasional vehicle tracks.

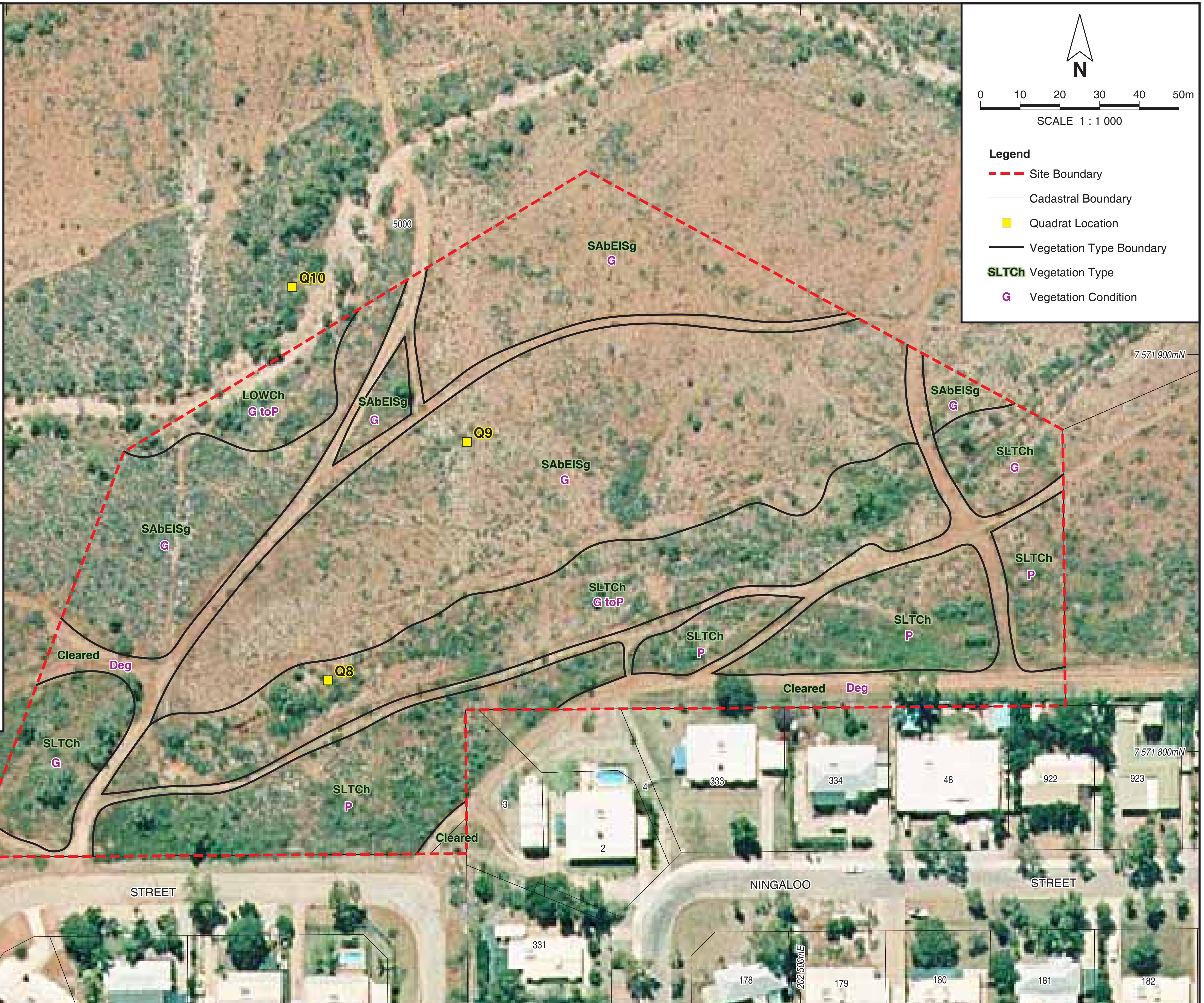
G - Good
More obvious signs of damage caused by activities of European man, including some obvious signs of impact on the vegetation structure such as that caused by low levels of grazing or by selective logging. Weeds as above, possibly plus some more aggressive ones.

P - Poor
Still retains basic vegetation structure or ability to regenerate to it after very obvious activities of European man, such as grazing, partial clearing (chaining) or frequent fires.Weeds as above, probably plus some aggressive ones such as **Cenchrus ciliaris*.

VP - Very Poor
Severely impacted by grazing, very frequent fires, clearing or a combination of these activities. Scope for some regeneration but not to a state approaching good condition without intensive management. Usually with a number of weed species including very aggressive species.

D - Degraded
Areas that completely or almost completely without native species in the structure of their vegetation,i.e. areas that are cleared or 'parkland cleared' with their flora comprising weed or crop species with isolated native trees or shrubs.

Devised by M.E Trudgen



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AERIAL PHOTOGRAPH SOURCE: Landgate, flown August 2007.

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FLORA AND VEGETATION ASSESSMENT, LOT 5000 LEARMONTH STREET AND UCL (NIMITZ STREET), EXMOUTH

VEGETATION TYPE AND CONDITION MAPPING LOT 5000 LEARMONTH STREET

Figure 2


N
0 20 40 60 80 100m
SCALE 1 : 3 000
Legend
Site Boundary
Cadastral Boundary
Quadrat Location
Releve Location
Priority Flora Location
Vegetation Type Boundary
SAb Vegetation Type
G Vegetation Condition
NIMITZ STREET
STEWART STREET
HALL
CAMERON STREET
REID STREET
LWEcAsAb P to VP
SMcAb P to VP
SAb P to VP
TOSAoAs P to VP
TSApAs P to VP
LOWChAs P to VP
TOSAbAs P to VP
SLTCh VG to G
SMcAb VG to G
TOSAsAb VG to G
TOSAs VG to G
TOSAs P to VP
SLTCh P to VP
SLTCh G to P
Q1
Q2
Q3
Q4
Q5
Q6
Q7
R1
Corchorus congener (P3) (3 plants)
7 571 250mN
7 571 000mN
7 570 750mN
202 250mE
202 500mE
202 750mE
203 000mE
AERIAL PHOTOGRAPH SOURCE: Landgate, flown August 2007.
G:\work\ENAUPERT02225AA\Flora and Veg Assessment\EP2010-208\EP2010-208F03a.dgn
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VEGETATION TYPE AND CONDITION MAPPING UCL (NIMITZ STREET)
Figure 3a

VEGETATION TYPES LEGEND

TOSAsAb
Tall Open Shrubland of *Acacia synchronicia* and *Acacia bivenosa* to 3.5m over Shrubland of *Eremophila longifolia* and *Senna artemisioides* subsp. *oligophylla* to 1.8m over Hummock Grassland of *Triodia wiseana* and *Triodia epactia* to 0.4m.

LOWChAs
Low Open Woodland to Scattered Low Trees of *Corymbia hamersleyana* and *Acacia sericophylla* to 8m over Tall Open Shrubland of *Acacia tetragonophylla, Acacia bivenosa* and *Acacia pyrifolia* var. *pyrifolia* to 3m over Tussock Grassland of *Cenchrus ciliaris* to 0.5m.

TOSAoAs
Tall Open Shrubland of *Alectryon oleifolius* subsp. *oleifolius* and *Acacia synchronicia* to 3.5m over Open Tussock Grassland of *Cenchrus ciliaris* to 0.3m.

LWEcAsAb
Low Open Woodland to Scattered Low Trees of *Eucalyptus camaldulensis* subsp. *obtusa* to 6m over *Acacia synchronicia* and *Acacia bivenosa* to 4m over Open Shrubland of *Senna artemisioides* subsp. *oligophylla* to 1.6m over Tussock Grassland of *Cenchrus ciliaris* and *Chrysopogon fallax* to 1.3m over Low Open Shrubland of *Scaevola spinescens* to 0.6m.

SLTCh
Scattered Low Trees of *Corymbia hamersleyana* to 6m over Tall Shrubland of *Acacia pyrifolia* subsp. *pyrifolia* to 3.5m over Open Shrubland of *Acacia bivenosa* and *Senna artemisioides* subsp. *oligophylla* to 2m over Hummock Grassland of *Triodia epactia* to 0.8m.

SMcAb
Shrubland of *Melaleuca cardiophylla* and *Acacia bivenosa* to 1.5m over Hummock Grassland of *Triodia epactia* and *Triodia wiseana* to 0.8m.

TSApAs
Tall Shrubland of *Acacia pyrifolia* and *Acacia synchronicia* to 4m over Open Tussock Grassland of *Cenchrus ciliaris* to 0.4m.

TOSAs
Tall Open Shrubland of *Acacia synchronicia* to 3.5m over Shrubland of *Acacia bivenosa* to 1.8m over Mid-dense Hummock Grassland of *Triodia epactia* and *Triodia wiseana* to 0.5m.

SAb
Shrubland of *Acacia bivenosa* to 1.5m over Hummock Grassland of *Triodia epactia* and *Triodia wiseana* to 0.5m.

VEGETATION CONDITION LEGEND

Ex - Excellent
Pristine or nearly so; no obvious signs of damage caused by activities of European man.

VG - Very Good
Some relatively slight signs of damage caused by activities of European man. For example, some signs of damage to tree trunks caused by repeated fire, the presence of some relatively non-aggressive weeds such as **Salvia verbenaca* or occasional vehicle tracks.

G - Good
More obvious signs of damage caused by activities of European man, including some obvious signs of impact on the vegetation structure such as that caused by low levels of grazing or by selective logging. Weeds as above, possibly plus some more aggressive ones.

P - Poor
Still retains basic vegetation structure or ability to regenerate to it after very obvious activities of European man, such as grazing, partial clearing (chaining) or frequent fires.Weeds as above, probably plus some aggressive ones such as **Cenchrus ciliaris.*

VP - Very Poor
Severely impacted by grazing, very frequent fires, clearing or a combination of these activities. Scope for some regeneration but not to a state approaching good condition without intensive management. Usually with a number of weed species including very aggressive species.

D - Degraded
Areas that completely or almost completely without native species in the structure of their vegetation,i.e. areas that are cleared or 'parkland cleared' with their flora comprising weed or crop species with isolated native trees or shrubs.

Devised by M.E Trudgen

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Checked:	C. Gray
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Scale:	Not to Scale at A4

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FLORA AND VEGETATION ASSESSMENT, LOT 5000 LEARMONTH STREET AND UCL (NIMITZ STREET), EXMOUTH

VEGETATION TYPE AND CONDITION MAPPING UCL (NIMITZ STREET) - LEGEND

Figure 3b

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Appendix A
Quadrat Data

Flora and Vegetation Assessment, Lot 5000 Learmonth Street and UCL (Nimitz Street), Exmouth

ENVIPERT02225AA
Lot 5000 Learmonth Street and UCL Nimitz Street, Exmouth
Quadrat 1

Described by: CLG **Date:** 4/10/2010 **Type:** Quadrat (20m x 20m)

Location: Nimitz Street

MGA Zone: 50 202450mE; 7570910mN
Habitat: Relatively flat
Soil: Red clay loam
Rock Type: Scattered calcrete rocks
Vegetation: Tall Open Shrubland of *Acacia synchronicia* and *Acacia bivenosa* to 3.5m over Shrubland of *Eremophila longifolia* and *Senna artemisioides* subsp. *oligophylla* to 1.8m over Hummock Grassland of *Triodia wiseana* and *Triodia epactia* to 0.4m
Condition: Very Good to Good
Fire Age: > 5 years

Species

Name	Cover (%)	Height (m)
Abutilon cunninghamii	<1	0.05
Acacia bivenosa	3	3.5
Acacia synchronicia	4	3.5
Acacia tetragonophylla	<1	1.8
Amyema preissii	<1	creeper
Bidens bipinnata	<1	0.3
Cenchrus ciliaris	1	0.3
Corchorus congener (P3)	<1	0.2
Cucumis maderaspatanus	<1	0.3
Eremophila longifolia	15	1.6
Euphorbia tannensis subsp. *eremophila*	<1	0.3
Evolvulus sp.	<1	0.05
Goodenia cusackiana	<1	0.1
Goodenia lamprosperma	<1	0.2
Haloragis trigonocarpa	<1	0.05
Hibiscus sp.	<1	0.3
Maireana planifolia	<1	0.3
Ptilotus helipteroides	<1	0.2

Ptilotus obovatus	<1	0.2
Rhynchosia minima	<1	creeper
Senna artemisioides subsp. *oligophylla*	5	1.8
Senna glutinosa subsp. *pruinosa*	<1	1.8
Solanum lasiophyllum	<1	0.3
Trichodesma zeylanicum var. *zeylanicum*	5	2.5
Triodia epactia	10	0.4
Triodia wiseana	20	0.4
Zygophyllum retivalve	<1	0.05

ENVIPERT02225AA
Lot 5000 Learmonth Street and UCL Nimitz Street, Exmouth
Quadrat 2

Described by: CLG **Date**: 4/10/2010 **Type:** Quadrat (20m x 20m)

Location: Nimitz Street

MGA Zone: 50 202706mE; 7571116mN
Habitat: Relatively flat
Soil: Hard cracked surface, red clayey silty loam
Vegetation: Tall Open Shrubland of *Alectryon oleifolius* subsp. *oleifolius* and *Acacia synchronicia* to 3.5m over Open Tussock Grassland of *Cenchrus ciliaris* to 0.3m
Condition: Poor to Very Poor
Fire Age: > 5 years

Species

Name	**Cover (%)**	**Height (m)**
Acacia colei var. *colei*	<1	0.5
Acacia synchronicia	5	2.5
Alectryon oleifolius subsp. *oleifolius*	5	3.5
Cenchrus ciliaris	15	0.3
Chrysopogon fallax	<1	1
Enchylaena tomentosa	<1	0.3
Erodium sp.	<1	0.05
Euphorbia tannensis subsp. *eremophila*	<1	0.2
Goodeniaceae sp.	<1	0.5
Lotus australis	<1	0.2
Ptilotus helipteroides	3	0.1
Ptilotus obovatus	<1	1
Rhagodia eremaea	<1	1
Scaevola spinescens	<1	0.8
Senna artemisioides subsp. *oligophylla*	<1	0.3
Solanum lasiophyllum	<1	0.3
Trichodesma zeylanicum var. *zeylanicum*	<1	0.2

ENVIPERT02225AA
Lot 5000 Learmonth Street and UCL Nimitz Street, Exmouth
Quadrat 3

Described by: CLG **Date:**4/10/2010 **Type:** Quadrat (20m x 20m)

Location: Nimitz Street

MGA Zone: 50 202838mE; 7571280mN
Habitat: Drainage line
Soil: Red brown clayey silty loam
Vegetation: Low Open Woodland to Scattered Low Trees of *Eucalyptus camaldulensis* subsp. *obtusa* to 6m over *Acacia synchronicia* and *Acacia bivenosa* to 4m over Open Shrubland of *Senna artemisioides* subsp. *oligophylla* to 1.6m over Tussock Grassland of *Cenchrus ciliaris* and *Chrysopogon fallax* to 1.3m over Low Open Shrubland of *Scaevola spinescens* to 0.6m
Condition: Poor
Fire Age: > 5 years

Species

Name	**Cover (%)**	**Height (m)**
Abutilon cunninghamii	<1	0.5
Acacia bivenosa	20	3
Acacia colei var. *colei*	<1	1.8
Acacia synchronicia	5	4
Acacia tetragonophylla	2	1.8
Alectryon oleifolius subsp. *oleifolius*	<1	1.3
Amyema preissii	<1	creeper
Asteraceae sp.	<1	0.1
Bidens bipinnata	<1	0.3
Calotis plumulifera	<1	0.1
Cenchrus ciliaris	50	0.6
Centaurium clementii	<1	0.05
Centipeda minima subsp. *macrocephala*	<1	0.1
Chrysopogon fallax	10	1.3
Eremophila longifolia	<1	1.2
Erodium sp.	<1	0.05
Eucalyptus victrix	20	6
Euphorbia biconvexa	<1	0.1

Glycine canescens	<1	creeper
Goodenia tenuiloba	<1	0.2
Ptilotus divaricatus var. *divaricatus*	<1	0.5
Ptilotus helipteroides	<1	0.1
Ptilotus polystachyus	<1	0.4
Rhodanthe humboldtiana	<1	0.3
Rhynchosia minima	<1	creeper
Scaevola spinescens	5	0.6
Senna artemisioides subsp. *oligophylla*	2	1.6
Senna artemisioides subsp. *oligophylla* x *helmsii*	<1	1
Sonchus oleraceus	<1	0.1
Streptoglossa liatroides	<1	0.2
Swainsona pterostylis	<1	0.3
Trichodesma zeylanicum var. *zeylanicum*	<1	0.3
Waltheria indica	<1	0.3

ENVIPERT02225AA
Lot 5000 Learmonth Street and UCL Nimitz Street, Exmouth
Quadrat 4

Described by: CLG **Date:** 4/10/2010 **Type:** Quadrat (20m x 20m)

Location: Nimitz Street

MGA Zone: 50 202499mE; 7570761mN
Habitat: Side of wide drainage line
Soil: Red clayey silt
Rock Type: Calcrete rock scattered
Vegetation: Scattered Low Trees of *Corymbia hamersleyana* to 6m over Tall Shrubland of *Acacia pyrifolia var. pyrifolia* to 3.5m over Open Shrubland of *Acacia bivenosa* and *Senna artemisioides* subsp. *oligophylla* to 2m over Hummock Grassland of *Triodia epactia* to 0.8m
Condition: Good
Fire Age: > 5 years

Species

Name	Cover(%)	Height (m)
Acacia arida	1	1
Acacia bivenosa	5	2
Acacia pyrifolia var. pyrifolia	12	3.4
Cenchrus ciliaris	2	0.4
Eremophila longifolia	<1	0.8
Erodium sp.	<1	0.05
Euphorbia tannensis subsp. *eremophila*	<1	0.2
Goodenia sp.	<1	0.1
Gossypium robinsonii	2	2
Haloragis trigonocarpa	<1	0.1
Indigofera monophylla	<1	0.3
Nicotiana occidentalis subsp. *occidentalis*	<1	0.2
Ptilotus obovatus	2	1
Senna artemisioides subsp. *oligophylla*	2	1.5
Senna artemisioides subsp. *oligophylla* x *helmsii*	<1	1
Solanum lasiophyllum	<1	0.3
Trichodesma zeylanicum var. *zeylanicum*	<1	0.2
Triodia epactia	25	0.8

ENVIPERT02225AA
Lot 5000 Learmonth Street and UCL Nimitz Street, Exmouth
Quadrat 5

Described by: CLG **Date:** 4/10/2010 **Type:** Quadrat (20m x 20m)

Location: Nimitz Street

MGA Zone: 50 202149mE; 7570957mN
Habitat: Low rocky rise
Soil: Red loamy clayey silt
Vegetation: Shrubland of *Melaleuca cardiophylla* and *Acacia bivenosa* to 1.5m over Hummock Grassland of *Triodia epactia* and *Triodia wiseana* to 0.8m
Condition: Very Good to Good
Fire Age: -> 5 years

Species

Name	Cover (%)	Height (m)
Acacia bivenosa	10	1.5
Acacia gregorii	1	0.3
Acacia tetragonophylla	<1	0.2
Eremophila forrestii subsp. *forrestii*	<1	0.6
Goodenia lamprosperma	<1	0.2
Leptosema macrocarpum	<1	0.4
Melaleuca cardiophylla	15	1.3
Scaevola pulchella	<1	0.2
Triodia epactia	10	0.8
Triodia wiseana	20	0.8

ENVIPERT02225AA
Lot 5000 Learmonth Street and UCL Nimitz Street, Exmouth
Quadrat 6

Described by: CLG **Date:** 4/10/2010 **Type:** Quadrat (20m x 20m)

Location: Nimitz Street

MGA Zone: 50 202967mE; 7570925mN
Habitat: Very gently undulating
Soil: Red clayey silt
Rock Type: Scattered calcrete rock and gravel
Vegetation: Tall Shrubland of *Acacia pyrifolia* var. *pyrifolia*, *Acacia tetragonophylla* and *Acacia synchronicia* to 4m over Open Tussock Grassland of *Cenchrus ciliaris* to 0.4m

Condition: Poor to Very Poor
Fire Age: > 5 years

Species

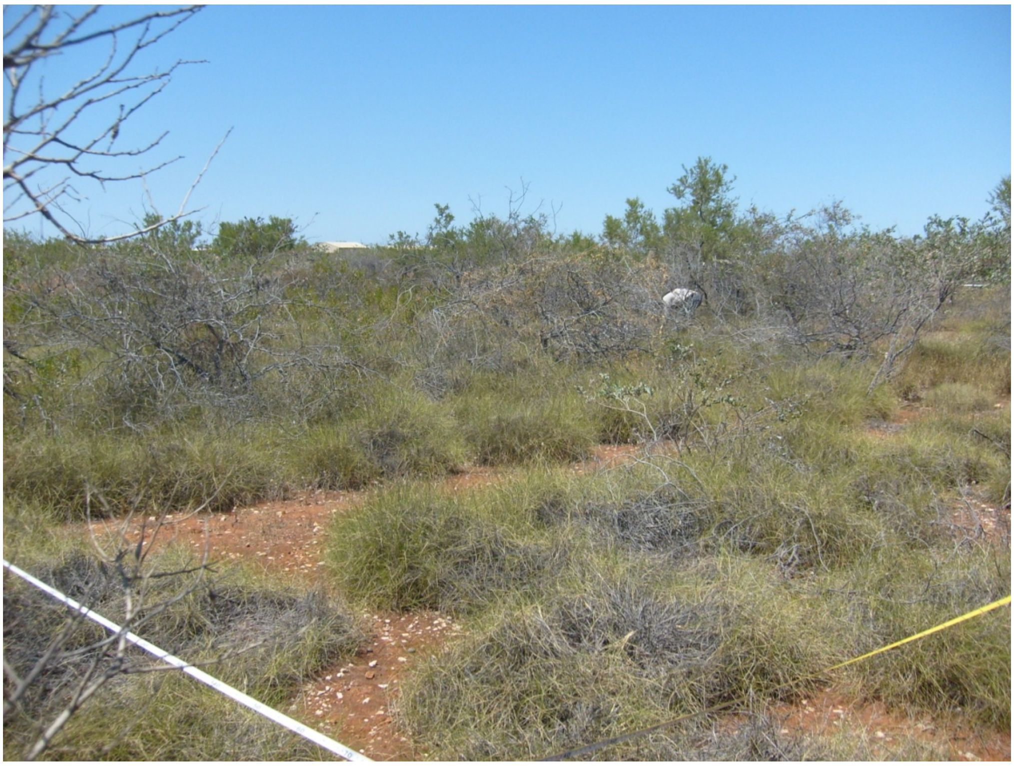
Name	Cover (%)	Height (m)
Abutilon cunninghamii	<1	0.2
Acacia pyrifolia var. *pyrifolia*	10	4
Acacia sericophylla	2	2.5
Acacia synchronicia	15	3
Acacia tetragonophylla	3	2.5
Bidens bipinnata	<1	0.1
Cenchrus ciliaris	25	0.4
Cucumis maderaspatanus	<1	creeper
Eremophila latrobei subsp. *latrobei*	<1	1.3
Erodium sp.	<1	0.05
Euphorbia tannensis subsp. *eremophila*	<1	0.1
Glycine canescens	<1	creeper
Ptilotus helipteroides	<1	0.1
Ptilotus obovatus	<1	1
Rhagodia eremaea	2	1.3
Senna artemisioides subsp. *oligophylla*	<1	1
Solanum lasiophyllum	<1	0.3
Trichodesma zeylanicum var. *zeylanicum*	<1	0.4

ENVIPERT02225AA
Lot 5000 Learmonth Street and UCL Nimitz Street, Exmouth
Quadrat 7

Described by: CLG **Date:** 5/10/2010 **Type:** Quadrat (20m x 20m)

Location: Nimitz Street

MGA Zone: 50 202802mE; 7570825mN
Habitat: Very gently undulating
Soil: Red clayey loam
Rock Type: Scattered calcrete
Vegetation: Tall Open Shrubland of *Acacia synchronicia* to 3.5m over Shrubland of *Acacia bivenosa* to 1.8m over Mid-dense Hummock Grassland of *Triodia epactia* and *Triodia wiseana* to 0.5m
Condition: Poor to Very Poor
Fire Age: > 5 years



Species

Name	Cover (%)	Height (m)
Acacia bivenosa	15	1.8
Acacia synchronicia	5	3.5
Acacia tetragonophylla	<1	2.5
Amyema preissii	<1	creeper
Bidens bipinnata	<1	0.3
Cenchrus ciliaris	<1	0.4
Cucumis maderaspatanus	<1	creeper
Erodium sp.	<1	0.05
Euphorbia tannensis subsp. *eremophila*	<1	0.2
Goodenia lamprosperma	<1	0.1
Haloragis trigonocarpa	<1	0.1
Indigofera brevidens	10	0.3
Ptilotus helipteroides	<1	0.2
Rhynchosia minima	<1	creeper
Scaevola spinescens	5	1
Trichodesma zeylanicum var. *zeylanicum*	1	0.3
Triodia epactia	25	0.5
Triodia wiseana	5	0.5

ENVIPERT02225AA
Lot 5000 Learmonth Street and UCL Nimitz Street, Exmouth
Quadrat 8

Described by: CLG **Date:** 5/10/2010 **Type:** Quadrat (20m x 20m)

Location: Learmonth Street

MGA Zone: 50 202381mE; 7571817mN
Habitat: Minor drainage
Soil: Red clayey loam
Rock Type: Scattered calcrete rock surface
Vegetation: Scattered Low Trees of *Corymbia hamersleyana* to 6m over Tall Open Scrub of *Gossypium robinsonii* and *Acacia bivenosa* to 3m over Shrubland of *Acacia arida* and *Acacia pyrifolia* var. *pyrifolia* to 1.8m over Low Open Shrubland of *Indigofera monophylla* to 0.6m over Open Hummock Grassland of *Triodia wiseana* to 0.4m over Very Open Tussock Grassland of *Cenchrus ciliaris* to 0.3m
Condition: Poor to Very Poor
Fire Age > 5 years

Species

Name	Cover (%)	Height (m)
Acacia arida	5	1.4
Acacia bivenosa	30	2.2
Acacia pyrifolia var. *pyrifolia*	2	1.8
Acanthocarpus preissii	<1	0.4
Amyema preissii	<1	creeper
Angianthus acrohyalinus	<1	0.05
Cenchrus ciliaris	3	0.3
Corchorus sp.	<1	0.3
Cucumis maderaspatanus	<1	creeper
Diplopeltis eriocarpa	<1	0.3
Eremophila longifolia	<1	1.4
Euphorbia tannensis subsp. *eremophila*	<1	0.2
Flaveria trinervia	<1	0.2
Glycine canescens	<1	creeper
Goodenia cusackiana	<1	0.3
Goodenia lamprosperma	<1	0.1
Gossypium robinsonii	10	3

Haloragis trigonocarpa	<1	0.1
Hibiscus sturtii	<1	0.5
Hybanthus aurantiacus	<1	0.1
Indigofera monophylla	2	0.6
Leptosema macrocarpum	3	0.3
Melaleuca cardiophylla	<1	1
Phyllanthus maderaspatensis	<1	0.2
Ptilotus exaltatus	<1	0.05
Ptilotus helipteroides	<1	0.1
Rhynchosia minima	<1	creeper
Salsola tragus	<1	0.2
Scaevola pulchella	<1	0.1
Senna glutinosa subsp. *glutinosa*		1.3
Senna glutinosa subsp. *pruinosa*	<1	0.8
Solanum lasiophyllum	<1	0.2
Streptoglossa sp.	<1	0.1
Stylobasium spathulatum	<1	0.8
Trichodesma zeylanicum var. *zeylanicum*	<1	0.3
Triodia wiseana	10	0.4
Zygophyllum sp.	<1	0.05

ENVIPERT02225AA
Lot 5000 Learmonth Street and UCL Nimitz Street, Exmouth
Quadrat 9

Described by: CLG **Date:** 5/10/2010 **Type:** Quadrat (20m x 20m)

MGA Zone: 50 202416mE; 7571878mN
Habitat: Low lying, relatively flat
Soil: Red gravelly clayey loam
Vegetation: Shrubland of *Acacia bivenosa*, *Eremophila longifolia*, *Senna glutinosa* subsp. *pruinosa* and *Stylobasium spathulatum* to 1.5m over Hummock Grassland of *Triodia wiseana* to 0.4m
Condition: Good
Fire Age: > 5 years

Species

Name	**Cover (%)**	**Height (m)**
Acacia bivenosa	15	2
Acacia synchronicia	<1	1.3
Amyema preissii	<1	creeper
Cenchrus ciliaris	<1	0.2
Diplopeltis eriocarpa	<1	0.4
Eremophila forrestii subsp. *forrestii*	<1	0.3
Eremophila longifolia	3	1.3
Indigofera monophylla	<1	0.4
Ptilotus exaltatus var. *exaltatus*	<1	0.05
Scaevola pulchella	<1	0.3
Senna glutinosa subsp. *pruinosa*	<1	1.5
Solanum lasiophyllum	<1	0.3
Stylobasium spathulatum	5	1.1
Triodia epactia	<1	0.4
Triodia wiseana	25	0.4
Zygophyllum sp.	<1	0.05

ENVIPERT02225AA
Lot 5000 Learmonth Street and UCL Nimitz Street, Exmouth
Quadrat 10

Described by: CLG **Date:** 5/10/2010 **Type:** Quadrat (20m x 20m)

Location Learmonth Street

MGA Zone: 50 202372mE; 7571917mN
Habitat: Drainage line
Soil: Red sandy fine gravel
Rock Type: Calcrete rock
Vegetation: Low Open Woodland of *Corymbia hamersleyana* to 4m over Tall Open Shrubland of *Acacia bivenosa*, *Gossypium robinsonii*, *Eremophila longifolia*, *Acacia arida* and *Acacia pyrifolia* var. *pyrifolia* to 2.5m over Open Hummock Grassland of *Triodia wiseana* and *Triodia epactia* to 0.5m
Condition: Good to Poor
Fire Age: > 5 years

Species

Name	Cover (%)	Height (m)
Acacia arida	10	2.2
Acacia bivenosa	5	2.5
Acacia pyrifolia var. *pyrifolia*	2	2
Acanthocarpus preissii	1	<1
Angianthus acrohyalinus	<1	0.1
Bidens bipinnata	0.1	<1
Calotis plumulifera	0.05	<1
Capparis lasiantha	creeper	<1
Cassytha capillaris	creeper	<1
Cenchrus ciliaris	<1	0.3
Corchorus crozophorifolius	0.6	<1
Corymbia hamersleyana	4	5
Cucumis maderaspatanus	creeper	<1
Cymbopogon ambiguus	0.8	<1
Dipteracanthus australasicus subsp. *australasicus*	0.1	<1
Eremophila forrestii subsp. *forrestii*	0.3	<1
Eremophila longifolia	2	2

Erodium sp.	0.05	<1
Euphorbia biconvexa	prostrate	<1
Euphorbia tannensis subsp. *eremophila*	0.1	<1
Glycine canescens	creeper	<1
Goodenia lamprosperma	<1	0.1
Goodenia stobbsiana	0.2	<1
Gossypium robinsonii	5	3
Haloragis trigonocarpa	<1	0.1
Hibiscus sturtii	0.1	<1
Hybanthus aurantiacus	<1	0.1
Indigofera monophylla	<1	0.1
Ipomoea costata	1.5	<1
Nicotiana occidentalis subsp. *occidentalis*	<1	0.3
Paraneurachne muelleri	0.2	<1
Phyllanthus erwinii	0.1	<1
Phyllanthus maderaspatensis	0.3	<1
Podolepis canescens	0.3	<1
Ptilotus exaltatus var. *exaltatus*	0.3	<1
Rhynchosia minima	creeper	<1
Scaevola pulchella	0.1	<1
Scaevola spinescens	0.2	<1
Senna artemisioides subsp. *oligophylla*	2	2.2
Senna glutinosa subsp. *glutinosa*	0.8	<1
Senna glutinosa subsp. *pruinosa*	0.8	<1
Solanum lasiophyllum	0.4	<1
Sonchus oleraceus	0.1	<1
Tephrosia rosea	<1	0.6
Trichodesma zeylanicum var. *zeylanicum*	<1	0.3
Triodia epactia	3	0.5
Triodia wiseana	6	0.5
Zygophyllum sp.	0.05	<1

ENVIPERT02225AA
Lot 5000 Learmonth Street and UCL Nimitz Street, Exmouth
Releve 1

Described by: CLG **Date:** 4/10/2010 **Type:** Releve

Location: Nimitz Street

MGA Zone: 50 202551mE; 7571140mN

Habitat: Drainage

Soil: Red brown clayey silty loam

Vegetation: Low Open Woodland to Scattered Low Trees of *Corymbia hamersleyana* and *Acacia sericophylla* to 8m over Tall Open Shrubland of *Acacia tetragonophylla*, *Acacia bivenosa* and *Acacia pyrifolia* var. *pyrifolia* to 3m over Tussock Grassland of *Cenchrus ciliaris* to 0.5m

Condition: Poor

Fire Age: > 5 years

Species

Name	Height
Acacia bivenosa	3
Acacia colei var. *colei*	3
Acacia pyrifolia var. *pyrifolia*	2.5
Acacia sericophylla	6
Acanthocarpus preissii	0.3
Alectryon oleifolius subsp. *oleifolius*	1.5
Cenchrus ciliaris	0.5
Corymbia hamersleyana	8
Eulalia aurea	0.8
Exocarpos aphyllus	0.8
Leucaena leucocephala subsp. *leucocephala*	5
Senna artemisioides subsp. *oligophylla*	1.5

Appendix B
Flora Species List

Flora and Vegetation Assessment, Lot 5000 Learmonth Street and UCL (Nimitz Street), Exmouth

ENVIPERT02225AA
Lot 5000 Learmonth Street and UCL Nimitz Street, Exmouth

		# Sites
031	**POACEAE**	
*	*Cenchrus ciliaris*	10
	Chrysopogon fallax	3
	Cymbopogon ambiguus	1
	Eulalia aurea	1
	Paraneurachne muelleri	1
	Poaceae sp.	1
	Triodia epactia	6
	Triodia wiseana	6
054C	**DASYPOGONACEAE**	
	Acanthocarpus preissii	3
090	**PROTEACEAE**	
	Grevillea erinacea	1
	Grevillea variifolia	1
092	**SANTALACEAE**	
	Exocarpos aphyllus	1
097	**LORANTHACEAE**	
	Amyema preissii	5
105	**CHENOPODIACEAE**	
	Enchylaena tomentosa	1
	Maireana planifolia	1
	Rhagodia eremaea	2
	Salsola tragus	1
106	**AMARANTHACEAE**	
*	*Aerva javanica*	1
	Ptilotus divaricatus var. *divaricatus*	2
	Ptilotus exaltatus var. *exaltatus*	3
	Ptilotus helipteroides	6
	Ptilotus obovatus	4
	Ptilotus polystachyus	2
131	**LAURACEAE**	
	Cassytha aurea	1
	Cassytha capillaris	1
137A	**CAPPARACEAE**	
	Capparis lasiantha	2
160	**SURIANACEAE**	
	Stylobasium spathulatum	2
163	**MIMOSACEAE**	
	Acacia arida	4
	Acacia bivenosa	9
	Acacia colei var. *colei*	3
	Acacia gregorii	2
	Acacia pyrifolia var *pyrifolia*	5
	Acacia sericophylla	2
	Acacia synchronicia	6
	Acacia tetragonophylla	5
*	*Leucaena leucocephala* subsp. *leucocephala*	1

164	CAESALPINIACEAE	
	Senna artemisioides subsp. *oligophylla*	7
	Senna artemisioides subsp. *oligophylla* x *helmsii*	2
	Senna glutinosa subsp. *glutinosa*	2
	Senna glutinosa subsp. *pruinosa*	4

165	PAPILIONACEAE	
	Cullen lachnostachys	1
	Glycine canescens	5
	Indigofera brevidens	1
	Indigofera linifolia	1
	Indigofera monophylla	4
	Isotropis atropurpurea	1
	Leptosema macrocarpum	2
	Lotus australis	2
	Rhynchosia minima	5
	Swainsona pterostylis	1
	Tephrosia rosea	1

167	GERANIACEAE	
	Erodium sp.	6

173	ZYGOPHYLLACEAE	
	Zygophyllum retivalve	1
	Zygophyllum sp.	4

185	EUPHORBIACEAE	
	Euphorbia biconvexa	2
	Euphorbia tannensis subsp. *eremophila*	7
	Phyllanthus erwinii	1
	Phyllanthus maderaspatensis	2

207	SAPINDACEAE	
	Alectryon oleifolius subsp. *oleifolius*	3
	Diplopeltis eriocarpa	2

220	TILIACEAE	
	Corchorus congener	1
	Corchorus crozophorifolius	2
	Corchorus sp.	1

221	MALVACEAE	
	Abutilon cryptopetalum	1
	Abutilon cunninghamii	3
	Gossypium robinsonii	4
	Hibiscus sp.	1
	Hibiscus sturtii	2
	Sida fibulifera	1

223	STERCULIACEAE	
	Hannafordia quadrivalvis subsp. *quadrivalvis*	1
	Waltheria indica	2

243	VIOLACEAE	
	Hybanthus aurantiacus	3

273	MYRTACEAE	
	Corymbia hamersleyana	2
	Eucalyptus victrix	1
	Eucalyptus xerothermica	1
	Melaleuca cardiophylla	3

276	**HALORAGACEAE**	
	Haloragis trigonocarpa	5
301	**OLEACEAE**	
*	*Olea europaea*	1
303	**GENTIANACEAE**	
	Centaurium clementii	1
305	**ASCLEPIADACEAE**	
	Marsdenia australis	1
307	**CONVOLVULACEAE**	
	Evolvulus sp.	1
	Ipomoea costata	1
310	**BORAGINACEAE**	
	Heliotropium sp.	1
	Trichodesma zeylanicum var. *zeylanicum*	8
311	**VERBENACEAE**	
*	*Lantana camara*	1
315	**SOLANACEAE**	
	Nicotiana occidentalis subsp. *occidentalis*	2
	Solanum diversiflorum	1
	Solanum lasiophyllum	7
325	**ACANTHACEAE**	
	Dicladanthera forrestii	1
	Dipteracanthus australasicus subsp. australasicus	2
326	**MYOPORACEAE**	
	Eremophila forrestii subsp. *forrestii*	3
	Eremophila latrobei subsp. *latrobei*	1
	Eremophila longifolia	6
337	**CUCURBITACEAE**	
	Cucumis maderaspatanus	5
341	**GOODENIACEAE**	
	Dampiera incana var. *incana*	1
	Goodenia cusackiana	2
	Goodenia lamprosperma	5
	Goodenia sp.	1
	Goodenia stobbsiana	1
	Goodenia tenuiloba	1
	Goodeniaceae sp.	1
	Scaevola pulchella	5
	Scaevola spinescens	4
345	**ASTERACEAE**	
	Angianthus acrohyalinus	2
	Asteraceae sp.	1
*	*Bidens bipinnata*	5
	Calotis plumulifera	3
	Centipeda minima subsp. *macrocephala*	1
	Flaveria trinervia	2
	Podolepis canescens	2
	Pterocaulon sphaeranthoides	1
	Rhodanthe floribunda	1

	Rhodanthe humboldtiana	1
*	*Sonchus oleraceus*	1
	Streptoglossa liatroides	1
	Streptoglossa sp.	2

APPENDIX 2

Nature Map Species Report and EPBC Act Protected Matters Report

NatureMap Species Report

Created By Guest user on 05/12/2011

Method	'By Circle'
Centre	114°07' 18'' E,21°56' 24'' S
Buffer	10km
Group By	Kingdom

Kingdom	Species	Records
Animalia	214	1035
Chromista	3	3
Fungi	6	12
Plantae	201	297
TOTAL	**424**	**1347**

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Animalia					
1.	24559	*Acanthagenys rufogularis (Spiny-cheeked Honeyeater)*			
2.	25332	*Acanthophis wellsi (Pilbara Death Adder)*			
3.	25535	*Accipiter cirrocephalus (Collared Sparrowhawk)*			
4.	25536	*Accipiter fasciatus (Brown Goshawk)*			
5.	-329	*Actitis hypoleucos*			
6.	30833	*Amphibolurus longirostris*			
7.	25647	*Amytornis striatus (Striated Grasswren)*			
8.	24312	*Anas gracilis (Grey Teal)*			
9.	24316	*Anas superciliosa (Pacific Black Duck)*			
10.	-344	*Anhinga novaehollandiae*			
11.	-446	*Anser sp.*			
12.	25318	*Antaresia perthensis (Pygmy Python)*			
13.	25241	*Antaresia stimsoni subsp. stimsoni*			
14.	-365	*Anthus novaeseelandiae*			
15.	24992	*Aprasia rostrata*		T	
16.	24285	*Aquila audax (Wedge-tailed Eagle)*			
17.	-331	*Ardea modesta*			
18.	24343	*Ardea sacra subsp. sacra*			
19.	24610	*Ardeotis australis (Australian Bustard)*		P4	
20.	25736	*Arenaria interpres (Ruddy Turnstone)*			
21.	25566	*Artamus cinereus (Black-faced Woodswallow)*			
22.	25567	*Artamus leucorynchus (White-breasted Woodswallow)*			
23.	24355	*Artamus minor (Little Woodswallow)*			
24.	24356	*Artamus personatus (Masked Woodswallow)*			
25.	33905	*Bamazomus subsolanus (Eastern Cape Range Bamazomus)*		T	Y
26.	-386	*Barnardius zonarius*			
27.	25716	*Cacatua sanguinea (Little Corella)*			
28.	-343	*Cacomantis pallidus*			
29.	24269	*Calamanthus campestris (Rufous Fieldwren)*			
30.	24788	*Calidris ruficollis (Red-necked Stint)*			
31.	34031	*Carcharodon carcharias (Great White Shark)*		T	
32.		*Cephrenes trichopepla*			
33.	-377	*Chalcites basalis*			
34.	-368	*Chalcites osculans*			
35.	25575	*Charadrius leschenaultii (Greater Sand Plover)*			
36.	25576	*Charadrius mongolus (Lesser Sand Plover)*			
37.	24377	*Charadrius ruficapillus (Red-capped Plover)*			
38.	24378	*Charadrius veredus (Oriental Plover)*			
39.	-355	*Cheramoeca leucosterna*			
40.	-401	*Chlidonias leucopterus*			
41.	-390	*Chroicocephalus novaehollandiae*			
42.	24833	*Cincloramphus cruralis (Brown Songlark)*			
43.	24834	*Cincloramphus mathewsi (Rufous Songlark)*			
44.	24289	*Circus assimilis (Spotted Harrier)*			
45.	24399	*Columba livia (Domestic Pigeon)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
46.	25568	*Coracina novaehollandiae (Black-faced Cuckoo-shrike)*			
47.	24416	*Corvus bennetti (Little Crow)*			
48.	25593	*Corvus orru (Torresian Crow)*			
49.	24420	*Cracticus nigrogularis (Pied Butcherbird)*			
50.	25596	*Cracticus torquatus (Grey Butcherbird)*			
51.	24872	*Ctenophorus femoralis (Dune Dragon)*			
52.	24876	*Ctenophorus isolepis subsp. isolepis*			
53.	24882	*Ctenophorus nuchalis (Central Netted Dragon)*			
54.	24886	*Ctenophorus reticulatus (Western Netted Dragon)*			
55.	25043	*Ctenotus grandis subsp. titan*			
56.	25044	*Ctenotus hanloni*			
57.	25046	*Ctenotus iapetus*			
58.	25064	*Ctenotus pantherinus subsp. ocellifer*			
59.	25069	*Ctenotus rufescens*			
60.	25073	*Ctenotus saxatilis (Rock Ctenotus)*			
61.	25090	*Cyclodomorphus melanops subsp. melanops*			
62.	25375	*Cyclorana maini (Sheep Frog)*			
63.	24322	*Cygnus atratus (Black Swan)*			
64.	30829	*Delma tealei*			
65.	25004	*Delma tincta*			
66.	25295	*Demansia psammophis subsp. cupreiceps*			
67.	25607	*Dicaeum hirundinaceum (Mistletoebird)*			
68.	24926	*Diplodactylus conspicillatus (Fat-tailed Gecko)*			
69.	34141	*Diplodactylus sp 'Cape Range' ('Cape Range Diplodactylus')*		P2	
70.	33907	*Draculoides brooksi (Northern Cape Range Draculoides)*		T	Y
71.	24470	*Dromaius novaehollandiae (Emu)*			
72.	24084	*Dugong dugon (Dugong)*		S	
73.	-330	*Egretta novaehollandiae*			
74.	-400	*Egretta sacra*			
75.	-353	*Elanus axillaris*			
76.		*Elodina padusa*			
77.	-326	*Elseyornis melanops*			
78.	24631	*Emblema pictum (Painted Finch)*			
79.	-322	*Eolophus roseicapillus*			
80.	25362	*Ephalophis greyae*			
81.	24570	*Epthianura tricolor (Crimson Chat)*			
82.	25108	*Eremiascincus fasciolatus (Narrow-banded Sand Swimmer)*			
83.	24837	*Eremiornis carteri (Spinifex-bird)*			
84.	24379	*Erythrogonys cinctus (Red-kneed Dotterel)*			
85.	-381	*Esacus magnirostris*			
86.	24043	*Eubalaena australis (Southern Right Whale)*		T	
87.	25621	*Falco berigora (Brown Falcon)*			
88.	25622	*Falco cenchroides (Australian Kestrel)*			
89.	25623	*Falco longipennis (Australian Hobby)*			
90.	25624	*Falco peregrinus (Peregrine Falcon)*		S	
91.	25727	*Fulica atra (Eurasian Coot)*			
92.	25301	*Furina ornata (Moon Snake)*			
93.	24765	*Gallirallus philippensis subsp. mellori*			
94.	24956	*Gehyra pilbara*			
95.	24959	*Gehyra variegata*			
96.	24401	*Geopelia cuneata (Diamond Dove)*			
97.	24402	*Geopelia humeralis (Bar-shouldered Dove)*			
98.	25585	*Geopelia striata (Peaceful Dove)*			
99.	25530	*Gerygone fusca (Western Gerygone)*			
100.	24443	*Grallina cyanoleuca (Magpie-lark)*			
101.	25627	*Haematopus fuliginosus (Sooty Oystercatcher)*			
102.	24487	*Haematopus longirostris (Pied Oystercatcher)*			
103.	24293	*Haliaeetus leucogaster (White-bellied Sea-Eagle)*			
104.	25541	*Haliastur indus (Brahminy Kite)*			
105.	24295	*Haliastur sphenurus (Whistling Kite)*			
106.	24961	*Heteronotia binoei (Bynoe's Gecko)*			
107.	-354	*Hieraaetus morphnoides*			
108.	25734	*Himantopus himantopus (Black-winged Stilt)*			
109.	24491	*Hirundo neoxena (Welcome Swallow)*			
110.	25368	*Hydrophis ocellatus*			
111.	-395	*Hydroprogne caspia*			
112.		*Jalmenus clementi*			
113.	-394	*Lalage sueurii*			
114.	25125	*Lerista bipes*			
115.	30928	*Lerista clara*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
116.	25133	*Lerista elegans*			
117.	25148	*Lerista lineopunctulata*			
118.	25163	*Lerista planiventralis subsp. planiventralis*			
119.	25005	*Lialis burtonis*			
120.	24575	*Lichenostomus keartlandi (Grey-headed Honeyeater)*			
121.	24578	*Lichenostomus penicillatus (White-plumed Honeyeater)*			
122.	24581	*Lichenostomus virescens (Singing Honeyeater)*			
123.	25661	*Lichmera indistincta (Brown Honeyeater)*			
124.	30932	*Limosa lapponica (Bar-tailed Godwit)*			
125.	-369	*Lophoictinia isura*			
126.	30933	*Lucasium stenodactylum*			
127.	24135	*Macropus robustus subsp. erubescens (Euro)*			
128.	25651	*Malurus lamberti (Variegated Fairy-wren)*			
129.	25652	*Malurus leucopterus (White-winged Fairy-wren)*			
130.	24583	*Manorina flavigula (Yellow-throated Miner)*			
131.	24051	*Megaptera novaeangliae (Humpback Whale)*		T	
132.	24736	*Melopsittacus undulatus (Budgerigar)*			
133.	25184	*Menetia greyii*			
134.	24598	*Merops ornatus (Rainbow Bee-eater)*			
135.	25542	*Milvus migrans (Black Kite)*			
136.	34025	*Milyeringa veritas (Blind Gudgeon)*		T	
137.	25545	*Mirafra javanica (Horsfield's Bushlark)*			
138.	25193	*Morethia ruficauda subsp. exquisita*			
139.	25424	*Neobatrachus fulvus (Tawny Trilling Frog)*			
140.	25685	*Neochmia ruficauda (Star Finch)*			
141.	24224	*Notomys alexis (Spinifex Hopping-mouse)*			
142.	25742	*Numenius phaeopus (Whimbrel)*			
143.	25564	*Nycticorax caledonicus (Rufous Night Heron)*			
144.	24407	*Ocyphaps lophotes (Crested Pigeon)*			
145.		*Ogyris amaryllis subsp. meridionalis*			
146.	34038	*Ophisternon candidum (Blind Cave Eel)*		T	
147.	24618	*Oreoica gutturalis (Crested Bellbird)*			
148.	-364	*Pandion cristatus*			
149.	24627	*Pardalotus rubricatus (Red-browed Pardalote)*			
150.	24648	*Pelecanus conspicillatus (Australian Pelican)*			
151.	-391	*Petrochelidon ariel*			
152.	-393	*Petrochelidon nigricans*			
153.	24142	*Petrogale lateralis subsp. lateralis (Black-footed Rock-wallaby)*		T	
154.	24662	*Phaethon lepturus (White-tailed Tropicbird)*			
155.	25697	*Phalacrocorax carbo (Great Cormorant)*			
156.	24667	*Phalacrocorax sulcirostris (Little Black Cormorant)*			
157.	25699	*Phalacrocorax varius (Pied Cormorant)*			
158.	24843	*Plegadis falcinellus (Glossy Ibis)*			
159.	24382	*Pluvialis fulva (Pacific Golden Plover)*			
160.	24383	*Pluvialis squatarola (Grey Plover)*			
161.	24907	*Pogona minor subsp. minor*			
162.	24681	*Poliocephalus poliocephalus (Hoary-headed Grebe)*			
163.	25706	*Pomatostomus temporalis (Grey-crowned Babbler)*			
164.	25261	*Pseudechis australis (Mulga Snake)*			
165.	25263	*Pseudonaja modesta (Ringed Brown Snake)*			
166.	25264	*Pseudonaja nuchalis (Gwardar)*			
167.	24390	*Psophodes occidentalis (Western Wedgebill)*			
168.	-347	*Ptilonorhynchus guttatus*			
169.	25009	*Pygopus nigriceps*			
170.	25277	*Ramphotyphlops grypus*			
171.	25279	*Ramphotyphlops hamatus*			
172.	-407	*Rhipidura albiscapa*			
173.	25614	*Rhipidura leucophrys (Willie Wagtail)*			
174.	24457	*Rhipidura phasiana (Mangrove Grey Fantail)*			
175.	25266	*Simoselaps bertholdi (Jan's Banded Snake)*			
176.	25267	*Simoselaps littoralis (West Coast Banded Snake)*			
177.	30948	*Smicrornis brevirostris (Weebill)*			
178.	24116	*Sminthopsis macroura (Stripe-faced Dunnart)*			
179.	24064	*Sousa chinensis (Indo-Pacific Humpback Dolphin)*		P4	
180.	25640	*Sterna dougallii (Roseate Tern)*			
181.	25642	*Sterna hirundo (Common Tern)*			
182.	-356	*Sternula albifrons*			
183.	-352	*Sternula nereis*			
184.	25656	*Stipiturus ruficeps (Rufous-crowned Emu-wren)*			
185.	25590	*Streptopelia senegalensis (Laughing Turtle-Dove)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
186.	24924	*Strophurus ciliaris subsp. aberrans*			
187.	24946	*Strophurus strophurus*			
188.	33963	*Stygiocaris lancifera (Lance-beaked Cave Shrimp)*		T	
189.	33964	*Stygiocaris stylifera (Spear-beaked Cave Shrimp)*		P4	
190.	33967	*Stygiochiropus isolatus*		T	Y
191.	33968	*Stygiochiropus peculiaris (Camerons Cave Millipede)*		T	Y
192.	25269	*Suta fasciata (Rosen's Snake)*			
193.	25705	*Tachybaptus novaehollandiae (Australasian Grebe)*			
194.	30870	*Taeniopygia guttata (Zebra Finch)*			
195.	34007	*Thalassarche chlororhynchos (Atlantic Yellow-nosed Albatross)*		T	
196.	-346	*Thalasseus bengalensis*			
197.	-375	*Thalasseus bergii*			
198.		*Theclinesthes albocincta*			
199.		*Theclinesthes miskini subsp. miskini*			
200.		*Theclinesthes serpentata subsp. serpentata*			
201.	24845	*Threskiornis spinicollis (Straw-necked Ibis)*			
202.	25207	*Tiliqua rugosa subsp. rugosa*			
203.	-366	*Todiramphus pyrrhopygius*			
204.	25549	*Todiramphus sanctus (Sacred Kingfisher)*			
205.	24803	*Tringa brevipes (Grey-tailed Tattler)*			
206.	24808	*Tringa nebularia (Common Greenshank)*			
207.	24809	*Tringa stagnatilis (Marsh Sandpiper)*			
208.	24851	*Turnix velox (Little Button-quail)*			
209.	24386	*Vanellus tricolor (Banded Lapwing)*			
210.	25209	*Varanus acanthurus (Spiny-tailed Monitor)*			
211.	25210	*Varanus brevicauda (Short-tailed Pygmy Monitor)*			
212.	25216	*Varanus giganteus (Perentie)*			
213.	25227	*Varanus tristis subsp. tristis (Racehorse Monitor)*			
214.	24857	*Zosterops luteus (Yellow White-eye)*			

Chromista

215.	26949	*Hydroclathrus clathratus*			
216.	27043	*Lobophora variegata*			
217.	27321	*Stypopodium flabelliforme*			

Fungi

218.	27587	*Aspicilia calcarea*			
219.	27698	*Clauzadeana macula*			
220.	-12452	*Graphis sp.*			
221.	-8341	*Heppia sp.*			
222.	27939	*Peltula omphaliza*			
223.	-6777	*Verrucaria sp.*			

Plantae

224.	4901	*Abutilon otocarpum (Desert Chinese Lantern)*			
225.	13074	*Acacia alexandri*		P3	
226.	3223	*Acacia arida*			
227.	3241	*Acacia bivenosa*			
228.	13500	*Acacia coriacea subsp. coriacea*			
229.	3356	*Acacia gregorii (Gregory's Wattle)*			
230.	29015	*Acacia pyrifolia var. pyrifolia*			
231.	13078	*Acacia sclerosperma subsp. sclerosperma*			
232.	3549	*Acacia spathulifolia*			
233.	13070	*Acacia synchronicia*			
234.	1209	*Acanthocarpus robustus*			
235.	1210	*Acanthocarpus rupestris*		P2	
236.	1211	*Acanthocarpus verticillatus*			
237.	17422	*Adriana tomentosa var. tomentosa*			
238.	2653	*Alternanthera pungens (Khaki Weed)*	Y		
239.	4907	*Alyogyne pinoniana (Sand Hibiscus)*			
240.	13266	*Amyema miraculosa subsp. miraculosa*			
241.	2383	*Amyema preissii (Wireleaf Mistletoe)*			
242.	35872	*Anadyomene plicata*			
243.	7822	*Angianthus acrohyalinus (Hook-leaf Angianthus)*			
244.	26469	*Anotrichium tenue*			
245.	217	*Aristida nitidula (Flat-awned Threeawn)*			
246.	12714	*Brachychiton obtusilobus*		P4	
247.	7879	*Brachyscome latisquamea*			
248.	750	*Bulbostylis barbata*			
249.	5484	*Calytrix truncatifolia*			
250.	2976	*Capparis lasiantha (Split Jack)*			
251.	12073	*Cassytha aurea var. aurea*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
252.	6569	*Catharanthus roseus (Pink Periwinkle)*	Y		
253.	26554	*Caulerpa brachypus*			
254.	26568	*Caulerpa lentillifera*			
255.	-5226	*Caulerpa peltata var. laetevirens*			
256.	27386	*Caulerpa racemosa var. lamourouxii*			
257.	258	*Cenchrus ciliaris (Buffel Grass)*	Y		
258.	26618	*Champia parvula*			
259.	2489	*Chenopodium gaudichaudianum (Cottony Saltbush)*			
260.	13114	*Chorizema racemosum*			
261.	273	*Chrysopogon fallax (Golden Beard Grass)*			
262.	2776	*Commicarpus australis (Perennial Tar Vine)*			
263.	18411	*Corchorus congener*		P3	
264.	17093	*Corymbia hamersleyana*			
265.	17084	*Corymbia zygophylla*			
266.	-10165	*Cressa sp.*			Y
267.	20179	*Crotalaria medicaginea var. neglecta*			
268.	33031	*Cucumis maderaspatanus*			
269.	17439	*Cullen lachnostachys*			
270.	17120	*Cullen pogonocarpum*			
271.	-11867	*Cullen sp.*			
272.	128	*Cymodocea angustata*			
273.	129	*Cymodocea serrulata*			
274.	6584	*Cynanchum floribundum (Dumara Bush)*			
275.	11723	*Dampiera incana var. incana*			
276.	14375	*Daviesia pleurophylla*		P2	
277.	7958	*Decazesia hecatocephala*			
278.	7164	*Dicladanthera forrestii*			
279.	6754	*Dicrastylis cordifolia*			
280.	313	*Digitaria ctenantha (Comb Finger Grass)*			
281.	6966	*Duboisia hopwoodii (Pituri)*			
282.	375	*Eragrostis cumingii (Cuming's Love Grass)*			
283.	15052	*Eremophila forrestii subsp. forrestii*			
284.	7234	*Eremophila longifolia (Berrigan)*			
285.	16363	*Eremophila maculata subsp. brevifolia (Native Fuchsia)*			
286.	23997	*Eremophila tietkensii*			
287.	16040	*Eremophila youngii subsp. lepidota*		P4	
288.	411	*Eriachne helmsii (Buck Wanderrie Grass)*			
289.	414	*Eriachne obtusa (Northern Wandarrie Grass)*			
290.	3871	*Erythrina vespertilio (Yulbah)*			
291.	35345	*Eucalyptus camaldulensis subsp. obtusa (Blunt-budded River Red Gum)*			
292.	15592	*Eucalyptus xerothermica*			
293.	11011	*Eulalia aurea*			
294.	4614	*Euphorbia alsiniflora (Namana)*			
295.	35307	*Euphorbia australis var. australis*			
296.	4623	*Euphorbia coghlanii (Namana)*			
297.	4635	*Euphorbia myrtoides*			
298.	4644	*Euphorbia sharkoensis*			
299.	12097	*Euphorbia tannensis subsp. eremophila (Desert Spurge)*			
300.	11416	*Evolvulus alsinoides var. decumbens*			
301.	10977	*Exocarpos aphyllus (Leafless Ballart)*			
302.	26835	*Galaxaura rugosa*			
303.	26837	*Ganonema farinosum*			
304.	3938	*Glycine canescens (Silky Glycine)*			
305.	2677	*Gomphrena celosioides (Gomphrena Weed)*	Y		
306.	7526	*Goodenia microptera*			
307.	-5011	*Goodenia sp.*			
308.	7556	*Goodenia tenuiloba*			
309.	4918	*Gossypium robinsonii (Wild Cotton)*			
310.	15686	*Grevillea variifolia subsp. bundera*			
311.	2784	*Gyrostemon ramulosus (Corkybark)*			
312.	2207	*Hakea stenophylla*			
313.	16897	*Hakea stenophylla subsp. stenophylla*			
314.	26894	*Halimeda macroloba*			
315.	131	*Halodule uninervis*			
316.	164	*Halophila ovalis (Sea Wrack)*			
317.	6180	*Haloragis trigonocarpa*			
318.	17327	*Harnieria kempeana subsp. rhadinophylla*		P2	
319.	6705	*Heliotropium crispatum*			
320.	17305	*Heliotropium glanduliferum*			
321.	6713	*Heliotropium ovalifolium*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
322.	26912	*Helminthocladia australis*			
323.	5171	*Hibbertia spicata*			
324.	9086	*Hibiscus pinonianus*			
325.	4942	*Hibiscus sturtii (Sturt's Hibiscus)*			
326.	5219	*Hybanthus enneaspermus*			
327.	8086	*Hypochaeris glabra (Smooth Catsear)*	Y		
328.	19547	*Indigofera chamaeclada*			
329.	3973	*Indigofera colutea (Sticky Indigo)*			
330.	3981	*Indigofera linnaei (Birdsville Indigo)*			
331.	3982	*Indigofera monophylla*			
332.	-6888	*Indigofera sp.*			
333.	6624	*Ipomoea costata (Rock Morning Glory)*			
334.	6633	*Ipomoea muelleri (Poison Morning Glory)*			
335.	11312	*Ipomoea pes-caprae subsp. brasiliensis*			
336.	6637	*Ipomoea polymorpha*			
337.	-4804	*Jania sp.*			
338.	29056	*Jasminum sp. Exmouth (G. Marsh 77)*			
339.	8098	*Launaea sarmentosa*			
340.	7588	*Lechenaultia subcymosa (Wide-branching Leschenaultia)*			
341.	16489	*Leptosema macrocarpum*			
342.	18351	*Leucaena leucocephala subsp. leucocephala*	Y		
343.	7403	*Lobelia heterophylla (Wing-seeded Lobelia)*			
344.	-8630	*Logania sp.*			
345.	4060	*Lotus australis (Austral Trefoil)*			
346.	5887	*Melaleuca cardiophylla (Tangling Melaleuca)*			
347.	4105	*Mirbelia viminalis*			
348.	1311	*Murchisonia volubilis*			
349.	11856	*Nicotiana occidentalis subsp. occidentalis*			
350.	15449	*Olearia dampieri subsp. dampieri*			
351.	18256	*Opercularia spermacocea*			
352.	17	*Ophioglossum lusitanicum (Adders Tongue)*			
353.	27121	*Penicillus nodulosus*			
354.	3674	*Petalostylis cassioides*			
355.	5230	*Pimelea ammocharis*			
356.	19744	*Pittosporum angustifolium*			
357.	3173	*Pittosporum phylliraeoides (Weeping Pittosporum)*			
358.	6814	*Pityrodia loxocarpa*			
359.	6818	*Pityrodia paniculata*			
360.	8168	*Pluchea rubelliflora*			
361.	8172	*Podolepis canescens*			
362.	6653	*Polymeria ambigua (Morning Glory)*			
363.	27171	*Polysiphonia blandii*			
364.	27186	*Portieria hornemannii*			
365.	-12591	*Portulaca sp.*			
366.	27204	*Ptilocladia vestita*			
367.	2699	*Ptilotus axillaris (Mat Mulla Mulla)*			
368.	11251	*Ptilotus divaricatus var. divaricatus*			
369.	2731	*Ptilotus helipteroides (Hairy Mulla Mulla)*			
370.	2751	*Ptilotus polystachyus (Prince of Wales Feather)*			
371.	3061	*Raphanus raphanistrum (Wild Radish)*	Y		
372.	2584	*Rhagodia preissii*			
373.	11240	*Rhagodia preissii subsp. obovata*			
374.	12578	*Scaevola acacioides*			
375.	13150	*Scaevola browniana subsp. browniana*			
376.	7606	*Scaevola crassifolia (Thick-leaved Fan-flower)*			
377.	7608	*Scaevola cunninghamii*			
378.	12584	*Scaevola pulchella*			
379.	7648	*Scaevola tomentosa (Raggedleaf Fanflower)*			
380.	8213	*Senecio magnificus (Showy Groundsel)*			
381.	25883	*Senecio pinnatifolius var. pinnatifolius*			
382.	18443	*Senna ferraria*			
383.	12306	*Senna glutinosa subsp. ferraria*			
384.	12312	*Senna notabilis*			
385.	-10308	*Sida sp.*			
386.	3072	*Sisymbrium orientale (Indian Hedge Mustard)*	Y		
387.	7002	*Solanum diversiflorum*			
388.	7018	*Solanum lasiophyllum (Flannel Bush)*			
389.	8231	*Sonchus oleraceus (Common Sowthistle)*	Y		
390.	27310	*Spyridia filamentosa*			
391.	4736	*Stackhousia umbellata*		P3	

	Name ID	Species Name	Naturalised	Conservation Code	Endemic To Query Area[1]
392.	17295	*Stemodia sp. Onslow (A.A. Mitchell 76/148)*			
393.	-12890	*Streptoglossa sp.*			
394.	4231	*Swainsona kingii*			
395.	4242	*Swainsona pterostylis*			
396.	132	*Syringodium isoetifolium*			
397.	36447	*Tecoma stans var. stans*	Y		
398.	33236	*Tecticornia halocnemoides (Shrubby Samphire)*			
399.	33318	*Tecticornia indica subsp. leiostachya (Samphire)*			
400.	31618	*Tecticornia pruinosa*			
401.	4263	*Tephrosia clementii*			
402.	19531	*Tephrosia rosea var. clementii*			
403.	169	*Thalassia hemprichii*			
404.	133	*Thalassodendron ciliatum*			
405.	17345	*Tinospora esiangkara*		P2	
406.	2829	*Trianthema pilosa*			
407.	4375	*Tribulus cistoides*			
408.	4380	*Tribulus occidentalis (Perennial Caltrop)*			
409.	18072	*Tribulus suberosus*			
410.	679	*Triodia angusta*			
411.	680	*Triodia basedowii (Lobed Spinifex)*			
412.	696	*Triodia pungens (Soft Spinifex)*			
413.	17873	*Triodia schinzii*			
414.	704	*Triodia wiseana (Limestone Spinifex)*			
415.	14694	*Triumfetta clementii*			
416.	13481	*Triumfetta ramosa*			
417.	17529	*Triumfetta tenuiseta*			
418.	36143	*Valonia fastigiata*			
419.	-8456	*Vigna sp.*			
420.	7385	*Wahlenbergia communis (Native Bluebell)*			
421.	7390	*Wahlenbergia queenslandica*			
422.	5106	*Waltheria indica*			
423.	1400	*Wurmbea odorata*			
424.	4395	*Zygophyllum retivalve*			

Conservation Codes
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

[1] For NatureMap's purposes, species flagged as endemic are those whose records are wholely contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

Australian Government

Department of Sustainability, Environment, Water, Population and Communities

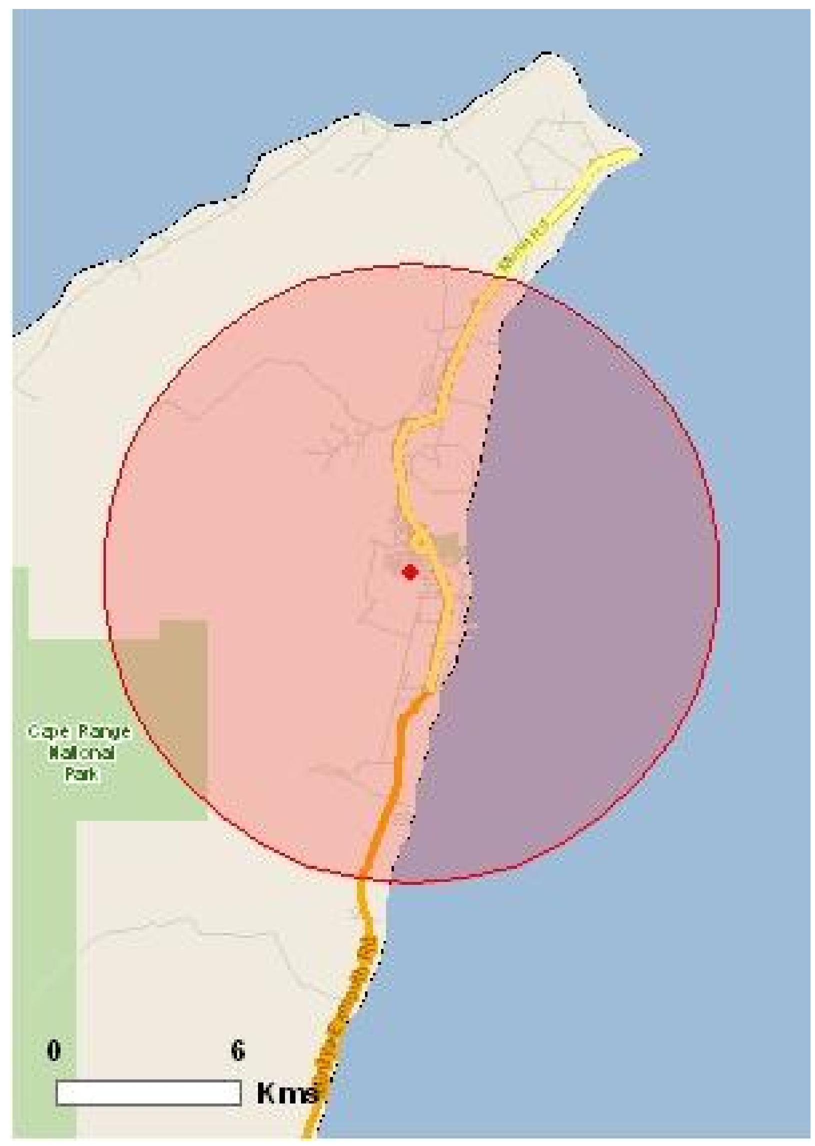
EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

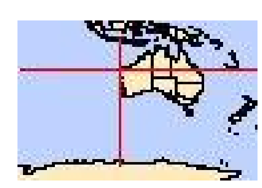
Information about the EPBC Act including significance guidelines, forms and application process details can be found at http://www.environment.gov.au/epbc/assessmentsapprovals/index.html

Report created: 28/11/11 12:26:55



Coordinates

Buffer: 10.0Km



Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance - see http://www.environment.gov.au/epbc/assessmentsapprovals/guidelines/index.html

World Heritage Properties:	1
National Heritage Places:	1
Wetlands of International	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Areas:	None
Threatened Ecological Communities:	None
Threatened Species:	16
Migratory Species:	25

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage/index.html

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species. Information on EPBC Act permit requirements and application forms can be found at http://www.environment.gov.

Commonwealth Lands:	3
Commonwealth Heritage Places:	1
Listed Marine Species:	54
Whales and Other Cetaceans:	13
Critical Habitats:	None
Commonwealth Reserves:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

Place on the RNE:	4
State and Territory Reserves:	3
Regional Forest Agreements:	None
Invasive Species:	5
Nationally Important Wetlands:	1

Details

Matters of National Environmental Significance

World Heritage Properties [Resource Information]

Name	State	Status
The Ningaloo Coast	WA	Declared property

National Heritage Properties [Resource Information]

Name	State	Status
Natural		
The Ningaloo Coast	WA	Listed place

Threatened Species [Resource Information]

Name	Status	Type of Presence

Name	Status	Type of Presence
BIRDS		
Macronectes giganteus		
Southern Giant-Petrel [1060]	Endangered	Species or species habitat may occur within area
FISH		
Milyeringa veritas		
Blind Gudgeon [66676]	Vulnerable	Species or species habitat likely to occur within area
Ophisternon candidum		
Blind Cave Eel [66678]	Vulnerable	Species or species habitat likely to occur within area
MAMMALS		
Balaenoptera musculus		
Blue Whale [36]	Endangered	Species or species habitat may occur within area
Dasycercus cristicauda		
Mulgara [328]	Vulnerable	Species or species habitat likely to occur within area
Eubalaena australis		
Southern Right Whale [40]	Endangered	Species or species habitat may occur within area
Megaptera novaeangliae		
Humpback Whale [38]	Vulnerable	Congregation or aggregation known to occur within area
Petrogale lateralis lateralis		
Black-flanked Rock-wallaby [66647]	Vulnerable	Species or species habitat likely to occur within area
REPTILES		
Aipysurus apraefrontalis		
Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat likely to occur within area
Caretta caretta		
Loggerhead Turtle [1763]	Endangered	Species or species habitat known to occur within area
Chelonia mydas		
Green Turtle [1765]	Vulnerable	Species or species habitat likely to occur within area
Dermochelys coriacea		
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Eretmochelys imbricata		
Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Natator depressus		
Flatback Turtle [59257]	Vulnerable	Species or species habitat likely to occur within area
SHARKS		
Pristis clavata		
Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Species or species habitat may occur within area
Rhincodon typus		
Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area

Migratory Species

[Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat may occur within area
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat may occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Macronectes giganteus		
Southern Giant-Petrel [1060]	Endangered	Species or species habitat may occur within area
Migratory Marine Species		
Balaenoptera edeni		
Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus		
Blue Whale [36]	Endangered	Species or species habitat may occur within area
Caretta caretta		
Loggerhead Turtle [1763]	Endangered	Species or species habitat known to occur within area
Chelonia mydas		
Green Turtle [1765]	Vulnerable	Species or species habitat likely to occur within area
Dermochelys coriacea		
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Dugong dugon		
Dugong [28]		Species or species habitat likely to occur within area
Eretmochelys imbricata		
Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Eubalaena australis		
Southern Right Whale [40]	Endangered	Species or species habitat may occur within area
Megaptera novaeangliae		
Humpback Whale [38]	Vulnerable	Congregation or aggregation known to occur within area
Natator depressus		
Flatback Turtle [59257]	Vulnerable	Species or species habitat likely to occur within area
Orcinus orca		
Killer Whale, Orca [46]		Species or species habitat may occur within area
Rhincodon typus		
Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area
Sousa chinensis		
Indo-Pacific Humpback Dolphin [50]		Species or species habitat may occur within area
Tursiops aduncus (Arafura/Timor Sea populations)		
Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat likely to occur

Name	Threatened	Type of Presence
		within area
Migratory Terrestrial Species		
[Haliaeetus leucogaster](#)		
White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
[Hirundo rustica](#)		
Barn Swallow [662]		Species or species habitat may occur within area
[Merops ornatus](#)		
Rainbow Bee-eater [670]		Species or species habitat may occur within area
Migratory Wetlands Species		
[Ardea alba](#)		
Great Egret, White Egret [59541]		Species or species habitat may occur within area
[Ardea ibis](#)		
Cattle Egret [59542]		Species or species habitat may occur within area
[Charadrius veredus](#)		
Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
[Glareola maldivarum](#)		
Oriental Pratincole [840]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Commonwealth Lands [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -
Defence - EXMOUTH ADMIN & HF TRANSMITTING
Defence - LEARMONTH RADAR SITE - TWIN TANKS EXMOUTH

Commonwealth Heritage Places [Resource Information]

Name	State	Status
Historic		
[Naval Communication Station Harold E Holt (Area B)](#)	WA	Indicative Place

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
[Apus pacificus](#)		
Fork-tailed Swift [678]		Species or species habitat may occur within area
[Ardea alba](#)		
Great Egret, White Egret [59541]		Species or species habitat may occur within area
[Ardea ibis](#)		
Cattle Egret [59542]		Species or species habitat may occur within area
[Charadrius veredus](#)		
Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Glareola maldivarum		
Oriental Pratincole [840]		Species or species habitat may occur within area
Haliaeetus leucogaster		
White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Hirundo rustica		
Barn Swallow [662]		Species or species habitat may occur within area
Macronectes giganteus		
Southern Giant-Petrel [1060]	Endangered	Species or species habitat may occur within area
Merops ornatus		
Rainbow Bee-eater [670]		Species or species habitat may occur within area
Fish		
Bulbonaricus brauni		
Braun's Pughead Pipefish, Pug-headed Pipefish [66189]		Species or species habitat may occur within area
Campichthys tricarinatus		
Three-keel Pipefish [66192]		Species or species habitat may occur within area
Choeroichthys brachysoma		
Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area
Choeroichthys suillus		
Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Doryrhamphus janssi		
Cleaner Pipefish, Janss' Pipefish [66212]		Species or species habitat may occur within area
Doryrhamphus negrosensis		
Flagtail Pipefish, Masthead Island Pipefish [66213]		Species or species habitat may occur within area
Festucalex scalaris		
Ladder Pipefish [66216]		Species or species habitat may occur within area
Filicampus tigris		
Tiger Pipefish [66217]		Species or species habitat may occur within area
Halicampus brocki		
Brock's Pipefish [66219]		Species or species habitat may occur within area
Halicampus grayi		
Mud Pipefish, Gray's Pipefish [66221]		Species or species habitat may occur within area
Halicampus nitidus		
Glittering Pipefish [66224]		Species or species habitat may occur within area
Halicampus spinirostris		
Spiny-snout Pipefish [66225]		Species or species habitat may occur within area
Haliichthys taeniophorus		
Ribboned Pipehorse, Ribboned Seadragon [66226]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
Hippocampus angustus Western Spiny Seahorse, Narrow-bellied Seahorse [66234]		Species or species habitat may occur within area
Hippocampus histrix Spiny Seahorse, Thorny Seahorse [66236]		Species or species habitat may occur within area
Hippocampus kuda Spotted Seahorse, Yellow Seahorse [66237]		Species or species habitat may occur within area
Hippocampus planifrons Flat-face Seahorse [66238]		Species or species habitat may occur within area
Micrognathus micronotopterus Tidepool Pipefish [66255]		Species or species habitat may occur within area
Solegnathus hardwickii Pallid Pipehorse, Hardwick's Pipehorse [66272]		Species or species habitat may occur within area
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
Solenostomus paegnius Rough-snout Ghost Pipefish [68425]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area
Trachyrhamphus longirostris Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish [66281]		Species or species habitat may occur within area
Mammals		
Dugong dugon Dugong [28]		Species or species habitat likely to occur within area
Reptiles		
Acalyptophis peronii Horned Seasnake [1114]		Species or species habitat may occur within area
Aipysurus apraefrontalis Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat likely to occur within area
Aipysurus duboisii Dubois' Seasnake [1116]		Species or species habitat may occur within area
Aipysurus eydouxii Spine-tailed Seasnake [1117]		Species or species habitat may occur within

Name	Threatened	Type of Presence
		area
Aipysurus laevis Olive Seasnake [1120]		Species or species habitat may occur within area
Astrotia stokesii Stokes' Seasnake [1122]		Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Disteira kingii Spectacled Seasnake [1123]		Species or species habitat may occur within area
Disteira major Olive-headed Seasnake [1124]		Species or species habitat may occur within area
Emydocephalus annulatus Turtle-headed Seasnake [1125]		Species or species habitat may occur within area
Ephalophis greyi North-western Mangrove Seasnake [1127]		Species or species habitat may occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Hydrophis elegans Elegant Seasnake [1104]		Species or species habitat may occur within area
Hydrophis ornatus a seasnake [1111]		Species or species habitat may occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat likely to occur within area
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and other Cetaceans [Resource Information]

Name	Status	Type of Presence
Mammals		
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat may occur within area

Name	Status	Type of Presence
Delphinus delphis Common Dophin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat may occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Congregation or aggregation known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Species or species habitat may occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat likely to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area

Extra Information

Places on the RNE [Resource Information]

Note that not all Indigenous sites may be listed.

Name	State	Status
Natural		
Cape Range National Park and Surrounds	WA	Registered
Cape Range and Adjacent Coastal Plain	WA	Registered
Ningaloo Marine Park and Proposed Additions	WA	Registered
Historic		
Naval Communication Station Harold E Holt (Area B)	WA	Registered

State and Territory Reserves [Resource Information]

Name	State
Bundegi Coastal Park	WA
Cape Range	WA
Ningaloo	WA

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit,

Name	Status	Type of Presence
Mammals		
Capra hircus		
Goat [2]		Species or species habitat likely to occur within area
Felis catus		
Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Oryctolagus cuniculus		
Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Vulpes vulpes		
Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Cenchrus ciliaris		
Buffel-grass, Black Buffel-grass [20213]		Species or species habitat likely to occur within area

Nationally Important Wetlands

[Resource Information]

Name	State
Cape Range Subterranean Waterways	WA

Coordinates

-21.93922 114.12251

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World Heritage and Register of National Estate properties, Wetlands of International Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Department of Environment, Climate Change and Water, New South Wales
-Department of Sustainability and Environment, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment and Natural Resources, South Australia
-Parks and Wildlife Service NT, NT Dept of Natural Resources, Environment and the Arts
-Environmental and Resource Management, Queensland
-Department of Environment and Conservation, Western Australia
-Department of the Environment, Climate Change, Energy and Water
-Birds Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-SA Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Atherton and Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
-State Forests of NSW
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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APPENDIX 3

Level 1 Fauna Assessment Report

LEVEL 1 FAUNA SURVEY REPORT

UCL Nimitz Street, Exmouth

RPS

LEVEL 1 FAUNA SURVEY REPORT

UCL Nimitz Street, Exmouth

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Disclaimer

SUMMARY

RPS Environment and Planning Pty Ltd (RPS) was commissioned by the Western Australian Land Authority (trading as 'LandCorp'), to provide a Level 1 Fauna Survey for inclusion in the Environmental Assessment Report (EAR) for UCL Nimitz Street, Exmouth – Overall Development Plan which is comprised of two land parcels. These land parcels (the subject land) form a 39.6 hectare (ha) extent of land directly to the south of the Exmouth Central Business District.

Under the Shire of Exmouth Town Planning Scheme No. 3 (Shire of Exmouth 2006) the subject land is identified as being subject to two zonings. The majority of the subject land is zoned "Rural" with a small portion of land enclosed within the subject land being zoned "Recreation and Open Space" (Shire of Exmouth 2006)

The main objective of this Level 1 Fauna Survey is to provide an initial investigation into the potential for the proposed development to impact on matters of environmental significance. The Level 1 Fauna Survey was undertaken to determine the potential for the proposed development to impact on matters of environmental significance, specifically resident fauna species and associated habitat. The following summarises the findings of the fauna investigation:

- Large trees, such as Corymbia hamersleyana and Eucalyptus camaldulensis were noted for their utilisation by bird species on site; in particular, feeding by honeyeater species and perching for feeding Rainbow Bee-eater. Trees with structural complexity provide essential roosting habitat for many bird species.

- The drainage line contains a number of mature trees and provides important habitat for fauna species inhabiting the site.

- A total of 184 known or previously recorded species potentially occur within the survey area. Of these, 137 are birds, five are mammals, 40 are reptiles and two are amphibians.

- A total of 137 bird species have been historically recorded within or in close proximity to the survey area. Of these, seven species are of conservation significance, which may potentially occur within the study area or be adversely impacted by the proposed development. Fourteen bird species were recorded on site during the field survey.

- A total of five mammal species were found to have been historically recorded and to potentially occur within the survey area, and of these, the Red fox is as introduced species. This list also includes two species of conservation significance. No mammal species were identified on site during the field survey, however kangaroo tracks and scats were present across the site.

- Forty reptile species have been historically recorded within and surrounding the site. Of these, two are of conservation significance. Only one reptile species was identified on site, *Amphibolurus longirostris.*

- Two species of amphibian were identified as potentially occurring within or adjacent to the site. Neither of these species are of conservation significance and were now identified on the site.

The following recommendations and general management guidelines are provided, in order to minimise adverse impacts to matters of environmental significance as a result of development:

- Habitat Tree Retention – It is recommended potential habitat trees are retained where possible, ideally within Public Open Space (POS) areas and road reserves. Minor adjustment of the lot layout and design will assist in achieving this outcome. The retention of habitat trees within developed sites provides a valuable resource for many species, particularly those of conservation significance.

- Staged Clearing – At the clearing stage of development, care should be taken to ensure that any fauna utilising the site is given every opportunity to relocate. To achieve this, clearing should be undertaken in a staged manner in the direction of vegetation to be retained and cleared vegetation should be left overnight in-situ to allow individuals further opportunity to disperse.

- Priority Flora – Two locations of *Corchorus congener* have been identified on site. It is recommended that these plants be protected within POS areas. However, impact to these plants is not of great environmental significance due to the occurrence of *C. congener* in other locations around Exmouth, in particular the Cape Range National Park.

- Drainage Line – the drainage line on site provides important habitat to fauna on site and should be retained within a POS area.

It is concluded that it is highly unlikely that any matters of environmental significance will be adversely impacted by the development of the subject land, if undertaken in accordance with the above recommendations.

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APPENDICES

1.0 INTRODUCTION

1.1 Background

RPS Environment and Planning Pty Ltd (RPS) was commissioned by the Western Australian Land Authority (trading as "LandCorp"), to provide a Level 1 Fauna Survey Report for UCL Nimitz Street, Exmouth – Overall Development Plan which is comprised of two land parcels. These land parcels (the subject land) form a 39.6 hectare (ha) extent of land directly to the south of the Exmouth Central Business District. This report has been prepared to support the proposed Overall Development Plan (ODP) for UCL Nimitz Street, Exmouth.

Under the Shire of Exmouth Town Planning Scheme No. 3 (Shire of Exmouth 2006) the subject land is identified as being subject to two zonings. The majority of the subject land is zoned "Rural" with a small portion of land enclosed within the subject land being zoned "Recreation and Open Space" (Shire of Exmouth 2006)

1.2 Report Objectives

The main objective of this Level 1 Fauna Survey is to provide an initial investigation into the potential for the proposed development to impact on matters of environmental significance. The fauna survey has been undertaken in accordance with the following Environmental Protection Authority (EPA) Guidance Statements:

- Position Statement 3 – Terrestrial Biological Surveys as an Element of Biodiversity Protection (EPA 2002)
- Guidance Statement 56 – Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia (EPA 2004b).

This report presents the findings of the Level 1 Fauna Survey and involves the following:

- a comprehensive fauna database search and literature review to compile background information relevant to the project area
- compilation of an inventory of vertebrate fauna potentially occurring in the project area
- identification of vertebrate fauna of conservation significance potentially occurring in the project area
- identification of broad fauna habitats and sensitive fauna habitats that may be expected to occur over the project area (based on vegetation mapping and landform)

- an opportunistic terrestrial fauna reconnaissance survey of project area
- recommendations of general management guidelines to minimise impacts of the proposed development program on terrestrial fauna and habitat in the project area.

2.0 EXISTING INFORMATION

2.1 Environment

2.1.1 Location

The site is located within the municipality of the Shire of Exmouth and is situated approximately one kilometre (km) south of the Exmouth Central Business District (Figure 1). Exmouth is situated in the Mid West region of Western Australia, is located about 1270 km north of Perth.

The site is comprised of multiple parcels of land and totals 39.6 hectares (ha) in extent. The subject land is separated from existing urban development of the town site to the west by Cameron Street, to the north by Nimitz Street and to the east by Reid Street. To the south and south-west the subject land is bordered by land reserved for "Recreation and Open Space". The southern boundary of the subject land is bordered by a drainage line.

2.1.2 Biogeographic Region

Exmouth is located within the Carnarvon bioregion and Carnarvon 1 subregion. The Carnarvon bioregion has a low and gently undulating landscape with open drainage. Vegetation is mainly acacia shrublands and saltbush and bluebush shrublands, with areas of tussock grassland in the north. It is composed of quaternary alluvial, Aeolian and marine sediments overlying cretaceous strata (DSEWPC 2011a).

2.1.3 Climate and Rainfall

Exmouth has a hot, semi arid climatic zone consisting of mean maximum temperatures in January of 38 °C and 24.2 °C in July. Annual rainfall averages about 300 mm, with most rainfall occurring between January and July (Bureau of Meteorology 2011).

Southerly winds dominate the wind pattern, with south to south-east winds in the morning and afternoon sea breezes arising from the west and south-west. Winds from the north and north-east are not common, however when they do occur it is usually associated with cyclones.

2.1.4 Geomorphology and Soils

Exmouth is located on a northerly trending peninsula bordered by the Indian Ocean and Exmouth Gulf. The regional geology of this peninsula consists of a sequence of carbonate rocks of Paleocene – Miocene age.

The subject land is situated within the Cape Giralia Coastal Zone of the Exmouth Province. The natural geology of the subject land can be described as consisting of alluvial plains and sandy plains, with some stony plains, on Cainozoic deposits and marine limestone over sedimentary rocks of the Carnarvon (Tille 2006) (Figure 2).

The soils of the Cape Giralia Coastal Zone are described as consisting of deep red sands and red loamy earths with some shallow calcareous loams, red-brown non-cracking clays and rocky soils.

2.1.5 Flora and Vegetation

The study area lies within the Carnarvon Botanical District of the Eremaean Botanical Province as defined by Beard (Coffey 2011). The study area is located over the Cape Range (663) Beard mapping unit which is described as hummock grasslands, shrub steppe; waterwood over soft spinifex.

Approximately 29, 016 hectares (95.65% of the pre European extent) of the Cape Range vegetation unit currently remains. The benchmark of 15% representation in conservation reserves (JANIS Forests Criteria 1997) has been met for Beard vegetation association 663, with approximately 22.5% of this vegetation type within the Carnarvon bioregion in conservation reserves (Shepherd et al 2001).

2.1.5.1 Vegetation Types

Coffey Environments undertook a flora and vegetation assessment in 2010 and 2011 (See Appendix 1 in Environmental Assessment Report) and recorded nine vegetation types within the site, these are listed below (Coffey Environments 2011):

TOSAsAb – tall open shrubland of *Acacia synchronicia* and *Acacia bivenosa* to 3.5 m over shrubland of *Eremophila longifolia* and *Senna artemisiodes* subsp. *Oligophylla* to 1.8 m over hummock grassland of *Triodia wiseana* and *Triodia epactia* to 0.4 m. This vegetation type is located within the south-western portion of the study area.

LOWChAs – low open woodland to scattered low trees of *Corymbia hamersleyana* and *Acacia sericophylla* to 8 m over tall open shrubland of Acacia tetragonophylla, *Acacia bivenosa* and *Acacia pyrifolia* var. *pyrifolia* to 3 m over tussock grassland of *Cenchrus ciliaris* to 0.5 m. This vegetation type is located along the drainage line.

TOSAoAs – tall open shrubland of *Alectryon oleifolius* and *Acacia synchronicia* to 3.5 m over open tussock grassland of *cenchrus ciliaris* to 0.3 m. This vegetation type is located in the central portion of the site.

LWEcAsAb – low open woodland to scattered low trees of *Eucalyptus camaldulensis* subsp. o*btuse* to 6 m over *Acacia synchronicia* and *Acacia bivenosa* to 4 m over open shrubland of *senna artemisiodes* subs. *oligophylla* to 1.6 m over tussock grassland of *Cenchrus ciliaris* and *Chrysopogon fallax* to 1.3 m over low open shrubland of *Scaevola spinescens* to 0.6 m. This vegetation type is located in the northern portion of the site.

SLTCh – scattered low trees of *Corymbia hamersleyana* to 6 m over tall shrubland of *Acacia pyrifolia* subsp. *Pyrifolia* to 3.5 m over open shrubland of *Acacia bivenosa* and *Senna artemisoides* subs. *Oligophylla* to 2 m over hummock grassland of *Triodia epactia* to 0.8 m. This vegetation type is located north of the major drainage line on site.

SMcAb – shrubland of *Melaleuca cardiophylla* and *Acacia bivenosa* to 1.5 m over hummock grassland of *Triodia epactia* and *Triodia wiseana* to 0.8 m. this vegetation type is located on the low rise near the western perimeter of the site.

TSApAs – tall shrubland of *Acacia pyrifolia* and *Acacia synchronicia* to 4 m over open tussock grassland of *Cenchrus ciliaris* to 0.4 m. this vegetation type is located in the south-eastern portion of the site.

TOSAs – tall open shrubland of *Acacia synchronicia* to 3.5 m over shrubland of *Acacia bivenosa* to 1.8 m over mide dense hummock grassland of Triodia epactia and *Triodia wiseana* to 0.5 m. this vegetation type is located on the southern portion of the site.

SAb – shrubland of *Acacia bivenosa* to 1.5 m over hummock grassland of *Triodia epactia* and *Triodia wiseana* to 0.5 m. This vegetation type was located in the western portion of the site.

2.1.5.2 Threatened and Priority Ecological Communities

A search of the Department of Environment and Conservations (DEC's) Threatened and Priority Ecological Database undertaken by Coffey Environments identified the *Camerons Cave Troglobitic Community* occurring within vicinity of the site. This Threatened Ecological Community (TEC) is classified as Critically Endangered, however it is considered highly unlikely that any proposed development of the site would impact this TEC. No other TECs or Priority Ecological Communities (PECs) were identified on the site by Coffey Environment or RPS during the site surveys.

2.1.5.3 Conservation Significant Flora

Coffey Environments undertook a search of the DECs Declared Rare and Priority Flora database to identify significant flora that may potentially occur in the area. A search of the Naturemap database and EPBC Protected Matters Search Tool was also undertaken (See Appendix 2 in Environmental Assessment Report). A total of 19 priority species were identified as potentially occurring within the site. No flora species protected under the EPBC Act were identified during database searches undertaken by Coffey Environment or RPS.

One Priority 3 species, *Corchorus congener,* was identified on site by Coffey Environment during the October 2010 and April 2011 surveys (see Appendix 1 in Environmental Assessment Report). During the targeted flora search, RPS did not identify any individuals of these species other than those identified by Coffey. However, during the targeted search undertaken by RPS these plants were not in flower and could therefore not be accurately.

No flora species protected under the EPBC Act were identified during database searches or site surveys undertaken by Coffey Environment or RPS.

2.1.5.4 Vegetation Condition

Coffey Environments determined that vegetation condition on the site ranged from Very Good to Degraded, although the majority of vegetation on site was considered to be in Poor to Very Poor condition due to weed invasion. Since Coffey Environment mapped the vegetation condition, there has been a fire across a portion of the site. Therefore, since Coffey undertook the vegetation survey, condition rating over the north-western portion of the site has been downgraded to Completely Degraded.

2.1.6 Fauna

A desktop search was undertaken within a 10 km radius of the DEC database, Naturemap and the EPBC matters of national environmental significance database by RPS in November 2011. Species that potentially occur in the area and that are identified in the DEC searches as protected under the *Wildlife Conservation Act 1950* and those identified in the matters of national environmental significance search that are protected under the EPBC Act are listed in Table 1. These species and the likelihood of their occurrence on site are discussed in greater length in Section 4.2.

Table 1: Conservation Significant Fauna Species potentially occurring within the Survey Area (DSEWPC 2011b)

Species	Common Name	Conservation Status (State)	Conservation Status (EPBC)
Birds			
Apus pacificus	Fork-tailed Swift		Migratory
Ardea alba	Great Egret		Migratory
Ardea ibis	Cattle Egret		Migratory
Ardeotis australis	Australian Bustard	P4	
Charadrius veredus	Oriental Plover, Oriental Dotterel		Migratory
Falco peregrinus	Peregrine Falcon	S	
Glareola maldivarum	Oriental Pratincole		Migratory
Haliaeetus leucogaster	White-bellied Sea Eagle		Migratory
Hirundo rustica	Barn Swallow		Migratory
Macronectes giganteus	Southern Giant Petrel		Endangered
Merops ornatus	Rainbow Bee-eater		Migratory
Mammals			
Dasycercus cristicauda	Mulgara		Vulnerable
Petrogale lateralis subs. Lateralis	Black-footed Rock Wallaby	T	Vulnerable
Reptiles			
Aprasia rostrata		T	

3.0 METHODOLOGY

3.1 Level 1 Fauna Survey

3.1.1 Threatened and Priority Fauna Species Legislation

3.1.1.1 State Legislation

There are four levels of conservation significance provided for fauna under the *Wildlife Conservation Act 1950*. Scheduled species are prioritised and listed as:

- Schedule 1 (S1): Fauna that is rare or likely to become extinct (also known as "Threatened Species")
- Schedule 2 (S2): Fauna presumed to be extinct
- Schedule 3 (S3): Migratory birds protected under an international agreement
- Schedule 4 (S4): Other specially protected fauna.

The DEC has also produced a supplementary list of "Priority" fauna, including species that are not considered "Threatened" or scheduled under the *Wildlife Conservation Act 1950*, but for which the DEC considers require attention (DEC 2010). These include:

- Priority 1 (P1): Taxa with few, poorly known populations on threatened lands
- Priority 2 (P2): Taxa with few, poorly known populations on conservation lands
- Priority 3 (P3): Taxa with several, poorly known populations, some on conservation lands
- Priority 4 (P4): Taxa in need of monitoring
- Priority 5 (P5): Taxa that are conservation dependent (i.e. their conservation status is dependent on ongoing active management).

The DEC also classifies species into one of five categories developed by the International Union for Conservation of Nature (IUCN): extinct (EX), extinct in the wild (EW), critically endangered (CR), endangered (EN) or vulnerable (VU). These categories are determined by the total distribution of the species within Australia (and internationally where migratory species are concerned), not just within Western Australia.

3.1.1.2 Federal Legislation

The *Environment Protection and Biodiversity Act 1999* (EPBC Act) protects matters of national environmental significance, including threatened and migratory species protected under international agreements such as the Japan–Australia Migratory Bird Agreement (JAMBA), the China–Australia Migratory Bird Agreement (CAMBA), the Republic of Korea–Australia Migratory Bird Agreement (ROKAMBA) and the Convention on the Conservation of Migratory Species of Wild Animals (the Bonn Convention). The EPBC Act states the proponent must not take an action that is likely to have a significant impact on any matters of national environmental significance without approval.

3.1.2 Fauna Database Searches and Literature Review

A number of database searches were conducted to determine a list of terrestrial fauna species (mammals, birds, reptiles and amphibians) that may potentially occur within the survey area.

The databases searched and the corresponding search areas are provided in Table 2.

Table 2: Fauna Databases Searched and Corresponding Search Areas

Database Name	Governing Organisation	Search Area Defined
NatureMap Database	DEC	Circle search within a 10 km radius of 114°07'18"E and 21°56' 24'S.
Threatened and Priority Fauna Database	DEC	Survey area plus 5 km buffer.
Protected Matters Search Tool	DSEWPC	Circle search within a 10 km radius of 114°07'18"E and 21°56' 24'S.
Species Profile and Threats (SPRAT) Database	DSEWPC	Search conducted by species, not area.

A number of species present on regional species lists rely on specific habitat requirements. Whilst these habitats were present within the broader region, they were not present within the survey area (e.g. marine environments) and it is therefore unlikely that these species are present within the survey area. As such, these species were excluded from discussion in this report.

3.1.3 Fauna Habitat Assessment

Important landform and vegetation features with value as fauna habitat were identified from the literature review, aerial photography and ground-truthing (vegetation survey).

These include:

- drainage lines
- mature trees
- grassland and spinifex.

3.1.4 Field Survey

An opportunistic fauna survey was undertaken by RPS ecologists in December 2011, focusing on each of the various habitat types within the survey area.

4.0 RESULTS

4.1 Vertebrate Fauna Habitats

Important landform and vegetation features with value as fauna habitat within the site include:

- a drainage line which mostly consists of low open woodland and scattered shrubs over grassland
- mature trees
- shrubland dominated by Acacia sp. Over grassland
- grassland and spinifex clumps.

A number of burrows were identified on the site, which were likely constructed by small mammals and reptiles. A number of these burrows appeared unused or were within the burned area of the site.

Dense spinifex on the site was utilised by reptiles, especially the long nosed dragon and it is likely that small mammals also use this habitat for shelter.

Large trees and shrubs were noted for their utilisation by bird species on site; in particular, being fed on by honeyeater species and used as a perch for foraging rainbow bee eaters (Plates 1 and 2). Trees with structural complexity provide essential roosting habitat for many bird species, most mature trees were located along the drainage line on site.

Plate 1: Feeding White Plumed Honeyeater

Plate 2: Perching Rainbow Bee Eater

Much of the habitat available to fauna on the site had been destroyed in a recent fire (see Plate 3). However, it was noted during the site survey that the burnt areas provided good foraging habitat for birds on site, while the unburnt areas provided sufficient cover when not feeding.

Plate 3: Vegetation Burnt in Recent Fire

4.2 Vertebrate Fauna

A list of potentially and actually occurring species within and surrounding the site (Appendix 1). This information has been collected from the DEC Threatened Species database (Appendix 2), DEC NatureMap, EPBC Protected Matters Search Tool database and the opportunistic field survey.

A total of 184 known or previously recorded species potentially occur within the survey area. A description of each of the vertebrate groups in the region is given in the following section.

4.2.1 Birds

A total of 137 birds have been historically recorded as potentially occurring within or in close proximity to the site. Of these, seven are of conservation significance and are discussed below.

Fork-tailed Swift (Apus pacificus)

The fork-tailed swift is listed as Migratory under the EPBC Act and is included in the JAMBA and the CAMBA. The fork-tailed swift breeds in Siberia and the Himalayas and migrates to Australia in October, before returning to the breeding grounds by May or June. Movements within Australia are in response to weather patterns, with this species often following thunderstorms. The species occurs year-round in the tropics, migrating southward in early spring. The birds then return north in autumn. When present, the fork-tailed swift is common and prominent in both natural and developed environments (DSEWPC 2011b).

It is unlikely this species occurs within the survey area, except as a mobile species overflying the site, and as such is highly unlikely to be impacted by development.

Great Egret (Ardea alba) and Cattle Egret (Ardea ibis)

Both of these Australian waterbird species are listed as Migratory under the EPBC Act. Both egrets are also listed under the JAMBA and the CAMBA. They are widespread in southern and eastern Asia and Australasia and are highly mobile, rendering them less susceptible to population fragmentation. In Western Australia breeding colonies nest predominantly in *Melaleuca* swamps in November and December although breeding is dependent to some extent on rainfall (DSEWPC 2011b).

As waterbird species, the egrets are unlikely to inhabit the site for most of the year, though they may interact with it in a transitory capacity during the wetter months due to the drainage line present on site. However, it is considered unlikely that these species will be impacted by development.

Oriental Plover (Charadrius veredus)

This species is listed as Migratory under the EPBC Act and under the JAMBA and ROKAMBA. It is a non-breeding visitor to Australia where it occurs in both coastal and inland areas, however it is mostly recorded along the north-western coast. When inland, the oriental plover generally inhabits flat, open, semi-arid or arid grasslands where areas of bare ground are prevalent (DSEWPC 2011b).

The oriental plover is considered unlikely to frequent the survey area and is therefore unlikely to be adversely impacted by development of the survey area, which covers only a small area of the extensive distribution of the species.

Oriental Pratincole (Glareola maldivarum)

This species is listed as Marine and Migratory under the EPBC Act, and occurs under the CAMBA, JAMBA and ROKAMBA. It is a medium-sized shorebird that occurs in small to very large flocks of thousands to millions of individuals. The oriental pratincole is widespread in the northern extent of Australia, particularly along the coastlines of Western Australia's Pilbara and Kimberley regions. The breeding season is spent in southern, south-eastern and eastern Asia, with the non-breeding season spent largely in Australia. During this time, the oriental pratincole preferably inhabits beaches, mudflats, islands, open plains, floodplains or short grassland, often with extensive areas of bare ground (DSEWPC 2011b).

As this species frequents shorelines, there is not considered suitable habitat on site and as such, it is unlikely to be adversely impacted by development of the site.

White-bellied Sea Eagle (Haliaeetus leucogaster)

Listed as Marine and Migratory under the EPBC Act and also listed under Appendix II of the CITES and under the China-Australia Migratory Bird Agreement (CAMBA), the white-bellied sea eagle is not globally threatened, but has been subject to population decline within Australia and South East Asia. In Australia, it is distributed along the coastline, and is restricted to a narrow band of coastline in south-western Australia. The population residing within Australia is estimated at 500 mating pairs. The sea eagle is found in coastal habitats and tends to occupy dunes, tidal flats, woodlands, forests and grasslands (generally in areas associated with large bodies of water). When not migrating, the home range of the sea eagle can be up to 100 square kilometres, although breeding adult birds are generally sedentary (breeding season runs from June to January). The nests of these birds are large and conspicuous, generally constructed in large trees, cliffs, rocky outcrops, mangroves, caves or on artificial structures (DSEWPC 2011b).

This species was not identified on site and is considered unlikely to frequent any habitat present on the site. Therefore, development of the site is not considered likely to impact this species.

Barn Swallow (Hirundo rustica)

Listed as Marine and Migratory under the EPBC Act, the barn swallow is also recognised under the CAMBA, JAMBA AND ROKAMBA agreements. It occurs in open land, such as agricultural pasture and plains, roosting or nesting in dead trees, banks, cliff cavities and rock shelves. It is a regular non-breeding summer migrant to northern Australia, where its range extends from the Kimberley region to north-eastern and south-eastern Queensland (Pizzey and Knight 1997).

There is potential habitat present on site for this species, however as the site only occupies a small area of the extensive distribution of this species it is unlikely to be impacted by development.

Rainbow Bee-eater (Merops ornatus)

The rainbow bee-eater is listed as Migratory under the EPBC Act and under the JAMBA. The population size of this species within Australia is not known, but it is assumed to be quite large. It is known to occur across the majority of the mainland. It migrates between Australia, Eastern Indonesia and Japan, and has formed a colony on Rottnest Island. The bee-eater tends to occupy open forests and woodlands, including cleared or semi-cleared areas and farmland, and prefers timbered landscapes. Their nests consist of an enlarged chamber at the end of a long burrow that is excavated by both the female and male bird from flat or sloping ground, cliff faces or mounds of gravel. They generally remain unlined (DSEWPC 2011b).

A number of individuals were identified feeding on site. However, as no nesting burrows were identified on site and the Rainbow Bee-eater is widespread in the region, it is considered unlikely that the proposed development will impact this species.

It is recommended however that the drainage line on site be retained as it contains banks that may prove suitable nesting habitat for the Rainbow Bee-eater.

The following bird species were recorded during the field survey and are likely to occur frequently within the survey area and surrounds:

- Black-faced Cuckoo-shrike (*Coracina novaehollandiae*)
- Zebra Finch (*Taeniopygia guttata)*
- Spiny Cheeked Honeyeater (*Acanthagenys rufogularis)*
- Black Kite (*Milvus migrans*)
- Rainbow Bee Eater (*Merops ornatus)*
- Little Button Quail (*Turnix velox)*

- Crested Pigeon (*Ocyphaps lophotes)*
- Yellow Throated Miner (*Manorina flacigula)*
- Singing Honeyeater (*Lichenostomus virescens)*
- White Plumed Honeyeater (*Lichenostomus penicillatus)*
- Nankeen Kestrel (*Falco cenchroides*)
- Mistletoe Bird (*Dicaeum hirundinaceum*)
- Little Corella (*Cacatua sanguinea)*
- Galah (*Eolophus roseicapilla).*

The aerial nature of the majority of the avifauna listed in Appendix 1 identifies these species as having an extremely broad range in comparison to other fauna species. Also, given the size of the area proposed for development is relatively small, it is highly unlikely these species will be adversely affected by development.

4.2.2 Mammals

A total of five mammal species potentially occur within the survey area, and of these, four species are introduced. This list also includes two species of conservation significance, which are discussed below.

Black-flanked Rock Wallaby (Petrogale lateralis lateralis)

The Black-flanked Rock Wallaby is listed as Vulnerable under the EPBC Act and Threatened under the WC Act. Threatening processes to this species includes predation by foxes and feral cats and degradation of habitat due to grazing by sheep, goats and rabbits.

The habitat of this species varies between colonies, however always involves proximity to some form of cliff, rock pile, escarpment or talus for refuge in areas of hummock grassland. They feed on grasses, herbs leaves and fruits and do not require close proximity to water as they conserve water through sheltering from warm temperatures in caves or rock overhangs. Consequently there is not considered suitable habitat on site for the Black-flanked Rock Wallaby and no signs of this species were seen during the site survey. Therefore, the proposed development is not considered likely to impact this species.

Mulgara (Dasycercus cristicauda)

The Crest-tailed Mulgara is listed as Vulnerable under the EPBC Act and Schedule 1 under the WC Act. This species can tolerate moderate local reduction in land cover, however a more severe reduction will lead to population decline. The main threat to this species is predation from introduced species and habitat reduction through agriculture and mining.

Mulgara predominantly occur in hummock grasslands and shrublands on sandy soils, burrowing in flat areas between sand dunes or on the low side of sand dunes. They are predominantly nocturnal, emerging from their burrows at night to feed on insects and small reptiles.

Based on the vegetation present on the site, it is considered likely that the site contains habitat suitable for the Mulgara, although no individuals were identified during the survey. However, due to the amount of similar habitat available nearby, the proposed development is not considered likely to have an impact on the Mulgara.

No mammal species were identified during the fauna survey, however kangaroo tracks and scats were prevalent throughout the site.

4.2.3 Reptiles

Forty reptile species are recorded as potentially occurring within the site. Of these, the Cape Range Diplodactylus (*Diptodactylus sp "Cape Range"*) and *Aprasia rostrata* are of conservation significance (Appendix 1), other species of significance will not be discussed in this report due to the lack of required habitat within the site (all are marine species such as turtles and sea snakes).

Neither of the species mentioned above were identified on the site, however there is potentially suitable habitat present for these species on the site. However, due to the availability of similar habitat within the area and the degraded nature of the site, it is unlikely that development of the site will impact these species.

The only reptile species recorded whilst conducting the opportunistic fauna survey was the Long-nosed Dragon (*Amphibolurus longirostris)* which is common throughout the Exmouth area.

4.2.4 Amphibians

Two species of amphibian have been identified as potentially occurring on the site. Of these, none are of Federal or State conservation significance.

No amphibian species were recorded whilst conducting the opportunistic fauna survey, although no formal trapping was carried out.

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5.0 RECOMMENDATIONS AND CONCLUSIONS

The following recommendations and general management guidelines are provided, in order to minimise adverse impacts to fauna and fauna habitat as a result of development:

- Habitat Tree Retention - It is recommended potential habitat trees are retained where possible, ideally within Public Open Space (POS) areas and road reserves. Minor adjustment of the lot layout and design will assist in achieving this outcome. The retention of habitat trees within developed sites provides a valuable resource for many species, particularly those of conservation significance.

- Staged Clearing - At the clearing stage of development, care should be taken to ensure that any fauna utilising the site is given every opportunity to relocate. To achieve this, clearing should be undertaken in a staged manner in the direction of vegetation to be retained and cleared vegetation should be left overnight in-situ to allow individuals further opportunity to disperse.

- Priority Flora – Two locations of *Corchorus congener* have been identified on site. It is recommended that these plants be protected within POS areas. However, impact to these plants is not of great environmental significance due to the occurrence of *C. congener* in other locations around Exmouth, in particular the Cape Range National Park.

- Drainage Line – the drainage line on site provides important habitat to fauna on site and should be retained within a POS area.

It is considered highly unlikely that any significant flora or fauna will be adversely impacted by the development of Nimitz Street, Exmouth, if undertaken in accordance with the above recommendations.

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FIGURES

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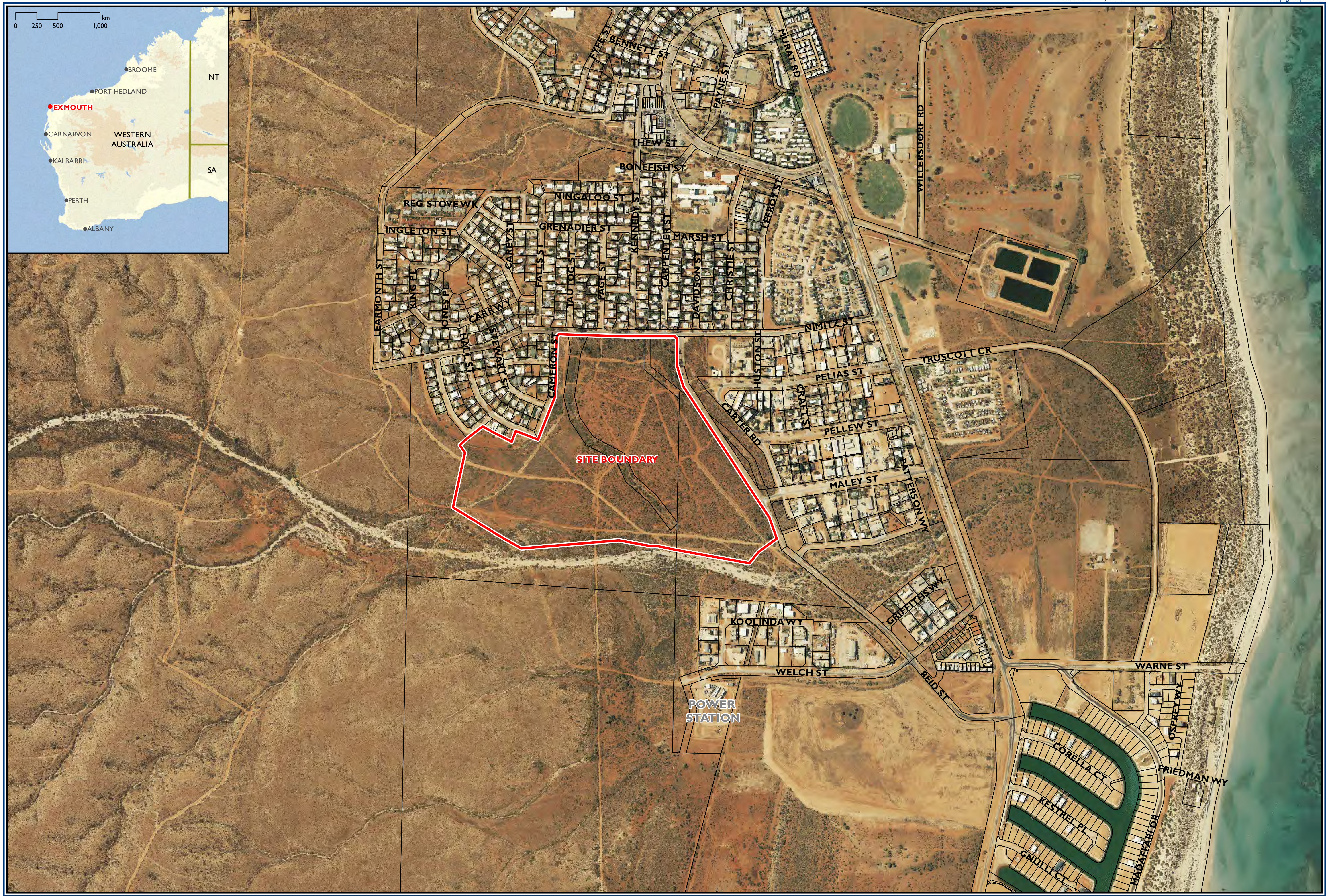

RPS

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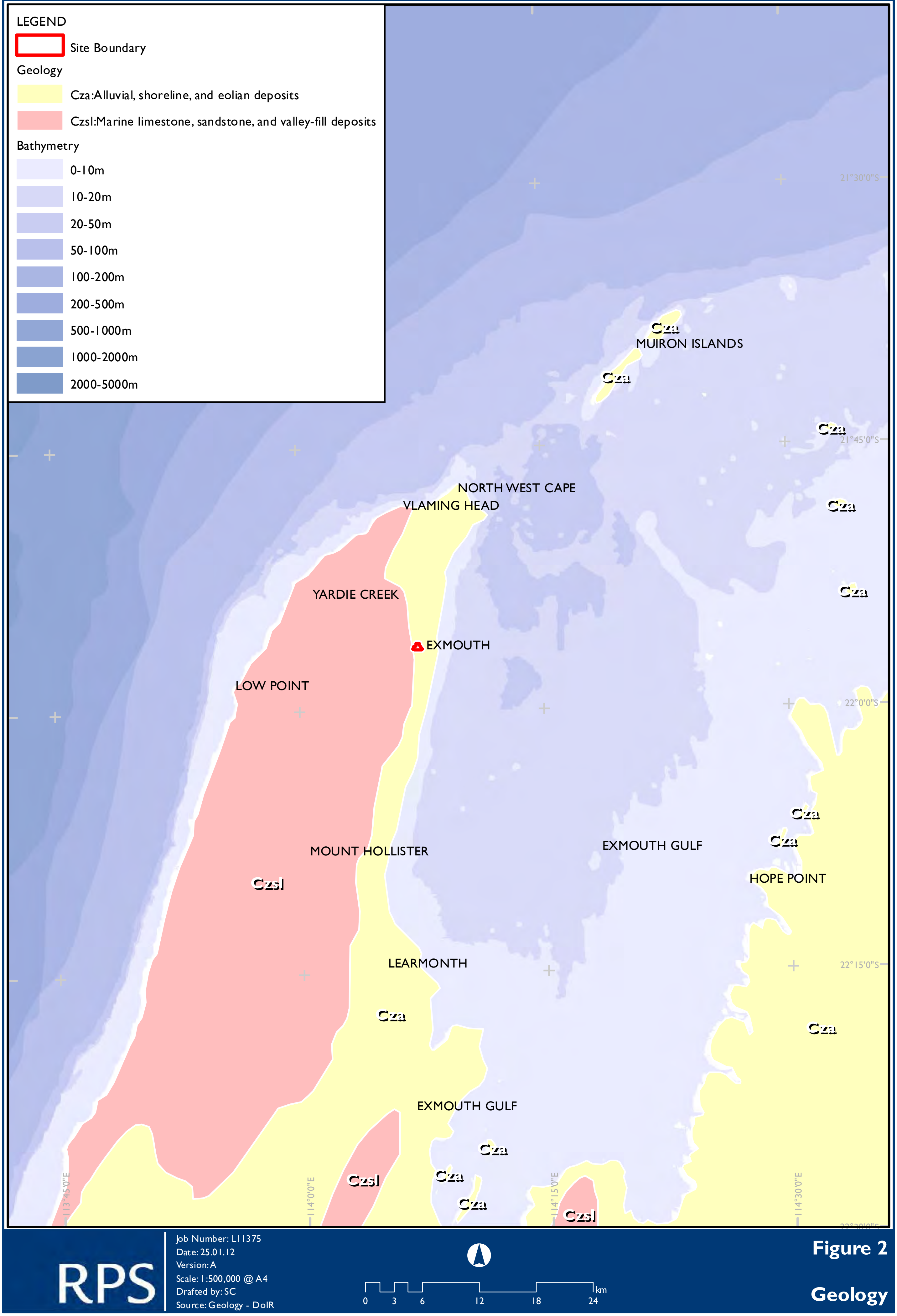
Date: 24.01.12
Scale: 1:10,000 @ A3
Version: A
Drafted by: SC
Source: Cadastre - Landgate, 2011 Orthophoto - Landgate, 2010

0 50 100 200 300 400 metres

Figure 1

Site Location



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Version: A
Scale: 1:500,000 @ A4
Drafted by: SC
Source: Geology - DoIR

RPS

Figure 2

Geology

APPENDIX 1

Fauna Species List and Information Sources

APPENDIX 1: Fauna Species List and Information Sources

A = recorded on site
B = DEC Threatened Fauna Database
C = EPBC Protected Matters Search Tool
D = DEC NatureMap Species Database
* = introduced species
^ = tentative identification

Species	Common Name	Conservation Status (State)	Conservation Status (EPBC)	Source (indicated by X)			
				A	B	C	D
Birds							
Acanthagenys rufogularis	Spiny-cheeked Honeyeater			X			X
Accipiter cirrocephalus	Collared Sparrowhawk						X
Accipiter fasciatus	Brown Goshawk						X
Actitis hypoleucos	Common Sandpiper						X
Amytornis striatus	Striated Grasswren						X
Anas gracilis	Grey Teal						X
Anas superciliosa	Pacific Black Duck						X
Anhinga novaehollandiae	Australian Darter						X
Anthus novaeseelandiae	Australian Pipit						X
Aquila audax	Wedge-tailed Eagle						X
Ardea alba	Great Egret		Migratory			X	
Ardea ibis	Cattle Egret		Migratory			X	
Ardea modesta	Eastern Great Egret						X
Ardea sacra subsp. sacra							X
Ardeotis australis	Australian Bustard	P4			X		X
Arenaria interpres	Ruddy Turnstone						X
Artamus cinereus	Black-faced Woodswallow			X			X
Artamus leucorynchus	White-breasted Woodswallow						X
Artamus minor	Little Woodswallow						X
Artamus personatus	Masked Woodswallow						X
Barnardius zonarius	Australian Ringneck						X
Cacatua sanguinea	Little Corella			X			X
Cacomantis pallidus	Pallid Cuckoo						X
Calamanthus campestris	Rufous Fieldwren						X
Calidris ruficollis	Red-necked Stint						X

Species	Common Name	Conservation Status (State)	Conservation Status (EPBC)	Source (indicated by X)			
				A	B	C	D
Chalcites basalis	Horsfield's Bronze Cuckoo						X
Chalcites osculans	Black-eared Cuckoo						X
Charadrius leschenaultii	Greater Sand Plover						X
Charadrius mongolus	Lesser Sand Plover						X
Charadrius ruficapillus	Red-capped Plover						X
Charadrius veredus	Oriental Plover		Migratory			X	
Cheramoeca leucosterna	White-backed Swallow						X
Chlidonias leucopterus	White-winged Tern						X
Chroicocephalus novaehollandiae	Silver Gull						X
Cincloramphus cruralis	Brown Songlark						X
Cincloramphus mathewsi	Rufous Songlark						X
Circus assimilis	Spotted Harrier						X
Columba livia	Domestic Pigeon						X
Coracina novaehollandiae	Black-faced Cuckoo-shrike			X			X
Corvus bennetti	Little Crow						X
Corvus orru	Torresian Crow						X
Corvus sp.	Crow			X			X
Cracticus nigrogularis	Pied Butcherbird						X
Cracticus torquatus	Grey Butcherbird						X
Cygnus atratus	Black Swan						x
Dicaeum hirundinaceum	Mistletoebird			X			X
Dromaius novaehollandiae	Emu						X
Egretta novaehollandiae	White-faced Heron						X
Egretta sacra	Pacific Reef Heron						X
Elanus axillaris	Australian Black-shouldered Kite						X
Elseyornis melanops	Black-fronted Dotterel						X
Emblema pictum	Painted Finch						X
Eolophus roseicapillus	Galah			X			X
Epthianura tricolor	Crimson Chat						X
Eremiornis carteri	Spinifex-bird						X
Erythrogonys cinctus	Red-kneed Dotterel						X
Esacus magnirostris							X

Species	Common Name	Conservation Status (State)	Conservation Status (EPBC)	Source (indicated by X)			
				A	B	C	D
Falco berigora	Brown Falcon						X
Falco cenchroides	Australian Kestrel			X			X
Falco longipennis	Australian Hobby						X
Falco peregrinus	Peregrine Falcon	S			X		X
Fulica atra	Eurasian Coot						X
Gallirallus philippensis subsp. mellori							X
Geopelia cuneata	Diamond Dove						X
Geopelia humeralis	Bar-shouldered Dove						X
Geopelia striata	Peaceful Dove						X
Gerygone fusca	Western Gerygone						X
Glareola maldivarum	Oriental Pratincole		Migratory			X	
Grallina cyanoleuca	Magpie-lark						X
Haematopus fuliginosus	Sooty Oystercatcher						X
Haematopus longirostris	Pied Oystercatcher						X
Haliaeetus leucogaster	White-bellied Sea-Eagle		Migratory			X	X
Haliastur indus	Brahminy Kite						X
Haliastur sphenurus	Whistling Kite						X
Hieraaetus morphnoides	Little Eagle						X
Himantopus himantopus	Black-winged Stilt						X
Hirundo neoxena	Welcome Swallow						X
Hirundo rustica	Barn Swallow		Migratory			X	X
Hydroprogne caspia	Caspian Tern						X
Lalage sueurii	White-winged Triller						X
Lichenostomus keartlandi	Grey-headed Honeyeater						X
Lichenostomus penicillatus	White-plumed Honeyeater			X			X
Lichenostomus virescens	Singing Honeyeater			X			X
Lichmera indistincta	Brown Honeyeater						X
Limosa lapponica	Bar-tailed Godwit						X
Lophoictinia isura							X
Malurus lamberti	Variegated Fairy-wren						X
Malurus leucopterus	White-winged Fairy-wren						X
Manorina flavigula	Yellow-throated Miner			X			X

Species	Common Name	Conservation Status (State)	Conservation Status (EPBC)	Source (indicated by X)			
				A	B	C	D
Melopsittacus undulatus	Budgerigar						X
Merops ornatus	Rainbow Bee-eater		Migratory	X		X	X
Milvus migrans	Black Kite			X			X
Mirafra javanica	Horsfield's Bushlark						X
Neochmia ruficauda	Star Finch						X
Numenius phaeopus	Whimbrel						X
Nycticorax caledonicus	Rufous Night Heron						X
Ocyphaps lophotes	Crested Pigeon			X			X
Oreoica gutturalis	Crested Bellbird						X
Pandion cristatus	Eastern Osprey						X
Pardalotus rubricatus	Red-browed Pardalote						X
Pelecanus conspicillatus	Australian Pelican						X
Petrochelidon ariel	Fairy Martin						X
Petrochelidon nigricans	Tree Martin						X
Phaethon lepturus	White-tailed Tropicbird						X
Phalacrocorax sulcirostris	Little Black Cormorant						X
Phalacrocorax carbo	Great Cormorant						X
Plegadis falcinellus	Glossy Ibis						X
Pluvialis fulva	Pacific Golden Plover						X
Pluvialis squatarola	Grey Plover						X
Poliocephalus poliocephalus	Hoary-headed Grebe						X
Pomatostomus temporalis	Grey-crowned Babbler						X
Psophodes occidentalis	Western Wedgebill						X
Ptilonorhynchus guttatus							X
Rhipidura albiscapa	Grey Fantail						X
Rhipidura leucophrys	Willie Wagtail						X
Rhipidura phasiana	Mangrove Grey Fantail						X
Smicrornis brevirostris	Weebill						X
Sterna hirundo	Common Tern						X
Sterna dougallii	Roseate Tern						X
Sternula albifrons							X
Sternula nereis							X

Species	Common Name	Conservation Status (State)	Conservation Status (EPBC)	Source (indicated by X)			
				A	B	C	D
Stipiturus ruficeps	Rufous-crowned Emu-wren						X
Streptopelia senegalensis	Laughing Turtle-Dove						X
Tachybaptus novaehollandiae	Australasian Grebe						X
Taeniopygia guttata	Zebra Finch			X			X
Thalassarche chlororhynchos	Atlantic Yellow-nosed Albatross				X		X
Thalasseus bengalensis							X
Thalasseus bergii							X
Threskiornis spinicollis	Straw-necked Ibis						X
Todiramphus pyrrhopygius	Red-backed Kingfisher						X
Todiramphus sanctus	Sacred Kingfisher						X
Tringa brevipes	Grey-tailed Tattler						X
Tringa nebularia	Common Greenshank						X
Tringa stagnatilis	Marsh Sandpiper						X
Turnix velox	Little Button-quail			X			X
Vanellus tricolor	Banded Lapwing						X
Zosterops luteus	Yellow White-eye						X
Mammals							
Macropus robustus subsp. erubescens	Euro						X
Notomys alexis	Spinifex Hopping Mouse		V				X
Petrogale lateralis subs. Lateralis	Black-footed Rock Wallaby					X	X
Sminthopsis macroura	Stripe-faced Dunnart						X
*Vulpes vulpes**	Red Fox					X	
Reptiles							
Acanthophis wellsi	Pilbara Death Adder						X
Amphibolurus longirostris				X			X
Antaresia perthensis	Pygmy Python						X
Antaresia stimsoni subs. Stimsoni							X
Aprasia rostrata		T					X
Ctenophorus femoralis	Dune Dragon						X
Ctenophorus isolepis subsp. isolepis							X
Ctenophorus nuchalis	Central Netted Dragon						X
Ctenophorus reticulatus	Western Netted Dragon						X
Ctenotus grandis subsp. titan							X

Species	Common Name	Conservation Status (State)	Conservation Status (EPBC)	Source (indicated by X)			
				A	B	C	D
Ctenotus hanloni							X
Ctenotus iapetus							X
Ctenotus pantherinus subsp. ocellifer							X
Ctenotus rufescens							X
Ctenotus saxatilis	Rock Ctenotus						X
Cyclodomorphus melanops subsp. melanops							X
Delma tealei							X
Delma tincta							X
Diplodactylus conspicillatus	Fat-tailed Gecko						X
Diplodactylus sp 'Cape Range	Cape Range Diplodactylus	P2			X		X
Eremiascincus fasciolatus	Narrow-banded Sand Swimmer						X
Furina ornata	Moon Snake						X
Gehyra pilbara							X
Gehyra variegata							X
Hydrophis ocellatus							X
Lialis burtonis	Burton's Legless Lizard						X
Lucasium stenodactylum							X
Menetia greyii	Common Dwarf Skink						X
Morethia ruficauda subsp. exquisita							X
Pogona minor subsp. minor							X
Pseudechis australis	Mulga Snake						X
Pseudonaja modesta	Ringed Brown Snake						X
Pseudonaja nuchalis	Gwardar						X
Pygopus nigriceps							X
Ramphotyphlops grypus	Beaked Black Snake						X
Simoselaps bertholdi	Jan's Banded Snake						X
Simoselaps littoralis	West Coast Banded Snake						X
Varanus acanthurus	Spiny-tailed Monitor						X
Varanus brevicauda	Short-tailed Pygmy Monitor						X
Varanus tristis tristis	Racehorse Monitor						X
Amphibians							
Cyclorana maini	Sheep Frog						X
Neobatrachus fulvus	Tawny Trilling Frog						X

APPENDIX 2

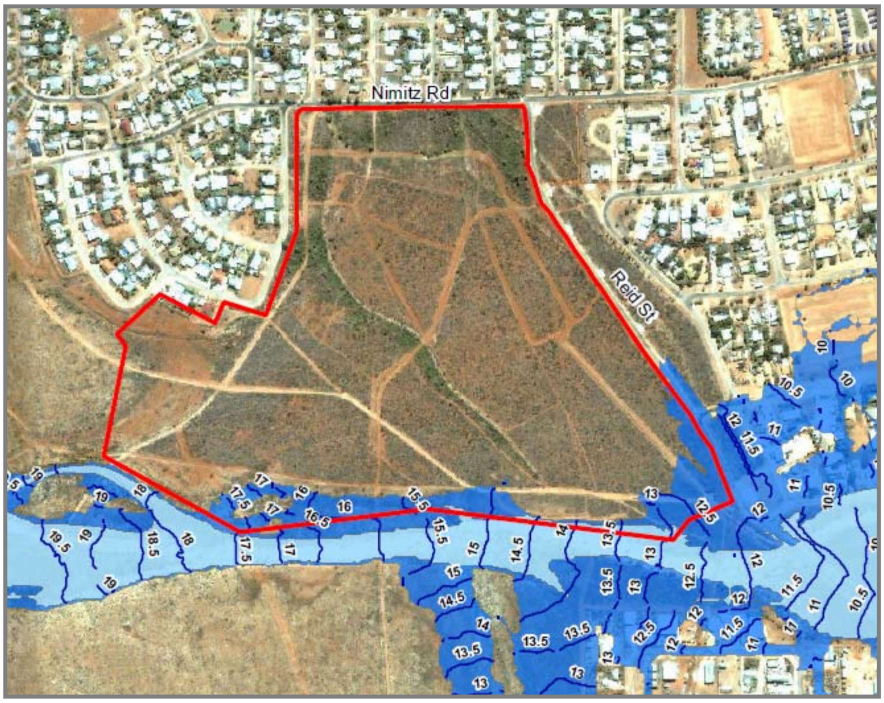
Fauna Database Search Results

NAME	SOURCE_CODE	SOURCE_ID	NAME_ID	FAMILY	GENUS	SPECIES	INFRARANK	INFRANAME	AUTHOR	VERNACULAR	CONSERVATION	CLASS	DAY	MONTH	YEAR	LOCALITY
Aprasia rostrata	WAMSPECIMENS	R130221	24992	Pygopodidae	Aprasia	rostrata			Parker		T	REPTILE	09	09	2008	NORTH WEST CAPE
Bamazomus subsolanus	TFAUNA	6095	33905	Hubbardiidae	Bamazomus	subsolanus			Harvey	Eastern Cape Range Bamazomus	T	INVERT	28	01	1998	NORTH WEST CAPE
Bamazomus subsolanus	TFAUNA	6092	33905	Hubbardiidae	Bamazomus	subsolanus			Harvey	Eastern Cape Range Bamazomus	T	INVERT	18	10	1996	NORTH WEST CAPE
Bamazomus subsolanus	TFAUNA	6093	33905	Hubbardiidae	Bamazomus	subsolanus			Harvey	Eastern Cape Range Bamazomus	T	INVERT	21	10	1996	NORTH WEST CAPE
Bamazomus subsolanus	TFAUNA	6088	33905	Hubbardiidae	Bamazomus	subsolanus			Harvey	Eastern Cape Range Bamazomus	T	INVERT	31	01	1998	NORTH WEST CAPE
Bamazomus subsolanus	TFAUNA	6090	33905	Hubbardiidae	Bamazomus	subsolanus			Harvey	Eastern Cape Range Bamazomus	T	INVERT	15	10	1996	NORTH WEST CAPE
Bamazomus subsolanus	TFAUNA	6098	33905	Hubbardiidae	Bamazomus	subsolanus			Harvey	Eastern Cape Range Bamazomus	T	INVERT	03	01	1998	NORTH WEST CAPE
Bamazomus subsolanus	TFAUNA	6097	33905	Hubbardiidae	Bamazomus	subsolanus			Harvey	Eastern Cape Range Bamazomus	T	INVERT	01	01	1998	NORTH WEST CAPE
Bamazomus subsolanus	TFAUNA	6096	33905	Hubbardiidae	Bamazomus	subsolanus			Harvey	Eastern Cape Range Bamazomus	T	INVERT	29	01	1998	NORTH WEST CAPE
Bamazomus subsolanus	TFAUNA	6094	33905	Hubbardiidae	Bamazomus	subsolanus			Harvey	Eastern Cape Range Bamazomus	T	INVERT	24	10	1996	NORTH WEST CAPE
Bamazomus subsolanus	TFAUNA	6091	33905	Hubbardiidae	Bamazomus	subsolanus			Harvey	Eastern Cape Range Bamazomus	T	INVERT	15	04	1998	NORTH WEST CAPE
Bamazomus subsolanus	TFAUNA	6089	33905	Hubbardiidae	Bamazomus	subsolanus			Harvey	Eastern Cape Range Bamazomus	T	INVERT	03	02	1998	NORTH WEST CAPE
Carcharodon carcharias	TFAUNA	7635	34031	Lamnidae	Carcharodon	carcharias				Great White Shark	T	FISH	28	08	2003	EXMOUTH
Draculoides brooksi	TFAUNA	5562	33907	Hubbardiidae	Draculoides	brooksi			Harvey	Northern Cape Range Draculoides	T	INVERT	28	04	1996	NORTH WEST CAPE
Eubalaena australis	WAMSPECIMENS	M54206	24043	Balaenidae	Eubalaena	australis			(Desmoulins)	Southern Right Whale	T	MAMMAL				EXMOUTH
Megaptera novaeangliae	TFAUNA	7636	24051	Balaenopteridae	Megaptera	novaeangliae			Borowski	Humpback Whale	T	MAMMAL	28	08	2003	EXMOUTH
Milyeringa veritas	TFAUNA	3495	34025	Eleotridae	Milyeringa	veritas				Blind Gudgeon	T	FISH	01	01	1963	NORTH WEST CAPE
Milyeringa veritas	TFAUNA	3503	34025	Eleotridae	Milyeringa	veritas				Blind Gudgeon	T	FISH	01	01	1993	NORTH WEST CAPE
Milyeringa veritas	FAUNASURVEY	40013	34025	Eleotridae	Milyeringa	veritas				Blind Gudgeon	T	FISH	22	05	2009	EXMOUTH
Milyeringa veritas	TFAUNA	3502	34025	Eleotridae	Milyeringa	veritas				Blind Gudgeon	T	FISH	01	01	1993	EXMOUTH
Milyeringa veritas	FAUNASURVEY	40012	34025	Eleotridae	Milyeringa	veritas				Blind Gudgeon	T	FISH	22	05	2009	EXMOUTH
Milyeringa veritas	TFAUNA	3476	34025	Eleotridae	Milyeringa	veritas				Blind Gudgeon	T	FISH	05	04	1969	EXMOUTH
Milyeringa veritas	TFAUNA	3497	34025	Eleotridae	Milyeringa	veritas				Blind Gudgeon	T	FISH	01	01	1991	EXMOUTH
Milyeringa veritas	TFAUNA	3485	34025	Eleotridae	Milyeringa	veritas				Blind Gudgeon	T	FISH	01	01	1991	EXMOUTH
Milyeringa veritas	TFAUNA	3488	34025	Eleotridae	Milyeringa	veritas				Blind Gudgeon	T	FISH	01	01	1993	EXMOUTH
Milyeringa veritas	TFAUNA	3506	34025	Eleotridae	Milyeringa	veritas				Blind Gudgeon	T	FISH	01	01	1993	EXMOUTH
Ophisternon candidum	TFAUNA	3504	34038	Synbranchidae	Ophisternon	candidum				Blind Cave Eel	T	FISH	01	01	1993	NORTH WEST CAPE
Ophisternon candidum	TFAUNA	3475	34038	Synbranchidae	Ophisternon	candidum				Blind Cave Eel	T	FISH	05	04	1969	EXMOUTH
Ophisternon candidum	TFAUNA	3498	34038	Synbranchidae	Ophisternon	candidum				Blind Cave Eel	T	FISH	01	01	1991	EXMOUTH
Ophisternon candidum	TFAUNA	3484	34038	Synbranchidae	Ophisternon	candidum				Blind Cave Eel	T	FISH	01	01	1991	EXMOUTH
Ophisternon candidum	TFAUNA	3489	34038	Synbranchidae	Ophisternon	candidum				Blind Cave Eel	T	FISH	01	01	1991	EXMOUTH
Petrogale lateralis subsp. lateralis	TFAUNA	10185	24142	Macropodidae	Petrogale	lateralis	subsp.	lateralis	Gould	Black-footed Rock-wallaby	T	MAMMAL	09	03	2001	NORTH WEST CAPE
Petrogale lateralis subsp. lateralis	TFAUNA	10184	24142	Macropodidae	Petrogale	lateralis	subsp.	lateralis	Gould	Black-footed Rock-wallaby	T	MAMMAL	09	03	2001	NORTH WEST CAPE
Stygiocaris lancifera	TFAUNA	5192	33963	Atyidae	Stygiocaris	lancifera				Lance-beaked Cave Shrimp	T	INVERT	01	08	1962	EXMOUTH
Stygiochiropus isolatus	TFAUNA	1550	33967	Paradoxosomatidae	Stygiochiropus	isolatus					T	INVERT	01	07	1991	EXMOUTH
Stygiochiropus peculiaris	TFAUNA	1630	33968	Paradoxosomatidae	Stygiochiropus	peculiaris				Camerons Cave Millipede	T	INVERT	11	01	1994	EXMOUTH
Thalassarche chlororhynchos	TFAUNA	10997	34007	Diomedeidae	Thalassarche	chlororhynchos			Gmelin	Atlantic Yellow-nosed Albatross	T	BIRD	01	09	2004	EXMOUTH
Dugong dugon	WAMSPECIMENS	M52161	24084	Dugongidae	Dugong	dugon			(Muller)	Dugong	S	MAMMAL				EXMOUTH
Falco peregrinus	BIRDATLAS1	5278	25624	Falconidae	Falco	peregrinus			Tunstall	Peregrine Falcon	S	BIRD	27	03	1977	EXMOUTH
Ardeotis australis	BIRDATLAS1	5270	24610	Otididae	Ardeotis	australis			(J.E. Gray)	Australian Bustard	4	BIRD	27	03	1977	EXMOUTH
Ardeotis australis	BIRDATLAS1	218842	24610	Otididae	Ardeotis	australis			(J.E. Gray)	Australian Bustard	4	BIRD	16	10	1980	EXMOUTH
Ardeotis australis	BIRDATLAS2	861742	24610	Otididae	Ardeotis	australis			(J.E. Gray)	Australian Bustard	4	BIRD	12	09	2002	EXMOUTH
Sousa chinensis	TFAUNA	6159	24064	Delphinidae	Sousa	chinensis			(Osbeck)	Indo-Pacific Humpback Dolphin	4	MAMMAL	21	07	1992	EXMOUTH
Stygiocaris stylifera	TFAUNA	5465	33964	Atyidae	Stygiocaris	stylifera				Spear-beaked Cave Shrimp	4	INVERT				EXMOUTH
Stygiocaris stylifera	TFAUNA	5464	33964	Atyidae	Stygiocaris	stylifera				Spear-beaked Cave Shrimp	4	INVERT				EXMOUTH
Diplodactylus sp 'Cape Range'	TFAUNA	16334	34141	Diplodactylidae	Diplodactylus	sp 'Cape Range'				'Cape Range Diplodactylus'	2	REPTILE	01	02	2007	NORTH WEST CAPE
Diplodactylus sp 'Cape Range'	TFAUNA	16324	34141	Diplodactylidae	Diplodactylus	sp 'Cape Range'				'Cape Range Diplodactylus'	2	REPTILE				EXMOUTH

APPENDIX 2

LandCorp

Nimitz St Urban Development, Exmouth
Local Water Management Strategy



May 2012

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EXECUTIVE SUMMARY

This Local Water Management Strategy has been prepared to support a Development Plan for the Nimitz Road Development Area, Exmouth in accordance with Better Urban Water Management (WAPC, 2008). A summary of the water management strategy is provided below.

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 10yr and 100yr ARI peak flows from the Study Area similar to current discharge levels where possible. • No lowering of groundwater levels.
Water Quality To maintain or improve the surface and groundwater quality within development areas relative to pre-development conditions.	• Use of treatment train approach to stormwater management • Application of source controls – including education to reduce nutrient application, use of native plantings in streetscapes. • Application of structural controls – retention/detention areas, vegetated swales, drop structures and sedimentation areas where possible.
Water Conservation To maximise the reuse of stormwater	• Encourage implementation of water efficiency and demand management measures both internal and external of buildings. • Use of native plantings in streetscapes to minimise irrigation requirements where possible.
Ecosystem Health To retain natural drainage systems and protect ecosystem health	• Maintain 10yr and 100yr ARI peak flows from the Study Area similar current discharge levels to the LIA Creek where possible.
Economic Viability To implement stormwater systems that are economically viable in the long term	• Use of proven structural water sensitive urban design 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	• Identification of 100yr ARI flood levels for Study Area. • Protection of downstream areas by restricting stormwater discharge to existing levels for storm events up to 100yr 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 & 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.

1. INTRODUCTION

This document presents a Local Water Management Strategy (LWMS) in support of an urban residential development for approximately 40ha of land located at Nimitz Street, Exmouth, herein referred to as the Study Area (Figure 1).

1.1 Background

This document has been prepared to support an Outline Development Plan for the abovementioned property. It presents a recommended approach for total water cycle management within the proposed development area consistent with sustainability principles and the *Better Urban Water Management* (BUWM) (WAPC, 2001) process. The relationship of this document to this BUWM planning process is shown in Table 1.

The LWMS has been developed by JDA Consultant Hydrologists on behalf of LandCorp. The compilation of this document includes a range of expertise and guidelines from leading authorities including the Department of Water (DoW) and the Shire of Exmouth (SoE) to assist in achieving the implementation of best practice in sustainable urban development and urban water management within the Study Area.

Preliminary guidelines to assist with the preparation of LWMS's specifically for the North West region of Western Australia by the DoW are summarised in Section 1.3. It is acknowledged that flood management and associated issues of erosion and sedimentation are dominant and that peak post development flow rates do not need to be detained to pre-development peak flow, but the velocity of the post development flow should be minimised.

A copy of the LWMS Checklist has been included as Appendix A to assist the DoW and SoE in review of this document.

TABLE 1: INTEGRATED PLANNING AND URBAN WATER MANAGEMENT PROCESS

Planning Phase	**Planning Document**	**Urban Water Management Document and Status**
District	Shire of Exmouth Town Planning Scheme (TPS 8)	N/A
Local	Nimitz Street, Exmouth Outline Development Plan	Nimitz Street Urban Development Local Water Management Strategy **THIS DOCUMENT**
Subdivision	Subdivision Application	Urban Water Management Plan (required for individual stages of development) **FUTURE PREPARATION**

1.2 Previous Studies

Preparation of this LWMS has included, but is not limited to using the following key documents to define its content, principles, and objectives.

- Exmouth Flood Management Study (JDA, 1999)
- Review of Exmouth Flood Management Study (JDA, 2002)
- State Planning Policy 2.9 – Water Resources (WAPC, 2005)
- Stormwater Management Manual for WA (DoW, 2007)
- Exmouth Floodplain Management Study (SKM, 2007)
- Better Urban Water Management (WAPC, 2008)

1.3 Key Design Principles and Objectives

A summary of the key principles and objectives applicable to the LWMS for the Study Area based on the above literature and previous advice provided to JDA by the DoW for preparation of LWMS's in the North West Region of Western Australia are as follows:

- Towns in the North West region have been developed using open drains rather than piped drainage. This is appropriate due to high rainfall intensities and runoff rates compared with South West WA.
- Safe conveyance of storm and flood waters to downstream areas without detention to pre-development flow rates is high priority.
- 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 North West region.
- DoW accepts there will not be 2 years of predevelopment groundwater monitoring data and do not expect any groundwater monitoring data to be supplied (unless there are existing bores nearby).
- DoW will not require any post development surface water or groundwater quantity or quality monitoring. If it is intended to use groundwater for irrigation purposes (within public drinking water catchment) then a licence must be obtained and monitoring for salinity (salt water incursion) should be commenced.
- The LWMS checklist contained in BUWM (WAPC, 2008) should still be used.

A summary of the key principles and objectives applicable to this LWMS for the Study Area in the North West region based on agreement with DoW is presented in Table 2.

TABLE 2: LWMS KEY PRINCIPLES AND OBJECTIVES

Key Water Sensitive Urban Design Principles		
• Facilitate implementation of sustainable best practice in water management in the Exmouth 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 streetscapes and any public open space areas to reduce/avoid irrigation.
Surface Water Flows and velocity	• Protect development from flooding. • Implement open drains for safe conveyance of floodwaters. • 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.	• For flood management, manage up to the 100yr ARI event within the development. • Finished floor levels to be 0.5m above 100yr ARI flood level. • Use road network as overland flow system and open drainage swales to disperse flow throughout the development. • Flows to be managed to minimise velocity to encourage sedimentation and prevent erosion. • Where there are identified impacts on significant ecosystems, maintain or restore desirable environmental flows and/or hydrological cycles consistent with DoW's requirements.
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 immediate vicinity. The receiving environment is LIA Creek which discharges to the intertidal zone prior to discharging to the Exmouth Gulf. • Nutrients not considered a priority in the North West.

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 condition.

2.1 Location and Topography

The Study Area is approximately 40ha and is located south of the Exmouth town site (Figure 1). The Study Area is bordered by Nimitz Street to the north and Reid St to the west. The northern section of the study area is surrounded by residential development, whereas the southern boundary is bordered by the Light Industrial Area (LIA) Creek and native vegetation (Figure 1).

The site is undulating and slopes gently towards Reid St in the east. Along the southern boundary a small portion of the Study Area slopes towards LIA Creek. Elevation ranges from approximately 19 mAHD at the western boundary of the Study Area to approximately 12 mAHD at the east (Figure 1).

2.2 Existing Land Use

The Study Area is currently covered sparsely by native vegetation consisting of low tussock and spinifex grass. There is no evidence of any other existing structures or buildings.

Surrounding land use consists of the residential development to the north west, and industrial land use east of Reid Street. The southern boundary of the Study Area is bordered by a LIA Creek which is steeply incised with depth ranging between 2-3m from surrounding natural surface.

2.3 Climate

Exmouth has an arid climate characterised by hot summers with periodic heavy rain and mild winters with occasional rainfall. The Pilbara coast experiences more cyclones than any other part of Australia. Since 1910 there have been 48 cyclones that have caused damaging wind gusts in excess of 90 km/h in the Roebourne region.

The long term average annual rainfall for Exmouth is 274 mm per year, with a maximum recorded annual rainfall of 641.7mm from records taken between 1968-2011, at Exmouth Townsite (005051) and Exmouth Golf (005004) (BoM 2012). Most of the recorded precipitation is received during the wet season, as a result of tropical cyclones and local thunderstorms. Along the central Pilbara coast the cyclone season runs from mid-December to April peaking in February. Figure 2 presents graphed rainfall data for Exmouth Townsite (BoM site 5051).

The average annual pan evaporation is approximately 3,590mm (Luke et al, 1988).

2.4 Geology and Soils

The surface geology of the area is shown in Figure 3. It indicates that the Study Area is comprised of Trealla Limestone and the Pilgrammunna formation which is confined to the western side of the Cape Range anticline (Water Authority, 1994). The majority of the Study Area is comprised of Colluvium deposits which have accumulated at the base of the range as a result of sheet erosion. Soils can range from being sandy and calcareous, to fine grained silts with a clayey nature. Infiltration is variable but is predominantly low due to the presence of the fine grained silts and clay in the Colluvium.

A hydrogeological cross section of Exmouth is also shown in Figure 3. The Study Area is broadly described as being situated on quaternary deposits underlain by Tulki and Mandu limestone formations. The Tulki and Mandu Limestones are of Tertiary age, and of shallow marine origin. The Tulki Limestone is approximately 60m thick beneath the site and consists of red to yellow partly clayey limestone. The Mandu Limestone is composed of marly limestone, which is significantly less permeable than the overlying Tulki Limestone, resulting in karstic development in the latter.

The presence of cavities and channels within the limestone formations increases the potential of salt water intrusion to the water table. A thin layer of fresh water is situated in the limestone formations underlain by denser salt water to the coast.

2.5 Groundwater Hydrology

Groundwater mapping indicates the Study Area is located on the Cape Range Mound, with confined and unconfined aquifers of Tulki and Mandu limestone.

The Tulki Limestone forms an unconfined aquifer, with the watertable varying seasonally by less than 0.5m. There is an upper layer of fresh groundwater approximately 5m thick, overlying a saltwater interface. The natural groundwater flow direction is eastwards towards the gulf. There are public water supply wells inland and up gradient from the site, which are managed to limit inland migration of the seawater interface.

Although there is no long term groundwater monitoring bores known to exist within the Exmouth Area, the watertable is expected to range from approximately 2m below natural surface adjacent to the coast to approximately 6m below natural surface on West side of Murat road where the Study Area is located.

2.6 Acid Sulphate Soils

The Department of Environment and Conservation (DEC) Acid Sulphate Soil (ASS) mapping indicates there are no mapped areas of known ASS within the Study Area, except near the LIA Creek as shown in Figure 3.

The LIA Creek located along the southern boundary of the Study Area is mapped as “Moderate to Low Risk” of acid sulphate soils occurring within 3m of natural soil surface (or deeper)” (DEC 2008).

2.7 Vegetation

The Study Area is currently covered sparsely by native vegetation consisting of low tussock and spinifex grass. Environmental Assessment performed by Coffey Environmental (2010) indicates the vegetation is not considered significant at the local, state or national level and there is no Threatened Ecological Community within the Study Area. This has been further supported by recent investigation performed by RPS Environment (Dec 2011).

2.8 Surface Water Hydrology

2.8.1 Existing Catchments & Flows

External surface water catchments that currently directly flow into the Study Area are shown in Figure 4. These catchments are comprised of residential lots, roads and native vegetation.

Spot heights from a feature survey conducted by Asphar Survey (2011) indicate two localised depressions within the Study Area approximately 0.5m deep. These can be seen in the aerial photos as the densely vegetated areas adjacent to the northern boundary and the vegetated strip located through the centre of the Study Area on a north-west alignment.

Stormwater runoff generated from the developed external catchments flow overland via the road network directly into the Study Area and then into these localised depressions to LIA Ceeek. Stormwater runoff from the undeveloped catchments (both internal and external) occurs as sheet flow into these depressions, which ultimately discharge into LIA Creek. Sheet flow east of the central depression flows in a north westerly direction towards Reid Street, and then south along Reid Street drain towards LIA Creek.

Conceptual stormwater modelling of these catchments were performed using the model XP-STORM to determine existing flow rates based on topographic contours. The design storms modelled were calculated internally by the model with reference to the methodology in Australian Rainfall & Runoff (Institution of Engineers, Australia 2000). The rainfall temporal pattern was assumed to be spatially uniform across the catchment and storm durations modelled ranged from 10 minutes to 72 hours for the 10yr and 100yr ARI storm events.

Catchment areas based on available topographic contours are presented in Figure 4. Lot and Road areas were proportioned as comprising of 70% and 30% respectively of each catchment area.

The loss model adopted for the modelling assumed no initial loss from all areas. A runoff rate of 70% was applied to Lots, 90% to Roads and 50% to Native Vegetation for the both 10yr and 100yr ARI rainfall events. The value adopted for the Native Vegetation is consistent with SKM (2007) and other areas in the Pilbara provided by the DoW.

Stormwater modelling indicates the critical storm duration ranges between 30mins to 60mins for both the 10yr and 100yr ARI events. Peak flows are presented in Figure 4.

2.8.2 LIA Creek

Along the southern boundary of the Study Area is a surface water course known as the LIA Creek which flows east through the Exmouth townsite, ultimately discharging into the Exmouth Gulf (Figure 5). The LIA Creek drainage catchment extends over approximately 13.4km^2 from the hills located to the west with a mainstream length of 13.2km. It is a seasonal water course and flows during extreme rainfall events.

Peak flow in the LIA Creek for various rainfall ARI's (critical 1hr event) were presented in SKM (2007) as follows:

- 10yr ARI 27.5 m^3/s
- 25yr ARI 65.9 m^3/s
- 100yr ARI 151.9 m^3/s

- 500yr ARI 277.5 m^3/s

Note that the location of these flows was not specified in the report.

100yr ARI floodplain mapping and levels modelled by SKM (2007) for the LIA Creek are shown in Figure 5. SKM (2007) categorised the floodplain into "Floodway" being the areas of high conveyance or deep ponded water and the "Floodzone" being the areas of shallow floodplain and the fringe of ponded areas.

The floodplain mapping indicates both part of the LIA Creek's 100yr ARI Floodway and Floodzone extends into the southern portion of the Study Area and therefore this will have to be taken into consideration when determining fill levels and drainage outlet design. The flood level ranges from approximately 18.5mAHD in the south west corner to 12 mAHD in the south east.

2.8.3 Reid St Flood Mitigation Works

100yr ARI floodplain modelling by SKM (2007) indicates that the light industrial area immediately downstream of Reid St is currently subject to inundation from the LIA Creek.

To minimise this flood inundation and ensure 100yr ARI trafficability for Reid St, SKM have proposed the construction of a series of flood mitigation bunds either side of the LIA Creek (Figure 5). The northern bund upstream of Reid St partially extends into the south eastern corner of the Study Area and is currently being constructed by the Shire of Exmouth.

100yr ARI flood modelling performed by SKM to assess the impact of the proposed bunds with revised flood levels is shown in Figure 5. With the bund in place, the floodplain in contained within the bunds and flooding over Reid St is reduced. The revised flood extent and levels along the southern boundary of the Study Area remain almost similar to previous.

2.9 Water Resources

Exmouth is located within the Rights in Water and Irrigation Act 1914 Pilbara Surface Water and Groundwater Area. The main source of water supply for the town of Exmouth is from the unconfined aquifer in the eastern scarp of Cape Range, which is replenished by infiltration and rainfall runoff from the ranges. There is an opportunity for construction of production bores for groundwater abstraction for irrigation purposes if required but will require a hydrogeological assessment and test pumping to prove if there is sufficient yield.

3. PROPOSED DEVELOPMENT

The proposed Outline Development Plan (RPS, 2012) for the Study Area is shown in Figure 6. It shows that land use in the proposed development will consist of a mixture of varying densities of residential (R17.5, R20 and R30), mixed use commercial and various pockets of public open space (POS) areas integrated with drainage. POS areas equate to approximately 4.5ha, 13.5% of the total sub dividable area.

The existing tree lined drainage path through the centre of the Study Area will be maintained and integrated into POS to have a dual function of provision of active and passive recreational form with drainage swale to convey stormwater runoff to LIA Creek.

The existing roadside drainage channel along Reid St will also be enhanced and integrated with POS to provide a drainage swale to convey stormwater runoff to LIA Creek.

Along the southern boundary of the Study Area with LIA Creek, a POS/Foreshore Reserve area is also proposed which provides an opportunity to create detention/sedimentation areas for stormwater treatment.

4. LOCAL WATER MANAGEMENT STRATEGY

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

Issues related to implementation are discussed in Section 5.

4.1 Water Use & Sustainability Initiatives

4.1.1 Water Sources

Potable water supply to the Study Area is proposed from scheme water serviced via an extension of the Water Corporation's existing infrastructure for the Exmouth town. It is envisaged that potable water supply will be used for in and ex house uses. POS and streetscape areas will be landscaped appropriately for the climatic conditions and any area requiring irrigation will be minimal. Irrigation water source will be from the scheme water supply.

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 for domestic supply as well as irrigation of POS. Water conservation measures will be promoted to reduce scheme water consumption within the development and will be consistent with Water Corporation's "Waterwise" land development criteria which could include:

- Use of native vegetation requiring less irrigation in any proposed streetscapes and public areas.
- Opportunities for localised capturing and storing of rainfall runoff within drainage swales will be investigated during landscape design to assist in enhancing the ecosystem and support vegetation growth.

Specific measures to achieve the water conservation strategy will be outlined in the Urban Water Management Plan (UWMP).

4.1.3 Non Potable Water Supply Options & 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.

Whilst development generally leads to an increase in the post development peak flow and volume of surface water discharge to the receiving environment, the limited infiltration and high runoff rates are similar for both pre and post development condition. Consequently, change in landuse to post development generates limited excess water from a water balance perspective.

To assist in conservation of scheme (potable) water supplies, substitution with an alternative water source or recycling and reuse can make significant savings to scheme water. This is most easily achieved for non-potable uses, and easier for ex-house (irrigation) than in-house (toilet flushing and cold water inlet to washing machines) in terms of required level of treatment, obtaining regulatory approvals and costs.

Potential non-potable supply options for scheme water substitution include domestic scale rainwater tanks and greywater reuse systems. Although installation of these systems will not be mandated by the developer or the Shire, landowners will be encouraged and supported where possible should they wish to include these measures.

4.2 Surface Water Management

Management of surface water in the Study Area following development involves mitigating the impacts from flooding and designing a suitable stormwater system to convey and improve water quality.

4.2.1 Flood Management Concepts

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 management system will consist of the network of roads and shallow drainage swales with the aim of safely conveying stormwater from the Study Area to LIA Creek, and to integrate them into the POS where possible. Due to the large rainfall intensity and volumes experienced in the North West Region of WA, conveyance of stormwater is via open drainage systems rather than underground pipe systems.

Due to the volume of stormwater runoff directly discharging into the Study Area from the external catchments, the existing drainage paths to the LIA Creek will be retained to maintain existing flow paths consistent with the stormwater principles and objectives. They will provide some attenuation of peak surface water flows, and some water quality treatment for the proposed development prior to discharge from the Study Area.

The stormwater drainage system will be designed using a major/minor approach. The minor drainage system is defined as the system of swales, kerbs, gutters etc. designed to carry runoff generated by low frequency ARI storms, typically less than 10 year ARI. The major drainage system is defined as the arrangement of roads, drainage swales and open space areas planned to provide safe passage of stormwater runoff from extreme events which exceeds the capacity of the minor system.

4.2.2 Minor Road Design

Minor roads are all roads other than those that are located adjacent to the drainage swales. The minor roads will convey stormwater runoff generated by impervious areas from both the lots and the road reserve via the road gutter system into the main drainage swales.

These roads will be crowned at the centre with stormwater runoff contained within the depth of the kerb for rainfall events up to the critical 10yr ARI. For rainfall events greater, stormwater runoff may exceed the depth of the kerb and utilise part of the road reserve as the overland flow path prior to discharge into the drainage swale.

Locations where flow from these minor roads discharge into a drainage swale or directly into the LIA Creek will be sufficiently protected by rock armour or engineering structures such as drop structures to assist in minimising or preventing scouring and erosion.

4.2.3 Drainage Swale Design

Two main drainage swales are proposed to convey stormwater runoff from both the adjacent road and the minor roads to LIA Creek by the shortest route where possible. The location of these drainage swales are proposed to be retained in their existing alignments through the centre and the along the eastern boundary of the Study Area. They will be integrated with the POS where possible (Figures 6 and 7).

The drainage swales will have varying base widths being smaller upstream to wider downstream as the contributing flow areas increase. The swales will have a nominal depth of approximately <1m to maintain a shallow profile for urban form and allow integration of drainage function with passive POS.

The drainage swales will flow under cross roads via culverts and over cross roads as a spillway for events greater than 10yr ARI. Some attenuation of flow maybe achieved within the drainage swale via the culverts.

The swales will be smooth lined with a trapezoidal form and will not be landscaped or contain rock pitching. The swales will not contain any permanent open water bodies, an approach consistent with the DoW’s current policy on the use of constructed lakes for stormwater management.

The outlets from the drainage swales into LIA Creek will to be appropriately designed during detail design with sufficient protection such as rock armouring, drop structures or concrete spillways to prevent or minimise scouring and erosion.

For safety purposes, the product of depth and velocity shall not exceed 0.4m2/s (IEAust, 2000).

Minimum building floor levels will be 0.5m above the estimated adjacent 100yr ARI flood level, consistent with Australian Rainfall & Runoff (AR&R) (Institution of Engineers, Australia 2000).

4.2.4 Post Development Stormwater System Design

Conceptual stormwater modelling was performed for the Study Area using the model XP-STORM to determine post development flood storage requirements and assess whether sufficient area has been provided in the Outline Development Plan for drainage purposes. Modelling was based on the proposed land use plan shown in Figure 6.

The design storms modelled were calculated internally by the model with reference to the methodology in Australian Rainfall & Runoff (Institution of Engineers, Australia 2000). The rainfall temporal pattern was assumed to be spatially uniform across the catchment and storm durations modelled ranged from 10 minutes to 72 hours for both the 10yr and 100yr ARI storm events.

The Study Area was modelled divided into 5 main catchments based on maintaining direction of flow from existing topography and flow discharge location to either the drainage swales or to LIA Creek (Figure 7). Loss model adopted is similar to that used for the pre-development modelling being 90% from Roads, 70% from Lots and 50% from Native Vegetation. Note that for the external catchment flowing into Catchment 3, part of it has been assumed to be developed as shown as future development on the ODP.

Both the western drainage swale (Drain A) and eastern drainage swale (Drain B) have been modelled assuming inverts based on existing topography with side slopes of 1 in 3. Base width for Drain A is 8m to maintain 100yr ARI flood depth at a maximum of 1m. Drain B base width varies from 6m upstream to 10m downstream to maintain flood depth at a maximum of 0.5m to allow integration with Reid St levels. Note that this stage of modelling does not incorporate any erosion and velocity reducing measures, sedimentation areas and landscaping treatments that may alter swale widths.

Drainage outlets that discharge directly to the LIA Creek have been modelled as occurring via a single overflow spillway at one location. During further detailed design, the location and size of each outlet location will be provided in the UWMP.

All drainage outlet inverts to LIA Creek have been modelled at the existing natural surface at the discharge location, effectively being at or above the LIA Creek 100yr ARI flood level (with flood mitigation bunds) so they are not impacted on by the LIA Creek tailwater.

4.2.5 Post Development Stormwater System Modelling Results

Stormwater modelling results for each catchment for the critical rainfall duration (ranging between 30min and 1hr) for the 10yr and 100yr ARI are presented in Figure 7.

Modelling results indicate that the POS areas allocated within the identified drainage swales and POS/foreshore areas can sufficiently accommodate stormwater runoff for up to the critical 100yr ARI rainfall event.

Maximum velocity modelled occurs in Drain A at 1.9m/s, just below the recommended maximum design velocity of 2.0m/s to protect against scouring and erosion of in-situ material. However refinement of the drainage swale dimensions and inclusion of engineering structures (where appropriate) during detail design can reduce the velocity and will be presented in the UWMP.

All inverts of the drainage outlets are proposed to discharge into the LIA Creek above the mapped 100yr ARI flood levels. Consequently, the 100yr ARI flood level of LIA Creek will not impact on discharge from the stormwater system. Further detail design of any detention or sedimentation structures at the drainage outlets within the POS/Foreshore area can also reduce flows and can be presented in the UWMP.

Note that the final drainage swale configuration (area, side slopes etc) and location will be documented in the UWMP and will be dependent on final earthworks, drainage and road design levels for the development. Minor changes (refinements) in catchment areas shown in this report are therefore considered likely to occur as detailed design proceeds.

4.3 Groundwater Management

A groundwater management strategy is required to ensure the required separation between building floor levels for development and groundwater level is achieved.

In circumstances where soil properties and current groundwater levels impact the required separation for building, groundwater management in the Study Area is proposed by use of the following approach:

- Adoption of the design watertable level as being approximately 0.5m below the existing pre-development natural surface level.
- Clearance to groundwater to be achieved through the use a combination of imported fill (possibly 1.5m) and/or subsoil drainage (where required) within road reserves and easements to limit groundwater rise post development.

Groundwater within the Study Area is approximately 6 metres below the natural surface, and the minimum natural surface is 12mAHD along the coastline. Therefore there is sufficient separation of building floor levels for development, and no groundwater management approach is required.

Note that fill required to satisfy flood levels and geotechnical requirements are considered to be the critical factor in determining fill requirements rather than groundwater levels.

Note that while this LWMS establishes criteria and the general approach for setting of development levels and finished lot levels, final fill requirements are a detailed design issue and will addressed during preparation of the Urban Water Management Plan (UWMP).

4.4 Construction Management

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

4.4.1 Dewatering

Although unlikely due to the depth to groundwater, dewatering of the superficial aquifer maybe required for some elements of subdivision construction. If required, the volume of dewatering will generally be minor and of a temporary nature, thus the overall impact on the aquifer will be minimal, although some drawdown will occur at the dewatering site.

Prior to the commencement of any dewatering, the construction contractor will prepare a Dewatering Management Plan consistent with the DoW’s Water Quality Protection Note (WQPN 13, 2006) and 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 and the Dewatering Management Plan.

Where possible, construction will be timed to minimise groundwater impacts and dewatering requirement.

4.4.2 Acid Sulphate Soils

As previously discussed in Section 2.8, the LIA Creek along the southern boundary of the Study Area has a “Moderate to Low Risk” of acid sulphate soils occurring within 3m of natural soil surface (or deeper)” (DEC 2008) (Figure 2).

However only a small portion of the identified area extends into the Study Area which will be incorporated into the foreshore or open space area where no development will occur. Consequently, no acid sulphate management plan will be required.

4.5 Water Management Strategy Summary

Table 4 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 4: 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 10yr and 100yr ARI peak flows from the Study Area at or below current discharge levels. • No lowering of groundwater levels.
Water Quality To maintain or improve the surface and groundwater quality within development areas relative to pre-development conditions.	• Use of treatment train approach to stormwater management • Application of source controls – including education to reduce nutrient application, use of native plantings and vegetated swales. • Application of structural controls – retention/detention areas and vegetated swales.
Water Conservation To maximise the reuse of stormwater	• Encourage implementation of water efficiency and demand management measures both internal and external of buildings. • Use of native plantings to minimise irrigation requirements where possible.
Ecosystem Health To retain natural drainage systems and protect ecosystem health	• Maintain 10yr and 100yr ARI peak flows from the Study Area at or below current discharge levels to the LIA Creek.
Economic Viability To implement stormwater systems that are economically viable in the long term	• Use of proven structural water sensitive urban design 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	• Identification of 100yr ARI flood levels for Study Area. • Protection of downstream areas by restricting stormwater discharge to existing levels for storm events up to 100yr 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 & 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 this LWMS involves defining the roles and responsibilities of the developer and the Shire, outlining further documentation required to support the development and defining operation, monitoring and maintenance of the stormwater system.

5.1 Roles and Responsibilities

Table 5 details the roles and responsibilities to undertake the implementation plan.

Construction of the stormwater management system will be the responsibility of the developer with ongoing operation and maintenance reverting to the Shire following handover. Preparation of the UWMP will be the responsibility of the developer.

TABLE 5: IMPLEMENTATION RESPONSIBILITIES

IMPLEMENTATION		RESPONSIBILITY	
LWMS Section	Action	Developer	Shire of Exmouth
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 will be submitted by the developer to the Department of Water and the Shire of Exmouth as required under relevant conditions of subdivision. 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)
- Implementation plan including monitoring program, roles, responsibilities, funding and maintenance arrangements. Contingency plans should also be indicated where necessary

5.3 Stormwater System Operation and Maintenance

Ongoing operation and maintenance of the drainage system will be the responsibility of the Shire of Exmouth. 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 blockages
- cleaning of sediment build up and litter layer on the bottom of drainage swales

A summary of the proposed maintenance schedule is presented in Table 6 below.

TABLE 6: MAINTENANCE SCHEDULE FOR DRAINAGE INFRASTRUCTURE

Item	Maintenance Interval		
	Quarterly	Biannually	As required
Drainage Swales			
Removal of debris to prevent blockages	✓		
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.			✓

6. REFERENCES

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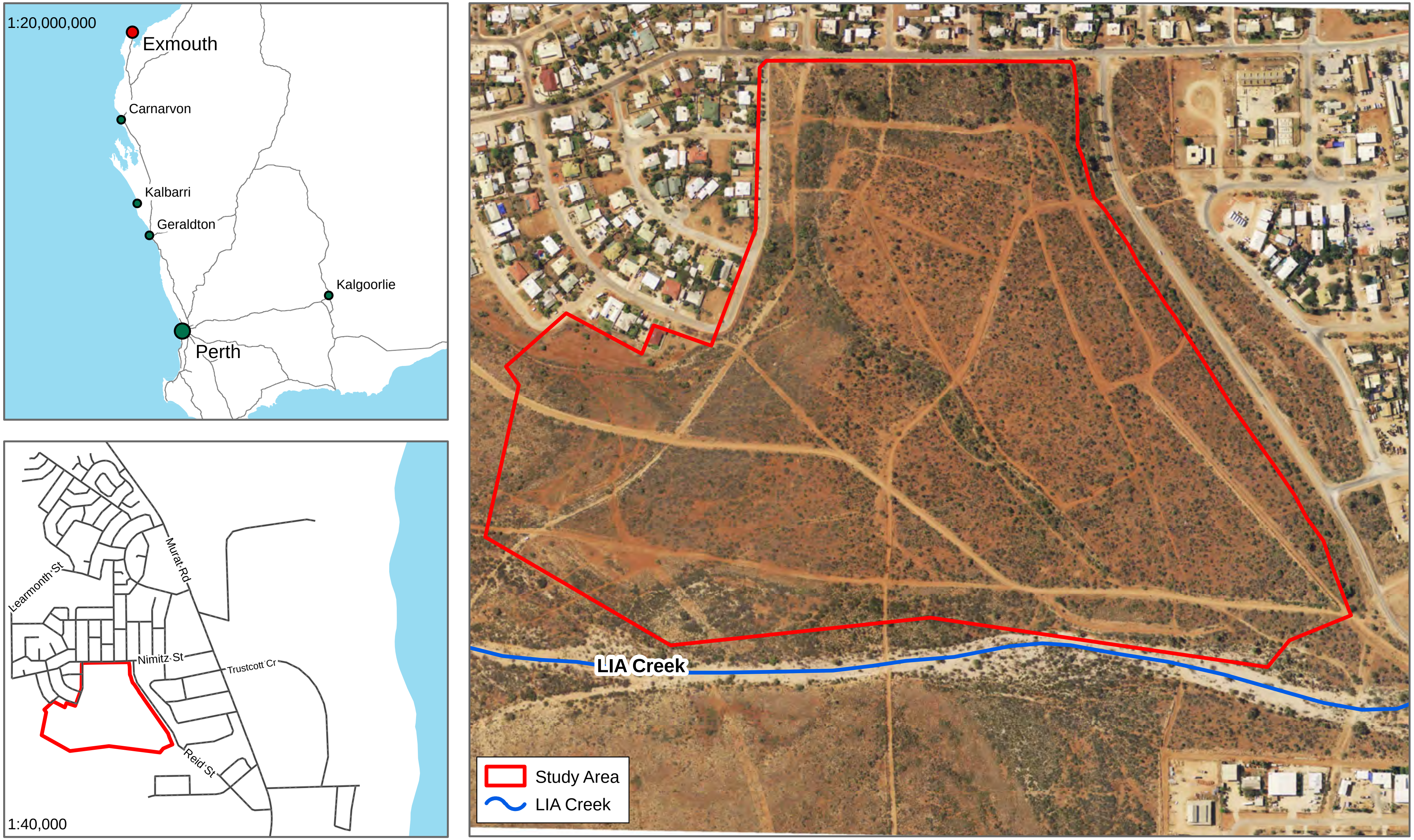
FIGURES



Data Source: Asphar Surveys (2012)

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0 100 200 300 400 500 Meters

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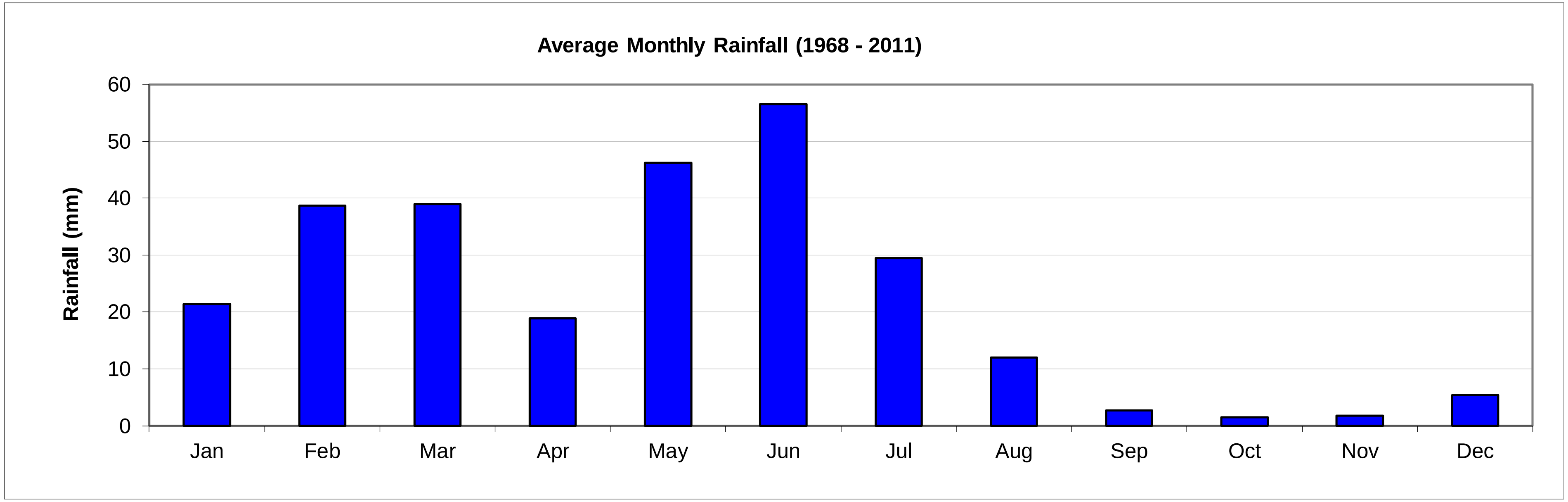
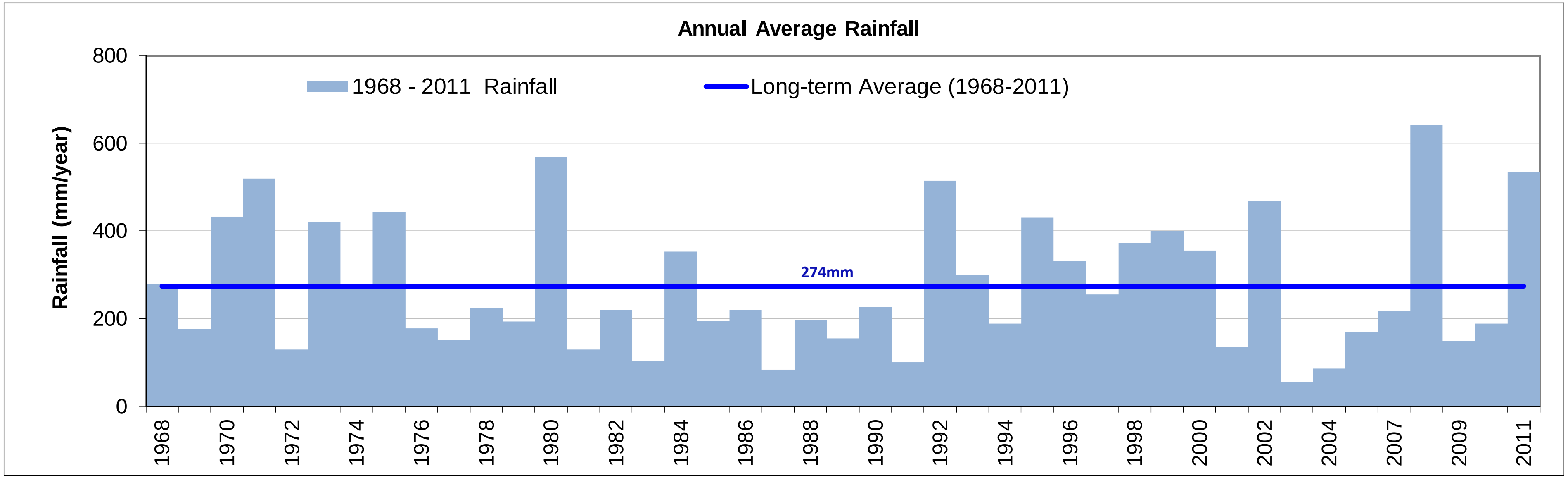
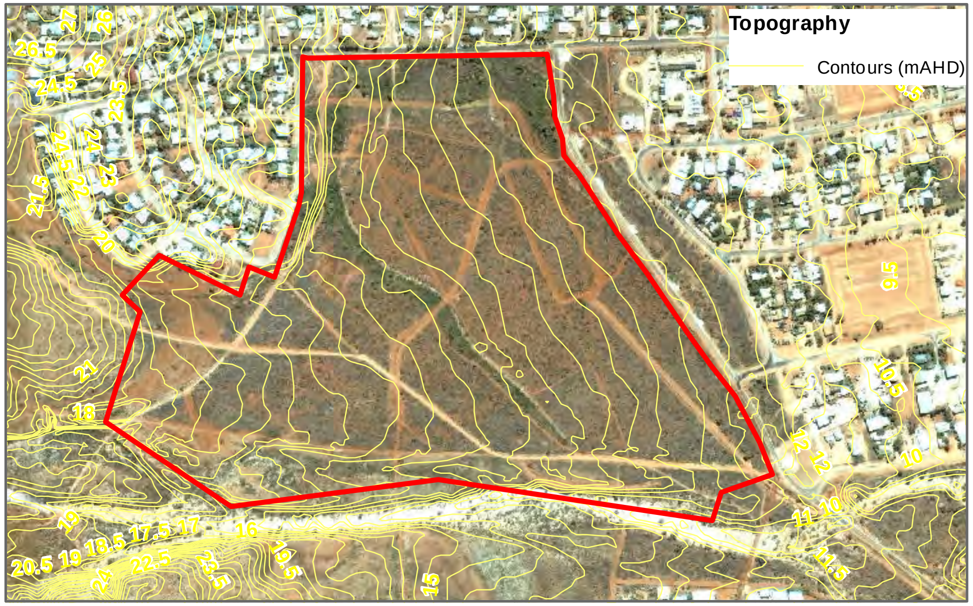
LandCorp
Nimitz Street Urban Development, Exmouth - LWMS
Figure 1: Location Plan

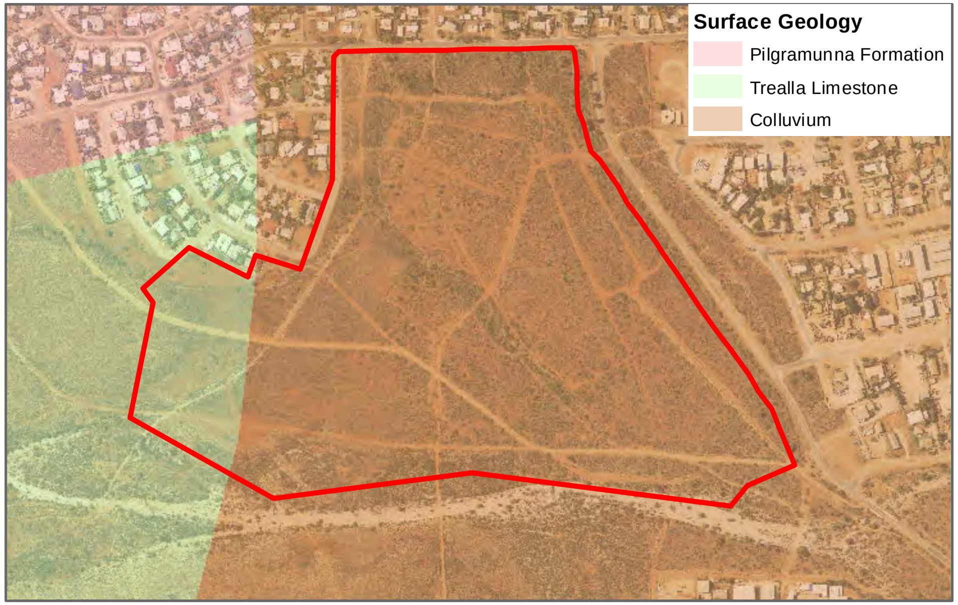


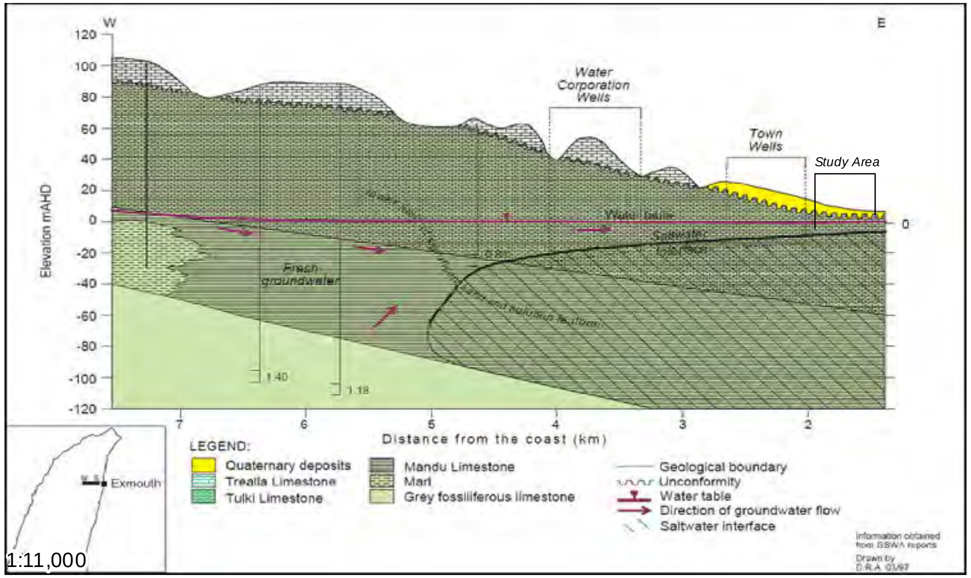


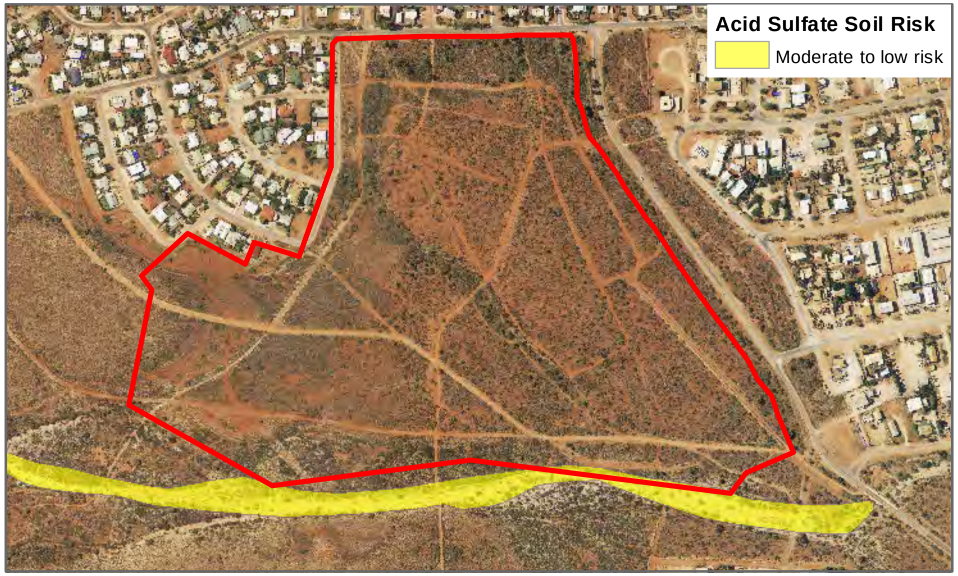
Data Source: Bureau of Meteorology (2011) Climate Data Online Exmouth Town (005004) & Exmouth Gulf (005004)

JDA	Job No. J5083	LandCorp Nimitz Street Urban Development, Exmouth- LWMS **Figure 2: Annual and Average Monthly Rainfall Data**









Data Source: GSWA (2010); Asphar (2012); WRC (2000)

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Scale: 1:7,500

0 100 200 300 400 500 Meters

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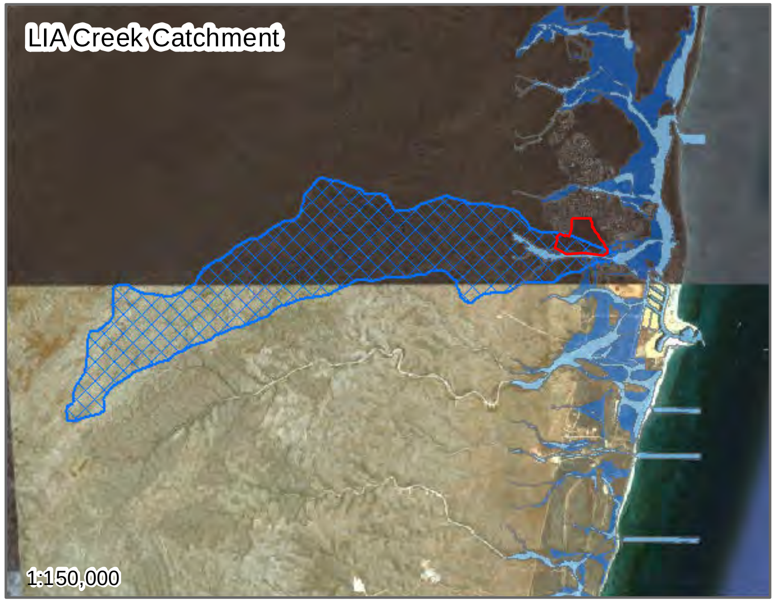
LandCorp

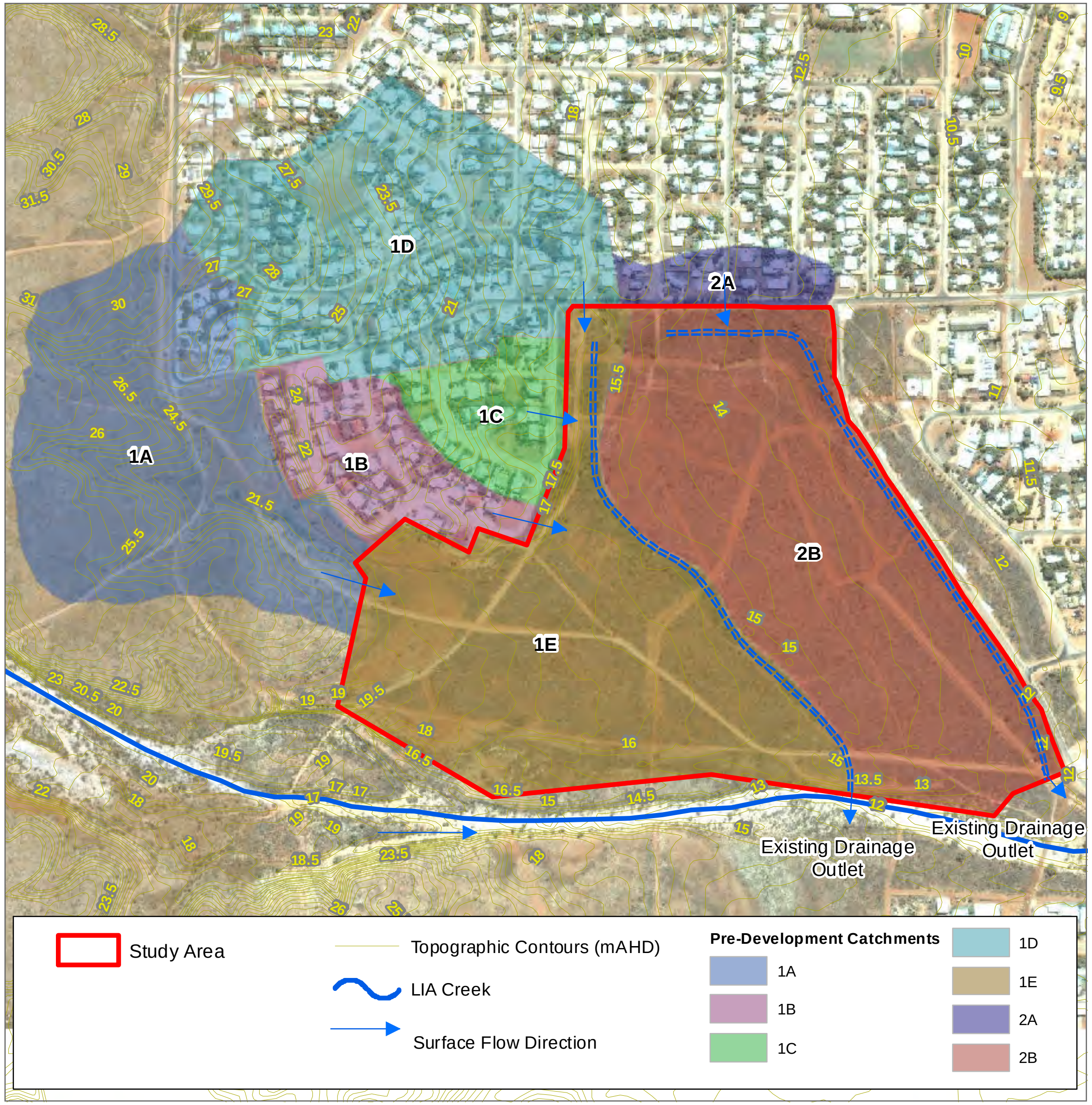
Nimitz Street Urban Development, Exmouth - LWMS

Figure 3: Environmental Setting



Pre-Development Modelling Results

Catchment Areas (ha)					Pre-dev Flows (m^3/s)			
Name	Road	Lots	Native Veg	Total	100yr ARI	Critical	10yr ARI	Critical
Catchment 1								
1A	-	-	15.69	15.69	4.30	60 min	2.24	60 min
1B	1.48	3.45	-	4.93	2.53	30 min	1.44	30 min
1C	1.06	2.47	-	3.53	1.84	30 min	1.10	30 min
1D	4.57	10.66	-	15.23	7.02	30 min	3.87	30 min
1E	-	-	19.56	19.56	2.37	60 min	1.07	60 min
Total	*7.11*	*16.58*	*35.25*	*58.94*	*12.66*	*60 min*	*6.47*	*60 min*
Catchment 2								
2A	0.60	1.41	-	2.01	0.66	60 min	0.34	60 min
2B	-	-	20.94	20.94	2.75	60 min	1.17	60 min
Total	*0.60*	*1.41*	*20.94*	*22.95*	*1.58*	*60 min*	*0.72*	*60 min*



Data Source: Asphar (2012)

Job No. J5083
Scale: 1:10,000
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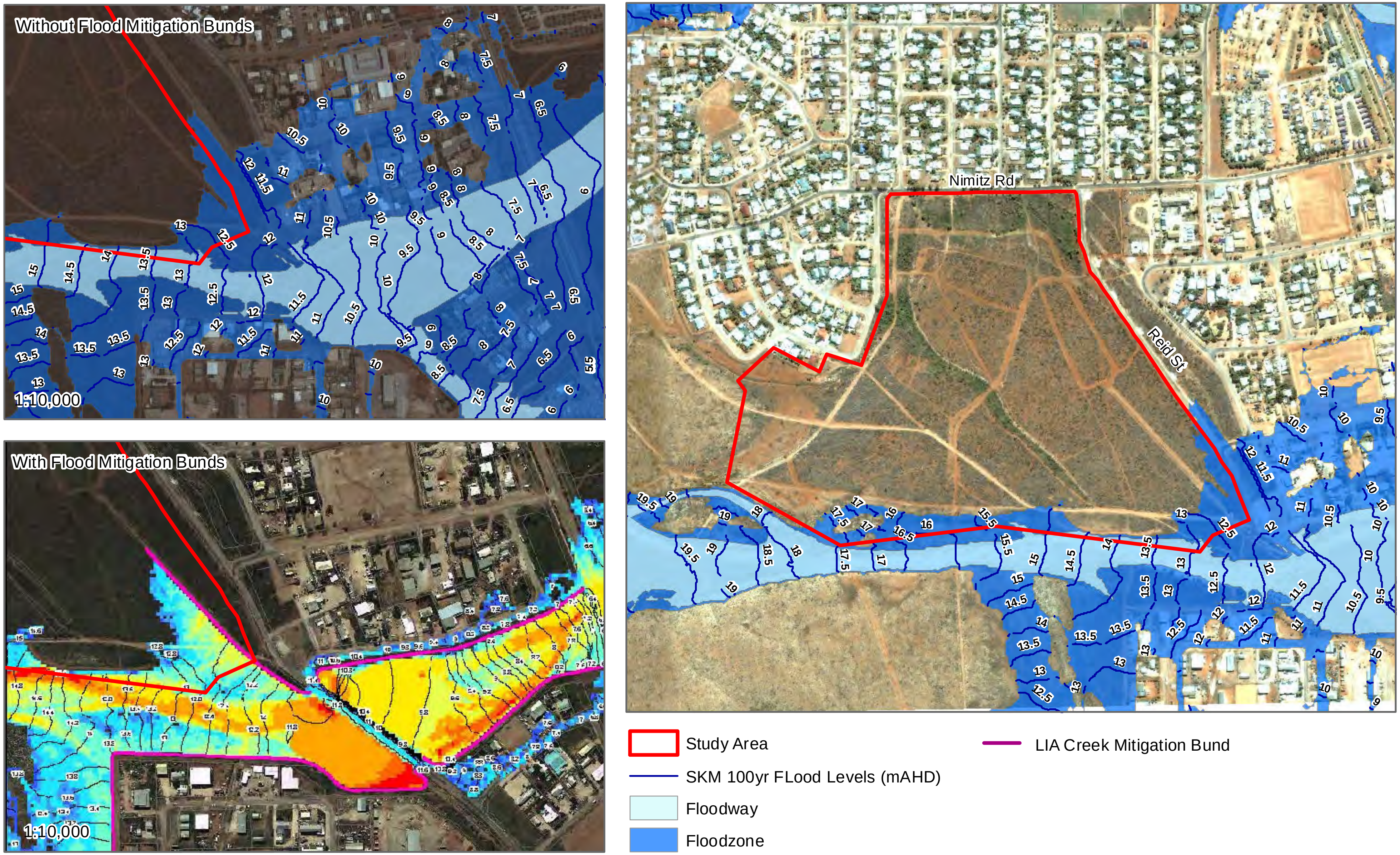
N

LandCorp
Nimitz Street Urban Development, Exmouth - LWMS
Figure 4: Pre-development Catchments & Flows



Data Source: DoW (2011); Asphar Surveys (2012)

JDA

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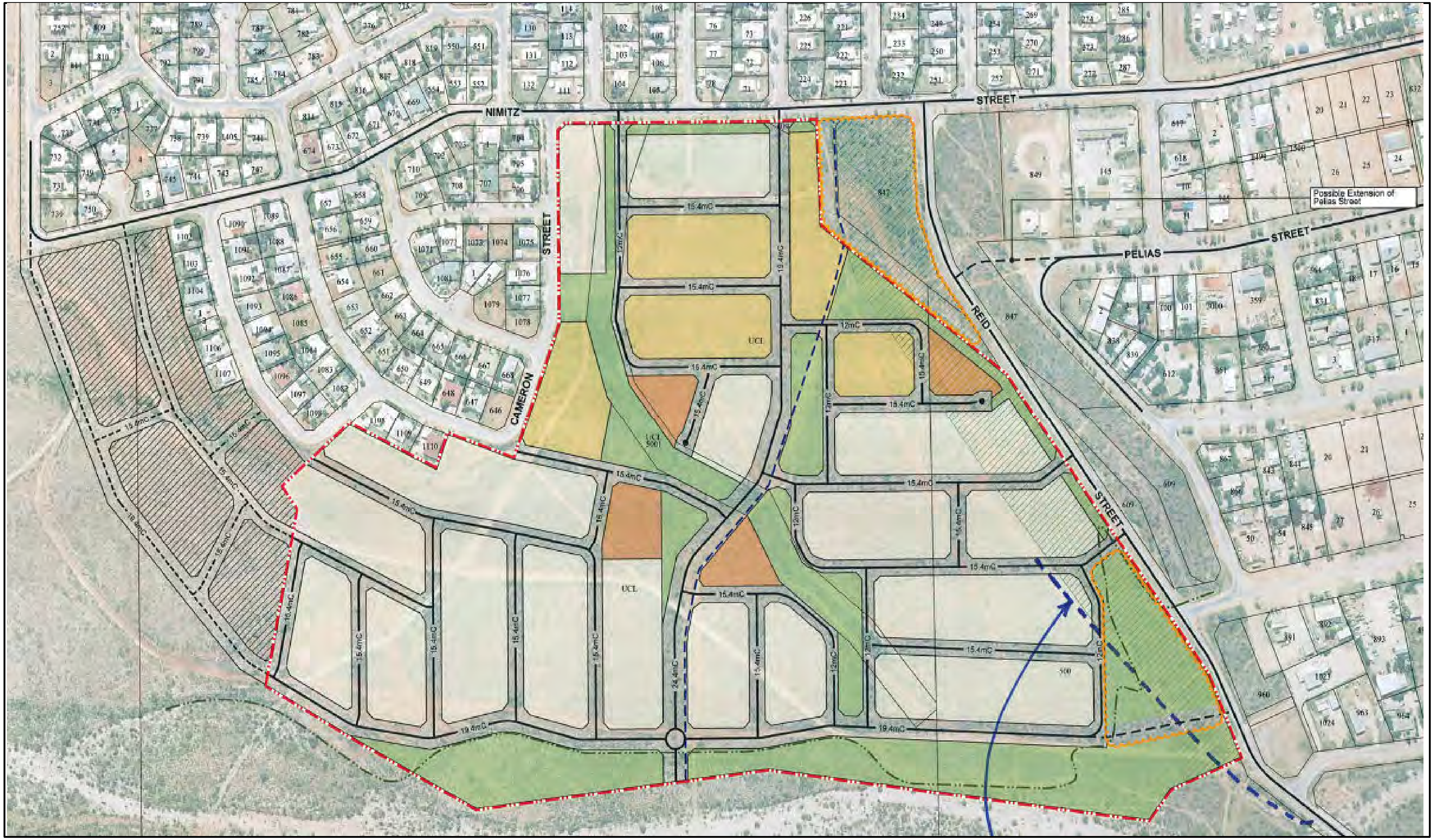
LandCorp
Nimitz Street Urban Development, Exmouth - LWMS

Figure 5: LIA Creek 100yr ARI Floodplain Mapping



Data Source: RPS (2012)

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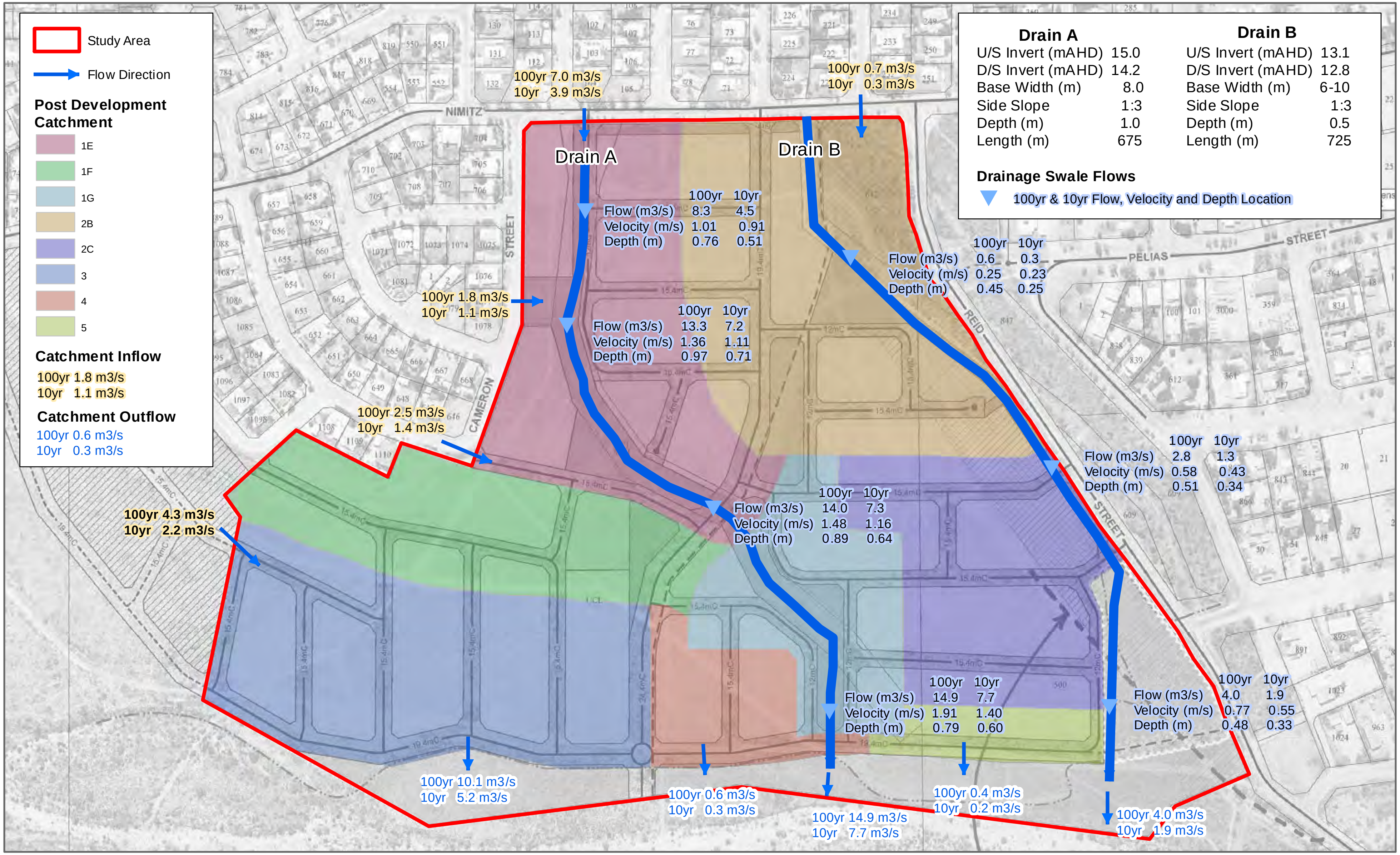
LandCorp

Nimitz Street Urban Development, Exmouth - LWMS

Figure 6: Outline Development Pan



Data Source:RPS (2012)

Job No. J5083

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Figure 7: Stormwater Management Plan

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: May 2012
Name of Plan: Nimitz Rd Urban Development, Exmouth	
Contact: Matthew Yan, JDA Consultant Hydrologists	
Address: Suite 1, 27 York St Subiaco WA 6008	
Telephone: 6380 3423	Email: matt@jdahydro.com.au

Local Water Management Strategy Item	Required Deliverable	Deliverable LWMS Reference	☐	Comment
Executive Summary				
Summary of the development design strategy, outlining how the design objectives are proposed to be met	Design elements and requirements for BMPs and critical control points	Executive Summary	✓	
Introduction				
Total water cycle management – principles & objectives Planning background Previous studies		Section 1.3	✓	
Proposed Development				
Structure plan, zoning and land use. Key landscape features Previous land use	Site context plan Structure plan	Sections 2, 3 Figs 1 & 6	✓	
Landscape - proposed POS areas, POS credits, water source, bore(s), lake details (if applicable), irrigation areas	Landscape Plan	N/A		
Design Criteria				
Agreed design objectives and source of objective		Section 1.3	✓	
Pre-development Environment				
Existing information and more detailed assessments (monitoring). How do the site characteristics affect the design?	Existing Site Charicteristics	Section 2	✓	
Site Conditions - existing topography / contours, aerial photo underlay, major physical features	Site Condition Plan	Section 2.1 Figure 1	✓	
Geotechnical - topography, soils including acid sulfate soils and infiltration capacity, test pit locations	Geology Description	Sections 2.4 & 2.6 Figure 3	✓	
Environmental - areas of significant flora and fauna, wetlands and buffers, waterways and buffers, contaminated sites	Environmental Plan plus supporting datasets where appropriate	Section 2.7 Figure 3	✓	
Surface Water – topography, 100 year floodways and flood fringe areas, water quality of flows entering and leaving (if applicable)	Surface Water Plan	Section 2.8 Figures 4 & 5	✓	
Groundwater – topography, pre development groundwater levels and water quality, test bore locations	Groundwater Plan	Section 2.5	✓	

Local Water Management Strategy Item	Required Deliverable	Deliverable LWMS Reference	☐	Comment
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	Section 4.2 Figure 7	✓	
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 Figure 7	✓	
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	1yr event plan	Section 4.2	✓	
Groundwater Management Strategy				
Post development groundwater levels, fill requirements (including existing and likely final surface levels), outlet controls, and subsoils areas/exclusion zones	Groundwater Plan	Section 4.3	✓	
Actions to address acid sulfate soils or contamination		Section 4.4.2	✓	
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		N/A		
Implementation				
Developer commitments		Section 5.1	✓	
Roles, responsibilities, funding for implementation		Section 5.1	✓	
Review		Section 5.1	✓	

Western Australian Planning Commission (2008), Better Urban Water Management, Perth, WA

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APPENDIX 3

NIMITZ STREET REVISED OUTLINE DEVELOPMENT PLAN

TRANSPORT ASSESSMENT ADDENDUM

INTRODUCTION

This addendum report has been prepared to support the "Nimitz Street Overall Development Plan Transport Assessment Report" following changes to the Outline Development Plan since issue of the Transport Assessment Report.

CHNAGES TO THE OUTLINE DEVELOPMENT PLAN

Changes to the Outline Development Plan with respect to the road network are best described by overlaying the previous road layout (as per the Transport Assessment Report) with the revised road layout. This is shown as **Figure 1** on the final page of this Addendum Report.

COMMENT ON CHANGES

It is understood that the Shire of Exmouth was reluctant to incorporate a roundabout at the four-way intersection on the Kennedy Street extension just south of Nimitz Street. This was included in the original layout as an effective control measure for a four-way intersection and to assist with controlling speeds along the Kennedy Street extension. The removal of the roundabout will require that careful attention is given to the detailed design of Kennedy Street to ensure that operating speeds do not exceed 50 km/h. Failure to do this could result in an unsafe environment for Kennedy Street given the large number of side roads intersecting with this street.

The revised layout shows two connections with Reid Street and the possibility of another connection on the southern boundary road. The previous layout minimised road connections to Reid Street in an effort to improve the drainage performance of the swale drain along the western boundary (by reducing the number of road crossings and hence culvert structures) and to reflect a forecast low demand for connections to Reid Street, especially after Kennedy Street extends through to Murat Road. The proposed southern connection to Reid Street will effectively result in a new east-west Neighbourhood Connector Road (Learmonth Street) and would require that the section of this road east of the Kennedy Street extension is designed as a Neighbourhood Connector Road and not a Local Access Street. It will also require a change to the proposed road network within the Exmouth Town Centre Structure Plan to reflect this and assess the requirement, if any, to changes to other Neighbourhood Connector Roads shown in the Exmouth Town Centre Structure Plan.

RELEVANCE OF CHANGES TO FORECAST TRAFFIC VOLUMES AND IMPACTS

The Transport Assessment found that all of the existing roads and intersections were operating well within capacity and that the forecast peak hour trips from the proposed development would have very little impact on these. The revised layout shows more connections to Reid Street and hence would result in even less volumes on the connecting street between Kennedy Street and Reid Street, and hence less of an impact on these streets and their intersections than assessed in the report.

SUMMARY

From a transport perspective, the revised layout is not expected to result in any greater impacts on streets and roads than assessed in the Transport Assessment report for the original layout. It will however, require that the following is also considered:

- That careful attention is given to the detailed design of Kennedy Street to ensure that operating speeds do not exceed 50 km/h;
- That the section of Learmonth Road east of the Kennedy Street extension is designed as a Neighbourhood Connector Road if it is intended to finally connect this to Reid Street; and
- That the proposed road network in the Exmouth Town Centre Structure Plan is amended to reflect the above and assess the requirement, if any, to changes to other Neighbourhood Connector Roads shown in the Exmouth Town Centre Structure Plan.

Reason: I am the author of this document
Date: 2012-02-16 11:52+08:00

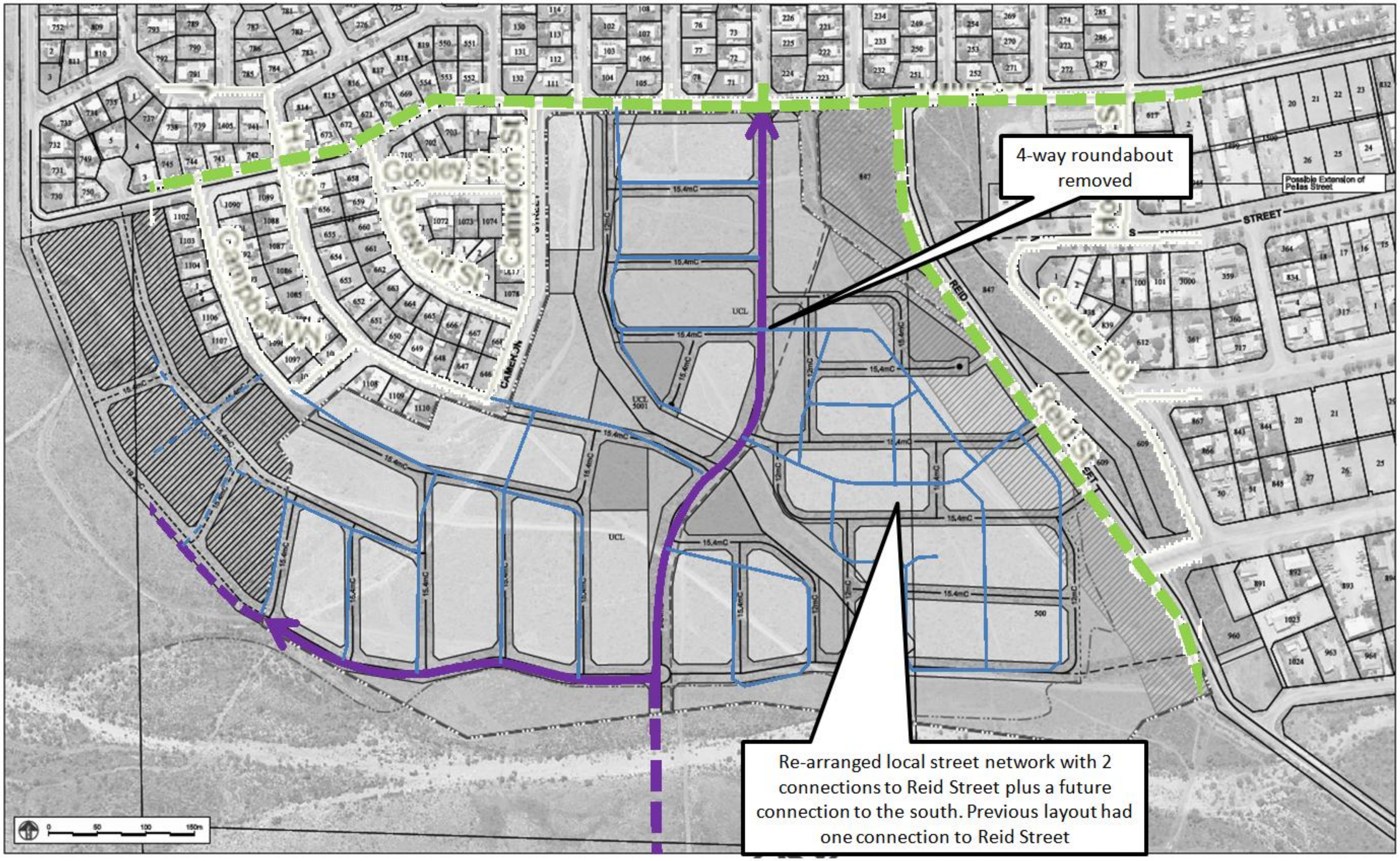

Figure 1 – Previous road layout (colour) overlaid on revised road layout

Prepared for:

Nimitz Street Overall Development Plan

Transport Assessment

Draft 1.0

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i3 consultants WA

TRAFFIC ENGINEERING - TRANSPORT PLANNING - ROAD SAFETY ENGINEERING - ROADWORKS TRAFFIC MANAGEMENT

Project details

Project ID	09803
Client	RPS
Description	A Transport Assessment for the Overall Development Plan for Nimitz Street in Exmouth prepared in accordance with the WAPC Liveable Neighbourhoods and associated Transport Assessment Guidelines For Development.

Business details

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Document control

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Publish date	3/02/2012

		Draft			Final				
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CONTENTS

1. EXECUTIVE SUMMARY

This *Transport Assessment* is a formal document prepared for a 'Local Structure Plan' (Draft Overall Development Plan – Nimitz Street, Exmouth) in accordance with the WAPC documents *Liveable Neighbourhoods* and *Transport Assessment Guidelines For Development*.

The *Transport Assessment* assesses the current and proposed transport elements of the proposed *Nimitz Street ODP* as well as the street network in the vicinity of this, specifically:

- traffic volumes and street hierarchy
- connectivity of streets
- connectivity with activity nodes
- street cross-sections
- traffic management
- clear network based on function, traffic volumes, vehicle speed, public safety and amenity
- public transport
- pedestrians, cyclists and disabled
- provision for safe/ convenient pedestrian, cyclists and vehicular access

The following is a brief summary of the main findings of this report.

- The development of the *Nimitz Street ODP* is specific to the needs of Exmouth, consistent with the Exmouth Townsite Structure Plan and has been carried out in accordance with best practice sustainable planning principles and policies such as the Western Australian Planning Commission (*WAPC*) Document *Liveable Neighbourhoods;*
- There is a need for a Road Hierarchy consistent with *Liveable Neighbourhoods* to be developed and adopted for the Exmouth townsite as soon as possible to assist with sustainable planning processes and procedures.
- There is plenty of mid-block capacity on all of the assessed roads with current usage between 2% and 17% of capacity;
- There is plenty of spare capacity within all of the assessed intersections (existing and proposed with the forecast volumes up to 2030) with all intersections formally assessed as "Good with minimal delays and plenty of spare capacity";
- There is a 'disconnect' between the main Integrator (Arterial) Road (Murat Road) and the Town Centre. At present Murat Road tends to lead unfamiliar motorists past the turn off to the town centre (Maidstone Crescent). The Shire of Exmouth is currently investigating ways of addressing this through the Town Centre Plan and recommendations within the Exmouth Townsite Structure Plan. This includes 'reclassifying' Kennedy Street as a Neighbourhood Connector Road and extending this through the *Nimitz Street ODP* area to connect to Murat Road south of the Marina Precinct. This will provide a more direct route to the Town Centre for local traffic.
- There are no public transport facilities or services within the Exmouth townsite and no plans to provide these.
- The majority of residential roads have paths on at least one side and provide good connective pedestrian links to facilities through to the town centre.
- The provision of a small retail outlet within the *Nimitz Street ODP* to serve the daily needs of residents would reduce car trips to and from the town centre.

2. INTRODUCTION

2.1 THE SCOPE

i3 consultants WA (*i3cWA*) has been commissioned by RPS to prepare a *Transport Assessment* for the Nimitz Street Overall Development Plan (*Nimitz Street ODP*) as shown in **Figure 1**.

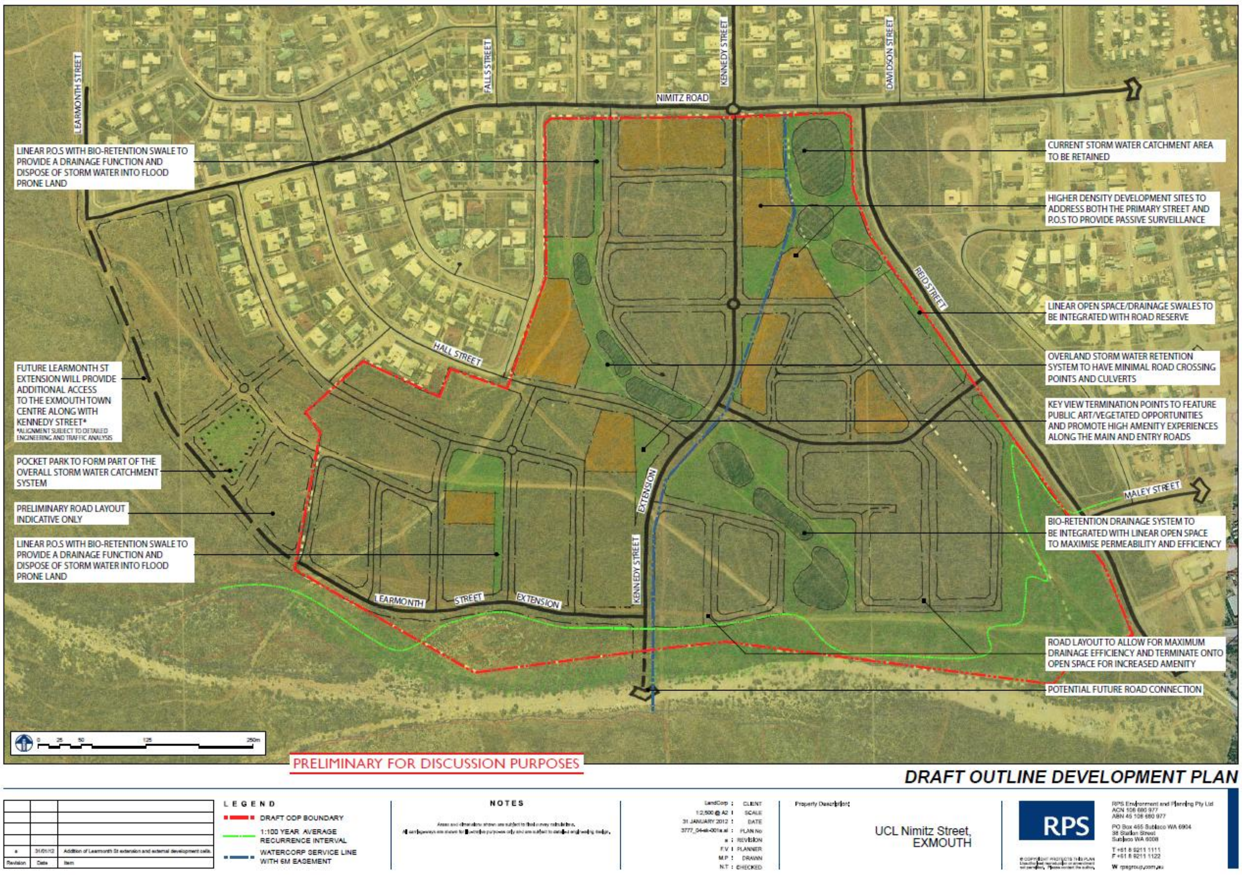


Figure 1 – Draft Overall Development Plan B – Nimitz Street, Exmouth

2.2 DESIGN PRINCIPLES AND INTENT

The development of the *Nimitz Street ODP* is specific to the needs of Exmouth and has been carried out in accordance with best practice sustainable planning principles and policies such as the Western Australian Planning Commission (*WAPC*) Document *Liveable Neighbourhoods* [1]. These principles are based on a process of creating a vibrant residential suburb south of Nimitz Street that will:

- Generate greater pedestrian activity.
- Provide flexibility through robust design.
- Provide greater diversity and choice of residential product.
- Encourage land uses which stimulate community and tourist activity.
- Provide further recreational opportunities for both long and short term residents.

The creation of integrated, highly connective, attractive and safe spaces for pedestrians, which respond to the local climate, have also been considered using the following urban design principles:

- Encouraging the upgrading of streets to serve as the primary pedestrian environment.
- Improving the amenity of streets for pedestrians, including provision of shading and shelter.
- Ensuring a highly connected and legible movement network to facilitate the most efficient and direct movement.
- Encouraging an active frontage to streets to maximise passive surveillance.
- Designing streets to ensure low speed environments for pedestrian safety.

3. EXISTING SITUATION

3.1 TRAFFIC VOLUMES AND STREET HIERARCHY

The Shire of Exmouth currently does not have a formal adopted road hierarchy in place. The Shire of Exmouth Policy 8.1 (Multi Use Paths within the Exmouth Town Site) defines the following roads as "Strategic Access Routes":

- Murat Road (Maidstone Crescent to Market Street);
- Nimitz Street;
- Maidstone Crescent;
- Krait Street;
- Kennedy Street; and
- Maddaffari Drive

Main Roads WA has a Functional Road Classification (Hierarchy) for all roads within the state that is available for viewing on its interactive mapping site at http://gis.mainroads.wa.gov.au/roadinformationmap/

The *Exmouth Townsite Structure Plan* (2) makes recommendations for future Neighbourhood Connector roads within the townsite as part of longer term development. Neighbourhood Connector roads are *Liveable Neighbourhood* (1) classifications, not MRWA classifications.

Liveable Neighbourhoods differs from the Main Roads WA Functional Classification in that route design considers character and land use integration as well as function.

In order to facilitate a logical assessment of existing and future streets it is necessary to adopt a road hierarchy that is consistent with the intended functions of the MRWA Road Hierarchy and the Liveable Neighbourhoods classifications, as used in the *Exmouth Townsite Structure Plan*.

Figure 2 on the following page has been prepared by *i3cWA* specifically for this purpose. It should not be seen as a formal road hierarchy for Exmouth. It is recommended that the development and adoption of a road hierarchy consistent with *Liveable Neighbourhoods* is undertaken by the Shire of Exmouth as soon as possible to assist with sustainable planning processes and procedures.

Traffic data for roads in the vicinity of the *Nimitz Street ODP* has been provided by the Shire of Exmouth and is shown as **Table 1**.

Metro Count Traffic Management Scheduler											
RSU # 1 (Serial No.Y468GWGZ)					PSL = Posted Speed Limit						
RSU # 2 (Serial No Y416QSSA)					RSU= Roadside Unit						
RSU	**Location**	**PSL**	**Start Date**	**Finish Date**	**Days**	**Total Hits**	**Daily Average**	**Weekly**	**Annually**	**AM Peak**	**PM Peak**
#1	Houston St	50	28/04/2008	6/05/2008	7	4720	674	4720	245440	9-11	3-5
#2	Grey St	50	28/04/2008	6/05/2008	7	247	35	247	12844	9-10	4-5
#1	Stewart St	50	7/05/2008	15/05/2008	7	546	78	546	28392	10-11	5-6
Estimate	Keillor St	50									
#2	Sargent St	50	7/05/2008	15/05/2008	7	1067	152	1067	55484	10-11	3-5
#2	Ried Street	60	15/05/2008	3/06/2008	20	12797	640	4479	232905	8-10	3-4
Estimate	Farley St	50									
#1	Eurayle St	50	15/05/2008	4/06/2008	21	1868	89	623	32379	10-11	3-5
#1	Carter St	50	5/06/2008	16/06/2008	11	1652	150	1051	54666	10-11	2-4
#2	Fitzharding St	50	5/06/2008	16/06/2008	11	1736	158	1105	57446	8-10	3-5
#1	Yardie Road	110	27/06/2008	20/06/2008	23	30414	1322	9256	481335	10-11	3-5
#1	CKR	80	17/06/2008	26/06/2008	10	573	57	401	20857	10-11	3-4
#2	Murat Road	60	27/06/2008	20/06/2008	23	73195	3182	22277	1158390	10-11	3-5
#2	Mildura Wreck Rd	80	17/06/2008	26/06/2008	10	2931	293	2052	106688	10-12	3-5

Table 1 – Shire of Exmouth Traffic Count Data

In order to obtain an understanding of the key roads and intersections for assessment, *i3cWA* undertook one hour turning movement/ volume/ pedestrian/ cyclists/ heavy vehicle surveys at the following seven intersections for the morning weekday peak hour and afternoon weekday peak hour:

1. Nimitz Street/ Kennedy Street;
2. Reid Street/ Nimitz Street;
3. Nimitz Street/ Murat Road;
4. Murat Road/ Reid Street;
5. Reid Street/ Welch Street;
6. Reid Street/ Maley Street; and
7. Reid Street/ Griffiths Way.

The location of these intersections with respect to the *Nimitz Street ODP* is shown in **Figure 3** on page 11. AM and PM weekday peak hour volumes on the adjacent road network are shown as **Figure 4** and **Figure 5** respectively on page 11. Detailed turning volumes, including pedestrian and cyclists movements for each intersection are included as **Appendix A**.

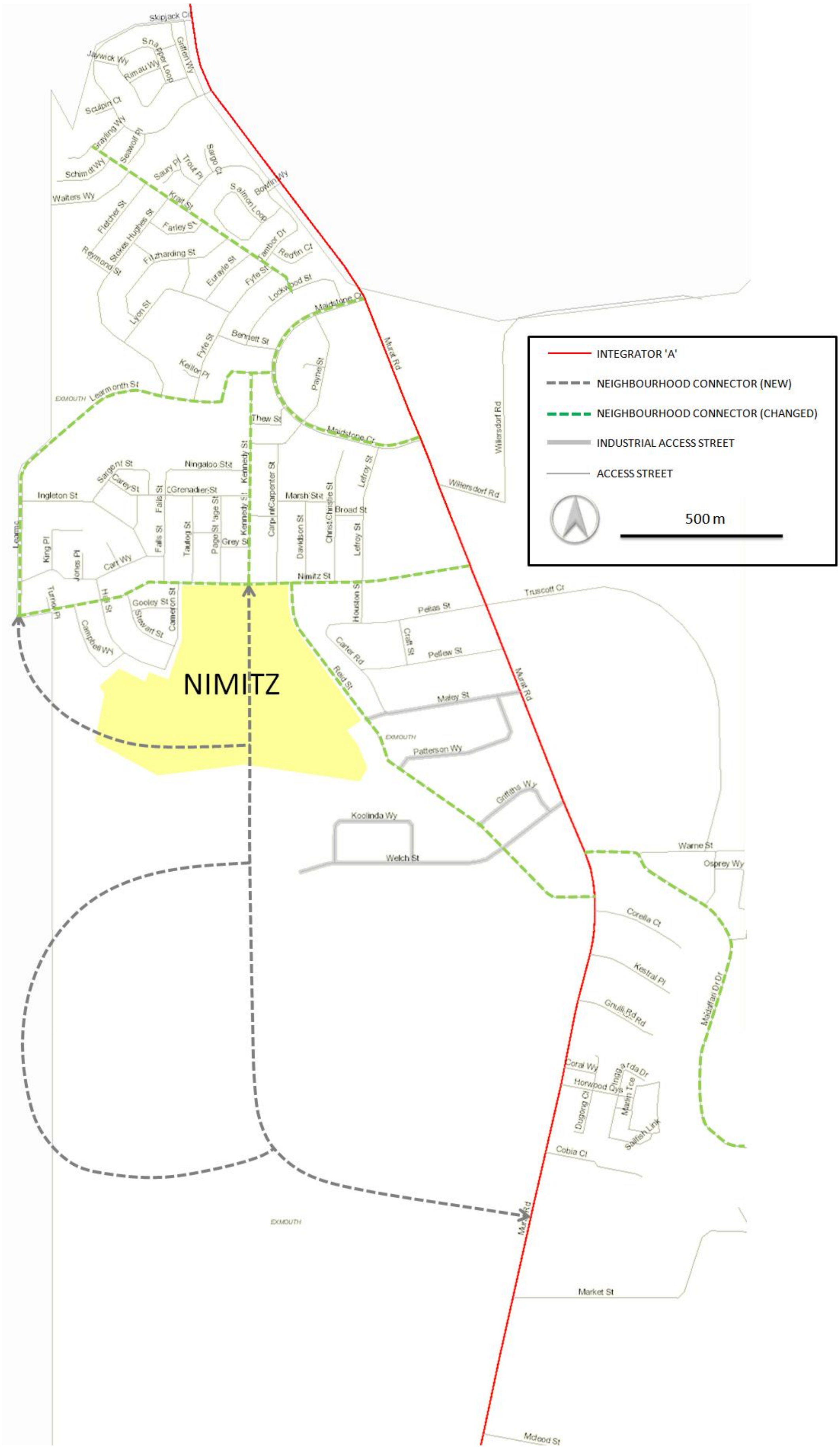


Figure 2 – Road Hierarchy adopted for use with this Traffic Study

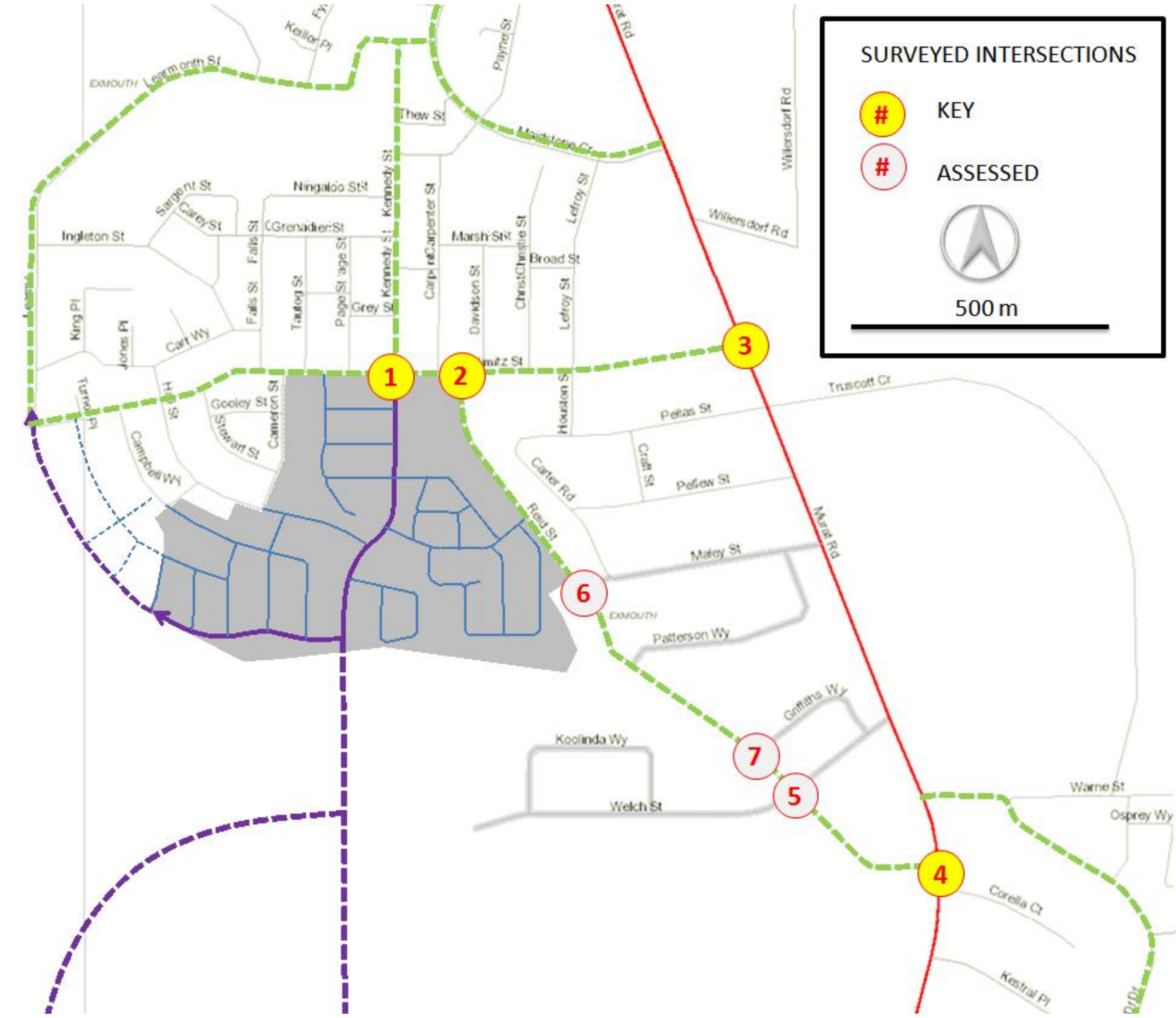


Figure 3 – Key and Assessed Intersections for the *Nimitz Street ODP*

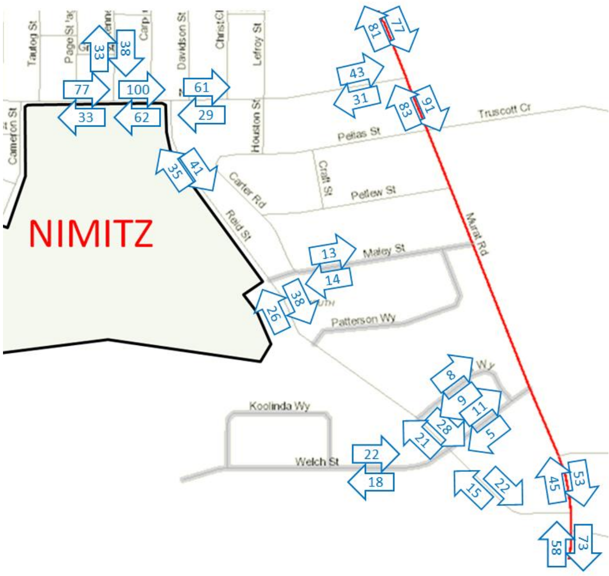


Figure 4 – Surveyed AM Peak Hour Volumes Dec 2011

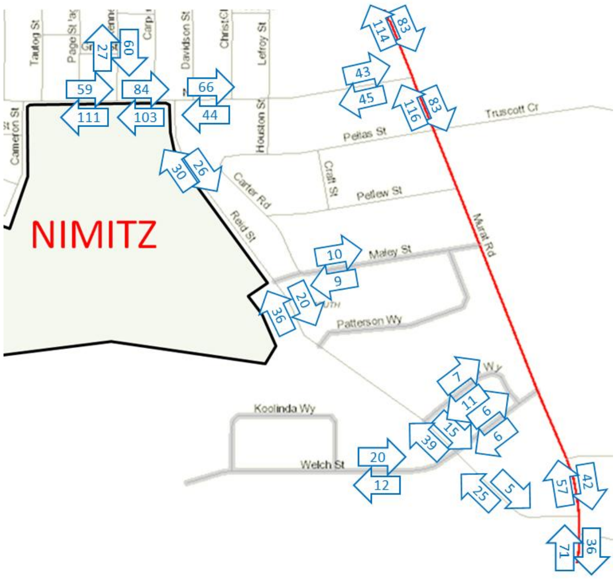


Figure 5 – Surveyed PM Peak Hour Volumes Dec 2011

The volumes in **Figure 4** and **Figure 5** are observed volumes in December during the school holidays just prior to the Christmas/ New Year break. They require adjusting to reflect Annual Average volumes.

All public roads within the Exmouth Townsite come under the care and control of the Shire of Exmouth. Main Roads WA has care and control of the Minilya Exmouth Road south of Preston Street which is approximately 3 km south of Reid Street. This road leads into Murat Road.

Main Roads WA has undertaken traffic counts on the Minilya Exmouth Road north of Burkett Road and South of Shothole Canyon Road. The Average Daily Weekday Traffic Volumes at these two locations are shown in **Table 2**.

	2005/2006		2007/2008		2008/ 2009	
	Daily Volume	% Heavy Vehicles	Daily Volume	% Heavy Vehicles	Daily Volume	% Heavy Vehicles
North of Burkett Road					420	14.4
South of Shothole Canyon Road	530	13.1	610	9.9		

Table 2 – MRWA Average Weekday Volumes and %HV Data in vicinity of Exmouth [3]

Peak Hour volumes are typically 10% of daily volumes. An estimation of the daily flows based on 10% of the maximum observed peak hour flows is shown as **Figure 6**.

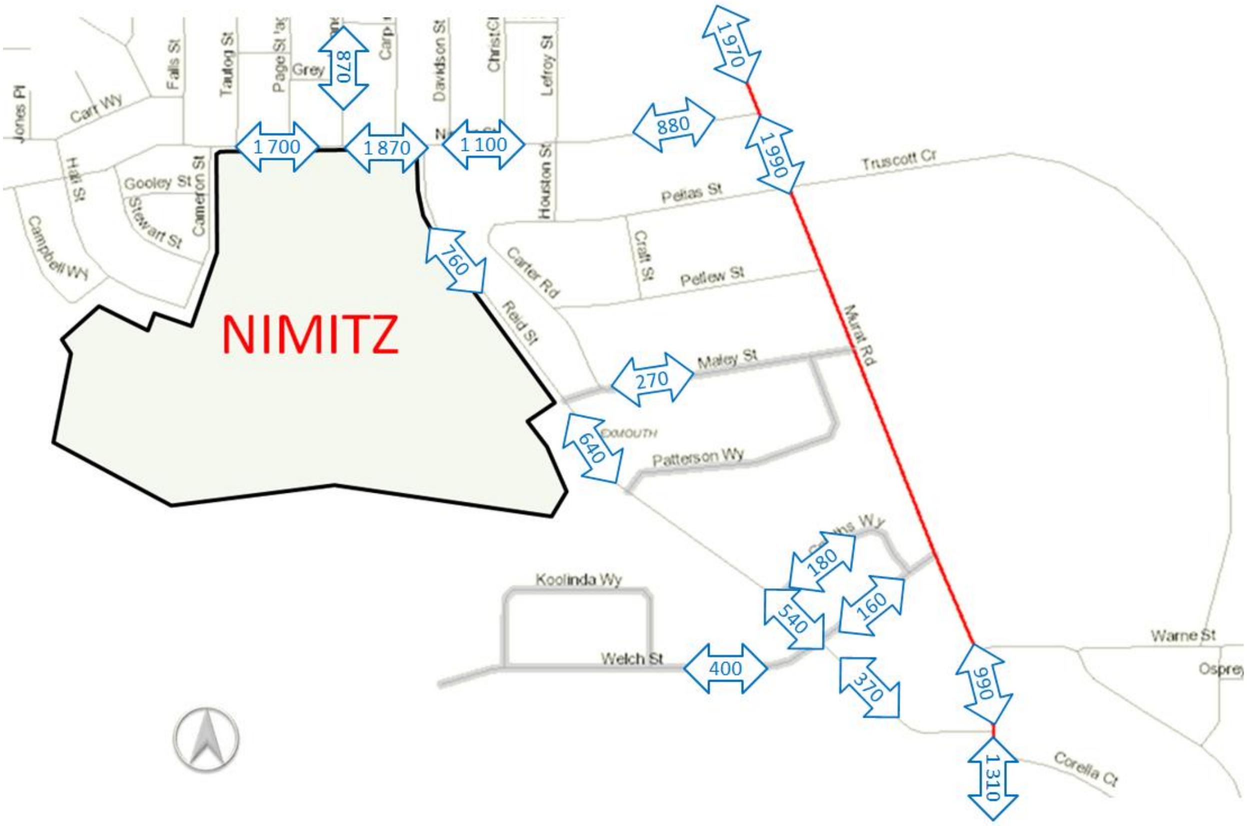


Figure 6 – Estimated Weekday Traffic Volumes (Dec 2011) based on 10% of maximum observed peak hour volume

Table 3 sets out typical mid-block capacities for various types of urban roads with interrupted flow, with unflared major intersections and with interruptions from cross and turning traffic at minor intersections. When improvements to isolated intersections are being considered, but without any change to upstream conditions, the figures in **Table 3** can be taken as limiting values. Peak period mid-block traffic volumes may increase to 1,200 to 1,400 vehicles per lane per hour on any approach road when the following conditions exist or can be implemented:

- Adequate flaring at major upstream intersections.
- Uninterrupted flow from a wider carriageway upstream of an intersection approach and flowing at capacity.
- Control or absence of crossing or entering traffic at minor intersections by major road priority controls.
- Control or absence of parking.
- Control or absence of right turns by banning turning at difficult intersections.

Type of Road	One-way mid block capacity per lane per hour
Median or inner lane	
- divided road	1,000
- undivided road	900
Outer or kerb lane	
- adjacent parking lane	900
- clearway conditions	900
- occasional parked vehicles	600

Table 3 – Typical mid-block Capacities for Urban Roads with Interrupted Flow (Based on Table 7.1 *GTEP2* [4])

An assessment of surveyed mid-block peak hour volumes with **Table 3** is provided as **Table 4**.

	LN [1] Classification	Layout	One-way mid block capacity per lane per hour	Current maximum one-way mid block volume per hour	% Capacity Used
Nimitz Street	Access	2 lanes undivided	600 (occasional parked vehicles)	100	17%
Reid Street	Access	2 lanes undivided	900	41	5%
Kennedy Street	Access	2 lanes undivided	600 (occasional parked vehicles)	46	8%
Murat Road	Integrator 'A'	2 lanes divided	1,000	116	12%
Maley Street	Industrial Access	2 lanes undivided	600 (occasional parked vehicles)	14	2%

Table 4 – Assessment of Existing mid-block capacity of streets in vicinity of the *Nimitz Street ODP* area

Table 4 indicates that all of the existing streets in the vicinity of the *Nimitz Street ODP* area are operating well within capacity and that they are all currently underutilised (i.e. they have been provided to accommodate future growth).

It should be noted that the capacity of the roads in **Table 4** are also affected by intersection performance. There is little use in providing a high capacity road layout if there are a number of intersections that are unable to satisfactorily operate with these volumes. Accordingly, this section should be considered in the context of **Section 3.6** (Current intersection performance).

3.2 CONNECTIVITY OF STREET SYSTEM

The connectivity of the street system in the vicinity of the *Nimitz Street ODP* area is good with regular intersections at intervals of approximately 100 m along Nimitz Road. There are also three direct connections between Reid Street and Murat Road, the main Integrator (Arterial) road, via Nimitz Street, Maley Street and Welch Street as well as Reid Street itself. These connections are approximately 500 m apart.

3.3 CONNECTIVITY OF THE STREET SYSTEM WITH ACTIVITY NODES

There is a 'disconnect' between the main Integrator (Arterial) Road (Murat Road) and the Town Centre. At present Murat Road tends to lead unfamiliar motorists past the turn off (Maidstone Crescent) to the town centre, which is located in an area approximately 300 m west of Murat Road (refer **Photograph 1**). The Shire of Exmouth is currently investigating ways of addressing this through the Town Centre Plan and recommendations within the Exmouth Townsite Structure Plan. This includes 'reclassifying' Kennedy Street as a Neighbourhood Connector Road and extending this through the *Nimitz Street ODP* area to connect to Murat Road south of the Marina Precinct. This will provide a more direct route to the Town Centre for local traffic. Tourist traffic is expected to continue to access the Town Centre via Murat Road.

As well as serving as the main road between Coral Bay, Learmonth Airport and many tourist destinations around the Exmouth Peninsula, Murat Road within the Exmouth Townsite provides access to the Exmouth Visitor Centre, Recreation Facilities (Kooborooo/ Talanjee) and Exmouth Marina. The location of these Activity Nodes in relation to the existing road network is shown in **Figure 7** on the following page.

Photograph 1 – Example of Murat Road 'bypassing' the Town Centre – turn off is on left past Caltex SS

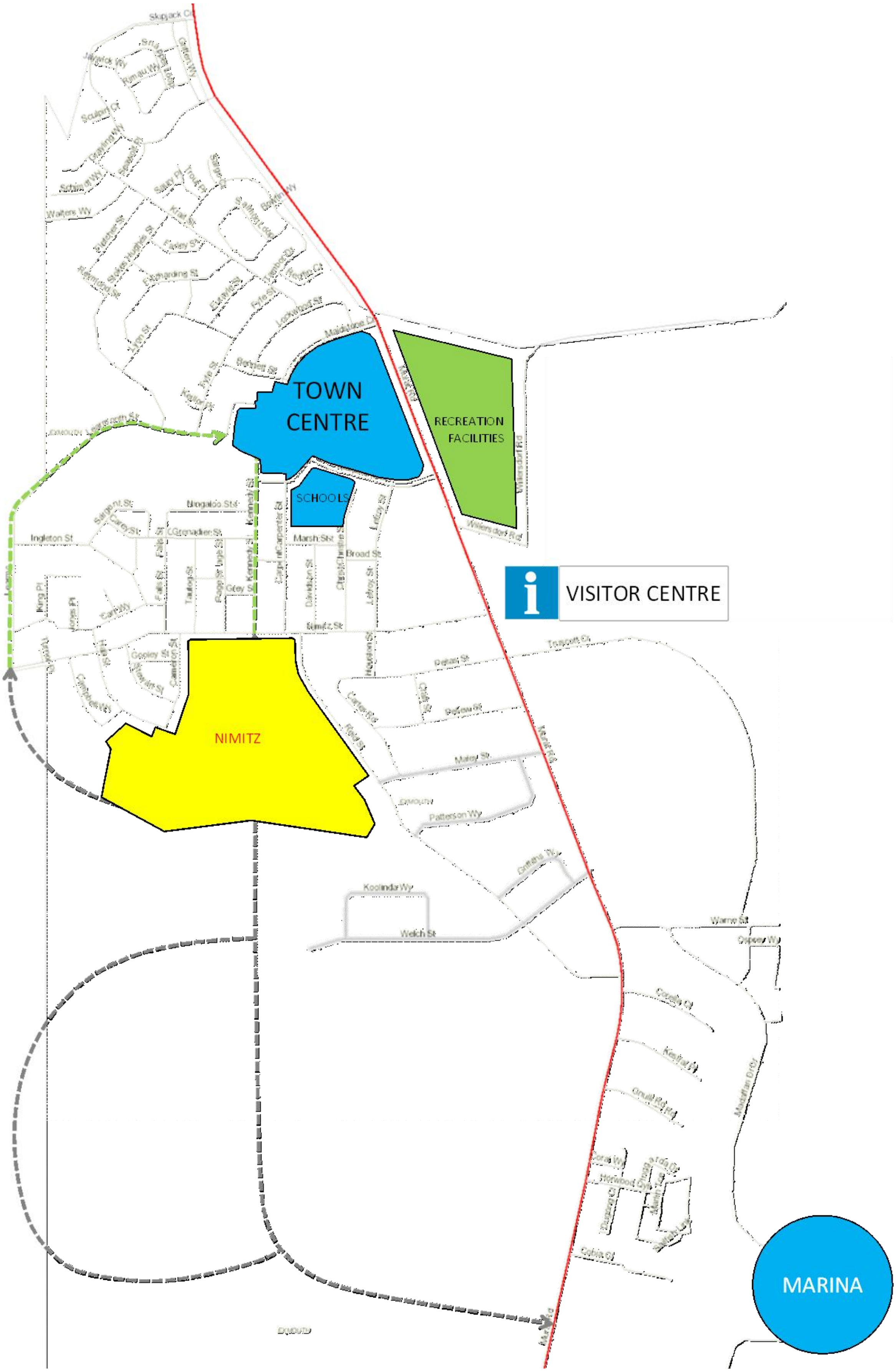


Figure 7 – Activity Nodes in relation to the *Nimitz Street ODP* Area, Existing & Proposed road network

3.4 STREET CROSS-SECTIONS

3.4.1 Nimitz Street

Nimitz Street is a 20.12 m wide road reserve. It generally consists of a 6 m wide carriageway with a kerb and 2.0 m wide path on the north side and unkerbed verge on the south side. There are overhead electricity services on both sides with steel posts at off-sets of approximately 3 m. Street lighting is provided off the electricity posts on the south side. An example of the layout is provided in **Photograph 2**.

Photograph 2 – Nimitz Street, looking west towards Kennedy Street

3.4.2 Reid Street

Reid Street is a 20.12 m wide road reserve. It generally consists of a 6 m wide carriageway with unkerbed verges on both sides. There is an overhead electricity service on the east side with steel posts at an off-set of approximately 3 m. No street lighting is provided. An example of the layout is provided in **Photograph 3**. Note: There is a current proposal to realign and raise Reid Street between Maley Street and Griffiths Way. This has no material effect on the transport elements within this report but it does improve the potential safety performance of this road as well as protecting it from inundation during certain flooding events.

Photograph 3 – Reid Street, looking south from Nimitz Street

3.4.3 Kennedy Street

Kennedy Street is a 20.12 m wide road reserve. It generally consists of a 6 m wide carriageway with a kerb and 2.0 m wide path on the west side and kerbed verge on the east side. There is an overhead electricity service on the east side with steel posts at an off-set of approximately 3 m. Street lighting is provided off the electricity posts. An example of the layout is provided in **Photograph 4**.

Photograph 4 – Kennedy Street, looking north from Nimitz Street

3.4.4 Murat Road

Murat Road is located within a 20.12 to 36 m wide road reserve depending on its location. It generally consists of a 3 m wide median with a single 5 m wide lane in each direction. The median consist of kerbed islands at regular intervals and includes landscaping and street lighting columns. Verges on both sides are unkerbed and form part of a drainage swale. A footpath is located on the west side approximately 10 m from the edge of the sealed carriageway. An example of the layout is provided in **Photograph 5**.

Photograph 5 – Murat Road, looking north towards Maley Street

3.5 TRAFFIC MANAGEMENT

Existing traffic management features such as intersection control, speed limits, warning and information signs shown schematically in **Figure 8**.

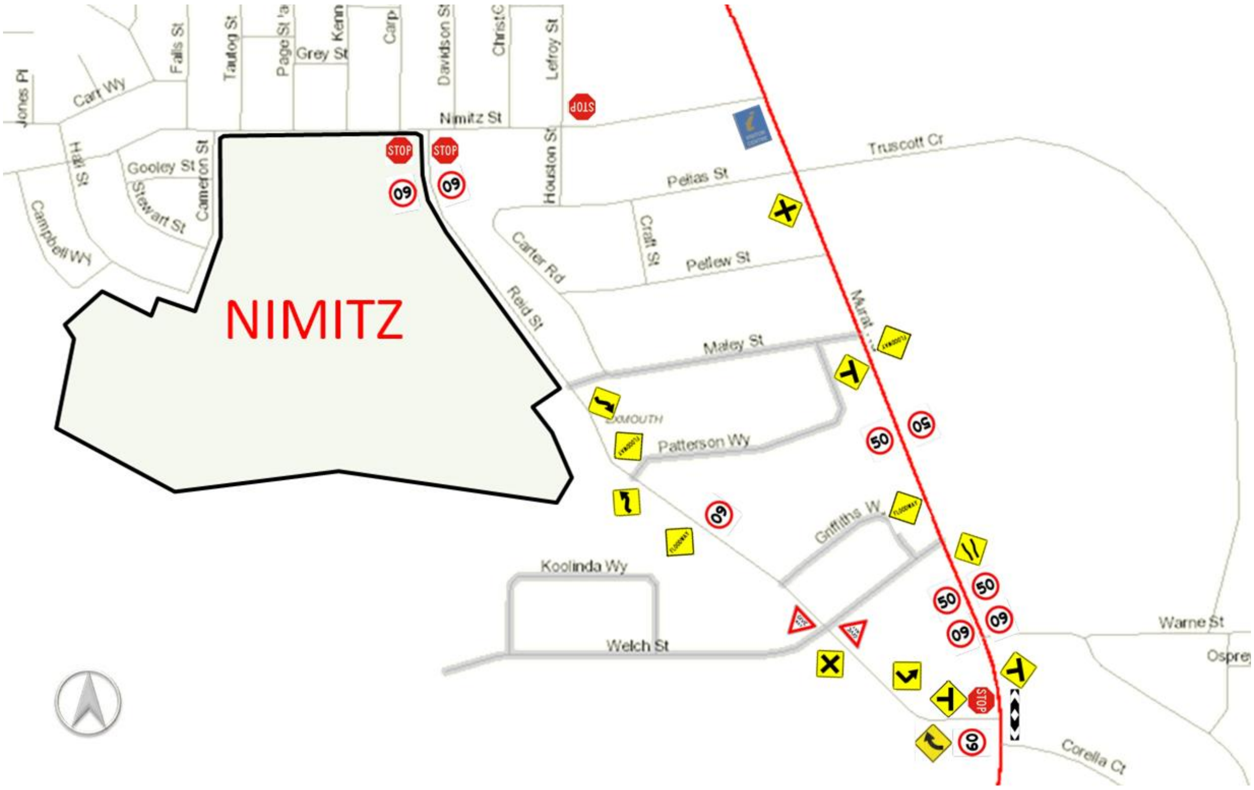


Figure 8 – Existing Traffic Management Devices in the vicinity of the *Nimitz Street ODP* Area

3.6 CURRENT INTERSECTION PERFORMANCE

Key intersections were surveyed during the morning and afternoon weekday peak hours, as per the data provided at **Appendix A**.

This weekday peak hour survey data was used to create calibrated *SIDRA Intersection* [5] models to enable an assessment to be made of current performance and future performance. An analysis and summary of existing intersection performance is provided in the following sections.

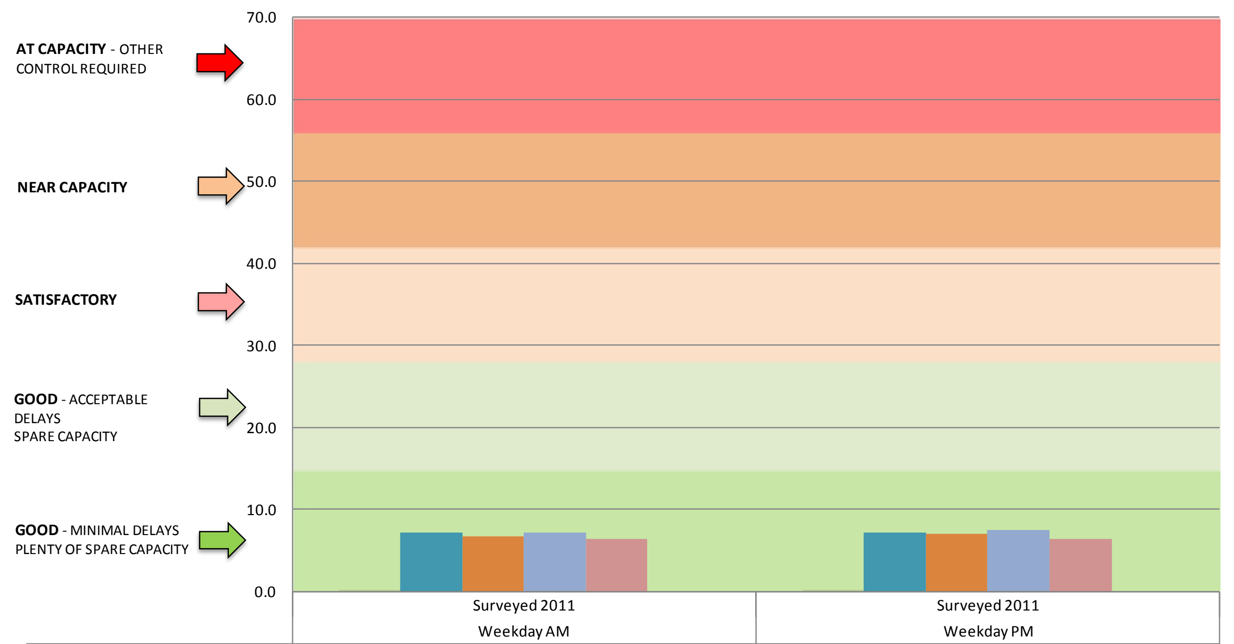
Intersection performance threshold criteria are provided in **Table 5**.

Level of Service (LoS)	Average Delay per Vehicle (secs/veh)	Traffic signals & Roundabouts	Give Way & Stop Signs
A	<14	Good operation.	Good operation.
B	15 TO 28	Good with acceptable delays and spare capacity.	Acceptable delays & spare capacity.
C	29 – 42	Satisfactory.	Satisfactory, but crash study required.
D	43 – 56	Operating near capacity.	Near capacity and crash study required.
E	57 - 70	At capacity; at signals incidents will cause excessive delays. Roundabouts require other control measure.	At capacity. Requires other control mode.

Table 5 - Level of service criteria for intersections (source Table 4.2 [6])

3.6.1 Nimitz Street/ Kennedy Street intersection performance

This default Give Way controlled T intersection currently performs well within capacity. No queues were noted on any approach during the morning and afternoon peak hours. An assessment of current Average Delays (the best performance indicator at this type of intersection) against performance criteria thresholds is provided in **Figure 9.**

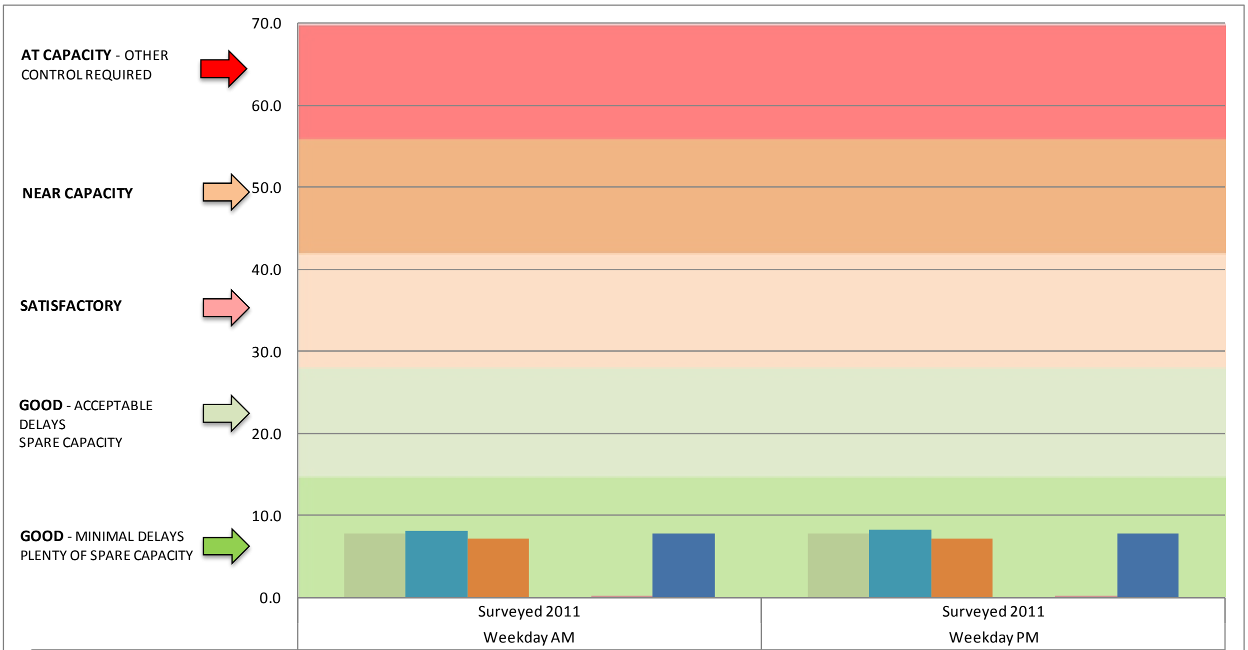


	Surveyed 2011 Weekday AM	Surveyed 2011 Weekday PM
Nimitz westbound straight through	0.2	0.2
Nimitz right into Kennedy	7.1	7.1
Kennedy left into Nimitz	6.7	7.0
Kennedy right into Nimitz	7.2	7.5
Nimitz left into Kennedy	6.4	6.4
Nimitz eastbound straight through	0.0	0.0

Figure 9 – Nimitz Street/ Kennedy Street – Current Average Delays

3.6.2 Nimitz Street/ Reid Street intersection performance

This STOP controlled T intersection currently performs well within capacity. No queues in excess of two vehicles were noted on any approach during the morning and afternoon peak hours. An assessment of current Average Delays (the best performance indicator at this type of intersection) along with performance criteria thresholds is provided in **Figure 10.**

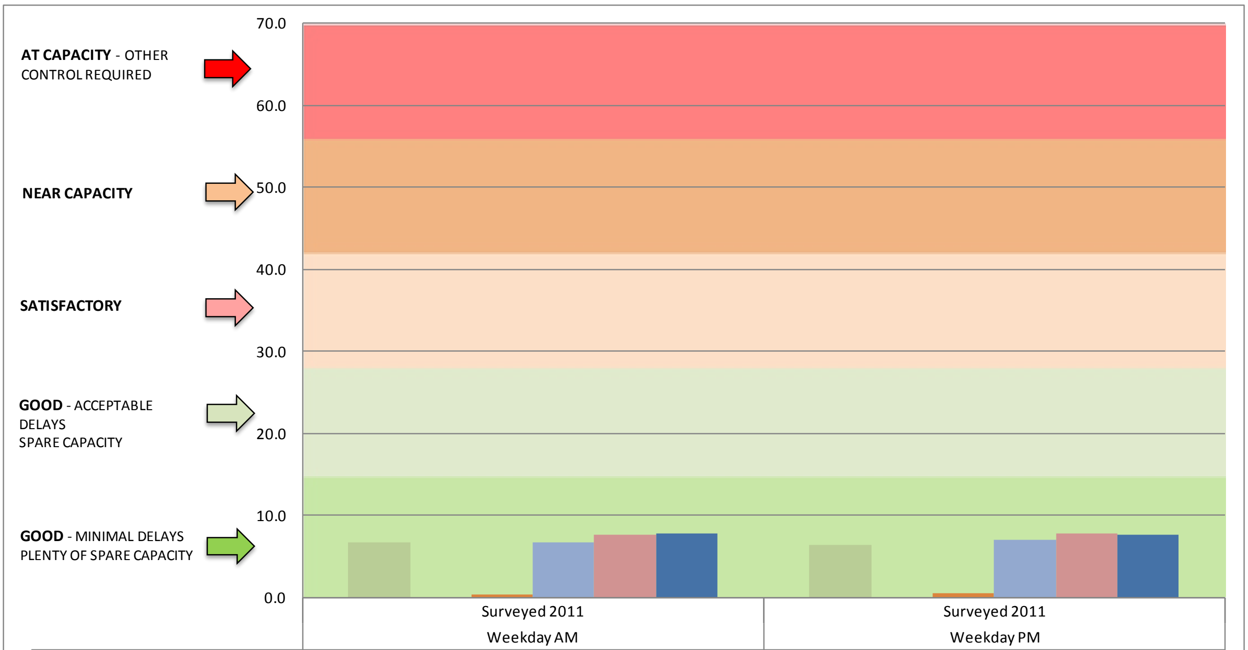


	Surveyed 2011 Weekday AM	Surveyed 2011 Weekday PM
Reid left into Nimitz	7.7	7.8
Reid right into Nimitz	8.1	8.3
Nimitz left into Reid	7.2	7.2
Nimitz westbound straight through	0.0	0.0
Nimitz eastbound straight through	0.1	0.1
Nimitz right into Reid	7.7	7.8

Figure 10 – Nimitz Street/ Reid Street – Current Average Delays

3.6.3 Nimitz Street/ Murat Road intersection performance

This STOP controlled T intersection currently performs well within capacity. No queues in excess of two vehicles were noted on any approach during the morning and afternoon peak hours. An assessment of current Average Delays (the best performance indicator at this type of intersection) against performance criteria thresholds is provided in **Figure 11.**

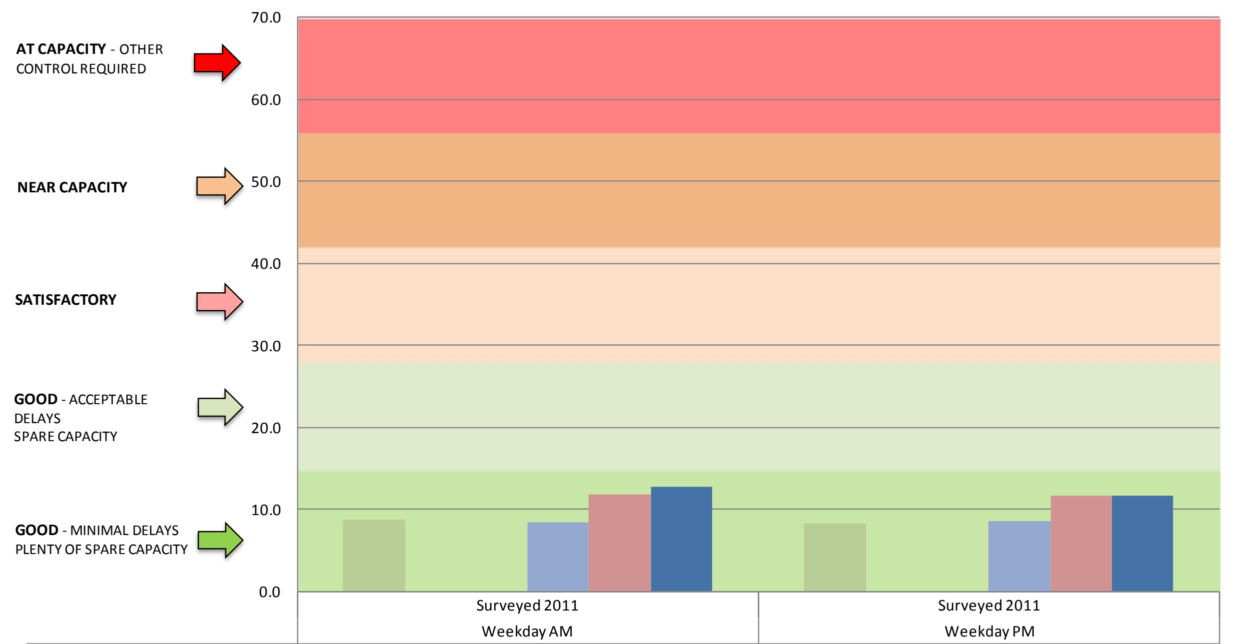


	Surveyed 2011 Weekday AM	Surveyed 2011 Weekday PM
Murat left into Nimitz	6.7	6.4
Murat northbound straight through	0.0	0.0
Murat southbound straight through	0.3	0.5
Murat right into Nimitz	6.7	7.0
Nimitz left into Murat	7.6	7.7
Nimitz right into Murat	7.7	7.6

Figure 11 – Nimitz Street/ Murat Road – Current Average Delays

3.6.4 Reid Street/ Murat Road intersection performance

This default Give Way controlled T intersection currently performs well within capacity. No queues were noted on any approach during the morning and afternoon peak hours. An assessment of current Average Delays (the best performance indicator at this type of intersection) against performance criteria thresholds is provided in **Figure 12.**



	Surveyed 2011 Weekday AM	Surveyed 2011 Weekday PM
Murat left into Reid	8.7	8.2
Murat northbound straight through	0.0	0.0
Murat southbound straight through	0.0	0.0
Murat right into Reid	8.4	8.5
Reid left into Murat	11.8	11.6
Reid right into Murat	12.7	11.6

Figure 12 – Reid Street/ Murat Road – Current Average Delays

3.7 PUBLIC TRANSPORT

There are no public transport facilities or services within the Exmouth townsite.

Several hotels/ motels and tour operators pick up customers from the airport and take them to their respective accommodation or tourist destinations.

Research has not revealed any plans for public transport services to be introduced.

3.8 PEDESTRIANS AND CYCLISTS

The Shire of Exmouth has prepared a “Trails and Pathways Plan” for Exmouth. This is reproduced as **Figure 13** on the following page.

The majority of residential roads have paths on at least one side and provide good connective pedestrian links to facilities through to the town centre.

The survey data included in **Appendix A** indicates that there are limited cycle and pedestrian movements during the peak hours. The main pedestrian movement is north-south along the west side of Murat Road.

TRAILS AND PATHWAYS PLAN - EXMOUTH

Streets
Bennett St G5
Bonefish St G7
Bowfin Wy G3
Broad St H8
Cameron St F9
Campbell Wy E9
Carey St E7
Carpenter St G8
Carr Wy D9
Carter Rd H10
Chanticleer St G12
Christie St H8
Craft St J9
Crane St J12
Davidson St H8
Donnelly St N13
Eurayle St F4
Falls St F8
Farley St F4
Fitzhardinge St E4
Fletcher St E4
Friedman Wy P14
Fyfe St F6
Golstar Lp H13
Gooley St F9
Grayling Wy E2
Grenadier St F7
Grey St G8
Griffin Wy F1
Griffiths Wy K12
Hall St E9
Horwood Qy M13
Huston St H9
Ingleton St D8
Jones Pl E8
Keillor Pl F6
Kennedy St G8
King Pl D8
Klein St F8
Koolinda Wy H12
Krait St E3
Learmonth St D9
Leeuwin St G12
Lefroy St H8
Lockwood St G5
Lonsdale St G12
Lyon St E5
Maidstone Cr G6
McLeod St M13
Maley St J10
Market St M13
Marsh St H7
Murat Rd F1
Nimitz St E9
Ningaloo St F7
Page St G8
Patterson Wy J11
Payne St H6
Pelias St J9
Pellew St J10
Potshot St F4
Redfin Ct G4
Reid St G9
Reymond St E4
Riggs St H6
Ross St G6
Rule St E4
Salmon Lp G3
Sargent St E7
Sargo Ct F3
Saury Pl F3
Schmidt Wy E3
Sculpin Ct E2
Seawolf Pl E3
Skipjack Cir E2
Snapper Lp E2
Stewart St E9
Stokes-Hughes St E5
Tambor Dr F3
Tautog St F8
Thew St G6
Tonge Pl E8
Trout Pl F3
Truscott Cr L9
Turner St D9
Walters Wy E3
Warne St M12
Warren Wy E3
Welch St G13
Willersdorf Rd K7
Yardie St G8
ZZ12LL

Accommodation
Exmouth Cape Tourist Village Caravan Park L9
Ningaloo Caravan & Holiday Resort J8
Potshot Resort Hotel H5

Tourism Guide
Airstrip M14
Brand Park H5
Council Office G5
Golf Course L6
Hospital F5
Information Bay L12
Information Centre K8
Kart Club M13
Kooboorоo Oval J6
Lighthouse G1
Lookout H1
Milyering Visitors Centre G2
Niblett Oval K8
Pony Club N11
Post Office G5
Racecourse M13
Swimming Pool H6
Talanjee Oval K7
Time Capsule H7
Truscott Memorial Club H6
Yacht Club P14
ZZ12LL

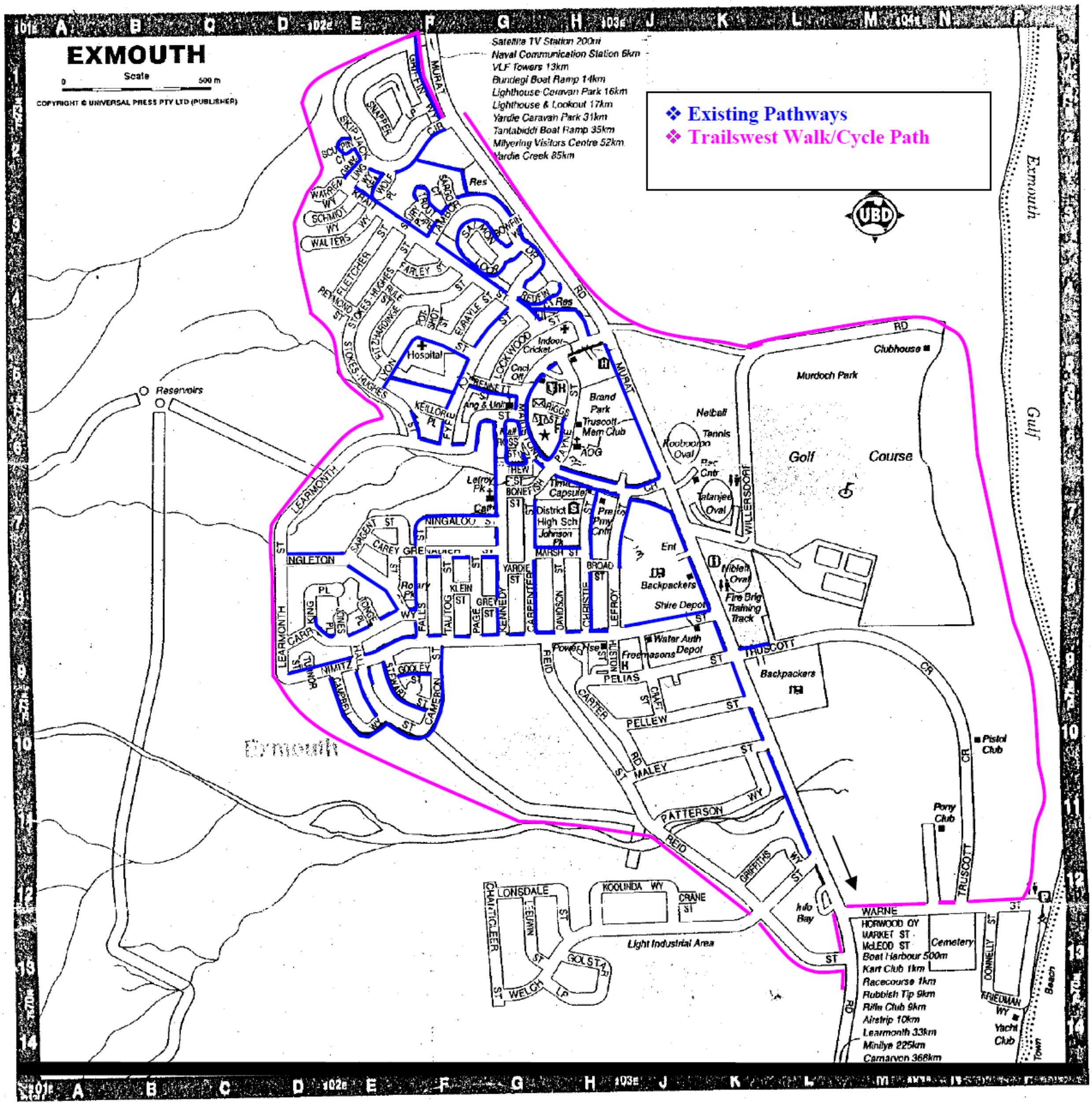


Figure 13 – Exmouth Trails and Pathway Plan

3.9 SUMMARY OF KEY ISSUES (EXISTING SITUATION)

This assessment of existing transport issues has determined that:

- The Shire of Exmouth currently does not have a formal adopted road hierarchy in place. It is recommended that the development and adoption of a road hierarchy consistent with *Liveable Neighbourhoods* is undertaken by the Shire of Exmouth as soon as possible to assist with sustainable planning processes and procedures.
- There is plenty of mid-block capacity on all of the assessed roads with current usage between 2% and 17% of capacity;
- There is plenty of spare capacity within all of the assessed intersections with all intersections formally assessed as “Good with minimal delays and plenty of spare capacity”;
- There is a ‘disconnect’ between the main Integrator (Arterial) Road (Murat Road) and the Town Centre. At present Murat Road tends to lead unfamiliar motorists past the turn off to the town centre (Maidstone Crescent). The Shire of Exmouth is currently investigating ways of addressing this through the Town Centre Plan and recommendations within the Exmouth Townsite Structure Plan. This includes ‘reclassifying’ Kennedy Street as a Neighbourhood Connector Road and extending this through the *Nimitz Street ODP* area to connect to Murat Road south of the Marina Precinct. This will provide a more direct route to the Town Centre for local traffic. Tourist traffic is expected to continue to access the Town Centre via Murat Road.
- There are no public transport facilities or services within the Exmouth townsite and no plans to provide these.
- The majority of residential roads have paths on at least one side and provide good connective pedestrian links to facilities through to the town centre.

3.10 OPPORTUNITIES FOR GUIDANCE OF *NIMITZ STREET ODP*

The *Nimitz Street ODP* should aim to address the issues raised by providing a clear route and street network based on function, traffic volumes and vehicle speeds.

From a Neighbourhood Connector perspective, this is best achieved by providing Neighbourhood Connector routes generally in accordance with Figure 12 (Development Imitative 4) in the *Exmouth Townsite Structure Plan*, as shown in **Figure 2** on page 10.

In addition to this, provision should be made to retain the Trailswest Walk/ Cycle path through the *Nimitz Street ODP* site as indicated in **Figure 13** on the previous page.

4. *NIMITZ STREET ODP* ASSESSMENT

4.1 TRAFFIC VOLUMES AND STREET HIERARCHY

The classification of roads is necessary to provide a logical basis for the planning, design, operation and administration of roads and road systems. The term ‘Hierarchy’ is often used instead of classification to reflect the order of classifications between the lowest (local) and highest (Arterial).

The current road classification system used by Main Roads WA is a “Functional Classification”, i.e. roads are classified on the basis of the functions they serve, namely as arterial, sub-arterial, collector or Local. *Liveable Neighbourhoods* differs from the Functional Classification in that route design considers character and land use integration as well as function.

As indicated in **Section 2.2**, the *Nimitz Street ODP* has been prepared partly on the basis of the principles of *Liveable Neighbourhoods.* **Figure 14** on the following page shows the intended classification of roads in accordance with these principles. It is important to note that the nature and classification of arterial routes and local streets may change along their length in response to the varying urban contexts they pass through, while still maintaining appropriate safety standards and efficiency for adjacent development, vehicles and other street users.

The functions and characteristics of each class of route and street shown in **Figure 14** are provided in **Table 6** and **Table 7** on the pages following **Figure 14**.

An assessment of the mid-block capacity of the proposed roads, as well as connecting roads, is included in **Section 4.4.** This has been done to enable reference to be made to the proposed cross sections and the relevance of these to the *Liveable Neighbourhood* capacity thresholds.

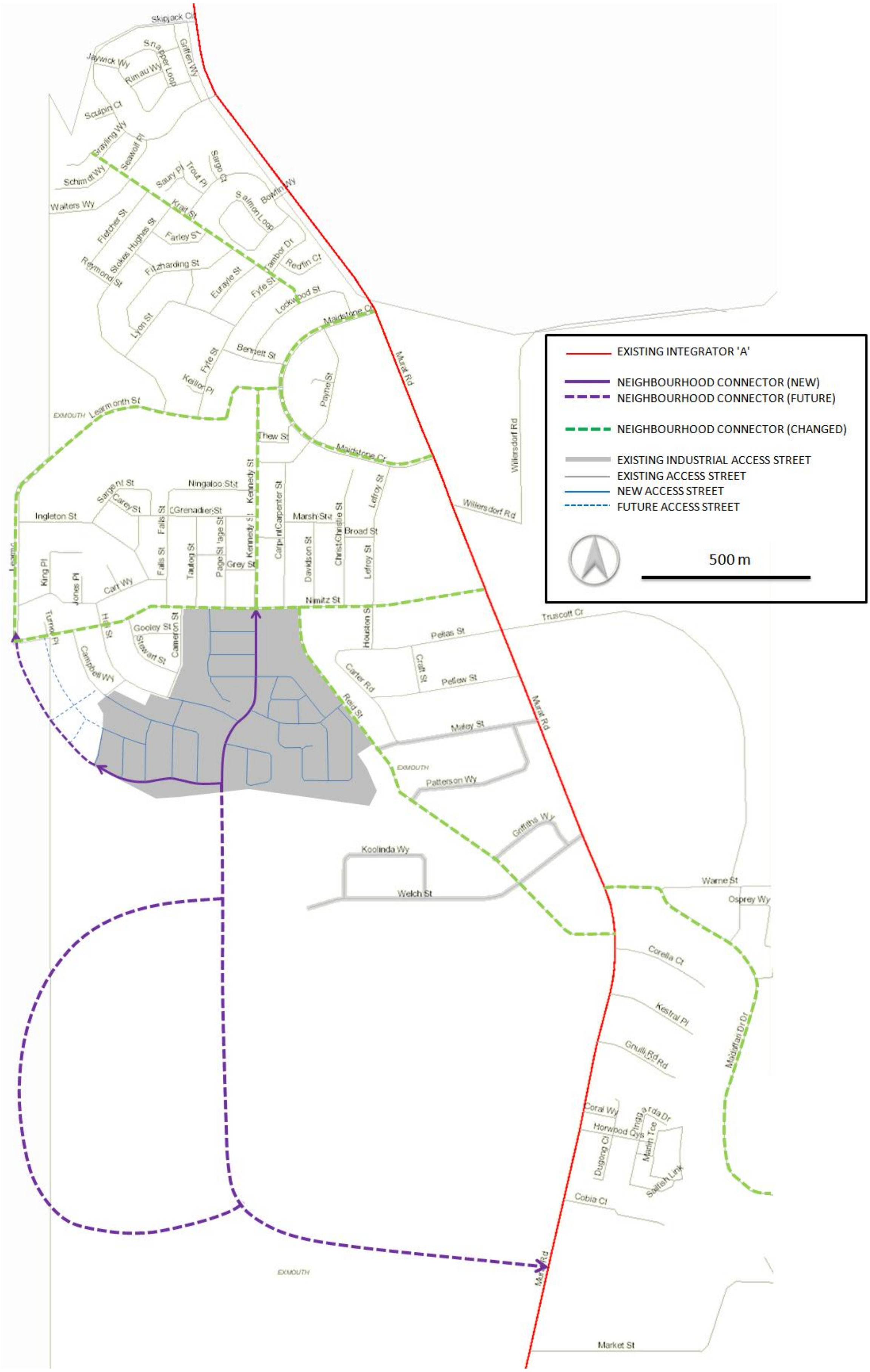


Figure 14 – Proposed Road Hierarchy

Route type and function	**Route characteristics**	**Route name**	**Max speed limit** (km/h)	**Indicative volume range*** (vehicles per day)	**Indicative street reserve width** (metres)**	**Indicative road pavement width** (metres)
Primary Distributors Cater for inter and intra-regional and form major truck routes.	Should be designed to be fronted by development and connected with service roads wherever possible, Usually median divided.	Six lane **Primary Distributor**	80	50,000	Determined by Main Roads WA.	
	Intersections limited and often traffic signal controlled.	Four lane **Primary Distributor**	80	35,000		
Integrator Arterials Form a finer grain of routes than the primary distributors, with frequent connections to local streets. Low percentage of trucks. Usually bus routes. On-street bike lanes and separate dual-use paths are usually required.	Four lane and two lane arterial road types. Integrators outside centres typically have service roads and development frontage to support a mix of uses.	Integrator A (Four lanes outside centres)	70 or 60	15,000 – 35,000	50.6 – 52.6	2 x 8.2 Including bike lane and 2 x 5.5 service roads with parking.
	Direct vehicle access from adjoining property should be limited where no service roads are provided. On-street parking desirable.	**Integrator A – centres** (Four lanes, in centres)	60	< 25,000	35.6	2 x 10.7 In centres Including combined on-street parking and bike lane.
	Integrators through centres typically will have at least one clear travel lane in each direction, and a parking and/ or manoeuvring lane. Volumes above 15,000 vpd need detailed design to manage traffic at intersections, facilitate bus movement and deal with parking access.	**Integrator B** (Two lanes, outside centres)	60	7,000 – 15,000	29.2	2 x 7.5 Including on-street parking and bike lane.
				15,000 – 20,000		2 x 7.5 Including bike lane. Parking requires special consideration on service roads may be needed.
		Integrator B - centres (Two lanes)	40 or 50	15,000	25.2	2 x 7.5 Including on-street parking

* All functions of streets need to be considered as well as traffic volume and through traffic needs.

** Refer to **Section 4.4** for indicative cross sections. Adequate reserves need to be provided to accommodate space for trees, varied service requirements, or wider shared path requirements, particularly where densities are at 15 dwellings per hectare or greater, and/ or mixed-use development is anticipated. Widening for intersections may also be required.

Table 6 – Function and characteristics of arterial routes (Source: Table 3 *Liveable Neighbourhoods*)

Street type and function	Street characteristics	Street name	Max speed/ target operating speed (km/h)	Indicative volume range* (vehicles per day)	Indicative street reserve width+ (metres)	Indicative road pavement width (metres)
Neighbourhood connectors Streets with mostly residential frontage that typically provide the lower order sub-arterial network. These streets service and link neighbourhoods and towns.	A two-lane divided street used for higher neighbourhood connector volumes, or for character, stormwater infiltration swales or safety. These are often special streets and their design needs to have particular regard to context, function and adjacent land uses.	**Neighbourhood connector A** (Median)	50 / 50	7,000	24.4**	2 x 7.1 Including parking, on-street bike lane, median plus shared path on one verge.
	A two-lane undivided street for lower volume neighbourhood connectors. Typically can accommodate buses, will have at least one shared path and above 3,000 vehicles per day separate on-street bike lane.	**Neighbourhood connector A** (Minor)	50 / 50	3,000	19.4	11.2 Including parking, plus shared path on one verge.
Access Streets Streets that accommodate shared pedestrian, bike and vehicular movements. The requirements of adjacent land uses should be supported through street design.	Varied formats to suit a range of typical conditions in predominantly residential areas at different densities and with different traffic volumes. An avenue access street (Access Street A) with median is particularly suited to incorporation of a drainage swale.	**Access street A** - Avenue	50 / 40	3,000	20.0 – 24.0	2 x 3.5 (or 2 x 3.6 under some conditions) plus indented parking)
	Access street B is a wider undivided street for situations with increased parking and/ or traffic demand.	**Access street B** – wider street	50 / 40	3,000	16.5 – 18.0	9.7

- - - table continued on next page - - -

Street type and function	Street characteristics	Street name	Max speed/ target operating speed (km/h)	Indicative volume range* (vehicles per day)	Indicative street reserve width⁺ (metres)	Indicative road pavement width (metres)
Access street (continued from previous page)	The most typical and common residential street will be Access street C – Yield street.	**Access street C** - Yield or Give Way street	50 / 40	3,000	15.4 – 16.0	7.2 (7.0-7.5)
	Access street D is for short, low volume and low parking demand streets. In addition, a comprehensively designed variant with 3.5 m travel lane with indented parking is also specified for very low volume short streets.	**Access Street D** - Narrow yield or Give Way street	50 / 30	1,000	14.2	5.5-6.0
			50 / 20	150	14.2	3.5 (plus parking indents)
Laneways Provide access to the side or rear of lots principally for access to garages.	Laneways may incorporate some services and can provide rubbish collection access. Laneways usually contain some studio units over garages for surveillance. Lane may be widened in parts to create mews courts.	**Laneway/ rear lane**	15	300	6.0** - 6.4	3.0-6.4 6.0** typical
Small Town Centre street Suited to small secondary streets in centres.	For use in predominantly pedestrian areas in centres (where the street is short and is specifically designed for pedestrian emphasis) and visual containment is required.	**Small town centre street**	50 / 20	300	10.0 – 12.0	5.5

* Function of streets needs to be considered as well as traffic volume and parking
⁺ Refer to **Section 4.4** for indicative cross sections. Verge widths may need to be increased if wider shared paths or trunk services are required. Verge widths on access streets abutting parks may be reduced from 4.1m to 1 m on the park side.
** Lesser reserve and road pavement widths may be applied over limited lengths where performance can be justified, such as at laneway entrances.

Table 7 – Function and characteristics of local streets (Source: Table 4 *Liveable Neighbourhoods*)

Traffic volumes for each street within the *Nimitz Street ODP* have been estimated based on the following:

- Adjusting the December 2011 survey data to Average Annual Weekday Traffic (*AAWT*) base data for 2011 by applying a seasonal variation factor of 1.2. (This factor was used to err on the side of caution in the absence of seasonal traffic data);
- Adopting an 'Assessment Year' of 2016 for full development and occupancy of the *Nimitz Street ODP* area;
- Adopting an 'Assessment Year' of 2030 for full development of the Neighbourhood Connector Roads through and around the *Nimitz Street ODP* area to take into account through traffic.
- Growing base 'through traffic' by 2% per annum for both Assessment Years;
- Using appropriate generic average daily trip rates for land use areas based on the land uses of 'Single Dwelling Residential' and 'Multiple Dwelling Residential' within zones bounded by Neighbourhood Connector Roads and connecting Access Streets; and
- Distributing through traffic according to current turning movement percentages where this is likely and according to the location of local generators and attractors where it isn't (refer **Figure 15** and **Figure 16** for graphical representation of current distribution).

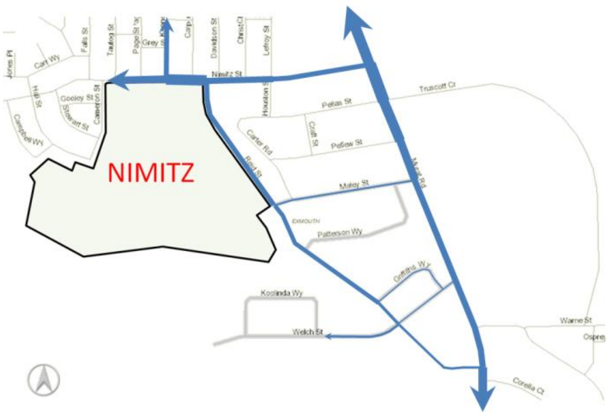


Figure 15 – Current AM Peak Hour Distribution

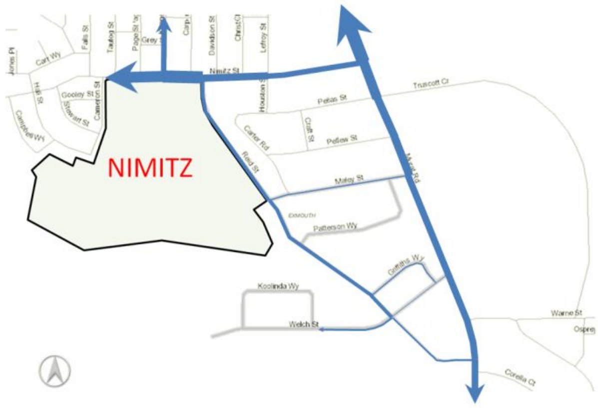


Figure 16 – Current AM Peak Hour Distribution

In order to assign generated trips to the road network it is necessary to divide the *Nimitz Street ODP* area into zones separated by Neighbourhood Connectors and connecting Access Streets. These are shown in **Figure 17** on the following page. It is also necessary to assign labels to each street to clearly show which streets have assigned trips. These labels should not be taken as ultimate road names as these will be determined by the Shire of Exmouth. The assigned street labels are shown in **Figure 18** on the following page.

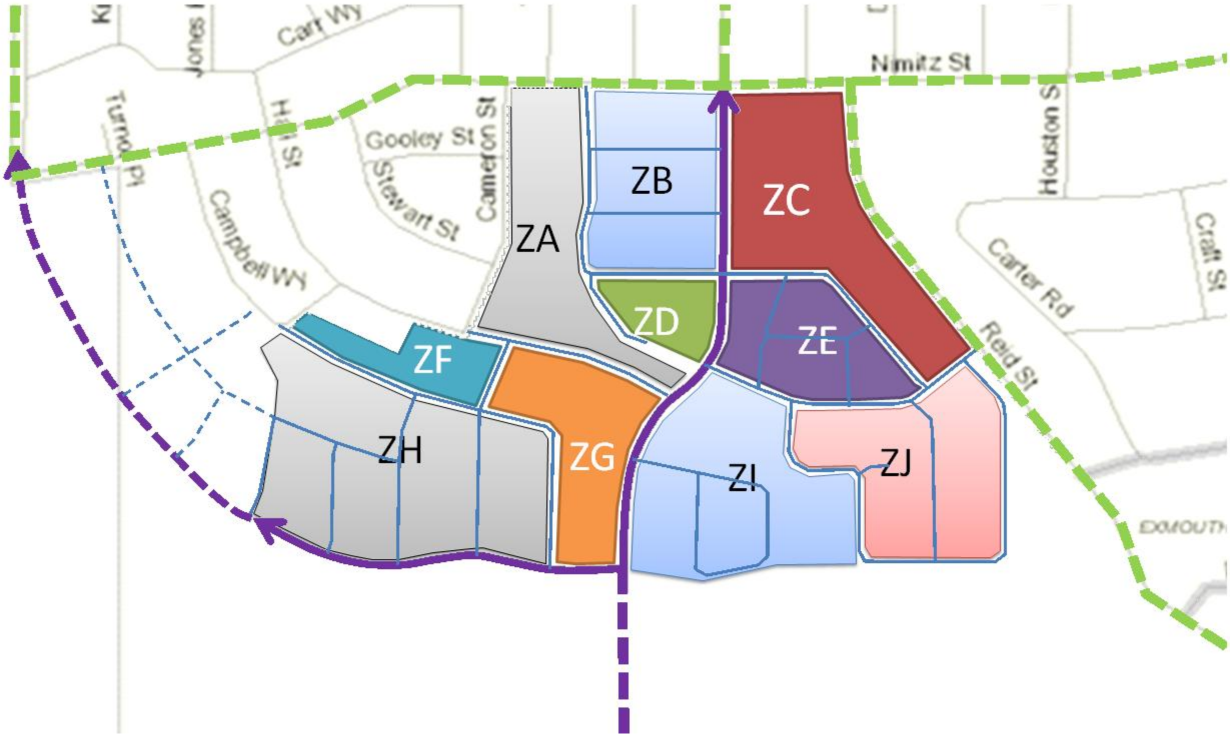


Figure 17 – Trip Generation Zones

Figure 18 – Street Labels (For Trip Generation Purposes Only)

An estimate of the number of additional trips likely to be generated by dwellings within the *Nimitz Street ODP* at time of full development and occupancy has been calculated as shown in **Table 8**. This table shows the number of 'Single Dwellings' (SD) and 'Multiple Dwellings' (MD) in each Zone, along with the relevant Daily Trip Generation Rate (DTGR) from the RTA document *Guide to Traffic Generating Developments* [(6)]. The following columns show the calculation of Daily Trips for each type of dwelling and the estimated AM and PM Peak Hour volumes (based on 10% of the Daily Volume) as well as the split between arrivals (IN) and departures (OUT).

Zone	SD	MD	SD DTGR	MD DTGR	SD Daily Trips	MD Daily Trips	Total Daily Trips	AM Peak (10% of Daily)			PM Peak (10% of Daily)		
								Total	IN (20%)	OUT (80%)	Total	IN (70%)	OUT (30%)
ZA	16	25	9.0	6.5	144	163	307	31	6	25	31	21	9
ZB	30	25	9.0	6.5	270	163	433	43	9	35	43	30	13
ZC	19	33	9.0	6.5	171	215	386	39	8	31	39	27	12
ZD	16	0	9.0	6.5	144	0	144	14	3	12	14	10	4
ZE	19	20	9.0	6.5	171	130	301	30	6	24	30	21	9
ZF	17	0	9.0	6.5	153	0	153	15	3	12	15	11	5
ZG	28	11	9.0	6.5	252	72	324	32	6	26	32	23	10
ZH	59	8	9.0	6.5	531	52	583	58	12	47	58	41	17
ZI	26	0	9.0	6.5	234	0	234	23	5	19	23	16	7
ZJ	49	0	9.0	6.5	441	0	441	44	9	35	44	31	13
TOTALS	**279**	**122**			**2511**	**793**	**3304**	**330**	**66**	**264**	**330**	**231**	**99**
	401												

Table 8 – Calculation of trips IN and OUT per Zone: Daily, AM & PM Peak Hours

The distribution of the estimated trips from **Table 8** is shown in **Figure 19** (AM Peak Hour), **Figure 20** (PM Peak Hour) and **Figure 21** (Daily Volumes) on the following page.

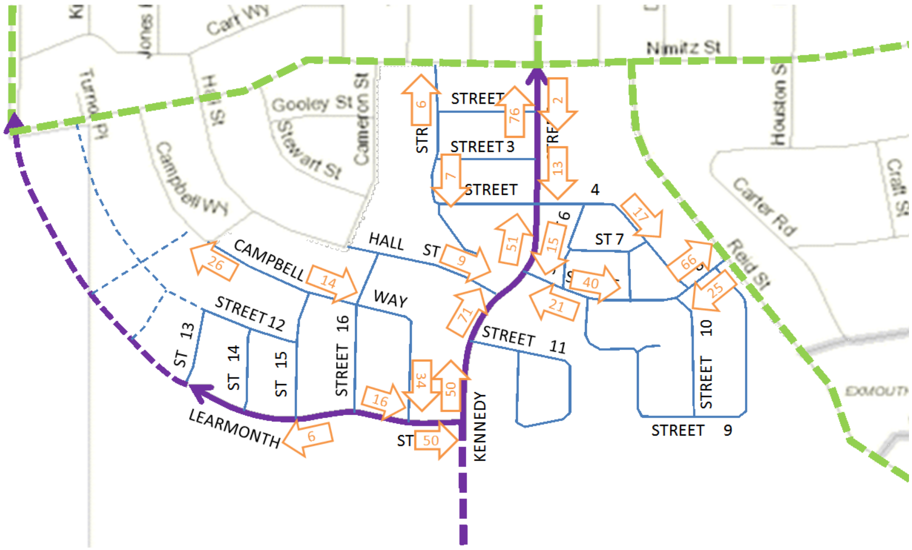


Figure 19 – Estimated 2016 AM Peak Hour trips: *Nimitz Street ODP* development only

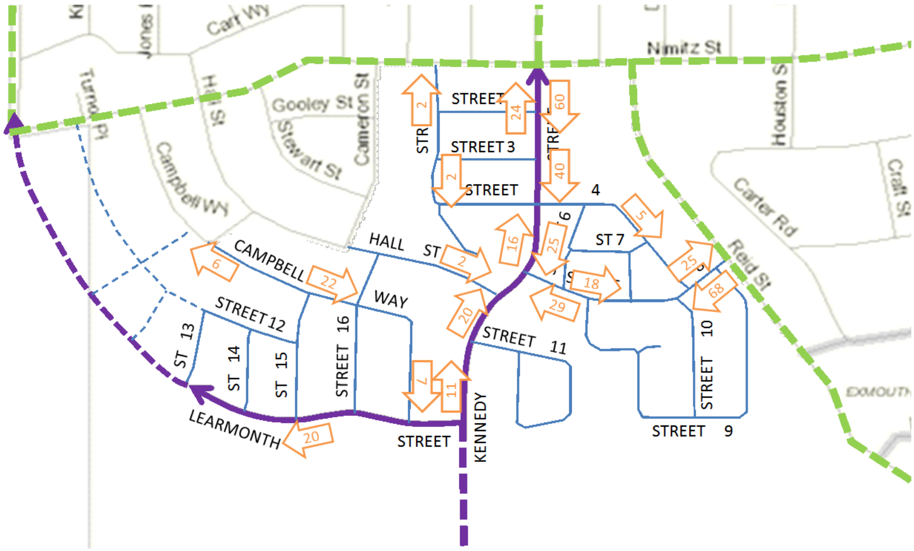


Figure 20 – Estimated 2016 PM Peak Hour trips: *Nimitz Street ODP* development only

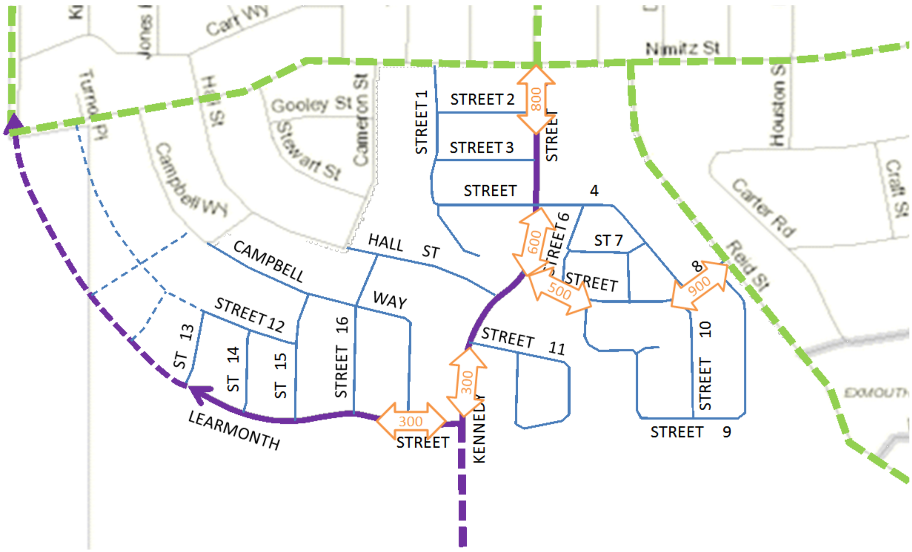


Figure 21 – Estimated 2016 Daily trips: *Nimitz Street ODP* development only

4.2 CONNECTIVITY OF STREET SYSTEM

Liveable Neighbourhoods proposes a site-responsive network where traffic volumes and speeds are managed, not a return to the rigid grids of the past.

The local street network should be highly interconnected with frequent junctions wherever possible with arterial routes to help limit travel distances and to promote walking, cycling, public transport usage and a strong sense of community. Junction spacings are specified in **Table 9**.

Street type	**L/R staggers** To avoid overlapping right turns	**R/L staggers** To provide for left-turn deceleration lanes arterials and to avoid cutting on local streets	**Junctions on same side of street**
ARTERIALS			
Integrator ‘A’ – 60 km/h*	190 m	130 m	130 m
Integrator ‘A’ – 70 km/h*	150 m	110 m	110 m
Integrator B	60 m	40 m	40 m
LOCAL STREETS			
Neighbourhood connector	40 m	40 m	40 m
Access street**	20 m	20 m	20 m
Laneway	NA	NA	
* Design speed used for integrator arterial street spacing is to be based on speed limit at full build out.			
** Laneway junctions are not to be located closer than 20 m from street intersections. There is no minimum spacing requirement between laneway junctions on local streets. Along Integrator B streets, laneway junctions should be located no closer than 30 m from unsignalised intersections and 40 m from signalised intersections.			

Table 9 – Junction Spacing (measured from road reserve centreline to centreline of terminating street pavements)

An assessment of intersection spacing is provided as **Table 10** on the following page along with comments regarding likely intersection control. A plan showing the street names used for this assessment is included as **Figure 18** on page 32.

Table 10 indicates that spacing is compliant with the recommendations of *Liveable Neighbourhoods*.

	CLASSIFICATION	From	Likely Intersection control	To	Likely Intersection control	DISTANCE (m) Next	Non-Local	Spacing Check
LOCAL STREETS	NEIGHBOURHOOD CONNECTORS							Minimum 40 m
	Kennedy Street	Learmonth Street	90° Bend (Future T)	Street 11	T (Give Way)	125	605	COMPLIES
		Street 11	T (Give Way)	Hall Street	T (Give Way)	75		COMPLIES
		Hall Street	T (Give Way)	Street 8	T (Give Way)	55		COMPLIES
		Street 8	T (Give Way)	Street 4	4-way roundabout	130		COMPLIES
		Street 4	4-way roundabout	Street 3	T (Give Way)	70		COMPLIES
		Street 3	T (Give Way)	Street 2	T (Give Way)	75		COMPLIES
		Street 2	T (Give Way)	Nimtz Street	4-way roundabout	75		COMPLIES
	Learmonth Street	Street 13	T (Give Way)	Street 14	T (Give Way)	90	400	COMPLIES
		Street 14	T (Give Way)	Street 15	T (Give Way)	80		COMPLIES
		Street 15	T (Give Way)	Street 16	T (Give Way)	75		COMPLIES
		Street 16	T (Give Way)	Campbell Way	T (Give Way)	75		COMPLIES
		Campbell Way	T (Give Way)	Kennedy Street	90° Bend (Future T)	80		COMPLIES
LOCAL STREETS	Access Streets							Minimum 20 m
	Street 1	Nimitz Street	T (Give Way)	Street 2	T (Give Way)	80	225	COMPLIES
		Street 2	T (Give Way)	Street 3	T (Give Way)	70		COMPLIES
		Street 3	T (Give Way)	Street 4	Y (Give Way)	75		COMPLIES
	Street 4	Street 1	Y (Give Way)	Kennedy Street	4-way roundabout	130	390	COMPLIES
		Kennedy Street	4-way roundabout	Street 6	T (Give Way)	65		COMPLIES
		Street 6	T (Give Way)	Street 7	T (Give Way)	100		COMPLIES
		Street 7	T (Give Way)	Street 8	T (Give Way)	95		COMPLIES
	Street 6	Street 4	T (Give Way)	Street 7	Y (Give Way)	60	140	COMPLIES
		Street 7	Y (Give Way)	Street 8	T (Give Way)	80		COMPLIES
	Street 7	Street 6	Y (Give Way)	Unamed	T (Give Way)	80	110	COMPLIES
		Unamed	T (Give Way)	Street 4	T (Give Way)	30		COMPLIES
	Street 8	Kennedy Street	T (Give Way)	Street 6	T (Give Way)	60	335	COMPLIES
		Street 6	T (Give Way)	Street 9	T (Give Way)	40		COMPLIES
		Street 9	T (Give Way)	Unamed	T (Give Way)	60		COMPLIES
		Unamed	T (Give Way)	Street 10	T (Give Way)	70		COMPLIES
		Street 10	T (Give Way)	Street 4	T (Give Way)	20		MINIMUM
		Street 4	T (Give Way)	Street 9	T (Give Way)	50		COMPLIES
		Street 9	T (Give Way)	Reid Street	T (Give Way)	35		COMPLIES
	Hall Street	Cameron Street	T (Give Way)	Street 16	T (Give Way)	35	215	COMPLIES
		Street 16	T (Give Way)	Kennedy Street	T (Give Way)	180		COMPLIES
	Campbell Way	Campbell Way	T (Give Way)	Street 15	T (Give Way)	155	455	COMPLIES
		Street 15	T (Give Way)	Street 16	4-way roundabout	70		COMPLIES
		Street 16	4-way roundabout	Learmonth Street	T (Give Way)	230		COMPLIES

Table 10– *Nimitz Street ODP* Intersection spacing and treatment assessment

4.3 CONNECTIVITY WITH ACTIVITY NODES

Connectivity with activity nodes is shown in **Figure 22** on the following page. It shows 400 m (5 min) and 800 m (10 min) 'ped sheds' for each activity node as well as connecting vehicular routes and streets. All vehicular routes and streets are walkable. The Diagram indicates that residences south of Hall Street/ Street 8 are not within acceptable walking distances of the Town Centre, Schools and Recreation Areas. None of the residences are within an acceptable walking distance of the Marina.

Whilst the *Nimitz Street ODP* will be providing recreational areas within public open spaces, there is no provision for a small retail area to serve the daily needs of residences. This will result in greater trips by car along Kennedy Street (to the Town Centre) than would be made if there were a retail centre within walking distance.

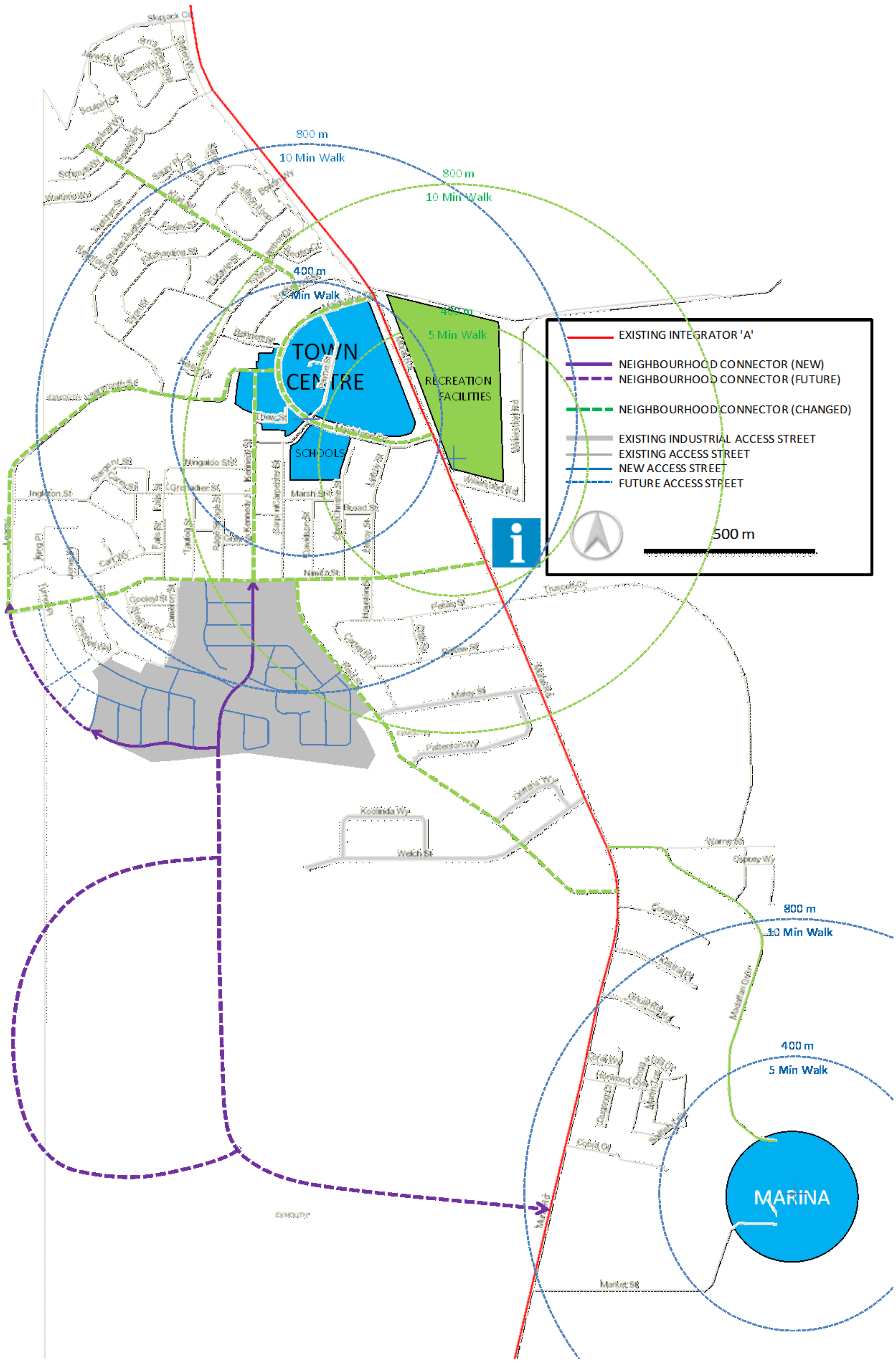
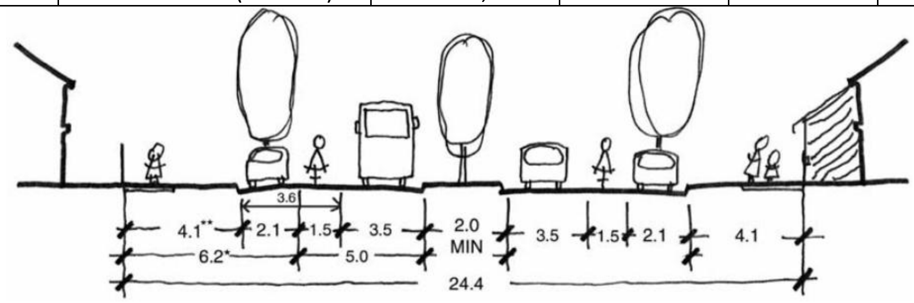


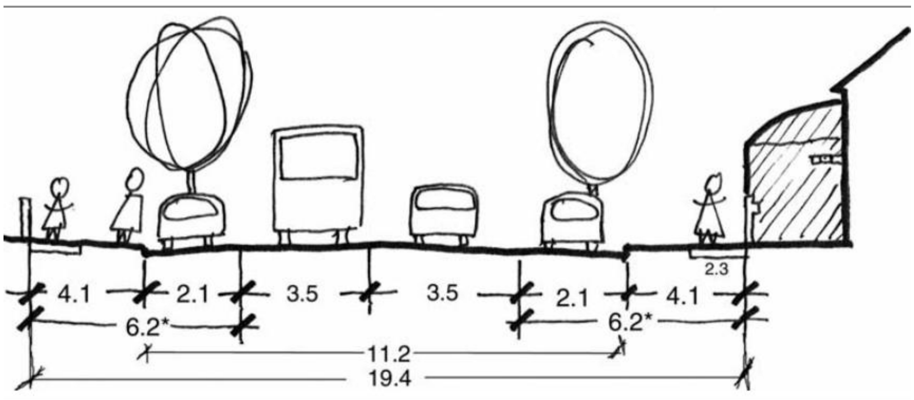
Figure 22 – Connectivity of Activity Nodes

4.4 STREET CROSS-SECTIONS

As indicated in **Section 3.1**, *Liveable Neighbourhoods* describes the function and characteristics of the different classifications of routes and streets (refer **Table 6** on page 28 and **Table 7** on page 30).

Typical cross sections for the Neighbourhood Connector Streets have been selected based on the function and characteristics of the streets with the Forecast 2016 and 2030 traffic volumes as summarised in **Table 11** below and on the following pages. Typical Cross Sections for Access Streets are shown in **Table 12** on the following pages.

<table>
<tr><th>Street & Section</th><th>Classification
Refer Typical Cross Sections</th><th>Forecast Volume</th><th>Section Length</th><th>Speed Limit</th><th>Frontage</th></tr>
<tr><td colspan="6">Kennedy Street</td></tr>
<tr><td>Learmonth Street – Nimitz Street</td><td>Neighbourhood Connector A (Median)</td><td>2016: 800
2030: 2,000</td><td>605 m</td><td>50 km/h</td><td>Limited (shared driveways)</td></tr>
<tr><td colspan="6">

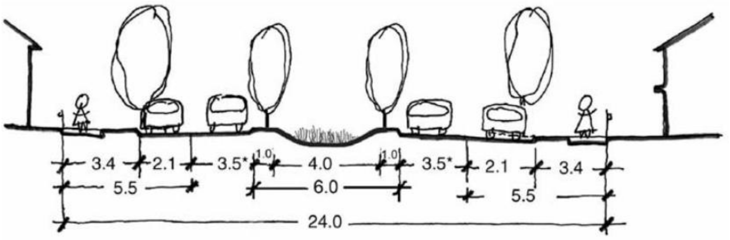
Neighbourhood connector A – 50 km/h (up to 7,000 vpd with >3,000 vpd preferred)
Relevant Liveable Neighbourhoods notes: Central median, buses, cycle lanes and parking. Bus stops are normally in travel lane against kerb extensions in parking lane. For larger trees, wider central median widths (2.5-4.0 m) are preferred. For medians with swale drains, a minimum width of 6 m is suggested.</td></tr>
<tr><td colspan="6">Learmonth Street</td></tr>
<tr><td>Learmonth Street – Nimitz Street</td><td>Neighbourhood Connector B (Minor)</td><td>2016: 300
2030: 1,000</td><td>400 m</td><td>50 km/h</td><td>Limited (side road access)</td></tr>
<tr><td colspan="6">

Neighbourhood connector B – 50 km/h (<3,000 vpd)
Lower volume neighbourhood connector, bus route, no cycle lanes, parking. Typically a residential environment with low parking turnover. Detailing of design to visually narrow street (e.g. including trees in parking lane, painted parking line), together with other speed control mechanisms to limit typical operating speeds to less than 50 km/h. Bus stops in travel lane against kerb extension in parking lane. A 2-2.3 m shared path provided on at least one verge in lieu of on-street cycle lane.
Note: Verge width (including parking) can be reduced from 6.2 m to 5.5 m with indented parking, to reduce overall reserve width to 18.0 m.</td></tr>
</table>

Table 11 – Street Characteristics and Typical Cross Sections: Neighbourhood Connectors

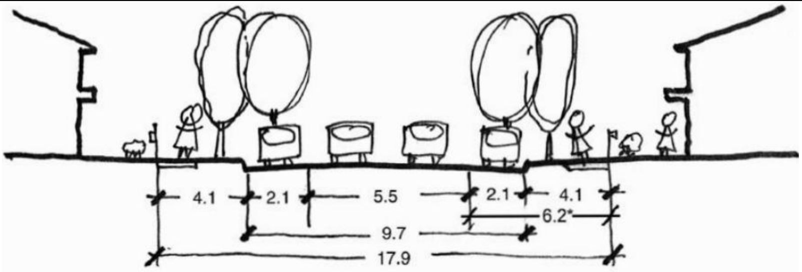
Access Streets

The various local roads will require detailed design to suit location, function, adjacent land use and available width. The following cross sections provide examples relevant to this criterion.



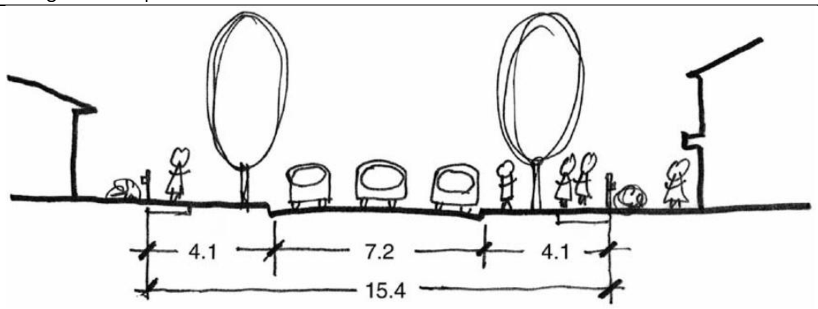
Access street A – avenue – Target speed 40 km/h (<3,000 vpd)

Relevant *Liveable Neighbourhoods* notes: Central median indented parking, no separate cycle lane, no buses. Suited to 6 m wide medians containing swale drains.



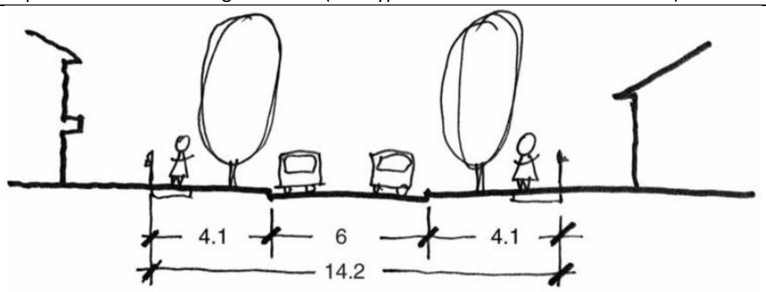
Access street B – wider access street Target speed 40 km/h (<3,000 vpd preferred)

Relevant *Liveable Neighbourhoods* notes: Wider access streets suited to higher density residential areas (typically R30 - R40+, or where dwelling density is greater than around 1 per 250 m^2) with higher parking demand. Extensive parking, no bike lane, no buses, trees in verge, with additional trees in parking lane if required.



Access street C – yield (or Give Way) street – Target speed 40 km/h (<3,000 vpd)

Relevant *Liveable Neighbourhoods* notes: Standard access street or yield (or Give Way) street. Relatively frequent parking on both sides of street (on the pavement) desirable and needed as part of speed control. No buses, no bike lane. This is likely to be the most common residential street in densities up to and often including R30 –R35 (or a typical lot size down to 250-300 m^2).



Access street D – narrow yield (or Give Way) street – Target speed 30 km/h (<1,000 vpd)

Relevant *Liveable Neighbourhoods* notes: Narrower access street for shorter lengths, low parking demand, serving larger lots. No buses, no bike lanes, no indented parking. Staggered parking on both sides of street as part of speed control, low speed. Not through route, low volume traffic.

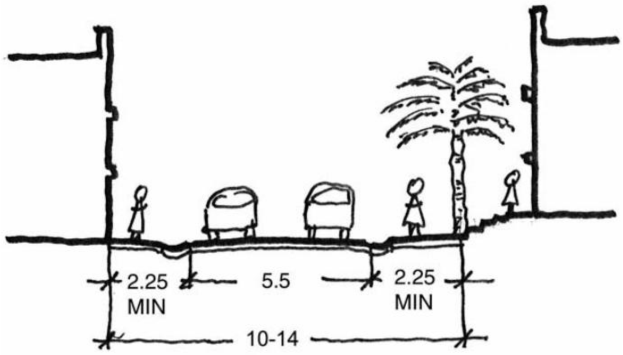
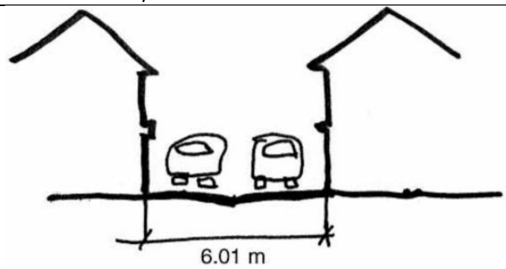
 Small town centre street – Target speed 30 km/h or less (up to 1,000 vpd)
Relevant *Liveable Neighbourhoods* notes: Suited to small secondary streets in centres where a visually contained street is required. Shared by cars, pedestrians and cyclists in low speed environment. Short length (less than 150 m), low traffic volume, may have parking on one side of street if one-way, limited or no parking on street if two-way.
 Laneway – for rear vehcile access – Target speed 15 km/h
Relevant *Liveable Neighbourhoods* notes: Two-way. Normally no parking. Normally central-invert drainage. Wide enough to allow vehicle access into garages located on the property boundary. Studio units above garages. In some circumstances, studios may have balconies projecting over the lane, provided that they are a minimum of 2.7 m above the pavement. Pavement may be narrowed to 3 m or 5 m at laneway entries. This improves sightlines to footpaths.

Table 12 – Street Characteristics and Typical Cross Sections: Access Streets

4.5 'KEY INTERSECTION' PERFROMANCE ASSESSMENT

An assessment of the appropriateness of intersection control has been undertaken using *SIDRA Intersection* [5]. Analysis of existing data (**Section 3.1**) revealed that the existing intersections had plenty of spare capacity but it has been deemed prudent to re-assess these with the forecast increases in traffic and changed movements for both the 2016 and 2030 Assessment Years due to some significant changes in turning movements.

As indicated in **Section 4.1**, Traffic volumes for each street within the *Nimitz Street ODP* have been estimated based on the following:

- Adjusting the December 2011 survey data to Average Annual Weekday Traffic (*AAWT*) base data for 2011 by applying a seasonal variation factor of 1.2. (This factor was used to err on the side of caution in the absence of seasonal traffic data);
- Adopting an 'Assessment Year' of 2016 for full development and occupancy of the *Nimitz Street ODP* area;
- Adopting an 'Assessment Year' of 2030 for full development of the Neighbourhood Connector Roads through and around the *Nimitz Street ODP* area to take into account through traffic.
- Growing base 'through traffic' by 2% per annum for both Assessment Years;

- Using appropriate generic average daily trip rates for land use areas based on the land uses of 'Single Dwelling Residential' and Multiple Dwelling Residential' within zones bounded by Neighbourhood Connector Roads and connecting Access Streets; and
- Distributing through traffic according to current turning movement percentages where this is likely and according to the location of local generators and attractors where it isn't.

Based on the above, 8 Key Intersections have been identified for assessment as indicated in **Figure 23**.

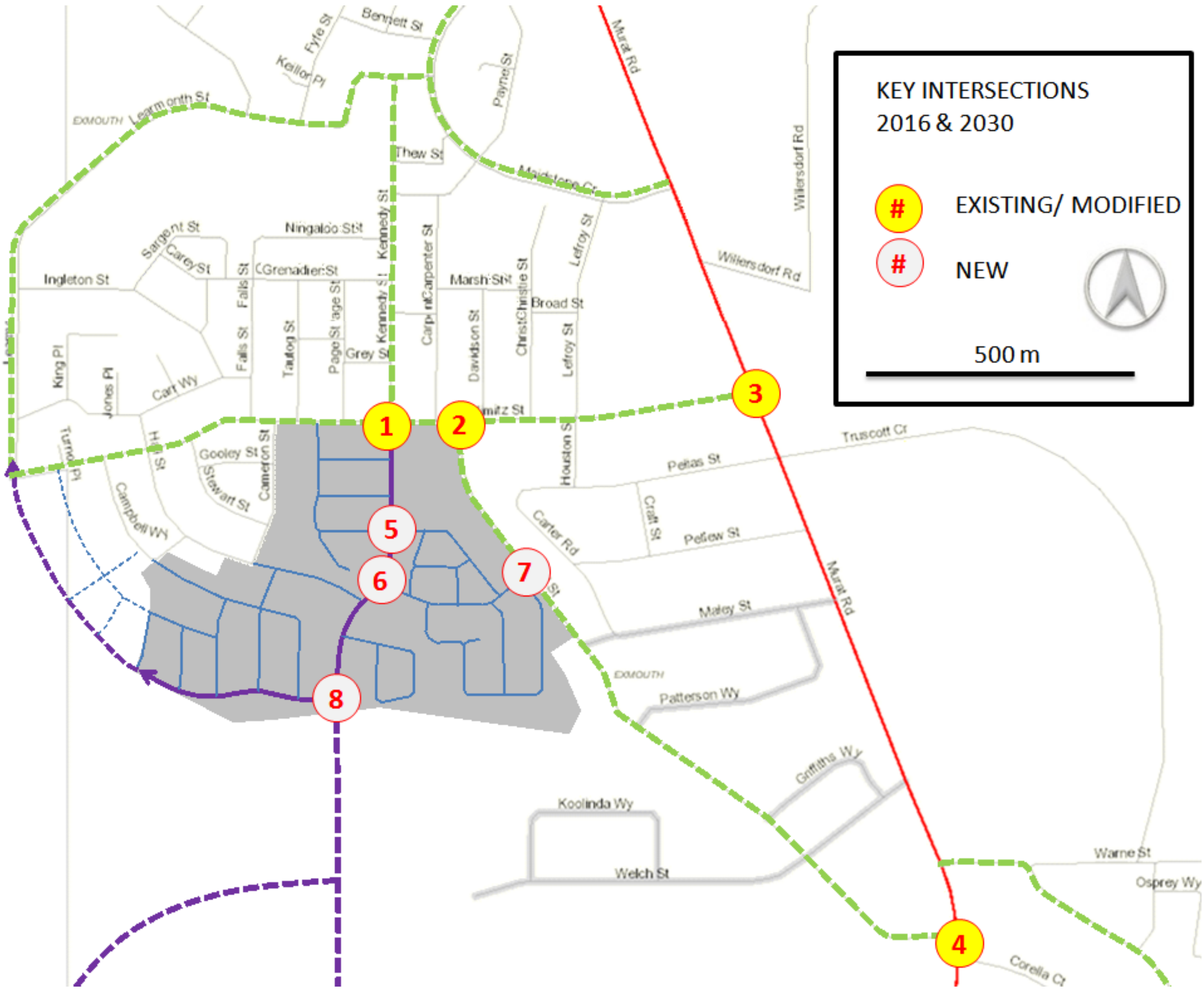


Figure 23 – Existing and Proposed Key Intersections

It should be noted that until the Kennedy Street and Learmonth Road Neighbourhood Connectors are completed (as per Assessment Year 2030), that *Nimitz Street ODP* generated traffic will use Street 8 (i.e. Key Intersections 6 and 7) to access Reid Street and then Murat Road. This is reflected in the assessments. Full details of the calculation of the 2016 and 2030 volumes and turning movements at each intersection are provided in **Appendix C** and **D** respectively.

4.5.1 Nimitz Street/ Kennedy Street

This intersection is currently a 'T' intersection with Kennedy Street as the terminating road (i.e. default Give Way control).

The extension of Kennedy Street will result in a new four way intersection controlled by a roundabout. Forecast volumes and turning movements for the Assessment Years of 2016 and 2030 are shown in **Figure 24**.

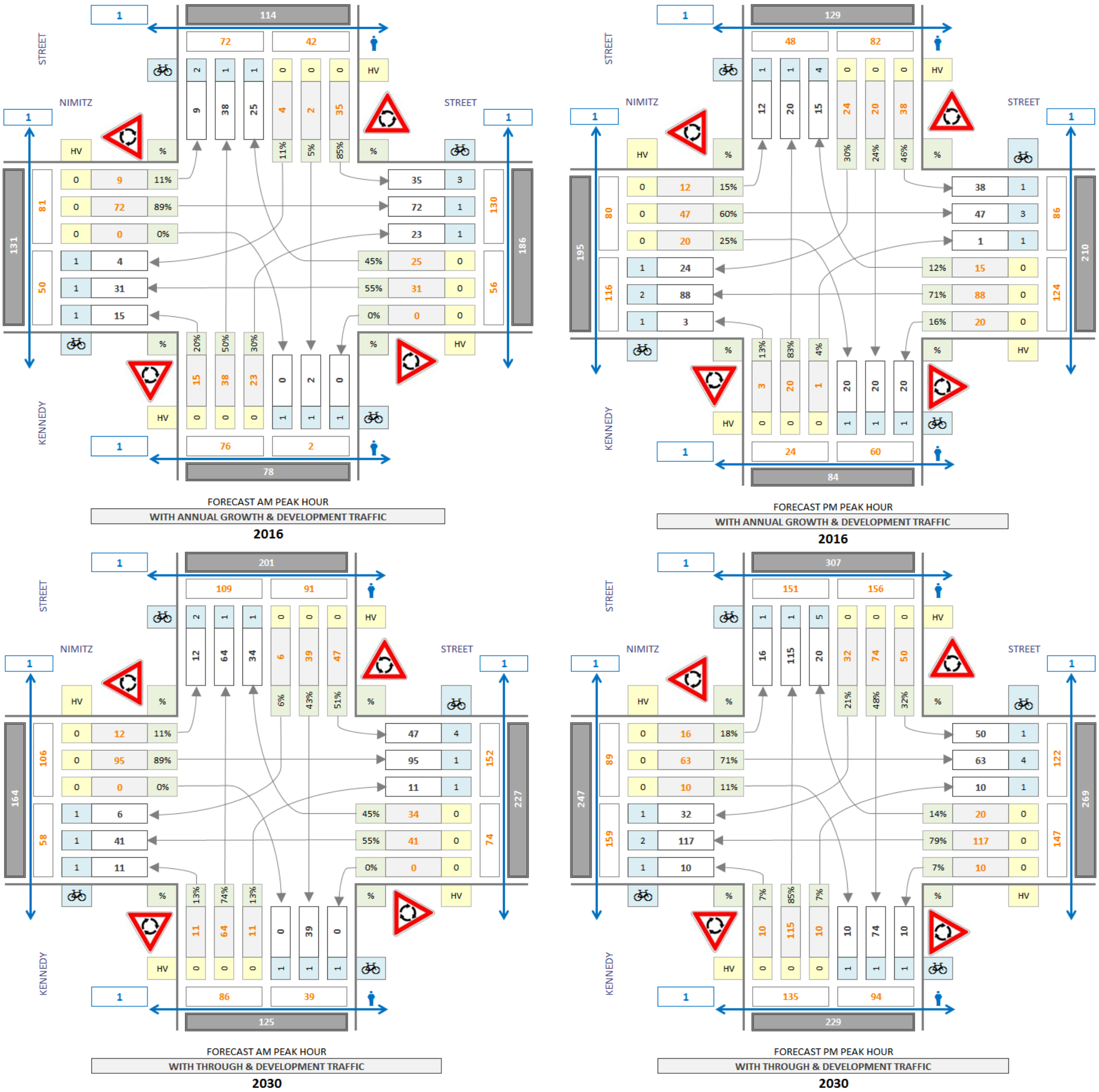
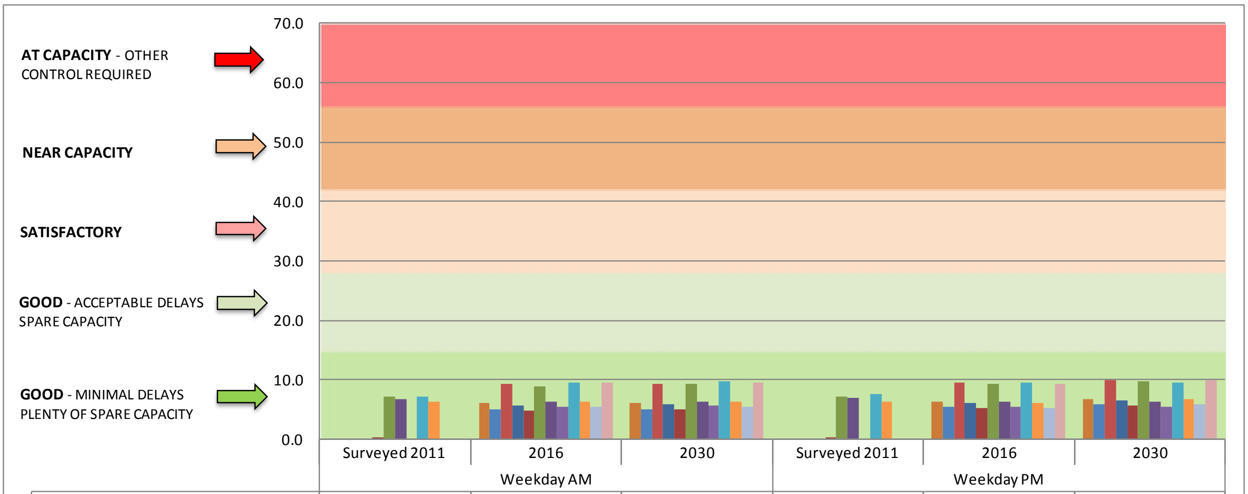


Figure 24 – Nimitz Street/ Kennedy Street: 2016 & 2030 Forecast Volumes

A comparison of surveyed, 2016 and 2030 intersection performance criteria (Average Delay) is shown in **Figure 25**. A summary of all intersection performance criteria is included in the relevant *SIDRA Intersection* summary report in **Appendix C** for 2016 and **Appendix D** for 2030.



	Weekday AM			Weekday PM		
	Surveyed 2011	2016	2030	Surveyed 2011	2016	2030
Kennedy northbound left into Nimitz		6.1	6.1		6.4	6.7
Kennedy northbound straight through		5.1	5.1		5.5	5.8
Kennedy northbound right into Nimitz		9.2	9.2		9.6	9.9
Nimitz westbound left into Kennedy		5.7	5.9		6.1	6.5
Nimitz westbound straight through	0.2	4.8	5.1	0.2	5.3	5.7
Nimitz westbound right into Kennedy	7.1	8.9	9.2	7.1	9.4	9.8
Kennedy southbound left into Nimitz	6.7	6.3	6.4	7.0	6.3	6.3
Kennedy southbound straight through		5.5	5.6		5.5	5.4
Kennedy southbound right into Nimitz	7.2	9.6	9.7	7.5	9.6	9.5
Nimitz eastbound left into Kennedy	6.4	6.3	6.3	6.4	6.0	6.7
Nimitz eastbound straight through	0.0	5.4	5.5	0.0	5.2	5.9
Nimitz Eastbound right into Kennedy		9.6	9.6		9.3	10.0

Figure 25 – Nimitz Street/ Kennedy Street – Peak Hour Intersection Performance comparison

Figure 25 indicates that the new four-way roundabout intersection is expected to perform with minimal delays for all movements and retain plenty of spare capacity.

4.5.2 Nimitz Street/ Reid Street

This intersection is currently a 'T' intersection with Reid Street as the terminating road under STOP sign control. It is proposed to retain this intersection in its current layout and control.

Forecast volumes and turning movements for the Assessment Years of 2016 and 2030 are shown in **Figure 26**.

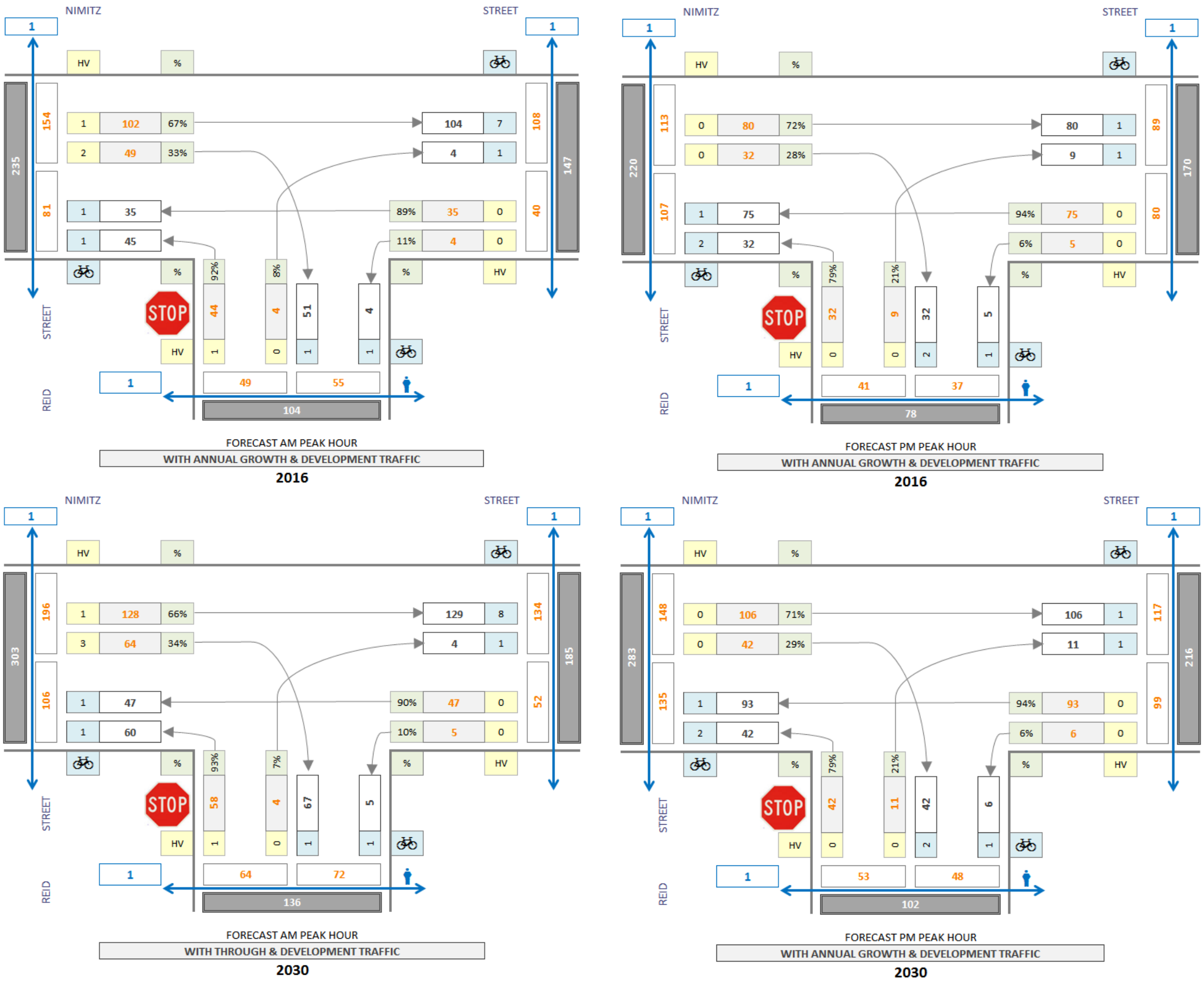
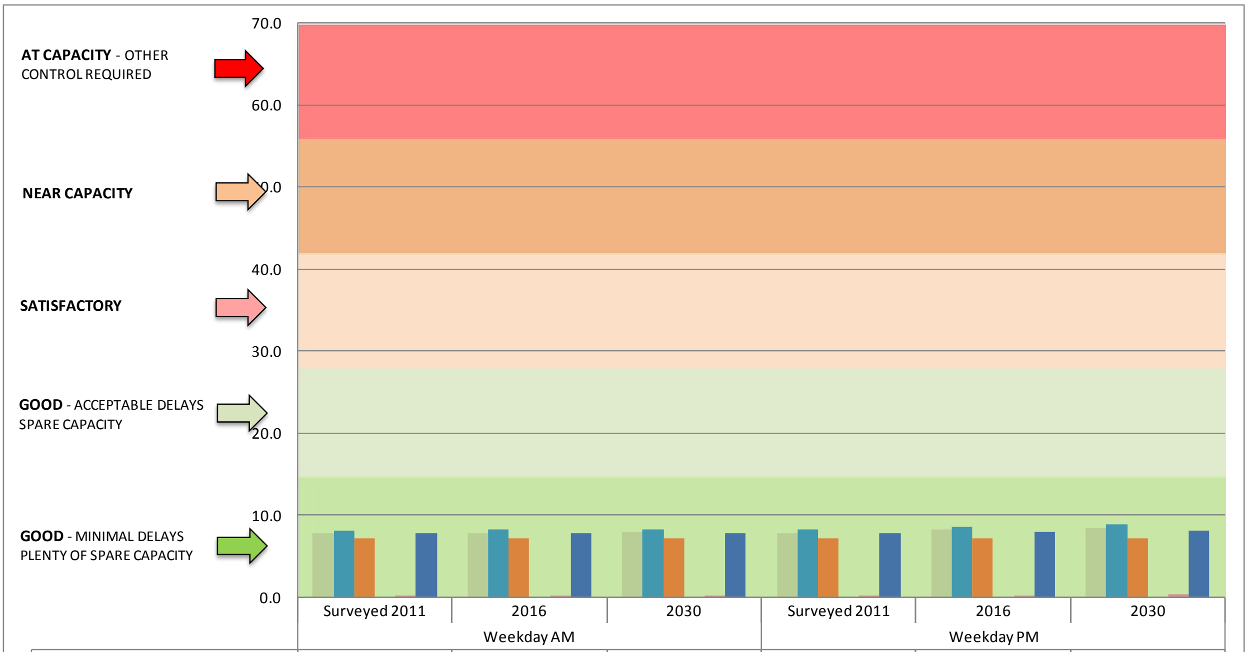


Figure 26 – Nimitz Street/ Reid Street: 2016 & 2030 Forecast Volumes

A comparison of surveyed, 2016 and 2030 intersection performance criteria (Average Delay) is shown in **Figure 27**. A summary of all intersection performance criteria is included in the relevant *SIDRA Intersection* summary report in **Appendix C** for 2016 and **Appendix D** for 2030.



	Weekday AM Surveyed 2011	Weekday AM 2016	Weekday AM 2030	Weekday PM Surveyed 2011	Weekday PM 2016	Weekday PM 2030
Reid left into Nimitz	7.7	7.8	7.9	7.8	8.2	8.4
Reid right into Nimitz	8.1	8.2	8.3	8.3	8.6	8.8
Nimitz left into Reid	7.2	7.2	7.2	7.2	7.2	7.2
Nimitz westbound straight through	0.0	0.0	0.0	0.0	0.0	0.0
Nimitz eastbound straight through	0.1	0.1	0.2	0.1	0.2	0.3
Nimitz right into Reid	7.7	7.8	7.8	7.8	7.9	8.0

Figure 27 – Nimitz Street/ Reid Street – Peak Hour Intersection Performance comparison

Figure 27 indicates that the current intersection layout and control is expected to perform with minimal delays for all movements and retain plenty of spare capacity.

4.5.3 Nimitz Street/ Murat Road

This intersection is currently a 'T' intersection with Nimitz Street as the terminating road (i.e. default Give Way control). It is proposed to retain this intersection in its current layout and control.

Forecast volumes and turning movements for the Assessment Years of 2016 and 2030 are shown in **Figure 28**.

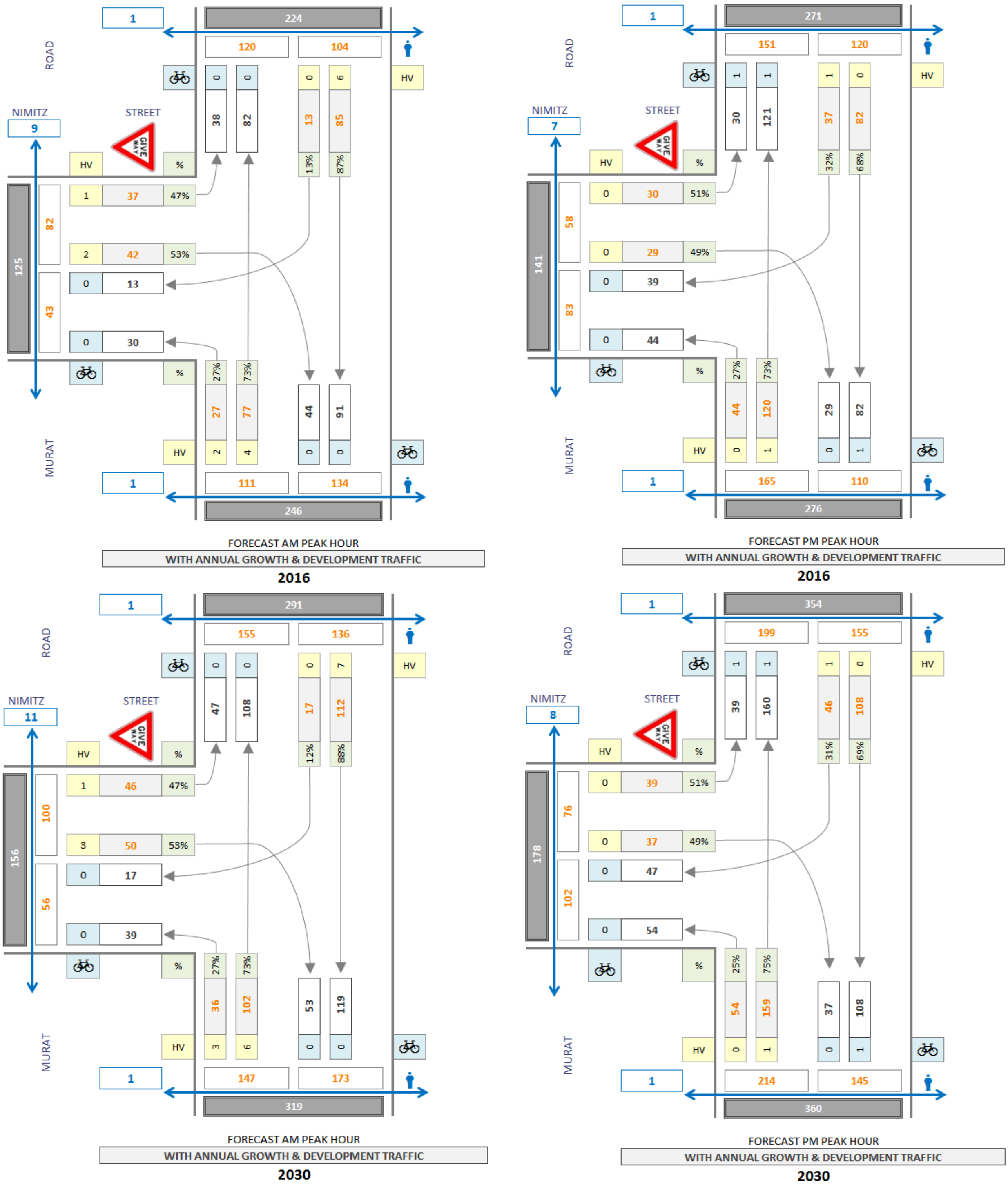
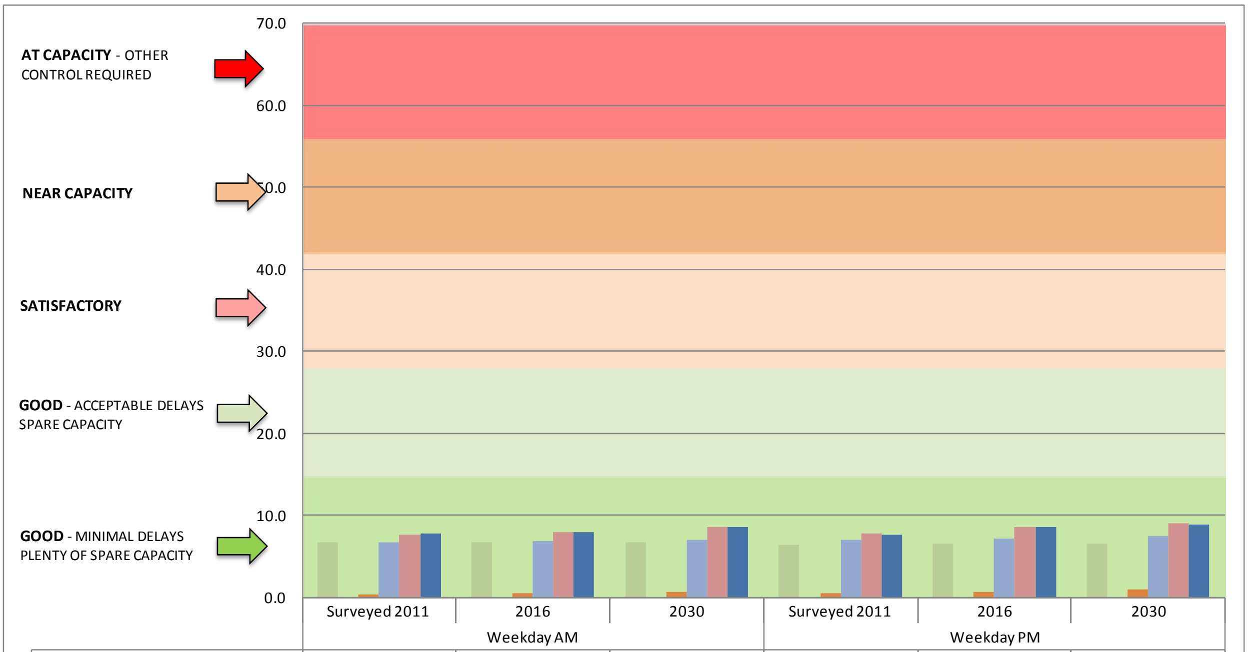


Figure 28 – Nimitz Street/ Murat Road: 2016 & 2030 Forecast Volumes

A comparison of surveyed, 2016 and 2030 intersection performance criteria (Average Delay) is shown in **Figure 29**. A summary of all intersection performance criteria is included in the relevant *SIDRA Intersection* summary report in **Appendix C** for 2016 and **Appendix D** for 2030.



	Weekday AM Surveyed 2011	Weekday AM 2016	Weekday AM 2030	Weekday PM Surveyed 2011	Weekday PM 2016	Weekday PM 2030
Murat left into Nimitz	6.6	6.7	6.7	6.4	6.5	6.5
Murat northbound straight through	0.0	0.0	0.0	0.0	0.0	0.0
Murat southbound straight through	0.3	0.4	0.6	0.5	0.7	0.9
Murat right into Nimitz	6.7	6.8	7.0	7.0	7.1	7.4
Nimitz left into Murat	7.6	7.9	8.6	7.7	8.5	9.0
Nimitz right into Murat	7.7	7.9	8.6	7.6	8.6	8.9

Figure 29 – Nimitz Street/ Murat Road – Peak Hour Intersection Performance comparison

Figure 29 indicates that the current intersection layout and control is expected to perform with minimal delays for all movements and retain plenty of spare capacity.

4.5.4 Reid Street/ Murat Road

This intersection is currently a 'T' intersection with Reid Street as the terminating road under STOP control. There are right turn and left turn auxiliary lanes for turns from Murat Road into Reid Street. It is proposed to retain this intersection in its current layout and control.

Forecast volumes and turning movements for the Assessment Years of 2016 and 2030 are shown in **Figure 30**.

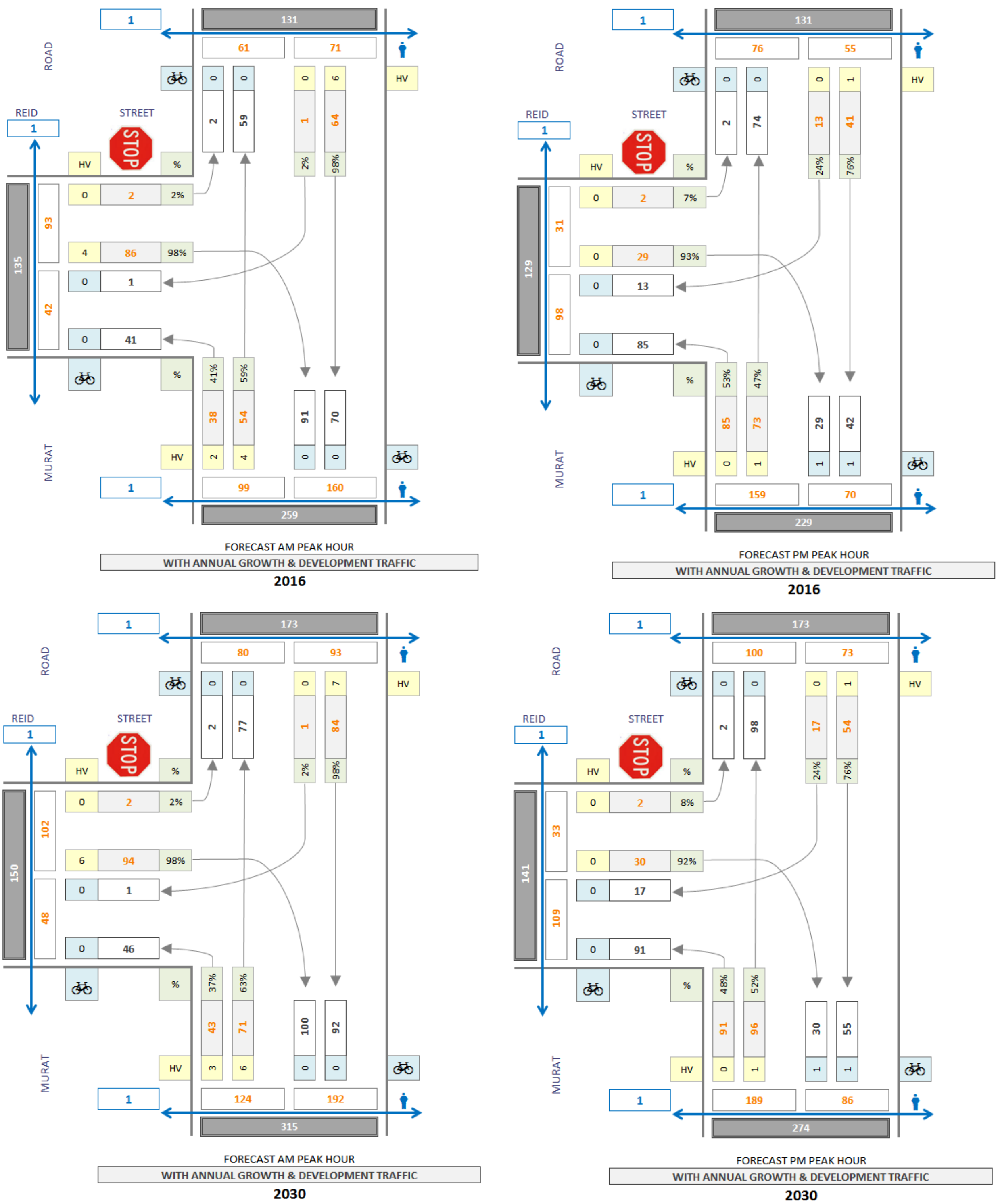
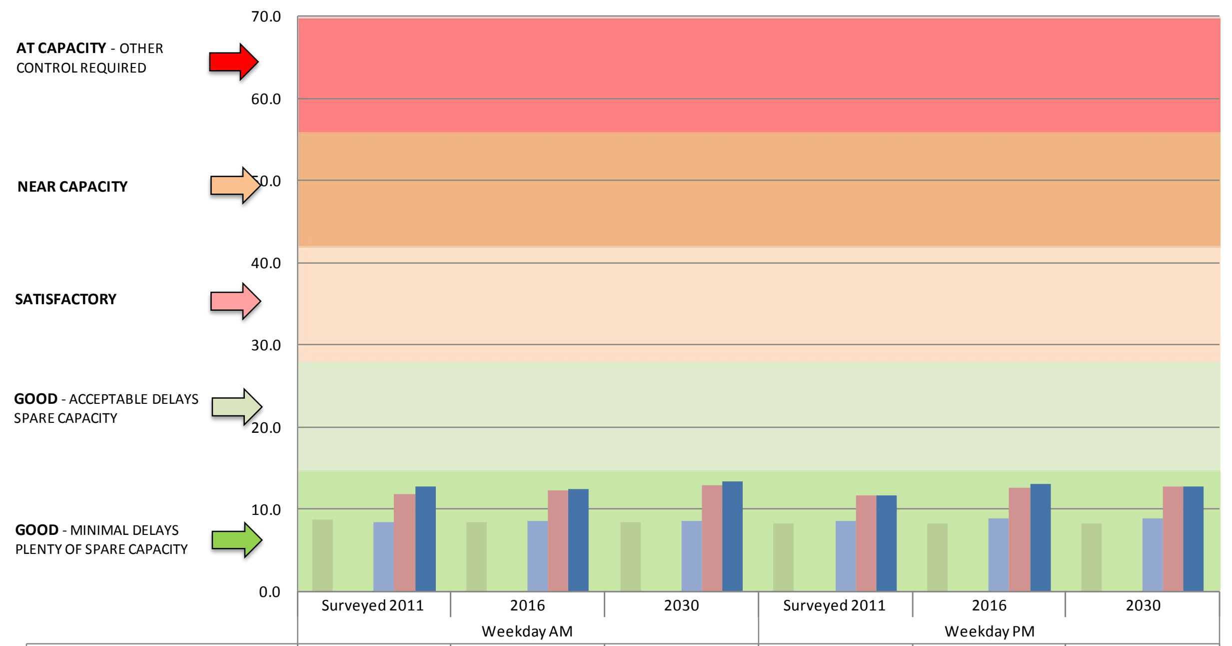


Figure 30 – Reid Street/ Murat Road: 2016 & 2030 Forecast Volumes

A comparison of surveyed, 2016 and 2030 intersection performance criteria (Average Delay) is shown in **Figure 31**. A summary of all intersection performance criteria is included in the relevant *SIDRA Intersection* summary report in **Appendix C** for 2016 and **Appendix D** for 2030.



	Weekday AM Surveyed 2011	Weekday AM 2016	Weekday AM 2030	Weekday PM Surveyed 2011	Weekday PM 2016	Weekday PM 2030
Murat left into Reid	8.7	8.4	8.4	8.2	8.3	8.2
Murat northbound straight through	0.0	0.0	0.0	0.0	0.0	0.0
Murat southbound straight through	0.0	0.0	0.0	0.0	0.0	0.0
Murat right into Reid	8.4	8.5	8.6	8.5	8.8	8.9
Reid left into Murat	11.8	12.2	12.9	11.6	12.5	12.8
Reid right into Murat	12.7	12.4	13.3	11.6	13.1	12.8

Figure 31 – Reid Street/ Murat Road – Peak Hour Intersection Performance comparison

Figure 31 indicates that the current intersection layout and control is expected to perform with minimal delays for all movements and retain plenty of spare capacity.

4.5.5 Kennedy Street/ Street 4

This intersection is a new 4-way roundabout within the *Nimitz Street ODP* Area.

Forecast volumes and turning movements for the Assessment Years of 2016 and 2030 are shown in **Figure 32**.

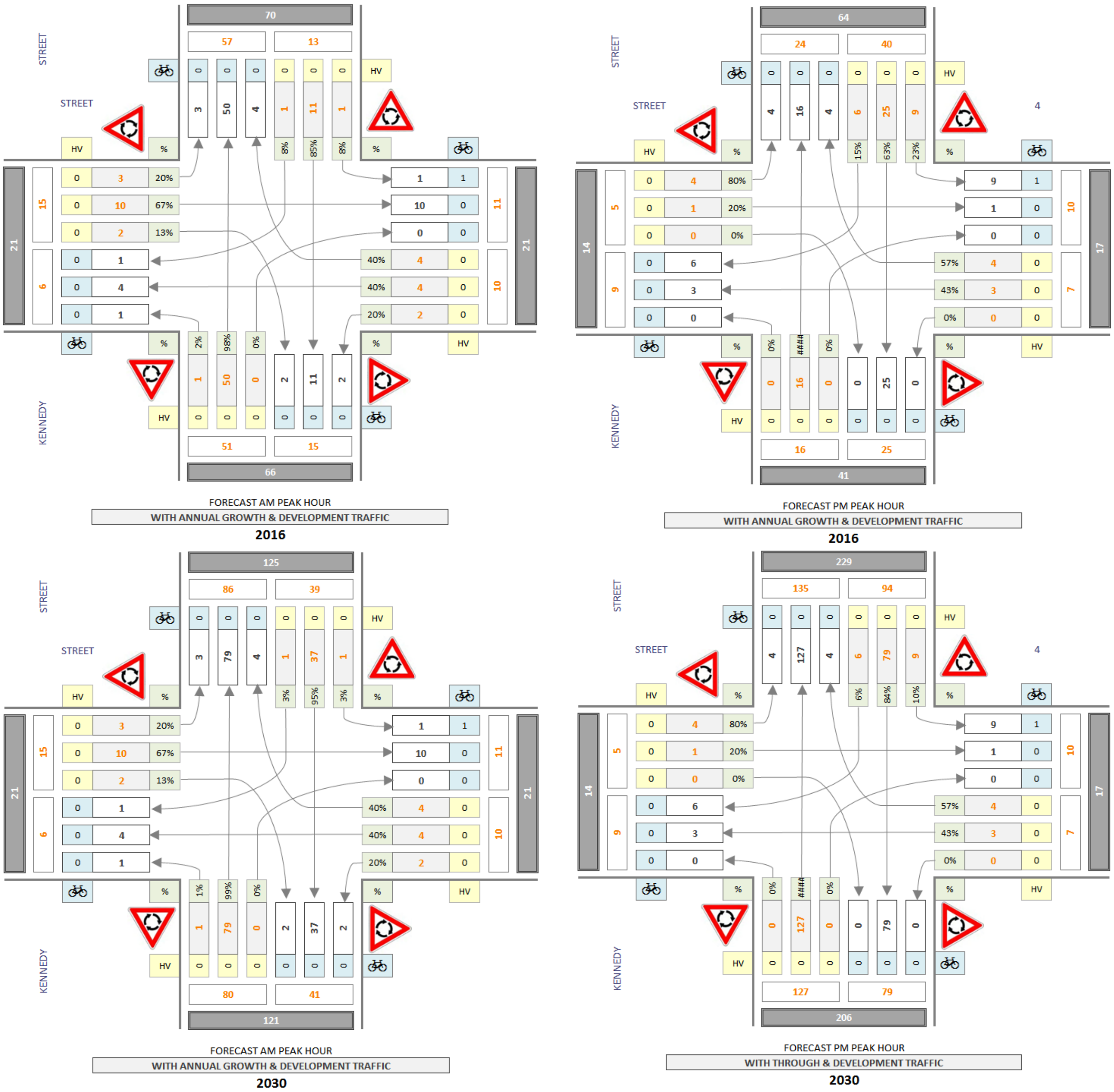
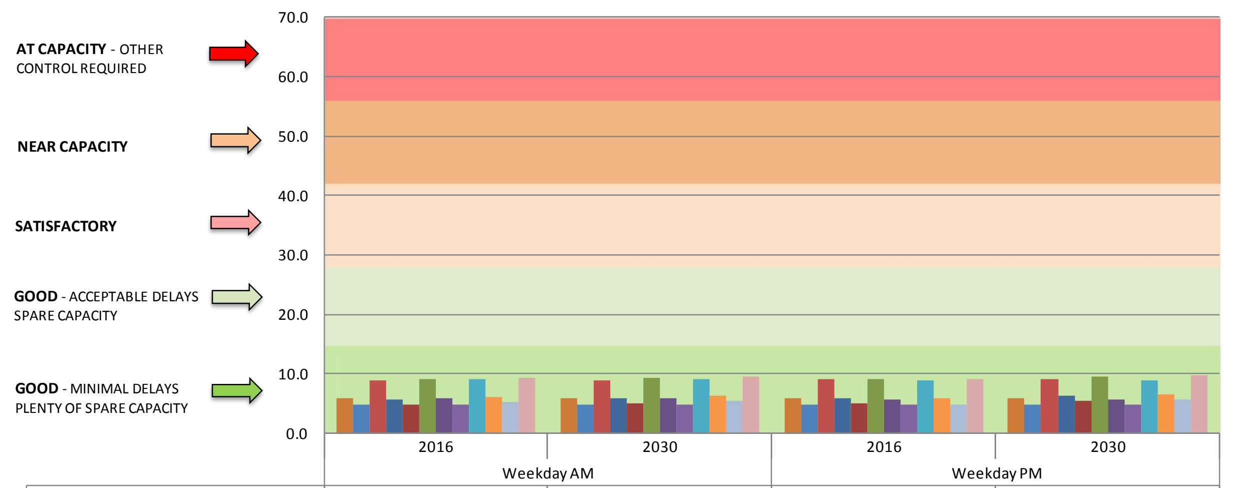


Figure 32 – Kennedy Street/ Street 4: 2016 & 2030 Forecast Volumes

A comparison of 2016 and 2030 intersection performance criteria (Average Delay) is shown in **Figure 33**. A summary of all intersection performance criteria is included in the relevant *SIDRA Intersection* summary report in **Appendix C** for 2016 and **Appendix D** for 2030.



	Weekday AM 2016	Weekday AM 2030	Weekday PM 2016	Weekday PM 2030
Kennedy northbound left into Street 4	5.8	5.8	5.8	5.8
Kennedy northbound straight through	4.8	4.8	4.9	4.9
Kennedy northbound right into Street 4	8.9	8.9	9.0	9.0
Street 4 westbound left into Kennedy	5.7	5.9	5.8	6.2
Street 4 westbound straight through	4.9	5.1	5.0	5.4
Street 4 westbound right into Kennedy	9.0	9.2	9.1	9.5
Kennedy southbound left into Street 4	5.8	5.8	5.7	5.7
Kennedy southbound straight through	4.9	4.9	4.8	4.8
Kennedy southbound right into Street 4	9.0	9.0	8.9	8.9
Street 4 eastbound left into Kennedy	6.0	6.2	5.8	6.5
Street 4 eastbound straight through	5.2	5.4	4.9	5.7
Street 4 eastbound right into Kennedy	9.3	9.5	9.0	9.8

Figure 33 – Kennedy Street/ Street 4 – Peak Hour Intersection Performance comparison

Figure 33 indicates that the new four-way roundabout is expected to perform with minimal delays for all movements with plenty of spare capacity.

4.5.6 Kennedy Street/ Street 8

This intersection is a new T junction within the *Nimitz Street ODP* Area with Street 8 as the terminating road under default Give Way control.

Street 8 will act as a connector road for the *Nimitz Street ODP* Area to the east and south until such time as Kennedy Street is extended through to Murat Road. For the purpose of assessment, the extension has been included in the 2030 Assessment Year. This explains the reduction in volumes on Street 8 between 2016 and 2030.

Forecast volumes and turning movements for the Assessment Years of 2016 and 2030 are shown in **Figure 34**.

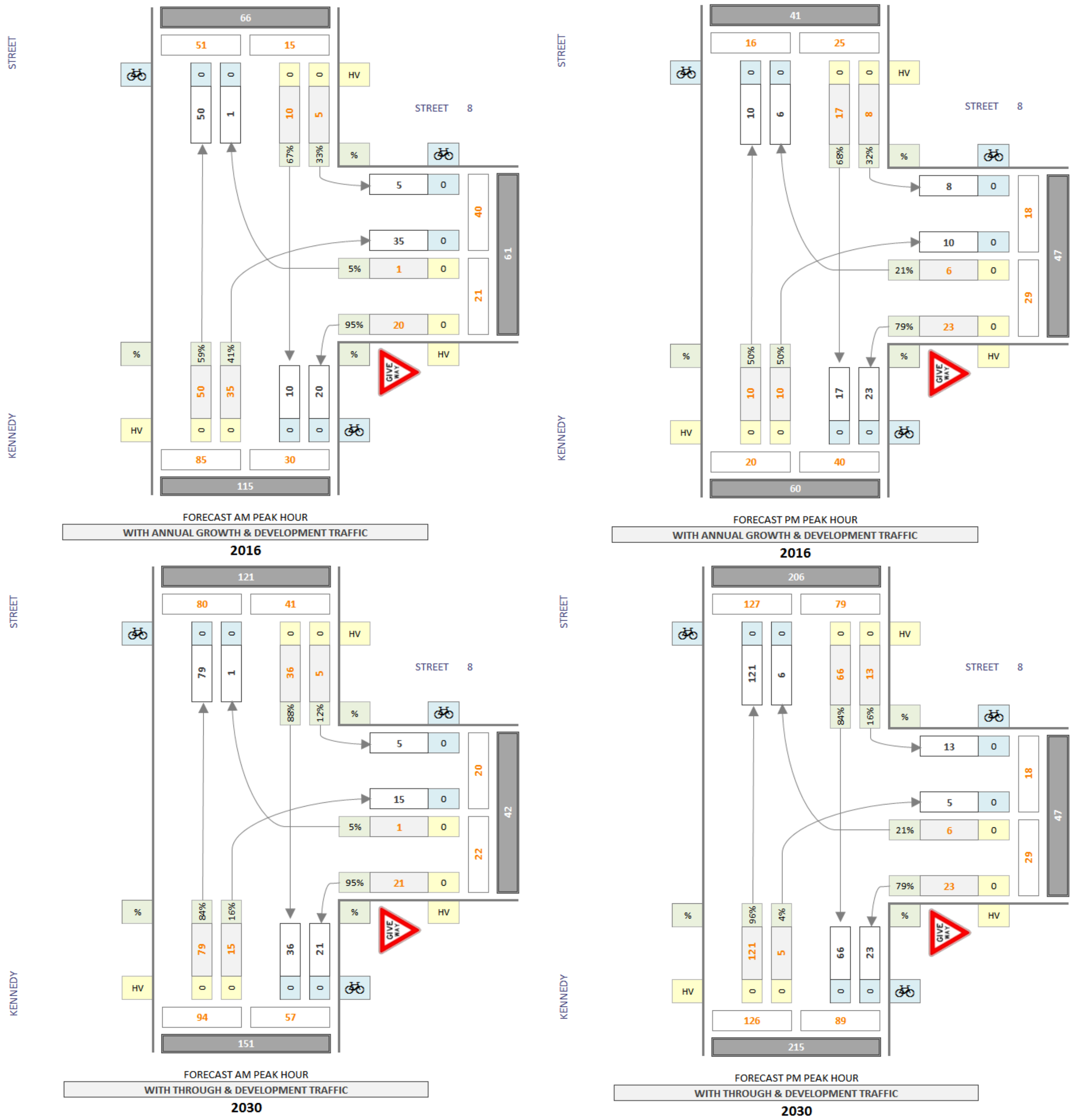
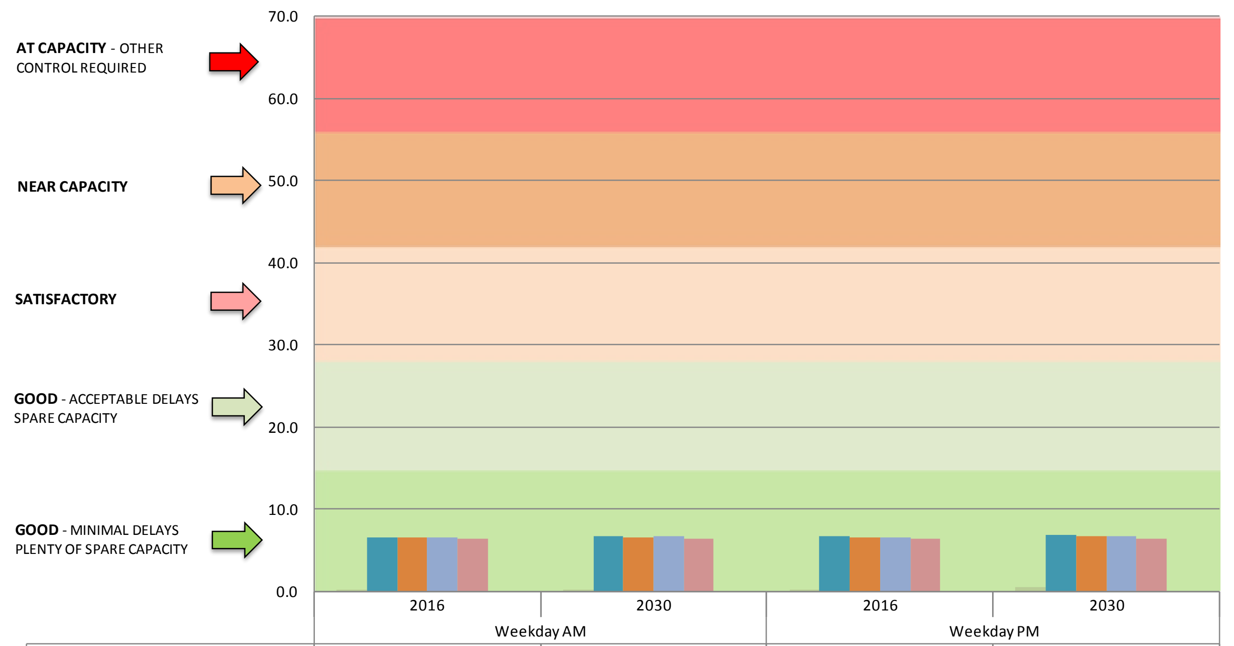


Figure 34 – Kennedy Street/ Street 8: 2016 & 2030 Forecast Volumes

A comparison of 2016 and 2030 intersection performance criteria (Average Delay) is shown in **Figure 35**. A summary of all intersection performance criteria is included in the relevant *SIDRA Intersection* summary report in **Appendix C** for 2016 and **Appendix D** for 2030.



	Weekday AM 2016	Weekday AM 2030	Weekday PM 2016	Weekday PM 2030
Kennedy northbound straight through	0.1	0.2	0.1	0.4
Kennedy right into Street 8	6.5	6.6	6.6	6.8
Street 8 left into Kennedy	6.5	6.5	6.5	6.7
Street 8 right into Kennedy	6.5	6.6	6.5	6.7
Kennedy left into Street 8	6.4	6.4	6.4	6.4
Kennedy southbound straight through	0.0	0.0	0.0	0.0

Figure 35 – Kennedy Street/ Street 8 – Peak Hour Intersection Performance comparison

Figure 35 indicates that the new T junction is expected to perform with minimal delays for all movements with plenty of spare capacity.

4.5.7 Street 8/ Reid Street

This intersection is a new T junction within the *Nimitz Street ODP* Area with Street 8 as the terminating road under default Give Way control. Refer comments under **Section 4.5.6** regarding Street 8 and the ultimate Kennedy Street extension.

Forecast volumes and turning movements for the Assessment Years of 2016 and 2030 are shown in **Figure 36**.

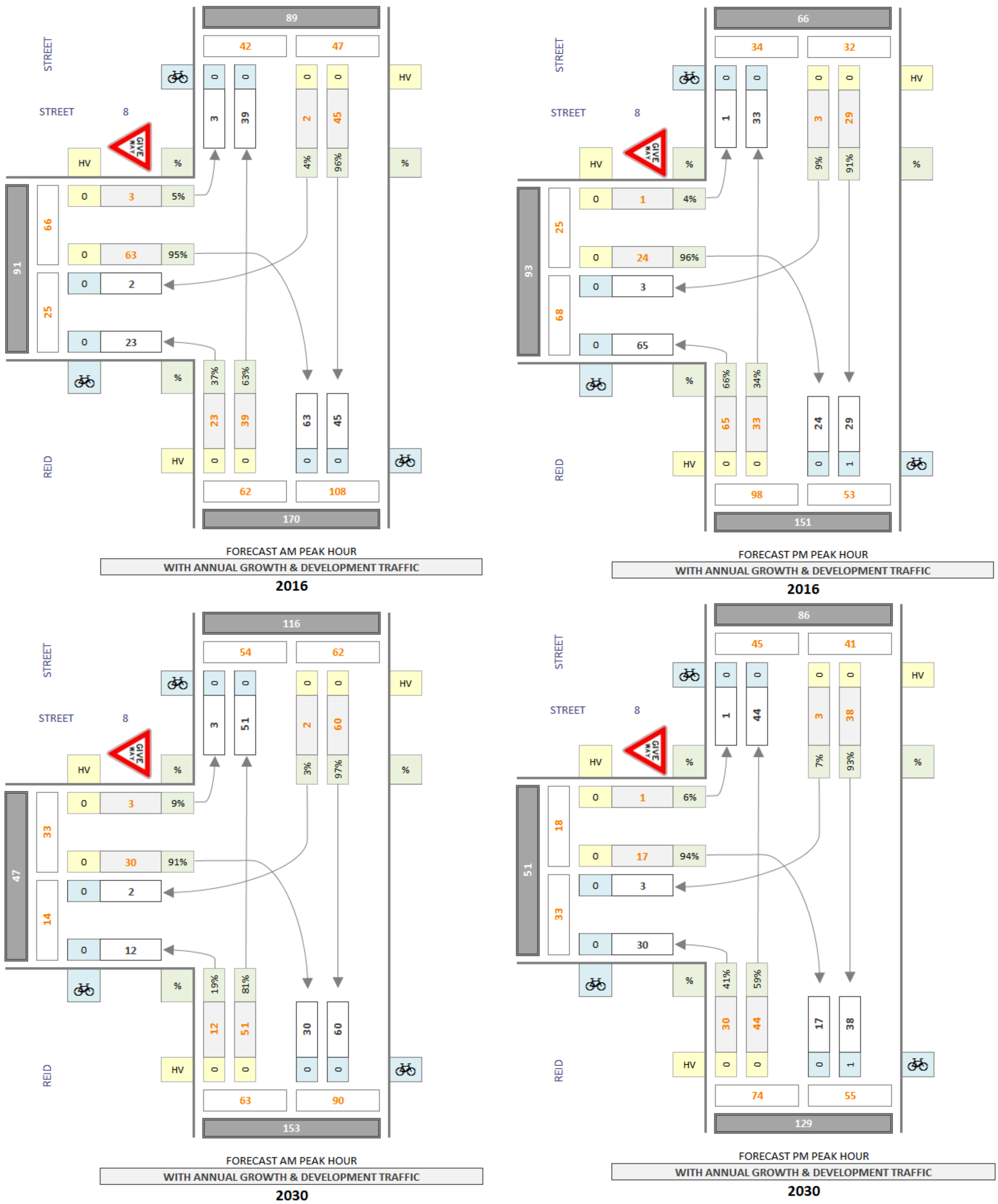
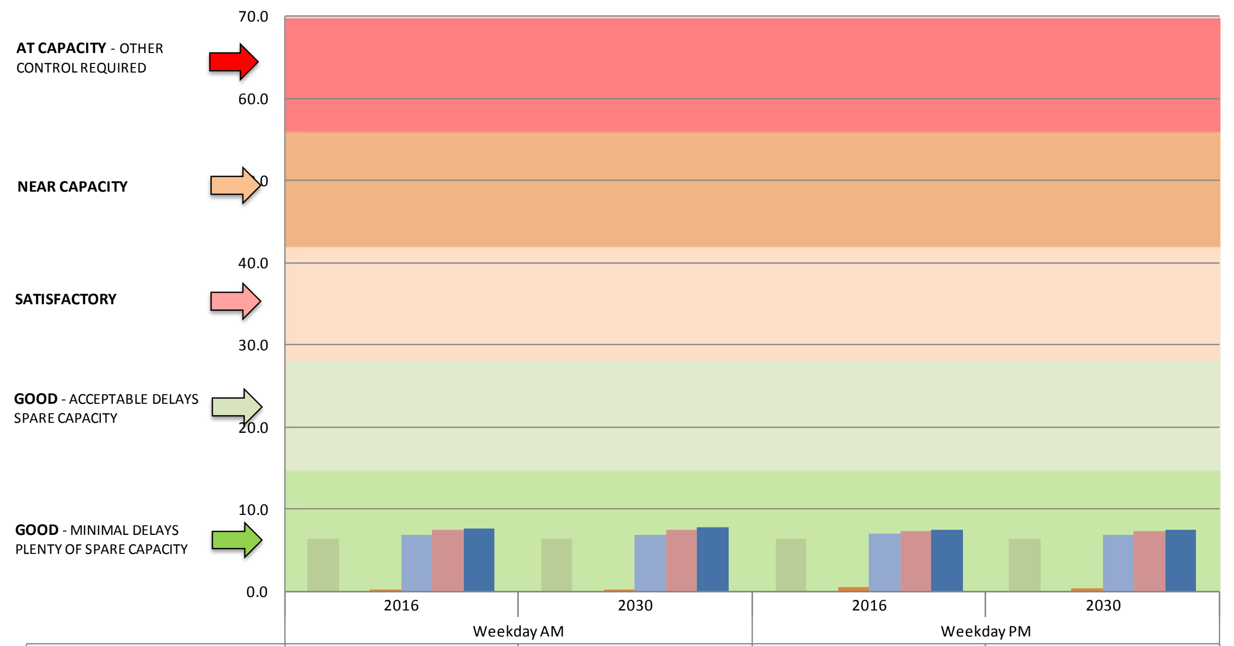


Figure 36 – Street 8/ Reid Street: 2016 & 2030 Forecast Volumes

A comparison of 2016 and 2030 intersection performance criteria (Average Delay) is shown in **Figure 37**. A summary of all intersection performance criteria is included in the relevant *SIDRA Intersection* summary report in **Appendix C** for 2016 and **Appendix D** for 2030.



	Weekday AM 2016	Weekday AM 2030	Weekday PM 2016	Weekday PM 2030
Reid left into Street 8	6.4	6.4	6.4	6.4
Reid northbound straight through	0.0	0.0	0.0	0.0
Reid southbound straight through	0.2	0.2	0.4	0.3
Reid right into Street 8	6.9	6.9	7.0	6.9
Street 8 left into Reid	7.4	7.5	7.3	7.3
Street 8 right into Reid	7.6	7.7	7.5	7.5

Figure 37 – Street 8/ Reid Street – Peak Hour Intersection Performance comparison

Figure 37 indicates that the new T junction is expected to perform with minimal delays for all movements with plenty of spare capacity.

4.5.8 Kennedy Street/ Learmonth Street

This intersection is a new T junction within the *Nimitz Street ODP* Area with Learmonth Street as the terminating road under default Give Way control. The ultimate extension of Kennedy Street is not expected to be in place by 2016, at which time there will not be an intersection, merely a 90° bend between Kennedy Street & Learmonth Street. Hence the intersection assessment is for 2030 only.

Forecast volumes and turning movements for the Assessment Year of 2030 are shown in **Figure 38**.

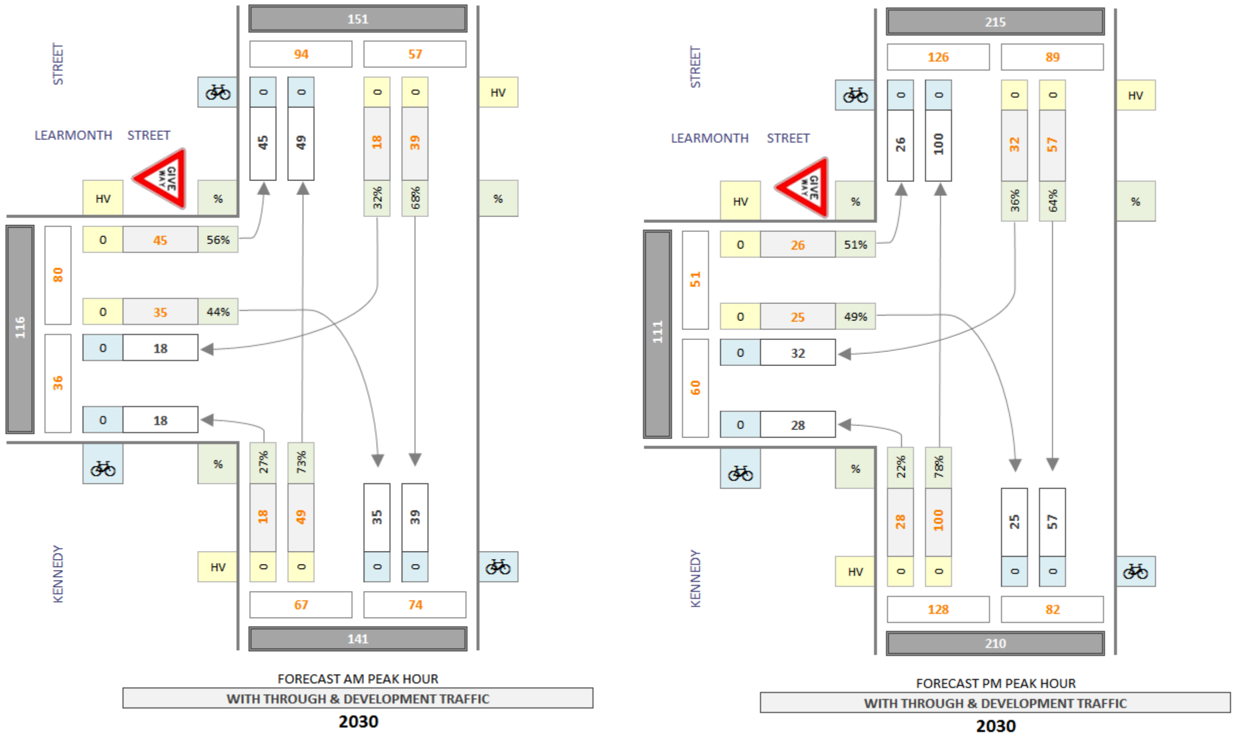
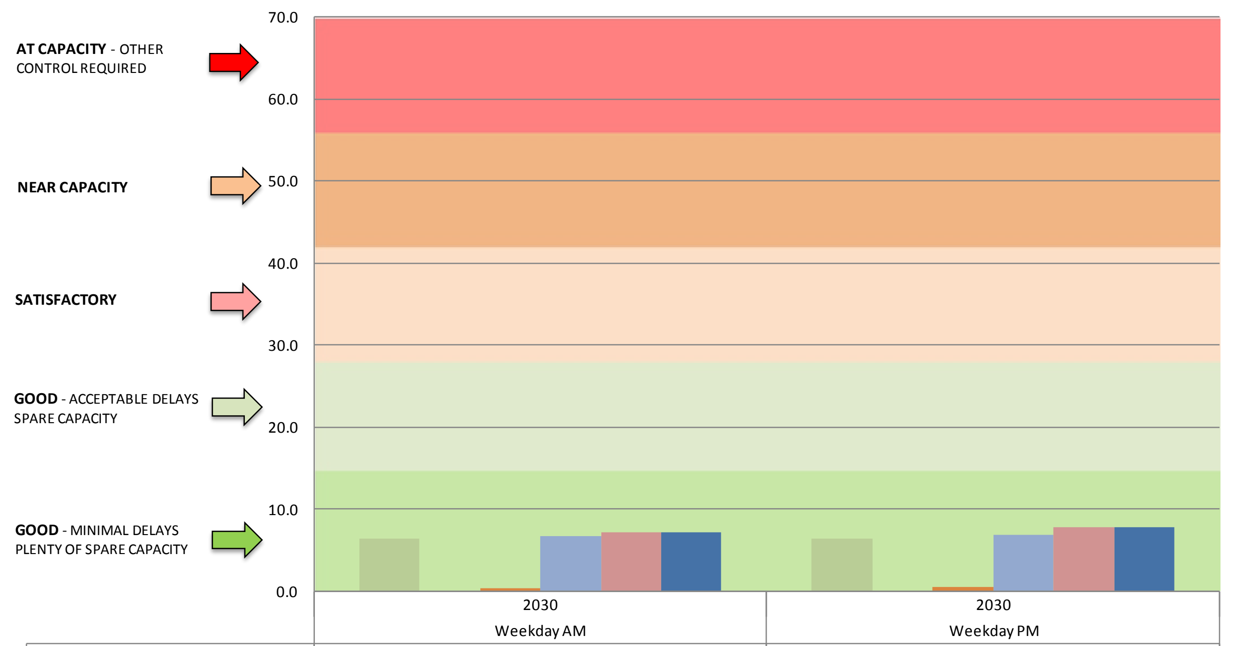


Figure 38 – Kennedy Street/ Learmonth Street: 2016 & 2030 Forecast Volumes

An assessment of the 2030 intersection performance criteria (Average Delay) is shown in **Figure 39**. A summary of all intersection performance criteria is included in the relevant *SIDRA Intersection* summary report in **Appendix D**.



	2030 Weekday AM	2030 Weekday PM
Kennedy left into Learmonth	6.4	6.4
Kennedy northbound straight through	0.0	0.0
Kennedy southbound straight through	0.3	0.5
Kennedy right into Leramonth	6.6	6.9
Learmonth left into Kennedy	7.1	7.8
Learmonth right into Kennedy	7.1	7.7

Figure 39 – Kennedy Street/ Learmonth Street – Peak hour Intersection Performance

Figure 39 indicates that the ultimate T junction is expected to perform with minimal delays for all movements with plenty of spare capacity.

4.6 CLEAR NETWORK

The *Nimitz Street ODP* has a clear route and street network based on function, traffic volumes and vehicle speeds. Public safety and amenity is provided through street and intersection layout and design and path provision.

4.7 PUBLIC TRANSPORT

As indicated in **Section 3.7**, Exmouth does not have a public transport service. The design and layout of the Connector Roads makes provision for bus routes to be established along these roads in the future.

4.8 PEDESTRIANS, CYCLISTS AND 'EASY ACCESS'

The *Liveable Neighbourhoods* approach to movement networks, street design and construction, and public transport has an emphasis upon connectivity, amenity, and integration to achieve safe, efficient and attractive street networks. The priority is to develop a street network that not only works for vehicles and public transport provision but specifically aims to attract a high level of use by pedestrians, cyclists and the disabled.

The layout of streets and lots within the *Nimitz Street ODP* area generally provide for residences fronting streets and create a relatively continuous street frontage for safe, attractive and efficient circulation of pedestrians, cyclists and drivers.

The *Nimitz Street ODP* has limited use of roundabouts as they are less conducive to pedestrians and cyclists, as well as providing fewer breaks in flow to support vehicle access into and out of side streets.

Good cycling conditions and encouragement of cycling should be designed into the urban fabric. This includes such measures as bike parking facilities, slower vehicle speeds and low traffic volumes, appropriate lane widths along local streets to allow cyclists to share travel lanes with cars, marked cycle lanes on busy streets and shared paths and routes parallel to arterials with less traffic.

Bicycle 'arterial' routes should be identified to efficiently serve key destinations. These may predominantly comprise on-street cycling on local streets, where detailed street design has provided safe and comfortable conditions for heavier cycle use.

The majority of cycling for daily activities will be on streets. On busier streets close to activity centres, wider footpaths designed for use by pedestrians, cyclists, and other small wheeled vehicle users are recommended.

An overlay of the "Trails and Pathways Plan" with the proposed *Nimitz Street ODP* is provided as **Figure 40**. It shows that the 'Reid Street/ Learmonth Trailswest Path can easily be accommodated via a wide dual use path along the southern boundary of the new Learmonth Road extension.

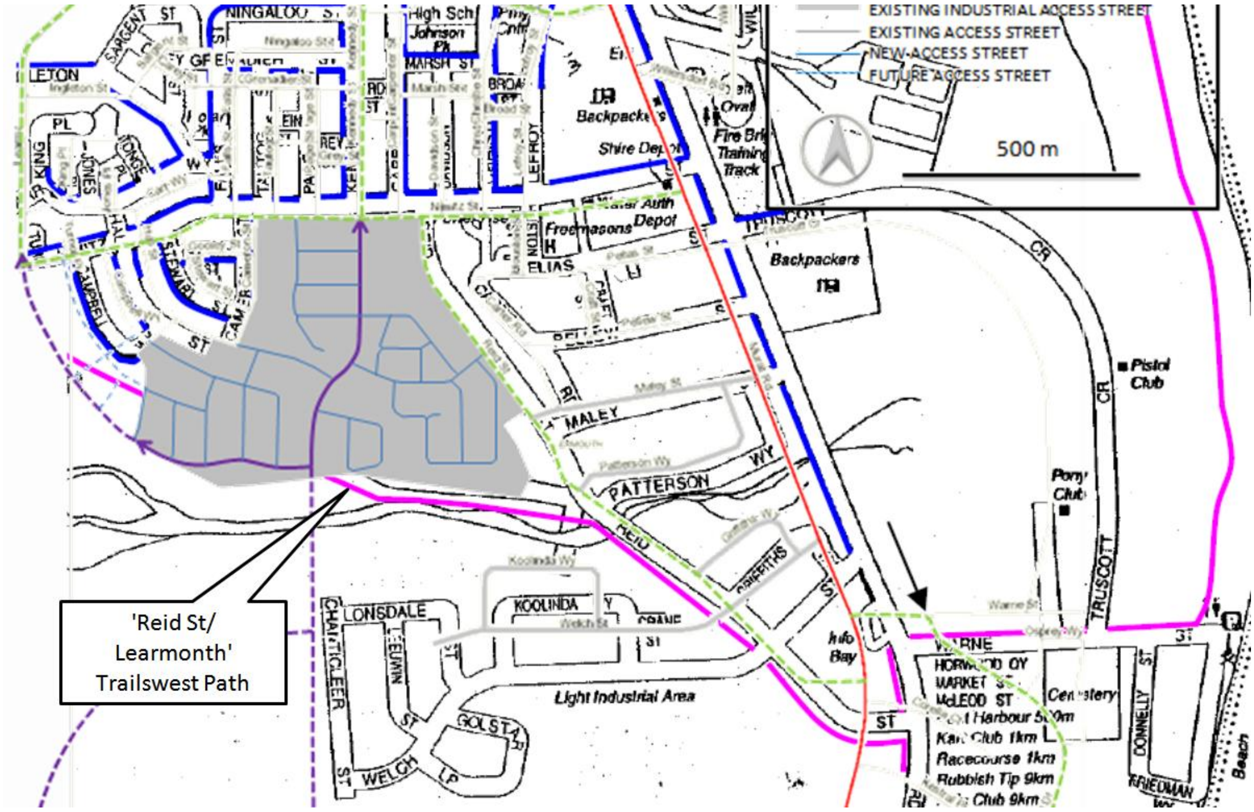


Figure 40 – Existing and proposed regional cycle network plan overlaid on *Nimitz Street ODP*

The Shire of Exmouth has a Policy (8.1 Multi Use Paths within the Exmouth Town Site) regarding the provision of dual use paths on existing and proposed streets. This policy is included as **Appendix G**. This *Transport Assessment* assumes that path provision for the *Nimitz Street ODP* is in accordance with this policy.

Figure 40 indicates that the *Nimitz Street ODP* is highly compatible with the existing and proposed cycle network plan for Exmouth. The selection of cross sections for routes and streets along the cycle network plan should ensure that appropriate facilities are incorporated for these commuting and recreational trips.

4.9 PROVISION FOR SAFE/ CONVENIENT ACCESS

Two of the principle aims of *Liveable Neighbourhoods* are:

- To provide for access generally by way of an interconnected network of streets which facilitate safe, efficient and pleasant walking, cycling and driving; and
- To facilitate new development which supports the efficiency of public transport systems where available, and provides safe, direct access to the system for residents.

Daily needs are generally within walking distance of most residents. With good design, more people will actively use local streets, enhancing safety.

Important aspects to consider in the design of new urban areas include how to establish an urban environment that can deliver improved social and community outcomes relative to conventional development. This aspect underlies the overall thrust of *Liveable Neighbourhoods*, with its focus on walkable mixed use communities that are well-served by services, facilities and public transport, and designed to create a special sense of place for each community.

This *Transport Assessment* is focussed on the street network within the *Nimitz Street ODP*. It has determined that the *ODP* provides for safe and convenient access throughout for vehicles, pedestrians and cyclists, both within the ODP area and on connections to the external road network.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSIONS

This assessment of existing and proposed transport issues has determined that:

- The development of the *Nimitz Street ODP* is specific to the needs of Exmouth, consistent with the Exmouth Townsite Structure Plan and has been carried out in accordance with best practice town centre principles and policies such as the Western Australian Planning Commission (*WAPC*) Document *Liveable Neighbourhoods;*
- There is a need for a Road Hierarchy consistent with *Liveable Neighbourhoods* to be developed and adopted for Exmouth as soon as possible to assist with sustainable planning processes and procedures.
- There is plenty of mid-block capacity on all of the assessed roads with current usage between 2% and 17% of capacity;
- There is plenty of spare capacity within all of the assessed intersections (existing and proposed with forecast volumes to 2030) with all intersections formally assessed as "Good with minimal delays and plenty of spare capacity";
- There is a 'disconnect' between the main Integrator (Arterial) Road (Murat Road) and the Town Centre. At present Murat Road tends to lead unfamiliar motorists past the turn off to the town centre (Maidstone Crescent). The Shire of Exmouth is currently investigating ways of addressing this through the Town Centre Plan and recommendations within the Exmouth Townsite Structure Plan. This includes 'reclassifying' Kennedy Street as a Neighbourhood Connector Road and extending this through the *Nimitz Street ODP* area to connect to Murat Road south of the Marina Precinct. This will provide a more direct route to the Town Centre for local traffic. Tourist traffic is expected to continue to access the Town Centre via Murat Road.
- There are no public transport facilities or services within the Exmouth townsite and no plans to provide these.
- The majority of residential roads have paths on at least one side and provide good connective pedestrian links to facilities through to the town centre.

5.2 RECOMMENDATIONS

It is recommended that:

- this *Transport Assessment* is used as the basis for development of the road and path network within the *Nimitz Street ODP*;
- appropriate cross sections are selected for sections of roads according to their function and adjacent land use, as described and indicated in **Section 4.4**.
- the Shire of Exmouth develops and adopts a Road Hierarchy consistent with *Liveable Neighbourhoods* to allow for sustainable planning processes and procedures;
- the disconnect between the Town Centre and Murat Road is addressed as soon as practicable;
- the 'Reid St/ Learmonth Road Trailswest bicycle/ pedestrian route is incorporated into the design of the Learmonth Road extension along its southern boundary.
- consideration is given to providing a small retail outlet within the *Nimitz Street ODP* to serve the daily needs of residents and thus reduce car trips to and from the town centre.

6. References

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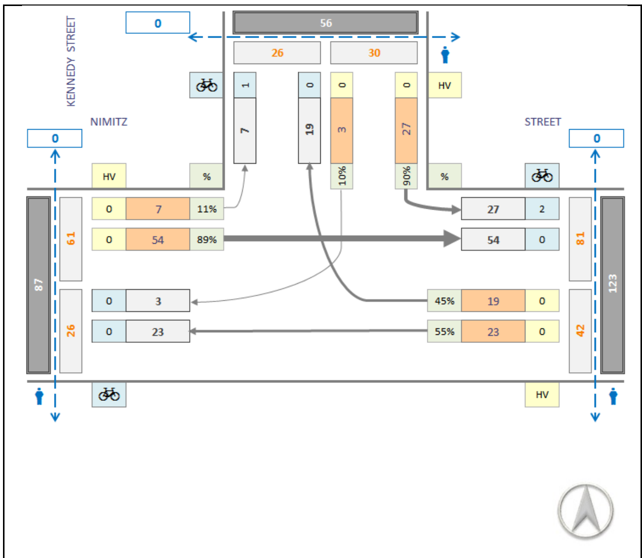
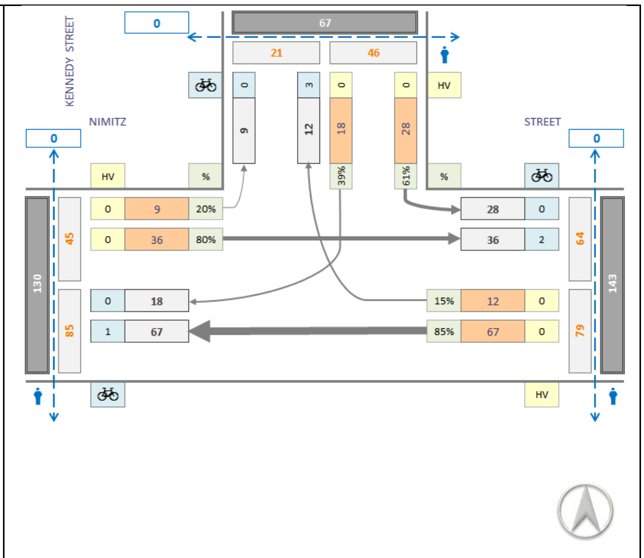
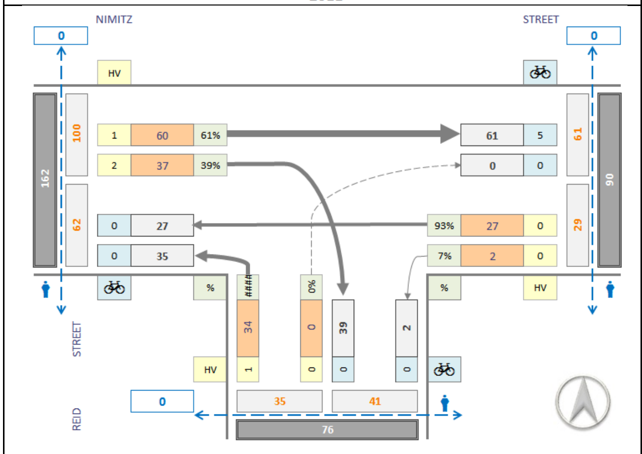
APPENDIX A SURVEYED TRAFFIC VOLUME DATA AT KEY INTERSECTIONS



SURVEYED AM PEAK HOUR
Thu 22 Dec 7.30 - 8.30 AM
2011



SURVEYED PM PEAK HOUR
Wed 21 Dec 4.30 - 5.30 AM
2011



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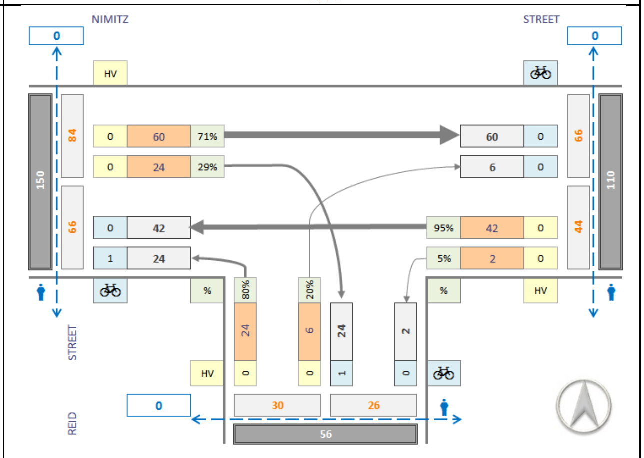
2011



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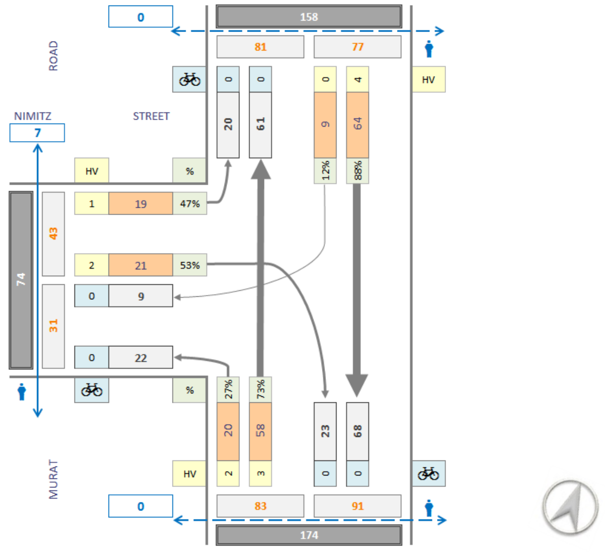
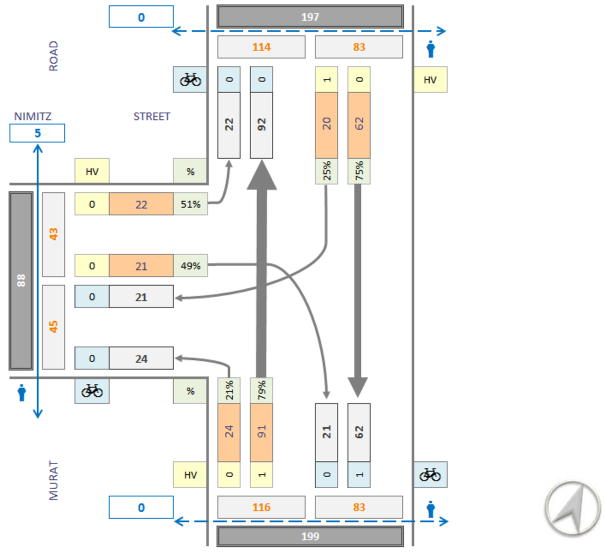
2011



SURVEYED AM PEAK HOUR
Fri 23 Dec 7.30 - 8.30 AM
2011



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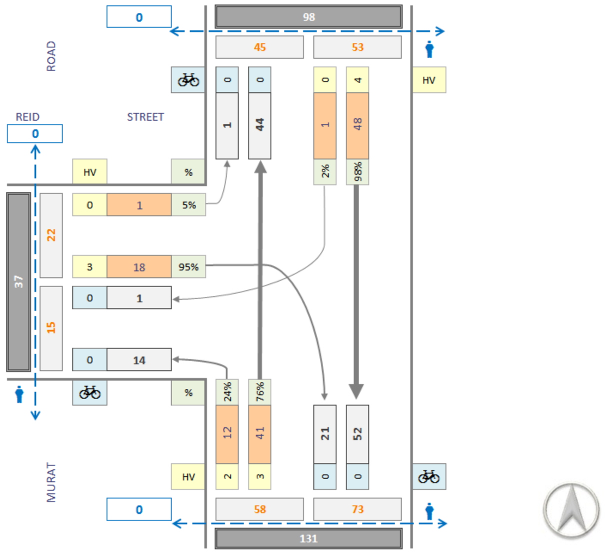
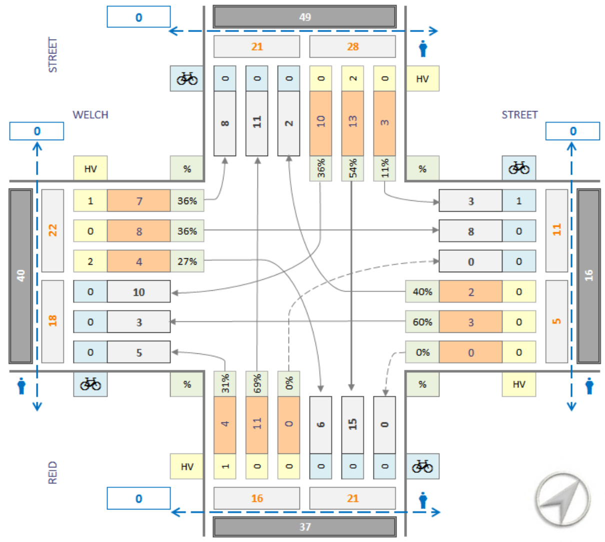
2011



SURVEYED AM PEAK HOUR
Fri 23 Dec 7.30 - 8.30 AM
2011

SURVEYED PM PEAK HOUR
Wed 21 Dec 4.30 - 5.30 AM
2011



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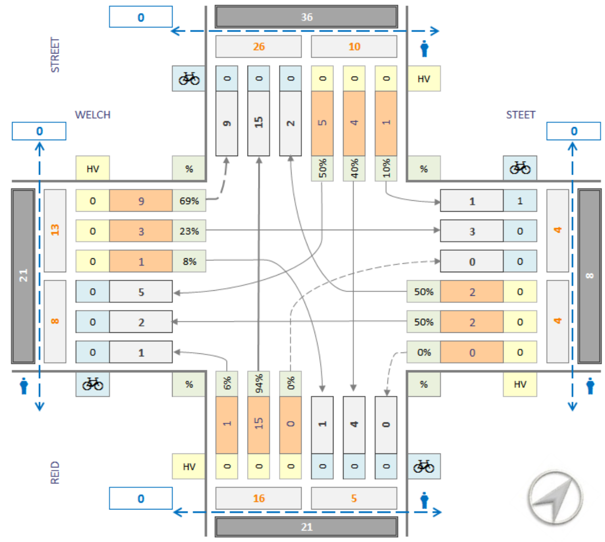
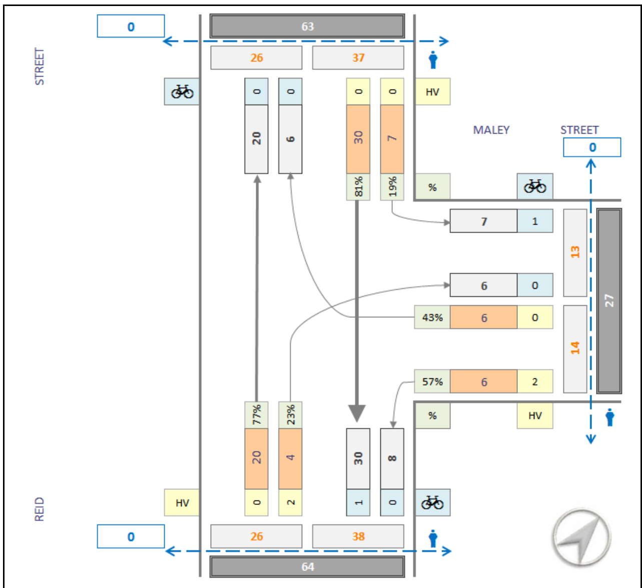
Fri 23 Dec 7.30 - 8.30 AM
2011



SURVEYED PM PEAK HOUR
Thu 22 Dec 4.30 - 5.30 PM
2011



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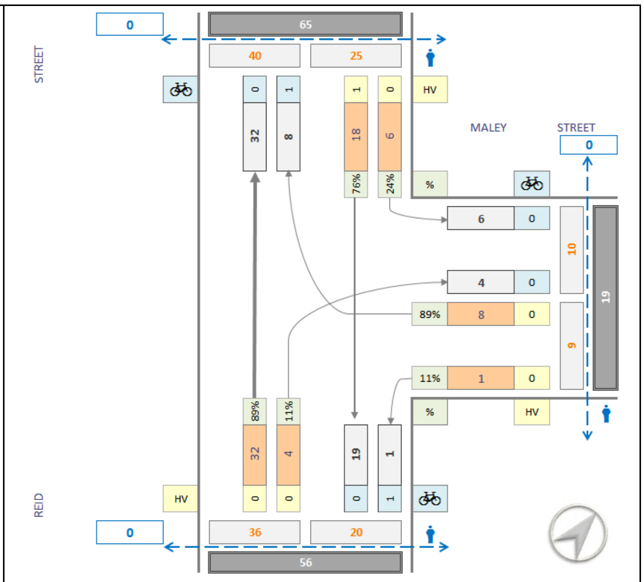

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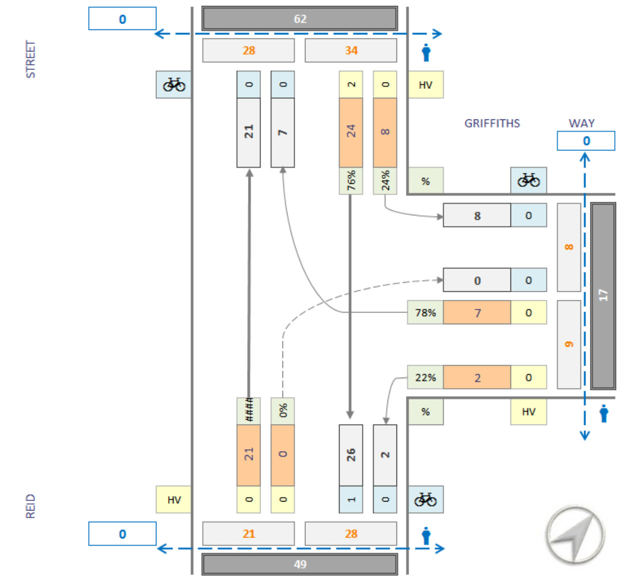
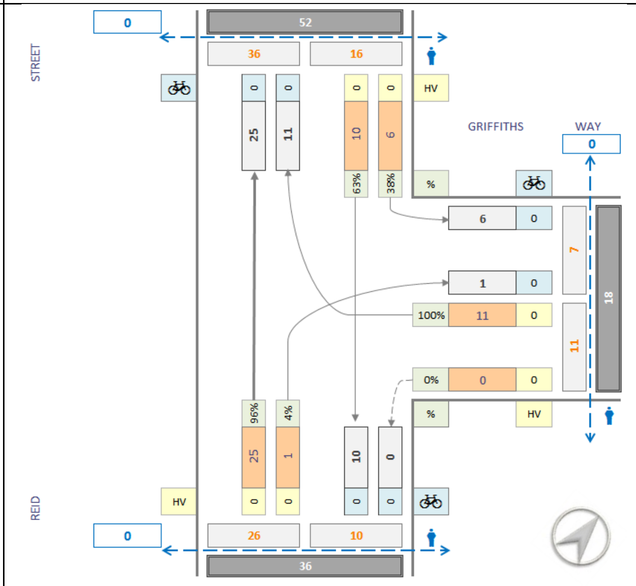


SURVEYED AM PEAK HOUR
Thu 22 Dec 7.30 - 8.30 AM
2011



SURVEYED PM PEAK HOUR
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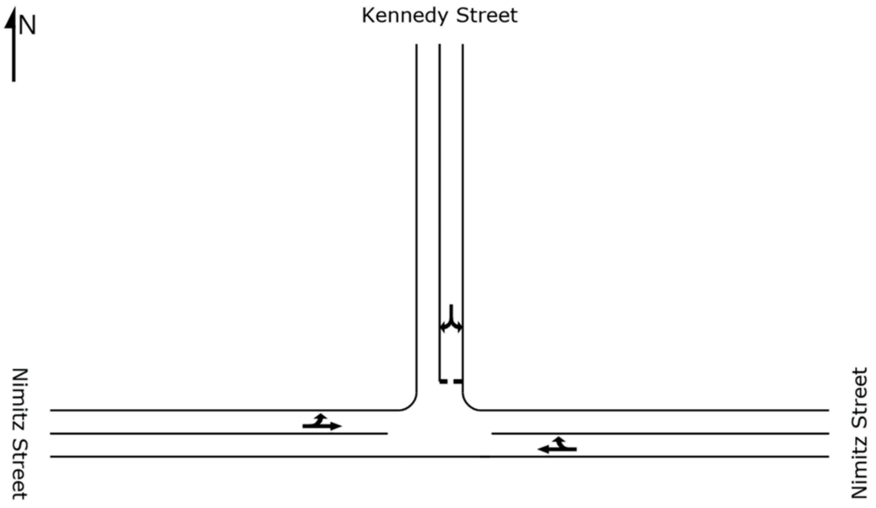
2011

APPENDIX B SIDRA REPORTS FOR EXISTING KEY INTERSECTIONS



MOVEMENT SUMMARY

Site: Nimitz St/ Kennedy St
Surveyed AM Peak Hour 2011

Movement Performance - Vehicles

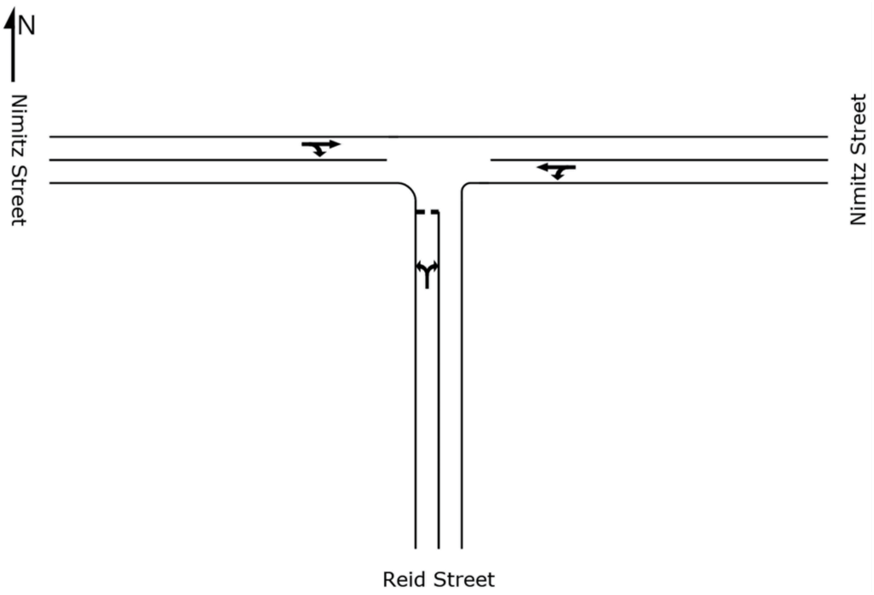
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Nimitz Street											
1	T	24	0.0	0.024	0.2	LOS A	0.1	0.8	0.17	0.00	47.5
2	R	20	0.0	0.024	7.1	LOS A	0.1	0.8	0.17	0.75	42.6
Approach		44	0.0	0.024	3.3	NA	0.1	0.8	0.17	0.34	45.2
North: Kennedy Street											
3	L	28	0.0	0.029	6.7	LOS A	0.1	0.7	0.16	0.57	42.7
4	R	3	0.0	0.029	7.2	LOS A	0.1	0.7	0.16	0.67	42.4
Approach		32	0.0	0.029	6.8	LOS A	0.1	0.7	0.16	0.58	42.7
West: Nimitz Street											
5	L	7	0.0	0.033	6.4	LOS A	0.0	0.0	0.00	0.87	43.3
6	T	57	0.0	0.033	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		64	0.0	0.033	0.7	NA	0.0	0.0	0.00	0.10	49.1
All Vehicles		140	0.0	0.033	2.9	NA	0.1	0.8	0.09	0.28	46.3

MOVEMENT SUMMARY

Site: Nimitz St/ Kennedy St
Surveyed PM Peak Hour 2011

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Nimitz Street											
1	T	71	0.0	0.044	0.2	LOS A	0.2	1.6	0.16	0.00	47.9
2	R	13	0.0	0.044	7.1	LOS A	0.2	1.6	0.16	0.88	42.8
Approach		83	0.0	0.044	1.2	NA	0.2	1.6	0.16	0.13	47.1
North: Kennedy Street											
3	L	29	0.0	0.051	7.0	LOS A	0.2	1.3	0.15	0.55	42.7
4	R	19	0.0	0.051	7.5	LOS A	0.2	1.3	0.15	0.67	42.4
Approach		48	0.0	0.051	7.2	LOS A	0.2	1.3	0.15	0.60	42.6
West: Nimitz Street											
5	L	9	0.0	0.025	6.4	LOS A	0.0	0.0	0.00	0.83	43.3
6	T	38	0.0	0.025	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		47	0.0	0.025	1.3	NA	0.0	0.0	0.00	0.17	48.5
All Vehicles		179	0.0	0.051	2.8	NA	0.2	1.6	0.11	0.27	46.1



MOVEMENT SUMMARY

Site: Nimitz St/ Reid St
Surveyed AM Peak Hour 2011

Movement Performance - Vehicles

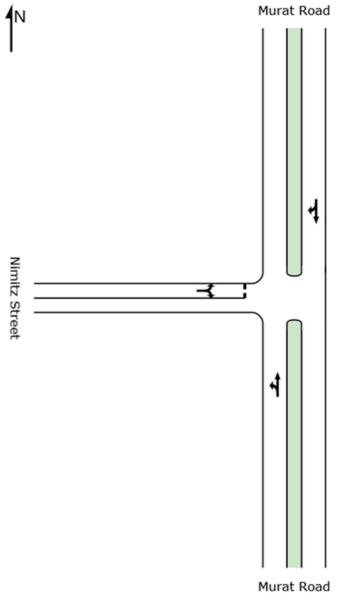
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Reid Street											
1	L	37	2.9	0.033	7.7	LOS A	0.1	0.8	0.10	0.61	48.1
2	R	1	0.0	0.033	8.1	LOS A	0.1	0.8	0.10	0.72	47.8
Approach		38	2.8	0.033	7.7	LOS A	0.1	0.8	0.10	0.61	48.1
East: Nimitz Street											
3	L	2	0.0	0.016	7.2	LOS A	0.0	0.0	0.00	0.87	43.8
4	T	28	0.0	0.016	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		31	0.0	0.016	0.5	NA	0.0	0.0	0.00	0.06	49.5
West: Nimitz Street											
5	T	63	0.0	0.055	0.1	LOS A	0.3	1.9	0.10	0.00	48.5
6	R	39	0.0	0.055	7.7	LOS A	0.3	1.9	0.10	0.80	43.2
Approach		102	0.0	0.055	3.0	NA	0.3	1.9	0.10	0.30	46.3
All Vehicles		171	0.6	0.055	3.6	NA	0.3	1.9	0.08	0.33	47.2

MOVEMENT SUMMARY

Site: Nimitz St/ Reid St
Surveyed PM Peak Hour 2011

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Reid Street											
1	L	25	0.0	0.031	7.8	LOS A	0.1	0.8	0.13	0.59	48.0
2	R	6	0.0	0.031	8.3	LOS A	0.1	0.8	0.13	0.70	47.6
Approach		32	0.0	0.031	7.9	LOS A	0.1	0.8	0.13	0.62	47.9
East: Nimitz Street											
3	L	2	0.0	0.024	7.2	LOS A	0.0	0.0	0.00	0.88	43.8
4	T	44	0.0	0.024	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		46	0.0	0.024	0.3	NA	0.0	0.0	0.00	0.04	49.7
West: Nimitz Street											
5	T	63	0.0	0.047	0.1	LOS A	0.2	1.7	0.13	0.00	48.2
6	R	25	0.0	0.047	7.8	LOS A	0.2	1.7	0.13	0.82	43.3
Approach		88	0.0	0.047	2.3	NA	0.2	1.7	0.13	0.23	46.6
All Vehicles		166	0.0	0.047	2.8	NA	0.2	1.7	0.10	0.25	47.7



MOVEMENT SUMMARY

Nimitz St/ Murat Rd Surveyed AM Peak Hour 2011

Movement Performance - Vehicles

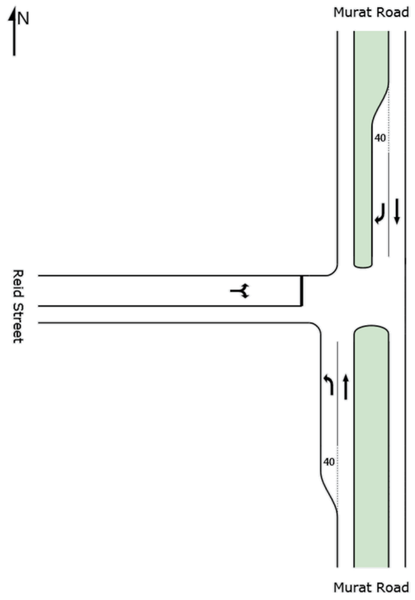
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Murat Road											
1	L	23	9.1	0.047	6.7	LOS A	0.0	0.0	0.00	0.81	43.3
2	T	64	4.9	0.047	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		87	6.0	0.047	1.8	NA	0.0	0.0	0.00	0.22	48.0
North: Murat Road											
3	T	72	5.9	0.045	0.3	LOS A	0.2	1.8	0.20	0.00	47.4
4	R	9	0.0	0.045	6.7	LOS A	0.2	1.8	0.20	0.77	43.1
Approach		81	5.2	0.045	1.1	NA	0.2	1.8	0.20	0.09	46.9
West: Nimitz Street											
5	L	21	5.0	0.054	7.6	LOS A	0.2	1.5	0.24	0.56	42.4
6	R	24	8.7	0.054	7.7	LOS A	0.2	1.5	0.24	0.61	42.4
Approach		45	7.0	0.054	7.6	LOS A	0.2	1.5	0.24	0.59	42.4
All Vehicles		214	5.9	0.054	2.7	NA	0.2	1.8	0.13	0.25	46.3

MOVEMENT SUMMARY

Site: Nimitz St/ Murat Rd Surveyed PM Peak Hour 2011

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Murat Road											
1	L	25	0.0	0.064	6.4	LOS A	0.0	0.0	0.00	0.83	43.3
2	T	97	1.1	0.064	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		122	0.9	0.064	1.3	NA	0.0	0.0	0.00	0.17	48.4
North: Murat Road											
3	T	65	0.0	0.051	0.5	LOS A	0.3	1.9	0.24	0.00	46.8
4	R	22	4.8	0.051	7.0	LOS A	0.3	1.9	0.24	0.73	43.0
Approach		87	1.2	0.051	2.1	NA	0.3	1.9	0.24	0.18	45.8
West: Nimitz Street											
5	L	24	4.3	0.055	7.7	LOS A	0.2	1.5	0.28	0.57	42.3
6	R	22	0.0	0.055	7.6	LOS A	0.2	1.5	0.28	0.62	42.3
Approach		46	2.3	0.055	7.7	LOS A	0.2	1.5	0.28	0.60	42.3
All Vehicles		256	1.2	0.064	2.7	NA	0.3	1.9	0.13	0.25	46.3



MOVEMENT SUMMARY

Site: Reid St/ Murat Rd
Surveyed AM Peak Hour 2011

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Murat Road											
1	L	15	14.3	0.009	8.7	LOS A	0.0	0.0	0.00	0.67	49.0
2	T	46	6.8	0.025	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		61	8.6	0.025	2.1	NA	0.0	0.0	0.00	0.16	56.9
North: Murat Road											
3	T	55	7.7	0.029	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
4	R	1	0.0	0.001	8.4	LOS A	0.0	0.0	0.15	0.60	48.3
Approach		56	7.5	0.029	0.2	NA	0.0	0.0	0.00	0.01	59.7
West: Reid Street											
5	L	1	0.0	0.033	11.8	LOS B	0.1	1.0	0.27	0.83	45.8
6	R	22	14.3	0.033	12.7	LOS B	0.1	1.0	0.27	0.87	45.8
Approach		23	13.6	0.033	12.6	LOS B	0.1	1.0	0.27	0.87	45.8
All Vehicles		140	9.0	0.033	3.1	NA	0.1	1.0	0.05	0.22	55.7

Movement Performance - Vehicles

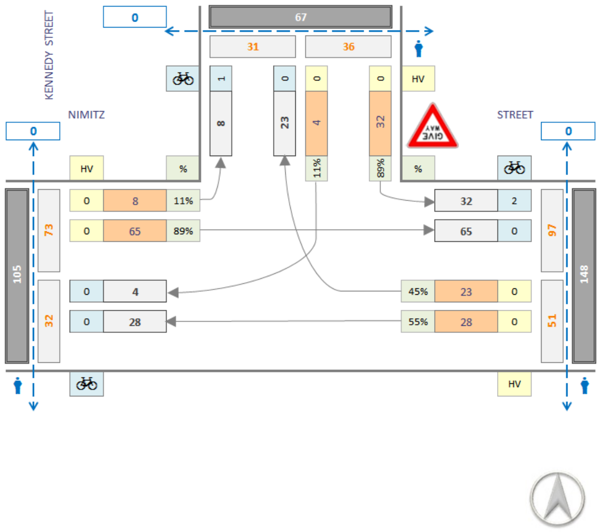
MOVEMENT SUMMARY

Site: Reid St/ Murat Rd
Surveyed PM Peak Hour 2011

Movement Performance - Vehicles

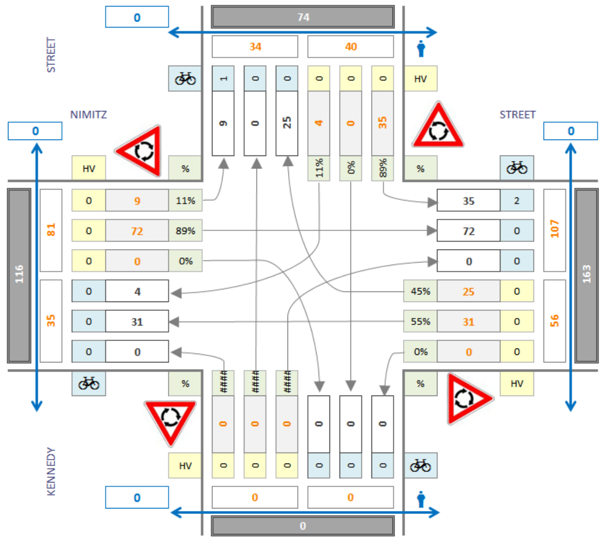
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Murat Road											
1	L	16	0.0	0.009	8.2	LOS A	0.0	0.0	0.00	0.67	49.0
2	T	59	1.8	0.031	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		75	1.4	0.031	1.7	NA	0.0	0.0	0.00	0.14	57.3
North: Murat Road											
3	T	34	3.1	0.018	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
4	R	11	0.0	0.009	8.5	LOS A	0.0	0.2	0.16	0.61	48.2
Approach		44	2.4	0.018	2.0	NA	0.0	0.2	0.04	0.15	56.7
West: Reid Street											
5	L	1	0.0	0.020	11.6	LOS B	0.1	0.5	0.25	0.84	46.0
6	R	15	0.0	0.020	11.6	LOS B	0.1	0.5	0.25	0.87	46.0
Approach		16	0.0	0.020	11.6	LOS B	0.1	0.5	0.25	0.87	46.0
All Vehicles		135	1.6	0.031	3.0	NA	0.1	0.5	0.04	0.23	55.5

APPENDIX C 2016 KEY INTERSECTION VOLUME CALCULATIONS



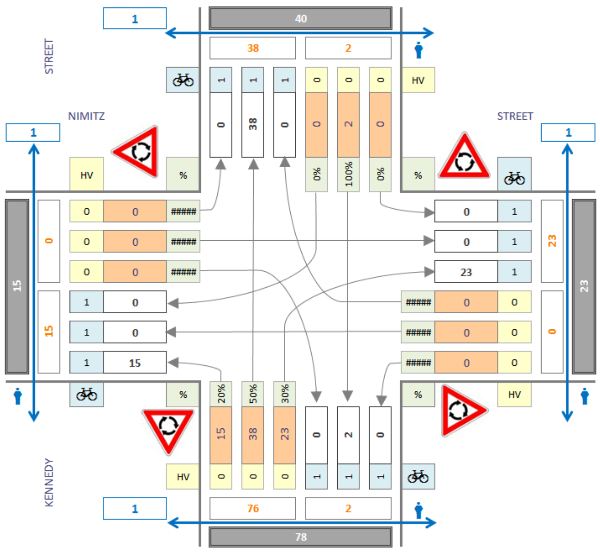
AVERAGE WEEKDAY AM PEAK HOUR

2011



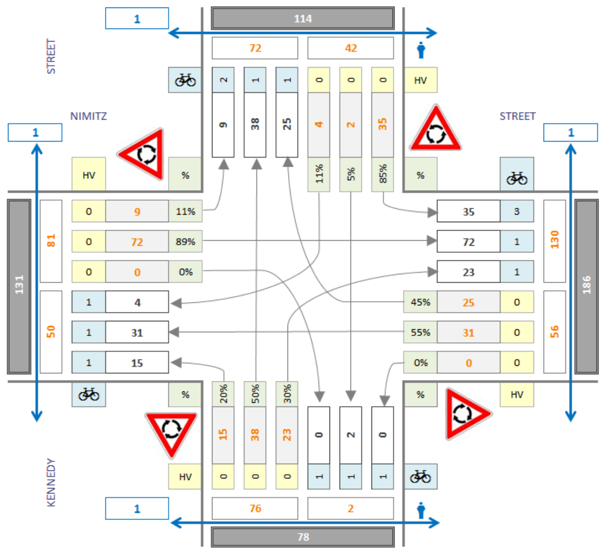
FORECAST AM PEAK HOUR
WITH ANNUAL GROWTH OF 2% in 5 YEARS

2016



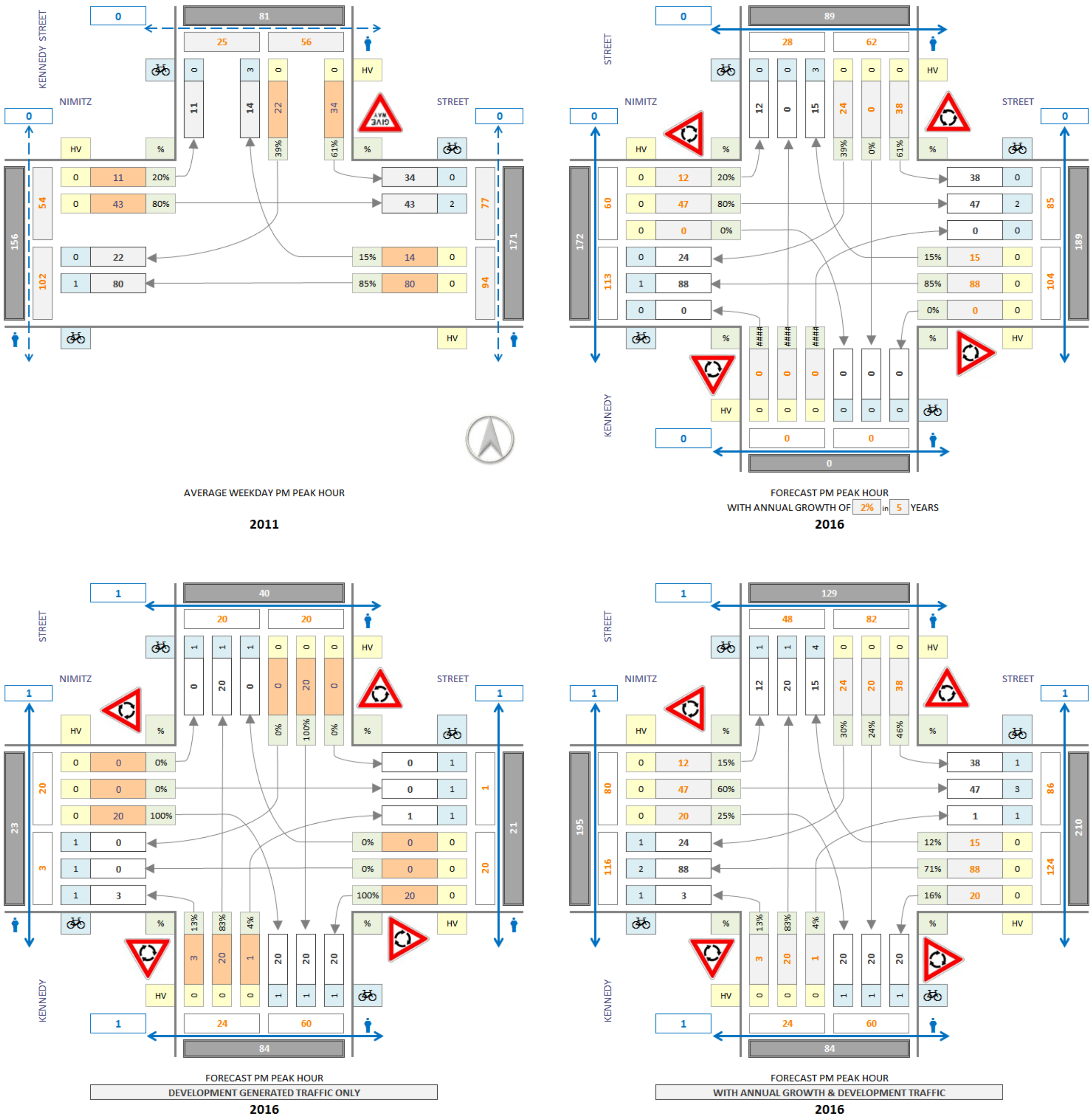
FORECAST AM PEAK HOUR
DEVELOPMENT GENERATED TRAFFIC ONLY

2016



FORECAST AM PEAK HOUR
WITH ANNUAL GROWTH & DEVELOPMENT TRAFFIC

2016


AVERAGE WEEKDAY PM PEAK HOUR
2011
FORECAST PM PEAK HOUR
WITH ANNUAL GROWTH OF 2% in 5 YEARS
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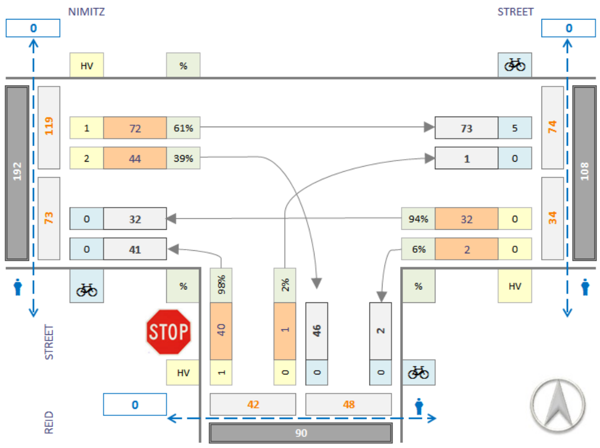
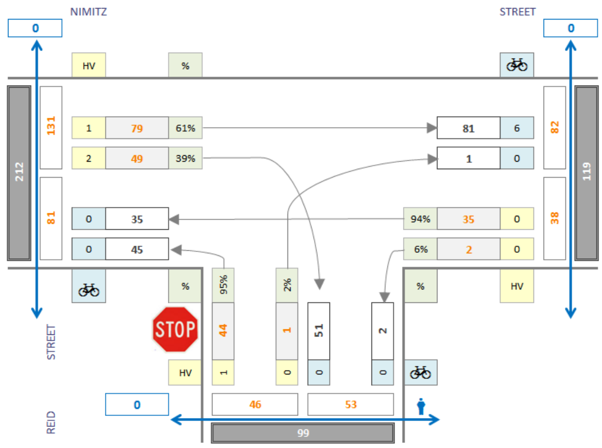
FORECAST PM PEAK HOUR
DEVELOPMENT GENERATED TRAFFIC ONLY
2016
FORECAST PM PEAK HOUR
WITH ANNUAL GROWTH & DEVELOPMENT TRAFFIC
2016



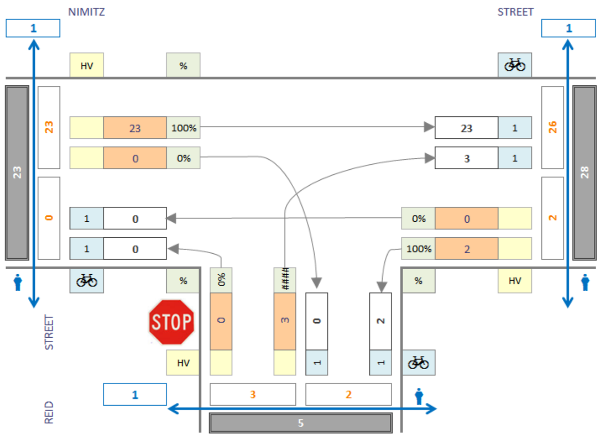
AVEARGE WEEKDAY AM PEAK HOUR

2011



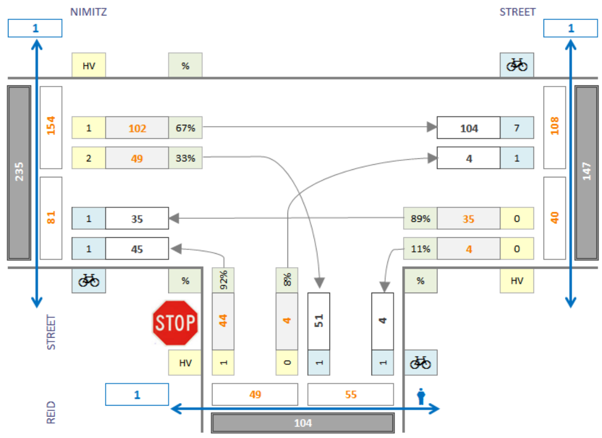
FORECAST AM PEAK HOUR
WITH ANNUAL GROWTH OF 2% in 5 YEARS

2016



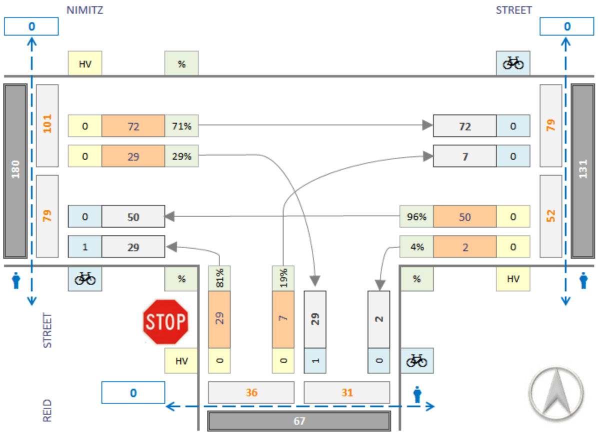
FORECAST AM PEAK HOUR
DEVELOPMENT GENERATED TRAFFIC ONLY

2016



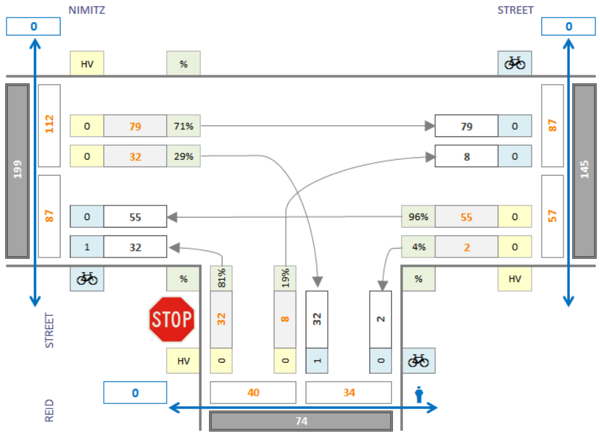
FORECAST AM PEAK HOUR
WITH ANNUAL GROWTH & DEVELOPMENT TRAFFIC

2016



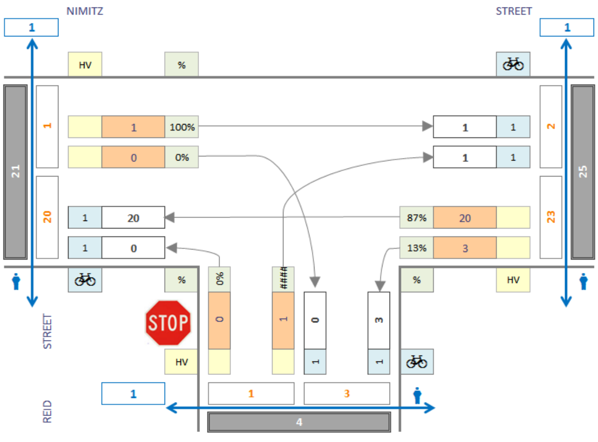
AVERAGE WEEKDAY PM PEAK HOUR

2011



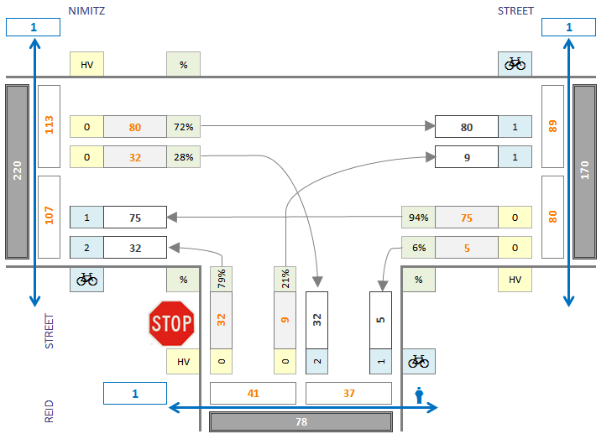
FORECAST PM PEAK HOUR
WITH ANNUAL GROWTH OF 2% in 5 YEARS

2016



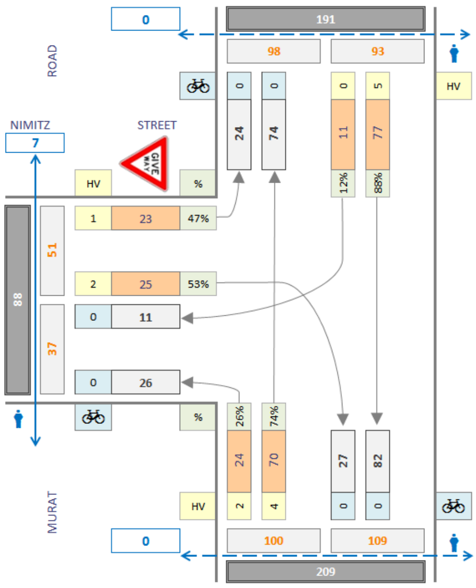
FORECAST PM PEAK HOUR
DEVELOPMENT GENERATED TRAFFIC ONLY

2016



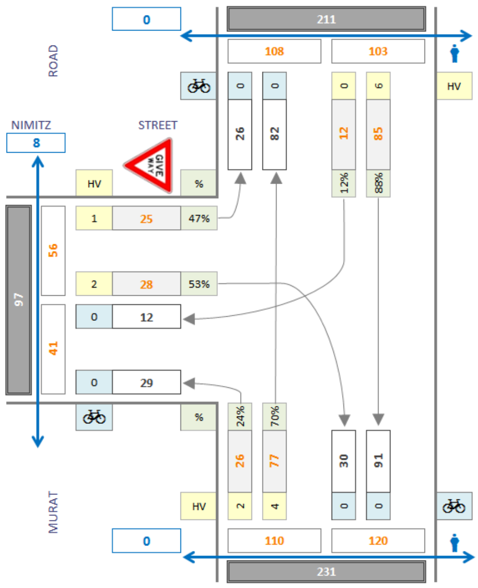
FORECAST PM PEAK HOUR
WITH ANNUAL GROWTH & DEVELOPMENT TRAFFIC

2016



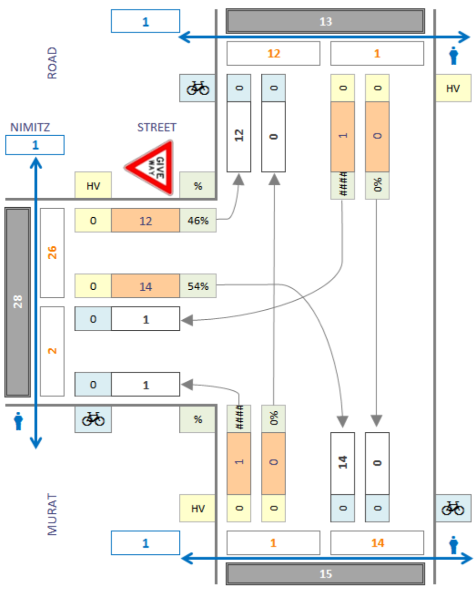
AVERAGE WEEKDAY AM PEAK HOUR

2011



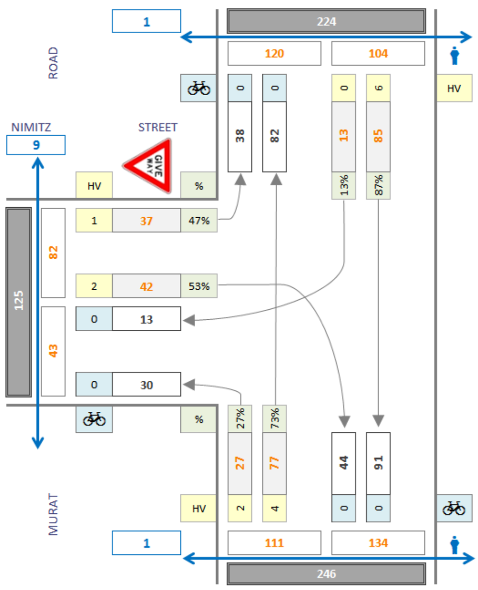
FORECAST AM PEAK HOUR
WITH ANNUAL GROWTH OF 2% in 5 YEARS

2016



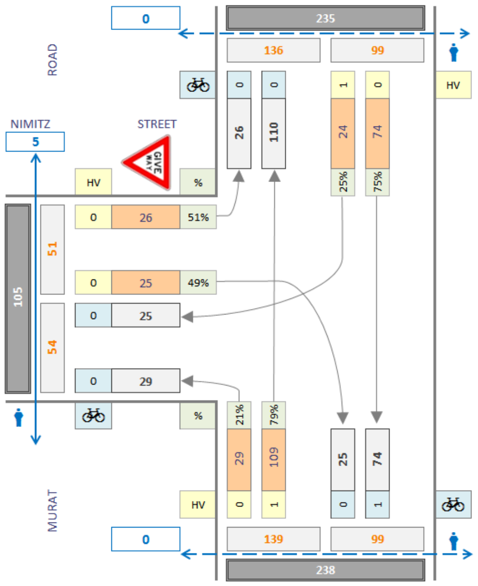
FORECAST AM PEAK HOUR
DEVELOPMENT GENERATED TRAFFIC ONLY

2016



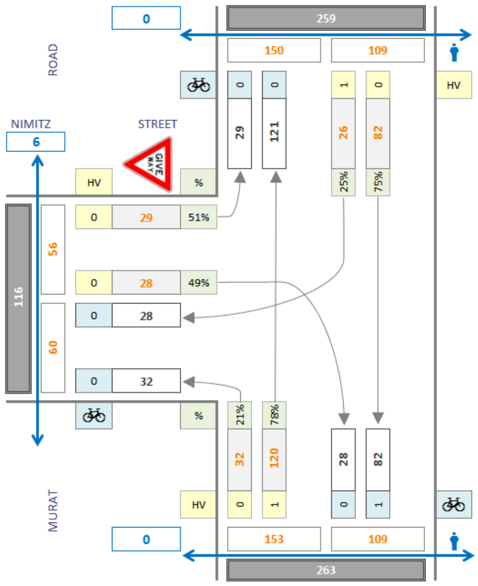
FORECAST AM PEAK HOUR
WITH ANNUAL GROWTH & DEVELOPMENT TRAFFIC

2016



AVERAGE WEEKDAY PM PEAK HOUR

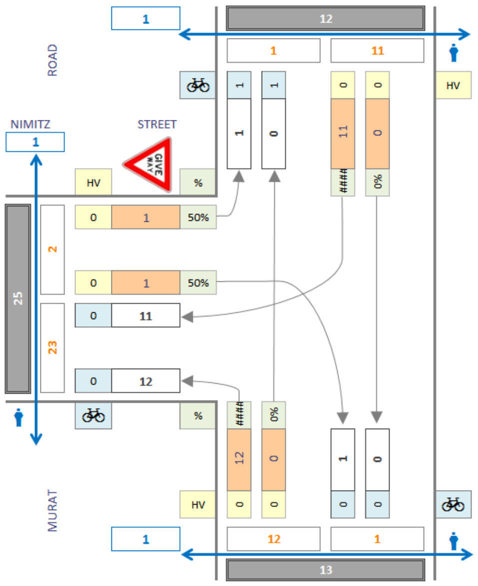
2011



FORECAST PM PEAK HOUR

WITH ANNUAL GROWTH OF 2% in 5 YEARS

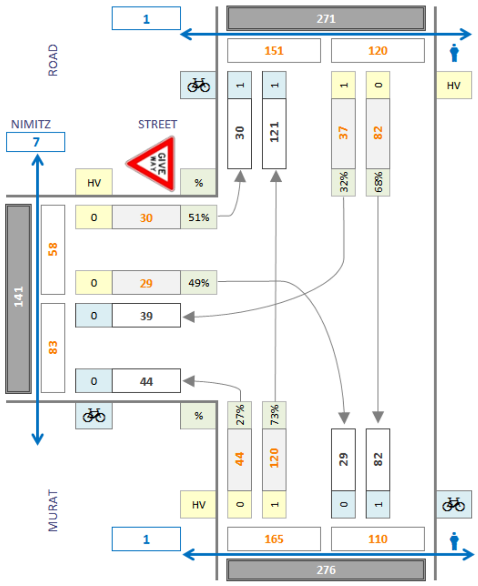
2016



FORECAST PM PEAK HOUR

DEVELOPMENT GENERATED TRAFFIC ONLY

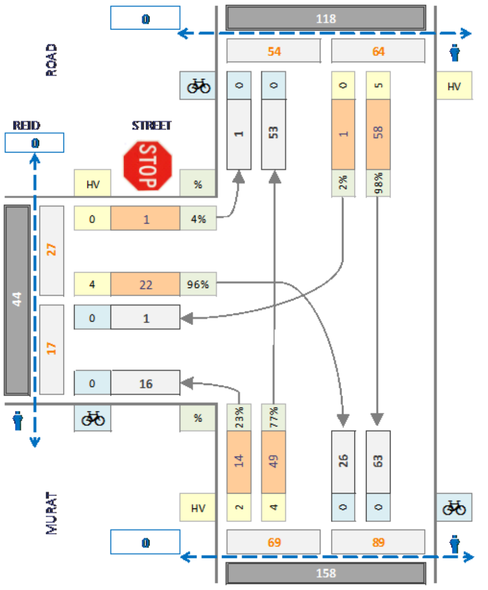
2016



FORECAST PM PEAK HOUR

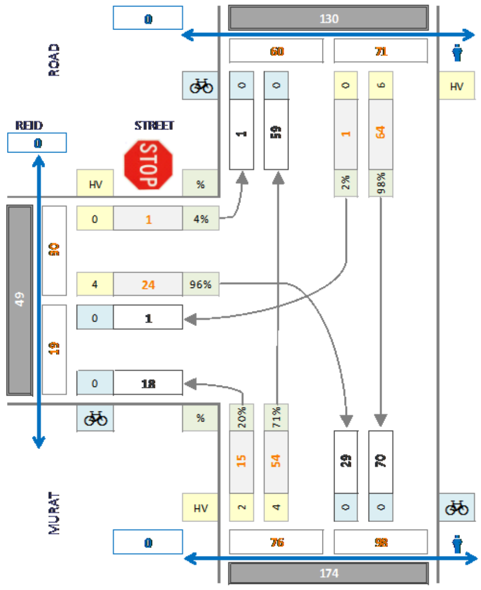
WITH ANNUAL GROWTH & DEVELOPMENT TRAFFIC

2016



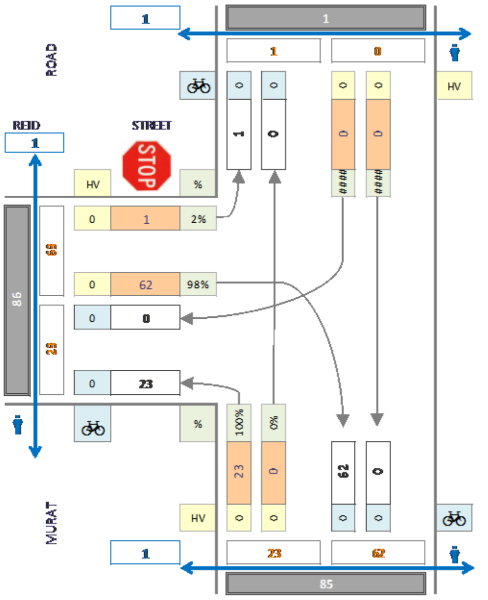
AVERAGE WEEKDAY AM PEAK HOUR

2011



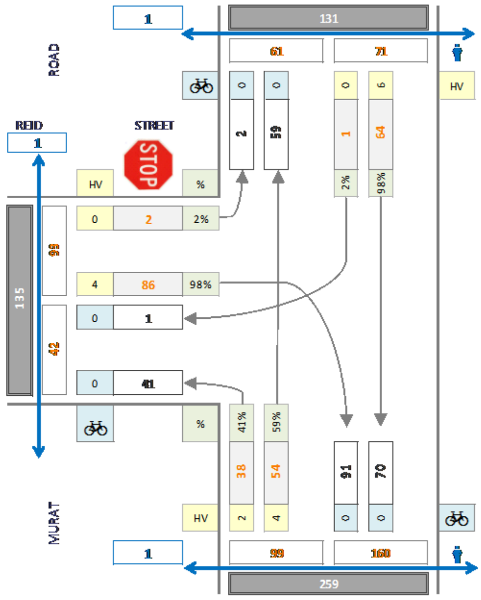
FORECAST AM PEAK HOUR
WITH ANNUAL GROWTH OF 2% in 5 YEARS

2016



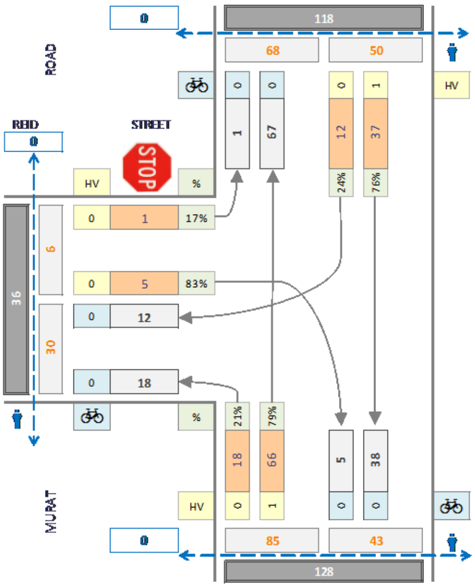
FORECAST AM PEAK HOUR
DEVELOPMENT GENERATED TRAFFIC ONLY

2016

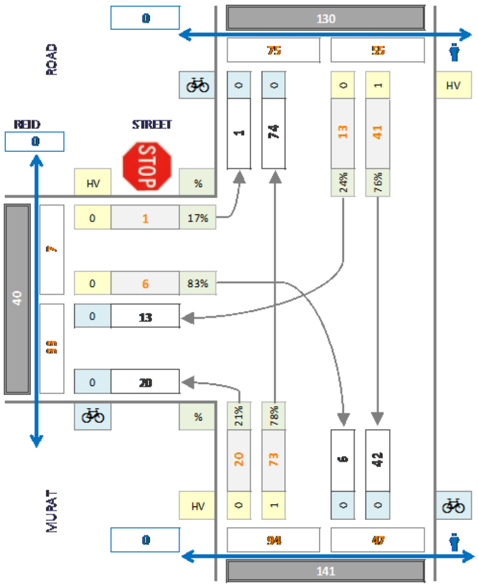


FORECAST AM PEAK HOUR
WITH ANNUAL GROWTH & DEVELOPMENT TRAFFIC

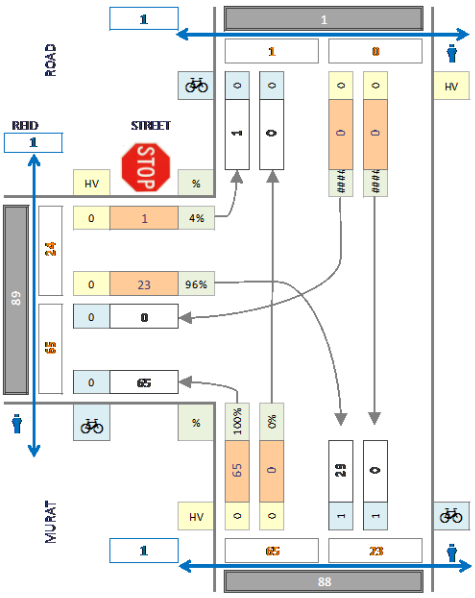
2016



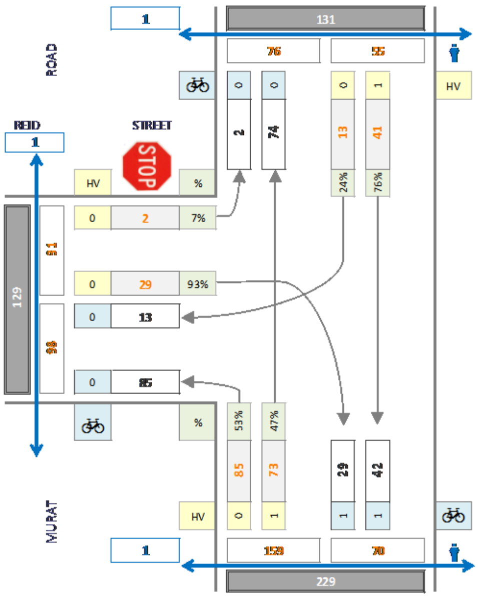
AVERAGE WEEKDAY PM PEAK HOUR
2011



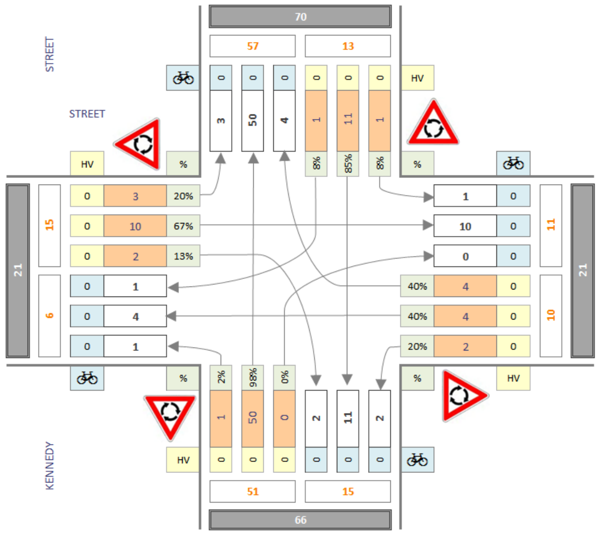
FORECAST PM PEAK HOUR
WITH ANNUAL GROWTH OF 2% in 5 YEARS
2016



FORECAST PM PEAK HOUR
DEVELOPMENT GENERATED TRAFFIC ONLY
2016



FORECAST PM PEAK HOUR
WITH ANNUAL GROWTH & DEVELOPMENT TRAFFIC
2016



FORECAST AM PEAK HOUR
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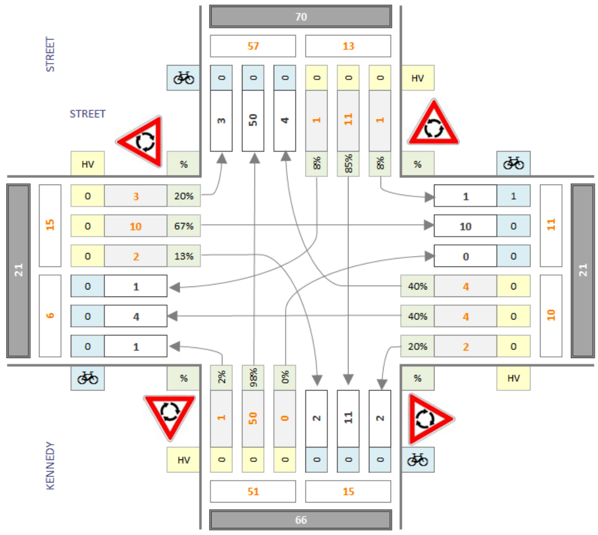
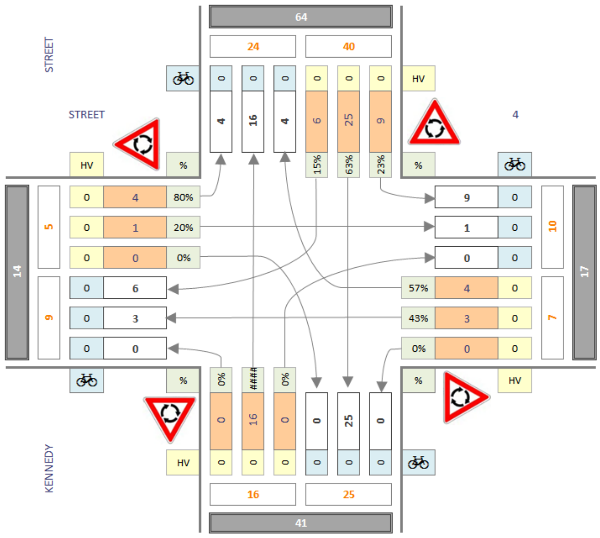
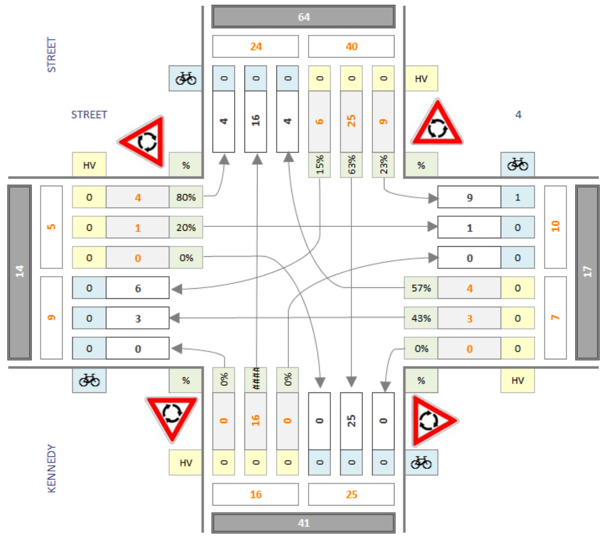
2016



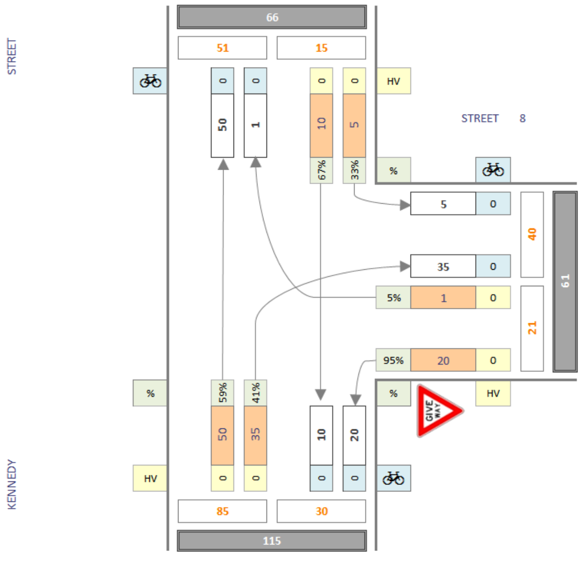
FORECAST AM PEAK HOUR
WITH ANNUAL GROWTH & DEVELOPMENT TRAFFIC
2016



FORECAST PM PEAK HOUR
DEVELOPMENT GENERATED TRAFFIC ONLY
2016



FORECAST PM PEAK HOUR
WITH ANNUAL GROWTH & DEVELOPMENT TRAFFIC
2016



FORECAST AM PEAK HOUR
DEVELOPMENT GENERATED TRAFFIC ONLY
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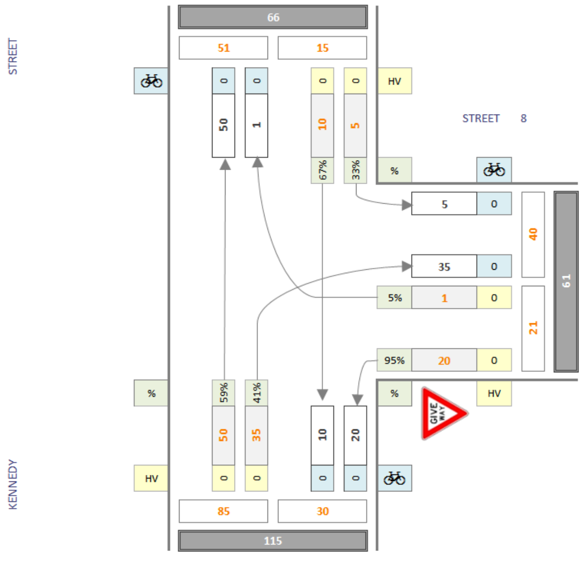
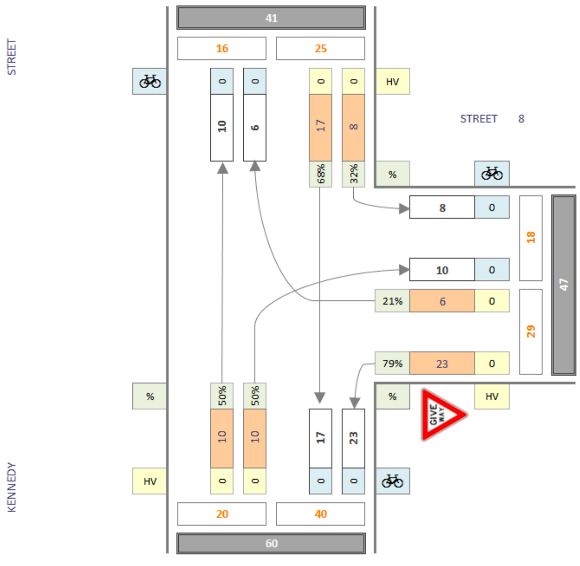


FORECAST AM PEAK HOUR
WITH ANNUAL GROWTH & DEVELOPMENT TRAFFIC
2016



FORECAST PM PEAK HOUR
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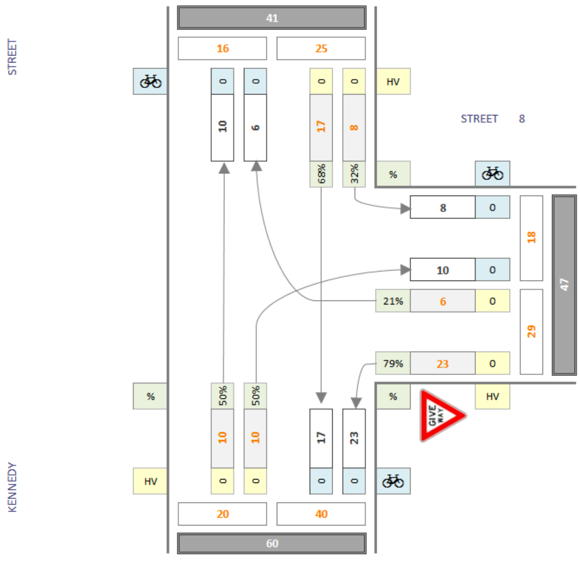

FORECAST PM PEAK HOUR
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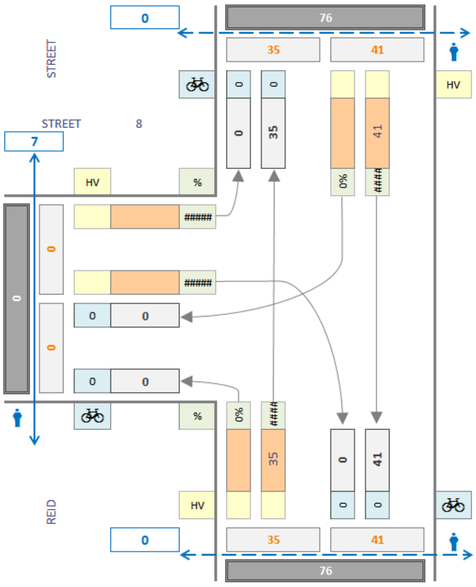
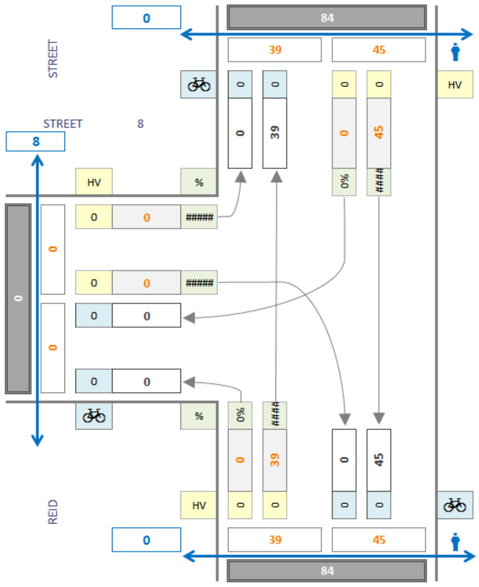
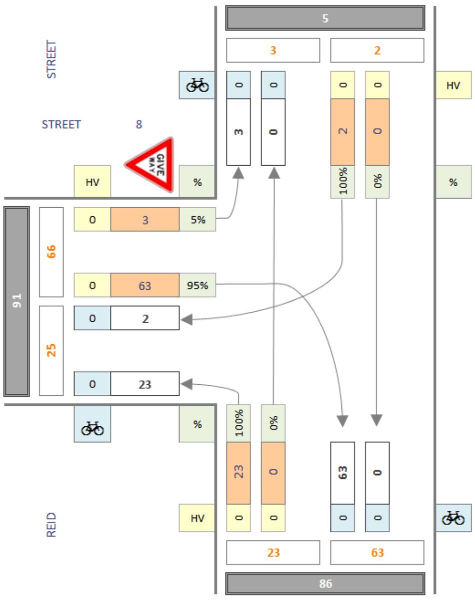
2016



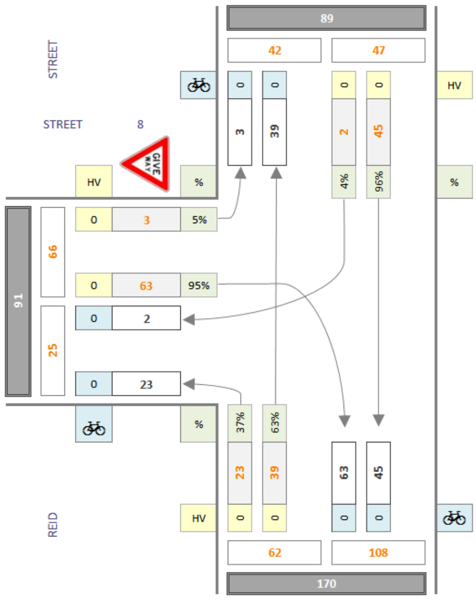
SURVEYED AM PEAK HOUR
Fri 23 Dec 7.30 - 8.30 AM
2011



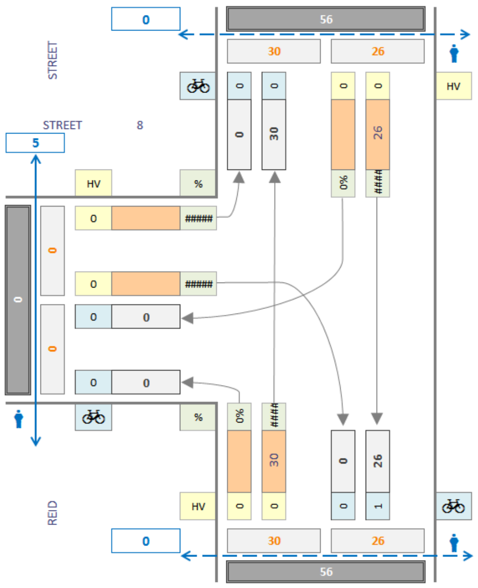
FORECAST AM PEAK HOUR
WITH ANNUAL GROWTH OF 2% in 5 YEARS
2016



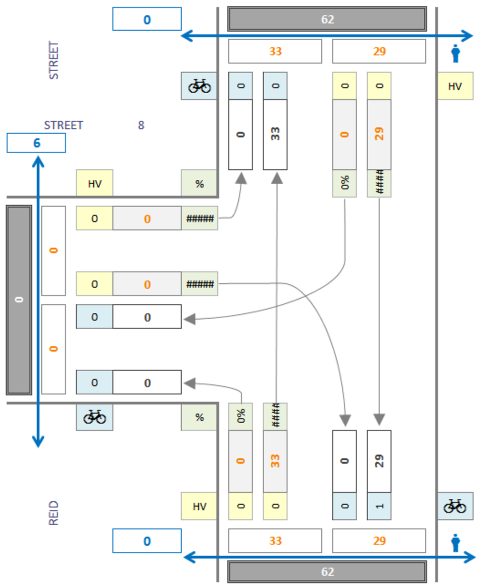
FORECAST AM PEAK HOUR
DEVELOPMENT GENERATED TRAFFIC ONLY
2016



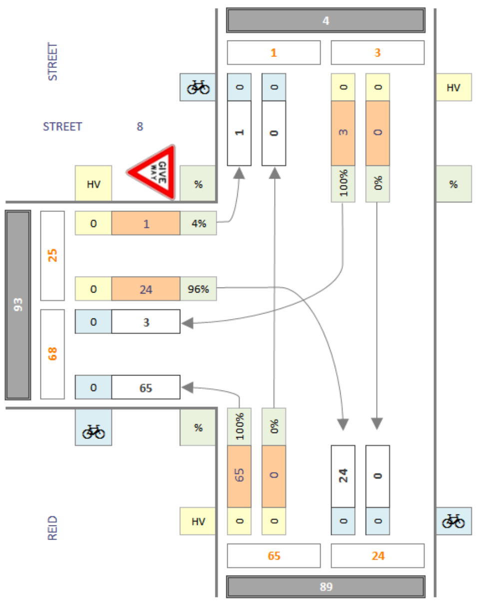
FORECAST AM PEAK HOUR
WITH ANNUAL GROWTH & DEVELOPMENT TRAFFIC
2016



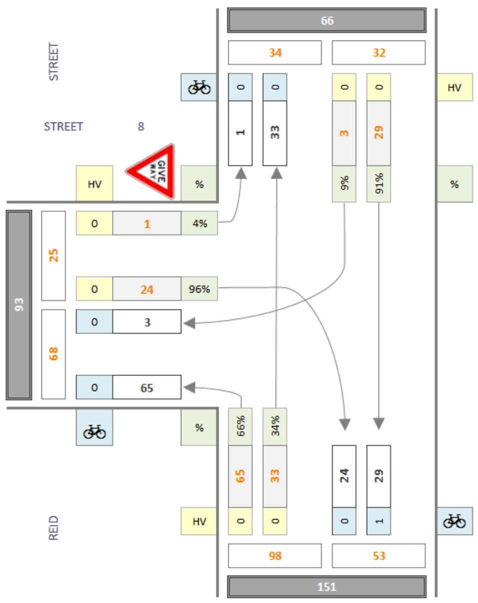
SURVEYED PM PEAK HOUR
Fri 23 Dec 7.30 - 8.30 AM
2011



FORECAST PM PEAK HOUR
WITH ANNUAL GROWTH OF 2% in 5 YEARS
2016

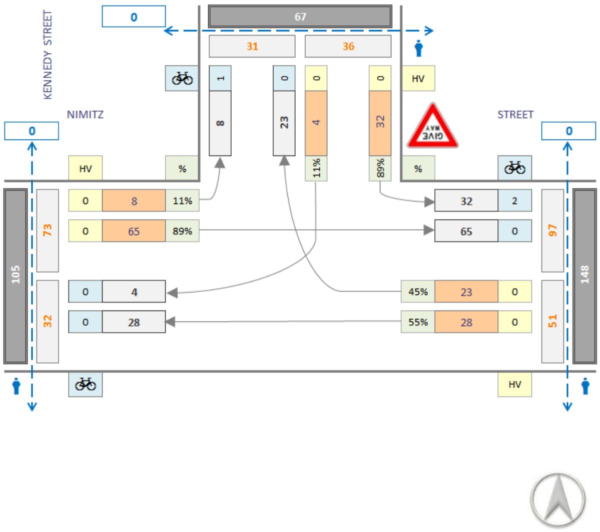


FORECAST PM PEAK HOUR
DEVELOPMENT GENERATED TRAFFIC ONLY
2016

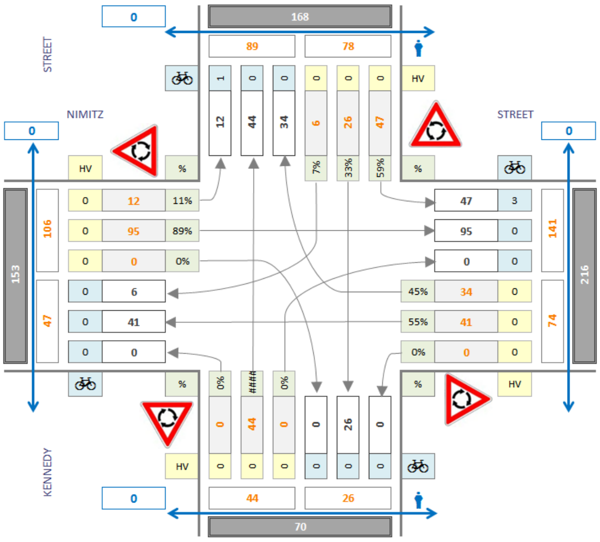


FORECAST PM PEAK HOUR
WITH ANNUAL GROWTH & DEVELOPMENT TRAFFIC
2016

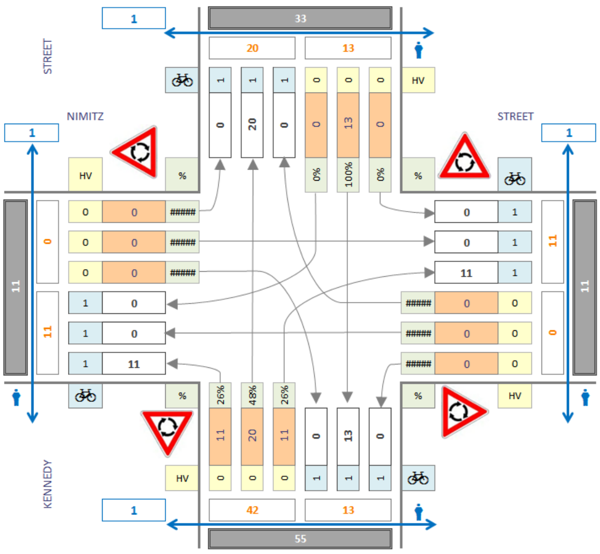
APPENDIX D 2030 KEY INTERSECTION VOLUME CALCULATIONS



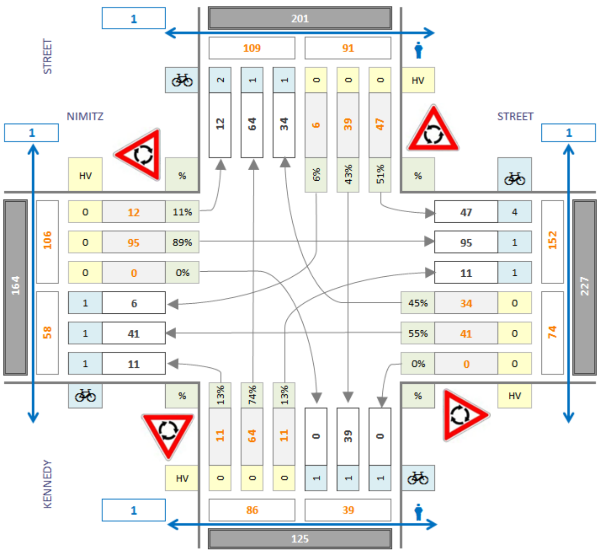
AVERAGE WEEKDAY AM PEAK HOUR
2011



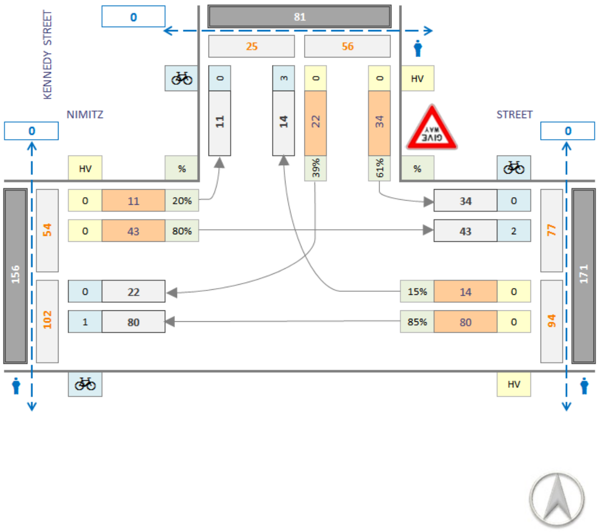
FORECAST AM PEAK HOUR
WITH ANNUAL GROWTH OF 2% in 19 YEARS
2030



FORECAST AM PEAK HOUR
DEVELOPMENT GENERATED TRAFFIC ONLY
2030

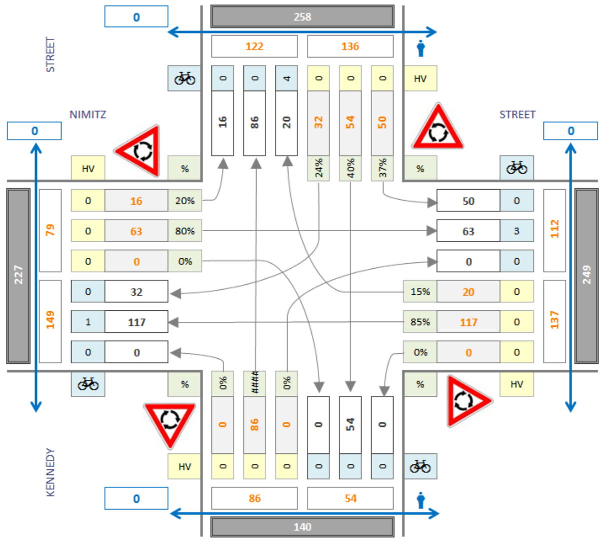


FORECAST AM PEAK HOUR
WITH THROUGH & DEVELOPMENT TRAFFIC
2030



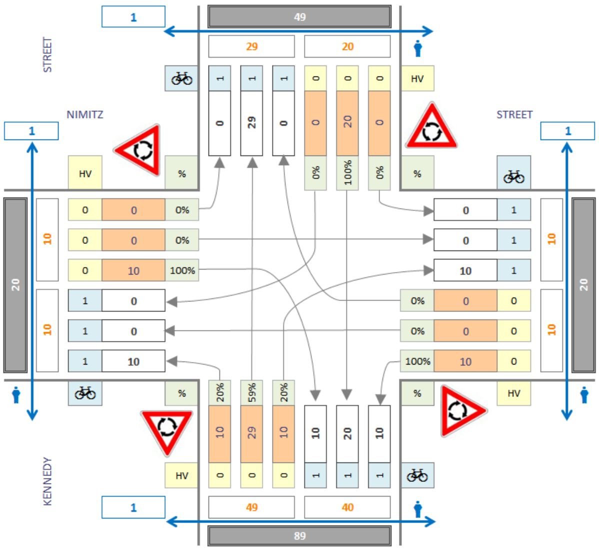
AVERAGE WEEKDAY PM PEAK HOUR

2011



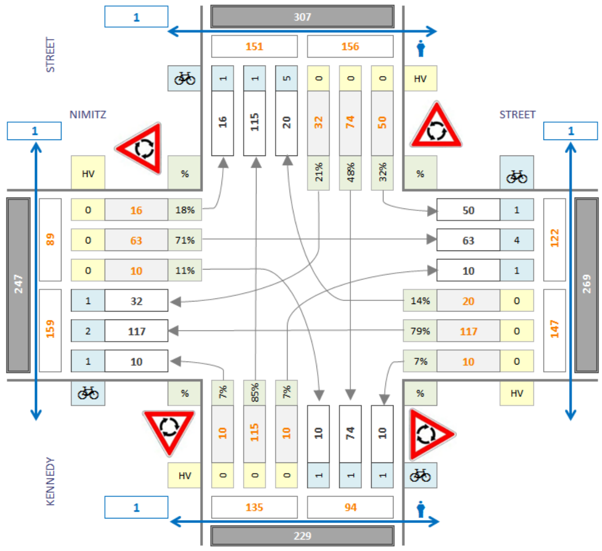
FORECAST PM PEAK HOUR
WITH ANNUAL GROWTH OF 2% in 19 YEARS

2030



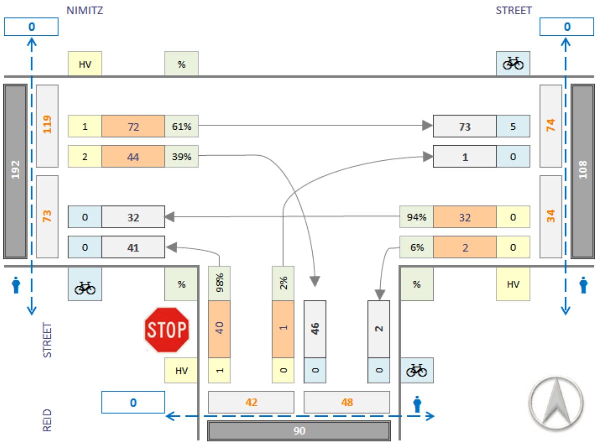
FORECAST PM PEAK HOUR
DEVELOPMENT GENERATED TRAFFIC ONLY

2030



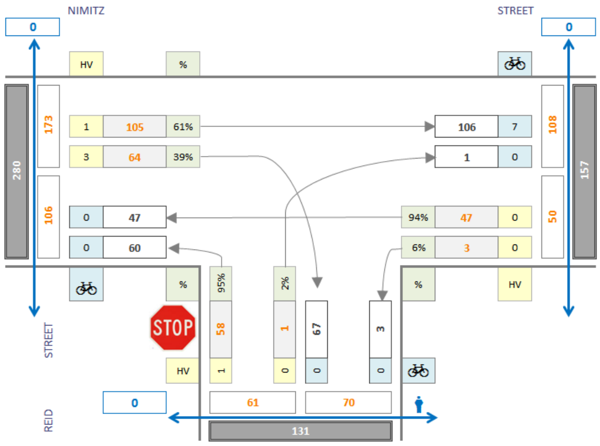
FORECAST PM PEAK HOUR
WITH THROUGH & DEVELOPMENT TRAFFIC

2030



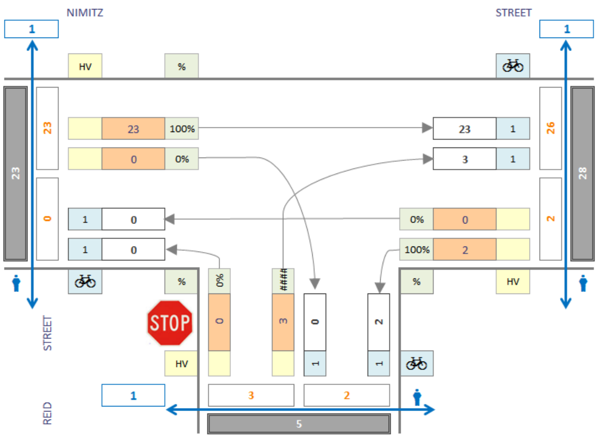
AVEARGE WEEKDAY AM PEAK HOUR

2011



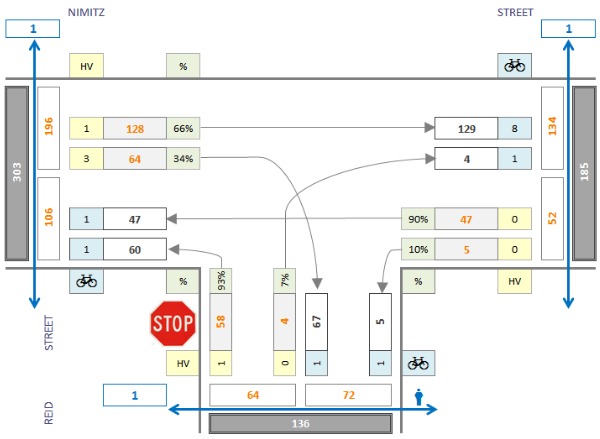
FORECAST AM PEAK HOUR
WITH ANNUAL GROWTH OF 2% in 19 YEARS

2030



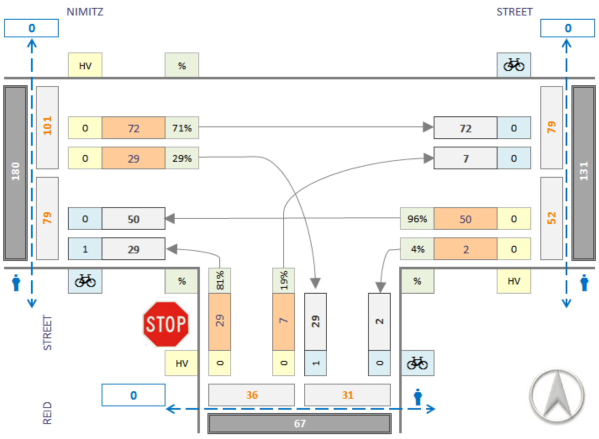
FORECAST AM PEAK HOUR
DEVELOPMENT GENERATED TRAFFIC ONLY

2030



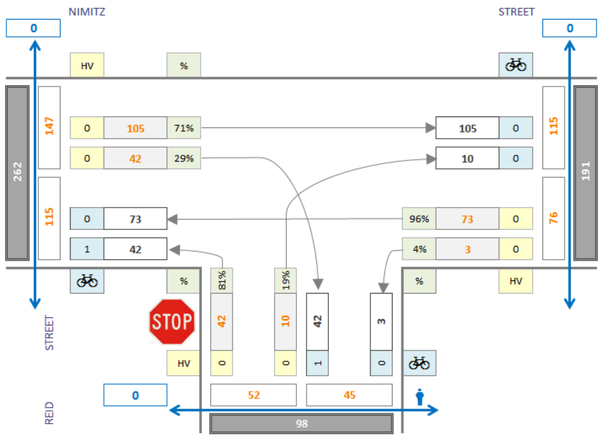
FORECAST AM PEAK HOUR
WITH THROUGH & DEVELOPMENT TRAFFIC

2030



AVERAGE WEEKDAY PM PEAK HOUR

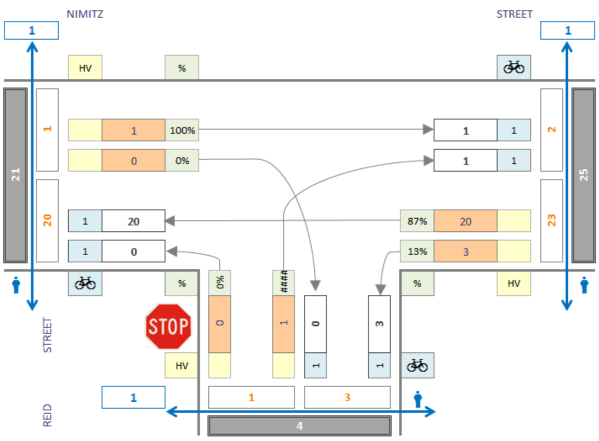
2011



FORECAST PM PEAK HOUR

WITH ANNUAL GROWTH OF 2% in 19 YEARS

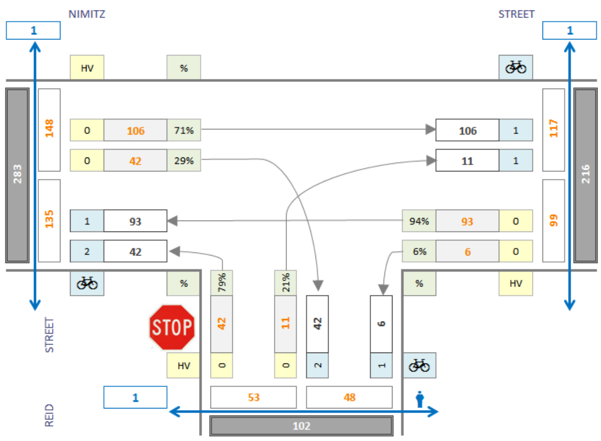
2030



FORECAST PM PEAK HOUR

DEVELOPMENT GENERATED TRAFFIC ONLY

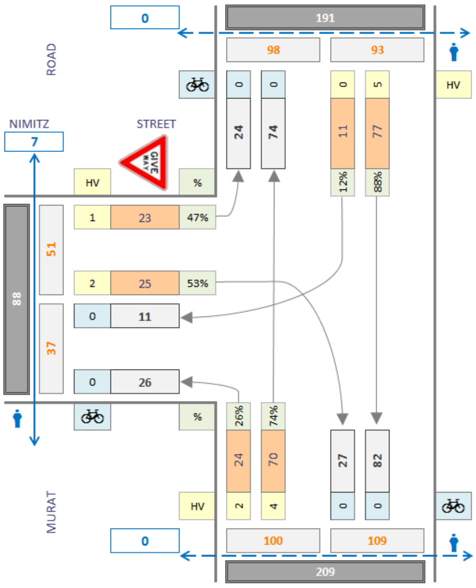
2030



FORECAST PM PEAK HOUR

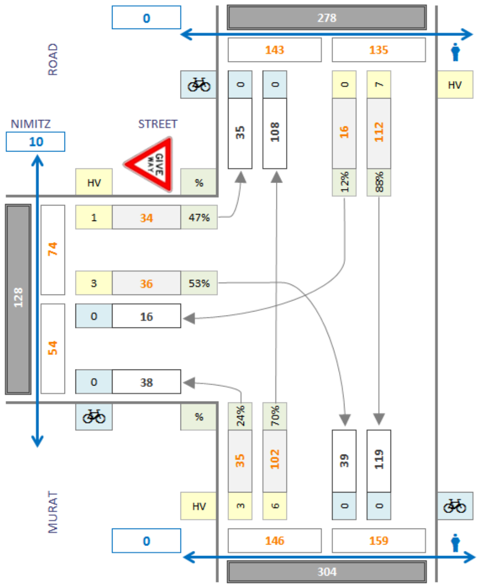
WITH ANNUAL GROWTH & DEVELOPMENT TRAFFIC

2030



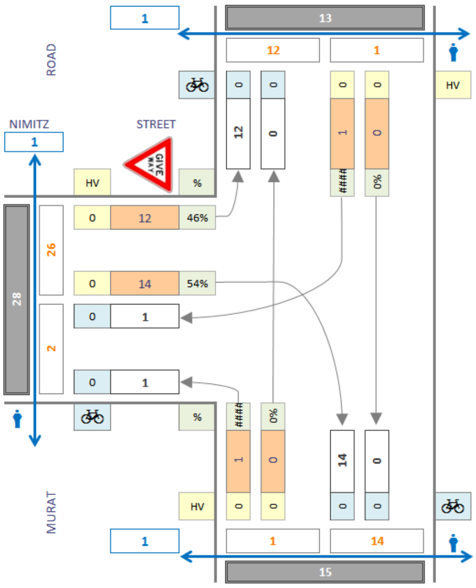
AVERAGE WEEKDAY AM PEAK HOUR

2011



FORECAST AM PEAK HOUR
WITH ANNUAL GROWTH OF 2% in 19 YEARS

2030



FORECAST AM PEAK HOUR
DEVELOPMENT GENERATED TRAFFIC ONLY

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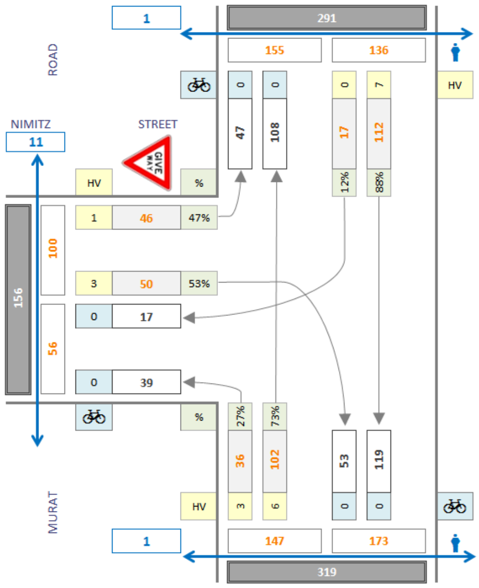
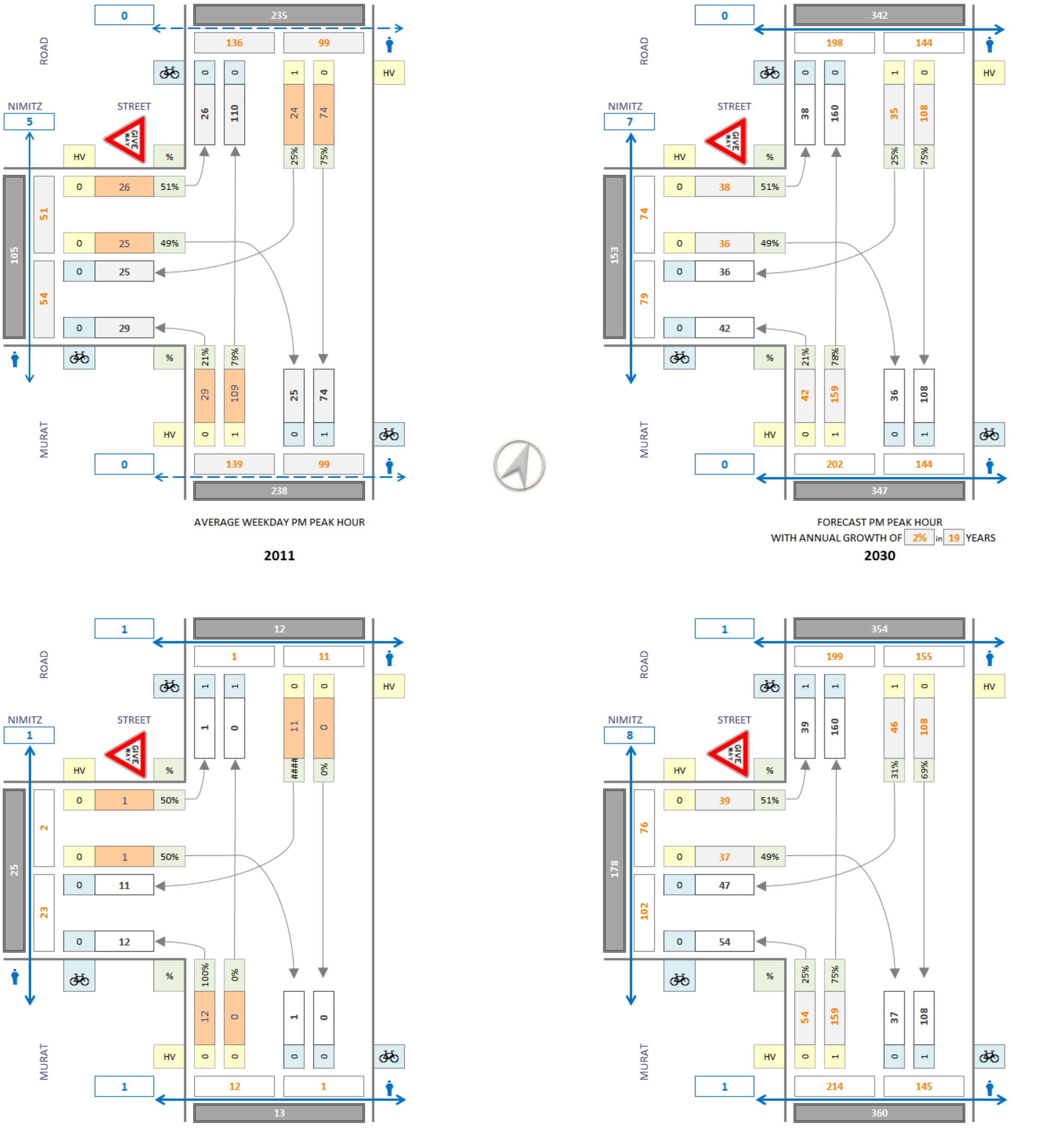


FORECAST AM PEAK HOUR
WITH ANNUAL GROWTH & DEVELOPMENT TRAFFIC

2030



AVERAGE WEEKDAY PM PEAK HOUR

2011

FORECAST PM PEAK HOUR
WITH ANNUAL GROWTH OF 2% in 19 YEARS

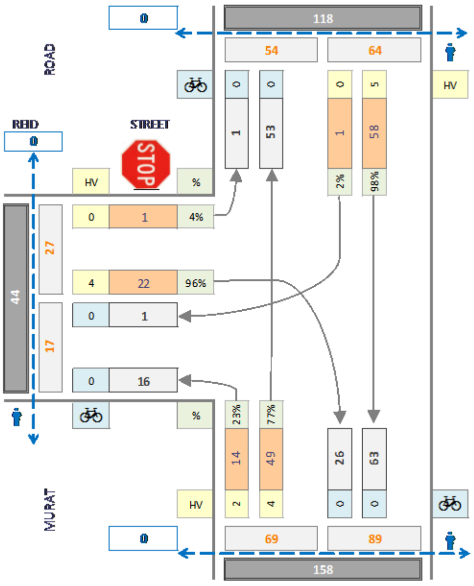
2030

FORECAST PM PEAK HOUR
DEVELOPMENT GENERATED TRAFFIC ONLY

2030

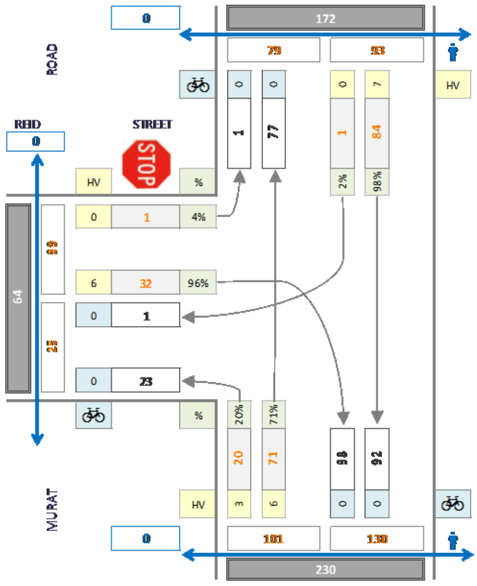
FORECAST PM PEAK HOUR
WITH ANNUAL GROWTH & DEVELOPMENT TRAFFIC

2030



AVERAGE WEEKDAY AM PEAK HOUR

2011



FORECAST AM PEAK HOUR
WITH ANNUAL GROWTH OF 2% in 19 YEARS

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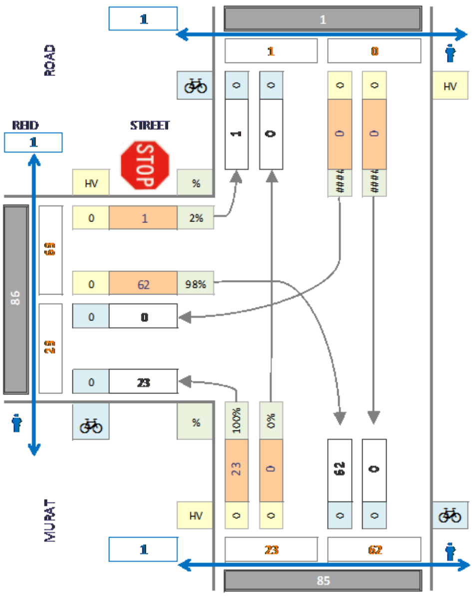

FORECAST AM PEAK HOUR
DEVELOPMENT GENERATED TRAFFIC ONLY

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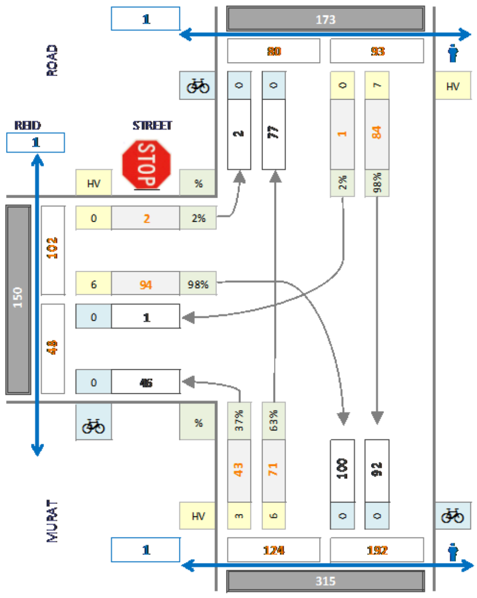
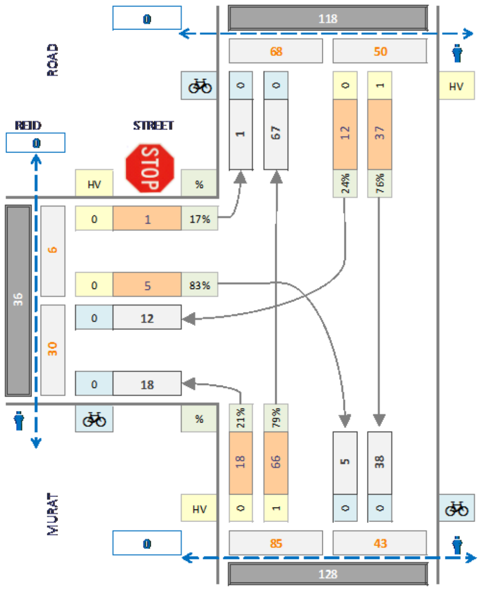


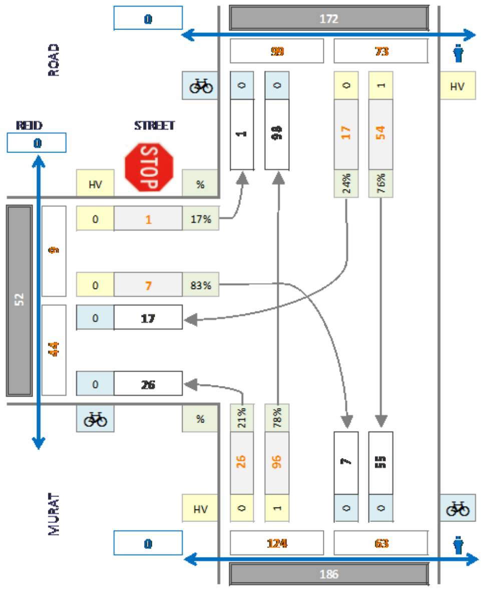
FORECAST AM PEAK HOUR
WITH ANNUAL GROWTH & DEVELOPMENT TRAFFIC

2030



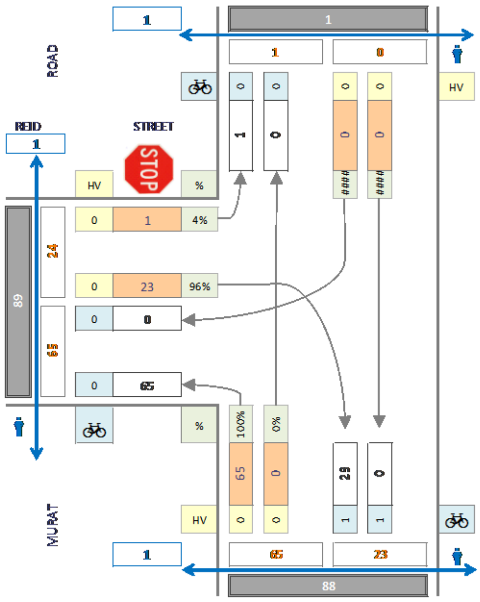
AVERAGE WEEKDAY PM PEAK HOUR

2011



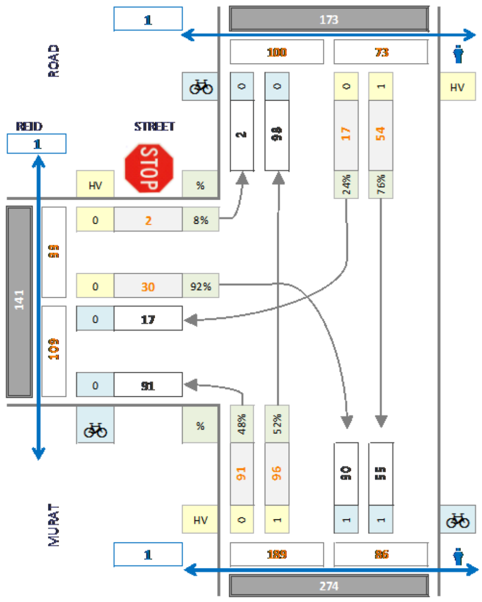
FORECAST PM PEAK HOUR
WITH ANNUAL GROWTH OF 2% in 19 YEARS

2030



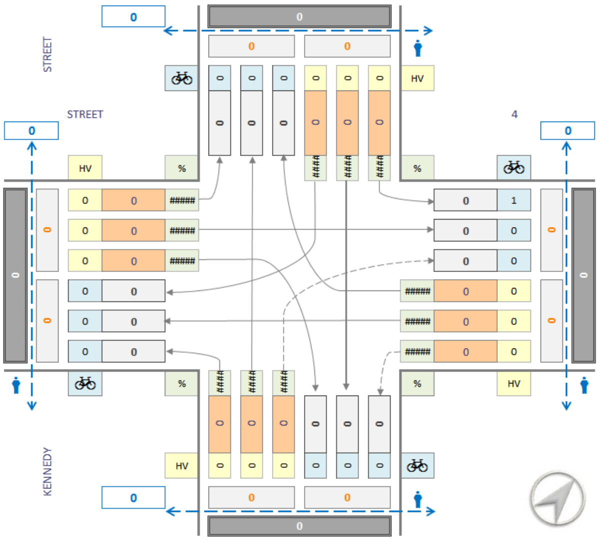
FORECAST PM PEAK HOUR
DEVELOPMENT GENERATED TRAFFIC ONLY

2030



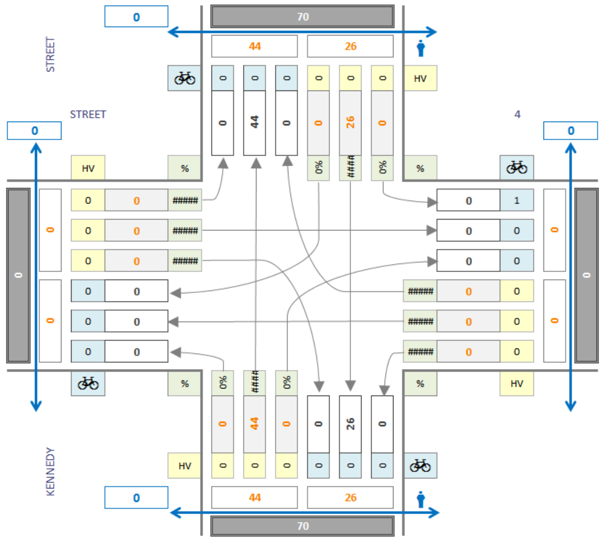
FORECAST PM PEAK HOUR
WITH ANNUAL GROWTH & DEVELOPMENT TRAFFIC

2030



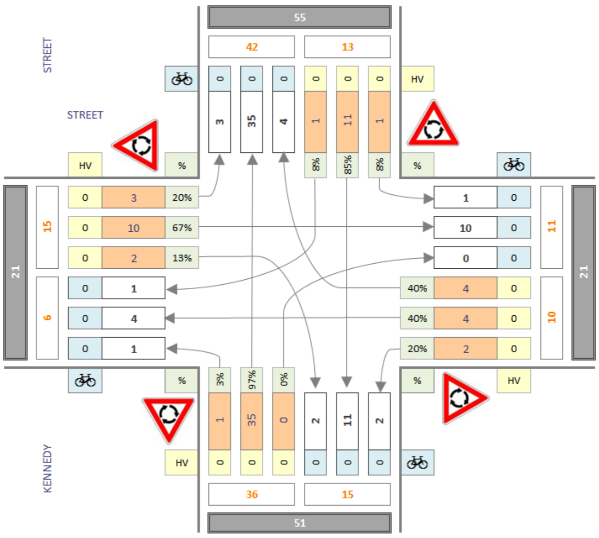
SURVEYED AM PEAK HOUR

2011



FORECAST AM PEAK HOUR
THROUGH TRAFFIC

2030



FORECAST AM PEAK HOUR
DEVELOPMENT GENERATED TRAFFIC ONLY

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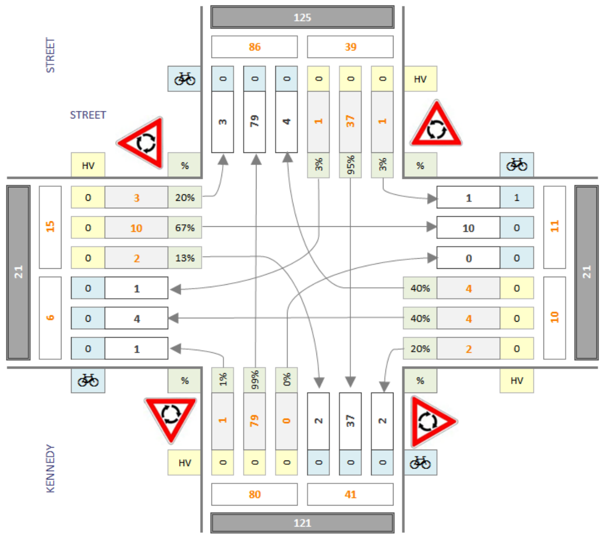
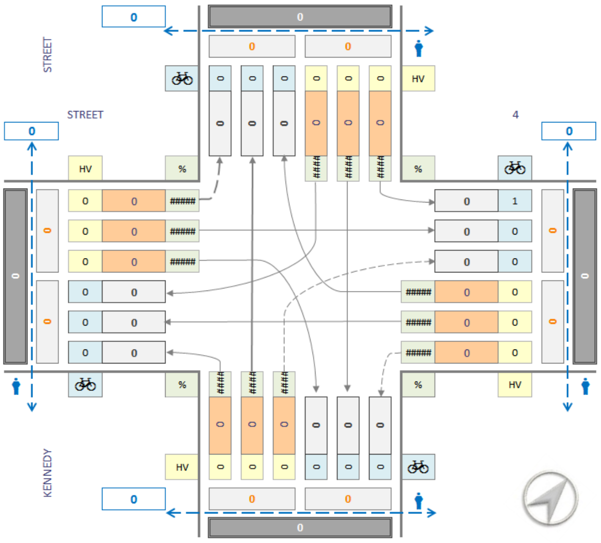
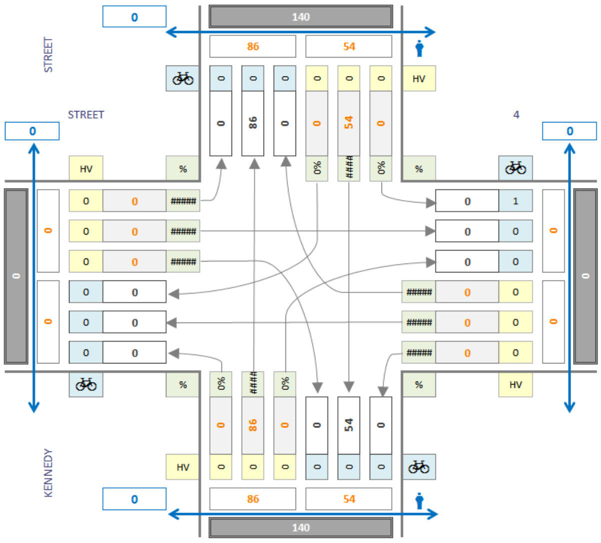


FORECAST AM PEAK HOUR
WITH ANNUAL GROWTH & DEVELOPMENT TRAFFIC

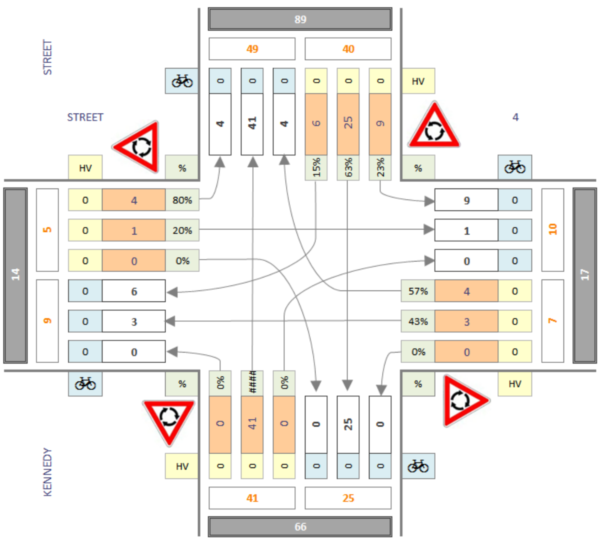
2030



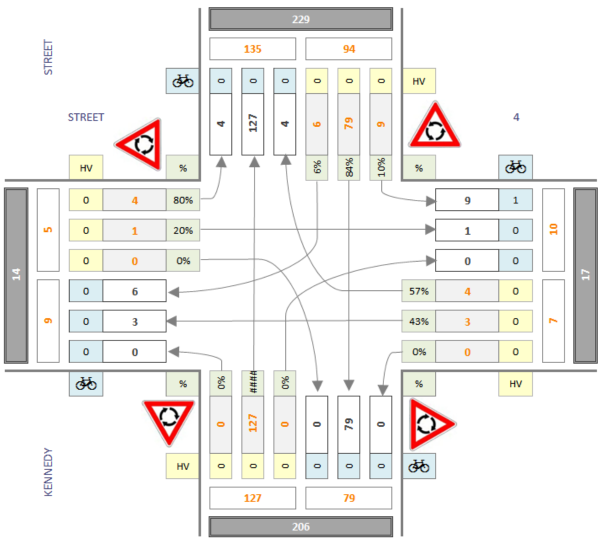
SURVEYED PM PEAK HOUR
Thu 22 Dec 4.30 - 5.30 PM
2011



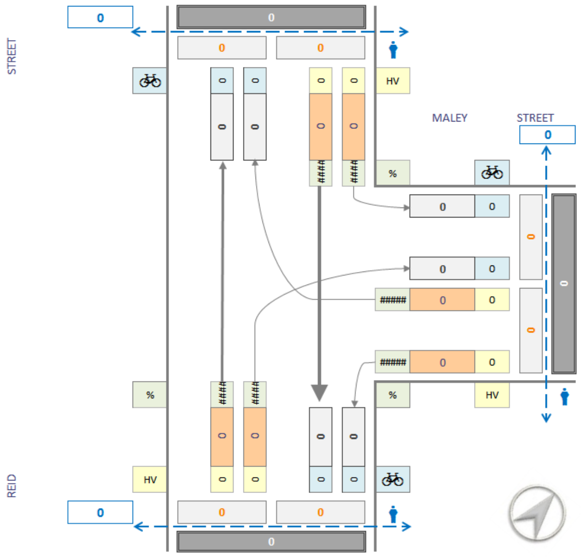
FORECAST PM PEAK HOUR
THROUGH TRAFFIC
2030



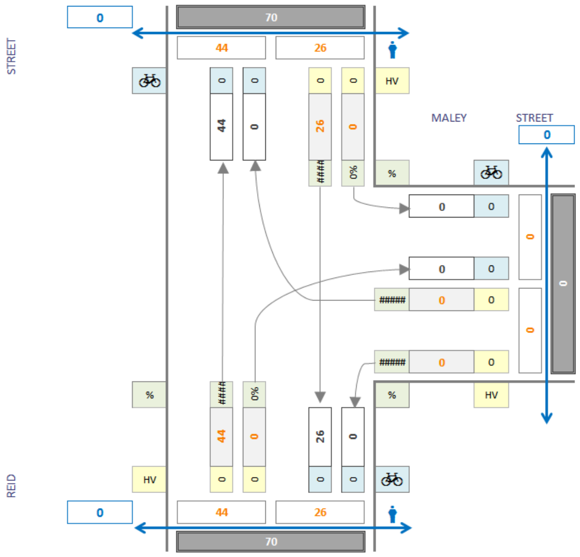
FORECAST PM PEAK HOUR
DEVELOPMENT GENERATED TRAFFIC ONLY
2030



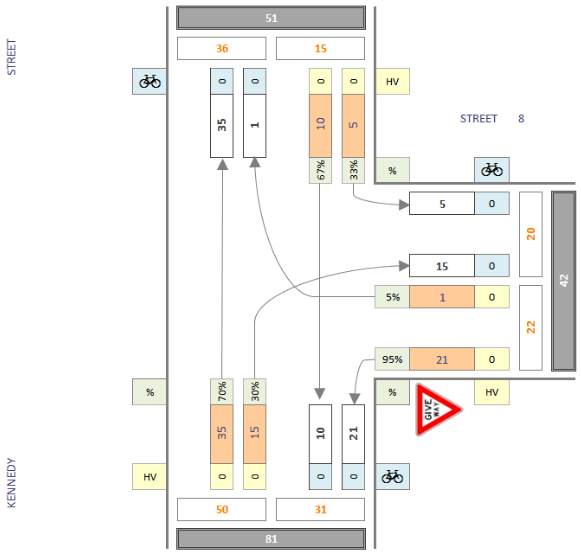
FORECAST PM PEAK HOUR
WITH THROUGH & DEVELOPMENT TRAFFIC
2030



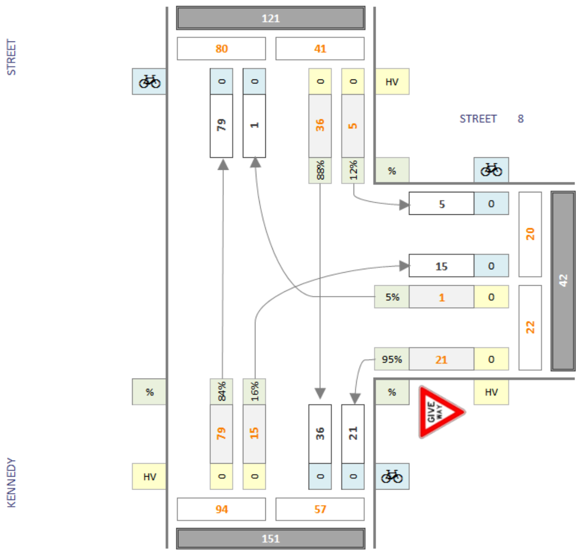
SURVEYED AM PEAK HOUR
Thu 22 Dec 7.30 - 8.30 AM
2011



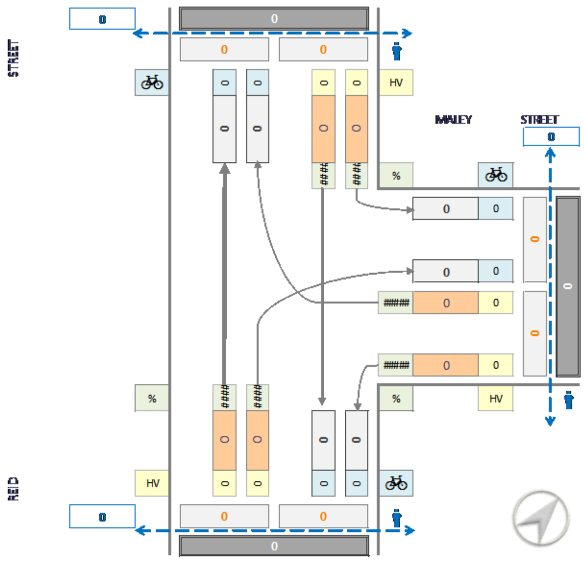
FORECAST AM PEAK HOUR
THROUGH TRAFFIC
2030



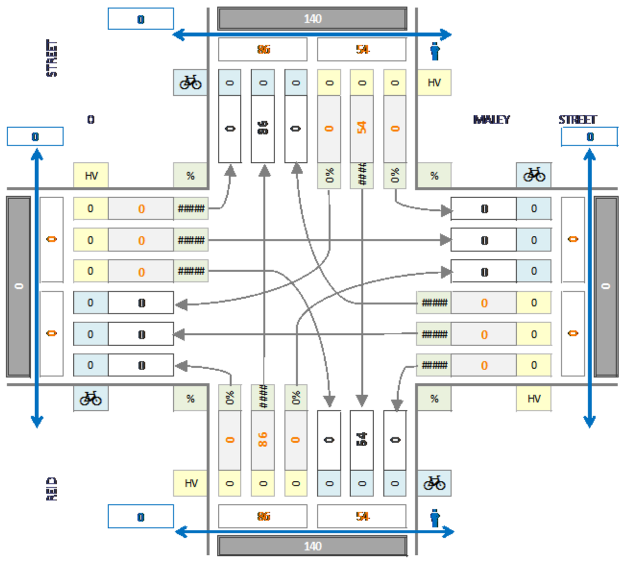
FORECAST AM PEAK HOUR
DEVELOPMENT GENERATED TRAFFIC ONLY
2030



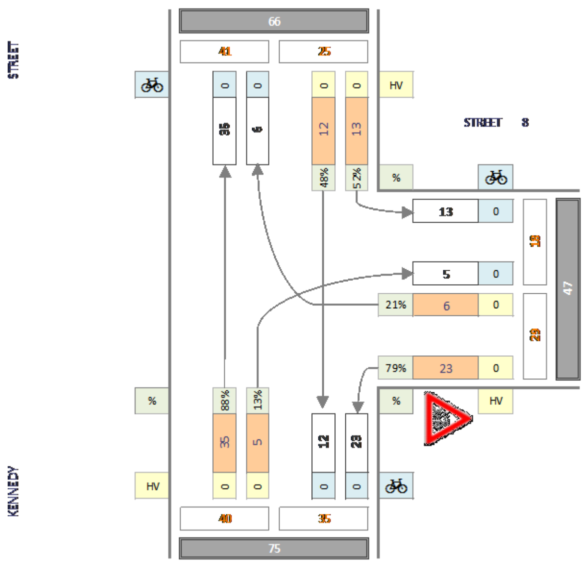
FORECAST AM PEAK HOUR
WITH THROUGH & DEVELOPMENT TRAFFIC
2030



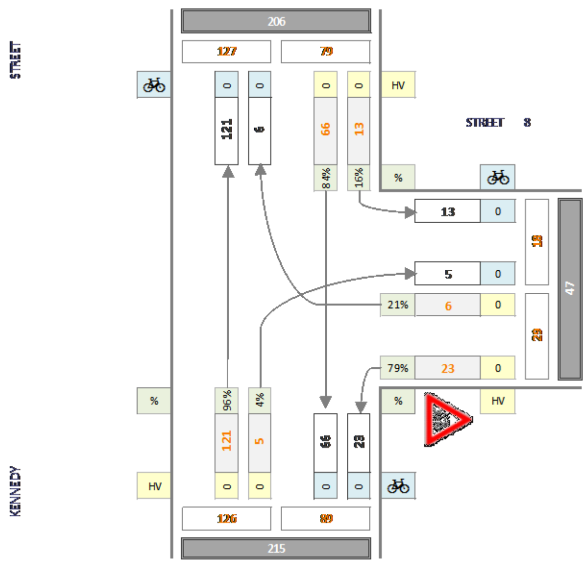
SURVEYED PM PEAK HOUR
Wed 21 Dec 4.30 - 5.30 PM
2011



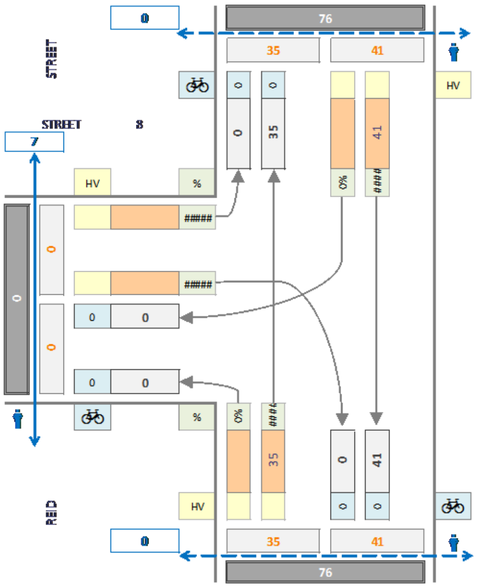
FORECAST PM PEAK HOUR
THROUGH TRAFFIC
2030



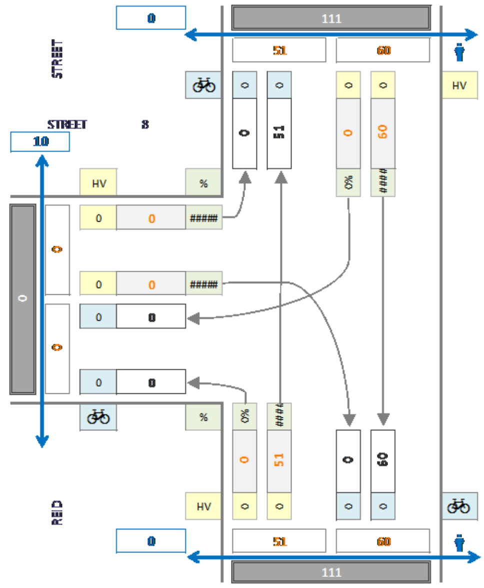
FORECAST PM PEAK HOUR
DEVELOPMENT GENERATED TRAFFIC ONLY
2030



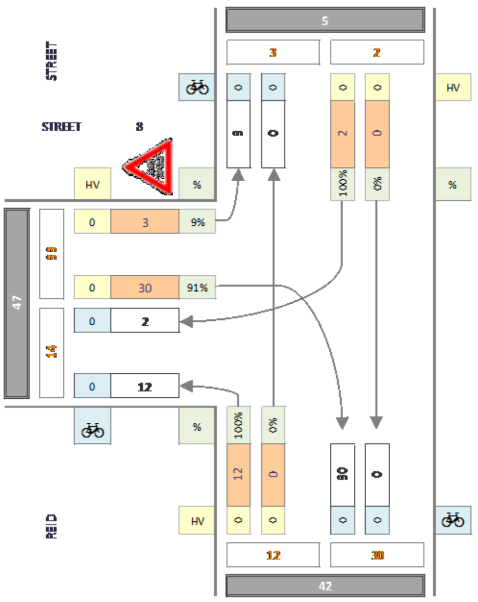
FORECAST PM PEAK HOUR
WITH THROUGH & DEVELOPMENT TRAFFIC
2030



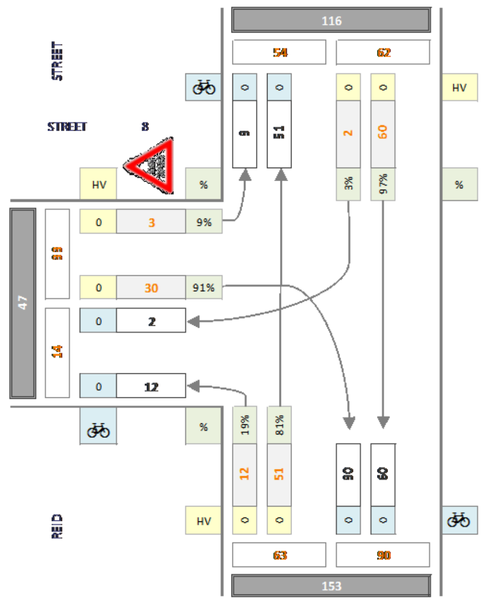
SURVEYED AM PEAK HOUR
Fri 23 Dec 7.30 - 8.30 AM
2011



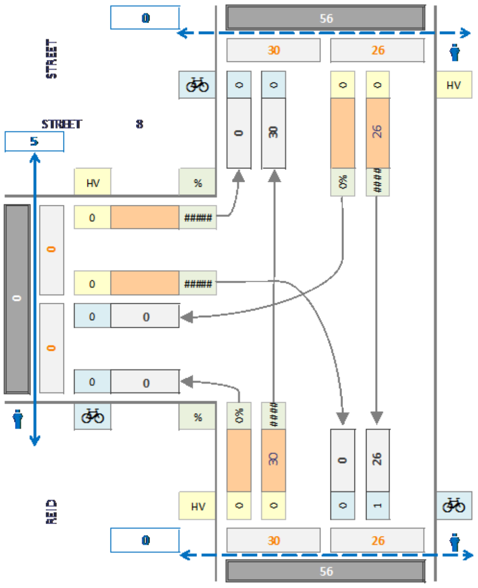
FORECAST AM PEAK HOUR
WITH ANNUAL GROWTH OF 2% in 19 YEARS
2030



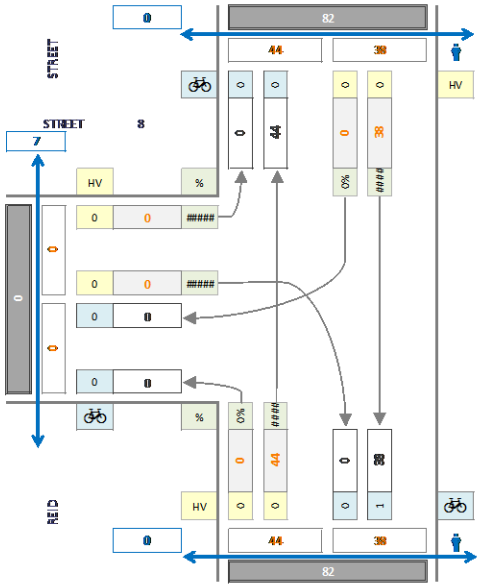
FORECAST AM PEAK HOUR
DEVELOPMENT GENERATED TRAFFIC ONLY
2030



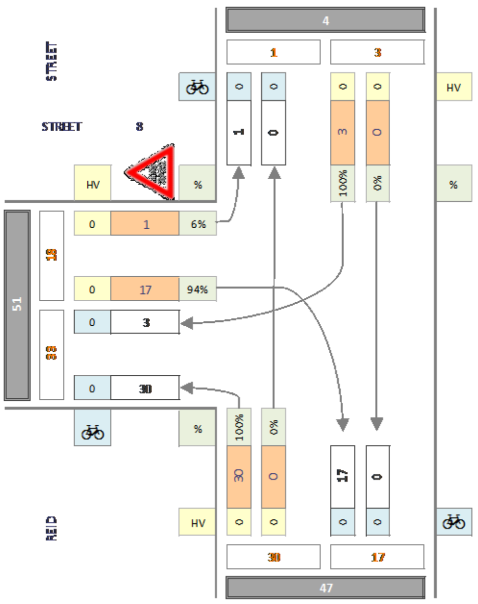
FORECAST AM PEAK HOUR
WITH ANNUAL GROWTH & DEVELOPMENT TRAFFIC
2030



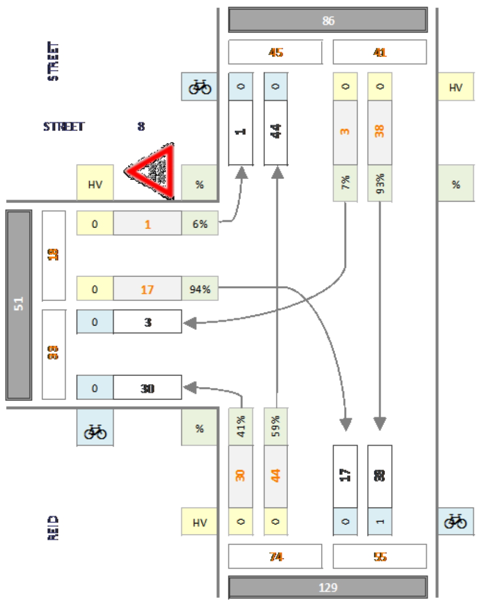
SURVEYED PM PEAK HOUR
Fri 23 Dec 7.30 - 8.30 AM
2011



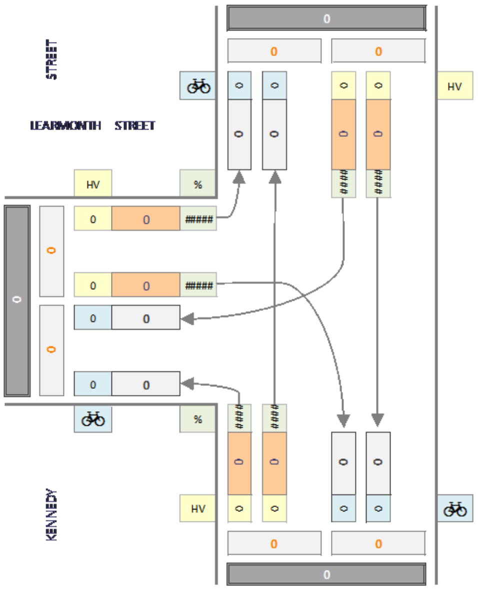
FORECAST PM PEAK HOUR
WITH ANNUAL GROWTH OF 2% in 19 YEARS
2030



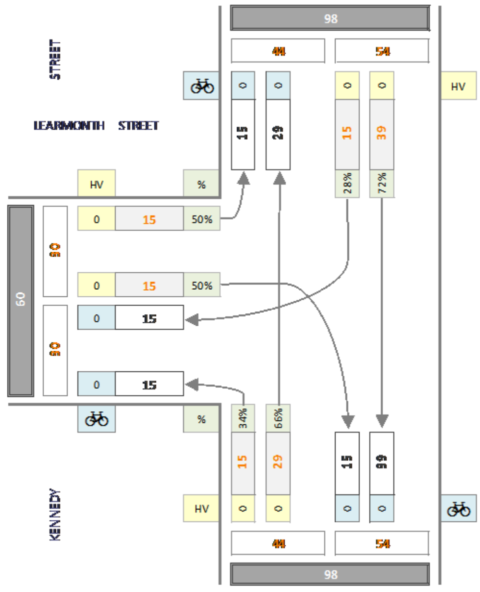
FORECAST PM PEAK HOUR
DEVELOPMENT GENERATED TRAFFIC ONLY
2030



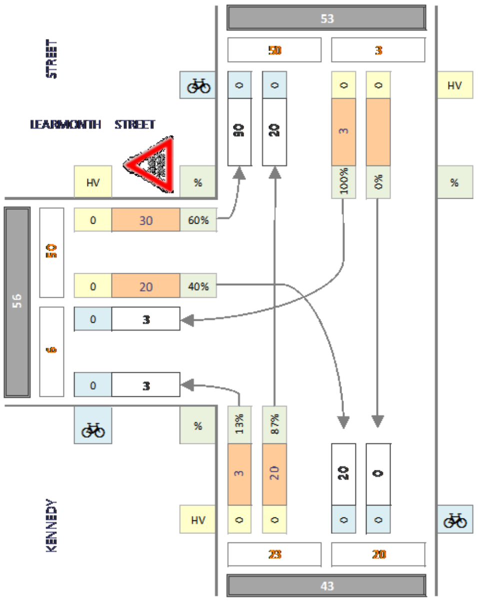
FORECAST PM PEAK HOUR
WITH ANNUAL GROWTH & DEVELOPMENT TRAFFIC
2030



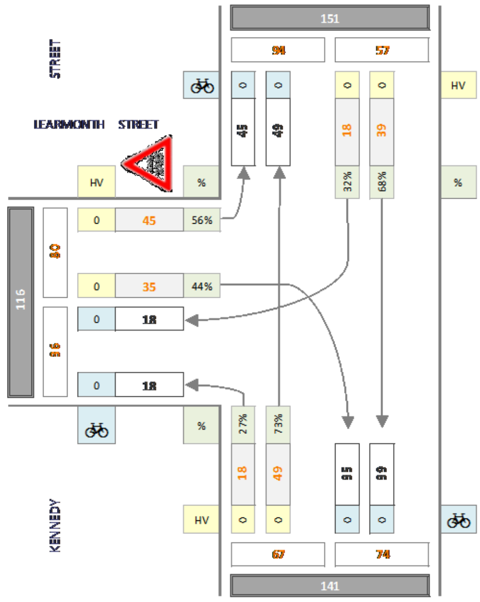
SURVEYED AM PEAK HOUR
Fri 23 Dec 7.30 - 8.30AM
2011



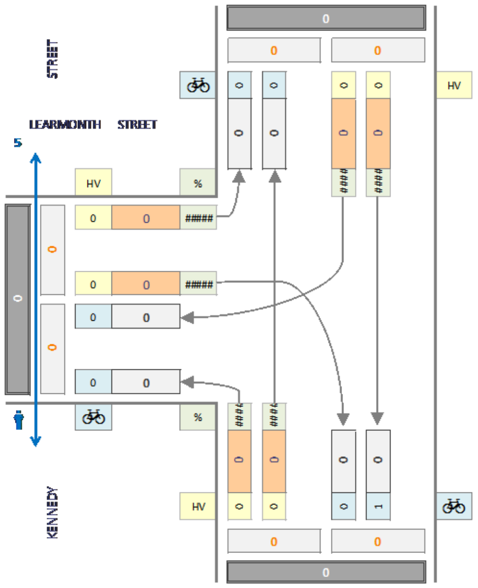
FORECAST AM PEAK HOUR
THROUGH TRAFFIC
2030



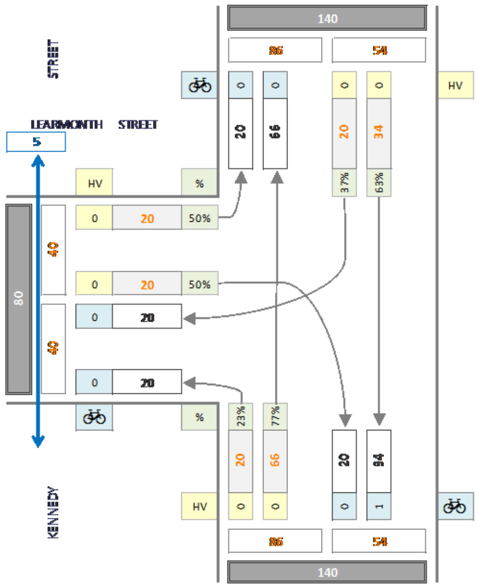
FORECAST AM PEAK HOUR
DEVELOPMENT GENERATED TRAFFIC ONLY
2030



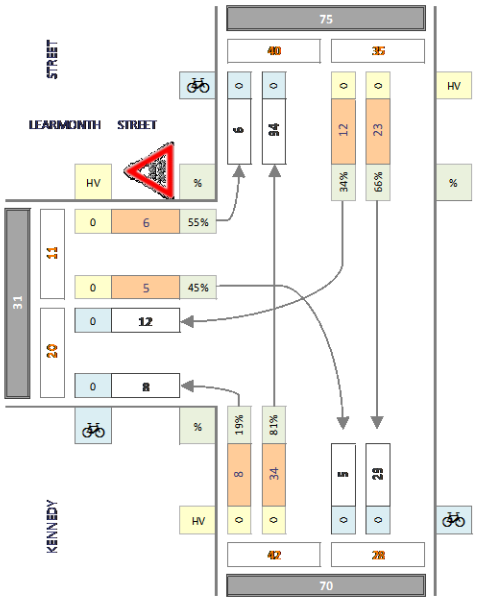
FORECAST AM PEAK HOUR
WITH THROUGH & DEVELOPMENT TRAFFIC
2030



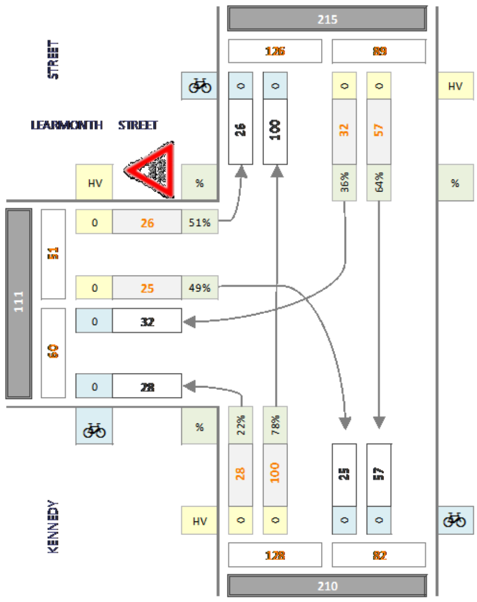
SURVEYED PM PEAK HOUR
Fri 23 Dec 7.30 - 8.30 AM
2011



FORECAST PM PEAK HOUR
THROUGH TRAFFIC
2030



FORECAST PM PEAK HOUR
DEVELOPMENT GENERATED TRAFFIC ONLY
2030



FORECAST PM PEAK HOUR
WITH THROUGH & DEVELOPMENT TRAFFIC
2030

APPENDIX E SIDRA REPORTS FOR 2016 ASSESSMENT YEAR

MOVEMENT SUMMARY

Site: Nimitz St/ Kennedy 2016
AM Peak Hour

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Kennedy Street											
8	L	16	0.0	0.065	6.1	LOS A	0.3	2.2	0.19	0.54	43.2
9	T	40	0.0	0.065	5.1	LOS A	0.3	2.2	0.19	0.44	43.8
10	R	24	0.0	0.065	9.2	LOS A	0.3	2.2	0.19	0.73	41.0
Approach		80	0.0	0.065	6.5	LOS A	0.3	2.2	0.19	0.55	42.8
East: Nimitz Street											
11	L	1	0.0	0.041	5.7	LOS A	0.2	1.7	0.06	0.54	43.8
1	T	33	0.0	0.041	4.8	LOS A	0.2	1.7	0.06	0.44	44.5
2	R	26	0.0	0.041	8.9	LOS A	0.2	1.7	0.06	0.77	41.2
Approach		60	0.0	0.041	6.7	LOS A	0.2	1.7	0.06	0.58	42.9
North: Kennedy Street											
3	L	37	0.0	0.038	6.3	LOS A	0.2	1.5	0.30	0.52	42.8
12	T	2	0.0	0.038	5.5	LOS A	0.2	1.5	0.30	0.44	43.2
4	R	4	0.0	0.038	9.6	LOS A	0.2	1.5	0.30	0.68	40.8
Approach		43	0.0	0.038	6.6	LOS A	0.2	1.5	0.30	0.53	42.6
West: Nimitz Street											
5	L	9	0.0	0.074	6.3	LOS A	0.4	3.0	0.29	0.55	43.0
6	T	76	0.0	0.074	5.4	LOS A	0.4	3.0	0.29	0.47	43.4
7	R	1	0.0	0.074	9.6	LOS A	0.4	3.0	0.29	0.76	41.1
Approach		86	0.0	0.074	5.6	LOS A	0.4	3.0	0.29	0.48	43.3
All Vehicles		269	0.0	0.074	6.3	LOS A	0.4	3.0	0.21	0.53	43.0

MOVEMENT SUMMARY

Site: Nimitz St/ Kennedy 2016
PM Peak Hour

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Kennedy Street											
8	L	3	0.0	0.041	6.4	LOS A	0.2	1.4	0.29	0.55	42.8
9	T	21	0.0	0.041	5.5	LOS A	0.2	1.4	0.29	0.46	43.2
10	R	22	0.0	0.041	9.6	LOS A	0.2	1.4	0.29	0.70	40.8
Approach		46	0.0	0.041	7.5	LOS A	0.2	1.4	0.29	0.58	42.0
East: Nimitz Street											
11	L	21	0.0	0.105	6.1	LOS A	0.6	4.5	0.25	0.54	43.1
1	T	93	0.0	0.105	5.3	LOS A	0.6	4.5	0.25	0.45	43.5
2	R	16	0.0	0.105	9.4	LOS A	0.6	4.5	0.25	0.74	41.1
Approach		129	0.0	0.105	5.9	LOS A	0.6	4.5	0.25	0.50	43.1
North: Kennedy Street											
3	L	40	0.0	0.075	6.3	LOS A	0.4	3.1	0.29	0.52	42.8
12	T	21	0.0	0.075	5.5	LOS A	0.4	3.1	0.29	0.45	43.2
4	R	25	0.0	0.075	9.6	LOS A	0.4	3.1	0.29	0.69	40.8
Approach		86	0.0	0.075	7.0	LOS A	0.4	3.1	0.29	0.55	42.3
West: Nimitz Street											
5	L	13	0.0	0.068	6.0	LOS A	0.4	2.8	0.23	0.53	43.1
6	T	49	0.0	0.068	5.2	LOS A	0.4	2.8	0.23	0.44	43.6
7	R	21	0.0	0.068	9.3	LOS A	0.4	2.8	0.23	0.73	41.0
Approach		83	0.0	0.068	6.4	LOS A	0.4	2.8	0.23	0.53	42.8
All Vehicles		345	0.0	0.105	6.5	LOS A	0.6	4.5	0.26	0.53	42.7

MOVEMENT SUMMARY

Site: Nimitz St/ Reid St 2016
AM Peak Hour

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Reid Street											
1	L	47	2.2	0.047	7.8	LOS A	0.2	1.2	0.11	0.60	48.1
2	R	4	0.0	0.047	8.2	LOS A	0.2	1.2	0.11	0.72	47.7
Approach		52	2.0	0.047	7.9	LOS A	0.2	1.2	0.11	0.61	48.0
East: Nimitz Street											
3	L	4	0.0	0.021	7.2	LOS A	0.0	0.0	0.00	0.86	43.8
4	T	37	0.0	0.021	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		41	0.0	0.021	0.7	NA	0.0	0.0	0.00	0.09	49.3
West: Nimitz Street											
5	T	107	0.0	0.085	0.1	LOS A	0.4	3.1	0.13	0.00	48.2
6	R	52	0.0	0.085	7.8	LOS A	0.4	3.1	0.13	0.81	43.2
Approach		159	0.0	0.085	2.6	NA	0.4	3.1	0.13	0.26	46.4
All Vehicles		252	0.4	0.085	3.4	NA	0.4	3.1	0.10	0.31	47.2

MOVEMENT SUMMARY

Site: Nimitz St/ Reid St 2016
PM Peak Hour

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Reid Street											
1	L	35	3.0	0.046	8.2	LOS A	0.2	1.2	0.20	0.59	47.6
2	R	9	0.0	0.046	8.6	LOS A	0.2	1.2	0.20	0.71	47.4
Approach		44	2.4	0.046	8.3	LOS A	0.2	1.2	0.20	0.62	47.6
East: Nimitz Street											
3	L	5	0.0	0.043	7.2	LOS A	0.0	0.0	0.00	0.87	43.8
4	T	79	0.0	0.043	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		84	0.0	0.043	0.4	NA	0.0	0.0	0.00	0.05	49.5
West: Nimitz Street											
5	T	84	0.0	0.063	0.2	LOS A	0.3	2.3	0.19	0.00	47.4
6	R	34	0.0	0.063	7.9	LOS A	0.3	2.3	0.19	0.80	43.2
Approach		118	0.0	0.063	2.4	NA	0.3	2.3	0.19	0.23	46.1
All Vehicles		246	0.4	0.063	2.8	NA	0.3	2.3	0.13	0.24	47.5

MOVEMENT SUMMARY

Site: Nimitz St/ Murat Rd 2016
AM Peak Hour

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Murat Road											
1	L	31	6.9	0.061	6.6	LOS A	0.0	0.0	0.00	0.81	43.3
2	T	84	3.8	0.061	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		115	4.6	0.061	1.8	NA	0.0	0.0	0.00	0.22	48.0
North: Murat Road											
3	T	94	4.5	0.060	0.4	LOS A	0.3	2.4	0.24	0.00	47.0
4	R	14	0.0	0.060	6.8	LOS A	0.3	2.4	0.24	0.76	43.1
Approach		107	3.9	0.060	1.3	NA	0.3	2.4	0.24	0.10	46.4
West: Nimitz Street											
5	L	40	2.6	0.107	7.9	LOS A	0.4	3.0	0.29	0.58	42.1
6	R	46	4.5	0.107	7.9	LOS A	0.4	3.0	0.29	0.64	42.1
Approach		86	3.7	0.107	7.9	LOS A	0.4	3.0	0.29	0.61	42.1
All Vehicles		308	4.1	0.107	3.3	NA	0.4	3.0	0.16	0.28	45.7

MOVEMENT SUMMARY

Site: Nimitz St/ Murat Rd 2016
PM Peak Hour

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Murat Road											
1	L	48	4.3	0.094	6.5	LOS A	0.0	0.0	0.00	0.81	43.3
2	T	129	2.4	0.094	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		178	3.0	0.094	1.8	NA	0.0	0.0	0.00	0.22	48.0
North: Murat Road											
3	T	91	4.7	0.080	0.7	LOS A	0.4	3.1	0.30	0.00	46.0
4	R	39	0.0	0.080	7.1	LOS A	0.4	3.1	0.30	0.72	42.9
Approach		129	3.3	0.080	2.7	NA	0.4	3.1	0.30	0.22	45.0
West: Nimitz Street											
5	L	33	3.2	0.089	8.5	LOS A	0.3	2.5	0.35	0.60	41.6
6	R	33	6.5	0.089	8.6	LOS A	0.3	2.5	0.35	0.67	41.6
Approach		65	4.8	0.089	8.5	LOS A	0.3	2.5	0.35	0.63	41.6
All Vehicles		373	3.4	0.094	3.3	NA	0.4	3.1	0.17	0.29	45.7

MOVEMENT SUMMARY

Site: Reid St/ Murat Rd 2016
AM Peak Hour

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Murat Road											
1	L	42	5.0	0.023	8.4	LOS A	0.0	0.0	0.00	0.67	49.0
2	T	60	5.3	0.032	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		102	5.2	0.032	3.5	NA	0.0	0.0	0.00	0.28	54.9
North: Murat Road											
3	T	72	5.9	0.038	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
4	R	1	0.0	0.001	8.5	LOS A	0.0	0.0	0.20	0.59	48.1
Approach		73	5.8	0.038	0.1	NA	0.0	0.0	0.00	0.01	59.8
West: Reid Street											
5	L	2	0.0	0.132	12.2	LOS B	0.5	3.9	0.34	0.82	45.6
6	R	94	3.4	0.132	12.4	LOS B	0.5	3.9	0.34	0.88	45.5
Approach		96	3.3	0.132	12.4	LOS B	0.5	3.9	0.34	0.88	45.5
All Vehicles		271	4.7	0.132	5.7	NA	0.5	3.9	0.12	0.42	52.2

MOVEMENT SUMMARY

Site: Reid St/ Murat Rd 2016
PM Peak Hour

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Murat Road											
1	L	92	2.3	0.050	8.3	LOS A	0.0	0.0	0.00	0.67	49.0
2	T	80	3.9	0.042	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		172	3.1	0.050	4.4	NA	0.0	0.0	0.00	0.36	53.6
North: Murat Road											
3	T	47	8.9	0.026	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
4	R	14	0.0	0.013	8.8	LOS A	0.0	0.3	0.27	0.61	47.8
Approach		61	6.9	0.026	2.0	NA	0.0	0.3	0.06	0.14	56.8
West: Reid Street											
5	L	2	0.0	0.054	12.5	LOS B	0.2	1.5	0.36	0.82	45.3
6	R	34	9.4	0.054	13.1	LOS B	0.2	1.5	0.36	0.87	45.3
Approach		36	8.8	0.054	13.1	LOS B	0.2	1.5	0.36	0.87	45.3
All Vehicles		268	4.7	0.054	5.0	NA	0.2	1.5	0.06	0.37	52.9

MOVEMENT SUMMARY

Site: Kennedy/ Street 4 2016
AM Peak Hour

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Kennedy Street											
1	L	1	0.0	0.039	5.8	LOS A	0.2	1.3	0.06	0.59	43.7
2	T	53	0.0	0.039	4.8	LOS A	0.2	1.3	0.06	0.47	44.5
3	R	1	0.0	0.039	8.9	LOS A	0.2	1.3	0.06	0.85	41.3
Approach		55	0.0	0.039	4.9	LOS A	0.2	1.3	0.06	0.48	44.4
East: Street 4											
4	L	2	0.0	0.008	5.7	LOS A	0.0	0.3	0.10	0.52	43.6
5	T	4	0.0	0.008	4.9	LOS A	0.0	0.3	0.10	0.43	44.3
6	R	4	0.0	0.008	9.0	LOS A	0.0	0.3	0.10	0.74	41.2
Approach		11	0.0	0.008	6.7	LOS A	0.0	0.3	0.10	0.57	42.8
North: Kennedy Street											
7	L	1	0.0	0.011	5.8	LOS A	0.0	0.3	0.08	0.58	43.6
8	T	12	0.0	0.011	4.9	LOS A	0.0	0.3	0.08	0.45	44.4
9	R	1	0.0	0.011	9.0	LOS A	0.0	0.3	0.08	0.82	41.3
Approach		14	0.0	0.011	5.2	LOS A	0.0	0.3	0.08	0.49	44.1
West: Street 4											
10	L	3	0.0	0.013	6.0	LOS A	0.1	0.5	0.21	0.52	43.2
11	T	11	0.0	0.013	5.2	LOS A	0.1	0.5	0.21	0.44	43.7
12	R	2	0.0	0.013	9.3	LOS A	0.1	0.5	0.21	0.74	41.1
Approach		16	0.0	0.013	5.9	LOS A	0.1	0.5	0.21	0.49	43.2
All Vehicles		95	0.0	0.039	5.3	LOS A	0.2	1.3	0.09	0.49	44.0

MOVEMENT SUMMARY

Site: Kennedy/ Street 4 2016
PM Peak Hour

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Kennedy Street											
1	L	1	0.0	0.015	5.8	LOS A	0.1	0.5	0.08	0.58	43.6
2	T	17	0.0	0.015	4.9	LOS A	0.1	0.5	0.08	0.46	44.4
3	R	1	0.0	0.015	9.0	LOS A	0.1	0.5	0.08	0.83	41.3
Approach		19	0.0	0.015	5.1	LOS A	0.1	0.5	0.08	0.49	44.2
East: Street 4											
4	L	1	0.0	0.007	5.8	LOS A	0.0	0.3	0.15	0.50	43.4
5	T	3	0.0	0.007	5.0	LOS A	0.0	0.3	0.15	0.42	43.9
6	R	4	0.0	0.007	9.1	LOS A	0.0	0.3	0.15	0.70	41.1
Approach		8	0.0	0.007	7.2	LOS A	0.0	0.3	0.15	0.57	42.4
North: Kennedy Street											
7	L	9	0.0	0.028	5.7	LOS A	0.1	0.9	0.03	0.58	43.8
8	T	26	0.0	0.028	4.8	LOS A	0.1	0.9	0.03	0.46	44.6
9	R	6	0.0	0.028	8.9	LOS A	0.1	0.9	0.03	0.82	41.3
Approach		42	0.0	0.028	5.6	LOS A	0.1	0.9	0.03	0.54	43.9
West: Street 4											
10	L	4	0.0	0.005	5.8	LOS A	0.0	0.2	0.12	0.51	43.5
11	T	1	0.0	0.005	4.9	LOS A	0.0	0.2	0.12	0.42	44.1
12	R	1	0.0	0.005	9.0	LOS A	0.0	0.2	0.12	0.73	41.1
Approach		6	0.0	0.005	6.2	LOS A	0.0	0.2	0.12	0.53	43.2
All Vehicles		76	0.0	0.028	5.7	LOS A	0.1	0.9	0.06	0.53	43.7

MOVEMENT SUMMARY

Site: Kennedy/ Street 8 2016
AM Peak Hour

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Kennedy Street											
1	T	53	0.0	0.055	0.1	LOS A	0.3	1.8	0.09	0.00	48.7
2	R	37	0.0	0.055	6.5	LOS A	0.3	1.8	0.09	0.72	43.1
Approach		89	0.0	0.055	2.7	NA	0.3	1.8	0.09	0.30	46.2
East: Street 8											
3	L	21	0.0	0.012	6.5	LOS A	0.1	0.4	0.06	0.59	43.1
4	R	1	0.0	0.012	6.5	LOS A	0.1	0.4	0.06	0.60	43.1
Approach		22	0.0	0.012	6.5	LOS A	0.1	0.4	0.06	0.59	43.1
North: Kennedy Street											
5	L	5	0.0	0.008	6.4	LOS A	0.0	0.0	0.00	0.78	43.3
6	T	11	0.0	0.008	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		16	0.0	0.008	2.1	NA	0.0	0.0	0.00	0.26	47.5
All Vehicles		127	0.0	0.055	3.3	NA	0.3	1.8	0.07	0.34	45.8

MOVEMENT SUMMARY

Site: Kennedy/ Street 8 2016
PM Peak Hour

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Kennedy Street											
1	T	11	0.0	0.014	0.1	LOS A	0.1	0.4	0.11	0.00	48.4
2	R	11	0.0	0.014	6.6	LOS A	0.1	0.4	0.11	0.69	43.1
Approach		21	0.0	0.014	3.3	NA	0.1	0.4	0.11	0.34	45.6
East: Street 8											
3	L	24	0.0	0.017	6.5	LOS A	0.1	0.5	0.08	0.58	43.0
4	R	6	0.0	0.017	6.5	LOS A	0.1	0.5	0.08	0.59	43.0
Approach		31	0.0	0.017	6.5	LOS A	0.1	0.5	0.08	0.58	43.0
North: Kennedy Street											
5	L	8	0.0	0.014	6.4	LOS A	0.0	0.0	0.00	0.79	43.3
6	T	18	0.0	0.014	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		26	0.0	0.014	2.1	NA	0.0	0.0	0.00	0.25	47.6
All Vehicles		78	0.0	0.017	4.1	NA	0.1	0.5	0.06	0.40	45.2

MOVEMENT SUMMARY

Site: Street 8/ Reid St 2016 AM Peak Hour

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Reid Street											
1	L	24	0.0	0.034	6.4	LOS A	0.0	0.0	0.00	0.77	43.3
2	T	41	0.0	0.034	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		65	0.0	0.034	2.4	NA	0.0	0.0	0.00	0.29	47.3
North: Reid Street											
3	T	47	0.0	0.026	0.2	LOS A	0.1	1.0	0.17	0.00	47.8
4	R	2	0.0	0.026	6.9	LOS A	0.1	1.0	0.17	0.87	43.0
Approach		49	0.0	0.026	0.5	NA	0.1	1.0	0.17	0.04	47.6
West: Street 8											
5	L	3	0.0	0.088	7.4	LOS A	0.4	2.5	0.26	0.53	42.3
6	R	66	0.0	0.088	7.6	LOS A	0.4	2.5	0.26	0.61	42.2
Approach		69	0.0	0.088	7.6	LOS A	0.4	2.5	0.26	0.61	42.2
All Vehicles		184	0.0	0.088	3.8	NA	0.4	2.5	0.14	0.34	45.3

MOVEMENT SUMMARY

Site: Street 8/ Reid St 2016 PM Peak Hour

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Reid Street											
1	L	68	0.0	0.055	6.4	LOS A	0.0	0.0	0.00	0.69	43.3
2	T	35	0.0	0.055	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		103	0.0	0.055	4.3	NA	0.0	0.0	0.00	0.46	45.3
North: Reid Street											
3	T	31	0.0	0.018	0.4	LOS A	0.1	0.7	0.22	0.00	47.2
4	R	3	0.0	0.018	7.0	LOS A	0.1	0.7	0.22	0.83	43.0
Approach		34	0.0	0.018	1.0	NA	0.1	0.7	0.22	0.08	46.8
West: Street 8											
5	L	1	0.0	0.033	7.3	LOS A	0.1	0.9	0.25	0.53	42.3
6	R	25	0.0	0.033	7.5	LOS A	0.1	0.9	0.25	0.60	42.2
Approach		26	0.0	0.033	7.5	LOS A	0.1	0.9	0.25	0.60	42.2
All Vehicles		163	0.0	0.055	4.1	NA	0.1	0.9	0.09	0.40	45.1

APPENDIX F SIDRA REPORTS FOR 2030 ASSESSMENT YEAR

MOVEMENT SUMMARY

Site: Nimitz St/ Kennedy 2030
AM Peak Hour

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Kennedy Street											
8	L	12	0.0	0.074	6.1	LOS A	0.4	2.5	0.20	0.56	43.2
9	T	67	0.0	0.074	5.1	LOS A	0.4	2.5	0.20	0.46	43.8
10	R	12	0.0	0.074	9.2	LOS A	0.4	2.5	0.20	0.76	41.1
Approach		91	0.0	0.074	5.8	LOS A	0.4	2.5	0.20	0.51	43.3
East: Nimitz Street											
11	L	1	0.0	0.048	5.9	LOS A	0.3	2.0	0.21	0.53	43.2
1	T	43	0.0	0.048	5.1	LOS A	0.3	2.0	0.21	0.44	43.7
2	R	15	0.0	0.048	9.2	LOS A	0.3	2.0	0.21	0.74	41.1
Approach		59	0.0	0.048	6.2	LOS A	0.3	2.0	0.21	0.52	43.0
North: Kennedy Street											
3	L	49	0.0	0.086	6.4	LOS A	0.5	3.6	0.33	0.54	42.7
12	T	41	0.0	0.086	5.6	LOS A	0.5	3.6	0.33	0.47	43.1
4	R	6	0.0	0.086	9.7	LOS A	0.5	3.6	0.33	0.72	40.9
Approach		97	0.0	0.086	6.3	LOS A	0.5	3.6	0.33	0.52	42.8
West: Nimitz Street											
5	L	13	0.0	0.098	6.3	LOS A	0.6	4.1	0.30	0.56	43.0
6	T	100	0.0	0.098	5.5	LOS A	0.6	4.1	0.30	0.47	43.4
7	R	1	0.0	0.098	9.6	LOS A	0.6	4.1	0.30	0.76	41.1
Approach		114	0.0	0.098	5.6	LOS A	0.6	4.1	0.30	0.49	43.3
All Vehicles		360	0.0	0.098	5.9	LOS A	0.6	4.1	0.27	0.51	43.1

MOVEMENT SUMMARY

Site: Nimitz St/ Kennedy 2030
PM Peak Hour

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Kennedy Street											
8	L	11	0.0	0.131	6.7	LOS A	0.7	4.8	0.37	0.60	42.7
9	T	121	0.0	0.131	5.8	LOS A	0.7	4.8	0.37	0.52	43.0
10	R	11	0.0	0.131	9.9	LOS A	0.7	4.8	0.37	0.77	40.9
Approach		142	0.0	0.131	6.2	LOS A	0.7	4.8	0.37	0.54	42.8
East: Nimitz Street											
11	L	11	0.0	0.138	6.5	LOS A	0.9	6.0	0.36	0.56	42.7
1	T	123	0.0	0.138	5.7	LOS A	0.9	6.0	0.36	0.49	43.0
2	R	21	0.0	0.138	9.8	LOS A	0.9	6.0	0.36	0.74	41.0
Approach		155	0.0	0.138	6.3	LOS A	0.9	6.0	0.36	0.53	42.7
North: Kennedy Street											
3	L	53	0.0	0.137	6.3	LOS A	0.9	6.2	0.31	0.54	42.8
12	T	78	0.0	0.137	5.4	LOS A	0.9	6.2	0.31	0.46	43.2
4	R	34	0.0	0.137	9.5	LOS A	0.9	6.2	0.31	0.71	40.9
Approach		164	0.0	0.137	6.5	LOS A	0.9	6.2	0.31	0.54	42.6
West: Nimitz Street											
5	L	17	0.0	0.087	6.7	LOS A	0.5	3.7	0.39	0.57	42.6
6	T	66	0.0	0.087	5.9	LOS A	0.5	3.7	0.39	0.50	42.9
7	R	11	0.0	0.087	10.0	LOS B	0.5	3.7	0.39	0.73	40.8
Approach		94	0.0	0.087	6.5	LOS A	0.5	3.7	0.39	0.54	42.6
All Vehicles		555	0.0	0.138	6.4	LOS A	0.9	6.2	0.35	0.54	42.7

MOVEMENT SUMMARY

Site: Nimitz St/ Reid St 2030
AM Peak Hour

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Reid Street											
1	L	62	1.7	0.061	7.9	LOS A	0.2	1.6	0.14	0.60	47.9
2	R	4	0.0	0.061	8.3	LOS A	0.2	1.6	0.14	0.73	47.6
Approach		66	1.6	0.061	7.9	LOS A	0.2	1.6	0.14	0.61	47.9
East: Nimitz Street											
3	L	5	0.0	0.028	7.2	LOS A	0.0	0.0	0.00	0.86	43.8
4	T	49	0.0	0.028	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		55	0.0	0.028	0.7	NA	0.0	0.0	0.00	0.08	49.3
West: Nimitz Street											
5	T	135	0.0	0.108	0.2	LOS A	0.6	4.0	0.15	0.00	47.9
6	R	67	0.0	0.108	7.8	LOS A	0.6	4.0	0.15	0.79	43.2
Approach		202	0.0	0.108	2.7	NA	0.6	4.0	0.15	0.26	46.2
All Vehicles		323	0.3	0.108	3.4	NA	0.6	4.0	0.12	0.31	47.0

MOVEMENT SUMMARY

Site: Nimitz St/ Reid St 2030
PM Peak Hour

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Reid Street											
1	L	45	2.3	0.061	8.4	LOS A	0.2	1.6	0.23	0.60	47.5
2	R	12	0.0	0.061	8.8	LOS A	0.2	1.6	0.23	0.73	47.2
Approach		57	1.9	0.061	8.5	LOS A	0.2	1.6	0.23	0.62	47.4
East: Nimitz Street											
3	L	6	0.0	0.054	7.2	LOS A	0.0	0.0	0.00	0.87	43.8
4	T	98	0.0	0.054	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		104	0.0	0.054	0.4	NA	0.0	0.0	0.00	0.05	49.6
West: Nimitz Street											
5	T	112	0.0	0.084	0.3	LOS A	0.4	3.1	0.22	0.00	47.1
6	R	44	0.0	0.084	8.0	LOS A	0.4	3.1	0.22	0.79	43.2
Approach		156	0.0	0.084	2.5	NA	0.4	3.1	0.22	0.22	45.8
All Vehicles		317	0.3	0.084	2.9	NA	0.4	3.1	0.15	0.24	47.3

MOVEMENT SUMMARY

Site: Nimitz St/ Murat Rd 2030
AM Peak Hour

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Murat Road											
1	L	41	7.7	0.084	6.6	LOS A	0.0	0.0	0.00	0.81	43.3
2	T	114	5.6	0.084	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		155	6.1	0.084	1.8	NA	0.0	0.0	0.00	0.22	48.0
North: Murat Road											
3	T	125	5.9	0.081	0.6	LOS A	0.5	3.5	0.29	0.00	46.3
4	R	18	0.0	0.081	7.0	LOS A	0.5	3.5	0.29	0.76	43.0
Approach		143	5.1	0.081	1.4	NA	0.5	3.5	0.29	0.10	45.9
West: Nimitz Street											
5	L	49	2.1	0.143	8.6	LOS A	0.6	4.1	0.35	0.60	41.5
6	R	56	5.7	0.143	8.6	LOS A	0.6	4.1	0.35	0.68	41.5
Approach		105	4.0	0.143	8.6	LOS A	0.6	4.1	0.35	0.64	41.5
All Vehicles		403	5.2	0.143	3.4	NA	0.6	4.1	0.20	0.28	45.4

MOVEMENT SUMMARY

Site: Nimitz St/ Murat Rd 2030
PM Peak Hour

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Murat Road											
1	L	57	0.0	0.112	6.4	LOS A	0.0	0.0	0.00	0.81	43.3
2	T	158	0.7	0.112	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		215	0.5	0.112	1.7	NA	0.0	0.0	0.00	0.21	48.0
North: Murat Road											
3	T	114	0.0	0.101	0.9	LOS A	0.6	4.1	0.35	0.00	45.5
4	R	49	2.1	0.101	7.4	LOS A	0.6	4.1	0.35	0.73	42.8
Approach		163	0.6	0.101	2.9	NA	0.6	4.1	0.35	0.22	44.7
West: Nimitz Street											
5	L	41	0.0	0.116	9.0	LOS A	0.4	3.1	0.40	0.62	41.1
6	R	39	0.0	0.116	8.9	LOS A	0.4	3.1	0.40	0.71	41.1
Approach		80	0.0	0.116	8.9	LOS A	0.4	3.1	0.40	0.67	41.1
All Vehicles		458	0.5	0.116	3.4	NA	0.6	4.1	0.19	0.30	45.5

MOVEMENT SUMMARY

Site: Reid St/ Murat Rd 2030
AM Peak Hour

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Murat Road											
1	L	48	6.5	0.027	8.4	LOS A	0.0	0.0	0.00	0.67	49.0
2	T	81	7.8	0.044	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		129	7.3	0.044	3.2	NA	0.0	0.0	0.00	0.25	55.3
North: Murat Road											
3	T	96	7.7	0.052	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
4	R	1	0.0	0.001	8.6	LOS A	0.0	0.0	0.23	0.59	47.9
Approach		97	7.6	0.052	0.1	NA	0.0	0.0	0.00	0.01	59.8
West: Reid Street											
5	L	2	0.0	0.162	12.9	LOS B	0.7	4.9	0.41	0.81	45.0
6	R	105	6.0	0.162	13.3	LOS B	0.7	4.9	0.41	0.90	45.0
Approach		107	5.9	0.162	13.3	LOS B	0.7	4.9	0.41	0.89	45.0
All Vehicles		334	6.9	0.162	5.5	NA	0.7	4.9	0.13	0.39	52.6

MOVEMENT SUMMARY

Site: Reid St/ Murat Rd 2030
PM Peak Hour

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Murat Road											
1	L	96	0.0	0.052	8.2	LOS A	0.0	0.0	0.00	0.67	49.0
2	T	102	1.0	0.053	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		198	0.5	0.053	4.0	NA	0.0	0.0	0.00	0.32	54.1
North: Murat Road											
3	T	58	1.8	0.030	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
4	R	18	0.0	0.016	8.9	LOS A	0.1	0.4	0.29	0.62	47.7
Approach		76	1.4	0.030	2.1	NA	0.1	0.4	0.07	0.15	56.6
West: Reid Street											
5	L	2	0.0	0.051	12.8	LOS B	0.2	1.3	0.38	0.82	45.1
6	R	32	0.0	0.051	12.8	LOS B	0.2	1.3	0.38	0.88	45.1
Approach		34	0.0	0.051	12.8	LOS B	0.2	1.3	0.38	0.87	45.1
All Vehicles		307	0.7	0.053	4.5	NA	0.2	1.3	0.06	0.34	53.5

MOVEMENT SUMMARY

Site: Kennedy/ Street 4 2030
AM Peak Hour

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Kennedy Street											
1	L	1	0.0	0.059	5.8	LOS A	0.3	2.0	0.06	0.59	43.7
2	T	83	0.0	0.059	4.8	LOS A	0.3	2.0	0.06	0.47	44.5
3	R	1	0.0	0.059	8.9	LOS A	0.3	2.0	0.06	0.85	41.3
Approach		85	0.0	0.059	4.9	LOS A	0.3	2.0	0.06	0.47	44.5
East: Street 4											
4	L	2	0.0	0.009	5.9	LOS A	0.0	0.3	0.18	0.51	43.3
5	T	4	0.0	0.009	5.1	LOS A	0.0	0.3	0.18	0.42	43.8
6	R	4	0.0	0.009	9.2	LOS A	0.0	0.3	0.18	0.70	41.0
Approach		11	0.0	0.009	6.9	LOS A	0.0	0.3	0.18	0.55	42.5
North: Kennedy Street											
7	L	1	0.0	0.030	5.8	LOS A	0.1	1.0	0.08	0.59	43.6
8	T	39	0.0	0.030	4.9	LOS A	0.1	1.0	0.08	0.46	44.4
9	R	1	0.0	0.030	9.0	LOS A	0.1	1.0	0.08	0.84	41.3
Approach		41	0.0	0.030	5.0	LOS A	0.1	1.0	0.08	0.47	44.3
West: Street 4											
10	L	3	0.0	0.014	6.2	LOS A	0.1	0.5	0.27	0.52	43.0
11	T	11	0.0	0.014	5.4	LOS A	0.1	0.5	0.27	0.44	43.4
12	R	2	0.0	0.014	9.5	LOS A	0.1	0.5	0.27	0.72	41.0
Approach		16	0.0	0.014	6.1	LOS A	0.1	0.5	0.27	0.50	43.0
All Vehicles		153	0.0	0.059	5.2	LOS A	0.3	2.0	0.09	0.48	44.1

MOVEMENT SUMMARY

Site: Kennedy/ Street 4 2030
PM Peak Hour

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Kennedy Street											
1	L	1	0.0	0.093	5.8	LOS A	0.5	3.2	0.08	0.59	43.6
2	T	134	0.0	0.093	4.9	LOS A	0.5	3.2	0.08	0.46	44.4
3	R	1	0.0	0.093	9.0	LOS A	0.5	3.2	0.08	0.85	41.3
Approach		136	0.0	0.093	4.9	LOS A	0.5	3.2	0.08	0.47	44.4
East: Street 4											
4	L	1	0.0	0.007	6.2	LOS A	0.0	0.3	0.27	0.50	42.9
5	T	3	0.0	0.007	5.4	LOS A	0.0	0.3	0.27	0.42	43.3
6	R	4	0.0	0.007	9.5	LOS A	0.0	0.3	0.27	0.67	40.8
Approach		8	0.0	0.007	7.5	LOS A	0.0	0.3	0.27	0.55	42.0
North: Kennedy Street											
7	L	9	0.0	0.063	5.7	LOS A	0.3	2.2	0.03	0.60	43.8
8	T	83	0.0	0.063	4.8	LOS A	0.3	2.2	0.03	0.47	44.6
9	R	6	0.0	0.063	8.9	LOS A	0.3	2.2	0.03	0.85	41.3
Approach		99	0.0	0.063	5.2	LOS A	0.3	2.2	0.03	0.50	44.3
West: Street 4											
10	L	4	0.0	0.006	6.5	LOS A	0.0	0.2	0.34	0.50	42.7
11	T	1	0.0	0.006	5.7	LOS A	0.0	0.2	0.34	0.43	43.0
12	R	1	0.0	0.006	9.8	LOS A	0.0	0.2	0.34	0.66	40.8
Approach		6	0.0	0.006	6.9	LOS A	0.0	0.2	0.34	0.52	42.4
All Vehicles		249	0.0	0.093	5.1	LOS A	0.5	3.2	0.07	0.49	44.2

MOVEMENT SUMMARY

Site: Kennedy/ Street 8 2030
AM Peak Hour

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Kennedy Street											
1	T	83	0.0	0.055	0.2	LOS A	0.3	2.0	0.15	0.00	48.1
2	R	16	0.0	0.055	6.6	LOS A	0.3	2.0	0.15	0.78	43.1
Approach		99	0.0	0.055	1.2	NA	0.3	2.0	0.15	0.12	47.2
East: Street 8											
3	L	22	0.0	0.013	6.5	LOS A	0.1	0.4	0.12	0.57	42.9
4	R	1	0.0	0.013	6.6	LOS A	0.1	0.4	0.12	0.59	42.9
Approach		23	0.0	0.013	6.5	LOS A	0.1	0.4	0.12	0.57	42.9
North: Kennedy Street											
5	L	5	0.0	0.022	6.4	LOS A	0.0	0.0	0.00	0.87	43.3
6	T	38	0.0	0.022	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		43	0.0	0.022	0.8	NA	0.0	0.0	0.00	0.11	49.1
All Vehicles		165	0.0	0.055	1.9	NA	0.3	2.0	0.10	0.18	47.0

MOVEMENT SUMMARY

Site: Kennedy/ Street 8 2030
PM Peak Hour

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Kennedy Street											
1	T	127	0.0	0.070	0.4	LOS A	0.4	2.8	0.22	0.00	47.3
2	R	5	0.0	0.070	6.8	LOS A	0.4	2.8	0.22	0.81	43.2
Approach		133	0.0	0.070	0.6	NA	0.4	2.8	0.22	0.03	47.1
East: Street 8											
3	L	24	0.0	0.019	6.7	LOS A	0.1	0.6	0.18	0.56	42.7
4	R	6	0.0	0.019	6.7	LOS A	0.1	0.6	0.18	0.59	42.7
Approach		31	0.0	0.019	6.7	LOS A	0.1	0.6	0.18	0.57	42.7
North: Kennedy Street											
5	L	14	0.0	0.043	6.4	LOS A	0.0	0.0	0.00	0.85	43.3
6	T	69	0.0	0.043	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		83	0.0	0.043	1.1	NA	0.0	0.0	0.00	0.14	48.8
All Vehicles		246	0.0	0.070	1.5	NA	0.4	2.8	0.14	0.13	47.1

MOVEMENT SUMMARY

Site: Street 8/ Reid St 2030 AM Peak Hour

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Reid Street											
1	L	13	0.0	0.034	6.4	LOS A	0.0	0.0	0.00	0.84	43.3
2	T	54	0.0	0.034	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		66	0.0	0.034	1.2	NA	0.0	0.0	0.00	0.16	48.6
North: Reid Street											
3	T	63	0.0	0.034	0.2	LOS A	0.2	1.3	0.18	0.00	47.8
4	R	2	0.0	0.034	6.9	LOS A	0.2	1.3	0.18	0.87	43.0
Approach		65	0.0	0.034	0.4	NA	0.2	1.3	0.18	0.03	47.6
West: Street 8											
5	L	3	0.0	0.045	7.5	LOS A	0.2	1.2	0.27	0.53	42.3
6	R	32	0.0	0.045	7.7	LOS A	0.2	1.2	0.27	0.61	42.1
Approach		35	0.0	0.045	7.7	LOS A	0.2	1.2	0.27	0.61	42.1
All Vehicles		166	0.0	0.045	2.3	NA	0.2	1.3	0.12	0.20	46.7

MOVEMENT SUMMARY

Site: Street 8/ Reid St 2030 PM Peak Hour

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Reid Street											
1	L	32	0.0	0.041	6.4	LOS A	0.0	0.0	0.00	0.76	43.3
2	T	46	0.0	0.041	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		78	0.0	0.041	2.6	NA	0.0	0.0	0.00	0.31	47.0
North: Reid Street											
3	T	40	0.0	0.023	0.3	LOS A	0.1	0.9	0.19	0.00	47.6
4	R	3	0.0	0.023	6.9	LOS A	0.1	0.9	0.19	0.85	43.0
Approach		43	0.0	0.023	0.8	NA	0.1	0.9	0.19	0.06	47.2
West: Street 8											
5	L	1	0.0	0.024	7.3	LOS A	0.1	0.6	0.25	0.53	42.3
6	R	18	0.0	0.024	7.5	LOS A	0.1	0.6	0.25	0.60	42.2
Approach		19	0.0	0.024	7.5	LOS A	0.1	0.6	0.25	0.60	42.3
All Vehicles		140	0.0	0.041	2.7	NA	0.1	0.9	0.09	0.27	46.4

MOVEMENT SUMMARY

Site: Kennedy/ Learmonth
2030 AM Peak Hour

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Kennedy Street											
1	L	19	0.0	0.037	6.4	LOS A	0.0	0.0	0.00	0.81	43.3
2	T	52	0.0	0.037	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		71	0.0	0.037	1.7	NA	0.0	0.0	0.00	0.22	48.0
North: Kennedy Street											
3	T	41	0.0	0.035	0.3	LOS A	0.2	1.2	0.17	0.00	47.7
4	R	19	0.0	0.035	6.6	LOS A	0.2	1.2	0.17	0.71	43.1
Approach		60	0.0	0.035	2.3	NA	0.2	1.2	0.17	0.23	46.1
West: Learmonth Street											
5	L	47	0.0	0.091	7.1	LOS A	0.4	2.5	0.20	0.57	42.6
6	R	37	0.0	0.091	7.1	LOS A	0.4	2.5	0.20	0.60	42.6
Approach		84	0.0	0.091	7.1	LOS A	0.4	2.5	0.20	0.58	42.6
All Vehicles		215	0.0	0.091	4.0	NA	0.4	2.5	0.12	0.36	45.2

MOVEMENT SUMMARY

Site: Kennedy/ Learmonth
2030 PM Peak Hour

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Kennedy Street											
1	L	29	0.0	0.070	6.4	LOS A	0.0	0.0	0.00	0.83	43.3
2	T	105	0.0	0.070	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		135	0.0	0.070	1.4	NA	0.0	0.0	0.00	0.18	48.4
North: Kennedy Street											
3	T	60	0.0	0.057	0.5	LOS A	0.3	2.1	0.25	0.00	46.6
4	R	34	0.0	0.057	6.9	LOS A	0.3	2.1	0.25	0.70	42.9
Approach		94	0.0	0.057	2.8	NA	0.3	2.1	0.25	0.25	45.2
West: Learmonth Street											
5	L	27	0.0	0.066	7.8	LOS A	0.2	1.7	0.30	0.58	42.1
6	R	26	0.0	0.066	7.7	LOS A	0.2	1.7	0.30	0.63	42.1
Approach		54	0.0	0.066	7.8	LOS A	0.2	1.7	0.30	0.60	42.1
All Vehicles		282	0.0	0.070	3.1	NA	0.3	2.1	0.14	0.28	46.0

APPENDIX G SHIRE OF EXMOUTH POLICY 8.1 MULTI USE PATHS

POLICY NUMBER - 8.1

POLICY SUBJECT	-	8.1 - Multi Use Paths within the Exmouth Town Site
ADOPTED	-	16 February 2006 Reviewed August 2011

Policy: To install a network of Multi Use Paths (footpaths) within the Exmouth townsite based on strategic pedestrian routes that meet a variety of user needs. These Multi Use Paths shall be constructed of different materials based on their location.

Objective To provide for safe pedestrian movement within the Exmouth townsite, taking into consideration long term maintenance requirements, aesthetic appeal and budgetary allocation.

Guidelines It is accepted that the primary purpose of Multi Use Paths (MUP's) is to provide for safe and easy pedestrian movement. The many and varied uses and users of the MUP's are as follows:-

- Recreation and Leisure – walking, jogging, bicycle riding, roller skates, skate boards, scooters, gophers, etc.
- Pedestrian movement – safe movement of pedestrians from one location to another. This can be done using a variety of means including walking, bicycling, motorised gophers, etc. Examples include walking to school, walking/riding to the shops, using the gopher to ride to the shops.

As road reserves form a significant proportion of public open space available to residents and can improve their streetscape and lifestyle, Multi Use Paths within those reserves have an equally important function.

The following principles shall apply to the future development, upgrading and improvement of Multi Use Paths:

RESIDENTIAL ZONE AREAS – STANDARD ACCESS ROUTES:

- All existing streets located within the residential zones of the Exmouth townsite shall have a 2.1 metre wide Multi Use Path on one side of the road verge within the safety zone as stated in the Australian Standards.
- Those streets identified as Standard pedestrian routes shall have Multi Use Paths constructed of concrete.
- All new residential subdivisions and developments are to incorporate Multi Use Paths as a condition of development.
- All paths are to incorporate disabled access needs and have suitable on and off ramps installed to enable access from the road to the path.
- The purpose of this policy is to reduce future maintenance requirements and provided a safer path that complies with all relevant Standards.

RESIDENTIAL / OTHER ZONE AREAS – STRATEGIC ACCESS ROUTES:

- All existing streets located within the residential and other zones of the Exmouth townsite shall have a 2.1 – 2.5 metre wide Multi Use Path on one side of the road verge within the safety zone as stated in the Australian Standards.
- Those streets identified as Strategic pedestrian routes shall have Multi Use Paths constructed of concrete and shall incorporate dedicated pedestrian lighting or be serviced by existing street lights..
- All paths are to incorporate disabled access needs and have suitable on and off ramps installed to enable access from the road to the path.
- The purpose of this policy is to reduce future maintenance requirements and provided a safer path that complies with all relevant Standards.

COMMERCIAL / BUSINESS ZONE AREAS:

- In general, within the Shopping Centre Precinct (Ross Street Mall) or the Exmouth Marina Commercial / Business precinct, all existing streets shall have a Multi Use Path on at least one side of the road verge extending from the road verge (kerbing) to the shop/business front and within the safety zone as stated in the Australian Standards. There will be exceptions where certain areas shall have Multi Use Paths on both sides of the road verge, or the width of the path will only be 2.1 or 2.5 metres wide.
- In general, all existing streets located within the commercial / business zone of the Exmouth townsite shall have a Multi Use Path on one at least one side of and contained within the road verge and within the safety zone as stated in the Australian

Standards. There will be exceptions where certain areas shall have Multi Use Paths on both sides of the road verge, or the width of the path will only be 2.1 or 2.5 metres wide.

- Those streets within the Shopping Centre Precinct (Ross Street Mall) or the Exmouth Marina Commercial / Business precinct shall have Multi Use Paths constructed of coloured paving brick or stencilled concrete. Those streets within the Commercial/Business zone shall have Multi Use Paths constructed of concrete or paving brick.
- All paths are to incorporate disabled access needs and have suitable on and off ramps installed to enable access from the road to the path.
- The purpose of this policy is to ensure continuity in theme and aesthetics for the Central Business District and Commercial Areas and to reduce future maintenance requirements.

INDUSTRIAL, LIGHT INDUSTRIAL & MIXED USE ZONE AREAS:

- In general Multi Use Paths are not required or provided in Industrial, Light Industrial or Mixed Use areas.

OTHER ZONE AREAS:

- In general, Dual Use Paths in other zones will be constructed along the same lines as the Residential Zone Areas – Standard Access Routes.

Definitions:

Strategic Access Routes

- Murat Road (from Maidstone Crescent in the north to Market Street in the south), Nimitz Street, Maidstone Crescent, Krait Street, Kennedy Street,Maddaffari Drive.