Buller Local Structure Plan

Buller, Western Australia

Prepared for the Shire of Chapman Valley by GHD Pty Ltd

SPN/0655

This structure plan is prepared under the provisions of the Shire of Chapman Valley Local Planning Scheme No. 2.

IT IS CERTIFIED THAT THIS STRUCTURE PLAN WAS APPROVED BY RESOLUTION OF THE WESTERN AUSTRALIAN PLANNING COMMISSION ON: 1 FEBRUARY 2016.

Signed for and on behalf of the Western Australian Planning Commission

an officer of the Commission duly authorised by the Commission pursuant to Section 16 of *the Planning and Development Act 2005* for that purpose, in the presence of:

Witness

4/2/16

Date

1 FEBRUARY 2031 Date of Expiry

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_____

Witness

_____

Date

And by

RESOLUTION OF THE COUNCIL OF THE SHIRE OF CHAPMAN VALLEY ON

_____

Date

and the seal of the Municipality was

PURSUANT TO THE COUNCIL'S RESOLUTION HERE UNTO AFFIXED IN THE PRESENCE OF:

J R Collingwood
_____

President, Shire of Chapman Valley

_____

Chief Executive Officer, Shire of Chapman Valley

17 June 2015
_____

Date

TABLE OF AMENDMENTS TO PART ONE AND STRUCTURE PLAN MAP

No.	Description of Amendments	Date endorsed by Council	Date endorsed by WAPC
No. 1	Amendments arising from review of submissions received during advertising period	17 June 2015	
No. 2	Amendments required by WAPC 17/11/15		
No. 3	Amendments required by WAPC 25/01/2016		

Executive Summary

The Buller Development Zone ("the site") is located on the fringe of the Geraldton urban area, approximately eight kilometres north of Geraldton adjacent to the North West Coastal Highway. Nestled within the municipality of the Shire of Chapman Valley, the site is bound by the highway to the east, ocean to the west, Drummond Cove urban development to the south, and the mouth of the Buller River to the north. The total area of the site is 197.21 ha.

The Buller Local Structure Plan (LSP) has been prepared to create new urban development in close proximity to Geraldton, characterised by strong coastal links, large lifestyle lots and conservation of environmental character. The site consists of 13 freehold lots, all in private ownership. The site is identified within the Development Zone of Shire of Chapman Valley Local Planning Scheme No. 2.

The site has been split into two sub-areas, Buller Structure Plan Area North (Lots 3, 11, 12, 15, 16, 17, 154 and 156 North West Coast Highway, Buller) and Buller Structure Plan Area South (Lots 7, 8, 9, 10 and 1891 North West Coast Highway, Buller). Further planning is required for Buller Structure Plan Area North prior to subdivision regarding the internal road network, public open space provision and location and the flooding environment of the Buller River.

The LSP area consists primarily of low density residential areas with a split coding of R5/10 to allow for diversity in housing choice, as well as ensuring conservation areas are protected. A range of lot sizes, layouts and frontages are encouraged generally in accordance with the R5 density to promote innovative conservation outcomes, including the reservation of areas with vegetation in good condition and conservation value. Some Residential (R10/15) lots are proposed in the southern portion of the LSP area, interfacing the existing residential area of Drummond Cove.

The location of the site and its proximity to the coast and foreshores is a key consideration of the structure plan. A significant portion of the LSP area identifies foreshore reserves and conservation areas where additional public open space is encouraged. The foreshore is expected to be of high value and use to residents and visitors; the advantageous nature of coastal living is promoted by the structure plan. The LSP recognises that the low density nature and large foreshore reserves of Buller satisfies much of the demand for open spaces, and regional variation for public open space can provide additional neighbourhood parks and support water sensitive urban design.

The LSP proposes a movement network that maximises permeability and legibility by establishing new connections with the North West Coastal Highway in both the north and south areas of the site. Guided by the appropriate road types from Liveable Neighbourhoods, neighbourhood connector roads are proposed as the key access and egress connectors for the structure plan area and include water sensitive urban design requirements as set out in a supporting Local Water Management Strategy. Traffic generation and management have been based on 650 dwellings, with a peak flow of 142 vehicles per hour. Forecasted traffic volumes for the next 15-20 years have been based from the forecast traffic volumes for North West Coastal Highway for 2021 and the anticipated population growth.

A strong pedestrian network is promoted in the structure plan, appropriately designed to enable connectivity and access between low density residential lots and coastal access, exemplified by a coastal path that will run north-south of the site.

The LSP proposes further detailed planning to resolve several potential issues that may arise through development of the site, including:

- Noise impacts associated with the North West Coastal Highway;
- Detailed planning for protection of areas identified as having conservation significance, which are impacted by existing approvals and uses; and
- Detailed planning for areas identified as containing Frankenia pauciflora.
- Bushfire hazard assessment and analysis in accordance with the State Planning Policy 3.4 Natural Hazards and Disasters and Planning for Bush Fire Protection Guidelines (edition 2) and the requirements in State Planning Policy 3.7 Planning for Bushfire Risk Management and associated Guidelines.

Structure Plan Summary Table

Item	Data	Section Number referenced in report
Total area covered by the structure plan:	197.21 ha	Refer Part 2, 1.2.2
Area of specific land uses:		
Development (residential)	156.83 ha (Includes 9ha Drummond Cove Holiday Park)	Refer Part 2, 3.1
Estimated lot yield	540-650	Refer Part 2, 3.1
Estimated number of dwellings	540-650	Refer Part 2, 3.1
Estimated population (2.6 persons per household)	1404-1690	Refer Part 2, 3.1
Number and area of open space	1 9 ha (incl. water sensitive urban design)	Refer Part 2, 3.2
Foreshore reserve	33.15 ha	Refer Part 2, 3.1
Public open space	7.72 ha	Refer Part 2, 3.1

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Buller Structure Plan

Part One - Implementation Section

Implementation Section

1.0 Structure Plan Area

This structure plan shall apply to Lots 156, 154, 17, 16, 15, 12, 11, 3, 8, 7, 9, 10, and 1891 North West Coastal Highway, Buller being the land contained within the inner edge of the line denoting the structure plan boundary on the structure plan map (Plan 1).

As shown on Plan 1, the Structure Plan area is divided into two sub-areas: Buller Structure Plan Area North and Buller Structure Plan Area South.

Buller Structure Plan Area North comprises Lots 3, 11, 12, 15, 16, 17, 154 and 156. Further planning is required for this sub area prior to subdivision, particularly with regard to the internal road network, public open space provision and location and the flooding environment of the Buller River.

Buller Structure Plan Area South comprises Lots 7, 8, 9, 10 and Lot 1891.

2.0 Structure Plan Content

This structure plan comprises:

a. Part 1 - Implementation section
   This section contains the structure plan map and statutory planning provisions and requirements.

b. Part 2 – Non-statutory (explanatory) section
   This section to be used as a reference guide to interpret and justify the implementation of Part One.

c. Appendices – Technical reports and supporting plans and maps.

3.0 Interpretation and Relationship with the Scheme.

3.1

Unless otherwise specified in this part, the words and expressions used in this Structure Plan shall have the respective meanings given to them in the Shire of Chapman Valley Local Planning Scheme No. 2 (the Scheme) including any amendments gazetted thereto.

The structure plan map (Plan 1) outlines land use, zones and reserves applicable within the structure plan area

4.0 Operation

4.1

The date the structure plan comes into effect is the date the structure plan is approved by the Western Australia Planning Commission (WAPC).

5.0 Land Use and Subdivision

The Structure Plan Map (Plan 1) outlines land use, zones and reserves applicable within the Structure Plan area.

5.1 Land Use Permissibility

Land use permissibility within the structure plan area shall be in accordance with the corresponding zone or reserve under the Scheme.

5.2 Residential

5.2.1 Density

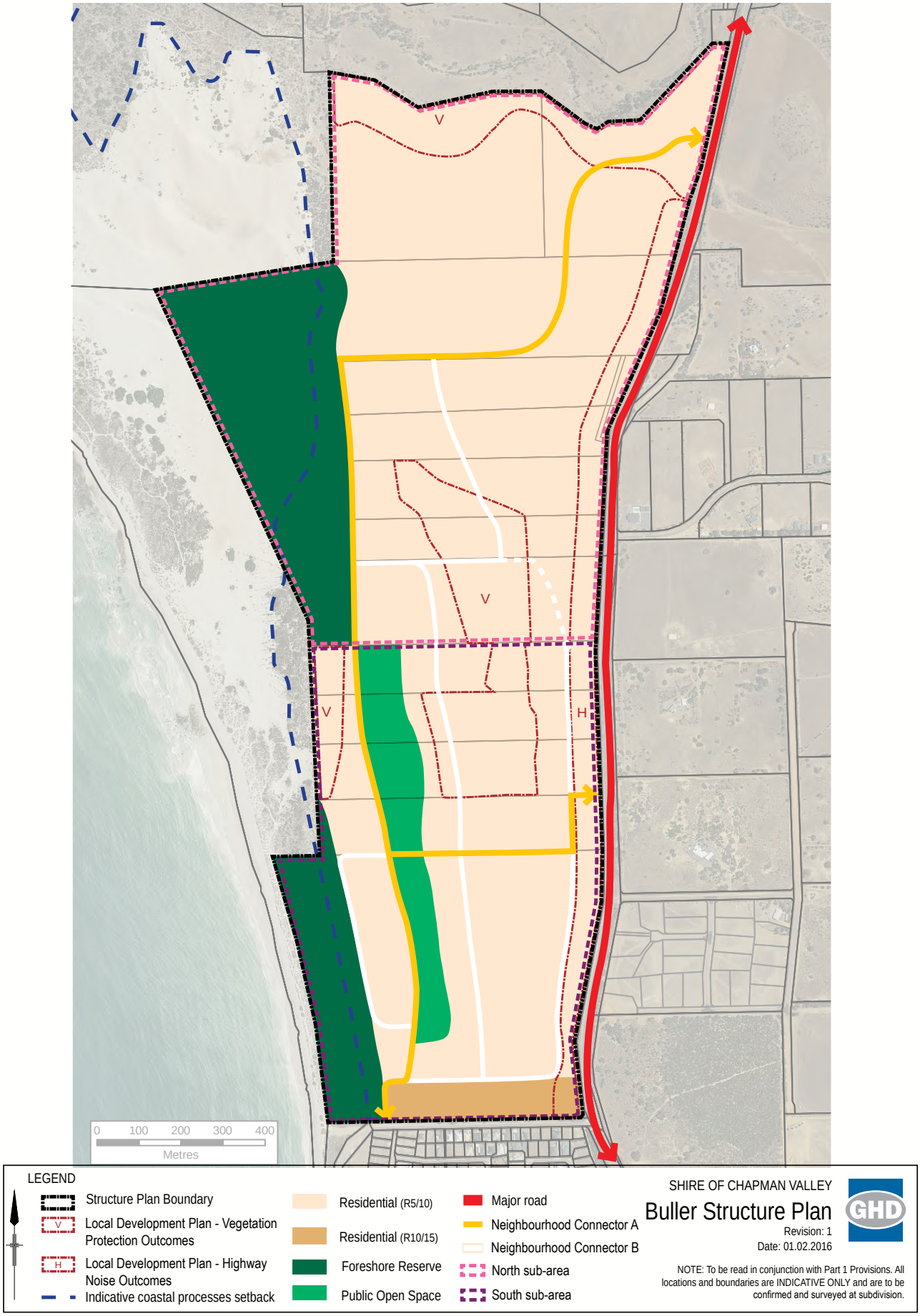
Plan 1 identifies residential density codes for the structure plan area.

A base density code of R5 is provided for all residential lots within the Structure Plan.

In the area identified on Plan 1 as having a density code of R5/10, a code of R10 may be applied where:

i. consistency with Government Sewerage Policy requirements is demonstrated; and,
ii. the land is located outside of the Vegetation Protection areas identified on Plan 1.

In the area identified on Plan 1 as having a density code of R10/15, the R10 or R15 code may be applied where consistency with Government Sewerage Policy requirements is demonstrated.



Plan 1: Buller Structure Plan

5.3 Public Open Space

In the Buller Structure Plan North sub-area, Public Open Space (POS) requirements are subject to further planning.

In the Buller Structure Plan South sub-area, POS is to be provided generally in accordance with Plan 1 and any requirements of the Local Water Management Strategy. A detailed public open space schedule is to be provided at the time of subdivision.

5.4 Reports/Strategies Required Prior to Subdivision

Prior to the lodgement of subdivision applications to the WAPC, the following information is to be prepared, as applicable, to the satisfaction of the relevant authority and provided with the application for subdivision:

a. Calculation of the current risk of storm surge inundation (S4 inundation) in accordance with SPP2.6 State Coastal Planning Policy for Lots 1891 and 10 and adjustment of the foreshore reserve width as applicable.
b. Survey of the Horizontal Setback Datum (HSD) and measure of the foreshore reserve width accordingly
c. For proposals located within the Vegetation Protection areas, a Local Development Plan demonstrating consistency with section 5.5.
d. For proposals located with the Highway Noise area a Local Development Plan demonstrating consistency with section 5.5.
e. Bushfire hazard level assessment and bushfire attack level (BAL) in accordance with relevant government policy and guidelines

5.5 Special Provisions for Vegetation Protection and Highway Noise

5.5.1 Local Development Plan - vegetation Protection Outcomes

A range of lot sizes, layouts and frontages are encouraged generally in accordance with the R5 density to promote innovative conservation outcomes, including the reservation of areas with vegetation in good condition and conservation value.

Building envelopes shall be identified for all lots in a Vegetation Protection area.

Frankenia sp is known to occur on the saline flats in the south western portion of the structure plan area. Building envelopes are to be located to avoid good quality examples.

The location of building envelopes for lots within the Vegetation Protection area adjoining the Buller River will also consider the floodplain environment and appropriate building levels;

All development, including incidental development and associated domestic firebreaks, shall be limited to the defined building envelope. No clearing of vegetation is permitted with the exception of clearing associated with construction and firebreaks for approved development locations.

The design and layout of all development should integrate fire breaks and access wholly within the building envelope.

Boundary fencing is to be avoided to minimise further fragmentation of vegetation. The 'Water Corporation's No. 63 Water Reticulation Standard' is deemed to be the baseline criteria for developments and should be applied.

Building/development setback from the vegetation edge is to be achieved in general accordance with relevant, state bushfire protection policy and guidelines.

5.5.2 Local Development Plan - Highway Noise Outcomes

The preparation of a detailed acoustic assessment and implementation of mitigation measures, is required.

All lots abutting the highway are to provide and maintain a 10m wide landscaped area to provide visual screening from the highway.

No direct vehicular access shall be permitted to lots from the North West Coastal Highway.

5.6 Conditions of Subdivision Approval

At the time of subdivision the following conditions may be recommended, as applicable, requiring the preparation and/or implementation of the following:

a. Bushfire Management Plan/s in accordance with relevant government bushfire protection policy and guidelines
b. Urban Water Management Plan
c. A Local Development Plan to address building envelope requirements in Vegetation Protection and Highway Noise areas.
d. A Local Development Plan to address noise amelioration and access arrangements for lots abutting the North West Coastal Highway.
e. Notification on titles of lots subject to Local Development Plans, advising that development is to be in accordance with a Local Development Plan as approved by the Local Government.

6.0 Development

Plan 2 has been prepared to identify all existing and approved development within the Buller Structure Plan at the time of Scheme gazettal.

7.0 Other Requirements

7.1 Infrastructure Contributions

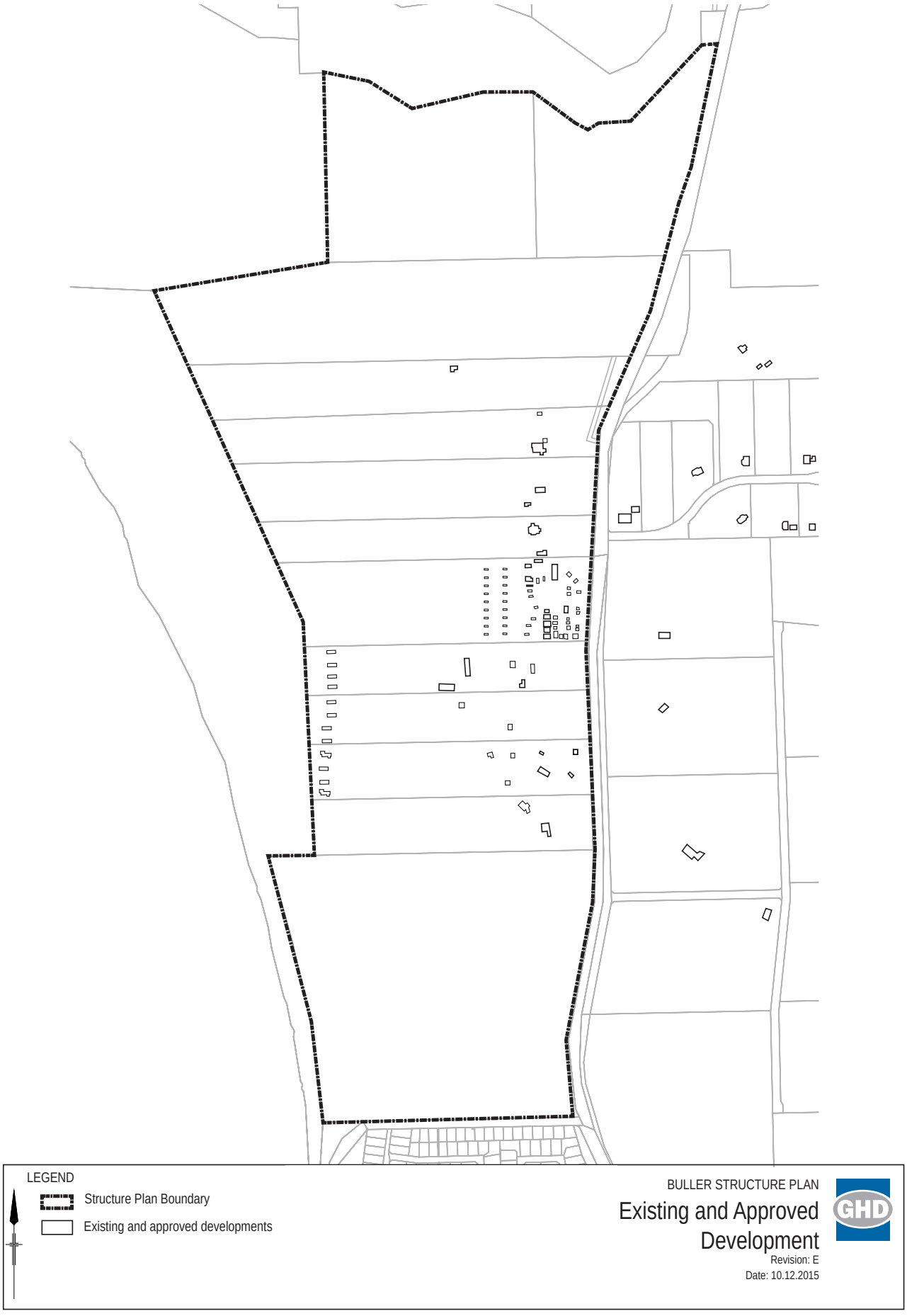
a. Subdividers shall be responsible for the construction and upgrade of connection points to North West Coastal Highway ('road upgrades').

b. A cost contribution for road upgrade will be requested as a condition of approval of a subdivision application by the Shire of Chapman Valley where it is determined that the upgrade works are necessary to support that stage of subdivision.

7.2 General Development Requirements

a. The orientation and design of buildings shall be sympathetic to existing landform, and natural landscape elements, including native vegetation.

b. The use of reflective roof and wall materials which prejudice the landscape amenity of the surrounding landform, will not be permitted.



Plan 2: Pre-existing and approved development

Buller Structure Plan

Part Two - Explanatory Section

1.0 Planning Background

1.1 Introduction and Purpose

The intent of the Buller Structure Plan is to create a new urban development within the Buller Development Zone on the fringe of the Geraldton urban area, characterised by:

- Strong coastal links;
- Large lifestyle lots; and,
- Conservation of environmental character.

The purpose of the structure plan is:

- To provide a statutory land use plan for the area.
- To provide a comprehensive framework for land use to facilitate future subdivision and development of the area.
- To address the environmental conditions outlined in Schedule 10 of the Shire of Chapman Valley Local Planning Scheme No. 2.

The intent of the Buller Structure Plan is to facilitate lifestyle residential lots with a strong relationship with the coast and natural landscapes.

1.2 Land Description

1.2.1 Location

The Buller Development Zone - the study area for the structure plan - is located approximately 8 kilometres north of Geraldton, adjacent to the North West Coastal Highway (see Figure 1). The site is bounded by the highway to the east, the ocean to the west, Drummond Cove urban development to the south, and the mouth of the Buller River to the north.

1.2.2 Area and Land Use

The site consists of primarily rural lifestyle land uses, including cleared areas, existing houses, ancillary buildings and remnant coastal bushland. The Drummond Cove Holiday Park is also located within the study area. An aerial photo of the site is included as Figure 2.

The total area of the site is 197.21 ha.

Figure 1: Location of the Buller Local Structure Plan Area

Figure 2: Buller Local Structure Plan Site Aerial and Lot Details (2014 imagery)

1.2.3 Legal Description and Ownership

The site consists of 13 freehold lots, all in private ownership. The ownership and Certificate of Title details are outlined in Table 2.

Table 1: Ownership and Certificate of Title Details

Lot	Owner	Certificate of Title (Volume/ Folio)
156	A & G Forth	2170/743
154	A & G Forth & R & V Kennedy	2170/742
17	A & G Forth	2215/880
16	C & J Mills	2204/86
15	A Harrop, D Bushell, B Carter, G & H Hoult, R Holm	2204/85
12	M McDonald	1980/612
11	J Tonkin & A Sloan	1980/611
3	D & A Bell	1367/724
8	K Gregory & A Knight	1205/999
7	C Miles-Cadman	1205/1000
9	M Thomas	270/36A
10	Sustento Pty Ltd	270/37A
1891	Hadril Holdings Pty Ltd	1759/604

1.3 Planning Framework

1.3.1 Zoning and Reservations

The Shire of Chapman Valley Local Planning Scheme No. 2 (LPS2), was gazetted on 20 November 2013. The subject land is zoned as 'Development' with an associated 'Development Contribution Area 1' zoning as shown in Figure 3.

1.3.2 Environmental Conditions

The identification of the Buller Development Zone within the Development Zone of LPS2 was subject to a public environmental review under the provisions of the Environmental Protection Act 1986. The Minister for Environment Statement No. 937 (Appendix A) provides the outcomes of the environmental assessment. The key outcome was the inclusion of four environmental conditions for the Buller Development Zone within LPS2. The four conditions have been listed below followed by a discussion outlining how these have been addressed in the Structure Plan.

1. Development within the Buller "Development" Zone in relation to the conservation areas shall be generally in accordance with concept 2A as outlined in the Shire of Chapman Valley Buller Development Zone Opportunities, Constraints and Concepts Study.

The structure plan is consistent with this condition.

Public Open Space and Local Development Plans are presented as key planning mechanisms in the structure plan. These are applied to all conservation areas identified in concept 2A to recognise their conservation purpose, and provide a planning response to protect their conservation value.

2. Any future structure plan shall identify future local scheme reserves for the purpose of conservation as outlined in concept 2A within the Shire of Chapman Valley Buller Development Zone Opportunities, Constraints and Concepts Study.

The structure plan meets the intent of this condition, although does not specifically apply local scheme reserves to all conservation areas. The structure plan proposes the use of Local Development Plans

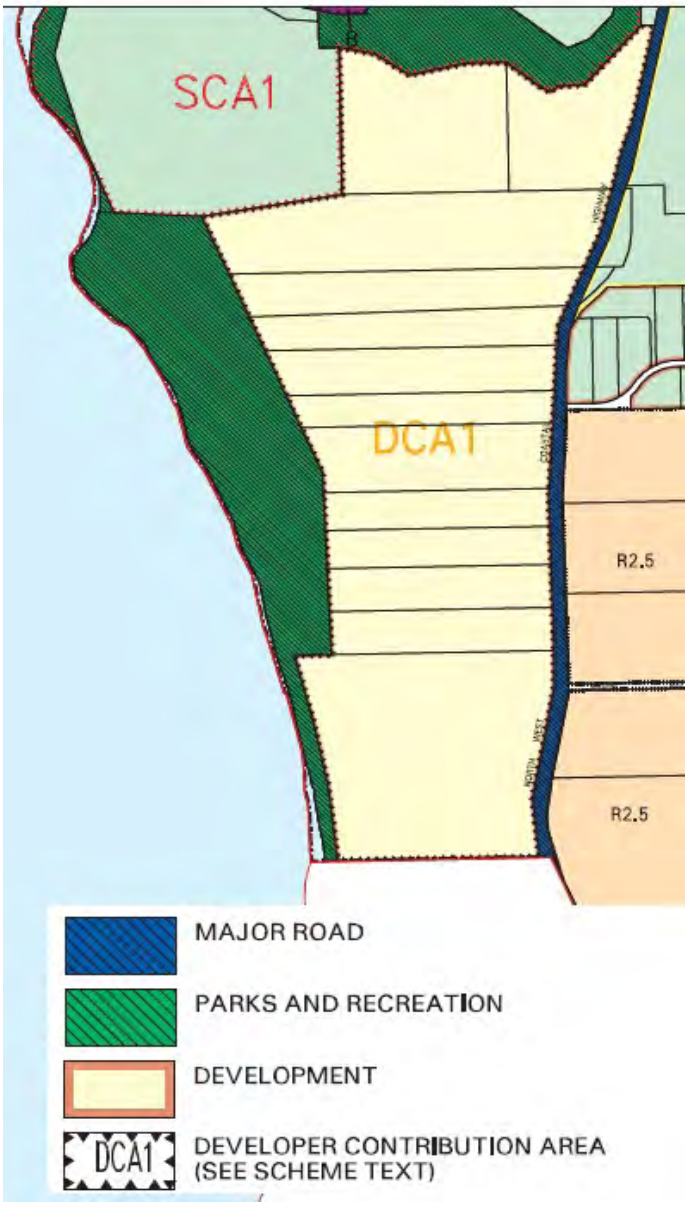


Figure 3: Local Planning Scheme No. 2

where more appropriate and effective to achieve the conservation intent. This is because local reserves cannot achieve the desired conservation outcome in the context of pre-existing development and approvals within some conservation areas.

Concept 2A shown in the Shire of Chapman Valley Buller Development Zone Opportunities, Constraints and Concepts Study is a schematic comparison of land use only and therefore did not provide sufficient detail for the purpose of identifying conservation assets that are viable for protection solely through reservation. To more accurately respond to onground conservation assets, the structure plan was prepared utilising one metre contours, specifically commissioned extremely high resolution aerial drone photography and accurate plotting of pre-existing approvals and disturbed areas on the site.

Figure 4 illustrates the general conservation areas from concept 2A that are identified by the structure plan for protection through Local Development Plans, showing existing disturbance and pre-existing approvals.

High resolution aerial photography demonstrates that the three conservation areas identified for protection through Local Development Plans are significantly impacted by pre-existing clearing. The level of pre-existing disturbance affects the longer term viability of these areas as publicly managed conservation reserves. It is acknowledged that local government resources cannot manage these fragmented areas as reserves for conservation, compared to the ability of private owners to perform regular maintenance, for example weed, fire and access management and achieve superior conservation outcomes in this instance.

Recent approvals for tourist accommodation and other uses within the conservation areas significantly limits the efficacy of local reserves as a planning response to protect conservation values. Identifying the land as a local reserve - to be ceded at the time of subdivision - does not enable the use of that land to be controlled or conservation assets protected until such time as the land is ceded. This is a significant issue within the structure plan where landowners elect not to undertake subdivision in the short to medium term where it would result in the loss of approved business activities. This would not enable the protection of the conservation values through any planning response. The use of Local Development Plans, as a means to achieve conservation

Photo courtesy of Quantum Surveys

Site flora and fauna surveys along with aerial drones have informed conservation responses of the structure plan

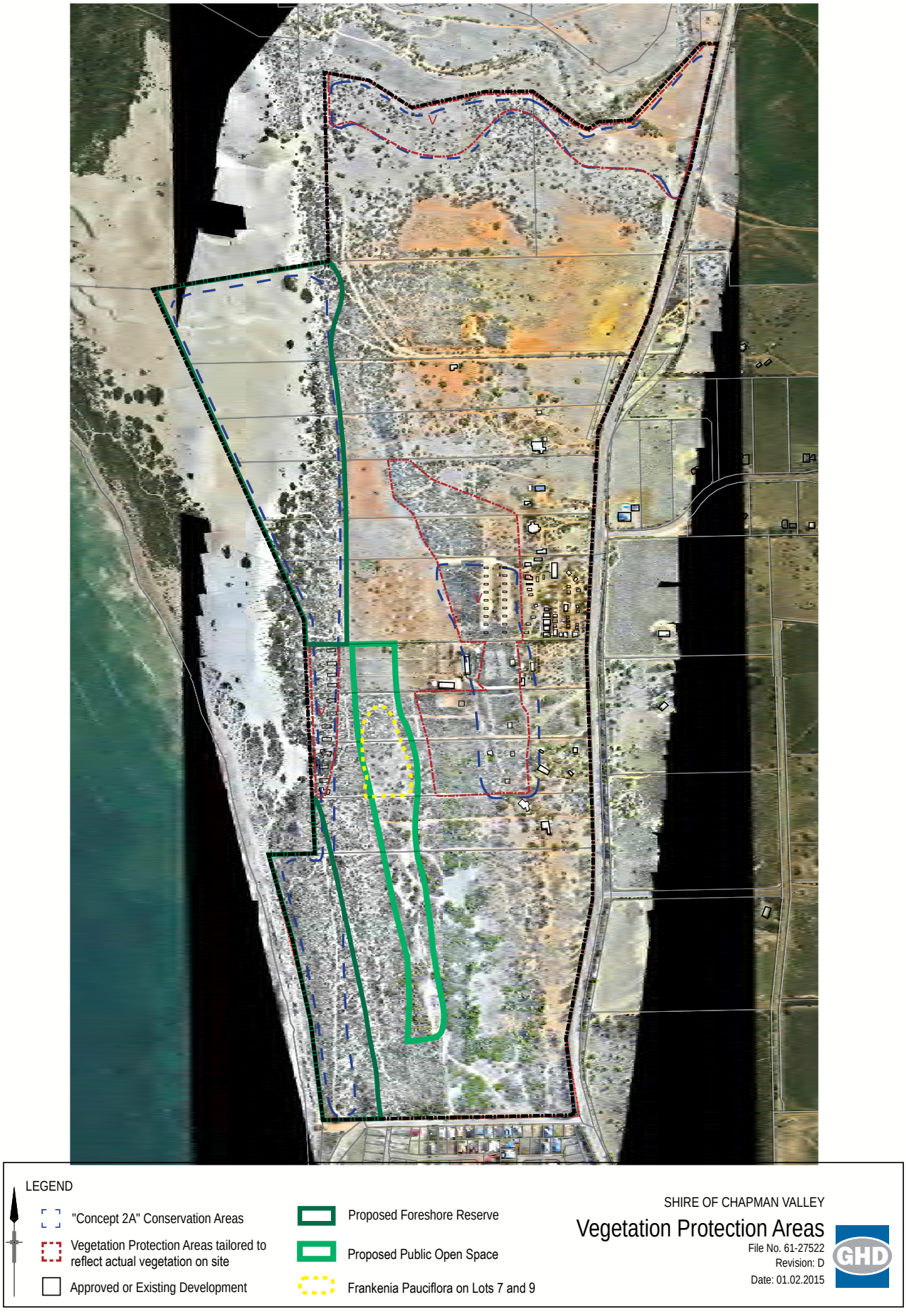


Figure 4: High resolution aerial photography showing disturbance and approved development within areas referred to within the Minister for Environment Statement No. 937.

outcomes, will enable owners to operate approved business uses, whilst protecting the conservation area from further development. The Local Development Plans shown on the structure plan define and regulate development within the areas identified by Concept 2A whilst accounting for existing and approved development and are in accordance with the conservation outcomes of the Minister for Environment Statement No. 937.

3. Any future structure plan shall identify R5-Low Density (minimum lot size 2000m²) residential areas as outlined in areas X and Y as depicted in Figure 1 of Minister for Environment Statement No. 937 published on 6 June 2013.

The structure plan is consistent with this condition.

A split coding of R5/10 will be applied across the area. The base zoning will be R5 (lots larger than 2000m²) and specific requirements will need to be met in order to achieve densities of R10, outside areas of high conservation value (inclusive of areas X and Y).

4. Any future structure plan shall identify the areas of Frankenia pauciflora community on Lots 7 and 9 theses areas would be subject to detailed area plans as outlined in the Western Australian Planning Commission's Liveable Neighbourhoods policy to address public open space, vegetation protection, future fences, building envelopes and setback of any future lots.

The structure plan is consistent with this condition.

Figure 4 illustrates the location of *Frankenia pauciflora* Lots 7 and 9 which falls within public open space areas identified by the structure plan.

1.3.3 Regional Structure Plans

Strategic planning for the area, through regional and district structure planning, has identified the role of the Buller Development Zone in providing housing and services to support the district and employment growth foreseen for the region.

The final Greater Geraldton Structure Plan (GGSP) was released in June 2011, and is an update of the 1999 Greater Geraldton Structure Plan. The document is intended as an interim measure until local governments have prepared new local planning strategies and/or district structure plans. The structure plan is used as a basis for the preparation of wider strategic regional planning.

The study area is identified within the GGSP as 'Future Urban', with an 'indicative rapid public transport alignment' identified along North West Coastal Highway, as shown in Figure 5. The GGSP also identifies the proximity of the site to the Oakajee Strategic Industrial Estate, with the edge of the Oakajee Industrial Structure Plan, and the industrial buffer, located at the northern boundary of the Buller Development Zone. This vision for the area has been implemented through the application of a 'Development' zone for urban purposes, primarily residential.

The R5/10 split density code is commensurate with the site's location at the northern-most extent of the Geraldton urban growth corridor, with the Oakajee Industrial Estate buffer precluding further residential expansion north of the Buller River. The R-coding also responds to the steep topography and conservation values of the site.

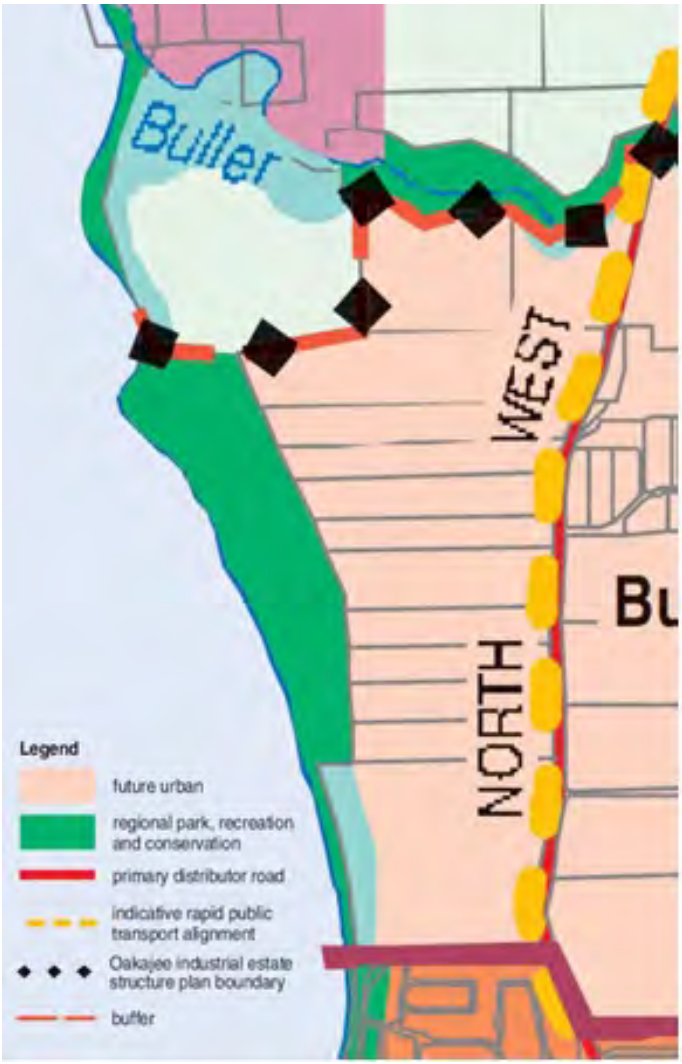


Figure 5: Greater Geraldton Structure Plan

1.3.4 State Planning Policy

State Planning Policy No. 1 - State Planning Framework (SPP1) sets the overarching framework that guides decisions made on growth and development in Western Australia. SPP1 sets the policy framework for a number of more specific state policies that target key environmental and social issues in the state.

This section summarises these policies as relevant to the Buller Structure Plan. These include:

- State Planning Policy No. 2.6 - State Coastal Planning Policy
- State Planning Policy No. 2.9 - Water Resources
- State Planning Policy No. 3.4 - Natural Hazards and Disasters
- State Planning Policy No. 3.7 - Planning for Bushfire Risk Management
- State Planning Policy 5.4 - Road and Rail Transport Noise and Freight Considerations in Land Use Planning
- Development Control Policy No. 2.2 - Residential Subdivision
- State Planning Policy No. 3.6 Developer Contributions for Infrastructure
- Liveable Neighbourhoods

State Planning Policy No. 2.6 - State Coastal Planning Policy

SPP2.6 sets out policy requirements for the community's management and enjoyment of the Western Australian coastline. The policy sets out policy expectations for coastal foreshore reserves that protect the coastal environs, manage future impacts of climate change, and balances development approaches for coastal facilities.

The physical processes setback for the Buller coast has been determined in accordance with SPP 2.6 and associated guidelines. Along with the coastal setback, the structure plan proposes a foreshore reserve to meet environmental, landscape, and public access way requirements of the policy. The structure plan's compliance with the policy is discussed in Section 2.6 (coastal processes setback) and Section 3.2 (foreshore reserve).

State Planning Policy No. 2.9 – Water Resources (SPP2.9)

SPP2.9 provides a policy basis for planning proposals and decisions to respond to integrated water cycle management. The policy is supported by detailed planning guidelines - Better Urban Water Management (WAPC 2008). Better Urban Water Management (WAPC 2008a) provides a model for developers to address water related management issues at various stages of planning and presents design objectives for water conservation, stormwater and groundwater management.

An LWMS, forming Appendix B to the Buller Structure Plan, has been prepared in accordance with SPP2.9 and Better Urban Water Management, on advice from the Department of Water (DoW) and Shire of Chapman Valley.

The LWMS sets out in detail how future planning and development within the Buller Development Zone will respond to integrated water cycle management.

State Planning Policy No. 3.4 – Natural Hazards and Disasters (SPP3.4)

SPP 3.4 ensures planning for natural disasters as a fundamental element of the preparation of the Local Structure Plan to minimise adverse impacts of such an event.

The Buller Structure Plan responds to the policy, and provides a spatial and planning framework to address issues associated with coastal hazards and bushfire risk as required by more detailed state planning policies.

State Planning Policy No. 3.7 – Bushfire Risk Management Policy Framework (SPP3.7)

The SPP 3.7 sets out to identify bushfire risks and guides mitigation and management plans in identified bushfire prone areas.

At the time of Council adoption of the Buller Structure Plan, the draft policy had not completed formal advertising, nor been endorsed and therefore can not be formally addressed. However, the structure plan addresses the intent of the policy, and provides commentary around bushfire hazard, and a clear planning framework for subdivision design to address areas of bushfire risk.

State Planning Policy No. 5.4 – Road and Rail Transport Noise and Freight Considerations in Land Use Planning (SPP5.4)

SPP 5.4 provides a policy framework to manage conflicts that arise between sensitive land uses and road and rail transport noise.

The North West Coastal Highway, which carries some freight vehicles, is located adjacent to the eastern boundary of the Buller Development Zone. Traffic volumes using the road are comparatively low, however heavy vehicles utilising the highway may present noise impacts to adjacent residential lots.

The Buller Structure Plan recognises that the Buller Development Zone has been identified for urban uses, and Main Roads is proposing an outer Geraldton bypass road that would remove heavy vehicles from the North West Coastal Highway in the long term.

The structure plan responds to the SPP and provides a framework to manage potential noise impacts prior to relocation of the highway in the short to medium term through Local Development Plans at the time of subdivision.

Development Control Policy 2.2 - Residential Subdivision (DC2.2)

DC2.2 is an operational policy, setting out how the Western Australian Planning Commission will make decisions in relation to development and subdivision. DC2.2 sets out key requirements for residential subdivision. Of key relevance to the Buller Structure Plan, DC2.2 sets out the WAPC's policy for connection to reticulated sewer for residential development - referring to the Country Towns Sewerage - Subdivision Policy for guidance on situations outside the Perth metropolitan region where sewer connection is not required.

There are currently two draft Country Sewerage Policies, neither of which have been formally endorsed in Western Australia.

The 2003 Draft Country Sewerage Policy (Department of Health) states that proposals for large lot subdivision or density development can be considered if they do not involve the creation of lots less than 2,000m^2.

In 2011, the draft Government Sewerage Policy was released, which contemplates development of unsewered lots down to 1,000m^2 where land capability requirements are met.

In the context of two draft policies and uncertainty in relation to future state policy positions, the Buller Structure Plan provides a flexible split coding response. This flexible response recognises that, at the time of subdivision, applications for lots less than 2,000m^2 will be referred to the Department of Health for comments and will have regard for the status of state policies at that time.

State Planning Policy No. 3.6 Developer Contributions for Infrastructure

SPP 3.6 provides a policy framework to ensure that community expectations for new and upgraded infrastructure in new and established areas can be met through the application of development contributions. The policy details the principles and considerations that apply to development contributions, including the form, content and process that should be followed.

The Buller Structure Plan outlines the required infrastructure contribution responsibilities for subdividers, described in section 7.1. This includes contributions and sharing of costs for key intersections with the North West Coastal Highway. Public open space costs will be shared across the development area though implementation of cash-in-lieu provisions provided by the Planning and Development Act 2005.

Liveable Neighbourhoods

Liveable Neighbourhoods is an operational policy of the WAPC, and applies to structure planning and subdivision for greenfield and infill development areas.

The Buller Structure Plan has been prepared in consideration of the principles and policies of Liveable Neighbourhoods. Section 3.0 of this report provides information on the structure plan design in the context and with reference to Liveable Neighbourhoods.

2.0 Site Conditions and Environment

2.1 Environmental Assets and Constraints

A flora and fauna survey was undertaken in 2007 and 2008 across the Buller Structure Plan area by a qualified botanist and environmental scientist to a level 2 survey requirement.

Vegetation

The Study Site retains remnant vegetation in 'Excellent' to 'Degraded' condition, made up of five vegetation communities:

- Coastal scrub / heath – includes foredune vegetation, and first stabilised dune;
- Acacia rostellifera / Lycium ferocissimum shrubland;
- Frankenia pauciflora on saline flats;
- Melaleuca cardiophylla mixed heath on limestone ridge; and,
- Degraded Riparian Low woodland – associated with the Buller River tributary.

No Declared Rare Flora or Priority Flora were located in the structure plan area. No Threatened or Priority Ecological Communities were located in the structure plan area.

Much of the remaining vegetation is in a "Degraded" condition, however some pockets of vegetation in a "Good" and better condition do exist within the structure plan area, within portions of the coastline and smaller pockets on the limestone ridge. The level of historical clearing in the Geraldton Coastal region increases the local signficance of vegetation within the structure plan area.

There has been additional clearing undertaken along the limestone ridge since the survey of 2008, therefore the structure plan has considered survey results against up to date high resolution aerial imagery sourced from a specifically commissioned aerial drone flight.

Fauna

A number of fauna species, predominately birds, were observed during the level 2 fauna survey. The number of species identified during the reconnaissance

Examples of flora within vegetated areas of the Buller Development Zone.

survey was limited by the short period and the purely reconnaissance nature of the survey, does not provide the opportunity to survey those species that are cryptic or nocturnal.

A search of the WA Museum database (Faunabase, 2007) for fauna records between the latitudes of 28 and 29°S and longitudes of 114 to 115°E was conducted. The results of this search, and from the opportunistic survey conducted at the Site, indicate that potentially 145 species of birds, 27 mammals, 80 reptiles and 11 amphibians could utilise or pass over the Site.

2.2 Landform and Soils

The Geological Survey of Western Australia (1971) indicates that most of the underlying geology of the Study Site is coastal limestone with the southwestern portion of the Site dominated by alluvium, colluvium, miscellaneous soils, undifferentiated quartz sand, clay and loam, as shown in Figure 6 and 7.

The topography of the Buller Development Zone presents significant benefit of viewscapes, and many parts of the site have strong views to the ocean. The site is characterised by a limestone ridge through the centre on a north south axis, in addition to the topographical influences of coastal dune formations. Generally, the western part of the site has the highest aspect, falling down along the limestone ridge at the centre until the coastal dune rises at the western boundary. These topographical features contribute to several 'character areas', each with slightly different qualities.

The northern area of the Buller Development Zone forms a small plateau with a naturally elevated topography that provides strong views to the coast and the valley of the Buller River. The aspect of this precinct provides access to cooling breezes off the ocean.

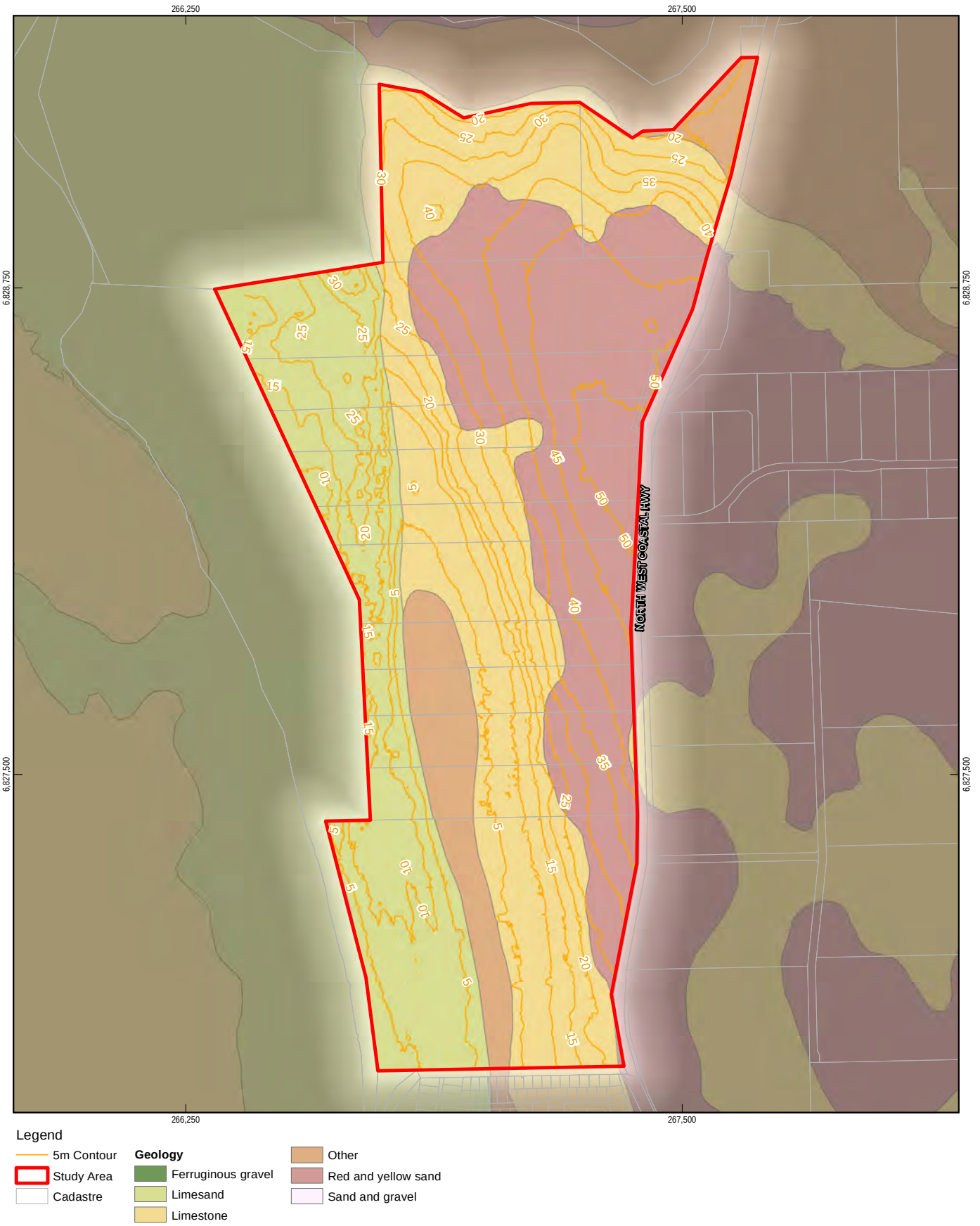
The south east corner of the Buller Development Zone is also characterised by a small plateau that provides strong views to the coast. The central eastern spine, falling between the protected limestone ridge and the North West Coastal Highway also enjoys views.

In the centre of the site between the dune and the ridge, the topography of the landscape channels inwards to

Reptile observed within the Buller Development Zone.

Landforms within the Buller Development Zone are characterised by a coastal dune edge, and a central limestone ridge separating plateau and low lying areas.

Figure 6: Buller Site Elevation - Slope Analysis



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Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 50

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Shire of Chapman Valley
Buller Development Zone Structure Plan

Geology

Job Number	61-27522
Revision	0
Date	21 Sep 2014

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Figure 7: Buller Site Geology

create a low lying area. This area does not experience ocean views, but would enjoy shorter views to areas of native vegetation along the ridge and on the dunal system. This area would not experience the cooling breezes of other character areas.

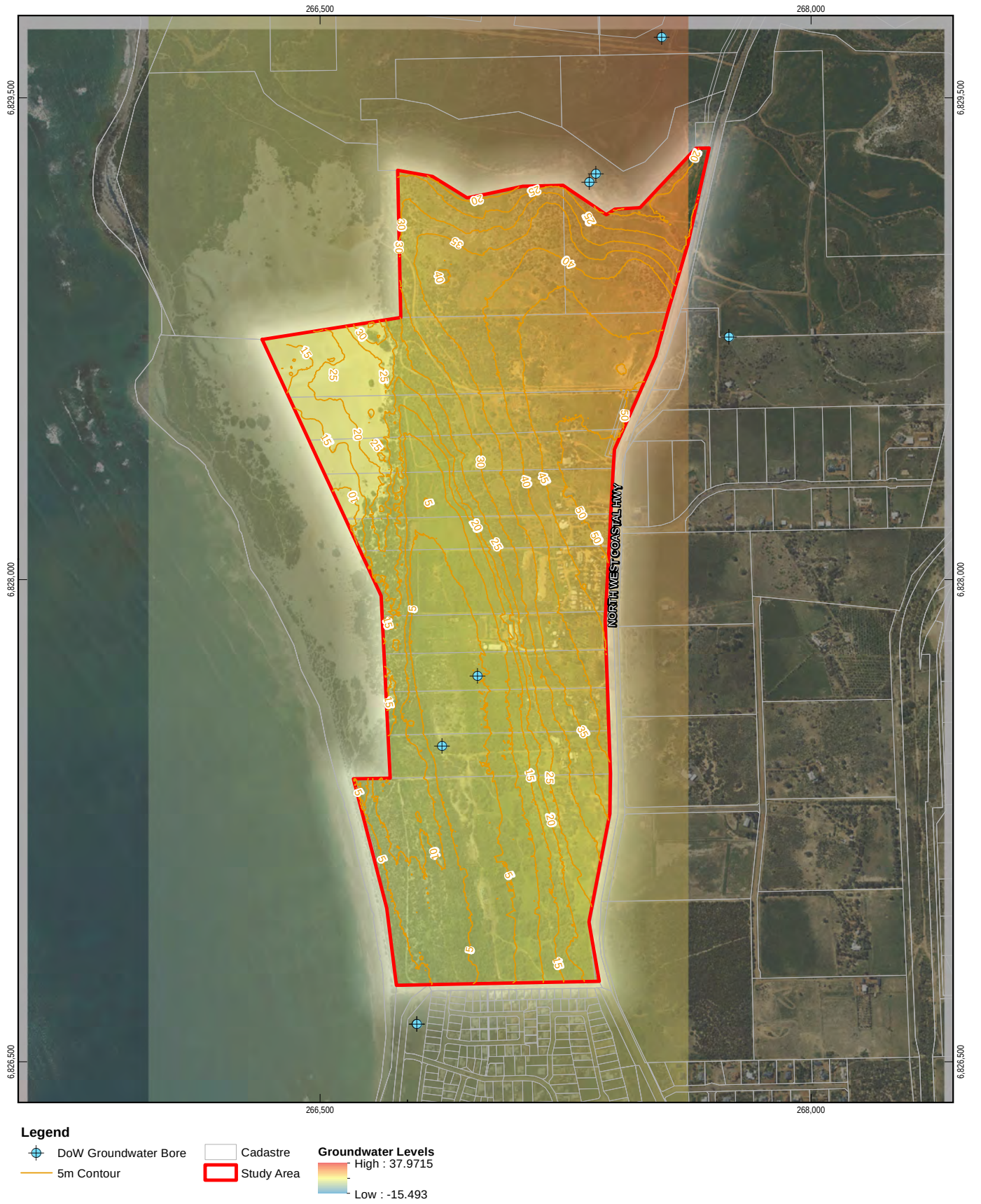
The topography of the site presents implications for vegetation protection across the site. Varied levels will require earthworking of roads to ensure traffic standards for grade are met; this will impact the ability to retain vegetation within road reserves. Larger lots at much lower densities are required, along with design guidelines requiring alternative foundations, to protect vegetation on private land. Such design guidelines and treatments require consideration of fire management techniques.

2.3 Groundwater and Surface Water

The Buller River defines the northern boundary of the Buller Development Zone. Local Development Plans should respect and reflect the environmental qualities of the river and its floodplain. The quality of the riparian environment presents significant opportunity.

Groundwater is generally at depth however there are low lying areas in the south which may be impacted by acid sulphate soils. The structure plan proposes that the majority of this area be encompassed within POS, as described in section 3.2 of the explanatory section of the structure plan. Where development or excavation is proposed within the area identified as having potential to be impacted by acid sulphate soils then this should not be undertaken without prior analysis and management in accordance with the Acid Sulfate Soils Planning Guidelines (WAPC).

The Buller River (below) delineates the northern boundary of the structure plan area.



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Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 50

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Shire of Chapman Valley
Buller Development Zone Structure Plan

Job Number 61-27522
Revision 0
Date 21 Sep 2014

Groundwater Levels

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Data source: Landgate: Gerladton Townsite 2012 - 20140114, Road Names - 20111202, Cadastre - 20130712; DoW: DoW Groundwater Bore - 20111202; GHD: Groundwater Levels - 20130712, Study Area - 20120112; Quantum Surveys: 5m Contour - 20130712. Created by: bflorczak, mczekaj

Figure 8: Buller Site Groundwater Levels

2.4 Bushfire Hazard

The majority of the structure plan area is cleared of vegetation. Remaining vegetation on the site is open coastal shrubland. The vegetation is of a class that may be defined as bushfire prone according to *AS 3959 Construction of Buildings in Bushfire Prone Areas*. Development on land within 100 metres of conservation areas (an area of bushfire-prone vegetation equal to or greater than one hectare) would therefore be deemed to be bushfire prone in accordance with Guidelines for Planning in Bushfire Areas (WAPC, 2015).

Within potentially bushfire prone areas, Guidelines for Planning in Bushfire Areas (WAPC, 2015) define three levels of bushfire hazard:

1. Low – this area will generally be:
- areas devoid of standing native vegetation (less than 0.25 ha cumulative area)
- areas which due to climatic or vegetation (e.g. rainforest) conditions, do not experience bush fires
- inner urban or suburban areas with maintained gardens and very limited native standing vegetation (less than 0.25 ha cumulative area)
- pasture or cropping areas with very limited native standing vegetation that is a shrubland, woodland or forest.

2. Moderate – this area will generally be:
- areas containing pasture or cropping areas with slopes in excess of 10°
- open woodlands
- open shrublands
- low shrubs with slopes of less than 10° or flat land
- suburban areas with some native tree cover.

3. Extreme – this area will generally be:
- forests
- woodlands
- tall shrubs.

Figure 9 illustrates future bushfire hazard with implementation of the structure plan. The majority of land within the Buller Development Zone, following development, would be within a low bushfire hazard area, as shown in Figure 9. Vegetation Protection

Much of the Buller Development Zone is cleared, and poses low bush fire risk (above). However, pockets of coastal heath proposed for retention (below) may present higher risk for development around Vegetation Protection areas. Once lot layouts and building envelopes are known through subdivision design and Local Development Plans, bushfire hazard assessments will be required to manage risk, consistent with WAPC policy.

Figure 9: Bushfire Risk Indicators

areas, where vegetation will be retained and allowed to regenerate, will have a moderate bushfire hazard, and development in these areas should be informed by an analysis of bushfire attack level and supported by bushfire management plans.

Varying conditions across the site will result in varying levels of bushfire management, and will require a detailed assessment of bushfire attack level. This requires knowledge of road and building locations, building use and ultimate lot configurations that is not available at the structure plan level. The methodology to measure bushfire attack level, which sets the necessary construction standards, as set out in AS3959 is designed to assess hazard at an individual dwelling level. Therefore, it is important that detailed assessment be undertaken at the time of subdivision or development, when detailed layout and the likely location of dwellings is known.

All development within bushfire prone areas will be required, at the time of subdivision, to undertake an assessment of bushfire attack level and prepare a bushfire management plan based on the assessment's outcomes. The preparation of Local Development Plans for Vegetation Protection areas will consider intended land use, building envelopes and lot layout, having regard for bushfire hazard assessment and analysis in accordance with both the State Planning Policy 3.4 Natural Hazards and Disasters and Planning Disasters and Planning for Bush Fire Protection Guidelines (edition 2) and the requirements in the State Planning Policy 3.7 Planning for Bushfire Risk Management and associated guidelines.

2.5 Heritage

The northern boundary of the Buller development zone is near to and abuts several registered Indigenous sites, which are outside the structure plan area. The Buller River provides a focus point for several sites.

Site 24415 (Buller River) is a mythological site associated with a natural feature, that follows the alignment of the Buller River, abutting the Buller Development Zone. The site has open access, and is not restricted.
Site 15857 (Buller River Area) is located to the northwest of the Buller Development Zone. This registered site has

Characteristic flora and landforms within the Buller Development Zone

open access, and is not restricted. The area, associated with the Buller River, is a hunting and camping place, and was an important water source for Indigenous people.

Site 5465 (Drummond Cove) is located to the northwest of the Buller Development Zone. The registered site has open access, and is not restricted. The coordinates of the particular site are unreliable, so the registered site is spatially arranged as a quadrat within which the site occurs. The site is registered as an area where burial occurred that includes skeletal materials.

No sites of indigenous heritage will be directly impacted by implementation of the structure plan.

The adjacent coastline is a key asset for the Buller Development Zone.

2.6 Coast and Foreshores

The location of the Buller Development Zone on the Mid West coast presents some key opportunities for future residents, with particular opportunities to enhance and create community access to the beach and activation of recreational nodes. The southwest corner of the site maintains the shortest distance to access the beach, and provides an opportunity to introduce small scale facilities to activate the coast. Access to the beach in the northern areas of the Buller Development Zone is impacted by the width of the coastal reserve and a dunal blow out. These areas provide opportunity for nature based coastal walks for residents to experience the natural coastal environs.

Before any development along the coast can commence, it is important to consider the physical coastline processes and access issues that may affect the development. The aim of State Coastal Planning Policy 2.6 is essentially to provide a buffer zone, which allows for the absorption of the physical processes (erosion or accretion, sea level rise, tides, storm events etc) and facilitate non-physical factors (public access and conflicts of interest) over a 100 year planning period.

Required setback allowances

The revised SPP 2.6, gazetted in July 2013, stipulates that the following allowances be made for shoreline movement, with the combined values of these allowances equating to the required total physical

setback distance from the Horizontal Shoreline Datum (HSD).

S1 Erosion – Allowance for the current risk of storm erosion

The distance is calculated by modelling the impact of an extreme storm event sequence on the shoreline, at the development site. In the absence of modelling, the minimum allowance is 40m on a typical sandy coast (such as this site).

S2 Erosion – Allowance for historic shoreline movement trends

The allowance for historic shoreline movement should be based on a review of the available shoreline records. The allowance for historic shoreline movement trends should generally be calculated as 100 times the historic annual rate of erosion.

On shoreline with a long term accretion rate of less than 0.2m per year, the setback allowance for historic shoreline trends should be zero.

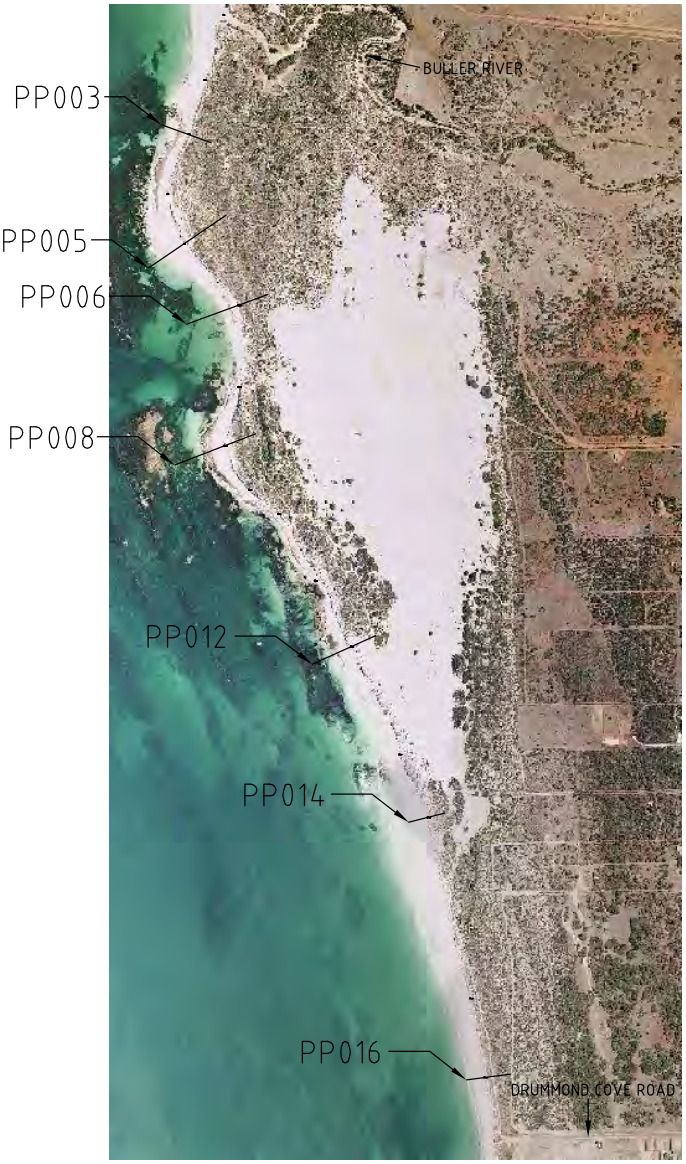
On shoreline where the long term accretion rate is found to be in excess of 0.2m per year, with compelling evidence that accretion is likely to continue at the same rate for at least the next 50 years, the allowance for historic shoreline movement trends should be calculated as minus 50 times the historic longer term annual rate of accretion.

S3 – Allowance for erosion caused by future sea level rise

Allowance for sea level rise should be 100 times the adopted sea level rise value of 0.9m over a 100-year timeframe, or 90 metres.

In addition to the three setback components, additional consideration of the net long shore sediment transport, structures in the area which may affect longshore transport and offshore sand bars that may input sand to the system, should be considered on a sediment cell scale.

The vegetation line movement data for the structure plan area was derived from photogrammetric analysis of aerial photographs for the years 1956, 1962, 1978, 1982,



1985, 1988, 1992, 1997, 2001, 2006, 2010, 2012 and 2013. The analysis of the shoreline movement from the historical aerial photographs at profile locations between 1956 and 2013 is presented in Figure 10 and Table 2.

In summary, the coastline appears to be eroding at an increasing rate moving northward along the coastline from PP014 to PP005. The southern end of the development (PP016) is the only area which was not eroded with 12m of accretion since 1956.

Setback Allowance

In accordance with SPP 2.6, the Buller coastline can be defined as a sandy shoreline and so the location of the HSD was positioned according to the vegetation line in November 2013.

Table 2: Vegetation Line Movement

Location	Net Movement (m)	Average Annual Rate (m/y)
PP016	12.2	0.3
PP014	-10	-0.1
PP012	-16.7	-0.2
PP008	-34.8	-0.3
PP006	-48.2	-0.8
PP005	-80.1	-1

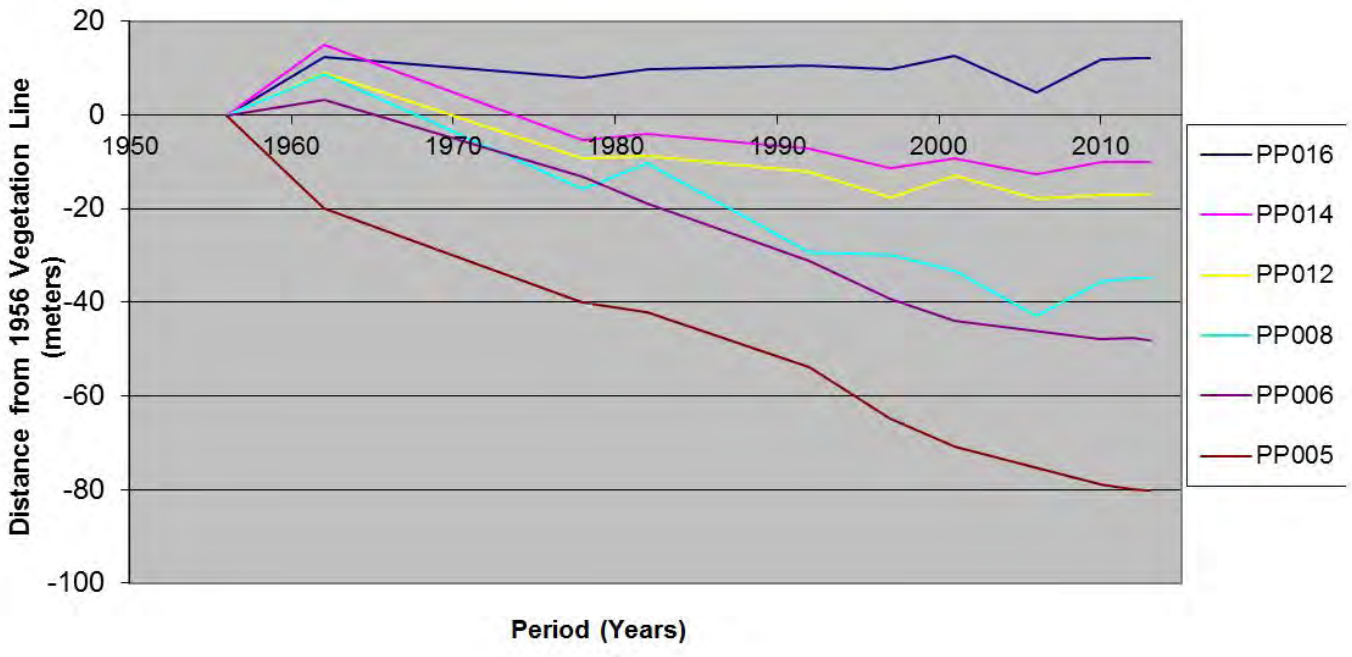


Figure 10: Vegetation Line Movement in relation to the 1956 vegetation line

Based on the SPP2.6 requirements for the site, the following components of the setback allowance have been determined:

S1 Erosion – Allowance for the current risk of storm erosion

In the absence of storm erosion modelling, the default setback allowance for S1 for this site is 40m. If this is sought to be investigated further, for example to confirm or reduce the setback at subdivision, cross shore storm profile modelling would need to be undertaken (there is no guarantee that a reduction in the setback would be the result of this analysis).

S2 Erosion – Allowance for historic shoreline movement trends

Studies of the historic trend in shoreline movement have indicated a general erosive trend but of a varying degree. This warrants a varying S2 allowance along the coastline to be implemented.

At PP016, there has been net historic long term accretion of 12m which has occurred at an average annual rate 0.33m per year. According to SPP 2.6, a long term accreting trend in excess of 0.2m provides enough evidence to warrant a reduction in the required setback allowance by 50 times the long term rate of accretion which is equivalent to 15m.
At PP014, there was net erosion of 10m between 1956 and 2013 with an average annual shoreline movement of 0.1m erosion per year. 100 times this historic annual rate of erosion would therefore be 10m to be used for the S2 allowance.

Figure 11: Indicative HSD and Setback line, to be surveyed and confirmed by landowners at subdivision

Table 3: Setback allowance (desktop analysis and default values)

Section	S1	S2	S3	Total Setback
South of Dune Field - PP016	40m	-15m	90m	115m
South of Dune Field - PP014	40m	10m	90m	140m
Dune Field	Setback line to follow dune field boundary			
North of Dune Field	40m	80m	90m	210m

Development within the dune field is not recommended as this may further reduce the supply of sediment down drift to the northern sections of beach. The setback line has been positioned to reflect this at the dune field location

The area to the north of the dune field has had significant erosive trends with an average annual shoreline movement of 0.8m erosion per year or greater. A calculation of 100 times this historic annual rate of erosion would therefore be 80m to be used for the S2 allowance.

S3 – Allowance for erosion caused by future sea level rise

Allowance for sea level rise is 100 times the adopted sea level rise value of 0.9m over a 100-year timeframe, or 90 metres.

Total Setback Allowance

The recommended combined setback allowance is therefore 210m north of the dune field and increasing from 115m to 140m from the south of the development to the start of the dune field. This has been mapped as a distance measured landward of the HSD and presented in Figure 3, and the components of the setback distance are summarised in Table 2.

2.7 Unexploded Ordnance

Department of Planning representatives have advised that the structure plan area may have potential unexploded ordnance due to its location within a former military defence training area. The advice of the Department of Fire and Emergency Services will need to be sought at subdivision application stage in relation to this matter.

2.8 Context and Constraints Analysis

North West Coastal Highway

The eastern boundary of the Buller Development Zone abuts the North West Coastal Highway, a major regional road managed by Main Roads which provides a movement corridor for freight and regional traffic. North West Coastal Highway presents constraints with regard to limited access and presents noise impacts along the eastern boundary. However, development of the Buller Development Zone presents an important opportunity to rationalise current access points along the highway, and improve the safety of access to the highway.

Main Roads is currently investigating and planning for the realignment of North West Coastal Highway to further inland to reduce the impact of freight movement on areas of Geraldton. The long term realignment of the highway will present important opportunities to provide for future additional access points, and links into adjacent development areas, than currently shown on the structure plan. This would be a trigger for a review of the structure plan.

Surrounding Development

The Buller Development Zone is surrounded by several existing and planned developments.

To the south, the study area abuts Drummond Cove, a developed medium density residential suburb. Existing rural residential and planned low density (R2.5) residential development characterises the eastern catchment to the structure plan area. The surrounding expanse of residential land uses provides opportunity to enhance servicing of these areas, along with the future community of the Buller Development Zone, through provision of retail, entertainment, tourism and community uses.

The planned Oakajee Port and associated strategic industrial area is located to the north of the Buller Development Zone, providing a potential significant future employment source for the local community (the Oakajee Industrial Estate is addressed through a separate WAPC adopted Structure Plan).

Relationship to nearby settlements

Buller is located at the most northern expanse of the Geraldton urban area, and represents an expansion of

the Geraldton regional centre urban fringe.

Recent strategic planning by the City of Greater Geraldton, with development of their local housing strategy, has identified that there is sufficient land available for greenfield and infill development at medium and high-density in close proximity to Geraldton to service current growth forecasts. There is potential for Buller to support the growth of Geraldton and provide alternative lower density lifestyle opportunities to the medium and high-density developments provided closer to the Geraldton City Centre. Key opportunities, constraints and general site analysis are shown on Figure 12.

Above - views to the ocean and Geraldton Port

Key opportunities

- Unique and extensive views to the coast, Geraldton port, and the Moresby Range.
- Employment source for the area provided by the nearby proposed Oakajee Port and Industrial Estate.
- Potential enhancement of the area through the provision of retail, entertainment, tourism and community uses.
- Nearby planned school facilities in Drummond Cove.
- Providing additional retail catchment to the existing northern Glenfield commercial node and the proposed Glenfield Beach Activity Centre.

Above - current rural landuses within the Buller Development Zone. Below - opportunity to integrate access with adjacent Drummond Cove.

Key challenges

- High level of fragmentation in land ownership.
- Noise impacts of North West Coastal Highway and uncertainty on timing of future realignment of the Highway further inland.
- Protecting natural assets in a manner that provides development equity across multiple landholdings.
- Bushfire risk posed by vegetation areas retained through the subdivision process and requiring attention to bushfire hazard assessment, analysis, fire management plans with attention to firebreaks and emergency access.

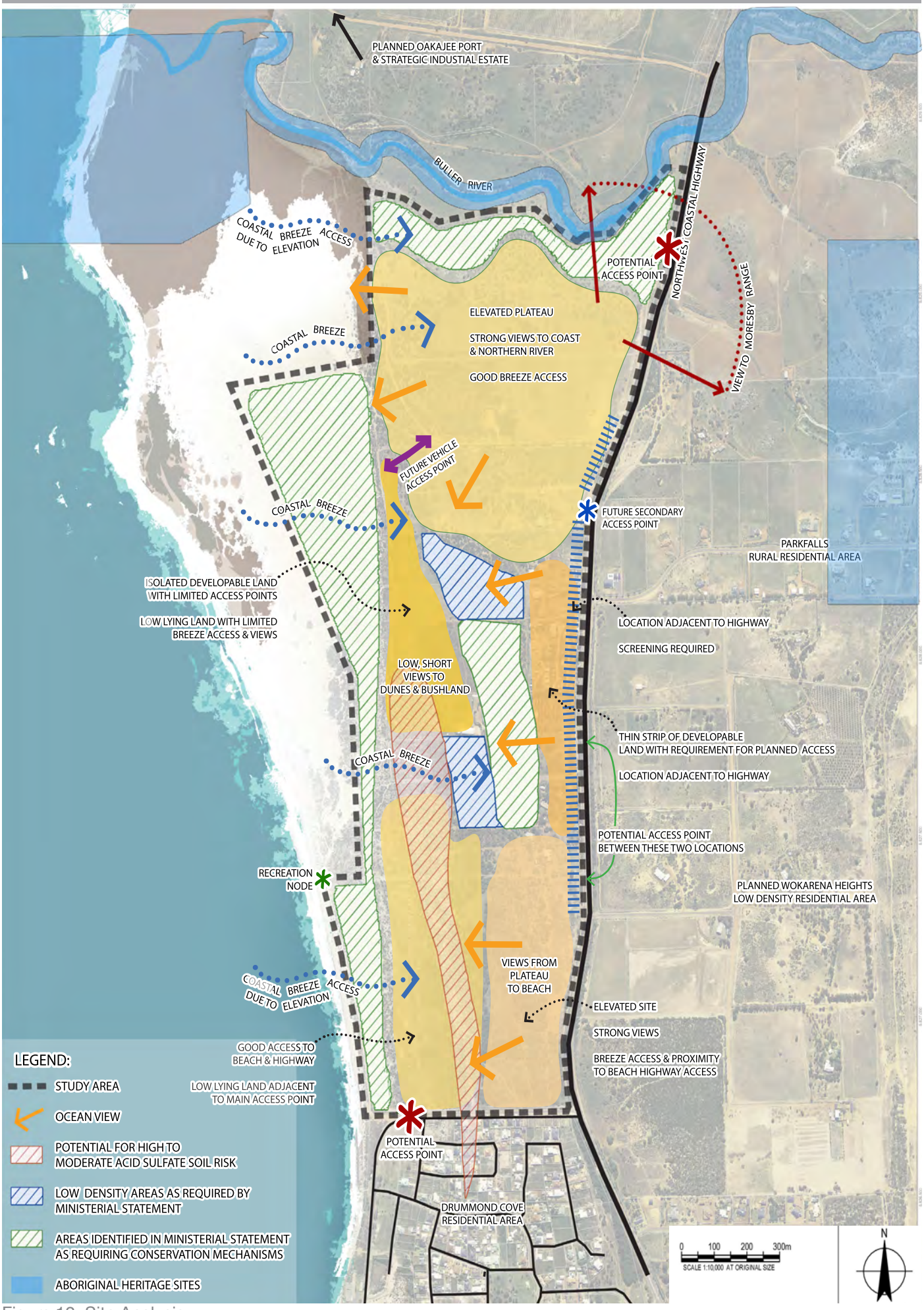


Figure 12: Site Analysis

3.0 Local Structure Plan

3.1 Land Use

The Local Planning Scheme applies a 'Development' zone to the Buller Structure Plan area. The Local Planning Scheme's key objective for the Development zone is to provide urban uses, primarily residential.

The Structure Plan remains flexible in the uses it proposes. A low residential density coding will be applied across the area. This type of residential development will provide rural lifestyle living within close proximity to a major regional centre. To the south is the medium density residential area of Drummond Cove and to the east, a low density residential area. The proposed predominantly residential area of the Buller 'Development' zone is compatible with these areas.

Low scale eco-tourism uses, incidental activities such as pearl galleries and micro-breweries can be considered in the area through the scheme zoning table for the Development zone.

Table 4: Structure Plan Summary

Item	
Total area covered by the structure plan:	197.21 ha
Area of specific land uses:	Development (residential): 156.83 ha Includes 9ha Drummond Cove Holiday Park
List of land uses proposed by the structure plan	Development (residential) Public Open Space
Estimated lot yield:	540-650
Estimated number of dwellings:	540-650
Estimated population (2.6 persons per household):	1404-1690
Number and area of open space:	1 9 ha (incl. water sesitive urban design features)
Foreshore reserve:	33.15 ha
Public open space:	7.72 ha

3.2 Open Space

The structure plan recognises that great open spaces make for a better quality of life and that the role of the foreshore is significant in enhancing the area's natural assets to the benefit of the community. The foreshore is expected to be of high value and use to residents *and* visitors. A strategic approach to open space provision maximises the opportunity for a variety of well-utilised, multi-functional open spaces developed alongside future subdivision.

Foreshore Reserve

The foreshore reserve has been determined by addressing all ecological, landscape and coastal processes functions as required by State Planning Policy (SPP) 2.6 State Coastal Planning.

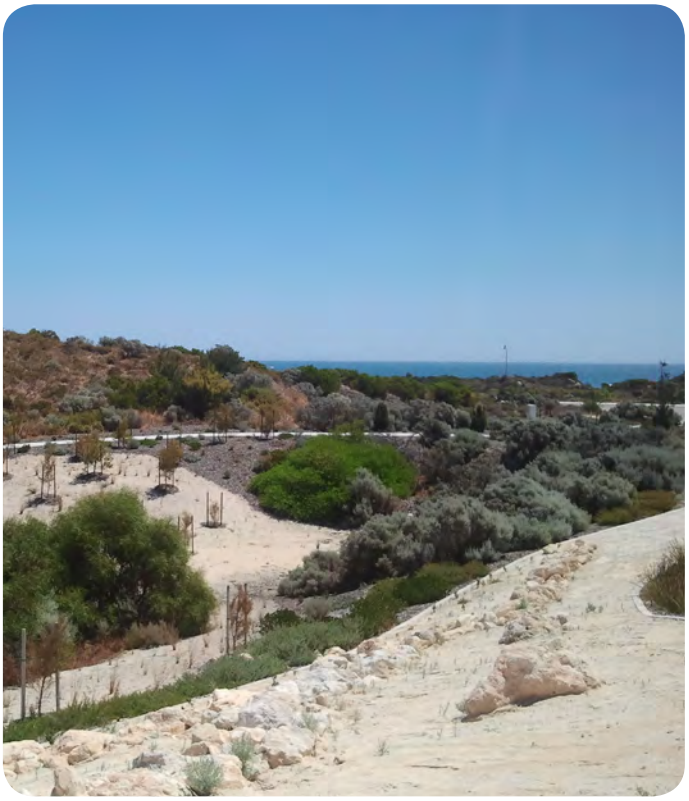
The foreshore reserve will function as a local beach, therefore will not require significant infrastructure, such as large parking areas, within the reserve. Future infrastructure requirements will include coastal paths, and small scale recreational areas. Formal access and car parking areas can be provided within the coastal road that forms the boundary of the foreshore reserve.

Reflecting the local function of the reserve, the proposed reserve incorporates the coastal processes setback, with additional reserve area (approximately 50 metres) to meet local beach requirements beyond the 100 year planning horizon.

The foreshore reserve incorporates all dunal features and vegetation of good or better quality along the coast, ensuring the most valuable foreshore assets are protected. Aerial photography and flora/fauna surveys show that land beyond the coastal setback and proposed foreshore reserve has limited ecological value.

Foreshore reserves play a significant role within the community. It is likely that the public will spend the most time visiting the foreshore, acting as a popular place to relax, fish, go for a walk, or to walk the dog. It is difficult to match the 'character' and natural beauty of the coastline. The structure plan aims to provide open space responding to the wants and needs of the community; Buller is in an advantageous position where foreshores and coastal areas are integral to public life.

In areas of foreshore reserve, the protection of the vegetation will provide opportunity for passive recreation based on the conservation value of the site. Retention of the vegetation in public ownership will facilitate the active management of the area for its conservation value. Access through to the beach at key points to serve the future Buller Structure Plan community and assist conservation will be an integral part of developing these open spaces. The space can include an area for unstructured active play and facilities, such as seating and barbecue facilities that provide for the activation of the conservation area and foster community ownership and stewardship to enhance management.



Representative examples of recreational use and development of coastal foreshore reserves

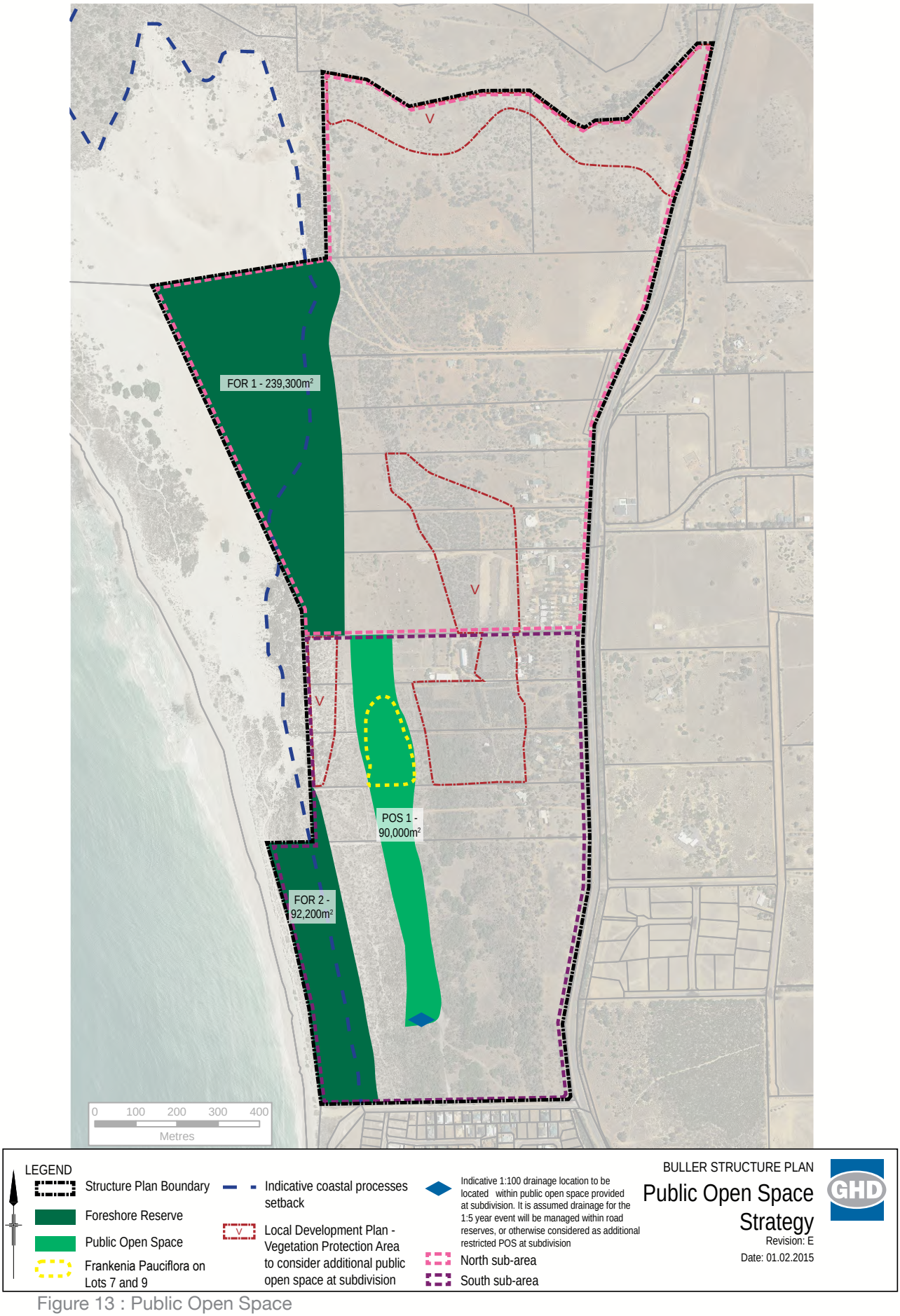


Figure 13 : Public Open Space

Public Open Space

A schedule of public open space (POS) for the Buller Structure Plan Area South is shown in Table 5. This reflects the minimum level of public open space to be provided in the structure plan sub-area, with additional POS provided as necessary for vegetation protection, water sensitive urban design, and landowner aspirations at the time of subdivision. Figure 13 illustrates the locations and size of open spaces, the foreshore reserves and the identified vegetation protection areas where additional public open space is encouraged.

Further planning for the Buller Structure Plan Area North will include provision of a POS Schedule for the sub-area and outline any "regional variation" to be applied to usual POS contribution requirements.

Within the Buller Structure Plan Area South, the area of restricted POS (estimated at 500m^2 to reflect the land required for management of stormwater for up to the 1 in 5 year event (excluding land required for the 1 in 1 year event) will need to be confirmed at subdivision as the design of the drainage basin will influence the area of land required.

Table 5: Public Open Space Schedule - Buller Structure Plan Area South

	Hectares
Total LSP area	**197.21 ha**
Total LSP area South	**76.34 ha**
Deductions:	
Total deductions	**10.5 ha**
Foreshore Reserve 2 - FOR 2	*9.22 ha*
Drainage reserve	*1.28 ha*
Total developable area	65.84 ha
Public Open Space:	
Required Public Open Space @ 10%	**6.584 ha**
Public Open Space Contribution:	
Neighbourhood Parks - POS 1	9 ha
Neighbourhood Parks - POS 1 (excluding water sensitive urban design features)	7.72 ha
May comprise: **Minimum 80% restricted**	**7.67ha**
Maximum 20% restricted	**0.05 ha**

Development of Open Spaces

Open space must be maintained to a high standard to be appealing to the community. There is a focus on ensuring the quality of open spaces reflect their function in the POS hierarchy.

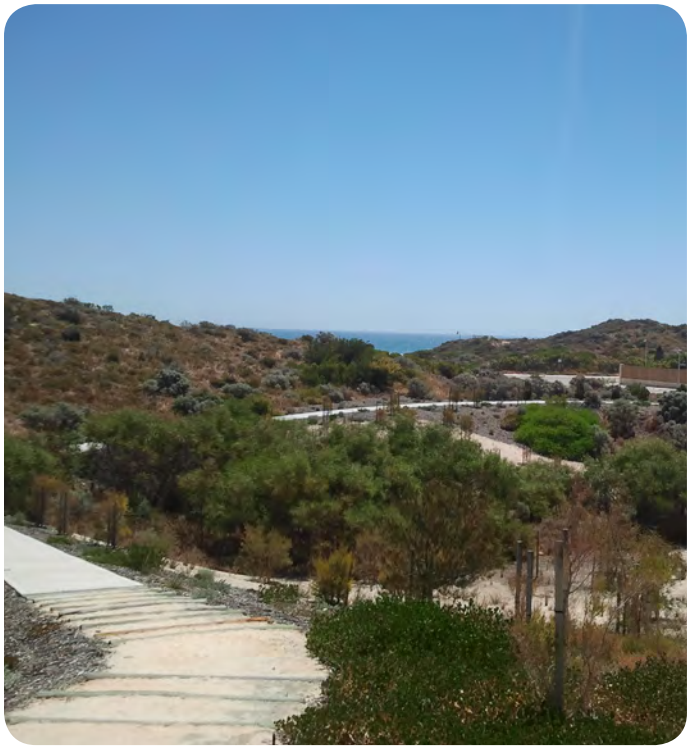
Open space may provide lighting, playground equipment, exercise facilities, barbeque and picnic areas, public toilets and other amenities and facilities to enhance this areas, with the aim to make public open space readily available to the community.

Neighbourhood Park

The structure plan aims to provide recreational opportunities while contributing to the unique identity of the Buller locality. Drainage areas for the one in 100 year event within POS1 have the potential to combine passive recreation and unstructured active play opportunities through water sensitive urban design. The space can include an area for unstructured active play and facilities, such as seating or a gazebo/barbecue area.

Subdivision should consider size and detailed location of this POS; encompassing a natural low point further south will reduce the extent of earthworks required to construct necessary drainage swales. Passive, conservation style POS is consistent with the desired character and lifestyle of the area.

The structure plan recognises that the low density nature of Buller does not create significant demand for active open spaces, such as playing fields and sporting facilities. These sporting facilities are not usually accessed by walking due to the need for sporting equipment. Regional facilities will provide organised sporting opportunities for the Buller community.



3.3 Residential

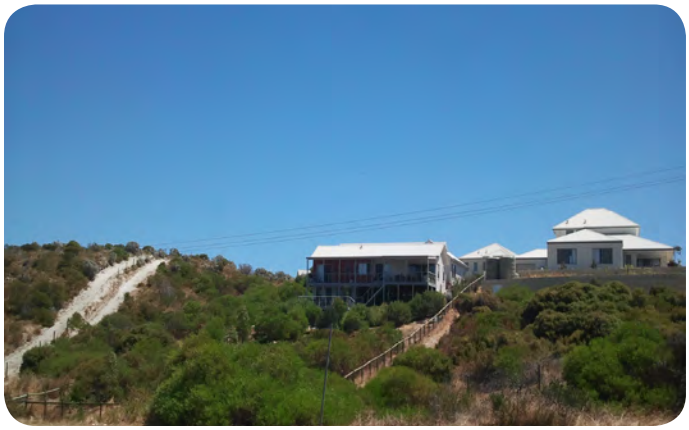
A low density coding of R5/10 has been proposed for the area, allowing for a diversity in housing choice in the region as well as allowing for the conservation of the natural assets. State Planning Policy 3.1 - Residential Design Codes of Western Australia, will apply within the structure plan area.

A split density of R5/10 is proposed for the majority of the structure plan area. The low density of R5 will ensure the preservation of the areas natural assets, whilst still providing housing in this unique area. Where the land permits it, development of a higher density, R10, can be considered. Lots at an R10 density would not generally be permitted in vegetation protection areas.

Residential development is to respond to the unique character of the area. Mechanisms such as the use of raw materials and working with the varying topography will assist to develop housing that forms part of the landscape. Houses should be set amongst native vegetation and views to the ocean should be maximised where possible.

To provide an interface into the Drummond Cove area, a strip of R10/15 is proposed in the southern most area of the structure plan. Development in that location should provide an interface by enabling development at both the higher and lower density code. Beyond this immediate interface larger lot sizes should be provided.

Representative examples of coastal housing at a density of R5 and R10



3.4 Movement Network

Road network hierarchy

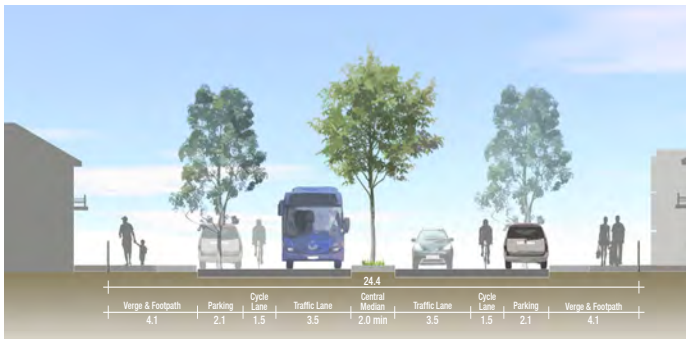
The structure plan proposes a movement network that maximises permeability and legibility. New connections to North West Coastal Highway could be achieved via accesses to the north and south of the structure plan area. The proposed movement network of the structure plan area relies on strong north south linkages that facilitate east-west lot orientation to maximise exposure to views, minimise the number of lots along view corridors, and provide multiple opportunities for egress in event of a fire.

The road hierarchy uses appropriate road types from Liveable Neighbourhoods and matches them to traffic and parking demands of the structure plan area. Throughout the structure plan area, vehicle movements are anticipated to be up to a total of 6,500 per day at time of completed subdivision and development. Neighbourhood connectors are proposed as the key access and egress connectors for the structure plan area.

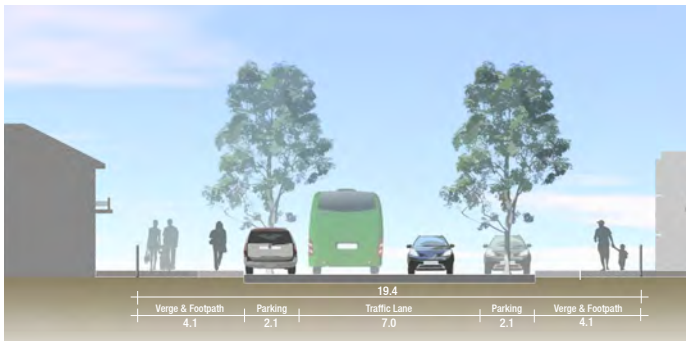
Neighbourhood Connector A roads are designed to accommodate 7,000 or less vehicle movements per day, and support on-street car parking. Cross sections for neighbourhood connectors within the precinct provide for informal on-street car parking in recognition of the limited demand likely to be presented by the low density residential land use compared to that required by Liveable Neighbourhoods. Internal subdivision roads are proposed to be access streets A and B, designed for use in areas of 7,000 and 3,000 (respectively) vehicle movements or less per day. Cross sections in Figure 14 show how the function of road corridors supports vehicle movements, on-street car parking, tree planting, pedestrian links, and water management.

The Neighbourhood Connector B Roads are forecast to carry 2000-3000vpd, with other roads less than 1000vpd. The cross-sections detailed in Figure 15 adopted from Liveable Neighbourhoods are recommended. Drainage issues will also need to be considered as part of the cross section.

The structure plan only identifies higher order roads and connection points consistent with WAPC guidelines (Figure 15). There is provision within Section 5.22 of the



Neighbourhood Connector A - 50km/hr (up to 7000 vehicles per day, with >3000 vehicles per day preferred)



Neighbourhood Connector B - 50km/hr (<3000 vehicles per day)

Figure 14: Indicative Road Cross Sections: Road reserves to include water sensitive urban design requirements as set out in the Local Water Management Strategy

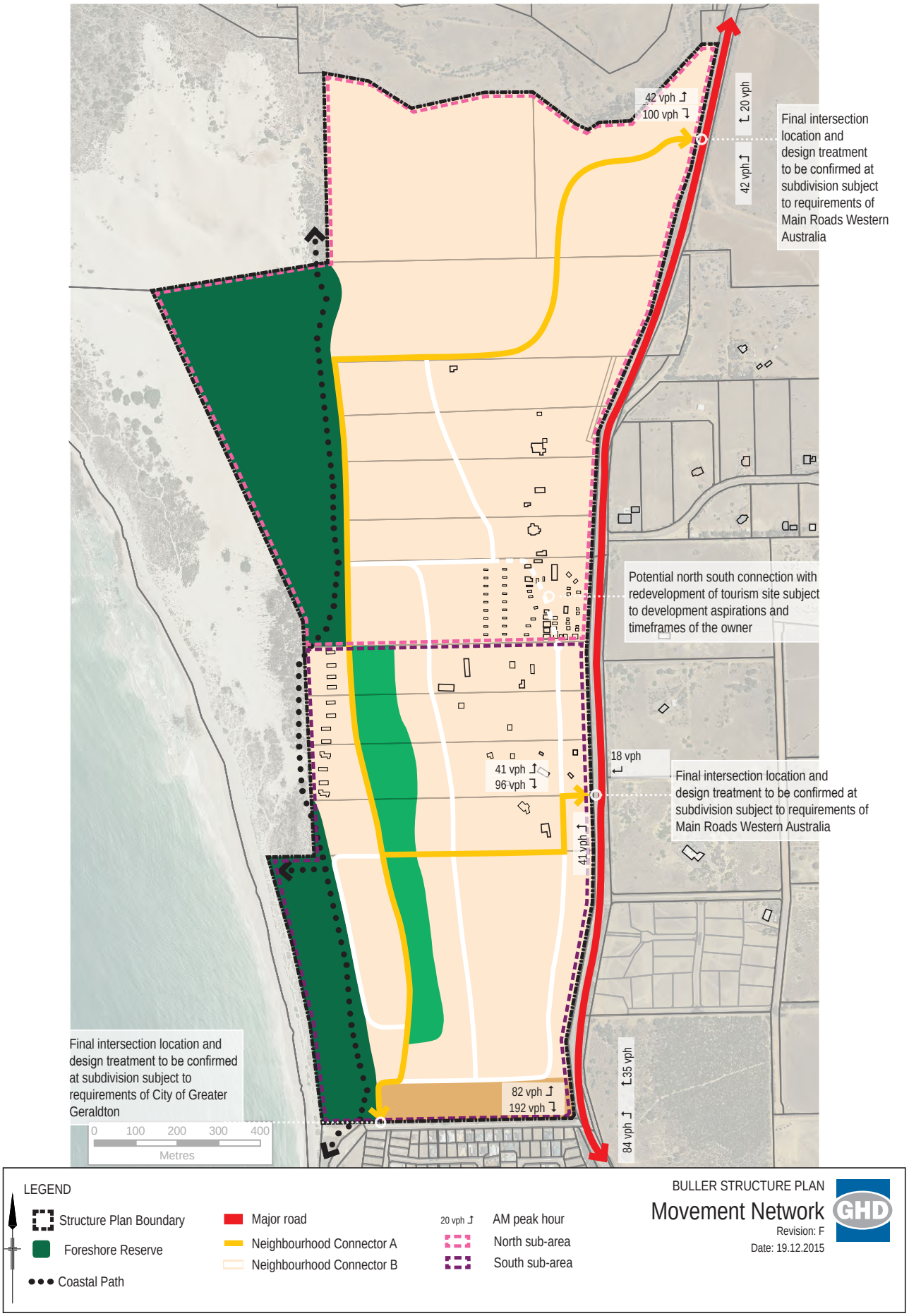


Figure 15: Movement Plan Network

Scheme Text to allow for future modifications of the road layout that may be instigated by the relevant landowner, for example a potential north south connection through the existing tourism development on Lot 3.

Pedestrian network

All roads within the precinct will include footpaths to facilitate pedestrian access throughout the site. Example cross sections are provided in Figure 14. A coastal path will run north-south and provide linkages between foreshore reserves as indicated in Figure 15.

Public transport

North West Coastal Highway has been identified as a possible rapid public transport route, connecting Buller to Geraldton in the south.

Traffic generation and management

Traffic generation of 650 dwellings has been determined from the New South Wales Roads & Traffic Authority's "Guide to Traffic-Generating Developments", Version 2.2 (October 2002).

According to this guide, using the rate for "dwelling houses", 650 dwellings would generate 6,500 daily vehicular trips, with 650 in the weekday peak hour. Surveyed flows on the North West Coastal Highway have been obtained from Main Roads. The survey data is for the Highway, south of Coronation Beach Road, and the average daily volume for the period Monday 16th May 2011 to Friday 20th May 2011 was used as a reasonable reflection of flows experienced along the Buller precinct. This daily volume is 1,421. It is assumed that the peak-hour flow is 10% of daily flow, giving 142 vehicles per hour.

Austroads "Guide to Road Design" Part 4A "Unsignalised and Signalised Intersections" (2009) provides guidance on the type of turning treatments, i.e. basic, auxiliary lane or channelised in Section 4.8. Given the above traffic volumes, and a design speed of 100 km/h (speed limit plus 10 km/h), the appropriate treatments would be channelised right turn treatment with short turn slot; and auxiliary left-turn treatment with short left-turn lane on the major road.

The following dimensions can be considered as probable requirements to manage the additional traffic generation from the site to North West Coastal Highway:

- Right turn treatment: additional width of 3.5m over a length of 219m, assuming flat grade and no B-doubles or road trains turning into the site. In total, the additional width requirements would therefore be 7m; this is in addition to the existing requirements which include, on each side, a 1m sealed shoulder, an unsealed shoulder (typically 1m) and a very (typically 5m);
- Vehicle turning templates should be used to determine the exact requirements, along with other detailed considerations; and,
- It may be advisable to also include additional treatments to reduce conflicts between cyclists and left-turning vehicles.

Forecast traffic volumes for 15-20 years

GHD have liaised with Main Roads for appropriate forecast volumes to use for analysis on North West Coastal Highway for 2031. Volumes from the Geraldton Strategic Model have been provided to 2021 only and are shown in Figure 16.

Forecast traffic volumes to 2031 on North West Coastal Highway are identified by applying a 3% per annum increase to the 2021 volumes based on anticipated population growth. Northbound volumes for 2031 on North West Coastal Highway are therefore 5,113vpd. Similarly, southbound volumes for 2031 on North West Coastal Highway are 5,476vpd. Peak hour volumes are assumed to be 10% of the daily traffic, resulting in 511

vehicles per hour northbound and 548 vehicles per hour southbound for 2031.

Intersection analysis (layout and capacity)

The existing road reserve widths of North West Coastal Highway are considered sufficient to accommodate required intersection upgrades, with potential for some additional area to be provided at the time of subdivision that creates highway intersection locations.

Required intersection treatments for subdivisional roads will be determined at the time of subdivision in accordance with the requirements of the Shire of Chapman Valley, and Main Roads WA as required.

The intersection onto Drummond Cove Road has been located to avoid headlight glare into existing residences further east along Drummond Cove Road, and to improve management of vehicles currently accessing at this location to reach the coast. The required intersection treatment will be determined at the time of subdivision in accordance with the requirements of the Shire of Chapman Valley and the City of Greater Geraldton. All proposed intersections have been discussed and confirmed on site with Main Roads WA.

Analysis of intersections on full development at 2031 has been undertaken as follows. The total traffic generation from the development is expected to be 650 per hour. Additionally, the following assumptions are made for analysis purposes:

- 70% of exiting traffic turn right and 30% turn left onto NWCH;
- 70% of traffic exits the area, and 30% of traffic enters the area in the AM peak hour.

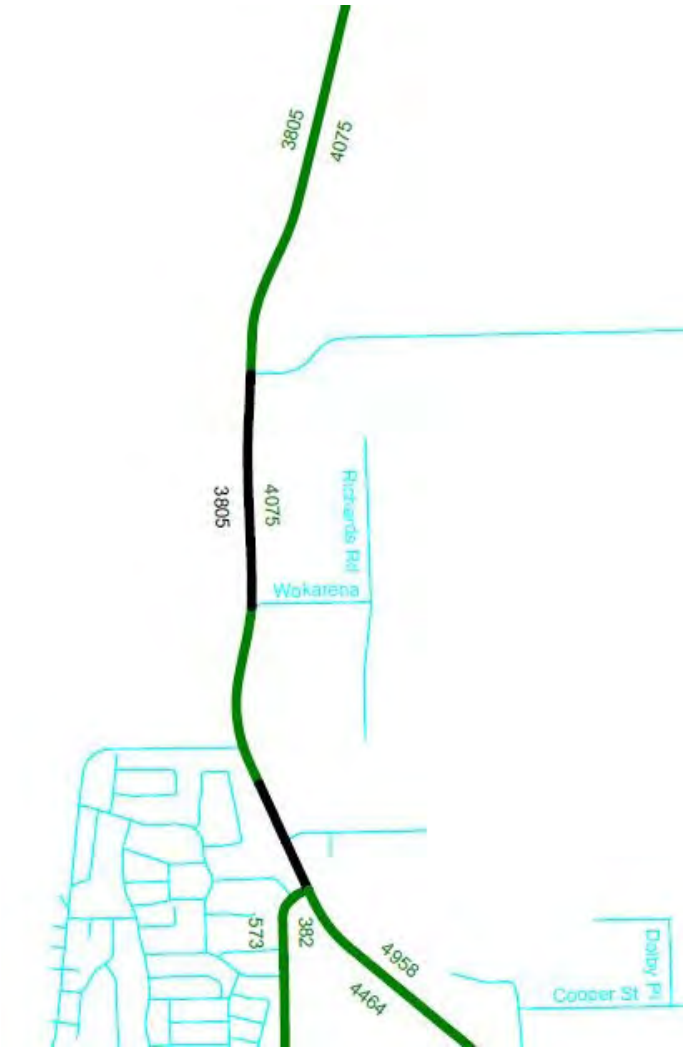


Figure 16: Forecast traffic volumes 2021

North West Coastal Highway / Northern Intersection, 2031

201 vehicles per hour are estimated to use the access road for 2031. Forecast AM peak hour volumes are identified in Table 6. The following geometry has been analysed and includes right and left turn lanes on North West Coastal Highway as shown in Figure 17.

An analysis of movement performance of vehicles for Buller northern access at full development 2031 is shown in Table 7. Analysis indicates a good operational performance with no movement forecast to be no worse than Level of Service C. The analysis assumes a right turning vehicle from the access road can store in the median.

Table 6: Forecast AM peak hour volumes: NWCH Northern Intersection

Location	AM Peak vehicles/hour
NWCH North	
Through	547
Right	20
Buller Access Road	
Left	42
Right	100
NWCH South	
Through	511
Left	42

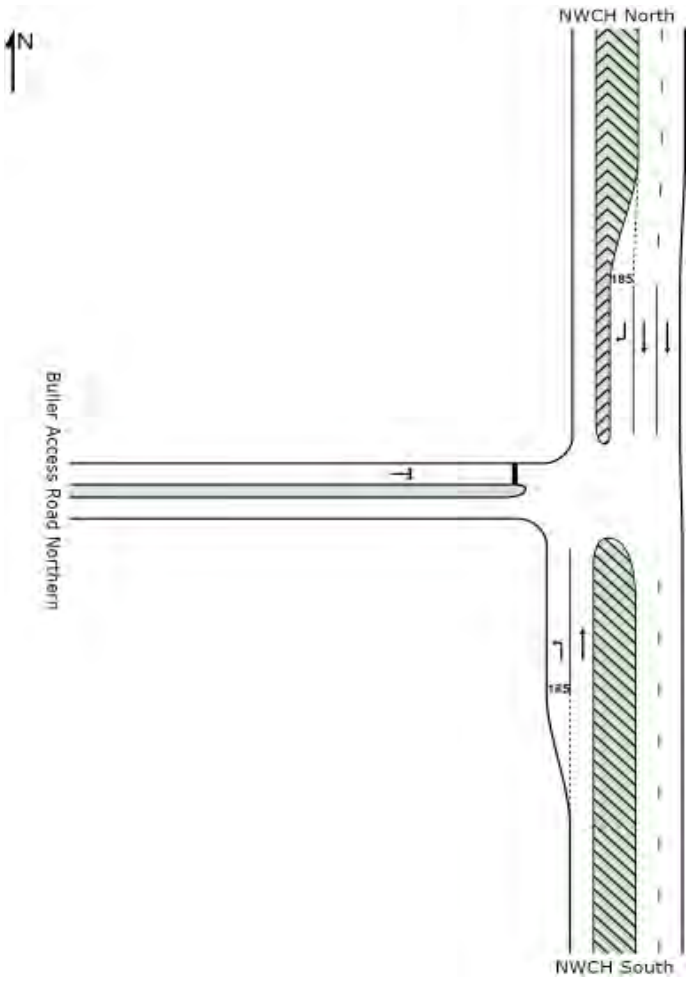


Figure 17: Buller Northern Access Road / NWCH turning lanes

Table 7: Movement performance - vehicles at northern intersection at full development, 2031

Movement Performance - Vehicles											
Mov ID	ODMov	Demand Flows		Deg. Satn	Average Delay	Levels of Service	95% Back of Queue		Prop Queued	Effective Stop Rate	Average Speed
		Total	HV				Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: NWCH South											
1	L2	42	2.0	0.023	8.2	LOS A	0.0	0.0	0.00	0.67	70.8
2	T1	511	15.0	0.288	0.0	LOS A	0.0	0.0	0.00	0.00	109.8
Approach		553	14.0	0.288	0.7	NA	0.0	0.0	0.00	0.05	105.3
North: NWCH North											
8	T1	547	15.0	0.154	0.0	LOS A	0.0	0.0	0.00	0.00	109.9
9	R2	20	2.0	0.028	10.9	LOS B	0.1	0.7	0.53	0.75	55.9
Approach		567	14.5	0.154	0.4	NA	0.1	0.7	0.02	0.03	106.3
Northwest: RT from Median											
29a	R1	100	2.0	0.358	22.0	LOS C	1.5	11.0	0.74	1.12	33.9
Approach		100	2.0	0.358	22.0	LOS C	1.5	11.0	0.74	1.12	33.9
West Buller Access Road Northern											
10	L2	42	2.0	0.455	21.7	LOS C	2.2	15.6	0.76	1.12	33.7
12	R2	100	2.0	0.455	21.5	LOS C	2.2	15.6	0.76	1.12	33.6
Approach		142	2.0	0.455	21.5	LOS C	2.2	15.6	0.76	1.12	33.7
All vehicles		1362	12.1	0.455	4.3	NA	2.2	15.6	0.14	0.23	76.7

North West Coastal Highway / Central Intersection, 2031

196vph are estimated to use the access road for 2031. Forecast AM peak hour volumes are shown in Table 8.The following geometry has been analysed and includes right and left turn lanes on North West Coastal Highway as show in in Figure 18.

An analysis of movement performance of vehicles at the central intersection at full development 2031 is shown in Table 9. Analysis indicates a good operational performance with no movement forecast to be worse than Level of Service C. The analysis assumes a right turning vehicle from the access road can store in the median.

Table 8: Forecast AM peak hour volumes: NWCH Central Intersection

Location	AM Peak vehicles/hour
NWCH North	
Through	547
Right	18
Buller Access Road	
Left	41
Right	96
NWCH South	
Through	511
Left	41

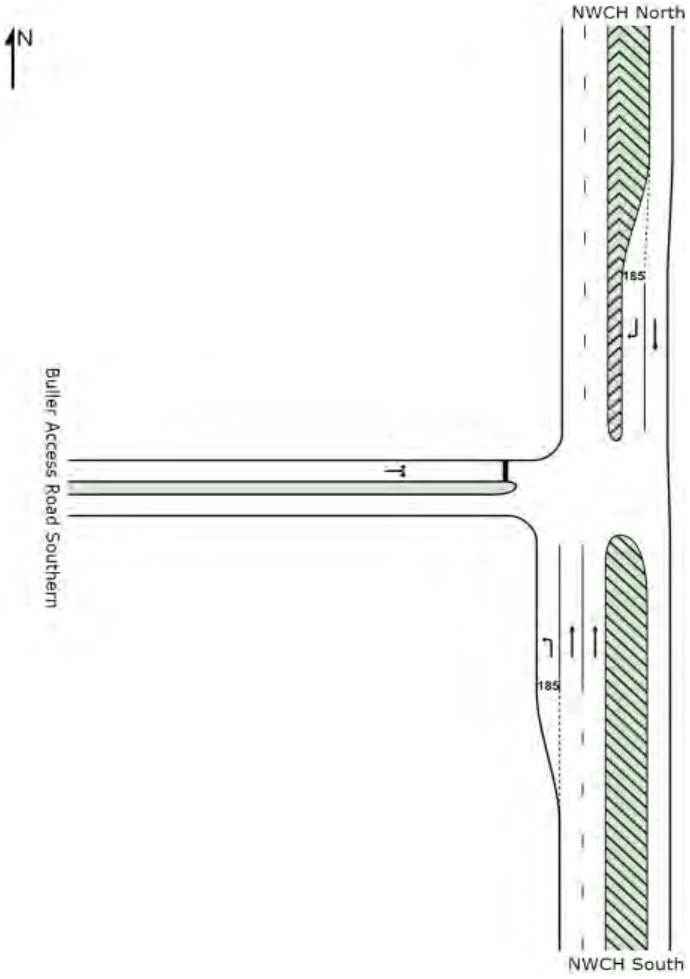


Figure 18: Buller Southern Access Road / NWCH turning lanes

Table 9: Movement performance - vehicles at central intersection at full development, 2031

Movement Performance - Vehicles											
Mov ID	ODMov	Demand Flows		Deg. Satn	Average Delay	Levels of Service	95% Back of Queue		Prop Queued	Effective Stop Rate	Average Speed
		Total	HV				Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: NWCH South											
1	L2	41	2.0	0.022	8.2	LOS A	0.0	0.0	0.00	0.67	70.8
2	T1	511	15.0	0.144	0.0	LOS A	0.0	0.0	0.00	0.00	109.9
Approach		552	14.0	0.144	0.6	NA	0.0	0.0	0.00	0.05	105.6
North: NWCH North											
8	T1	547	15.0	0.308	0.0	LOS A	0.0	0.0	0.00	0.00	109.7
9	R2	18	2.0	0.023	10.8	LOS B	0.1	0.6	0.52	0.72	56.4
Approach		565	14.6	0.308	0.4	NA	0.1	0.6	0.02	0.02	106.5
Northwest: RT from Median											
29a	R1	41	2.0	0.169	21.6	LOS C	0.6	4.0	0.73	1.05	44.8
Approach		41	2.0	0.169	21.6	LOS C	0.6	4.0	0.73	1.05	44.8
West Buller Access Road Southern											
10	L2	41	2.0	0.403	19.4	LOS C	1.9	13.5	0.72	1.09	38.8
12	R2	96	2.0	0.403	19.5	LOS C	1.9	13.5	0.72	1.09	38.8
Approach		137	2.0	0.403	19.5	LOS C	1.9	13.5	0.72	1.09	38.8
All vehicles		1295	12.6	0.403	3.2	NA	1.9	13.5	0.11	0.18	86.4

North West Coastal Highway / Drummond Cove Road Intersection, 2031

250vph are estimated to use the access road off Drummond Cove Road. Current volumes on Drummond Cove Road are 166vpd; total traffic on Drummond Cove Road is 391vpd. Forecast AM peak hour volumes are as detailed in Table 10.

The existing geometry provides some localised widening on NWCH to facilitate through traffic passing right turning traffic into Drummond Cove. As traffic volumes increase the intersection will need to be upgraded to include a left turn lane in NWCH and a right turn lane in NWCH.

The following geometry has been analysed and includes right and left turn lanes on NWCH as shown in Figure 19. An analysis of movement performance of vehicles at the Drummond Cove Road intersection at full development 2031 is shown in Table 11. Analysis indicates that should the surrounding regional growth eventuate, the right turn from Drummond Cove Road will have difficulty assessing North Western Coastal Highway. The operation of NWCH will need to be reassessed when the development in the region is confirmed and actual volumes are available. This data will determine whether the intersection may need a future upgrade.

Table 10: Forecast AM peak hour volumes: Drummond Cove Road Intersection

Location	AM Peak vehicles/hour
NWCH North	
Through	547
Right	35
Drummond Cove Road	
Left	82
Right	192
NWCH South	
Through	511
Left	82

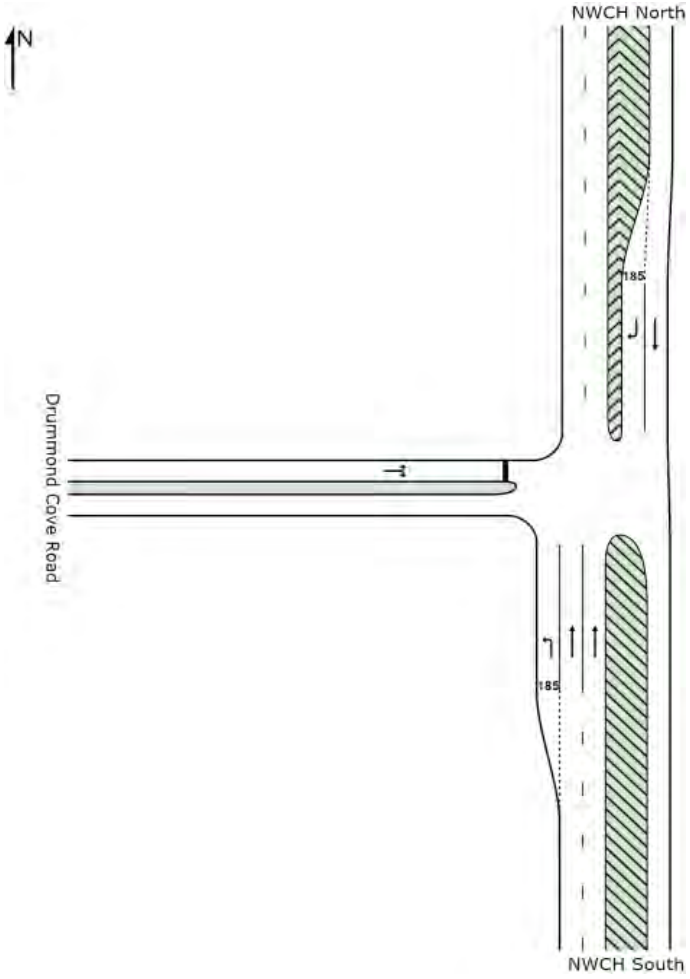


Figure 19: Drummond Cove Road / NWCH turning lanes

Table 11: Movement performance - vehicles at Drummond Cove Road intersection at full development, 2031

Movement Performance - Vehicles											
Mov ID	ODMov	Demand Flows		Deg. Satn	Average Delay	Levels of Service	95% Back of Queue		Prop Queued	Effective Stop Rate	Average Speed
		Total	HV				Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: NWCH South											
1	L2	82	2.0	0.045	8.2	LOS A	0.0	0.0	0.00	0.67	70.8
2	T1	511	15.0	0.144	0.0	LOS A	0.0	0.0	0.00	0.00	109.9
Approach		593	13.2	0.144	1.2	NA	0.0	0.0	0.00	0.09	102.1
North: NWCH North											
8	T1	547	15.0	0.308	0.0	LOS A	0.0	0.0	0.00	0.00	109.7
9	R2	35	2.0	0.047	11.2	LOS B	0.2	1.3	0.54	0.76	56.1
Approach		582	14.2	0.308	0.7	NA	0.2	1.3	0.03	0.05	103.8
Northwest: RT from Median											
29a	R1	192	2.0	0.794	38.1	LOS E	5.9	42.0	0.92	1.42	27.6
Approach		192	2.0	0.794	38.1	LOS E	5.9	42.0	0.92	1.42	27.6
West Drummond Cove Road											
10	L2	82	2.0	0.859	41.2	LOS E	9.4	66.6	0.91	1.73	31.6
12	R2	192	2.0	0.859	41.3	LOS E	9.4	66.6	0.91	1.73	31.6
Approach		274	2.0	0.859	41.2	LOS E	9.4	66.6	0.91	1.73	31.6
All Vehicles		1641	10.4	0.859	12.0	NA	9.4	66.6	0.27	0.50	65.4

3.5 Water Management

A separate Local Water Management Strategy has been prepared for the structure plan in accordance with Better Urban Water Management (Western Australian Planning Commission, 2008). This document forms part of the structure plan, and should be utilised by developers and planning authorities in designing and considering applications for subdivision and the delivery of subdivisional works.

The proposed stormwater management strategy (Figure 20) employs the following principles for managing water quantity:

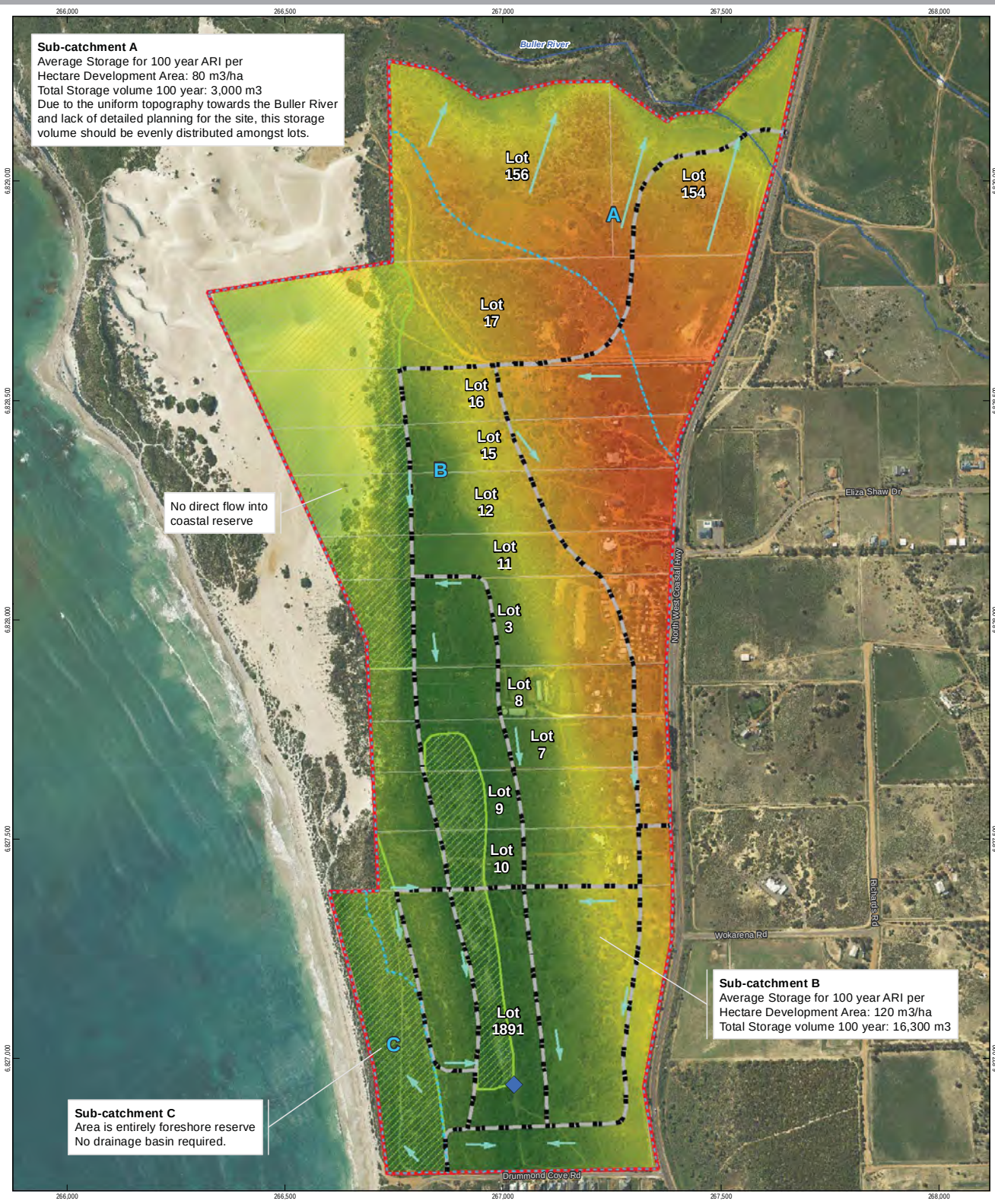
- For the 1 year average recurrent interval (ARI) event lot and road runoff will be infiltrated as close to source as practical using water sensitive urban design (WSUD) measures such as infiltration devices. These include swales and soakwells.
- Events greater than the 5 year ARI event and up to and including the 100 year ARI event will be collected and conveyed via road side swales into drainage basins integrated within public open space or drainage reserve identified at subdivision. These swales and basins will be sized to compensate for major events up to the 100 year ARI event.

Furthermore, the following measures are advised for managing water quality:

- Structural measures - Using WSUD and best management practices to ensure that stormwater is infiltrated as close to the source as practical; and
- Non-structural measures - Nutrient control and landscaping, sediment and litter control and construction management, and community awareness and education

Urban Water Management Plans will be required as a condition of subdivision as informed by the Local Water Management Strategy (Appendix B).

Examples of drainage infrastructure recommended by the local water management strategy; swale within open space (top); roadside swale (centre and bottom).



LEGEND

Drainage Basin
Flow Direction
Swale
River
Sub-Catchment
POS Areas
Cadastre
Study Area
Elevation
High : 53
Low : 2

Opportunities for infiltration road runoff, using infiltration areas and infiltration swales will be investigated within the subsequent UWMP's so as to distribute the required storage throughout the catchment.

1: 8,000 (at A3)
0 80 160 240 320 400
Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 50

N

GHD

Shire of Chapman Valley
Buller Development Zone LWMS

Job Number 61-27522
Revision 0
Date 17 Feb 2015

Recommended drainage plan

G:\61\27522\GIS\Maps\MXD\LWMS\6127522_G11_Rev0.mxd

239 Adelaide Terrace Perth WA 6004 Australia T 61 8 6222 8222 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com.au

Data source: Landgate: Geraldton Townsite 2012 - 20130712, Cadastre - 20130712, Rivers - 20140402, Roads - 20130712; GHD: Study Area - 20130712, Flow Direction - 20140402, Swales / Structure Plan Roads - 20150206, POS Areas - 20150206. Created by: jbmonteignies

Figure 20: Stormwater Management Strategy

3.6 Educational Facilities

No school facilities are required within the Buller Local Structure Plan area based on the low densities proposed. School sites have been planned in Drummond Cove and Glenfield that will service the development.

3.7 Infrastructure Coordination

Gas

There are no nearby reticulated gas mains to service the Study Area. Gas is supplied to Geraldton from the Dampier Bunbury Natural Gas Pipeline. The supply main to Geraldton follows the Walkaway Nangetty Road alignment into the Narngulu Industrial Area before being reticulated throughout much of the Geraldton urban areas.

Water

Consultation has been undertaken with the Water Corporation with the following advice being provided.

Planning Review

The water connection points provided are conditional on the Geraldton northern water scheme having spare capacity to serve the areas. The existing infrastructure is able to serve the current development rate. Should this significantly increase capacity may be limited. Proposed projects to increase capacity for the north Geraldton area are programmed to be completed during 2016 (subject to the annual capital infrastructure prioritisation review).

- Edward Road Transfer Pump Station approximate location Galleon Drive/Edward Road intersection
- Twelve kilometres of 600 diameter pressure main from Edward Road Pump Station to Nanson Road Tank on Chapman Valley Road

A planning review of these timeframes has commenced and is due to be completed by the end of 2014.

Dedicated Northampton Water Transfer Main

A water transfer main has been constructed to upgrade the water supply to Northampton. It is located in a 10 metre easement west of the North West Coastal Highway road reserve and is located within Lots 15, 16, 17 and 2632. The easement over Lots 15 and 16 are finalised, while the easements over Lots 17 and 2632 are in progress.

Future Oakajee Industrial Estate Distribution Main

Various options to service the Oakajee site have been considered, including an additional water main in the easement located for the dedicated Northampton water transfer main.

Buller Structure Plan Area

The development area was included in the last Geraldton water scheme planning review 2007 to be served as residential R20. The development area is currently in the Nanson Road Tank water zone and projects are currently being completed to transfer the area into the Brown Lane Tank water zone that was constructed and commissioned in 2013. A review of the Geraldton water scheme planning has recently started and will consider the water zones and connection points for this area. They are likely to be from the existing 150 diameter reticulation on Drummond Cove Road and reticulation on the North West Coastal Highway where the proposed internal road for the development area intersects with the North West Coastal Highway.

Wastewater

No reticulated wastewater scheme is generally proposed for the development area, with onsite treatment and disposal of effluent through aerobic treatment units on individual lots permitted by the proposed lot sizes and relevant Government wastewater policy.

The structure plan proposes unsewered lots of R5 density (lots of 2,000m^2 or more), consistent with the Department of Health Draft Country Sewerage Policy (2003).

To provide flexibility to achieve greater conservation outcomes and in response to Government wastewater policies as released, the structure plan provides a split coding that would enable lots less than 2,000m^2 in some locations where supported by land capability

and state wastewater policy at the time of subdivision. Applications for lots less than 2,000m² will be referred to Department for Health for comment, and will have regard for the status of state policies at the time of subdivision and/or development application.

Any densities greater than those proposed by the structure plan would require a reticulated wastewater service and would discharge into the Drummond Cove service main. A preliminary review indicates the need for mains extension and upgrades. Water Corporation advise there is currently limited capacity for treatment of additional waste water generated north of Geraldton North wastewater treatment ponds. A wastewater planning review would be required should more intensive development be considered across the Structure Plan Area.

Power

There are existing electrical connections into the study area, although the capacity of the electricity network in the region is limited. The need for any reinforcement works or infrastructure upgrades should be determined at the time of subdivision through a Western Power feasibility study.

Telecommunications

All lots in the Buller Development Zone structure plan will be connected to Telstra by copper wire connection and the National Broadband Network (NBN).

Corridors through local roads should be considered in the design and construction of each subdivision. Telecommunications infrastructure must be in accordance with appropriate guidelines of network providers.

The installation of the Geraldton to Port Hedland fibre optic cable is in progress along the North West Coastal Highway. This will allow the optimal connection point or multiple connection points to the National Broadband Network.

3.8 Development Contribution Arrangements

Subdividers should refer to section 7.1 of Part 1 Statutory Section of the Buller Structure Plan for infrastructure contribution responsibilities. This section operates as a Development Contribution Plan in accordance with clause 6.5 of the Scheme.

Public open space costs will be shared across the development area through implementation of cash-in-lieu provisions provided by the Planning and Development Act 2005.

Some water management costs will be shared through the delivery of the Local Water Management Strategy that provides a coordinated approach to drainage locations. The use of roadside swales rather than traditional pit and pipe networks will facilitate the onsite infiltration of most rainfall events. The location of drainage swales for the 100 year flood within public open space facilitates the sharing of drainage land costs through public open space cash-in-lieu processes.

3.9 Implementation

Implementation of the structure plan will be through application of the provisions of Part 1 of the structure plan through subdivision processes.

A number of technical studies and surveys will be required to facilitate subdivision of the site. These include:

- Urban Water Management Plan (condition of subdivision)
- Bushfire Management Plan (condition of subdivision)

3.10 Staging

Staging will be influenced by access, and will radiate from access points according to market forces and

aspirations of individual owners. Each parent lot will represent a stage of subdivision; however it is not expected in the outset that each lot will subdivide to the ultimate development layout through a single subdivision stage. Staged subdivision may retain large lots around existing houses and improvements, whilst providing for part development as an interim measure.

It is anticipated that subdivision will move along stages from south to north, however this is not a statutory requirement of the structure plan and in reality staging will be according to the development aspirations of landholders.

The structure plan and Local Water Management Strategy provide for coordinated stormwater management, with basins for the 100 year flood located within public open space. Subdivision stages occurring ahead of the development of public open space on other lots will need to incorporate temporary measures and areas for flood mitigation. The sizing, location, and decommissioning of temporary drainage infrastructure should be incorporated within Urban Water Management Plans prepared as a condition of subdivision.

3.11 Local Development Plans

Several potential issues arising through development of the Buller Local Structure Plan will require further detailed planning to resolve. These include:

- Noise impacts associated with the North West Coastal Highway;
- Detailed planning for protection of areas identified as having conservation significance, which are impacted by existing approvals and uses; and
- Detailed planning for areas identified as containing Frankenia pauciflora.
- Bushfire hazard assessment and analysis in accordance with the State Planning Policy 3.4 Natural Hazards and Disasters and Planning for Bush Fire Protection Guidelines (edition 2) and the requirements in State Planning Policy 3.7 Planning for Bushfire Risk Management and associated Guidelines.

To manage these impacts, specific provisions for lots in these locations will be required. Local Development Plans, which provide additional development standards for particular circumstances, will be required to be developed for lots identified by the structure plan to manage potential impacts. Key issues to be considered and resolved in the preparation and adoption of Local Development Plans include:

Lots abutting highway:

- Consideration of increased setbacks and/or landscape buffering to assist noise attenuation and/or 'Quiet building design'. with regard for State Planning Policy 5.4 Road and Rail Transport Noise and Freight Considerations in Land Use Planning and its implementation guidelines.

Lots with conservation significant vegetation:

- Identification of building envelopes and/or building exclusion areas to ensure significant vegetation is conserved.
- Bushfire protection.
- Consideration of strategic fire breaks rather than fire breaks and fencing along boundaries to assist vegetation protection outcomes.

Appendix C provides a conceptual example of a Local Development for Lots 7, 8 and 9 which are influenced by existing approvals. This is intended to serve as a conceptual example only and Local Development Plans are to be prepared in accordance with the Planning and Development (Local Planning Schemes) Regulations 2015.

Appendix A: Minister of Environment Statement No. 937

Published on: 6 June 2013 Statement No: 937

STATEMENT THAT A SCHEME MAY BE IMPLEMENTED (PURSUANT TO THE PROVISIONS OF DIVISION 3 OF PART IV OF THE *ENVIRONMENTAL PROTECTION ACT 1986*)

Shire of Chapman Valley Local Planning Scheme No. 2 - Lots 3, 7-12, 15-17, 154, 156 and Street No. 1891, North West Coastal Hwy, Buller

Scheme Purpose: The Shire of Chapman Valley Local Planning Scheme (LPS) No. 2 – to rezone Lots 3, 7 to 12, 15 to 17, 154, 156 and Street Number 1891 (Buller Locality), North West Coastal Highway from "General Farming" to "Development" zone.

Responsible Authority: Shire of Chapman Valley

Responsible Authority Address: Lot 7 Chapman Valley Road
NABAWA WA 6532

Assessment Number: 1674

Report of the Environmental Protection Authority: Report 1403

Subject to the following conditions, there is no known environmental reason why the Town Planning Scheme to which the above report of the Environmental Protection Authority relates should not be implemented:

CONDITIONS TO BE INCORPORATED INTO THE SCHEME BY INSERTION OF PROVISIONS IN SCHEME TEXT

1. Insert the following into the scheme under 4.2.3 Development Zone:

    1.1 The Buller "Development" zone is subject to the conditions as outlined in Schedule 10 – Environmental Conditions.

2. Insert the following conditions into the scheme under Schedule 10 – Environmental Conditions:

    2.1 Development within the Buller "Development" zone in relation to the conservation areas shall be generally in accordance with concept 2A as outlined in the *Shire of Chapman Valley Buller Development Zone Opportunities, Constraints and Concepts Study*.

2.2 Any future structure plan shall identify future local scheme reserves for the purpose of conservation as outlined in concept 2A within the *Shire of Chapman Valley Buller Development Zone Opportunities, Constraints and Concepts Study.*

2.3 Any future structure plan shall identify R5- Low Density (minimum Lot size 2000m^2) residential areas as outlined in areas x and y as depicted in Figure 1.

2.4 Any future structure plan shall identify the areas of *Frankenia pauciflora* community on Lots 7 and 9 theses areas would be subject to detailed area plans as outlined in the Western Australian Planning Commission's *Liveable Neighbourhoods* policy to address public open space, vegetation protection, future fences, building envelopes and setback of any future lots.

[Signed 5 June 2013]

Albert Jacob MLA
MINISTER FOR ENVIRONMENT; HERITAGE

Attachments: Figure 1

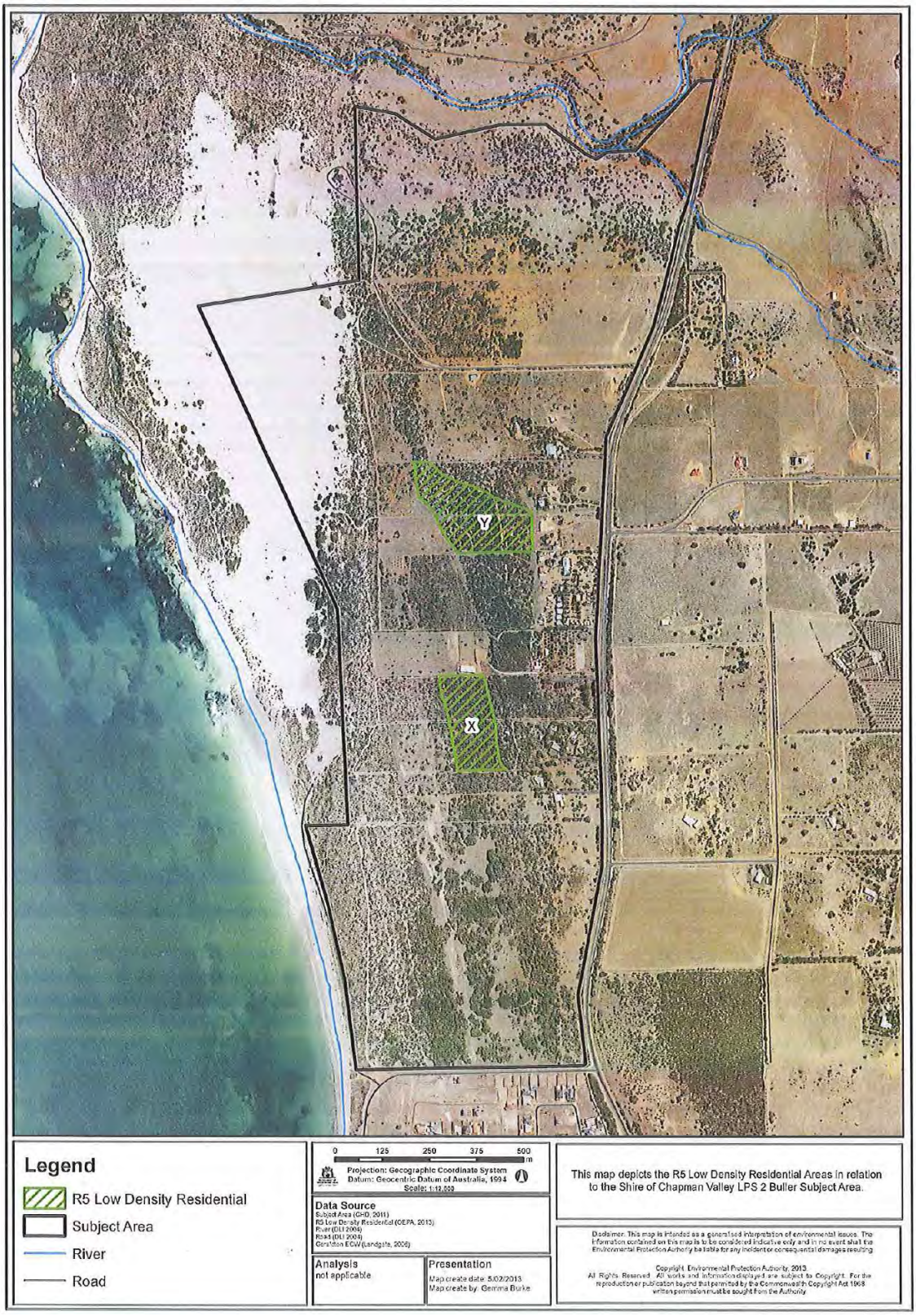


Figure 1 – Low residential density areas

Appendix B: Local Water Management Strategy

Shire of Chapman Valley

Buller Development Zone

LWMS

February 2016

Executive summary

GHD Pty Ltd was commissioned by the Shire of Chapman Valley to prepare a Local Water Management Strategy (LWMS) for the Buller Development Zone (the site).

The Buller Development Zone is located approximately 8 km north of Geraldton, adjacent to the North West Coastal Highway. The site is bounded by the highway to the east, the Indian Ocean to the west, the Drummond Cove development to the south and the mouth of the Buller River to the north.

The Buller Development Zone is approximately 197 ha in size.

This Local Water Management Strategy (LWMS) has been prepared in accordance with *Better Urban Water Management* (Western Australian Planning Commission, 2008).

Principles

The key principles of integrated urban water management for the Buller development area are:

- Minimise total water use in the development area
- Protect infrastructure and assets from inundation and flooding
- Manage groundwater levels to protect infrastructure and assets
- Protect environmental values of receiving water bodies

Water conservation and efficiency

To make the Buller development a leading example of water efficiency the following measures are recommended:

Require all new buildings to incorporate certified water efficient appliances, as set out in the Criteria for Waterwise Homes developed by the Water Corporation

No potable water is to be used outside of homes and buildings

Wastewater management

The site will not be connected to a centralised sewage treatment plant so the proposed rural residential lots are to be serviced by onsite effluent disposal systems, such as aerobic treatment units (ATUs) to treat and dispose of all household sewage.

Stormwater management

The proposed stormwater management strategy employs the following principles for managing water quantity:

- For the 1 year ARI event lot and road runoff will be infiltrated as close to source as practical using water sensitive urban design (WSUD) measures such as infiltration devices. These include soakwells (lots) and swales (roads).
- Events greater than the 5 year ARI event and up to and including the 100 year ARI event will be collected and conveyed via road side swales into drainage basins located throughout the area. These swales and basins have been sized to compensate for major events up to the 100 year ARI event.

Groundwater management

To ensure that existing groundwater levels and quality is maintained, the quality of the stormwater infiltration to groundwater will be maximised through use of WSUD and best management practices (BMPs) to ensure that stormwater is infiltrated as close to the source as practical.

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Appendices

1. Introduction

GHD Pty Ltd was commissioned by the Shire of Chapman Valley to prepare a Local Water Management Strategy (LWMS) for the Buller Development Zone (the site).

The Buller Development Zone is located approximately 8 km north of Geraldton, adjacent to the North West Coastal Highway. The site is bounded by the highway to the east, the Indian Ocean to the west, the Drummond Cove development to the south and the mouth of the Buller River to the north.

The Buller Development Zone is approximately 197 ha in size.

1.1 Total water cycle management

Total water cycle management, also referred to as integrated water cycle management, 'recognises that water supply, stormwater and sewage services are interrelated components of catchment systems and therefore must be dealt with using a holistic water management approach that reflects the principles of ecological sustainability' (DoW 2004-2007, *Stormwater Management Manual for Western Australia*).

The *State Planning Policy 2.9: Water Resources* (WAPC 2004) outlines the key principles of integrated water cycle management as:

- Considerations of all water resources, including wastewater in water planning.
- Integration of water and land use planning.
- The sustainable and equitable use of all water sources, having consideration of the needs of all water users, including the community, industry and the environment.
- Integration of human water use and natural water processes.
- A whole of catchment integration of natural resource use and management.

The principles and objectives for managing urban water as stated in the *Stormwater Management Manual for Western Australia* (DoW 2004-2007) are as follows;

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

1.2 Planning background

In accordance with state government planning framework as outlined in Better Urban Water Management (WAPC 2008), a LWMS is required to accompany the structure plan. Urban water management plans (UWMPs) will be required to accompany the subsequent development applications where further information is required to support development (Section 8).

This LWMS has been prepared in accordance with S*tate Planning Policy 2.9: Water Resources* (WAPC 2004) and *Better Urban Water Management* (WAPC 2008a), on advice from the Department of Water (DoW) and Shire of Chapman Valley. *Better Urban Water Management* (WAPC 2008a) provides a model for developers to address water related management issues at various stages of planning and presents design objectives for water conservation, stormwater and groundwater management.

The planning framework for land and water planning is illustrated in Figure 1.

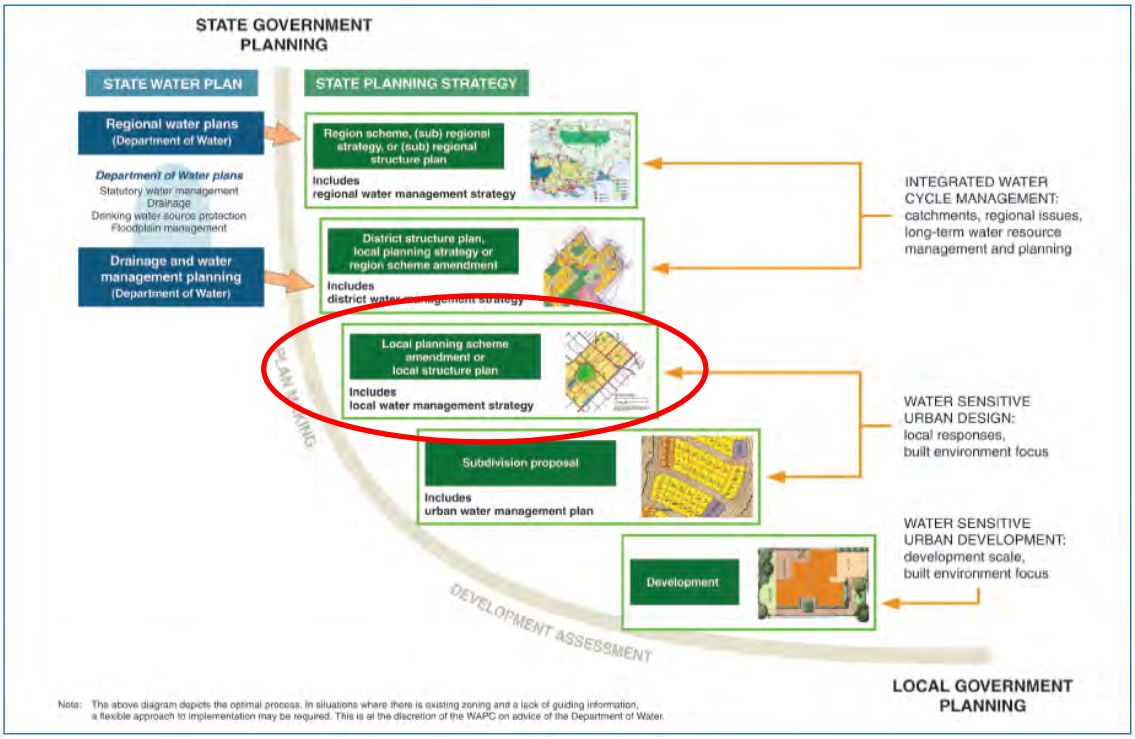


Figure 1 Framework for integrating water planning with land planning

The preparation of this LWMS is not supported by a preceding District Water Management Strategy (DWMS) or Regional Water Management Strategy (RWMS).

The strategies presented in this LWMS have been prepared to be consistent with the requirements of the following key documents:

- Better Urban Water Management (WAPC 2008a)
- Liveable Neighbourhoods: Edition 4 (2007)
- State Planning Policy 2: Environmental and Natural Resources (2003)
- State Planning Policy 2.9: Water Resources (2006)
- Geraldton Region Plan Final (WAPC 1999)
- Draft North Geraldton District Structure Plan (WAPC 2006)
- Shire of Chapman Valley Local Planning Strategy (WAPC 2008b)

- Land Development Specifications (City of Geraldton-Greenough 2007), which has been adopted by the Shire of Chapman Valley as a Local Planning Policy

1.3 Previous studies

In addition to the planning documents identified in Section 1.2, the following investigations undertaken in the Buller locality have been used to inform the water management principles and design criteria outlined in this LWMS:

- *Geraldton rural-residential land capability study* (Dye *et al.* 1990)
- *Shire of Chapman Valley Coastal Management Strategy* (Koltasz Smith 2007)
- *Shire of Chapman Valley, Buller Locality Town Planning Scheme Flora and Fauna Survey* (GHD 2008)
- *Shire of Chapman Valley Local Planning Scheme No. 2 Environmental Review* (GHD 2010)
- *Buller Development Zone, Opportunities, Constraints and Concepts* (GHD 2012)

1.4 Purpose of this report

This LWMS has been prepared to support new development and redevelopment within the Buller Structure Plan area. The strategy identifies characteristics of the study area, and identifies key principles, design criteria and development requirements, and additional guidance to support development in the study area.

1.5 Scope and limitations

This report: has been prepared by GHD for Shire of Chapman Valley and may only be used and relied on by Shire of Chapman Valley for the purpose agreed between GHD and the Shire of Chapman Valley as set out in section 1 of this report.

GHD otherwise disclaims responsibility to any person other than Shire of Chapman Valley arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer section(s) 1 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Shire of Chapman Valley and others who provided information to GHD (including Government authorities)], which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including omissions in the report which were caused by errors or omissions in that information.

2. Proposed development

The Buller Development Zone is a 197 ha coastal strip of land located approximately 8 km north of Geraldton. The site is bounded by the North West Coastal Highway to the east, the Indian Ocean to the west, Drummond Cove urban development to the south, and the mouth of the Buller River to the north.

The site consists of primarily rural lifestyles land uses, including cleared areas, existing houses, ancillary buildings and remnant coastal bushland. The site consists of 13 freehold lots, all in private ownership. The site is currently zoned 'General Farming' under the Shire of Chapman Valley TPS1.

The Shire of Chapman Valley Local Planning Scheme No. 2 (LPS2), zones the 13 lots as 'Development' with an associated 'Development Contribution Area 1' zoning. The proposed development as identified in the Buller Structure Plan (Appendix A) will likely consist of:

- R5 and R10/15 residential lots
- Residential areas with support for tourism industries
- Public open space (POS)
- Foreshore Reserve
- Residential conservation zone
- Tourism and conservation zone

The study area is also identified within the Greater Geraldton Structure Plan (2011) as 'Future Urban', with an 'indicative rapid public transport alignment' identified along North West Coastal Highway.

3. Design criteria

The design criteria adopted for this LWMS have been based on the design criteria objectives outlined in *Better Urban Water Management* (WAPC 2008). This criteria is outlined below:

3.1 Water conservation and efficiency

Principle

Achieve the sustainable management of all aspects of the water cycle within the Buller Development Zone and ensure that potable water use is efficient as possible.

Objectives

- Minimise total water use. The Western Australian State Water Plan (Government of Western Australia, 2007) sets a target of 100 kL/person annual water consumption, including not more than 40 – 60 kL/person/year scheme water use
- Minimise potable water use outside of buildings
- Substitute drinking quality water with fit-for-purpose water for non-drinking uses
- Meet 5 Star Plus requirements
- Promote the use of native plants

3.2 Stormwater quantity

Principle

Maintain post development annual discharge peak flows relative to pre development conditions, unless otherwise established through determination of ecological water requirements for sensitive environments.

Objectives

- **Ecological protection** – retain and / or infiltrate runoff from constructed impervious surfaces generated by the critical one year average recurrence interval (ARI) even using soakwells, rain water tanks, vegetated swales or bottomless pits in piped systems
- **Serviceability of roads and infrastructure in minor ARI events** – runoff form the entire catchment generated by up to the 5 year ARI event should be managed within stormwater conveyance systems and landscaped areas such as swales, basins, living streams or constructed wetlands
- **Flood management** – manage the catchment runoff for up to the 1 in 100 year ARI event in the development area to pre development peak flows, unless otherwise indicated in an approved strategy or as negotiated with the relevant drainage service provider.

3.3 Groundwater quantity

Principle

Manage and minimise changes in groundwater levels following development.

Objectives

- Protect groundwater as a resource
- Protect infrastructure and assets from flooding and inundation by high seasonal groundwater levels, perching and/or soil moisture
- Protect groundwater dependent ecosystems (GDEs) from the impacts of urban runoff

3.4 Stormwater and groundwater quality

Principle

Maintain surface and groundwater quality at pre development levels (winter concentrations) and if possible, improve the quality of water leaving the development area to maintain and restore ecological systems.

Objectives

- Ensure that all runoff contained in the drainage infrastructure network receives treatment prior to discharge to a receiving environment consistent with the *Stormwater Management Manual (Department of Water 2004-7).*

3.5 Disease vector management

To reduce health risks from mosquitoes, retention and detention treatments should be designed to ensure that between the months of November and May stationary stormwater is fully infiltrated in less than 72 hours. Detention and infiltration areas should be free of depressions and potholes to avoid immobile water.

The proponent must ensure that onsite mosquito breeding is minimised through effective design and maintenance of water-holding infrastructure.

The ‘Chironomid midge and mosquito risk assessment guide for constructed water bodies’ (Midge Research Group, 2011) should be referred to during the early stages of planning to ensure that the potential for on-site mosquito breeding is minimised.

Objectives

- No permanent water bodies will be constructed on site

3.6 Commitment to best management practices

In order to meet the design criteria outlined above, the following best management practices will be employed:

- Implement controls at or near source to prevent pollutants entering the system
- Install in-transit measures to treat stormwater and mitigate pollutants that have entered the system
- Implement end-of-pipe controls to treat stormwater, addressing any remaining pollutants prior to discharging to the receiving environment

4. Pre-development environment

4.1 Study area

The Buller Development Zone is a 197 ha coastal strip of land located approximately 8 km north of Geraldton (Figure 2). The study area is bounded by the North West Coastal Highway to the east, the Indian Ocean to the west, Drummond Cove urban development to the south and the Buller River to the north.

The site consists of primarily rural lifestyle land uses, including cleared areas, existing houses, ancillary buildings and remnant coastal bushland. The Drummond Cove Holiday Park is also located within the study area.

4.2 Climate

The site is located in the mid-west of Western Australia, which has a Mediterranean climate consisting of hot, dry summers and cool, wet winters. The closest weather station with complete rainfall record for recent years is located 13 km away at Geraldton Town (Site ID 008050).

Mean annual rainfall is 451.6 mm, and average monthly rainfall is shown in Table 1.

Table 1 Mean monthly rainfall Geraldton Town

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean rainfall (mm)	5.9	8.5	13.2	23.3	68.9	113.0	90.2	64.9	30.4	18.0	7.9	3.7

4.3 Topography

The site is located on the coastal dune system, with the western boundary of the site roughly coinciding with the peak of the foredune system while the eastern boundary of the site reaches part way up the secondary dune (Kolsatz Smith 2007).

The site reaches a maximum elevation of 53 mAHD at the eastern boundary, and falls west into a natural dunal depression at around 3 mAHD. The relief then rises to 14 mAHD at the peak of the primary dune before falling towards the coast. In the northern part of the site, there is also fall north towards the Buller River.

4.4 Geology and soils

The Buller Redevelopment Zone is located within the Central Coast region, which is comprised primarily of Tamala limestone and its products. The Tamala dune system comprises of lithified limestone overlain by deep yellow sands and red loams.

The Geological Survey of Western Australia (1971) mapping of surface geology identifies that the study area progresses from red and yellow sands, to limestone and lime sand from east to west (Figure 4). The dunal depression is dominated by alluvium, colluvium, miscellaneous soils, undifferentiated quartz sand, clay and loam (Figure 4).

The freely draining yellow sandplain overlying limestone makes up the bulk of the soils within the study area. Near the coastal escarpment in the west, red Spearwood sands occur over limestone. These too are freely draining and are more fertile than the yellow sandplain soils.

The soil characteristics at the site should be confirmed prior to the preparation of Urban Water Management Plans so confirm the infiltration rate of soils within the study area.

4.4.1 Acid sulfate soils

The presence of acid sulfate soils has been recognised as an issue of concern in Western Australia since 2003. Proponents of developments that involve the disturbance of soil or the change of groundwater levels in areas susceptible to acid sulfate soils are required to conduct desktop and field based investigations. Adequate investigations are required prior to soil disturbance to determine the potential risks and to allow for the formulation of appropriate management strategies.

Mapping by Land Gate indicates there is a high to moderate risk of acid sulfate soils occurring within 3 m of the surface in the natural depression between the two dune systems (Figure 5). The at risk area covers almost 60 ha however has been identified as primarily POS

Figure 2 Locality

Figure 2

Figure 3 Topography

Figure 4 Surface geology

Figure 5 Acid sulfate soils and Heritage

4.5 Aboriginal heritage

The Buller Development Zone is near to and abuts several registered Indigenous sites. The Buller River provides a focus point for several sites. Site 24415 (Buller River) is a mythological site associated with a natural feature, that follows the alignment of the Buller River, abutting the Buller Development Zone. The site has open access, and is not restricted.

Site 15857 (Buller River Area) is located to the northwest of the Buller Development Zone. This registered site has open access, and is not restricted. The area, associated with the Buller River, is a hunting and camping place, and was an important water source for Indigenous people.

Site 5465 (Drummonds Cove) is located to the northwest of the Buller Development Zone. The registered site has open access, and is not restricted. The coordinates of the particular site are unreliable, so the registered site is spatially arranged as a quadrat within which the site occurs. The site is registered as an area where burial occurred that includes skeletal materials.

4.6 Environmental assets

4.6.1 Environmentally sensitive areas

There are no environmentally sensitive areas within the Buller Development Zone.

4.6.2 Vegetation and flora

The site is part of the Greenough System within the Irwin District of the South-Western Botanical province (Speck 1958).

The study area retains remnant vegetation in “Excellent’ to ‘Degraded’ condition within the following vegetation types (GHD 2008):

- Dune Blowout – primarily bare sand.
- Coastal scrub / heath – includes foredune vegetation, and first stabilised dune.
- *Acacia rostellifera* / *Lycium ferocissimum* shrubland.
- *Frankenia* / *pauciflora* on saline flats.
- *Melaleuca cardiophylla* mixed heath on limestone ridge.
- Degraded riparian Low woodland – associated with the Buller River tributary.
- Pasture/Improved vegetation.
- Mixed degraded vegetation.

No declared rare flora or priority flora were identified during flora survey of the site, and no threatened or priority ecological communities have been located within the study area (GHD 2008). However the study area may host locally significant vegetation given the level of historical clearing in the Geraldton Coastal region.

The Shire of Chapman Valley Local Planning Scheme No. 2 (LPS2) identifies the *Frankenia pauciflora* community as part of a conservation zone. A flora survey of the site identified this community as limited to the winter wet flats associated with the dunal depression.

The Buller Development Zone is covered under the Shire of Chapman Valley *Coastal Management Strategy* which was prepared to guide sustainable coastal development, and manage development pressure from competing land uses (Koltasz Smith 2007).

4.7 Surface water

The Buller Development Zone is located within 50 m of the coast and immediately south of the Buller River, a short coastal stream. There are no other permanent surface water features at the site, however it is likely that stormwater flows may pond in the low lying area (dunal depression) after heavy rains.

Surface water runoff across the Buller Development Zone is predominantly towards the low lying area, although the northern part of the site drains towards the Buller River.

4.8 Groundwater

4.8.1 Groundwater level

The Department of Water WIN database identifies two bores within the site boundary however no groundwater level or quality data is available for these bores. Within a 5 kilometre radius of the site there are a further 40 bores. Bores located south of the Buller River include two bores located within 500 m of the southern site boundary (WIN Site ID 23043480 and 23042381), within the existing Drummond Cove development area, which reported static water levels of 3.45 m and 3.96 m below ground level in June 2000.

Further groundwater levels from groundwater bores located between 1.4 km and 2.8 km from the southern boundary of the site reported static water levels of 2.76 m and 4.14 m relative to ground level in February 2007 (Win Site ID 23043803, 23043805, 23043810). As these water level data were collected during summer and early winter they may be considered to be representative of minimum groundwater levels to the south of the site. It is uncertain if these are representative of groundwater levels at the site.

Where development is proposed in proximity to the dunal depression groundwater monitoring should be undertaken to inform the preparation of urban water management plans to confirm groundwater levels in the area.

4.8.2 Groundwater quality

As for groundwater level, there is no groundwater data available for bores within the site boundary. Two bores located 2.8 km from the southern boundary of the site reported pH values of 7.3 and 7.6 and total dissolved solids concentrations of 21,000 and 32,000 mg/L (WIN Site ID 23043810 and 23043805 respectively). Due to the single grab sample nature of these samples it is uncertain if they are representative of site groundwater quality.

Figure 6 Groundwater levels

5. Water use sustainability

5.1 Water conservation and efficiency

The Buller Development Zone will manage all aspects of the water cycle sustainably and ensure that the use of potable water is as efficient as possible.

5.1.1 In-house water efficiency

Water use efficiency is part of the "business as usual" approach and is enabled through the use of technology and by changing behaviour to use less water. The Western Australian Government has introduced a range of measures to ensure that new houses built in Western Australia meet minimum standards for energy and water efficiency. The 5 star Plus Building Standards (Appendix B) introduced in September 2007 is now an addition under the *Western Australian Appendix to the Building Code of Australia (BCA)* and require:

- All tap fittings must be minimum 4 stars WELS rated
- All showerheads bust be minimum 3 stars WELS rated
- All sanitary flushing systems must be a minimum 4 stars WELS rated dual flush
- Home water heaters to be located within 5 m of major hot water using points.

5.1.2 Ex-house water efficiency

Irrigation is the single most significant water use within residential households and public spaces. Thus irrigating efficiently can have a major impact on the water consumption of a whole development.

The following waterwise measures will be encouraged at the individual property scale:

- Water efficient irrigation systems (deliver water evenly, to near the root zone, at specified rate).
- Waterwise garden design/landscaping.
- Native vegetation with low water demand.
- Group plants with similar water requirements.
- Minimise irrigated lawn/turf area.
- Soil improvers, to reduce infiltration loss below root zone.
- Mulch, to reduce evaporative loss.

Whilst not mandatory, these strategies are required to meet the Water Corporation *Criteria for Waterwise Homes* (Appendix E), and are recommended water and nutrient efficient practices that both save water and maintain water quality of existing and downstream environments.

5.1.3 Public open spaces

The nature of the land use zoning, with larger residential lots (R5 zoning) enables the creation of private open space, therefore reducing the need for formal public open space.

Public open spaces in the Buller Development Zone are intended to provide a range of passive and unstructured active recreational opportunities, incorporating protection of conservation areas and water sensitive urban design.

The designated public space areas will retain existing native vegetation, with formal areas limited to seating and barbeque facilities and unstructured play areas. Any landscaping within these areas will be undertaken with water conservation in mind incorporating the following:

- Use of native species that require a local climate based low water-use and nutrient use regime.
- Any planting will be watered during establishment phase only.

5.2 Potable water

The potable water for the Buller Development Zone will be provided by Water Corporation. Review of the development area completed in 2007 identified the site within the Nanson Road Tank water zone. The Geraldton water scheme planning review has recently commenced and shall further consider water zones and connection points for the area. Likely connections are from the existing 150 dia. reticulation along Drummond Cove Road and North West Coastal Highway, where internal roads intersect with these.

5.3 Water supply – fit for purpose strategy

In conjunction with water efficiency measures, supplying fit-for-purpose water can also reduce the demand for potable water. This involves substituting drinking quality water with fit-for-purpose water for non-drinking uses. Potential non-drinking water uses are;

- In-house non-drinking water such as toilets and washing machines
- Irrigation for private (domestic gardens) and public (public open spaces and road reserves) areas
- Aquifer recharge

Substituting potable water with an alternative source of non-potable water can make significant savings in potable water demand and the associated chemicals and energy required treating and delivering water to drinking water standard. Alternative water supply sources include rainwater, groundwater, stormwater and wastewater.

5.3.1 Rainwater

A rainwater supply assessment was conducted for the nearby Dongara DWMS. The assessment found that rainfall patterns limited the reliability of rainwater tanks in the area. In Dongara a roof area of 500 m^2 and a rainwater tank with 150 L capacity is required to achieve 99% reliability. In Port Denison the target reliability could not be achieved due to the rainfall amount and distribution. A target reliability of 99% is set down in the *Guidance on Use of Rainwater Tanks* (Australian Government 2004).

Collection and reuse of rainwater at a lot scale using rainwater tanks systems is ideal for the Buller Development Zone due to the large size of lots. Rainwater tanks could effectively support in-house non-potable water requirements, such as toilets and washing machines. Given rainfall pattern and distribution a roof area of 500 m^2 and a rainwater tank with 150 L capacity is required to achieve 99% reliability. Subsequent UWMP will need to confirm proposed roof and tank size of sufficient to achieve required reliability.

The major potential risk associated with the use of rainwater tanks is the risk to public health due to poor water quality if the tank system is not maintained and managed appropriately. Rainwater quality is generally considered to be of a high standard if regular maintenance and appropriate system management is undertaken. Appropriate maintenance and management of rainwater tank systems includes;

- Installation of first flush diverters

- Prevention of access to any vermin or disease vectors
- Filter to minimise the entry of large particles and leaves
- Regular desludging to avoid build-up of sediments at the base of the tank
- Regular inspection and maintenance of gutters and downpipes

With appropriate maintenance and management it is considered that the rainwater quality would be of a sufficient standard to be used for non-potable in-house use without further treatment.

5.3.2 Groundwater

Shallow groundwater is considered to be the easiest and usually most cost effective method of provided an alternative to scheme water for irrigation. The use of groundwater presents small risk in terms of water quality. With respect to irrigation, the presence of significant iron concentrations, hardness, alkalinity, nutrients or salinity can impact upon the receiving vegetation and soils and/or contribute to the scaling or scour of irrigation pipework.

The extraction of shallow groundwater via private bores is supported by the Shire of Chapman Valley, and will be at the expense of the landowner.

There is no information available on the quality of groundwater at the Buller Development Zone, however two bores located 2.8 km from the southern boundary of the site reported pH values of 7.3 and 7.6 and total dissolved solids (TDS) concentrations of 21,000 and 32,000 mg/L (WIN Site ID 23043810 and 23043805 respectively) (Section 4.8.2).

The Department of Water categorises the groundwater salinity according to the salt content and its application for public drinking, irrigation, stock water etc. Brackish groundwater of salinity 1000-3000 mg/L TDS is used for parkland irrigation, and the more saline groundwater with salinity greater than 3000 mg/L is used for industry and stock watering (up to 10,000 mg/L TDS).

Garden bores provide a fit-for-purpose water supply for domestic irrigation that reduces demand on potable water. Private home owners will have the option of installing a garden bore in line with relevant government regulations and should refer to the Department of Water fact sheet in Appendix D.

The high TDS of the groundwater to the south of the site may be due to saltwater intrusion into the local aquifer, and therefore the quality of local groundwater should be investigated prior to the implementation of groundwater for irrigation.

5.3.3 Stormwater

Stormwater runoff increases during land development due to the introduction of impermeable surfaces. The increase in stormwater runoff at the Buller Development Zone is expected be minimal due to the low proportion of impermeably surfaces associated with the predominantly rural residential and conservation land uses proposed for the area.

Stormwater can be harvested via infiltration to the superficial aquifer at, or close to, source followed by abstraction from private bores. Collection and storage of stormwater for reuse other than by aquifer storage is considered impractical due to the small amounts of stormwater expected at the Buller Development Zone, and inefficient due to the need to construct large water collection infrastructure.

5.3.4 Wastewater

Wastewater includes grey water and black water. Grey water is wastewater generated from domestic activities such as laundry, dish washing and bathing, and can be reused with minimal

treatment for applications such as irrigation, toilet flushing and washing machines. Black water is wastewater generated from sewage, and must undergo extensive treatment before reuse.

Due to the R5 zoning of the Buller Development Zone lots will be serviced by onsite effluent disposal systems to treat and dispose of all household sewage.

The Department of Health (2010) requires that in unsewered areas the primary onsite wastewater system should be sized to receive the total wastewater flow in case any additional grey water system fails. Furthermore the removal of grey water from the primary sewage system may adversely impact on the proper operation of that system. Therefore land owners may find it impractical to install an additional grey water system as well as the required effluent disposal system.

The *National Water Quality Management Strategy: Guidelines for Sewerage Systems – Use of Reclaimed Water* (Agriculture and Resource Management Council of Australia 2000) applies to effluent from municipal (ie community) wastewater plants, and has been adopted by the Department of Health for application to individual household systems, as stated in the *Code of Practice for the Design, Manufacture, Installation and Operation of ATUs*. The strategy outlines the potential applications for black water and the level of treatment, water quality, monitoring and control requirements.

5.4 Wastewater management

The wastewater management methodology differs according to zoning and density.

5.4.1 Proposed R5 zoned area

No reticulated wastewater is proposed for the R5 zoned area, and the proposed rural residential lots are to be serviced by onsite effluent disposal systems to treat and dispose of all household sewage.

Individual lots within the rural residential development will be serviced by on-site effluent disposal systems such as Aerobic Treatment Unit (ATU) systems with the condition that use of an ATU meets the requirements outlined in Sections 5.1 and 5.7 of WAPC's Statement of Planning Policy No 2.1, and Section 5.2.2 of the *WAPC Government Sewerage Policy: Perth Metropolitan Region* (1995).The selection of an appropriate ATU for the individual lots is the responsibility of the landowner, and the unit must comply with the Department of Health Code of Practice for the *Code of Practice for the Design, Manufacture, Installation and Operation of ATUs* (Department of Health 2011).

Effluent from ATU's is able to be disposed of via irrigation areas. Disposal to surface irrigation is not considered for a suitable option for this rural residential development due risks associated with surface disposal such as public health risks, risk of runoff, risk of surface ponding, and disinfection.

Effluent shall be disposed of via sub-surface irrigation (eg closely spaced and pressurised subsurface dripper pipework installed at a depth of 100 mm below the ground level) of a vegetated or landscaped disposal area. The sub-surface irrigation disposal area will be required to comply with setback requirements for buildings and other infrastructure.

The following measures are required to manage the risk nutrient runoff into the surrounding environment:

- Subsurface irrigation (closely spaced and pressurised subsurface dripper pipework installed at a depth of 100 mm below the ground level) is required to dispose of the effluent over a vegetated or landscaped disposal area;

- Construction of an irrigation disposal area with a minimum area of 150 m^2 which includes a layer of imported fill incorporating material that reduces phosphorus export; and
- The irrigation pad requires a minimum 1.2 m vertical separation to from the groundwater, in areas of minimal separation to groundwater, fill is required to ensure adequate separation is achieved.
- The ATU is required to be at least 6 m away from any well, bore, dam or water course that supplies domestic water or any proclaimed water catchment.
- The ATU should be situated downslope of the building wherever possible, to remove the need for diversion trenches.

The Shire of Chapman Valley and Department of Health guidelines stipulate that each onsite effluent disposal system is to be assessed individually to determine site specific characteristics and requirements. Builders and owners of the property will have to design the onsite effluent disposal system to suit local conditions and submit an "*Application to construct or install an apparatus for the treatment of sewage*" to the Shire of Chapman Valley. If the application is approved the effluent disposal system should be installed according to the conditions of approval and must then be inspected by an Environmental Health Officer and a *Permit to Use* issued before the system can be used. Additional applications and approvals are required to reuse treated blackwater.

It is the responsibility of the individual landowner and/or developer to receive approval from appropriate regulatory agencies to install an appropriate ATU system and ensure that quarterly servicing of the system is conducted by a contactor approved by the Department of Health.

5.4.2 Higher density areas

The Water Corporation have advised proposed residential densities higher than R5 for the development area will require wastewater reticulation.

A preliminary review by Water Corporation of an area of higher density residential development along the southern boundary of the site adjacent to Drummond Cove identified some existing capacity may be available within the Drummond Cove catchment area via a sewerage mains extension and upgrades (M. Wilson pers. comm. 28th January 2015). It is intended to connect these lots to the reticulated sewer serviced by the proposed Glenfield Beach Drive pump station. The timing and connection of the sewer is to be confirmed with the Water Corporation by lot owners and developers. This should be completed by a consulting engineer, to confirm the expected development flow rate from the proposed area and a request to review/amend the wastewater planning for the region. Associated infrastructure upgrades to support connection to the Water Corporation sewerage network would be borne by the developer.

6. Stormwater management strategy

The post development annual discharge volumes and peak flows are to be maintained relative to pre-development conditions. To achieve this principle, the following criteria will be applied:

- To manage flows for ecological protection and manage the serviceability of roads and other infrastructure, lot and road runoff for minor rainfall events will be either captured in rainwater tanks or infiltrated as close to the source as practical. Due to the low density nature of the development (predominantly R5) it is expected that all post development stormwater runoff in excess of pre development flows for all storm events up to and including 1 year ARI events will be accommodated at the lot scale.
- The post-development area should retain all catchment runoff exceeding the pre-development level, up to and including the 100 year ARI event, while protecting infrastructure and assets from flooding.

6.1 Catchments

The Buller Development Zone has an external upstream catchment to the northwest of around 200 ha.

The study area was divided into three sub-catchments based on pre-development water pathways and roads depicted in the Structure Plan, to calculate pre and post development stormwater flows. The adopted catchments are illustrated in Figure 7. Sub-catchment A directs water north into Buller River. Surface water in sub-catchments B and C flow to existing natural low points and are internally drained and as such all surface water will be detained within them through infiltration within low points which have been identified as POS within the structure plan.

Note that these catchments do not include runoff from upstream catchments outside the Buller study area, as this land is already developed and has its own stormwater retention requirements.

The external catchment to the southeast of the site drains south along the North-West Coast Highway and does not cross the highway into the site.

6.2 Surface water quantity management

1 year up to 10 year ARI event

The typically sandy soil types which are prevalent in the area are ideally suited to the promotion of infiltration at, or close to source. This has the advantage of maintaining recharge into the aquifer as well as minimising the need for drainage infrastructure. As such the most efficient and effective option for managing and reusing stormwater within the Buller development is infiltration of stormwater to the groundwater system at (or close to) source. However, on site soil permeability testing is recommended prior to development.

No infiltration testing has been conducted within the proposed development. An infiltration rate of 1 m/day (consistent with industry standards for long term unmaintained basins) was assumed as the preliminary infiltration rate used in design. It is likely a higher infiltration rate would be expected for the coastal sands at this site and as such storage required should be revised during subsequent UWMP's based on more detailed infiltration rates for the site.

Lot and road runoff for minor rainfall events up to and including 5 year ARI events will be either captured in rainwater tanks or infiltrated to the aquifer as close to the source as practical, using water sensitive urban design (WSUD) measures such as soakwells (lots) and roadside swales (roads).

Table 2 gives the single lot storage volumes required to retain 1, 5 and 10 year ARI events for the typical R5 (2,000 m^2) lot size. The storage is calculated as the product of the rainfall intensity and the impervious area of the lot (30% for R5 lot density (Department of Planning 2013)). Roadside swales will be designed to infiltrate the 1 year ARI and convey up to the 10 year ARI in accordance with the engineering requirements of the Shire of Chapman Valley.

Table 2 Single lot (2,000 m^2) storage volumes

Rainfall Event	1 year ARI, 1 hr	5 year ARI, 1 hr	10 year ARI, 1 hr
Rainfall Intensity (mm/hr)	17.9	28.1	31.1
Storage required (m^3)	7.2	11.2	12.4

10 year up to 100 year ARI event

Events greater than the 10 year ARI event and up to and including the 100 year ARI event will be collected and conveyed via road side swales into drainage basins located throughout the structure plan area. These swales and basins have been sized to detain major events up to the 100 year ARI event.

The study area was divided into three sub-catchments based on the pre-development flow pathways and roads depicted in the Structure Plan (Section6.1). In the absence of a road grading plan the sub-catchments were based on the assumption that the majority of roads follow the natural topography and grade towards the low point in sub-catchment B, excluding the minor roads in sub-catchment C, as shown in Figure 7. Additionally an east-west draining swale will need to be constructed through Lot 3 (approximately 150 m long) to facilitate drainage sub-catchment B.

Table 3 gives the sub-catchment storage volumes required to retain a 100 yr rainfall event within each sub catchment. Given the required storage volumes and the direction of surface water flow in each sub-catchment, the recommended drainage basin locations, with indicative flow paths through the catchment are shown in Figure 7.

Opportunities for infiltration road runoff, using infiltration areas and infiltration swales will be investigated within the subsequent UWMP's so as to distribute the required storage throughout the catchment.

As noted previously no infiltration testing has been conducted within the proposed development. An infiltration rate of 1 m/day (consistent with industry standards for long term unmaintained basins) was assumed as the preliminary infiltration rate used in design. It is likely a higher infiltration rate would be expected for the coastal sands at this site and as such total storage volumes should be revised during subsequent UWMP's based on more detailed infiltration rates for the site.

Table 3 Sub-catchment storage required to maintain pre-development flows

Sub-catchment	Total Area (ha)	Road Surface Area (ha)	Average Storage for 100 year ARI per Hectare Development Area (m^3/Ha)	Indicative Total Required Storage Volume for 100 yr ARI within Catchment (m^3)	Maximum Water Level of Storage Basin (m AHD)
A	39.6	0.53	80	3,000	19.57
B	137.2	6.00	120	16,300	4.14
C	3.4	0.28	120	400	3.89

Infiltration basins

Infiltration basins for up to the 100 year event will be large shallow depressions located within POS areas. The basins should be appropriately sized for flood storage, and shaped to minimise impact on adjacent native vegetation. All basins within POS are to be designed in accordance with the Shire of Chapman Valley engineering requirements.

The basin for sub-catchment B will be located within POS designated for conservation and in an area that is identified as potential acid sulfate soils (Section 4.4.1, Figure 5). The basin should preferably be sited within the natural low point for the POS area to minimise excavation and disturbance of the site.

Figure 7 Recommended drainage plan

Road drainage

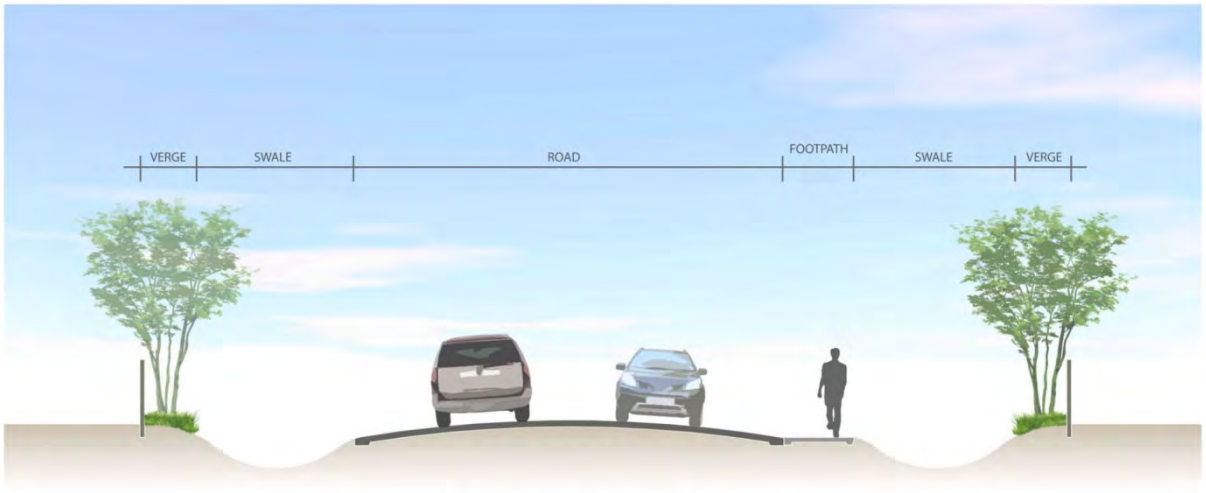
The road drainage system will comprise shallow roadside swales to infiltrate small events and convey larger events from the paved surface.

Peak flows resulting from the 100 year ARI event may result in slight overtopping of the road side swales. Therefore habitable floors are required to be at least 300 mm above the 100 year ARI flood or storage level at all locations.

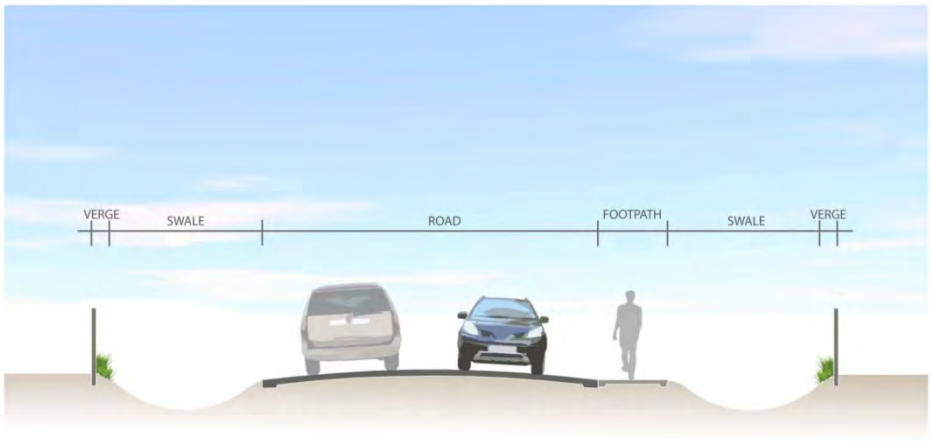
The swales will be bunded at regular intervals to ensure that they do not concentrate the flows. Where kerbing is required at roundabouts and intersections, soakwells may be used in conjunction with kerb openings.

Swales may be landscaped with appropriate native vegetation to ensure high nutrient control, low/no water usage and easy maintenance.

Figure 8 provides typical sections of road reserves (including Neighbourhood Connectors shown within the structure plan, and Access Roads which will be identified at the time of subdivision) within the Buller structure plan area, showing the conceptual location of the roadside swales. The width of swales should be determined through preparation of Urban Water Management Plans at the time of subdivision.



NEIGHBOURHOOD CONNECTOR



ACCESS ROAD

Figure 8 Roadside swales within indicative road cross sections

Peak flows resulting from 100 year ARI events may result in slight overtopping of the road side swales. Therefore habitable floors are required to be at least 300 mm above the 100 year ARI flood or storage level at all locations.

6.3 Surface water quality management

The post-development water quality is to be maintained at pre-development levels (winter concentrations) and if possible, the quality of water leaving the development area is to be improved to maintain and restore ecological systems. To achieve this principle, the following criteria will be applied:

- Ensure that all surface and groundwater contained in the drainage infrastructure network receives treatment prior to discharge to receiving environment consistent with the Stormwater Management Manual for Western Australia (Department of Water, 2004- 2007).

Urban runoff is a significant source of nutrients and other contaminants that are discharged to the shallow aquifer. Runoff water quality from roads and other paved surfaces can be variable

and is dependent on local soil types, land use and climate. Maintaining pre-development discharge rates and volumes from developed catchments is expected to prevent the majority of contaminants from reaching the receiving environment by ensuring that the majority of flows from high-frequency events are retained or infiltrated on site.

Provided that the initial flow of more significant events is subject to the same retention and treatment received by high-frequency events, surface runoff that occurs during more significant events represents a lower risk to water quality. This is because nutrients and other contaminants that represent a threat to water quality are typically transported within the 'first flush' of an event.

Managing water quality has been divided into categories: Structural measures and non-structural measures.

6.3.1 Structural measures

Use WSUD elements and best management practices (BMPs) promoting retention, infiltration and treatment of events up to the 1 year ARI events as close to the source as practical, in accordance with the Stormwater Management Manual for Western Australia (Department of Water, 2004- 2007).

The key WSUD element to be incorporated into the design of the development area is grassed swales, with infiltration as close to source as possible.

6.3.2 Non-structural measures

Nutrient control and landscaping

- Implement the swales relatively early to avoid temporary facilities and allow new vegetation to establish before housing construction of the developed lots is completed.

Sediment and litter control and construction management

- Require all development construction projects, including lot development, road and infrastructure construction, to implement sediment and erosion control measures.
- Ensure that drainage basins area cleared biannually to ensure functionality.

7. Groundwater management strategy

7.1 Groundwater levels

To ensure that existing groundwater levels are maintained, stormwater runoff will be infiltrated as close to source as practical using WSUD and BMPs.

Extrapolation of existing Department of Water groundwater monitoring to the north and south of the site (Figure 6) indicates that depth to groundwater across much of the site exceeds 5 m, so it is unlikely that either on site wastewater disposal or stormwater infiltration will affect the local aquifer.

Where groundwater at the site is indicated to be within 5 m of ground level, it is recommended that site specific groundwater monitoring be undertaken to confirm local groundwater levels (see Section 8.1). This information will inform potential fill requirements for the house pad and onsite effluent disposal system.

7.2 Groundwater quality

The post development groundwater quality is to be maintained at pre-development levels (winter concentrations) and, if possible, the quality of water leaving the site is to be improved to maintain and restore ecological systems.

To ensure that existing groundwater quality is maintained, the quality of the stormwater infiltration to groundwater will be maximised by using WSUD and BMPs to ensure that stormwater is infiltrated as close to source as possible.

7.3 Impact on Groundwater Dependant Ecosystems

Since there are no groundwater dependent ecosystems (GDEs) within or adjacent to the site and it is proposed to contain stormwater runoff within the site there will be no impact on GDEs.

7.4 Matters to be addressed in UWMPs

Infiltration testing should be carried out in conjunction with geotechnical investigations to confirm that the site is suitable for the proposed infiltration methods and to identify appropriate infiltration rates to enable further refinement of modelling at the UWMP stage, where required.

8. Implementation framework

As the Buller study area features fragmented ownership it is anticipated that implementation of this local water management strategy will occur over extended time frames and on an ad-hoc basis, as development proposals are approved and constructed.

8.1 Monitoring

Surface water

There is no existing or proposed waterways or water body's onsite and all stormwater runoff generated on site is to be retained within the site boundaries. Therefore surface water monitoring is not required. If stormwater runoff is not retained on site then post development surface water monitoring of the Buller River to the north may be required to ensure no adverse impacts.

Groundwater

No groundwater level monitoring was conducted as part of this LWMS.

Extrapolation of existing Department of Water groundwater monitoring to the north and south of the site indicates that depth to groundwater across much of the site exceeds 5 m, so it is unlikely that either on site wastewater disposal or stormwater infiltration will affect the local aquifer.

Pre-development groundwater monitoring may not be required in areas where the depth to groundwater exceeds 5 metres, based on the extrapolation of Department of Water bores located to the north and south of the site (Figure 6).

Exemption from groundwater monitoring should be discussed in consultation with the Department of Water. Where groundwater at the site is indicated to be within 5 m of ground level, it is recommended that site specific groundwater monitoring be undertaken to confirm local groundwater levels. This information will inform potential requirements for fill and will be required to design and assess operation of onsite effluent disposal systems.

Groundwater monitoring should occur prior to the preparation of UWMPs, where required, to confirm groundwater levels in the area.

8.2 Requirements for future planning and development

This local water management strategy provides guidance on water management within the Buller study area.

Urban water management plans are not anticipated to be required to support development of single lots across the majority of the study area.

Urban water management plans may be required to support urban development where:

- Local Development Plans are required for vegetation protection areas as identified in the Buller Local Structure Plan (Plan 1).
- Development is proposed that will significantly alter the hydrology or drainage of a site or is unable to meet the design criteria identified in Section 3.

Where an urban water management plan is required it should be consistent with the requirements of the Department of Water's *Urban water management plans: Guidelines for preparing plans and complying with subdivision conditions* (DoW 2008). The urban water management plan should demonstrate that water management within the subdivision will meet

the objectives and criteria in the local water management strategy, except where alternative agreement has been reached with the Department of Water and the Shire of Chapman Valley.

8.2.1 Subdivision

Small scale subdivision should be undertaken in accordance with the structure plan and the objectives, strategies and design criteria in this local water management strategy. An urban water management plan will generally not required unless the Department of Water or Shire of Chapman Valley require additional information to demonstrate compliance with this local water management strategy, or where proposed development may have an impact on significant resources.

Developers subdividing land for urban residential development are required to provide a stormwater drainage system. The drainage system should consider the total contributing catchment area, ensuring that the ultimate design is capable of carrying the ultimate design flow from the upstream catchment. Developers whose land shares a common drainage catchment have a shared responsibility for ensuring that the whole of the catchment, including roads, is drained.

8.2.2 Local Development Plan

Where subdivision is subject to a local development plan, the subdivision should be undertaken in accordance with the local development plan and the accompanying urban water management plan, as well as demonstrating compliance with this local water management strategy.

8.3 Responsibilities

Table 4 sets out the roles and responsibilities for the actions outlined for the future planning for the development area. This strategy is based on the Buller Structure Plan prepared by GHD in February 2014. Should the Structure Plan be altered the LWMS will be reviewed.

Table 4 Roles and responsibilities

Role	Responsibility	Requirement and Period
Prepare an urban water management plan	Developer/ landowner if required	Prior to commencement of subdivision works.
Design and construction of surface drainage system demonstrating compliance with this LWMS	Developer	Prior to commencement of subdivision works. Maintain infrastructure for a minimum of 2 years after practical completion, until successful handover to Shire of Chapman Valley.
ATU's/rainwater tanks: *Requirements*	Shire of Chapman Valley	Ensure lots meet requirements relating to ATUs and rainwater tanks
ATU's/rainwater tanks: *Implementation and maintenance*	Developer/ landowner	Ensure onsite water and wastewater infrastructure is installed by a licensed contractor and appropriately maintained.
Structural control compliance	Shire of Chapman Valley after practical	Drainage structures to be cleared biannually for a period of two years from

	completion	practical completion and monitored to ensure functionality
Non-structural controls *Land use and management*	Developer	Sediment and erosion control during construction
Non-Structural Controls: *Public awareness campaigns*	Shire of Chapman Valley	Sustainability information packs, including educational information regarding non-structural control measures, such as fertiliser application, native gardens, herbicide use, weed control and waste management, to be provided at settlement.

9. References

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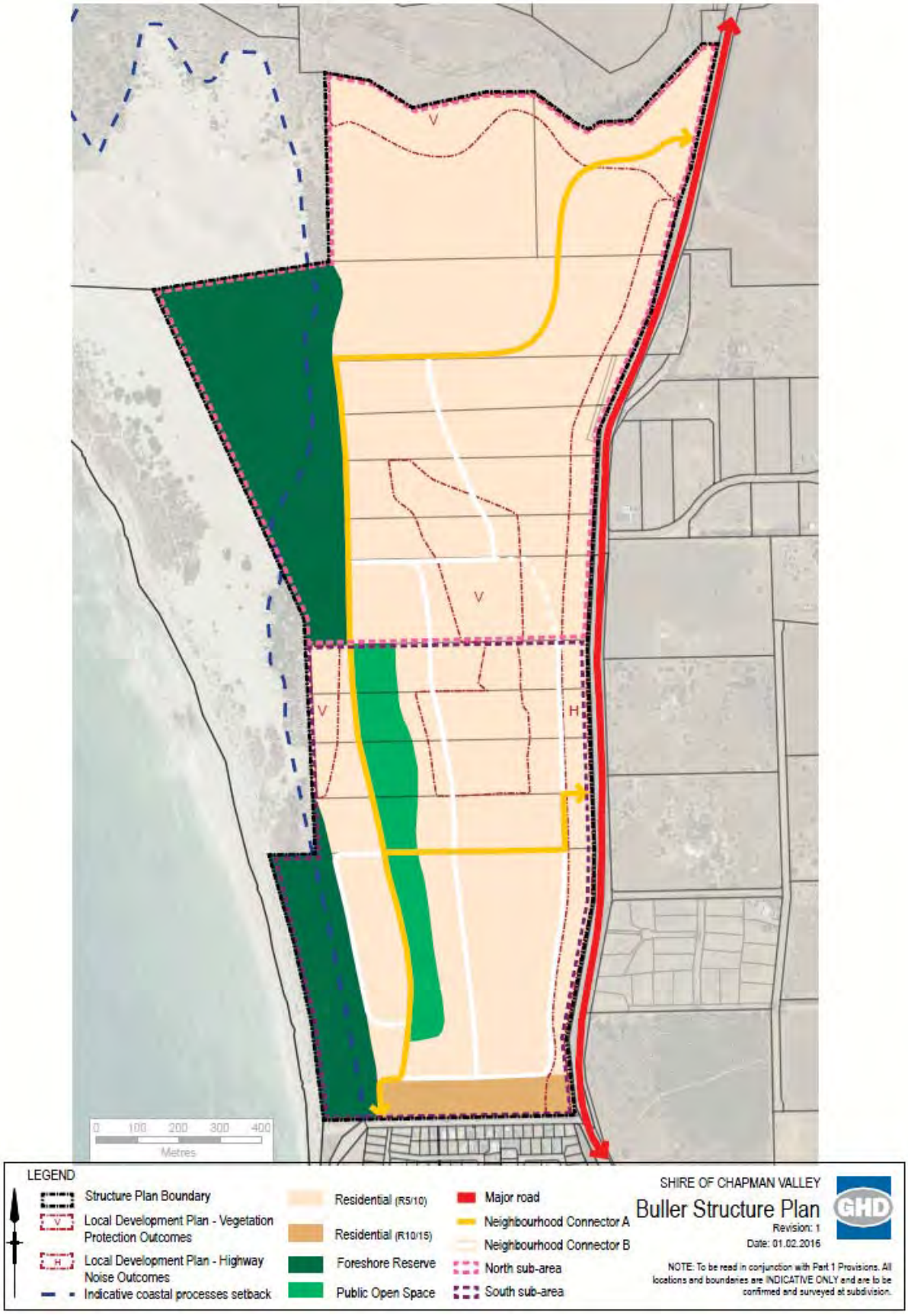
Appendices

Appendix A – Buller Structure Plan



Appendix B – 5 Star Plus Building Standards

Department of Housing and Works
Government of Western Australia

5 Star Plus

Energy Use in Houses Code
Water Use in Houses Code

Playing our part in building better communities for Western Australia

Introduction

In May 2006, Western Australia adopted the minimum 5 Star energy efficiency provisions of the Building Code of Australia for all new homes. Now the Government has gone further and introduced 5 Star Plus – that builds on the energy efficiencies from 5 Star with the added benefits of water reduction measures for all homes right across the State.

5 Star Plus is based around two new Codes:

The Energy Use in Houses Code - confirms the existing 5 Star provisions for house design and construction and adds requirements for energy efficient water heating.

The Water Use in Houses Code - aims to reduce the consumption of water in residential homes by requiring water efficient fittings, minimising the wastage of water and facilitating the appropriate use of alternative sources of water such as grey water and rain water.

5 Star Plus will be applicable to new homes approved for construction after 1 September 2007, however, existing home owners can also use these Codes to improve energy and water efficiency in their homes. During 2008, the Government will investigate measures to apply the 5 Star Plus provisions to existing homes.

The Energy Use in Houses Code and Water Use in Houses Code are written to supplement the Building Code of Australia (BCA) and adopt BCA definitions and format for consistency. The Codes are published together for the convenience of builders, plumbers and certifiers who may need a convenient reference on site.

The Codes are available online at **www.5starplus.wa.gov.au**

Energy Use in Houses Code

Application

This Code applies to all new buildings classified as Class 1 and 10 buildings by the Building Code of Australia.

Interpretation

"The Building Code of Australia" means the latest edition of the Building Code of Australia published from time to time by, or on behalf of, the Australian Building Codes Board, but not including explanatory information published with that Code.

Objective

The objective of this Code is to reduce greenhouse gas emissions.

Functional Statement

In order to reduce greenhouse gas emissions, a building, including its services, is to be capable of efficiently using appropriate sources of energy.

Compliance With This Code

A building will comply with this Code if its construction satisfies all the Performance Requirements. Compliance with the Performance Requirements can be shown by:

(a) Complying with the Deemed-to-Satisfy provisions as listed in the Acceptable Construction Practice; or

(b) Formulating an alternative solution that is shown to be equivalent to the Deemed-to-Satisfy provisions; or

(c) Formulating an alternative solution that is verified using an acceptable verification method; or

(d) Formulating an alternative solution that is based on expert judgement or supported by suitable evidence in accordance with clause 1.2.2 of the Building Code of Australia; or

(e) Any combination of the above.

Energy Use in Houses Code

Performance Requirements

PR1 – Building

A building must comply with the Building Code of Australia Performance Requirement P2.6.1.

PR2 – Services

A building's domestic services including any associated distribution system and components must have features that comply with the Building Code of Australia, Performance Requirement P2.6.2.

PR3 – Hot Water Systems

A building's hot water systems including any associated components must have features that produce low levels of greenhouse gases when heating water.

Acceptable Construction Practice

(a) Compliance with all of the Deemed-to-Satisfy provisions of DTS1 satisfy the Performance Requirement PR1 for a building.

(b) Compliance with all of the Deemed-to-Satisfy provisions of DTS2 satisfy the Performance Requirement PR2 for a building.

(c) Compliance with all of the Deemed-to-Satisfy provisions of DTS3 satisfy the Performance Requirement PR3 for a building.

Deemed to Satisfy Provisions

DTS 1 – Thermal Comfort

The building must comply with the provisions of Part 3.12 of the Building Code of Australia for Building Fabric, External Glazing, Building Sealing and Air Movement.

DTS 2 – Services

The building must comply with the provisions of Part 3.12 of the Building Code of Australia for Services.

DTS 3 – Hot Water Systems

A hot water system must be either:

(i) a solar hot water system, complying with AS 2712-2002, that has been tested in accordance with AS 4234-1994, and achieves a minimum energy saving of 60% for a hot water demand level of 38MJ per day for climate zone 3; or

(ii) a gas hot water system, complying with AS 4552-2005 that achieves a minimum energy rating of "5 stars"; or

(iii) a heat pump hot water system, complying with AS 2712-2002 that has been tested in accordance with AS 4234-1994, and achieves a minimum energy saving of 60% for a hot water demand level of 38MJ per day for climate zone 3.

Explanatory Notes:

1. **BCA Performance Requirement P2.6.1**

   A building must have, to the degree necessary, a level of thermal performance to facilitate the efficient use of energy for artificial heating and cooling appropriate to –

   (a) the function and use of the building; and
   (b) the internal environment; and
   (c) the geographic location of the building; and
   (d) the effects of nearby permanent features such as topography, structures and buildings; and
   (e) solar radiation being—
      (i) utilised for heating; and
      (ii) controlled to minimise energy for cooling; and
   (f) the sealing of the building envelope against air leakage; and
   (g) the utilisation of air movement to assist cooling.

2. **BCA Performance Requirement P2.6.2 – Services**

   A building's domestic services including any associated distribution system and components must have features that, to the degree necessary, facilitate the efficient use of energy appropriate to –

   (a) the domestic services and its usage; and
   (b) the geographic location of the building; and
   (c) the location of the domestic services; and
   (d) the energy source.

3. **AS 2712-2002** details the design and construction of solar and heat pump water heaters.

4. **AS 4234-1994** sets out the method of testing and calculation of energy consumption for domestic solar water heaters and heat pumps.

5. **AS 4552-2005** details the design of gas forced water heaters for hot water supply and/or central heating.

Water Use in Houses Code

Application

This Code applies to all new buildings classified as Class 1 and 10 buildings by the Building Code of Australia.

Interpretation

"The Building Code of Australia" means the latest edition of the Building Code of Australia published from time to time by, or on behalf of, the Australian Building Codes Board, but not including explanatory information published with that Code.

"Alternative Internal Water Supply" refers to a water supply such as collection of rainwater on site, external third pipe non-potable water source, on-site bores or the like, other than potable water supplied by a licensed water service provider, and approved for use inside a dwelling.

"Alternative External Water Supply" refers to a water supply such as collection of rainwater on site, external third pipe non-potable water source, re-cycled grey water, on-site bores or the like, other than potable water supplied by a licensed water service provider, and approved for use outside a dwelling.

"Potable Water" refers to water intended for human consumption supplied by a licensed water service provider.

Objective

The objective of this Code is to reduce water demand by efficiently using water, and minimising the wasting of water, and facilitating the appropriate use of alternative sources of water.

Functional Statement

To reduce potable water demand a building must:

(a) enable the efficient use of potable water; and
(b) prevent excessive loss of potable water; and
(c) have the capacity to connect to alternative sources of water supply; and
(d) use alternative sources in situations of high water demand or restricted availability of potable water.

Compliance With This Code

A building will comply with this Code if its construction satisfies all the Performance Requirements. Compliance with the Performance Requirements can be shown by:

(a) complying with the Deemed-to-Satisfy provisions as listed in the Acceptable Construction Practice; or
(b) formulating an alternative solution that is shown to be equivalent to the Deemed-to-Satisfy provisions; or
(c) formulating an alternative solution that is verified using an acceptable verification method; or
(d) formulating an alternative solution that is based on expert judgement or supported by suitable evidence in accordance with clause 1.2.2 of the Building Code of Australia; or
(e) any combination of the above.

Explanatory Notes:

Stage 1 of the Code will be prescribed in the Building Regulations to apply from 1 September 2007.

Stage 2 of the Code will be prescribed in the Building Regulations to apply from date to be determined.

Implementation of Stage 2 of the Code is dependent on further consultation and research to determine areas of application and on amendments to plumbing regulations and processes as well as ensuring compliance with health regulations and policies.

Water Use in Houses Code

Stage 1 - To apply from 1 September 2007

Performance Requirements

PR1 – Water Use Efficiency

A building must have features that, to the degree necessary, facilitate the efficient use of potable water appropriate to:

(a) the geographic location of the building; and
(b) the available potable water supply for the building; and
(c) the function and use of the building.

PR2 – Water Loss Prevention

A building, including any water holding structures, must have features that, to the degree necessary, prevent the excessive loss of potable water appropriate to:

(a) the geographic location of the building; and
(b) the available potable water supply for the building; and
(c) the function and use of the building; and
(d) the effects of permanent features such as topography, structures and buildings.

PR3 – Hot Water Use Efficiency

A building must have features that, to the degree necessary, facilitate the efficient use of hot water appropriate to:

(a) the geographic location of the building; and
(b) the available hot water supply for the building; and
(c) the function and use of the building.

Acceptable Construction Practice

(a) Compliance with all of the Deemed-to-Satisfy provisions of DTS1 satisfies the Performance Requirement PR1 for a building.
(b) Compliance with all of the Deemed-to-Satisfy provisions of DTS2 satisfies the Performance Requirement PR2 for a building.
(c) Compliance with all of the Deemed-to-Satisfy provisions of DTS3 satisfies the Performance Requirement PR3 for a building.

Deemed to Satisfy Provisions

DTS 1 – Water Use Efficiency

(a) all tap fittings other than bath outlets and garden taps must be minimum 4 stars WELS rated.
(b) all showerheads must be minimum 3 stars WELS rated.
(c) all sanitary flushing systems must be a minimum 4 stars WELS rated dual flush.

DTS 2 – Swimming Pool Covers and Blankets

An outdoor private swimming pool or spa associated with a Class 1 building must be supplied with a cover, blanket or the like that:

(a) is designed to reduce water evaporation; and
(b) is listed on the Smart Approved Watermark Scheme.

DTS 3 – Hot Water Use Efficiency

All internal hot water outlets (taps, showers, washing machine water supplies) must be connected to a hot water system or a recirculating hot water system with pipes installed and insulated in accordance with AS/NZS 3500:2003. Plumbing and Drainage, Part 4 Heated Water Services. The pipe from the hot water system or recirculating hot water system to the furthest hot water outlet must not exceed 20 metres in length or 2 litres of internal volume.

Explanatory Notes:

The Smart Approved Watermark Scheme is implemented through the National Water Commission as a simple identification label about water efficient products. Further information can be obtained from www.nwc.gov.au

Stage 2 - To apply from (date to be determined)

Performance Requirements

PR4 – Alternative Water Supply Use Capacity

A building, including any associated plumbing, must have features that, to the degree necessary, facilitate the future use of alternative water supplies appropriate to:

(a) the geographic location of the building; and
(b) the function and use of the building; and
(c) the soil type and ground condition; and
(d) the available alternative sources of water; and
(e) the size and type of external landscaping.

PR5 – Grey Water Use Capacity

A building including any associated plumbing, located on a lot of a size and in a location suitable for recycling of grey water, must have features that, to the degree necessary, facilitate the future use of grey water recycling appropriate to:

(a) the geographic location of the building; and
(b) the available potable water supply for landscaping; and
(c) the function and use of the building; and
(d) the soil type and ground condition; and
(e) the available alternative sources of water; and
(f) the size and type of external landscaping.

Deemed to Satisfy Provisions

DTS 4 – Alternative Water Supply Use Capacity

All sanitary flushing systems and washing machines must be able to be connected at a later date, to an appropriate alternative water supply without the need to break, or cut into the fabric of the building to run new pipes.

DTS 5 – Grey Water Use Capacity

All shower, bath, laundry trough and washing machine drains must be able to be connected at a later date to an appropriate grey water diversion system without the need to break, or cut into the fabric of the building to run new pipes.

Acceptable Construction Practice

(a) Compliance with all of the Deemed-to-Satisfy provisions of DTS4 satisfies the Performance Requirement PR4 for a building.
(b) Compliance with all of the Deemed-to-Satisfy provisions of DTS5 satisfies the Performance Requirement PR5 for a building.

Explanatory Notes:

1. Health regulations apply to the use of alternative water supplies and will, amongst other things, limit the alternative water sources suitable for various uses.
2. The DTS 4 provisions do not require rainwater tanks. They require buildings to be able to be connected to such alternative water supplies relatively easily at a later date (i.e. the buildings are to be alternative supply 'ready'). Subject to health regulations and policies, alternative water supplies could also include bore water, third pipes, and the like.
3. All plumbing work associated with these requirements must be carried out by licensed plumbers and in accordance with all relevant plumbing regulations.

Water Use in Houses Code

Performance Requirements

PR6 – Alternative Internal Water Supply

A building with more than two showers or two WC facilities must use alternative internal water supplies for internal uses appropriate to:

(a) the geographic location of the building; and
(b) the available potable water supply for the building; and
(c) the function and use of the building; and
(d) the available alternative sources of water.

PR7 – Alternative External Water Supply

A building located on a lot of a size and in a location likely to use significant potable water for landscaping use must use alternative internal or external water supplies appropriate to:

(a) the geographic location of the building; and
(b) the available potable water supply for the building; and
(c) the function and use of the building; and
(d) the soil type and ground condition; and
(e) the available alternative sources of water; and
(f) the size and type of external landscaping.

Deemed to Satisfy Provisions

DTS 6 – Alternative Internal Water Supply

All sanitary flushing systems and clothes washing facilities must be connected to an alternative internal cold water supply.

DTS 7 – Alternative External Water Supply

(a) All external garden taps and irrigation systems must be connected to an alternative external water supply; or
(b) all shower, bath, laundry trough and washing machine drains must be connected to an approved grey water diversion and recycling system.

Acceptable Construction Practice

(a) Compliance with all of the Deemed-to-Satisfy provisions of DTS6 satisfies the Performance Requirement PR6 for a building.
(b) Compliance with all of the Deemed-to-Satisfy provisions of DTS6 or DTS7 satisfies the Performance Requirement PR7 for a building.

Explanatory Notes:

1. Houses required to be "grey water ready" under PR5 are those on large enough lots to allow drains carrying appropriate water to be run outside the house before connection to other waste pipes, and where there is likely to be enough landscaped area to adequately dilute the grey water.
2. Lots where houses are required to comply with PR7 will be identified through regulations. Further research is needed with relevant stakeholders to resolve which lots will be subject to this requirement.
3. Health regulations apply to the use of alternative water supplies and will, amongst other things, limit the alternative water sources suitable for internal or external use in different localities. For example most private bore water, whilst it may be suitable for garden use, may be inappropriate for use internally.
4. Alternative water supplies can include but is not limited to, rainwater tanks, bore water, third pipes, and the like.
5. Subject to health regulations an acceptable alternative internal water supply is an appropriately sized rainwater tank harvesting the rainwater runoff from the roof.
6. Subject to health regulations an acceptable alternative external water supply is a domestic bore.
7. All plumbing work associated with alternative water supplies must be carried out by licensed plumbers and in accordance with all relevant plumbing regulations.
8. The Water Use in Houses Code is implemented in two stages to allow amendment of plumbing regulations and training of licensed plumbers to ensure alternative water supplies are appropriate and safe, and that there is no risk of cross contamination with potable water supplies.

Further information

These Codes are intended to supplement the Building Code of Australia and will be called up by the Building Regulations 1989

For further information about 5 Star Plus please visit our website at www.5starplus.wa.gov.au

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Appendix C – Waterwise Criteria

Water Corporation Guidelines for Waterwise Criteria

The Water Corporation recognises the link between urban design, landscape architecture and alternate water supplies in developing new water sensitive properties and developments. To assist with the shift towards waterwise homes and suburbs the Corporation has developed two Waterwise Programs in partnership with the building and development industry; Waterwise Display Villages and Waterwise Land Developments. The Corporation also actively participates in the assessment of the water efficiency categories of major building industry awards to help recognise and promote those builders and developers leading the way in water efficiency.

The range of waterwise advice and information the Corporation promotes to the community is to enable its customers to select the most 'fit for purpose' option/s that best suit their individual needs, lifestyle and budget. The Corporation advocates customer choice and does not promote one option or product above the others. By applying the waterwise options offered below the building industry and homebuyers have the opportunity to play an important role in conserving our State's water supply and to help make WA a more water efficient community.

For further information on Being Waterwise visit our website.

Waterwise Homes and Gardens Criteria

With the implementation of mandatory minimum water efficiency requirements for all new homes, through the Building Codes of Australia (**http://www.abcb.gov.au**), the benchmark has been set. Therefore the use of fittings and fixtures better than those mandated, the use of water saving technology, alternate water supplies and waterwise garden design have become increasingly important for those wishing to raise the bar in terms of household water efficiency. Properties that showcase water efficiency both inside and outside the home typically have the following water saving features incorporated (see ***Attachment 1*** for detailed descriptions):

Inside:

- Showerheads installed are better than the minimum mandated WELS 3 Star (9 Litres per minute).
- Taps installed are better than the minimum mandated WELS 4 Star (6 Litres per minute).
- Dual flush toilets installed are better than the minimum mandated WELS 4 Star (Average 3.5 Litre flush).
- Water using appliances installed are rated WELS 4 Star or better.

Outside:

- Garden design incorporates waterwise or endemic plant species and includes a functional mix of paved areas, garden beds and lawn.
- Only use turf species endorsed by the UWA Turf Industries Research Steering Committee (**Attachment 2**).
- Improve the soil prior to planting and laying down lawn.
- Garden beds are mulched to a minimum of 5cm with Smart Approved WaterMark mulch certified to Australian Standard AS4454.
- The irrigation system has been installed to Irrigation Australia Ltd Standards (**Attachment 3**).

Attachment 1

Detailed Criteria for Waterwise Homes
Water Saving Features

INSIDE

Building Codes of Australia (**http://www.abcb.gov.au**)

- Showerheads installed should be better than the minimum mandated WELS 3 Star (9 Litres per minute).
- Taps installed should be better than the minimum mandated WELS 4 Star (6 Litres per minute). Consider aerators - reduce flow, reduce splash, improve wetting and spring-loaded controls - prevents running taps.
- Dual flush toilets installed should be better than the minimum mandated WELS 4 Star (Average 3.5 Litre flush).
- Baths are low volume and small surface area.
- Spas are low volume and small surface area.
- Hot water system should be located less than the minimum mandated 20m from points of use and / or a recirculation or heat pump system is installed. Consider grouping of fixtures relative to their need for heated water, consider multiple water heaters as an option, pipe work configuration (i.e. Where to branch off for off-takes) and lagging pipes for insulation.
- Pressure control - consider the installation of a pressure control device to regulate water pressure to a maximum of 35 metres. High pressures contribute to poor water efficiency; pipe leakage, dripping taps, etc.
- If evaporative air conditioners are installed use models with an auto dump triggered by salinity rather than the continuous discharge type. And provide advice to future homebuyers on the appropriate use of an evaporative air conditioner to limit water wastage.
- Water using appliances installed, such as washing machines and dishwashers, should be rated WELS 4 Star or better.

To determine the star rating of WELS rated products – visit their website (http://www.waterrating.gov.au/)** and search by brand name and product.

OUTSIDE

- Garden design should incorporate waterwise or endemic plant species and includes a functional mix of paved areas, garden beds and lawn. Use the Waterwise Plants for WA database on the Corporation's website to find waterwise plants suitable for regions throughout WA.
- Plants should be grouped according to their water needs (hydrozones) and garden beds should be densely planted where appropriate to maximise irrigation effectiveness, and appearance.
- Only use turf species endorsed by the UWA Turf Industries Research Steering Committee (**Attachment 2**). Lawn areas should be minimised and verges planted with waterwise plants instead of turf.
- Soil in the garden and lawn areas should be improved prior to planting. Improved soils retain more moisture around the root zone longer, soils improved with soil conditioners certified to AS4454 are recommended.

- Mulches dramatically reduce surface evaporation, and break down to improve the moisture holding capabilities of the soil. Garden beds should be mulched to a minimum of 5cm with a Smart Approved WaterMarked mulch certified to Australian Standard AS4454.
- Windbreaks; artificial (fences, walls, pergolas) or natural (mounds, shrubs, trees) should be used to reduce irrigation losses and protect plants from heat and stress as wind is a significant element in evaporation and transpiration.
- The irrigation system should be installed to Irrigation Australia Ltd Standards (**Attachment 3**).

Garden beds should:
- Use dripper systems or subsurface irrigation, or if overhead watering is required, use large drop sprinklers. The use of microsprays is not encouraged due to their poor efficiency rating.

Lawn areas (if not watered by a greywater system) should:
- Use MP rotator type sprinklers that use coarse drop sprays to minimise evaporation.
- Have spray patterns and layouts which minimise overspray.
- Have sprinkler placements which optimise water distribution.
- Not have different types of sprinklers on the one watering station.

- Irrigation system should be sufficiently sophisticated to allow:
- Separation of zones.
- No watering station to service more than one hydrozone.
- No watering station to service more than one style of sprinkler.
- Controller to be set to apply the "Standard Drink" (10mm) per watering period, preferably watering in the early morning, and in accordance with the appropriate watering roster for the region, as defined on the Water Corporation's website.

- Inclusion of a rain sensor or soil moisture sensor that is designed to shut off the automatic system when it rains.
-
- Alternate non-potable water supply sources should be considered:
- Rainwater tanks should be plumbed in to the house and utilised to flush toilets and/or for washing machine use.
- Grey water re-use systems should be plumbed in to the house and utilised to flush toilets and/or water the garden.
- In areas deemed suitable for a bore by the Department of Water, garden bores should be installed and used to water the garden in accordance with the permanent water efficiency measures.

OTHER

- Affordability – demonstrates the ability to save water without compromising the cost of the development, or ongoing maintenance and/or running costs (including energy).
- Waterwise aesthetics.
- Plants and lawn in good health, none dead.
- No large water features installed, especially in full sun.
- Pool blanket on the pool, not on the roller.
- Property showcases a range of water efficiency options available for both inside and outside the home.

Attachment 2

UWA Turf Water Use Research Project

Turf Types Demonstrating Water Efficient Characteristics
(when tested at UWA Turf Research Site Shenton Park)

Scientific name	Common name	Cultivar or selection
Cynodon dactylon	Couch or Bermuda grass	Wintergreen Windsor Green CT-2
C. dactylon x *C. transvaalensis*	Couch hybrid or Bermuda grass hybrid	Santa Ana
Paspalum vaginatum	Saltene or Seashore Paspalum	
Stenotaphrum secundatum	Buffalo or St. Augustine grass	
Pennisetum clandestinum	Kikuyu grass	
Zoysia japonica	Zoysia grass (may be referred to by growers as simply Empire Grass, or Empress Grass)	

Attachment 3

Irrigation Australia Limited (WA Region)
Standards for Domestic Irrigation Installation

1. Activities Prior to Commencement

Prior to commencement of a domestic irrigation installation, the Irrigation Contractor shall:

1.1 Conduct a flow test, using a 'Flow and Pressure Testing device' and record the flow/s at the appropriate pressure/s recommended by the manufacturers of the components of the irrigation system.
1.2 Present to the Client a written quotation detailing all works and activities that will be conducted.
1.3 Present the client with a design of the proposed irrigation system.

2. System Design and Components

Irrigation system design and product selection shall comply with appropriate Australian Codes and standards and conform to the manufacturer's recommendations for the products used. These include:

2.1 System design to be according to the flow test results in 1.1 (above) with individual station demand (at the manufacturer's recommended operating pressure) no greater than the tested flow. Where station demand is less than the tested flow a pressure regulating device/s must be installed where such is required to ensure operation to manufacturers' recommended operating pressure.
2.2 Pipe will be sized to ensure water velocity does not exceed 1.5 metres per second at design flow.
2.3 Sprinklers shall be spaced at no more than the radius of throw specified by the manufacturer's recommendations.
2.4 Sprinklers shall operate at the manufacturer's recommended operating pressure.
2.5 Mainlines shall be minimum PN9 PVC, PN8 polyethylene or other appropriate material of no lesser pressure rating; pipe under live mains pressure should be minimum PN12 rating or as otherwise specified by Water Corporation regulations.
2.6 Valves under live mains pressure shall be Water Corporation approved 'tested' valves.
2.7 Sprinklers on any station shall be fitted with matched precipitation nozzles.
2.8 Part-Circle Sprinklers shall be used in locations where they will prevent wasteful overspray.
2.9 Where an irrigation controller is installed to operate stations of different water requirements it shall be a minimum three-program controller and must be programmable to comply with Water Corporation and Department of Water guidelines or restrictions.

3. Installation of the System

The installation of the irrigation system shall be conducted to meet the requirements of applicable statutory regulations, including backflow prevention.

3.1 The Client shall be advised of all installation work that, as a requirement of law, will be completed by a licensed tradesperson.
3.2 Master solenoid valves shall be used when connecting to scheme water supply and when installing more than two station valves.
3.3 Solenoid wires shall be buried under pipework. Where wires do not run with such pipework they should be placed in electrical conduit.
3.4 A colour code for solenoid wires shall be used, black for "Common" wires, red for 'Master Valve' control wires and white for 'spare' wires. Spare wires shall be taped (or otherwise waterproofed) at their field termination point. Station valves shall be installed with cable colours other than those listed. Wire from each valve to the controller shall be one single colour.
3.5 Solenoid wire connections shall be made only at valve boxes and a minimum 300mm loop of wire left at each valve for ease of service.
3.6 Solenoid wire connections shall be either crimped or soldered and covered with heat shrink material or made with gel-filled or silicone grease type electrical cable connectors made for this purpose.
3.7 All pipework shall be buried other than where expressly stated.
3.8 Mainline and lateral piping shall be buried to the minimum recommended cover of 150 mm.
3.9 Low Density poly pipe shall be secured at all connections by ratchet clamps or other device according to manufacturer's specifications.
3.10 All valves shall be located in valve boxes designed for this purpose, the lid thereof to be no higher than surrounding material.
3.11 All systems shall have a minimum of 150 mm of pipe either side of valve to enable service removal of valve and replacement without major disruption.
3.12 All irrigation stations should be established to water areas of similar demand (hydrozones).

4. Completion and Handover

4.1 At the completion of the work the site is to be left in neat and tidy state.
4.2 The Irrigation Contractor shall perform a system "hand-over", including a working demonstration of all functions of the irrigation controller. The installer is to install a program (compliant with current Water Corporation and Department of Water regulations and recommendations) and explain same to the client.
4.3 The Client shall be given a recommended watering schedule for peak demand, with recommended seasonal reduction (as a percentage of maximum) detailing all stations (with description of each) plus an estimated P.R. (Precipitation Rate) for each station.
4.4 If the installed controller requires a battery, a battery of the type recommended by the manufacturer is to be supplied and installed by the Irrigation Contractor prior to hand-over.

5. Warranty

5.1 The Irrigation Contractor to specify a minimum one-year warranty on all parts and labour.

6. General

6.1 Where any variations from these standards have occurred the Irrigation Contractor will provide detail of these, and the requirements for the changes, to the client as well as a clear indication that such changes do not comply with the "Standards for Domestic Irrigation Installation" of Irrigation Australia Ltd (WA Region).

Disclaimer:

The Standards for Domestic Irrigation Installation have been developed by members of Irrigation Australia Ltd's Western Australian region. These Standards have been designed for use in Western Australia and are based on current knowledge and practice at the time of the preparation of this material (October 2002, Revised 2007).

These Standards are issued as a guide only. Their use is of a voluntary nature and the IAL is not liable for any loss, injury, damages, costs or other consequences of any kind that result from their use. All persons conducting or procuring domestic irrigation installation should comply strictly with the manufacturer's recommendations for the use and installation of equipment. The IA reserves the right to modify, add to or delete Standards prescribed herein at any time.

Irrigation Australia Ltd
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Appendix D – Groundwater bore fact sheet

Water facts 12

GOVERNMENT OF WESTERN AUSTRALIA WATER AND RIVERS COMMISSION AUGUST 1998

Bore water use in Perth gardens

People in most areas of Perth are able to draw on shallow groundwater by sinking private bores.

Each year in Perth, about 70 million kilolitres of high-quality household scheme water is used on Perth's gardens. This is more than the entire contents of Mundaring weir. Instead of using scheme water, many people use shallow groundwater pumped from their own bores to water their gardens.

Perth's groundwater resources

The Swan Coastal Plain, upon which Perth is situated, is covered by a veneer of sediments, particularly sand and limestone. These sediments have been deposited over thousands of years by water and wind. The superficial sediments extend to a depth of about 100 metres (average 50 metres) over the top of older and often less permeable sediments. Rainwater percolates into the superficial sediments and accumulates as groundwater.

Shallow groundwater is an important source of water for Perth's scheme supply and is also extracted through bores for watering private gardens, parks, sporting areas and market gardens.

A distinguishing characteristic of the shallow groundwater that we draw upon for garden watering is that it is generally at the same pressure as the atmosphere. This means that most householders can dig down several metres into the sand to reach the top of the saturated soil, called the watertable, but then must lift the water up to the surface for use. Perth's early settlers lowered a bucket on a rope but most people now have electric pumps to draw the water up. In contrast, deeper sources of groundwater, sometimes called artesian aquifers, hold groundwater under pressure. When a drill is used to bore down through the confining rock, the groundwater may rise to the surface.

Who has bores?

There are estimated to be 130 000 private bores in Perth. The number of private bores increased rapidly when water restrictions were imposed in the late 1970s due to a long dry spell of weather.

The number of bores in an area depends on:

- depth to the watertable — installation costs can be discouraging where the watertable is more than 10 metres deep;
- difficulty — coastal areas have fewer bores possibly because of the high cost of drilling into limestone;
- chance of success — bores are fewer in some eastern suburbs particularly in areas of clay or granite where bore yields are generally low.

Activities removing large volumes of groundwater require an abstraction licence from the Water and Rivers Commission. However, household bores in the Perth metropolitan area do not need a licence mainly due to the relatively minor amounts of water they remove. If you are unsure if a licence is required for your property, please contact the Commission on the phone numbers provided.

Perth's garden bore strategy

In 1997 the Minister for Water Resources launched a campaign to promote the use of garden bores. Currently almost a third of Perth's scheme water supply is used on gardens. Instead of using this high quality water, garden bore owners use shallow groundwater.

Where clean and accessible groundwater exists in areas suitable for garden bores, they are a good way of utilising this resource.

The Commission recently released the 'Perth Groundwater Atlas' to provide information on the areas suitable for garden bores. The Groundwater Atlas is a source of easily accessible groundwater information to assist drillers, irrigators and the public. This publication is available at many libraries, and through the Commission.

Although groundwater may be readily available, it should still be considered a precious resource. Groundwater is very important to the environment and should be used in a responsible manner.

Given that in many areas gardens are not as large as they used to be, consideration should be given to sharing a bore between neighbours. This will provide all the benefits of owning a bore while allowing the cost of installation to be shared.

Groundwater prior to urbanisation

Groundwater is part of a dynamic water cycle. Where the Swan Coastal Plain is still covered in native vegetation, an average of about 10% to 20% of rainwater percolates down into the shallow aquifer to become groundwater. The groundwater then moves very slowly under the force of gravity until it discharges into rivers and the ocean. However, much is returned to the atmosphere along the way via evaporation from wetlands and transpiration by vegetation.

Groundwater is important to the health of the coastal plain environments. The Swan Coastal Plain was once a patchwork of wetlands (lakes and swamps) and many still remain despite draining for agriculture and urban development. These wetlands depend on the groundwater level being at or near the surface. The natural vegetation also relies on groundwater. In many areas, the plants are able to survive and even continue to grow through the summer by reaching down to the watertable.

Groundwater levels have a seasonal cycle. The watertable of the Swan Coastal Plain rises in winter with rainfall recharging the groundwater, and then gradually drops over the summer months. The wetland and woodland vegetation and animals have adapted to this cycle.

Changes with clearing and urbanisation

Since European settlement, the groundwater balance has been altered in three ways:

- Clearing — the natural vegetation, which removed much of the groundwater through transpiration, has been cleared in many areas, causing the watertable to rise.
- Drainage — the watertable has been lowered in low-lying land in and around wetlands, often for agriculture and housing. The excess water is drained to the river, ocean and a few wetlands which have been set aside as permanently inundated collection points, such as Lake Monger.
- Sealing of surfaces — covering the ground with houses, roads and paving increases the amount of water runoff from rainfall. Through much of Perth, these large volumes of runoff are concentrated into compensation basins and into the ground, adding to high watertable problems.

Raised watertables have meant that many suburbs need to be drained to keep houses dry in winter — 520 million cubic metres (twice the scheme water supply) is drained annually from an area of 84 000 hectares in northern, central and southern Perth. Some reduction in watertable levels back toward the natural balance has occurred in the older suburbs where gardens and parklands are well established. However, the current tendency to increase housing density, with increased roof and pavement runoff, is likely to reverse this trend.

The permanently higher watertable and need for drainage has upset the natural balance. In particular, some of the wetlands that have not been drained have grown broader and deeper. Many previously seasonal wetlands are now permanently inundated. The higher watertables have killed trees in and around the water and lakes have lost birds that rely on seasonally receding mudflats.

Private bores can be a good thing

There are many parts of Perth where bores should be encouraged for garden irrigation. In areas where the watertable is close to the surface, a drainage system exists to prevent further groundwater level rises. Using groundwater for irrigating gardens in these areas will reduce the amount that has to be drained to wetlands, rivers or the ocean. The combined effect of many bores can be to draw the watertable down more in summer than at present, but this can help to restore a seasonal cycle.

The benefits are several:

- scheme water savings — use of groundwater for irrigation purposes reduces draw on scheme water supplies, delaying the time when new resources (dams and wellfields) are needed;
- recycling of local water — using the excess groundwater brought about by urbanisation for irrigating gardens is a good idea whereas 'importing' scheme water for garden irrigation adds to the already high groundwater levels.

Waterwise garden bore use

Groundwater bores should be used efficiently. Even though groundwater is readily available in most areas, watering your garden with bore water should still be undertaken responsibly and in a Waterwise manner.

You can be Waterwise by:

• only watering enough to meet the garden's needs

• using plants that require less water (e.g. native species)

• not watering during the daylight hours

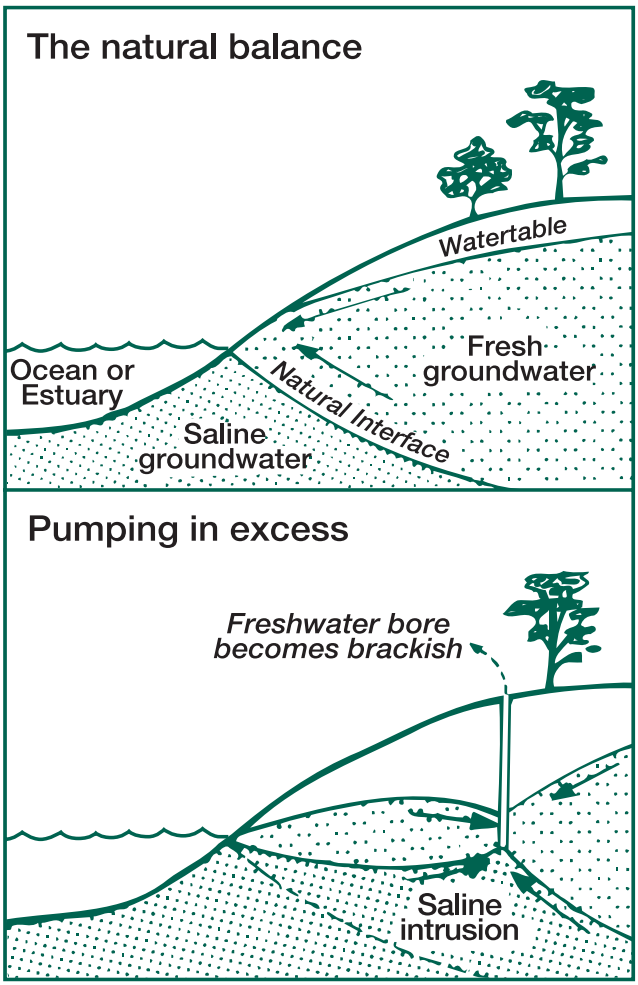
While bores offer a range of benefits, their excessive use can contribute to a number of environmental problems:

- Groundwater draw-down — overpumping can lower the watertable to undesirable levels in about 10% of suburban areas and be detrimental to the environment.
- Nutrient loss — most of Perth soils are very poor in nutrients and do not readily bind fertiliser. Over-watering will leach out the fertilisers that gardeners need to add to their lawns and flower-beds. This is an unnecessary cost to the gardener and risks polluting the groundwater and local wetlands with nutrients (nitrogen and phosphorus).
- Saltwater intrusion — in areas prone to saltwater intrusion (close to the coast or Swan River estuary) excessive bore use is a major contributing factor to the influx of saline water.

Possible constraints on bores

Bores are an excellent water supply for garden use in much of Perth. However, not all areas of Perth are suitable for bores.

- In some places, the watertable is deep beneath the ground surface or the rock type encountered makes drilling for water difficult and expensive.
- Near the foothills and in places where there are clay soils, groundwater supplies may be limited and bore yields may be low.
- Other areas are environmentally sensitive. Wetlands, and the plants and animals that depend on them, need groundwater to maintain water levels. Pumping out too much water near wetlands could disrupt the natural water cycle and cause environmental damage. Wetlands of conservation value are depicted in the 'Perth Groundwater Atlas'. If you plan on installing a bore near such a wetland (within 500 metres), please contact the Commission.
- In areas near the Swan River estuary or the ocean, saltwater may be drawn into the bores if they are excessively pumped. Because the water within the ocean and estuaries is saline, a wedge-shaped boundary (or interface) is formed between this saline groundwater and the fresh groundwater below the land. This saltwater wedge may extend more than a kilometre inland. For example, all of the Cottesloe peninsula is underlain by saline groundwater.



Saltwater intrusion into bores

- Where there is or has been industrial activity, and in areas near old waste disposal sites, the groundwater may be contaminated. The Perth Groundwater Atlas shows the location of known and inferred contaminated sites in the metropolitan area.

Areas suitable for bores

Throughout the Perth area the Commission's 'Perth Groundwater Atlas' provides information such as the depth to groundwater, groundwater salinity and identifies areas unsuitable for garden bores. The areas which are generally suitable for drilling garden bores include:

- the northwestern urban corridor;
- the central sandy areas north and south of the Swan River;
- the northeastern urban corridor in areas without clay;
- suburbs west of Jandakot;
- suburbs around Winthrop.

Areas not suitable for bores

Areas generally unsuitable for drilling more garden bores include:

- the Cottesloe peninsula (saltwater intrusion)
- suburbs around Secret Harbour and Port Kennedy (limited groundwater resources)
- within 200 metres of the ocean or the Swan River estuary (saltwater intrusion)
- areas in and around the foothills (groundwater is limited)
- near wetlands (possible excessive lowering of groundwater if bores are overpumped)
- near contaminated areas (groundwater may be polluted)

Groundwater contamination

Groundwater contamination occurs in some Perth suburbs, but is generally of little concern provided that water from household bores is only used for watering gardens and is not used for drinking. Groundwater contamination is most likely to be detected in bores near existing or old commercial or industrial areas.

Pumping from bores can affect groundwater flow and alter the movement of a contaminant plume towards the bore. Garden bores that are located in areas of groundwater contamination may pump contaminated water. While this may or may not harm plants, the contaminated groundwater may be harmful to humans, if consumed. The Water and Rivers Commission strongly recommends that the water from garden bores is not used for drinking unless analysed and certified safe by the Health Department of Western Australia.

The Water and Rivers Commission advises that bores should not be located in areas of groundwater contamination. If in doubt, please contact the Water and Rivers Commission. For more information on groundwater contamination, see Water Facts 10, Groundwater Pollution.

For more information

Copies of the Commission's 'Perth Groundwater Atlas' are available for sale from the Water and Rivers Commission and for viewing in a number of local libraries. The atlas provides easy access to groundwater information for assist drillers, irrigators and the public.

Groundwater and bores: If you wish to find out more about the groundwater resources of Perth and the wise use and management of these resources, contact the Commission on (08) 9278 0300.

Information on Waterwise gardening is also available from the Water Corporation on (08) 9420 2420.

Sinking a bore: Irrigation and reticulation installation companies that are members of the Irrigation Association of Australia can advise on practical aspects of sinking bores. If you are interested in sharing a bore with your neighbours, then some corporate members of the Irrigation Association are able to provide information on agreements that may be used to confirm the arrangement.

To ensure consumer protection, the Australian Drilling Industry Association recommends the use of drillers certified by the ADIA (or suitably equivalent qualifications). The ADIA can provide information on suitably qualified drillers in your area.
Phone: (08) 9354 8436.

Limitations of information

While particular areas are considered suitable for bores, the actual yield and quality of groundwater cannot be guaranteed. Both are highly variable and depend on a number of factors including the precise location and depth of the bore.

For more information contact

WATER AND RIVERS
COMMISSION
Level 2, Hyatt Centre
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Website: http://www.wrc.wa.gov.au

This Water facts sheet is one in a series providing information on water issues of interest to the community.

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Appendix E - Modelling Summary

Modelling Discussion

GHD built a DRAINS hydrologic and one-dimensional hydraulic model of the existing and proposed development, and simulated the model for a range of design storms. DRAINS is a computer program for simulating catchment hydrology and one-dimensional flows in conduits and open channels. Data is input via tables and a graphical user interface, and results are produced graphically and in GIS and tabular format.

Time varying surface runoff generated by the runoff routing model discharges into the hydraulic network. The hydraulic network consists of interconnected nodes (manholes, basins and outfalls) and links (pipes, open channels and culverts).

The hydrology was simulated using the ILSAX model, based on the parameters listed below.

Modelling assumptions

- All roads connected to an at source infiltration system sized for the 1 year 1 hour storm (18 mm)
- All lots to hold 1 year 1 hour storm (18 mm) on site
- Infiltration rates assumed 1 m/day
- Conservative parameterisation
- R10/R15 zone is entirely within catchment B

Modelling parameters

DRAINS used the ILSAX routing model to generate rainfall runoff from identified catchments. The runoff model consists of three components: initial loss, soil model (assumed as type B moderate infiltration rates and moderately well-drained soils) and roughness (runoff routing value). Each sub catchment is divided in three surface runoff types with runoff properties described in the table below.

Runoff Surface	Surface Type	Runoff Routing Value	Initial Loss Value (mm)
1	Pervious	0.030	8
2	Impervious (infiltration at source)	0.015	18
3	Impervious	0.015	1

Note: Impervious (infiltration at source) is included to accounts for lot infiltration using soakwells as specified.

The percentage of surface types for individual catchment was calculated from existing land use and local structure plan based on the land use surface breakdown as reported in Forrestdale ADS (DoW, 2009).

Land Use Category	Runoff Area 1 (%)	Runoff Area 2 (%)	Runoff Area 3 (%)	Equivalent Runoff Coefficient (approximate)
Open Space	100	0	0	0.1
Road	40	0	60	0.7
Urban	70	30	0	0.2

Conduits roughness values are typical values for the identified conduit type.

Drain Type	Manning's Coefficient of Roughness
Concrete Pipe	0.013
Maintained Open Drain	0.030
Overland Flow Route	0.035

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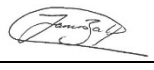
3	C. Thompson	J Balfour		C. Thompson		01/02/2016

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Appendix C: Conceptual Example of Local Development Plan for Lots 7, 8 & 9

LEGEND

- Local Development Plan Boundary
- Vegetation Protection Area
- Area subject to noise provisions
- Approved/existing development
- Public Open Space
- Public Open Space (including Frankenia Pauciflora community)

Local Development Plan (for lots 7, 8 & 9) Conceptual Example Only

Revision: 1
Date: 01.02.2016

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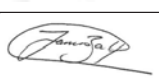
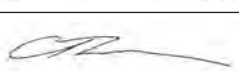
4	C Thompson	J Balfour		C Thompson		01/02/2016

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