APPENDIX 4
LAND CAPABILITY AND ENVIRONMENTAL ASSESSMENT REPORT

Lot 150
South Coast Highway
Nornalup WA

Land Capability & Environmental Assessment Report

Kathryn Kinnear

Bio Diverse Solutions

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DOCUMENT CONTROL

TITLE

Land Capability & Environmental Assessment Report

Author (s): Kathryn Kinnear

Reviewer (s): Sam Williams & Kath Lyman

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Bio Diverse Solutions
55 Peppermint Drive
Albany WA 6330
08 9841 3936/ 0447555516
kath@biodiversesolutions.com.au
www.biodiversesolutions.com.au
ABN 48 138 824 272

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APPENDICES

1. Executive Summary

Kath Lymon and Associates ("the client") commissioned Bio Diverse Solutions (Environmental Consultants) to undertake an Environmental and Land Capability Assessment of property at Lot 150 South Coast Highway, Nornalup, in the Shire of Denmark, Western Australia ("the subject site"). The Shire of Denmark has supported a Scheme Amendment Request over the subject site. The amendment comprising this proposal formally seeks to obtain Council's support to rezone the site from "Rural" to "Residential R5" under the Shire of Denmark's Town Planning Scheme No.3 (TPS3).

The subject site is on the northern side of the South Coastal Highway, in the Nornalup town site and 10km from Walpole townsite. The subject site measures approximately 97 metres along the widest section of the western to east and 107 metres from north to south The Subject site is approximately 7201m^2. It is proposed to subdivide the property into 3 newly created lots ranging from 2104m^2 to 2715m^2.

The subject site is surrounded by freehold land comprising of farmland, residential properties and has proximity to the Frankland River (142m to the west and north west) which runs in a north to south direction. The South Coast Highway borders the entire length of the southern boundary of the subject site, beyond which is freehold land across the road to the south. The western side of the subject sites shares a boundary with a neighbouring private freehold land which holds only an old shed. The eastern border is Macpherson Drive and to the north is Public Open Space (POS) reserve vested with the Shire of Denmark which has areas of cleared vegetation and isolated Karri trees.

The Environmental and Land Capability Assessment is required for the subject site to support the rezoning of the site for residential development purposes. Land Capability Assessment informs and guides planning decisions from the relevant regulatory authorities for the purposes of rezoning or subdivision of the Subject Site. The assessment process compares the physical requirements for a particular land use with the qualities of the land. The analysis determines the ability of the land to sustain a particular land use without resulting in significant environmental degradation.

The Scope of works undertaken by Bio Diverse Solutions included:

- Undertake a flora survey of subject site to identify any presence of native vegetation on the site;
- Undertake soil sampling to ascertain conditions on the subject site (soil types, water table levels, soil assessment) to identify site suitability for on-site effluent disposal;
- Undertake Environmental Assessment of the subject site to identify any other site constraints;
- Undertake Bushfire Hazard Assessment to WAPC Planning for Bushfire Protection Guidelines (2010) with due regard to the Draft "Planning for Bushfire Risk Management Guidelines (WAPC, 2015).
- Assess the subject site in terms of vicinity (i.e. buffer requirements etc) to the Frankland River and the Walpole National Park;
- Assess the ability of the site to retain stormwater from any new infrastructure; and
- Prepare a Land Capability Assessment Report, which includes all of the above environmental considerations.

The assessment of the subject site involved desktop analysis of climate, site history, vegetation, fauna, and geology of the subject site. Site assessment included general flora survey and analysis of soils to ascertain site suitability and assist in the planning of on-site effluent disposal, building envelopes and limitations mapping.

The soil testing was undertaken by Bio Diverse Solutions on 26 August 2015. The soils are typically Sandy silty clay loams over clay and Silty sands with loam and gravels over clay (duplex soils). The subject site is located on a south west aspect at the lower end of the slope in an undulating landscape with the average slope for the site assessed to be approximately 3.3 degrees

(5.8% Grade) across the site. The central dominant hill of the northern edge of the site is at approximately 15m to 25 m AHD, and the slope calculated at 9.4 Degrees (16.6% grade). The average slope assessed for the subject site is between 0-<5 degrees.

The subject site is located 216m (closest boundary) to an Environmentally Sensitive Area, being the Walpole Nornalup National Park, located to the west north and north west of the subject site. The subject site is located 142m (closest boundary) to the Frankland River. As the site is over 100m from the Frankland River and the Walpole Nornalup National Park, no buffer requirements are required.

The subject site soil conditions are fairly uniform across the site and were found to be two soil categories – Sandy silty clay over clay; and Silty sands and loamy gravels over clay. Water table was encountered in four test pits ranging from 270mm BGL (Below Ground Level) at the highest water table to 1870mm BGL at the lowest water table, all were located in the western lot (proposed Lot B). No water table was reached in the eastern lot (lot A).

The subject site is cleared land with paddocks and building infrastructure along the South Coast Highway. Historically the building was a private residence built in the early settlement of Nornalup which for a time in the 1930s was used as a hospital before reverting to a private residence in the early 1940s. There is little native vegetation cover on site excepting Tea tree scrub and Low Open Peppermint Woodland along open swale drains. A small seasonal pond occurs central to the lot which captures stormwater from Macpherson Drive and associated land uphill of the subject site. The vegetation is overall in "Very Degraded" condition and there is very little diversity of flora species due to grazing of the site by sheep. A targeted search for possible Threatened Flora Species revealed no Priority Flora or Declared Rare Flora within survey areas.

The mapping of land units revealed two Mapping Units:

1) Map Unit A: Sandy silty clay loams over clay, in the northern area of Lot B slopes less than 5 degrees PRI very high, low permeability, soils have a higher clay content in the A horizon than the soils in Map Unit B. Water tables range from 270mm to 730mm. Bare paddock areas.
2) Map Unit B: Silty sands with loam and gravels over clay, slopes less than 5 degrees PRI very high, low permeability, soils have a higher loam and gravel content in the A horizon than the soils in Map Unit B. Water tables range 1870mm to nil intercepted. Peppermint woodland, tea tree scrub and bare paddock areas.

The Land Capability Assessment process found that:

- Map Unit A – areas with a High capability (Land Capability Class II) of supporting the land use and limitations can be overcome by design and management inputs.
- Map Unit B – areas with a Very high capability (Land Capability Class I) of supporting the land use, there are very few physical limitations to the specified use are present or else they are easily overcome. Risk of land degradation under the proposed use is negligible.

Both areas are suitable for residential development, with minor constraints relating to on-site effluent disposal setbacks. Some planning considerations are required for Rural Residential construction, particularly a 6m buffer from the drains and sumps on site; and the north-north west corner to be avoided from on-site effluent disposal. There is no requirement for a Bushfire Management Plan as the Bushfire Hazard Assessment indicates the site would be classified as BAL-Low.

Stormwater from each dwelling should be contained on site through "Point of Source Infiltration" through capture of rainwater into tanks and treatment of the water into swales or sumps. Rainwater tanks should be installed at building development stages as a potable water source as there will be no reticulated water servicing the area. Water for potable/consumption may need to be treated and the Department of Health can provide information on treatment of dwelling water supply. Rainwater will also be available for non-potable water uses which will

minimise the importation of water and can assist in the reduction of stormwater exiting the development. All stormwater structures should be located within the lots and given the size of the lots (>2000m^2), this should be achievable. Given the only hard stand areas will be the access driveways, dwellings and possible associated sheds, (sheds and dwellings will be capturing the rainfall), it is anticipated there will be minimal increase in stormwater from the development.

Consideration from the Shire of Denmark should be given to the directional flows of the stormwater off Macpherson Drive and away from the subject site to the stormwater system along South Coast Highway. The current arrangement of directing water (from uphill road and infrastructure) into the subject site is not a sound long term solution and investigations could be made into the POS area to the north of the subject site as a possible location for any stormwater treatments from the subdivision to the north east of the subject site.

It is noted that this assessment does not include an engineering assessment or geotechnical assessment for structural footings/building construction and road pavement design. Bio Diverse Solutions recommends that these reports may be required prior to commencement of building/ development.

Bio Diverse Solutions conclude that if the listed “Planning and Management Recommendations” (Section 7.0) are implemented by the client, the site is capable to rezone from “Rural” to “Residential R5” under the Shire of Denmark’s Town Planning Scheme No.3 (TPS3). If the listed recommendations are undertaken, the proposed subdivision development could be implemented sustainably and in an environmentally sound manner.

2. Introduction

Bio Diverse Solutions was commissioned to undertake an Environmental and Land Capability Assessment of the Subject Site for the purposes of a proposed subdivision development requiring approval from the relevant regulatory bodies in relation to subdivision of the site. The Land Capability Assessment is aligned to the State Planning Commission Land Capability Assessment for Local Rural Strategies (1989).

The Subject Site is on the northern side of the South Coastal Highway, in the Nornalup town site and 10 kilometres from Walpole Townsite in the Municipality of the Shire of Denmark. Please refer to Location Mapping Appendix A. The Shire of Denmark has supported a Scheme Amendment Request over the subject site. The amendment comprising this proposal formally seeks to obtain Council's support to rezone the site from "Rural" to "Residential R5" under the Shire of Denmark's Town Planning Scheme No.3 (TPS3). Refer to Subdivision guide Plan Appendix B.

2.1. Land Capability Assessment Method

Bio Diverse Solutions (Environmental Consultants) was commissioned to undertake a Land Capability Assessment of Lot 150 South Coast Highway, Nornalup. This Land Capability Assessment details the sustainability of the property for Rural Residential and Rural land use (not land use as designated under any other Shire Scheme) and is aligned to the Department of Agriculture and Food standards and State Planning Commission Land Capability Assessment for Local Rural Strategies (1989).

The Land Capability Assessment involves a number of inter-related stages including:

1. **Land Use Requirements** – Specifies and defines the proposed land use, list the land qualities and characteristics to determine each land quality.
2. **Land Resource Survey** – Divides the study area into mapping units which have measureable differences and may influence the land attributes and land capabilities.
3. **Land Capability Analysis** – For each mapping unit rate each individual land quality and determine overall capability to sustain the land use.

The land use that has been considered for this study area is defined as "*Rural Residential with on-site effluent disposal"* as per the definition in the State Planning Commission, *Land Capability Assessment for Local Rural Strategies* (1989) document and not any other planning instrument (i.e. Shire of Denmark zoning terminology).

The Land Capability Assessment compares the physical requirements for a particular land use with the qualities of the land. This analysis determines the ability of the land to sustain a particular land use without resulting in significant environmental degradation.

This study was undertaken in late winter conditions in August 2015 and has included analysis of the soil and landform from soil survey, field vegetation survey and analysis, environmental assessment and laboratory analysis of soils.

2.2. Alignment to Legislation, Policy and Guidelines

In assessing the site, Bio Diverse Solutions has prepared this report aligned to the following legislation:

- State Planning Commission, Land Capability Assessment for Local Rural Strategies (1989);
- *Health Act (1911)* and draft *Health Act (2008);*
- *Biosecurity and Agriculture Management Act 2007 (BAM Act);*
- *Environmental Protection Act* 1986;
- *Environmental and Protection and Biodiversity Conservation Act 1999 (EPBC Act 1999)*;

- Environmental Protection Authority (EPA) (2005) *Environmental Guidance for Planning and Development* Draft Guidance Statement No 33 June 2005;
- *Environmental Protection (Clearing Native Vegetation) Regulations;*
- Environmental Weeds Strategy for Western Australia 1999;
- *Wildlife Conservation Act* 1950 (*WC Act);*
- *Contaminated Sites Act 2003*;
- Draft Government Sewerage Policy – Consultation Draft 2011;
- *Country Area Water Supply Act 1947;* and
- *CALM Act 1980;*
- Forest Management Plan 2004 – 2013 (Department of Environment and Conservation);
- Walpole Wilderness Area and Adjacent Park and Reserves Draft Management Plan (2008); and
- Walpole and Nornalup Inlets Marine Park Management Plan (2009 - 2019) Management Plan No. 62.

2.3. Desktop Assessment

Desktop assessment of the Subject Site was undertaken of government databases and associated literature. This assessment phase was conducted to various levels, ranging from state-wide, regional and local-area specific information. The following searches were undertaken as part of this report:

- Interim Biogeographic Regionalisation of Australia (IBRA) – Identifies, at a regional level, the vegetation communities and land systems present within Australia;
- Land Systems – Further detailed information on the vegetation communities and land systems;
- Department of Indigenous Affairs - Aboriginal Heritage Database
- Department of Water (DoW)– 250K Hydrogeological Mapping and Public Drinking Water Source Areas datasets, 2001;
- Department of Agriculture and Food WA (DAFWA) – Declared weeds database;
- Pre-European vegetation mapping dataset (DEC 2005) based on the project AJM Hopkins, GR Beeston, JM Harvey (2000);
- Beard's Vegetation Classification dataset, 1:3,000,000 digital representation of Beard's vegetation map of the state of Western Australia.

2.4. Site survey

The Vegetation Survey has been undertaken on the whole of the property, flora searches were undertaken on 26 August 2015 by Kathryn Kinnear, (Environmental Consultant Bio Diverse Solutions). Soil sampling was undertaken on the Subject Site by Kathryn Kinnear (Environmental Consultant, Bio Diverse Solutions) on 26th August 2015 and sent to CSBP and Mining & Civil Geotest laboratories for technical analysis.

3. Site Details

The Subject Site is located to the east of Walpole, in the settlement of Nornalup which a simple rural hamlet nestled in the Frankland River valley surrounded by karri forest and farmland. The Subject Site is on the northern side of the South Coastal Highway, in the Nornalup town site and 10km east of Walpole. The subject site measures approximately 97 metres along the widest section of the western to east and 107 metres from north to south The Subject site is approximately 7201m^2. It is proposed to subdivide the property into 3 newly created lots ranging from 2104m^2 to 2715m^2. Please refer to Figure 1 below and Location Mapping Appendix A.

Figure 1 – Subject Site Locality

The subject site is surrounded by freehold land comprising of farmland, residential properties and has proximity to the Frankland River (142m to the north west and west) which runs in a north to south direction. The South Coast Highway borders the entire length of the southern boundary of the subject site, beyond which is freehold land across the road. The western side of the subject sites shares a boundary with a neighbouring private freehold land which holds only an old shed. To the north is Public Open Space (POS) reserve vested with the Shire of Denmark which has areas of cleared vegetation and isolated Karri trees.

Around the Nornalup town further sections of freehold land comprising of residential, hobby farm and farmlands surround the area. The town of Walpole and one of the main attractions of the Walpole-Nornalup National Park is the Valley of the Giants tree-top walk in close proximity, being only 8 km west of the subject site.

This Land Capability Assessment process assesses the subject site as per the requirements of '*Rural Residential with on site effluent disposal'* as defined in the State Planning Commission, Land Capability Assessment for Local Rural Strategies (1989) Guideline, not any other planning instrument (i.e. Shire zoning terminology).

3.1. Current site land use

The subject site currently has buildings built in the early settlement of Nornalup as a private residence which, for a time in the 1930s, was used as a Hospital. Since early 1940s it has been maintained as a private residence and remains a habitable dwelling. There are paddocks along the northern side of the lot which is used for grazing by sheep. The subject site is predominantly cleared of native vegetation. Refer to Photographs 1 to 4 below.

Photograph 1: View from the north of existing buildings at the subject site.

Photograph 2: View from the south of existing buildings at the subject site.

Photograph 3: View along South Coast highway of the Old Nornalup Hospital sign.

Photograph 4: View of paddocks in the northern area of the subject site.

3.2. Zoning and Proposed Development

The Shire of Denmark has supported a Scheme Amendment Request over the subject site. The amendment comprising this proposal formally seeks to obtain Council's support to rezone the site from "Rural" to "Residential R5" under the Shire of Denmark's Town Planning Scheme No.3 (TPS3). Refer to Subdivision Guide Plan Appendix B.

The proposed dwellings are to be serviced by onsite effluent disposal systems, on-site collection of water via a rainwater tank for potable water and mains power. Currently, the only access to the site by vehicle is an unsealed track that comes directly off South Coast Highway to a small carpark. The site has been surveyed for a better visibility access point and a proposed road directly off Macpherson Drive (eastern boundary). Please refer to Photographs 5 and 6 over the page.

Photograph 5 – View of South Coast Highway and access into the site (LHS of photograph).

Photograph 6 – View from western side of Macpherson Drive, along the eastern boundary of the subject site, proposed access point.

3.3. Adjacent Land uses

The subject site is situated within a residential area with private dwellings to the east, south and west. To the north of the subject site is Shire of Denmark POS, which is predominantly vacant land. The subject site is located within Nornalup townsite, which is further surrounded by the Walpole – Nornalup National Park (north west and west along the Frankland River) and freehold and leasehold land further to the south and east. Refer to Photographs 7 and 8.

Photograph 7 – View of residential dwellings to the east.

Photograph 8 – View of Shire of Denmark POS reserve to the north.

3.4. Historical land use

The area of national park/wilderness surrounding Walpole and Nornalup townsites, coined the "Walpole Wilderness" area, has long been valued for its natural beauty and resources. (DEC, 2012) The estuaries were highly significant hunting and gathering areas for Aboriginal communities and artefacts on the shores of the inlet system and surrounding region provides evidence Aboriginal groups have used the area extensively for camping and fishing. (DEC, 2009)

The first substantial use of the inlets occurred following the settlement of Albany in 1826 when Nornalup Inlet was used as a base for sealers hunting New Zealand fur seals. However, the outstanding scenic beauty of the inlets and surrounding area was quickly recognised. Although coastal areas of the region were used to graze cattle from about 1870 to 1900, the

first permanent settlers close to the inlet system were around 1909. Despite intense pressure to develop the area for timber production and agriculture, 920 acres of land adjacent to the Frankland River were reserved for conservation in 1910. (DEC, 2012, 2009).

Walpole townsite was first settled under the Land Settlement Scheme in 1930, and tourism developed in and around the inlets during the 1920s, although access remained difficult until the Denmark to Nornalup railway opened up in 1929. (DEC, 2009)

The subject site is in the town of Nornalup although as the municipality boundary is the Frankland River, is termed to be part of Walpole townsite. Traditionally the Southern Forests (Denmark, Walpole, Manjimup) and surrounding towns were logging towns in the early settler years until the 1960s to 1970s. Old growth logging may have continued through to these times. The area of Teatree Scrub vegetation type comprising the northeast corner of the property could possibly be regrowth following previous clearing (Pers obs Kathryn Kinnear, 2015), as it is not represented on the 2007 aerial imagery used for this project.

There are permanent buildings, sheds, and a dam on the subject site, with the small paddock at the north and west of the existing buildings presently used for grazing a small number of sheep.

3.5. Climate

The lower south-west of Western Australia has a Mediterranean climate with mild to moderately hot dry summers with cool evenings. Winters are typically cool and wet and are punctuated by periodic winter fronts bearing strong winds and rainfall. (DEC, 2009)

Information on Nornalup's climate and weather is based on information for the neighbouring town of Denmark (Bureau of Meteorology (BOM) Station # 9531). A major factor influencing Denmark's climate is the Southern Ocean. The town is situated on the southern coast of WA and the ocean imparts a moderating influence via sea breezes in the warmer months and more generally through the effects of a relatively mild and moist air mass at any time of the year. Another significant factor is the position of a band of high pressure known as the sub-tropical ridge, and seasonal variations are mainly due to the north-south movement of this ridge.

An easterly broad scale flow prevails in summer when the ridge is south of the State, however the movement of high pressure cells from west to east along this ridge brings a commonly repeated pattern of wind changes to south coast locations. Denmark's south coast aspect means that the progression of winds from east through north, west, south and returning to east over periods of several days to a week or more during summer can bring a large variation in weather from fine and mild, to hot with thundery showers, to cool and cloudy with drizzle.

When the ridge moves north in the cooler months, the moisture-laden westerly winds south of the ridge deliver much of Denmark's annual rainfall. Atmospheric disturbances embedded in the westerly's are common in the winter months with sometimes several cold fronts passing through southwest WA in a week.

3.5.1. Rainfall

Denmark's long-term median annual rainfall has been in decline in the last decade. Table 1 shows the annual rainfall recorded at Denmark since 2006. This table shows that 2015 maybe facing a dry annual rainfall as in 2006, 2007 and 2014 with averages below 1000mm.

Table 1- BoM Denmark Station Annual rainfall since 2006

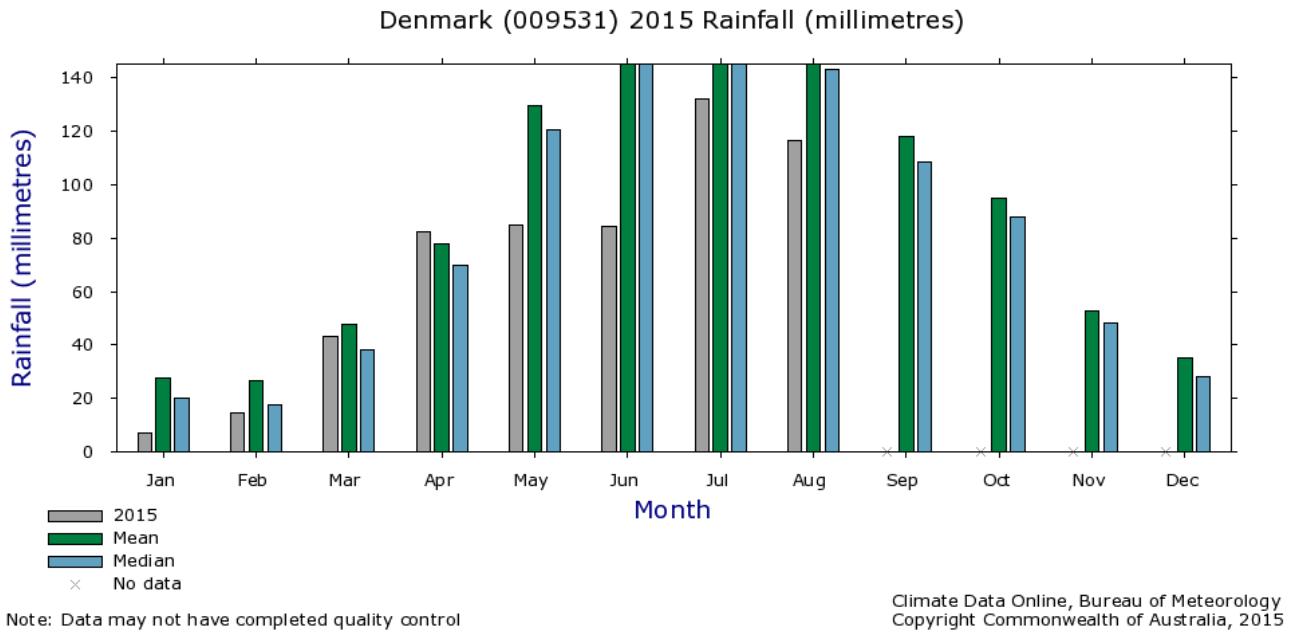
Year	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
2006	33.2	28.2	92.8	82.6	78.3	62.2	154.6	97.0	68.8	45.2	48.5	13.8	805.2
2007	33.0	4.4	53.6	71.4	103.8	85.2	140.2	142.8	154.2	81.4	19.4	74.8	964.2
2008	9.3	10.6	9.6		132.6	158.4	175.4	82.8	130.2	130.8	153.0	31.2	
2009	8.8	22.2	54.2	36.4	111.4	236.2	161.4	184.6	190.6	45.6	34.8	7.6	1093.8
2010	24.6	6.6	27.4		68.4	129.6	157.8		63.4	*57.6*	48.2	90.2	
2011	86.0	13.4	10.6	88.4	109.4	121.4	194.0	144.6	100.6	113.8	73.8	50.8	1106.8
2012	15.0	11.0	11.4	57.6	79.0	241.2	136.0	102.0	173.6	64.2	82.2	47.2	1020.4
2013	35.0	15.6	96.4	59.0	152.6	78.6	120.2	181.6	238.2	58.4	37.2	37.0	1109.8
2014	*4.4*	9.4	21.1	41.6	107.0	92.4	179.4	*40.2*	108.4	77.0	54.4	31.4	*766.7*
2015	7.0	*14.6*	*43.0*	*82.2*	*85.0*	*84.2*	*132.0*	*116.6*					

(BoM, 2015)

The average rainfall recorded at Denmark is 1082.5mm (BoM, 2015), though there can be considerable variation in the total rainfall from year to year. The year to date prior to the soil testing in August 2015 has a recorded 564.6mm at Denmark station (BoM, 2015). Approximately 72 per cent of the annual rainfall occurs between May and October. Although cold fronts are responsible for much of the recorded rainfall total, a moist onshore flow can occur in any season and bring showers or drizzle. Denmark records rainfall on average 138.3 days annually (BOM, 2015).

July is the wettest month, with the wettest month recorded in August 1955 of 292.6, rain occurs on two days out of every three during an average winter. The driest month is February with a mean of 26.7mm and in winter the average is 170.6mm (July). Please refer to Figure 2 below - Mean Rainfall Denmark (BOM 2015), showing all months excepting April 2015 is below the mean rainfall at Denmark Station.

Figure 2 – Mean Rainfall Denmark Station (BOM)



(Source BoM, 2015)

Annual rainfall in Walpole (10km away) is approximately 1300mm and is strongly seasonal, like Denmark, with the highest falls occurring between May and August. Annual rainfall can vary greatly from year to year and within a year. In recent decades, a slight but

consistently decreasing trend in annual rainfall has been apparent in the region around the inlet system, which has amounted to a reduction of around 200 mm since the 1950s (DEC, 2009).

3.6. Temperature

Average maximum temperatures peak in January and February in Denmark, with monthly means of 25.9°C although temperatures above 35°C sometimes occur when hot, dry northerly winds arrive from the interior of WA. Overnight minima also peak in January and February at a mild 13.5°C, on average.

Winter daily maximum temperatures average approximately 16.1°C, while the average minimum is approximately 6.9°C in July and August. Daily minimum temperatures below 5°C can be expected about once or twice a month in winter, but Denmark daily temperature records between 1907 and 1965 show no occasion where the temperature fell to zero. Please refer to Figure 3 and Figure 4 below illustrating Average Temperatures Denmark (BOM 2015).

Figure 3 –Mean Maximum Temperatures Denmark Station (BOM, 2015)

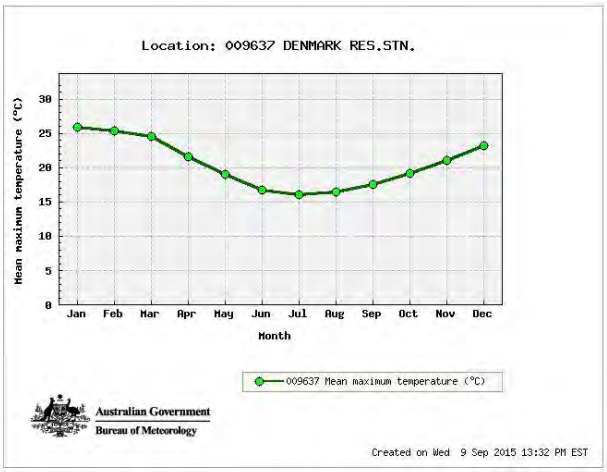
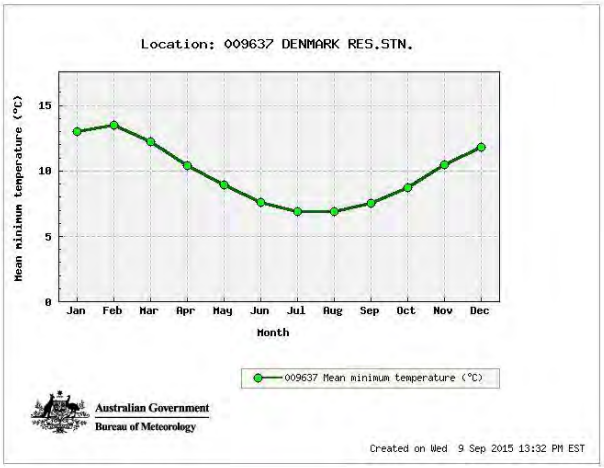


Figure 4 –Mean Minimum Temperatures Denmark (BOM, 2015)



(BoM, 2015)

3.6.1. Wind

The dominant wind direction in summer is from the southeast/southwest and afternoon sea breezes occur from October to March. During winter, southwest winds prevail and northwest storm events occur (BOM, 2015). Although fronts and depressions may bring strong to gale force winds, winter winds are more variable and generally lighter than those of summer.

Evaporation in the summer months is high with a January average of 240mm (8mm a day). The monthly evaporation decreases to 66mm in June (2mm a day). Daily evaporation can vary significantly from over 15mm on a hot windy summer day to almost negligible on a cold wet winter day. Please refer to Figure 5 and 6.

Figure 5 – Summer (Jan) wind rose BoM

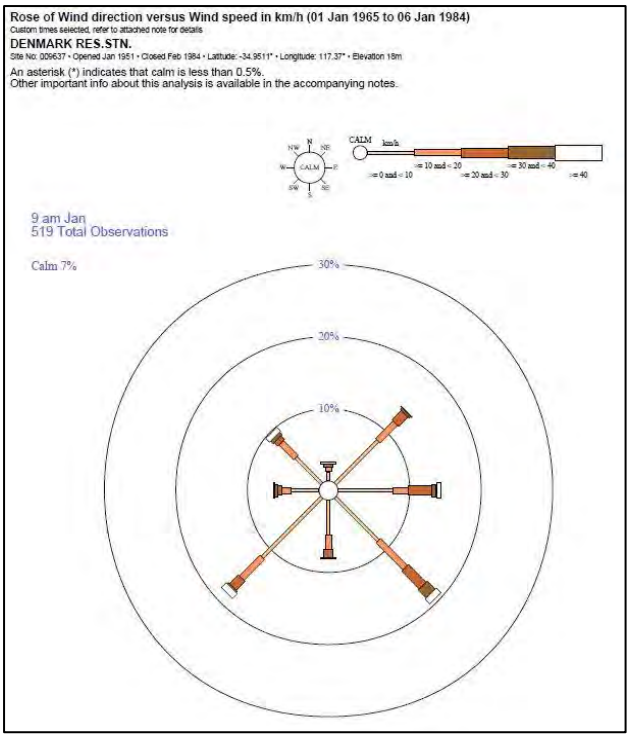
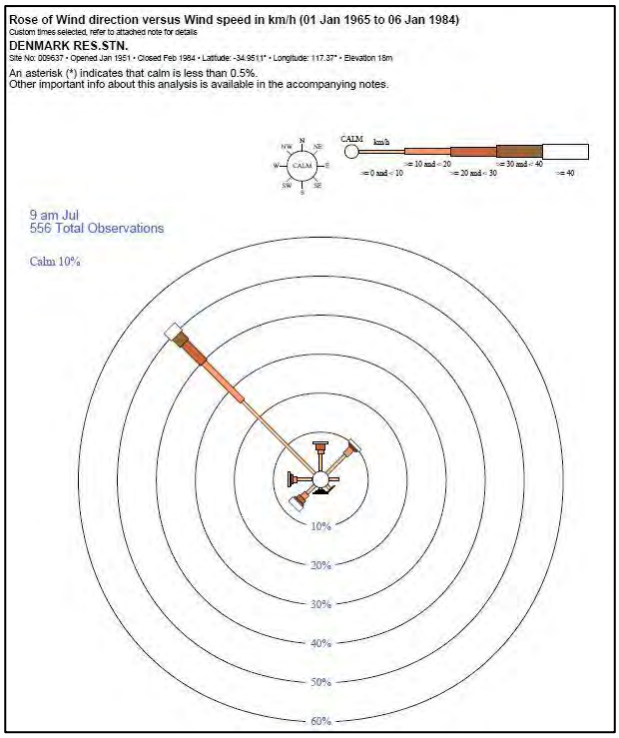


Figure 6 – Winter (July) wind rose BoM



(BoM, 2015)

3.7. Climate Change

Climate change is expected to impact on the future rainfall pattern of the area. It is recognised that the average rainfall has already declined by 20%-30% over the past few decades and that the long term impact of climate change may lead to a shift in rainfall, as well as dryer climatic conditions for the region. The long term changes are predicted to impact on the flora, fauna and water availability for the region (Climate Commission 2010).

The Climate Commission (Climate Commission 2010) estimates that
"…Rainfall patterns in Western Australia have changed over the last 40 years. There is significant evidence that climate change has contributed to the marked drying trend in the southwest of the state."

The construction of the proposed development is not anticipated to be affected by sea - level rise as the entire site is above the 5m contour, however, could be affected from increased intensity rainfall events or extended drying periods. Increased extreme weather from climate change could affect fire frequency and behaviour in Western Australia (DEC, 2012). Although the region is presently experiencing a dry winter, testing was undertaken in the required time period and future unpredictability of climate change cannot be fully accounted for when assessing the site suitability for effluent disposal purposes.

3.8. Aboriginal Heritage

A search of the Department of Indigenous Affairs (DIA) database revealed that there are no Aboriginal Heritage sites located within the Subject Site. The Frankland River to the east and south of the Subject Site and the Walpole and Nornalup inlets were highly significant hunting and gathering areas for Aboriginal communities of south-western Australia. (DEC, 2009). This area still holds a strong significance for the indigenous people of the south – west.

4. Site Assessment

Assessment of the subject site involved desktop analysis of climate, site history, vegetation, and geology of the site. Site assessment was undertaken through field survey of remnant vegetation, site soil analysis and laboratory testing of soils was undertaken by Mining & Civil Geotest Pty Ltd (permeability) and CSBP Laboratories (PRI).

4.1. Topography and Slope

The subject site is located on a south west aspect at the lower end of the slope in an undulating landscape with the average slope for the site assessed to be approximately 3.3 degrees (5.8% Grade) across the site. The central dominant hill of the northern edge of the site is at approximately 15m to 25 m AHD, and the slope calculated at 9.4 Degrees (16.6% grade). The average slope assessed for the subject site is between 0-<5 degrees please refer to slope analysis on the Test Pit mapping Appendix C.

4.2. Geology, Hydrogeology and Site Soils

Australian Geoscience Mapping and Department of Water 250K Hydrogeological mapping places the subject site from the Proterozoic Period (P_no*): Granitoid gneiss, migmatite, quartzo-feldspathic gneisses; subsurface weathered to clay.* The Aquifer is fractured and weathered rocks – local aquifer, very minor or no groundwater resources.

Site soil testing in late winter conditions, August 2015 confirmed the site to be two soil categories – Sandy silty clay loams over clay; and Silty sands with loam and gravels over clay. Please refer to the Soil Profile Sampling at Appendix C. Ground water was noted in the north-north west area of the site between 250-1870mm. Vegetation noted surrounding the site and present on the subject site (predominantly Peppermint trees, *Agonis flexuosa*) further indicates the site is not subject to severe water logging as Peppermint trees generally do not occur in severely inundated areas (prefer not to have “wet feet”) (*Pers obs* Kathryn Kinnear 2015).

4.2.1. Sandy Silty Clay loams over clay

This soil type was encountered over north west area of the subject site in Lot B at Test pits 2, 3, and 4. Top soils were generally dark brown sandy silty clay with organic matter from 0mm – 70mm BGL. Generally this soil type had an A Horizon of brown to dark brown silty clays and sandy silty clays at around 50mm– 700mm Below Ground Level (BGL) and a B Horizon of moist to wet silty clay with gravel at around 700mm – 1400mm BGL grading to a dry mottled red/orange/grey/white clay (becoming dry) with pebbles at around 1400mm – 2000mm BGL. Groundwater was intersected in the holes drilled in these Test Pits between 270mm to 730mm (water table recorded after one hour of excavation), with the wettest area of the subject site in the north west corner at Test pit 2 (270mm). Please refer to Soil Profile Sampling results at Appendix C.

4.2.2. Silty Sands with loam and gravels and clay

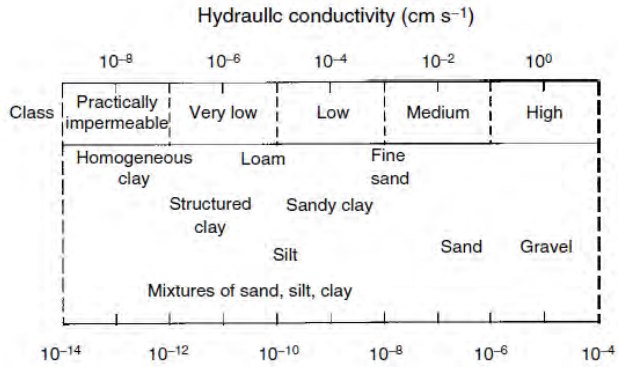
This soil type was encountered over the majority of the Subject Site, as recorded at Test Pits 1, 5, 6, and 7. This soil type had a higher presence of gravels and loams compared to the previous group of soils. Top soils were mostly dark brown sandy loam, organic matter topsoils from 0mm – 80mm. The A Horizon between 0mm – 600mm BGL was dark brown and brown sandy silty loams (with gravels), grading to gravelly/clayey loams and silty clays (600-1000mm) with the B Horizon at 1000-2000 of moist sandy and silty clays with gravels over mottled red/grey/white clays (dry). Test Pit 1, on slightly higher ground had a water table recorded at 1870mm BGL, whereas all other test pits did not record a water table or water seepage after one hour of excavation. Please refer to Appendix C for Soil Profile Sampling results.

4.2.3. Soil Permeability

Permeability Testing was undertaken by Mining & Civil Geotest Pty Ltd indicating the soils are low- to poorly draining (refer to Laboratory test certificates Appendix D). The sandy silty clay/loams (this soil type featured over a majority of the site) generally were very low permeability being 7.6 10^{-9} m/sec (Test pit 1), 9.9 $x10^{-9}$ m/sec (Test pit 2), 1.5 10-8 m/sec (Test pit 5), 4.2 $x10^{-9}$ m/sec (Test pit 7). Silty, clayey soils generally record poor permeability results, and the presence of silt

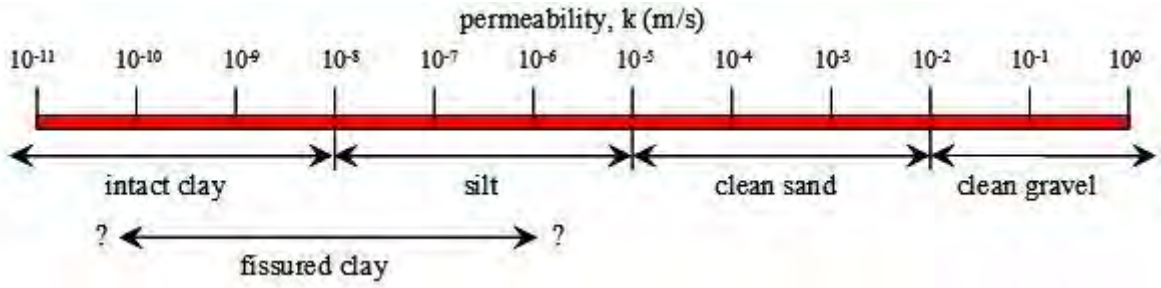
and loam in the samples also accounts for the low permeability. Loamy soils are generally of very low permeability and clay soils are generally of an impermeable nature (Figure 7 and 8).

Figure 7 – Generalised Permeability (Hydraulic Conductivity of Soil Types)



(Source, Artiola *et al* 2004)

Figure 8 – Permeability scale m/sec



Source: UWA, 2013

4.2.4. Phosphorous Retention Index

Phosphorous retention Index (PRI) is the ability of soils to absorb and treat nutrients within the soil (i.e. Soil microbe disinfecting ability). Soils with a PRI less than 1 have a very poor ability to treat effluent waters, with soils >5 have a high ability to treat effluent waters (nutrients). PRI Testing was undertaken on the same samples for permeability by CSBP Soil Laboratories (refer to Appendix D). The test results indicate the site has a high ability of treating effluent waters, with PRI of 2053.1, 401.9, 906.9, and 1016.6 recorded of the 4 soil samples (Test Pit 1, Test Pit 2, Test Pit 5 and Test Pit 7 respectively).

The laboratory testing (CSBP, 2012) at Appendix D demonstrates that these soils have an extremely high Phosphorous Retention Ability with values exceeding 5. Test Pit 2 PRI results are noticeably a lower PRI than other soils across the site (401.9) which could be attributable to the higher sand/silt content of those soils, (as the soils were “silty sands”).

4.2.5. On site effluent disposal

The health and environmental requirements for wastewater treatment and disposal for developments not serviced by deep sewerage systems are contained in the *Draft Government Sewerage Policy*, (Department of Health, 2011). The subject site is situated in an area that does not have deep or reticulated sewerage. The subject site is 140m from the Frankland River and thus is not required to meet the criteria for Environmentally Sensitive Areas (ESA) section of the Draft Government Sewerage Policy.

The Draft Government Sewerage Policy (2011) states the following minimum requirements apply for all on-site sewage disposal systems. Please refer to Table 1 below.

Table 2 – Minimum requirements for all on-site wastewater disposal systems

Site Feature	Minimum Requirement
Drainage System/channels	No apparatus shall be constructed so sewage is discharged into the ground within 6 metres of any sub-soil drainage system or open drainage channel.
Flooding	Land application area shall not be subject to inundation or flooding at a probability greater than once in twenty (1:20) years.
Gradient to the Land	Not to exceed one in five (1:5). Shall be engineered to prevent run-off from the land application area (e.g. bunding, Gradient of the land terracing). application area
	Surface contours shall be provided on the site plan
Land application area	Depending on the soil type, an unencumbered area of at least 150m^2, or the area calculated from Appendix 4.2A in AS/NZS 1547:2000, must be set aside for the disposal of sewage for each dwelling [1]. This area excludes the area required for the apparatus.
	In the case of non-residential development or subdivision, the unencumbered area to be set aside shall be approved by the Department of Health.
Land application area	The area set aside for the disposal of the sewage shall: • not be built on or paved in a manner which precludes reasonable access; and • be kept in a manner which enables servicing and maintenance of the disposal system.
	All sewage shall be confined within the bounds of the designated land application area.
	All sewage shall be confined within the bounds of the designated land application area.
Soil absorption zone	For absorptive soils, the soil absorption zone of the land application area shall have a depth of at least 0.6 metres [2] above the highest seasonal or permanent water table.
	For sandy soils, the soil absorption zone of the land application area shall have a depth of at least 1.5 metres above the highest seasonal or permanent water table.
Soil permeability	Tests to be conducted as per Appendix 4.1F *Soil permeability measurement – Constant head test* in AS/NZS 1547 *On-site domestic wastewater management.*
Soil profile	To be carried out in accordance with Appendix 4.1A Site and soil evaluation:procedures, 4.1D *Site and soil properties* and Appendix 4.1 E *Dispersive soils and sodicity* in AS/NZS 1547:2000 *On-site domestic wastewater management.*
	Depth of soil samples shall be a minimum of 2.0 metres from ground level.
Water supply	Apparatus shall not be constructed or situated in a place where sewage will be discharged into the ground at a distance less than 30 metres from any well or other underground source of water supply, which water is used or intended or likely to be used for human consumption,

(DoH, 2011)

Groundwater was encountered in four of the Test Pits in late August 2015 (wet time of the year). It is noted that these Test Pit sites -Test Pit 1, 2, 3 and 4 were located above the 10m AHD contour, with the wettest test pit (Test pit 2) at the north–north western edge of the subject site. The area around Test pit 2 should be avoided for any disposal field from on-site effluent disposal. All other test pits recorded water levels below 600mm as per the Department of Health requirements (see Table 2).

There is a surface table drain along the eastern edge of the existing infrastructure on the subject site draining to an open holding area (seasonally inundated), which further has an overflow sump in the south western portion of the site, these areas should be avoided (minimum of 6 metres). A water supply bore is located in the southern portion of the subject site near the existing dwelling, this is measured at 40m from any new proposed lot boundary. All lots meet the minimum size requirements for the soil category with all lots over 2000m^2 (1000m^2 for gravels and sands, sandy loams and loams; and 2000m^2 for Clay loams, light clays and medium to heavy clays) (DoH, 2011 Table 2).

The site soils on both lots meet the requirements of Table 1 (DoH, 2011) for on-site effluent disposal and traditional septics and leach drains could be utilised within the sites, a possible site plan is provided in Appendix E for each lot. This assessment does not include meeting the objectives of the Code of Practice for On-site Sewerage management with detailed loadings and design capacity of the septic system to be provided by the owner (to the Shire) at time of building approval stages.

It is therefore recommended that:

- Residences will need to be a minimum setback of 6m from any drain, drainage channel or sub-surface drain;
- Recommended on-site effluent is via traditional effluent disposal systems with a possible site plan for each lot in Appendix E; and
- Effluent disposal is not recommended in the north-western portion of the subject site (Test pit 2).

4.3. Vegetation Types

Desktop assessment reveals the subject site lies within the Warren IBRA bioregion. This bioregion is comprised of '*Dissected undulating country of the Leeuwin Complex, Southern Perth Basin (Blackwood Plateau), South-West intrusions of the Yilgarn Craton and western parts of the Albany Orogen with loamy soils supporting Karri forest, laterites supporting Jarrah-Marri forest, leached sandy soils in depressions and plains supporting low Jarrah woodlands and paperbark/sedge swamps, and Holocene marine dunes with Agonis flexuosa and Banksia woodlands and heaths*.' (Hearn et al 2002)

The vegetation of WA was mapped on a broad scale by Beard in the 1970's, whereby a system was devised for state-wide mapping and vegetation classification based on geographic, geological, soil, climate structure, life form and vegetation characteristics (Sandiford and Barrett 2010).

A DPAW database search of Beards vegetation classification for general area places the site within 1 broad Vegetation Association for the site:

1. **System Association: Nornalup**

- Vegetation Association number: 27
- Vegetation Description: Low woodland; paperbark (Melaleuca sp.) (mLi)
  (Source DEC Pre-European Vegetation GIS dataset).

4.3.1. Vegetation Assessment Methodology

The survey area is defined as Lot 150 South Coast Highway, Nornalup, with the whole property mapped for vegetation types and intensive flora sampling undertaken by K.Kinnear (Bio Diverse Solutions) in late August 2015. The subject site was traversed on foot and a list of

dominant flora species present (native and exotic) was compiled as seen; samples or photographs were collected for unfamiliar species. Specimens collected were pressed, dried and identified. Specialist texts were used to identify specimens (Wheeler *et al,* 2002). The authority for taxonomic names was DPAW's Florabase website as of September 2015. Vegetation condition was assessed during the field survey. Vegetation condition was assessed using the vegetation condition scale as per Keighrey (1994).

Vegetation condition was assessed to the criteria as outlined in *Bushland Plant Survey, A Guide to Community Survey for the Community*:

- *Pristine: Pristine or nearly so, no obvious signs of disturbance;*
- *Excellent: Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species;*
- *Very good: Vegetation structure altered, obvious signs of disturbance;*
- *Good: Vegetation structure significantly altered by very obvious signs of multiple disturbance. Retains basic vegetation structure or ability to regenerate to it; and*
- *Degraded: Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management.* (Keighrey, 1994)

The subject site is predominantly in a disturbed state as is evident in most of the subject site, and of the minimal native vegetation cover identified, was generally considered to be in 'Degraded' condition as per Keighrey (1994).

4.3.2. Results of Flora and Vegetation Survey

Two vegetation types were identified on the subject site:

- Low Open Woodland of Peppermint (*Agonis flexuosa*);
- Teatree (*Taxandria parviceps*) Scrub; and
- Bare areas and cleared paddocks.

Refer to Vegetation Mapping Appendix F. Further vegetation types were identified surrounding the subject site within 100m of the proposed new buildings for the purpose of the Bushfire Hazard Assessment Process – refer to Section 4.11.

4.3.3. Peppermint low open forest

This vegetation type forms approximately <2% of the subject site. This vegetation type is represented in the southern boundary of Lot A along the open drain. This vegetation type has dominant tree species of Peppermint (*Agonis flexuosa*) with a cleared/disturbed understorey of introduced grasses such as Kikuyu, Water Couch and Arum Lilly (refer to Section 4.5 for more detail on weed species). Small patches of *Baumea juncea* occur along drainage swales and in the paddock to the north of the Peppermint Open Woodlands. Refer to Photographs 9 and 10 below and Vegetation Mapping Appendix F.

Photograph 9 – View of Low Open Peppermint Woodland over drainage swales along eastern boundary of lot A.

Photograph 10 – View of Low Open Peppermint Woodland over drainage swales along eastern boundary of lot A.

4.3.4. Teatree Scrub

This vegetation type forms approximately less than 1% of the subject site, and is represented in the eastern boundary of the subject site. As previously discussed, it is possible that this vegetation type is regrowth having been previously cleared, with the 2007 aerial photograph used for the project not reflecting this vegetation being present on the site. The vegetation is dense, and consists only of *Taxandria linearifolia* (Karri tea tree) with no other vegetation structure. Refer to Photograph 11 and Vegetation Mapping Appendix F.

Photograph 11 – View of Taxandria Scrub located along the eastern boundary.

Photograph 12 – View of *B.juncea* located in Lot A paddock areas.

4.3.5. Bare areas and cleared paddocks

In the paddock area of Lot A, a small patch of *Baumea juncea* occurs which is typical of paddocks which are seasonally wet, see Photograph 12. No high water tables were recorded in this area (Test pits 5, 6 and 7) of the lot, indicating there is thick "matted" silty topsoil's with organic matter which can form impermeable topsoil's over gravels (as recorded – refer to Site soil profiles Appendix C). It is likely the *B.juncea* is representing a "damp" area due to the excess stormwater in winter being diverted from Macpherson Drive to the subject site. (See Section 4.9 for more detail)

The remainder of the site is paddocks which are grazed by sheep and lambs intermittently. Paddock grasses included Kikuyu, Clovers, water couch and Hare's tail grass. Refer to Section 4.5 for more detail.

4.4. Environmentally Sensitive Areas (ESA's) and Threatened Ecological Communities (TEC's)

The Subject site is located 216m (closest boundary) to an Environmentally Sensitive Area, being the Walpole Nornalup National Park, located to the west north and north west of the subject site. The subject site is located 142m (closest boundary) to the Frankland River. As the site is over 100m from the Frankland River and the Walpole Nornalup National Park, no buffer requirements are required. A search for Threatened Ecological Communities (TECs) within the Warren IBRA bioregion on the DPaWs database found that there are no TECs present on the subject site.

4.5. Weeds and introduced species

In 1976 the Agriculture Protection Board introduced legislation to control weeds – the *Agriculture and Related Resources Protection Act 1976*. As of 1 May 2013, the *Biosecurity and Agriculture Management Act 2007 (BAM Act)* and regulations came into force. Legislation to be repealed is now covered by the BAM Act and its regulations. This legislation sets out "declared" plants and legal obligations to landowners in regards to these species. If a plant is declared then landowners are obliged to control that plant on their properties.

Environmental Weeds are defined by the "Environmental Weeds Strategy for Western Australia" (1999) as *"plants that establish themselves in natural ecosystems and proceed to modify natural processes, usually adversely, resulting in the decline of the communities they invade"*. At present there is no legislation governing management of Environmental Weeds, landowners are encouraged to control movement and restrict further spread of these species.

Any plant other than a declared plant can be prescribed as a "Pest Plant", under Section 22 of the *Biosecurity and Agriculture Management Act 2007 (BAM Act)*. Typically these are prescribed whereby the occurrence of these may adversely affect property values, comfort or convenience of the inhabitants of a particular district.

The Act states (6) (1) .*The council may serve on the owner or occupier of private land…a duly completed notice…requiring him/her to destroy eradicate, or otherwise control any pest plant on that land' (Agriculture and Related Resources Protection Act 1976).*

Few environmental weeds were present across the site, and were only seen on and adjacent to access tracks. A summary of the weeds located on site is shown in Table 3 below.

Table 3 – Weed Species identified from Site Survey

Grasses	Scientific Name
Kikuyu	*Pennisetum clandestinum*
Annual veldt grass	*Ehrharta longifolia*
Flat weed	*Hypochaeris spp*
Hare's-tail Grass	*Lagurus ovatus*
Water Couch	*Paspalum distichum*
Herbs	
Arum Lilly	*Zantedeschia aethiopica*
Spear Thistle	*Cirsium vulgare*
Pale-flowered Oxalis	*Oxalis incarnata*

The weed species identified are not 'Declared' weeds under the *Biosecurity and Agriculture Management Act 2007 (BAM Act)*, and none are declared "Pest Species" under the Shire of Denmark (Schedule 1 of their local laws). All are listed environmental weeds which should be restricted from movement off-site and further into any adjacent vegetation. To maintain a weed free site it is recommended that only native species are used for replanting in landscaped areas and at private dwellings. All machines entering the site for clearing or site works should be clean and free of woody material or soil.

It is therefore recommended that:

- Environmental Weeds should be controlled from any further spread and controlled on site;
- To maintain a weed free site it is recommended that only native species are used for replanting in landscaped areas and at private dwellings; and
- All machines entering the site for clearing or site works should be clean and free of woody material or soil.

4.6. Disease Management

Phytophthora cinnamomi, otherwise known as dieback, is a soil borne water fungus which causes large scale death of vegetation, particularly the Jarrah trees and Banksia species. A survey for the presence of *P. cinnamomi* was not conducted for the purposes of this report. The spread of *P. cinnamomi* is through the movement of soil as a result of human activities which cause the translocation of soil sediments, be it a large scale (i.e. soil brought in for infill) or small scale (i.e. soil brought in unknowingly on machinery, shoes etc.) incidents. The site is most likely infested with the disease due to clearing and grazing and therefore no recommendations for prevention are required.

4.7. Fauna

Native animal populations have generally been in decline since European settlement (CALM 2005). This is primarily due to native vegetation habitat loss and the introduction of pest animals. A full fauna survey was not undertaken of the site, with site reconnaissance undertaken of vegetation types. There are at least 21 species of native mammals in the Southern Forests national parks. This includes one pinniped, four macropods, three possums, four dasyurids, one bandicoot, two rodents and six bats. Although it is thought that only three mammals have become extinct within the national parks (the pale field rat *Rattus tunneyi*, the heath rat *Pseudomys shortridgei* and probably Gilbert's potoroo *Potoroo tridactylus gilbertii*, populations of many species are thought to have declined and now exist only as small isolated populations (CALM 2005).

How *et al* (1987) outlined 6 species of mammals recorded or collected within the survey area being – *Macropus fuliginosus* (Western grey kangaroo), *Isoodon obesulus (Southern brown bandicoot), Mus musculus* (Common house mouse), *Rattus fuscipes* (Bush rat), *Falsistrellus mackenziei* (Western false pipistrelle) and *Tarsipes rostratus* (Honey Possum).

The possible mammal fauna within the survey area include *Isoodon obesulus (Southern brown bandicoot), Psuedocheirus occidentalis*, (Western ringtail possum), *Trichosurus vulpecula* (Brushtail Possum), *Cercartetus concinnus* (Western pygmy possum) and *Tarsipes rostratus* (Honey Possum). There is limited understorey vegetation so the likelihood of the quenda inhabiting the area is deemed low, as they prefer thick dense shrubbery and long grasses for cover from predators. The peppermint trees may support possums, however the threatened Western Ringtail possum is unlikely to inhabit the area due to the limited canopy cover and the relative isolation and connectivity of the peppermint woodland. No obvious signs of dreys or scats were noted during site survey.

Approximately 135 birds species have been recorded in the southern forests and southern coastal areas by Christenson et al (1985, 1992). The richest assemblages were found in open and low forests and open and low woodlands. Jarrah open woodlands and Karri Type Forests typical to the Nornalup and Walpole area support bird species such as cockatoos, parrots, robins, the tawny frog mouth, the Rufus tree creeper and wrens. The subject site does not support possible habitat and feed trees for the black cockatoos. No signs or site indications of feed and habitat trees were noted during the assessment by the Forest Red-tailed Black Cockatoo, Baudin's or Carnaby's Black Cockatoo.

Christenson *et al* (1985, 1992) recorded few reptiles for the area, presumably due to low temperatures and higher rainfall. Some species noted during these surveys include: dugite, tiger snake, crowned snake, carpet python, Mueller's' snake, Smiths' skink, burrowing skink, Kings' skink and bob tail lizard.

The presence of frogs is highly seasonal; Christenson recorded 17 species known to the area some of these include: burrowing frog, motorbike frog/moaning frog, slender tree frog, green and gold tree frog, and the western banjo frog.

Frogs which are in the regional area include *Litoria adelaidensis* (Slender tree frog), *Litoria moorei* (Motorbike frog), *Crinia georgiana* (Quacking Froglet), *Crinia glauerti* (Glauert's Froglet), *Crinia pseudinsignifera* (False Western Froglet), *Geocrinia leai* (Lea's Froglet), *Geocrinia rosea* (Roseate Froglet), *Heleioporus eyrei* (Moaning Frog) *Heleioporus psammophilus* (Sand Frog), *Limnodynastes dorsalis* (Western Banjo Frog) and possibly *Geocrinia lutea* (Nornalup Frog) and *Spicospina flammocaerulea* (Sunset frog*)*. (ARC 2011).

Native species and introduced species were noted (scats, tracks and visuals) by Bio Diverse Consultants during the site visit to the survey site. This included: crow, blue wren, kookaburra, magpie, gilgie, ringneck parrot, honeyeater and brown falcon. No threatened species subject to the *Wildlife Act 1950* or the *EPBC Act* were recorded during site reconnaissance.

4.8. Waterways and wetlands

The Frankland River is connected to the Nornalup Inlet, a much larger body of water that feeds to the southern ocean. The Nornalup inlet system is geologically recent, having only attained its present form during the Holocene sea level changes of approximately 7000 years before present. The inlet system was created by the isolation of flooded embayments of relatively old river valleys by the formation of dunes. Subsequent and highly dynamic processes, such as a fall in sea level, longshore drift of coastal sand, the infilling of estuaries with catchment sediments and highly seasonal water flows, have increasingly isolated these estuaries from the ocean. The opening and closing regimes of the estuaries depend on the degree of exposure of the inlet mouth to onshore sediment transport by swell and the flow characteristics of waterways that enter the system (DEC, 2009).

The Walpole and Nornalup inlet system is a basin estuary that formed in association with geologically ancient river channels. This system remains one of only three permanently open estuarine systems on the south coast of Western Australia. An undulating landscape of forested laterite hills and low-lying peat swamp surrounds the inlet basins and the catchments of the lower Frankland river. The Frankland/Gordon river system extends for around 400km to the northeast of the inlet system onto the low relief plains and salt lakes of the Precambrian Western Shield Plateau. This catchment is approximately 6000sq/km and much of the land in the north has been extensively cleared for cereal cropping, sheep farming and cultivation of vegetables. Although generally shallow, the Frankland River is up to 5 m deep. (DEC, 2009)

The Frankland River flows all year round and about 80% of this discharge occurs during the winter and spring (i.e. from June to October) within negligible flow during summer, except for infrequent floods in the upper Frankland River. The Frankland River as connected to the inlet system, is marine and tidal for around 12 km (upstream from the Nornalup Inlet) in the summer months. The saline water gradually extends up the river with the deeper parts of the Frankland River to the head of the estuary (approximately 12 km). (DEC, 2009)

The inlet system is relatively well flushed as it has a high net inflow of water relative to basin volume. The system is subject to irregular and occasionally large flood events, the last major instance of which was in January 1982. (DEC, 2009).

Groundwater was intersected at Test Pit 1, 2, 3 and Test Pit 4 when the site was soil tested in late winter conditions, August 2015. These Test pits were located above the 10m AHD contour line. Surface water seepage and surficial groundwater flows are likely towards the river in the north and west of the site. Ongoing management of water quality and prevention of pollution or contamination to the Frankland River catchment is not considered an impact from this development as the site is located<100m from the Frankland River.

4.9. Drainage and storm water

A series of surface cut-off swale drains occur across the eastern extent of lot A and Lot B. The water is predominantly from the adjacent Macpherson Drive road reserve. Two cut off drains (open swales) enter from the eastern boundary of lot and are retained in a small seasonal pond. Overflow from this is then dispersed into a below ground sump. The Department of Health recommend a 6m setback from any drain or subsurface drain (DoH, 2011), therefore this is applied from any – on-site effluent disposal field.

To enable implementation of Water Sensitive Urban Design principles, planning consideration should be given at design stage to effectively manage drainage across the site. According to the indicative permeability of each soil category with regard to AS/NZS 1547:2000 permeability results for the site indicate that the clays are poor draining soils and the loamy sands are moderately/poor draining. Stormwater from each dwelling should be contained on site through “Point of Source

Infiltration" through capture of rainwater into tanks and treatment of the water into swales or sumps.

Rainwater tanks should be installed at building development stages as a potable water source as there will be no reticulated water servicing the area. Water for potable/consumption may need to be treated and the Department of Health can provide information on treatment of dwelling water supply. Rainwater will also be available for non-potable water uses which will minimise the importation of water and can assist in the reduction of stormwater exiting the development. All stormwater structures should be located within the lots and given the size of the lots (>2000m^2), this should be achievable. Given the only hard stand areas will be the access driveways, dwellings and possible associated sheds, (sheds and dwellings will be capturing the rainfall), it is anticipated there will be minimal increase in stormwater from the development.

Water use within each of the proposed lots will be at the discretion of the new lot purchaser, it is recommended that education is provided to the new lot owners about the use of water wise practices (e.g. water efficient taps, showers, toilets and appliances). Information regarding this can be obtained from Water Corporation's website at:
www.watercorporation.com.au

Consideration from the Shire of Denmark should be given to the directional flows of the stormwater off Macpherson Drive and away from the subject site to the stormwater system along South Coast Highway or into the POS area to the north. The current arrangement of directing water (from uphill road and infrastructure) into the subject site is not a sound long term solution and investigations could be made into the POS area to the north of the subject site or the highway stormwater system as a possible location for any stormwater treatments from the subdivision uphill. Refer to Photographs 13 and 14 below.

Photograph 13 – View from the north east towards the subject site along McPherson Drive. Most of the stormwater from uphill is being directed into the subject site. (mid-RHS of photograph)

Photograph 14 – View from the eastern boundary of the subject site, where the drain/swale enters the property from McPherson Drive.

It is therefore recommended that:

- A 6m setback from any drain or subsurface drain is applied from any –on-site effluent disposal field;
- On-site rainwater will be mandatory with the installation of rain water tanks for consumption;
- Treatment of rainwater maybe required for potable water supply refer to DoH for guidance;
- Waterwise initiatives considered at the new lots; and
- The Shire of Denmark consider diverting the current stormwater into the adjacent POS reserve and away from the subject site.

4.10. Constructability

This report does not include any structural engineering assessment. The site is conducive to ease of excavation due to the development areas not having encountered rock. The proposed development areas would most likely be classified as *M Class Sites – Moderately reactive clay sites which can experience high ground movement from moisture.* Prior to any building construction, this would need to be assessed by a certified structural engineer.

It is therefore recommended that:

- A structural engineer is engaged prior to building construction to ascertain structural ratings for any buildings on site.

4.11. Bushfire Management

A Bushfire Management Plan has not been prepared as part of this assessment. Bushfire hazard assessment is usually undertaken for residential areas and aligned to Planning for Bushfire Edition 2 (2010) with "Due regard" to the Draft "Planning for Bushfire Risk Management Guidelines (WAPC, 2015).

As of September 2015 it is proposed that the *Planning and Development (Bushfire Risk Management) Regulations 2014* and Western Australian State Bushfire Prone Mapping will be gazetted.
This means that:

- *Any building licence application for residential buildings and outbuildings i.e. Class 1, 2 or 3 buildings or associated Class 10a buildings or decks associated with Class 1, 2 or 3 buildings in designated bushfire prone areas will be required to be constructed in accordance with AS3959 Construction of Buildings in Bushfire Prone Areas;*
- *A Bushfire Attack Level (BAL) assessment must be undertaken on the site; and*
- *Development on sites with a BAL-40 or BAL-FZ rating will require a planning application under the Planning and Development (Bushfire Risk Management) Regulations 2014.*

(DoP, 2015)

The *Planning and Development (Bushfire Risk Management) Regulations 2014* define Bushfire Prone Vegetation as:
"...means contiguous vegetation including grasses and shrubs but not including maintained lawns, parks and gardens, nature strips, plant nurseries, golf courses, vineyards, orchards or vegetation on land that is used for horticultural purpose." (DoP, 2015)
The *Planning and Development (Bushfire Risk Management) Regulations 2014* outline "Bushfire Prone Areas" as:
" (a) where the development site is on land covered by a Bushfire Prone Area Map endorsed by the FES Commissioner – if any part of the development of the site is designated on that map as being bushfire prone; or
(b) where the development is not on land covered by a Bushfire Prone Area Map endorsed by the FES Commissioner – if any part of the development is within 100m of an area of bushfire prone vegetation equal or greater than one hectare."
(DoP, 2015)

The site is not deemed to be Bushfire Prone as per the above draft regulations as the site is not situated within 100m of >1 ha of bushfire prone vegetation (and in the absence of any publicly released state-wide bushfire prone mapping). Refer to Vegetation mapping Appendix F.

Hazard assessment of the subject site revealed that there are small areas of Low Open Peppermint Woodland, Tea Tree Scrub and Bare areas internal to the site. These areas are <0.25ha and therefore would be classified as per AS3959-2009 as BAL-Low (*Section 2.2.3.2 (c) Multiple areas of vegetation less than 0.25ha in area and not within 20m of the site or each other)*

External to the subject site to the east there is an area of Peppermint Woodland approximately 4000m^2 which is 30m from the subject site. This would be classified as per

AS3959-2009 as BAL-Low (*Section 2.2.3.2 (b) Single areas of vegetation less than 1 ha in area and not within 100m of other areas of vegetation being classified*). To the north in the Shire of Denmark POS area there is a stand of isolated Karri trees, again this would be classified as BAL-Low (*Section 2.2.3.2 (c) Multiple areas of vegetation less than 0.25ha in area and not within 20m of the site or each other)*

To the south and west there are established buildings and road reserves (South Coast Highway) which would also be classified as BAL-Low (*Section 2.2.3.2 (e) Non-vegetated areas including waterways, roads, footpaths, buildings and rocky outcrops.*

It is recommended that a 20 metre wide BPZ as the minimum width is to be constructed around all buildings. Activity within the BPZ must include:

- Width: 20 metres measured from any external wall of the building to adjacent vegetation;
- Location: within the boundaries of the lot on which the building is situated;
- Fuel load: reduced to and maintained to a maximum of 2 tonnes per hectare (as per Shire of Denmark Fire Regulations);
- Trees (crowns) are a minimum of 10 metres apart;
- Trees are low pruned at least to a height of 2 metres;
- No tall shrub or tree is located within 2 metres of a building (including windows);
- There are no tree crowns overhanging the building;
- Fences and sheds within the BPZ are constructed using non-combustible materials (e.g. colour bond iron, brick, limestone);
- Shrubs in the BPZ have no dead material within the plant;
- Tall shrubs in the BPZ are not planted in clumps close to the building i.e. within 5 metres; and
- Trees in the building protection zone have no dead material within the plant's crown or on the bole.

The 20metre Building Protection Zone (BPZ) can be contained lot (as recommended) for ease of maintenance from the lot owner. As the subject site is classified as BAL-Low a detailed Bushfire Management Plan is not required. Refer to Bushfire Hazard (vegetation) mapping Appendix F.

It is therefore recommended that:

- Building Protection Zones (20m) are located within the individual lot to ensure that these can be maintained by the individual lot owners; and
- The proposed new dwellings are BAL-Low and a Bushfire Management Plan is not required.

4.12. Access and infrastructure

The proposed development is to be accessed off Macpherson Drive along the northern boundary. Power and telecommunications are available to service each new lot. Reticulated water and sewer are not available to the site. Potable water is to be collected from roof catchment areas from both dwellings and outbuildings limiting excess stormwater through retention. Landowners should further be encouraged to minimise water usage and reuse household water where able for household and garden use.

It is therefore recommended that:

- Waterwise initiatives are implemented at lots;
- Water recycling, reuse and water reduction is encouraged for the development; and
- Potable water via rainfall collection from dwellings to reduce stormwater runoff.

5. Land Use Requirements

Areas of land for sub-division approval are assessed through Land Capability to analyse the sustainability of the particular activity and the environmental effects the proposed use may have on the land. This determines the attributes the land contains which can affect the proposed land use for the area. The land use proposed for this Subject Site is '*Rural – Residential with on-site effluent disposal'* as defined by the assessment process in the *State Planning Commission (1989) Land Capability Assessment for Local Rural Strategies.* The "*Rural – Residential"* definition used in this report is not reflective of any zoning or Shire designations and is the Land Capability assessment criteria definition.

5.1. Rural - Residential

To assess the capability of the land, the WAPC Land Capability Assessment guideline, the site has been assessed as "Rural Residential with on-site effluent disposal" (as per the State Planning Commission (1989) Land Capability Assessment definition and not any other planning instrument, i.e. shire zoning terminology) and is aligned to the Department of Agriculture and Food standards and State Planning Commission Land Capability Assessment for Local Rural Strategies (1989).

The State Planning Commission (1989) Land Capability Assessment for Local Rural Strategies defines Rural - Residential as:

"Rural Residential is a multiple form of land use where land is utilised primarily for residential purposes, but often also for some form of agricultural uses. Individual lot sizes range from 1 hectare upwards, but are generally between 2 and 5 hectares in size. One standard residential dwelling (i.e. not for hotel, guesthouse etc) is permitted.

State Planning Commission Policy requires that Scheme water be provided to each residence on lots smaller than 2 hectares but households on larger lots may not necessarily be provided with Scheme water. In this case, water for domestic purposes is obtained from rainfall stored in rainwater tanks and/or surface storage dams or groundwater supplies.

Deep sewerage is generally not provided to the residence and domestic sewerage and sullage are disposed of in on-site septic tank systems. Telephone and electricity connections are provided to each residence. Roads are often constructed to a lesser standard than in urban areas and are sometimes narrow, gravel rather than bitumen sealed and unkerbed.

Domestic gardens are usually established around the dwelling for fire protection purposes. The possible range of agricultural uses include dryland grazing (sheep, horses, goats, cattle), annual horticulture (market gardens) and perennial horticulture (orchards, vines) and are generally determined by the available of water for irrigation purposes, soil factors which affect production, and by the potential to pollute water resources.

Agriculture use on the balance of the lot is generally of a non-commercial nature and is often promoted as an integral part of the rural-residential lifestyle. However, the use may supplement the income of the household. Land use requirements are divided into two groups; requirements relating to residential use and requirements relating to agriculture use.

<u>Land Use requirements – residential use</u>

- *The land should provide stable surface and stable soil conditions for housing construction;*
- *The land should be capable of being trenched to approximately 1m deep;*
- *The land should be capable of being relatively easily excavated to a maximum depth of 1.5 metres to allow installation of septic tank system;*
- *Soil should be capable of absorbing the effluent efficiently and purifies waterstream percolating through the soil;*
- *Soils should be capable of absorbing stormwater discharge;*
- *Soils should not be subject to waterlogging; and*
- *Dwelling and septic tank should not be threatened by flooding, wind erosion, soil erosion or bushfires.*

5.2. Land Resource Characteristics

The Land Resource Characteristics have been overlaid to determine the mapping units assessed at the subject site. The mapping units were determined by the following information:

- Soil and Landscape characteristics, including texture, depth, soil profile, aspect, slope and water table;
- Site soil testing;
- Laboratory testing of soils;
- Environmental/vegetation mapping; and
- Historical land use.

The 2 Mapping Units are defined in Table 4 below.

Table 4 – Mapping Units Proposed Rural Residential Lot 150 South Coast Highway Nornalup

Map Unit	Characteristics
Map Unit A	Sandy silty clay loams over clay, in the northern area of Lot B, slopes less than 5 degrees PRI very high, low permeability, soils have a higher clay content in the A horizon than the soils in Map Unit B. Water tables range from 270mm to 730mm. Bare paddock areas.
Map Unit B	Silty sands with loam and gravels over clay, slopes less than 5 degrees PRI very high, low permeability, soils have a higher loam and gravel content in the A horizon than the soils in Map Unit B. Water tables range 1870mm to nil intercepted. Peppermint woodland, tea tree scrub and bare paddock areas.

The mapping units of the Subject Site are shown as generalised soil diagrams below. The mapping units of the Subject Site are also illustrated in a “Mapping Units” Map over the page.

BGL **Map Unit A**

0m
Topsoil dark brown
Sandy silty clay

250mm
Dark brown silty clays
and sandy silty clays
(moist becoming wet)

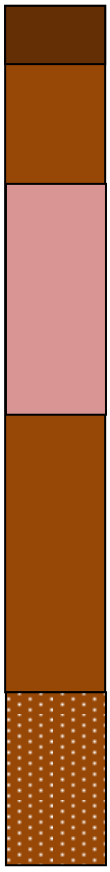
500mm

Moist to wet silty clays
(gravel pebbles)

1000mm

Mottled red/orange/grey
white clay with pebbles
(becoming dry)

2000mm



Water table between 250-730mm

(Test pits 2, 3, and 4)

Map Unit B

0m
Topsoil dark brown
sandy loam

250mm
dark brown sandy silty
loam (with gravels)
(moist)

500mm

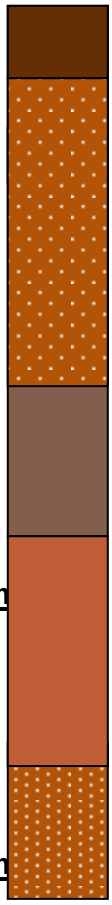
Gravelly/clay loams
and silty clays (moist)
(gravel pebbles)

1000mm

Sandy/silty clay with
gravel

Mottled red/grey/
White clay (dry)

2000mm



(Test Pits 1, 5, 6, and 7)

483270.000000 483340.000000 483410.000000

6127840.000000 6127800.000000 6127760.000000

Map Unit A

Test Pit 1

Test Pit 2

Test Pit 3

Test Pit 4

Test Pit 5

Test Pit 6

Test Pit 7

Map Unit B

10m AHD

15m AHD

South Coast Highway

McPherson Drive

Legend

- Test Pits
- Map unit A
- Map Unit B
- Cadastre
- Subject site

Scale
1:700@ A3

0 5 10 20 30 40 Meters

BIO DIVERSE SOLUTIONS

55 Peppermint Drive
Albany, WA 6330
Australia
Tel: 08 9841 3936
Fax: 08 9841 3936
Mob: 0447 555 516

CLIENT K.Lyman
150 South Coast Highway
Nornalup

Map Units

STATUS	FILE	DATE
FINAL	MSC0851	9/09/2015

6. Land Resource Survey

The Department of Agriculture and State Planning Commission utilise a five class system of assessing Land Capability, these five classes rate the degree of physical limitations associated with land use and management needed for these. Please refer to Table 5.

Table 5 Land Capability Classes

CAPABILITY CLASS	DEGREE OF LIMITATION	GENERAL DESCRIPTION
I	Very low	Areas with a very high capability for the proposed activity or use. Very few physical limitations to the specified use are present or else they are easily overcome. Risk of land degradation under the proposed use is negligible.
II	Low	Areas with a high capability for the proposed activity or use. Some physical limitations to the use do occur affecting either its productive use or the hazard of land degradation. These limitations can however, be overcome through careful planning.
III	Moderate	Areas with a fair capability for the proposed activity or use. Moderate physical limitations to the land use do occur which will significantly affect its productive use or result in moderate risk of land degradation unless careful planning and conservation measures are undertaken.
IV	High	Areas with a low capability for the proposed activity or use. There is a high degree of physical limitations which are either not easily overcome by standard development techniques or which result in a high risk of land degradation without extensive conservation requirements.
V	Very High	Areas with a very poor capability for the proposed activity or use and the severity of physical limitations is such that its use is usually prohibitive in terms of either development costs or the associated risk of land degradation.

6.1. Qualities and limitations

The proposed land use has a set of qualities for which the Land Capability Assessment will be considered. Table 6 below outlines the landscape qualities and the overall Capability rating for septic tanks in rural residential and this Subject Site. The alphabet symbol given to each quality (e.g. Ease of excavation, "x") represents the WAPC Guidelines (1989) reference to that same characteristic.

Note that for Rural Residential there are land qualities for each of the separate uses; residential, annual and perennial horticulture, and hobby farm grazing. This report focuses on the land use of Residential Use in Rural Areas (detailed at Table 9 of the WAPC Guidelines).

The main qualities required in assessing land capabilities for this Subject Site are:

- Ease of excavation;
- Foundation stability;
- Water logging hazard;
- Water erosion hazard;
- Soil nutrient retention capacity;
- Soil microbe disinfectant ability;
- Soil absorption;
- Flood hazard;
- Water pollution; and
- Water availability.

Table 6 – Land Capability for Residential Use in Rural Areas

The following table is the land capability classification system for Rural Residential from the State Planning Commission (1989) Land Capability Assessment for Local Rural Strategies.

Landscape Qualities Rural Residential					
Ease of excavation, x	Very high	Moderate	Low	Low	
Foundation stability, b	Very high	High	Moderate	Low	Very Low
Water logging hazard, i	Low	Moderate	High	Very High	
Water erosion hazard, e	Low	Moderate	High	Very High	
Wind erosion hazard, w	Low	Moderate		High	Very High
Wave erosion hazard, u				High	Very High
Soil absorption ability, a	High	Moderate	Low	Very Low	
Flood hazard, f				High	Very High
Water pollution hazard, s	Low	Moderate	High		
Bushfire hazard, z	Very low	Low	Moderate	High	Very High
Soil Salinity, y	Very low	Low	Moderate	High	
Overall capability rating	**I**	**II**	**III**	**IV**	**V**

Utilising the above table the following assessment for limitations to the Subject Site is made for Map Units A and B, please refer to Tables 7 and 8 over the page.

Table 7 – Land Capability Rating Map Unit A

Landscape Qualities Rural Residential	Map Unit A	Comments
Ease of excavation, x	Very High	Silty sands and silty clays over clay
Foundation stability, b	Moderate	Reactive clays and water table encountered
Water logging hazard, i	Moderate	Poor draining soils as compacted clay, water table intercepted between 270mm – 730mm.
Water erosion hazard, e	Low	Low slopes <5 degrees
Wind erosion hazard, w	Low	Site subject possibly to prevailing south westerly winds, low in aspect so not a high risk
Wave erosion hazard,u	N/A	Site not subject to
Soil absorption ability, a	Moderate	High PRI's low permeability, area around Test pit 2 to be avoided (north-northwest)
Flood hazard, f	Low	Elevated areas above the 10m AHD contour
Water pollution hazard,s	Low	Setbacks from riverbank over 100m can be achieved, high PRI's, water table intercepted but most areas >600mm BGL, avoid north-north west corner
Bushfire hazard, z	Very Low	BAL-Low
Soil Salinity, y	Very Low	Loamy gravelly clay soils, nil to low salinity expected and site well elevated.
Overall capability rating	**II**	**Areas with a High capability for the proposed activity or use.**

Utilising Table 6 the following assessment is made for Map Unit B, please refer to Table 8 below.

Table 8 – Land Capability Rating Map Unit B

Landscape Qualities Rural Residential	Map Unit B	Comments
Ease of excavation, x	Very High	Silty loams over gravels and clay, no rock
Foundation stability, b	Moderate	Silty sands and silty clay over clays
Water logging hazard, i	Low	Low to nil water table intercepted
Water erosion hazard, e	Low	Low slopes <5°degrees
Wind erosion hazard, w	Low	Site subject possibly to prevailing south westerly winds, low in aspect so not a high risk
Wave erosion hazard,u	N/A	Site not subject to
Soil absorption ability, a	High	High PRI recorded, low permeability
Flood hazard, f	Low	Elevated areas above the 10m AHD contour
Water pollution hazard, s	Low	Setbacks from riverbank over 100m can be achieved, low to nil groundwater intercepted.
Bushfire hazard, z	Very Low	BAL- Low
Soil Salinity, y	Very Low	Silty sandy/Clayey soils, nil to low salinity expected and site well elevated.
Overall capability rating	**I**	**Areas with a Very High capability for the proposed activity or use..**

Limitations: The different Map Units each present specific limitations due to the particular soil or landform conditions.

1) **Map Unit A – Sandy silty clay loams over clay** This unit is only limited by the waterlogging in the north-northwest and setbacks from the drains/sump, these are only considerations for on-site effluent disposal. A recommended "Land Application Area" (LAA) (150m^2 disposal field for septics) is shown in Appendix E and overlain on the Limitations mapping (note the LAA is not a limitation). . Soils have low-poorly draining soils, but with a high ability to treat of nutrients (High PRI); and

2) **Map Unit B – Silty sands with loam and gravels over clay**: this unit is only limited by the presence of the open swale drains where a 6m setback is recommended, this setback is for on-site effluent disposal only. A recommended "Land Application Area" (LAA) (150m^2 disposal field for septics) is shown in Appendix E and overlain on the Limitations mapping (note the LAA is not a limitation). Little to no water table intercepted in this Map unit.

Both areas are suitable for residential development, with minor constraints relating to on-site effluent disposal setbacks.

The overall capability of the subject area to sustain the proposed developments is summarised as **Map Unit A –** ***areas with a High capability (Land Capability Class II) of supporting the land use and limitations can be overcome by design and management inputs.***

Map Unit B – areas with a Very high capability (Land Capability Class I) of supporting the land use, there are very few physical limitations to the specified use are present or else they are easily overcome. Risk of land degradation under the proposed use is negligible.

Please refer to Limitations Mapping over the page.

483270.000000 483340.000000 483410.000000

6127840.000000 6127800.000000 6127760.000000

Test Pit 1
Test Pit 2
Test Pit 3
Test Pit 4
Test Pit 5
Test Pit 6
Test Pit 7

10m AHD
15m AHD

2382m²
2104m²
2715m²
2295m²
1097m²
1092m²

South Coast Highway
McPherson Drive

Legend

- sump
- Test Pits
- Drains
- Land Application Area
- Waterlogging
- Drain setback
- Cadastre
- Map unit A
- Map Unit B
- Subject site

Scale
1:700@ A3

0 5 10 20 30 40 Meters

BIO DIVERSE SOLUTIONS
55 Peppermint Drive
Albany, WA 6330
Australia
Tel: 08 9841 3936
Fax: 08 9841 3936
Mob: 0447 555 516

CLIENT K.Lyman
150 South Coast Highway
Nornalup

Limitations

STATUS	FILE	DATE
FINAL	MSC0851	9/09/2015

7. Planning and Management Considerations

The following recommended planning and land management considerations arise from the Environmental and Land Capability Assessment.

On-site effluent Disposal

- Residences will need to be a minimum setback of 6m from any drain, drainage channel or sub-surface drain;
- Recommended on-site effluent is via traditional effluent disposal systems with a possible site plan for each lot in Appendix E; and
- Effluent disposal is not recommended in the north-western portion of the subject site (Test pit 2).

Vegetation & Threatened Flora

- Nil constraints identified

Weed Management

- Environmental Weeds should be controlled from any further spread and controlled on site;
- To maintain a weed free site it is recommended that only native species are used for replanting in landscaped areas and at private dwellings; and
- All machines entering the site for clearing or site works should be clean and free of woody material or soil.

Fauna

- Nil constraints identified

Waterways and Wetlands

- Nil constraints identified

Disease Management

- Nil constraints identified

Drainage and Stormwater

- A 6m setback from any drain or subsurface drain is applied from any on-site effluent disposal field;
- On-site rainwater will be mandatory with the installation of rain water tanks for consumption;
- Treatment of rainwater maybe required for potable water supply refer to DoH for guidance;
- Waterwise initiatives considered at the new lots; and
- The Shire of Denmark consider diverting the current stormwater into the adjacent POS reserve and away from the subject site.

Fire Management

- Building Protection Zones (20m) are located within the individual lot to ensure that these can be maintained by the individual lot owners; and
- The proposed new dwellings are BAL-Low and a Bushfire Management Plan is not required.

Constructability

- A structural engineer is engaged prior to building construction to ascertain structural ratings for any buildings on site.

Access and Infrastructure

- Waterwise initiatives are implemented at lots;

- Water recycling, reuse and water reduction is encouraged for the development; and
- Potable water via rainfall collection from dwellings to reduce stormwater runoff.

8. Conclusions

Kath Lyman commissioned Bio Diverse Solutions (Environmental Consultants) to undertake an Environmental and Land Capability Assessment of Lot 150 South Coast Highway, Nornalup, Western Australia ("Subject Site"). The Land Capability Assessment compares the physical requirements for a particular land use with the qualities of the land. The analysis determines the ability of the land to sustain a particular land use without resulting in significant environmental degradation. The land use that has been considered for this study area is *Rural Residential with on-site effluent disposal* (as per the State Planning Commission (1989) Land Capability Assessment definition not any other planning instrument).

The assessment of the subject site involved desktop analysis of climate, site history, vegetation, river systems and geology of the site. Site assessment was undertaken of remnant vegetation, and spring flora survey. Assessment of the Subject Site included soil testing and laboratory analysis.

The mapping of land units revealed two Mapping Units:

3) Map Unit A: Sandy silty clay loams over clay, in the northern area of Lot B slopes less than 5 degrees PRI very high, low permeability, soils have a higher clay content in the A horizon than the soils in Map Unit B. Water tables range from 270mm to 730mm. Bare paddock areas.
4) Map Unit B: Silty sands with loam and gravels over clay, slopes less than 5 degrees PRI very high, low permeability, soils have a higher loam and gravel content in the A horizon than the soils in Map Unit B. Water tables range 1870mm to nil intercepted. Peppermint woodland, tea tree scrub and bare paddock areas.

The Land Capability Assessment process found that:

- Map Unit A – areas with a High capability (Land Capability Class II) of supporting the land use and limitations can be overcome by design and management inputs.
- Map Unit B – areas with a Very high capability (Land Capability Class I) of supporting the land use, there are very few physical limitations to the specified use are present or else they are easily overcome. Risk of land degradation under the proposed use is negligible.

Both areas are suitable for residential development, with minor constraints relating to on-site effluent disposal setbacks. Some planning considerations are required for Rural Residential construction, particularly a 6m buffer from the drains and sumps on site; and the north-north west corner to be avoided from on-site effluent disposal.

It is noted that this assessment does not include an engineering assessment or geotechnical assessment for structural footings/building construction and road pavement design. Bio Diverse Solutions recommends that these reports may be required prior to commencement of building/ development.

Bio Diverse Solutions conclude that if the listed "Planning and Management Recommendations" (Section 7.0) are implemented by the client, the site is capable to rezone from "Rural" to "Residential R5" under the Shire of Denmark's Town Planning Scheme No.3 (TPS3). If the listed recommendations are undertaken, the proposed subdivision development could be implemented sustainably and in an environmentally sound manner.

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Appendices

Appendix A – Location Mapping

Appendix B – Subdivision Guide Plan

Appendix C - Soil Profile Sampling Results and Test Pit Mapping

Appendix D – Soil Laboratory Results

Appendix E – Site Plan Onsite effluent disposal

Appendix F – Vegetation Mapping

Appendix A:

Location Mapping

483270 483340 483410

6127840 6127800 6127760

10m AHD

15m AHD

Lot 150 South Coast Highway Nornalup

South Coast Highway

McPherson Drive

483270 483340 483410

Legend

Subject site

Cadastre

Scale
1:700@ A3
MGA GDA 94

0 5 10 20 30 40 50 Meters

BIO DIVERSE SOLUTIONS

55 Peppermint Drive
Albany, WA 6330
Australia
Tel: 08 9841 3936
Fax: 08 9841 3936
Mob: 0447 555 516

CLIENT K.Lyman
150 South Coast Highway
Nornalup

Location Mapping

STATUS	FILE	DATE
FINAL	MSC0851	9/09/2015

476000 478000 480000 482000 484000 486000

6131000 6130000 6129000 6128000 6127000 6126000 6125000

Proposed National Park

DISTRICT HQ

WALPOLE

WALPOLE-NORNALUP NATIONAL PARK

Tingle 4 rea

Monastery Landing

Douglas Lookout

Coalmine Beach

NORNALUP INLET

Nornalup Bridge

Nornalup Timber

Lot 150 South Coast Highway Nornalup

rocky crossing

FRANKLAND RIVER

MANJIMUP

DENMARK

FICIFOLIA

sand

Bellanger Beach

476000 478000 480000 482000 484000 486000

Legend

Subject site

Scale
1:43,000@ A3
MGA GDA 94

0 0.3 0.6 1.2 1.8 2.4 3 Kilometers

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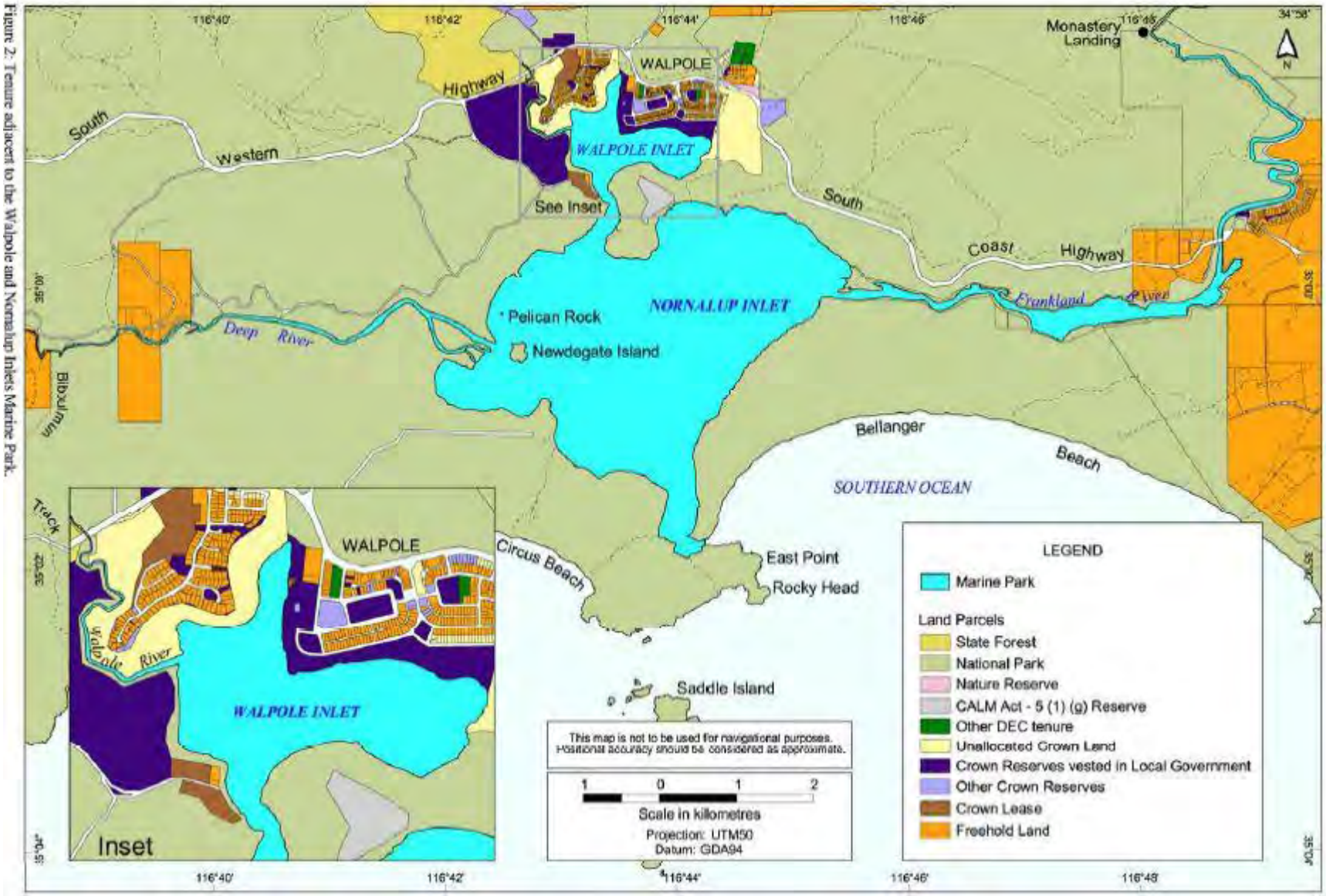
150 South Coast Highway
Nornalup

Regional Location

STATUS	FILE	DATE
FINAL	MSC081	9/09/2015

Source: DEC, 2009



BIO DIVERSE SOLUTIONS

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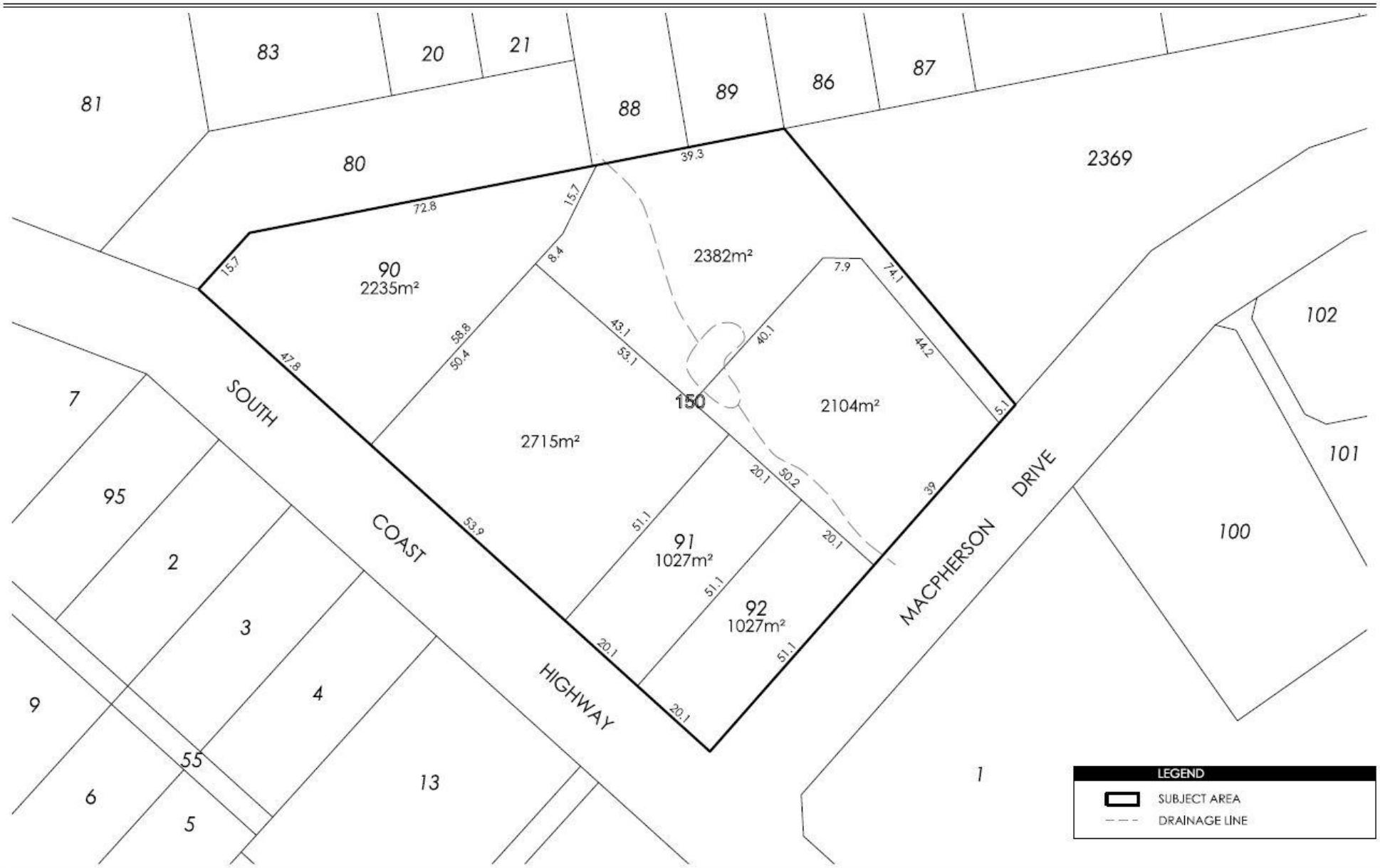
Appendix B

Subdivision Guide Plan



SUBDIVISION GUIDE PLAN

LOT 150 SOUTH COAST HIGHWAY, NORNALUP

N

SAM WILLIAMS | TOWN PLANNER
ph: 0418 116216 | email: samwilliams@westnet.com.au

scale = 1:1000 @ A4 | date = 5 MAY 2015
plan no.15-004-001

0m 5 10 15 20m

ALL AREAS, DIMENSIONS & CONTOUR LEVELS DISPLAYED ARE SUBJECT TO DETAIL SURVEY

PLANNING

Appendix C

Soil Profile Sampling Results and

Soil Test Pit Mapping

483270.000000 483340.000000 483410.000000

6127840.000000 6127800.000000 6127760.000000

Test Pit 1
Test Pit 2
Test Pit 3
Test Pit 4
Test Pit 5
Test Pit 6
Test Pit 7

Lot 150

2382m²
2104m²
2715m²
1097m²
1097m²
2235m²

Water bore

10m AHD
15m AHD

COAST South Coast Highw
McPherson Drive

Legend

- Nornalup2_1
- Cadastre

Scale
1:700@ A3

0 5 10 20 30 40 Meters

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Nornalup

Site Soil Test Pits

STATUS	FILE	DATE
FINAL	MSC0851	9/09/2015

Soil Profile Sampling

Location: Lot 150 South Coast Highway, Nornalup , WA

Date tested: 26 August 2015

Sampled by: K. Kinnear of Bio Diverse Solutions (Environmental Consultants)

Weather: Slightly overcast 15 °C

Location	Site description	Depth of profile (mm)	Soil Description	Laboratory test
Test Pit 1 6127816 483344	South west corner, middle lot B	0-70 70-600 600-1000 1000-1800 1800-2000	Moist dark brown sandy loam, organic matter Topsoil Moist brown clayey loamy gravel pebbles 20-30mm (gravels) Moist light brown clayey loam 10-20mm pebbles (gravels) Slightly moist mottled orange/grey/brown clay pebbles 10-30mm (gravels) Dry compacted light grey mottled red and pink clay, minor pebbles Water Table 1870mm  	Sample 1 PRI & Permeability 0-600mm
Test Pit 2 6127820 483367	North west Corner	0-70 70-400 400-1200 1200-1700 1700-2000	Moist dark brown silty clay, organic matter Topsoil Wet brown sandy silty clay Wet light brown silty clay Moist light brown mottled red clay pebbles 20-30mm (gravel) Moist brown sandy silt with gravel Water Table 270mm  	Sample 1 PRI & Permeability 400-800mm

Location	Site description	Depth of profile (mm)	Soil Description	Laboratory test
Test Pit 3 6127813 483363	East end of lot	0-70 70-250 250-500 500-1400 1400-2000	Wet dark brown silty clay, organic matter, topsoil Wet dark brown sandy silty clay Wet light brown sandy silty clay minor pebbles 5-10mm Wet becoming dry light brown to orange clay Dry white/grey clay Water Table 730mm  	
Test Pit 4 6127817 483330	Western boundary	0-50 50-250 250-1000 1000-1400 1400-2000	Moist dark brown silty clay, organic matter (topsoil) Moist dark brown sandy gravel pebbles 15-30mm (gravels) Moist light brown mottled red sandy clay Moist red loamy clay with pebbles 20-30mm (gravels) Dry grey mottled pink clay Water table 700mm 	

Location	Site description	Depth of profile (mm)	Soil Description	
Test Pit 5 6127797 483367	Lot a western border	0-50 50-200 200-500 500-700 700-1000 1000-1200 1200-2000	Moist dark brown sandy loam, organic matter (topsoil) Moist brown gravelly loam, pebbles 10-20mm Moist light brown sandy clayey loam pebbles 10-20mm (gravels) Moist light brown sandy clay Moist light brown sandy clay with gravels 2-30mm Moist light brown gravelly clay Slightly moist mottled red/grey/orange clay with granite granules No Water Table reached 	Sample 1 PRI & Permeability 200-1000mm
Test Pit 6 6127786 483375	Mod lot A	0-50 50-250 250-530 530-1100 1100-1700 1700-2000	Moist dark brown sandy loam, organic matter (topsoil) Moist dark brown sandy silty loam moist light brown sandy silty loam Slightly moist light brown silty clay pebbles 20-30mm Slightly moist mottled red/orange/grey clay Dry compacted red slightly mottled grey clay No Water Table reached 	

Location	Site description	Depth of profile (mm)	Soil Description	
Test Pit 7 6127787 483391	Eastern end of lot A	0-80 80-450 450-1000 1000-1200 1200-2000	Moist dark brown sandy loam, organic matter (topsoil) Moist brown sandy silty loam pebbled 15-30mm (gravels) Moist light brown silty clay pebbles 20-30mm (gravels) Moist yellow/light brown sandy clay Dry mottled red/grey/orange clay No Water table reached	Sample 1 PRI & Permeability 400-1000mm

Appendix D

Soil Laboratory Results

Permeability &

Phosphorus Retention Index (PRI)

Customer Bio Diverse Solutions
Job Nornalup
Date Rec'd 2/09/2015
Laboratory Test: Phosphorous Retention Index

Lab Number	Name	Code	Customer	Depth mm	Phosphorus Retention Index
4SS15079	TEST PIT 1	2/9/15	K KINNEAR	0-600	2053.1
4SS15080	TEST PIT 2	2/9/15	K KINNEAR	400-800	401.9
4SS15081	TEST PIT 5	2/9/15	K KINNEAR	200-1000	906.9
4SS15082	TEST PIT 7	2/9/15	K KINNEAR	400-1000	1016.6

Falling Head Permeability
AS 1289.6.7.2

Mining & Civil Geotest Pty Ltd
Ph (08) 9414 8022 Fax (08) 9414 8011
Unit 1/1 Pusey Road, JANDAKOT WA 6164

		Job No:	60211
		Report No:	60211-P15/6269
		Date of issue:	18-Sep-15
Client:	Albany Soils & Concrete (Bio Diverese Solutions)	Date tested:	Sep 2015
Client Email:	marty_albanysoil@yahoo.com.au		
Project:	Submitted Clay Samples	Tested by:	R. Donaldson
Location:	Test Pits - 150 Sth Cst Hwy - Nornalup	Checked by:	S. Davies

Sample Number	P15/6269	P15/6270	P15/6271	P15/6272
Sample Identification	Pit 1	Pit 2	Pit 5	Pit 7
Laboratory Moisture Ratio (%)	100.0	100.0	100.0	100.0
Laboratory Density Ratio (%) (%)	92.5	93.0	94.0	93.5
Compactive Effort	Modified	Modified	Modified	Modified
Hydraulic Gradient	0.6	0.6	0.6	0.6
Surcharge (kPa)	3	3	3	3
% Retained on 19mm sieve				
Coefficient of Permeability (m / sec)	$7.6 \times 10^{(-9)}$	$9.9 \times 10^{(-9)}$	$1.5 \times 10^{(-8)}$	$4.2 \times 10^{(-9)}$
Tested as received				

Constant Head Aug 2013

NATA

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Approved Signature Matt van Herk

Appendix E

Site Plan for on-site effluent disposal

483340 000000 483410 000000

6127840 000000 6127800 000000 6127760 000000

Land Application Area
(disposal field)
230m2, (min requirement of 150m2)

Lot B

Test Pit 2

Test Pit 4

Test Pit 1

2382m²

Test Pit 3

15m AHD

10m AHD

2369

9.4 degrees

90

Sump

Drain

Land Application Area
(disposal field)
230m2, (min requirement of 150m2)

Test Pit 5

150

Test Pit 6

Test Pit 7

2104m²

Drain

Lot A

2715m²

Drain

Water bore, 40m to new lot boundaries

Macpherson Drive

COAST

South Coast

91

483340 000000 483410 000000

Legend

- Sump
- Sub surface sump
- Nornalup2_1
- Drains
- Land Application Area
- Drain setback
- Subject site
- Cadastre

Scale
1:600@ A3

0 4.5 9 18 27 36 Meters

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150 South Coast Highway
Nornalup

Site Plan Lot A and B

STATUS	FILE	DATE
FINAL	MSC0851	9/09/2015

Appendix F

Vegetation Mapping

483200 483300 483400 483500 483600

6127940 6127880 6127820 6127760 6127700 6127640

10m AHD

15m AHD

Isolated Karri trees

Lot 150

Pine trees

Tea Tree Scrub

Peppermint Woodland

McPherson Drive

Coast Highway

Legend

- 100m Bushfire Prone
- subject site
- Tea tree scrub
- Peppermint Woodland
- Cadastre
- Isolated Karri Trees
- Cleared or bare areas

Scale 1:1,900@ A3

0 12.5 25 50 75 100 Meters

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Vegetation Mapping

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