

- Legend**
- Site Boundary
 - Cadastral Boundary
 - - - Easement Boundary
 - Topographic Contour
 - Watercourse
 - ★ Rural Dwelling
 - ★ Dwelling Within Subject Land
 - Combined Buffer
 - Land to be Used as Rotational Outdoor Piggery (ROP)

- Buffers required:
- National Environmental Guidelines for Piggeries (Australian Pork Limited (Tucker et al., 2010))**
- Public road carrying < 50 vehicles per day 100m
 - Public road carrying > 50 vehicles per day 200m
 - Property boundary 20m
- Department of Agriculture and Food (2000) Environmental Guidelines for New and Existing Piggeries Bulletin 4416**
- Isolated rural dwellings 300 m
 - Neighbouring rural property boundaries 50 m
 - Major water course 100 m
 - Minor water course 50 m

CONTOUR SOURCE: Dept. of Agriculture, 2000.
 CADASTRAL SOURCE: Landgate, October 2021.
 AERIAL PHOTOGRAPH SOURCE: ESRI, January 2020.
 WATERCOURSE SOURCE: Landgate 1:50 000 topographic mapping.

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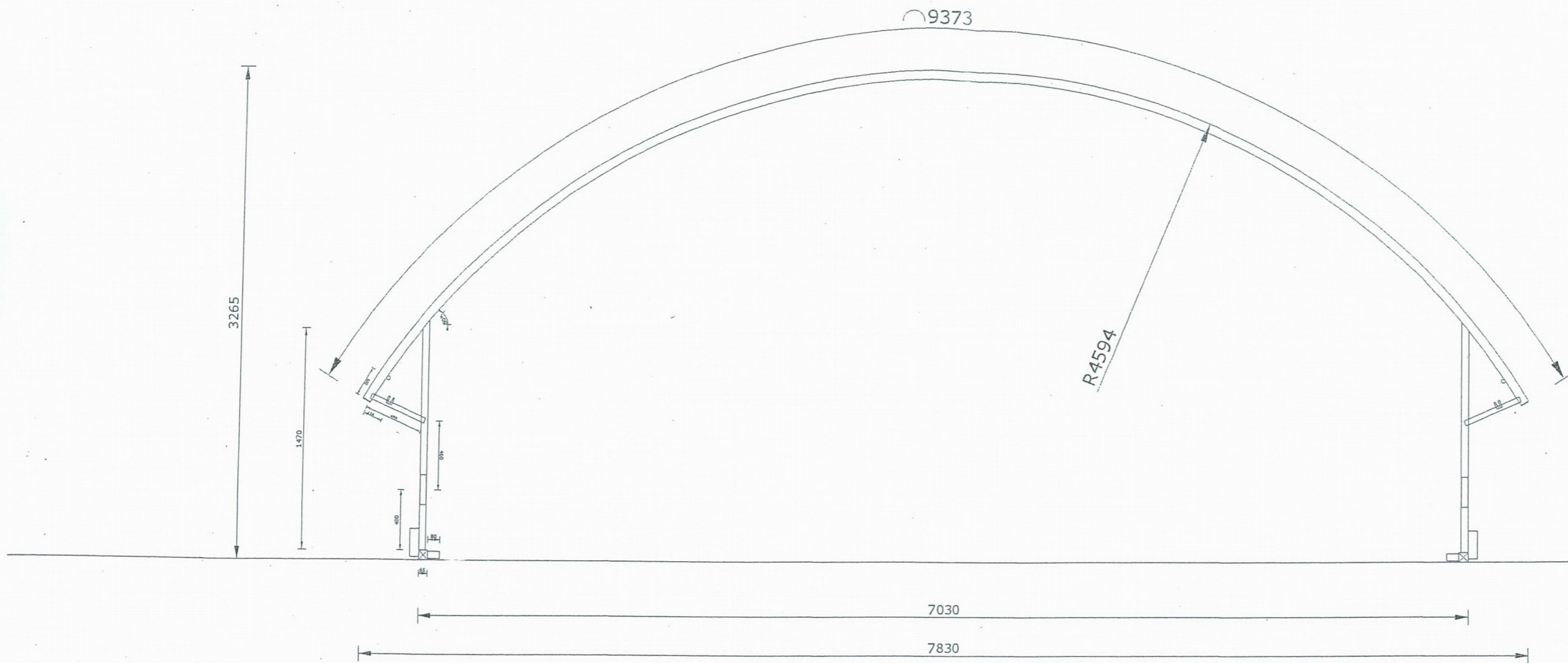
Sangarra South Pty Ltd aff Sangarra Livestock Trust
 ENVIRONMENTAL ASSESSMENT & MANAGEMENT PLAN - OUTDOOR ROTATIONAL PIGGERY BREEDER FACILITY - LOT 5856 (NO. 1028) YUNGUP ROAD, NARRIKUP

Drawn: M. Price Date: 3 Nov 2021

SITE FEATURES

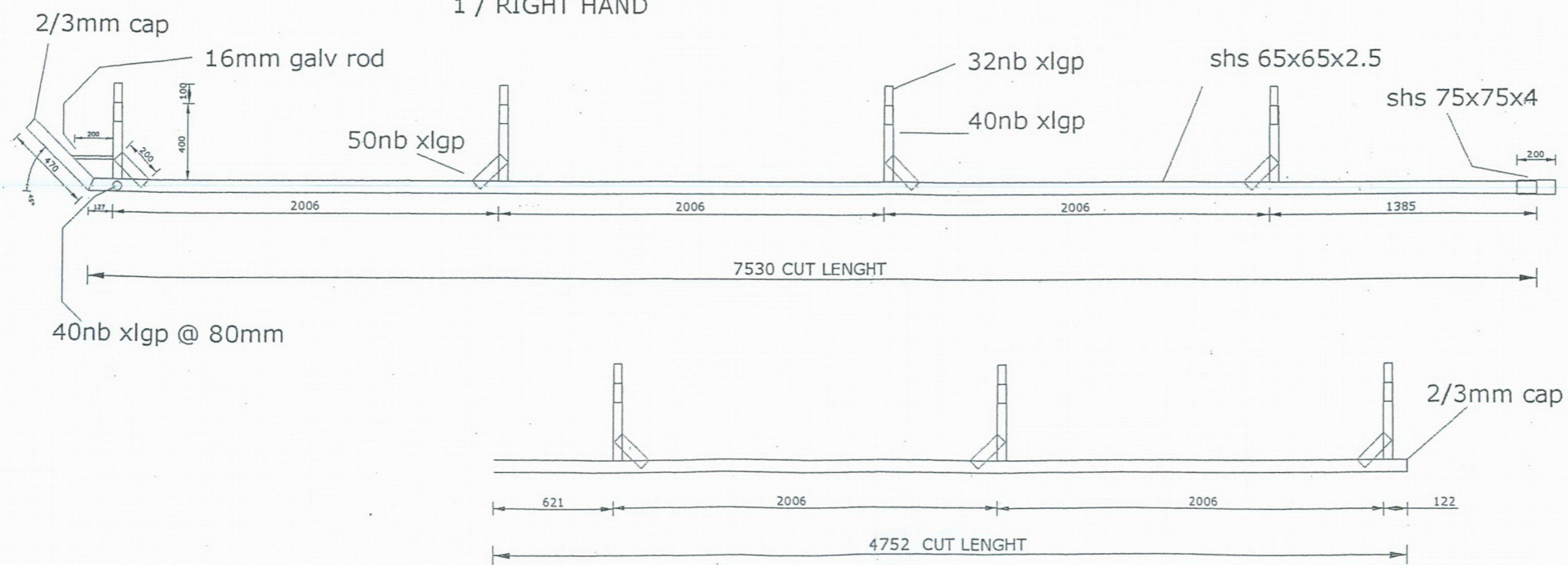
Figure 2

Job: SLT2021-001



12x7m DOME SHELTER SKIDS - 1 / SET

- 1 / LEFT HAND
- 1 / RIGHT HAND



**ENVIRONMENTAL ASSESSMENT & MANAGEMENT PLAN
OUTDOOR ROTATIONAL PIGGERY – BREEDER FACILITY
LOT 5856 (NO. 1028) YUNGUP ROAD, NAPIER
CITY OF ALBANY**



Prepared For:

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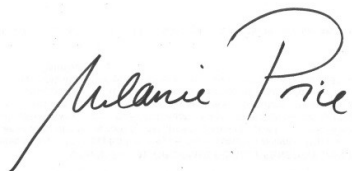
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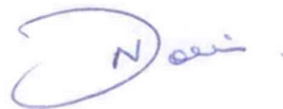


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LIST OF ABBREVIATIONS

AEP	Annual exceedance probability
AHD	Australian Height Datum
ARVS	Albany Regional Vegetation Survey
ASS	Acid Sulfate Soil
CER	Consultative Environmental Review
EPA	Environmental Protection Authority
ha	Hectare
kg	Kilogram
km	Kilometre
m	Metre
mS/cm	Millisiemen per centimetre
L	Litre
UCL	Unallocated Crown Land
WAPC	Western Australian Planning Commission

EXECUTIVE SUMMARY

This document outlines an environmental assessment and management plan (EAMP) for the operation of a breeder rotational outdoor piggery (ROP) Lot 5856 (No. 1028) Yungup Road, in Napier in the City of Albany. The EAMP has been prepared to demonstrate how the operation will satisfy guidelines, policies and legislation which apply to piggeries of this type.

The following matters have been considered in planning for the ROP:

- Policy framework for the establishment of piggeries generally and outdoor rotational operations specifically;
- Land capability, buffers and sensitive receptors; and
- Process and environmental management of the proposed operation.

The ROP will operate under the National accreditation process of the Australian Pork Industry Quality Assurance Program (APIQ[✓][™]) which sets standards for management, animal welfare, biosecurity, environmental sustainability and transport.

Property details include:

Property Details	Lot 5856 (No. 1028) Yungup Road, Napier, City of Albany Deposited Plan 116112
Area	304.7289 hectares (ha)
Ownership	Sangarra South Pty Ltd atf Sangarra Livestock Trust
City of Albany Local Planning Scheme No. 1 - Zoning	The subject land is zoned 'Priority Agriculture'.

The proposal comprises the following:

Piggery Type:	Free range breeder piggery based on a rotational operation.	The piggery will be certified and operated in accordance with the APIQ Assurance Program ¹ . In addition, the pigs will be compliant with RSPCA Approved Farming Scheme Standards for Pigs (RSPCA, 2018)
Total number of pigs:	50 gilts, 830 gestating sows, 170 lactating sows, 50 boars and 1445 suckers (piglets). 338 pigs to market per week.	1000 sow - Output of approximately 17,600 weaner pigs per year
Rotation	This investigation identifies areas which are suitable for ROPs based on environmental criteria.	Areas have been calculated based on the densities in the Model Code for Pigs (2008). Each rotation area will be used for two years and used for intensive cropping for at least two years. This

¹ APIQ Program Outline Australian Pork Limited, 2021: <https://www.apiq.com.au/about/program-outline/>

		assessment concludes that 130.23 ha is suitable for a ROP which provides 3 rotations based on each rotation comprising 43.14 ha.
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This assessment concludes that the subject land is suitable for the proposed ROP. Recommendations regarding sustainable management are made in Sections 6 and 7.

The following summarises compliance with policies, guidelines and planning requirements:

Item	Guideline/ requirement	Comment
National Environmental Guidelines for Piggeries - Australian Pork Limited (Tucker <i>et al.</i>, 2010)		
Buffers requirements	<p>Buffers required:</p> <ul style="list-style-type: none"> - Public road carrying < 50 vehicles per day – 100m. - Public road carrying > 50 vehicles per day – 200m - Town - 750m - Rural residential area - 500m - Rural dwelling – 250m - Property boundary – 20m 	<p>The proposed ROP meets buffer requirements.</p> <p>The closest dwellings external to the subject land is Lot 71 Elliot Road which has a dwelling within 629 m of the nearest possible ROP. The distance exceeds the minimum requirement of 250 m/ 300² m from any possible ROP unit.</p> <p>All other dwelling external to the property are in excess of 300 m from the proposed ROP area.</p>
Model Code of Practice for the Welfare of Animals – Pigs (Primary Industries Standing Committee, 2008)		
Royal Society for the Prevention of Cruelty to Animals (RSPCA) Approved Farming Scheme Standards for Pigs		
Density of Pigs	<p>Model Code of Practice for the Welfare of Animals – Pigs (COP; Primary Industries Standing Committee, 2008): 20 – 25 dry sows/hectare (ha) and 9 - 14 lactating sows with piglets per ha.</p> <p>Royal Society for the Prevention of Cruelty to Animals (RSPCA) Approved Farming Scheme Standards for Pigs – 30 adult pigs/ha</p>	<p>Current calculations have used Model Code of Practice and RSPCA pig densities:</p> <p>Application of buffer requirements indicate that 130.23 ha is available for ROP. This includes setbacks from boundaries, roads and water features, plus removal of some of the blue gums. There is room for 3 rotations for a 1000 sow ROP.</p>

² A buffer 300m from rural dwellings is recommended in the Department of Agriculture *Guidelines for New and Existing Piggeries* (2000). 250m is considered adequate in Australian Pork Limited *National Guidelines for Rotational Outdoor Piggeries* (2013). In this case, the most conservative distance has been included.

Fact Sheet - Design and Management of Outdoor Free Range Areas for Pigs – Australian Pork Limited (APL, 2011)		
Site selection factors:	Recommendation	
Annual rainfall less than 750mm	730mm per annum (Weatherzone, 2021)	The subject land meets this site selection requirement.
Mean maximum January temperature less than 28°C	26.1°C in January (Weatherzone, 2021)	The subject land meets this site selection requirement.
Mean minimum July temperature exceeding 3°C	6.1°C in July (Weatherzone, 2021)	The subject land meets this site selection requirement.
Densities: Based on Model Code densities (which are less dense than RSPCA standards)	Based on Model Code densities, a 1000 sow operation would require a minimum of 46.33 ha area per ROP rotation (not including access ways).	If 130.23 ha of the site is usable for the ROP, this would allow for 3 rotations. At least 2 and preferably 3 rotation areas are recommended for operation.
Buffer of 800 m between piggery and major water supply storage	There are no major water supply storage areas within 800m of the subject land.	Proposed ROP meets this site selection requirement.
Buffer of 100m between piggery and a defined water course	ROP set back at least 100m from water courses, dams and wetlands..	The ROP has been designed to comply with these buffer requirements.
Buffer of 200 m to a public road carrying more than 50 vehicles per day	Yungup Road (presumably) carries more than 50 vehicles per day. A buffer for proposed ROP allows for a 200m buffer. Elliot Road is presumed to carry less than 50 vehicles per day. A buffer of 100 m has been applied	Proposed ROP meets this site selection requirement.
Buffer of 750 m to a town site.	There are no town sites within 750 m. The closest townsites are Narrikup and Redmond which are 16 km to the north west and south west, respectively.	Proposed ROP meets this site selection requirement.
Buffer of 500 m to a rural residential area.	There are no rural residential areas within 500 m.	Proposed ROP meets this site selection requirement.
Buffer of 250 m to external rural dwelling	The closest dwelling external to the subject land is Lot 71 Elliot Road which has a dwelling within 629 m of the nearest proposed ROP area. The distance exceeds the minimum requirement of 250 m/ 300 m from any possible ROP unit.	No dwellings are within 250 m/ 300 m of the proposed ROP.
Buffer of 20m from a property boundary	All proposed ROP units are at least 20m from the property boundary.	The ROP can be designed to comply with this buffer requirements.
Sensitive Agricultural Sites (DPIRD)	Sensitive sites do not preclude other agricultural land uses but highlight the need to consider sensitive agricultural pursuits.	No DPIRD registered sensitive agricultural sites are within 1km of proposed development. The closest is 10 km to the

		south west on Redmond Hay River Road (viculture; DPIRD, 2021).
Soils: Well drained soils with sufficient capacity to retain nutrients	The ROP sites will ideally be placed in well drained loams with a high PBI (e.g. gravelly sands and sandy soils with a clay content at depth).	The subject land meets the drainage site selection requirement. Adsorption of phosphorus will be moderate to extremely low, rather than high.
Slopes: Gently sloping land	The site is gently sloping to allow for drainage but not so steep that erosion is likely to occur.	The subject land meets with this requirement for most areas and should be acceptable if sufficient drainage measures are implemented to manage surface runoff.
DPIRD (Department of Agriculture and Food, 2000) Environmental Guidelines for New and Existing Piggeries Bulletin 4416		
Buffers	<p>Townsite boundaries -1000 m</p> <p>Special rural areas – 1000 m</p> <p>Isolated rural dwellings – 300 m</p> <p>Public roads – 50m</p> <p>Neighbouring rural property boundaries – 50 m</p> <p>Public Drinking Water Source – not permitted</p> <p>Major water course – 100 m</p> <p>Minor water course – 50 m</p> <p>Bores, wells, soaks for private drinking water supply and or stock irrigation water supply – 300 m</p>	The ROP has been designed to comply with these buffer requirements, except rather than a 50 m buffer to neighbouring rural property boundaries, 20 m has been applied, consistent with National Environmental Guidelines for Piggeries - Australian Pork Limited (Tucker <i>et al.</i> , 2010).
	<p>Water requirements:</p> <p>Summer: 15 L per dry sow per day to 80 L per lactating sow per day.</p> <p>Winter: 15 L per weaner per day to 58 L per lactating sow per day.</p> <p>Water for wallows are also required.</p> <p>Water quality: Short term upper level salinity of 4,500 mg/L of total dissolved solids or 3000 mg/L for long term use.</p>	<p>Not including wallows, approximately 11.5 ML of good quality water will be needed per annum. The landowner has advised that water requirements have been considered and that there are adequate resources for the ROP.</p> <p>Water quality is not known at this stage, but it is presumed to be adequate for pigs.</p>
	<p>Drainage: well drained, level or gently sloping</p> <p>Slope: Between 1:20 and 1:200 to prevent erosion (if steep) and ponding (if flat).</p> <p>Groundwater: Maximum 1.5 m below ground level (throughout the year).</p> <p>Soil phosphorus retention index greater than 10.</p>	<p>The subject land is relatively flat with gentle slopes, with a fall of 10 m over its entirety. Water gaining areas will be avoided to reduce land degradation and nutrient export. Drainage design and management will be key to the successful operation of the ROP.</p> <p>Due to the duplex soils, depth to groundwater exceeds 1.5 m below ground</p>

		<p>surface. Groundwater levels most likely around 80 mAHD (Smith, 1992).</p> <p>The subject land meets this site selection requirement, with well drained soils although adsorption of phosphorus is likely to be low to moderate rather than high for some areas.</p>
<p>Guidance for the Assessment of Environmental Factors – Separation Distances between Industrial and Sensitive Land Uses No. 3 June 2005 (EPA 2005)</p>		
<p>Buffers</p>	<p>Extensive Piggery – premises on which pigs are fed, watered and housed in outside paddocks or enclosures – 1000m</p>	<p>There are no EPA³ defined sensitive sites within 1km of proposed ROP.</p>

³ Noting that in the case of free range piggeries, a separation of 1000 m to single rural residences is not required – 250 – 300 m separation are the guideline recommendations.

1 INTRODUCTION

Sangarra South Pty Ltd as trust for Sangarra Livestock Trust is seeking planning approval from the City of Albany to establish a breeder rotational outdoor piggery (ROP) at Lot 5856 (No. 1028) Yungup Road, in Napier (Figure 1). The subject land comprises 304.7289 hectares (ha) and is currently used for broad acre farming including grazing and blue gum plantings. The piggery operation is proposed to complement the existing operations, with the ROP area intended to rotate over some of the current grazing and blue gum plantation areas.

The proposed ROP is a free range system, not a shedded operation. Shedded operations are much more intensive than ROPs, with significant implications for noise, odour and effluent disposal. Free range piggeries are defined by the fact that the pigs that are not closely confined and have access to outdoor areas compared to pigs that are confined to small stalls or pens in sheds.

1.1 PROPERTY AND APPLICANT DETAILS

Property and applicant details are summarised in Table 1.

TABLE 1: PROPERTY AND APPLICANT DETAILS

Property Details	Lot 5856 (No. 1028) Yungup Road, in Napier, City of Albany Deposited Plan 116112
Area	304.7289 hectares (ha)
Ownership	Sangarra South Pty Ltd atf Sangarra Livestock Trust
City of Albany Local Planning Scheme No. 1 - Zoning	The subject land is zoned 'Priority Agriculture'.

1.2 SCOPE OF WORKS

This document considers the existing environment of the subject land and requirements for ROPs according to national standards and environmental guidelines, state policies and codes of practice. The document also considers City of Albany planning instruments.

Information gathered during desktop and field surveys in relation to the subject land is considered in the potential impacts of the ROP. This EAMP outlines management strategies to ensure sustainable operation of the piggery.

Preparation of this document has included:

- A desktop review of existing information;
- Site inspection;
- Soil assessment and testing;
- Consideration of applicable standards, guidelines and policies.

2 POLICIES AND PLANNING FRAMEWORK

The following standards, guidelines and policies apply to the operation and management of the ROP.

2.1 NATIONAL GUIDELINES

2.1.1 National Environmental Guidelines for Rotational Outdoor Piggeries

The *National Environmental Guidelines for Rotational Outdoor Piggeries* (Tucker and O’Keefe, 2013) provides guidance with respect to the siting, buffers and operation of piggeries which are free range and operated on a rotational basis. This document provides a useful guide in the form of a planning principles checklist that is applicable to this development. The structure of this EAMP is based on the *National Environmental Guidelines for Piggeries Planning Principles*. A copy of the Planning Principles checklist is included in Appendix A.

2.1.2 APIQ[✓]™ Standards Manual for Rotational Outdoor Piggeries

APL has worked with key stakeholders to develop a *Standards Manual for Rotational Piggeries* (2012), referred to as the *Australian Pork Industry Quality Assurance Program* (APIQ[✓]™). The program aims to put into place documented procedures and methodologies to carry out key tasks to ensure that high quality pig products can be produced consistently and impacts on the environment and surrounding amenity are reduced and sustainably managed. A number of sections of the APIQ[✓]™ relate to planning principles which are considered in this EAMP, including (see Appendix B):

- Site selection;
- Environmental impact assessment;
- Proposed environmental management;
- Free range production requirements (including soil monitoring);
- Nutrient management;
- Land and water protection strategies; and
- Other requirements.

This ROP will be registered and operated in accordance with the APIQ[✓]™ framework.

2.1.3 Fact Sheet, Design and Management of Outdoor Free Range Areas for Pigs

Australian Pork Limited (2011) has produced a fact sheet that summarises the desired site selection characteristics, buffer distances and nutrient management actions specifically for outdoor free range piggeries. This fact sheet provides a reference for the assessment of the suitability of the site for the development of a free range piggery, and independent verification of the proposed management practices. A copy of the fact sheet is included in Appendix C.

2.1.4 Piggery Manure and Effluent Management and Reuse Guidelines

The *Piggery Manure and Effluent Management and Reuse Guidelines* (Tucker, 2015) were developed by APL to provide best practice guidelines for the treatment and management of piggery outputs using

methodologies such as composting. Outputs such as spent bedding and manure are valuable resources that can help to generate a viable income stream for piggery operators. Sustainable practices are required to ensure that management of these products does not cause nutrient overloading or result in nutrient export to waterways.

2.1.5 Model Code of Practice for the Welfare of Animals – Pigs (Revised)

The Model Code of Practice for the Welfare of Animals – Pigs (Revised) was prepared by the Animal Welfare Working Group (AWWG) within the Primary Industries Ministerial Council (PIMC) committee system in 2007. The document guides the care and management of pigs so that the basic needs of food, water, space, socialisation, accommodation/shelter and health care are of an adequate standard.

2.2 WESTERN AUSTRALIAN POLICIES AND GUIDELINES

2.2.1 Environmental Protection Act 1986

ROPs do not constitute a prescribed activity under the *Environmental Protection Act 1986* (EP Act) and therefore do not require a works approval or licence from the Department of Water and Environmental Regulation (DWER).

2.2.2 Environmental Protection Authority Guidelines

The Western Australian Environmental Protection Authority (EPA) uses *Guidance for the Assessment of Environmental Factors – Separation Distances between Industrial and Sensitive Land Uses No. 3* (EPA, 2005). The guidance statement is intended to provide advice on generic separation distances between specific industry and sensitive land uses to avoid or minimise the potential for land use conflict. The distances outlined are not intended to be absolute separation distances, rather they are a default distance for the purposes of:

- Identifying the need for specific separation distance or buffer definition studies; and
- Providing general guidance on separation distances in the absence of site specific technical studies.

The separation distances in EPA *Guidance Statement 3* (EPA, 2005) are intended to be used as a tool, supplemented by other appropriate techniques, to assist in the assessment of:

- New individual industries, infrastructure and estates, in the vicinity of existing/proposed sensitive land uses; and
- New individual sensitive land uses or estates, in the vicinity of existing/proposed industry and infrastructure.

The Guidance states that extensive piggery (premises on which pigs are fed, watered and housed in outside paddocks or enclosures) may need a 1000 m buffer to sensitive land uses (Table 2). Land uses considered by the guidelines to be potentially sensitive to emissions from industry and infrastructure include residential developments, hospitals, hotels, motels, hostels, caravan parks, schools, nursing homes, child-care facilities, shopping centres, playgrounds, and some public buildings. Some commercial, institutional and industrial land uses which require high levels of amenity or are sensitive to particular emissions may also be considered “sensitive land uses”. Examples include some retail outlets, offices and training centres, and some types of storage and manufacturing facilities.

Single rural dwellings are generally not considered to be a sensitive receptor requiring a 1,000 m buffer. The EPA Guidance statement refers to Department of Primary Industry and Regional Development (DPIRD) *Guidelines for New and Existing Piggeries* (Latto *et al.* 2000; Table 2 Page 10) which state that a buffer to isolated rural dwellings should be 300m.

The *National Environmental Guidelines for Rotational Outdoor Piggeries* (Tucker and O’Keefe, 2013) recommend a 250m buffer to rural residences and are based on extensive research and experience and have been adopted in New South Wales, Victoria and Queensland. Additional research has been undertaken by the University of Queensland in support of the ROP Guidelines (Banhazi, 2013) for noise, dust and odour.

TABLE 2: EPA GUIDANCE STATEMENT NO. 3 FOR EXTENSIVE PIGGERIES

Industry	Description	DWER Licence or Works Approval Required?	Key Government Agency for Advice	Code of Practice	Impacts	Buffer Distance to defined sensitive land uses
Piggery - Extensive	Premises on which pigs are fed, watered and housed in outside paddocks or enclosures	Not required	DPIRD, DWER, Local Government Authority	DPIRD Guidelines (Latto <i>et al.</i> , 2000)	Dust and odour	1000m (Guidance defers to DPIRD buffer for isolated rural dwellings of 300m)

2.2.3 Statement of Planning Policy No 2.5 –Rural Planning

The objectives of *State Planning Policy 2.5 Rural Planning* (SPP 2.5; Western Australian Planning Commission, WAPC, 2016) are to protect rural land from incompatible land uses by making land use decisions to support existing and future primary production and protection of priority agricultural land, particularly for the production of food. The policy supports regional development of rural enterprises, seeks to protect and improve environmental and landscape assets and minimise land use conflicts. The policy guides the preparation of planning schemes and other planning decisions.

2.2.4 Department of Primary Industries and Regional Development Western Australia – ‘Sensitive Sites’

Sensitive Sites Western Australia (WA) is a DPIRD service designed to help identify the location of sensitive agricultural production systems within the agricultural region of WA. This service aims to assist growers in preparing risk assessment and risk mitigation plans for their ongoing production activities and help protect sensitive agricultural production systems. There are no DPIRD listed ‘sensitive sites’ within 5km of the proposed ROP (DPIRD, 2018).

2.3 LOCAL GOVERNMENT AUTHORITY

The City of Albany Local Planning Scheme (LPS) No. 1 defines extensive piggeries as a 'Animal Husbandry - Intensive'. This type of land use is discretionary in 'Priority Agriculture' zones and subject to planning scheme consent by the City of Albany, subject to meeting the requirements of environmental guidelines and other applicable standards. Development for such a purpose requires approval by Council to ensure that siting, operations and management objectives can be met. Council considers each application based on its merits and likely impacts, to ensure that relevant factors are taken into consideration.

2.4 RESEARCH REGARDING ODOUR, DUST AND NOISE

Studies undertaken by the University of Southern Queensland and National Centre for Engineering in Agriculture, (Banhazi, 2013) for representative free-range piggeries suggest that odour, dust and noise related to operations are not likely to be significant issues if National Environmental guidelines are adhered to. Key findings of the 2013 study were:

Odour: The measured odour emission rates were not significantly different between farms ($p=0.29$) and compared to mean odour emissions measured from beef feedlot pens, the emission rates measured in this study were very low. Therefore, odour reduction strategies other than standard management of manure and bedding are not required.

Dust: Very low dust concentrations were measured on all farms. Most peak dust concentrations were associated with tractor/machinery movements. The high peak concentrations lasted only for a short period of time and the dust settled quickly after these events. It is likely that the low dust concentrations helped maintain low odour concentrations on farms as well. These results would be strongly linked to soil type.

Noise: Very low noise levels were detected on all farms and the results demonstrated that free-range piggeries are quieter places than traditional piggery buildings. Casual observations indicated that many of the noise peaks were related to machinery noise, bird and insect activity. Wind and rain also contributed to general noise levels. Very few vocalisations by pigs were observed during data recording. It was concluded that free-range piggeries would contribute very little to noise pollution levels of neighbouring areas.

2.5 ENVIRONMENTAL PRACTICE

The Proponent is committed to protecting the environment by reducing the environmental risks of operations. Therefore, the operators and owners voluntarily commit to the following:

1. Sustainable development - Integrate environmental management into planning and decision making processes, to ensure sustainability and minimal impact on the environment.
2. Pollution prevention – Conduct operations in a manner that prevents pollution, conserves resources and proactively addresses past environmental contamination (where this is applicable).
3. Legal compliance - Ensure that operations comply with applicable environmental guidelines, regulations and requirements.

4. Employee involvement - Ensure environmentally responsible stewardship by employees through recycling, conserving resources, reducing waste and eliminating environmental risks in business operations.
5. Continual improvement - Regularly measure performance and practice continual improvement.
6. Training - Staff will be adequately trained in environmental management.

3 THE PROPOSAL

Table 3 summarises the proposal, which is to establish a breeder ROP where pigs are bred and piglets removed at weaning for grow-out elsewhere. The proposal is for a 1000 sow ROP. Notionally, a 1,000 sow ROP would comprise the number and type of pigs outlined in Table 3, at any one time. A total of 17,576 weaner pigs is likely to be exported from the property each year. The piggery will be certified and operated in accordance with the APIQ Assurance Program and to RSPCA Standards.

TABLE 3: THE PROPOSAL

Piggery Type:	Free range breeder piggery based on a rotational operation.	The piggery will be certified and operated in accordance with the APIQ Assurance Program ⁴ . In addition, the pigs will be compliant with RSPCA Approved Farming Scheme Standards for Pigs (RSPCA, 2018)
Total number of pigs:	50 gilts, 830 gestating sows, 170 lactating sows, 50 boars and 1445 suckers (piglets). 338 pigs to market per week.	1000 sows - Output of approximately 17,576 weaner pigs per year
Rotation	This investigation identifies areas which are suitable for ROPs based on environmental criteria.	Areas have been calculated based on the densities in the Model Code for Pigs (2008). Each rotation area will be used for two years and used for intensive cropping for at least two years.

⁴ APIQ Program Outline Australian Pork Limited, 2021: <https://www.apiq.com.au/about/program-outline/>

4 SITE DESCRIPTION

4.1 LOCATION AND CURRENT LAND USE

The subject land is situated in the locality of Napier (Figure 1), approximately 6.8 km west of Napier Hall on Chester Pass Road and 16 km east of Redmond and Narrikup townsites. The subject land comprises 304.7289 ha and is zoned 'Priority Agricultural' under the City of Albany LPS No. 1 (Appendix D) and is currently used for grazing and blue gum plantings.

The main access to the proposed ROP area for traffic will be via Settlement Road (bitumen) and Elliot Road (gravel).

The subject land is located in a farming area comprising lots between 46 ha and 346 ha, which are largely used for grazing, cereal cropping, blue gum plantations and mixed horticulture.

4.2 SURROUNDING LAND USES AND SENSITIVE RECEPTORS

The property abuts the boundary to the Shire of Plantagenet (immediately to the north and west). Surrounding land is zoned for the following uses (Appendix D):

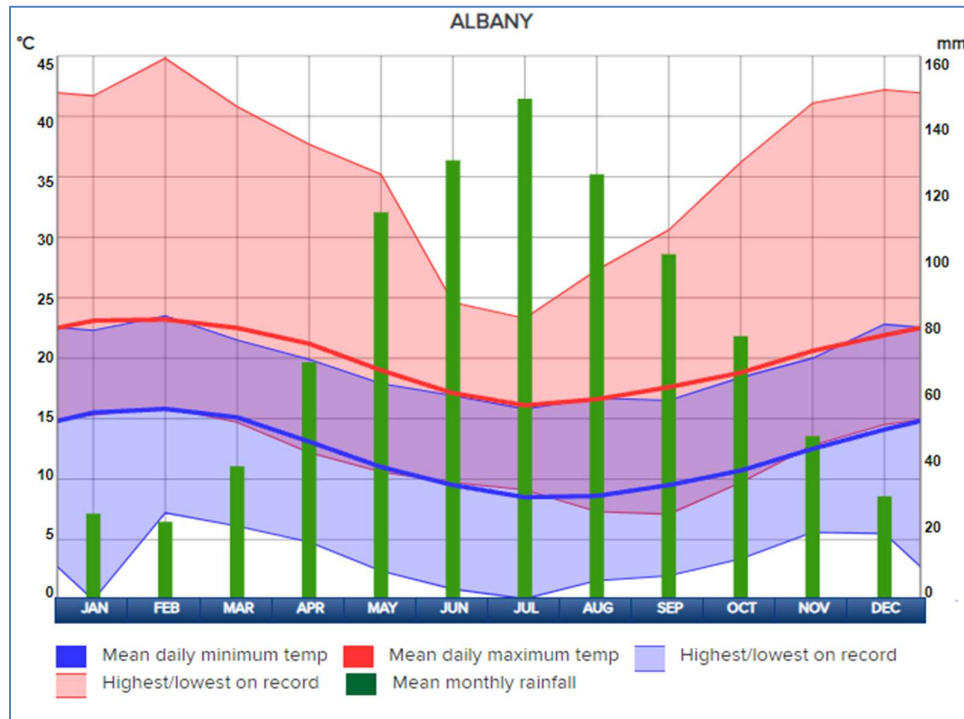
- 'Priority Agriculture' to the east and south (City of Albany Local Planning Scheme No. 1);
- 'Rural' for land to the north and west (Shire of Plantagenet Local Planning Scheme No. 5);
- 'Parks and Recreation' Millbrook Nature Reserve 2 km to the south; and
- Fletcher's Abattoir is 5 km to the west on Settlement Road.

4.3 CLIMATE

Napier has a Mediterranean climate with generally hot summers and cool, wet winters. Proximity to the south coast 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 the area's annual rainfall. Atmospheric disturbances embedded in the westerly winds are common in the winter months with sometimes several cold fronts passing through southwest Western Australia in a week.

Climate is summarised in Plate 1 and discussed below. The climate in the region is conducive to the establishment of a ROP as extremes of heat and cold are generally not experienced.

PLATE 1: CLIMATE



Source: Weatherzone, 2021. <https://www.weatherzone.com.au/climate/station.jsp?lt=site&lc=9581>

Rainfall

The closest rainfall measurement station to the subject land is Kalgan River (Bureau of Meteorology (BOM) site number 9559; Plate 1). The Kalgan River’s long-term median annual rainfall is 730 mm per annum, although there can be considerable variation in the total rainfall from year to year (BOM, 2021). On average, approximately 50% of the annual rainfall occurs between May and September. 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. July is the wettest month, with a long-term average of over 107.1 mm. The driest month is February with a mean of 24.2 mm. Like other parts of south-west WA, winter rainfall has decreased in the region during the latter half of the twentieth century, which is thought to be due to natural variability and climate change.

Rainfall levels in the area are conducive for the establishment of a ROP as consistent rain prevents the ROP from becoming too dry. In addition, the proposed ROP area is not too wet, which could contribute to other management issues.

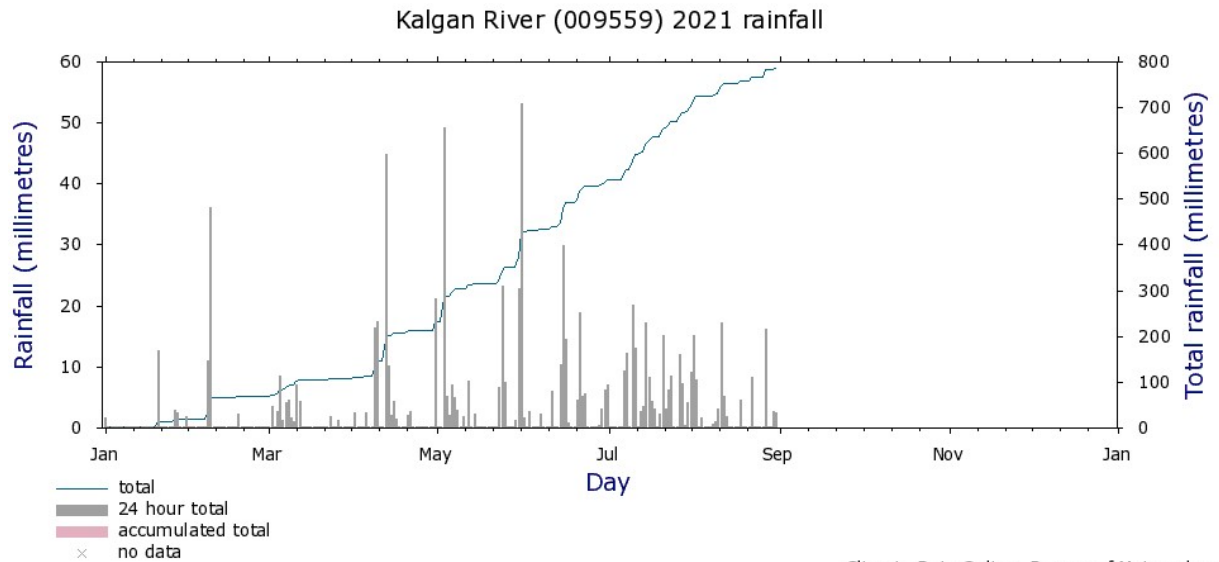
Site selection for outdoor pork production systems (APL, 2011) identifies that an annual rainfall of less than 750mm per annum is desirable. The proposed site meets this climate requirement with its annual average of 730 mm.

Cumulative rainfall for Kalgan River was used to determine year to date data for 2021⁵, which was approximately 790 mm to the end of August 2021 (Plate 2). 2021 has had significantly higher rainfall

⁵ Data was incomplete for Mount Barker.

than average. This indicates that groundwater levels assessed during the site evaluation (11 October 2021) are likely to represent maximum winter levels. The monthly rainfall statistics are provided as Plate 3.

PLATE 2: CUMULATIVE RAINFALL (2021)



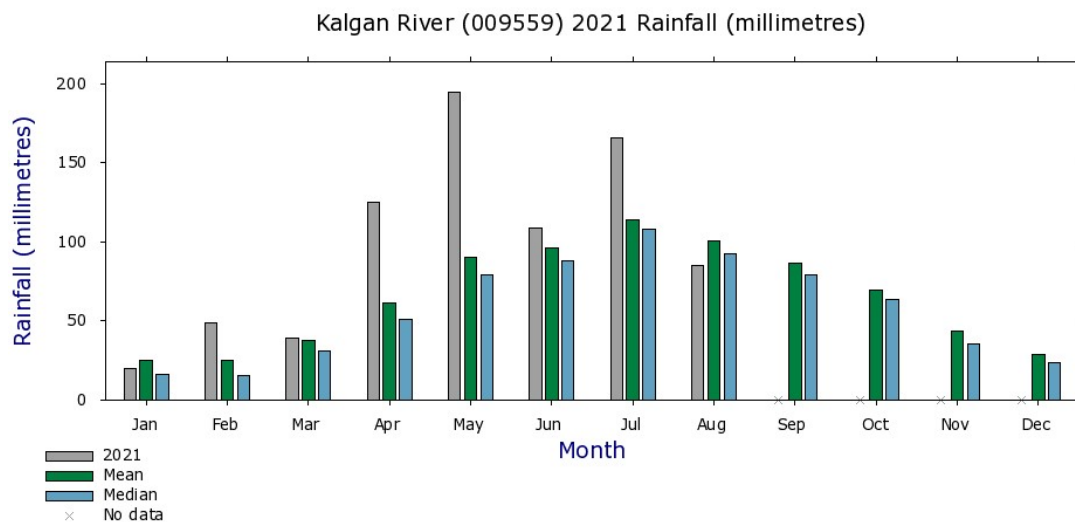
Note: Data may not have completed quality control.

Climate Data Online, Bureau of Meteorology
 Copyright Commonwealth of Australia, 2021

Created: 12 October 2021:

http://www.bom.gov.au/jsp/ncc/cdio/weatherData/av?p_display_type=dataDGraph&p_stn_num=009559&p_nccObsCode=136&p_month=13&p_startYear=2021

PLATE 3: MONTHLY RAINFALL



Note: Data may not have completed quality control

Climate Data Online, Bureau of Meteorology
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Created: 12 October 2021 from BOM:

http://www.bom.gov.au/jsp/ncc/cdio/weatherData/av?p_display_type=dataSGraph&p_stn_num=009581&p_nccObsCode=136&p_month=13&p_startYear=2015

Temperature

The closest temperature measurement station (with complete data) to the subject land is Albany Airport (BOM site number 9581; Plate 1) which is located approximately 25km north west of the subject land. Average maximum temperatures peak in January and February, with monthly means of 26°C although considerably hotter maximum temperatures (above 35°C) often occur when hot, dry northerly winds blow from inland. Overnight average minima peak in February at 13°C, with frosty conditions sometimes experienced during the winter months (e.g. July 6°C). Winter daily maximum temperatures drop to around 14°C in July (Plate 1). Temperatures in the area are conducive to the establishment of a ROP as extremes are generally not experienced or do not occur for extended periods of time.

Site selection for outdoor pork production systems (Australian Pork Limited, 2011) identifies that a mean maximum January temperature of less than 28°C and a mean minimum July temperature exceeding 3°C is desirable. The proposed site meets these climate requirements with a mean maximum January temperature of 27°C and a mean minimum July temperature of 6°C.

Prevailing Winds

Wind speed and direction can be significant factors in the dispersal and transmission of odours from intensive rural industries. However, odours are usually associated with intensive operations such as indoor/shedded piggeries and poultry farms. Experience and research around Australia has shown that the extensive nature of ROPs means they are not likely to cause odour issues, when adequate buffers to sensitive environments are in place (Banhazi, 2013). In the unlikely event that the ROP activities generate odours, an analysis of wind speed and direction factors has been undertaken as follows.

The nearest weather station to the subject land that records wind direction and speed data is the Albany Airport, which is 13 km to the south west of the subject land. It is considered that the conditions experienced at the Airport reflect those at the site, although the sea breeze influence may be less pronounced.

The Albany Airport experiences a varied wind climate with a bias toward an easterly wind component in summer and a westerly component in winter. On average, the windiest part of the day during winter is the morning and in summer is the afternoon. Spring and summer afternoon sea breezes are regularly experienced from directions from the southwest through to the east. However, sea breezes from the south-east or east are most common. Summer sea breezes are frequently quite fresh and sometimes reach 25 knots (46km/h) or more. Late autumn, winter and early spring see regular north-westerly morning winds due to a combination of the sub-tropical ridge being located to the north, with a high centre over the continent, and a land-breeze effect. Cold fronts with winter westerly winds regularly occur during this period and may bring strong to gale force winds.

The wind data for different times of the day, based on the Albany Airport weather information from the Western Australia Bureau of Meteorology, is described below (Table 4) and shown in Appendix E.

TABLE 4: PREVAILING WIND DIRECTIONS DURING DAYTIME FOR THE ALBANY AIRPORT

SEASON	PREVAILING WIND		DETAILS
	9am (% of time)	3pm (% of time)	
Summer (January)	Easterly (24%)	South-easterly (31%)	<p>In Summer mornings, calm conditions occur 6% of the time and the wind blows in an easterly direction 24% of the time (2% at 1-10km/h, 7% at 10-20km/h). Wind blows from the south east 13% of the time (2% at 1-10km/h, 4.5% at 10-20 km/h). Southerly winds blow 12% of the time (2% at 0-10km/h and 6.3% at 10-20km/h). South westerly winds blow 14% of the time (3% at 1-10km/h and 5% at 10-20km/h).</p> <p>The most prevalent wind in the afternoon (blowing 31% of the time) is from the south east (3% at 10-20km/h and 17% at 20-30km/h). Winds from the south occur 22% of the time (7.5% at 10-20km/h and 11% at 20-30km/h). South west winds occur 22% of the time (3% of 10-20km/h and 12.5% of 20-30km/h). There are rarely calm conditions at this time of the day in Summer.</p>
Autumn (April)	North-westerly (20%)	South-westerly (15%) to South-easterly (19%)	<p>In Autumn, mornings are calm for 17% of the time. Wind is most prevalent from the north west at 20% of the time (5% at 0-10km/h and 8% at 10-20km/h). Winds from the south west (4.5%), south (5%) and south east (4%) are relatively infrequent.</p> <p>Autumn afternoons have 4% time calm, with the most prevalent wind direction being south easterly 19% (2% at 0-10km/h and 7.5% at 10-20km/hr). Winds from the south occur 15% of the time (2% at 0-10km/h and 9% at 10-20km/h).</p>
Winter (July)	North-westerly (37%)	Westerly (27%) to North-westerly (24%)	<p>Winter mornings are calm for 13% of the time. The most prevalent wind is from the north west for 37% and north for 23% of the time. Winds from the south west (6%), south (2.5%) and south east (1%) occur relatively infrequently.</p> <p>Winter afternoons have calm conditions 5% of the time with predominant winds coming from a westerly (27%) and north westerly (24%) direction. Winds from the south west occur 18% (2% 0-10km/h and 3% 10-20km/h). Winds from the south (5%) and south east (3%) occur infrequently.</p>
Spring (October)	Westerly (22%)	South-west (25%), West (18%) to South-easterly (15%)	<p>Spring mornings are calm for 8% of the time. The most prevalent winds are from the west (22%). Winds from the south west occur 12% of the time (1.5% 0-10km/h and 4% 10-20km/h). Winds from the south and south east occur less commonly (7%).</p>

SEASON	PREVAILING WIND		DETAILS
	9am (% of time)	3pm (% of time)	
			Spring afternoons are calm 1% of the time. The most prevalent winds are from the south west 22% of the time (0.9% at 0-10km/h and 9% at 10-20km/h). Winds from the west and the south occur 18% of the time (2% at 0-10km/h and 10% at 10-20km/h). Winds from the south east occur 15.5% of the time (1% at 0-10km/h and 4% at 10-20km/h).

Source: Bureau of Meteorology, 2008. Percentages based on the number of days that wind direction was recorded over the total number of observation days at the Albany Bureau of Meteorology Station between 1965 and 2004.

Should odours be generated by the ROP, they would be unlikely to impact surrounding residences due to the appropriate buffer distances that are in place at the site, and also as winds from the south east, south and south west sectors are typically strong, blowing more than 20 km/h. High velocity winds would have the effect of dissipating any odours through mixing within the air stream. Light winds from the south-west, south and south-east, which would have a greater capacity to transport odours offsite, occur less than 5 % of the time in autumn and spring and less than 10 % of the time in summer. As a result, there is a low risk of odour from the ROP impacting on surrounding residences.

4.4 TOPOGRAPHY AND SLOPES

National Environmental Guidelines for Piggeries (APL, 2010) state that optimal slopes for ROP areas are between 2-6% (1 in 50 to 1 in 16 and 1.1° to 3.4°). These slopes assist in optimising drainage without promoting erosion. Ideal slopes depend on soil type, land use, vegetative cover, rainfall intensity, agronomic practices and soil conservation methods.

The subject land comprises a gently undulating plateau which slope into a valley containing Napier Creek, with slopes from a high of 100 mAHD in the north eastern corner, down to the south western portion of the subject land with a low point of approximately 80 mAHD.

The proposed ROP rotational areas are located on the most elevated portions of the subject land between elevations of 90 mAHD and 100 mAHD (approximately 1:70 slope). This slope equates to a 1.5% grade. Recommended slope grades for ROPs are usually between 2% and 6%. As the surface layer of the soil is free draining, the slightly more shallow slope is not expected to have negative environmental impacts, such as ponding of water. Seasonal management is likely to be required to place enclosures outside of areas with depressions where water may pond after rainfall.

In order to ensure that no soil leaves the dedicated pig areas, erosion control measures will be used should areas start to experience erosion along the downstream sides of active pig areas. This will ensure that any surface water flow is slowed and sediment is captured before potentially leaving the cells. The use of sand and silt trapping devices (e.g. silt trapping fences) and vegetated filter strips also satisfies APIQ[✓]™ recommendations for land management. Specifications for drainage management are shown in Appendix F.

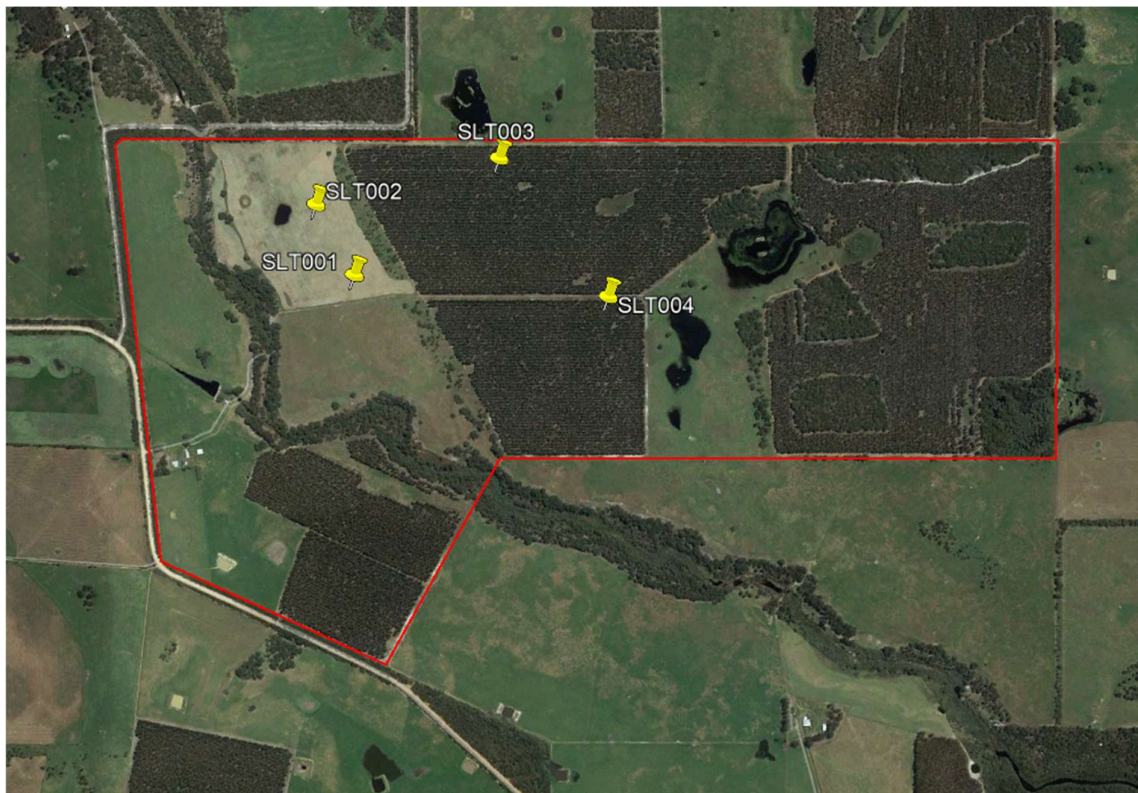
4.5 SITE AND SOIL EVALUATION

During site investigations by Aurora Environmental on 23 September 2021 and 11 October 2021, the following activities were undertaken at sample sites SLT001 – SLT004 (Plate 4):

- Photographs were taken to indicate the ROP areas (Appendix G).
- Excavation of four test pits to determine soil profile characteristics. Results are described in Chapter 4.6.
- Assessment of groundwater levels.
- Collection of eight soil samples at four sites (samples from near soil surface and subsurface) to test for phosphorus buffering index (PBI). Results are described in Section 4.6.2 with laboratory results in Appendix H.
- Permeability testing at four sites with results described in Section 4.6.3 and Appendix I.

After approval, soil testing will be undertaken in order to determine the baseline levels of nutrients, in line with APIQ[✓]™ accreditation requirements. The baseline information will be used as a guide to compare nutrient levels after a rotation of the piggery.

PLATE 4: SOIL INVESTIGATION LOCATIONS



4.6 LANDFORM AND SOILS

Landform, soils and vegetation types found on the subject land are listed in Table 5 and shown in Plate 5. Of the two major soil types which occur on the subject land, the soil units which are associated with the ROP rotations comprises:

242ReRD: Redmond Subsystem - Broadly undulating plateau; scattered lakes and depressions. Yellow duplex soils and laterite on plains. Marri-Jarrah-Albany Blackbutt forest. Yellow solonetzic soils in depressions; Paperbark woodland.

PLATE 5: SOIL TYPES

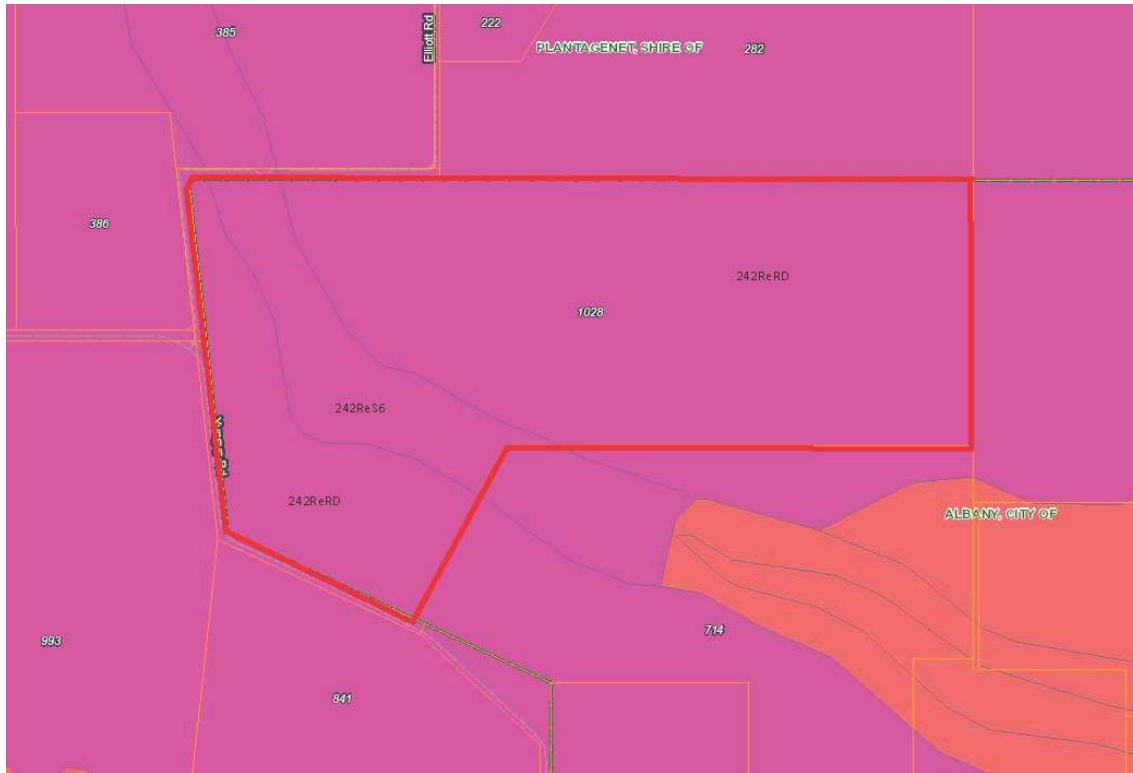


TABLE 5: SOIL UNITS AND LANDFORM

SOIL UNIT	SUMMARY DESCRIPTION	LOCATION AND SUITABILITY
242ReRD	Redmond Subsystem - Broadly undulating plateau; scattered lakes and depressions. Yellow duplex soils and laterite on plains. Yellow solonetzic soils in depressions.	Occurs where ROP compartments are proposed. Considered suitable for ROP.
242ReS6	Minor Valleys 6 Subsystem - Narrow V-shaped valleys, in sedimentary rocks;<10 m relief. Sandy yellow duplex soils on slopes. Deep sands on narrow swampy floor.	Associated with Napier Creek and valley floor. Not suitable for ROP

Source: Landgate, 2021 DPIRD-027

The soil profile varies over the mapped soil type with the profiles described in Table 6.

TABLE 6: SOIL PROFILES BY SAMPLE LOCATION

SAMPLING LOCATION	PROFILE
SLT001	<ul style="list-style-type: none"> 0- 0.2 m: Dark brown grey gravelly sand 0.2 – 0.75 Sandy yellow clay, becoming dense and stiff at 0.75 m (refusal).
SLT002	<ul style="list-style-type: none"> 0-0.15 m: Dark brown/grey clayey sand with organic matter 0.1 – 0.3 m: gravelly clayey sand with refusal at 0.4m due to gravel.
SLT003	<ul style="list-style-type: none"> 0 – 0.1 m: Grey fine sand with organic matter 0.1- 0.3 m: Grey to yellow fine sand with small gravel 0.3- 1.0 m: Sandy gravel becoming increasingly yellow. Refusal due to gravel at 1 m.
SLT004	<ul style="list-style-type: none"> 0 – 0.1 m: Grey fine sand with organic matter 0.1- 0.3 m: Grey to yellow fine sand with small gravel 0.3- 1.0 m: Sandy clayey gravel. Refusal due to gravel at 1 m.

Phosphorus Buffering Index (PBI)

Phosphorus Buffering Index (PBI) provides an indication of the ability of the soil to sorb phosphorus (BCG, 2014). The classifications for PBI are shown in Table 7.

TABLE 7: PBI CATEGORIES AND CLASSIFICATIONS

CLASSIFICATION	PHOSHORUS BUFFER CAPACITY
Extremely low	<15
Very very low	15-35
Very low	36-70
Low	71-140
Moderate	141-280
High	281-840
Very high	>840

Source: Summit,2021

Soil samples were taken from ground surface (0 – 10 cm) and subsurface (5 to 0.8m BGL) 12 October 2021; See Appendix H) and tested for PBI. PBI results are described in Table 8. Results varied between topsoil (0.1 and 0.2m BGL) and subsoil (0.4 and 1.0m BGL) with subsoil generally having a greater PBI capacity. The soil PBI ranged from ‘extremely low’ to ‘moderate’. Liming of areas of the property that present with low pH (based on soil testing) will assist in increasing the phosphorus binding potential.

TABLE 8: PHOSPHORUS BUFFERING INDEX RESULTS

SAMPLING SITE	PBI VALUE	CLASSIFICATION
SLT 001 0.0 – 0.1m	52.2	Very low
SLT 001 0.3 – 0.4m	155.2	Moderate
SLT 002 0.0 – 0.2m	40.4	Very low
SLT 002 0.4 – 0.5m	60.5	Very low
SLT 003 0.0 – 0.1m	6.1	Extremely low
SLT 003 0.8 – 1.0m	19.3	Very very low
SLT 004 0.0 – 0.1m	18.3	Very very low
SLT 004 0.5 – 0.8m	32.7	Very very low

See Appendix H for laboratory report.

Permeability

Soil permeability is a measure of the rate at which water flows through a soil profile and is important in determining land capability as it provides an indication of whether rain and other water will infiltrate readily into the soil, or if it will potentially cause ponding and/or surface runoff.

Infiltration tests were undertaken at four test holes augured at the site to determine the general permeability of the soil types where the ROP is proposed to be located (Plate 4). A CL26100 well permeameter which is designed to meet the requirements set out in AS/NZS 1547:2012 (Standards Australia, 2012) was used for the investigation. This method is a constant head test, whereby water that infiltrates an unlined test hole is replenished at the same rate from a reservoir, keeping the level of water in the hole constant (i.e. constant head). Field records are taken to measure the loss of water from the reservoir over time, which are then used to calculate the coefficient of permeability (K_{SAT}) for the particular soil profile. The 0.5m deep test holes were created using a hand auger at each location. The permeability calculations, based on field measurements are detailed in Appendix I. The K_{SAT} results and interpreted soil categories are summarised in Table 9.

High gravel/sand content in the top 0.7m of soil indicates good drainage across the ROP area, which will also help to minimise surface runoff. In addition, the presence of sandy clay in the subsoil suggests a high ability for the soils to capture and hold nutrients onsite.

TABLE 9: CALCULATED K_{SAT} VALUES AND DRAINAGE CLASSIFICATION

LOCATION	K _{SAT} (M/DAY)	SOIL CATEGORY*/ SOIL TEXTURE	SOIL TYPE#	PERMEABILITY^
SLT001	0.01	6, Medium to heavy clay below sandy surface	242ReRD	Low to very low permeability
SLT002	0.14	4, Clay loam, weakly structured		Low permeability
SLT003	0.95	3, Loam, weakly structured or massive		Low permeability
SLT004	0.14	4, Clay loam, weakly structured		Low permeability

* Soil Category as per AS 1547:2012. # Soil type from Landgate – DPIRD-027; Plate 5. ^ Appendix I.

Based on infiltration testing results, calculated K_{SAT} values range from 0.01 m/day to 0.95 m/day which equates to ‘very low’ to ‘low’ permeability. Based on field observations and permeability, the soils at sample location SLT001 falls into category 6, heavy clay, SLT002 and SLT004 into category 4, clay loam and SLT003 into category 3, loam (Standards Australia, 2012). These permeability ratings are considered to be adequate for the ROP, when combined with the gentle slope of the land, which will allow adequate drainage and prevent ponding of water on the surface.

4.7 SURFACE AND GROUNDWATER

The subject land is in the Kalgan River catchment, which ultimately discharges into Oyster Harbour. A portion of Napier Creek runs through the subject land and forms a tributary of the Kalgan River.

Other hydrological related information for the subject land includes:

- No Country Area Water Supply Act Clearing Control Catchments within 10km.
- Nearest Public Drinking Water Source Area (PDWSA) is 13.5 km to south west – Marbelup Brook Catchment area. However, this PDWSA is in a different catchment.
- The nearest Rights in Water Irrigation Act Ground Water Area is 13 km to the south west – Albany Groundwater Area (different catchment).

National Environmental Guidelines for Rotational Outdoor Piggeries (Tucker and O’Keefe, 2013) recommends that ROPs are located at least 100m from a defined water course.

The subject land contains various dams and soaks (Figure 2). Buffers of 100 m have been established around these features.

Groundwater in the area has been characterised by Smith (1992) as part of the Plantagenet group – with siltstone, spongelite, minor sandstone, peat and conglomerate. The area is likely to support minor to major aquifers with fresh to saline water. The regional groundwater table is most likely at 80 mAHD.

Four augur holes were dug to refusal due to clay or gravel and no groundwater was intercepted. Due to the duplex nature of the soil (sand and gravel over clay) there is not likely to be a groundwater resource within 1.5 m of the ground surface.

The proponent has investigated the water supply on the property (a bore near the existing dwelling) that has been tested and will provide adequate water volumes and quality for the ROP. The subject land is not in a surface or groundwater protection area and licenses are not required for the use of water for stock purposes.

4.8 WETLANDS

The subject land contains seasonally inundated areas, some of which contain native wetland vegetation (tea tree thickets and *Melaleuca* species) (Figure 4). Most of these areas are modified or degraded due to previous grazing and other agricultural activities (Plate 6). Areas prone to inundation will not be used for the ROP (Figure 2) and will be given a 100m buffer.

PLATE 6: DEGRADED WETLANDS



The 'South Coast Significant Wetland' dataset (Landgate, 2021; DBCA-18) indicates that wetlands associated with Millbrook Nature Reserve (2 km to the south) are conservation category wetlands. These wetlands are not 'downstream' of the subject land.

There are no RAMSAR Sites (i.e. areas covered by the Convention on Wetlands of International Importance) within 5km of the subject land (Landgate, 2015).

4.9 VEGETATION

Existing vegetation types (and those previously found on the subject land) are summarised in Table 10 by soil type and Plate 7. Most of the subject land has historically been cleared of native vegetation for the establishment of agricultural pursuits. Pockets of native vegetation have been retained as shown in Figure 2 and Plate 6. Remaining vegetation is in a relatively degraded condition due to long term grazing of livestock and weed invasion. No native vegetation is proposed to be cleared for the establishment of the ROP. Some areas of blue gum plantings will be removed to incorporate the ROP (Figure 2).

It is considered unlikely that vegetation on or off the property will be negatively impacted by the ROP.

TABLE 10: INDICATIVE VEGETATION TYPES

SOIL UNIT	SUMMARY DESCRIPTION
242ReRD	Marri-Jarrah-Albany Blackbutt forest with paperbark woodland in depressions.
242ReS6	Jarrah-Marri low forest with sedges and reeds on valley floor.

Source: Landgate, 2021 (DPIRD-027).

PLATE 7: NATIVE VEGETATION



Source: Landgate, 2021. Green areas are native vegetation.

5 DESCRIPTION OF PROPOSED OPERATION

5.1 ROTATIONAL OUTDOOR PIGGERY – BREEDER AND GROW OUT

The proposed operation will breed and raise pigs using an accredited free range system and the ROP will allow the pigs to be raised outdoors with shelter from the elements. The operation consists of outdoor paddocks which allow for rooting and foraging areas and huts with bedding for shelter. The huts allow the pigs to shelter from environmental extremes.

Free range systems such as this provide enough space for the land to assimilate nutrients which are generated through pig manure, as long as suitable soil types and slopes are chosen, stocking rates are consistent with recommendations and rotations occur after two years of use by piggery. Outdoor operations reduce the levels of odour build up (in comparison to shed based piggeries).

5.1.1 Density of Pigs

Densities of pig housing are guided by the Code of Practice for Animal Welfare–Pigs (Animal Welfare Working Group; AWWG, 2007) and the RSPCA Approved Farming Scheme Standards for Pigs⁶ (RSPCA, 2011) as shown in Table 11. Through all phases of the production cycle, the stocking rate will be compliant with the Code of Practice.

Boars, gilts and gestating sows will be kept in paddocks at 30 pigs per hectare. Farrowing sows with piglets will be in shared paddocks at 14 sows per hectare.

TABLE 11: ROTATIONAL OUTDOOR PIGGERY DENSITIES

GUIDELINE	MAXIMUM STOCKING DENSITY
Model Code of Practice for the Welfare of Animals	Sows kept in groups - 300m ² per sow (20 - 25 sows per ha) Lactating sows with piglets – 9 - 14 sows per ha
RSPCA Approved Farming Scheme Standards for Pigs	Boars, lactating sows and gestating gilts/sows - 30 adult pigs per ha

Source: Code of Practice (AWWG, 2007); RSPCA Approved Farming Scheme Standards for Pigs (RSPCA, 2011).

5.1.2 Number of Pigs and ROP Rotational Areas

When comparing pig numbers and impacts, it is useful to consider standard pig units (SPU). SPU is a unit for defining piggery capacity, inputs and outputs and for comparing outputs between ages, sizes and stages in a pig’s life. SPU conversion factors are summarised in Table 12. The ROP will support 2,067 SPU at any one time (see Table 12).

⁶ This ROP operation is not intending to be accredited with the RSPCA Approved Farming Scheme Standards for Pigs.

TABLE 12: COMPOSITIONS OF PIGS IN ROP (AND STANDARD PIG UNITS – SPU) BASED ON A 1000 SOW UNIT

Pig Type	1000 sows	SPU
Gilt (1 = 1.8 SPU)	50	90
Boar (1 = 1.6 SPU)	50	80
Gestating (1 + 1.6 SPU)	830	1328
Lactating (1 = 2.5 SPU)	170	425
Suckers (1 = 0.1 SPU)	1445	144.5
Total (at any one time)	3,545	2,067

Each rotational area will comprise 43.14 ha (plus alley ways and access based on the densities required by the RSPCA and the Code of Practice as shown in Table 13).

TABLE 13: AREA (HA) ONE ROTATION FOR TWO YEARS

RSPCA: 30 Dry sows (and boars) per ha	if	1000 sow operation	930	Sows over	31.00	ha	plus alleys and access
COP: 14 lactating sows per ha			170		12.14	ha	
			TOTAL		43.14	ha	

The subject land has 130.23 ha suitable for use as an ROP. This equates to 3 rotations.

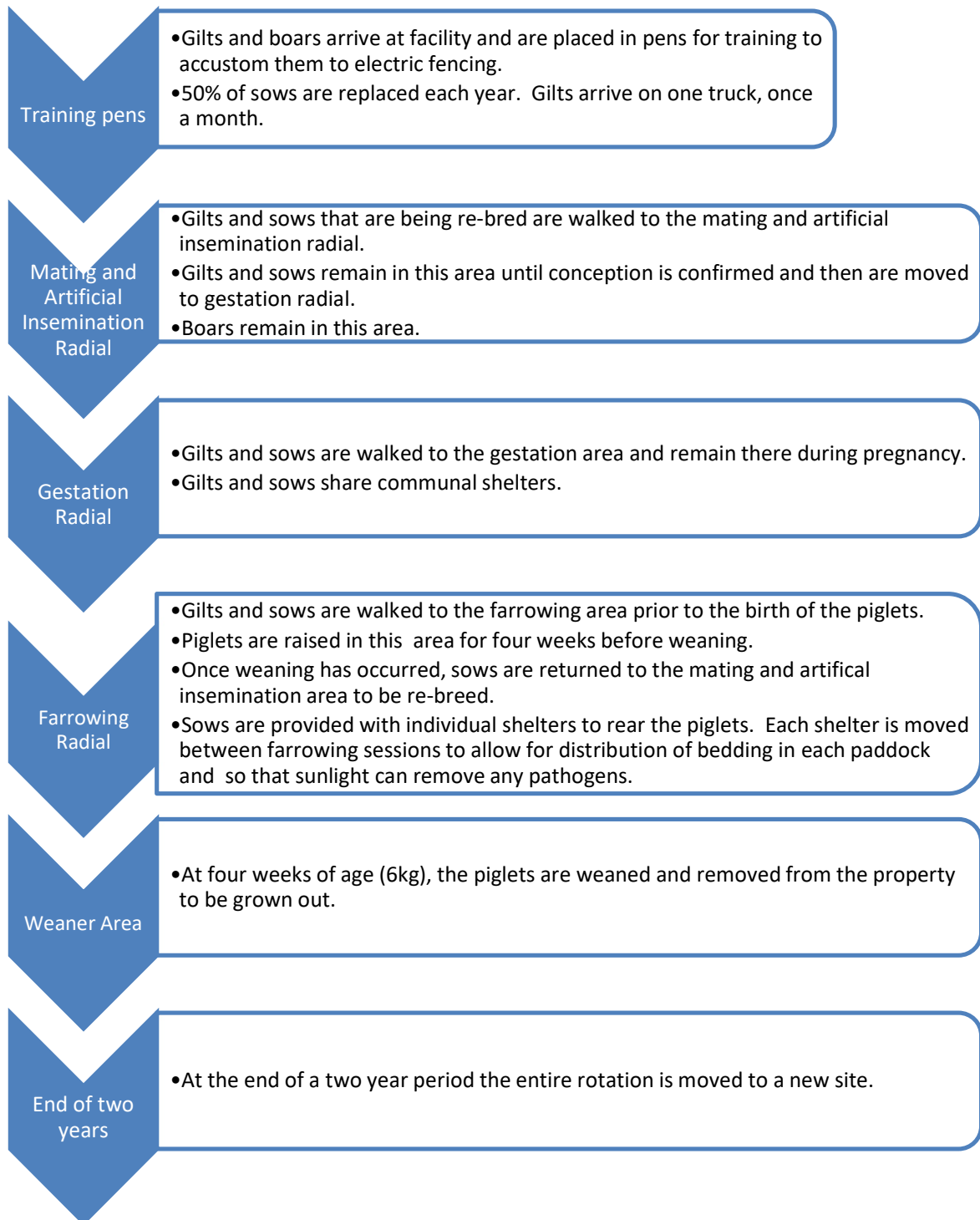
Note: The number of adult pigs is greater than 1000 due to boars and gilt numbers.

5.1.3 Rotation Description

Each rotation requires approximately 43.14 ha of land. Approximately 130.237ha is proposed for the ROP which will allow for up to 3 rotations (Figure 2). Rotating the use of active pig areas will be undertaken on a minimum two year cycle, to allow utilisation of nutrients through cropping. Rotation reduces the risk of land degradation and disease.

Each rotation follows the process outlined in Plate 8. Photographs of the rotation areas are included in Appendix G.

PLATE 8: BREEDING ROP PROCESS



5.2 BUFFERS AND SEPARATION

One of the criteria for establishment of an outdoor pork production system is the availability of a sufficient area of land to operate a sustainable rotational system. The subject land provides an adequate area of land with sufficient buffers to accommodate the outdoor piggery system. 130.23 ha of suitable land has been identified as meeting buffer and other requirements, which will allow for up to 3 rotations.

Buffers have been applied, consistent with DPIRD buffer guidelines (Department of Food Western Australia, 2000) and *Environmental Guidelines for Rotational Outdoor Piggeries* (Tucker and O’Keefe, 2013) as summarised in Table 14. The areas which meet buffer requirements are shown in Figure 2.

There are 6 rural dwellings located within 1km of the subject land’s boundaries as shown in Figure 2. The closest residence to any of the proposed ROP cells is located at Lot 71 Elliot Road and is 629 m from the nearest proposed ROP. Other dwellings within 1 km of the proposed ROP, vary between 785 m and 805 m from the nearest proposed ROP area.

No enterprises such as tourist venues or tourist accommodation are known to exist within 1km of the proposed ROP rotational areas.

TABLE 14: BUFFER AND SEPARATION DISTANCES

Item	Guideline/ requirement	Comment
National Environmental Guidelines for Piggeries - Australian Pork Limited (Tucker <i>et al.</i>, 2010)		
Buffers requirements	Buffers required: - Public road carrying < 50 vehicles per day – 100m. - Public road carrying > 50 vehicles per day – 200m - Town - 750m - Rural residential area - 500m - Rural dwelling – 250m - Property boundary – 20m	The proposed ROP meets buffer requirements. The closest dwellings external to the subject land is Lot 71 Elliot Road which has a dwelling within 629 m of the nearest possible ROP. The distance exceeds the minimum requirement of 250 m/ 300 ⁷ m from any possible ROP unit. All other dwelling external to the property are in excess of 300 m to the nearest proposed ROP.

⁷ A buffer 300m from rural dwellings is recommended in the Department of Agriculture *Guidelines for New and Existing Piggeries* (2000). 250m is considered adequate in Australian Pork Limited *National Guidelines for Rotational Outdoor Piggeries* (2013). In this case, the most conservative distance has been included.

Item	Guideline/ requirement	Comment
<p>Model Code of Practice for the Welfare of Animals – Pigs (Primary Industries Standing Committee, 2008)</p> <p>Royal Society for the Prevention of Cruelty to Animals (RSPCA) Approved Farming Scheme Standards for Pigs</p>		
Density of Pigs	<p>Model Code of Practice for the Welfare of Animals – Pigs (COP; Primary Industries Standing Committee, 2008): 20 – 25 dry sows/hectare (ha) and 9 - 14 lactating sows with piglets per ha.</p> <p>Royal Society for the Prevention of Cruelty to Animals (RSPCA) Approved Farming Scheme Standards for Pigs – 30 adult pigs/ha.</p>	<p>Current calculations have used Model Code of Practice and RSPCA pig densities:</p> <p>Application of buffer requirements indicate that 130.23 ha is available for ROP. This includes setbacks from boundaries, roads and water features, plus removal of some of the blue gums. There is room for 3 rotations for a 1000 sow ROP.</p>
<p>Fact Sheet - Design and Management of Outdoor Free Range Areas for Pigs – Australian Pork Limited (APL, 2011)</p>		
<p>Site selection factors: Recommendation</p>		
Annual rainfall less than 750mm	730mm per annum (Weatherzone, 2021)	The subject land meets this site selection requirement.
Mean maximum January temperature less than 28°C	26.1°C in January (Weatherzone, 2021)	The subject land meets this site selection requirement.
Mean minimum July temperature exceeding 3°C	6.1°C in July (Weatherzone, 2021)	The subject land meets this site selection requirement.
Densities: Based on Model Code densities (which are less dense than RSPCA standards)	Based on Model Code densities, a 1000 sow operation would require a minimum of 46.33 ha area per ROP rotation (not including access ways).	If 130.23 ha of the site is usable for the ROP, this would allow for 3.2 rotations. At least 2 and preferably 3 rotation areas are recommended for operation.
Buffer of 800m between piggery and major water supply storage	There are no major water supply storage areas within 800m of the subject land.	Proposed ROP meets this site selection requirement.
Buffer of 100m between piggery and a defined water course	ROP set back at least 100m from water courses, dams and wetlands.	The ROP has been designed to comply with these buffer requirements.
Buffer of 200m to a public road carrying more than 50 vehicles per day	<p>Yungup Road (presumably) carries more than 50 vehicles per day. A buffer for proposed ROP allows for a 200m buffer.</p> <p>Elliot Road is presumed to carry less than 50 vehicles per day. A buffer of 100 m has been applied</p>	Proposed ROP meets this site selection requirement.

Buffer of 750m to a town site.	There are no town sites within 750 m. The closest townsites are Narrikup and Redmond which are 16 km to the north west and south west, respectively.	Proposed ROP meets this site selection requirement.
Buffer of 500m to a rural residential area.	There are no rural residential areas within 500 m.	Proposed ROP meets this site selection requirement.
Buffer of 250m to external rural dwelling	The closest dwelling external to the subject land is Lot 71 Elliot Road which has a dwelling within 629 m of the nearest proposed ROP area. The distance exceeds the minimum requirement of 250 m/ 300 m from any possible ROP unit.	No dwellings are within 250 m/ 300 m of the proposed ROP.
Buffer of 20m from a property boundary	All proposed ROP units are at least 20m from the property boundary.	The ROP can be designed to comply with this buffer requirements.
Sensitive Agricultural Sites (DAFWA)	Sensitive sites do not preclude other agricultural land uses but highlight the need to consider sensitive agricultural pursuits.	No DPIRD registered sensitive agricultural sites are within 1km of proposed development. The closest is 10 km to the south west on Redmond Hay River Road (viticulture; DPIRD, 2021).
Soils: Well drained soils with sufficient capacity to retain nutrients	The ROP sites will ideally be placed in well drained loams with a high PBI (e.g. gravelly sands and sandy soils with a clay content at depth).	The subject land meets this site selection requirement, with well drained soils although adsorption of phosphorus is likely to be low to moderate rather than high for some areas.
Slopes: Gently sloping land	The site is gently sloping to allow for drainage but not so steep that erosion is likely to occur.	The subject land meets with this requirement for most areas and should be acceptable if sufficient drainage measures are implemented to manage surface runoff.
DPIRD (Department of Agriculture and Food, 2000) Environmental Guidelines for New and Existing Piggeries Bulletin 4416		
Buffers	<p>Townsite boundaries -1000 m</p> <p>Special rural areas – 1000 m</p> <p>Isolated rural dwellings – 300 m</p> <p>Public roads – 50m</p> <p>Neighbouring rural property boundaries – 50 m</p> <p>Public Drinking Water Source – not permitted</p> <p>Major water course – 100 m</p> <p>Minor water course – 50 m</p> <p>Bores, wells, soaks for private drinking water supply and or stock irrigation water supply – 300 m</p>	The ROP has be designed to comply with these buffer requirements.

	<p>Water requirements:</p> <p>Summer: 15 L per dry sow per day to 80 L per lactating sow per day.</p> <p>Winter: 15 L per weaner per day to 58 L per lactating sow per day.</p> <p>Water for wallows are also required.</p> <p>Water quality: Short term upper level salinity of 4,500 mg/L of total dissolved solids or 3000 mg/L for long term use.</p>	<p>Not including wallows, approximately 11.5ML of good quality water will be needed per annum. The landowner has advised that water requirements have been considered and that there are adequate resources for the ROP.</p> <p>Water quality is not known at this stage, but it is presumed to be adequate for pigs.</p>
	<p>Drainage: well drained, level or gently sloping</p> <p>Slope: Between 1:20 and 1:200 to prevent erosion (if steep) and ponding (if flat).</p> <p>Groundwater: Maximum 1.5 m below ground level (throughout the year).</p> <p>Soil phosphorus retention index greater than 10.</p>	<p>The subject land is relatively flat with gentle slopes, with a fall of 10 m over its entirety. Water gaining areas will be avoided to reduce land degradation and nutrient export. Drainage design and management will be key to the successful operation of the ROP.</p> <p>Due to the duplex soils, depth to groundwater exceeds 1.5 m below ground surface. Groundwater levels most likely around 80 mAHD (Smith, 1992).</p> <p>The soil Phosphorus Buffering Index indicates the soils have a extremely low to moderate ability to sorb phosphorus</p>
<p>Guidance for the Assessment of Environmental Factors – Separation Distances between Industrial and Sensitive Land Uses No. 3 June 2005 (EPA 2005)</p>		
<p>Buffers</p>	<p>Extensive Piggery – premises on which pigs are fed, watered and housed in outside paddocks or enclosures – 1000m</p>	<p>There are no EPA⁸ defined sensitive sites within 1km of proposed ROP.</p>

5.3 HOUSING

Communal shelters for the pigs comprise skid mounted structures which can be moved after each batch of pigs. The number of enclosures is dependent on the number of pigs associated with a particular rotational cycle.

Shelters will be constructed from galvanised steel with a covering of either white polypropylene based polyfabric or colourbond (or similar material).

Dry sow paddocks will comprise 5 radial units, each with 10 paddocks and 8 by 5m shelters. At full capacity there will be 65 dry sow shelters.

⁸ Noting that in the case of free range piggeries, a separation of 1000 m to single rural residences is not required – 250 – 300 m separation are the guideline recommendations.

Farrowing huts (2.4 x 2.4m) are designed to house a single sow and her litter of piglets. These shelters will be constructed from marine ply (or similar) and will be a timber or dark colour. There will be 200 of these huts when the ROP is at full capacity.

5.4 FENCING AND WATER SUPPLY

Pigs are contained and protected from predators such as foxes by providing shelters and using secure fencing and electrification (where necessary). Other pest control methods, such as exclusion fencing are also used to reduce risk (e.g. from foxes). All pigs are securely enclosed and are unlikely to escape from the pens.

Adult pigs introduced to the ROP are put into a ring lock paddock with an electric outrigger to allow the pigs to become used to electric fence systems. Once trained, a single strand electric wire is used to contain adult pigs.

Drinking water for the pigs will be provided from a bore and several dams on the property. Water will be provided to the pens via pipe work that sits on the surface of the ground at the perimeter fence (so that it can be relocated as required).

5.5 INFRASTRUCTURE AND OTHER FEATURES

Infrastructure and other features associated with the operation of the ROP includes:

- Water pipes and pumps to transport water from dams or bores;
- Silo/s for food storage; and
- Storage area for straw for bedding.

5.6 TRANSPORT AND OPERATIONS

The processes and operations for pig breeding, rearing and transport will be in line with the Model Code of Practice for the Welfare of Animals-Pigs (Revised) (AWWG, 2007).

- Feed for the pigs will be transported to the site using a road train which will visit the property 4 times per week. Feed comprises pellets which will be stored in silos. Feed will be provided to the farrowing pigs in 1.5 tonne feeder bins. Other pigs have food blown into the pens from the perimeter to ensure it is distributed widely. This allows the pigs to forage, reduces competition and prevents hotspots of nutrient build up.
- Straw is used for bedding in communal shelters and weather protection at the end of the shelters. Straw will partially be sourced from the subject land or imported periodically. Straw will be kept at two locations central to ROP activities, in an open area to reduce fire risk.
- Incoming pigs (gilts and boars) will be transported using a road train. Initially, animals will be brought in every week, until the operation is at capacity. Subsequently, replacement animals will be brought in every month.
- Weanlings will be transported to a grower/ finisher facility in a small truck on a weekly basis;
- Spent bedding will be removed via up to two truck visits weekly; and
- Any fuel storage area will be bunded to contain any spills.

All traffic accessing the site will enter from Settlement and Elliot Road. It is expected that there will be 14 truck movements (i.e. arriving and departing) per week, plus occasional movements for straw delivery.

5.7 BIOSECURITY

Australian agriculture is free from many of the more devastating diseases that exist in other countries around the world. The introduction of exotic diseases and those that already occur in Australia could have a large impact on the livestock industry, including pig production. Adequate biosecurity is required on a pig farm to maintain sanitation, disease control and vermin management and is integral to the health of the pigs and quality of the product. This means that access to the ROP needs to be limited to authorised personnel with a high standard of hygiene at all times.

The proponent will ensure that effective contingency plans are in place and that staff are adequately trained to respond to disease risk and other emergency situations. The Australian Veterinary Emergency Plan (AUSVETPLAN; Animal Health Australia, 2021) is a coordinated national response for the control and eradication of high impact animal diseases. In addition, APL and affiliated operators are party to the Animal Health Australia Cost Sharing Deed of Agreement on Emergency Animal Disease Response (Animal Health Australia, 2001).

The proponents will implement the following:

- Signage installed to inform visitors they cannot enter the ROP area without permission as per Plate 9;
- Visiting vehicles are not permitted to drive over alleyways used to walk pigs from pen to pen. Visiting vehicles, including trucks that visit other pig properties are only allowed access to a quarantined area;
- Visitors must not have come into contact with pigs in the 24 hours prior to visiting the ROP. This includes contact with pigs at agricultural shows, farm stays, transport vehicles, abattoirs and pig processing. Exemptions may apply if the pig contact is within production group and visitation is approved by the Livestock Manger or the consultant veterinarian;
- Visitors must not be experiencing any cold or flu like symptoms;
- Visitors must not have been on an aircraft in the preceding 72 hours;
- Visitors must sign the visitors book and provide relevant details;
- Visitors must wear the protective clothing and footwear provided; and
- Visitors must not feed food scraps to the pigs.

PLATE 9: SIGNAGE



5.8 ACCIDENTS AND EMERGENCY RESPONSE

Emergency responses in the pig industry sector are guided by AUSVETPLAN Enterprise Manual-Pig Industry (Animal Health Australia, 2011) and the Australian Pork Industry Biosecurity Program (APL, 2003). AUSVETPLAN is a series of technical response plans that describe the proposed Australian approach to an emergency animal disease incident. APL (2003) outlines a code of practice for dealing with emergency pig disease responses in accordance with Clause 14 of the Government and Livestock Industry Cost Sharing Agreement. The documents provide guidance based on recent analysis of risks, linking policy, strategies, implementation, coordination and emergency management plans.

Mass pig deaths due to factors such as abnormal heat stress or disease rarely occur. However, a plan is required for disposal of the pigs should mass deaths occur and management of the issue should the cause be an infectious disease. When disease is the cause of death, the farm owner will obtain a veterinary report and immediately contact the Emergency Disease Watch Hotline (1800 675 888), City of Albany Environmental Health Officer (EHO), DPIRD and Department of Health (DOH), where applicable. These agencies will provide guidance to the landowner on disease control and hygiene, transport and disposal of diseased and/or dead pigs.

Harsh chemicals such as disinfectants will not be used in this piggery operation. However, as for any farming operation, any person storing, handling or transporting dangerous goods (including agricultural chemicals) is required to report spills and other dangerous events to a dangerous goods officer within the Department of Mines, Industry Regulation and Safety as soon as practicable. Where an agricultural chemical spill is likely to cause pollution or environmental harm, the occupier of the land on which the discharge occurred is required to inform DWER (Albany Office).

5.9 FIRE RISK MANAGEMENT

Each rotational area will have a 4m firebreak around its boundary and the property will have a fast attack unit to respond to a fire on the property, should the situation arise. Fire risk within each

rotational area will be minimised by storing flammable material such as straw bedding in a single section of the operational area. The subject land is in the Napier Volunteer Bush Fire Brigade area.

5.10 PUBLIC RELATIONS AND TRAINING

The proponent wishes to promote good relations with neighbours and the general public to reduce the risk of complaints based on lack of adequate information of farm operations or fears based on misconceptions. All complaints received directly will be recorded in a log book and dealt with in a professional and sensitive manner. Where issues cannot be resolved easily, the proponent will liaise with the City of Albany Environmental Health Officer and/or Planning Officer.

A piggery manager will primarily be responsible for the operation of the ROP, including transport of pigs to, from and within with property, unloading and loading, feeding and general management and maintenance. Staff will be adequately trained in best practice methodology for management of the ROP.

6 ROTATIONAL OUTDOOR PIGGERY – PROPOSED MANAGEMENT

Free range piggeries, when adequately located and managed, present few management issues. The main management considerations for any piggery are odour, dust, noise, waste, fly breeding, pest management, nutrient management and visual management. The magnitude of possible impacts is closely related to the size of the operation, density of pigs, management and type of operation being carried out. Generally, the more intensive the operation, the more risk there is of generating impacts on-site and off-site. This ROP will operate within the recommended density of pigs on a site which has suitable characteristics to support sustained operation. It is important to note that free range piggeries with rotational components are much less intensive operations compared to shedded operations where odour, dust and effluent disposal issues require larger buffer. The buffers outlined in this EAMP are consistent with national and other standards, which indicates that the ROP impacts can be adequately managed.

6.1 ODOUR

ROPs are not required to meet site-specific separation distances but should meet the minimum separation distances set out in the *National Environmental Guidelines for Piggeries* (Tucker *et al.*, 2010). The ROP areas proposed in this EAMP meet all separation distances outlined. ROPs pose a low risk of causing significant off-site odour impacts, provided they are designed and managed according to sustainable nutrient loading rate criteria (Tucker and O’Keefe, 2013). Measures that assist in keeping odour to acceptable levels include:

- Keeping pig densities at recommended levels;
- Ensuring that there is adequate infiltration of water and drainage of pens;
- The existing screens of mature vegetation and proposed tree planting adjacent to all ROP cells will assist in creating turbulent airflow, which will help to disperse any odour generated on the site; and
- Dead animals will be immediately collected and placed in dedicated burial trenches. The animals will be covered with a minimum of 0.5m of clean fill within 3 hours of disposal.

Research by University of Southern Queensland and National Centre for Engineering in Agriculture (Banhazi, 2013) indicates that risk associated with ROPs from odour is low.

6.2 DUST

Dust from ROP operations can be generated from traffic movements, dry conditions when pens have dry soil exposed or from associated farm operations such as feeding. The proposed setbacks from roads and property boundaries, plus existing shelter belts and vegetation buffers will ensure that impact from dust is minimal. Dust generation will be minimised through:

- Placement of pens in suitable soil types (i.e. coarse sand/loamy soils with clay and laterite elements); and
- Vehicle movements on access roads to be restricted to moderate speeds, and minimise distances travelled on gravel or sand.

Research by University of Southern Queensland and National Centre for Engineering in Agriculture (Banhazi, 2013) indicates that risk associated with ROPs from dust is low.

6.3 NOISE

A low level of noise is likely to be generated by the pigs and use of associated equipment. Noise risk in ROPs is generally not an issue due to setbacks and the fact that the low density of pigs reduces noise related to aggression and competition for food. Noise associated with loading and unloading the pigs will be limited to daylight hours. In the event of adversely high daytime temperatures, loading and unloading will be undertaken during early morning and evening. It is also considered that noise impacts are unlikely to be a problem given the distances to nearby rural residences, the nearest of which will be a minimum of 785 m to the west of the nearest rotational area. In addition, noise generated will be of a volume generally associated with farming activities in a rural area.

Research by University of Southern Queensland and National Centre for Engineering in Agriculture (Banhazi, 2013) indicates that risk associated with ROPs from noise is low.

6.4 WASTE MANAGEMENT

The ROP will generate waste products including pig manure mixed with straw bedding. The nutrients present in these materials including nitrogen (N), phosphorus (P) and potassium (K) will need to be managed to reduce the risk of export from the property. Design and management factors which will be applied to this ROP (in accordance with *National Environmental Guidelines for Rotational Outdoor Piggeries*; Tucker and O’Keefe, 2013) include:

- **Nutrient Budgeting:** While N, P and K accumulate in soils of ROPs, the nutrient accumulation rate is generally not high unless an area has been stocked continuously for more than two years (APL, 2011). Consequently, rotations will be planned so that pigs are not continuously stocked on an area for longer than two years. Following the pig stocking phase, crops for hay (or cereals) will be grown to utilise accumulated N, P and K;
- **Facilitating Even Spreading of Manure Nutrients:** In ROPs, manure and consequently nutrients, are not spread evenly across the paddocks. This increases the risk of nutrient overloading a specific location, through leaching and/or runoff. Moving pig shelters and feeding facilities regularly during the stocked phase will help spread nutrients more evenly. Feed is blown into the enclosures and spread over a relatively large area and in a variety of locations. Numerous water access points will also be available within each enclosure. These practices assist in evenly distributing the nutrients within the ROP paddock areas;
- **Minimising Uncontrolled Movement of Nutrients from ROP Paddocks:** This will be achieved through regular spelling from pig production, with a plant growth and harvest phase to remove the nutrients added through the stocked phase. The pig growing areas will be rested for at least two years before reuse. APIQ[✓]™ accreditation requires that soil testing be undertaken prior to reuse of a previous rotational area. Nutrient levels must be returned to acceptable levels before a new pig phase can begin.

Interceptor drains and vegetated strips will be incorporated into the ROP. In addition, water management and sediment trapping devices will be located along the downstream side of all

ROPs should any surface runoff be observed. This will slow the rate of runoff and capture any sediment that may be transported from the ROP.

- **Providing and maintaining wallows:** Wallows will be monitored and locations changed to prevent excessive impacts on a single site. Wallows will be remediated at the end of each rotation by ripping, refilling and levelling.
- **Monitoring and Surveillance:** Routine environmental monitoring of soil and surveillance of drainage lines will be undertaken during the pig growing phase and following the cropping phase of the rotation. Soil sampling will be undertaken in accordance with the APIQ[✓]™ guidelines, include samples collected prior to the pig phase commencing on a site, and then again prior to reusing an area as an ROP. This will be undertaken to ensure that the nutrient levels have returned to satisfactory levels prior to reusing an area as an ROP.
- **Removal and Treatment of Waste Products:** The ROP will produce more nutrients than can be spread on the property over an extended period of time. To manage this, a proportion of manure and bedding will be collected and stored and/or composted and exported from the property.

Details for these strategies are summarised below.

6.5 NUTRIENT MANAGEMENT

The management of nutrients during and following the pig growing phase is an important part of the operation of the facility. Bedding with manure from shelters will be collected each time a shelter is moved (e.g. after each batch of pigs) and removed from the property immediately. Residual manure and straw bedding will be applied evenly to the soil of the ROP area so that nutrients can be taken up by a cropping phase when the pig production phase has been completed. Table 15 provides estimates of the total nutrients applied from a range of pig classes.

Based on the average stocking rate for the ROP and nutrients per pig class, Table 16 presents the total annual nutrients produced. Half the manure and straw bedding will be collected and removed from the property (via composting or as spent bedding). For the remaining bedding and manure, nutrients will be assimilated and provide nutrients for the subsequent cropping phase.

Due to the nature of nitrogen in fresh pig manure, a significant portion will be lost through ammonia volatilisation and nitrous oxide emissions (estimated at 30%). It should also be noted that not all nitrogen, phosphorus and potassium are in the form that is readily available for uptake by plants. This is a result of manure having a slow release effect which will continually release bioavailable nutrients over a longer timeframe than synthetic fertilisers.

Depth to groundwater on the subject land is not considered a risk for nutrient migration, as winter groundwater level monitoring indicated that groundwater was not present within 1.5 m of the ground surface. Water gaining/retaining areas will not be used for pig areas during winter months.

**TABLE 15: PREDICTED NUTRIENT OUTPUT BY CLASS OF PIG AND BEDDING MATERIAL
(KG/HEAD/YEAR)**

PIG CLASS	TOTAL SOLIDS	VOLATILE SOLIDS	ASH	NITROGEN	PHOSPHORUS	POTASSIUM
Gilt	197	162	35	12.0	4.6	4.0
Boar	186	151	35	15.0	5.3	3.8
Gestating sow	186	151	35	13.9	5.2	3.7
Lactating sow	310	215	95	27.1	8.8	9.8
Sucker	11.2	11.0	0.2	2.3	0.4	0.1
Sow and litter	422	325	97	50.0	13.0	11.0
Weaner pigs	54	47	7	3.9	1.1	1.1
Grower pigs	108	90	18	9.2	3.0	2.4
Finisher pigs	181	149	32	15.8	5.1	4.1
Wheat straw	89	-	-	0.58	0.41	0.51

Source: *National Environmental Guidelines for Piggeries* (Tucker et al., 2010). Highlighted rows indicate pig classes proposed for this operation.

Following the pig phase, the land will be used for cropping. The net result of cropping is the removal of nutrients from the soil, and the export of these offsite. Typical data for cropping suggests that nutrient removal rates provided in Table 17 would be applicable for to the site. Both the *National Environmental Guidelines for Rotational Outdoor Piggeries* (Tucker and O’Keefe, 2013) and the APIQ[✓]™ guidelines have a heavy emphasis on the sustainable management of nutrients. In addition, APL fact sheet (APL, 2011) states the accumulation of nitrogen, phosphorus and potassium in free range piggeries is unlikely to be high unless an area is stocked for more than two years.

The proponent is committed to undertaking APIQ[✓]™ standard soil monitoring to ensure that nutrient limits have returned to acceptable levels prior to reusing an area for ROP operation. When approvals have been secured, soil testing will be undertaken to determine baseline data which will be lodged with APIQ[✓]™ for approval to maintain accreditation.

These management measures, having room for up to three rotations and on site operations will ensure that nutrients are appropriately managed to maximise reuse and minimise potential impacts on the environment.

TABLE 16: PREDICTED SOLID AND NUTRIENT OUTPUT FOR CLASSES OF PIGS

Source	TOTAL SOLIDS (kg/head/year)	1000 Sow Operation tonnes/solids/year	SOLIDS (kg/head/year)	1000 Sow Operation tonnes/year	ASH (kg/head/year)	1000 Sow Operation tonnes/year	NITROGEN (kg/head/year)	1000 Sow Operation tonnes/year	PHOSPHORUS (kg/head/year)	1000 Sow Operation tonnes/year	POTASSIUM (kg/head/year)	1000 Sow Operation tonnes/year
Gilts	197.0	9.9	162.0	8.1	35.0	1.8	12.0	0.6	4.6	0.2	4.0	0.2
Boars	186.0	9.3	151.0	7.6	35.0	1.8	15.0	0.8	5.3	0.3	3.8	0.2
Gestating sows	186.0	154.4	151.0	125.3	35.0	29.1	13.9	11.5	5.2	4.3	3.7	3.1
Lactating sows	310.0	52.7	215.0	36.6	95.0	16.2	27.1	4.6	8.8	1.5	9.8	1.7
Suckers	11.2	16.2	11.0	15.9	0.2	0.3	2.3	3.3	0.4	0.6	0.1	0.1
Bedding tonnes/year		573.5						3.6		0.4		12.2
AGGREGATE TOTALS												
kg/year			528.0		165.2		58.3		19.7		17.4	
tonnes/year		815.9		193.4		49.0		24.4		7.2		17.5
Tonnes/year/ha (43 ha rotation area)		18.975		4.498		1.139		0.567		0.169		0.407
Tonnes/ha/year entire farm		2.678		0.635		0.161		0.080		0.024		0.057

Source: Tucker *et al.*, 2010. Assumptions: Area for all rotations: 0.23ha. Total area of farm: 304.7 ha. Single rotational area: 43 ha. Bedding straw: 0.76 kg/SPU/day or 573.5 tonnes/ year

Ratios	1000 Sow Operation	SPU ratio	SPU
Gilt	50	1.8	90
Boar	50	1.6	80
Gestating	830	1.6	1328
Lactating	170	2.5	425
Suckers	1445	0.1	144.5
		Total SPU	2067.5

TABLE 17: TYPICAL NUTRIENT REMOVAL THROUGH CROPPING

	AVERAGE YIELD	NITROGEN		PHOSPHORUS		POTASSIUM	
	tonnes/ha	kg/tonne	kg/ha	kg/tonne	kg/ha	kg/tonne	kg/ha
Hay	6	20	120	2	12	25	150
Wheat	3.5	23	80.5	3	10.5	4	14
Barley	3.5	20	70	2.9	10.15	4.4	15.4
Canola	1.8	40	72	6.5	11.7	9.2	16.6

*Source: Summit Fertiliser Nutrient Removal Tables (2015).

6.6 RUNOFF AND DRAINAGE MANAGEMENT

Due to the proximity of the proposed ROP to Napier Creek (noting there will be a 100m grassed buffer), careful management will be implemented to ensure there is no uncontrolled loss of nutrients from the ROP. As such, a number of management measures are proposed to be implemented in each rotational area prior to the commencement of each pig phase. These measures include:

- Construction of cut-off or roll over drains down gradient of rotational areas (where appropriate);
- Retention of existing pasture or blue gums (at least 10m wide) and/or establish vegetation strips adjacent to internal waterways.

The APIQ Standards Manual (Australian Pork Limited, 2012) provides guidelines for the management of nutrients on-site:

Land and Water Protection Standard

The removal of nutrients in stormwater runoff is minimised by:

- Maintaining groundcover over paddocks throughout both the pig and the crop, forage or pasture phases; and/or
- Maintaining a continuous resilient vegetative buffer strip ideally consisting of a runner developing, non-clump forming grass species at least 10 m wide immediately downslope of the entire paddock area/s (e.g. Kikuyu); and/or
- Installing terminal ponds associated with roll over and/or cut off drains, sized and located to catch the first 12 mm of runoff from the piggery paddocks and other land within the same local catchment area.

As outlined above, the Proponent proposes to satisfy this standard through the installation of a series of cut-off or roll over drains and terminal basins which will effectively catch and treat the first 12mm of runoff.

6.7 DISPOSAL OF DEAD PIGS

A mortality rate of less than 5% of pigs per year is generally accepted in breeder and grower facilities. This means that of the 18,676 pigs (output per annum of 17,567 weaners and herd of 1,100 adult pigs),

up to 934 pigs may die. However, this number is expected to be significantly lower in a well operated free range piggery. Most of the pigs that die will be piglets (less than 10 kg).

The most feasible way to dispose of dead pigs at this site is by placing them in a purpose dug trench. Burial trenches will be designed, constructed and maintained in accordance with the *National Environmental Guidelines for Rotational Outdoor Piggeries* (2nd edition; Tucker and O’Keefe, 2013). Lime will be added and the trench will be backfilled as required. It should be noted that mass pig deaths will be dealt with as outlined in Section 5.6.

6.8 FLY BREEDING AND PEST MANAGEMENT

Fly breeding will be minimised by undertaking the following:

- Manure and bedding will be spread as thinly as possible and not left to accumulate to reduce the risk of fly breeding conditions;
- Spoilt feed around feed troughs will be regularly removed; and
- Dead pigs will be disposed of as quickly as possible.

Free range operations are at risk of attracting rodents and predators such as foxes. Good management of pig paddocks and feeding will help to minimise pests. Strategic baiting and trapping may be used if pests are identified.

6.9 WEED MANAGEMENT

As for any agricultural enterprise, monitoring for weeds and pests is an important priority for ROP management. General monitoring and treatment of weeds will be undertaken seasonally.

6.10 VISUAL

The visual impacts of the ROP will be minimal due to the existing vegetation that screens the ROP areas from all external vantage points.

6.11 TRANSPORT AND ACCESS

The ROP will rely on vehicle movements to bring pig feed, straw bedding, deliver breeding pigs and transport weaners from the site. The subject land will be serviced via Settlement Road (bitumen) and Elliot Road (gravel). Access within the property comprises a well-formed gravel road and other stable tracks.

Heavy vehicle use associated with the operation will be limited to the operation of road trains on Yungup Road.

Transport impacts will be minimised by:

- Ensuring that loads are appropriately sized, secured and coordinated to reduce movements;
- Keeping traffic speed on internal access road low (20kmh); and
- Not moving pigs during the night.

As outlined in Section 5.5 it is expected that there will be 14 truck movements (i.e. coming and going from the subject land) each week, with occasional deliveries of straw.

6.12 CHEMICALS AND FUELS

ROPs use far fewer chemicals than many other farming enterprises (e.g. no disinfectants). However, from time to time the use of pesticides, vaccines and other pharmaceutical products may be required. These materials will be stored in the farm sheds on the subject land according to manufacturer instructions and legislative requirements (where applicable). This applies to any rural activity where chemicals are required. In this instance, chemicals will be stored in an enclosed shed with a concrete floor. All pesticides will be stored, applied, transported and disposed of in accordance with the *Health (Pesticides) Regulations 1956*. Medications such as vaccines will be stored in a refrigerator solely for that purpose.

6.13 MONITORING AND EVALUATION

The Australian Pork Industry Quality Assurance Program (APIQ[✓][™]) is an on-farm quality assurance program designed by the pork growing industry in consultation with producers, key customers and government. APIQ[✓][™] enables pig producers to demonstrate that their on-farm practices reflect good agricultural practices for management, food safety, animal welfare, biosecurity and traceability. Part of the APIQ[✓][™] program involves soil testing for nutrients, firstly to determine baseline nutrient levels and prior to reuse of rotational areas to ensure that nutrient levels continue to be managed sustainably. Soil testing must be undertaken as part of the accreditation process as described in Appendix B.

7 SUMMARY AND COMMITMENTS

Suppliers of pigs are required to meet exacting standards to ensure that the end product meets processor and market expectations. This ROP will meet the standards set by the APIQ[✓]™ Accreditation System and the *Model Code of Practice for the Welfare of Animals-Pigs* (Revised) (AWWG, 2007).

Examination of environmental factors, guidelines and policy requirements indicates that the proposed ROP can be managed to meet desired objectives for its operations without impacting on the surrounding environment or the health or amenity of surrounding property owners and the wider public.

The following commitments are made by the proponent in support of this EAMP (Table 18).

TABLE 18: PROPONENT COMMITMENTS

	COMMITMENT	TIMING/RESPONSIBILITY
1	ROP areas will only be established within the boundaries shown on Figure 2.	Proponent.
2	The ROP areas identified will be used for two years and rested for at least two years prior to reuse (and pending results of APIQ [✓] ™ nutrient testing).	Two years use, at least two years rest with production of cereal crops. Proponent.
3	Density of pigs will meet Model Code of Practice Guidelines.	Proponent.
4	Surface water flow from the ROP rotation areas will be monitored and controlled through the installation of cut off or roll over drains and basins. In addition, vegetated buffers (pasture and/or blue gums) and temporary structures such as water/sediment control devices will be used.	Proponent.
5	Apply <i>National Environmental Guidelines for Rotational Outdoor Piggeries</i> (Tucker and O'Keefe, 2013), <i>Model Code of Practice for the Welfare of Animals – Pigs (Revised)</i> (AWWG, 2007) and <i>RSPCA Approved Farming Scheme Standards for Pigs</i> (RSPCA, 2011) to operations of the ROP.	Proponent.
6	After use, each ROP rotational area will be planted to a suitable harvestable crop (e.g. oaten hay) for at least two seasons to utilise nutrients.	Minimum two years. Proponents.
7	Testing for nutrient levels prior to re-use of ROP area for pigs (as per APIQ [✓] ™ program).	Proponents.
8	Biosecurity measures will comply with the <i>Australian Pork Industry Biosecurity Program</i> (APL, 2003) and <i>AUSVETPLAN</i> (Animal Health Australia, 2021).	Proponents.
9	Pigs which die on the property will be placed in a designated burial trench and immediately covered with soil (as per Tucker <i>et al.</i> , 2010). This does not apply where mass deaths or disease occurs.	Proponent – immediately following pig deaths.

COMMITMENT		TIMING/RESPONSIBILITY
10	Vehicle speed on internal tracks will be limited to 20km/hour.	Proponents and suppliers.
11	Signage will be installed at entry to ROP compartments with information regarding biosecurity.	Proponents.
12	Operations such as delivering and removal of pigs from the property will be undertaken during daylight hours.	Proponents.
13	Any complaints will initially be dealt with by the Proponent, with advice and assistance from the City of Albany Environmental Health and/or Planning Officer, where necessary. A register of complaints will be kept.	Proponents and City of Albany
14	Application of lime to ROP areas and locations where litter is spread, to aid in the retention of phosphorus.	Proponents.
15	Drainage and run-off management measures will be implemented as rotational areas are developed. Erosion will be managed by use of suitable management devices (Appendix F).	Proponents.

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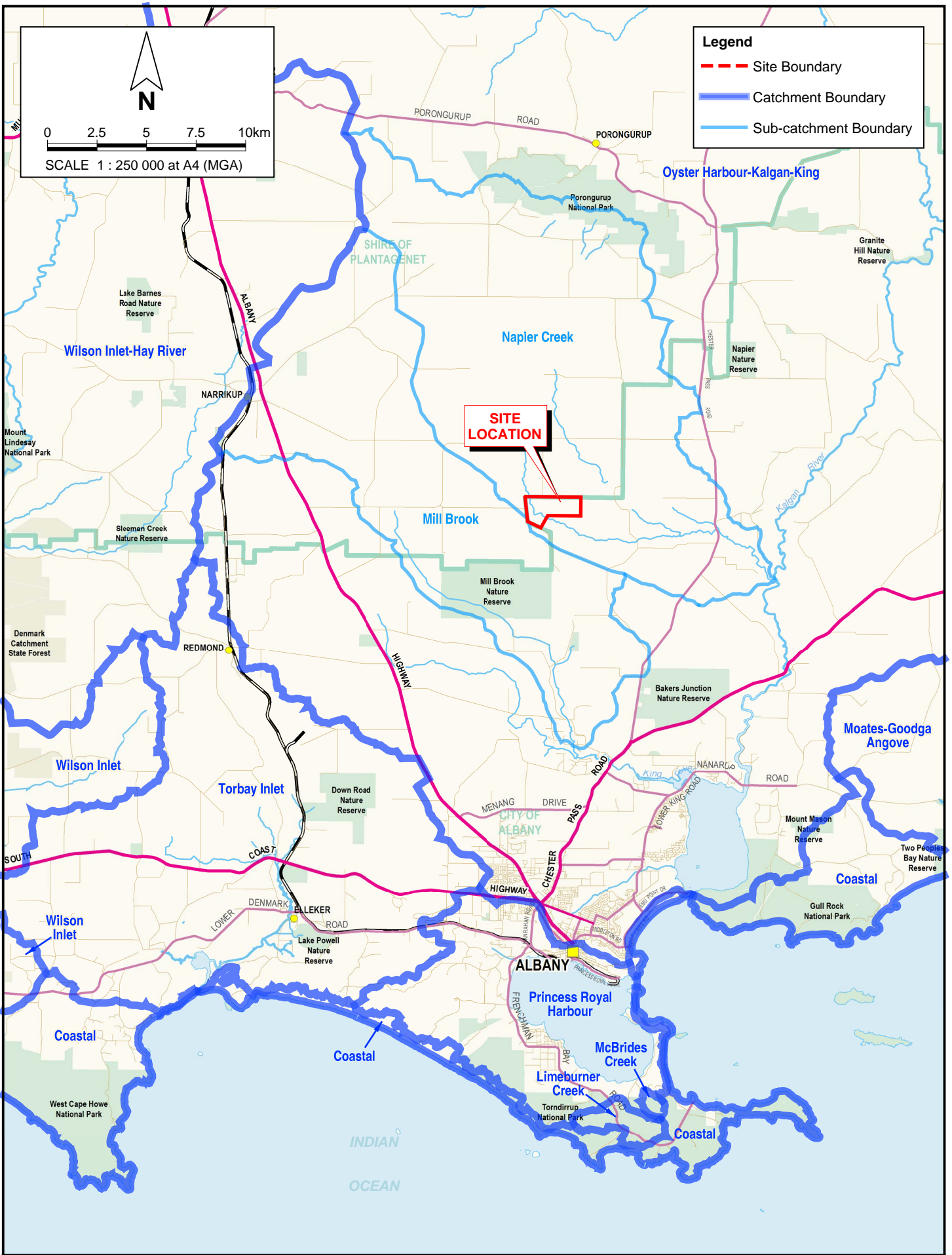
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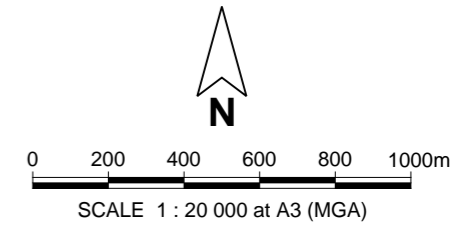
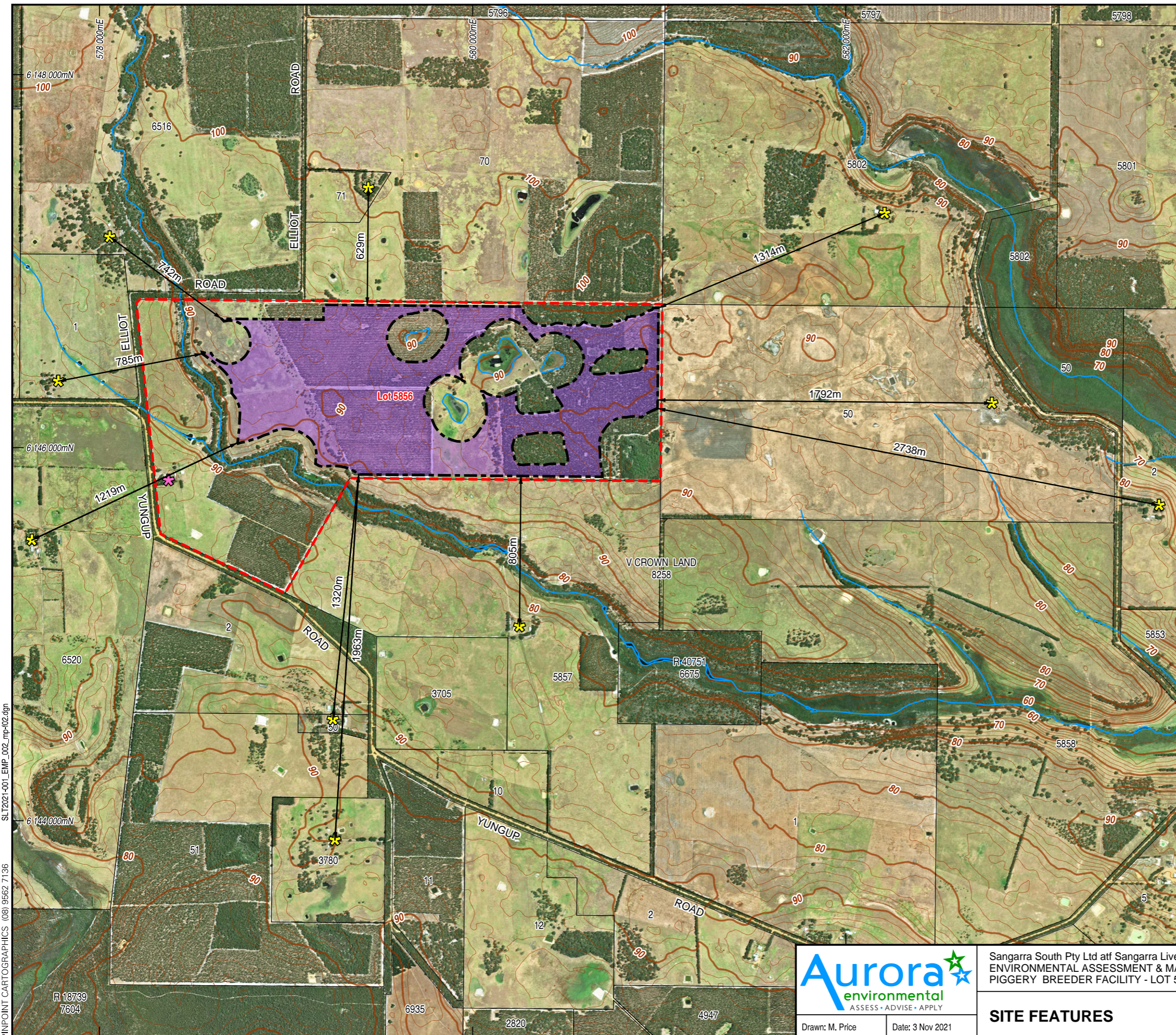
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FIGURES



SLT2021-001_EMP_002_mp-101.dgn
PINPOINT CARTOGRAPHICS (08) 9562 7136

 <p>ASSESS • ADVISE • APPLY</p>	<p>Sangarra South Pty Ltd aff Sangarra Livestock Trust ENVIRONMENTAL ASSESSMENT & MANAGEMENT PLAN - OUTDOOR ROTATIONAL PIGGERY BREEDER FACILITY - LOT 5856 (NO. 1028) YUNGUP ROAD, NARRIKUP</p>	<p>Figure 1</p>
	<p>REGIONAL LOCATION</p>	
<p>Drawn: M. Price</p>	<p>Date: 12 Oct 2021</p>	



Legend

- Site Boundary
- Cadastral Boundary
- - - Easement Boundary
- Topographic Contour
- Watercourse
- ★ Rural Dwelling
- ★ Dwelling Within Subject Land
- - - Combined Buffer
- Land to be Used as Rotational Outdoor Piggery (ROP)

Buffers required:

- National Environmental Guidelines for Piggeries (Australian Pork Limited (Tucker et al., 2010))**
- Public road carrying < 50 vehicles per day 100m
 - Public road carrying > 50 vehicles per day 200m
 - Property boundary 20m

- Department of Agriculture and Food (2000) Environmental Guidelines for New and Existing Piggeries Bulletin 4416**
- Isolated rural dwellings 300 m
 - Neighbouring rural property boundaries 50 m
 - Major water course 100 m
 - Minor water course 50 m

CONTOUR SOURCE: Dept. of Agriculture, 2000.
 CADASTRAL SOURCE: Landgate, October 2021.
 AERIAL PHOTOGRAPH SOURCE: ESRI, January 2020.
 WATERCOURSE SOURCE: Landgate 1:50 000 topographic mapping.



Drawn: M. Price Date: 3 Nov 2021

Sangarra South Pty Ltd atf Sangarra Livestock Trust
 ENVIRONMENTAL ASSESSMENT & MANAGEMENT PLAN - OUTDOOR ROTATIONAL
 PIGGERY BREEDER FACILITY - LOT 5856 (NO. 1028) YUNGUP ROAD, NARRIKUP

SITE FEATURES

Figure 2

Job: SLT2021-001

PINPOINT CARTOGRAPHICS (08) 9562 7136 SLT2021-001_EMP_002_imp-02.dgn

APPENDIX A

Planning Principles Checklist

2 Planning Principles

The following planning principles can apply to new developments, expansions or changes in material use at piggeries. The first step in planning involves the identification of any land use or zoning issues from local government, and the state government agencies responsible for piggery licensing and approval, water licensing, soil conservation and vegetation clearing. Consultation with the relevant agencies, ideally through a pre-lodgement, on-site meeting, helps to determine if the site is suitable, and the major issues to be addressed in an application. These issues are listed below in a checklist.

The next step is to gather and compile the information. As the National Guidelines provide recommended siting, design and management information, they can be used to assemble the supporting information for a piggery development application. Submission of application forms and supporting information, advertising the development and formal assessment, will follow. For large or complex applications, professional assistance may be necessary.

ISSUES	CHECK
Applicant details	
Site description (including plans) and assessment	
Real property description	
- Land tenure	
- Land area	
- Cadastral plan	
Land zoning, and zoning of the surrounding land	
Climatic data	
- Median annual rainfall	
- Average monthly rainfall	
- Rainfall intensity data (1-in-20-year design storm, 1-in-20-year 24-hour storm)	
- Average monthly evaporation	
- Monthly maximum and minimum temperatures	
- Wind speed and direction	
Soil description for the piggery complex site (including analysis of basic physical properties) and reuse areas (including analysis of basic chemical and physical properties)	
Description of groundwater resources and geology of the site	
- Details of any bores on the subject property	

PLANNING PRINCIPLES (continued)

ISSUES	CHECK
- Analysis of the chemical properties of groundwater for use in piggery	
- Details of any licenses held	
Description of surface water resources on the property or in the vicinity of property	
- Analysis of the chemical properties of surface waters for use in piggery.	
- Details of any licenses held	
Description of the current vegetation of the site and the extent of any proposed clearing	
Identification of any items, sites or places that may have cultural heritage significance	
Description of the proposed piggery operation	
Total pig or standard pig unit (SPU) numbers	
- herd composition	
- numbers and weights of incoming and outgoing stock	
- sources of stock	
Description of housing and layout plans	
Water requirements for drinking, cooling, cleaning and shandying with effluent, and water sources and quality	
Bedding requirements and bedding sources	
Feed requirements, sources and storage areas	
Staff numbers	
Hygiene practices	
Prediction of manure production and mass balance estimate of the nutrient content of solid and liquid by-products	
Design of effluent collection, pre-treatment and treatment system, including plans	
Sizing and proposed management of the reuse areas, including location, area, method, frequency and general management of spreading/irrigation activities	
Description of carcass management or disposal, including plan for mass mortalities	
Calculation of traffic numbers and consideration of access and road safety. There is also a need to negotiate with state or territory and local governments regarding road upgrading and maintenance responsibilities	

PLANNING PRINCIPLES (continued)

ISSUES	CHECK
Environmental impact assessment	
Community amenity impacts - particularly odour, dust, noise, traffic Calculate separation distances to sensitive receptors	
Surface water impacts – quality and availability for other potential users	
Groundwater impacts – quality and availability for other potential users	
Vegetation impacts – effects of clearing on rare and threatened species and communities	
Impacts on items, sites or places of cultural heritage significance	
Impacts to soils of reuse areas	
Summary of design and management features to minimise adverse environmental impacts	
Proposed environmental monitoring and reporting	
Environmental Management Plan (EMP) - An EMP focuses on the general management of the whole farm, taking into account the environment and associated risks. It should document design features and management practices; identify risks and mitigation strategies; include ongoing monitoring to ensure impacts are minimised; and processes for continual review and improvement	
Plans including:	
<i>Topographic plan</i> - showing watercourses and drainage lines; flood lines, protected land; and location of nearby residences	
<i>Recent aerial photograph</i>	
<i>Farm plan</i> – showing current land uses; proposed piggery complex location; proposed carcass composting or burial site; proposed reuse areas; on-farm roads; location of on-farm bores; and location of any soil conservation or drainage works	
<i>Piggery complex layout plan</i> - including location of by-products treatment and storage facilities	
<i>Effluent treatment ponds plan</i> - (if applicable)	
<i>Separation and buffer distances plan</i> - showing location of piggery complex (including feed storage; and by-products storage and treatment facilities) and reuse areas; and distances to sensitive land uses e.g. houses and towns, as well as buffers around sensitive natural resources	

APPENDIX B

Australian Pork Industry Quality Assurance Program
(APIQ[✓]™)

1.2 Free Range Production Requirements

Standard	The piggery production system complies with the APIQ✓ [®] definition and standards for 'Free Range' (FR).
Performance indicators:	
<p>A. Weaners and growers and the sows from which they were bred have access to paddocks at all times for their entire life.</p> <p>Where pigs are confined temporarily for vaccinations, mating or under veterinary advice, systems are in place which support the need for confinement.</p>	
<p>B. Shelter is available to provide protection from the elements at all times.</p> <p>Steps are taken to minimise the risks to pigs from predators.</p> <p>All pigs are able to move freely in and out of shelter provided.</p> <p>Bedding is provided in the shelters.</p>	
<p>C. Suitable paddocks with rooting and/or foraging areas are available to pigs at all times.</p> <p>Wallows are provided where state regulations and the season permits.</p>	
<p>D. Shelter provided for weaners and growers meets the space allowance standards of the <i>Model Code</i>, 3rd edition, 2007, Appendix 3, Table 5.</p>	
<p>E. Shelter for dry sows in groups, lactating sows with piglets and boars meet the space allowance in the <i>Model Code</i>, 3rd edition, 2007, Appendix 3, Table 8.</p>	

1.2.1 Soil Monitoring Standard

Standard	<p>Sampling and analysis of soils is either:</p> <ul style="list-style-type: none"> - Done in accordance with the conditions of a licence, approval or consent that requires specific soil monitoring but at least every two years; OR - Done before pigs move onto that land if the pig phase is expected to exceed 24 months in length; AND - At the end of any 24 month period in which pigs are stocked on an area for any length of time and at the end of each subsequent 24 months that includes a pig phase; AND - Samples are collected from the expected nutrient-rich area of each block of paddocks.
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Performance indicators:

A. Soil sampling produces a set of samples that is representative of the expected nutrient-rich area of each block of paddocks¹ by:

- drilling at least ten holes from dispersed locations between the shelter/s and the feeding and watering points from a block of paddocks; **AND**
- bulking the samples of soils collected from common depths to produce a single composite sample for each depth from all blocks of paddocks sampled (i.e. a bulked top soil, subsoil and profile sample).

B. Soil sampling occurs

- before the commencement of each pig phase that is expected to exceed 24 months in length; **AND**
- at the end of any 24 month period in which pigs are stocked on an area for any length of time; **AND**
- at the end of any subsequent 24 month period that includes a pig phase.

C. Soil sampling depths and analysis parameters are either in accordance with the conditions of a planning or development consent, approval, permit or licence; **OR**

if not stipulated, in accordance with the following:

Soil test parameter	Depth
pH	0-0.1 m 0.3-0.6 m OR bottom 0.3 m of soil profile OR 0.3 m to base of root zone
Electrical conductivity	0-0.1 m 0.3-0.6 m OR bottom 0.3 m of soil profile OR 0.3 m to base of root zone
Nitrate-nitrogen	0-0.1 m 0.3-0.6 m OR bottom 0.3 m of soil profile OR 0.3 m to base of root zone
Available phosphorus	0-0.1 m 0.3-0.6 m OR bottom 0.3 m of soil profile OR 0.3 m to base of root zone
Phosphorus buffer capacity or phosphorus sorption index	0-0.6 m OR 0 m to base of soil profile OR 0 m to base of root zone
Potassium	0-0.1 m 0.3-0.6 m OR bottom 0.3 m of soil profile OR 0.3 m to base of root zone
Organic carbon	0-0.1 m
Exchangeable cations and CEC	0-0.1 m 0.3-0.6 m OR bottom 0.3 m of soil profile OR 0.3 m to base of root zone

¹ A block of paddocks is defined as a group of adjacent paddocks used simultaneously to run pigs. For piggeries that operate with a radial paddock system, one radial would constitute a block of paddocks. Similarly, if a piggery uses eight adjacent rectangular paddocks at a time this would constitute a block of paddocks.

1.2.2 Nutrient Management Standard

Standard	<p>If the pig phase is expected to last for 24 months or longer, the results of soil testing show that soil nutrients are at suitable levels before the pigs move onto a land area; AND</p> <p>The results of soil testing undertaken at the end of any 24 month period that includes a pig phase show that soil nutrients are at suitable levels for the area to be used for ongoing or subsequent pig phases.</p>
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Performance indicators²:

A. Before the commencement of a pig phase expected to exceed 24 months in length, the results of soil testing show that:

- the soil properties are below the trigger values suggested as indicators of sustainability in section 17.5.4 of the *APL National Environmental Guidelines for Piggeries, Second Edition (Revised)* Published in 2011; **OR**
- the soil properties are similar to; i.e. no more than 30% greater³ than those of a representative background plot⁴; **OR**
- the soil properties are satisfactory to the licensing authority or an independent soil scientist or agronomist⁵.

B. The results of soil testing undertaken on areas that have included a pig phase over any part of any 24 month period show that:

- the soil properties are below the trigger values suggested as indicators of sustainability in section 17.5.4 of the *APL National Environmental Guidelines for Piggeries, Second Edition (Revised)* Published in 2011; **OR**
- the soil properties are similar to; i.e. no more than 30% greater³ than those of a representative background plot; **OR**
- the soil properties are satisfactory to the licensing authority or an independent soil scientist or agronomist.

2 A Nutrient Management Plan (NMP) is not specifically included as a Performance Indicator. However, it is valuable to develop and implement a NMP to ensure the soil nutrient properties required by the Performance Indicators can be achieved.

3 APIQ[✓]® FR and OB Standards Guide for Producers and Auditors.

4 A representative background plot is an area of land that has a similar soil type and is physically close to the land being monitored, that is sampled and analysed at the same time, to provide a basis for comparison when interpreting soil test results. It should not have been used for outdoor pig production, irrigated with effluent or spread with manure, or recently had fertiliser applied. It is recognised that it is not always easy to find a suitable background plot. The location of the representative background plot should be carefully noted as samples should be collected from the same location each time.

5 It is the farm's responsibility to ensure that their business complies with the permit/licensing arrangements required by their state authority/local council.

1.2.3 Promoting Even Nutrient Distribution Standard

Standard	Facilities and practices are actively managed to promote dispersal of manure nutrients over the paddock area.
Performance indicators:	
A. For breeder paddocks:	
<ul style="list-style-type: none"> - readily movable structures that could include shelters, shade, feeding points, waterers, wallows and spray or drip cooling facilities are moved within the paddock at least every six months to promote more even manure deposition over the land; OR - feed is always delivered right along the length of a paddock perimeter fence line or dispersed over a significant part of the paddock area and feeding areas are well separated from shelters; OR - when the length of the pig phase is less than six months, readily movable structures that could include either shelters, shade, feeding points, waterers, wallows and spray or drip cooling facilities are located in different positions before the return of pigs to the area. 	
B. For grower paddocks:	
<ul style="list-style-type: none"> - readily movable structures that could include shelters, shade, feeding points, waterers, wallows and spray or drip cooling facilities are moved within the paddocks at least every three months to promote more even manure deposition over the land; OR - feed is always delivered right along the length of a paddock perimeter fence line or dispersed over a significant part of the paddock area and feeding areas are well separated from shelters or these feeding areas are moved to a new location at least every three months; OR - before the return of pigs to the area and when the length of the pig phase is less than three months, readily movable structures that could include shelters, shade, feeding points, waterers, wallows and spray or drip cooling facilities are moved to different positions within the paddock. 	
C. If significant quantities of spent bedding are produced from shelters, this material is:	
<ul style="list-style-type: none"> - dispersed over land within the pig paddocks that is not within the expected nutrition rich areas that are bounded by the shelters, shade, feeding points, waterers, wallows and spray or drip coolers; OR - removed from the pig paddocks for spreading on other parts of the farm or for reuse off-farm. 	

1.2.4 Land and Water Protection Standard

Standard	Land and water are protected by minimising soil erosion throughout both the pig and the crop, forage or pasture phases of the rotation; by rehabilitating the site after the pig phase; by using water protection measures; and by properly constructing and managing wallows.
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Performance indicators:

A. Land is managed to minimise soil erosion by:

- selecting sites with a flat to gentle slope; **AND**
- maintaining sufficient groundcover⁶ over paddocks as much as practical throughout both the pig and the crop, forage or pasture phases to minimise erosion; **AND / OR**
- installing and maintaining properly designed shelter belts and / or filter strips and / or contour banks in blocks of paddocks.

B. Each block of paddocks is examined:

- on completion of the pig phase; **OR**
- where the pig phase exceeds 24 months in length the paddocks are examined at least every 24 months; **AND**
- any soil erosion or structural issues that need addressing are identified; **AND**
- a plan to address these is developed and implemented within three months of the completion of the examination.

C. Where significant soil compaction has resulted from the pig phase, the site is remediated by:

- only cultivating the soil when the moisture content is between wilting point and field capacity; **AND / OR**
- growing pasture ley crops (ungrazed); **AND / OR**
- deep ripping the soil (if this is a suitable measure for the soil type); **AND / OR**
- applying gypsum to the soil (if this is a suitable measure for the soil type).

D. Removal of nutrients in stormwater runoff is minimised by:

- maintaining groundcover over paddocks throughout both the pig and the crop, forage or pasture phases; **AND / OR**
- maintaining a continuous resilient vegetative buffer strip ideally consisting of a runner developing, non-clump forming grass species at least 10 m wide immediately downslope of the entire paddock area/s; **OR**
- installing terminal ponds sized and located to catch the first 12 mm of runoff from the piggery paddocks and other land within the same local catchment area.

E. Sites selected for wallows have loam to clay soils or the base of the wallow is lined with compacted clay.

⁶ Groundcover is any material on or near the soil surface that provides protection for the soil against the erosive action of rainfall runoff or wind. It may include plant material (alive or dead), spent bedding and other cover materials providing these will not be carried away in rainfall runoff or blown away by the wind. Since attached plant material is more effective than dead plant material or other light matter lying on the soil surface it is recommended that it make up the majority of the groundcover.

F. Wallows are remediated when they are replaced and if needed within three months of completion of the pig phase by:

- deep ripping the soil; **AND / OR**
- applying gypsum to the soil (if these are suitable measures for the soil type); **AND**
- filling with soil; **AND**
- levelling to match the slope of the immediately surrounding land.

G. A forage crop or pasture is given time to establish before the commencement of a pig phase.

NOTE: Only producers who meet the full set of APIQ✓[®] FR Standards will be APIQ✓[®] FR certified. Those producers who meet Standards 1.2A to 1.2E and are able to demonstrate that they are in the process of addressing Standards 1.2.1 to 1.2.4, will be certified as Conditional APIQ✓[®] FR. A producer with Conditional APIQ✓[®] FR certification has until close of business (COB) 30 April 2014 to comply with all APIQ✓[®] FR Standards at which time APIQ✓[®] Certification Policy 9 (CP9), Producer APIQ✓[®] Certification Status and non compliance to APIQ✓[®] Standards, comes into effect.

1.3 Outdoor Bred Production Requirements

Standard	The piggery production system complies with the APIQ [✓] ® definition and standards for 'Outdoor Bred' production. Production is carried-out according to accepted Good Agricultural Practices (GAP) for the production of Outdoor Bred pigs.
----------	--

Performance indicators:

Sows and piglets are managed as per Free Range Standards until weaning (see 1.2 B – E)

A. The piglets up until weaning and the sows from which they are bred have access to paddocks at all times.

Where pigs are confined temporarily for vaccinations, mating or under veterinary advice systems are in place which support the need for confinement.

B. At weaning piglets are transferred to deep litter housing, intensive indoor housing, or feedlot outdoor pens for growing and/or finishing.

Note: Additional standards for outdoor bred piggeries are being developed and will be available once approved.

APPENDIX C

APIQ[✓]™ Standards Site Selection Characteristics

APL (2011)

7 Site Selection

Environmental Outcome: Protection of natural resources and the community through good piggery siting.

Environmental advisers can provide guidance on the suitability of a proposed site for an outdoor piggery. The main factors to consider include:

- statutory land use planning restrictions
- availability of suitable land area
- suitable road access
- availability of a reliable water supply
- climate
- the site's natural resources
- possible effects on community amenity or cultural heritage
- any possible future expansion plans.

Each of these factors is discussed below.

7.1 Planning Restrictions

The suitability of a farm for a rotational outdoor piggery depends on its land use, zoning and any legal constraints. The current and future land zoning of the property and surrounding land should be discussed with the local government authority to confirm the long-term suitability of the zoning. Environmental advisers can identify state and territory department planning controls.

7.2 Available Land Area

The farm must be large enough to accommodate all of the paddocks and related facilities needed for the pig phase. Generally, there will need to be sufficient space for future pig phases although some herds move from one farm to the next on completion of the pig phase. Owning land around the piggery complex prevents encroachment by nearby developments and offers options for providing separation distances and buffers to sensitive areas or features. The shape of the property and other physical constraints also influence both the piggery layout and the separation distances and buffers to nearby sensitive land uses and features.

7.3 Suitable Road Access

Piggery roads must provide all-weather access for trucks. It is very important to consider safety when selecting and designing property access points. Farm access points should provide good visibility in both directions and allow for safe entry and exit by vehicles. Where alternative routes are available, consider those that avoid passing nearby houses and other sensitive locations like schools, bus pick-up points, halls and community areas. Selecting routes with sealed roads may reduce the impact of dust at nearby houses and have lower maintenance requirements.

7.4 Availability of a Suitable Water Supply

Rotational outdoor piggeries need water for stock consumption, wallows and possibly for spray or drip cooling and dust control.

Water licensing and allocation conditions vary between states and territories, and regions within them. It is essential to confirm that water can legally be used in a piggery. The holding of a water allocation may not guarantee the supply of that volume. Pump testing of bores is recommended.

Water quality influences herd health and performance. Potential water sources should be analysed to identify suitable supplies. Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand (2000) provide specific guidance on water quality for stock drinking and irrigation purposes. A pig husbandry or veterinary consultant can also advise on drinking water suitability.

7.5 Climate

Temperature and rainfall should be considered when selecting a site for an outdoor piggery.

In general, outdoor piggeries are better suited to temperate climates. The risk of the heat wave conditions linked to summer infertility is lower if the mean maximum summer temperatures are less than 28°C. A location in which the mean minimum winter temperatures exceed 3°C has a lower likelihood of water pipelines freezing and provides a more comfortable environment for stock and staff. Sites with an annual rainfall of less than 760 mm are generally preferable (McGugan & Fahy n.d.).

Based on these climatic constraints, ideal locations for outdoor piggeries are limited to the south coast of New South Wales; northern Gippsland and south-western Victoria, the Eyre Peninsula and south-eastern South Australia; and parts of the lower south-west, great southern and south-eastern regions of Western Australia (see Figure 1). However, outdoor piggeries can operate in other climates with good design and management. Consult pig production experts about design and husbandry recommendations for other locations.

FIGURE I Ideal climatic locations for outdoor piggeries



7.6 Natural Resources

7.6.1 Topography

Gently sloping or undulating sites promote good drainage in outdoor piggeries. Flat sites may be subject to localised flooding or waterlogging. Sites with a steeper slope may promote soil erosion and nutrient loss through both erosion and stormwater runoff. The ideal slope depends on soil type, the amount of vegetative cover it is possible to continuously maintain and soil conservation measures.

Topographical barriers (hills, ridges etc) between the piggery and sensitive locations are desirable. For some, the sight of a piggery is not aesthetically pleasing. For others, it is a reminder of the presence of a piggery, which may trigger complaints. Undesirable sites are often elevated and cleared providing a clear line of sight between nearby roads or neighbouring houses and the piggery.

7.6.2 Soils

Suitable soils provide acceptable paddock conditions for stock in wet weather, can be formed into all-weather roads, can grow pastures, forage or crops that can be harvested and removed from the site, have low erosivity and have a reasonable water holding capacity. Heavy clays are often unsuitable as they tend to stay wet and get puggy after wet weather. They may also be prone to compaction. Very sandy soils are also unsuitable as they drain rapidly which may move nutrients below the root zone of future crops, posing a risk to groundwater.

7.6.3 Water

The piggery site should be well separated from watercourses and other surface waters to protect water quality. However, buffers alone are insufficient and good nutrient management is also needed to ensure surface waters are protected.

Rotational outdoor piggeries should be sited above the 1 in 100 year flood line since flooding may not only harm the operation, but also cause surface water contamination. Information on land submerged by a 1 in 100-year flood is available from the local government authorities, or state water resources agencies.

Consider groundwater vulnerability when selecting a site for a rotational outdoor piggery. Ideally groundwater should be reasonably deep and stored within a confined aquifer or well protected by a clay layer. Avoid sandy soils, particularly if there is shallow groundwater. Good nutrient management is also necessary to protect groundwater quality.


7.6.4 Flora and Fauna

Avoid areas of remnant vegetation, wildlife habitats and natural wetlands for rotational outdoor piggeries. Pigs can quickly destroy trees, shrubs and other vegetation by chewing, rooting, soil compaction and nutrient deposition. Tree guards can reduce physical damage. Consult relevant local, state and territory authorities to determine specific restrictions on tree clearing.

7.7 Community Amenity

Good site selection is fundamental to minimising community amenity impacts. Fortunately, APL-funded research has shown that rotational outdoor piggeries produce very low levels of odour, dust and noise. Providing appropriate separation distances between FR or OB piggeries and nearby sensitive land uses offers additional protection. Section 8.2 provides information on recommended separation distances.

However, appropriate layout, design, management and a good communication strategy are also necessary to prevent conflicts with neighbours. Conflicts arising from amenity issues are often very emotive, and the people involved sometimes experience great personal stress. Hence, it is important to prevent and quickly resolve conflicts.



Since the public sometimes perceives piggeries negatively, it is desirable to screen the piggery complex from public view. This can be challenging given that rotational outdoor piggeries can cover large areas. Take advantage of the topography and existing vegetation where possible.

Landscaping can improve the aesthetics of FR or OB piggeries. It can also conceal the piggery from nearby roads or sensitive land uses. If the piggery is clearly visible from nearby houses or roads, consider planting groves of indigenous trees and shrubs along property boundary fences and waterways.

7.8 Cultural Heritage

Items, sites or places of Aboriginal or European cultural significance must be considered when selecting a piggery site. If artefacts are found consult the appropriate bodies, including the traditional land owners, to determine the most suitable course of action. The issue may be resolved by properly recording, preserving or relocating special objects to allow development to proceed, or, in rare cases, permanently sectioning off parts of the property to prevent any potential detrimental effects.

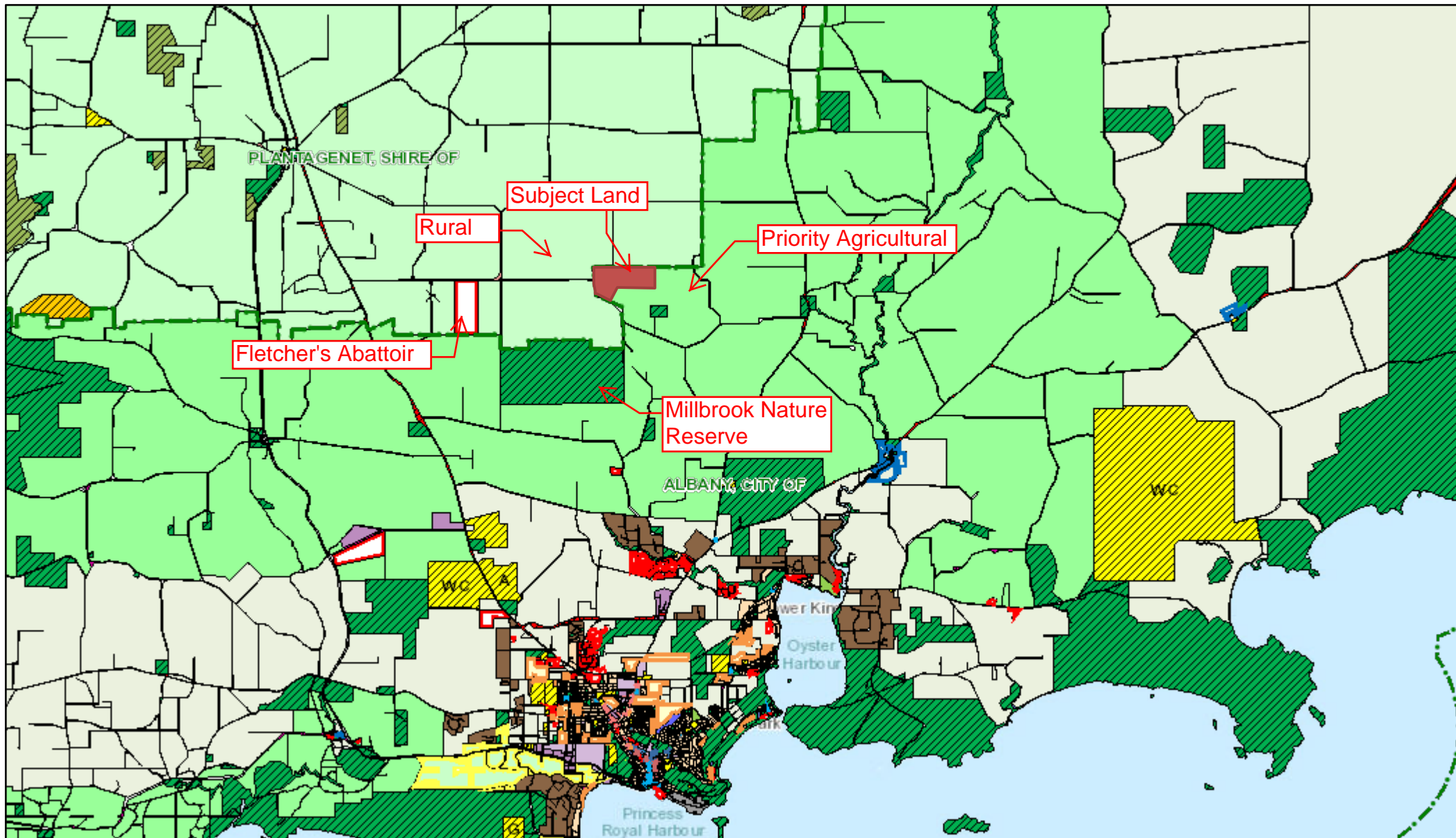
7.9 Future Expansion Plans

During the site selection process, consider any possible future expansion plans. In particular, take into account the land area needed for additional paddocks, and for buffers and separation distances to sensitive land uses.

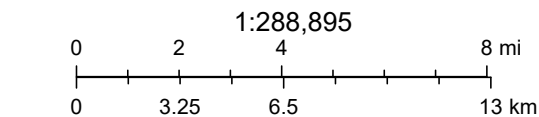
APPENDIX D

Zoning

Local Planning Schemes



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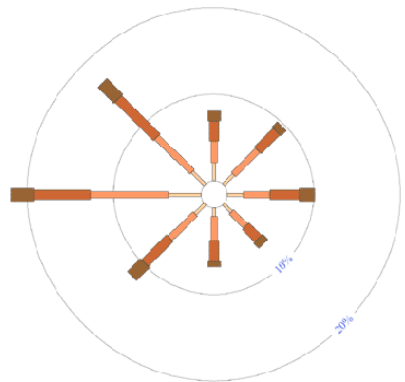
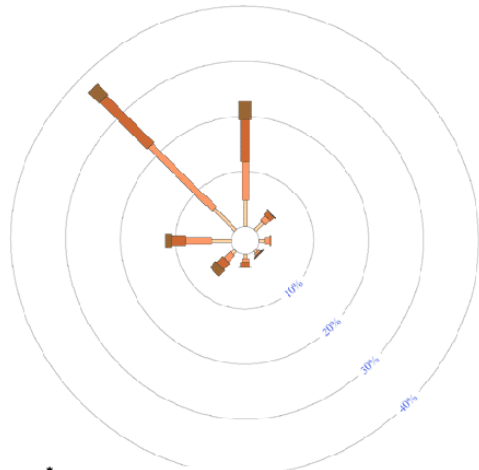
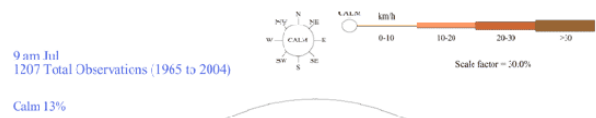
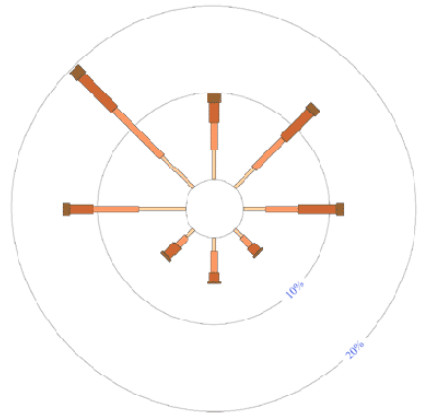
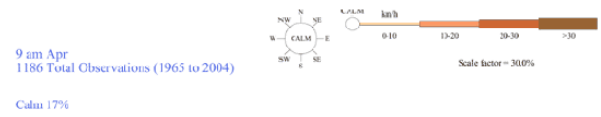
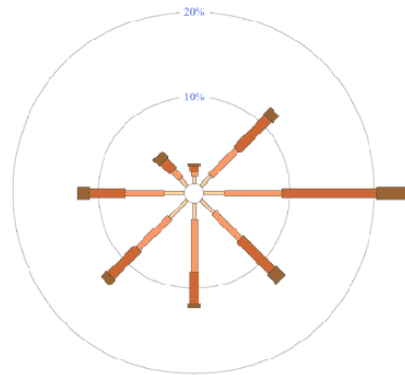
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community, SLIP/LANDGATE, SLIP/Landgate

APPENDIX E

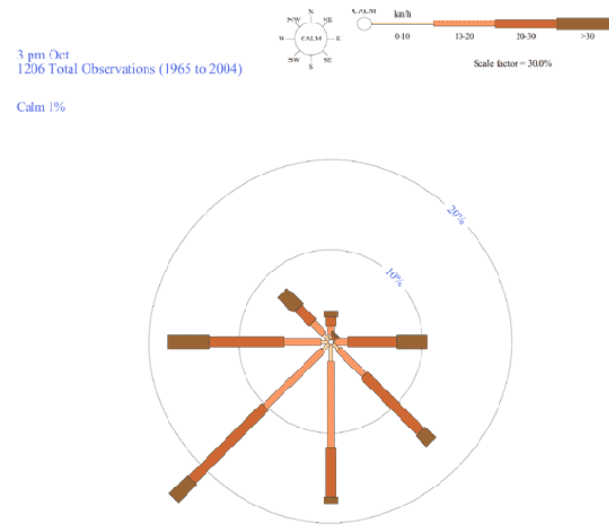
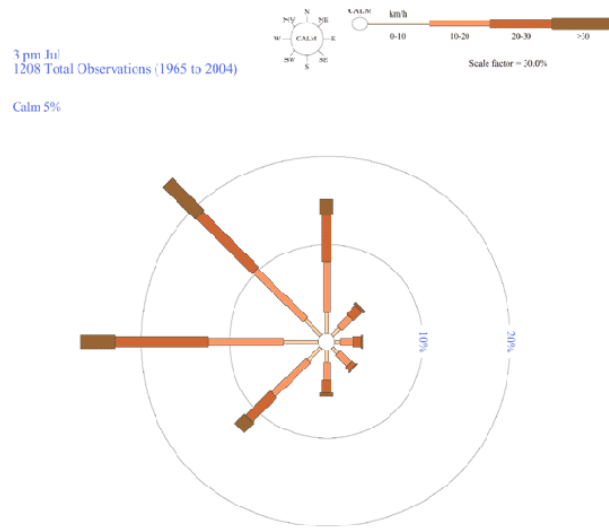
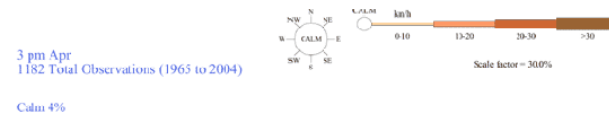
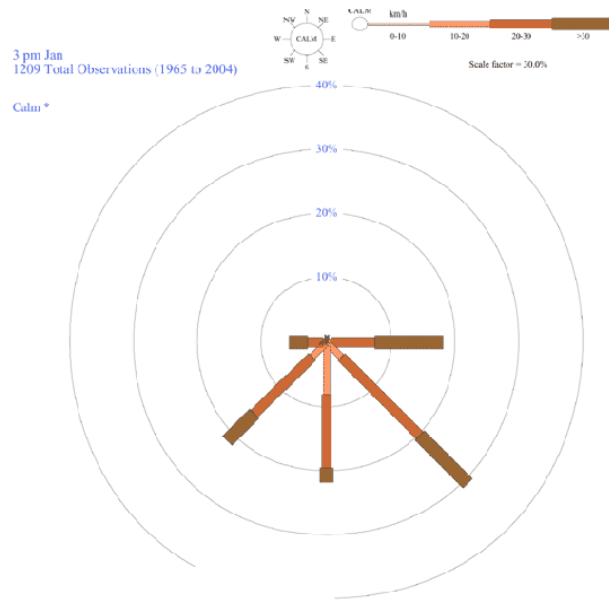
Wind Roses (Albany)

Appendix C: Albany Wind Roses

Wind Roses for Albany Airport at 9am



Wind Roses for Albany Airport at 3pm



APPENDIX F

Drainage Management

Fact Sheet

1

Fact Sheet 1

Site - Planning

The overall principle is to stop both erosion and sediment leaving your site. However, this requires careful planning and forethought. The way you run your building site can have a large impact on the amount of pollution in stormwater run-off.

When planning the site layout, building location and earthworks, it is possible to make sure control devices don't interfere with the building process. Your council will have guidelines for your DA submission.

- ✓ Avoid stripping and excavating until ready to build.
- ✓ Minimise the reshaping of the land, any fill needs to be well compacted.
- ✓ Allow stormwater to flow around the building area and any disturbed areas.
- ✓ In new estates, temporary revegetation may be required.
- ✓ Allow room for a sediment barrier (e.g. sediment fence) to be located along the lower end of the disturbance.
- ✓ Ensure that stockpiles are stored within the sediment fence.
- ✓ Avoid long, steep, unstable driveways.
- ✓ Limit the amount of material on site to what is required at any one time.
- ✓ Ensure all material is immediately removed from the site at the completion of work.
- ✓ Instruct site workers on the need to prevent materials from washing or blowing into the stormwater system.
- ✓ Ensure all materials are immediately removed from site when work is completed.



Fact Sheet 3

Sediment Fencing

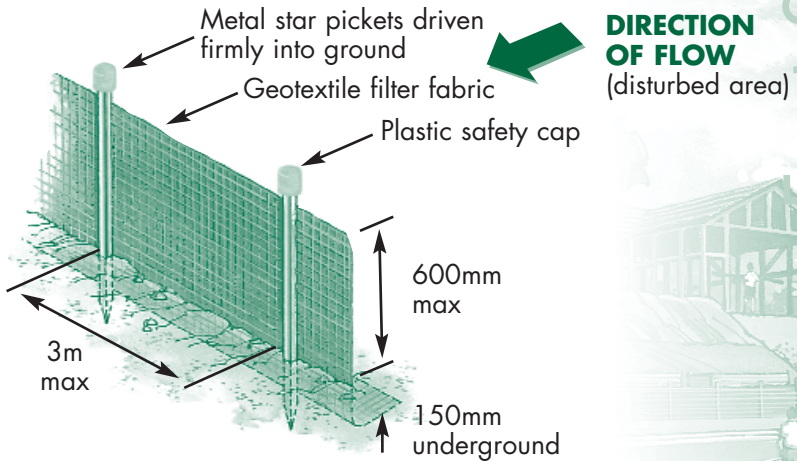
The most efficient and widely accepted sediment barrier for construction sites is a specially manufactured geotextile sediment fence. Sediment fences act like dams - trapping the sediment while allowing water to leave the site. They are effective in retaining suspended solids coarser than 0.02 mm. They are simple to construct, relatively inexpensive and easily moved as development proceeds.

When using a sediment fence, keep in mind that it will be effective within the following parameters:

- It is generally not designed to filter concentrated flows and therefore needs to be placed following the contours whenever possible.
- It should last for up to six months but requires regular maintenance and weekly checks are needed. The performance of a sediment fence diminishes considerably when crushed by delivery of building materials. It must remain vertical and keyed into the soil.
- Where the sediment fence is not installed correctly water will inevitably flow through the point of least resistance. Damaged fences must be repaired promptly.
- Sediment fences need to be trenched in at least 150 mm and buried so the water flows through and not underneath.
- Soil on both sides of the fence must be compacted to avoid seepage under the barrier.

On a typical residential building block (approx. 700sq.m), a sediment fence should work well providing it is situated on the low side of the block. If there needs to be a break in the fence for any reason (say, an access point) a contour bank/diversion bank or bund needs to be constructed to direct water back to the fence. The sediment fence must have uphill returns at either end to prevent sediment flowing around it.

Advantages. It is a simple strategy that is easily installed, shifted or removed. Sediment fences work well and, if maintained, will last for the duration of the construction stage.



Construction Notes

1. Construct sediment fences as close as possible to follow the contours of the site.
2. Drive 1.5 metre long posts into ground, maximum 3 metres apart.
3. Staple to 40 mm square hardwood posts or wire tied to steel posts.
4. Dig a 150 mm deep trench along the up-slope line of the fence for the bottom of the fabric to be entrenched.
5. Backfill trench over base of fabric and compact on both sides.

Fact Sheet 4

Straw Bale Filter

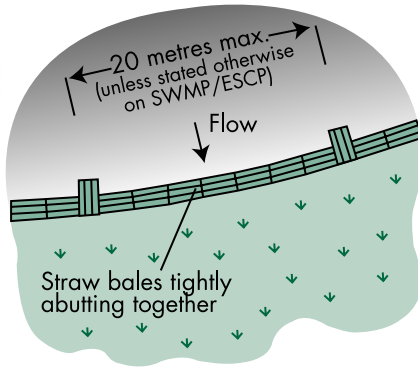
Straw bales are suitable for low flows of water. It is only recommended that these are used in limited applications such as reducing the flow velocity.

The return of straw bales every 20 metres is recommended to ensure some stability for this style of barrier. Please note that they need to be embedded in the ground and held firmly in place with star pickets.

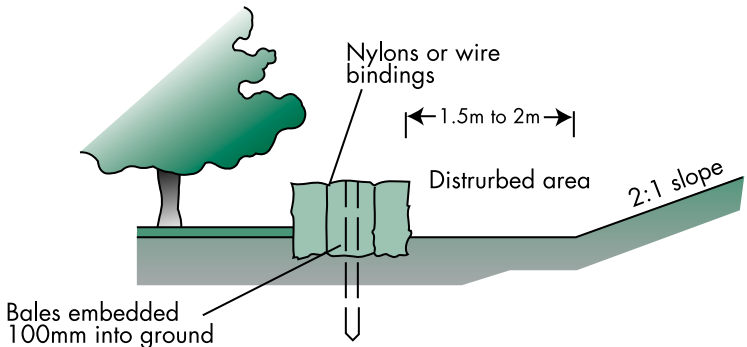
The minimum number of bales to be used is four. If only two bales are used during a storm event, the water will simply hit the bales and flow around, increasing erosion. The bales must dam the run off and allow the sediment to settle behind the bales.

Please note straw bales do not filter sediment-laden waters. They will only hold back water if installed correctly.

Plan



Section



Fact Sheet 7

Grass Filter Strips

Strips of vegetation left or planted down-slope from earthworks provide a simple method of trapping coarse sediment.

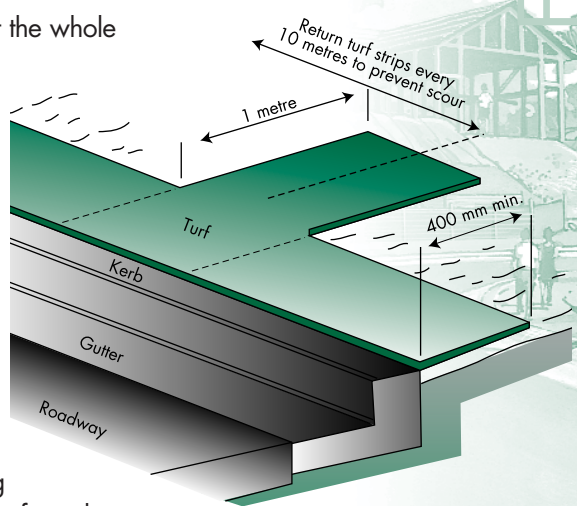
The flatter and wider the filter strips are, the more effective they become. Grass filter strips have little effect in a storm, but form an important part of a sediment control program.

A 400 mm wide grass strip can be installed next to a kerb to stabilise the area between the kerb and footpath. It is also valuable for trapping sediment in very small storm events.

For best results it is advised that the whole footpath is planted.

Grass strips will stabilise a disturbed site quickly and easily and act as an excellent erosion & sediment control device.

Advantages. Grass filter strips can be very effective in removing coarse sediment upstream from detention basins or infiltration structures. They prevent sediment travelling from bare soil areas towards the formal drainage system.



Remember that grass filter strips are only suitable on low grades.

Construction Notes

1. Install minimum 400 mm wide roll of turf on the footpath adjacent to the kerb and at the same level as the top of the kerb.
2. Lay 1.5 metre long turf strips (at 90 degrees) every 10 metres.
3. Rehabilitate disturbed soil behind the turf strip in accordance with the ESCP/SWMP.



Maintenance of Control Measures

Proper maintenance of erosion and sediment controls is vital to their success. After a storm event the effectiveness of the established controls can be assessed. The site manager should check the operation of all erosion and sediment controls each day and initiate repair or maintenance as required.

An effective maintenance program should include ongoing modification to plans as development progresses. These plans are usually based on a specific landform, but as development proceeds changes occur in slope gradients and drainage paths.

Best practice includes anticipating potential risks as well as being prepared for abnormal circumstances and emergencies. This could include storing extra sediment fence fabric and posts on-site to facilitate emergency repairs, or ensuring that the sediment control contractor's phone number is available on site.

- ✓ The entry/exit pad will require reapplication of aggregate if excessive sediment build-up occurs.
- ✓ Clean any catch drains.
- ✓ Erosion in drainage channels should be repaired with rock, turf or erosion control matting.
- ✓ Sediment fences should be replaced if the fabric is ripped or otherwise damaged. Retrenching may also be needed. Sediment fences work well if they are maintained on a weekly basis and/or after every storm event.
- ✓ Keep an eye on the weather.



Channel or
drain - Soil
or rock filter
in a
stabilised
channel

6



6 tonnes per ha of straw mulch on a disturbed area



Uniform perennial vegetative cover (e.g. kikuyu)



Straw bale
barrier



Silt trapping
fence

APPENDIX G

Site Photographs



Photo 1:

Location of Sampling Site SLT001



Photo 2:

Soil profile of SLT001

**Environmental Assessment and Management Plan -
Outdoor Rotational Piggery – Breeder Facility -Lot 5856
(No. 1028) Yungup Road, Napier - City of Albany**





Photo 3

Location of Sample SLT002



Photograph 4

Soil profile SLT002

**Environmental Assessment and Management Plan -
Outdoor Rotational Piggery – Breeder Facility -Lot 5856
(No. 1028) Yungup Road, Napier - City of Albany**





Photograph 3

Location SLT003



Photograph 6

Profile SLT003

**Environmental Assessment and Management Plan -
Outdoor Rotational Piggery – Breeder Facility -Lot 5856
(No. 1028) Yungup Road, Napier - City of Albany**





Photograph 7

Location SLT004



Photograph 8

Profile SLT004

**Environmental Assessment and Management Plan -
Outdoor Rotational Piggery – Breeder Facility -Lot 5856
(No. 1028) Yungup Road, Napier - City of Albany**





Photograph 9

Dam to the west of SLT002. The dam has been incorporated into a buffer of 100m



Photograph 10

Lateritic pavement associated with Dam west of SLT002

**Environmental Assessment and Management Plan -
Outdoor Rotational Piggery – Breeder Facility -Lot 5856
(No. 1028) Yungup Road, Napier - City of Albany**



APPENDIX H

Phosphorus Buffering Index Results

Analysis Results

CSBP Soil and Plant Laboratory



86486
Aurora Environmental (Albany)

Lab No		5SS21096	5SS21103	5SS21104	5SS21105	5SS21106	5SS21107	5SS21108	5SS21109
Name		SLT001	SLT001	SLT002	SLT002	SLT003	SLT003	SLT004	SLT004
Code		14/10/21	14/10/21	14/10/21	14/10/21	14/10/21	14/10/21	14/10/21	14/10/21
Customer		Aurora Environmental	Aurora Environmental	Aurora Environmental	Aurora Environmental	Aurora Environmental	Aurora Environmental	Aurora Environmental	Aurora Environmental
Depth		0-10	30-40	0-20	40-50	0-10	80-100	0-10	50-80
Phosphorus Colwell	mg/kg	10	3	10	4	8	2	< 2	3
Potassium Colwell	mg/kg	48	278	58	30	50	22	67	27
PBI		52.2	155.2	40.4	60.5	6.1	19.3	18.3	32.7

APPENDIX I

Permeability Results

Job No.: SLT2021-001
 Lot 5856 (No. 1028) Yungup Road,
 Site: Narrikup
 Location ID: SLT001
 Operator: MP
 Date: 12/10/2021
 Elevation approximately 90 m AHD
 Vegetation: Pasture

Zone: 50H
 Northing: 6146343
 Easting: 578897
 Slope: Flat, gently undulating



Soil structure: Depth **Soil Description**
 0 - 0.2 m: Dark brown grey gravelly sand
 0.2 - 0.75 Sandy yellow clay, becoming dense and stiff at 0.75 m (refusal).

Average time to fall 10cm: 5500.00 sec

Depth of water in hole: 50 cm
 Diameter of test hole: 8 cm
 Depth to impermeable layer: 0 cm

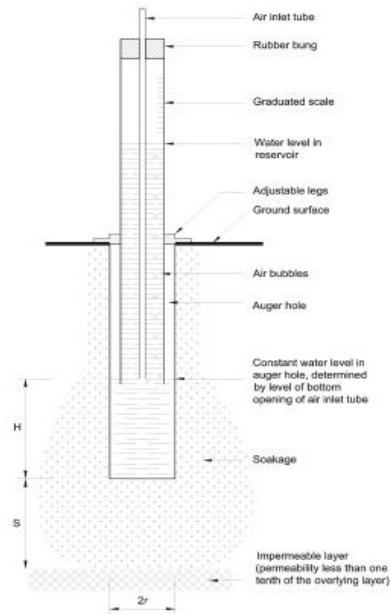
Diameter of water reservoir: 6 cm
 Diameter of air inlet tube: 0.8 cm

The method of calculation is taken from AS 1547:2000 On-site Domestic Wastewater Management

$$K_{sat} = \frac{4.4Q \left[0.5 \sinh^{-1} \left(\frac{H}{2r} \right) - \sqrt{\left(\frac{r}{H^2} + 0.25 \right) + \frac{r}{H}} \right]}{2\pi H^2}$$

where

- K_{sat} = saturated hydraulic conductivity of the soil in cm/min
- 4.4 = correction factor for a systematic under-estimate of soil permeability in the mathematical derivation of the equation
- Q = rate of loss of water from the reservoir in cm³/min
- H = depth of water in the test hole in cm
- r = radius of the test hole in cm



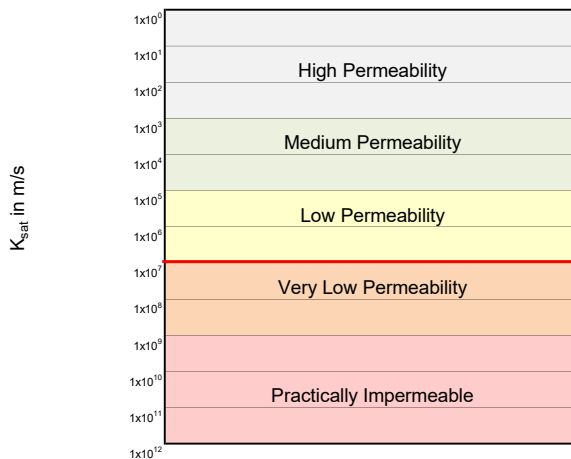
NOTE -
 H = depth of water in the test hole
 S = the depth to an underlying impermeable layer
 r = radius of the test hole

Rate of water loss

Q = 0.0001 L/sec
 Q = 3.0 cm³/min

Saturated hydraulic conductivity

K_{sat} = 0.00 cm/min
 K_{sat} = 0.01 m/day
 K_{sat} = 1.19E-07 m/sec



Job No.: SLT2021-001
 Lot 5856 (No. 1028) Yungup Road,
 Site: Narrikup
 Location ID: SLT002
 Operator: MP
 Date: 12/10/2021
 Elevation approximately 90 m AHD

Zone: 50H
 Northing: 6146554
 Easting: 578784
 Slope: Flat, gently undulating



Vegetation: Pasture
 Soil structure: Depth Soil Description
 0-0.15 m: Dark brown/grey clayey sand with organic matter
 0.1 – 0.3 m Gravelly clayey sand with refusal at 0.4m due to gravel

Average time to fall 10cm: 392.86 sec

Depth of water in hole: 50 cm
 Diameter of test hole: 8 cm
 Depth to impermeable layer: 0 cm

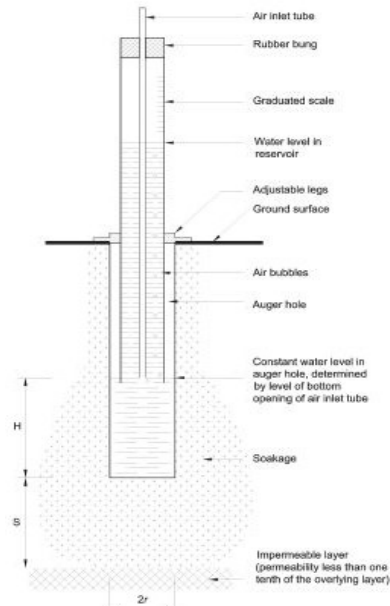
Diameter of water reservoir: 6 cm
 Diameter of air inlet tube: 0.8 cm

The method of calculation is taken from AS 1547:2000 On-site Domestic Wastewater Management

$$K_{sat} = \frac{4.4Q \left[0.5 \sinh^{-1} \left(\frac{H}{2r} \right) - \sqrt{\left(\left(\frac{r}{H^2} \right) + 0.25 \right) + \frac{r}{H}} \right]}{2\pi H^2}$$

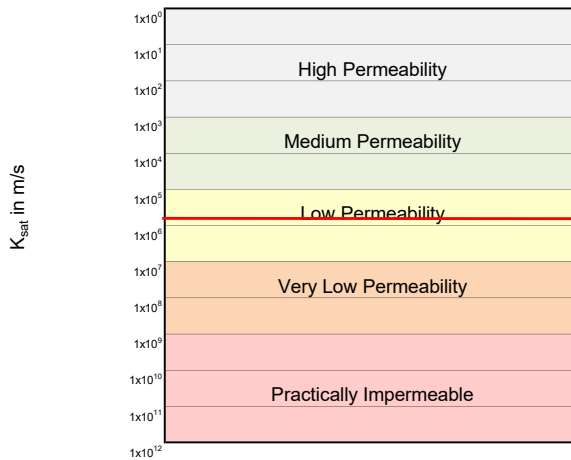
where

- K_{sat} = saturated hydraulic conductivity of the soil in cm/min
- 4.4 = correction factor for a systematic under-estimate of soil permeability in the mathematical derivation of the equation
- Q = rate of loss of water from the reservoir in cm³/min
- H = depth of water in the test hole in cm
- r = radius of the test hole in cm



NOTE -
 H = depth of water in the test hole
 S = the depth to an underlying impermeable layer
 r = radius of the test hole

Rate of water loss		Saturated hydraulic conductivity	
Q=	0.0007 L/sec	K_{sat} =	0.01 cm/min
Q=	42.4 cm ³ /min	K_{sat} =	0.14 m/day
		K_{sat} =	1.67E-06 m/sec



Job No.: SLT2021-001
 Lot 5856 (No. 1028) Yungup Road,
 Site: Narrikup
 Location ID: SLT003
 Operator: MP
 Date: 12/10/2021

Zone: 50H
 Northing: 6146687
 Easting: 579334
 Slope: Flat, gently undulating



Elevation approximately 90 m AHD
 Vegetation: Bluegum Plantation

Soil structure: Depth	Soil Description
0 – 0.1 m	Grey fine sand with organic matter
0.1 – 0.3 m	Grey to yellow fine sand with small gravel
0.3- 1.0 m	Sandy gravel becoming increasingly yellow. Refusal due to gravel at 1 m.

Average time to fall 10cm: 59.46 sec

Depth of water in hole: 50 cm
 Diameter of test hole: 8 cm
 Depth to impermeable layer: 0 cm

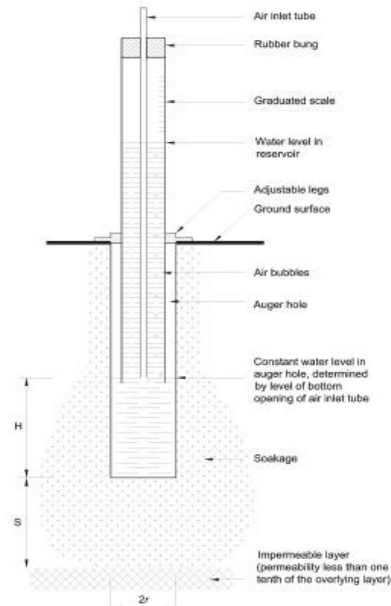
Diameter of water reservoir: 6 cm
 Diameter of air inlet tube: 0.8 cm

The method of calculation is taken from AS 1547:2000 On-site Domestic Wastewater Management

$$K_{sat} = \frac{4.4Q \left[0.5 \sinh^{-1} \left(\frac{H}{2r} \right) - \sqrt{\left(\frac{r}{H^2} \right) + 0.25} \right] + \frac{r}{H}}{2\pi H^2}$$

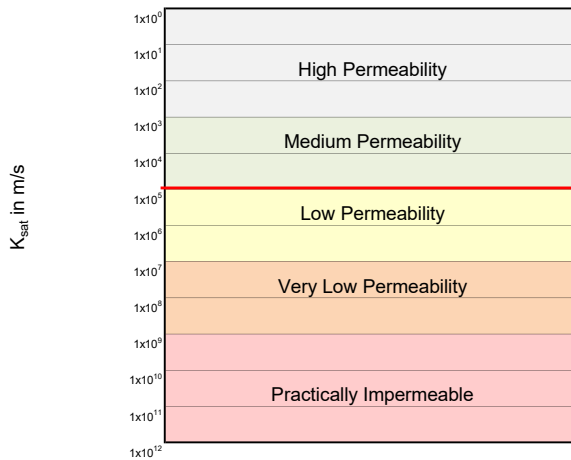
where

- K_{sat} = saturated hydraulic conductivity of the soil in cm/min
- 4.4 = correction factor for a systematic under-estimate of soil permeability in the mathematical derivation of the equation
- Q = rate of loss of water from the reservoir in cm³/min
- H = depth of water in the test hole in cm
- r = radius of the test hole in cm



NOTE -
 H = depth of water in the test hole
 S = the depth to an underlying impermeable layer
 r = radius of the test hole

Rate of water loss	Saturated hydraulic conductivity
Q = 0.0047 L/sec	K_{sat} = 0.07 cm/min
Q = 280.2 cm ³ /min	K_{sat} = 0.95 m/day
	K_{sat} = 1.10E-05 m/sec



Job No.: SLT2021-001
 Lot 5856 (No. 1028) Yungup Road,
 Site: Narrikup
 Location ID: SLT004
 Operator: MP
 Date: 12/10/2021

Zone: 50H
 Northing: 6146272
 Easting: 579657
 Slope: Flat, gently undulating



Elevation approximately 90 m AHD
 Vegetation: Bluegum Plantation

Soil structure: Depth	Soil Description
0 – 0.1 m	Grey fine sand with organic matter
0.1 – 0.3 m	Grey to yellow fine sand with small gravel
0.3- 1.0 m	Sandy gravel becoming increasingly yellow. Refusal due to gravel at 1 m.

Average time to fall 10cm: 407.41 sec

Depth of water in hole: 50 cm
 Diameter of test hole: 8 cm
 Depth to impermeable layer: 0 cm

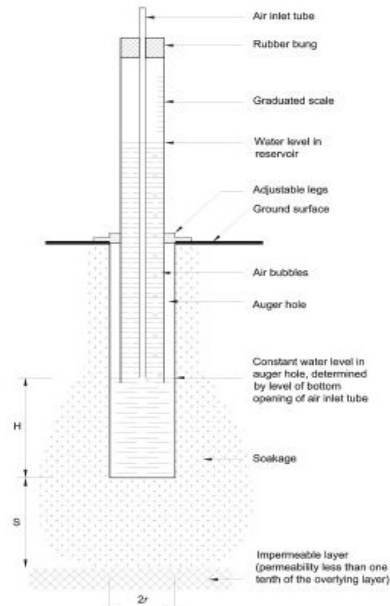
Diameter of water reservoir: 6 cm
 Diameter of air inlet tube: 0.8 cm

The method of calculation is taken from AS 1547:2000 On-site Domestic Wastewater Management

$$K_{sat} = \frac{4.4Q \left[0.5 \sinh^{-1} \left(\frac{H}{2r} \right) - \sqrt{\left(\left(\frac{r}{H^2} \right) + 0.25 \right) + \frac{r}{H}} \right]}{2\pi H^2}$$

where

- K_{sat} = saturated hydraulic conductivity of the soil in cm/min
- 4.4 = correction factor for a systematic under-estimate of soil permeability in the mathematical derivation of the equation
- Q = rate of loss of water from the reservoir in cm³/min
- H = depth of water in the test hole in cm
- r = radius of the test hole in cm



NOTE -
 H = depth of water in the test hole
 S = the depth to an underlying impermeable layer
 r = radius of the test hole

Rate of water loss	Saturated hydraulic conductivity
Q = 0.0007 L/sec	K_{sat} = 0.01 cm/min
Q = 40.9 cm ³ /min	K_{sat} = 0.14 m/day
	K_{sat} = 1.61E-06 m/sec

