REHABILITATION MANAGEMENT PLAN
LOT 9 ON PLAN 43302
STRATHAM, SHIRE OF CAPEL
WESTERN AUSTRALIA
(EPBC 2007/3333)

REVISION 2

PREPARED FOR:

BUNBURY CATHEDRAL GRAMMAR SCHOOL
ABN: 36 007 093 540

MARCH 2017

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LOT 9 PLAN 43302 STRATHAM
REHABILITATION MANAGEMENT PLAN - REVISION 2

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Revision 2 Final Report	Kirsi Kauhanen	Kristy Sell	16 March 2017

Declaration of Accuracy

I declare that:

1. To the best of my knowledge, all the information contained in, or accompanying this Rehabilitation Management Plan is complete, current and correct.

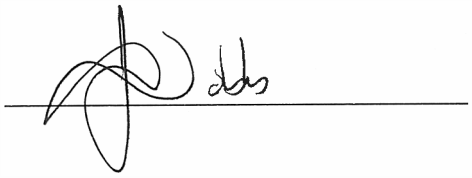
2. I am duly authorised to sign this declaration on behalf of the approval holder.

3. I am aware that:

   a. Section 490 of the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) makes it an offence for an approval holder to provide information in response to an approval condition where the person is reckless as to whether the information is false or misleading.

   b. Section 491 of the EPBC Act makes it an offence for a person to provide information or documents to specified persons who are known by the person to be performing a duty or carrying out a function under the EPBC Act or the *Environment Protection and Biodiversity Conservation Regulations 2000* (Cth) where the person knows the information or document is false or misleading.

   c. The above offences are punishable on conviction by imprisonment, a fine or both.

Signed: 

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Title: Bursar

Organisation: **Bunbury Cathedral Grammar School**

Date: 7/3/2017

EXECUTIVE SUMMARY

In December 2010, Bunbury Cathedral Grammar School (BCGS) was granted approval EPBC 2007/3333 under *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) to clear 2.3 ha of native vegetation for a sporting field at the school premises on Lot 73 Allen Road, Gelorup, Western Australia (WA). In order to offset the impacts of the vegetation clearing on Western Ringtail Possum (*Pseudocheirus occidentalis*) and White-tailed Black Cockatoos (*Calyptorhynchus baudinii* and *C. latirostris*), protected under the EPBC Act, the approval required the implementation of a Rehabilitation Management Plan (RMP) at Lot 9 on Plan 43302 in Stratham, WA.

The original RMP (September 2010) was implemented between May 2011 - April 2016, but failed to achieve some of the set completion criteria. Subsequently the EPBC 2007/3333 approval was revised with a variation to the conditions signed on 23 December 2016 (EPBC 2007/3333 Variation 2016). This revised approval requires preparation and implementation of a revised RMP. This document, RMP Revision 2 (March 2017) is submitted to meet this requirement. Conditions of EPBC 2007/3333 Variation 2016 relevant to the RMP include Condition 2, Condition 3, Condition 6, Condition 7, Condition 8, Condition 9, Condition 10 and Condition 11.

The purpose of this plan is to rehabilitate parts of Lot 9 (Rehabilitation Area 10.5 ha) to provide habitat for the target fauna species Western Ringtail Possum (*Pseudocheirus occidentalis*) and White-tailed Black Cockatoos (*Calyptorhynchus baudinii* and *C. latirostris*). Specifically BCGS is committed to achieving the following environmental outcomes by 30 June 2021:

- Establishment of a self-sustaining vegetation community that, in the longer term, will provide habitat for the Western Ringtail Possum (*Pseudocheirus occidentalis*) and White-tailed Black Cockatoos (*Calyptorhynchus baudinii* and *C. latirostris*).
- Species diversity (flora) of at least 80% of the appropriate species (as defined later in this document).
- An average live weed cover of less than 50%.

Detailed milestones and performance targets have been set to track progress towards these environmental outcomes. Key management measures to achieve the outcomes, milestones and targets include planting of seedlings of appropriate species and weed control. In 2017, a minimum of 10,000 seedlings will be planted with additional infill planting during subsequent years as necessary.

Rehabilitation monitoring will be undertaken to assess progress towards and achievement of environmental outcomes, milestones and targets and to determine whether contingency measures are necessary. Trigger values have been set for selected performance indicators so that contingency measures such as infill planting and additional weed control are undertaken where necessary to ensure the program remains on track to achieve the outcomes and milestones.

Managing the risk of failure has been incorporated into the plan and includes measures such as mortality allowances in the number of planted seedlings, monitoring of progress, and contingency measures should trigger values be reached.

The implementation of the RMP and compliance with EPBC 2007/3333 will be subject to internal and potentially external auditing. Annual Compliance Reports will be made publicly available. The RMP will be subject to regular reviews in accordance with adaptive management.

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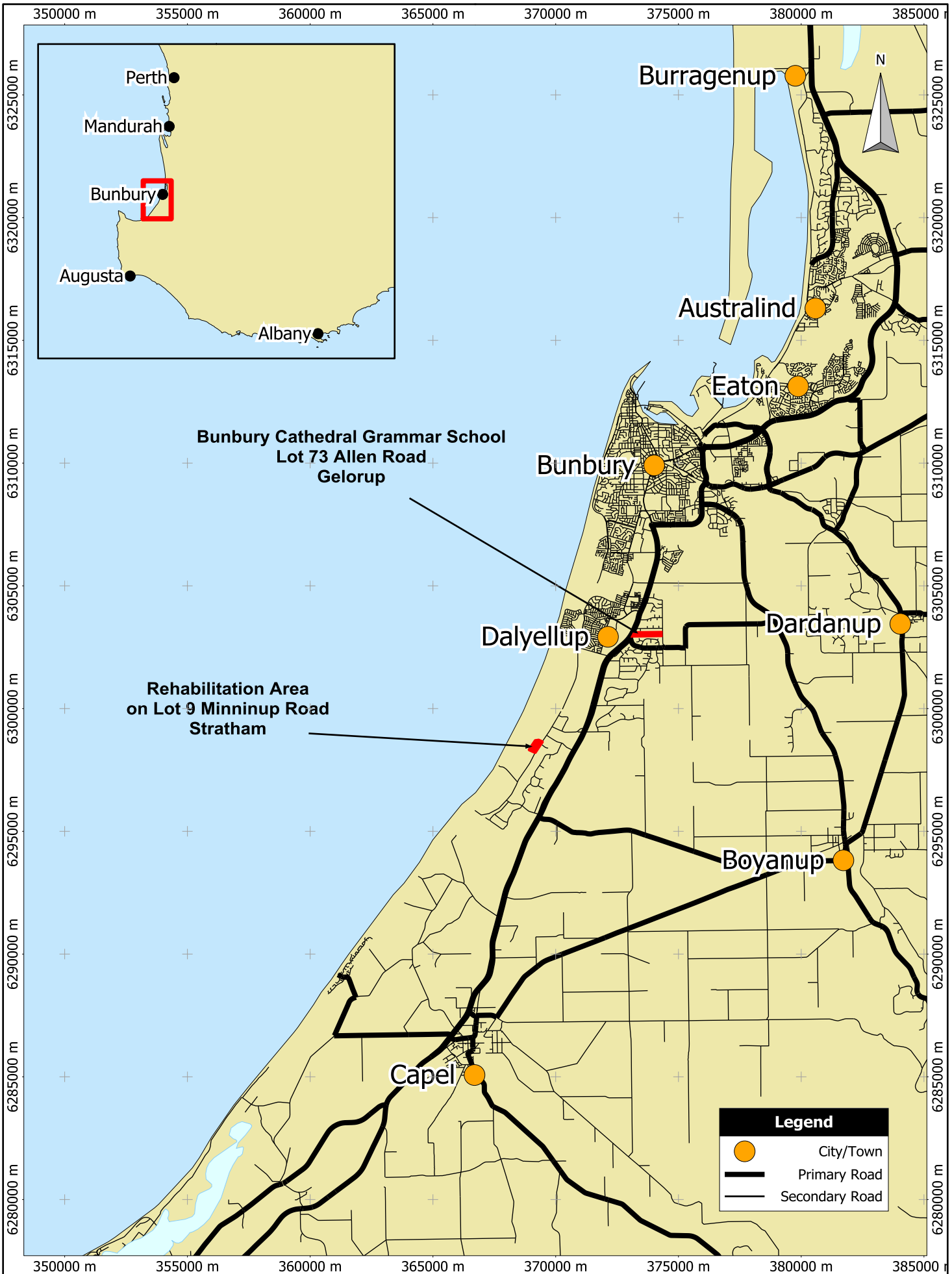
1. INTRODUCTION

In December 2010, Bunbury Cathedral Grammar School (BCGS) was granted approval EPBC 2007/3333 under *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) to clear 2.3 ha of native vegetation for a sporting field at the school premises on Lot 73 Allen Road, Gelorup, Western Australia (WA) (Figure 1). In order to offset the impacts of the vegetation clearing on Western Ringtail Possum (*Pseudocheirus occidentalis*) and White-tailed Black Cockatoos (*Calyptorhynchus baudinii* and *C. latirostris*), protected under the EPBC Act, the approval required the implementation of a Rehabilitation Management Plan (RMP) at Lot 9 on Plan 43302 in Stratham, WA (Figure 1). Lot 9 is a 12.1 ha property owned by Western Australian Planning Commission (WAPC), forming part of the Muddy Lakes Regional Open Space (ROS). The rehabilitation areas cover 10.5 ha of the property.

The original RMP (September 2010) was implemented between May 2011 and April 2016, but failed to achieve some of the set completion criteria. Subsequently the EPBC 2007/3333 approval was revised to include a variation to the conditions signed on 23 December 2016 (EPBC 2007/3333 Variation 2016). The variation requires preparation and implementation of a revised RMP.

This document, RMP Revision 2 (RMP Rev2, March 2017) has been prepared to satisfy EPBC 2007/3333 Variation 2016 and has been prepared in accordance with the Department of the Environment and Energy's (the Department) Environmental Management Plan Guidelines (2014).



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Grid: MGA94(50)

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Bunbury Cathedral Grammar School
Rehabilitation Management Plan
Lot 9 Plan 43302 Stratham
EPBC 2007/3333

Figure 1

Location Plan

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2. CONDITIONS OF APPROVAL

Conditions of approval EPBC 2007/333 Variation 2016 relevant to this RMP Rev2 are listed in Table 1 along with relevant RMP sections and key commitments for each condition.

Table 1: Conditions of Approval and Key Commitments

EPBC 2007/3333 Variation 2016 Condition		Relevant RMP Section	Summary of Associated Key Commitments in RMP
2	By 30 March 2017 the approval holder must submit for the Minister's approval a revised version of the Rehabilitation Management Plan (RMP) at Attachment B of the approval dated 21 December 2010. The purpose of the revised RMP is to rehabilitate the Rehabilitation Areas to provide habitat for the Western Ringtail Possum (*Pseudocheirus occidentalis*) and White-tailed Black Cockatoos (*Calyptorhynchus baudinii* and *C. latirostris*).	Section 1 Section 3	• RMP submitted in March 2017. • Purpose of RMP as stated in approval condition.
	The revised RMP must be prepared in accordance with the Department's Environmental Management Plan Guidelines (2014), and must include:	All	• RMP prepared in line with the Department's guideline.
2a	the following milestones. By 31 December 2017 achieve and maintain an overall plant density: i. of 1,500 stems per hectare in the Western Rehabilitation Area and Eastern Rehabilitation Areas. ii. of 380 stems per hectare within the Sumpland Rehabilitation Area.	Section 7	By 31 December 2017 achieve and maintain an overall plant density: i. of 1,500 stems per hectare in the Western Rehabilitation Area and Eastern Rehabilitation Areas. ii. of 380 stems per hectare within the Sumpland Rehabilitation Area.
2b	the following outcomes; By 30 June 2021, the Rehabilitation Areas will achieve: i. a self-sustaining vegetation community that, in the longer term, will provide habitat for the Western Ringtail Possum (*Pseudocheirus occidentalis*) and White-tailed Black Cockatoos (*Calyptorhynchus baudinii* and *C. latirostris*). ii. a species diversity of at least 80% of the appropriate species. iii. an average live weed cover of less than 50%.	Section 7	By 30 June 2021, the Rehabilitation Areas will achieve: i. a self-sustaining vegetation community that, in the longer term, will provide habitat for the Western Ringtail Possum (*Pseudocheirus occidentalis*) and White-tailed Black Cockatoos (*Calyptorhynchus baudinii* and *C. latirostris*). ii. a species diversity of at least 80% of the appropriate species. iii. an average live weed cover of less than 50%.
2c	Environmental management actions to achieve the above milestones and outcomes, including; i. site planting activities. ii. ongoing site maintenance.	Section 6.2 Section 9	• Minimum 10,538 seedlings will be planted in 2017 to achieve the milestones. • Infill plantings during subsequent years as necessary to maintain the

EPBC 2007/3333 Variation 2016 Condition		Relevant RMP Section	Summary of Associated Key Commitments in RMP
			milestones. • Weed control to achieve the milestones and outcomes. • Other maintenance (contingency measures) undertaken if determined necessary on the basis of monitoring.
2d	The timing of environmental management actions.	Section 6.4	• Schedule for management actions.
2e	A monitoring program, which must include: i. performance indicators comprised of clear and concise criteria which are capable of accurate and reliable measurement, against which achievement of outcomes will be determined. ii. monitoring requirements, including the timing and frequency of monitoring activities to detect changes in the performance indicators, to determine if outcomes are being achieved, and to inform adaptive implementation of the RMP.	Section 8	• Biannual monitoring of general development, fencing and vegetation (including weeds) will be undertaken. • Monitoring will collect data on performance indicators that allow 1) assessment of progress towards and achievement of outcomes, milestones and targets, and 2) assessment against trigger values to determine the need for contingency measures.
2f	Trigger values, and corrective actions where trigger values are reached, reporting requirements, and how environmental incidents and emergencies will be managed.	Section 9 Section 14 Section 12	• Trigger values and contingency measures set including infill planting, additional weed control and others. • Monitoring reports, Annual Compliance Reports, reporting of failure to meet milestones. • Reporting and responding to environmental incidents and emergencies.
2g	Effort and resources to ensure outcomes and milestones are achieved when monitoring results indicate that outcomes or milestones are not on track to being achieved.	Section 9	• Trigger values and contingency measures set including infill planting, additional weed control and others.
2h	Annual reporting requirements including a commitment to notify the Department within 14 days following a failure to meet milestone targets outlined in condition 2.	Section 14	• Monitoring reports, Annual Compliance Reports, reporting of failure to meet milestones.
6	If the person taking the action wishes to carry out any activity otherwise than in accordance with the plan, as specified in Condition 2, the person taking the action must submit to the Department for the Minister's written approval a revised version of that plan. The varied activity shall not commence until the Minister has approved the revised plan in writing. The Minister will not approve a revised plan unless the revised plan would result in an equivalent or improved environmental outcome. If the Minister approves the revised plan that plan must be implemented in place of the plan originally approved.	Section 17	• As detailed in the approval.

EPBC 2007/3333 Variation 2016 Condition		Relevant RMP Section	Summary of Associated Key Commitments in RMP
7	The person taking the action must maintain accurate records substantiating all activities associated with or relevant to the conditions of approval, including measures taken to implement the RMP required by this approval, and make them available upon request to the Department. Such records may be subject to audit by the Department or an independent auditor in accordance with section 458 of the *EPBC Act*, or used to verify compliance with the conditions of approval. Summaries of audits will be posted on the Department's website. The results of audits may also be publicised through the general media.	Section 13	• Records will be maintained regarding compliance with approval and implementation of RMP. • These records will be made available to the Department on request.
8	Within three months of every 12 month anniversary of the commencement of the action, the approval holder must publish a compliance report and provide documentary evidence providing proof of the date of publication to the Department by email (to EPBCMonitoring@environment.gov.au or another email address agreed to in writing by the Minister). The first compliance report must cover the period beginning on the day of the commencement of the action through 12 months, and subsequent compliance reports must cover the 12 month period after the previous compliance report. The approval holder may cease preparing compliance reports required by this condition with written agreement of the Minister. Compliance reports must: consider the Department's Annual Compliance Report Guidelines; and must address any contraventions of the conditions of this approval including requirements of the RMP; and must address whether outcomes and milestones required by these conditions have been met or are likely to be achieved.	Section 14	• Annual Compliance Reports in line with the approval and Department guidelines will be prepared. • Annual Compliance Reports will be made publicly available.
9	Upon the direction of the Minister, the person taking the action must ensure that an independent audit of compliance with the conditions of approval is conducted and a report submitted to the Minister. The independent auditor must be approved by the Minister prior to the commencement of the audit. Audit criteria must be agreed to by the Minister and the audit report must address the criteria to the satisfaction of the Minister.	Section 16	• If directed by the Minister, an independent audit of compliance will be conducted.

EPBC 2007/3333 Variation 2016 Condition		Relevant RMP Section	Summary of Associated Key Commitments in RMP
10	The revised RMP must be published on the approval holder's website within 1 month of being approved by the Minister.	Section 14	• As detailed in the approval.
11	If the Minister believes that it is necessary or convenient for the better protection of listed threatened species to do so, the Minister may request that the person taking the action make specified revisions to the plan/s specified in the conditions and submit the revised plan/s for the Minister's written approval. The person taking the action must comply with any such request. The revised approved plan/s must be implemented. Unless the Minister has approved the revised plan/s, then the person taking the action must continue to implement the plan/s originally approved, as specified in the conditions.	Section 17	• As detailed in the approval.

3. PURPOSE

The purpose of this RMP Rev2 is to rehabilitate parts of Lot 9 to provide habitat for the target species Western Ringtail Possum (*Pseudocheirus occidentalis*) and White-tailed Black Cockatoos (*Calyptorhynchus baudinii* and *C. latirostris*). Specific environmental outcomes are detailed in Section 7. Habitat suitability for the target species is dependent on the availability of habitat characteristics as summarised in Table 2.

Table 2: Target Species Habitat Characteristics

Species	Habitat Characteristics
Western Ringtail Possum (*Pseudocheirus occidentalis*)	Critical habitat of the species is not well understood and varies between management zones, but common themes appear to be high nutrient foliage availability for food, suitable structures for protection/nesting, and canopy continuity to avoid/escape predation and other threats. Diet almost exclusively comprises the dominant or co-dominant upper and mid-storey myrtaceous plants: Peppermint (*Agonis flexuosa*), Marri (*Corymbia calophylla*) and Jarrah (*Eucalyptus marginata*). Diurnal resting sites include dreys, platforms, tree hollows, hollow logs, Balga (*Xanthorrhoea* spp.) skirts, under sedges, forest debris and disused rabbit warrens (Department of Parks and Wildlife 2014, Department of the Environment and Energy 2017).
Baudin's Cockatoo (*Calyptorhynchus baudinii*)	The species mainly feeds on the seeds, flowers, buds and nectar of Marri (*Corymbia calophylla*) and Jarrah (*Eucalyptus marginata*), but also on the seeds of *Banksia spp., Hakea spp., Dryandra spp.* (now *Banksia* spp.), *Xanthorrhoea preissii*, *Kingia australis* and *Erodium botrys.* It will also feed on cultivated fruits, insect larvae and the nectar, buds and flowers of other Eucalyptus spp. Banksias and other native flora. The species nests in large hollows of mature live or dead Marri (*Corymbia calophylla*), Karri (*Eucalyptus diversicolour*), Jarrah (*E. marginata*), Wandoo (*E. wandoo*) and Tuart (*E. gomphocephala*) in the southwest (Department of Environment and Conservation 2008, Department of the Environment and Energy 2017).
Carnaby's Cockatoo (*Calyptorhynchus latirostris*)	The species feeds on the seeds of a variety of native and introduced plants (mainly *Banksia, Hakea, Grevillea, Allocasuarina, Eucalyptus, Pinus*), nectar from flowers of *Lambertia, Callistemon, Banksia* and *Eucalyptus*, cultivated fruits and insect larvae. The species nests in large hollows of mature live or dead eucalypts, mainly Salmon Gum (*Eucalyptus salmonophloia*) and Wandoo (*Eucalyptus wandoo*), but breeding has also been recorded in *E. longicornis*, *E. loxophleba*, *E. gomphocephala*, *E. rudis*, *E. occidentalis*, *E. salubris* and *Corymbia calophylla*. Breeding occurs mainly in the Wheatbelt but has been extending further west and south (Department of Parks and Wildlife 2013, Department of the Environment and Energy 2017).

4. BACKGROUND INFORMATION

4.1 REGIONAL SETTING

Lot 9 on Plan 43302 is located on Minninup Road in Stratham (Shire of Capel), approximately 180 km south of Perth, 15 km south of Bunbury and 1 km inland from the Indian Ocean. The site is located 6.5 km south-southwest of the proposed clearing area on Lot 73 in Gelorup. The locations of both properties are shown in Figure 1.

4.2 ZONING AND LAND USE

Stratham falls within the Greater Bunbury Region Scheme in which Lot 9 is zoned as 'Regional Open Space' (ROS). The site is also zoned as ROS in the Shire of Capel Town Planning Scheme. During the preparation of the original RMP (September 2010), Lot 9 was still zoned 'Rural', however the property has since been integrated into the Muddy Lakes Reserve (ROS). According to WAPC, the Muddy Lakes Reserve will ultimately be proposed for inclusion in the Preston River to Coast Regional Park. The Muddy Lakes Reserve ROS and other nearby ROS areas are shown in Figure 2.

Lot 9 covers 12.1 ha and includes a residential dwelling and some outbuildings. In line with the previous rural zoning, the property was used for grazing, most recently horses. Previous land uses resulted in clearing of approximately 85% of the original native vegetation on the property. Remnant vegetation and buildings that were present in 2009 are shown in Figure 3. The residential dwelling, including a fenced-off yard of approximately 2,000 m^2, is currently leased.

4.3 ECOLOGICAL LINKAGES

Lot 9 is located in close proximity to a recognised Southwest Regional Ecological Linkage (SWREL) (Maidens/Muddy Lake/Ludlow) shown in Figure 4 with other regional linkages (Molloy et al. 2009). Revegetating Lot 9 will greatly improve the east-west connectivity between the vegetated coastal wetlands and the vegetated, residential bush blocks zoned 'Special Rural' in the east (Figure 3).

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Grid: MGA94(50)
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Bunbury Cathedral Grammar School
Rehabilitation Management Plan
Lot 9 Plan 43302 Stratham
EPBC 2007/3333

Figure 2

Location of Areas of Regional Open Space

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Scale: 1:3000 Original Size: A4 Air Photo Date: NearMap December 2009 Grid: MGA94(50) 0 100 m	Bunbury Cathedral Grammar School Rehabilitation Management Plan Lot 9 on Plan 43302 Stratham EPBC 2007/3333	**Figure 3** **Aerial Photograph of Lot 9**	4 Cook St West Perth WA 6005 Ph: (08) 9226 3166 Fax: (08) 9226 3177 info@mbsenvironmental.com.au www.mbsenvironmental.com.au

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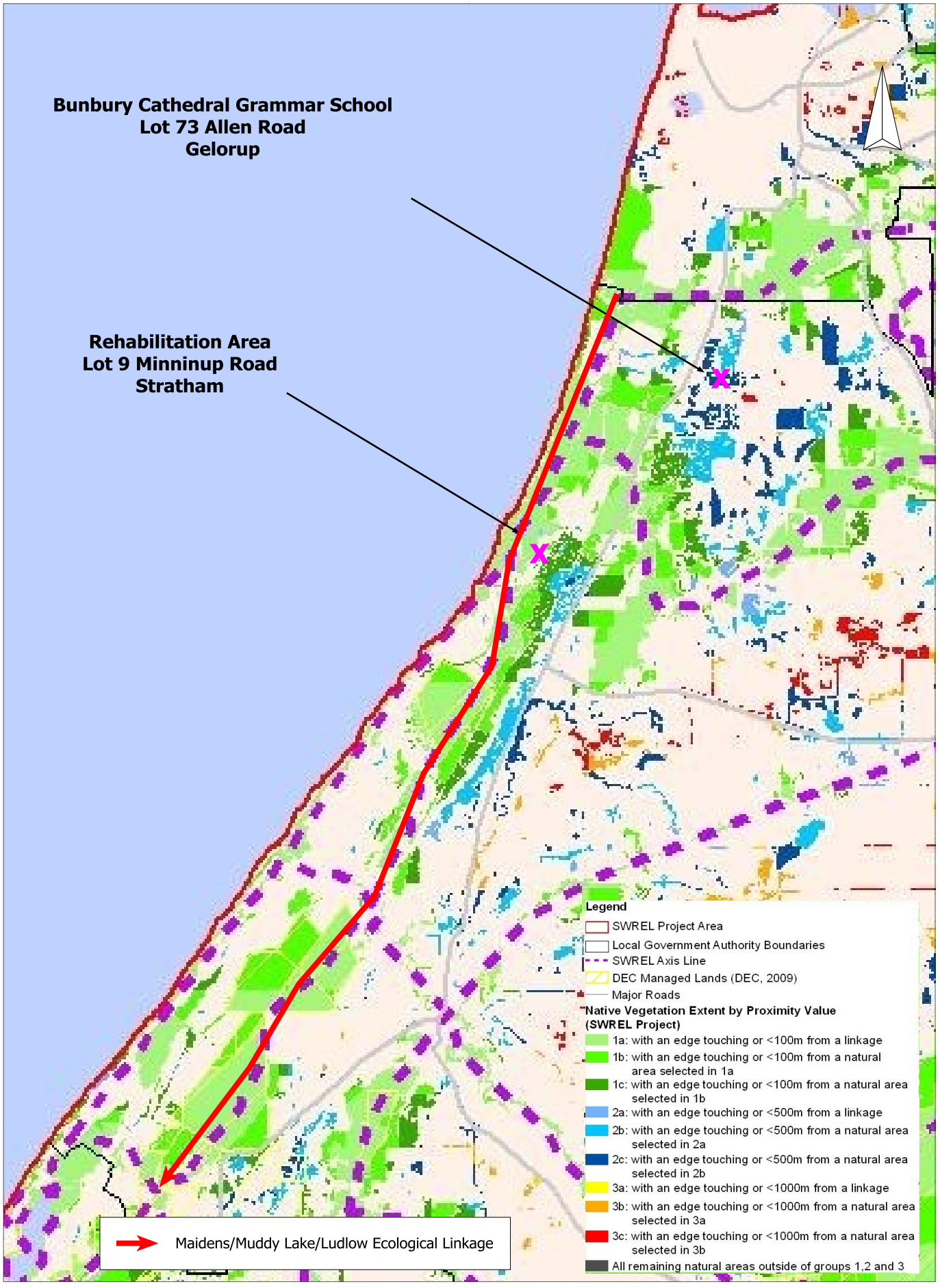

Original Size: A4 Extract from: South West Regional Ecological Linkages Technical Report (WAPC and DEC 2009).	Bunbury Cathedral Grammar School Rehabilitation Management Plan Lot 9 on Plan 43302 Stratham EPBC 2007/3333	**Figure 4** **South West Ecological Linkages Bunbury Wellington Area**	Martinick Bosch Sell Pty Ltd 4 Cook St West Perth WA 6005 Ph: (08) 9226 3166 Fax: (08) 9226 3177 info@mbsenvironmental.com.au www.mbsenvironmental.com.au MBS ENVIRONMENTAL

5. EXISTING ENVIRONMENT

5.1 LANDFORM

Lot 9 is located on the lower slopes of the Spearwood Dunes close to the western margin of this landform unit. The property lies on an interface between free flowing deep sands and poorly drained interdunal swales where the deep bleached sands are underlain by an organic pan or peat deposit (Department of Agriculture and Food 2008a).

Overall the landscape on Lot 9 slopes gently to the west towards the coastal wetlands, however there is a narrow depression comprising a sumpland in the eastern portion of the property. The land surface varies between approximately 10 mAHD along the eastern property boundary to 5 mAHD along the western boundary. Landform contours at 5 m intervals are shown in Figure 5.

Previous land uses have not included extractive operations or other major earthworks and overall the landform and soil profiles on Lot 9 have not been significantly altered from the pre-settlement era. Three small man-made stock watering holes, shown in Figure 3, were present in the sumpland area at the start of the rehabilitation project. These have subsequently been filled in.

5.2 SOILS

Soil sampling was conducted on Lot 9 on 2 June 2010 as detailed in Appendix 1. Results of the field and laboratory tests and a map illustrating the samplings sites are provided in Appendix 1. The soil sampling results indicated that there were two types of soils on the property, sumpland and dryland soils.

The dryland soils sampled at five locations (field tests at five sites, laboratory testing for three) were slightly acidic and fairly uniform with depth, which is typical of the grey sandy soils in southwestern Australia. Electrical conductivity values were low indicating very little salt and good drainage. There appeared to have been some input of phosphate fertilisers in the past, but the remaining levels of phosphorus (14-23 mg/kg) outside the sumpland were not anticipated to result in toxicity for planted seedlings even in phosphorus sensitive plants such as *Banksia* species (Handreck 1997).

The results for the sumpland soils were based on one sampling site on the eastern side of the sumpland area and showed elevated sulfur, phosphorus and potassium concentrations as well as elevated electrical conductivity. The soil pH at 6.2 was similar to results from other parts of the property. For additional information, the three manmade watering holes in the sumpland (Figure 3) were surveyed for water pH on 3 July 2010. Two of the watering holes on the western side of the sumpland had very low water pH at 2.85 and 3.00 respectively whereas the watering hole on the eastern side was only mildly acidic at 6.22. Iron staining was observed in one of the holes on the western side.

The results as described above indicate that the sumpland contains acid sulfate soils. The manmade watering holes on the western side had exposed subsurface soils to oxygen, which had resulted in acidification of the water and release of nutrients and potentially heavy metals. The impact was considered localised due to the small scale of the historic soil disturbance. Corrective measures for the watering holes were included in the original RMP (September 2010) and have been implemented.

High phosphorus concentration (80 mg/kg) recorded at a sampling site in the eastern part of the sumpland (Appendix 1) indicates an evapo-concentration effect from leachable nutrients higher in the landscape. This level of phosphorus may result in toxicity in sensitive plants and was taken into consideration during plant selection (RMP 2010, Handreck 1997).

5.3 SURFACE WATER AND DRAINAGE

The eastern portion of Lot 9 includes a narrow sumpland extending from the vicinity of the residential dwelling south-southwest into the neighbouring property (Figure 5). The wetland has been classified as a resource enhancement sumpland, Unique Feature Identifier (UFI) 1030 (Department of Environment and Conservation DEC 2010a, 2010b). Surface water in the sumpland has only been observed in the three small manmade watering holes (subsequently filled in).

The western portion of Lot 9 borders an extensive coastal sumpland, UFI 14502 that has been classified as a multiple use wetland (DEC 2010a). This wetland forms part of the Muddy Lakes ROS. According to Landcare Management Services, no inundation has been observed along the southwestern margin of Lot 9. The boundaries of the wetlands are shown in Figure 5. Mapping is based on the Geomorphic Wetlands Swan Coastal Plain dataset (DEC 2010b).

Overall the property drains from east to west, but the flow is interrupted by the sumpland UFI 1030. The majority of the flow is anticipated to be subsurface flow as a result of the free draining sands. There is a narrow, very shallow drain running roughly east west from the sumpland to the western property boundary which may be directing water away from the sumpland during significant flood events.

Hydrology monitoring was undertaken at the property as part of the implementation of the original RMP between 2011 and 2016. The monitoring consisted of at least one site inspection per year during the winter period. Hydrology was also monitored opportunistically during site visits for other purposes, usually scheduled for spring and early autumn. No surface water was recorded on the property during this monitoring apart from water in the man-made watering holes (subsequently filled in).

5.4 GROUNDWATER

Lot 9 is located on a superficial unconfined aquifer (Swan) with an estimated salinity of 500-1,000 mg/L. Below the superficial aquifer are also the confined Leederville and Yarragadee South aquifers (Department of Water 2010). The water level of the local superficial unconfined aquifer is dependent on rainfall and is impacted by the use of bore water in the general area.

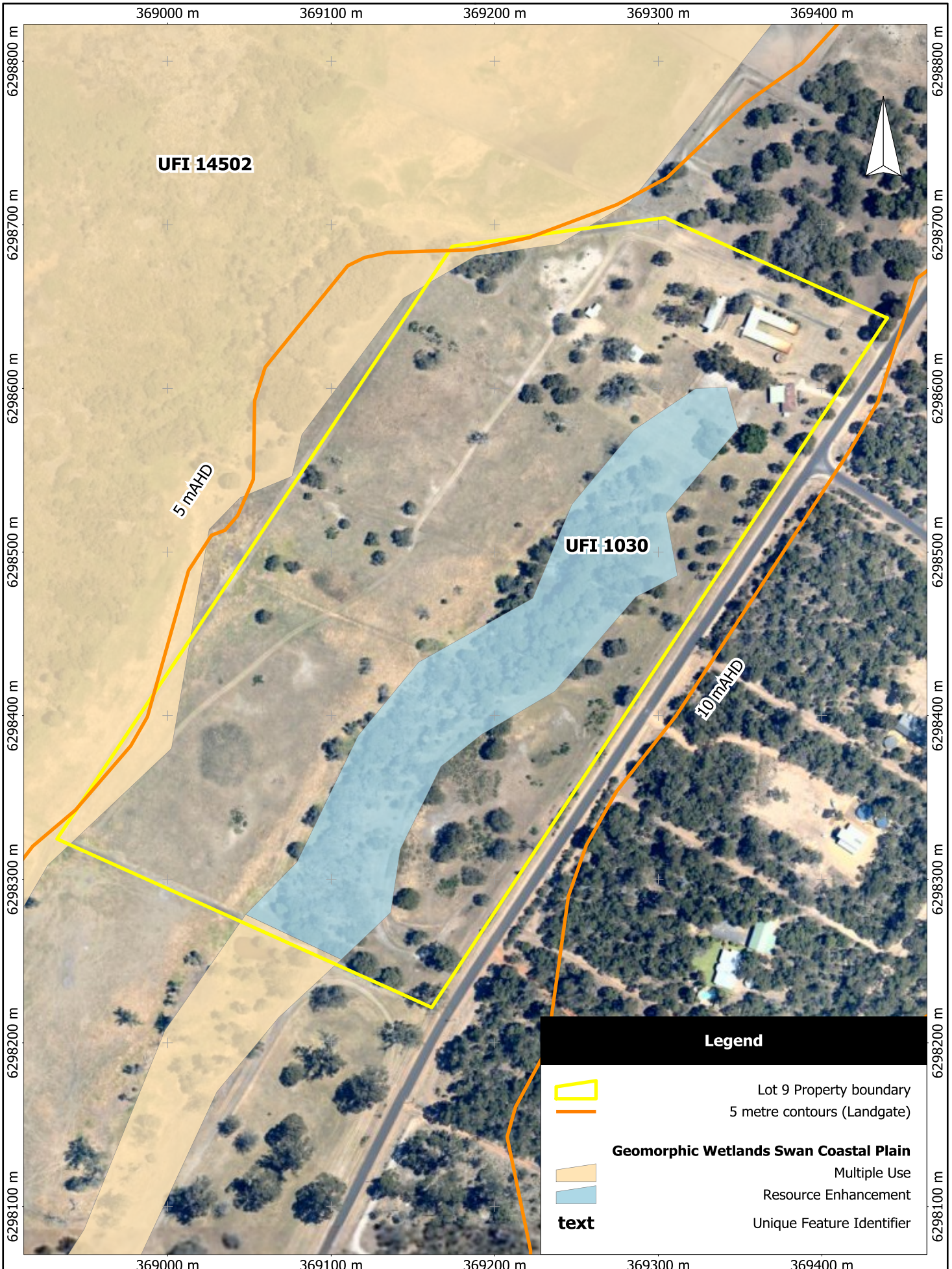

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Figure 5

Landform Contours

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5.5 VEGETATION

The majority of Lot 9 has been mapped as Beard Vegetation Association 37 'Shrublands: tea-tree thicket' with Association 6 'Medium woodland: tuart and jarrah' occurring along the eastern property margin (Department of Agriculture and Food 2008b, Shepherd et al. 2001). Other mapping by Beard (1981) in 1,000,000 scale identified the area as *Eucalyptus gomphocephala* woodland bordering *Agonis flexuosa* scrub. Gibson et al. (1994) surveyed two locations between Beard Associations 37 and 6, approximately 4 km to the south of Lot 9 and described these sites as Community type 25: Southern *Eucalyptus gomphocephala – Agonis flexuosa* woodlands.

As previously stated, approximately 85% of the property had been cleared of native vegetation prior to the commencement of rehabilitation works and the majority of the remaining vegetation is located in and around the sumpland. There are mature trees and shrubs scattered across the remainder of the property (Figure 5, Plate 1 to Plate 9).

A basic vegetation survey involving a desktop study and a reconnaissance site visit was undertaken on Lot 9 in June 2010 and the survey memorandum is attached (Appendix 2). The vegetation associated with the sumpland consisted of dense low forest of *Melaleuca rhaphiophylla* and *Eucalyptus rudis* over scrub of *Viminaria juncea* over introduced grasses and scattered individuals of *Gahnia trifida, Juncus pallidus* and *Lepidosperma gladiatum*. The occurrence of *Agonis flexuosa* and *Acacia saligna* increased when moving from the inner to the outer wetland zone. Along the eastern margin of the sumpland and extending east into the paddock there were some significant patches of the Bracken fern *Pteridium esculentum*. Arum lily (**Zantedeschia aethiopica*), a Declared Pest species, was also present within the sumpland area. Under the *Biosecurity and Agriculture Management Act 2007*, Arum lily is classified in C3 category (management)[1] in the whole of Western Australia. No Rare or Priority Flora species were recorded. A complete species list is contained in Appendix 2.

The survey in 2010 found that the vegetation structure in the sumpland had been significantly altered by previous disturbances such as grazing, fire and construction of the small stock watering holes and a drain. These disturbances had resulted in the replacement of much of the understorey with introduced species. However, there were signs of natural regeneration of the upper and middle storey species. Overall, the vegetation condition in the sumpland area was rated as 'Degraded' according to the vegetation condition scale by Keighery (1994).

The remnant individual trees and clusters of vegetation scattered across the paddock areas consisted mainly of *Agonis flexuosa* over *Acacia saligna* with occasional *Jacksonia furcellata*, *Hibbertia cuneiformis* and *Rhagodia baccata*. Along the eastern and southeastern margins of the property there were also scattered *Eucalyptus gomphocephala*, *Macrozamia riedlei* and one *Xylomelum occidentale*.

Whilst degraded, the remnant vegetation in the western portion of Lot 9 did not reflect the characteristics of Beard Vegetation Association 37 'Shrublands: tea-tree thicket' that had been mapped for the area. The boundary of this Association on ground seemed to rather follow the boundary of the large coastal sumpland UFI 14502 on the western side of Lot 9. The remnant vegetation in the western portion of Lot 9 and in similar areas north and south of the property was more characteristic of *Eucalyptus gomphocephala – Agonis flexuosa* woodland.

Across Minninup Road, immediately to the east of the property, the vegetation was dominated by *Corymbia calophylla*, *Agonis flexuosa* and *Banksia* spp. Rural properties to the north and south of Lot 9 had been mostly cleared of native vegetation and the understorey comprised introduced pasture grasses. Whilst Muddy Lakes Reserve ROS on the western side of Lot 9 sustained better coverage of native vegetation it also had very high weed cover (up to 100%) especially along the Lot 9 boundary.

[1] C3 Category (Management): Pests will be assigned to this category if they are established in Western Australia but it is feasible, or desirable, to manage them in order to limit their damage. Control measures can prevent a C3 pest from increasing in population size or density or moving from an area in which it is established into an area which currently is free of that pest (Department of Agriculture and Food 2017).

A number of non-local species were found in the vicinity of the residential dwelling including Blue Gums (*Eucalyptus saligna*), Lemon Scented Gum (*Eucalyptus citriodora*), Fig tree, *Callistemon* spp., *Acacia* spp., *Melaleuca* sp. and a Cypress.

Vegetation monitoring during Years 1-5 found that the most common weed species on Lot 9 with potential to outcompete revegetation are *Cynodon dactylon* (Couch grass), *Lupinus* sp. (Lupins) and a combination of other grasses (*Avena* sp., *Bromus* sp., *Ehrharta* sp., *Eragrostis* sp., *Lolium* sp., *Pennisetum clandestinum*). Other commonly recorded weed species were *Arctotheca calendula* (Cape Weed), *Erodium* sp. (Storksbill), *Malva parviflora* (Marshmallow), *Oenothera* sp. (Evening Primrose), *Oxalis* spp., *Solanum nigrum* (Nightshade), *Trachyandra divaricata* (Dune Onion Weed) and *Verbascum virgatum* (Green Mullein). Two Declared Pest species (Arum Lily **Zantedeschia aethiopica* and Narrow leaf Cotton Bush **Gomphocarpus fruticosus*) were also recorded both belonging to the C3.

Plate 1: View from Southeast Corner Northeast Along Fence, 02/06/2010

Plate 2: View from Southeast Corner to West, 02/06/2010

Plate 3: View from Southwest Corner Northeast Along Fence, 03/07/2010

Plate 4: View from Southwest Corner to East, 03/07/2010

Plate 5: View from Northwest Corner to Southwest, 03/07/2010

Plate 6: Sumpland from the West, 02/06/2010

Plate 7: Melaleucas in Sumpland, 02/06/2010

Plate 8: Other Vegetation in Sumpland, 02/06/2010

Plate 9: Vegetation on Eastern Side of Minninup Road, 02/06/2010

5.6 DISEASE AND OTHER PLANT HEALTH FACTORS

No visible evidence of dieback was observed on Lot 9 during the 2010 vegetation survey and Banksias on the neighbouring properties appeared healthy. Due to the extent of vegetation clearing and lack of indicator species on Lot 9, no formal dieback assessment was undertaken.

Mature Melaleucas in the Sumpland area experienced significant canopy loss during a major storm in June 2012 and have only partly recovered. The reasons underlying the poor recovery are uncertain.

Monitoring during Years 1-5 found that the site was subject to a high grazing pressure by kangaroos, rabbits and snails and this was impacting on the health of younger plants.

5.7 FAUNA

A fauna survey was undertaken within the rehabilitation areas over October and November 2015 by zoologist Greg Harewood (Harewood 2015). This survey was one of the monitoring commitments made in the original RMP (September 2010). The survey included a bird survey transect, targeted Western Ringtail Possum surveys, bat call recordings, the use of motion sensing cameras and opportunistic observations. In total 40 species were recorded, the assemblage being made up of one species of reptile, 28 species of bird (including one introduced species), seven species of native mammal (including four species of bat) and four species of introduced mammal. The presence of Western Ringtail Possum was confirmed and three other conservation significant species were recorded (Southern Brush-tailed Phascogale, Western False Pipistrelle, Rainbow Bee-eater). No White-tailed Black Cockatoos were observed.

Quokka (*Setonix brachyurus*), listed as Vulnerable under the *EPBC Act*, has been recorded in the adjacent Muddy Lakes area (Sinclair & Hyder 2009). The presence of Quokka is significant as this is the only confirmed population on the Swan Coastal Plain.

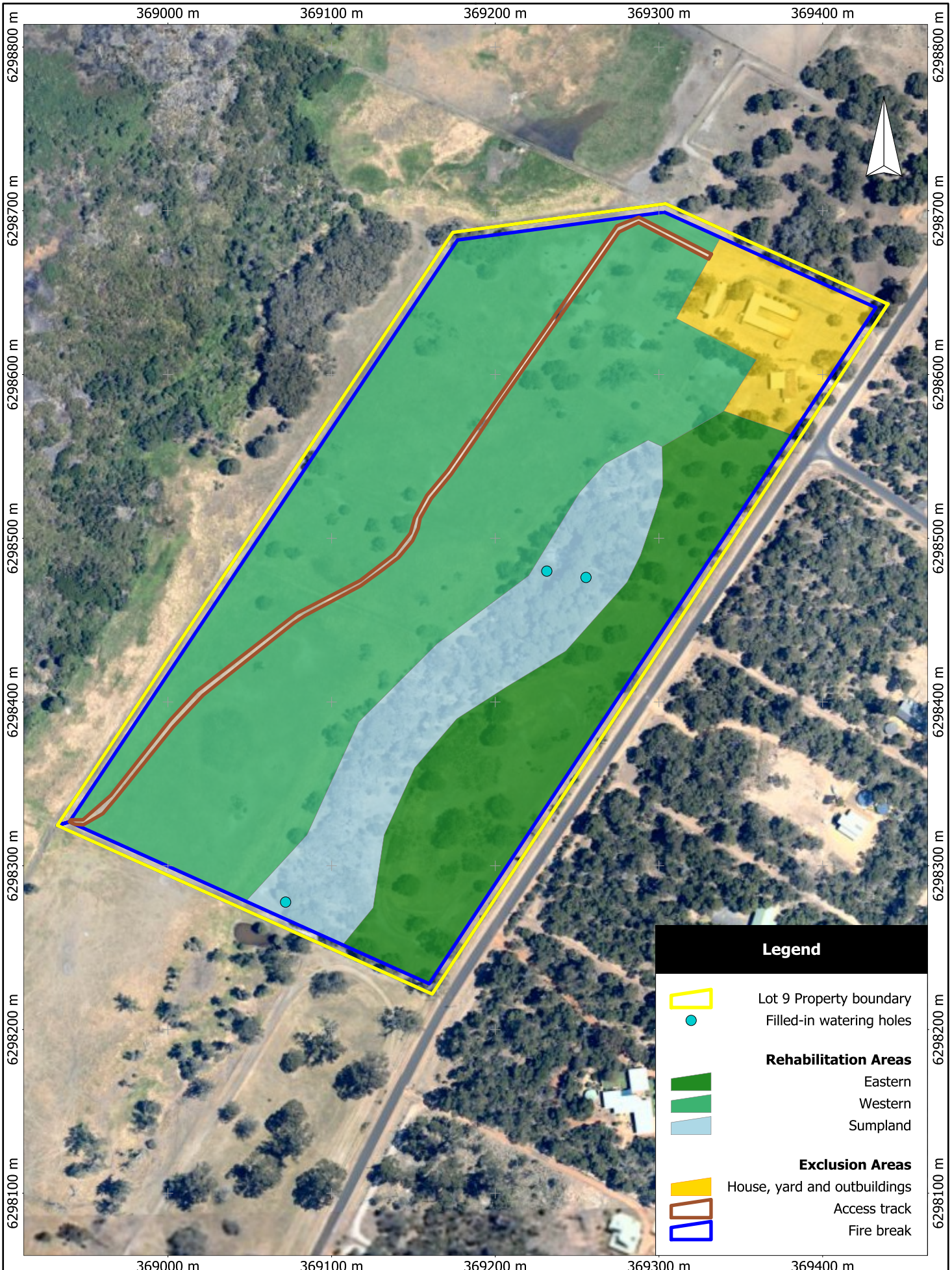
6. REHABILITATION

6.1 REHABILITATION AREAS

The residential dwelling, yard and primary outbuildings are excluded from the rehabilitation works, as demolition of these structures is beyond the scope of this project. Further exclusions include access tracks and a 5 m wide fire break along property boundaries. The remaining rehabilitation area has been divided into three areas (Eastern, Western and Sumpland, collectively called Rehabilitation Areas) on the basis of the soil, landform, hydrology and vegetation characteristics described in earlier sections. The boundaries between the areas are approximate and are shown in Figure 6. Approximate sizes of the rehabilitation and exclusion areas are presented in Table 3.

Table 3: Rehabilitation and Exclusion Areas

Area Name	Size (ha)
Rehabilitation	
Eastern Area	2.3
Sumpland	1.7
Western Area	6.5
Subtotal	10.5
Exclusions	
House, yard, outbuildings	0.7
Main track	0.2
Firebreaks (5 m wide)	0.7
Subtotal	1.6
Lot 9 TOTAL	12.1



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Rehabilitation Management Plan
Lot 9 on Plan 43302 Stratham
EPBC 2007/3333

Figure 6

Rehabilitation Areas

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6.2 REHABILITATION MANAGEMENT MEASURES

The following sections provide a summary of rehabilitation measures undertaken during Years 1-5 under the original RMP (September 2010) and detail further management measures that will be undertaken under this RMP Rev2 commencing in 2017.

6.2.1 Removal of Infrastructure

Two small outbuildings and some internal fencing that were present in the Rehabilitation Areas were removed between 2011 and 2012 as described in the relevant Annual Progress Reports (APRs). No further removal of infrastructure from the Rehabilitation Areas is required.

6.2.2 Acid Sulfate Soil Mitigation

As discussed in Section 5.2, the Sumpland is likely to contain acid sulfate soils. The original main management concern was the three manmade watering holes exposing subsurface materials to oxygen. These holes were filled with a blend of surrounding soil and agricultural lime in 2012 as described in the APR 2012. Seedlings were planted over the filled-in holes and have grown well. Significant natural regeneration has also occurred. No soil or hydrology related limitations to the re-establishment of native vegetation have been observed.

No further action in regards to acid sulfate soil is necessary. The naturally occurring acid sulfate soils in the Sumpland do not pose a threat to revegetation efforts unless disturbed and exposed to oxygen.

6.2.3 Fencing

During Years 1-5 of the original RMP, property boundary fencing was maintained to prevent access by livestock from neighbouring properties. The boundary fence between Lot 9 and the Muddy Lakes ROS was removed in 2016 to incorporate Lot 9 to the ROS. The decision to remove the fence was made by the landowner WAPC and may impact the rehabilitation project on Lot 9 through increased grazing by kangaroos due to easier access.

Under RMP Rev2, the remaining boundary fencing will be maintained to prevent livestock access from neighbouring properties. Trials involving additional fencing will be considered for the highest mortality areas to reduce grazing impact of kangaroos.

6.2.4 Fire Management

The Shire of Capel requires maintenance of a minimum 3 m wide and 5 m high fire break along property boundaries. During the rehabilitation program, the maintenance of the fire break will remain the responsibility of the WAPC.

6.2.5 Ground Preparation

Ground preparation works were undertaken in June 2012 ahead of the initial planting of seedlings and included rotary hoeing, surface ripping, furrowing and mounding as reported in APR 2012. As planned, the grading only occurred in areas accessible by machinery and in order to preserve the existing native vegetation, no grading was conducted in the Sumpland. Some additional ground preparation works (slashing, rotary hoeing and furrowing) were undertaken in infill planting areas in May 2013. No further ground preparation works are likely to be necessary, however the need for such works will be determined ahead planting on an annual basis.

6.2.6 Weed Management

An experienced weed management contractor (Mainspray) was engaged in 2011 and weed control was undertaken between 2011 and 2016 as detailed in the APRs. In summary, weed control involved combination of boom and hand spray with either broad spectrum or selective herbicide depending on the area of spray and the target species. Generally there were two main rounds of weed control per year, targeting winter and summer weeds respectively and additional targeted sprays for any observed Declared Pest species (Arum Lily **Zantedeschia aethiopica* and Narrow leaf Cotton Bush **Gomphocarpus fruticosus*).

Weed control from 2017 onwards will comprise two main control rounds per year (for winter and summer weeds respectively) unless site conditions indicate no benefit. Weed control methods (boom spray versus hand spray), herbicide type and timing of control will be tailored for a particular control round on the basis of site conditions. Annual control of any Declared Pest species will also continue.

The main purpose of weed control on Lot 9 during the rehabilitation project is to reduce weed competition on juvenile native seedlings and minimise associated seedling mortality. Once the rehabilitation project is completed weed control will become the responsibility of the landowner WAPC and it is anticipated that any weed control program for the Muddy Lakes ROS will be extended to cover Lot 9.

6.2.7 Planting

A summary of the planting numbers undertaken during initial and infill planting rounds in Years 2-5 (no planting was undertaken in Year 1) is provided in Table 4. Further details on plantings have been provided in APRs. All plantings were undertaken in the late autumn – winter period following substantial commencement of seasonal rainfall. Plastic corflute-type tree guards were used to protect young seedlings.

Table 4: Seedling Planting Numbers Years 2-5

Item	Eastern	Western	Sumpland	Total
Total Number of Seedlings Planted in 2012 (Year 2)	4,124	10,037	2,226	16,387
Total Number of Seedlings Planted in 2013 (Year 3)	1,527	5,526	0	7,053
Total Number of Seedlings Planted in 2014 (Year 4)	550	2,522	0	3,072
Total Number of Seedlings Planted in 2015 (Year 5)	541	1,675	0	2,216
Overall Total	6,742	19,760	2,226	28,728
Area (Ha)	2.3	6.5	1.7	10.5
Overall Planting Stem Density per Hectare	2,931	3,040	1,309	N/A

As per approval EPBC 2007/3333 Variation 2016, stem density targets (milestones discussed further in Section 7) are on average 1,500 stems per hectare in Eastern and Western Areas and on average 380 stems per hectare in the Sumpland. Results of biannual vegetation monitoring 2011-2016 are presented in Table 5 showing that the Sumpland and Eastern Area were above these targets in October 2016 whereas the Western Area was significantly below the target.

Table 5: Stems per Hectare

Monitoring Occasion	Stems per Hectare[1]											
	All Areas			Eastern			Western			Sumpland		
	Average	SE[3]	n[2]	Average	SE	n[2]	Average	SE	n[2]	Average	SE	n[2]
Oct. 2012	990	264	10	1,500	204	4	320	193	5	2,300	-	1
March 2013	627	132	15	775	397	4	490	99	10	1,400	-	1
Nov. 2013	1,153	134	15	1,650	318	4	940	111	10	1,300	-	1
March 2014	670	92	20	740	258	5	600	99	13	950	250	2
Oct. 2014	1,020	75	25	975	119	8	953	84	15	1,700	200	2
March 2015	2,083	540	41	2,033	672	12	778	97	23	7,183	2,703	6
Oct. 2015	1,505	428	22	1,140	175	5	853	110	15	7,300	1,900	2
April 2016	1,258	307	33	1,410	544	10	594	69	18	3,340	1,447	5
Oct. 2016	1,045	262	29	1,619	695	8	503	85	18	2,767	1,271	3
Target as per milestones (Section 7)	N/A	N/A	N/A	1,500	N/A	N/A	1,500	N/A	N/A	380	N/A	N/A

[1] Calculated on the basis of biannual vegetation monitoring quadrat data. Figures for 2012, 2013 and 2014 include only planted seedlings. From March 2015 onwards the figures include both planted seedlings and natural regeneration.

[2] Number of quadrats.

[3] SE = standard error

Required planting numbers for 2017 have been estimated as detailed in Table 6. These calculations include 10% contingency margin (management trigger in Section 9) and 40% mortality allowance (e.g. due to weather, grazing and weed competition). On the basis of the calculations, a minimum 10,538 seedlings will be planted in 2017.

Table 6: Planting Requirement Calculation

Area Name	Size (ha)	Milestone (stems/ha)	Management Trigger[1] (stems/ha)	Mortality Allowance[2]	Formula: (Trigger - Latest Monitoring data) * Size + Mortality Allowance = stems/ha
Eastern Area	2.3	1,500	1,650	40%	(1,650 - 1,619) * 2.3 * 1.4 = 100
Western Area	6.5	1,500	1,650	40%	(1,650 - 503) * 6.5 * 1.4 = 10,438
Sumpland	1.7	380	420	40%	No further planting required (latest monitoring data > Associated Trigger)
				Total	10,538

1 Management triggers detailed in Section 9.

2 This mortality allowance may be changed depending on monitoring results.

Further infill planting will be undertaken in 2018 and subsequent years as necessary to maintain average 1,500 stems per hectare in Eastern and Western Areas and 380 stems per hectare in Sumpland.

A species list for the rehabilitation is provided in Section 6.2.9. All planting will be undertaken during the late autumn – winter period following commencement of substantial seasonal rainfall. Seedlings will be planted with a slow release native fertiliser pill (e.g. ArboTab or similar). Plastic corflute tree guards will be used to protect young seedlings. In the areas of very poor success rates, trials of additional treatments (e.g. water crystals and mulching) will be considered.

In addition to the formal revegetation plantings described above, BCGS will consider undertaking student planting days at the site. The primary purpose of a planting day is educational but seedlings planted will also contribute towards the environmental outcomes of the site.

6.2.8 Seeding

No seeding was undertaken in Years 1-5 and no seeding will be undertaken in 2017. The option of seeding during subsequent years will be considered on an annual basis depending on site conditions and availability of suitable local provenance seed. Species selection for seeding would be consistent with Section 6.2.9.

6.2.9 Revegetation Species

The original RMP (September 2010, Table 2) listed 20 potential revegetation species for the Eastern Area, 17 for the Western Area and 11 for the Sumpland. The original species selection was guided by vegetation mapping by Beard (1981) and Gibson et al. (1994), as well as species observed on the property or immediately adjacent to it. Species and numbers planted during Years 1-5 have been detailed in APRs. Five of the planned species were not planted due to issues obtaining local provenance seedlings (*Macrozamia riedlei, Hibbertia hypericoides, Phyllanthus calycinus, Lepidosperma gladiatum* and *Gahnia trifida*).

As detailed in the original RMP (September 2010), the species list was subject to change based on seed availability. Due to ongoing issues obtaining local provenance stock of *Hibbertia hypericoides, Phyllanthus calycinus* and *Gahnia trifida,* these three species have been removed from the list. None of these species are considered to provide critical habitat for the target fauna species as described in Table 2. The revised species list for rehabilitation is provided in Table 7 which also details which species are anticipated to be suitable for which Rehabilitation Area. Species for plantings from 2017 onwards will be chosen from this list on the basis of rehabilitation monitoring results to achieve the performance and completion targets as detailed in Section 7.

Table 7: Flora Species for Rehabilitation

Scientific Name	Common Name	Eastern	Western	Sumpland
Trees				
Agonis flexuosa	Peppermint	x	x	x
Banksia attenuata	Candle Banksia	x	-	-
Banksia grandis	Bull Banksia	x	-	-
Banksia littoralis	Swamp Banksia	-	-[1]	x
Corymbia calophylla	Marri	x	x[2]	-
Eucalyptus gomphocephala	Tuart	x	x	-
Eucalyptus marginata	Jarrah	x	x	-
Eucalyptus rudis	Flooded Gum	x[2]	x[2]	x
Melaleuca preissiana	Moonah	-	-	x
Melaleuca rhaphiophylla	Swamp Paperbark	-	-	x
Xylomelum occidentalis	Woody Pear	x	-	-

Scientific Name	Common Name	Eastern	Western	Sumpland
Shrubs				
Acacia cyclops	Red Eye Wattle	x	x	x
Acacia saligna	Orange Wattle	x	x	x
Bossiaea eriocarpa	Common Brown Pea	x	x	-
Hakea prostrata	Harsh Hakea	x[2]	x	-
Hibbertia cuneiformis	Cutleaf Hibbertia	x	x	-
Jacksonia furcellata	Grey stinkwood	x	x	-
Macrozamia riedlei	Zamia	x	-	-
Rhagodia baccata	Berry Saltbush	x	x	x[2]
Spyridium globulosum	Basket Bush	x	x	x[2]
Viminaria juncea	Swish Bush	-	-	x
Herbs and Creepers				
Acacia pulchella	Prickly Moses	x	x	-
Conostylis aculeata	Prickly Conostylis	x	x	-
Hardenbergia comptoniana	Native Wisteria	x	x	-
Sedges and Rushes				
Lepidosperma gladiatum	Coastal Sword Sedge	-	-	x
Juncus pallidus	Pale Rush	-	-	x
	Total Number of Species	20	16	12

1 - Removed (not suitable for Western area as requires higher soil moisture).

2 - Added (suitable for the area).

' – ' Not suitable for rehabilitation in this area.

6.3 NATURAL REGENERATION

Natural regeneration, referring to the recruitment of native seedlings from the soil seed stock (or seed brought in by fauna) was not addressed in the original RMP (September 2010), mainly because no data was available on the soil seed stock and its viability was expected to be poor following decades of grazing and cropping.

Vegetation monitoring during Years 1-5 provided opportunistic as well as some quantifiable data on natural regeneration summarised as follows:

- The amount of natural regeneration is higher in the Sumpland and the Eastern Area compared to the Western Area. Only very limited regeneration has been observed in the Western Area.
- Mortality rates for natural regeneration during the juvenile stage are high.
- The most common species recorded emerging have been *Agonis flexuosa* (Peppermint), *Eucalyptus rudis* (Flooded Gum) and *Acacia* species, so far observed in the range of hundreds of seedlings across the Sumpland and Eastern Area.
- Other species recorded have included *Banksia attenuata*, *Banksia grandis*, *Diplolaena* sp., *Eucalyptus* sp., *Melaleuca* sp., *Hibbertia cuneiformis*, *Jacksonia furcellata*, *Macrozamia riedlei*, *Nuytsia floribunda*, *Rhagodia baccata*, *Olearia axillaris*, *Spyridium globulosum*, *Viminaria juncea* and *Juncus pallidus*. The observed number of individuals for these other species has varied from one into tens across the site. A species of the Solanum genus, potentially native *Solanum symonii*, has also been recorded.

Natural regeneration observed on Lot 9 is strongly associated with the commencement of the rehabilitation works that have created conditions suitable for germination of the soil seed stock and supported the growth of young seedlings (e.g. via control of grazing and weeds). As noted in the APRs, it became increasingly impossible to differentiate between planted seedlings and natural regeneration during vegetation monitoring and from 2015 onwards the two were counted together.

Natural regeneration is expected to continue and will be included in any plant counting associated with biannual vegetation monitoring, and as such will count towards the completion criteria and milestones described in Section 7.

6.4 REHABILITATION IMPLEMENTATION SCHEDULE

This RMP Rev2 covers the period from June 2017 up to 30 June 2021 (unless completion criteria satisfied earlier). The rehabilitation implementation schedule is provided in Table 8.

Table 8: Rehabilitation Implementation Schedule

Management Objective	Management Measures	Where	When	Performance Target	Performance Indicator	Related Monitoring or Audit Tool
Native plant stem density milestones (Table 9)	Planting (Section 6.2.7)	Rehabilitation Areas not yet completed	During late autumn-winter period in 2017 and subsequent years as necessary to meet completion criteria	Plant at least 10,538 stems across the Rehabilitation Areas in 2017	Number of stems planted Native plant stem density	Invoice from planting contractor detailing number and species of plants planted Vegetation monitoring (Section 8).
Native plant species composition milestones and outcomes (Table 9)	Planting (Section 6.2.7)	Rehabilitation Areas not yet completed	During late autumn-winter period in 2017 and subsequent years as necessary to meet completion criteria	Plant at least 10,538 stems of appropriate species across the Rehabilitation Areas in 2017	Native plant species composition	Invoice from planting contractor detailing number and species of plants planted Vegetation monitoring (Section 8)
Live weed cover milestones and outcomes	Weed control (Section 6.2.6)	Rehabilitation Areas not yet completed	Twice per year to target winter and summer weeds (unless site conditions indicate no benefit)	Undertake weed control	Live weed % foliage cover	Vegetation monitoring (Section 8)

1 Including planted seedlings and native regrowth.

7. PERFORMANCE AND COMPLETION CRITERIA

Progress towards the completion criteria of the original RMP (September 2010) has been documented in the APRs. Due to high rates of seedling mortality caused by mainly weather (below average rainfall), but also grazing and weed competition, some of the completion criteria relating to species richness and stem density set in the original RMP were not met.

In this RMP Rev2, completion criteria are environmental outcomes that define measurable targets for ecological attributes associated with the target fauna. In addition, measurable milestones have also been set to track progress towards the outcomes. The environmental outcomes and milestones for this RMP Rev2 are presented in Table 9. Performance targets from Table 8 are also included.

The three Rehabilitation Areas (Eastern, Western and Sumpland) may achieve the completion criteria at different times before June 2021. Once the monitoring data indicates that the completion criteria have been met in a particular Rehabilitation Area (Eastern, Western, Sumpland), a request will be made to the Department to consider that area completed and removed from any further rehabilitation works (including monitoring and reporting).

Table 9: Environmental Outcomes, Milestones, Targets and Performance Indicators

Completion Criteria - Environmental Outcome Latest by 30 June 2021	Milestone[1]	Performance Target	Associated Performance Indicator
At least 80% of the species listed in Table 7 for a particular Rehabilitation Area are present in that Rehabilitation Area[2]	By 31 December 2017, achieve and maintain at least 80% of the species listed in Table 7 for a particular rehabilitation area[2]	Plant at least 10,538 stems of appropriate species as detailed in Table 6 and Table 7 across rehabilitation areas in 2017.	Native species composition
Achieve a self-sustaining vegetation community that, in the longer term, will provide habitat for the Western Ringtail Possum (*Pseudocheirus occidentalis*) and White-tailed Black Cockatoo (*Calyptorhynchus baudinii* and *C. latirostris*)	By 31 December 2017, achieve and maintain on average at least 1,500 stems per hectare in the Western and Eastern Areas[2] By 31 December 2017, achieve and maintain on average at least 380 stems per hectare in the Sumpland[2]	Plant at least 10,538 stems of appropriate species as detailed in Table 6 and Table 7 across rehabilitation areas in 2017.	Native plant stem density. Native species composition. Native vegetation structure
The average live weed cover is <50%	By 31 December 2017, achieve and maintain the average live weed cover of <50%	Undertake weed control biannually	Live weed % foliage cover

1 These milestones will be assessed on the basis of rehabilitation monitoring scheduled for October 2017 (see Section 8).

2 Including planted seedlings and native regrowth.

8. MONITORING PROGRAM

8.1 PURPOSE AND SCHEDULE

In this RMP Rev2, the purpose of monitoring is to determine progress towards and achievement of environmental outcomes, milestones and targets and to determine the need for contingency measures. Monitoring focuses on collecting data linked to performance indicators and completion criteria in Section 7 and also trigger levels for contingency measures in Section 9.

8.2 PHOTO MONITORING

Photo monitoring will continue at the eight permanent locations (Table 10) monitored during Years 1-5 of the original RMP. Photo monitoring will be biannual (spring and autumn) and coincide with vegetation monitoring. At each location, four photos will be taken facing approximately north, east, south and west. The purpose of photo monitoring is to maintain a visual record of revegetation progress and photo monitoring is not linked to any performance targets or contingency measures.

Table 10: Photo Monitoring Point Locations

Photo Point ID	UTM GDA 94 (Zone 50)		Rehabilitation Area
	Easting	Northing	
ST1	369021	6298362	Western Area
ST2	369100	6298465	Western Area
ST3	369177	6298571	Western Area
ST4	369253	6298487	Sumpland
ST5	369308	6298487	Eastern Area
ST6	369259	6298417	Eastern Area
ST7	369179	6298399	Sumpland
ST8	369159	6298327	Eastern Area

8.3 FENCE MONITORING

Fence monitoring will comprise opportunistic visual inspection of fences and the Rehabilitation Areas for any signs of livestock access. The fence monitoring will be undertaken biannually and will coincide with vegetation monitoring. Fence monitoring is linked to performance triggers and contingency measures as detailed in Section 9.

8.4 VEGETATION MONITORING

Vegetation monitoring will comprise surveying of permanent and random quadrats (each 10 m by 10 m) in the Western Area and permanent and random belt transects (2 m wide by 100 m long) in the Eastern Area and Sumpland. The minimum number of quadrats and transects to be surveyed is presented in Table 11. The locations of permanent quadrats and transects are shown in Figure 7 with coordinates detailed in Table 11. Opportunistic observations on vegetation will also be made during the monitoring rounds.

Quadrats are commonly used in vegetation surveys and the quadrat size of 10 m by 10 m was chosen as this size is commonly used in the south west of WA (EPA 2016). Also, previous monitoring using quadrats this size in the Western Area indicated that the method is suitable.

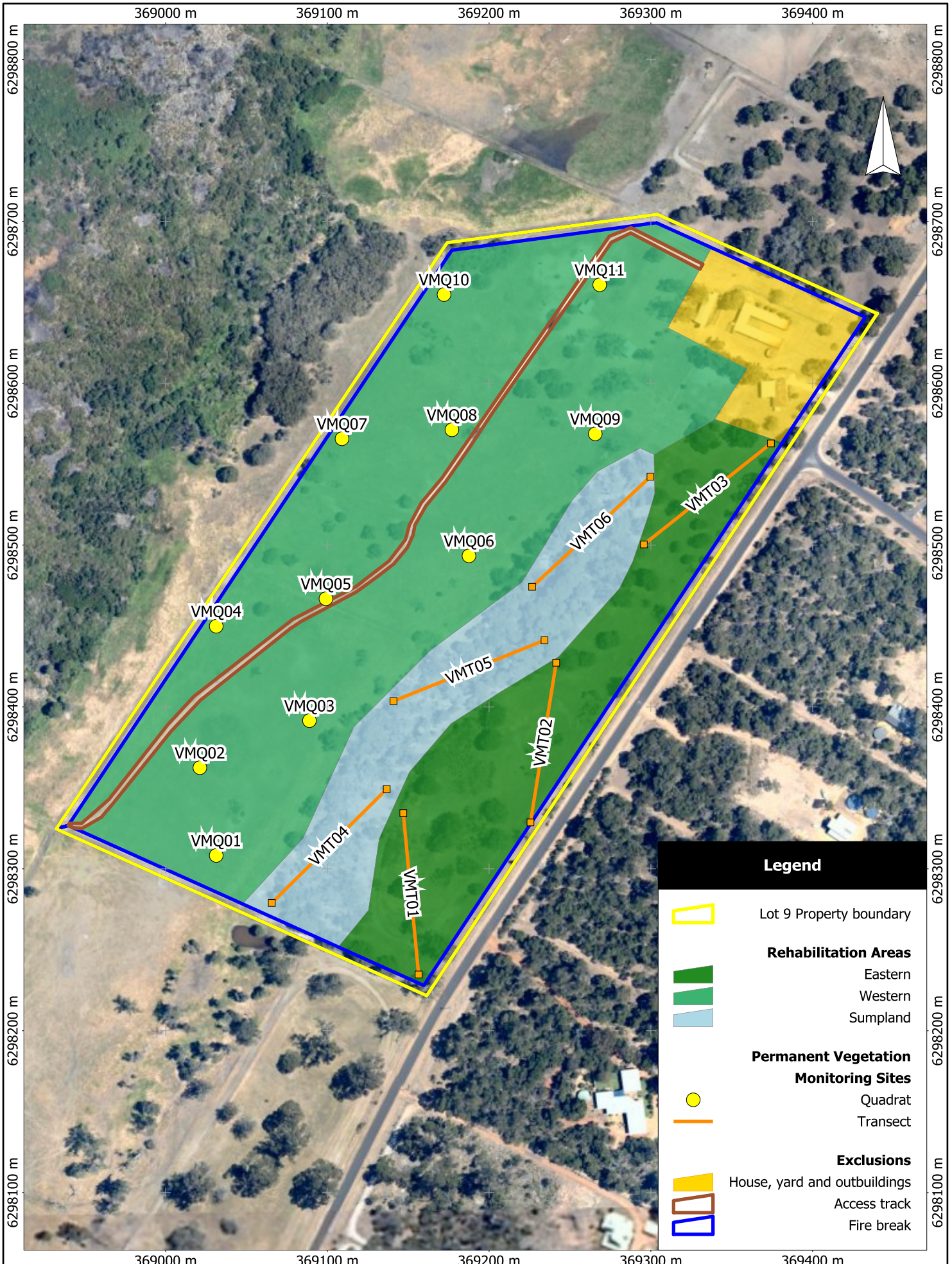
Compared to the original RMP, the vegetation monitoring method for Eastern Area and Sumpland has been changed from quadrats to belt transects. This is in order to improve the reliability of stem density estimates for these areas that experience clusters of high and low stem densities depending on the degree of natural regeneration. In the Eastern Area there is also some potential zonation from the road in the east to the Sumpland in the west (possibly based on depth to groundwater) and transects are more suitable for capturing this type of change in the environment (EPA 2016).

In comparison to previous monitoring that used only random site selection, vegetation monitoring from 2017 onwards will incorporate both random and permanent sites. The permanent sites will enable more direct and reliable assessment of changes between monitoring occasions. The random sites will ensure that any potentially significant changes outside the permanent sites are also captured.

Vegetation monitoring will be undertaken biannually, during spring and autumn. Spring was chosen as it is the preferred flora and vegetation survey time in the south west of WA, due to being the main flowering season (EPA 2016). Autumn was chosen to establish seedling survival rates following the main mortality period (dry and hot summer).

Table 11: Vegetation Monitoring Locations

Rehabilitation Area	Minimum Number Quadrats/Transects	Locations of Permanent Quadrats/Transects		
		Monitoring Point ID	UTM GDA 94 (Zone 50)	
			Easting	Northing
Western Area	Minimum 19 quadrats: 11 permanent 8 random	VMQ01	369031	6298308
		VMQ02	369021	6298362
		VMQ03	369089	6298392
		VMQ04	369031	6298450
		VMQ05	369099	6298467
		VMQ06	369188	6298493
		VMQ07	369109	6298566
		VMQ08	369177	6298571
		VMQ09	369266	6298569
		VMQ10	369172	6298655
		VMQ11	369268	6298661
Eastern Area	Minimum 6 belt transects: 3 permanent 3 random	VMT01-start	369156	6298235
		VMT01-end	369147	6298334
		VMT02-start	369226	6298329
		VMT02-end	369241	6298427
		VMT03-start	369374	6298563
		VMT03-start	369296	6298500
Sumpland	Minimum 4 belt transects: 3 permanent 1 random	VMT04-start	369066	6298279
		VMT04-end	369137	6298349
		VMT05-start	369141	6298404
		VMT05-end	369234	6298441
		VMT06S-start	369227	6298474
		VMT06S-end	369300	6298542



Scale: 1:3000
Original Size: A4
Air Photo Date: NearMap Dec 2009
Grid: MGA94(50)
0 100 m

Bunbury Cathedral Grammar School
Rehabilitation Management Plan
Lot 9 on Plan 43302 Stratham
EPBC 2007/3333

Figure 7

Permanent Vegetation Monitoring Sites

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C:\Users\kkauhanen\Documents\Bunbury Grammar\Drawings\Rehab Plan\Rev2\Figures.map 16/03/2017 F7

Data to be collected at each quadrat and transect as well as opportunistically are listed in Table 12. A summary of parameters to be calculated on the basis of the data are also provided in Table 12. Monitoring data will be stored and protected by the environmental consultancy engaged to undertake the monitoring. Monitoring data will be analysed and interpreted in a timely manner and the results will be summarised into twice yearly reports as detailed in Section 14. These reports will be subject to internal quality control.

Table 12: Vegetation Monitoring Data Collection and Analysis

Item	Data Collection Method		
	Quadrats	Transects	Opportunistic
Data Collection	• Number of native plants (planted or naturally recruited). • Species of native plants (planted or naturally recruited). • Maximum height for each native species. • Native vegetation structure. • Species of weeds. • Estimated live % foliage cover of weeds. • Qualitative assessment of grazing impact. • Location coordinates and photograph.	• Number of native plants (planted or naturally recruited). • Species of native plants (planted or naturally recruited). • Maximum height for each native species. • Native vegetation structure (note any significant changes along transect). • Species of weeds. • Estimated live % foliage cover of weeds (average of estimates at 20m interval). • Qualitative assessment of grazing impact. • Start and end location coordinates and photograph.	• Native or weed species not observed in quadrats/transects.
Data Analysis	On the basis of the data collected, the following will be calculated/described for each Rehabilitation Area: • Native species composition. • Native vegetation structure. • Average native plant stem density per hectare, standard error of mean and relative standard error (SE/mean as %). • Weed species composition. • Average live weed % foliage cover, standard error of mean and relative standard error (SE/mean as %). • Grazing impact.		

8.5 REHABILITATION MONITORING SCHEDULE

The rehabilitation monitoring schedule is presented in Table 13. All monitoring and related reporting will be undertaken by an independent, appropriately qualified environmental professional. Monitoring in a particular Rehabilitation Area will cease once that area has been deemed completed by the Department/Minister. The monitoring program will be subject to periodic review as detailed in Section 17.

Table 13: Rehabilitation Monitoring Schedule

Monitoring Activity	Performance Indicators/ Contingency Trigger	Objective	Relevant Guidelines/Standards	Where	When	Reliability
Photo point monitoring of general development Section 8.2	Establishment of native vegetation (visual effect) Not used to assess performance or need for contingency measures	Maintain visual record of revegetation progress. Not used to assess performance or need for contingency measures.	None	All Rehabilitation Areas not yet completed	Biannual (spring and autumn)	GPS coordinates of photo points
Fence monitoring Section 8.3	Fence condition Signs of livestock access	Determine the need for contingency measures	None	All Rehabilitation Areas not yet completed	Biannual (spring and autumn)	None
Vegetation monitoring Section 8.4	Native species composition.[1] Native vegetation structure.[1] Native plant stem density.[1] Weed species composition. Live weed % foliage cover. Grazing impact.	Determine progress towards and achievement of outcomes, milestones and targets Determine the need for contingency measures	No compulsory guideline or standard. The following document was used to provide some guidance in the preparation of this monitoring program: *Technical Guidance - Flora and Vegetation Surveys for Environmental Impact Assessment* (WA Environmental Protection Authority December 2016).	All Rehabilitation Areas not yet completed	Biannual (spring and autumn).	Minimum number of quadrats/transects set in the RMP Rev2 For native plant density and live weed % foliage cover, reliability will also be quantified as relative standard error (SE/mean as %) with desired level being <30%

1 Includes planted seedlings and natural regeneration.

9. CONTINGENCY MEASURES

Monitoring results will be assessed against performance indicators and contingency trigger values presented in Table 14 and contingency measures will be implemented where necessary. Assessment against the trigger values will be undertaken following each monitoring round until a particular Rehabilitation Area has been deemed completed by the Department. The trigger values are not performance targets and triggering of contingency measures does not constitute non-compliance with this RMP. The trigger values and contingency measures are purely for operational management purposes and form a safety margin against potential future compliance issues. Consequently trigger values have been set higher than the outcomes and milestones. Trigger values will not be taken into consideration in determining whether the completion criteria (environmental outcomes) have been met. Trigger values are only applicable to areas that have not yet been deemed completed by the Department.

Table 14: Trigger Values and Contingency Measures

Parameter	Performance Indicator[1]	Trigger Value	Contingency Measures
Fencing	Fence condition	Fence condition does not prevent livestock access	Fix the fence to prevent livestock access
	Signs of livestock access	Signs of livestock access	Inspect the fence and fix if necessary Contact neighbouring land owners and WAPC as necessary to address the issue
Vegetation	Native species composition	Less than 85% of target flora species for a Rehabilitation Area present in that area (target species listed in Table 7)[1]	Undertake infill planting to increase species diversity[2]
	Native plant density.[2]	<u>In 2017 and 2018:</u> • Less than 1,650 stems per hectare on average in Eastern and Western Areas[1] • Less than 420 stems per hectare on average in Sumpland[1] <u>Subsequent years:</u> • Less than 1,550 stems per hectare on average in Eastern and Western Areas [1] • Less than 400 stems per hectare on average in Sumpland[1]	Undertake infill plantings that increase the stem densities to above these minimum trigger values [2]
	Weed species composition	Presence of Declared Pest species.	Undertake targeted weed control for the Declared Pest species
	Live weed % foliage cover	<u>In 2017 and 2018:</u> • Average live weed % foliage cover 40% or higher <u>Subsequent years:</u> • Average live weed % foliage cover 45% or higher	Undertake additional weed control

1 - Including planted seedlings and native regrowth.

2 - Plantings will only be undertaken during autumn-winter period.

10. RISK OF FAILURE

Events and circumstances that may prejudice achievement or maintenance of milestones of this RMP have been identified in Table 15. Table 15 also provides a risk assessment for such events/circumstances and details triggers, contingency measures and monitoring measures used to manage and monitor the risk of failure.

Table 15: Risk Assessment and Management

Objective	Event or Circumstance[1]	Risk Assessment	Trigger	Contingency	Related Monitoring
Native plant stem density and species composition milestones	Failure to meet stem density or species composition milestones due to high mortality rates caused by poor weather	Likelihood: Possible Climate change related drying and warming has been recorded and a particularly poor year might occur during the rehabilitation program Consequence: Moderate Isolated pockets of poor stem density or species composition that can be reversed with additional planting Risk Level: Medium	See trigger values for native species composition and native plant stem density in Table 14	See contingency measures for native species composition and native plant stem density in Table 14	Vegetation monitoring (Section 8)
Native plant stem density and species composition milestones	Failure to meet stem density or species composition milestones due to high mortality rates caused by grazing of kangaroos, rabbits and snails	Likelihood: Possible Grazing of young seedlings minimised by tree guards, but grazing still occurs, especially on older seedlings. The degree of grazing pressure depends on weather conditions, food availability on neighbouring properties and pest/animal control on neighbouring properties Consequence: Moderate Isolated pockets of poor stem density or species composition that can be reversed with additional planting Risk Level: Medium	See trigger values for native species composition and native plant stem density in Table 14	See contingency measures for native species composition and native plant stem density in Table 14	Vegetation monitoring (Section 8)
Native plant stem density and species composition milestones	Failure to meet stem density or species composition milestones due to high mortality rates caused by grazing of livestock from neighbouring properties	Likelihood: Unlikely Access by livestock from neighbouring properties is prevented by fencing and no issues were recorded in Years 1-5 Consequence: Moderate Isolated pockets of poor stem density or species composition that can be reversed with additional planting Risk Level: Low	See trigger values for fence condition, signs of livestock access, native species composition and native plant stem density in Table 14	See contingency measures for fence condition, signs of livestock access, native species composition and native plant stem density in Table 14	Fencing monitoring and Vegetation monitoring (Section 8)

Objective	Event or Circumstance[1]	Risk Assessment	Trigger	Contingency	Related Monitoring
Native plant stem density and species composition milestones	Failure to meet stem density or species composition milestones due to bushfire	Likelihood: Unlikely Bushfire is a possibility, but not a regular occurrence under current management. Firebreaks and internal tracks are maintained to allow access for firefighters	None other than triggers related to stem density	None other than actions related to stem density	None other than vegetation monitoring (Section 8)
		Consequence: Moderate Isolated pockets of poor stem density or species composition that can be reversed with additional planting			
		Risk Level: Low			
Establishment of native vegetation	Excessive live weed cover outcompeting native vegetation	Likelihood: Possible Ongoing weed control is undertaken, but there is high weed seed stock in soil and additional weed seed is imported by wind and fauna. High rainfall years increase weed competition.	See trigger values for weed species composition and live weed % foliage cover in Table 14	See contingency measures for weed species composition and live weed % foliage cover in Table 14	Vegetation monitoring (Section 8)
		Consequence: Moderate Isolated pockets of poor stem density or species composition that can be reversed with additional planting			
		Risk Level: Medium			
Establishment of native vegetation	Mass plant death due to dieback or other disease	Likelihood: Unlikely (during project life) Vegetation has so far been established across the site and disease does not appear to be a cause of seedling mortality. Access to site is limited, which reduces the potential introduction of disease.	None other than triggers related to stem density	None other than actions related to stem density	None other than vegetation monitoring (Section 8)
		Consequence: High Dieback or another serious plant disease has potential to result in permanent loss of some of the target flora species and would result in need to modify target flora species list for the rehabilitation project			
		Risk level: Medium			

11. MANAGING UNCERTAINTY

The sources of uncertainty associated with this RMP are summarised in Table 16. Management and mitigation of uncertainty is also detailed in Table 16. Where the degree of uncertainty is low, no specific management and mitigation measures are provided.

Table 16: Sources and Management of Uncertainty

Data/Information	Degree of Uncertainty	Management and Mitigation of Uncertainty
Information on the existing environment (e.g. landform, soil, hydrology, vegetation, fauna) from publicly available environmental databases and site specific data from Years 1-5	Low	Not required
Expected weather/climate conditions including data from Bureau of Meteorology and site data Years 1-5	High Weather conditions have not followed long-term averages and unseasonal conditions have been encountered. South west of WA has become drier and hotter.	Plantings will be undertaken during late autumn-winter to minimise the impact of poor weather conditions and maximise seedling survival Number of seedlings planted allows for mortality
Expected suitability of selected species for the area based on information from publicly available sources and site data from Years 1-5	Medium Suitability of species for the area may be in transition due to climate change	Continue to plant those species that are surviving well
Availability of local provenance seedlings for the selected species including data from Years 1-5	Low Potential issues were established and resolved during Years 1-5	The species list for RMP Rev2 was adjusted from the original RMP (September 2010) to remove three species not readily available
Likely planting success rates based on site data from Years 1-5 and other examples	High Despite data from Years 1-5, uncertainty remains high as success rates are highly variable and impacted by number of factors including weather, grazing and weeds	Plantings will be undertaken during late autumn-winter to minimise the impact of poor weather conditions Seedlings will be planted with tree guards to minimise grazing Weed control will be undertaken to minimise weed competition Number of seedlings planted will allow for mortality
Natural regeneration based on site data from Years 1-5	Medium Rates of natural regeneration are highly variable between Rehabilitation Areas and between seasons. Also impacted by grazing and weed competition.	Only existing natural regeneration has been taken into account in formulating the plan. Any potential future recruitment will be a positive addition

Data/Information	Degree of Uncertainty	Management and Mitigation of Uncertainty
Weed composition and cover based on site data from Years 1-5	Medium The site has high weed seed stock in soil and fauna (especially kangaroos and rabbits) continue to import weed seed from surrounding properties. Weed composition and cover varies depending on site conditions (especially weather).	Weed control methods (boom spray versus hand spray), herbicide type and timing of control will be tailored for a particular control round on the basis of site conditions
Degree of grazing by kangaroos, rabbits and snails based on site data from Years 1-5	High Highly variable between years and dependent on weather conditions, food availability elsewhere and any local pest control programs (e.g. fox control)	Seedlings are planted with tree guards to minimise grazing Number of seedlings planted will allow for mortality

12. ENVIRONMENTAL INCIDENTS AND EMERGENCIES

Operations within the Rehabilitation Area are limited to rehabilitation works, associated monitoring and contingency measures, and maintenance of fences and fire breaks as described in this RMP Rev2. For the majority of time, no one is present at the Rehabilitation Area. There were no environmental incidents within Years 1-5 and the likelihood of an environmental incident associated with the planned operations is considered unlikely.

Should an environmental incident occur within the Rehabilitation Area, it will be reported to the BCGS as soon as possible. Depending on the nature of the incident, the BCGS may inform the landowner (WAPC) and seek appropriate advice to mitigate the matter. Records will be kept of any environmental incidents and response measures.

In case of any emergency, the first point of contact will be triple zero (call 000). BCGS should be informed of any emergency as soon as possible when safe to do so. BCGS will then inform the landowner (WAPC). Records will be kept of any emergencies and response measures.

13. RECORD KEEPING

Accurate records will be maintained substantiating all activities associated with approval conditions and the implementation of the RMP Rev2. Record keeping will include at least the following:

- Baseline environmental information collected about the site.
- Timing and nature of any rehabilitation measures undertaken.
- Timing and nature of monitoring activities and associated data.
- Timing and nature of any contingency measures.
- Invoices for any works related to the site.
- Any reports (e.g. monitoring reports, Annual Compliance Reports, audit reports).
- Publication date and method (for documents requiring publication).
- Email and postal communication with the Department.

Records will be stored by BCGS and/or consultant engaged for managing the rehabilitation project. Relevant records will be made available to the Department upon request. Such records may be subject to audit by the Department or an independent auditor in accordance with section 458 of the *EPBC Act*, or used to verify compliance with the conditions of approval.

Additional details on data handling relating to monitoring data is provided in Section 8.

14. REPORTING AND PUBLIC AVAILABILITY

The latest version of the RMP will be published on the website of BCGS within one month of being approved by the Minister.

Annual Compliance Reports (ACR) will be prepared in accordance with the Department's Annual Compliance Report Guidelines. The reporting period is determined on the basis of the commencement date of the approved action. As clearing at BCGS commenced on 17 January 2011, the 12 month reporting period will run from 17 January to 16 January. The ACR is required to be published on BCGS website within three months of the end of the reporting period (17 April) each year and evidence of publication submitted to the Department.

The ACR will address any contraventions of the conditions of the EPBC approval including requirements of the RMP Rev2 and will detail whether outcomes and milestones required by these conditions have been met or are likely to be achieved.

Monitoring results will be summarised in a report twice yearly, with spring monitoring results reported by the end of December and autumn monitoring results by end of May. These reports will remain internal BCGS documents until included as evidence in the relevant ACR.

Approval EPBC 2007/3333 Variation 2016 requires that the Department will be notified within 14 days following failure to meet milestones detailed in Table 9. The achievement and maintenance of the milestones will be determined on the basis of the biannual monitoring rounds (spring and autumn). The spring monitoring results will be analysed and reported by the end of December and the Department notified by 14 January of any failure to meet the milestones. The autumn monitoring results will be analysed and reported by the end of May and the Department notified by 14 June of any failure to meet the milestones.

15. ACCOUNTABILITIES

The Bursar of BCGS will be accountable for the implementation of this RMP Rev2 and ensuring that sufficient resources remain available for the project. In particular the Bursar of BCGS will be accountable for following:

- Engaging a weed management contractor and a revegetation contractor to undertake the rehabilitation measures.
- Engaging an environmental consultancy to undertake monitoring, reporting, review and internal auditing.
- Managing the risk of failure by engaging contractors as necessary to undertake contingency works (the need for such works identified in biannual monitoring).

16. AUDITING

Records maintained in regards to the implementation of the RMP and compliance with associated approval conditions (as detailed in Section 14) will be made available for auditing by the Department on request.

Internal desktop audits of compliance with the latest version of the RMP and associated approval conditions will be undertaken in preparation of ACR annually. The results of the internal desktop audits will form the ACR and there will be no separate audit report.

The Department may undertake a compliance audit with the conditions of the approval. Alternatively, the Minister may direct BCGS to organise an independent third party audit of compliance and submit the audit report to the Minister. Any independent third party auditor must be approved by the Minister prior to the commencement of the audit. The audit criteria must be agreed to by the Minister and the audit report must address the criteria to the satisfaction of the Minister.

Summaries of audits will be posted on the Department's website. The results of audits may also be publicised through the general media.

17. PLAN REVIEW

This RMP Rev2 will be reviewed on an annual basis during the preparation of the ACRs to determine whether any changes are necessary to maintain compliance and ensure effectiveness of the plan. This annual review will include a technical review and evaluation of the monitoring program and will be undertaken by an environmental consultancy. The reviews ensure that new information from the monitoring program or other sources is taken into consideration as part of the adaptive management strategy and changes are made where necessary. Specific instances that will trigger an immediate review of RMP Rev2 include:

- Monitoring reports indicate milestones or performance targets may not be achieved.
- Following a significant environmental incident (any incident that would kill or remove large portion of plants e.g. bushfire).

If RMP review indicates changes to the plan are necessary, a revision of the RMP will be prepared and submitted to the Department to obtain the Minister's written approval of the revision. The Minister may also ask for a specific revision in which case a revised RMP will be prepared and submitted for approval. The varied activity shall not commence until the Minister has approved the revised plan in writing. The Minister will not approve a revised plan unless the revised plan would result in an equivalent or improved environmental outcome. If the Minister approves the revised plan, that plan must be implemented in place of the plan originally approved.

18. GLOSSARY

Acronyms and terms with a specific meaning in the context of this RMP Rev2 are defined in Table 17. Some of the definitions come from the EPBC 2007/3333 2016 Variation.

Table 17: Glossary

Term	Definition
ACR	Annual Compliance Report
APR	Annual Progress Report (prepared for Years 1-5 under original RMP)
Appropriate species	As defined in Table 2 of Attachment B of the approval decision dated 21 December 2010.
BCGS	Bunbury Cathedral Grammar School
Department	The Australian Government Department administering the *Environment Protection and Biodiversity Conservation Act 1999.*
Eastern Rehabilitation Area	As described in Figure 6 Attachment B of the approval decision dated 21 December 2010.
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999.*
Minister	The Minister administering the *Environment Protection and Biodiversity Conservation Act 1999* and includes a delegate of the Minister.
Rehabilitation Areas	Lot 9 on Plan 43302, Stratham, Shire of Capel, Western Australia as described in Figure 2 and 3 in Attachment B of the approval decision dated 21 December 2010.
RMP	Rehabilitation Management Plan
Self-sustaining vegetation community	A vegetation community that is likely to persist in the absence of intervention.
Sumpland Rehabilitation Area	As described in Figure 6 Attachment B of the approval decision dated 21 December 2010.
Years 1-5	Years 1-5 referred to in the original RMP (September 2010) running from May 2011 to April 2016.
WAPC	Western Australian Planning Commission
Western Rehabilitation Area	As described in Figure 6 Attachment B of the approval decision dated 21 December 2010.

19. REFERENCES

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APPENDICES

APPENDIX 1: SOIL SURVEY

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MEMORANDUM

Attention:	Jenny Nobbs	From:	Kirsi Kauhanen
Company:	Bunbury Cathedral Grammar School	Date:	21 July 2010
Subject:	Soil Survey - Lot 9 Stratham	Project:	Sports Oval

Please advise if any part of this transmission failed or was misdirected

SOIL TESTING AT LOT 9 PLAN 43302 MINNINUP ROAD, STRATHAM

1. Introduction

Bunbury Cathedral Grammar School (BCGS) has engaged MBS Environmental to develop a Rehabilitation Management Plan for a portion of Lot 9 on Plan 43302, Minninup Road, Stratham. The rehabilitation works will constitute an offset proposal for the planned clearing of 2.3 hectares of native vegetation on the school property Lot 73 on Plan 32355 Allen Road, Gelorup.

This memorandum summarises the soil testing that was conducted at the site on 2 June 2010. The main objective of the soil testing was to identify any major soil related limitations to the re-establishment of native vegetation.

2. Methods

Soil samples were collected at six locations (SSL1-SSL6) on Lot 9 as illustrated in Figure 1. At each location grass was cut off to expose the surface soil. Using a hand trowel, samples were collected from three depths: 0-100, 100-200 and 200-300 millimetres. Samples were placed in plastic cups and photographed. The colour, texture and presence of organic matter were recorded for each sample. A one teaspoon subsample was taken from each sample and placed in a rinsed plastic cup. Distilled water was added to achieve a mixture of one part soil to five parts water. The sample was mixed vigorously then left for approximately 30 seconds, and then mixed again. Electrical conductivity and pH were measured in the field using a Hanna HI 98130 pH/EC metre.

Four of the sampling sites were chosen for further laboratory analysis (Figure 1). The sites were chosen to provide a good spatial coverage of the total area. Only four sites were chosen for laboratory analysis at this stage due to budget constraints with additional soil testing to be completed as necessary if the offset proposal is approved. A one litre subsample of the 0-100 millimetre layer was placed in a plastic bag and sent to be analysed at a soil laboratory for colour, gravel percentage, texture, ammonium nitrogen, nitrate nitrogen, phosphorus (Colwell), potassium (Colwell), sulphur, organic carbon, conductivity and pH.

For additional information, three manmade watering holes in the Sumpland, shown in Figure 1, were surveyed for pH on 3 July 2010.

3. Results

The data that was collected in the field is presented in Table 1. The results of the laboratory analysis are presented in Appendix 1.

Table 1: Field Results for Soil Sampling at Lot 9

Site ID	Depth (mm)	Field pH	Field EC (mS/cm)	Field Colour	Organic Matter Content*
SSL1	0-100	6.58	0.041	grey	2
SSL1	100-200	6.41	0.039	grey	2
SSL1	200-300	6.35	0.036	grey-brown	1
SSL2	0-100	6.22	0.04	dark brown	3
SSL2	100-200	6.05	0.032	dark brown	2
SSL2	200-300	6.22	0.039	brown	1
SSL3	0-100	6.02	0.039	grey	3
SSL3	100-200	5.66	0.031	grey	2
SSL3	200-300	5.96	0.031	grey	1
SSL4	0-100	6.17	0.033	grey-brown	2
SSL4	100-200	6.02	0.033	grey-brown	2
SSL4	200-300	6.38	1.14	brown	1
SSL5	0-100	6.37	3.02	grey-black	5
SSL5	100-200	6.41	2.6	grey-black	5
SSL5	200-300	6.36	0.26	grey-black	5
SSL6	0-100	6.32	0.031	dark grey	4
SSL6	100-200	6.36	0.032	grey	3
SSL6	200-300	6.50	0.034	grey	2

* Scale of 1-5 where 1 very low, 2 low, 3 medium, 4 high, 5 very high

4. Discussion and Conclusions

The results indicate that all sampling sites, apart from SSL5 were quite similar. SSL5 was the only sampling site located in the vegetated sumpland and the soil test results illustrate the differences in the soil conditions between the sumpland and the surrounding areas.

Outside of the sumpland, the average field and laboratory soil pH value of 6.2 indicates a slightly acidic soil with little variation with depth, which is typical of the grey sandy soils in the southwest of WA. Electrical conductivity values were low indicating very little salt and good drainage. There appears to have been some input of phosphate fertilisers in the past, but the remaining levels of Coldwell Phosphorus are not a concern for most native plant species.

The results for the sumpland area show elevated sulphur, phosphorus and potassium concentrations as well as elevated electrical conductivity. The soil pH at 6.2 was similar to the other parts of the property.

Two of the watering holes on the western side of the sumpland, #2 and #3 had very low pH, 2.85 and 3.00 respectively, whereas the watering hole on the eastern side #1 was only mildly acidic at pH 6.22. Watering hole #2 with pH 2.85 showed signs of iron staining.

On the basis of the above results it is likely that the sumpland contains acid sulphate soils. The manmade watering holes on the western side have exposed subsurface material to oxygen and are resulting in acidification of the water and release of nutrients and potentially heavy metals. So far the impact is considered localised due to the small scale of the soil disturbance. It is noted however that if lowering of the groundwater table was to occur in the general area, for example as a result of significant bore water use, the whole sumpland could be at risk of acidification.

It is recommended that the watering holes are filled using a blend of soil and agricultural lime. The fill should be clean and certified dieback free. The quantity of agricultural lime will need to be determined by conducting further soil testing in the vicinity of the watering holes, including field pH testing and laboratory SPOCAS (Suspension Peroxide Oxidation Combined Acidity and Sulfate) testing.

If you have any questions, please do not hesitate to contact me on 0405 083 765 or kkauhanen@mbsenvironmental.com.au.

Yours sincerely
MBS Environmental

Kirsi Kauhanen
Environmental Scientist

enc. Figure 1: Soil Sampling Sites
Appendix 1: CSBP Laboratory Results

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Original Size: A4
Air Photo: NearMap December 2009
Grid: MGA94(50)
0 100 m

Bunbury Cathedral Grammar School
Rehabilitation Project
Lot 9 on Plan 43302
Stratham

Soil Sampling Sites

Figure 1

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MBS Environmental

Soil & Plant Analysis Laboratory

ANALYSIS REPORT

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		Lab No	YQS10111	YQS10112	YQS10113	YQS10114
		Name	SSL6	SSL2	SSL4	SSL5
		Code	02/06/2010	02/06/2010	02/06/2010	02/06/2010
		Customer	MBS - KK	MBS - KK	MBS - KK	MBS - KK
		Depth	0-100	0-100	0-100	0-100
Colour			DKBR	DKBR	GRBR	GRBK
Gravel	%		0	0	0	0
Texture			1.5	1.5	1.5	2.0
Ammonium Nitrogen	mg/Kg		1	12	5	22
Nitrate Nitrogen	mg/Kg		5	11	3	17
Phosphorus Colwell	mg/Kg		15	23	14	80
Potassium Colwell	mg/Kg		61	58	29	910
Sulphur	mg/Kg		3.82	7.23	3.88	622.00
Organic Carbon	%		2.54	3.26	1.69	8.75
Conductivity	dS/m		0.031	0.041	0.029	2.420
pH Level (CaCl2)	pH		5.30	5.10	5.30	5.70
pH Level (H2O)	pH		6.30	6.10	6.30	6.20

APPENDIX 2: VEGETATION SURVEY

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MEMORANDUM

Attention:	Jenny Nobbs	From:	Kirsi Kauhanen
Company:	Bunbury Cathedral Grammar School	Date:	21 July 2010
Subject:	Vegetation Survey - Lot 9 Stratham	Project:	Sports Oval Offset

VEGETATION SURVEY AT LOT 9 PLAN 43302, MINNINUP ROAD, STRATHAM

1. Introduction

Bunbury Cathedral Grammar School (BCGS) has engaged MBS Environmental to develop a Rehabilitation Management Plan for a portion of Lot 9 on Plan 43302, Minninup Road, Stratham. The rehabilitation works will constitute an offset that will be offered to seek approval to clear 2.3 hectares of native vegetation on the school property Lot 73 on Plan 32355 Allen Road, Gelorup.

This memorandum summarises the vegetation survey that was conducted at the site on 2 June 2010. The objectives of the vegetation survey were to identify dominant native flora and weed species on the property and describe the remnant vegetation communities. The property includes a residential dwelling and yard as illustrated in Figure 1. This area was excluded from the survey as the dwelling is currently leased out.

2. Methods

A survey of the entire property was conducted on foot by Environmental Scientist Kirsi Kauhanen. All flora species observed were recorded. In addition to the walkthrough survey, two 20 by 40 metre quadrats were surveyed within the inner zone of the more densely vegetated sumpland area. Data collection in each quadrat included: plant species, height, percentage cover, strata, soil material, evidence of fire or other disturbance, and vegetation condition. Photographs were taken of the remnant vegetation across the property, including the survey quadrats.

During the survey it was found that the Old Yard included a number of introduced garden species. The Old Yard will be excluded from the Rehabilitation Plan due to the presence of outbuildings and is not discussed in more detail in this memorandum.

The timing of the survey in winter meant that many species did not exhibit reproductive features and could not be conclusively identified. The season was also not favourable for recording ephemeral or cryptic species (e.g. orchids).

3. Results

The survey area was divided into three parts, two representing the main vegetation communities (Paddock and Sumpland) and one representing the highly disturbed Old Yard area. These areas are illustrated in Figure 2. There are differences between the eastern and western parts of the Paddock area, but drawing a boundary between these two areas on the basis of the observed vegetation is not practicable.

A total of 37 vascular plant species, including 16 weed species, were recorded from an area covering the Paddock and the Sumpland. The most common families recorded were Fabaceae, Myrtaceae and Asteraceae. There were several introduced grass species that were not identified due to lack of reproductive material, and it is assumed that actual number of species in the Poaceae family is much higher than the reported two. A complete species list is presented in Appendix 1. No Rare or Priority Flora species were recorded.

On the basis of the quadrats surveyed in the inner zone of the Sumpland (Appendix 2), the vegetation consisted of dense low forest of *Melaleuca rhaphiophylla* and *Eucalyptus rudis* over scrub of *Viminaria juncea* over introduced grasses and scattered individuals of *Gahnia trifida, Juncus pallidus* and *Lepidosperma gladiatum.* The occurrence of *Agonis flexuosa* and *Acacia saligna* increased when moving from the inner to the outer wetland zone. Along the eastern margin of the Sumpland and extending into the Paddock area to the east there were some significant patches of the fern *Pteridium esculentum.* Juvenile forms of Arum lily (**Zantedeschia aethiopica*), a Declared Plant, were also present within the Sumpland area. Arum lily has been classified as Category P1 and P4 Declared Plant in the whole of Western Australia. The categories have been described in Appendix 3.

The vegetation structure in the Sumpland was considered to have been significantly altered by previous disturbances such as grazing, fire and construction of small stock watering holes and a drain. These disturbances have resulted in the replacement of much of the understorey with introduced species. However, there were signs of natural regeneration of the upper and middle storey species. Overall, the vegetation condition in the seasonally inundated area was rated as 'Degraded' following the vegetation condition scale by Keighery (1994).

The remnant individual trees and clusters of vegetation scattered across the Paddock areas consisted mainly of *Agonis flexuosa* over *Acacia saligna* with occasional *Jacksonia furcellata, Hibbertia cuneiformis* and *Rhagodia baccata*. Along the eastern and south-eastern margins of the property there were also scattered *Eucalyptus gomphocephala, Macrozamia riedlei* and one *Xylomelum occidentale*.

Across Minninup Road, immediately to the east of the property, the vegetation was dominated by *Corymbia calophylla, Agonis flexuosa* and *Banksia* spp.

4. Discussion and Recommendations

Arum lily (**Zantedeschia aethiopica*) recorded in the Sumpland is a Declared Plant (P1 and P4) under the *Agriculture and Related Resources Protection Act 1976,* administered by the Department of Agriculture and Food. Landowners are required to control this species on their properties in accordance with the above Act and guidelines provided by the Department of Agriculture and Food. It is recommended that measures to control this plant are included in the pre-planting weed management.

The fern *Pteridium esculentum* is native to eucalyptus forests in the southwest of WA, but often acts like a weed in paddocks (Hussey *et al.* 2007). Some patches of the fern on Lot 9 were dense monocultures, likely to out-compete any planted seedlings. It is recommended that measures to control the fern are included in the pre-planting weed management.

The extensive grass cover will pose a significant challenge for revegetation with native species, in particular in the Paddock areas. An experienced weed management contractor should be engaged to control kikuyu, couch and pasture grasses prior to commencement of any revegetation works. It is anticipated that it may take a couple of seasons to bring the grasses under control so that they are less likely to out-compete planted seedlings.

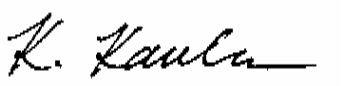
Another serious weed species on the property is Lupin (no flowers were present, but likely to be *Lupinus cosentinii*). According to Landcare Management Services who maintain the property, Lupins have been controlled on the site for the past few years, however some significant patches remain. It is recommended that Lupin control is included in the pre-planting weed management.

Typha is present in the Sumpland area, but only in two of the manmade watering holes. As part of the rehabilitation, these holes are proposed to be filled in and this should eliminate Typha.

It is recommended that any additional flora survey work, should it be required, is undertaken in the spring during the main flowering season.

In case of any questions, please do not hesitate to contact me on 0405 083 765 or kkauhanen@mbsenvironmental.com.au.

Yours sincerely
MBS Environmental



Kirsi Kauhanen
Environmental Scientist

enc. Figure 1: Vegetation Survey Area
Figure 2: Vegetation Communities
Appendix 1: Species List
Appendix 2: Quadrat Data
Appendix 3: Declared Plant Categories

References:

Hussey, B.M.J., Keighery, G.J., Dodd, J., Lloyd, S.G. and Cousens, R.D. 2007. *Western Weeds. A guide to the weeds of Western Australia*. 2nd Edition. The Weed Society of Western Australia, Victoria Park, WA.

Keighery, B.J. 1994. *Bushland Plant Survey: a Guide to Plant Community Surveys for the Community*. Wildflower Society of Western Australia (Inc.) Nedlands, Western Australia.

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Bunbury Cathedral Grammar School
Rehabilitation Management Plan
Lot 9 Plan 43302 Stratham

Vegetation Survey Area

Figure 1

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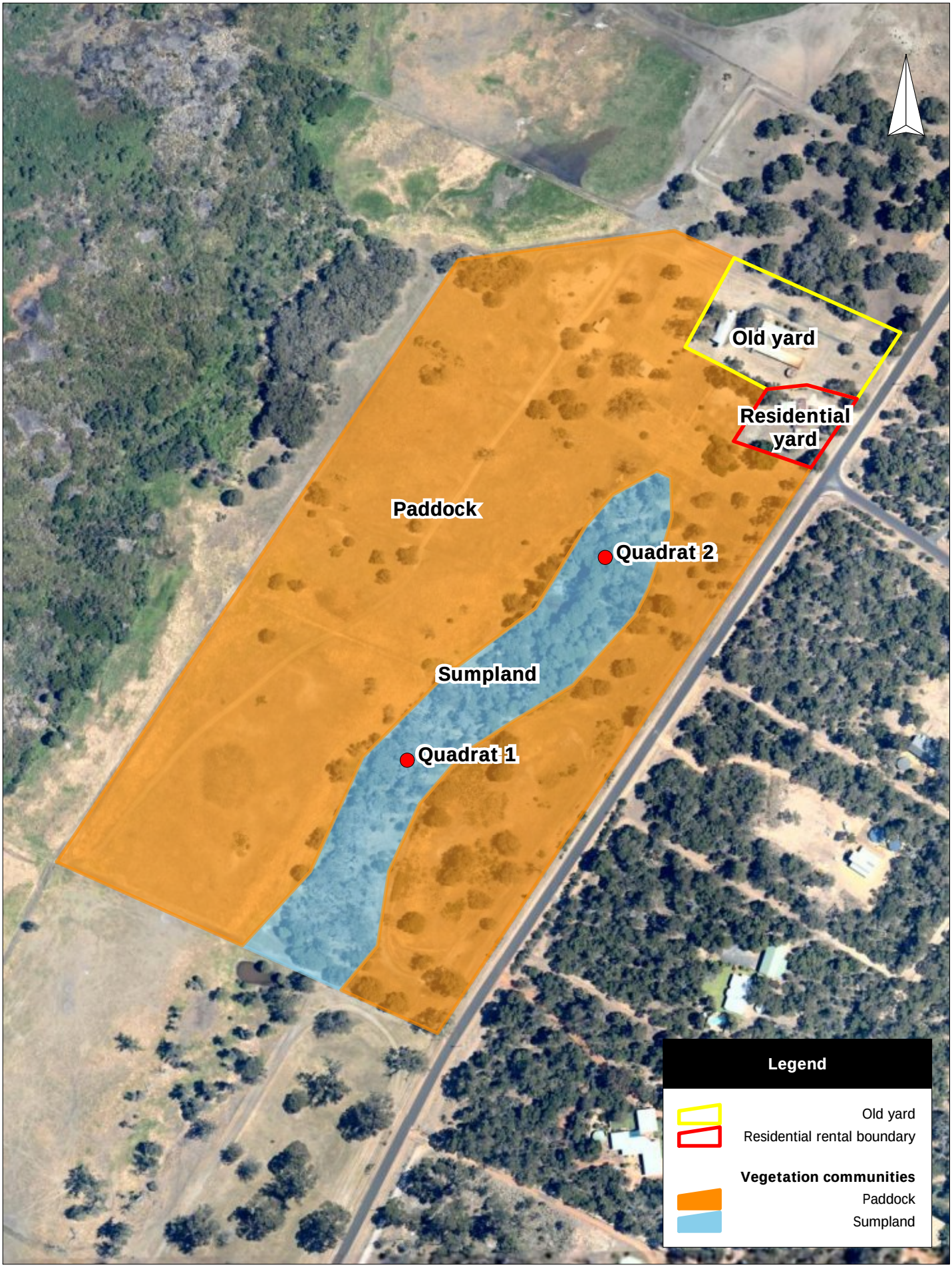

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Bunbury Cathedral Grammar School
Rehabilitation Management Plan
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Vegetation Communities and Other Areas

Figure 2

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APPENDICES

APPENDIX 1:
SPECIES LIST

Appendix 1: Species List

Family	Genus	Species	Common Name	Paddock	Sumpland
Dennstaedtiaceae	*Pteridium*	*esculentum*	Bracken	x	x
Zamiaceae	*Macrozamia*	*riedlei*	Zamia palm	x	
Araceae	*Lemna*	*disperma*	Duckweed		x
Araceae	**Zantedeschia*	*aethiopica*	Arum lily		x
Amaryllidaceae	**Narcissus*	*tazetta*	Jonquil	x	
Asphodelaceae	**Trachyandra*	*divaricata*	Strapweed	x	x
Typhaceae	**Typha*	*orientalis*			x
Juncaceae	*Juncus*	*pallidus*	Pale rush		x
Cyperaceae	*Gahnia*	*trifida*	Coast saw sedge		x
Cyperaceae	*Lepidosperma*	*gladiatum*	Coast sword sedge		x
Anarthriaceae	*Lyginia*	sp.			x
Poaceae	**Cynodon*	*dactylon*	Couch	x	x
Poaceae	**Pennisetum*	*clandestinum*	Kikuyu	x	x
Poaceae	*Spp.*			x	x
Proteaceae	*Xylomelum*	*occidentale*	Woody pear	x	
Dilleniaceae	*Hibbertia*	*cuneiformis*		x	x
Fabaceae	*Acacia*	*saligna*	Orange wattle	x	x
Fabaceae	*Acacia*	*cyclops*	Coastal wattle	x	x
Fabaceae	*Jacksonia*	*furcellata*	Grey stinkwood	x	
Fabaceae	**Lupinus*	sp.	Lupins	x	x
Fabaceae	**Trifolium*	sp.		x	x
Fabaceae	*Viminaria*	*juncea*	Swish bush		x
Oxalidaceae	**Oxalis*	*pes-caprae*	Sour grass	x	x
Oxalidaceae	**Oxalis*	*purpurea*		x	x
Myrtaceae	*Agonis*	*flexuosa*	Peppermint	x	x
Myrtaceae	**Eucalyptus*	*saligna*	Blue gum	x	
Myrtaceae	*Eucalyptus*	*rudis*	Flooded gum	x	x
Myrtaceae	*Eucalyptus*	*gomphocephala*	Tuart	x	
Myrtaceae	*Melaleuca*	*rhaphiophylla*	Swamp paperpark		x
Malvaceae	**Malva*	sp.		x	x
Chenopodiaceae	*Rhagodia*	*baccata*	Berry saltbush	x	x
Solanaceae	**Solanum*	*americanum*	Glossy nightshade		x
Asteraceae	**Arctotheca*	*calendula*	Capeweed	x	x
Asteraceae	**Cotula*	*turbinata*	Funnel weed	x	x
Asteraceae	**Hypochaeris*	sp.		x	x
Asteraceae	**Sonchus*	*oleraceus*	Sowthistle		x

Following species were identified in the Old Yard:	
Acacia	*baileyana*
Callistemon	*sp.*
Cypress	*sp.*
Eucalyptus	*citriodora*
Eucalyptus	*saligna*
Ficus	*sp.*
Melaleuca	*nesophila*

APPENDIX 2:
QUADRAT DATA

QUADRAT 1

Location: Sumpland

GPS: 369143/6298385 (MGA94, Zone 50)

Size: 20 by 40 metres along the sumpland

Soil: Black sandy soil with a lot of organic material.

Vegetation Condition: Degraded

Comments: Signs of fire (estimate more than 10 years ago), clearing and grazing has removed understorey, evidence of kangaroo grazing.

Vegetation Description: Dense low forest of *Melaleuca rhaphiophylla* and *Eucalyptus rudis* over scrub of *Viminaria juncea* over introduced grasses.

Genus	Species	Height (m)	% Cover
Acacia	*saligna*	2.0	+
Agonis	*flexuosa*	2.0	+
**Cynodon*	*dactylon*	0.15	+
Eucalyptus	*rudis*	10.0	10
Gahnia	*trifida*	1.5	+
Hibbertia	*cuneiformis*	1.3	+
Lepidosperma	*gladiatum*	1.5	+
Melaleuca	*rhaphiophylla*	12	70
**Oxalis*	*pes-caprae*	0.2	+
**Pennisetum*	*clandestinum*	0.15	+
Rhagodia	*baccata*	1.0	+
**Solanum*	*americanum*	0.4	+
**Sonchus*	*oleraceus*	0.2	+
Viminaria	*juncea*	3.0	15
**Zantedeschia*	*aethiopica*	0.2	+
Other introduced grasses		<0.2	90

QUADRAT 2

Location: Sumpland

GPS: 369262 / 6298507 (MGA94, Zone 50)

Size: 20 by 40 metres along the sumpland

Soil: Black sandy soil with a lot of organic material.

Vegetation Condition: Degraded

Comments: No signs of fire, clearing and grazing has removed understorey, evidence of kangaroo grazing.

Vegetation Description: Dense low forest of *Melaleuca rhaphiophylla* and *Eucalyptus rudis* over scrub of *Viminaria juncea* and *Agonis flexuosa* over introduced grasses.

Genus	Species	Height (m)	% Cover
Acacia	*saligna*	2.3	+
Agonis	*flexuosa*	5.0	10
**Cynodon*	*dactylon*	0.15	+
Eucalyptus	*rudis*	12.0	5
Gahnia	*trifida*	1.2	+
Hibbertia	*cuneiformis*	1.0	+
Hypochaeris	*sp.*	0.2	+
Juncus	*pallidus*	1.3	+
Lepidosperma	*gladiatum*	1.5	+
Melaleuca	*rhaphiophylla*	12	70
**Pennisetum*	*clandestinum*	0.15	+
Rhagodia	*baccata*	0.5	+
**Solanum*	*americanum*	0.3	+
Viminaria	*juncea*	3.0	10
**Zantedeschia*	*aethiopica*	0.15	+
Other introduced grasses		<0.2	90

APPENDIX 3:
DECLARED PLANT CATEGORIES

Appendix 3: Definition of Standard Control Codes for Declared Plant Species in Western Australia (Department of Agriculture and Food 2010)

Control Codes	Conditions
P1 Prohibits movement	The movement of plants or their seeds is prohibited within the State. This prohibits the movement of contaminated machinery and produce including livestock and fodder.
P2 Aim is to eradicate infestation	Treat all plants to destroy and prevent propagation each year until no plants remain. The infested area must be managed in such a way that prevents the spread of seed or plant parts on or in livestock, fodder, grain, vehicles and/or machinery.
P3 Aims to control infestation by reducing area and/or density of infestation	The infested area must be managed in such a way that prevents the spread of seed or plant parts within and from the property on or in livestock, fodder, grain, vehicles and/or machinery. Treat to destroy and prevent seed set all plants:- • Within 100 metres inside of the boundaries of the infestation • within 50 metres of roads and highwater mark on waterways • within 50 metres of sheds, stock yards and houses • Treatment must be done prior to seed set each year. Of the remaining infested area:- • Where plant density is 1-10 per hectare treat 100% of infestation. • Where plant density is 11-100 per hectare treat 50% of infestation. • Where plant density is 101-1000 per hectare treat 10% of infestation. • Properties with less than 2 hectares of infestation must treat the entire infestation. Additional areas may be ordered to be treated.
P4 Aims to prevent infestation spreading beyond existing boundaries of infestation.	The infested area must be managed in such a way that prevents the spread of seed or plant parts within and from the property on or in livestock, fodder, grain, vehicles and/or machinery. Treat to destroy and prevent seed set all plants:- • within 100 metres inside of the boundaries of the infested property • within 50 metres of roads and highwater mark on waterways • within 50 metres of sheds, stock yards and houses Treatment must be done prior to seed set each year. Properties with less than 2 hectares of infestation must treat the entire infestation. Additional areas may be ordered to be treated.
Special considerations	In the case of P4 infestations where they continue across property boundaries there is no requirement to treat the relevant part of the property boundaries as long as the boundaries of the infestation as a whole are treated. There must be agreement between neighbours in relation to the treatment of these areas.