

Final Report

Conservation Management Plan: Rosenthal Estate

100 Vineyard Road, Sunbury, Victoria

Prepared for

Urban Design and Management Pty Ltd

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Ecology and Heritage Partners Pty Ltd

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GLOSSARY

Acronym	Description
AVW	Atlas of Victorian Wildlife
CaLP	<i>Catchment and Land Protection Act 1994</i>
CEMP	Construction Environmental Management Plan
CMA	Catchment Management Authority
CMP	Conservation Management Plan
DBH	Diameter at Breast Height
DTV	Degraded Treeless Vegetation
DEPI	Victorian Department of Environment and Primary Industries
DELWP	Victorian Government Department of Environment, Land, Water and Planning
DoE	Federal Department of Environment (former Department of Sustainability, Environment, Water, Population and Communities)
DTPLI	Victorian Department of Transport, Planning and Linear Infrastructure (former Department of Planning and Community Development)
EES	Environment Effects Statement
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
EVC	Ecological Vegetation Class
FFG Act	<i>Flora and Fauna Guarantee Act 1988</i>
FIS	Flora Information System
HabHa	Habitat Hectare
LOT	Large Old Tree
MinTV	Minor Treeless Vegetation
ModTV	Modified Treeless Vegetation
MOT	Medium Old Tree
NES	National Environmental Significance
NVIM Tool	Native Vegetation Information Management Tool (DEPI)
PMST	Protected Matters Search Tool (DoE)
ST	Small Tree
TRZ	Tree Retention Zone
VBA	Victorian Biodiversity Atlas (DEPI)
VLOT	Very Large Old Tree

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1 INTRODUCTION

1.1 Background

Ecology and Heritage Partners Pty Ltd was commissioned by Urban Design and Management Pty Ltd to develop a Conservation Management Plan (CMP) for the proposed *in-situ* conservation reserves and open spaces within the approved development area of the future Rosenthal Estate located at 100 Vineyard Road, Sunbury, Victoria (i.e. the study area) (Figure 1).

The CMP is designed to address matters relating to the management of retained native vegetation and fauna habitat in the context of the ongoing development of Rosenthal Estate. A separate Offset Management Plan (OMP) has also been prepared to address the compensatory requirements and necessary management actions to offset the approved impacts and removal of both native vegetation and fauna habitat associated with the development of Rosenthal Estate.

A series of ecological assessments and targeted surveys have previously been undertaken within the study area to inform the various planning phases of this project and the current development plan (Urban Design and Management, Plan Ref: 11031_DP-PP Rev. C, Dated 3 December 2014). Relevant reports include:

- Wlodarczyk, P. & Williams, L. (2005a). *A Botanical Assessment and Habitat Significance of 100 4Vineyard Rd*, City of Hume;
- Wlodarczyk, P. & Williams, L. (2005b). *A Short Report into the Habitat Hectare Value and Net Gain Analysis of Habitat Zone PG4*;
- Wlodarczyk, P. & Williams, L. (2005c). *Addendum 2: A botanical assessment and habitat significance of 100 Vineyard road*, City of Hume;
- Wlodarczyk, P. & Williams, L. (2006). *Brief Report: Presence of Synemon plana (Golden Sun Moth) at 100 Vineyard Rd Sunbury*;
- Wlodarczyk, P., Williams, L. & Hatt, T. (2007). *Targeted Fauna Search Delma impar – Striped Legless Lizard, 100 Vineyard Rd Sunbury*;
- Wlodarczyk, P. & Hatt, T. (2008). *Flora and of Habitat Hectare Assessment for the area of the Retarding Basin - 100 Vineyard Road*;
- Wlodarczyk, P., Hatt, T. & Richards, J. (2008). *Second Report: Presence & Density of Synemon plana (Golden Sun Moth) at 100 Vineyard Rd Sunbury* (Amended August 2008);
- Wlodarczyk, P. & Richards, J. (2009a). *Abundance and Distribution of the Golden Sun Moth Synemon plana at 100 Vineyard Road, Sunbury*;
- Wlodarczyk, P. & Richards, J. (2009b). *Survey for the Presence of Striped Legless Lizard Delma impar - 100 Vineyard Rd Sunbury*;
- Wlodarczyk, P. & Richards, J. (2009c). *Presence of the Growling Grass Frog Litoria raniformis 100 Vineyard Rd Sunbury*;
- Richards, J. & Wlodarczyk, P. (2009). *Flora Assessment- 100 Vineyard Road*;
- Richards, J. & Wlodarczyk, P. (2010). *Habitat Hectare Assessment of Non-ploughed Vegetation - 100 Vineyard Road, Sunbury*;

- Brett Lane and Associates Pty Ltd (2011). *100 Vineyard Road Sunbury. Suitability of Habitat for Grassland Earless Dragon*;
- Ecology and Heritage Partners Pty Ltd (2014). *Net Gain review of a previous habitat hectare assessment of land at Vineyard Road, Sunbury, Victoria*; and,
- Ecology and Heritage Partners Pty Ltd (2015a). *Targeted Surveys for Golden Sun Moth, 100 Vineyard Road, Sunbury, Victoria*.

The following matters of ecological significance have previously been identified within the study area:

- One fauna species listed as Critically Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act): Golden Sun Moth *Synemon plana*;
- One significant ecological community listed under the EPBC Act: Natural Temperate Grassland of the Victorian Volcanic Plain (NTGVVP)¹;
- Two remnant ecological vegetation classes (EVCs) both with a Bioregional Conservation Status of Endangered within the Victorian Volcanic Plain: Plains Grassland (EVC 132_61) and Creekline Tussock Grassland (EVC 654); and,
- Eight remnant scattered indigenous trees (River Red-gum *Eucalyptus camaldulensis*).

Patches of remnant vegetation approved to be impacted by the proposed development and areas to be retained in two conservation reserves are shown in Figure 2 and summarised in Table 1. Areas of retention and removal are based on the approved Rosenthal Estate Development Plan (Plan Ref: 11031_DP-PP Rev. C, Dated 3 December 2014).

Table 1. Matters of ecological significance

Matter of Ecological Significance	Total amount within study area	Area proposed for removal	Area retained in western reserve	Area retained in eastern reserve
Golden Sun Moth habitat	54.91 hectares	42.27 hectares	11.17 hectares	1.47 hectares
Plains Grassland	26.34 hectares	16.18 hectares	8.95 hectares	1.21 hectares
Creekline Tussock Grassland	2.53 hectares	2.53 hectares	0 hectares	0 hectares
Scattered Indigenous Trees	8 trees	0 trees	8 trees to be retained in passive open space adjacent to western conservation reserve (Figure 2)	

Based on the significant impact thresholds specified in the Significant Impact Guidelines for the Critically Endangered Golden Sun Moth *Synemon plana* (DEWHA 2009), it was determined that the development footprint of the study area will have a significant impact on this matter of national environmental significance (NES). As such, an EPBC Act referral was submitted to the federal Department of Environment (DoE) (formerly the Department of Sustainability, Environment, Water, Population and Communities [SEWPaC]) on 21 April 2008 (EPBC 2008/4214). On 11 July 2008, DoE advised that the proposal had been

¹ Note: the majority of Plains Grassland patches also qualify as the EPBC Act listed ecological community *Natural Temperate Grassland of the Victorian Volcanic Plain* (NTGVVP). The former Department of Environment, Water Heritage and the Arts (DEWHA – now known as the Department of Environment [DoE]) have previously issued a formal response that all NTGVVP areas to be removed as part of the development of Rosenthal Estate are exempt from offset requirements. However, areas of NTGVVP avoided and retained within the proposed conservation reserves are still required to be protected and managed under the CMP and associated *in-situ* Offset Management Plan, in a manner that maintains the quality of vegetation above the condition thresholds for the nationally listed community.

considered as a 'controlled action', and would be assessed by Preliminary Documentation. An approval decision notice was issued to the proponent on 2 July 2014.

1.2 Study Area

The study area is located approximately 40 kilometres north-west of the Melbourne CBD. The entire property is a U-shaped parcel of land that encompasses the area bound by Mitchells Lane to the north, Vineyard Road to the east, farmland to the south and medium density residential housing to the west (Figure 1). Medium density housing and a large recreation reserve/oval is also present between the northern arms of the property. The site is approximately 119 hectares in size.

The study area slopes from north to south with several steep gullies and rises. A man-made dam occurs in the north-west portion of the study area, connected via an ephemeral drainage line to Harpers Creek which dissects the property from east to west and eventually flows into Jacksons Creek, approximately two kilometres east of the study area. Vegetation throughout the study area ranges from poor to good condition. A relatively high cover of native grasses is present throughout much of the site, however, the diversity of native herbaceous species is generally poor and high threat weeds such as Chilean Needle-grass *Nassella neesiana* are prevalent throughout the entire site. Ecological Vegetation Classes (EVCs) recently documented include *Heavier Soils - Plains Grassland* (EVC 132_61) and *Creekline Tussock Grassland* (EVC 654) (Figure 2) (Ecology and Heritage Partners Pty Ltd 2013). Two patches of Modified Treeless Vegetation (ModTV) are also present within the north-eastern arm of the study area (Figure 2).

According to the Department of Environment, Land, Water and Planning (DELWP) Biodiversity Interactive Map (DELWP 2015), the study area is located within the Victorian Volcanic Plains (VVP) bioregion, and is closely bordered by the Central Victorian Uplands (CVU) bioregion to the north and west. The study area is currently zoned General Residential Zone – Schedule 1 (GRZ1) and the entire site is covered by a Development Plan Overlay – Schedule 9 (DPO9) (DTPLI 2015). The study area occurs within the greater Urban Growth Boundary but does not occur in a proposed or approved Precinct Structure Plan (PSP) area.

1.3 Conservation Reserves and Open Spaces

Conservation Reserves are located in both the north-western and north-eastern arms of the study area (Figure 2). In total, the reserves cover approximately 12.64 hectares, of which approximately 10.16 hectares consists of high quality remnant Plains Grassland (EVC 132_61). The largest conservation reserve (11.17 hectares) is situated in the western arm of the study area and contains the highest quality vegetation. The eastern conservation reserve is 1.47 hectares in size. Both reserves currently support Golden Sun Moth and have been specifically designated as conservation reserves to retain and protect habitat for Golden Sun Moth, as well as to avoid and minimise impacts to remnant patches of Plains Grassland (Figure 2). Throughout this report the two conservation reserves will be referred to as the 'Western' and 'Eastern' conservation reserves.

It is important to note that the alignment of two existing sewerage easements intersect with the western conservation reserve (Figure 2). Both easements are managed by Western Water. The north-south easement that intersects the eastern boundary of the conservation reserve will ultimately be realigned within Elizabeth Drive and the existing sewer will be decommissioned with no disturbance to the

conservation area. The east-west easement within the southern half of the western conservation reserve will be retained in its current position. Western Water has advised that removal or disturbance of native vegetation is unlikely to be required in order to maintain the east-west sewer, as any works can be achieved through existing inspection points/manholes. However, as the water authority cannot give a long-term guarantee that ground disturbance will not be required at some point in the future, the total area of the easement (approximately 0.11 hectares) will be considered as effectively lost and accounted for within the final offset target for Rosenthal Estate (see Offset Management Plan, Ecology and Heritage Partners Pty Ltd 2015b).

The Rosenthal Estate Development Plan also contains five zones proposed for use as open space (Figures 2 & 3). With exception of open space reserve two, which adjoins directly to the western conservation reserve, all of the open space reserves are discrete areas that will be separated from one another by the future development of the estate. Open space reserves will require a different management strategy to the two conservation reserves, especially Harpers Creek drainage reserve, which is listed on the development plan as a 'linear open space vegetated pedestrian link'.

1.4 Objectives

The objective of the CMP is to provide a framework for management of the proposed conservation areas in order to maintain and enhance or improve the viability of Golden Sun Moth populations and their habitat, as well as protect remnant vegetation (Plains Grassland) within the reserves. Specifically, the objectives of the CMP are to:

- Protect, improve and maintain retained areas of Golden Sun Moth habitat;
- Ensure that management objectives also consider the maintenance and improvement of both Plains Grassland and Natural Temperate Grassland of the Victorian Volcanic Plain where applicable;
- Ensure the ongoing protection of scattered trees adjacent to the western conservation reserve;
- Ensure that management objectives and actions also consider the habitat requirements of additional threatened species relevant to the local region, including Growling Grass Frog and Striped Legless Lizard; and,
- Provide management guidance for the open space reserves.

2 SITE CONTEXT

2.1 Flora and Fauna

A total of 77 flora species have previously been recorded within the study area (Richards, J. & Wlodarczyk 2009).

As far as we can determine there has never been a general assessment of all fauna species associated with the study area. However, surveys have been conducted for a range of significant fauna species throughout the study area over many years including Golden Sun Moth, Growling Grass Frog *Litoria raniformis*, Striped Legless Lizard *Delma impar* and Grassland Earless Dragon *Tympanocryptis pinguicolla* (Wlodarczyk, P. & Williams, L. 2006; Wlodarczyk, P., Williams, L. & Hatt, T. 2007; Wlodarczyk, P., Hatt, T. & Richards, J. 2008; Wlodarczyk, P. & Richards, J. 2009a; Wlodarczyk, P. & Richards, J. 2009b; Wlodarczyk, P. & Richards, J. 2009c; Ecology and Heritage Partners Pty Ltd 2015a).

2.1.1 Significant Flora Species

Despite the presence of suitable habitat, no Nationally significant flora species have been recorded from the study area (Richards, J. & Wlodarczyk 2009), however, one State significant grass species, Rye Beetle-grass *Tripogon loliiformis*, listed as rare under the Advisory List of Rare or Threatened Plants in Victoria (DSE 2005) was incidentally recorded during the Net Gain review assessment (Ecology and Heritage Partners Pty Ltd 2013).

2.1.2 Significant Fauna Species

One nationally significant fauna species, Golden Sun Moth, has consistently been identified within the study area over a ten year period (Wlodarczyk, P. & Williams, L. 2006; Wlodarczyk, P., Hatt, T. & Richards, J. 2007; Wlodarczyk, P. & Richards, J. 2009a; Ecology and Heritage Partners Pty Ltd 2015a).

Golden Sun Moth was first identified at 100 Vineyard Road, Sunbury in December 2005 (Wlodarczyk, P. & Williams, L. 2006), with five moths detected during a brief 'observational survey' over one day.

A second 'observational survey' was undertaken in December 2007. Three small areas were assessed over two consecutive days, with the presence of Golden Sun Moth confirmed within the property. The number of individuals recorded in each area is not stated within the report (Wlodarczyk, P., Hatt, T. & Richards, J. 2008).

A more formalised targeted survey for Golden Sun Moth was conducted over four days in November and December 2008, which identified a large number of individuals across both the eastern and western paddocks (Wlodarczyk, P. and Richards, J. 2009a). A total of 2,451 moths were recorded: 1,323 in the eastern arm of the site and 1,128 in the western arm.

Further targeted surveys for Golden Sun Moth over the 2014-2015 flying season confirmed that the species has persisted across the northern portion of the site, recording a total of 363 individuals over a four day survey period (Ecology and Heritage Partners Pty Ltd 2015a).

Targeted surveys for all other significant fauna species including Growling Grass Frog, Grassland Earless Dragon and Striped Legless Lizard failed to detect these species despite the presence of suitable habitat

(surface and embedded rock, soil cracking, tussock-grasses and inter-tussock spaces etc) throughout the study area (Wlodarczyk, P. & Richards, J. 2009b; 2009c; Brett Lane and Associates Pty Ltd 2011).

2.1.2.1 Golden Sun Moth

EPBC Act Conservation Status: Critically Endangered

FFG Act Conservation Status: Listed

DEPI Advisory List: Endangered



Plate 1: Golden Sun Moth (Ecology and Heritage Partners Pty Ltd)

The Golden Sun Moth typically occurs in native grassland, grassy woodland, dominated by greater than 40% cover of wallaby-grass, in particular *Rytidosperma* spp. (DSE 2004), but may also inhabit areas dominated by Kangaroo Grass *Themeda triandra* (Endersby and Koehler 2006) and introduced grassland dominated by Chilean Needle-grass *Nassella neesiana* and other introduced species (A. Organ pers. obs.). Male flight is typically low, to about a metre above the ground, fast and can be prolonged, but they are generally not recorded flying more than 100 metres from suitable habitat (Clarke and O'Dwyer 1999).

Prior to European settlement, the Golden Sun Moth was widespread and relatively continuous throughout its range, inhabiting grassy open woodlands and grassland, although it now mainly inhabits small isolated sites (DSE 2004). The species is threatened by habitat loss, disturbance and fragmentation due to agricultural expansion and urbanisation. Many populations are isolated and fragmented, impeding the ability of the relatively immobile females to recolonise areas, thereby reducing the likelihood of genetic exchange (DSE 2004). Such populations are therefore vulnerable as there is little likelihood of recolonisation in the event of a local extinction.

2.2 Matters for Consideration

Both the western and eastern conservation reserves consist primarily of Very High conservation significance Plains Grassland: referred to as Management Zone A (Figure 2). However, both reserves also contain discrete areas that do not meet the condition thresholds to qualify as either a remnant patch or Modified Treeless Vegetation: referred to as Management Zone B (Figure 2). Relevant matters are discussed in further detail below.

2.2.1 Plains Grassland

Patches of Plains Grassland are in good condition and typically contain a wide variety of native grasses, including Wallaby-grasses *Rytidosperma* spp., Spear-grasses *Austrostipa* spp., Windmill Grass *Chloris truncata*, Australian Wheat-grass *Anthosacne scabra*, Weeping Grass *Microlaena stipoides* var. *stipoides* and Kangaroo Grass *Themeda triandra* (Plate 2). Very high quality patches of Plains Grassland such as PG4 (Figure 2) also contain a relatively high diversity of common herbaceous species such as Lemon Beauty-heads *Calocephalus citreus*, Berry Saltbush *Atriplex semibaccata*, Cotton Fireweed *Senecio quadridentatus* and Blue Devil *Eryngium ovinum*.

All areas of Plains Grassland currently provide critical habitat for the nationally listed Golden Sun Moth.



Plate 2: High quality Plains Grassland within the study area

2.2.2 Modified Treeless Vegetation

Two areas of Modified Treeless Vegetation (ModTV) are present within the eastern arm of the study area. Although these areas contain greater than 25% cover of native grasses, the diversity of native species is poor and essentially restricted to just one or two Wallaby-grasses that are not considered representative of the pre-1750 cohort, and scattered and embedded rock is absent suggesting the areas have previously been disturbed. These areas also contain a high cover of Chilean Needle-grass and Serrated Tussock *Nassella trichotoma*, which are both listed as Weeds of National Significance (WoNS). Areas of ModTV provide moderate habitat value for Golden Sun Moth and a range of common bird and reptile species. Areas of ModTV will be removed as part of the approved development plan for Rosenthal Estate.

2.2.3 Scattered Trees

Eight scattered indigenous River Red-gum trees occur immediately adjacent to the western conservation reserve within open space area two (Figure 2). These trees will not be protected within the western conservation reserve, as they are located within an area of future open space (Figure 3). The scattered trees are all semi-mature and provide important foraging and nesting habitat for common bird species such as Australian Magpie *Gymnorhina tibicen*. Very few large old trees are present within land parcels surrounding the study area, therefore the existing scattered River Red-gums likely act as important 'stepping stone' habitats for mobile fauna species moving through the local region.

2.2.4 Introduced Grassland

Both conservation reserves contain discrete areas that do not qualify as either a remnant patch or Modified Treeless Vegetation, referred to as Management Zone B within each reserve (Figure 2). These zones are dominated by introduced grasses and herbaceous weeds and contain a high cover of two Weeds of National Significance (WoNS): Chilean Needle-grass and Serrated Tussock (Plate 4).

Introduced grassland is typically defined as having low habitat value and used only by species adapted to modified environments or for dispersal opportunities. However, these areas also currently support Golden

Sun Moth, as the dominant flora species (Chilean Needle-grass) is a known food source for Golden Sun Moth larvae (Ecology and Heritage Partners Pty Ltd 2015a).



Plate 4: Introduced grassland dominated by Chilean Needle-grass

3 MANAGEMENT PLAN

The following report section presents the actions required to implement the management strategy for Golden Sun Moth habitat, Plains Grassland and or Natural Temperate Grassland of the Victorian Volcanic Plain (NTGVVP), as well as scattered trees within the conservation reserves and future open spaces. The two conservation reserves are to be secured and managed for conservation purposes in perpetuity. It is understood that the conservation reserves will eventually be vested to the City of Hume for ongoing management.

It should be highlighted that management actions may not always be straight forward due to the somewhat conflicting ecology and legislative requirements for both the nationally significant Golden Sun Moth and the Weed of National Significance (WoNS), Chilean Needle-grass. Given that Golden Sun Moth is known to use Chilean Needle-grass as a food source, a potential conflict exists between the legislative requirements to manage a nationally significant species under the EPBC Act, and the need to remove or control a WoNS under the *Catchment and Land Protection Act 1994* (CaLP).

In combatting Chilean Needle-grass, it should be recognised that there may be potential impacts to the existing Golden Sun Moth population and that management actions must be conducted in a phased approach, whereby only small sections of the conservation reserve are treated at any one time (e.g. mosaic burns). Adaptive, flexible and to some degree experimental management, will therefore play a critical role in the ongoing success of the conservation reserves and the maintenance of the existing Golden Sun Moth population.

While the basis of this plan focuses on the preservation, maintenance and improvement of Plains Grassland/NTGVVP, primarily as habitat for Golden Sun Moth, the plan also acknowledges that the recommended management actions will be beneficial for additional threatened species such as Striped Legless Lizard, despite previous targeted surveys failing to detect the species within the study area.

3.1 Security Arrangements

The proposed conservation reserves will be protected via the establishment of an on-title agreement (such as a Section 173 agreement with Council) to ensure they are secured and managed appropriately in perpetuity. The agreement for each reserve is to be implemented and the reserves secured prior to commencement of construction activities within each of the respective precincts (i.e. the Rosenthal Estate North-west and North-east Precincts) (Figure 3). As there are no nominated conservation reserves south of Harpers Creek, a security agreement is not required for the Rosenthal Estate Southern Precinct in which development has already commenced.

3.2 Management Actions

Management actions described below are to be implemented for a mandatory period of 10 years. Following this period, the responsible authority will continue to manage the conservation reserve after the completion of year 10 as specified in this plan, such that:

- Habitat is maintained in a condition suitable for Golden Sun Moth;
- The condition thresholds for both Plains Grassland and Natural Temperate Grassland of the Victorian Volcanic Plain are maintained or improved;
- Scattered indigenous trees are protected and scope is provided for natural recruitment of additional trees;
- Weed cover is managed in perpetuity to ensure it does not increase beyond the level attained at year 10 of management; and,
- Any proposed uses or development of the site which conflict with the landowner commitments are not permitted under this plan.

3.2.1 Mitigation Measures during Construction

All construction activities (i.e. civil works such as site scraping and cleaning) are to be strictly prevented within each conservation reserve, to avoid direct or indirect impacts. A series of mitigation measures will be implemented prior to and during the construction phase for each stage (precinct) of the proposed development to ensure that construction activities do not impact on environmental values within the conservation reserves or in surrounding areas, and that appropriate environmental protection measures are implemented during construction works.

At a minimum, the following measures will be undertaken prior to commencement of construction:

- Erect temporary fencing around each of the conservation reserves. Fencing is to be constructed with minimal impact to the conservation reserves (i.e. no materials or soil stock piling), and where possible, avoiding areas where there are large amounts of surface rock, significant flora species and remnant vegetation. Protective fencing will remain in place for the duration of construction or until replaced by permanent fencing (Section 3.2.2);
- Fencing of the conservation areas must be completed and clearly designated as a “no go or no construction zones”, prior to any construction or development activities reaching within 50 metres of any part of the conservation reserve; and,
- Interpretive and educational signs will be placed around the reserve to highlight the importance of the conservation reserve. Fence and signage condition will be monitored during each site visit with any gaps or holes repaired immediately (Section 3.2.7).

In addition to the above matters, a Construction Environment Management Plan, or equivalent (to be approved by Hume City Council) will be prepared to ensure impacts to the conservation reserve during the construction phase are avoided. The plan will include (but not be limited to):

- Environmental site induction to inform contractors of the environmental values present on site and the importance of protecting these areas;
- Controlling weeds and pathogens and preventing further introduction of weeds during the construction phase;
- Pest animal management;
- Wash down areas;

- Erosion and sedimentation control;
- Fuel and chemical storage;
- Fire management; and,
- Noise management.

3.2.2 Access Control and Perimeter Fencing

Without active management and appropriate fencing, unrestricted access into the conservation reserve by vehicles and machinery may result in loss of native vegetation cover, soil disturbance and compaction, weed facilitation and rubbish dumping. As such, permanent fencing with controlled access points will eventually be required to protect the conservation reserves.

Perimeter landscaping will be accommodated within a four metre buffer zone established around each reserve to ensure that the interfaces are neat and resilient to edge effects, such as weed establishment and rubbish. The buffer zones are also intended to provide a fire break around each reserve that may be regularly slashed and bolster public confidence that the reserves will not be regarded as a future safety hazard. Buffer zones will consist of a one metre strip of Tuscan topplings at the immediate interface of each conservation reserve, followed by a three metre grass nature strip facing into the future roadway (Appendix 1: Biodiversity Area Interface Plan – Thompson Berrill Landscape Design Pty Ltd, Dated 8 August 2014).

Access control will proceed in accordance with the following measures:

- Erect permanent fences around the conservation reserves with multiple access gates for maintenance works and emergency access. Fences should be constructed with minimal impact to the conservation reserves (i.e. no materials or soil stock piling), and where possible, avoiding areas where there are large amounts of surface rock, significant flora species and stony knolls;
- Excess augured soil from the construction of fences will be removed and disturbed areas will be re-sown with locally sourced indigenous grasses.
- The proposed fencing design for the conservation reserves (Appendix 1) was approved by the former Department of Environment and Primary Industries (DEPI) on 29 September 2014 (L. Surace email correspondence). The fencing design comprises 125 x 125mm charcoal coloured, solid recycled plastic square posts set at 5 metre intervals with a single wire strand at the top. Posts at every 25 metre interval will be 145 x 145mm and contain an additional icon signifying the area as a conservation reserve (Appendix 1);
- Interpretive and educational signs will be placed around the conservation reserves to highlight their importance and the significance of Golden Sun Moth within the local region (see Section 3.2.8); and,
- The condition of fencing, signage and all other built infrastructure will be monitored during each site visit with any damage, gaps or holes repaired immediately.

Perimeter interfaces around the conservation reserves will be constructed considering the following measures:

- Perimeter buffers are to be located outside the designated GSM conservation reserves and include an additional mown firebreak where possible between any footpaths and roads (see Appendix 1);

- Only indigenous and/or native plants, or those already approved within the current interface plan are to be used within buffer zones;
- Where proposed, buffer plantings within open spaces should ideally be fire retardant, non-invasive and relatively low to prevent shading of conservation reserves, or the creation of hidden areas for the dumping of rubbish;
- Tuscan toppings will be utilised on the immediate reserve interfaces to suppress weed growth (Appendix 1).

3.2.3 Biomass Control

Biomass control or reduction is essential for protection against unwanted or excessively hot grassland fires, and for the maintenance of flora and fauna values. Species such as Golden Sun Moth require open-structured grassland with inter-tussock spaces.

Biomass reduction over recent history has been achieved throughout the study area via the grazing of cattle, as well as slashing and baling. It is unlikely that grazing will be considered appropriate for future biomass control upon commencement of construction in both north-east and north-west precincts, therefore adaptive management regimes (such as slashing and burning) will be employed to reduce biomass. Prescribed burns are the preferred biomass control method, however, slashing and baling of biomass in non-rocky sections inside the conservation areas may provide an alternative biomass control method, where burning is not considered safe or applicable under the prevailing conditions.

Careful consideration will need to be given to all biomass control methods, as management actions are constrained by the presence of Golden Sun Moth. In order to avoid impacting Golden Sun Moth in either the larval or emergent stage, prescribed burns and other biomass control methods would need to be conducted outside of the normal activity period for Golden Sun Moth (generally October to January) and in a manner that will not adversely impact the species.

A key part of biomass control in the long-term will also include the gradual replacement of tall, high fuel-load exotic grasses such as Toowoomba Canary-grass and Chilean Needle-grass, with smaller, low fuel-load indigenous species such as Wallaby-grasses.

The following principles should be considered with regard to biomass control:

- Develop a burn plan that includes consideration of nearby properties and landholders and submit for approval by DELWP and the City of Hume;
- Evaluate the need for biomass control on an annual basis;
- For safety reasons any prescribed burns must be conducted in calm and cool weather conditions only; and,
- Burns are only to be conducted greater than one month prior to the Golden Sun Moth flying season (typically October to January) or at least six weeks after the end of the flying season to prevent impacts to any eggs that may have been oviposited on grass tussocks. Cool autumn burns are therefore recommended, however it may also be possible to conduct burns in early spring. Ultimately, the timing of prescribed burns will be informed on an annual basis by prevailing

environmental conditions such as the amount of rainfall and fuel loads, and the results of monitoring surveys.

Where possible, in addition to biomass control within the reserves, the perimeter interface surrounding the conservation reserves should also contain a designated firebreak that can be readily accessed and slashed to complement the interface treatments and property setbacks.

3.2.4 Weed Control

Weed control activities will be strategically employed to gradually competitively replace non-native species with a range of indigenous species. Weed control efforts will include all reserves and open spaces. With regard to the conservation reserves, weed control and revegetation efforts will initially focus on Management Zone B within each reserve, as these areas are dominated by a very high cover of introduced grasses. Information pertaining to revegetation efforts is detailed in Section 3.2.5.

Prior to the commencement of control works, a weed survey should be conducted to map the cover and distribution of key introduced species throughout each reserve. This information will provide baseline data to be used as a benchmark for the evaluation of improvement or success within each reserve/open space area over time.

The following general guidelines should be taken as basic management principles in regards to weed control:

- Weed control methodology for eradicating graminoid and herbaceous weeds will consist of manual removal and/or spot spraying weeds with an appropriate herbicide. Care should be taken when spraying herbicide to ensure that the action does not affect native vegetation in the local application area. Weed species should be treated before seed is set, which may involve localised slashing if spot-spraying proves ineffective. A dye should be used in the spray to mark where the spraying has occurred;
- Selective herbicide application is preferable to broad area application, although the loss of non-target species needs to be balanced with the threat of incomplete control of the existing weed cover. Broad scale herbicide application may be appropriate in Management Zone B of each reserve. However, the profile of these areas is also very steep, therefore any sudden decrease in biomass may result in unwanted erosion or slumping. Golden Sun Moth may also reside within Management Zone B of each reserve; and,
- Eliminate woody weeds throughout all reserves and open spaces;
- Eliminate high threat environmental weeds (cover reduced to <1%) within areas of higher quality native vegetation that currently support low weed cover, and controlling high threat environmental weeds within areas native vegetation currently containing a medium cover of weeds (cover reduced to <5%);
- Control all other weeds to a cover of <5%;
- Weed control is to be conducted outside of the normal active period for Golden Sun Moth (November to February) to avoid any unexpected impacts affecting the entire Golden Sun Moth population at the same time. Where possible weed control efforts should consider selective application of herbicides only, as the effects of such chemicals on Golden Sun Moth larvae remain unknown;

- All weed control actions should be conducted in a manner that minimises soil disturbance;
- Where herbicide application is employed, waterway sensitive products and non-residual herbicides are to be employed;
- Pest plants that reproduce sexually (by seed) are best controlled before seed set. A summary of weed control protocols is provided in Table 2;
- To reduce the amount of herbicide used and increase effectiveness, target areas should be reduced (e.g. burnt or slashed) before application where possible, so that the herbicide can be more readily absorbed by the active growing plant parts; and,
- Weed control works should be monitored regularly to assess their effectiveness, and follow up works conducted to evaluate the feasibility of management objectives and the need for repeat treatment.

Table 2. Control protocols for key weed species recorded within the conservation areas and open space areas

Species	Weed Type	Treatment Methods	Timing of Treatment	Desired Outcome
<i>Acetosella vulgaris</i> Sheep Sorrel	Herbaceous	Annual Spraying (before seeding)	Early-mid Spring	C
<i>Agrostis capillaris</i> Brown-top Bent	Graminoid	Annual Spraying (before seeding)	Early-mid Spring	C
<i>Anthoxanthum odoratum</i> Sweet Vernal-grass	Graminoid	Annual Spraying (before seeding)	Early-mid Spring	C
<i>Avena barbata</i> Bearded Oat	Graminoid	Annual Spraying (before seeding)	Early-mid Spring	C
<i>Bromus</i> spp. Brome	Graminoid	Annual Spraying (before seeding)	Early-mid Spring	C
<i>Cirsium vulgare</i> Spear Thistle	Herbaceous	Manual Removal, Annual Spraying (before seeding)	Early-mid Spring	E
<i>Cynara cardunculus</i> Artichoke Thistle	Herbaceous	Manual Removal, Annual Spraying (before seeding)	Early-mid Spring	E
<i>Hypochoeris radicata</i> Flatweed	Herbaceous	Annual Spraying (before seeding)	Early-mid Spring	C
<i>Lolium perenne</i> Perennial Rye-grass	Graminoid	Annual Spraying (before seeding)	Early-mid Spring	C
<i>Lycium ferocissimum</i> African Boxthorn	Woody	Manual Removal, Spot Spraying, Cut and Paint	Remove before seeding autumn to winter	
<i>Lysimachia arvensis</i> Pimpernel	Herbaceous	Annual Spraying (before seeding)	Early-mid Spring	C
<i>Nassella neesiana</i> Chilean Needle-grass	Graminoid	Annual Spraying (before seeding)	Early-mid Spring	C
<i>Phalaris aquatica</i> Toowoomba Canary-grass	Graminoid	Annual Spraying (before seeding)	Early-mid Spring	C
<i>Plantago lanceolata</i> Ribwort	Herbaceous	Annual Spraying (before seeding)	Early-mid Spring	C
<i>Romulea rosea</i> Onion Grass	Herbaceous	Annual Spraying (before seeding)	Early-mid Spring	C
<i>Trifolium</i> spp. Clover	Herbaceous	Annual Spraying (before seeding)	Early-mid Spring	C

Notes: C = Control (<5% cover), E = Eliminate (<1% cover)

3.2.5 Revegetation, Supplementary Planting and Direct Seeding

3.2.5.1 Conservation reserves

The majority of Golden Sun Moth habitat present within the conservation reserves comprises high quality Plains Grassland with relatively low weed cover (Management Zone A; Figure 2). However, both reserves contain discrete areas dominated by introduced vegetation with a very high cover of Chilean Needle-grass and other high threat weeds (Management Zone B). Although Chilean Needle-grass forms part of the preferred diet for Golden Sun Moth, it is also a listed Weed of National Significance (WONS). This presents a management challenge for the conservation reserves as the extant Golden Sun Moth population must be protected in accord with the EPBC Act, while Chilean Needle-grass is required to be controlled or eliminated where possible in accord with the CaLP Act. As such, the overarching management strategy in all reserves is to progressively reduce and replace introduced grasses with native vegetation consistent with the surrounding EVC (i.e. Plains Grassland).

It is envisaged that localised revegetation and supplementary planting will be employed within the main, 'high quality' areas of each conservation reserve, where any weed control works result in bare areas and recruitment of native species from the seed bank is limited or outcompeted by recruitment of weed species. In contrast, alternative revegetation methods such as surface scraping and direct seeding, or thatching, may be considered within Management Zone B of each reserve, as these areas contain negligible native vegetation cover. However, the steepness of the landscape profile in Management Zone B of both reserves may be unsuitable for surface scraping and direct seeding proposals and all management actions must consider the timing of actions with regard to the ecology of Golden Sun Moth.

Revegetation and supplementary planting will proceed in accordance with the following aims:

- Areas to be revegetated typically require two years of site preparation before supplementary planting, thatching or direct seeding should commence. Site preparation will include burning, as well as selective/targeted herbicide application on at least two occasions per year (or as deemed necessary), with the aim of preventing weed species from setting seed. This process will aid in reducing weed seed banks and enhance the success of native grass recruitment via thatching or direct seeding;
- Where appropriate, supplementary planting and revegetation will be undertaken at a minimum of 20,000 plants per hectare or an agreed direct seeding rate;
- Revegetation efforts will focus on establishing native grasses to competitively replace pasture grasses and high threat weeds. Key species will include a range of wallaby-grasses that are known to provide suitable habitat and a food source for Golden Sun Moth and importantly are smaller with lower fuel loads. Other grasses may include Red-legged Grass *Bothriochloa macra*, spear-grasses *Austrostipa spp.* and Kangaroo Grass *Themeda triandra*. Once a sward of native grasses has been established, revegetation efforts may consider introducing other herbaceous species relevant to the Plains Grassland EVC to increase species diversity;
- Tubestock and seed will be of local provenance with species appropriate to the local EVC (i.e. Plains Grassland); and,

- All management activities will be conducted outside of the normal above-ground activity period for Golden Sun Moth (October to January) and no spraying of herbicides is to occur at least six weeks post flying season to prevent impacts to any Golden Sun Moth eggs that may be present. Given the management timing constraints imposed by the potential presence of Golden Sun Moth and assuming that management will also be constrained by wet conditions over the winter period, the available window for most management actions is likely to be restricted to autumn, early-winter and possibly early spring. Ultimately, the timing of actions will be informed on an annual basis by the prevailing environmental conditions.

3.2.5.2 Open space reserves

Open space reserve 1: Occurs on the western edge of the study area, and is designed to provide a continuation of Lillee Park within the existing residential area (Figure 2). Lillee Park currently consists of manicured lawns of introduced grasses and a variety of both native and introduced trees arranged in a circular pattern. It is proposed that the extension to Lillee Park is treated similarly through the planting of additional indigenous trees for added connectivity provision to scattered trees retained within Rosenthal Estate. The creation of additional lawn space suitable for passive recreation is recommended in line with existing conditions.

Open space reserve 2: Occurs on the north-eastern boundary of the western conservation reserve (Figure 2). This area is currently dominated by introduced grasses, especially Chilean Needle-grass, and contains eight scattered indigenous River Red-gum trees (Figure 2).

The consulting arborist report for Rosenthal Estate recommends that all of the trees in this area are weight reduced through the removal of deadwood to minimise the risk of branch or whole tree failure (Arboriculture Pty Ltd 2014). The report also recommends that infrastructure such as playground equipment, barbeques and picnic tables, are not placed within or around the canopy zone of these trees in order to minimise prolonged occupation beneath the trees.

In accordance with the arborist report, strategic landscaping between and around the base of each tree is recommended as a simple method to prevent occupation of the tree zones. It is therefore recommended that scattered River Red-gum trees within open space reserve 2 be mulched in an 'island' fashion and that plantings of local indigenous shrubs be incorporated within the drip zones and connecting areas between the scattered trees. The balance of the open space reserve can then be sown with grass species suitable for passive open space and regular slashing. Note: the capacity to slash or regularly mow grass cover within open space reserve 2 is critical given the direct nexus of the area to the western conservation reserve, as this will not only maintain a firebreak around the reserve but also prevent introduced grasses and weeds from producing seed and invading the conservation reserve.

Open space reserve 3: Occurs within the eastern arm of the study area, largely over an existing patch of Plains Grassland (PG1b; Figure 2). Although designated as future public open space, it is recommended that the cover of native grasses in this reserve is maintained and enhanced rather than converted to a typical landscaped lawn of Kikuyu *Cenchrus clandestinum* or Couch *Cynodon dactylon* var. *dactylon*. Retention of native grasses in this reserve, particularly low growing Wallaby-grasses, such as Kneed Wallaby-grass *Rytidosperma geniculatum* will provide additional refuge habitat for Golden Sun Moth, and can be easily managed with little fire risk via slashing.

Open space reserve 4: Occurs within the south central portion of the precinct. This area currently contains no native vegetation and has been cultivated with introduced pasture grasses for hay production for greater than 50 years. Golden Sun Moth has never been recorded within this section of the study area. The reserve will be highly isolated from all areas of remnant vegetation upon completion of the surrounding estate, and is therefore likely to provide only limited ecological value in the future.

Open space reserve 5: Open space reserve 5 relates to the entire Harpers Creek corridor (Figure 2). The Harpers Creek corridor is listed as a 'linear open space vegetated pedestrian link' within the approved Rosenthal Estate Development Plan (Plan Ref: 11031_DP-PP Rev. C, Dated 3 December 2014). Vegetation within Harpers Creek is currently highly modified and the system relatively degraded. Multiple uses and considerations are required for the Harpers Creek corridor, such as the inclusion of a shared path, picnic areas and seating, provision of additional vegetation and habitat to facilitate fauna movement, and capacity for flood mitigation such as a 1:100 year flood event. All of these considerations are outlined in the Harpers Creek Landscape Concept Plan for Rosenthal Estate (Thompson Berrill Landscape Design Pty Ltd, Dated 21 August 2014) (Appendix 2). The landscape plan for Harpers Creek will be realised in three stages.

The plan highlights that the majority of the creekline will be rehabilitated as 'low flow channel' with intermittent 'deep marsh and open water pools'. The plan indicates that all existing native trees will be retained where possible throughout the interface area of the creek corridor, along with a provision for the planting of a substantial number of additional trees and shrubs for both aesthetic purposes and to provide additional habitat and fauna dispersal opportunities. While the landscape plan also states that the existing creek channel will be rehabilitated, details regarding the selection of plant species, the desired structure and type of habitat produced are absent from the plan. It is recommended that a range of native species and lifeforms are incorporated into the immediate creekline to provide complex vegetation structure suitable for a wide range of fauna species. Revegetation within the creek line should include a diversity of floating, aquatic and emergent flora species appropriate as frog habitat, particularly the nationally-listed Growling Grass Frog *Litoria raniformis*, in order to potentially facilitate future movement of this species from Jacksons Creek (see Appendix 3 for recommended flora species).

3.2.6 Pest Animal Control

Few pest species have previously been recorded within the study area, however, European Rabbit *Oryctolagus cuniculus* and European Hare *Lepus europaeus* remain a threat for the regeneration/recruitment of many native species within the conservation reserves. Any vermin harbour (i.e. burrows) should be removed, without disturbance to native vegetation and with minimal soil disturbance. The land owner/contractor is to monitor pest animal use of the conservation reserves whilst undertaking vegetation management works. Any changes in the influences of pest animals may require a change in the management actions.

The following key management actions will be undertaken to ensure success of the pest animal program:

- Identify potential harbour and burrows, and destroy if soil disturbance can be minimised and all native vegetation retained;
- Undertake pest animal control program (e.g. fumigation); and,
- Monitor the population of pest animals during weed control works and adapt management as considered appropriate.

3.2.7 Threatened Flora Species

One State significant flora species (Rye Beetle-grass) and one nationally significant fauna species (Golden Sun Moth) are known to occur within the study area. Where possible, management actions should be undertaken to ensure firstly that known significant species are protected, and secondly habitat is improved to promote the long-term survival of the species and also a potential increase in distribution and abundance.

Ongoing management activities must always consider the ecology of known significant species and all workers involved in the control of pest plants and animals must be able to identify the significant plant and animal species present within the study area and the wider region, as well as have an understanding of their ecology.

It is recommended that the single specimen of Rye Beetle-grass be salvaged if it is still present and can be relocated, then translocated into the western conservation reserve.

The large size of the western conservation reserve may also provide opportunities for use as a recipient site for the salvage and translocation of species such as Matted Flax-lily *Dianella amoena* or Spiny Rice-flower given that these species are known from the local and wider area and have previously triggered EPBC Act relocation requirements in surrounding residential development. The introduction of additional threatened species would also act to enhance the level of biodiversity at the site.

3.2.8 Site Interpretations

The current ecological assets within the conservation reserves offer an opportunity for various site interpretations using a variety of signage types to engage and inform local residents and other stakeholders of its values. This method will not only raise the profile of the conservation reserves, but will also increase the level of future passive surveillance over the reserves.

It is envisaged that signage will be located at all entry points and approximately every 100-150 metres around the entire perimeter fence of the GSM conservation reserves. Following the 'Start with the Grasslands' design guidelines (Marshall 2013) a series of succinct, consistently stylised interpretive signs, constructed out of graffiti and fire resistant materials will be regularly spaced around the conservation reserves that:

- Outline the purpose of the conservation reserves;
- Emphasise a sense of place, history and importance of the site;
- Present the reserve and its vegetation as inclusive rather than exclusive;
- Are highly legible in terms of font, style and size, and where possible include graphics, icons and illustrations to emphasise any messages. Translations for different ethnicity groups should also be considered; and,
- Provide links to sites where further information can be sourced, as well a contact phone number to report any relevant matters to the responsible managing authority.

Relevant matters that may be considered for signage could include descriptions of:

- The Cultural Heritage of the site and wider geographical area;
- The Victorian Volcanic Plain;

- Plains Grassland EVC;
- Golden Sun Moth;
- Growling Grass Frog along Harpers Creek.

3.3 Monitoring and Reporting

Monitoring of native vegetation and Golden Sun Moth habitat by a suitably qualified ecologist should be undertaken to ensure key performance targets are met and the responsible authorities notified of the successes and failures of works through regular progress reports. Progress reports will be provided to the responsible authority at the end of year 2, 5 and 10 of the program (Table 3). Ongoing monitoring will also provide feedback to inform an adaptive management approach, which is critical to tailor management actions to prevailing environmental conditions and also for the provision of contingency plans. For example, if monitoring data suggests that one form of management, such as burning compared to slashing, or scraping for direct seeding, appears to be having a detrimental effect, or alternatively a positive effect on a particular matter, then management will be adapted accordingly.

3.3.1 Monitoring

3.3.1.1 *Native vegetation*

Monitoring is required to assess the positive and negative impacts of management actions on the integrity of the study area, and to implement change if required. Vegetation monitoring will be conducted annually, with progress reports provided to the responsible authority at the end of year 2, 5 and 10 of the program.

This monitoring will be undertaken by a suitably qualified ecologist, with some input from the landowners. However, the frequency of monitoring may need to vary to allow for seasonal variations and to target periods of active weed growth. Similarly, pest animal monitoring should be undertaken at a time of year when these animals are most active so that an accurate assessment of population sizes can be made.

It is recommended that monitoring be undertaken by qualified ecological consultants familiar with the methodology as well as any offset and EPBC Act referral requirements. Monitoring and progress reports should include information on the following matters:

- Collection of baseline data to be used as a reference point to assess the impacts of management actions;
- Overall condition and composition of vegetation as well as consideration of Gain requirements;
- The condition and health of scattered trees;
- Biomass levels;
- Distribution and abundance of significant species;
- The extent, severity, trend and presence of current weed species and any new and emerging weed species; and,
- Implementation of permanent photo points. Photographs must be taken at the same location and during the same time of each year. Photo points will allow monitoring of weed populations and

maintenance of the current condition of native vegetation within the offset site. Details of photo points and photographs will be provided to DELWP where required as evidence of progress.

3.3.1.2 Golden Sun Moth

Golden Sun Moth populations are known to vary on spatial and temporal scales depending upon habitat conditions at a particular site (Kutt *et al.* 2015). Monitoring is required to determine if Golden Sun Moth has persisted in grassland areas, to determine reproductive success and to ensure that management actions and habitats are suitable for a viable Golden Sun Moth population in the future.

Annual monitoring (targeted surveys) for Golden Sun Moth will be undertaken for an initial 4 year period, and then in years 6, 8 and 10 (within the 10 year management timeframe). If, at the end of the four year monitoring program, the results indicate a decline in the Golden Sun Moth population or degradation of Golden Sun Moth habitat, the CMP will be re-evaluated and adapted accordingly.

Specific survey procedures will follow those approved by DoE and outlined in the Biodiversity Precinct Planning Kit (DSE 2009) and EPBC Act Policy Statement 3.12 *Significant Impact Guidelines for the Critically Endangered Golden Sun Moth* (DEWHA 2009). The following will be undertaken as part of population and habitat monitoring of Golden Sun Moth habitat for the initial 4 year period (and extended if required):

- Surveys are to be conducted by suitably qualified ecologists familiar with the ecology of Golden Sun Moth;
- Surveys must take place during the Golden Sun Moth flight season. This period is typically from late October to early January.
- Ensure moths are active on the day of assessment by using a reference site where the species is known to be present;
- Surveys must be undertaken during conditions suitable for detecting the species. Male moths generally fly between 10am and 3pm on warm days (over 20°C by 10am) with minimal cloud cover and still conditions. However if males are observed flying after 3pm or during moderately windy conditions surveys can continue until males are no longer observed flying; and,
- Surveys should be conducted using 50 metre wide, parallel transects with two observers walking or, if terrain permits, driving in a car at < 10 km / hour (flying male moths can be readily seen from a vehicle) until moths are observed. Tracks (transects) must be recorded with a GPS to show where survey has been undertaken.

3.3.1.3 Other Monitoring

Information relating to fencing and signage, weed control and pest animal control will be provided by landowners and the relevant contractors. This information will be included in the required progress reports, discussed below.

3.3.2 Reporting

Progress reports will be provided to the responsible authority at the end of year 2, 5 and 10 of the program. Information to be provided in the progress report includes:

- A copy of the Management Actions Table (Table 3) detailing actions completed during the reporting period;
- A description of the specific monitoring results from ecological surveys undertaken;
- Success of weed and pest animal control work;
- Successful management tools (i.e. techniques used to control weed species, protection of new plants, monitoring technique, etc.);
- Any problems or issues experienced (i.e. new infestation of weed species, etc.);
- Any corrective actions and contingency measures where monitoring indicates that there has been a deterioration in the cover of native vegetation or decline in Golden Sun Moth habitat; and,
- Photographs showing evidence of works.

In order to meet EPBC Act referral conditions, all records/evidence of management actions must be maintained, and be submitted to DoE upon request, and any proposed management changes must be submitted to DoE prior to the changes being undertaken.

If any agreed management actions or commitments are incomplete or have not been undertaken in the times specified, the contractor is to document the justification and the actions that will be undertaken to implement management requirement.

Note: The timing of progress reports may be clarified subject to any future ownership transfer of land to a different responsible authority.

3.4 Management Actions Table

Management actions are summarised in Table 3. The actions constitute the minimum management requirements for the conservation reserve over the mandatory 10 year management period and provide a guide for ongoing management of the reserves in perpetuity.

Table 3. Management Actions Table

Year	Action	Management action	Responsible authority / personnel	Timing of action	Report reference	Date completed
0	0.1	Implement on-title legal agreements for each conservation reserve	Liaise between the landowner, DEPI and Council.	Pre-construction	Section 3.1	
0	0.2	Erect temporary fences surrounding the conservation reserve, implement 50m buffer zone, install signage	Landowner	Pre-construction	Section 3.2.1	
0	0.3	Acquire baseline monitoring data	Suitably qualified ecological specialist	Pre-construction	Section 3.3.1.1	
0	0.4	Prepare detailed specifications to inform tenders for management contractors and other required actions such as native grass direct seeding and site preparation noting that all works and site preparation are to be completed by a suitably qualified works contractor using locally sourced seed	Landowner or representative	Pre-construction	Section 3.2.4.1	
0	0.5	Prepare and implement Construction Environmental Management Plan (CEMP)	Ecological Consultant / Landowner	Pre- and during construction	Section 3.2.1	
1	1.1	Erect permanent fences and signage surrounding the conservation reserves	Landowner	Upon completion of construction	Section 3.2.2	
1	1.2	Conduct weed control and implement revegetation plan	Landowner/Bushland Management Contractor	Refer to Table 2	Section 3.2.4	
1	1.3	Monitor populations of pest animals and conduct control works if required	Landowner/Pest Animal Contractor	After peak breeding season - late summer/early autumn	Section 3.2.6	
1	1.4	Conduct monitoring of all vegetation and Golden Sun Moth habitat	Suitably qualified ecological specialist	One year after commencement of works	Section 3.3.1	
1	1.5	Monitor organic litter and biomass density and develop ecological burn or fuel reduction plan if appropriate	Landowner/Bushland Management Contractor/CFA	Outside of the GSM active season	Section 3.2.3	

Year	Action	Management action	Responsible authority / personnel	Timing of action	Report reference	Date completed
2	2.1	Conduct weed control and continue revegetation plan	Landowner/Bushland Management Contractor	Refer to Table 2	Section 3.2.4	
2	2.2	Monitor populations of pest animals and conduct control works if required	Landowner/Pest Animal Contractor	After peak breeding season - late summer/early autumn	Section 3.2.6	
2	2.3	Conduct monitoring for vegetation and Golden Sun Moth	Suitably qualified ecological specialist	Two years after commencement of works	Section 3.3.1	
2	2.4	Maintain fences	Landowner/Fencing Contractor	As required	Section 3.2.2	
2	2.5	Monitor organic litter and grass density and enact ecological burn or other approved biomass reduction plan if appropriate	Landowner/Bushland Management Contractor/CFA	Outside of the GSM active season	Section 3.2.3	
2	2.6	Monitor and assess works, and prepare progress report	Suitably qualified ecological specialist	Two years after commencement of works	Section 3.3.2	
3	3.1	Conduct weed control and continue revegetation plan	Landowner/Bushland Management Contractor	Refer to Table 2	Section 3.2.4	
3	3.2	Monitor populations of pest animals and conduct control works if required	Landowner/Pest Animal Contractor	After peak breeding season - late summer/early autumn	Section 3.2.6	
3	3.3	Conduct monitoring for vegetation and Golden Sun Moth	Suitably qualified ecological specialist	Three years after commencement of works	Section 3.3.1	
3	3.4	Maintain fences	Landowner/Fencing Contractor	As required	Section 3.2.2	
3	3.5	Monitor organic litter and grass density and enact ecological burn or other approved biomass reduction plan if appropriate	Landowner/Bushland Management Contractor/CFA	Outside of the GSM active season	Section 3.2.3	
4	4.1	Conduct weed control and continue revegetation plan	Landowner/Bushland Management Contractor	Refer to Table 2	Section 3.2.4	
4	4.2	Monitor populations of pest animals and conduct control works if required	Landowner/Pest Animal Contractor	After peak breeding season - late summer/early autumn	Section 3.2.6	

Year	Action	Management action	Responsible authority / personnel	Timing of action	Report reference	Date completed
4	4.3	Conduct monitoring for vegetation and Golden Sun Moth	Suitably qualified ecological specialist	Four years after commencement of works	Section 3.3.1	
4	4.4	Maintain fences	Landowner/Fencing Contractor	As required	Section 3.2.2	
4	4.5	Monitor organic litter and grass density and enact ecological burn or other biomass reduction plan if appropriate	Landowner/Bushland Management Contractor/CFA	Outside of the GSM active season	Section 3.2.3	
5	5.1	Conduct weed control and continue revegetation plan	Landowner/Bushland Management Contractor	Refer to Table 2	Section 3.2.4	
5	5.2	Monitor populations of pest animals and conduct control works if required	Landowner/Pest Animal Contractor	After peak breeding season - late summer/early autumn	Section 3.2.6	
5	5.3	Conduct monitoring for vegetation	Suitably qualified ecological specialist	Five years after commencement of works	Section 3.3.1	
5	5.4	Maintain fences	Landowner/Fencing Contractor	As required	Section 3.2.2	
5	5.5	Monitor organic litter and grass density and enact ecological burn or other biomass reduction plan if appropriate	Landowner/Bushland Management Contractor/CFA	Outside of the GSM active season	Section 3.2.3	
5	5.6	Monitor and assess works, and prepare progress report	Suitably qualified ecological specialist	Five years after commencement of works	Section 3.3.2	
6	6.1	Conduct weed control and continue revegetation plan	Landowner/Bushland Management Contractor	Refer to Table 2	Section 3.2.4	
6	6.2	Monitor populations of pest animals and conduct control works if required	Landowner/Pest Animal Contractor	After peak breeding season - late summer/early autumn	Section 3.2.6	
6	6.3	Conduct monitoring for vegetation and Golden Sun Moth	Suitably qualified ecological specialist	Six years after commencement of works	Section 3.3.1	
6	6.4	Maintain fences	Landowner/Fencing Contractor	As required	Section 3.2.2	
6	6.5	Monitor organic litter and grass density and	Landowner/Bushland Management	Outside of the GSM active	Section 3.2.3	

Year	Action	Management action	Responsible authority / personnel	Timing of action	Report reference	Date completed
		enact ecological burn or other biomass reduction plan if appropriate	Contractor/CFA	season		
7	7.1	Conduct weed control and continue revegetation plan	Landowner/Bushland Management Contractor	Refer to Table 2	Section 3.2.4	
7	7.2	Monitor populations of pest animals and conduct control works if required	Landowner/Pest Animal Contractor	After peak breeding season - late summer/early autumn	Section 3.2.6	
7	7.3	Conduct monitoring for vegetation	Suitably qualified ecological specialist	Seven years after commencement of works	Section 3.3.1	
7	7.4	Maintain fences	Landowner/Fencing Contractor	As required	Section 3.2.2	
7	7.5	Monitor organic litter and grass density and enact ecological burn or other biomass reduction plan if appropriate	Landowner/Bushland Management Contractor/CFA	Outside of the GSM active season	Section 3.2.3	
8	8.1	Conduct weed control and continue revegetation plan	Landowner/Bushland Management Contractor	Refer to Table 2	Section 3.2.4	
8	8.2	Monitor populations of pest animals and conduct control works if required	Landowner/Pest Animal Contractor	After peak breeding season - late summer/early autumn	Section 3.2.6	
8	8.3	Conduct monitoring for vegetation and Golden Sun Moth	Suitably qualified ecological specialist	Eight years after commencement of works	Section 3.3.1	
8	8.4	Maintain fences	Landowner/Fencing Contractor	As required	Section 3.2.2	
8	8.5	Monitor organic litter and grass density and enact ecological burn or other biomass reduction plan if appropriate	Landowner/Bushland Management Contractor/CFA	Outside of the GSM active season	Section 3.2.3	
9	9.1	Conduct weed control and continue revegetation plan	Landowner/Bushland Management Contractor	Refer to Table 2	Section 3.2.4	
9	9.2	Monitor populations of pest animals and conduct control works if required	Landowner/Pest Animal Contractor	After peak breeding season - late summer/early autumn	Section 3.2.6	

Year	Action	Management action	Responsible authority / personnel	Timing of action	Report reference	Date completed
9	9.3	Conduct monitoring for vegetation	Suitably qualified ecological specialist	Nine years after commencement of works	Section 3.3.1	
9	9.4	Maintain fences	Landowner/Fencing Contractor	As required	Section 3.2.2	
9	9.5	Monitor organic litter and grass density and enact ecological burn or other biomass reduction plan if appropriate	Landowner/Bushland Management Contractor/CFA	Outside of the GSM active season	Section 3.2.3	
10	10.1	Conduct weed control and continue revegetation plan	Landowner/Bushland Management Contractor	Refer to Table 2	Section 3.2.4	
10	10.2	Monitor populations of pest animals and conduct control works if required	Landowner/Pest Animal Contractor	After peak breeding season - late summer/early autumn	Section 3.2.6	
10	10.3	Conduct monitoring for vegetation and Golden Sun Moth	Suitably qualified ecological specialist	Ten years after commencement of works	Section 3.3.1	
10	10.4	Maintain fences	Landowner/Fencing Contractor	As required	Section 3.2.2	
10	10.5	Monitor organic litter and grass density and enact ecological burn or other biomass reduction plan if appropriate	Landowner/Bushland Management Contractor/CFA	Outside of the GSM active season	Section 3.2.3	
10	10.6	Monitor and assess works, and prepare final report	Suitably qualified ecological specialist	Ten years after commencement of works	Section 3.3.2	

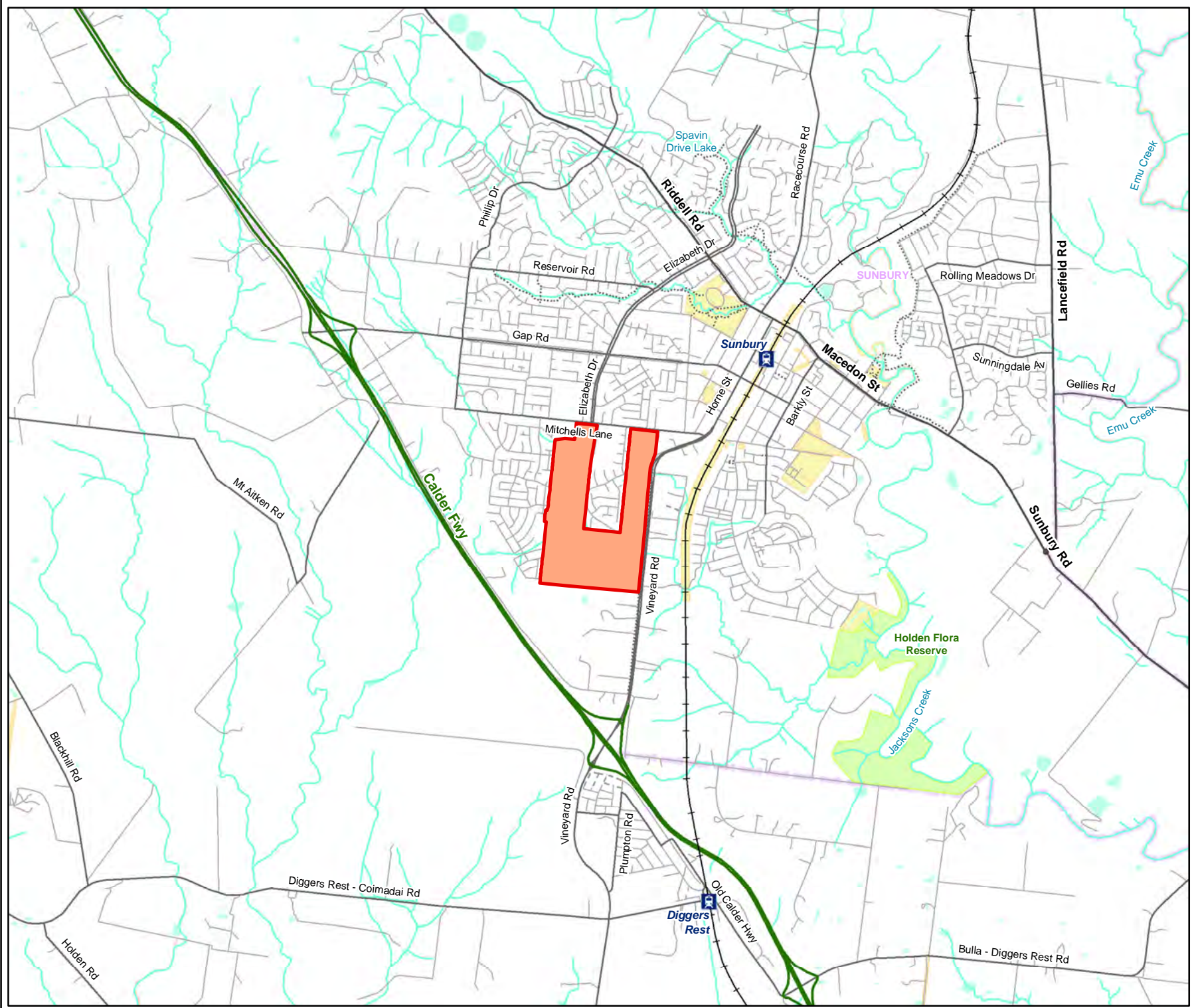
Notes: CFA: Country Fire Authority; CEMP: Construction Environmental Management Plan; GSM: Golden Sun Moth.

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FIGURES



- Legend**
- Study Area
 - Freeway
 - Major Road
 - Collector Road
 - Minor Road
 - Proposed Road
 - Walking Track
 - Minor Watercourse
 - Permanent Waterbody
 - Land Subject to Inundation
 - Parks and Reserves
 - Crown Land
 - Localities

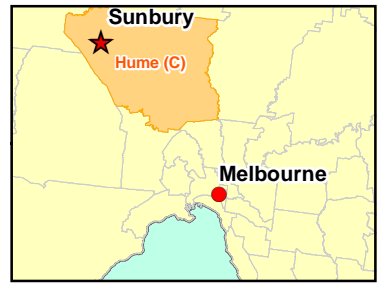
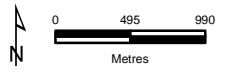
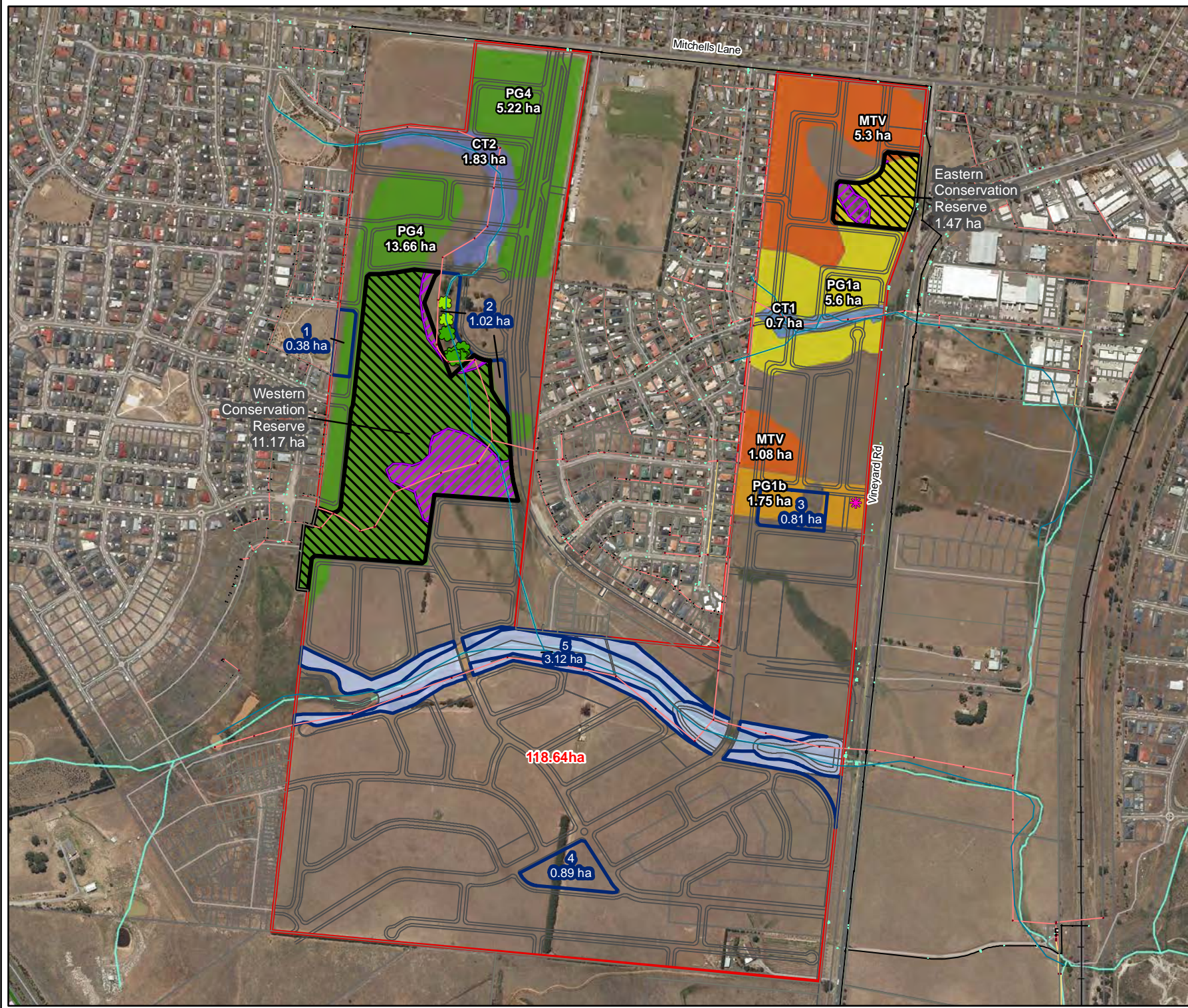


Figure 1
Location of the study area
Rosenthal Estate, Sunbury



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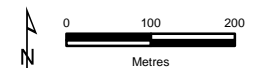
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Legend

- Study Area
- ✱ Rye Beetle-grass
- Scattered Trees**
- 🌳 Large Old Tree
- 🌱 Small Tree
- Vegetation**
- Plains Grassland - PG1a
- Plains Grassland - PG1b
- Plains Grassland - PG4
- Creekline Tussock Grassland - CT1
- Creekline Tussock Grassland - CT2
- Modified Treeless Vegetation - MTV
- Fenceline
- Management Zone A (10.16ha)
- Management Zone B (2.48ha)
- Open Spaces 1 - 5

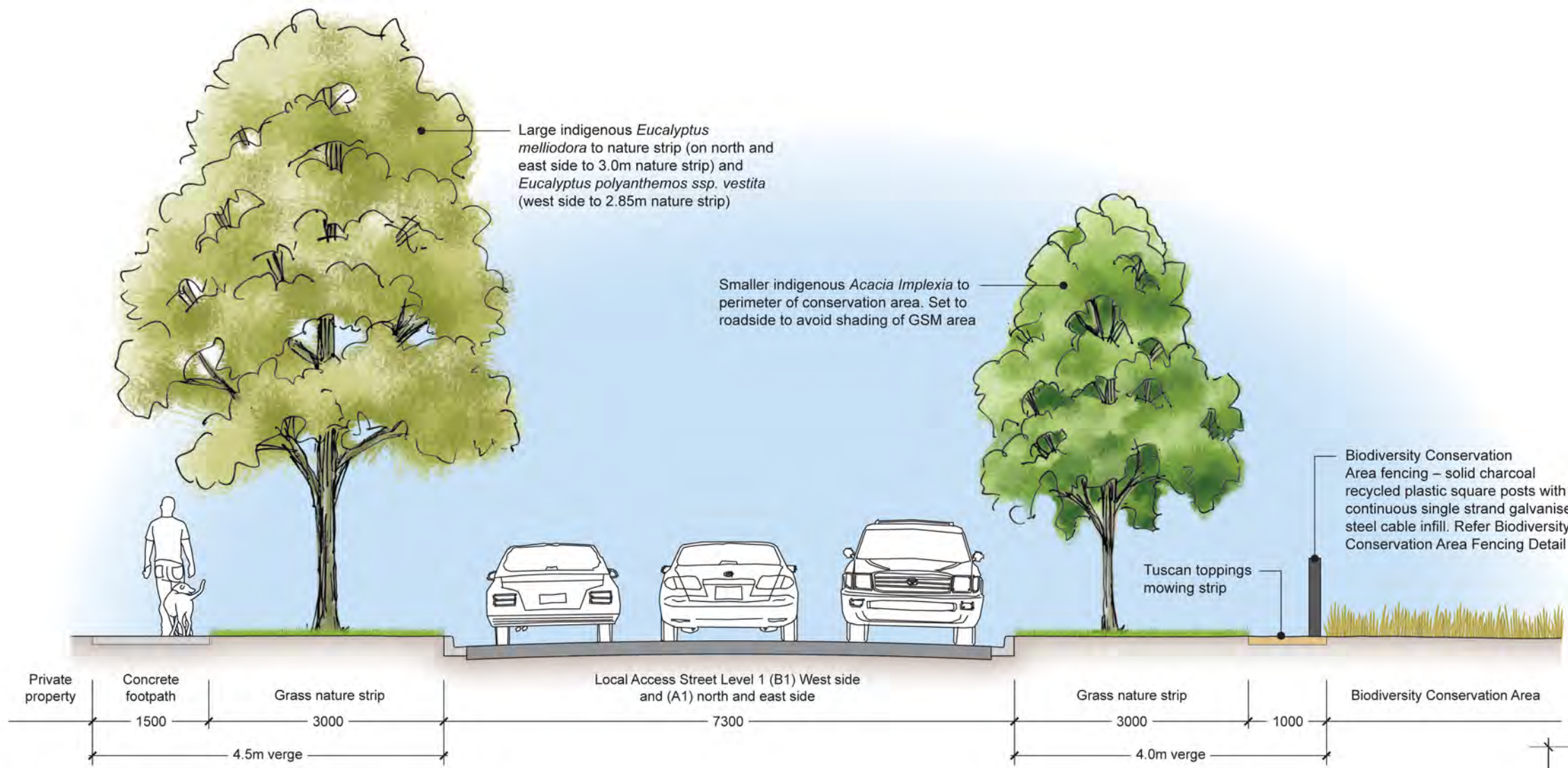
Figure 2
Ecological features,
Management Areas and
Development Plan
Rosenthal Estate, Sunbury



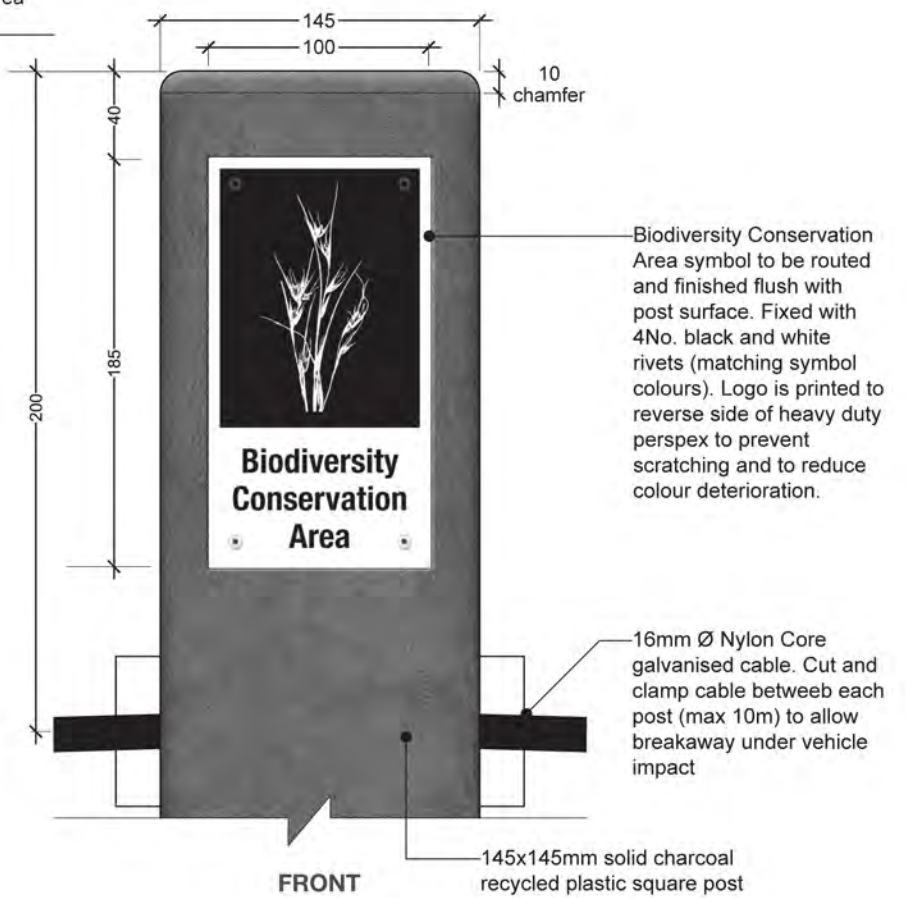
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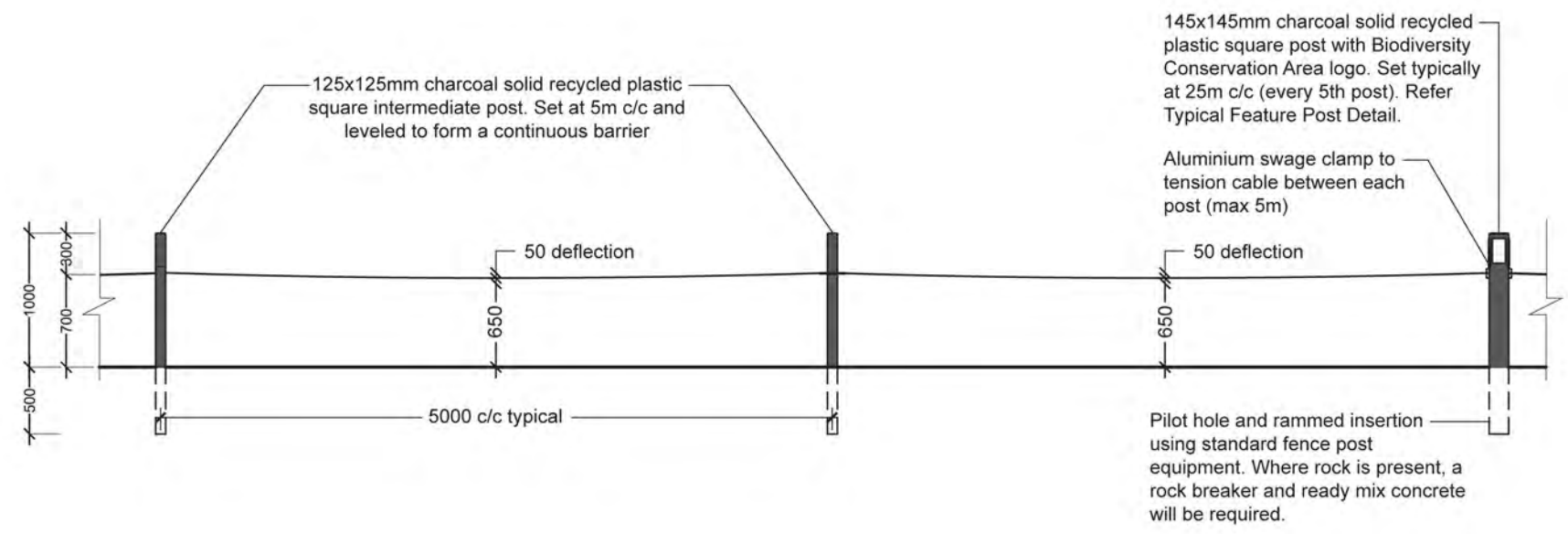
APPENDICES



BIODIVERSITY AREA INTERFACE TYPICAL CROSS-SECTION



TYPICAL FEATURE POST DETAIL – NTS



BIODIVERSITY CONSERVATION AREA FENCING DETAIL

THOMPSON BERRILL LANDSCAPE DESIGN P/L

- 1 Seat overlooking the proposed deeper pool upstream Vineyard Road. Planting will retain views up along the open space corridor to the proposed Budburst Drive Bridge.
- 2 Natural basalt stone wall terracing to future mixed use site fill embankment. Use feature indigenous planting beds to soften interface to creek and Vineyard Road.

- 3 Small picnic area accessed off the main trail with low rock retaining/seating wall, feature planting, drinking fountain and picnic table overlooking the creek.
- 4 2.5m wide concrete shared trail connection graded at max 1 in 20 up to Budburst Drive from existing path on Vineyard Road.
- 5 Budburst Drive bridge to include a 2.5m wide concrete path to the western side overlooking the deeper pool with stone cladding, pillars and handrail.

- 6 Seating area with low stone wall and integrated fitness station overlooking deeper pool upstream Budburst Drive bridge.
- 7 Seating area overlooking the creek and Budburst Drive bridge.
- 8 A 40x20m flat open grass area is provided on the south bank with picnic table, drinking fountain and integrated fitness station.

- 9 Liaise with Council to investigate improvements to undeveloped existing open space on the north bank at Marl Court overlooking Harpers Creek. Works may include establishment of a small playground, fitness station, drinking fountain, upgraded flat grass open space area and additional shade tree planting. Development of the local playground on this side is preferred to avoid duplication of facilities at Toms Park and to promote circuit walking.

- 10 Seat overlooking Harpers Creek and across to existing open space on the north bank.
- 11 Rosenthal Boulevard will cross the creek upstream of the existing dam and will allow for looped walking access with a 2.5m concrete path to the western side overlooking the deeper pool.
- 12 Existing farm dam will be modified to form an online wetland pool upstream of Rosenthal Boulevard.
- 13 Seating area with picnic table overlooking the deeper pool upstream Rosenthal Boulevard.
- 14 Seat overlooking Ashfield Retarding Basin Wetland.
- 15 Existing retarding basin wall levels will be reviewed and adjusted.
- 16 Picnic table with drinking fountain overlooking the existing wetland and adjoining flat open grassed area.
- 17 Remove existing fence. Review level of existing high flow bypass to maximise open grass area and improve interface to the existing wetland.
- 18 Liaise with Council to investigate establishment of a pedestrian boardwalk crossing of the existing stormwater drain outfall channel from Waugh Street to link the existing and proposed shared trail network.
- 19 Retain and protect large Sugar Gum growing in the farm dam wall if possible (subject to confirmation of bridge design requirements).



OVERALL DESIGN INTENT

The design will establish a generous east west open space corridor along Harpers Creek connecting the existing open space reserves around the Ashfield Estate wetland through to Vineyard Road and the proposed supermarket and activity centre. The open space corridor will vary in width as required for flood conveyance while also establishing over 2ha of local open space. A concrete shared path will be established to both sides, except on the north bank east of Budburst Drive. The combination of existing and proposed road bridge crossings will form a series of local walking loops for each section of creek. Revegetation of the new waterway channel will use local indigenous species to re-establishment natural floodplain vegetation improving biodiversity and habitat values. The existing local open space will be further developed to provide a playground and useable flat open space.

STAGE THREE: Rosenthal Boulevard to Ashfield Wetland

- Completion of the 2.5m wide concrete shared path to both sides of Harpers creek will form a 1.8km loop from Rosenthal Boulevard up and around Ferris Street and the Ashfield Wetland.
- Link to Ashfield Estate Parkland and playground via a new boardwalk. This boardwalk will also link residents in Ashfield Estate off road via new path to the new Supermarket and Activity Centre and link into town along Vineyard Road.
- New picnic area on north bank will overlook the wetland and adjoining flat open grass area.
- Rehabilitate the existing creek channel to improve links through to the existing wetland.
- Scattered tree planting will retain open views to the creek and across the Ashfield Estate wetland.

STAGE TWO: Budburst Drive to Rosenthal Boulevard

- 2.5m concrete shared trail to both sides of Harpers creek will form a 1.2km circuit walk.
- Three fitness stations will be integrated with the shared path for circuit training and for use as informal seating areas.
- The existing farm dam and small offline sediment traps will be used to protect downstream creek rehabilitation works.
- Redevelop the creek interface at the existing local open space reserve at Marl Court including provision of new playground.
- Establish seating areas along the path with views to the creek.
- More dense planting on the north bank will be used to soften interface to future mixed use site.

STAGE ONE: Vineyard Road to Budburst Drive

- 2.5m wide concrete path along southern bank linking Vineyard Road to Budburst Drive.
- Retain maintenance access only to north bank.
- Pool upstream of Budburst Drive bridge will be used to protect downstream creek rehabilitation works.
- Seating area is provided close to existing Vineyard Road path.
- Picnic table and drinking fountain provided closer to Budburst Drive with views to the bridge and down the rehabilitated creek and open space corridor.
- Scattered tree planting on the south bank will provide open views to creek from Jersey Drive. More dense planting on the north bank will be used to soften interface to the future mixed use site.

Drawing Key

- 2.5m wide concrete shared path
- Existing shared path
- Existing native trees retained
- Proposed indigenous trees
- Proposed indigenous shrubs
- Indigenous creek revegetation
- Mown grass
- Low flow channel
- Deep marsh and open water pools
- Indicative 1:100yr ARI floodline
- Picnic areas
- Fitness stations
- Bench seats
- Playground
- Drinking fountain
- Proposed 1.2m high fencing
- Sewer
- Bridge



Appendix 3 –Potential flora species suitable for the restoration of Harpers Creek

Appendix 3: Potential flora species for the restoration of Harpers Creek

Botanical Name	Common Name
<i>Alisma plantago-aquatica</i>	Water Plantain
<i>Amphibromus fluitans</i>	River Swamp Wallaby-grass
<i>Baumea articulata</i>	Jointed Twig-sedge
<i>Calystegia sepium</i>	Large Bindweed
<i>Carex appressa</i>	Tall Sedge
<i>Carex fascicularis</i>	Tassel Sedge
<i>Carex gaudichaudiana</i>	Fen Sedge
<i>Cladium procerum</i>	Leafy Twig-sedge
<i>Crassula helmsii</i>	Swamp Crassula
<i>Eleocharis acuta</i>	Common Spike-sedge
<i>Glyceria australis</i>	Australian Sweet-grass
<i>Juncus amabilis</i>	Hollow-rush
<i>Juncus gregiflorus</i>	Green Rush
<i>Juncus procerus</i>	Tall Rush
<i>Juncus sarophorus</i>	Broom Rush
<i>Lycopus australis</i>	Australian Gypsywort
<i>Lythrum salicaria</i>	Small Loosestrife
<i>Myriophyllum crispatum</i>	Upright Water-milfoil
<i>Myriophyllum simulans</i>	Amphibious Water-milfoil
<i>Neopaxia australasica</i>	White Purslane
<i>Ottelia ovalifolia</i>	Swamp Lily
<i>Persicaria decipiens</i>	Slender Knotweed
<i>Persicaria praetermissa</i>	Spotted Knotweed
<i>Poa labillardierei</i> var. <i>labillardierei</i>	Common Tussock-grass
<i>Potamogeton ochreatus</i>	Blunt Pondweed
<i>Ranunculus amphitrichus</i>	Running Marsh Flower
<i>Ranunculus inundatus</i>	River Buttercup
<i>Rumex bidens</i>	Mud Dock
<i>Schoenoplectus tabernaemontani</i>	River Club-sedge
<i>Triglochin procerum</i> s.l.	Water Ribbons
<i>Urtica incisa</i>	Scrub Nettle
<i>Vallisneria americana</i>	Ribbon-weed
<i>Villarsia reniformis</i>	Running Marsh Flower