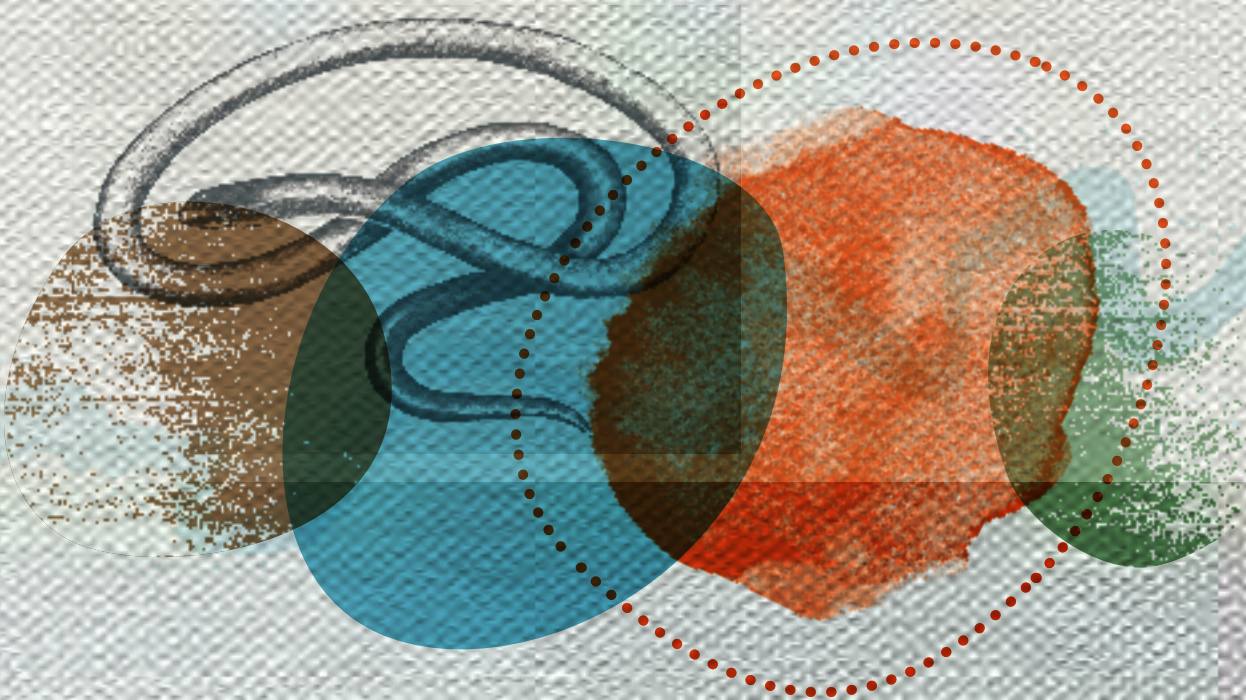


MOLONGLO RIVER RESERVE



Adaptive Management Strategy

May 2013



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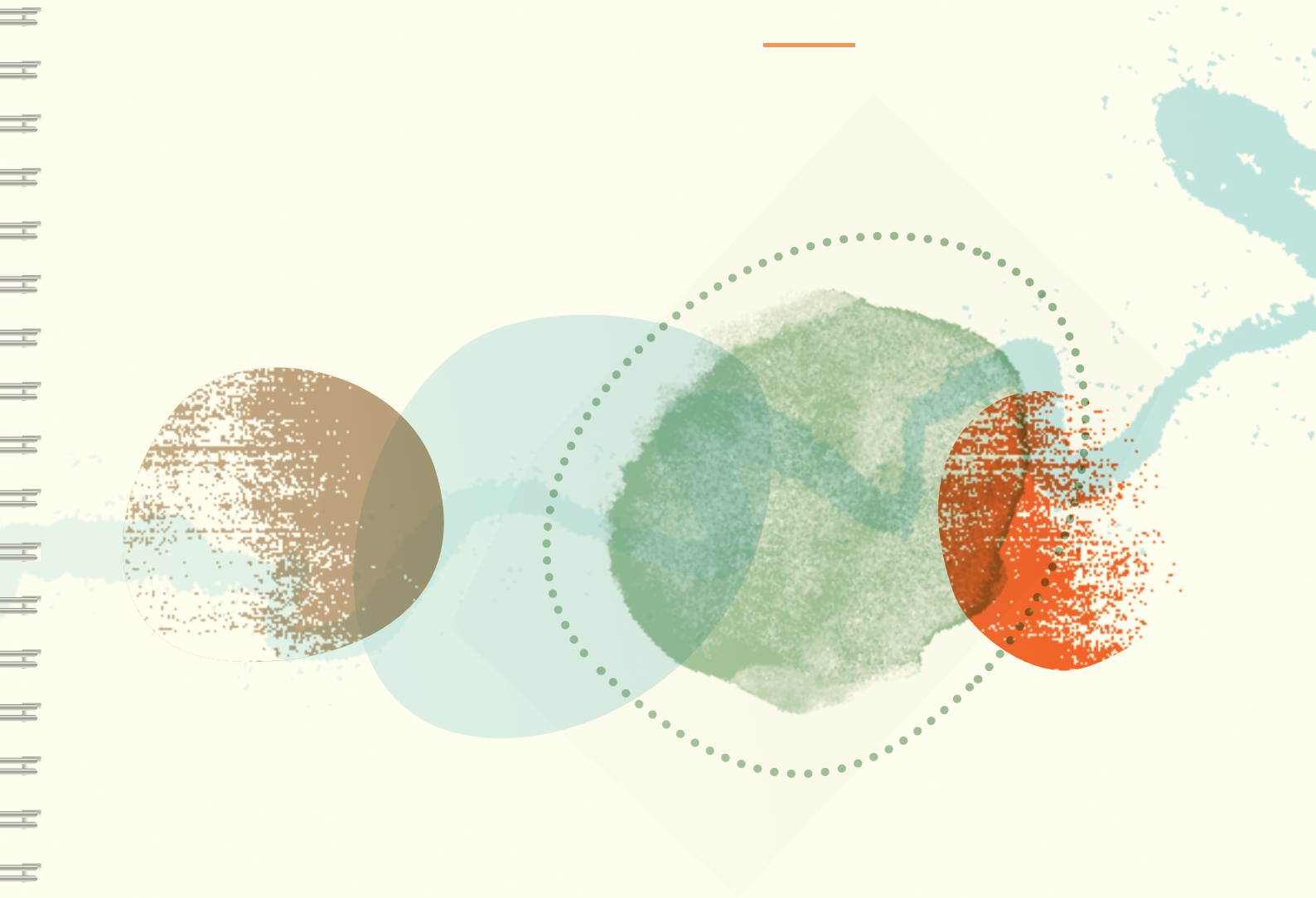
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MOLONGLO RIVER RESERVE



Adaptive Management Strategy

May 2013

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GLOSSARY OF TERMS

Baseline ecological condition: The condition of an MNES that exists at the time the baseline condition assessment is carried out and the results recorded. Baseline conditions are not necessarily pristine or optimal conditions.

Enhance: Raise the ecological condition of a particular MNES to a level which exceeds the established baseline condition.

EPBC Act: Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999*. (EPBC Act)

Maintain: Preserve the ecological condition of a particular MNES at the same level as determined by the baseline condition assessment.

MNES: Matters of National Environmental Significance under the EPBC Act.

Operational plans: the day-to-day management planning tool that will provide detail about on-ground works and activities that will implement the key components of the AMS. The operational plans, together with the Ecological Management Guidelines (Nghienviet et al in prep) will be the primary mechanism for providing for adaptive management approaches based on the results of monitoring, evaluation and review.

Statutory plan of management: management plan required for certain land zones in the ACT under the *Planning and Development Act 2007*.

Strategic Assessment Area: the area of the Molonglo Valley subject to the EPBC Act strategic assessment (see Figure 1).

Creamy Candles - *Stackhousia monogyna*

1. INTRODUCTION

THE MOLONGLO VALLEY PLAN FOR THE PROTECTION OF MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE (NES PLAN) (ACTPLA 2011) ESTABLISHES THE AUSTRALIAN CAPITAL TERRITORY (ACT) GOVERNMENT'S COMMITMENTS REGARDING URBAN DEVELOPMENT AND BROADACRE LAND USE IN EAST AND WEST MOLONGLO (SEE FIGURE 1), INCLUDING COMMITMENTS TO PROTECT MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE (MNES).

The *Molonglo Adaptive Management Strategy* (AMS) is a key commitment arising out of the NES Plan. It forms the foundation on which the MNES values in the Molonglo area are protected and enhanced through ongoing improvement in management practices.

1.1 Molonglo Valley strategic assessment and the NES Plan

In September 2008, the ACT and Commonwealth Governments commenced a strategic assessment under Section 146 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Strategic assessments under the EPBC Act encourage a bigger picture approach to assess how MNES can best be protected while allowing sustainable development. This is achieved through addressing a number of individual actions or a class of actions (by several proponents) on a regional scale that would otherwise be assessed on a project-by-project basis.

The nature and scale of the proposed urban development and the significance of the MNES in the Molonglo Valley resulted in both the Commonwealth and Territory governments agreeing that optimal environmental results would be achieved through a strategic approach to land use and environmental planning in the area.

The NES Plan (which details the ACT Government's commitments to protect MNES in the Molonglo Valley) was strategically assessed by the Commonwealth and endorsed in October 2011. Actions associated with urban development within East Molonglo were then approved in December 2011.

The NES Plan commits the ACT Government to certain scheduling requirements. Commitments must either commence or be completed within a specified period of time from the strategic assessment endorsement date of 7 October 2011.

1.2 Purpose of the AMS

The AMS adopts a set of measures that are designed to achieve the conservation outcomes and performance targets for MNES in the Molonglo strategic assessment area. It achieves this by setting out the way in which the MNES values of the area will be assessed, monitored, and adaptively managed.

The AMS gives practical effect to the recognition that MNES exist in an area subject to the increasing and ongoing pressures of urban development. These pressures are not always known and their effects may be uncertain.

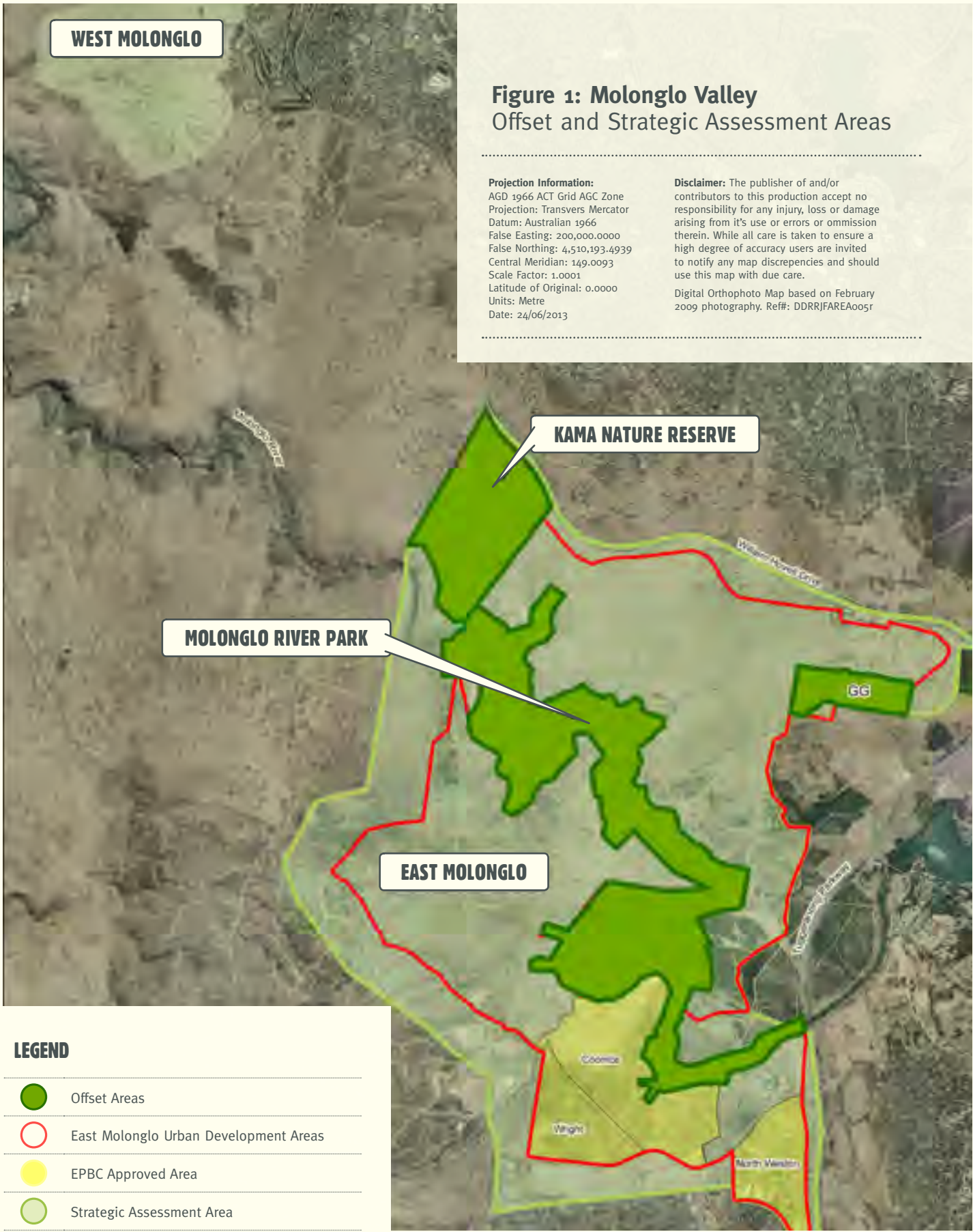
The AMS deals with these anthropogenic uncertainties as well as natural uncertainties (such as climate variability) by prescribing monitoring and assessment processes which iteratively update the state of knowledge and the subsequent direction of management. It provides a plan for:

- establishing the current ecological condition and value of MNES within the Molonglo strategic assessment area;
- identifying performance targets and objectives;
- monitoring and evaluation of management actions;
- revising actions as required; and
- ensuring that the NES Plan's objectives for MNES continue to be met.

The AMS also identifies the key threats to MNES conservation as well as uncertainties in relation to management and the achievement of performance targets and objectives. The AMS establishes measures to deal with these threats and uncertainties.

1.3 Scope of the AMS

The AMS applies to MNES values within the managed lands of the Molonglo strategic assessment area (shown in Figure 1). The strategic assessment area is located between Black Mountain and Mount Stromlo. It is centrally located between the ACT town centres of Belconnen, Woden and Canberra City.



NB: Following the endorsement of the NES Plan by the Commonwealth Minister for Sustainability, Environment, Water, Population and Communities on 7 October 2011, an error in the extent of the EPBC pre-approved Area relating to North Weston was found. The NES Plan indicates that all of North Weston received prior EPBC approval. This is incorrect, only North Weston south of the Cotter Road received prior EPBC approval. The Holdens Creek valley at Coombs was removed from the River Park offset area on 16 April 2010, through the reconsideration decision of EPBC 2009/5050. Accordingly, Figure 1 (of the AMS) has been updated to reflect the correct EPBC pre-approved area.

1.4 Key MNES in the Molonglo strategic assessment area

The NES Plan identifies the following key MNES within the Molonglo strategic assessment area:

- White Box – Yellow Box – Blakely’s Red Gum Grassy Woodland and Derived Native Grassland (Box-Gum Woodland).
- Natural Temperate Grassland of the Southern Tablelands of NSW and the ACT (Natural Temperate Grassland).
- Pink-tailed Worm-lizard (*Aprasia parapulchella*).
- Superb Parrot (*Polytelis swainsonii*).
- Swift Parrot (*Lathamus discolor*).

These key MNES are the focus of the conservation outcomes of the NES Plan. However, it should be noted that other MNES are present in the strategic assessment area and will benefit from ongoing management of conservation areas. For example, the Rainbow Bee-Eater (*Merops ornatus*) is known to occur within the river corridor.

s 2 and 3 provide an overview of the areas of Box-Gum Woodland, Natural Temperate Grassland and Pink-tailed Worm-lizard habitat that will be protected within the strategic assessment area. It should be noted that the extent and condition presented in

Figures 2 and 3 were obtained recently through the baseline ecological condition of MNES established in accordance with the approved AMS (see Section 2) and therefore do not reflect precisely the mapping in the NES Plan. Potential Superb and Swift Parrot habitat is predominately associated with the Box-Gum Woodland and is not mapped separately.

The NES Plan also identifies the conservation outcomes for the key MNES (see Table 1) and prescribes a set of commitments or actions to achieve the outcomes. The AMS aims to ensure the conservation outcomes are delivered by providing a consistent framework for adaptive management across the strategic assessment area.

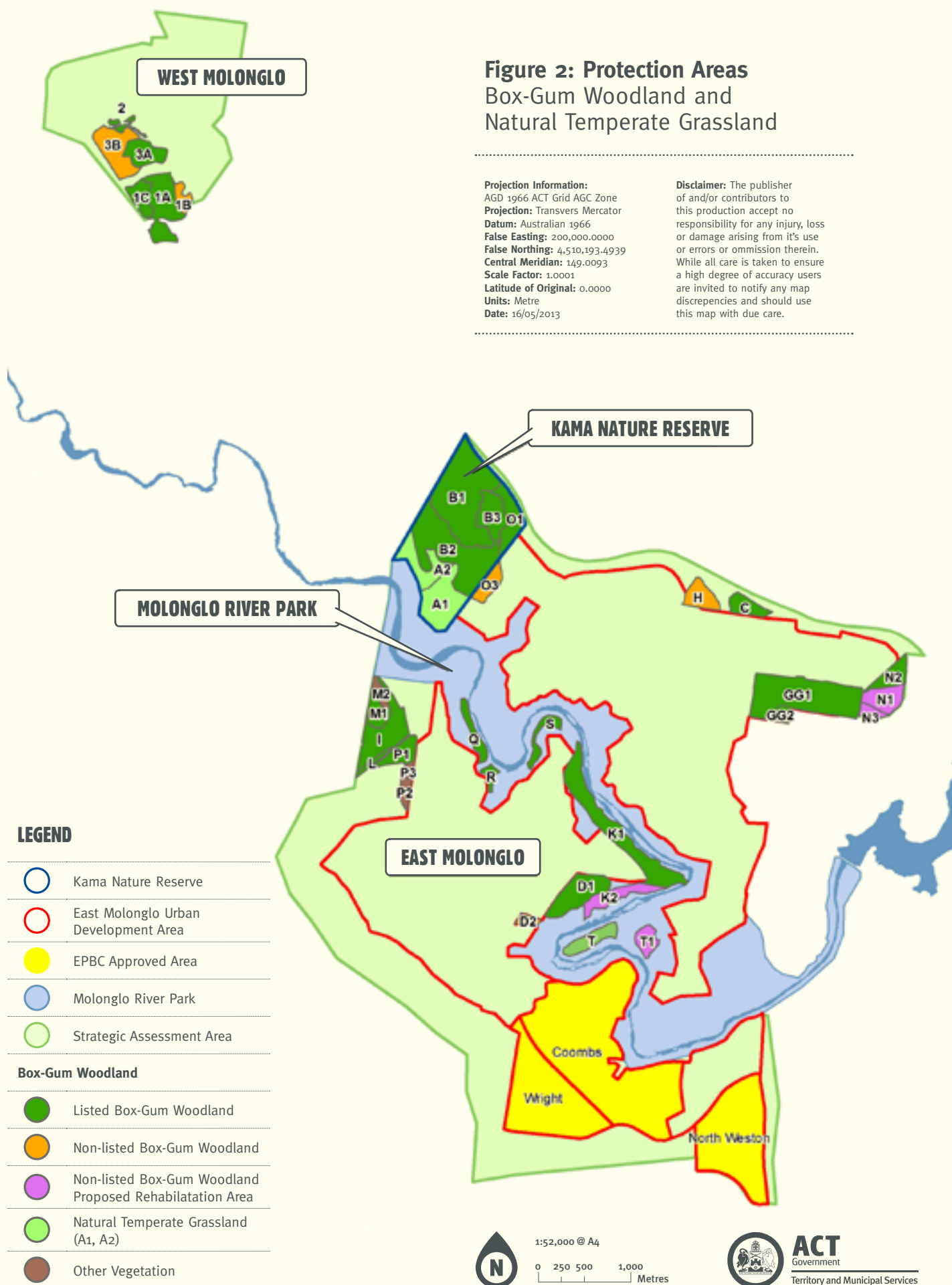


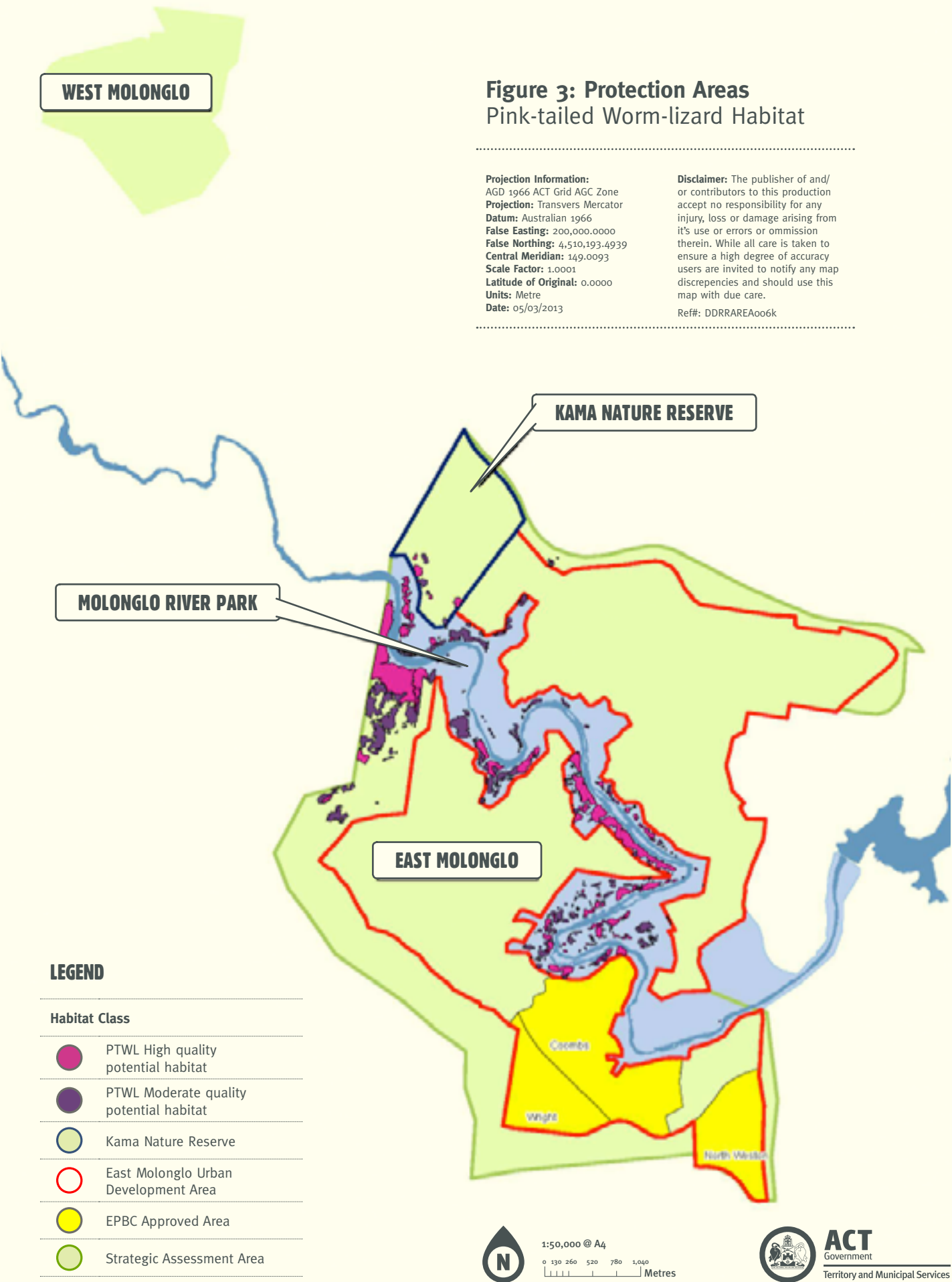
Kangaroo Grass *Themeda triandra*

Table 1: Conservation outcomes for MNES (taken from NES Plan)

MNES	Conservation outcomes
Box-Gum Woodland NES Plan p.20	<ul style="list-style-type: none"> a) Impacts to Box-Gum Woodland will be limited to a maximum of 110 ha and a range of measures will be implemented to minimise these impacts. b) Three offset sites will be established within the strategic assessment area (Kama Nature Reserve, Molonglo River Park, Patch GG) that will provide for the long term protection of 234 ha of Box-Gum Woodland. The three offset sites will be adaptively managed to maintain and enhance the ecological condition* of the Box-Gum Woodland that occurs there. c) Adaptively manage 28 ha of Box-Gum Woodland within the strategic assessment area to maintain and enhance its ecological condition*. This will be made up of patches C, H and N. d) Adaptively manage 45.4 ha of Box-Gum Woodland within the strategic assessment area to maintain its ecological condition*. This will be made up of patches I, L, M and P e) Maintenance and enhancement of the Box-Gum Woodland that occurs within the West Molonglo component of the strategic assessment area. f) Improving and applying the knowledge about the management of Box-Gum Woodland.
Natural Temperate Grassland NES Plan p.27	<ul style="list-style-type: none"> a) No impacts to Natural Temperate Grassland. b) Adaptive management of the Natural Temperate Grassland that occurs within the Kama Nature Reserve to maintain and enhance its ecological condition*.
Pink-tailed Worm-lizard NES Plan p.29	<ul style="list-style-type: none"> a) Impacts to high and moderate quality Pink-tailed Worm-lizard habitat will be limited to a maximum of 27 ha and a range of measures will be implemented to minimise these impacts. b) Two offset sites will be established within the strategic assessment area (Kama Nature Reserve and the Molonglo River Park) that will provide for the long term protection of 66 ha of high and moderate quality Pink-tailed Worm-lizard habitat. These areas will be adaptively managed to maintain and enhance the ecological condition* of the Pink-tailed Worm-lizard habitat that occurs there. c) Continued protection of 28.1 ha of high and moderate quality Pink-tailed Worm-lizard habitat within the Lower Molonglo Nature Reserve. These areas will be adaptively managed to maintain the ecological condition* of the Pink-tailed Worm-lizard habitat that occurs there. d) Protection of an additional 23.3 ha of high and moderate quality Pink-tailed Worm-lizard habitat within the strategic assessment area outside of the development and offset areas. These areas will be adaptively managed to maintain and enhance the ecological condition* of the Pink-tailed Worm-lizard habitat that occurs there e) Improving and applying the knowledge about the management of Pink-tailed Worm-lizard.
Superb and Swift Parrot NES Plan p.34	Given the clear link between Box-Gum Woodland areas and habitat values for these two species, the conservation outcomes and actions for Box-Gum Woodland will also provide positive outcomes for the Superb and Swift Parrots.

* The NES Plan specifies requirements for the measurement of 'ecological condition'. The methodology for the ongoing measurement of ecological condition is provided in Section 7 of the AMS.





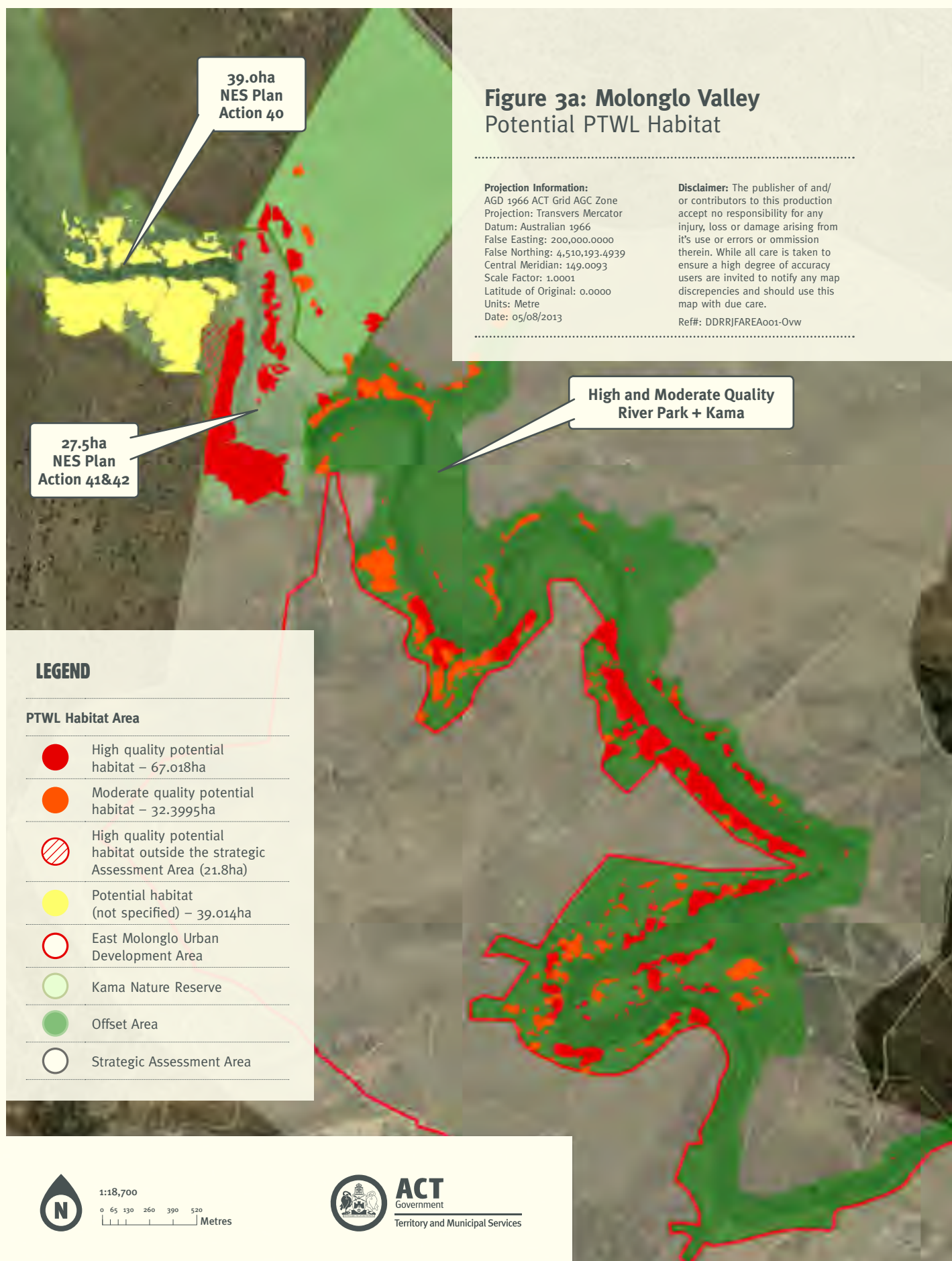


Figure 3b: Molonglo Corridor
High Quality Potential PTWL Habitat
Kama Nature Reserve and River Park

Projection Information:

AGD 1966 ACT Grid AGC Zone
Projection: Transvers Mercator
Datum: Australian 1966
False Easting: 200,000.0000
False Northing: 4,510,193.4939
Central Meridian: 149.0093
Scale Factor: 1.0001
Latitude of Original: 0.0000
Units: Metre
Date: 05/08/2013

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LEGEND

PTWL Habitat Area

- High quality potential habitat – 39.48oha
- East Molonglo Urban Development Area
- Kama Nature Reserve
- Offset Area
- Strategic Assessment Area

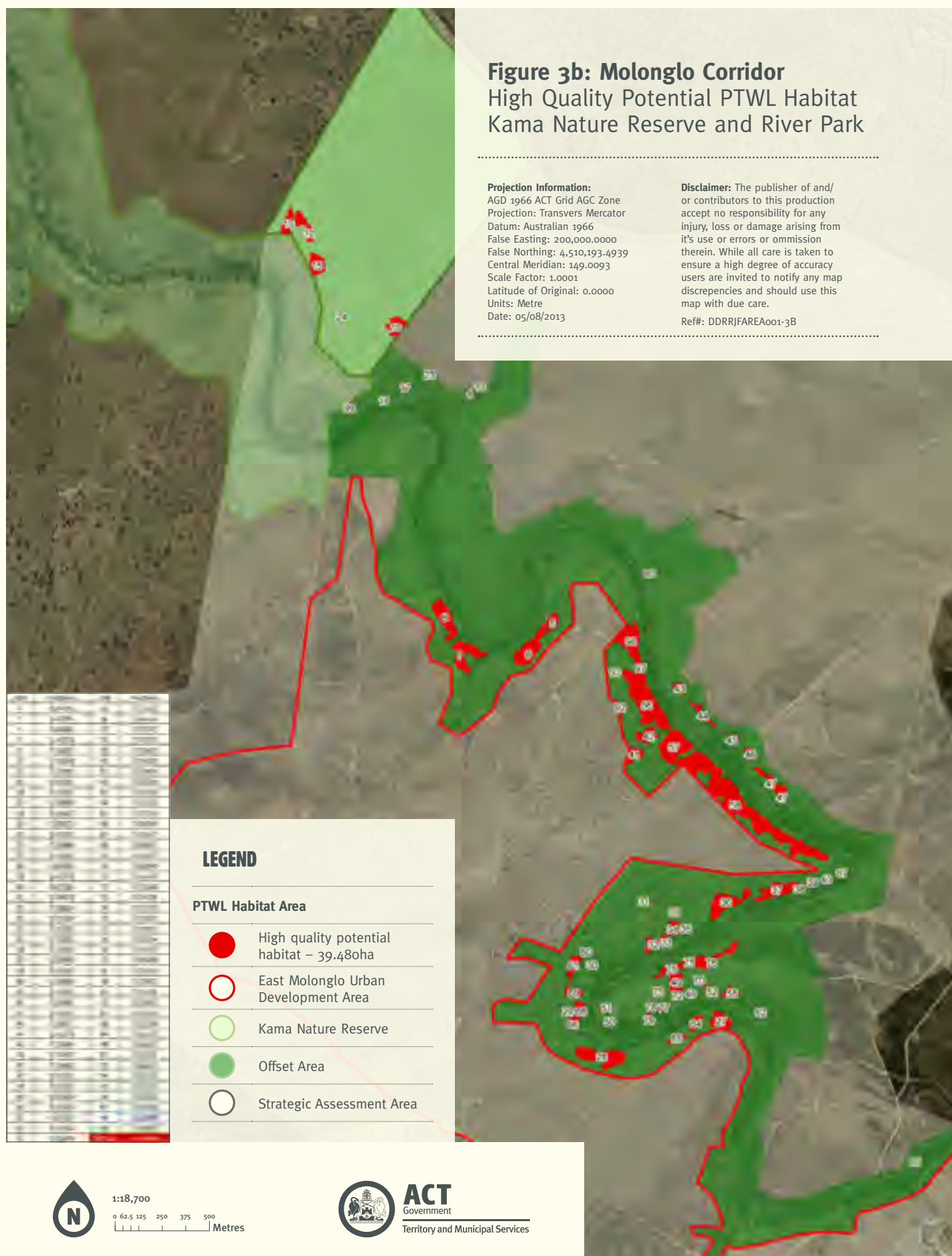


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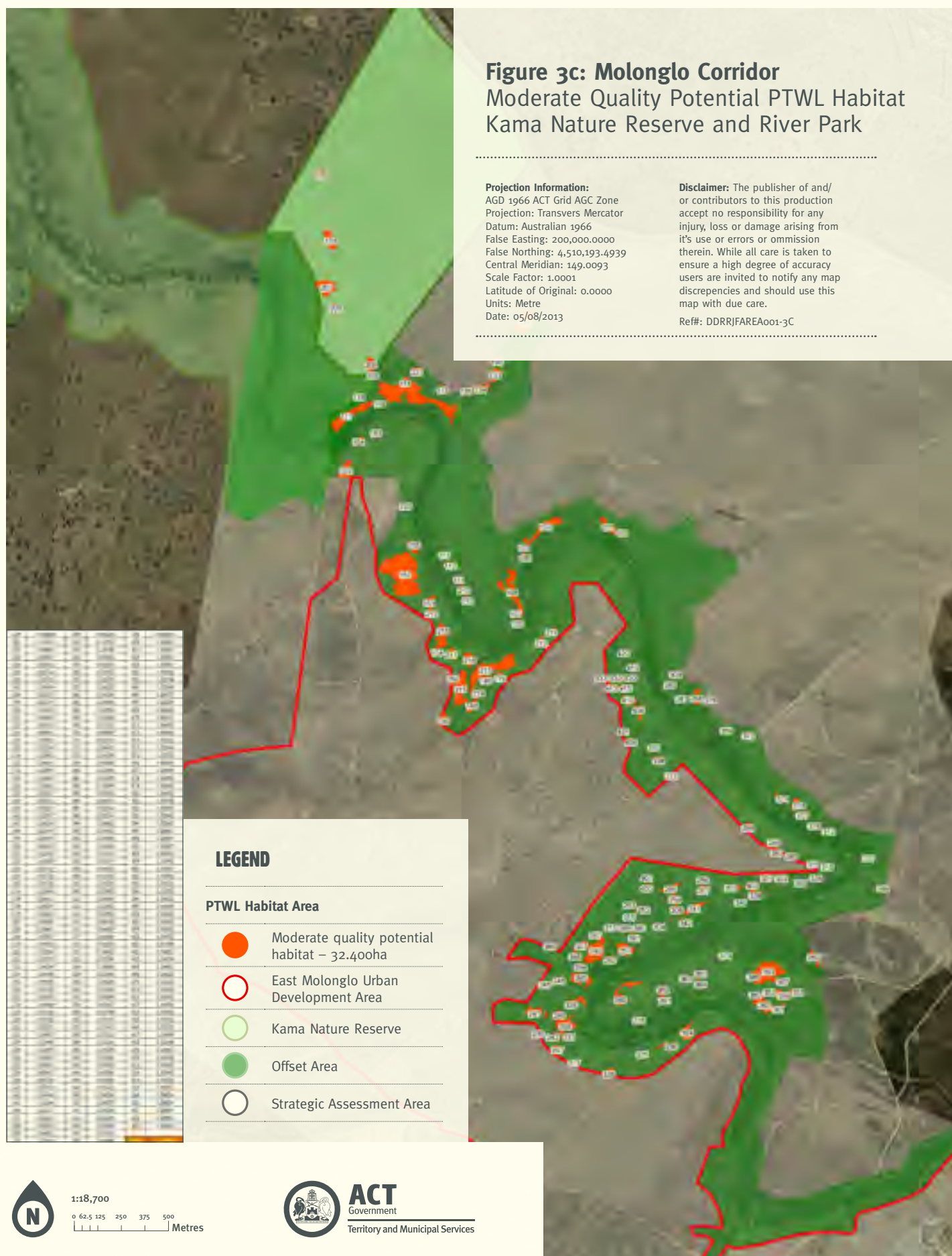
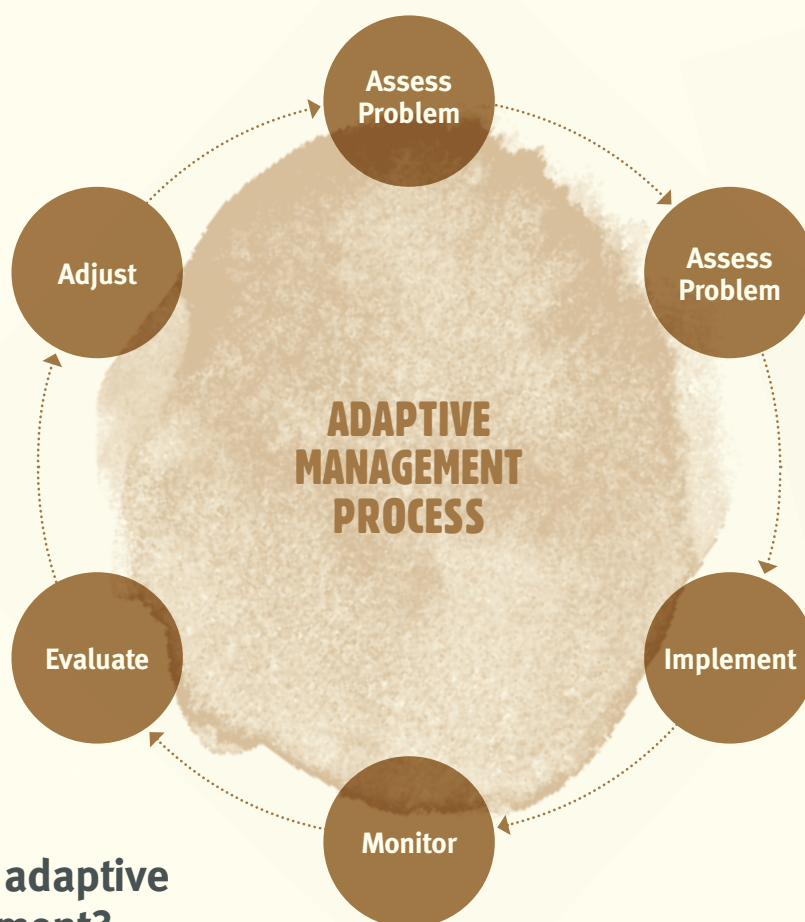


Diagram 1: Adaptive management process (taken from the NES Plan page 36)



1.5 What is adaptive management?

Adaptive management is a scientific approach that combines research, management and monitoring to effectively manage complex ecosystems in the face of threats and uncertainties. Threats and uncertainties generally take the form of pressures or stressors on MNES. These pressures may be anthropocentric (e.g. barriers to movement or disturbance) or natural (e.g. climate variability or 100 year flood events). Resolving threats and uncertainties is a key feature of the adaptive management process.

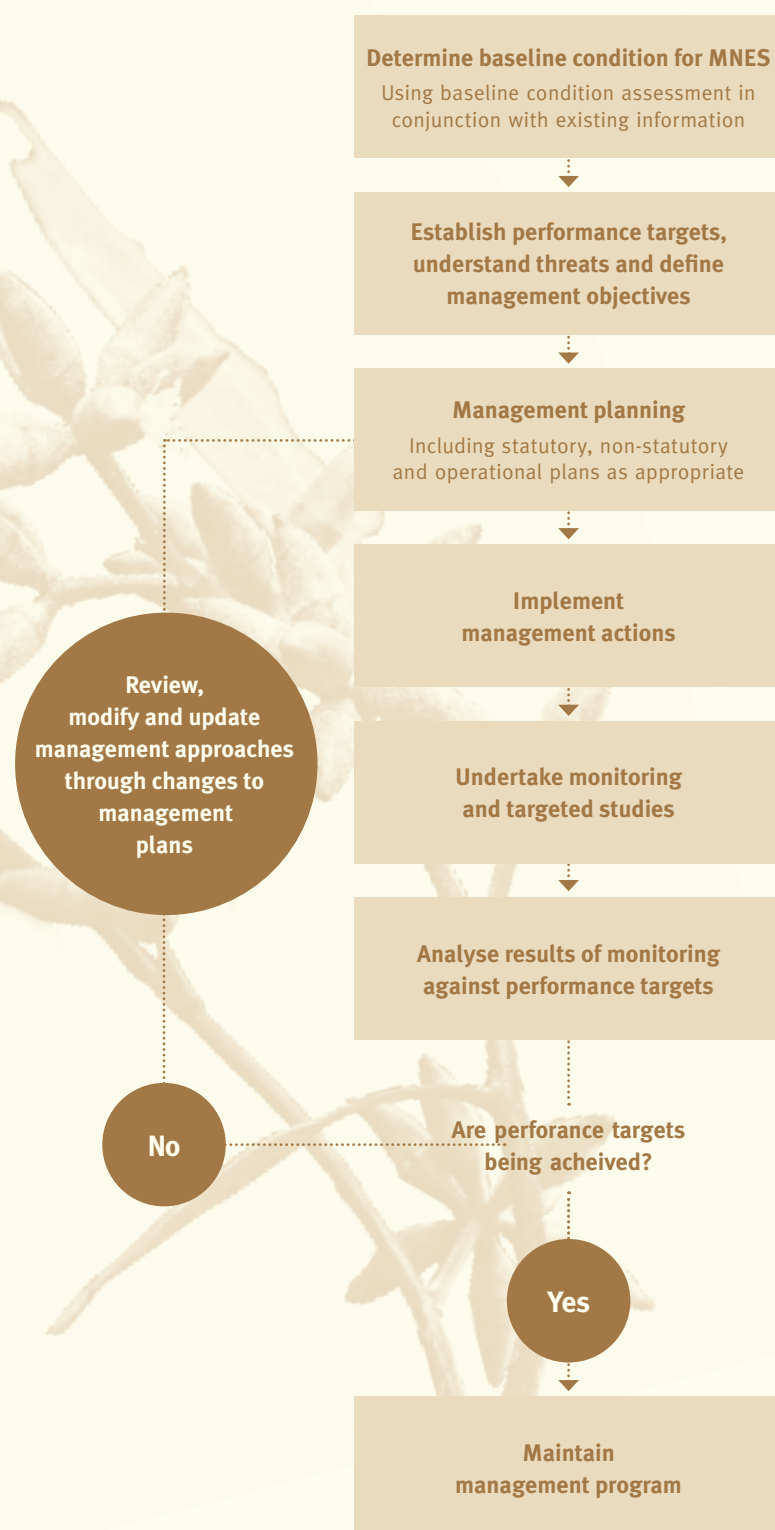
Adaptive management promotes flexible decision-making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood.

In terms of process, adaptive management works through the identification of clear objectives, identifying areas of uncertainty and alternative hypotheses, testing assumptions, monitoring to provide feedback about the system and actions, learning from the system as actions are taken to manage it, and incorporating what is learned into future actions (see Diagram 1).

In summary adaptive management:

- allows resource managers to maintain flexibility in their decisions, knowing that uncertainties exist;
- provides managers the latitude to change direction;
- improves understanding of ecological systems to achieve management objectives; and
- ensures actions are taken to improve progress towards desired outcomes.

In the case of Molonglo, threats to MNES from stressors such as weeds, pests and recreational impacts will be adaptively managed through a program of monitoring and evaluation, and the review and modification of management decisions. Uncertainties, resulting from lack of scientific certainty, will be addressed through a number of targeted studies. These studies form part of the NES Plan commitments (specifically NES Plan action 43). The data collected from these projects will be evaluated and the results incorporated into management planning for the MNES.

Diagram 2: Framework of the AMS

1.6 Framework and structure of the AMS

The Molonglo AMS has been designed to provide consistent and achievable adaptive management of MNES to help ensure the conservation outcomes of the NES Plan are achieved.

The framework of the AMS is shown in Diagram 1.

This is based around a practical application of the adaptive management process (outlined in Section 1.5). The AMS is presented in accordance with this framework as follows:

- Section 2 – Baseline condition assessment.
- Section 3 – Performance targets and milestones for management.
- Section 4 – Threats and management objectives.
- Section 5 – Management planning.
- Section 6 – Uncertainties and targeted studies.
- Section 7 – Monitoring.
- Section 8 – Evaluation and review.
- Section 9 – Reporting.
- Section 10 – Amending the AMS.



Pink-tailed Worm-lizard *Aprasia parapulchella*



2. BASELINE CONDITION ASSESSMENT

DETERMINING THE BASELINE ECOLOGICAL CONDITION OF MNES WITHIN THE STRATEGIC ASSESSMENT AREA IS A CRITICAL FIRST STEP IN THE ESTABLISHMENT OF ADAPTIVE MANAGEMENT WITHIN MOLONGLO. IT ENABLES A CONSISTENT UNDERSTANDING ABOUT THE STARTING CONDITIONS FOR MNES AND ALLOWS FUTURE MONITORING TO GUIDE MANAGEMENT AND UNDERSTAND ITS EFFECTS.

While many ecological studies have been conducted throughout Molonglo, they were predominantly undertaken to identify areas containing (or likely to contain) threatened communities and/or species, and were not carried out with the aim of measuring condition within a framework of an ongoing monitoring program. As a result, baseline condition assessment is required within the strategic assessment area to identify the condition of MNES, issues pertaining to management of those areas, and the monitoring that is required to measure change in condition of MNES over time (this is described in detail within Section 7).

The methodology for the baseline condition assessment is established by Sharp 2012 *Procedures Manual – Baseline Condition Assessment in the Lower Molonglo River Valley Conservation Areas* (the ‘Procedures Manual’). A summary of this process is provided here and for further detail reference should be made to the Procedures Manual itself.

2.1 Baseline condition assessment for Box-Gum Woodland and Natural Temperate Grassland

The baseline condition assessment for Box-Gum Woodland and Natural Temperate Grassland was carried out in early summer of 2012.

2.1.1 Aims

The aims of the baseline condition assessment for Box-Gum Woodland and Natural Temperate Grassland were to (Sharp 2012):

- Collect data to understand the starting conditions for Box-Gum Woodland and Natural Temperate Grassland and provide a benchmark (of condition and diversity) against which changes over time can be compared.
- Identify a strategic conservation goal and desired outcomes for each conservation area.
- Assist in the identification of actions required to manage the conservation areas for conservation (e.g. fencing or revegetation requirements) incorporated into an operational plan for each conservation area.
- Identify what should be monitored to determine if the management being applied has realised the desired outcomes.

It is critical to note that the baseline condition assessment for Box-Gum Woodland and Natural Temperate Grassland

helps to establish the on-going monitoring that will be conducted within each patch (see Section 7), and it is not expected that this initial assessment will be exactly the same as the on-going monitoring.

2.1.2 Methodology

The baseline condition assessment involved:

- Identifying the vegetation community that occurs within each patch.
- Identifying the diversity of plant species and vegetation structure present in each patch and conservation area.
- Identifying habitat features that may be supporting particular groups of fauna species.
- Identifying the condition of each conservation area.
- Identifying issues present that require management intervention (e.g. rabbit disturbance, dumping, erosion and invasive weeds) in each remnant and patch to guide the development and implementation of operational plans.

As part of identifying the condition of the vegetation, a quantitative score will be applied to each patch (out of 100 where benchmark = 100) using the methodology of Gibbons et al 2009 (as adapted for the ACT). This quantitative method provides one means of comparing vegetation condition over the life of the NES Plan (ACTPLA 2011). Other quantitative measurements have also been made that allow for comparison of vegetation and habitat quality within sites over time and between sites at one or more times. These include changes in abundance and distribution of populations of threatened species and invasive weeds and modification to other habitat features (including creation of unauthorised tracks) (see Section 7 for more information).

2.1.3 Application

The baseline condition assessment for Box-Gum Woodland and Natural Temperate Grassland was applied to the areas shown in

Figure 2 and which are described below.

Kama Nature Reserve

Comprising 154.6 ha and incorporating patches:

- Patch A1 (Natural Temperate Grassland) – 22.1ha
- Patch A2 (NTG) – 14.5ha
- Patch B1 (Box-Gum Woodland).- 51.2ha
- Patch B2 (BGW).- 42.7ha
- Patch B3(BGW).- 12.1ha
- Patch O1 (BGW) – 12.0ha

An assessment was undertaken of the buffer zone (Patches O2, O3 & O4) located to the east of the reserve which is not representative of a Threatened Ecological Community.

Arboretum Patch GG and Patch N

- Patch GG1 (BGW) – 43.9ha
- Patch GG2 (BGW) – 3.7ha
- Patch N1 (BGW) – 10.2ha (for rehabilitation)
- Patch N2 (BGW) – 7.8ha
- Patch N3 (BGW) – 3.1ha (for rehabilitation)

Patch N is contiguous with Patch GG.

Patches C and H

- Patch C (BGW) – 6.9ha
- Patch H (BGW) – 8.6ha (not representative of a Threatened Ecological Community)

Patches I, L, M and P

- Patch I (BGW) – 20.7ha
- Patch L (BGW) – 2.2ha
- Patch M1 (BGW) – 6.7ha
- Patch M2 (BGW) – 3.1ha (not representative of a Threatened Ecological Community)
- Patch P1 (BGW) – 7.8ha
- Patch P2 (BGW) – 1.7ha (not representative of a Threatened Ecological Community)
- Patch P3 (BGW) – 3.2ha (not representative of a Threatened Ecological Community)

Patches Q, R, S, T, K and D (Molonglo River Park)

Comprising 71 ha of Box-Gum Woodland these six patches occur within a matrix of other woodland, shrubland and grassland within the Molonglo River Park

- Patch Q(BGW) – 6.0ha
- Patch R(BGW) – 2.5ha
- Patch S (BGW) – 5.6ha
- Patch T (BGW) – 6.4ha
- Patch T1 (BGW) – 4.5ha (for rehabilitation)
- Patch K1(BGW) – 33.2ha
- Patch K2 (BGW) – 10.2ha (for rehabilitation)
- Patch D1 (BGW) – 17.2ha
- Patch D2 (BGW) – 2.3ha (not representative of a Threatened Ecological Community)

Patches West Molonglo

Comprising 38.8ha of Box-Gum Woodland within West Molonglo within Patches 1, 2&3.



Pink-tailed Worm-lizard *Aprasia parapulchella*

2.2 Baseline condition assessment for Pink-tailed Worm-lizard

Baseline condition of Pink-tailed Worm-lizard habitat in the strategic assessment area has been assessed through previous surveys and mapping as part of the EPBC Act strategic assessment process. Figures 3 and 3A-C show the results of these studies for the areas to be conserved within the strategic assessment area.

The baseline condition of Pink-tailed Worm-lizard habitat within the strategic assessment area has been based on qualitative descriptions of habitat condition (Osborne and Wong 2010 and updated from Wong et al 2011) under the following categories:

- high quality (least disturbed – predicted to be occupied by the species);
- moderate quality (intermediate disturbance – predicted to be occupied by the species, abundance may be lower); or
- low quality (most disturbed – likely to no longer support the species).

The monitoring methods for Pink-tailed Worm-lizard habitat are described in detail in Section 7.



Swift Parrot *Lathamus discolor*



2.3 Baseline condition assessment for Superb Parrot and Swift Parrot

A targeted Survey will be undertaken in 2013 to establish the baseline condition of Superb Parrots within the strategic assessment area based on distribution, abundance and breeding status. Monitoring will be carried out subsequently. The surveys will be consistent with Superb Parrot surveys commissioned by the Conservation, Planning and Research unit within the ACT Government within the central Molonglo Valley and Throsby.

In addition, a Survey will be undertaken to establish the baseline condition of Woodland birds in the strategic assessment area. Monitoring will be carried out subsequently and at appropriate intervals. The Woodland bird survey will pick up any changes in the significance of the area to the Swift Parrot.

A close-up photograph of a lorikeet, a small parrot-like bird, perched on a thin brown branch. The bird has bright green plumage on its head and back, with a yellow patch on its chest and a red patch on its throat. It has a small, dark beak and a red eye. The background is a soft-focus view of green leaves and branches, suggesting a natural habitat.

3. PERFORMANCE TARGETS AND MILESTONES FOR MANAGEMENT

The NES Plan establishes the conservation outcomes for MNES in the Molonglo area (see Table 1 in Section 1.4). These take the form of both:

Ecological outcomes

for MNES which include outcomes such as protecting MNES values within the strategic assessment area, enhancing the ecological value of certain areas of Box-Gum Woodland, undertaking targeted studies into the Pink-tailed Worm-lizard and a restoration project for Box-Gum Woodland; and

Administrative actions

to achieve these outcomes such as amending the East Molonglo development boundary to reduce the impact of development on Box-Gum Woodland and the development and approval of an AMS.

This section provides:

Performance targets

which focus on providing a measurable and quantifiable way to determine if the ecological outcomes for MNES are being achieved; and

A process

for establishing milestones for management.

3.1 Performance targets for MNES

3.1.1 Performance targets for Box-Gum Woodland

The performance targets for Box-Gum Woodland are to ensure that:

The Box-Gum Woodland that occurs within the protected areas of the strategic assessment area (see Figure 2) continues to meet the EPBC Act listing criteria for the ecological community (NES Plan Conservation Outcome for Box-Gum Woodland Section 4.1 Outcomes b, c, d & e).

- The ecological condition scores for Box-Gum Woodland in the Kama Nature Reserve, the Molonglo River Park and Patches C, GG1, GG2, N1, N2 AND N3 will be maintained and enhanced (as measured by the ecological condition assessment methodology for Box-Gum Woodland contained in Section 7) (NES Plan Section 4.1 Actions 5, 6, 9, 10, 12, 13, 14 & 15).
- The ecological condition score for Box-Gum Woodland Patches I, L, M1 & P1 will be at least maintained (as measured by the ecological condition assessment methodology for Box-Gum Woodland contained in Section 7) (NES Plan Section 4.1 Actions 16, 17 & 18).
- West Molonglo in accordance with Action 21

3.1.2 Performance targets for Natural Temperate Grassland

The performance targets for Natural Temperate Grassland within the Kama Nature Reserve (see Figure 2) are to ensure that:

- The Natural Temperate Grassland continues to meet the EPBC Act listing criteria for the ecological community. (NES Plan Section 4.2 Outcome b).
- The ecological condition of Natural Temperate Grassland will be maintained and enhanced (as measured by the ecological condition assessment methodology for Natural Temperate Grassland contained in Section 7) (NES Plan Section 4.2 Actions 25 & 26).

3.1.3 Performance targets for the Pink-tailed Worm-lizard

The performance targets for the Pink-tailed Worm-lizard are to ensure that:

- The ecological condition of high and moderate quality Pink-tailed Worm-lizard habitat located within the Offset Areas of the strategic assessment area (other than on the Lower Molonglo Nature Reserve) (see Figure 3B and C) will be maintained and enhanced (as measured by the ecological condition assessment methodology for Pink-tailed Worm-lizard habitat contained in Section 7) (NES Plan Section 4.3 Actions 32, 33, 34, 35, 36, 37, 38, 41 & 42).
- The ecological condition of high and moderate quality Pink-tailed Worm-lizard habitat located within the Lower Molonglo Nature Reserve (see Figure 3A) will be maintained (as measured by the ecological condition assessment methodology for Pink-tailed Worm-lizard habitat contained in Section 7) (NES Plan Action 40).

- The Pink-tailed Worm-lizard is protected within the strategic assessment area outside of the development and offset areas (Figure 3A) (Action 41 & 42).

3.1.4 Performance targets for the Superb and Swift Parrots

The NES Plan states that “given the clear link between Box-Gum Woodland areas containing an overstorey and habitat values for these two species, many of the conservation outcomes and actions for Box-Gum Woodland will also provide positive outcomes for the Superb and Swift Parrots” (NES Plan Section 4.4 p 34). As such, it is anticipated that the achievement of performance targets and the management of Box-Gum Woodland will provide positive outcomes for the Superb and Swift Parrots. This assumption will be tested through monitoring (see Section 7.4).

3.2 Milestones for management

Within the overarching framework established by the performance targets, a key aim of the AMS for many of the conservation areas is to ensure ‘enhancement’ of ecological condition. This is a process that will provide for continual improvement and in order to achieve that, milestones for ecological condition will need to be set and revised over time.

The process of setting and revising milestones for management (in line with performance targets) will occur as part of the adaptive management cycle. Key elements of this cycle are described in particular in:

- Section 5 – Management planning; and
- Section 8 – Evaluation and review.



4. THREATS AND MANAGEMENT OBJECTIVES

THE IDENTIFICATION OF KEY THREATS TO THE ACHIEVEMENT OF CONSERVATION OUTCOMES AND PERFORMANCE TARGETS FOR MNES IS CRUCIAL TO THE AMS. IT IS THE PRE-EMPTIVE IDENTIFICATION OF THREATS AND THE SUBSEQUENT ACCOUNT OF THEM INTO MANAGEMENT PLANNING THAT DISTINGUISHES AN ADAPTIVE MANAGEMENT APPROACH FROM ONE OF TRIAL AND ERROR.

It is important to note the distinction between threats and uncertainties. In the context of the Molonglo AMS, threats refer to pressures on MNES which can be managed with a high degree of certainty to ensure that conservation outcomes and performance targets are met. Uncertainties relate to those areas of MNES ecology where current scientific practices and ecological knowledge is more limited. The achievement of conservation outcomes and performance targets does not necessarily result in the management and resolution of uncertainties. Uncertainties and their management through targeted studies are explained in Section 6.

The key threats to achieving the conservation outcomes and performance targets for the MNES are as follows:

- weeds;
- pests;
- fire and fuel suppression;
- impacts from recreation;
- soil and water contamination;
- soil erosion;
- tree planting in Natural Temperate Grassland and tree planting or revegetation projects in Pink-tailed Worm-lizard habitat; and
- increased resource competition from both native and exotic species.

The adaptive management of these issues is addressed through the setting of objectives for each threat and through the monitoring of MNES to ascertain where any changes to management may be required.



4.1 Management objectives for weeds

The objectives for weed management in the MNES areas protected under the NES plan are (to the greatest extent possible):

- control the major environmental weeds or reduce them to ecologically benign maintenance levels;
- reduce the incursion and spread of new weeds through coordinated action, hygiene controls, visitor management, surveillance, staff training, community education and rapid response following reports of new weeds and following disturbance events such as earthworks, fire, drought or floods; and
- locate, design and manage infrastructure, facilities and activities to minimise potential weed risks.
- These objectives will be attained through implementation of the operational plans (see Section 5) for each area of protected MNES in the strategic assessment area. These operational plans will be guided by the:
 - Ecological Management Guidelines for the Molonglo River Corridor (ngnvironmental et al in prep);
 - determination of Weeds of National Significance (Thorp & Lynch n.d.);
 - list of species declared under section 7 of the *Pest Plants and Animals Act 2005*;
 - ACT Weeds Strategy 2009-2019 (DECCEW 2009); and
 - performance targets for the MNES contained in this strategy.

ACT Weeds Strategy 2009-2019

Along with a range of other listed statutory and policy tools, the ACT Weeds Strategy 2009-2019 underpins the operational plans (see Section 5). It is based on the following best practice principles:

- Weed management is essential for the sustainable management of natural resources and the environment and for social well-being, and requires an integrated, community-wide approach.
- Prevention and early intervention are the most cost-effective approaches that can be deployed against weeds.

- Successful weed management requires a coordinated approach involving all levels of government in partnership with industry, landholders and community.
- All land managers have a duty of care to manage weeds on their land.
- Community interests shall be protected from weeds by appropriate legislation.

4.2 Management objectives for pests

The objectives for pest management in the MNES areas protected under the NES plan are (to the greatest extent possible):

- control major pest animal populations or reduce them to ecologically benign maintenance levels;
- reduce the incursion and spread of new pest animals through coordinated action, fencing, surveillance, staff training, community education and rapid response following reports of new pests; and
- locate, design and manage infrastructure, facilities and activities to minimise potential pest risks.

These objectives will be attained through implementation of the operational plans (see Section 5) for each area of protected MNES in the strategic assessment area. These operational plans will be guided by the:

- Ecological Management Guidelines for the Molonglo River Corridor (ngnvironmental et al in prep);
- ACT Pest Management Strategy 2012–2022 (ESDD 2012);
- ACT Vertebrate Pest Management Strategy (Environment ACT 2002); and
- Pest Animal Control Plan which covers the MNES conservation areas.

The ACT Pest Management Strategy 2012–2022 (ESDD 2012) and the ACT Vertebrate Pest Management Strategy (Environment ACT 2002) underpin the operational plans and provide a framework for managing pest animals across all land tenures in the ACT.

ACT Pest Management Strategy 2012–2022

The ACT Pest Management Strategy 2012–2022 (ESDD 2012) is based on a series of principles, including:

- The need to understand the attitudes and concerns of the key individuals and groups that have a significant interest in the pest animals.
- Prevention and early intervention are the most cost-effective management techniques.
- Management programs should strategically target actual (rather than perceived) pest problems.
- Pest animal damage should be managed using a risk-based, whole-of-system approach.
- Accurate monitoring and evaluation of management programs is required.
- Coordination between government agencies, industry, land and water managers and the community is required.

ACT Vertebrate Pest Management Strategy

The ACT Vertebrate Pest Management Strategy (Environment ACT 2002) is based on the following principles:

- Management of pest animal damage.
- Management of new or potential pests.
- Coordination of vertebrate pest management programs.
- Increasing knowledge, awareness and understanding.
- Monitoring and assessment.

Pest Animal Control planning

Pest animal control planning will be incorporated into the operational plans for the MNES conservation areas and will address the following principles and protocols:

- Pest control planning will consider the need for management action, the feasibility of control and the assessment of an integrated set of control options, including habitat destruction or modification, biological control (disease), fertility control and pesticides.

- Major pest animal occurrences and the extent and significance of impacts of these species will be identified, mapped and monitored. Potentially significant or potential future problems will also be recorded, mapped and monitored (such as hollows colonised by European Bees and European Wasps and aquatic organisms).
- Priority species for control will include species predating on or displacing native fauna, inhibiting the revegetation and regeneration of woodland and grassland ecological communities and riparian areas, representing threatening processes affecting threatened species.
- Control measures will be managed to ensure that they do not significantly impact non-target native fauna, or have undesirable indirect consequences (such as exacerbating other pest animal or plant problems).
- Ongoing management access for pest animal control will be maintained throughout the strategic assessment area, and coordinated with access requirements for weed control and fire protection.

4.3 Management objectives for fire

The objectives for fire management and biomass control in relation to MNES are to ensure ecological condition targets are achieved through:

- balancing the priorities of biodiversity conservation, fire management and urban development;
- maintaining acceptable fire regimes within the MNES protected areas which support the conservation of significant flora and fauna species, vegetation communities and key fauna habitats, the protection of soils and water quality and the protection and enhancement of landscape function. As required under the *Emergencies Act 2004*, meeting the fuel management and other standards as specified in the Strategic Bushfire Management Plan Version Two (ACT Government 2009);
- managing herbaceous groundcover biomass using slashing, grazing, burning or other methods to reduce fire fuel, where this will not negatively impact ecological values by destroying or reducing habitat values, increasing weed invasion, destroying revegetation or preventing natural regeneration. Where it is considered biomass management techniques threaten to negatively impact ecological values, other biomass or urban

design features will be developed to meet the standards specified in the Strategic Bushfire Management Plan Version Two (ACT Government 2009); and

- maintaining fuel hazard levels which meet biodiversity conservation as well as human life and property protection objectives.

These objectives will be attained through implementation of the operational plans (see Section 5) for each area of protected MNES in the strategic assessment area.

These operational plans will be compatible with the Strategic Bushfire Management Plan Version Two (ACT Government 2009) and the Fire Management Plan for the Molonglo River Park (ACT Government in prep).

Strategic Bushfire Management Plan Version two

This plan identifies strategies and actions to suppress and reduce the impacts of bushfires while taking into account the management of built, environmental (ecological, hydrological and physical), agricultural and cultural assets.

The Strategic Bushfire Management Plan Version Two (ACT Government 2009) identifies a series of core principles which apply to fire management and the management of MNES within the strategic assessment area. These principles include:

- rapid fire detection and response;
- science-based risk management;
- strategic use of planned fires for fuel reduction;

- the identification of desirable fire regimes to maintain the ecological integrity of ecosystems; and
- that adverse biodiversity impacts may occur if planned fire regimes do not reflect natural processes adequately, noting that in some cases, planned fire regimes may differ from the natural regimes, and may cause changes to natural ecosystems.

Fire Management Plan for the Molonglo River Valley

The Fire Management Plan for the Molonglo River Park will specifically address the conservation of MNES values. The Plan will consider the interplay between Box-Gum Woodland and Natural Temperate Grassland resilience and connectivity and Pink-tailed Worm-lizard habitat requirements with fire protection objectives. It will also consider access trail locations and strategic advantage zones and develop a prioritised program of works.

Fire management activities for the purposes of protecting the urban development east of Kama Nature Reserve will be undertaken outside Kama Nature Reserve. The prescribed eastern buffer zone for Kama Nature Reserve is to ensure that fire management is undertaken outside of the Reserve and will provide protection against urban edge effects.

4.4 Management objectives for recreation

The objective for managing impacts from recreation on the MNES areas protected under the NES plan is:

- the control of public use commensurate with promoting an appreciation of ecologically sensitive areas.

This objective will be attained through implementation of the operational plans (see Section 5) for each area of protected MNES in the strategic assessment area. These operational plans will be guided by the Molonglo River Park Concept Plan (see Section 5). This plan addresses the protection of Pink-tailed Worm-lizard habitat through establishing principles and protocols for recreational use including:

- identification of high use sites such as picnic areas, fishing spots, walking trails and vantage points;
- identification of vehicular and pedestrian river crossing sites;
- identification and management of illicit disturbance such as turning or rolling rocks and rock theft;
- control of pedestrian routes through the strategic placement of walking tracks and barriers; and
- regulation of horse riding, mountain bike riding and unleashed dogs.

The statutory plan of management, described in Section 5.2, will provide the legislative basis for these recreation management objectives.

4.5 Management objectives for soil and water

The objectives for soil and water management in the MNES areas protected under the NES plan are:

- to maintain and enhance the ecological functions and processes;
- to prevent active erosion;
- to stabilise existing active erosion;
- to ensure water run-off into the river corridor is of high quality; and
- to avoid soil compaction, disturbance and increased nutrient levels.

There are several comprehensive references which guide the protection of soils and water in the ACT. These guides are used both during and post construction and development. They include:

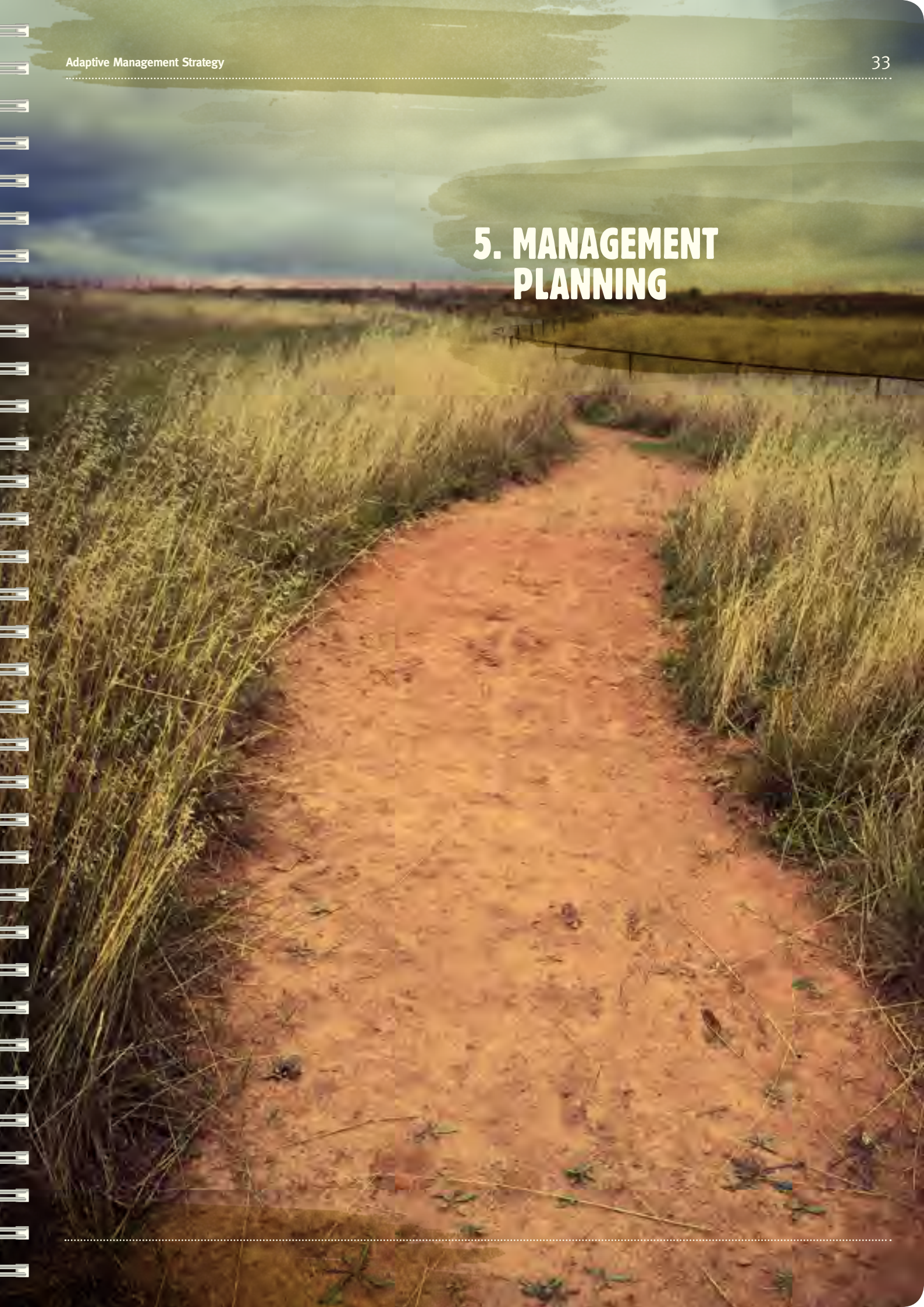
- Landcom (2004) Managing Urban Stormwater: Soils and Construction (the 'Blue Book');
- DECC (2008b) Managing Urban Stormwater, Soils and Construction; and
- ACT Think Water (ACT Government 2004), ACT Water Sensitive Urban Design General Code (ACTPLA 2009).

The implementation of these guidelines, both within and around the Molonglo Valley, will promote the protection of soil and water values and dependent flora, fauna and ecosystems.

Water quality and environmental flows in the Molonglo strategic assessment area are regulated by the following statutory instruments:

- Schedule 4 of the *Environment Protection Regulation 2005* which prescribes allowable standards for various water uses; and
- the *Water Resources Act 2007* which requires that water needed to maintain river systems and associated ecosystems is identified and reserved for that purpose. The ACT Environmental Flow Guidelines 2011 (ESDD 2011) give effect to this requirement.

5. MANAGEMENT PLANNING



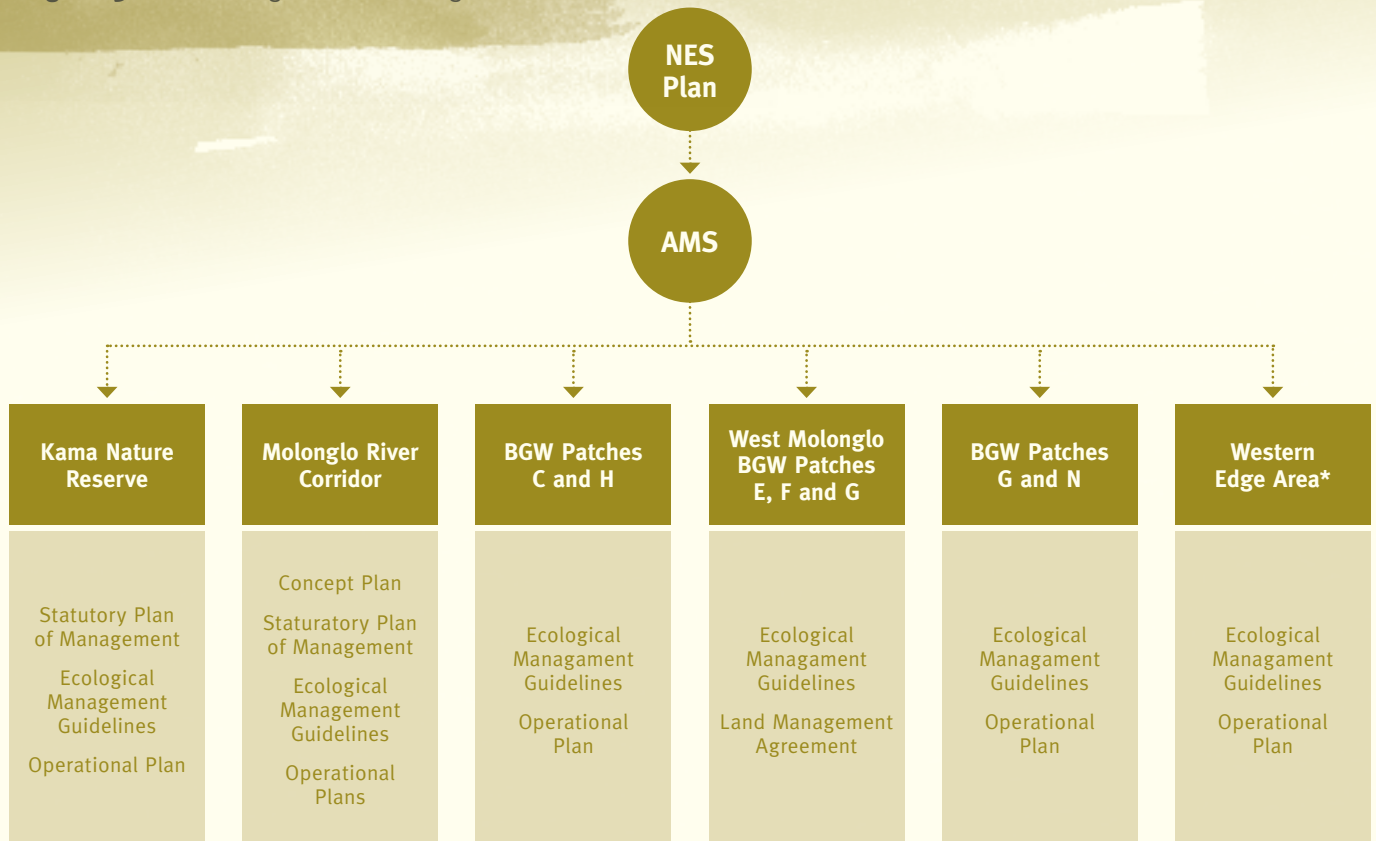
The NES Plan sets out the planning regime for protecting MNES in the Molonglo strategic assessment area. In doing so the NES Plan commits the ACT Government to the development of the following suite of plans:

- Molonglo River Park Concept Plan;
- Statutory plans of management for Kama Nature Reserve and the Molonglo River Corridor; and
- Management plans for different areas of MNES (refer to footnote 4 below).

The AMS refines this planning process to ensure the NES Plan's conservation outcomes are met. The planning framework for the AMS is illustrated in Diagram 2 and 3. Importantly, in terms of adaptive management it is the operational plans that are of most significance. These plans have no statutory prescriptions and are hence best placed to respond to the evaluation results and recommendations arising from the monitoring program (Section 7), and it is the operational plans which complete the adaptive management loop (Diagram 2 and 3).

Pink-tailed Worm-lizard protective fence

Diagram 3: AMS Management Planning Framework



* The western edge area occurs on the western side of East Molonglo. It contains BGW and PTWL habitat (see Figures 2 and 3)

It is important to note that:

- The NES Plan commits the ACT Government to developing and implementing management plans for:
- Kama Nature Reserve (for Box-Gum Woodland, Natural Temperate Grassland and high and moderate quality Pink-tailed Worm-lizard habitat).
- Molonglo River Park (for Box-Gum Woodland and high and moderate quality Pink-tailed Worm-lizard habitat).
- Box-Gum Woodland patches:
- GG;
- C, H & N; and
- I, L, M & P.
- The high and moderate quality Pink-tailed Worm-lizard habitat that occurs within the strategic assessment area and outside of the development and offset areas.
- The NES Plan provides a set of overarching principles that will inform both the AMS and the management plans. The NES Plan also provides a list of issues to be incorporated into the management plans. These principles and issues have been incorporated into:
- this Adaptive Management Strategy; and/or
- the Ecological Management Guidelines (nghenvironmental et al in prep) and/or
- the operational plans (see Figure 4 and Figure 5); and/or
- in the case of establishing 20 m buffers to protect high and moderate quality Pink-tailed Worm-lizard habitat, the Molonglo River Park Concept Plan.

Collectively these plans encompass the NES Plan's commitments to developing and implementing management plans.

- The NES Plan commits the ACT Government to developing statutory plans of management for Kama Nature Reserve and the Molonglo River Park. These statutory plans will be developed as one document and will incorporate the Lower Molonglo River Corridor 2001 statutory plan of management.
- The Ecological Management Guidelines (nghenvironmental et al in prep) combined with the operational plans for the MNES areas fulfill the NES Plan commitment (NES Plan section 4.6) to develop management plans.

5.1 Molonglo River Park Concept Plan

The Molonglo River Park Concept Plan (Concept Plan) is one of the major commitments in the NES Plan. The Concept Plan is relevant to the AMS as it informs the development of the statutory plan of management for Kama and the Molonglo River corridor.

The Concept Plan was developed in 2011 and finalised in 2012 in parallel with the Molonglo Valley Stage 2 planning and design framework. It was developed because the interrelationship between the Molonglo Valley development and the river park is critical to the overall future success of Molonglo Valley as Canberra's newest residential area.

The Concept Plan was developed to:

- enhance environmental values in the river corridor, including protection of threatened flora and fauna species, weed removal and heritage protection;
- provide appropriate recreation opportunities to the Molonglo River for the community that does not impact on environmental values;
- provide trail networks for a range of users including walkers, cyclists, vehicles and maintenance, that links with the wider National Capital Open Space System; and
- provide a plan for bushfire management, land-care and landscape works, and public education, interpretation and research.

The Concept Plan also establishes areas to be designated as nature reserve and special purpose reserve.

5.2 Statutory plan of management

The *Planning and Development Act 2007* (Planning Act) is the main ACT Government statute governing the management of the Molonglo River Corridor and Kama Nature Reserve, and the MNES values within these areas.

The Planning Act (s. 317, Schedule 3) provides for the identification of Public Land and defines management objectives for these areas. The Molonglo River Corridor¹

¹ Note that as at September 2012 the Molonglo River Corridor was zoned Special Purpose Reserve under s317, Schedule 3 of the Planning Act. Rezoning of parts of the river corridor to Nature Reserve will be considered pursuant to the River Park Concept Plan, the NES Plan commitment for the Concept Plan to establish the management areas for the river corridor, and the development of the statutory plan of management for the river corridor.

and Kama Nature Reserve are Public Land reserved for the purposes of Special Purpose Reserve and Nature Reserve respectively. Under Schedule 3 the management objectives for a Nature Reserve are:

- To conserve the natural environment.
- To provide for public use of the area for recreation, education and research.

The statutory requirements for plans of management are extensive. Part 10.4 of the Planning Act prescribes that plans must be subject to a full public consultation process, they must be referred to a Legislative Assembly Standing Committee, they must receive Ministerial approval, and they must be presented to the ACT Legislative Assembly as a Disallowable Instrument. Statutory Plans of Management must be reviewed at least every 10 years.

It is important to note that the NES Plan commits the ACT Government to developing statutory plans of management for Kama Nature Reserve and the Molonglo River Park. These plans however are to be combined into one and, further, the Lower Molonglo River Corridor Statutory Plan of Management (2001) will also be integrated into this single document. The conservation outcomes from the amalgamation of these three areas will be significant. A single plan will ensure consistency of objectives and management for each of the MNES while reducing the risk of fragmentation and inconsistent management approaches for the different locations of MNES.

5.3 Ecological Management Guidelines

The Ecological Management Guidelines (nghenvironmental et al in prep) have been developed to guide the conservation of natural values in the Lower Molonglo River Valley. They are complementary with the AMS and required outcomes for MNES defined in the NES Plan. They are intended for use by design professionals, land managers and planners to inform conservation planning, design and development activities.

The Ecological Management Guidelines cover the conservation of natural values of MNES within the strategic assessment area as well as broader biodiversity values such as Riparian Woodland, Snow Gum Woodland, Red Stringybark – Scribbly Gum Tableland Forest, Black Cypress Pine Tableland Open Forest, and the flora and fauna within these communities. These non-MNES communities are subject to different regulatory prescriptions under ACT laws and policies.

The Ecological Management Guidelines will inform the content of the operational plans and works plans, and contain general management principles which set out the objectives, protocols and methods, and monitoring and management recommendations for:

- protecting ecological values;
- fire management and biomass control;
- weed control;
- pest animal control;
- soils and water protection; and
- restoration and extension.

In addition to the Ecological Management Guidelines, the ACT Government has developed a Procedures Manual (Sharp 2012) that sets out in detail the methods for undertaking the baseline condition assessment and the ongoing monitoring.

5.4 Operational plans

Operational plans are the key day-to-day management planning tool that will provide detail about on-ground works and activities that will implement the key components of the AMS. The operational plans, together with the Ecological Management Guidelines (nghenvironmental et al in prep) will be the primary mechanism for providing for adaptive management approaches based on the results of monitoring, evaluation and review. Operational plans incorporate the requirements of the statutory plan of management, the ACT Strategic Bushfire Management Plan, the ACT Weeds Strategy and other ACT Government plans and policies as relevant.

Development of the specific management approaches outlined in the operational plans will be informed by the:

- MNES values of each operational plan area;
- conservation outcomes and performance targets for MNES;
- key documents identified in relation to management objectives (see Section 4);
- Ecological Management Guidelines; and
- results of monitoring, evaluation and review described in this AMS.

Operational plans will be developed and implemented across the areas identified in figure 4 and figure 5. They will be subject to review and updated as necessary (see Section 8). They are developed by the TAMS Directorate.



Pink-tailed Worm-lizard protective fence

Operational plans provide the following information:

- GIS information relating to;
- physical assets;
- ecological assets;
- fire history;
- regional bushfire planning; and
- location of specific studies or activities (e.g. monitoring, survey and research programs).
- Past management actions including grazing, fuel hazard reduction, pest and weed control and fencing.
- Any research, monitoring or survey programs that have been or are being conducted on the land.
- Management issues, for example a description of fallen timber, pressure from kangaroo grazing, rabbit numbers, prevalence of weed species, bushfire mitigation actions, plantings and visitor use.
- Performance targets and management objectives for the area.
- Prioritised actions necessary to achieve the performance targets and management objectives.

Operational plans are put into effect through works programs. Work programs will be reviewed and updated annually. Works programs are a set of instructions providing relevant personnel with the following information:

- description of activity;
- plant and equipment requirements, such as herbicide application instructions and vehicle numbers and type;
- location of work (map references and size of area);
- scheduled start and finish times;
- training requirements; and
- stand-by or contingency arrangements, for instance certain rainfall levels will reduce the effectiveness of herbicide.

5.5 Land Management Agreements

Land Management Agreements (LMAs) are required for all rural leases under section 283 of the Planning Act. LMAs provide a basis for co-operative land management regimes between lessees of land in the Australian Capital Territory and ACT Government agencies responsible for managing rural and non-urban land for the Territory.

While LMAs are a cooperative mechanism between landholders and the government, they are subject to compliance and enforcement action under sections 339 and 361 and Schedule 2 of the Planning Act. Further, under the *Nature Conservation Act 1980*, the Conservator of Flora and Fauna can issue conservation directions to the occupier of land for the protection or conservation of native animals, native plants and native timber on the land.

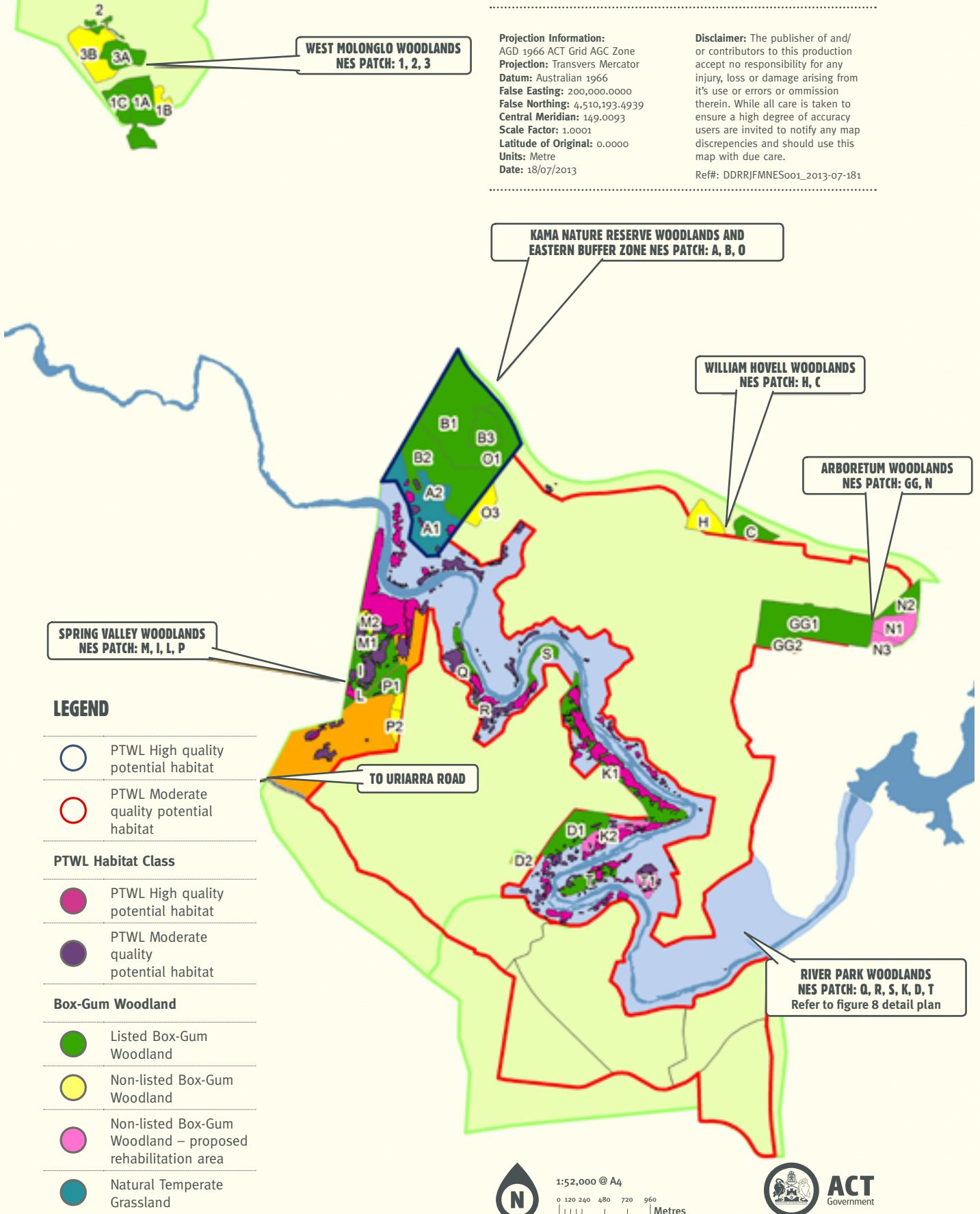
LMAs are the regulatory mechanism by which the NES Plan commitments and the AMS can ensure the conservation objectives for Box-Gum Woodland on rural leases are met.

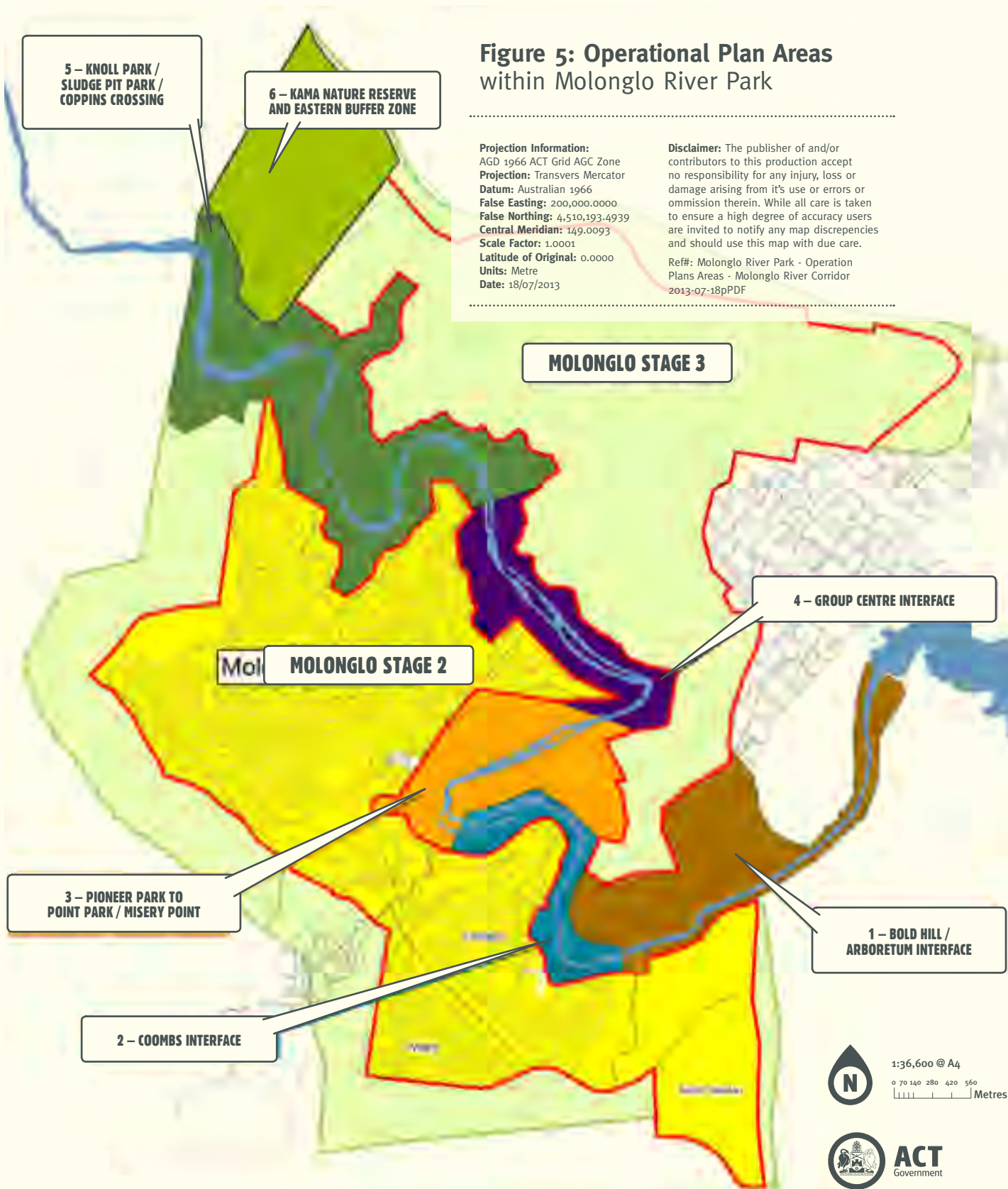
5.6 Patch GG and the Arboretum

Patch GG is to be incorporated into the National Arboretum Canberra (Arboretum). The operational plan for Patch GG will be managed through the Arboretum's planning regime in accordance with the AMS. The adaptive management of Patch GG through the AMS is assured through the Arboretum's administrative and regulatory provisions.

Planning and development of the Arboretum is overseen by an ACT Government constituted Board of Governors. The Board is made up of academic experts and executive administrators. The Arboretum is under the jurisdiction of the TAMS Directorate.

Figure 4: Operational Plan Areas within Strategic Assessment Area





6. UNCERTAINTIES AND TARGETED STUDIES

UNCERTAINTY IN RELATION TO THE MANAGEMENT OF ECOLOGICAL SYSTEMS IS UNAVOIDABLE DUE TO THE INHERENT COMPLEXITY OF THE BIOLOGICAL, PHYSICAL, CHEMICAL AND SOCIAL INTERACTIONS WITHIN SUCH SYSTEMS.



Key uncertainties for the management of MNES in the Molonglo strategic assessment area include:

- the best methods for the restoration and rehabilitation of Box-Gum Woodland;
- how to monitor populations of the Pink-tailed Worm-lizard in a low impact way; and
- the best methods for the restoration of Pink-tailed Worm-lizard habitat.

Targeted studies will be carried out to address each of these issues, and the results of the studies will be assessed and incorporated into the adaptive management process through review and evaluation (see Section 8).

6.1 Box-Gum Woodland restoration project

The Box-Gum Woodland restoration project involves the use of species indigenous to the Molonglo valley with a view to restoring Box-Gum Woodland on Misery Hill². Seed collected from within the strategic assessment area will also be stored for future restoration projects (Section 4.7 NES Plan).

Table 2 outlines the activities that will be undertaken as part of the project. It is important to note that the monitoring and evaluation activity described in Table 2 will be undertaken as part of the AMS review and evaluation process outlined in Section 8.

In terms of process the following activities will apply:

- Establishment of baseline condition through vegetation surveys which were carried out in two stages through a winter 2012 and a spring 2012 survey.
- Establishment of baseline condition (see Section 2) will inform the development of a restoration plan for the Misery (Barrer) Hill Box-Gum Woodland. Note that this restoration plan will contain all the activities described in Table 2.
- The restoration plan will inform the operational plan (see Section 5) to be developed and implemented at Misery (Barrer) Hill.
- Restoration works will complement existing ecological values. For example, no tree planting will occur in areas of existing or potential Pink-tailed Worm-lizard habitat and planting of any understorey vegetation in these areas will be undertaken only after agreement by reptile ecologists.

² Misery Hill has been nominated for a change of name to “Barrer Hill” by the Bush on the Boundary (Molonglo) and Molonglo Catchment Groups.

Table 2: Box-Gum Woodland restoration project

Core Activity	Activity Description
1. Site assessment & recommendations	Field visits to Box-Gum Woodland sites to be lost to development and sites to be kept and enhanced: <ol style="list-style-type: none"> 1. Identify presence and frequency of plant species – native and exotic 2. Recommend species to introduce, reintroduce or increase underrepresented populations 3. Investigate the merits and processes of translocating Box-Gum Woodland species from areas to be lost to Misery Hill (especially key understorey species) 4. Develop a seed supply and propagation works plan referencing items 1 & 2 above and drawing on the availability of collecting plant material from nearby sites of higher quality
2. Rehabilitation Scoping Study	Scope a woodland revegetation and restoration plan that will factor development stages, weed management & incorporate local knowledge about species availability and successful reestablishment approaches
3. Seed supply & plant rescue future use at Misery Hill	<ol style="list-style-type: none"> 1. Identify current provenance stock in regional seed banks that would be suitable for use in high-conservation box gum woodland restoration 2. Collect, process and store needed seed in accordance to the national code of practice, “FloraBank” 3. Rescue plants or collect plant material from species of significance that will be destroyed – this may involve establishing temporary or permanent seed production areas in consultation with the ACT Government
4. Plant production	Seasonally propagate plants in accordance to the rehabilitation plan e.g. quantities and species
5. On-ground rehabilitation works	Deliver staged works in accordance to the rehabilitation plan. This will be seasonally influenced by the weather e.g. best time for planting is autumn & spring
6. Monitoring and evaluation	<p>Establish benchmark data & monitor rehabilitation success using scientifically credited performance measurements already adopted by regional leaders in rehabilitation assurance</p> <p>Throughout the duration of the 30 year plan results will be used to review on-ground ecological performance and where relevant implement best practice change or modification</p>

6.2 Pink-tailed Worm-lizard targeted studies

The following two targeted studies will be undertaken in relation to the Pink-tailed Worm-lizard (Section 4.8 NES Plan).

6.2.1 Direct low impact monitoring methods for the Pink-tailed Worm-lizard

Background

The construction of urban infrastructure immediately adjacent to occupied habitat in the Lower Molonglo River corridor may have adverse effects on the Pink-tailed Worm-lizard. Although the habitat may not obviously change, there may be an increase in some threatening processes (for example increased predation by cats, changes in soil surface hydrology, disturbance to rocks and spread of weeds). A further potential threat to the Pink-tailed Worm-lizard habitat is the spread of Burgan (*Kunzea ericoides*), which is a native shrub capable of colonising open ground, including Pink-tailed Worm-lizard habitat, and forming dense thickets.

The Draft National Recovery Plan (Brown in prep) for the Pink-tailed Worm-lizard notes that monitoring the species by the standard survey method of searching beneath stones is problematic because it results in considerable disturbance when the stones are moved. Due to the fact that monitoring requires repeated visits to a site, and



Pink-tailed Worm-lizard habitat extension and connectivity works

hence repeated turning of stones, the plan recommends that the technique of rock turning should only be used once at a site unless effective alternative low impact techniques are discovered or if impacts can be mitigated.

There is no obvious alternative to the technique of searching beneath rocks as an approach to surveying the species. In the past some specimens have been caught in pitfall traps (Rauhala 1993). However, an extensive trial of pitfall traps near suitable occupied habitat at the Lower Molonglo Water Quality Control Centre undertaken by Jones (1999) was unsuccessful – no lizards were caught despite months of trapping.

In order to address the recommendations in the Draft Recovery Plan and ensure the objectives and performance targets for the Pink-tailed Worm-lizard are met, a less invasive procedure for monitoring the relative abundance of the species is required.

Study outline

The study is based on the potential for artificial refuges to be incorporated into the monitoring program (see Section 7). The provision of artificial refuges (e.g. shelter sites made by placing concrete slabs, bricks, boards, roof tiles, corrugated iron on the ground at suitable locations) has been successfully used for many species of ground layer reptiles (Croak et al 2010; Grant et al 1992) including other species of legless lizards (Brown in prep).

In the ACT it appears that rocks are the preferred shelter substrates because they favour the establishment of ant colonies that the Pink-tailed Worm-lizard feeds on and because they provide ideal thermal conditions and protection from predators. Very few individuals have ever been found under logs or timber in the ACT (Wong et al 2011). The species has been found under rocks and paving bricks placed within or near occupied habitat, under dislodged stones in areas that have been previously ripped for tree planting (Osborne and Wong unpublished observation), and recently under roof tiles laid out as part of a survey for striped legless lizard in East Fyshwick.

There will be four strategically placed sites for conducting the artificial habitat trials. Population monitoring will occur at these sites and the results will be evaluated and incorporated into the adaptive management review and evaluation process (see Section 8).

6.2.2 Pink-tailed Worm-lizard habitat restoration

Background

The Molonglo River corridor is particularly important for the Pink-tailed Worm-lizard because the interconnected linear nature of the reserve and adjacent landscapes provides extensive corridors of habitat that potentially allow for dispersal and gene flow between populations. The maintenance of such processes is essential for effective conservation and is an important consideration with respect to the planning of urban development in the Molonglo Valley. Parts of the corridor are in very poor ecological condition because of the former use of the area for softwood production, and the clearing of native vegetation and establishment of exotic pasture.

There have been no studies conducted to determine whether Pink-tailed Worm-lizard habitat can be restored to a condition suitable for re-occupation by the species. However, it may be possible, using the knowledge of the species habitat (e.g. Jones 1999; Wong et al 2011) to design an approach that is practicable.

Study outline

The project will involve the development and implementation of guidelines for restoration of habitat located in the Lower Molonglo Valley. These guidelines will focus on habitat occurring within the Molonglo River Corridor reserve upstream of the western edge of the former Blewett's pine forest block. There is considerable potential for this area to be rehabilitated as habitat for the species. The guidelines will take an experimental approach to landscape restoration that includes the establishment of key corridor linkage areas and the rehabilitation of disturbed areas within the study area. The guidelines will also include a description of a series of in situ experimental treatments involving different types of planted grass cover and rock placement.

Areas rehabilitated in accordance with the guidelines will be monitored in accordance with the monitoring methodology described in Section 7. Monitoring results will be evaluated and incorporated into the adaptive management review and evaluation process (see Section 8).

6.2.3 Implementation program

The Pink-tailed Worm-lizard targeted studies described above and outlined in the NES Plan (Section 4.8) will be undertaken as outlined in Table 3.

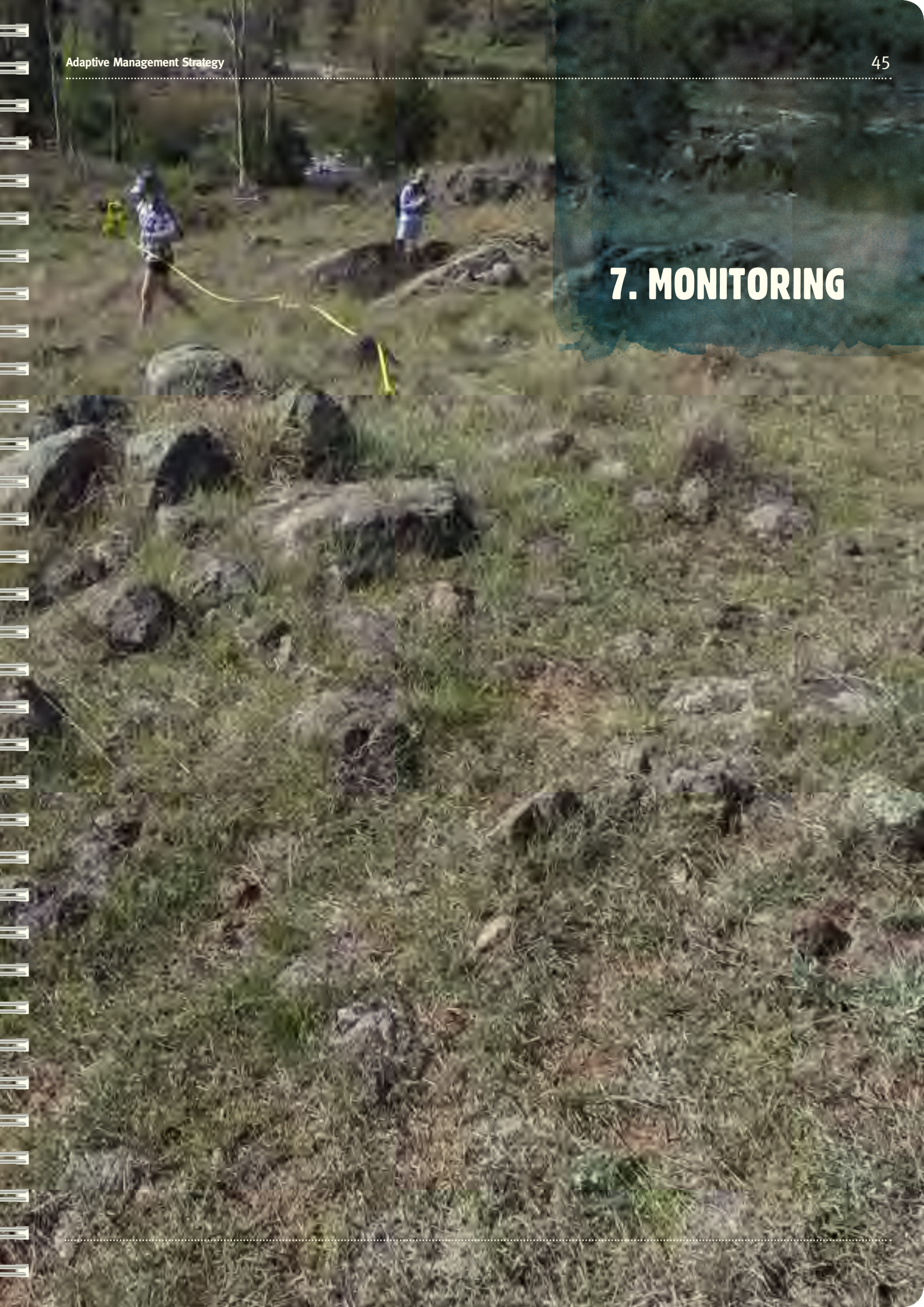
Table 3: Pink-tailed Worm-lizard targeted studies

NES Plan Section 4.8 reference	Description of study	Scope of study	Status
1a	Mt Taylor habitat disturbance, including fragmentation, and the effect of habitat proximity to urban areas		<ul style="list-style-type: none"> • Complete
1b	In accordance with the draft National Recovery Plan for Pink-tailed Worm-lizard (Brown in prep), develop low impact survey and monitoring techniques for the species	<ul style="list-style-type: none"> • Preparation of a research plan • Description of an approach for monitoring habitat condition • Location of suitable site • Recommendation of suitable shelter substrates that can be trialed • Preparation of habitat restoration guidelines • Research plan for evaluation of rehabilitation works • Recommendation of suitable areas for rehabilitation trials 	<ul style="list-style-type: none"> • Dr Will Osborne engaged • Start date 14 September 2012 • Completion December 2012
2c	Extensive survey work to determine population densities in areas of low, moderate and high quality Pink-tailed Worm-lizard habitat in the Strategic Assessment Area	<ul style="list-style-type: none"> • Baseline surveys have been completed for low, moderate and high quality Pink-tailed Worm Lizard habitat within the Strategic Assessment area. Further condition assessments of habitat will be conducted of research plots in conjunction with 2d and 2e below 	<ul style="list-style-type: none"> • To commence on completion of 1b in 2013
2d	Field trials, to be conducted in areas of low quality habitat only, involving different methods of restoration and relocation	<ul style="list-style-type: none"> • Field trials to be conducted in accordance with 1b findings 	<ul style="list-style-type: none"> • To commence on completion of 1b in 2013
2e	Research and field trials involving methods for reducing habitat fragmentation and increasing connectivity	<ul style="list-style-type: none"> • Field trials to be conducted in accordance with 1b findings 	<ul style="list-style-type: none"> • To commence on completion of 1b in 2013
3	Monitoring and adaptive management of Pink-tailed Worm-lizard habitat	<ul style="list-style-type: none"> • Monitoring incorporating the findings of 1b 	<ul style="list-style-type: none"> • To commence on completion of 2c



Pink-tailed Worm-lizard habitat
restoration experiment

7. MONITORING



Ongoing monitoring of MNES is a key component of the AMS. Monitoring provides the opportunity to understand if performance targets and management objectives are being achieved, and to determine if changes to management are required.

This section outlines the:

- general approach to monitoring that will be applied under the AMS (Section 7.1);
- methods for measuring the ecological condition of Box-Gum Woodland and Natural Temperate Grassland (Section 7.2);
- methods for measuring the ecological condition of Pink-tailed Worm-lizard habitat (Section 7.3);
- methods for monitoring Superb and Swift Parrots (Section 7.4);
- monitoring studies to measure particular responses (Section 7.5);
- timing and frequency of monitoring (Section 7.6).

More detail about monitoring methods and techniques is provided in the Ecological Management Guidelines (nghenvironmental et al in prep) and the associated Procedures Manual (Sharp 2012).

7.1 General approach to monitoring

Monitoring will be undertaken by suitably qualified experts under the guidance of the ACT Government.

7.1.1 Objectives of monitoring under the AMS

The objectives of the monitoring program under the AMS are to:

- Measure changes in the condition of MNES and the landscape more broadly within conservation areas.
- Understand the population status of MNES fauna within conservation areas.
- Inform management approaches as part of the adaptive management process.

7.1.2 Principles of monitoring under the AMS

The monitoring program will be based on the following principles:

- Application of the same methodology across a range of sites to provide replication.
- Repeatability: consistency of technique to collect data.
- Monitoring for an adequate length of time for changes to be statistically measureable and to be able to interpret causes.
- Ideally, include control sites where specific management is not applied (this may be provided through replication of sites with different management activities applied) to assist in interpreting cause and effect.

7.1.3 Scope of monitoring under the AMS

Under the AMS, monitoring will be undertaken at three levels:

- Vegetation condition (Box-Gum Woodland and Natural Temperate Grassland).
- Fauna (Pink-tailed Worm-lizard, Superb Parrot, Swift Parrot).
- Detailed monitoring studies, as required.

Together, these three levels of monitoring will provide a comprehensive picture of the state of MNES and ecological condition within the Molonglo strategic assessment area. Further details about each level of monitoring are provided below.

7.2 Ecological condition assessment methodology for Box-Gum Woodland and Natural Temperate Grassland

The NES Plan (ACTPLA 2011) requires that the ecological condition of Box-Gum Woodland and Natural Temperate Grassland be “measured using a peer reviewed, repeatable and scientifically robust methodology”. The ACT Government will meet this requirement using three complementary approaches:

- Monitoring the EPBC Act listing status of Box-Gum Woodland and Natural Temperate Grassland patches in accordance with the EPBC Act listing criteria for those ecological communities.

- Monitoring the ecological condition of Box-Gum Woodland and Natural Temperate Grassland patches based on the methodology of Gibbons et al (2009) as applied to vegetation condition and adapted for ACT vegetation types.
- Use of a number of other indicators for determining condition as required to inform management.

The aims of this approach are to:

- ensure that Box-Gum Woodland and Natural Temperate Grassland patches continue to meet the minimum threshold for being listed as threatened ecological communities under the EPBC Act;
- be able to measure and quantify the ecological condition of the vegetation using a well recognised and established methodology (i.e. Gibbons et al 2009); and
- to inform ongoing management decisions.

7.2.1 Monitoring the EPBC Act listing status of Box-Gum Woodland and Natural Temperate Grassland

The first component to measuring the ecological condition of Box-Gum Woodland and Natural Temperate Grassland will be to monitor the EPBC Act listing status of the various patches over time. Ensuring the vegetation continues to meet the minimum threshold for being listed as threatened ecological communities under the EPBC Act provides a base level condition to be achieved through management.

The EPBC Act definitions of Box-Gum Woodland (TSSC 2006) and Natural Temperate Grassland (ESSS 2000) are provided by the Commonwealth Government. The data that will be collected as part of the condition assessment methodology (see Section 7.2.2) will provide the necessary information to determine if the patches continue to meet the EPBC Act listing criteria for Box-Gum Woodland and Natural Temperate Grassland.

7.2.2 Monitoring ecological condition

Comparing data against the benchmark and assessing ecological condition

Gibbons et al (2009) provides a consistent and repeatable process for measuring the ecological condition of vegetation types. The process involves:

- collecting vegetation data against ten variables such as species diversity and percentage of native ground cover; and
- comparing the data against the ideal benchmark for that vegetation type (i.e. how close the vegetation is to a pristine ecosystem) and quantifying the results to provide an overall score of ecological condition.

This data will be collected using a combination of plots and transects within patches. The detailed methodology for this process is provided in the Procedures Manual (Sharp 2012).

Following data collection, the ecological condition

Table 4: Pink-tailed Worm-lizard potential habitat categories (Osborne and Wong 2010 and updated from Wong et al 2011)

Pink-tailed Worm-lizard potential habitat category*	Description
High quality	Suitable rocky areas dominated by, or with a large component of, kangaroo grass (<i>Themeda triandra</i>) – and also often containing <i>Aristida ramosa</i> , <i>Cymbopogon refractus</i> , <i>Poa sieberiana</i> and <i>Lomandra</i> spp. – and often a high diversity of disturbance sensitive native forbs. Exotic annual species such as Haresfoot Clover (<i>Trifolium arvense</i>) and <i>Vulpia</i> spp. may also be present
Moderate quality	Suitable rocky areas usually dominated by Spear Grasses (<i>Austrostipa</i> spp.) and Wallaby Grasses (<i>Austrodanthonia</i> spp.). Native forb species and exotic annual species such as Haresfoot Clover (<i>Trifolium arvense</i>), Wild Oats (<i>Avena</i> sp.), and Saffron Thistle (<i>Carthamus lanatus</i>) may also be present
Low quality	Suitable rocky areas that have been subject to high levels of disturbance in the recent past (e.g. areas previously under mature pine plantation) displaying high levels of disturbance to the soil layer or dominated by sown pasture grasses, other agronomic species and weeds; includes former sheep camps that no longer support native ground cover

* It is important to note that the habitat categories represent areas of potential habitat. The species is likely to occur in most areas of moderate and high quality habitat, although population density is predicted to be higher in high quality habitat. Low quality habitat is generally unlikely to support the species.

of each patch of Box-Gum Woodland and Natural Temperate Grassland will be assessed by comparing the measured values for each of the ten variables against the ACT benchmarks for Box-Gum Woodland and Natural Temperate Grassland. The ACT benchmarks have been prepared by the ACT Government (Mulvaney et al 2010) and are adapted from the NSW process. The ACT benchmarks are specific to the nature of the vegetation within the Territory.

Measuring change in ecological condition using raw data

In addition to the application of Gibbons et al (2009), other indicators for assessing condition of Box-Gum Woodland and Natural Temperate Grassland may be used. The Ecological Management Guidelines (nghenvironmental et al in prep) provide a suite of indicators that can be drawn on to answer specific questions about particular patches as they are managed over time.

The detailed analysis of raw data will provide quantitative assessments of changes relevant to particular issues in the patches. For example, whether weed cover has reduced or native plant diversity has increased. Other factors not included in the benchmark that may have particular importance to certain patches including changes in habitat features or landscape attributes, abundance and distribution of environmental weeds or rare or uncommon species will be measured at sites (where relevant). The Procedures Manual (Sharp 2012) describes the methods recommended for use to collect this data. The operational plans will identify which attributes should be monitored within each Box- Gum Woodland patch.



Fringe Lily *Thysanotus tuberosus*

7.3 Ecological condition assessment methodology for Pink-tailed Worm-lizard habitat

The NES Plan (ACTPLA 2011) requires that the ecological condition of Pink-tailed Worm-lizard habitat be “measured using the criteria described in Osborne, W., and Wong, D. (2010) *Extent of potential pink-tailed worm-lizard (Aprasia parapulchella) habitat in the Stage 2 Investigation Area – East Molonglo downstream of Coppins Crossing. Report commissioned by ACTPLA*”. The ACT Government will meet this requirement using two complementary approaches:

- Monitoring the ecological condition of Pink-tailed Worm-lizard habitat by building on the work of Osborne and Wong (2010) and using the most recent survey methods (noting that advancements in understanding of Pink-tailed Worm-lizard habitat have already occurred since the completion of the NES Plan).
- Direct monitoring of the population status of the species when suitable low impact methods are devised (see Section 6.2.1).

The aims of this approach are to:

- be able to measure the ecological condition of Pink-tailed Worm-lizard habitat using the most up-to-date approaches;
- understand the population status of the species over time; and
- to inform ongoing management decisions.

7.3.1 Pink-tailed Worm-lizard habitat condition monitoring

The habitat of the Pink-tailed Worm-lizard is described in detail by Wong et al (2011). Techniques for describing the ecological condition of the habitat of the species have been developed in recent years (e.g. Osborne and Wong 2010) and have been further refined (Wong and Osborne unpublished data). This information is now incorporated into the Ecological Management Guidelines (nghenvironmental et al in prep).

The highest quality sites are those dominated by a moderate to high diversity of native grasses and forbs (typically including *Themeda triandra* and/or species such as *Aristida ramosa*, *Cymbopogon refractus*, *Poa sieberiana* and *Lomandra* spp.) as well as disturbance sensitive forbs. High quality sites with Pink-tailed Worm-lizards often also include a strong presence of exotic annual grasses such as *Vulpia bromoides*, *Aira elegantissima* and *Avena fatua* as well as forbs such as *Trifolium* spp.

In more disturbed sites (moderate quality habitat) potential habitat has a much lower diversity of native grasses and forbs. The sites are often dominated by just a few species (particularly spear grasses *Austrostipa* spp. and wallaby grasses (*Rytidosperma* spp)). Native and exotic forbs are also typically present in the inter-tussock spaces and around the edges of rocks.

Low quality habitat has suitable rocks but typically completely lacks a cover of native grasses and forbs, although Corkscrew *Austrostipa scabra* may be present. The sites may display high levels of disturbance to the ground surface, rocks and vegetation (for example in areas that previously supported pine forest) and may be dominated by exotic pasture grasses (pasture improved paddocks) as well as other agronomic species and weeds. Some rocky areas that may be considered to be potential habitat are likely to be unsuitable for the species because they only include large very deeply embedded boulders.

Osborne and Wong (2010) provide three categories of potential habitat which are described in Table 4.

Surveys of Pink-tailed Worm-lizard habitat will be undertaken to collect data in relation to the criteria for each potential habitat category.

7.3.2 Direct population monitoring

In addition to habitat condition monitoring, direct population monitoring will be undertaken for the Pink-tailed Worm-lizard.

However, previous techniques for direct monitoring are thought to be problematic as they have the potential to negatively impact on the species if conducted frequently at the same site. Direct monitoring methods will therefore only be applied broadly across the strategic assessment area on completion of the targeted study to identify appropriate new low impact methods (Section 6.2.1).

7.4 Monitoring methods for Superb and Swift Parrots

In the ACT, the Canberra Ornithologists Group (COG) is active and well informed in relation to the presence of birds. They undertake annual surveys and have a particular interest in the Superb Parrot. The ACT Government will work closely with COG in Molonglo to ensure information is shared about Superb and Swift Parrots and management of conservation areas takes into account habitat values for those species.

7.4.1 Superb Parrot

Surveys for the Superb Parrot will be undertaken in known and potential habitat within the strategic assessment area between September and January (as appropriate). The methodology to be applied will be consistent with Davey (2011).

7.4.2 Swift Parrot

Regular surveys for the Swift Parrot are not possible given the species' variable use of the landscape each season. However, the species is notable and it will be well known when it is present in the ACT. Where that is the case, surveys in areas where the species is present will be undertaken.

7.5 Monitoring studies to measure particular responses

In addition to the specific methods for measuring the ecological condition of key MNES described above, analysis of broader landscape attributes may also be undertaken to inform the adaptive management process. A number of methods are available for use depending on the nature of the site being managed and the key management questions. These may include biomass assessment, landscape function analysis (Tongway and Hindley 2004), ephemeral drainage line stability (Tongway and Ludwig 2011), riparian condition (e.g. Rapid Appraisal of Riparian Condition (RARC) Version 2 (Jansen et al 2005) and remote sensing. Such methods allow for more detailed studies and analysis of particular processes, such as erosion of slopes and drainage lines and changes in vegetation cover.

The methods applied to each conservation area will be determined in the development of the operational plans (Section 5) and the ongoing evaluation and review process (Section 8). Prior to the implementation of monitoring in the conservation areas the proposed program tailored for each patch and area will be assessed by suitably qualified ecologists.



Research experiment on the development of a low impact monitoring technique for Pink-tailed Worm-lizards

7.6 Timing and frequency of monitoring

The timing and frequency of monitoring is outlined in Table 5.

Table 5: Timing and frequency of monitoring

MNES value	Monitoring focus	Timing	Frequency
Box-Gum Woodland	Ecological condition	Spring	Annually
Natural Temperate Grassland	Ecological condition	Spring	Annually
Pink-tailed Worm-lizard	Ecological condition of habitat	Spring	Annually
	Population status	Spring*	Every five years
Superb Parrot	Population status	Spring	Annually
Swift Parrot	Frequency of use of Molonglo strategic assessment area	When present	When present

* Direct population monitoring for Pink-tailed Worm-lizards will commence within the conservation areas of the strategic assessment area on completion of the targeted study described in Section 6.2.1 and development of an appropriate methodology.

8. EVALUATION AND REVIEW

THE FINAL STEPS IN THE ADAPTIVE MANAGEMENT PROCESS ARE TO EVALUATE AND UPDATE MANAGEMENT (THESE MECHANISMS INCLUDE THE VARIOUS PLANS DESCRIBED IN SECTION 5) IN LIGHT OF THE KNOWLEDGE GAINED THROUGH MONITORING.



The updating and review process might simply increase the confidence in the suitability of existing management. However, this process may also uncover new insights about the ecology of MNES and/or how management actions are affecting the achievement of conservation outcomes, performance targets and management objectives.

Three key sources of information will be evaluated to assess whether, and to what extent, management is achieving the environmental outcomes and performance targets for the MNES. These are:

- statistical analysis of the results of the monitoring program outlined in Section 7;
- the results of the targeted studies described in Section 6; and
- new information arising out of other relevant adaptive management and research programs and peer reviewed scientific literature.

Management will be amended based on this information to ensure that MNES values are being maintained and improved.



8.1 Implementation of the evaluation and review program

The TAMS Directorate will establish an expert panel made up of scientists and land managers with established expertise in Box-Gum Woodland, Natural Temperate Grassland, Pink-tailed Worm-lizard and Superb and Swift Parrot ecology. Given that this panel will be making recommendations which may have resource impacts on the Territory the panel will have representatives from both the government and non-government sectors.

The expert panel will:

- Meet within one year of approval of the AMS.
- Establish a methodology for evaluating the results of the monitoring program and other relevant information. This will include information arising out of:
 - the monitoring program;
 - the targeted studies; and
 - other relevant adaptive management and research programs.
- Consider the implications of the results as evaluated in relation to the operational plans for the MNES.
- Provide a report containing advice and recommendations for any amendments necessary to ensure the operational plans are achieving the conservation outcomes and performance targets for the MNES.

Timing for the evaluation and review program will be as follows:

- The results of the monitoring program (Section 7) will be internally reviewed when the results of monitoring come to hand. Internal review will be undertaken by ACT Government ecologists and environmental managers.
- The results of these internal reviews will be used to check and, if required, amend the operational plans once results become available.

- Monitoring and trial data will be analysed statistically every five years.
- At a minimum, the expert panel will convene every five years to consider the results as evaluated in relation to the operational plans for the MNES. Where substantial issues are shown to arise through the internal reviews, the expert panel may be called on at that point to provide comment and input, particularly if it is demonstrated that benchmark condition is not being maintained.
- At a minimum, the expert panel will provide a report every five years containing advice and recommendations for any amendments necessary to ensure the operational plans are achieving the conservation outcomes and performance targets for the MNES.

8.2 Contingency response

As part of the adaptive management cycle, a process for contingency responses in the case of negative changes to MNES will be applied. This will be based on a graded hierarchy of responses to ensure the causes of any problems are understood and changes to management are applied to reverse the situation.

The contingency response process will include:

- increased monitoring to help determine the cause of the problem;
- internal review by ACT Government ecologists to analyse the issue;
- additional expert analysis if required;
- identification and evaluation of possible solutions;
- implementation of revised management actions;
- further monitoring, evaluation and review to determine if the problem has been addressed; and
- incorporation of the outcomes of the process in the annual report (see Section 9).

9. REPORTING

Reporting outcomes for MNES against the NES Plan's commitments will be carried out in accordance with Sections 6, 8 and 9 of the NES Plan.

The ACT Government will report annually to the public on the implementation of the NES Plan. This annual report will highlight the conservation outcomes achieved, and any non-conformance, in the previous year and will be published by the ACT Government and provided to the Commonwealth's Environment Department. The report will include:

- the results of the monitoring program outlined in Section 7; and
- the results of the targeted studies described in Section 6.

The annual report will be completed within five months of the end of each financial year and will be made publically available.

The NES Plan and its associated actions will be audited by an independent, third party expert and provided to SEWPaC every 5 years for a 30 year period.

The results of annual and audit reports will inform the adaptive management process.

Rainbow bee-eater *Merops ornatus*



10. AMENDING THE ADAPTIVE MANAGEMENT STRATEGY

The ACT Government is committed to ensuring the conservation outcomes for MNES through adherence to the management measures documented in this AMS.

The ACT Government also recognises that, over the 30 year life of this strategy, there may be unforeseen scientific changes that warrant amendments to the AMS.

In the event that any such amendment is deemed necessary, the ACT Government will ensure that:

- any proposed amendment is consistent with, and necessary to achieve, the NES Plan's conservation outcomes for MNES; and
- any amendment that may have a substantive effect on the commitments contained in this AMS and directly related to MNES conservation outcomes will be approved by the Commonwealth Environment Minister or a delegate of the Minister.

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Yellow Burr-daisy *Calotis lappulacea*





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