Appendix F

Terrestrial flora and fauna study

Googong Township water cycle project

Environmental Assesment

November 2010

Ecowise Environmental

Canberra Investment Corporation

GOOGONG WATER CYCLE PROJECT ECOLOGICAL ASSESSMENTS - TERRESTRIAL FLORA AND FAUNA

REPORT

December 2009

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BIOSIS RESEARCH

CERTIFICATE OF APPROVAL FOR ISSUE OF DOCUMENTS

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Abbreviations

DECC	NSW Department of Environment and Climate Change (now DECCW)
DECCW	NSW Department of Environment, Climate Change and Water
DEWHA	Commonwealth Department of the Environment, Water, Heritage and the Arts
DoP	NSW Department of Planning
EIS	Environmental Impact Statement
EP&A Act	NSW *Environmental Planning and Assessment Act 1979*
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
LGA	Local Government Area
NES	National Environmental Significance
NPWS	National Parks and Wildlife Service (now part of DECCW)
REF	Review of Environmental Factors
ROTAP	Rare or Threatened Australian Plant (as listed by Briggs and Leigh, 1995)
SIS	Species Impact Statement
SEPP	State Environmental Planning Policy
TSC Act	NSW *Threatened Species Conservation Act 1995*
sp.	species (singular)
spp.	species (plural)
ssp.	sub species
var.	variety
WTP	Water Treatment Plant
WRP	Water Recycling Plant

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1. Executive Summary

Canberra Investment Corporation Limited (CIC) is progressing with the environmental assessment of a staged subdivision of the Googong New Town, south of Queanbeyan, NSW, near Googong Dam. Planning is underway for the Googong Water Cycle Project (WCP), which aims to provide wastewater, recycled water and potable water infrastructure for the entire development. In particular, planning for Stage 1 of the WCP is currently well progressed and would provide infrastructure for the first neighbourhood – Neighbourhood 1A (NH1A).

The subdivision of NH1A will be assessed via Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and is subject to a separate flora and fauna assessment.

This report focuses on the potential impacts to terrestrial flora and fauna, as a result of the Water Cycle Project (the Proposal) and has been prepared to assist the assessment process under Part 3A of the EP&A Act.

Study Area

The study area for this assessment includes:

Neighbourhood 1A.

A corridor to the east of the Old Cooma Road and an area to be used for potable and recycled water reservoirs;

The Googong Dam Road corridor, the roadway that leads to the existing Googong Water Treatment Plant (WTP) and a section of land within the WTP that is likely to be used for construction of water delivery mains and a bulk water pumping station; and

Googong Creek, which is proposed to be used for future stormwater discharges, located to the north of the Googong Dam Road.

Objectives

Within the above areas, the ecological assessments focused on the terrestrial flora and fauna likely to be impacted by the following components of the Water Cycle Project:

Proposed channel works for stormwater management and Googong Creek.

Proposed sites for wastewater infrastructure:

Water Recycling Plant (WRP) site east of NH1A.

Sites for sewage pumping stations 1 and 2 and proposed routes of the rising mains.

Proposed sites for potable and recycled water infrastructure:

The hill (Reservoir Hill) where the potable and recycled water reservoirs are to be located, southwest of NH1A.

Potable bulk water pumping station within the existing Googong WTP site and associated pipeline to the north-east of NH1A in a corridor leading to the Googong WTP.

A corridor along the eastern side of Old Cooma Road (rising mains)

A corridor either side of the Googong Dam Road from the junction with Old Cooma Road to the Googong Foreshores Gate.

As part of the study, a review of terrestrial flora and fauna ecological values of Googong Foreshores was undertaken, to enable the assessment of potential impacts on the Googong Foreshores.

Flora Surveys

Flora field surveys were conducted during late October 2008 to mid-January 2009 using transects at specific locations, complimented by random meanders, adequately covering the study area. A species list of indigenous and exotic plant species present in the study area surveyed was generated and the abundance of species established. Assessments of the condition of vegetation communities (i.e. structure and integrity of the vegetation and common plant species) and their habitat were also undertaken.

Database searches and review of previous studies indicated the potential presence of the following Endangered Ecological Communities (EECs) and threatened species or their habitat in the study area. These are:

- 'Natural Temperate Grasslands of the Southern Tablelands of NSW and the ACT' (EEC);
- 'White Box -Yellow Box and Blakely's Red Box-Gum Woodlands and Derived Native Grassland' (EEC);
- Button Wrinklewort - Rutidosis leptorrhynchoides;
- Mountain Swainson Pea - *Swainsona recta*;
- Silky Swainson Pea - *Swainsona sericea*;
- Hoary Sunray - Leucochrysum albicans var. tricolor;
- Tessellated Spider Orchid - *Caladenia tessellata*;
- Pale Pomaderris - *Pomaderris pallida*;
- Mauve Burr-daisy - *Calotis glandulosa*; and
- Austral Toadflax - *Thesium australe*.

Systematic searching was conducted for the above species, using transects at particular sites of interest and by random meanders across the study area. Assessments were also made of the likelihood of occurrence and availability of potential habitat for EECs and threatened species.

The majority of the study area is poor quality grazing land with 30-40% bare ground in most areas, due to compaction, trails of herds of animals and continuing disturbances. The land is interspersed with surface rock cover and scattered *Eucalyptus* trees.

In most paddocks, there is very little cover of native grasses. Non-native pasture grasses dominate the grassland landscape. Native grasses, particularly Poa tussock (*Poa seiberiana*) and Spear Grasses (*Austrostipa* spp.) are widespread in this landscape, but are sub-dominant to the pasture species within the assessed areas. Much of the study area is infested with a variety of Thistles and other common weeds, including St. John's Wort (*Hypericum perforatum*), Mullein (*Verbascum* spp.) and Briar Rose (*Rosa rubiginosa*) and is of no conservation value.

The roadside vegetation on both Old Cooma Road and Googong Dam Road and in the road corridor leading to the Googong WTP is highly disturbed and is poor in quality, except for a few populations of Kangaroo Grass (*Themeda australis*). Introduced pasture species and common roadside weeds dominate this vegetation. Medium to small sized, but common Acacia bushes and Eucalyptus trees occur along these road corridors. Although common, as part of previously rehabilitated roadsides, some of this vegetation is of conservation value.

Googong Creek is vegetated with an overstorey of *Eucalyptus* spp. and dense shrublands (mainly Burgan - *Kunzea ericoides, Acacia dealbata, A. mearnsii* and other *Acacia* species) and relatively sparse groundcovers. Although much disturbed and fragmented by past land uses, this vegetation is considered a remnant of the Box-Gum Woodlands and Derived Grasslands EEC.

No threatened flora species were found in the surveys in the areas likely to be impacted by the Water Cycle Project. However, potential habitat does exist for all of the previously listed species (above dot points). The existence of potential habitat for some of the constituent species of the two EECs is also recognised in these areas.

Based on the existence of potential habitat, assessments of significance were conducted for the EECs and the threatened species, following the guidelines of the *Threatened Species Conservation Act 1995* (TSC Act) and the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The assessments concluded that there would be some loss of potential habitat for the threatened species and some of the constituent species that characterise the EECs.

However, no large clearing of native vegetation is expected in the Proposal. The areas to be excavated and disturbed by the Water Cycle Project are heavily degraded pasture, largely devoid of native species and are also not extensive.

Also, the proposed discharges of stormwater down Googong Creek, after implementation of Water Sensitive Urban Design (WSUD) within the subdivision, are not likely to modify the terrestrial habitat of the creek, preferred by the species being assessed.

Therefore, the proposal is not likely to reduce the availability of habitat for any of the species within the degraded pasturelands, roadsides or in the Googong Creek environment. Nor is it likely that the proposal would cause fragmentation or isolation of habitat that might put at risk the occurrence of the threatened species or the EECs, in the local area or in the region.

As a result, a significant impact on EECs and threatened flora species is unlikely and no further impact assessment, or referrals under the EPBC act are required.

Fauna Surveys

Fauna field surveys were conducted from late October 2008 to January 2009. Surveys focussed on targeted surveys for threatened grassland fauna, including the Golden Sun Moth, Pink-tailed Legless Lizard, Striped Legless Lizard and Grassland Earless Dragon. Targeted surveys were also conducted for threatened birds, mammals (including bats), frogs and Rosenberg's Goanna.

Fauna recorded in the study area include 45 bird species (four introduced), 14 mammals (three introduced), three amphibians and four reptiles. Two threatened species, the Eastern Bent-wing Bat and the Pink-tailed Legless Lizard, were recorded in the study area. A range of threatened species has previously been recorded in the locality and potential habitat is present within the study area for a number of threatened fauna species.

It is possible that the Proposal would result in a significant impact to the Golden Sun Moth (critically endangered under the EPBC Act) and the Pink-tailed Legless Lizard (Vulnerable under the EPBC Act).

Although the Golden Sun Moth has not been recorded within the study area, it has been previously recorded about 400 m to the west of the study area. Potential habitat for this species is present in the study area, and given the sensitivity of the species to development, it is considered that a significant impact is possible, should it be present. As such, it is recommended that further surveys are undertaken for this species, to determine the presence or absence of the species. If the species is not found to be present, there would be no appreciable impact upon the Golden Sun Moth.

The Pink-tailed Legless Lizard was recorded within the study area, near where the most eastern sewage pumping station (SPS 2) is proposed. It is recommended this SPS and associated works be located outside of the potential habitat of the Pink-tailed Legless Lizard.

Recommendations

This report recommends several management and mitigation measures that should be implemented to reduce the potential impacts of the Proposal on native terrestrial flora and fauna. Pre-construction surveys are recommended for the Pink-tailed Legless Lizard to ensure avoidance of habitat and individual species during construction. Further investigations should be undertaken to determine the presence or absence of the Golden Sun Moth. This would determine whether any impacts to the species are likely and would inform whether it is required to prepare a referral to the Commonwealth Minister for the Environment. An addendum to this report will be provided following finalisation of the additional Golden Sun Moth study.

2. Introduction

Canberra Investment Corporation Limited (CIC) is proposing to develop a new residential community at Googong, which is located south of Queanbeyan in NSW. The proposed new town (Googong New Town) will be at the cutting edge of environmental and social sustainability, incorporating a host of major initiatives ranging from safe, walkable neighbourhoods to water re-use and savings that will reduce water usage by up to 70% compared to traditional developments (CIC, 2008a).

Manidis Roberts Pty Ltd is coordinating the sustainability and environmental planning aspects for the proposed development, and provides advice on potential environmental issues that are relevant to the planning and environmental regulators' approval process in due course.

Several broad-scale preliminary environmental assessments have already been undertaken in relation to this development proposal. These address a range of issues, including the biophysical environment of the development site, fauna and flora, soils, geology, drainage, groundwater, slope and erosion and cultural heritage. The overall planning for the Googong development is, therefore, currently well advanced.

This report is on terrestrial flora and fauna assessments, covering various locations and issues, within the area earmarked for development, as discussed below.

3. Project Description

3.1 Introduction

Planning is underway for the Googong Water Cycle Project (WCP), which aims to provide wastewater, recycled water and potable water infrastructure for the entire development. In particular, planning for Stage 1 of the WCP is currently well progressed and would provide infrastructure for the first neighbourhood – Neighbourhood 1A (NH1A).

It is understood that the subdivision will be assessed via Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act, 1979) and is subject to a separate flora and fauna assessment. The Water Cycle Project for the Googong development will be assessed via Part 3A of the EP&A Act.

The ecological assessments detailed in this report include assessments of the following components of the Water Cycle Project:

Proposed channel works for stormwater management - assessment of 50 m either side of centre of watercourses (100 m corridor) and the Googong Creek corridor (for future discharges of stormwater).

Proposed wastewater infrastructure:

Water Recycling Plant (WRP) site (250 m radius) east of NH1A.

Sites for sewage pumping stations 1 and 2 (100 m radius) and the proposed routes of the rising mains, 50 m either side of centre of the routes (100 m corridor).

Proposed potable and recycled water infrastructure:

A 50 m corridor along the eastern side of Old Cooma Road (rising mains).

A 60 m corridor either side of the Googong Dam Road from the junction with Old Cooma Road to the Googong Foreshores Gate.

- The hill where the reservoirs are to be located (south of NH1A) - referred to in this report as Reservoir Hill.
- Potable water pumping station (within the existing Googong WTP) and pipeline to the north-east of NH1A along the road leading to the WTP (50 m corridor) and areas within the WTP site.

3.2 Study Objectives and Aims

This study involved ecological assessments focusing on terrestrial flora and fauna of various locations within the development area (as given above), in order to determine the potential impacts on flora and fauna due to the Water Cycle Project proposed for the Googong New Town (in particular, NH1A), supporting a Part 3A planning assessment process. Specifically, this required the following:

1. Conducting terrestrial flora and fauna assessments, in particular:
    a. Within the area subject to the Part 3A concept approval process (i.e. Water Cycle infrastructure for the entirety of the Googong New Town);
    b. Within the study area for the Part 3A part of project approval process (i.e. Water Cycle infrastructure servicing NH1A only); and
    c. An assessment of impacts on terrestrial flora and fauna species, populations and communities (including those of NSW and Commonwealth importance) or critical habitat likely to be affected by the proposed activities.
2. Conducting a desktop review of ecological values of Googong Foreshores and conducting terrestrial flora and fauna assessments to enable the assessment of potential impacts on the Googong Foreshores due to works directly on that land or works adjacent to that land associated with the Googong Water Cycle Project.

3.3 Study Area

The study area (**Figure 1** and **Figure 2 - Appendix 1**) is located 8 km south of the Queanbeyan CBD, within Queanbeyan Local Government Area (LGA), the Monaro sub region of the Murrumbidgee Catchment Management Authority and the South-eastern Highlands Bioregion (DECC, 2009a).

The study area includes the following:

Neighbourhood 1A (NH1A) – bound by Googong Dam Road to the north and generally by farmland to the east, south and west (**Plate 1**; **Figure 2 - Appendix 1**). NH1A is several hundred metres away from the Googong Dam catchment boundary;

An area covering the sewage pipeline route connecting NH1A to sewage pumping station 2 (south-east of NH1A);

A corridor to the east of the Old Cooma Road and an area to be used for potable and recycled water reservoirs;

The Googong Dam Road corridor, the roadway that leads to the existing Googong Water Treatment Plant (WTP) and a section of land within the WTP that is likely to be disturbed during construction of water delivery mains and a bulk water pumping station (**Plate 1**); and

Googong Creek, located to the north of Googong Dam Road, behind 'Talpa' property, draining in a north-easterly direction towards the Queanbeyan River (**Plate 1**), proposed to be used for future stormwater discharges.

This region south of Queanbeyan, within which the study area is located, is characterised by a variety of land-uses including, nature reserves, low-intensity forestry, rural residential, cattle and sheep grazing and recreation. Elevation varies across the study area from 620 m to 816 m. The study area varies in landform from virtual flat land to steep slopes and the topography is gently undulating hills. Rocky outcrops feature on the upper slopes and crests of several hills in the study area, and partially buried surface rock is found in several locations.

Most of the study area is mixed sheep and cattle grazing land. There are occasional trees and tree clumps, spread throughout the site, and some sections of the road reserves are vegetated. There are a small number of farm dams and dry drainage lines. North of the study area, on either side of the Googong Creek, there is high quality remnant forest/woodland vegetation, which is part of the western side of the Googong Foreshores.

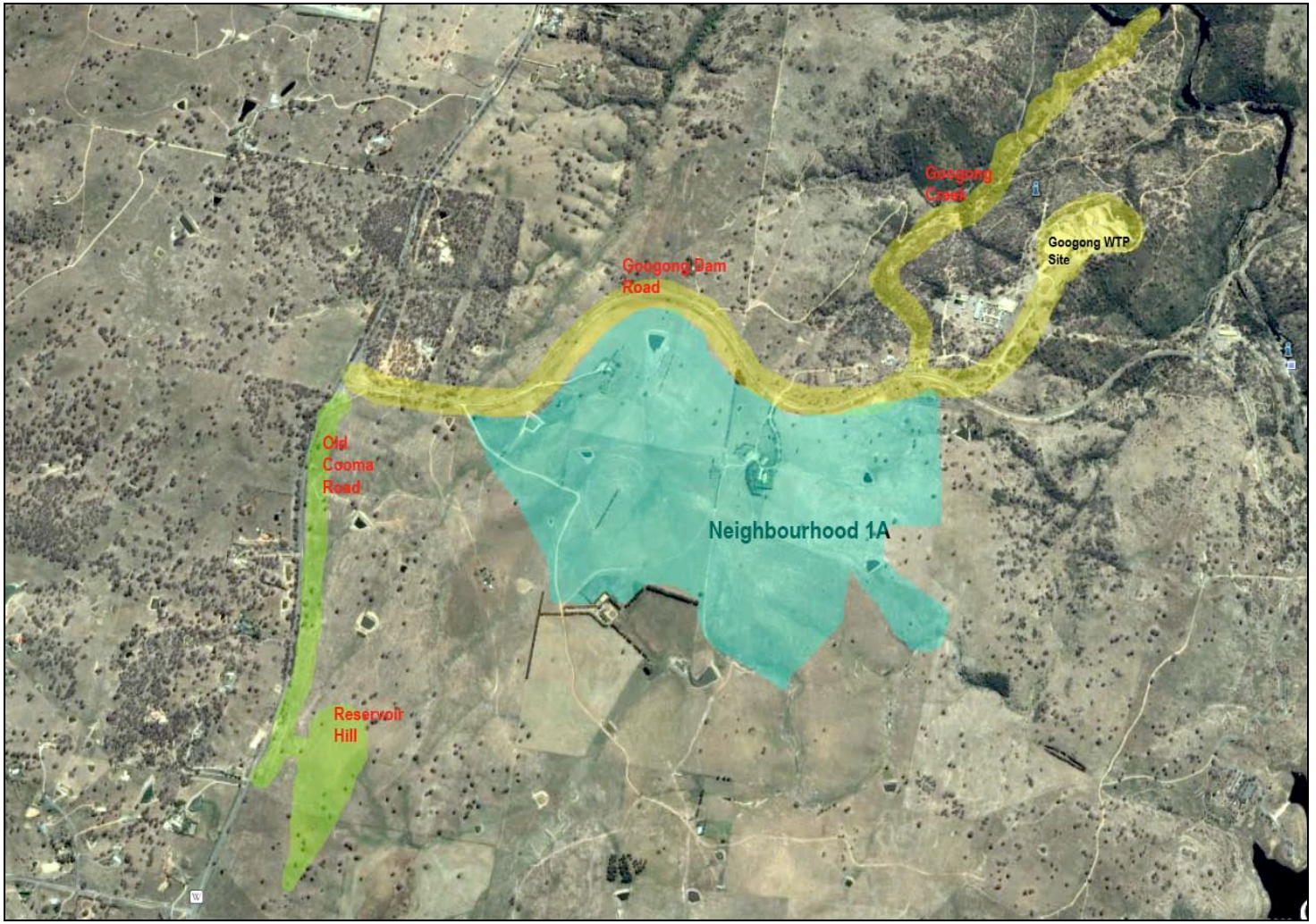

Plate 1. A broad aerial view of the Study Area

3.4 Proposed Development - Description of Works

General

A description of major works associated with the Water Cycle Project includes the following:

- Clearing and grubbing of land, stripping and stockpiling topsoil;
- Bulk earthworks (cut to fill) to design levels, including re-grading;
- Trench excavation for sewer, stormwater, potable water main, recycled water main services and backfill of all underground services;
- Construction of the WRP and pumping stations;
- Construction of rip rap and placement of other erosion protection material;
- Excavation for and planting of trees, shrubs, grasses and for dry mulches; and
- Rehabilitation and re-installation of all disturbed and/or re-graded areas.

The above works are likely to involve clearing of low value trees and dead trees. In some cases of excavations, the use of explosives may be required to break through rock.

Specific descriptions of the proposed works at different sites, provided by the planning and design consultants, are summarised below.

Stormwater Management System

Stormwater management in the New Town will be based on water sensitive urban design (WSUD) principles, to achieve a quality of the runoff from the site that will be consistent with that of agricultural grazing uses, which would have higher levels of nitrogen (N) and phosphorus (P) than that of typical runoff from bushland.

This will be achieved using an integrated, multi layered approach, from the individual house (reuse of stormwater using rainwater tanks and recycled water systems), to the overall site (reduction of hard and impervious surfaces), and the creation of systems that will progressively treat the runoff as it flows through the street and drainage networks (bio-retention swales or rain-garden systems).

These systems will filter and treat the water and provide passive irrigation to the street verges. The final treatment of stormwater will then be provided through larger wetland or bio-retention systems, before being discharged to the watercourses.

The exact discharge points of excess stormwater down Googong Creek are not known at this stage. However, the construction activities for this element would involve clearing and grubbing of vegetation, installation of pipe line and control valves, construction of minor concrete structure (a pit) to accept discharge, placement of erosion protection material, trenching for digital monitoring equipment; and re-instatement of topsoil and vegetation.

Potable and Recycled Water Delivery Mains

The construction activities associated with the trunk mains/ delivery mains from the WTP to the reservoirs and back to NH1A connections at Googong Dam Road will involve clearing low value trees, as required and excavation of a trench in which to place watermains (up to 675 mm diameter), backfilling of trenches and reinstating surface. The corridor likely to be affected is approximately 10-15 m wide in total.

Potable and Recycled Water Reservoir Site

The construction activities in this zone include the clearing and grubbing of vegetation, stripping and stockpiling of topsoil and bulk excavation (most likely through rock) to foundation and any filling of spoil to create a gravel access track. The work will involve construction of (most likely concrete) reservoirs and associated valve structures and connections of rising and delivery mains to tanks. There will also be trench excavation for electricity and telephonic service to reservoirs, installation of security fencing, and re-installing and rehabilitation of re-graded areas.

Water Recycling Plant

The construction activities for the WRP will include the clearing and grubbing of vegetation, stripping and stockpiling of topsoil, and bulk excavation (most likely through rock) to foundation level structures, and filling of spoil to create flexible pavements and all weather access/service roads.

The work will also involve construction of kerbs and above and below ground WRP reinforced concrete structures and associated valve structures. Construction of connections of rising and delivery mains to tanks with above surface electrical control panels is also required.

There will be construction of service/office and amenities building(s), as well as trench excavation for electricity and telephonic service to all structures and excavation and installation of potable water service from subdivision reticulation mains. Installation of security fencing, lighting, and re-installing and/or rehabilitation of re-graded areas will follow construction.

NH1A Sewage Pumping Station (SPS) Sites

The construction activities for this element will include the clearing and grubbing of vegetation, stripping and stockpiling of topsoil and bulk excavation (most likely through rock, using explosives) to foundation and filling of spoil to create flexible pavement all weather access track.

There will also be construction of (most likely concrete) below ground SPS wells and associated valve structures and connections of rising and delivery mains to tanks and installation of pumping equipment in SPS wells.

The work will also involve installation of above surface electrical control panel, connection of SPS to rising main and reticulation mains (from the urban development) and trench excavation for electricity and telephonic service to the control panels.

Excavation and installation of water service from subdivision recycled reticulation mains will also be necessary. Security fencing is likely to be installed around pumping stations, and all re-graded and disturbed areas re-installed and/or rehabilitated.

3.5 Legislative Context

A brief overview of the legislation and policy framework relevant to the management and conservation of biodiversity of the Googong Water Cycle Project is given below.

3.5.1 Commonwealth Legislation

3.5.1.1 Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)

The Commonwealth EPBC Act (1999) provides a national scheme for protecting and conserving the environment and biodiversity values from activities that could directly or indirectly affect Commonwealth land. Approval from the Commonwealth Environment Minister is required under the EPBC Act if the action (which can include a project, development, undertaking or activity) will, or is likely to, have a significant impact on matters of “National Environmental Significance” (NES matters). NES matters relevant to this proposal include migratory and/or threatened species that are listed under the Act.

The EPBC Act protects Australia's native species and ecological communities by providing for:

- Identification and listing of species and ecological communities as threatened;
- Development of conservation advice and recovery plans for listed species and ecological communities;
- Development of a register of critical habitat;
- Recognition of key threatening processes; and
- Where appropriate, reducing the impacts of these processes through threat abatement plans.

Googong Foreshores and Googong Dam Road are Commonwealth owned land, however Googong Dam Rd is in the process of being transferred to Queanbeyan City Council ownership.

3.5.2 State Legislation

3.5.2.1 Environmental Planning and Assessment Act 1979

The proposal falls under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act). Under Part 3A, the proponent and consent authority must consider all aspects of the environment, including biological, physical, social and economic factors and the principles of ecologically sustainable development, when assessing the impacts of the project.

Assessment under Part 3A of the EP&A Act includes consideration of threatened species, endangered populations and communities listed under the TSC Act, NES matters listed under the EPBC Act and requires a maintain or improve outcome with respect to biodiversity values.

Part 3A of the EP&A Act negates the requirement to assess the significance of impacts on threatened species, populations and ecological communities or their habitat pursuant to Section 5A of the EP&A Act (the 7-part test).

However, an assessment of the magnitude and extent of impacts and the significance of the impacts as related to the conservation importance of the habitat, individuals and populations of flora and fauna, likely to be affected is required (DEC, DPI, 2005).

Details of these assessments are provided in **Section 6** and **appendices 12** and **13**.

3.5.2.2 Threatened Species Conservation Act 1995

The *Threatened Species Conservation Act 1995* (TSC Act) defines 'endangered' as a species, population or ecological community that is likely to become extinct or is in immediate danger of extinction. A 'vulnerable' species is likely to become endangered unless the circumstances and factors threatening its survival or evolutionary development cease to operate.

The TSC Act aims to protect and encourage the recovery of threatened species, populations and communities listed under the Act, aiming to conserve threatened species, populations, ecological communities and their habitats, as well as promote their recovery.

The Act also aims to manage the key processes that threaten or endanger threatened species/communities through the development of species recovery and threat abatement programs.

3.5.2.3 Native Vegetation Act 2003

The objectives of the *Native Vegetation Act 2003* are to:

- Provide for, encourage and promote the management of native vegetation on a regional basis in the social, economic and environmental interests of the State;
- Prevent broad-scale clearing unless it improves or maintains environmental outcomes;
- Protect native vegetation of high conservation value, having regard to its contribution to protecting water quality, biodiversity, or the prevention of salinity or land degradation;
- Improve the condition of existing native vegetation, particularly where it has high conservation value; and
- Encourage the revegetation of land, and the rehabilitation of land, with appropriate native vegetation, in accordance with the principles of ecologically sustainable development.

3.5.2.4 Noxious Weeds Act 1993

The *Noxious Weeds Act 1993* outlines the definition, declaration and control of noxious weeds throughout the state. Local government bodies have the responsibility to ensure that the Act is complied with within their boundaries. For a plant to be declared a noxious weed by order of the Minister for Agriculture, it must be considered to pose a serious threat to humans, agriculture and/or the environment. There must also be consideration given to the feasibility of control and enforcement of those methods.

Landowners and/or occupiers have obligations under the Act to control any declared weed on their property. Council is required to conduct inspections of private properties to check compliance with the Act and Noxious Weed Officers have the authority to issue control notices for any breach.

The Act aims to reduce the negative impact of weeds on the economy, community and environment of NSW by establishing control mechanisms to: (a) prevent the establishment in NSW of significant new weeds; (b) restrict the spread in NSW of existing significant weeds; (c) reduce the area in NSW of existing significant weeds; and (d) provide for monitoring of and reporting on the effectiveness of management of weeds in NSW.

3.5.2.5 Draft local environmental plans

A local environmental study has been prepared to support separate resolutions made by the former Queanbeyan City and Yarrowlumla Shire Councils to prepare draft local environmental plans (LEPs) to rezone the study area known as the Googong Urban Investigation Area.

With the creation of the Greater Queanbeyan City Council in February 2004, portions of the former Yarrowlumla LGA were incorporated in the new LGA for this council.

The study area for the Googong Water Cycle Project is located within the new Greater Queanbeyan City Council LGA. Pending the preparation of a new LEP for this new LGA, land use and development controls within the study area will be subject to the existing provisions of the Queanbeyan LEP and the Yarrowlumla LEP.

However, a draft Queanbeyan LEP (Googong) 2007 is in existence. The zones proposed in the Draft Queanbeyan LEP (Googong) 2007 are:

R1 - General Residential;

R5 - Large Lot Residential;

B2 - Local Centre;

RE1 - Public Recreation; and

E2 - Environmental Conservation.

All proposed zonings cater for utility installations and/or public utility undertakings as being activities that are permitted with consent. SP2 specifically provides for sewage treatment infrastructure with proposed objectives as follows:

> To provide for infrastructure and related uses; and
>
> To prevent development that is not compatible with or that may detract from the provision of infrastructure.

The placement of the WRP will be in accordance with the zoning area for SP2. It is likely that the water cycle infrastructure associated with the stage 1 of the project will be located on land zoned SP2 and R1.

3.5.2.6 Local environmental plans

The Yarrowlumla LEP (2002) comprises the principal local environmental planning instrument governing land use and development control within the Googong study area. The relevant local government authority responsible for this LEP is Palerang Council.

According to Part 4, division 1, section 76A of the EP&A Act, if an environmental planning instrument provides that specified development may not be carried out except with development consent, a person must not carry the development out on land to which the provision applies unless:

(a) Such a consent has been obtained and is in force, and

(b) The development is carried out in accordance with the consent and the instrument.

As per these provisions, Palerang Council has vested authority for the management of the land within the Palerang LGA, and development in that area is guided by the requirements of the Yarrowlumla LEP.

Land within the study area for the Googong Water Cycle Project is currently zoned either 1(a) General Rural or 7(e) Environmental Protection in accordance with the Yarrowlumla LEP.

Additionally, the Yarrowlumla LEP caters for protection of the Googong Foreshores area. This land is zoned 5(a) - Water Catchment Zone - the stated objective of which is to restrict development of land to such uses as are compatible with the water catchment area identified by this zone.

3.6 Definitions

The following terms are used frequently throughout the report:

The proposal is the Water Cycle Project for the Googong New Town and activities or actions associated with it.

Study area is described in **Section 3.3** and shown in **Plate 1**.

Subject site is defined in *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities - Working Draft* (DEC, 2004) as the area directly affected by the proposal. The subject sites are shown in **figures 3-14 (Appendix 1)**.

Locality is the area within a 5 km radius of the study area.

Threatened biota refers to threatened species, populations and ecological communities as listed on the TSC Act and EPBC Act.

Critically Endangered**,** under the EPBC Act, a native species is eligible to be included in the critically endangered category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria in the Act.

Endangered**,** under the EPBC Act, a native species is eligible to be included in the endangered category at a particular time if, at that time, (a) it is not critically endangered; and (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.

Vulnerable, under the EPBC Act, a native species is eligible to be included in the vulnerable category at a particular time if, at that time, (a) it is not critically endangered or endangered; and (b) it is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.

Key Threatening Process**,** under the EPBC Act, a process that threatens or may threaten the survival, abundance or evolutionary development of a native species or ecological community.

Local population is defined in DECC (2007a) as the population of a species within the study area. Potential impacts to a local population with potential habitat in the study area are considered in the context of known records and potential habitats within the locality (see below).

4. Ecological Assessment Methods

4.1 Literature and Database Review

As a preliminary step to obtaining an understanding of the baseline ecological condition of the study area, Ecowise Environmental and Biosis Research undertook a literature and database search and a review of environmental assessments and information that have been conducted by various groups. This information review included the following:

A database search using the NSW Wildlife Atlas (http://wildlifeatlas.nationalparks.nsw.gov.au/wildlifeatlas/watlas.jsp); an area of 10 km^2, including the Googong development and the Queanbeyan LGA, was searched for Threatened (endangered or vulnerable) species listed by the TSC Act (DEC, 2007); and

A search of the EPBC database (http://www.environment.gov.au/epbc/protect/species-communities.html) and protected matters search tool (http://www.deh.gov.au/erin/ert/epbc/index.html) for flora and fauna species, ecological communities and key threatening processes listed in the EPBC Act.

The following reports and publications were also reviewed.

Googong Urban Investigation Area - Local Environment Study (2004) - prepared by Willana Associates for Greater Queanbeyan City Council (Willana Associates, 2004);

Environmental Assessment Googong Urban Investigation Area (2004) - conducted by Johnstone Centre, Charles Sturt University (Johnstone Centre, 2004);

Googong Local Environment Study, Phase 1 Environmental Site Assessment (2004) - conducted by Coffey Geoscience for Willana Associates;

Googong Release Area Water and Wastewater - Preliminary Design and Costing (2006) - A Study by Montgomery Watson Harza (MWH) for CIC (CIC, 2006);

Googong Design Assumptions for Potable and Recycled Water Systems (2008a) - A Report by MWH for CIC and Queanbeyan Council (CIC, 2008b);

Googong Neighbourhood 1A Tree Assessment (2009) - conducted by J. Easthope & Associates for Brown Consulting (JEA, 2009);

Googong Catchment: The State of Drainage Networks and Trends in Catchment Condition since 1944 (Starr, 2000);

Googong Dam Phase 1 Environmental Assessment, December 2007 - prepared by Gutteridge, Haskins & Davey Pty Ltd. for United Group Process Solutions (GHD, 2007);

Googong Foreshores Draft Plan of Management, 2007 - prepared by Territory and Municipal Services (www.tams.act.gov.au) (ACT, 2007a); and

State of the Environment Reports 2004 (ACT Government, 2004b), 2008 (ACT Government, 2007b; c) and publications available on Queanbeyan City Council Web Site (http://www.qcc.nsw.gov.au/page.aspx?page=6925).

4.2 Flora Surveys

The proposed development site and specific areas (see below for details) were inspected between late October 2008 and January 2009. The surveys aimed to determine the following:

Presence of threatened species or Endangered Ecological Communities (EECs) listed under the TSC Act and/or EPBC Act or their potential habitat;

An assessment of the likelihood of occurrence of rare or regionally or locally significant species or plant communities of high conservation value, occurring at the subject sites;

Presence and abundance of introduced species, which may reduce the biodiversity values of the sites; and

Potential impacts of proposed future works on all of the above and on properties that might be affected by the works.

Flora surveys were conducted using both the random meander technique and transects to describe the condition of vegetation communities and identify threatened species and their habitat. The random meander technique (Cropper, 1993) involves the area to be traversed in no set pattern while searching for plants. Generally, species encountered were recorded, providing a species list of indigenous and exotic plant species of the study areas surveyed.

A detailed systematic field survey was done for threatened plant species by systematically inspecting the vegetation in a series of belt transects, located across the sites of interest, complementing the random meanders and adequately covering the broad study area. While conducting the survey, notes were made on vegetation structure, dominant canopy species, and common plant species in the area.

To maximise the value of the information gathered, transects were located in a manner that covered significant landscape features (i.e. dams and buildings, like farm sheds) and vegetation, such as native trees, shrubs and grasslands.

Specific details of the sites assessed are provided in **Section 3**.

All species observed were identified and recorded. Most plant species were identified on site using botanical resources and field guides (Auld and Medd, 2002; Brooker and Kleinig, 1999; Eddy *et al*., 1998; Harden, 1991-93; Costermans, 1983; NPA, 2007; Royal Botanic Gardens, 2005; Richardson *et al*., 2007; Robinson, 1991; Wriggley and Fagg, 2003).

Where plant species could not be identified in the field, or confirmation was necessary, specimens with flowers and fruits (where available) were collected and pressed for later identification and/or verification using the resources available at the National Herbaria in Canberra and Sydney.

4.2.1 Flora Habitat Assessment

The survey also assessed the quality of vegetation and habitat, using parameters such as intactness, species diversity, history of disturbance, weed invasion and health. Three categories given in **Table 1** were used to describe the condition of the vegetation at the subject sites.

In all of the areas surveyed, habitat characteristics were noted and an assessment conducted to ascertain whether suitable habitat exists for threatened species, EECs and other regionally significant flora (see below).

To enable an impact assessment, the following were also studied:

Habitat - habitat continuity and extent;

Cover - vegetation structure and structural complexity;

Natives - dominance of natives versus exotics; and

Other landscape features - such as farm dams and relatively undisturbed areas.

4.2.2 Targeted Surveys - Threatened Species and Endangered Ecological Communities

Information on the threatened species and EECs and their habitat likely to be present in the study area, including Googong Foreshores, was obtained from the literature reviews and NSW Wildlife Atlas and EPBC database searches.

Habitat characteristics and distribution maps of the threatened species/communities were also studied using literature, prior to field surveys.

During the field surveys, scouting was undertaken, with particular regard for locating these species, if they occurred within or in the vicinity of transects and random meanders.

Assessments of likelihood of occurrence of threatened species were based on previous studies, habitat on site, known distributions and professional opinion.

4.3 Fauna Surveys

4.3.1 Introduction

The scope of the fauna assessment was designed around the findings of the study conducted by the Johnstone Centre (2004).

An initial site inspection was conducted on 27 October 2008. This was followed by one full week of fieldwork from the 3 to 7 November 2008 involving between two and five staff. During this week, pit-falls and spider burrows were dug, and targeted surveys were conducted for birds, bats and Pink-tailed Legless Lizard (*Aprasia parapulchella*).

Pit-fall traps were then checked every day for at least three weeks, and spider burrows every two to four days for three months (finishing in late January 2009).

Golden Sun Moth (*Synemon plana*) surveys were conducted sporadically between early November and January, when weather conditions were favourable. Call playback for the Barking Owl (*Ninox connivens*) was conducted over five non-consecutive nights.

4.3.2 Fauna Habitat Assessment

Fauna habitat assessments were conducted throughout the study area. The three categories used to evaluate fauna habitat values were: good, moderate or poor, as detailed in **Table 1**.

Table 1. Condition categories used in flora and fauna habitat assessments

Condition	Attributes – Flora	Attributes - Fauna
Good	Vegetation retains a high number of indigenous species, assemblages of species and structural characteristics of the pre-European equivalent. Such vegetation has usually changed very little over time, is relatively undisturbed and displays resilience to weed invasion, due to intact ground cover, shrub and canopy layers.	Ground flora containing a high number of indigenous species; vegetation community structure, ground, log and litter layer intact and undisturbed; a high level of breeding, nesting, feeding and roosting resources available; a high richness and diversity of native fauna species.
Moderate	Vegetation generally retains its structural integrity, containing a moderate number of indigenous species, but has been highly disturbed, and has lost some component of its original species complement. Weed invasion is significant.	Ground flora containing a moderate number of indigenous species; vegetation community structure, ground log and litter layer moderately intact and undisturbed; a moderate level of breeding, nesting, feeding and roosting resources available; a moderate richness and diversity of native fauna species.
Poor	Vegetation has been subject to high levels of disturbance and has lost most of its original species. The vegetation is significantly modified structurally, and left with only a discontinuous canopy of the original tree cover, very few shrubs and very little of its original groundcover. Vegetation is dominated by exotic species, such as introduced pasture grasses or weeds, replacing much of the indigenous ground cover. Environmental weeds are dominant or co-dominant with the original indigenous species.	Ground flora containing a low number of indigenous species, vegetation community structure, ground log and litter layer disturbed and modified; a low level of breeding, nesting, feeding and roosting resources available; a low richness and diversity of native fauna species.

Other habitat features, such the value of the study area as a habitat corridor, the presence of remnant communities or unusual ecological vegetation community structure were also used to assess habitat quality.

4.3.3 Targeted Surveys

Pit-fall Trapping

Surveys for the Striped Legless Lizard (*Delma impar*) and the Grassland Earless Dragon (*Tympanocryptis pinquicolla*) involved the placement of seven pit-fall arrays across the study area. The position of pit-fall arrays was determined based on areas of potential habitat (native grassland). However, sites were limited by a lack of native grassland because much of the study area was improved pasture.

Pit-fall arrays included two buckets with drainage holes in the bottom set into the ground. Between each bucket (which were separated by approximately 10 m), and extending a distance of approximately 5 m from each bucket, was a plastic fence set into the ground to direct fauna to the buckets. Each bucket had a plastic cover set above it to provide shelter. Some dirt, leaf litter and sticks were placed in the bottom of each bucket to provide additional shelter. Each bucket was moistened with water once a day.

Pit-falls were checked every day in the morning for three weeks and all captures and observations recorded, including location and number of individuals.

Artificial Arthropod Burrows

The Grassland Earless Dragon was surveyed using artificial arthropod burrows (spider burrows) within suitable habitat throughout the study area. Burrows consisted of plumbers pipe approximately 3 cm in width and 10 cm long, with a removable pipe inside. The removable pipe was painted with sand for grip.

Seven transects of ten burrows were set, with burrows about 10 m apart. Burrows were left in place for three months and monitored every two to four days. A plastic shelter was set above each burrow. All captures were identified and fauna released at the site of capture (or into nearby dams or tussocks if frogs).

Rock Turning

The most appropriate method for surveying the Pink-tailed Legless Lizard is turning over suitable rocks. All appropriately sized rocks in areas of potential habitat were turned over and the presence of either live Pink-tailed Legless Lizard or their shed skins were recorded. All rocks were immediately returned to their appropriate position.

Golden Sun Moth Surveys

The Golden Sun Moth flight season can occur anytime between mid October and January. Regular visits to known Golden Sun Moth sites during October are necessary to determine when flying has commenced. Surveys were undertaken within areas of preferred habitat on warm days with little or no wind between 10:00 and 14:00 hours, generally in association with checking pit-falls and spider burrows.

Diurnal Bird Point Surveys

Diurnal birds were surveyed for 20 minutes by two zoologists at a number of sites within the study area. Each point was approximately 1 hectare (ha) in size. Surveys were conducted during periods of relatively high bird activity (i.e. early morning or late afternoon) and all bird species seen or heard were recorded.

Anabat Detection

Anabat detectors were used to survey microchiropteran bats within the study area. The detectors were set before dusk at a number of sites and left to record overnight. Detectors were set over a farm dam, in gully vegetation, near a hollow tree in a paddock, and in roadside vegetation, covering the foraging areas of all targeted bat species.

Frog Surveys

Very little water was present in the study area in natural drainage areas. One large pool was present in Googong Creek at the time of surveys. This site was visited a number of times during the day and once in the evening. Any frogs calling were identified. There was no water in Montgomery Creek, part of which is just south of NH1A. Farm dams, present in a number of locations in the study area, were visited during the day on a number of occasions and calling frogs were identified.

Owl Call Playback

Call playback for the Barking Owl was conducted on five non-consecutive nights in the study area. Call playback started with five minutes of quiet listening, followed by five minutes of call playback and ten minutes of silent listening and spotlighting.

Cage Trapping

Five cage traps were set in vegetation along Googong Creek for four consecutive nights to target Rosenberg's Goanna (*Varanus rosenbergi*). Traps were baited with chicken and checked every morning.

4.4 Survey Effort

Ecowise Environmental and Biosis Research ecologists undertook the flora and fauna field surveys during late October 2008 to mid-January 2009. The weather during the survey period was clear and mostly warm (day temperatures ranging from 20-30 ^{0}C and night temperatures 12-18 ^{0}C). Occasional light showers and wet weather events also occurred during this period. **Table 2** details the survey effort implemented during the ecological surveys.

Table 2. Flora and Fauna Survey Effort

Survey	Technique/Traps/ Locations	Total Effort
Flora		
Terrestrial Flora Surveys	Transects/Random Meanders	160 person hours
Flora Habitat Assessment	Transects/Random Meanders	32 person hours
Fauna		
Artificial Spider Burrows	Seven sets of ten traps	Checked every 2-4 days between November and January
Pit-fall Traps	Seven sets of arrays (two traps each)	Checked daily for 21 days
Rock Turning	Four locations	6.5 person hours
Cage Traps	One transect of five traps	20 trap nights
Anabat recording	Four locations	1 night at each location
Diurnal Bird Surveys	Eleven locations	5.5 person hours
Nocturnal Bird Surveys (call playback)	Two locations	0.5 person hours
Nocturnal Frog Surveys	One location	1 person hour
Sun Moth Surveys	Surveys conducted in association with checking pit-falls and burrows across the survey season	
Habitat Assessment & Incidental Records	Across the entire study area over the three month survey season	

4.5 Limitations

This survey was not designed to enable all species, either resident or transitory to the study area, to be detected. Instead it was aimed at providing an overall assessment of the ecological values of the corridors and associated sites, together with the overall study area, with particular emphasis on the presence of EECs and threatened flora and fauna species.

For those species of conservation significance that were not detected, but with the potential to occur within the subject site, an assessment of the likelihood of their occurrence was made based on known habitat requirements. The potential loss of habitat for those threatened or migratory species and the EECs was also considered during the assessment of the impacts of development, regardless of whether or not they were detected during the survey.

The flora and fauna assessments were conducted from late October to January, over a 3-month period, which may not be an optimal time for surveying all species. Flora species, which are not growing strongly and are not flowering, are difficult to detect in some habitats. Migratory fauna may be seasonally absent and some fauna species are more active at certain times of the year.

Weather conditions at the time of a survey can also influence the detection of species. Given that surveys were conducted during late October to January, weather was generally warm to hot, with some rainy days and thunderstorms. All of the flora and fauna surveys, including the bird surveys involving call playback were conducted in suitable weather.

No temporal replication of surveys was undertaken within the current scope of works. Despite this, the survey efforts employed during the assessment are considered satisfactory, particularly when used in combination with the literature reviews and mapping of potential habitat.

5. Results

5.1 Geology and Soils

The landscape of the study area is generally undulating hills over Silurian volcanics including the Colinton volcanics and the Cappanana Formation. There are various tuffs with minor siltstone, shale, sandstone and limestone (Jenkins, 2000).

The majority of the study area sits on soils of the Burra transferral landscape. Soils are shallow (less than 60 cm) well drained lithosols and earthy sands on crests and upper slopes, and moderately deep (less than 90 cm) moderately drained red podzolic soils and red earths on mid slopes and most lower slopes (Jenkins, 2000). Two small outcrops of Celeys Creek soil landscape occur in the eastern side of the study area. Soils are shallow and moderately drained, with outcropping granite rock (Jenkins, 2000).

Geology and soils associated with Googong Creek include Campbell and Round Hill landscapes. Campbell soils are shallow and rapidly-drained with common large outcrops of rock. Round Hill soils are similar with outcropping granite.

A small area of Anembo is present near the proposed WTP. Soils are shallow, well-drained earthy sands over granite and all soils in the study area are infertile. Burra soils are strongly acid (Jenkins, 2000).

5.2 Flora Surveys

The sections below describe the results of the flora surveys identifying the general vegetation communities and species present in the areas studied, including the presence and absence of threatened species and ecological communities and their habitat.

5.2.1 Plant Communities - Literature Review

5.2.1.1 General Vegetation

The study area, including Googong Foreshores, is located in the South Eastern Highlands Bioregion, as defined in the Interim Biogeographic Regionalisation for Australia (Thackway and Cresswell, 1995; Environment Australia, 2000).

At the time of European settlement, the following general vegetation communities characterised the Southern Tablelands part of this bioregion (Keith, 2004):

- Extensive areas of native tussock grasslands at lower elevations (included in Temperate Montane Grasslands);
- Grassy woodlands on plains, low hills and foothills (included in Southern Tableland Grassy Woodlands); and
- Dry open forests that occupied slightly higher areas, stony ridges and rugged ranges (included in Southern Tableland Dry Sclerophyll Forests).

Grassy woodlands and dry, open sclerophyll forests were probably the main vegetation communities at Googong Foreshores. Grasslands may have occupied some of the lower elevation ‘frost hollow’ areas, such as along Burra Creek (ACT Government, 2004a; 2005; Starr, 2000). Since European settlement, this original vegetation in the area has been considerably altered by a combination of land clearing, tree felling, development of pastoralism, resulting in modified grassland areas, dotted with isolated trees or small clusters of trees.

Changed fire regimes, pastoral economy and associated urban and infrastructure development (roads, power lines), dwellings, overgrazing by animals and weed incursions would have also contributed to decline of native vegetation in the area (ACT Government 2004a; 2005). However, there are some remnants of high conservation value vegetation, in particular isolated, remnant trees of Box-Gum Woodlands, and pockets of natural temperate grasslands, within the land associated with the development site, including the western side of Googong Foreshores.

The flora survey conducted by the Johnstone Centre (Johnstone Centre, 2004) covered a large area that was considered for rezoning and subdivision. This survey included the Googong development site, which was subsequently approved for development in 2006 by a decision of the NSW Department of Planning (NSW Department of Planning, 2006).

Most of the "Googong" area has been subject to grazing or cropping and consequently has little remnant vegetation. In the extreme south, some scattered Yellow Box occurs on a low rise, but predominantly the site comprises introduced pasture species, with scattered native species (Johnstone Centre, 2004).

The 2004 study indicated the following three main vegetation communities to be present in the area: (a) Native Tussock Grasslands; (b) Grassy Woodlands; and (c) Dry, open Sclerophyll Woodland/forest.

Grasslands

There are two grassland communities present in the area, which are characterised by the dominant grassland vegetation present. These are: (a) improved pasture, and (b) mixed pasture. The latter is a mixture of native (mainly *Austrodanthonia* spp., *Austrostipa* spp. and *Poa* spp. tussock) and a variety of exotic species, such as *Phalaris* spp., *Lolium* spp., *Avena* spp., *Bromus* spp., *Hordeum* spp. and *Eragrostis* spp.

These pasture types often intergraded (Johnstone Centre, 2004) and their boundaries are difficult to determine. Generally, mixed pastures with native species were lightly grazed or ungrazed, while improved pastures were subject to a much higher grazing pressure.

Starr (2000) noted that Serrated Tussock (*Nasella trichotoma*) has aggressively colonised parts of the Googong Foreshores.

Woodlands and Trees

Three tree-dominated vegetation alliances have been described for Googong Foreshores (ACT Government, 2004a; 2007b):

Eucalyptus macrorhyncha - E. rossii (Red Stringybark – Scribbly Gum) Dry Sclerophyll Open Forest/Woodland;

E. melliodora - E. blakelyi (Yellow Box - Blakely's Red Gum) Grassy Woodland;

E. pauciflora - E. stellulata (Snow Gum - Black Sallee) Grassy Woodland.

The two grassy woodland alliances and the open forest alliance are included within the more general vegetation 'classes' defined by Keith (2004).

Since 1982, significant plantings (estimated at 40 000 trees and shrubs) have been undertaken in the western Googong Foreshores area, to complement natural regeneration (ACT Government, 2007a). While the survival rate of plantings has been low, the remaining plantings have contributed to changing some of the landscape, from mainly grassland to an open woodland character.

The Johnstone Centre (2004) identified a number of canopy species as the most abundant in the area. These included: Yellow Box (*Eucalyptus melliodora*), Apple Box (*E. bridgesiana*), Long-leaved Box (*E. nortonii*), Red Box (*E. polyanthemos*), Blakely's Red Gum (*E. blakelyi*) and Inland Scribbly Gum (*E. rossii*).

A recent tree survey conducted by J. Easthope & Associates (JEA, 2009) for NH1A, including along the Old Cooma Road and Googong Dam Road, listed the following species as the most dominant in the study area: Yellow Box (*Eucalyptus melliodora*); Red Box (*E. polyanthemos*); Apple Box (*E. bridgesiana*); and Broad-leaved Peppermint (*E. dives*).

JEA (2009) also noted the occurrence of isolated trees of Brittle Gum (*E. mannifera*), Long-leaved Box (*E. nortonii*), Narrow-leaved Black Peppermint (*E. nicholli*), Candlebark (*E. rubida*), Manna Gum (*E. viminalis*) and Red Ironbark (*E. sideroxylon*).

5.2.1.2 Threatened Species and Endangered Ecological Communities

The literature survey and databases searches (DECC Atlas of NSW Wildlife and Biosis Research records) indicated the presence of a number of threatened (endangered/vulnerable) species and Endangered Ecological Communities (EECs) in the vicinity of the study area, including the Googong Foreshores. These are given in **Table 3**.

Appendix 1 - Figure 3 depicts information on the known distribution of the species listed in the TSC Act and EPBC Act. In general, these locations are outside the study area.

Table 3. Threatened Species and Ecological Communities known in the vicinity of the study area, including Googong Foreshores

Common Name (*Species Name*)	*TSC Act Status	*EPBC Act Status
Natural Temperate Grasslands of the Southern Tablelands of NSW and ACT	N/A	E
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	E	CE
Button Wrinklewort - *Rutidosis leptorrhynchoides* [Fabaceae]	E	E
Mountain Swainson Pea - *Swainsona recta* [Fabaceae]	E	E
Silky Swainson Pea - *Swainsona sericea* [Fabaceae]	V	N/A
Pale Pomaderris - *Pomaderris pallida* [Rhamnaceae]	V	V
Hoary Sunray - *Leucochrysum albicans* var. *tricolor* [Asteraceae]	N/A	E
Tessellated Spider Orchid - *Caladenia tessellata* [Orchidaceae]	E	V
Mauve Burr-daisy - *Calotis glandulosa*	V	V
Austral Toadflax, Toadflax - *Thesium australe*	V	V

*E - Endangered; CE - Critically Endangered; V - Vulnerable; N/A - Not Applicable

A population of Button Wrinklewort (*Rutidosis leptorrhynchoides*), an endangered species under both the TSC Act and EPBC Act has been known to occur in a nearby property - 'The Poplars'; this resulted in the Queanbeyan City Council listing the property on the heritage list within the Jerrabomberra Creek Catchment (Maunsell, 2005).

In the 2004 surveys, Silky Swainson Pea (*Swainsona sericea*), a species listed as vulnerable under the TSC Act, was found in areas west of the Old Cooma Road (Johnstone Centre, 2004). However, this area is outside the current study area.

The Hoary Sunray (*Leucochrysum albicans* var. *tricolor*), listed as endangered under the EPBC Act, was also found in the 2004 surveys at a property (Mueller's Property) north-west of Googong Dam Road. This area too is outside the current study area.

Two listed EECs in the area require close attention. Given that these EECs or their habitat is likely to be present within Googong Foreshores and lands associated with the Googong Creek, they are discussed below.

Natural Temperate Grasslands of Southern Tablelands of NSW and the ACT (EPBC Act)

The 'Natural Temperate Grasslands of the Southern Tablelands of NSW and the ACT' are a low elevation ecological community dominated by native perennial grasses with a diversity of native herbaceous plants. These are declared as an EEC under the EPBC Act.

The dominant cover of native grasses, in particular *Themeda australis*, *Austrodanthonia* spp., *Austrostipa* spp. and *Poa* spp, distinguishes this EEC, while daisies, lilies and native legumes usually grow in the inter-tussock spaces (ACT Government, 1997b; DEWHA, 2000a; b; DECC, 2009b). The dense to open tussock grassland could have up to 70% cover of forbs.

The Johnstone Centre (2004) noted that some grasslands in the study area could be a part of this EEC. However, the report expressed some doubt as to whether what is present in the study area was in fact the EEC, or whether it was a secondary grassland (i.e. a grassland that has been derived from clearing the shrub and tree layer).

The Natural Temperate Grasslands community is known to exist on the western side of the Googong Reservoir and in a limited area in the south-west of Googong Foreshores, but the extent of the grasslands has not yet been accurately mapped (GHD, 2007).

This community is under pressure (loss and fragmentation, degradation of remnants, particularly from invasive weeds) from ongoing development in the area (Benson, 1994; Benson and Wyse Jackson, 1994; ACT Government, 1997b; 2005; Environment ACT, 2005).

White Box-Yellow Box-Blakely's Red Gum Grassy Woodlands and Derived Grasslands (TSC Act, EPBC Act)

This EEC is found on relatively fertile soils on the tablelands and western slopes of NSW and generally occurs between the 400 and 800 mm isohyets extending from the western slopes, at an altitude of about 170 m to 1200 m, on the northern tablelands (DECC, 2009c).

The community occurs within the NSW North Coast, New England Tablelands, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands and NSW South Western Slopes Bioregions.

The most obvious species in the EEC are one or more of the following: White Box (*Eucalyptus albens*), Yellow Box (*E. melliodora*) and Blakely's Red Gum (*E. blakelyi*). Grass and herbaceous species generally characterise the ground layer. In some locations, the tree overstorey may be absent as a result of past clearing, and at these locations only an understorey may be present.

The understorey in intact sites is characterised by native grasses and a high diversity of herbs; the most commonly encountered include: Kangaroo Grass (*Themeda australis*), Poa Tussock (*Poa sieberiana*), Wallaby grasses (*Austrodanthonia* spp.), Spear-grasses (*Austrostipa* spp.), Common Everlasting (*Chrysocephalum apiculatum*), Scrambled Eggs (*Goodenia pinnatifida*), Small St John's Wort (*Hypericum gramineum*), Narrow-leafed New Holland Daisy (*Vittadinia muelleri*) and Blue-bells (*Wahlenbergia spp.*). Shrubs are generally sparse or absent, though they may be locally common (NSW Scientific Committee, 2002a).

The previous listing in NSW under the TSC Act recognised that intact sites contain a high diversity of plant species, including the main tree species, additional tree species, some shrub species, several climbing plant species, many grasses and a very high diversity of herbs. However, intact stands that contain diverse upper and mid-storeys and ground layers are rare. Modified sites, on the other hand, could be:

- Areas where the main tree species are present, ranging from an open woodland to a forest structure, and the ground layer is predominantly composed of exotic species; and
- Sites where there are no trees, but only the grassy ground layer and some herbs remain.

In recent times, under the EPBC Act, the Commonwealth Scientific Committee for Threatened species and EECs proposed the name ‘White Box-Yellow Box-Blakely’s Red Gum Grassy Woodland and Derived Native Grasslands’, to replace the name for the EEC, which had been previously known as ‘White Box-Yellow Box-Blakely’s Red Gum Woodland’ (DEH, 2006b; c; DEWHA, 2006a; b). This change was made largely to recognise the important contribution of the understorey to the biodiversity and function of this ecological community, and to include areas in which no overstorey remains.

Areas that are part of the Commonwealth listed EEC must have either:

- An intact tree layer and predominately native ground layer; or
- An intact native ground layer with a high diversity of native plant species, but no remaining tree layer.

Characteristic tree species include one or more of the following species in varying proportions and combinations: *Eucalyptus albens* (White Box), *Eucalyptus melliodora* (Yellow Box) or *Eucalyptus blakelyi* (Blakely's Red Gum).

Associated, and occasionally co-dominant trees include, but are not restricted to: Grey Box (*Eucalyptus microcarpa*), Fuzzy Box (*E. conica*), Apple Box (*E. bridgesiana*), Red Box (*E. polyanthemos*), Red Stringybark (*E. macrorhyncha*), White Cypress Pine (*Callitris glaucophylla*), Black Cypress Pine (*C. enderlicheri*), Long-leaved Box (*E. gonicalyx*), New England Stringybark (*E. calignosa*), Brittle Gum (*E. mannifera*), Candlebark (*E. rubida*), Argyle Apple (*E. cinerea*), Kurrajong (*Brachychiton populneus*) and Drooping She-oak (*Allocasuarina verticillata*) (DEH, 2006b; c; DEWHA, 2006a; b).

5.2.2 Flora Survey Results

5.2.2.1 General

The flora surveys conducted in the study areas (**Appendix 1 - Figure 2)**, including the Googong Creek, recorded 151 species. The flora species list is provided in **Appendix 2 – Table A11**.

Details of locations of the transects and random meanders, which were used to sample the subject sites, are given in the tables and plates presented in **appendices 3-10** and are mapped on **Figures 1-11 (Appendix 1)**.

No threatened species listed under the TSC Act or EPBC Act was found in the current surveys, although habitat exists for several species. Additionally, none of the listed EECs was found, although habitat does exist for some of the constituent species of the EECs, as discussed in **Section 5.2.4**.

Given that the potential habitat does exist for both individual species and EECs, impacts of development on these communities, species and their habitats are required to be assessed for the Part 3A assessment process (DEC, DPI, 2005). This assessment, based on the existence of potential habitat, is presented in **Appendix 12** and **Appendix 14**.

Major highlights of the flora survey findings are discussed below.

5.2.2.2 Existing Vegetation Communities

A broad overview of the general vegetation of the surveyed areas, including the area south of Googong Dam Road (NH1A), Googong Creek and Googong Foreshores is presented below.

Grasslands - mixed pasture and native

Much of the study area can be characterised as grasslands, predominantly comprising non-native pasture, which is highly degraded and of little conservation value. These grasslands and habitat have declined in quality over a long period, due to grazing pressure (mixed sheep and cattle) and other human disturbances associated with such farming (i.e. dwellings, access roads, off-road vehicles).

The grasslands, both regularly grazed and infrequently grazed paddocks, are estimated visually to be 30-40% bare ground, due to compaction, trails of herds of animals and continuing disturbances (**Plate 2**). Non-native pasture grasses (viz. *Phalaris aquatica*, *Bromus* spp., *Lolium* spp., *Poa* spp., *Avena* spp., *Agrostis* spp., *Holcus lanatus*, *Hordeum* spp., *Paspalum dilatatum*, *Eragrostis* spp., etc.) dominate the grassland landscape (**Plate 3**).

Native grasses, particularly Poa tussock (*Poa seiberiana*) and Spear Grasses (*Austrostipa* spp.), are widespread in this landscape, but are sub-dominant to the pasture species within the assessed areas.

The native species are common in pockets, particularly around Reservoir Hill to the south-west of NH1A, the SPS site to the south-east of Neighbourhood 1A, and along the road sides. Wallaby Grass (*Austrodanthonia carphoides*) is less common in the study area, but can be found in pockets of paddocks, which are not heavily grazed.

Much of the study area is infested with a variety of Thistles and other common weeds, including St. John's Wort (*Hypericum perforatum*), Mullein (*Verbascum* spp.) and Briar Rose (*Rosa rubiginosa*). Common native forb species are scarce among the degraded grass, but include *Chrysocephalum apiculatum*, *Convolvulus erubescens* and *Leptorhynchos squamatus*.

Plate 2. Degraded grassland habitat dotted with occasional trees

Plate 3. Barley Grass infested paddocks, Reservoir Hill

Remnant Woodland Trees

Although not a woodland or forest 'community', the study areas are dotted with isolated remnant trees or small clusters of trees, which could have been once part of a dry, sclerophyll woodland/forest community. The surveys identified a number of species in NH1A and in the areas assessed for water cycle infrastructure. By far the commonest species recorded at sites associated with the Googong development are: Yellow Box (*Eucalyptus melliodora*), Red Box (*E. polyanthemos*), and Apple Box (*E. bridgesiana*).

In addition, there are some isolated specimens and small clusters of Broad-leaved Peppermint (*E. dives*), Long-leaved Box (*E. nortonii*), Box Apple (*E. goniocalyx*), Brittle Gum (*E. mannifera*), Blakely's Red Gum (*E. blakelyi*), Inland Scribbly Gum (*E. rossii*), White Gum (*E. viminalis*) and Red Ironbark (*E. sideroxylon*).

Googong Creek

At least part of the vegetation associated with the Googong Creek, which flows partly through the 'Talpa' property, heading in a northeast direction towards the Queanbeyan River, needs to be recognised as significant. This vegetation is 'White Box-Yellow Box-Blakely's Red Gum Woodlands and Derived Grasslands', which is protected native vegetation under the EPBC Act, as previously discussed (**Section 5.2.1.2**).

This ecological community comprises canopy trees of Yellow Box (*Eucalyptus melliodora*), Brittle Gum (*Eucalyptus mannifera*), Red Box (*Eucalyptus polyanthemos*), Scribbly Gum (*E. rossii*), Apple Box (*E. bridgesiana*), Yellow Box (*E. melliodora*), Red Stringybark (*E. macrorhyncha*) and Broad-leaved Peppermint (*E. dives*) (**Plate 4**).

The Googong Creek vegetation has been disturbed in the past by the construction of access ways, maintenance roads and fire trails associated with the Googong WTP's infrastructure. These disturbances are ongoing, and have led to serious deterioration of conservation values in some sections (**Plate 5**).

Burgan (*Kunzea ericoides*), a native species, which is an aggressive 'coloniser'[1], dominates the understorey of the Googong Creek area, sometimes achieving >75% cover on either side of the creek banks. Silver Wattle (*Acacia dealbata*), Green Wattle (*Acacia mearnsii*), Blackthorn (*Bursaria spinosa*), and several *Pomaderris* spp. also occur in the understorey shrublands.

Various invasive species, often referred to as 'weeds'[2], are also common in the creek habitats. These are largely escapees from agricultural lands and gardens of adjacent properties.

Plate 4. White Box-Yellow Box-Blakely's Red Gum Woodlands and Derived Grasslands in the vicinity of the creek in the lower-middle section

[1] Invasive plants in Australia are defined as naturalized species that are spreading; 'Naturalized' species are those from distant ecosystems, outside a given region that can maintain populations in the wild.

[2] The general use of the term weed in Australia encompasses its broadest contemporary meaning, i.e. a 'weed' is *any plant growing where it is not wanted*. Ecologically, all 'weeds' are *pioneers of secondary succession* or *colonisers*. This means that they are adapted to rapidly colonise and take advantage of habitat created by any disturbance, human-caused or otherwise. A more technical definition is: '*a weed is a species that adversely affects biodiversity, the economy or society*' (Groves *et al*., 2005).

Plate 5. Areas in the lower-middle section of Googong Creek, showing the same woodland vegetation, but in a relatively poor state due to disturbances

Blackberry (*Rubus fruiticosus*) infestations are serious in the creek; heavy infestations cover about 10-15% of the length of the creek. Hemlock (Conium), fennel (*Foeniculum vulgare*), St. John's Wort (*Hypericum perforatum*), Patterson's Curse (*Echium plantagineum*), Wild Sage (*Salvia verbenaca*), Dead Nettle (*Lamium amplexicaule*) and several other herbaceous weeds are also prominent in various disturbed sections of the creek.

The small pools in the creek have abundant *Azolla filiculoides*. Moist sections of the creek and some of the now abandoned dams have aquatic species, such as Cumbungi (*Typha orientalis*), *Veronica anagalis-aquatica* and Swamp Crassula (*Crassula helmsii*). Serrated tussock (*Nasella trichotoma*) has infested many areas of the creek habitat.

Roadside Vegetation

The roadside vegetation (both Old Cooma Road and Googong Dam Road) is characterised by the dominance of a variety of invasive species. Among the dominant 'weedy' grass species present at roadside sites are: *Phalaris aquatica*, *Paspalum dilatatum*, *Eragrostis curvula*, and a variety of pasture grasses like *Bromus* spp., *Lolium* spp., *Poa* spp, *Avena* spp., *Holcus lanatus*, *Hordeum spp.* There are however, several roadside locations, on both roads, where significant populations of the native Kangaroo Grass (*Themeda australis*) dominate.

As a result of spread by human disturbances, invasive herbaceous weeds are also common on the roadsides. The commonest species are: Purpletop (*Verbena bonariensis*), Mullein (*Verbascum* spp.), Buchan Weeds (*Hirschfeldia incana*), Spear Thistle (*Cirsium vulgare*), Scotch Thistle (*Onopordum acanthium*), Cotton Fire weed (*Senecio quadridentatus*) and Prickly Lettuce (*Lactuca seriola*).

Mixed with the weeds, there are also some sedges, such as *Juncus* spp. and *Cyperus eragrostis*, prominent in the ditches and depressions that run along the roads.

Disturbed and rehabilitated area (Googong WTP)

The proposal for the development of the water cycle infrastructure to support the Googong New Town includes the roadway that leads to the Googong WTP from the Googong Dam Road and the WTP site itself.

Whilst the conservation values of the nearby vegetation is well recognised (ACT Government, 2007a), as part of the original 'White Box-Yellow Box-Blakely's Red Gum Grassy Woodlands and Derived Grasslands' EEC, this section is regarded as already heavily fragmented and not representing any particular vegetation community.

Despite rehabilitation of the landscape and revegetation of the Googong Dam Road corridor, possibly since the construction of the WTP and the Visitors' Centre, this area is subject to continuous human disturbance, arising mainly from public access, maintenance vehicles and activities of the Visitors' Centre, the WTP site's routine maintenance, vehicles and operations.

Broadly, in regards to conservation of species and ecological communities, the vegetation in this area cannot be considered as a 'community' of any kind due to the high level of fragmentation. Except for some significant, live, remnant Gum trees, the area is considered to be devoid of high conservation value vegetation.

5.2.2.3 Noxious Weeds and other problem species

As stated above, a large array of invasive species was recorded in the surveys. Of those, the ones that have been declared as 'Noxious Weeds' within the Greater Queanbeyan City Council area (NSW Department of Primary Industries, 2005) are given in **Table 4**. From this list of declared species, many are common and sometimes dominant in sections of the subject site, as discussed in **Section 5.2.3**.

Table 4. Noxious Weeds and declared invasive species in the vicinity of the development site, subdivision and Googong Foreshores

Common Name	Scientific Name	[1]Category	[2]Category
African Boxthorn	*Lycium ferocissimum*	W2	4
Serrated Tussock	*Nassella trichotoma*	W2	4
Tree of Heaven	*Ailanthus altissima*	W2	4
Sifton Bush	*Cassinia arcuata*	W2	4
Sweet Briar	*Rosa rubiginosa*	W2/W3	4
Blackberry	*Rubus fruiticosus complex*	W2	4
Hemlock	*Conium maculatum*	W2	4
Scotch/English Broom	*Cystis scoparius*	W2	4
St John's Wort	*Hypericum perforatum*	W2	3
Fireweed	*Senecio madagascariensis*	W2	
African Lovegrass	*Eragrostis curvula*	W3	
Paterson's Curse	*Echium plantagineum*	W3	4
Vipers Bugloss	*Echium vulgare*	W3	4
Scotch Thistle	*Onopordum* spp.	W3	4
Willows	*Salix spp.* other than *S. babylonica, S. reichardtii* and *S. calodendron*	W4g	5

[1]NSW Noxious Weeds Categories up to 2006; [2]New NSW Noxious Weeds Categories, since 2006; **Class 4 - Locally Controlled Weeds:** The growth and spread of the plant must be controlled according to measures specified in a management plan published by the local control authority. **Class 5 - Restricted Plants:** The requirements in the *Noxious Weeds Act* 1993 for a notifiable weed must be complied with; the control objective is to prevent the introduction of those plants into NSW, the spread of those plants within NSW or from NSW to another jurisdiction.

In addition to the above, a number of other species are considered as 'problematic' species within the Yarrowlumla Shire (Yarrowlumla DCP, 2002), because of their capacity to spread rapidly and in some cases, invade relatively undisturbed areas of native vegetation.

These species (**Table 5**) have not been declared noxious weeds, but are actively discouraged from being grown in the area; their removal is often encouraged within the Shire.

Table 5. Species regarded as 'problematic' within Yarrowlumla Shire found in the surveys

Common Name	Scientific Name
Cootamundra Wattle	*Acacia baileyana*
Slender Thistle	*Cardus pycnocephalus*
Slender Thistle	*Cardus tenuiflorus*
Saffron Thistle	*Carthamus lanatus*
Star Thistle	*Centaurea calcitrapa*
Spear Thistle	*Cirsium vulgare*
Hawthorn	*Crataegus monogyna*
Fennel	*Foeniculum vulgare*
Horehound	*Marrubium vulgare*
Radiata Pine	*Pinus radiata*

All of the species listed in **Table 5** are common at various locations within the subject site, and contribute to reducing the overall conservation values of the landscape. Among other dominant 'weedy' species present at the subject sites are: *Phalaris aquatica*, *Paspalum dilatatum*, and a variety of pasture grasses like *Bromus* spp., *Lolium* spp., *Poa* spp, *Avena* spp., *Holcus lanatus* and *Hordeum* spp.

While these plants are not regarded as noxious weeds, they are well recognised in Australian landscapes as having a high potential to invade grassland ecosystems and greatly reduce the quality of habitat available for native grass and herb species.

As discussed above, the list of invasive species found at the subject site is extensive, which is an indication of human disturbances, both past and current, associated with the pastoral agricultural economy and supporting urban infrastructure, such as main roads (both Old Cooma Road and Googong Dam Road) and electricity, telephone and gas supply lines.

5.2.3 Targeted Surveys

This section provides the summary of results of the flora assessments conducted by transects and random meanders in specific areas of the subject site. Detailed results of the flora transects and representative photographs are provided in **appendices 3-10**.

5.2.3.1 Drainage lines

The general area surveyed for drainage lines and basins for the proposed riparian corridors and management of stormwater is shown in **Plate 6** and in **Figure 4** (**Appendix 1)**. Results of the flora transects are given in **Appendix 3 - Table A12**.

As shown in **Plate 6**, the area is characterised by heavily degraded pasture, with only a few scatterings of Yellow Box (*Eucalyptus melliodora*), Red Box (*E. polyanthemos*), Poplars (*Populus* spp.) and Willow (*Salix* spp.) trees. Non-native pasture grasses (*Phalaris aquatica*, *Phalaris minor*, *Bromus* spp., *Lolium* spp., *Poa* spp., *Avena* spp., *Holcus lanatus*, *Hordeum* spp., *Paspalum dilatatum*, *Eragrostis* spp., etc.) are common. Despite the presence of grassland, the general area is about 40% bare ground, due to over grazing and compaction.

Several farm dams connect the drainage lines. There is evidence that livestock, mainly sheep, heavily use these; as a result, their riparian margins are mostly very poor in quality, except at a few locations. Among sedges and rushes growing around some of the dams are *Carex* spp., *Juncus* spp. and *Eleocharis* spp. However, the quality of this aquatic vegetation is regarded as poor, due to the high level of grazing and trampling by sheep.

Plate 6. General area surveyed for drainage lines and basins

Much of the area and the drainage lines are infested with a variety of Thistles (*Cardus* spp., *Centaurea* spp., *Cirsium vulgare*). Other common weeds dominating the landscape include St John's Wort (*Hypericum* spp.), Patterson's Curse (*Echium plantagineum*), Great Mullein (*Verbascum* spp.), Horehound (*Marrubium vulgare*), Plantain (*Plantago* spp.) and Sweet Briar.

Common forbs, associated with grasslands of Southern Tablelands are largely absent in this landscape, also due to heavy grazing, trampling and compaction. However, there are many poor quality herbaceous species, like Sheep Sorrel (*Acetosella vulgaris*), Common Woodruff (*Asperula conferta*), Wireweed (*Polygonum arenastrum*), Prostrate Knotweed (*Persicaria prostrata*) associated with the drainage lines and basins.

5.2.3.2 Old Cooma Road Corridor

The area surveyed and the locations of flora transects on the eastern side of Old Cooma Road are given in **Figure 5** (**Appendix 1)**. Detailed results are given in **Appendix 4 - Table A13**.

Non-native pasture grasses (viz. *Phalaris aquatica*, *Phalaris minor*, *Bromus* spp., *Lolium* spp., *Avena* spp., *Holcus lanatus*, *Hordeum* spp., *Paspalum dilatatum*, *Eragrostis* spp., etc.) and some Poa tussock (*Poa* spp.), dominate the vegetation in the transects, achieving about 70% cover. The transects, which extended from the eastern edge of the roadside towards the development site, have about 20% bare ground, due to over grazing and compaction. The introduced species are mixed with some native grasses, in particular, Kangaroo Grass (*Themeda australis*), which is common along the roadside vegetation, but other species are poorly represented.

Many types of common ground cover forbs (*Trifolium* sp., *Acetosella vulgaris*, *Rumex* sp., *Persicaria* sp., *Polygonum prostrata*), sporadic clumps of low quality sedge (*Juncus usitatus*) are intermingled with the grasses and forbs. A variety of weedy species, including thistles, typical of degraded pasture (*Cardus* spp., *Centauria* spp., *Cirsium vulgare*, *Hypericum perforatum, Verbascum* spp.) are also common in the degraded paddocks.

The commonest Gum trees along this section of the Old Cooma Road are Yellow Box (*E. melliodora*) and Red Box (*E. polyanthemos*). Several large trees are found both inside and outside the fence line that runs along the road.

A few common Acacias: Green Wattle (*A. mearnsii*), Black Wattle (*A. decurrens*) and Wedge-leaf Wattle (*A. pravissima*) and several juveniles of *Eucalyptus* sp. occur along the roadside, mixed with Scotch Broom (*Cystis scoparius*) and some Hop Bushes (*Dodonaea viscosa*) in some sections. Some of the Acacias and Eucalypts are in poor condition, either dead or partially dead. Apart from the large Eucalyptus trees, found both inside and outside the fence line, the vegetation in the Old Cooma Road corridor is considered to be of low quality.

5.2.3.3 Googong Dam Road Corridor

The area surveyed (part of Googong Foreshores) and the locations of the flora transects of a 30 m corridor on either side of the Googong Dam Road are given in **Figure 6** (**Appendix 1)**. Detailed results of the flora transects are given in **Appendix 5 - Table A14**.

As in the Old Cooma Road transects, the Googong Dam Road transects also indicate roadside vegetation that is essentially dominated by a mix of non-native pasture grasses (viz. *Phalaris aquatica*, *Bromus* spp., *Lolium* spp., *Poa* spp, *Avena* spp., *Hordeum* spp., *Paspalum dilatatum*, *Eragrostis* spp., etc.).

Most transects, on either side of the road, have about 30-40% open, bare ground, due to grading of roadside verges, poor substratum, disturbances and compaction. Although native Australian species are poorly represented, there are several significant pockets of the native Kangaroo Grass (*Themeda australis*) along the roadside.

The commonest Eucalyptus species on either side of the road are Yellow Box (*Eucalyptus melliodora*), Red Box (*E. polyanthemos*), and Apple Box (*E. bridgesiana*). In addition, there are some specimens of Box Apple (*E. goniocalyx*), Broad-leaved Peppermint *(E. dives*) and *E. viminalis* (White Gum) in the roadway corridor.

Many types of common Acacia bushes are found along the roadside, on both sides. The commonest species is Green wattle (*A. mearnsii*). In addition, there are bushes of Silver Wattle *Acacia dealbata*, Red-leaved Wattle (*A. rubida*) and Wedge-leaf Wattle (*A. pravissima*).

The drainage ditches along the road have sporadic patches of common, low quality sedges (*Cyperus eragrostis*, *Juncus vaginatus* and *J. usitatus*), mixed with moisture-loving grasses like *Paspalum dilatatum* and *Phalaris aquatica*.

Many types of common ground cover forbs (viz. *Wahlenbergia* spp., *Trifolium* spp., *Acetosella vulgaris*, *Rumex* sp., *Persicaria* spp., *Dianella revoluta*) are intermingled with the grasses. Close to the junction with the Old Cooma Road, on the northern side, there are many small-to-medium sized bushes of native shrubs, including *Hibbertia calycina, Dillwynia sericea* and *Pultenaea procumbens*. However, along the road corridor, other native shrubs are sparse, except for the prominent Acacia clumps and sporadic clumps of *Daviesia mimosoides* and *Bursaria spinosa*.

A variety of weedy species, including thistles, typical of the adjacent degraded pasture (viz. *Cardus* sp., *Centauria* sp., *Cirsium vulgare*, *Hypericum perforatum, Verbascum* spp., *Polygonum arenastrum*) are common on the degraded road verges. Common roadside weeds (viz. Purpletop - *Verbena bonariensis*; Fleabane - *Conyza bonariensis*; Prickly Lettuce - *Lactuca seriola*; Buchan Weed - *Hirschfeldia incana*, Plantain - *Plantago* spp., Wild Sage - *Salvia verbenaca*) are also prominent, and the aggressive native coloniser- Burgan (*Kunzea ericoides*) is quite abundant in some sections of the roadway.

At Transect GR2 (**Appendix 5 - Table A14**), a few clumps of Chilean Needle Grass (*Nassella neesiana*) were found within and outside the fence line of the property north of the road. This is a highly invasive species, although listed only as a Class 4 weed in the Queanbeyan City Council and the Greater Queanbeyan region (NSW Department of Primary Industries, 2005)

Overall, the transects along Googong Dam Road indicate a highly disturbed roadside vegetation, which is generally poor in condition, dominated by many invasive species, some of which have encroached from degraded pasture, and others which are spread along roadways by vehicles. Apart from a few large Eucalyptus trees (mainly *E. melliodora* and *E. polyanthemos*), found on both sides along the Googong Dam Road, the vegetation in the corridor and the general habitat are considered to be of low quality.

5.2.3.4 Reservoir Hill

The vegetation of the Reservoir Hill (**Plate 7**) was assessed using walk-through transects and random meanders, criss-crossing and circumnavigating the site (see **Figure 7** - **Appendix 1)**. Detailed results of the flora found are provided in **Appendix 6 - Table A15**.

The vegetation in all of the areas of Reservoir Hill is highly degraded pasture, interspersed with remnant Yellow Box (*Eucalyptus melliodora*) and Red Box (*E. polyanthemos*) trees. Much of the landscape in the hill is rocky outcrops and about 30-40% open, bare ground devoid of grass cover, due to over grazing, poor substratum and compaction.

A variety of non-native pasture grasses (viz. *Phalaris sp.*, *Bromus* spp., *Lolium* sp., *Poa* spp., *Avena* spp., *Holcus lanatus*, *Hordeum* spp., *Paspalum dilatatum*, *Eragrostis* spp., etc.) and Poa tussock is present; however, reflecting heavy grazing pressure, the cover of any of these grasses is low. Minor patches of native Wallaby Grasses (*Austrodanthonia* spp.) and Spear Grass (*Austrostipa scabra*) also occur, mixed with the introduced species.

Many types of common ground cover forbs (viz. *Wahlenbergia* spp., *Trifolium* spp., *Acetosella vulgaris*, *Rumex* sp., *Persicaria* spp., *Polygonum arenastrum, Dianella revoluta*) are intermingled with the grasses. Sporadic clumps of the sedge *Juncus usitatus* also occur.

In amongst the degraded pasture are a variety of weedy species, including thistles, typical of degraded pasture (viz. *Cardus* spp., *Centauria* spp., *Cirsium vulgare*), and other widespread species like St. John's Wort (*Hypericum perforatum*) and Mullein *(Verbascum* spp).

Plate 7. Reservoir Hill - eastern side landscape, looking north, showing rocky outcrops and isolated Gum trees

The results of the flora surveys indicate the high level of disturbance operating on the Hill's landscape and vegetation. Given this, broadly the vegetation in Reservoir Hill is of minimal conservation value, except for some of the large Gum trees, which were noted previously.

5.2.3.5 Water Recycling Plant Site, Sewage Pumping station Sites and Rising Mains Corridor

The vegetation of the proposed Water Recycling Plant (WRP) site, the two sewage pumping station sites and the rising mains corridor was assessed using a combination of walk-through transects and random meanders, criss-crossing the sites, as shown in **Figure 8 (Appendix 1)**.

Detailed results of the surveys at the sites are given in **Appendix 7 - Table A16**.

The proposed WRP site (**Plate 8**), the SPS sites and the rising mains corridor for rising mains are also characterised by heavily degraded pasture, and are essentially similar in terms of their vegetation. The landscape, which is gently undulating, has a few farm dams, rocky outcrops, depressions and drainage lines and a scattering of Gum trees.

The area to the north of the WRP site, adjacent to the Googong Dam Road (**Plate 8**), has been revegetated in the recent past. This area has both juveniles and older *Eucalyptus* trees and several well-established Acacias (viz. Silver Wattle - *Acacia dealbata*, Green wattle - *A. mearnsii*, Black Wattle - *A. decurrens*), Red-leaved Wattle - *A. rubida*) and Wedge-leaf Wattle - *A. pravissima*) and many bushes of Burgan (*Kunzea ericoides*).

A mix of isolated trees or small clumps of *Eucalyptus* trees (viz. Yellow Box - *Eucalyptus melliodora*, Red Box - *E. polyanthemos*, Brittle Gum - *E. mannifera*) dot the landscape.

A variety of non-native pasture grasses (viz. *Phalaris sp.*, *Bromus* spp., *Lolium* sp., *Poa* spp., *Avena* spp., *Holcus lanatus*, *Hordeum* spp., *Paspalum dilatatum*, *Eragrostis* spp., etc.) and Poa tussock is present at these sites; however, due to heavy grazing pressure, their cover is low. Minor patches of native Wallaby Grasses (*Austrodanthonia* spp.) Spear Grass (*Austrostipa scabra*) also occurs, mixed with the introduced species.

Plate 8. Area surveyed - proposed location of Water Recycling Plant

A wide variety of common ground cover forbs (viz. *Wahlenbergia* spp., *Trifolium* spp., *Acetosella vulgaris*, *Rumex* sp., *Persicaria* spp., *Polygonum arenastrum, Dianella revoluta*) occur on the sites, but they are heavily grazed and their cover is negligible.

On the other hand, many weed species, typical of degraded pasture (viz. *Cardus* spp., *Centauria* spp., Spear Thistle - *Cirsium vulgare,* St. John's Wort - *Hypericum perforatum*, and Mullein - *Verbascum* spp) are widespread and common at all of the areas.

The general vegetation, habitat and landscape has clearly been subject to high levels of disturbance over a long period, and hence, considered of minimal conservation value, except for some of the remnant large Gum trees.

5.2.3.6 Water Treatment Plant Site and Corridor

The vegetation of the Water Treatment Plant (WTP) site and the road corridor that leads to the WTP are part of the Googong Foreshores. The area was assessed using a combination of transects and random meanders, as indicated in **Figure 9** (**Appendix 1)**. Detailed results of the flora found are given in **Appendix 8 - Table A17**.

The WTP site is largely a rehabilitated landscape. It is characterised by on-going, high level of disturbances, as a result of operational activities. The disturbances have resulted in an environment that is of very little conservation value, within the boundary fence lines of the WTP.

Various trees and shrubs have been planted at the site and along the roadway that leads to the site, possibly after the establishment of the WTP. The species that have been planted are part of the assemblage of species that represents the Googong Foreshores vegetation, and include a variety of Wattles, mainly Green wattle (*A. mearnsii*), Golden Wattle (*A. pycnantha*) and Silver Wattle (*A. dealbata*) and Gum trees.

The commonest Eucalypts on the site, mostly on the eastern side and along the roadway corridor, include Yellow Box (*Eucalyptus melliodora*), Red Box (*E. polyanthemos*), Brittle Gum (*E. mannifera*), Apple Box (*E. bridgesiana*) and Box Apple (*E. goniocalyx*).

It is evident that around the northern-most, distal areas, beyond the fence line of the WTP site, the land slopes on all sides into the western Googong Foreshores vegetation, which is protected Box-Gum Woodland. The remnant has been fragmented by water infrastructure development and human activities.

Various weed species have invaded the site, particularly along the roadway corridor and its rehabilitated, sparsely vegetated sides. Despite site maintenance, which might be occurring, weeds are prominent at various locations and include: Spear Thistle (*Cirsium vulgare*), St. John's Wort (*Hypericum perforatum*), Patterson's Curse (*Echium plantagineum*), Nightshades (*Solanum* spp.), Buchan Weed (*Hirschfeldia incana*), Cotton Fireweed (*Senecio quadridentatus*), and Mullein *(Verbascum* spp.).

As a landscape and vegetation subject to high levels of disturbance, the WTP site and the corridor is of minimal conservation value, except for some of the remnant large Gum trees.

5.2.3.7 Neighbourhood 1A (NH1A)

The vegetation of the broad NH1A area was assessed using a combination of walk-through transects and random meanders, criss-crossing the sites, as indicated in **Figure 10** (**Appendix 1)**. Detailed results of the flora found are given in **Appendix 9 - Table A18**.

As shown in **Plate 9**, the area is characterised by heavily degraded pasture associated with pastoral agriculture and the homesteads. Clearing has been intense in the past, which has left behind only a few scatterings of Yellow Box (*Eucalyptus melliodora*) and Red Box (*E. polyanthemos*) trees.

A few dams (see **Section 5.2.3.1**) and drainage lines also occur within the landscape. A few Willow trees (*Salix* spp.) occur in the vicinity of the drainage lines.

A number of Poplars (*Populus* spp.), Chinese Elm (*Ulmus* spp.), Radiata Pine (*Pinus radiata*), various fruit trees (*Pyrus* sp., *Prunus* sp., *Malus* sp.) and a tree line of mixed Eucalypts exist on the property to the eastern side. Several trees of Cupressus (*Cupressus arizonica*) occur associated with some of the farm properties, adjacent to the dwellings.

Non-native pasture grasses (*Agrostis capillaris, Bothriochloa macra, Phalaris aquatica, Phalaris minor, Bromus* spp., *Lolium perenne, Poa* spp., *Avena* spp., *Holcus lanatus*, *Hordeum* spp., *Paspalum dilatatum*, *Eragrostis* spp., etc.) are common across the landscape. These introduced species are mixed with native grasses (mainly Wallaby Grasses - *Austrodanthonia* spp. and Spear Grasses - *Austrostipa* spp.), which are also widespread, but sometimes occur in relatively less grazed or ungrazed pockets, such as adjacent to the dwellings and along some fence lines.

Despite the presence of grassland communities, the general area is estimated as about 20% open, bare ground, due to over grazing and compaction.

A variety of common ground cover forbs (viz. *Wahlenbergia* spp., *Trifolium* spp., *Acetosella vulgaris*, *Rumex* sp., *Persicaria* spp., *Polygonum arenastrum, Dianella revoluta*) occur across NH1A, but their overall cover is negligible.

Plate 9. Area surveyed - Neighbourhood 1A

Weed species, typical of degraded pasture (viz. various kinds of Thistles - *Cardus* spp., *Centauria* spp., *Carthamus lanatus*, *Cirsium vulgare*; St. John's Wort - *Hypericum perforatum*, Sheep's Burr - *Acaena ovina*; Bidgee Widgee - *A. novae-zelandiae*; Parsley Piert - *Aphanus arvensis*, and Mullein- *Verbascum* spp.) are widespread and common across the NH1A site.

These are mixed with other species, which are usually spread by human disturbances (viz. Dandelion - *Taraxacum officinale*; Purpletop - *Verbena bonariensis*; Fleabane - *Conyza bonariensis*; Prickly Lettuce - *Lactuca seriola*; Buchan Weed - *Hirschfeldia incana*, Plantain - *Plantago* spp., Wild Sage - *Salvia verbenaca*) are also prominent. The native coloniser, Burgan (*Kunzea ericoides*), is also present at various locations across the NH1A site.

Given the existing poor quality of the vegetation, and the level of disturbance that has occurred in the past and is on going, the vegetation of NH1A is broadly of little conservation value. The only exceptions are some of the large Gum trees, which have been identified for retention by the Tree Survey Report (JEA, 2009).

5.2.3.8 Googong Creek

Beginning from a farm dam (**Plate 10**), the Googong Creek, located to the north of Googong Dam Road, flows partly through the 'Talpa' property and a series of deep gullies, in a northeast direction, discharging into the Queanbeyan River. Its vegetation was assessed by walk-through survey and a series of transects, across the creek 50 m on either side (see **Figure 11**, **Appendix 1)**. Detailed results of the species found are given in **Appendix 10 - Table A19**.

On either side of the Googong Creek, the vegetation is essentially 'White Box-Yellow Box-Blakely's Red Gum Garssy Woodland and Derived Native Grassland' community, which is listed as critically endangered, nationally. The dominant canopy trees, a mix of Yellow Box (*Eucalyptus melliodora*), Brittle Gum (*Eucalyptus mannifera*), Red Box (*Eucalyptus polyanthemos*), Scribbly Gum (*E. rossii*), Apple Box (*E. bridgesiana*), Yellow Box (*E. melliodora*), Red Stringybark (*E. macrorhyncha*) and Broad-leaved Peppermint (*E. dives*) characterise the EEC (see **Plate 4**).

As discussed in **Section 5.2.2.1**, the proximity of the Googong Creek vegetation to the Googong WTP (**Plate 10**) results in continuing disturbance, as access ways and fire trails associated with the water infrastructure are regularly maintained (also see **Plate 5**). The vegetation is therefore representative of high-level fragmentation of the previous Sclerophyll Woodland/forest.

Plate 10. Location of Googong Creek

Adjacent properties and past land uses (i.e. pastoral agriculture) have also had a major impact on the creek's vegetation. Blackberry (*Rubus fruiticosus*) infestations are serious in the creek; heavy infestations cover about 10-15% of the length of the creek (**Plate 11**).

Burgan (*Kunzea ericoides*) dominates the understorey of more than half the length of the creek. In the lower and middle sections, the cover achieved by Burgan is greater than 75% on either side of the creek banks (**Plate 12**). Burgan infestations, as well as Serrated Tussock (*Nasella trichotoma*) infestations, intergrade with the Box-Gum Woodlands.

Plate 11. Blackberry (*Rubus fruiticosus*) infestations along Googong Creek

Plate 12. Burgan (*Kunzea ericoides*) infestations of the Googong Creek

The understorey vegetation is generally sparse and disturbed in many locations, through the gullies, which are steep. Erosion of varying degrees and collapsing of banks is common, mainly adjacent to the trails that criss–cross (**Plate 10**) the area.

In most sections, large Gum trees line the creek, with the thick understorey of Burgan scrub. On either side of the creek, trees or large-sized shrubs of Silver Wattle (*Acacia dealbata*), Green Wattle (*A. mearnsii*), Golden Wattle (*A. pycnantha*), Blackthorn (*Bursaria spinosa*) and *Pomaderris* spp. are prominent, as components of the understorey shrublands vegetation.

Various ferns, exotic and native grasses, a diversity of native forbs and herbaceous weeds are present as ground covers. However, these are largely sub-dominant to the invasive species like Hemlock (Conium), fennel (*Foeniculum vulgare*), St. John's Wort (*Hypericum perforatum*), Patterson's Curse (*Echium plantagineum*), Wild Sage (*Salvia verbenaca*), Dead Nettle (*Lamium amplexicaule*), which are abundant in various disturbed sections of the creek.

Underneath the shrublands and tree-lined vegetation, the small pools in the creek have abundant *Azolla filiculoides*. Moist sections of the creek and some of the now unused dams have aquatic species, such as Cumbungi (*Typha orientalis*), *Veronica anagalis-aquatica* and Swamp Crassula (*Crassula helmsii*). Serrated tussock (*Nasella trichotoma*) is very common in the middle sections, and has infested many of the depressions and flatter terrain of unused dams, associated with the creek habitat.

At the top end of the Googong Creek, at the back of the 'Talpa' property, the vegetation is much disturbed and is dominated by groundcover weedy species, amongst some native Acacia trees, Gum trees and shrubs.

Googong Creek vegetation and habitat are of significant conservation value due to its location through the now partially fragmented Box-Gum Woodlands. Despite continuing disturbances and the present heavy infestations of invasive species, there is evidence of strong regeneration of Box-Gum Woodland species in many sections.

The Box-Gum Woodlands and assemblages of species represent pre-European conditions, although the community is fragile and under continuing pressure from human disturbances. Given that this area is part of the fragmented western side of the Googong Foreshores, many elements of the vegetation may have to be protected from further disturbances to assist the natural regeneration of the area.

5.2.4 Flora Habitat Assessment - General

Table 6 summarises the results of the general vegetation and habitat conditions of the study area, discussed in the previous sections, in terms of the vegetation features (intactness, species diversity, history of disturbance, weed invasion and general health) and characteristics that were considered (**Section 4.2.1**).

Table 6. Summary of Habitat Assessment

Subject Site	Condition
Drainage lines and future riparian corridors	Poor
Old Cooma Road Corridor	Poor
Googong Dam Road Corridor	Poor
Reservoir Hill and adjacent	Poor
Water Recycling Plant Site, Sewage Pumping station Sites, rising mains corridor	Poor
Water Treatment Plant Site and road corridor	Poor
Neighbourhood 1	Poor
Googong Creek	Moderate

5.2.5 Flora Habitat Assessment - Threatened Species and EECs

This section considers the habitat condition and availability for the threatened species and EECs that were recorded from the study area in the vicinity of the subject sites.

The assessment is summarised in **Table 7**. The conclusion of this habitat assessment is that the existence of 'potential habitat' for the two EECs and the species needs to be recognised. As a consequence, in assessing impacts of the proposed works, 'assessments of significance' (DECC, 2007a) need to be conducted for those species and EECs.

Table 7. Threatened Species and Ecological Communities known in the vicinity of the Study area, including Googong Foreshores

Common Name (*Species Name*)	*TSC Act Status	*EPBC Act Status	Habitat Association	Likelihood of Occurring within assessed sites
EECs				
Natural Temperate Grasslands of the Southern Tablelands of NSW and the ACT	N/A	E	The EEC is dominated by moderately tall (25-50 cm) to tall (50 cm-1 m), dense to open tussock grasses with up to 70% of species being forbs. The dominant cover of native grasses, in particular *Themeda australis*, *Austrodanthonia* spp., *Austrostipa* spp. and *Poa* spp, distinguishes this EEC, while daisies, lilies and native legumes usually grow in the inter-tussock spaces (DEWHA, 2000a). The community may be treeless or contain up to 10% cover of trees, shrubs or sedges. In the Southern Tablelands natural temperate grasslands are located at altitudes between 560 and 1200 metres in valleys influenced by cold air drainage and in broad plains. The community occurs within the geographical region of Southern Tablelands of NSW and ACT, which extends southwards from the Abercrombie River to the Victorian Border, from Boorowa and Jindabyne to the west and Goulburn to Braidwood and Bombala to the east (DECC, 2009a; DEWHA, 2002a; b).	Unlikely to occur in their pre-European state, but appropriate habitat exists.
**White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	E	CE	'Box Gum Grassy Woodlands' are characterised by a species-rich understorey of native tussock grasses, herbs and scattered shrubs, and the dominance of White Box, Yellow Box or Blakely's Red Gum trees. The tree-cover is generally discontinuous and consists of widely spaced trees of medium height in which the canopies are clearly separated (DECC, 2009b; DEWHA, 2006a; b). In its pre-1750 state, this ecological community was characterised by: a ground layer dominated by tussock grasses; an overstorey dominated or co-dominated by White Box, Yellow Box or Blakely's Red Gum, or Grey Box in the Nandewar bioregion; and, a sparse or patchy shrub layer. Modified sites may include areas where the main tree species are present ranging from an open woodland formation to a forest structure, and the ground layer is predominantly composed of exotic species; and sites where the trees have been removed and only the grassy ground layer and some herbs remain.	Unlikely to occur in their pre-European state, but appropriate habitat exists in Googong Creek habitat.

*E - Endangered; CE - Critically Endangered; V - Vulnerable; N/A - Not Applicable;

**The 'White Box-Yellow Box-Blakely's Red Gum Woodland' EEC' (TSC Act) is slightly different from the characteristics of the 'White Box-Yellow Box-Blakely's Red Gum Woodlands and Derived Native Grassland' EEC (commonly referred to as 'Box-Gum Grassy Woodlands'). The main difference is that areas recognised by the Commonwealth listed EEC must have either: an intact tree layer and predominately native ground layer; or an intact native ground layer with a high diversity (more than 12 recognised native grassland species), but no remaining tree layer.

Table 7 (cont.). Threatened Species and Ecological Communities known in the vicinity of the Study area, including Googong Foreshores

Common Name (*Species Name*)	TSC Act Status	EPBC Act Status	Habitat Association	Likelihood of Occurring within assessed sites
FLORA				
Button Wrinklewort- *Rutidosis leptorrhynchoides* [Asteraceae]	E	E	Button Wrinklewort is a perennial, multi-stemmed herb, with narrow basal leaves and leafy flower stems to 35 cm tall. Flower heads are bright yellow, domed and button-like, to 2 cm wide. Flower heads are produced at the ends of the stems in summer and are surrounded at their bases by a cup of broad, overlapping, smooth bracts with light papery edges (ACT Government, 1997a; DEC, 2005h; DEWHA, 2009d). The species occurs in Box-Gum Woodland, secondary grassland derived from Box-Gum Woodland or in Natural Temperate Grassland and in the ecotone between the two communities. It grows on shallow soils and stony red-brown clay loams. It tends to occupy areas where there is relatively less competition from herbaceous species (either due to the shallow nature of the soils, or at some sites due to the competitive effect of woodland trees). It exhibits an ability to colonise disturbed areas (e.g. vehicle tracks, bulldozer scrapings and areas of soil erosion). The stems usually die back in late summer or autumn and new basal leaves are evident by early winter. It has been observed flourishing at a site a few years after the area was burnt by a wildfire. The species is susceptible to grazing, being retained in only a small number of populations on roadsides, rail reserves and other un-grazed or very lightly grazed sites.	Potential to occur in the roadside corridors and Googong Creek habitat
Mountain Swainson Pea- *Swainsona recta* [Fabaceae]	E	E	Mountain Swainson-pea is a slender, erect, perennial, 30 cm tall herb. The leaves are divided into up to six pairs of 10 mm long, very narrow leaflets, each with a pointed tip. There is also a single leaflet at the end of each divided leaf (DEC, 2005i). Flowers throughout spring, with a peak in October, followed by pods up to 10 mm long in summer. Individual plants have been known to live for up to 20 years. Plants die back in summer, surviving as rootstocks until they shoot again in autumn. The species is tolerant of fire, which enhances germination by breaking the seed coat, and reduces competition from other species. The species was recorded historically from places like Carcoar, Culcairn and Wagga Wagga where it is now extinct. Populations still exist in the Queanbeyan and Wellington-Mudgee areas. Over 80% of the southern population grows on a railway easement. It is also known from the ACT and Victoria. Before European settlement Mountain Swainson-pea occurred in the grassy understorey of woodlands and open-forests dominated by Blakely's Red Gum *Eucalyptus blakelyi*, Yellow Box *E. melliodora*, Candlebark Gum *E. rubida* and Long-leaf Box *E. goniocalyx*. It grows in association with understorey dominants that include Kangaroo Grass *Themeda australis*, Poa tussocks *Poa* spp. and spear-grasses *Austrostipa* spp.	Potential to occur in the roadside corridors and Googong Creek habitat

Table 7 (cont.). Threatened Species and Ecological Communities known in the vicinity of the Study area, including Googong Foreshores

Common Name (*Species Name*)	TSC Act Status	EPBC Act Status	Habitat Association	Likelihood of Occurring within assessed sites
Silky Swainson Pea- *Swainsona sericea* [Fabaceae]	V	N/A	Silky Swainson-pea is a prostrate or erect perennial, growing to 10 cm tall. The stems and leaves are densely hairy. The leaves are up to 7 cm long, composed of 5 - 13 pointed, narrow leaflets, each up to 15 mm long. The purple pea flowers are to 11 mm long, in groups of up to 8 flowers, on a stem to 10 cm tall. Hairy pods, up to 17 mm long, follow the spring flowers (DEC, 2005j). The species has been recorded from the Northern Tablelands to the Southern Tablelands and further inland on the slopes and plains. There is one isolated record from the far north-west of NSW. Its stronghold is on the Monaro. Also found in South Australia, Victoria and Queensland. It has been found in Natural Temperate Grassland and Snow Gum *Eucalyptus pauciflora* Woodland on the Monaro and in Box-Gum Woodland in the Southern Tablelands and South West Slopes of NSW and sometimes, in association with cypress-pines *Callitris* spp. The habitat on plains is unknown, but the species is known to regenerate from seed after fire.	Potential to occur in the roadside corridors and Googong Creek habitat
Pale Pomaderris- *Pomaderris pallida* [Rhamnaceae]	V	V	Pale Pomaderris is currently only known from sites in NSW and the ACT, where it is scattered along the Cotter, Paddys and Murrumbidgee Rivers, and in Molonglo Gorge (Briggs and Leigh, 1985; Harden, 1991; Garnett and Hyndes, 1992; DEC, 2005k). The species is found at numerous small sites along the plateau edge and very steep upper slopes and cliffs of river valleys at 480-600 m above sea level. The ACT sites are only on the eastern banks of the rivers, with an aspect ranging from north-westerly through westerly to southerly. The soils are shallow pale brown sandy loams over granite rock; large exposed granite boulders may be present. The species grows in near pure stands in a shrub community surrounded by *Eucalyptus* or *Callitris* woodland, or in open forest. The shrubland is commonly dominated by *Bursaria spinosa, Grevillea juniperina, Acacia rubida* and *Leptospermum* spp. (Briggs and Leigh, 1985; Harden, 1991).	Potential to occur in habitat associated with Googong Creek
Hoary Sunray- *Leucochrysum albicans* var. *tricolor* [Asteraceae]	N/A	E	Hoary Sunray is an erect, perennial or annual herb with woody rootstock. It has greyish-green, narrow linear leaves, usually growing to about 30-45 cm high. In spring and summer, solitary flowers are produced on slender 7-15 cm long peduncles. Flowers are 25 to 40 mm in diameter. Outer involucral bracts are white or pale brown. Inner involucral bracts bright yellow. Grows in a wide range of communities and habitats, from peaty upland to stony plains; widespread in Southern Tablelands. Hoary Sunray has suffered extensive loss due to cultivation and pasture improvement and is now mainly confined to road reserves and areas, which have remained relatively intact. Threats include frequent fire, fragmentation of habitat, weed infestation, bush rock removal, grazing, and rubbish dumping (DEWHA, 2009a).	Potential to occur in the roadside corridors and Googong Creek habitat

Table 7 (cont.). Threatened Species and Ecological Communities known in the vicinity of the Study area, including Googong Foreshores

Common Name (*Species Name*)	TSC Act Status	EPBC Act Status	Habitat Association	Likelihood of Occurring within assessed sites
Tessellated Spider Orchid- *Caladenia tessellata* (Syn. *Arachnochis tessellata*) [Orchidaceae]	E	V	The Tessellated Spider Orchid is a perennial scrambler, which occurs within distinct bands associated with a transitional geology between Hawkesbury and Watagan soil landscapes. It grows in dry sclerophyll forest on sandstone-derived soils, flowering in summer. Threats for the species include inappropriate fire regimes, road maintenance and weed spraying, habitat loss due to track use and widening and urban development, and low population numbers (Bishop, 2000; DEC, 2005l). The species is known from the Sydney area (old records), Wyong, Ulladulla and Braidwood in NSW. Populations in Kiama and Queanbeyan are presumed extinct. It was also recorded in the Huskisson area in the 1930s. The species occurs on the coast in Victoria from east of Melbourne to almost the NSW border.	Potential to occur in Googong Creek habitat
Mauve Burr-daisy *Calotis glandulosa* [Asteraceae]	V	V	Mauve Burr-daisy is an erect or ascending, branching herb growing to 35 cm high. Leaves are 3 cm long, 9 mm wide, soft, bright green, hairy, and with indented edges. Solitary flower heads are 2 cm wide, white, mauve or blue with a yellow centre. The achenes (fruits) are 1–2.5 mm long, red-brown at maturity, covered with peg-like projections, and have four to five barbed awns of uneven length (DECC, 2005a; DEWHA, 2008f; 2009b). This species grows in mid- to high-altitude temperate grasslands and corresponding Snow Gum *Eucalyptus pauciflora* woodlands on a range of soil types. It occurs in montane and subalpine grassland dominated by *Poa* spp., temperate grassland, woodland, and dry sclerophyll forest at high altitude in the Australian Alps. This species prefers grazing-restricted sites, suggesting that grazing may have led to a decline in abundance throughout its range. Mauve Burr-daisy is often recorded at recently disturbed sites (McDougall and Walsh, 2002; 2007). This species occurs within the Central West, Murrumbidgee and Southern Rivers (NSW) NRM Regions. Its distribution overlaps with the EPBC Act-listed EEC: White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland.	Potential to occur in the roadside corridors and Googong Creek habitat
Austral Toadflax *Thesium australe* [Santalaceae]	V	V	This species is a hairless, yellowish-green perennial herb with wiry, slender, sparingly branched stems up to 30 cm high. Its leaves are yellowish-green, alternate, narrow-linear, 1-3 cm long, 0.5-1.5 mm wide; the upper leaves are much smaller. Flowers are small, inconspicuous, greenish-yellow, borne singly on very short peduncles between two linear bracteoles that are inserted on a subtending leaf base, 2-4 mm above the leaf axil. Each flower has a narrow tubular perianth, 1.5-2 mm long with 5 broadly linear lobes about the same length as the tube. The fruit is an ovoid, vertically ribbed barrel-shaped nut, 2-3 mm long, which is crowned by the persistent, incurved perianth lobes. Flowering is from February to March. It is known to occur in grassy woodlands, often in damp places, in association with wet *Themeda* grasslands (DEC, 2005m; DEWHA, 2009c).	Potential to occur in Googong Creek habitat