2. Methods

In order to assess the impacts of the proposed landfill biodiversity values in the local area a desktop database review and field investigations were undertaken on the subject site.

2.1 Information Sources

Records of flora and fauna within 20 km of the study area were obtained from the National Parks and Wildlife Service (NPWS) Wildlife Atlas to determine if any threatened species had been recorded at the study area or in a similar habitat in the district (http://wildlifeatlas.nationalparks.nsw.gov.au/) (Appendix G).

The EPBC Protected Matters Search Tool was also accessed to determine if any Matters of National Environmental Significance are likely to occur within a 20 km radius of the study area (http://www.deh.gov.au/erin/ert/epbc/index.html) (Appendix H).

A list of birds previously recorded in the adjacent Gara TSR north of the Waterfall Way was obtained from Birds Australia (Appendix F).

The list rare or threatened Australian plants (ROTAP species: Briggs & Leigh 1996) was consulted, to identify any plant species that may be locally significant, although not necessarily listed as threatened under the relevant legislation.

2.2 Field Investigations

Desktop review of topographic maps and aerial photographs was used to help determine stratification units for the field surveys. Stratification units for this study corresponded with vegetation communities on the subject site, Figure 4). The intensity of survey effort was tailored to the size and complexity of each stratification unit. Field surveys were conducted in seasons which are appropriate for detecting the majority of taxa.

The purpose of field investigations were to systematically survey the study area and to fill in any information gaps identified from the preliminary desktop investigations. The field surveys were designed to target threatened biodiversity which may occur in the area, to identify potential habitat for these species, and to determine the likelihood of their presence and how the proposal will impact upon them.

2.3 Flora

The site was surveyed for flora in autumn and in spring in 2005. Dr Lachlan Copeland and Ms Sally Egan completed the autumn flora survey on 3 April 2005 and Dr Lachlan Copeland completed the spring flora survey on 15 October 2005. On each occasion an assessment of vegetation communities and significant flora species was conducted using a Random Meander search (Cropper 1993).

The purpose of the flora surveys was to:

- Obtain an understanding of the plant communities in the survey area and identify community boundaries;
- Define community structure;
- List the species present on the site;
- Identify the potential distribution of threatened plants and record inconspicuous species; and
- Obtain opportunistic flora records.

An additional survey in September 2006 was undertaken by Dr Elizabeth Broese to assess the current condition of the areas proposed for clearing activities for the landfill development. This survey entailed (20 x 50) nested quadrats consistent with the *Native Vegetation Regulation 2005*, Environmental Outcomes Assessment Methodology (DNR 2005) and random meander targeted searches for threatened species.

A number of condition variables were recorded to assess current site condition of remnant woodland areas that are proposed to be cleared, i.e., the TSR access route, Waterfall Way turning lane for the landfill access and the landfill operational area. These variables included native plant species, native over-storey cover, native mid-storey cover, native ground cover (grasses), native ground cover (shrubs), native ground cover (other), exotic plant cover, number of trees with hollows, overstorey regeneration, and length of fallen logs.

2.4 Fauna

Fauna surveys were carried out in autumn and spring 2005 to record fauna present on the proposed landfill site and the adjacent TSR. The autumn survey was completed by Dr Stephen Debus, Mr Martin Dillon, and Ms Sally Egan on 29th and 30th March 2005 and the spring survey was completed by Dr Stephen Debus, Mr Martin Dillon and Ms Sarah-Jane Hackett on 18th and 19th October 2005. An additional survey in September 2006 was undertaken by Dr Stephen Debus and Mr Martin Dillon to assess the impact of the proposed access route through the TSR. This survey included an intensive search for evidence of Koala utilisation in a 3 ha area around the proposed access route. A final follow-up survey of the landfill site and TSR was undertaken on 23-24 November 2009 by Dr Stephen Debus and Dr Lisa Doucette. This survey was to search for potentially threatened birds for which a preliminary determination was pending under the TSC Act. A diurnal (including a search for scats and scratches) and nocturnal Koala survey (spotlighting) in the TSR and at the landfill site was also undertaken.

Diurnal birds were surveyed visually and aurally by habitat search. Searches for reptiles and signs of presence of fauna species involved scanning of trees and logs, searching under rocks, litter and logs, and inspection of tree cavities and hollow stumps. Reptiles and frogs were identified with reference to Cogger (2000) and Swan (1990). Searches for mammals included visual scans, diurnal searches for scats and tracks, and nocturnal spotlighting.

A search for nocturnal fauna was conducted by 2-3 observers on 5 nights. On each night a megaphone was used to playback calls of masked and barking Owls in the Box Gum Woodland and beside the Stringybark Woodland community. Hand held 100 watt spotlights ('Clulite', Cluson Engineering) were used on foot for spotlight searches of nocturnal mammals and birds. Frogs were identified from their calls with reference to Stewart (1998). An ultrasonic bat detector ('Anabat' Titley Electronics) was used to record bat calls onto a Compact Flash memory card. Identification of bat calls was determined by using ANALOOK 4.9j software (Corben 2004) with reference to Pennay *et al*. (2004) and Reinhold *et al*. (2001). Call identification is based on the following levels of confidence: (C) – Confident, (P) – Probable. Bat taxonomic nomenclature and common names follow those of Churchill (1998).

Survey conditions were generally conducive to good quality results during the survey period. Weather conditions and total survey effort are presented in Table 2. A total of 119.6 person hours was spent surveying for fauna and 37 person hours was spent surveying flora on the site.

Pitfall or Elliott trapping for mammals was not conducted. This was on the basis that previous extensive trapping in similar or better habitat remnants in the Armidale area has detected only introduced rodents but no native terestrial small mammals (Debus *et al.* unpublished data). Additionally no threatened reptiles or frogs occur in the local area (Debus *et al.* unpublished data).

Table 2. Flora and Fauna Survey Effort and Weather Conditions

Date	Task	Time	Person Hours (no. people x hrs)	Weather
29 March 2005	Diurnal fauna survey Nocturnal fauna survey	0930-1830 1830-2000	3 x 9 = 27 2 x 1.5 = 3	Cloud 3/8 Light E to SE wind. Max Temp ~ 23°C
30 March 2005	Diurnal fauna survey Nocturnal fauna survey	0800-1500 1730-1830 1830-2000	 3 x 8 = 24 2 x 1.5 = 3	Cloud 3/8 Light E to SE wind. Max Temp ~ 23°C
3 April 2005	Flora survey	0900 - 1700	2 x 9 = 18	Cloud 1/8 Moderate WSW wind Max Temp ~ 24°C
15 October 2005	Flora survey	0900 - 1700	1 x 9 = 9	Cloud 8/8 Moderate E wind Max Temp ~ 20°C
18 October 2005	Diurnal fauna survey	0740-1400	2 x 9 = 18	Cloud 7/8 Light E wind. Max Temp ~ 17°C
19 October 2005	Nocturnal fauna survey	1815-2215	3 x 4 = 12	Cloud 3/8 Light E wind. Max Temp ~ 14°C
18 September 2006	Flora survey Diurnal fauna survey Nocturnal fauna survey	0730-1830 0700-1500 1730-1830 1815-2215	1 x 10 = 10 1 x 8 = 8 2 x 4 = 8	Cloud 1/8 Light E to SE wind. Max Temp ~ 23°C
23 November 2009	Diurnal fauna survey	0625-0915 (landfill), 0925-1045 (TSR)	2 x 3 = 6 2 x 1.3 = 2.6	Cloud 0/8 No wind Max Temp ~ 30°C
24 November 2009	Diurnal fauna survey Nocturnal fauna survey (spotlighting)	1715-1825 (TSR) 18:30-20:20 (landfill) 20:35-21:45 (TSR)	2 x 1 = 2 2 x 3 = 6	Cloud 1/8 Light-moderate N wind Max Temp ~20°C

3. Survey Results

3.1 Limitations of the Survey

The main limitation of the survey was its 'snapshot' nature meaning that only a proportion of the full species diversity was likely to be detected.

The weather conditions for most of each survey period were considered conducive to good quality results. These weather conditions were generally light to moderate winds, partially cloudy skies, and mild temperatures (Table 2). The seasonal conditions for the flora surveys were considered conducive to moderate quality results in autumn and very good quality results in spring. The seasonal conditions for the fauna survey were considered conducive to good quality results on all survey dates. The lack of trapping was unlikely to limit the results for native mammals (see Section 2.4).

3.2 Flora

The flora surveys recorded 180 species, including 11 trees, 29 shrubs (3 exotic), 3 climbers/vines, 2 mistletoes, 35 grasses (7 exotic), 98 herbs (24 exotic) and 2 aquatic plants (Appendix C). One threatened flora species was recorded on the study area: Narrow-Leaved Black Peppermint (*Eucalyptus nicholii)*. This species is listed as vulnerable under both the NSW TSC Act and the Commonwealth EPBC Act. One Rare or Threatened Australian Plant (ROTAP Briggs and Leigh 1996) species, Bendemeer white gum, *E. elliptica* was recorded. It is locally and regionally significant, although not subject to legal provisions under the TSC or EPBC Acts.

Five vegetation communities occur on the study area: Stringybark Woodland, Box Gum Woodland, cleared grassland, sedgeland and wetland. The distribution of these communities is presented in Figure 4. Photos of each community are presented in Plates 1 to 10.

Community 1 - Stringybark Woodland

This partially cleared woodland community occurs in the southern section of the site and is dominated by re-grown New England Stringybark (*Eucalyptus caliginosa*) and occasional Yellow Box (*E. melliodora*). Isolated individuals of Fern-Leaved Wattle (*Acacia filicifolia*) and Black She-Oak (*Allocasuarina littoralis*) occur sparsely. Blakely's Red Gum (*E. blakelyi*) are found rarely in some fragments. Trees are generally spaced from 4-20 m apart. There are very few fully mature trees, and hollows and den sites suitable for arboreal mammals and bats are rare. Overall the diversity of tree species in this community is poor. A significant feature present within the site is numerous log piles that have been pushed together following clearing 10 to 20 years ago. These log piles occur at a density of 11-17 piles per hectare (Plate 2).

The shrub layer is sparse with widely scattered individuals of three main species: Blackthorn (*Bursaria spinosa*), Peach Heath (*Lissanthe strigosa*) and Guinea Flower (*Hibbertia linearis*) and rare or sporadic occurrence of individuals of a further 13 species listed in Appendix C. Exotic shrubs were also occasionally present including Hawthorn (*Crataegus monogyna*), Blackberry (*Rubus fruticosus* complex) and Sweet Briar (*Rosa rubiginosa*).

The grass layer is moderately diverse with a number of native grasses and occasional herbs scattered throughout the woodland despite heavy grazing. The most common grasses include Slender Rat's Tail Grass (*Sporobolus creber*), Red-Leg Grass (*Bothriochloa macra*), Rough Speargrass (*Austrostipa scabra*), Couch (*Cynodon dactylon*), Snow Grass (*Poa sieberiana*), Small Lovegrass (*Eragrostis leptostachya*), Purple Wiregrass (*Aristida ramosa*) and Slender Wallaby Grass (*Austrodanthonia racemosa*). Growing amongst these grasses are herbaceous

species such as native Stinging Nettle (*Urtica incisa*), Slender Sedge (*Cyperus gracilis*), Pin Rush (*Juncus usitatus*), exotic Stinging Nettle (*Urtica urens*) and native Burr-Daisy (*Calotis cuneifolia*). Burr-Daisy is the only herb to occur in any great abundance and this daisy appears to be particularly resilient to the heavy grazing regime.

The Stringybark Woodland community occurs in a series of irregular shaped patches on the study area. The smallest of these are clumps of a few trees that occupy less than 0.02 hectares (200 square metres) while the largest contiguous patch is 32 ha in area (see Figure 4). The total area of this community within the area surveyed is 62.8 ha. This community occupies 17% of the surveyed area. The patches are predominantly surrounded by cleared grassland, but never-the-less form part of an intermittent band of woodland patches within the local region that is likely to be a relatively significant corridor for fauna and flora.

The Stringybark Woodland community is widespread in the region surrounding the proposed landfill site, albeit in fragmented and dispersed patches. The Stringybark Woodland community on the study area falls within the category of "New England Grassy Woodlands" defined by Keith (2004). Between 60 and 90% of grassy woodlands on the Northern Tablelands have been cleared since European settlement (Keith, 2004). The overall habitat value of the Stringybark Woodland community is considered to be moderate. The proposed development will require an access easement through a portion of the Gara TSR that lies between the Waterfall Way and the northern boundary of Edington. Approximately 25% of the Stringybark Woodland within the subject land will be cleared for the landfill site, but this is a negligible proportion (less than 1%) of that available in the region.

Community 2 – Cleared grasslands

Cleared grassland occupies 212.6 ha or 68% of the flora survey within the study area and occurs in the northern half of the proposed development area. Historically, this community was woodland prior to clearing for pasture establishment over the last 100 years. It has been almost completely cleared and only isolated individual trees are scattered in the northern and southern parts of the grassland community, particularly close to the Stringybark Woodland patches in the south, and close to the Box Gum Woodland in the northern part of the study area. There are also dead tree stags still standing in some areas. There is no evidence of any recent regeneration of trees or shrubs. It has been intensively grazed by sheep and cattle and generally has low habitat quality.

The cleared grassland community is dominated by native grasses such as Slender Rats Tail Grass (*Sporobolus creber*), Blown Grass (*Lachnagrostis avenaceus*), Red-Leg Grass (*Bothriochloa macra*), Couch (*Cynodon dactylon*) and Small Lovegrass (*Eragrostis leptostachya*) as well as exotic grass species like Pale Pigeon Grass (*Setaria pumila*) and Paspalum (*Paspalum dilatatum*). Pinrush (*Juncus usitatus*) and the exotic weed Spear Thistle (*Cirsium vulgare*) are common in the grassland. Shrubs are mostly absent, apart from occasional exotic Hawthorn (*Crataegus monogyna*) and Sweet Briar (*Rosa rubiginosa*).

Even though the tree cover has been mostly removed (more than 30 years ago), a high proportion of this grassland community meets the definition as the Box Gum Woodland EEC. The cleared grasslands do not have sufficient non-grass native understorey species to qualify for inclusion under the EPBC Act, but does qualify under the broader description of the TSC Act (Appendix J). The proposed development will require an access route through the grassland community that will occupy approximately 3.3 ha.

The exotic grasses potentially occupy a high proportion (50% or greater) of grass cover in low-lying areas adjoining the sedgeland. Approximately 25% of the grassland community within the subject land will be cleared for the landfill site, but this is a negligible proportion (less than 1%) of that available in the region.

Community 3 – Sedgeland

Sedgelands occupy the shallow drainage lines running through the grassland. This community is dominated by Tall Sedge (*Carex appressa*), Umbrella Sedge (*Cyperus eragrostis*, exotic), Paspalum (*Paspalum dilatatum*, exotic) and Pinrush (*Juncus usitatus*). Trees and shrubs are absent from this community. The division between sedgeland and grassland is not always distinct. Sedgeland and grassland intergrade to form grassy sedgeland on low lying parts of the study area.

Sedgeland occupies 9.43 ha or 3% of the flora survey area. The sedgeland community has been heavily grazed by sheep and cattle and generally has low to moderate habitat quality. The exotic grasses and sedges potentially occupy a high proportion (50% or greater) of cover in the sedgeland. Approximately 50% of the sedgeland community within the subject land will be cleared for the landfill site, but this is a negligible proportion (less than 1%) of that available in the region.

Community 4 – Wetland (dams)

The farm dams on the site support a small assemblage of wetland plants. Around the waters edge are moisture loving species such as Tall Sedge, Umbrella Sedge, Water Couch (*Paspalum distichum*) and Spreading Knotweed (*Persicaria prostrata*) while in the water itself are Ribbonweed (*Vallisneria gigantea*) and Swamp Lily (*Ottelia ovalifolia*).

The total area of farm dams on the site is 0.6 ha. The edges of the farm dams in the proposed footprint area have been subject to pugging (trampling by domestic livestock) and the habitat quality is low to moderate.

Community 5 Box Gum Woodland

Box Gum Woodland occurs on the portion of the Gara TSR that lies between the Waterfall Way highway and the northern boundary of *Edington.* This community is classed as the Box Gum Woodland EEC under the TSC Act and Critically Endangered EC under the EPBC Act (Appendix J). The proposed development will require an access easement through this community across the narrowest, most degraded and westerly part of the TSR. Approximately 2 ha will be affected, in an area where the woodland is already partly cleared and open, with mostly young Stringybark trees. Less than 5% of the relevant part of the TSR (south of Waterfall way) is affected, a negliglible proportion (less than 1%) of that available in the local area.

The dominant trees in this community are New England Stringybark (*E. caliginosa*), Yellow Box (*E. melliodora*), Blakely's Red Gum (*E. blakelyi*), Apple-Topped Box (*E. bridgesiana*), Bendemeer White Gum (*E. elliptica*) and a small population of Narrow-Leaved Black Peppermint (*E. nicholli*). Trees are generally spaced from 6 to 20 m apart. Both mature and juvenile trees are common, and hollows and denning sites suitable for arboreal mammals and bats are abundant.

Narrow-Leaved Black Peppermint is listed under Schedule 2 (vulnerable) of the TSC Act and as vulnerable under the EPBC Act. The small population of this species consisting of six adults and five juvenile trees was found within 40 m of the corner post of the far north-western tip of the proposed development area (Figure 6). Narrow-Leaved Black Peppermint is endemic to the Northern Tablelands of NSW where it occurs from Niangala in the south to Glen Innes in the north (Williams 1992; Brooker & Kleinig 1999; Hill 2002). A large population is reserved close to its western limit in Single National Park (30 km north-west of Guyra) while another significant population is known to occur 10 km east of the study area along the Waterfall Way. The Wildlife Atlas records this species from 2 to 10 km east of the site along Waterfall Way. This species is not located within the parts of the site identified for clearing.

Bendemeer White Gum was found near the southern boundary fence of the TSR (Figure 6). Bendemeer White Gum is a rare species (ROTAP) on the Northern Tablelands, but is not listed under the TSC or EPBC Act. This species is scattered over the southern part of the Northern Tablelands (e.g. Walcha, Bendemeer and Wollomombi districts). It prefers grassy woodland on sandy soils, and is known to occur 22 km east of the study area along the Waterfall Way. This species is not located within the parts of the site identified for clearing.

The shrub layer is mostly sparse with occasional plants of Spiny Parrot Pea (*Dillwynia sieberi*), Chinese Lespedeza (*Lespedeza juncea*) and Peach Heath (*Lissanthe strigosa*). Thes are relatively common species in the better woodland remnants around Armdiale.

The ground layer is dominated by native grasses such as Kangaroo Grass (*Themeda australis*), Snow Grass (*Poa sieberiana*), Slender Wallaby Grass (*Austrodanthonia racemosa var. racemosa)* and Native Sorghum (*Sarga leiocladum*). Two of these species (Kangaroo Grass and Native Sorghum) were rare to absent from the heavily grazed block to the south, indicating a disturbed understorey. These native grasses are not listed under the TSC or EPBC Acts.

Vegetation in the Box Gum Woodland is in good condition with many species that are sensitive to grazing pressure present. These species were absent from the grazed blocks in the other communities on the study area. A total of 140 different native species were recorded in the Box Gum Woodland community (Appendix C). The Box Gum Woodland community occurs as a single patch occupying 29.6 ha or 9.4% of the flora survey area (see Figure 4). The community is contiguous with a larger patch of woodland in the main part of the Gara TSR on the northern side of the Waterfall Way.

Box Gum Woodland communities are widespread in the region surrounding the proposed landfill site, albeit in fragmented and scattered patches. The Box Gum Woodland community on the study area falls within the category of *New England Grassy Woodlands* defined by Keith (2004). Between 60 and 90% of grassy woodlands on the Northern Tablelands have been cleared since European settlement (Keith, 2004). The overall habitat value of the Box Gum Woodland community on the study area is considered to be high.

3.3 Condition of Proposed Clearing Areas

The condition of all the remnant woodland survey quadrats, as assessed during the field flora surveys, was moderate to good with little bare soil observed, and there was natural regeneration of all overstorey eucalypts and a diverse native understorey present (Table 3). The proposed Waterfall Way turning lane (landfill access route) had the highest proportion of weedy exotic species, reflecting the disturbed roadside verge vegetation. The survey quadrats within the propsed TSR access route, which is currently partly cleared and open, had a higher percentage of ground cover (due to the increased light availability in cleared areas) and lower percentage of overstorey cover than the adjoining TSR survey quadrats. The project will not require the whole of the TSR to be cleared, and the TSR as a whole is in better condition than the small part within the proposed access route. The Stringybark Woodland had higher overstorey cover and more fallen logs than the Box Gum Woodland remnants.

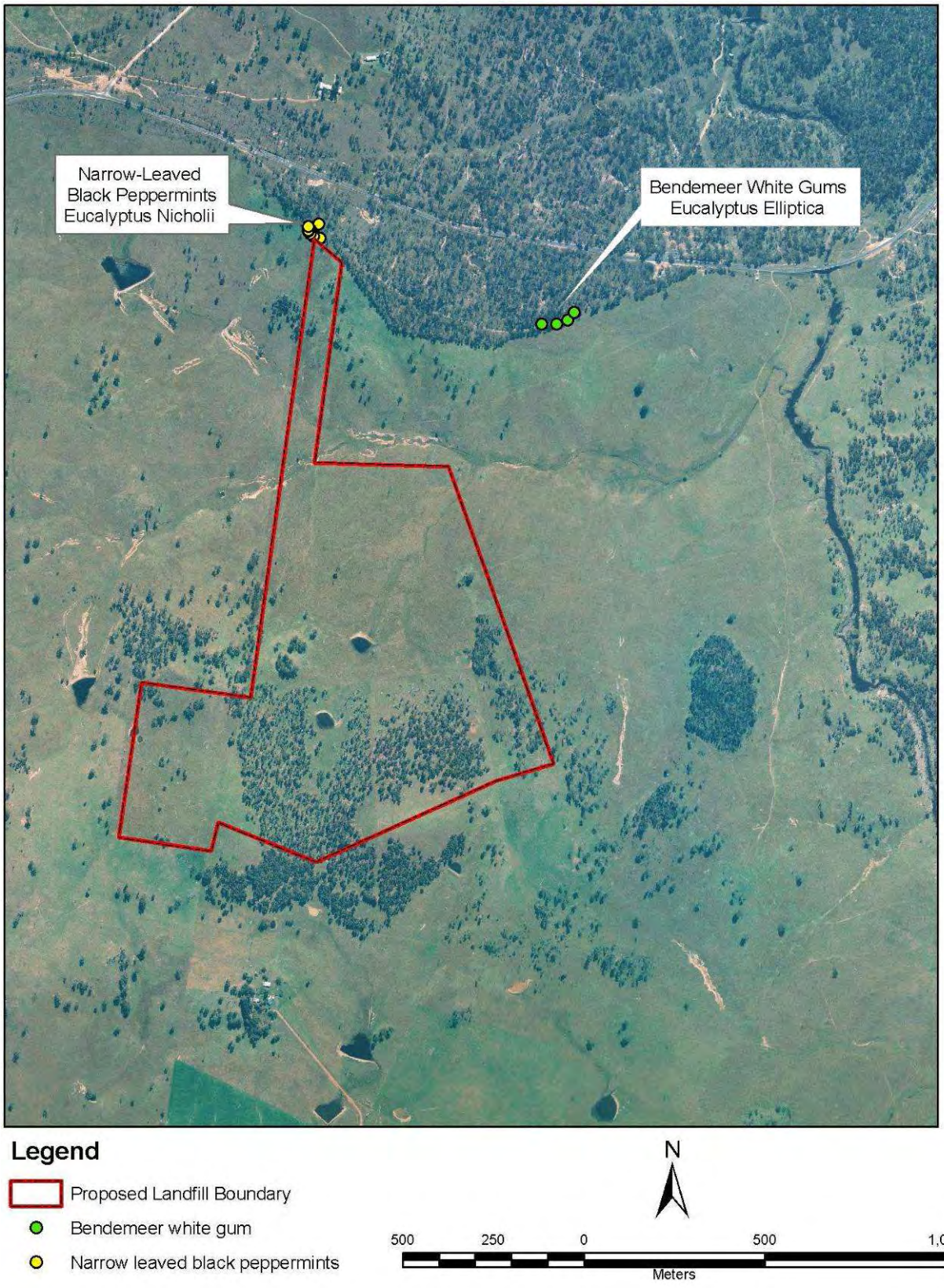

Figure 6. Map showing locations of observed threatened flora species

Table 3. Quadrat Survey. Site condition (20 x 50 m plot) 18 September 2006

Variable	TSR 1		TSR 2		TSR_A 1		TSR_A 2		WFW		StrBk 1		StrBk 2	
	%Cover	No spp	%Cover	No spp	%Cover	No spp	%Cover	No spp	%Cover	No spp	%Cover	No spp	%Cover	No spp
Native overstorey cover	11	**4**	12	**3**	6	**4**	0	**3**	8	**2**	16		30	**1**
Native mid-storey cover	0		2	**1**	0	**2**	0	**2**	0	**1**	0		2	**1**
Native ground cover shrubs <1m	4	**5**	2	**7**		**6**		**3**		**2**	2	**2**	0	
Native ground cover (grasses)	54	**3**	42	**7**	44	**3**	60	**5**	38	**8**	30	**8**	12	**6**
Native ground cover (other)	2	**12**	2	**20**	2	**18**	2	**21**		**18**	4	**11**	4	**12**
Exotic cover (ground)	2	**3**	2	**2**		**3**		**5**		**11**		**2**		
Exotic cover (shrub)				**2**										
Number of trees with hollows	2		1		0		0				0		0	
Regeneration	yes		yes		yes		yes		yes		yes		yes	
Total length of fallen logs	16		25		0		5		3		20		40	
Total species (20x50m)		**36**		**32**		**36**		**39**		**42**		**23**		**22**

TSR – Travelling Stock Reserve 50 m from access route; TSR_A1&2 – TSR access route; WFW – Waterfall Way turning lane; StrBk - Stringybark Woodland

3.4 Fauna

3.4.1 Birds

The assessment of the study area identified 80 bird species (1 exotic), as shown in Table D1, Appendix D. Two threatened bird species, Speckled Warbler *Pyhrrolaemus* (now *Chthonicol*a) *sagittata* and Diamond Firetail *Stagonopleura guttata* (TSC Act - Vulnerable), were detected on the study area in both the TSR beside Waterfall Way and in the Stringybark Woodland. These species were identified within the proposed development area (Figure 7). Three bird species currently the subject of a Preliminary Determination to list them as threatened (TSC Act – Vulnerable) were also detected, in both the TSR and in the Stringybark Woodland in the proposed development area (Appendix D; Figure 7): the Little Eagle *Hieraaetus morphnoides*, Scarlet Robin *Petroica boodang* and Varied Sittella *Daphoenositta chrysoptera*.

3.4.2 Mammals

The fauna survey recorded 15 species of mammals of which 4 were exotic (Appendix D). Two threatened mammal species were detected on the study area: A single Koala (TSC Act – Vulnerable) was observed in the Box Gum Woodland in the TSR beside Waterfall Way in 2005. Scats and scratches made by a Koala were recorded in the Stringybark Woodland at the landfill site in 2009. Eastern Bent-Wing Bat (TSC Act - Vulnerable) echo-location calls were recorded using an Anabat bat detector in the Stringybark Woodland in 2005.

The parameters used to assign bat calls to particular species using ANALOOK software (Corben 2004) are presented in Appendix D. The frequency vs. time graphs for all microbat species identified using ANALOOK software are presented in Appendix E.

Although, not threatened the Common Brushtail Possum (*Trichosurus vulpecular*) was very abundant in the Box Gum Woodland on the TSR. Eighteen (18) individuals, including two with young were recorded on the night of 24 November alone. Monitoring of tree removal to relocate disturbed individuals during tree felling for the access road should be undertaken.

3.4.3 Amphibians

Eight (8) species of frogs were recorded on the site (Appendix D). No threatened frogs were detected on the study area.

3.4.4 Reptiles

Ten (10) species of reptiles observed on the site (Appendix D). No threatened reptiles were detected on the study area

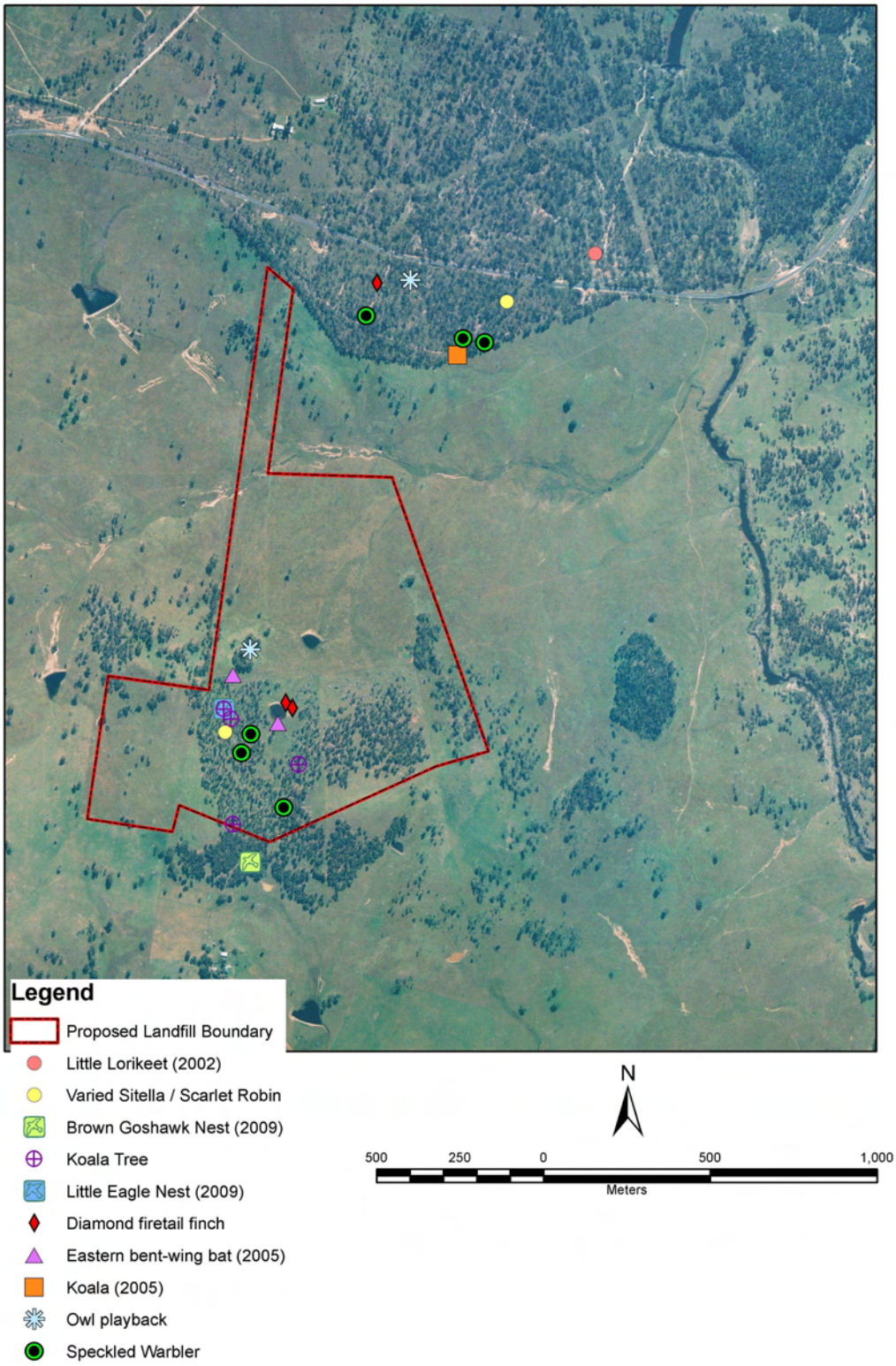

Figure 7. Map showing locations of observed threatened fauna species and the locations for owl call playback

4. Impacts and Mitigations Measures

Potential impacts of the proposal on native flora and fauna were considered in relation to direct and indirect impacts, the sensitivity of the environment and, the nature, extent, frequency, duration and timing of their effects.

Apart from continuing agricultural practices in the locality of the landfill site, it is unlikely that there will be any other developments, activities or actions that could contribute to cumulative impacts during the operational lifetime of the landfill since the proposed landfill site is 12 km from urban development in the rural zone.

The aim of the proposed mitigation measures is to avoid or ameliorate potential adverse impacts of the proposal on threatened biodiversity. Progressive rehabilitation of the landfill site will aim to recreate a landscape that is compatible with the surrounding land which is likely to be suitable for agricultural use.

4.1 Potential Impacts of the Proposed Development

In relation to native flora and fauna, the adverse impacts that may result from clearing, construction, and operation of a landfill include vegetation clearance, loss of habitat, weed invasion, increased competition and predation from feral animals and vermin, increased dust and noise levels, increased traffic hazards, and risk of pollution. Such disturbances reduce the habitat quality of the affected land and may threaten viable populations of threatened species found in the subject site.

4.1.1 Habitat loss

Impact:

Impacts to biodiversity resulting from the landfill development will span time scales that are at least inter-generational, if not permanent. The losses that will occur at the landfill site also contribute to the already significant level of cumulative habitat loss that has occurred at a regional scale on the New England Tablelands (DEC 2006).

The proposed action will involve clearing which will result in a reduction in the area of woodland and grassland habitat that supports native flora and fauna, including five threatened species, one ROTAP species and one EEC. Hollow-bearing trees will be lost in the Box Gum Woodland in the TSR.

Mitigation measures:

Clearing will be progressive, with landfill cells 4 and 5 not cleared for use for 30 to 40 years. Spent cells within the landfill pit will be progressively rehabilitated to stabilise soils and restore the landscape to a form that is compatible with the surrounding land and comparable to pre-existing land use. The first step in rehabilitation will be earthworks to create geomorphologically stable landscapes. The area over the landfill will be rehabilitated in a manner suitable for agricultural purposes.

Vegetation / Rehabilitation Management Plan: The vegetation management plan will include revegetation and landscaping works during construction, operation and post operation of the landfill site. The plan will also include details of actions to assist natural regeneration in areas where viable natural seed bank is likely to exist (such as areas where on-site stored topsoil is used for rehabilitation works). This plan should provide for.

- Minimising the extent of clearing: clearing should be undertaken in a staged process consistent with operational requirements;
- Avoiding clearing areas not immediately required for operational purposes;
- Fencing to exclude stock and Rabbits from regeneration and revegetation areas;
- Planting for landscaping and vegetated buffers using locally occurring native species. These areas should be established and planted as early as possible in the construction phase;
- The maintenance of adequate ground cover on all parts of the landfill site not required for day-to-day operations;
- Tube stock planting/direct seeding undertaken following autumn rains;
- Progressive rehabilitation and revegetation of spent landfill areas;
- Revegetation along fringes of proposed water storages (sedimentation and leachate ponds) to encourage use by native mammal, reptile, amphibian and bird species;
- Ongoing monitoring of condition of native vegetation in areas likely to be impacted by the proposed development including revegetated areas such as pit rehabilitation works, landscaping, vegetated buffers and other native vegetation communities occurring on the subject site;
- If understorey response is minimal, apply assisted rehabilitation (selected replanting of shrubs and seeding if feasible) especially in treeless areas; and
- Ongoing monitoring and follow-up control of weeds and pests that establish on disturbed areas, with particular attention to the eradication of noxious weeds and pests identified as Key Threatening Processes such as Rabbits and Foxes (Section 6.8).

Compensatory Habitat Offset Plan: Offsetting is a means by which the biological shortfall between a rehabilitated (stabilised) landscape and a pre-disturbance landscape can be narrowed. Actions to remove threats or 'enhance' biodiversity at another site are taken to compensate for loss of biodiversity values in the landfill site and the cumulative loss at regional scale (DEC 2006).

It is proposed to set aside an area of Stringybark Woodland and native grassland adjacent to the proposed landfill operational area to offset the area lost to development (see Offset Management Plan). The Stringybark Woodland and grassland offset areas are three times that proposed to be cleared for the landfill. Management of the offset area will be adaptive (i.e., the response of flora and fauna to management actions will be monitored and reviewed every 5 years).

Actions will include:

- fencing to exclude stock and Rabbits;
- revegetation to fill gaps;
- managed beneficial clearing to thin dense regrowth in accordance with DECCW guidelines for thinning regrowth (See Offset Management Plan);
- relocation of logs;
- weed and pest animal control; and,
- Ongoing maintenance and monitoring.

These actions should be implemented immediately once the land is purchased to minimise ecological risks from time lags.

Understorey response to grazing removal should be monitored from the outset. If understorey response is minimal, apply assisted regeneration (revegetate with local provenance tree and shrubs seedlings) especially in treeless areas. Growth and stand structure response should be monitored to assess the response of the understorey to thinning (see Offset Management Plan).

4.1.2 Impacts on aquatic habitats and groundwater dependant ecosystems (GWDE)

Clearing Impact:

Two small farm dams and a small area of sedgeland will be incorporated into the proposed landfill pit area and downstream sedimentation pond, leachate pond and dry basin resulting in a loss of approximately 0.5 ha of wetland (dams) and sedgeland. The wetland and sedgeland that is proposed to be lost to the development is currently in poor condition due to impacts of cattle pugging and grazing.

During the field assessment of the study site in 2005 no significant flora or fauna were observed in the two small farm dams within the development footprint area. 9.4 ha of sedgeland lays immediately downstream of the proposed new landfill footprint area. This sedgeland is confined to the shallow drainage lines that carry surface flows of water from the study area towards the Gara River 1 km to the east. The hydrological studies accompanying the Environmental Assessment indicate that there are no perched water tables in the study area. No groundwater dependent ecosystems have been identified in the study area, nor in the Oxley Wild Rivers National Park downstream of the proposed new landfill (DNR 2002). Thus, the proposed new landfill is not likely to have any impacts on groundwater dependant ecosystems, either in the study area or further downstream in Oxley Wild Rivers National Park.

Water Quality Impacts:

Changes to the amount and quality of drainage into the Gara River via the drainage channels running in an easterly direction along the northern section of *Edington* are dealt with in the Armidale Regional Landfill Environmental Assessment (AECOM 2010).

4.1.3 Vegetation Clearing and Relocation of Log Piles

Impact:

The proposal will involve clearing of less than 1 ha of native vegetation in the Gara TSR for a single access easement. The vegetation to be cleared in the Gara TSR is part of the EEC Box Gum Woodland.

The proposal will involve clearing 12.7 ha of the regrowth Stringybark Woodland community. This clearing will also involve the relocation of previously felled regrowth that has been pushed into numerous log piles (about 10 years ago).

Hollow-bearing stags in the grassland and hollow-bearing trees from Stringybark Woodland in the landfill area will be relocated to offset areas as logs or erect as stags if feasible in line with DECCW recommendations.

The access route through the cleared grassland and sedgeland will clear approximately 3.3 ha of ground cover.

Mitigation measures:

Vegetation Clearing Protocol and Native Fauna Management Plan: Preparation and implementation of a vegetation clearing protocol and fauna management plan to minimise negative impacts of vegetation clearing and log pile dispersal on threatened species and other locally significant native fauna. An ecologist should be present to monitor clearing operations.

The *vegetation clearing protocol* should address the following:

- Pre-clearing collection of locally sourced seeds for direct seeding and/or propagation of tube stock;
- The extent of clearing should be minimised, and undertaken in a staged process consistent with operational requirements;
- Clearly mark areas occupied by *Eucalyptus nicholii* and *E. elliptica* prior to any clearing or construction works. A minimum buffer of at least 30 m should be designated around these species and avoided during construction and operational phases;
- Identify and where possible avoid clearing 'habitat trees' that contain significant hollows likely to be used by native fauna (arboreal mammals, birds and bats);
- Where possible, retain dead trees and logs in the study area that have not been pushed into piles; and
- To minimise clearing of the Box Gum Woodland EEC it is recommended that the access road for the landfill site be located in the existing partially cleared area in the western part of the Gara TSR, where possible

The ***Native Fauna Management Plan*** should address the following issues in relation to clearing:

- Development of a protocol for responding to the detection of native fauna present in trees and log piles prior to clearing operations;

- Where practical, tree clearing and log-pile relocation should be restricted to late summer and autumn to avoid disturbing spring-breeding birds including the Little Eagle as well as species that nest in hollows, and over-wintering bats.

4.1.4 Fire

Impact:

Uncontrolled bushfire (originating off site, or by lightning strike in the offset areas) may result in temporary loss of habitat and thereby affect the viability of local populations of threatened species and the EEC occurring on the site.

Mitigation measures:

Fire Management Plan: Preparation and implementation of a fire management plan for the landfill site as well as surrounding bushland. This plan should provide for.

- Monitoring of fuel loads;
- Fuel reduction such as slashing, controlled grazing, and controlled burning where appropriate;
- A maintained perimeter firebreak between the landfill (external offset area boundaries) and all adjoining properties, to minimise bushfire hazard; and
- Hazard reduction burning in offset areas will not be permitted in line with DECC's requirements for offset areas.

4.1.5 Fragmentation, edge effects and reduced connectivity

Impact:

Clearing of parts of the Box Gum Woodland in the TSR and parts of the Stringybark Woodland will contribute to fragmentation of woodland habitat with associated edge effects and reduced connectivity.