Community 6: Carex Fen

PCT: 582 - Sedgeland fens wetland of impeded drainage of the Nandewar Bioregion and New England Tablelands Bioregion.

Keith: Montane Bogs and Fens.

TEC Type:

Carex Sedgelands of the New England Tableland, Nandewar, Brigalow Belt South and NSW North Coast Bioregions - Endangered Ecological Community TSC Act
http://www.environment.nsw.gov.au/determinations/carexsedgelandFD.htm

Montane peatlands and swamps of the New England Tableland, NSW North Coast, Sydney Basin, South East Corner, South Eastern Highlands and Australian Alps Bioregions - Endangered Ecological Community TSC Act.
http://www.environment.nsw.gov.au/determinations/MontanePeatlandsEndSpListing.htm

Full floristic sample sites (4): BH122, BH127, BH140 & FEN53 (Hunter & Bell 2009).
Rapid sample sites (3): BHR15, BHR16, BHR22.

No. of taxa: 47
Area mapped: 6.9 ha
Good: 0 ha *Moderate:* 5.3 ha *Poor:* 1.6 ha *TEC:* 6.9 ha

Most common natives: listed in order of decreasing summed cover scores (fidelity x cover).

Trees: none apparent.

Shrubs: none apparent.

Climbers & trailers: none apparent.

Ground cover: *Carex gaudichaudiana, Carex appressa, Glyceria australis, Carex* sp. undetermined, *Epilobium billardierianum, Stellaria angustifolia, Lythrum salicaria, Juncus usitatus, Haloragis heterophylla, Juncus vaginatus, Juncus prismatocarpus, Isachne globosa, Cyperus sphaeroideus, Carex fascicularis, Pratia purpurascens, Pennisetum alopecuroides, Lomandra multiflora, Juncus pauciflorus, Hypericum japonicum, Eleocharis gracilis, Baumea rubiginosa, Schoenoplectus validus, Ranunculus lappaceus, Oxalis perennans, Lomandra longifolia, Lachnagrostis filiformis.*

Introduced taxa: *Paspalum dilatatum, Cirsium vulgare, Holcus lanatus, Medicago polymorpha, Hypochaeris radicata, Verbena bonariensis, Plantago lanceolata, Festuca elatior, Briza minor, Vicia sativa, Trifolium repens, Rubus anglocandicans, Prunella vulgaris, Lolium perenne, Bromus brevis, Anthoxanthum odoratum, Taraxacum officinale, Andropogon virginicus, Ammi majus.*

Notes: found associated with areas of impeded drainage throughout the study area both in upland and lowland areas. There may be difficulty in determining which threatened ecological community this assemblage falls within without further on-ground work. Carex Sedgelands that are largely dominated by *Carex gaudichaudiana* and which may form a peaty subsurface layer will fall into the Montane Peatlands and Swamps TEC, however those sedgelands dominated by *Carex appressa* or co-dominated by *Carex appressa* are more likely to be placed within the Carex Sedgelands of the Northern Tablelands TEC. Across the regional landscape, fens are most commonly found on the lowest parts of broad drainage depressions or in more or less narrow bands along creeks. Fens also occur in less predictable situations such as on the beds of closed basin wetlands. Keith (2004) infers that fens are more common on basalts and shales, and bogs on acidic substrates such as leucomonzogranites and sandstones. Hunter and Bell (2007 & 2009) indicate that substrate is less important as a driver of community patterns than variables such as rainfall, altitude and the origin of nutrients entering the system. Fens are sensitive to small changes in groundwater flow (Van Diggelen 2006). In the New England Tablelands Bioregion many of the largest fens have been significantly altered, reduced in size or completely destroyed by drains and dams; these activities still continue today. Sites that may have once contained Carex fens are now grasslands. On some soil types Pennisetum grassland rather than Carex fen are present in open depressions, suggesting that changes in moisture relationships could drive fen communities towards these and other grasslands. Recurrent fires may also cause degradation of the thin layers of peat or change its water holding capacity. One of the dominant *Carex* species found within these fens has not been found within the state before (Hunter & Bell 2009) and as yet it is undetermined whether the species is a new species or a new native invasive species. It is unlikely that confirmation will occur in the near future.

Community 7: Broad-leaved Stringybark – Rough-barked Apple – Blakely's Red Gum Woodland

PCT: 1331 – Yellow Box – Broad-leaved Stringybark Shrubby Open Forest of the New England Tableland Bioregion.

Keith: New England Grassy Woodlands.

TEC Type: *in part.*

White Box Yellow Box Blakely's Red Gum grassy woodlands - Endangered Ecological Community under *TSC* Act
http://www.environment.nsw.gov.au/ThreatenedSpeciesApp/profile.aspx?id=10837

White Box Yellow Box Blakely's Red Gum grassy woodlands and derived native grasslands –Critically Endangered Ecological Community under *EPBC* Act
http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=43&status=Critically+Endangered

Full floristic sample sites (33): BH36, BH50, BH51, BH52, BH53, BH56, BH57, BH58, BH59, BH60, BH61, BH62, BH63, BH64, BH66, BH68, BH69, BH71, BH73, BH74, BH75, BH80, BH81, BH82, BH84, BH86, BH87, BH109, BH110, BH129, BH135, BH136, BH137.
Rapid sample sites (10): BHR01, BHR02, BHR03, BHR04, BHR05, BHR06, BHR10, BHR17, BHR18, BHR21.

No. of taxa: 208.
Area mapped: 200.1 ha
Good: 82.4 ha *Moderate:* 81.58 ha *Poor:* 36.7 ha *TEC:* 11.9 ha

Most common natives: listed in order of decreasing summed cover scores (fidelity x cover).

Trees: *Eucalyptus caliginosa, Angophora floribunda, Eucalyptus blakelyi, Acacia neriifolia, Eucalyptus melliodora, Eucalyptus banksii, Eucalyptus bridgesiana, Brachychiton populneus, Eucalyptus youmanii, Eucalyptus prava, Acacia pycnostachya, Eucalyptus andrewsii, Banksia integrifolia, Callitris endlicheri, Eucalyptus dealbata, Eucalyptus caleyi, Allocasuarina littoralis.*

Shrubs: *Leptospermum brevipes, Melichrus urceolatus, Cassinia quinquefaria, Pimelea neo-anglica, Xanthorrhoea johnsonii, Notelaea microcarpa, Acacia fimbriata, Hibbertia obtusifolia, Bursaria spinosa, Acacia implexa, Jacksonia scoparia, Brachyloma daphnoides.*

Climbers & trailers: *Desmodium varians, Commelina cyanea, Glycine microphylla, Eustrephus latifolius, Stephania japonica, Clematis glycinoides, Rubus parvifolius, Glycine tabacina, Glycine tomentella, Davallia solida, Cayratia clematidea.*

Ground cover: *Cymbopogon refractus, Microlaena stipoides, Aristida personata, Gahnia aspera, Dichondra* sp. A*, Calotis cuneifolia, Lomandra multiflora, Echinopogon caespitosus, Dichelachne micrantha, Eragrostis leptostachya, Themeda triandra, Poa sieberiana, Panicum simile, Cheilanthes sieberi, Aristida jerichoensis, Digitaria ramularis, Dichelachne crinita, Geranium solanderi, Austrostipa scabra, Vittadinia dissecta* var. *hirta, Pteridium esculentum, Lepidosperma laterale, Tripogon loliiformis, Lomandra longifolia, Bothriochloa macra, Solanum cinereum, Euchiton sphaericus, Dichondra repens, Desmodium brachypodum, Carex breviculmis, Aristida vagans, Wahlenbergia communis, Poranthera microphylla, Opercularia hispida, Glossocardia bidens, Scleria mackaviensis, Chloris truncata, Austrostipa verticillata.*

Introduced taxa: *Bidens pilosa, Hypochaeris radicata, Conyza bonariensis, Rubus anglocandicans, Opuntia stricta, Bidens subalternans, Verbascum thapsus, Solanum nigrum, Sida rhombifolia, Rosa rubiginosa, Petrorhagia nanteuilii, Hypochaeris glabra, Hyparrhenia hirta, Eragrostis curvula, Conyza sumatrensis, Anthoxanthum odoratum, Zinnia peruviana, Tagetes minuta, Plantago lanceolata, Paspalum dilatatum, Gomphocarpus fruticosus, Gamochaeta purpurea, Chloris virgata, Capsella bursapastoris, Andropogon virginicus, Anagallis arvensis.*

Notes: highly variable in terms of overstorey dominants this community is dominated by *Eucalyptus blakelyi* (Blakely's Red Gum), *Eucalyptus melliodora* (Yellow Box) and *Angophora floribunda* (Rough-barked Apple) with a predominantly grassy understorey in some locations that would place this community within the Box Gum Grassy Woodlands determinations (above). It is difficult to be precise about the inclusion of this unit into the EPBC as the intermingling and dominance of introduced grasses is highly stochastic and will require very individualistic mapping. Once a route is chosen it would be easier to further dissect where this unit falls within the EPBC determination. Most of the time this community has a cover of *Eucalyptus caliginosa* (Broad-leaved Stringybark) and either *Eucalyptus banksii* (Tenterfield Woollybutt) and *Eucalyptus bridgesiana* (Apple Box) amongst others to be considered the TECs. Primarily found dominating mid to higher altitude locations within the study area.

Community 8: Blakely's Red Gum – Rough-barked Apple – Fuzzy Box Grassy Woodland

PCT: 510 – Blakely's Red Gum – Yellow Box grassy woodland of the New England Tableland Bioregion *and possibly* 734 – Broad-leaved Stringybark - Blakely's Red Gum grassy woodlands of the New England Tableland Bioregion.

Keith: New England Grassy Woodlands.

TEC Type: *primarily*

White Box Yellow Box Blakely's Red Gum grassy woodlands - Endangered Ecological Community under *TSC* Act
http://www.environment.nsw.gov.au/ThreatenedSpeciesApp/profile.aspx?id=10837

White Box Yellow Box Blakely's Red Gum grassy woodlands and derived native grasslands –Critically Endangered Ecological Community under *EPBC* Act
http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=43&status=Critically+Endangered

but in part
Ribbon Gum - Mountain Gum - Snow Gum grassy open forest/woodland of the New England Tableland Bioregion - Endangered Ecological Community under TSC Act
http://www.environment.nsw.gov.au/ThreatenedSpeciesApp/profile.aspx?id=20040

Full floristic sample sites (13): BH70, BH83, BH102, BH103, BH104, BH105, BH106, BH107, BH108, BH111, BH121, BH123, BH125, BH128.
Rapid sample sites (2): BHR07, BHR13.

No. of taxa: 137.
Area mapped: 42.2 ha
Good: 24.58 ha *Moderate:* 17.3 ha *Poor:* 0.3 ha *TEC:* 39.25 ha

Most common natives: listed in order of decreasing summed cover scores (fidelity x cover).

Trees: *Eucalyptus blakelyi, Angophora floribunda, Eucalyptus conica, Eucalyptus caliginosa, Eucalyptus viminalis, Eucalyptus bridgesiana, Eucalyptus melliodora, Acacia pycnostachya.*

Shrubs: *Acacia implexa, Pimelea neo-anglica, Melichrus urceolatus, Leptospermum brevipes, Cassinia quinquefaria, Notelaea microcarpa, Bursaria spinosa, Acacia fimbriata, Pimelea curviflora* subsp. *divergens*.

Climbers & trailers: *Desmodium varians, Rubus parviflorus, Commelina cyanea.*

Ground cover: *Microlaena stipoides, Cymbopogon refractus, Aristida personata, Echinopogon caespitosus, Eragrostis leptostachya*, *Dichondra* sp. A, *Dichelachne micrantha, Calotis cuneifolia, Themeda triandra, Scleranthus biflorus, Geranium solanderi, Carex inversa, Poa sieberiana, Oxalis perennans, Cheilanthes sieberi, Lomandra filiformis, Aristida jerichoensis, Wahlenbergia communis, Tricoryne elatior, Schoenus apogon, Calotis lappulacea, Juncus remotiflorus, Schenkia spicata, Lomandra multiflora, Imperata cylindrica, Echinopogon ovatus, Dichelachne crinita, Desmodium brachypodum, Vittadinia dissecta, Veronica calycina, Dianella caerulea, Asperula conferta, Wahlenbergia planiflora, Sorghum leiocladum, Rumex brownii, Luzula flaccida, Juncus pauciflorus, Juncus fockei, Hypericum gramineum, Hydrocotyle laxiflora, Haloragis heterophylla, Euchiton sphaericus, Entolasia stricta, Dichondra repens, Dianella revoluta, Crassula sieberiana, Coronidium scorpioides, Chrysocephalum semipapposum, Aristida vagans.*

Introduced taxa: *Eragrostis curvula, Conyza bonariensis, Hypochaeris radicata, Hyparrhenia hirta, Plantago lanceolata, Trifolium dubium, Rosa rubiginosa, Medicago polymorpha, Verbena bonariensis, Bidens pilosa, Acetosella vulgaris, Vulpia bromoides, Solanum nigrum, Hypochaeris glabra, Rubus anglocandicans, Paronychia brasiliana, Cirsium vulgare, Andropogon virginicus, Setaria pumila, Opuntia stricta, Guileminea densa, Bromus brevis, Briza minor, Arenaria leptoclados, Anagallis arvensis.*

Notes: most of this community would be included within the Box – Gum Grassy Woodlands TECs (see above). Furthermore most of the area mapped as this community is of very high quality and are some of the better examples of this threatened type of community. The occasional single individual of *Acacia pycnostachya* was found scattered through this community type. Primarily found in intermediate altitude zones within the study area, above the low land flats dominated by Communities 1 and 2 and below Community 7 and 9. Some areas grade into the low land areas dominated by Community 2 and some of the dominants such as *Eucalyptus viminalis* (Manna Gum) and *Eucalyptus conica* (Fuzzy Box) are also found merging into this assemblage. Small open patches within the intact mosaic are dominated by *Eragrostis curvula* (African Lovegrass). Care should be taken not to spread this invasive species that is listed as a Key Threatening Process (Invasion by Perennial Exotic Grasses).

Community 9: Broad-leaved Stringybark – Mountain Banksia – Apple Box Shrubby Woodland and Forest

PCT: *possibly* 508 Blakely's Red Gum – Stringybark - Rough-barked Apple open forest of the Nandewar Bioregion and western New England Tablelands Bioregion *or* 991 – New England Blackbutt – Youmans Stringybark grassy open forest of the western New England Tableland Bioregion.

Keith: Northern Tableland Dry Sclerophyll Forest.

TEC Type: *in part*

Ribbon Gum - Mountain Gum - Snow Gum grassy open forest/woodland of the New England Tableland Bioregion - Endangered Ecological Community under TSC Act http://www.environment.nsw.gov.au/ThreatenedSpeciesApp/profile.aspx?id=20040

Full floristic sample sites (12): BH85, BH92, BH100, BH101, BH112, BH113, BH114, BH115, BH131, BH134, BH138, BH139.
Rapid sample sites (0): none placed.

No. of taxa: 151.
Area mapped: 49.7 ha
Good: 24.7 ha *Moderate:* 10.8 ha *Poor:* 13.1 ha *TEC:* 4.2 ha

Most common natives: listed in order of decreasing summed cover scores (fidelity x cover).
Trees: *Eucalyptus caliginosa, Banksia integrifolia, Eucalyptus bridgesiana, Angophora floribunda, Allocasuarina torulosa, Eucalyptus viminalis, Eucalyptus banksii, Eucalyptus andrewsii, Eucalyptus prava, Eucalyptus caleyi, Brachychiton populneus.*
Shrubs: *Acacia fimbriata, Bursaria spinosa, Jacksonia scoparia, Melichrus urceolatus, Xanthorrhoea johnsonii, Leptospermum brevipes, Notelaea microcarpa, Maytenus*

silvestris, Pimelea venosa, Pimelea neo-anglica, Hibbertia obtusifolia, Cassinia quinquefaria, Acacia implexa, Acacia filicifolia.

Climbers & trailers: *Rubus parvifolius, Desmodium varians, Eustrephus latifolius, Clematis glycinoides, Pyrrosia rupestris, Glycine tomentella, Glycine clandestina, Davallia solida, Billardiera scandens.*

Ground cover: *Poa sieberiana, Microlaena stipoides, Echinopogon caespitosus, Imperata cylindrica, Cymbopogon refractus, Lomandra longifolia, Pteridium esculentum, Lomandra multiflora, Wahlenbergia communis, Themeda triandra, Dichondra* sp. A, *Rytidosperma pallidum, Geranium solanderi, Calotis cuneifolia, Oxalis perennans, Entolasia stricta, Aristida personata, Pratia purpurascens, Dianella revoluta, Lomandra filiformis, Gahnia aspera, Dichelachne micrantha, Adiantum hispidulum, Poranthera microphylla, Lepidosperma laterale, Juncus pauciflorus, Haloragis heterophylla, Arthropodium milleflorum, Acaena novae-zelandiae, Wahlenbergia planiflora, Veronica calycina, Scleranthus biflorus, Plectranthus graveolens, Luzula flaccida, Lomandra confertifolia, Euchiton sphaericus, Carex inversa, Austrostipa rudis.*

Introduced taxa: *Hypochaeris radicata, Conyza bonariensis, Eragrostis curvula, Cirsium vulgare, Verbena bonariensis, Rubus anglocandicans, Hyparrhenia hirta, Verbascum virgatum, Verbascum thapsus, Solanum nigrum, Rosa rubiginosa, Bidens subalternans, Bidens pilosa, Andropogon virginicus, Acetosella vulgaris.*

Notes: found at higher altitudes in more protected locations than Community 8. Usually on steeper eastern to south eastern facing slopes. This assemblage is closer in resemblance to those that occur further to the east such as the northern Butterleaf and western Gibraltar Range areas and probably occurs here due to the high altitudes and only in more protected locations. Much of this assemblage has been cleared within the study area though a reasonable area remains in very good condition. It is within this community that the extant population of the Endangered *Pimelea venosa* was found.

Community 10: Black Pine – Caley's Ironbark – Kurrajong Shrubland, Shrubby Woodland & Dry Rainforest

PCT:
502 – Black Cypress Pine – Orange Gum – Tumbledown Red Gum shrubby woodland on granites of the Nandewar Bioregion and the New England Tableland Bioregion
609 - Black Cypress Pine – Caley's Ironbark – Tumbledown Red Gum shrubby woodland on Mole Granite of the Torrington area of the New England Tableland Bioregion.
1124 – Rusty Fig – Wild Quince – Native Olive dry rainforest of rocky areas of the Nandewar Bioregion.

Keith: Dry Rainforests & Northern Tableland Dry Sclerophyll Forests & Northern Montane Heaths.

TEC Type: none applicable.

Full floristic sample sites (10): BH67, BH76, BH77, BH78, BH79, BH89, BH90, BH130, BH132, BH133.
Rapid sample sites (2): BHR19, BHR20.

No. of taxa: 132.
Area mapped: 19.2 ha
Good: 7.5 ha *Moderate:* 7.4 ha *Poor:* 4.0 ha *TEC:* 0 ha

Most common natives: listed in order of decreasing summed cover scores (fidelity x cover).
Trees: *Callitris endlicheri, Eucalyptus caleyi, Brachychiton populneus, Eucalyptus dealbata, Eucalyptus prava, Eucalyptus bridgesiana, Eucalyptus blakelyi, Acacia pycnostachya, Eucalyptus macrorhyncha*.
Shrubs: *Notelaea microcarpa, Leptospermum brevipes, Ficus rubiginosa, Bursaria spinosa, Pimelea neo-anglica, Cassinia quinquefaria, Melichrus urceolatus, Xanthorrhoea*

johnsonii, Zieria cytisoides, Leptospermum polygalifolium, Acacia fimbriata, Olearia ramulosa, Hibbertia cistoidea, Dodonaea triquetra.

Climbers & trailers: *Pyrrosia rupestris, Stephania japonica, Eustrephus latifolius, Davallia solida, Dockrillia linguiformis.*

Ground cover: *Lomandra longifolia, Entolasia stricta, Plectranthus graveolens, Lepidosperma laterale, Rytidosperma pallidum, Lomandra multiflora, Oplismenus aemulus, Cheilanthes sieberi, Entolasia marginate, Tripogon loliiformis, Dendrobium speciosum, Microlaena stipoides, Lepidosperma gunnii, Digitaria ramularis, Dichelachne micrantha, Cymbopogon refractus, Aristida personata, Stypandra glauca, Rytidosperma longifolium, Rytidosperma bipartitum, Opercularia hispida, Grammitis billardieri, Gahnia aspera, Eragrostis leptostachya, Einadia nutans, Dianella revoluta, Calotis cuneifolia, Adiantum hispidulum, Viola hederacea, Urtica incisa, Senecio diaschides, Scleria mackaviensis, Rytidosperma caespitosum, Pomax umbellata, Eriochilus cucullatus, Doodia caudate, Dichondra* sp. A, *Dianella longifolia, Carex appressa, Aristida vagans, Aristida jerichoensis.*

Introduced taxa: *Rubus anglocandicans, Opuntia stricta, Eragrostis curvula, Conyza bonariensis, Hypochaeris radicata, Bidens pilosa, Anagallis arvensis, Solanum nigrum, Gamochaeta purpurea, Cirsium vulgare, Briza maxima, Bidens subalternans, Andropogon virginicus.*

Notes: this assemblage type is highly variable in both structure and dominants but share a shallow rocky habitat. Structurally this community can be present as a woodland, shrubby woodland, shrubland and at times herbfield. Despite these structural differences there are a large number of shared taxa. The threatened *Acacia pycnostachya* (Bolivia Hill Wattle) is more commonly found in this community than any other and at times forms a dominant overstorey on some rocky slopes. The bare rocky slopes are described within assemblage 8: Western New England Shrublands and Herbfields of Hunter & Clarke (1998) and in the strictest sense are restricted to rocky outcrop areas here and at Bluff River Nature Reserve. Within the rocky creek lines some disjunct species not normally found this far west can be found such as *Grammitis billardieri* which is more normally associated with rocks in locations such as rainforest within Gibraltar Range. Similarly *Dendrobium speciosum* (Rock Orchid) and *Platycerium bifurcatum* (Elkhorn) are also normally found in wetter communities further east. Four mapping sub-associations have delineated that are definable in the full dendrogram at a lower dissociation measure. These additional mapping units are:

10a:Rock Outcrop Shrubland.

10b: Black Pine – Caley's Ironbark. Main image. Found on exposed sites around dissected boulders.

10c: Dry Rainforest. Found around protected slopes and larger boulders often at the base of bare granite slopes with greater runoff.

10d: Rocky Creek-line. Found along a single highly dissected creek line.

2.5 Communities and taxa of conservation significance

2.5.1 *Communities found within the study area*

Four listed communities on the *EPBC* or *TSC* Acts were found within the designated study area at Bolivia Hill. The specific determinations and website links are given within each community description in the previous section. These combined account for total of 112.7 ha (23.4% of the total area mapped) (Table 1). Of particular note is that 30.2 ha (27%) of these listed threatened communities are in good condition. It should be noted that it was not always clear which threatened ecological community (TEC) that the Carex Fen (Community 6) may belong too as this depends on the overall cover of *Carex gaudichaudiana*, which is highly variable at this locality. However to simplify the situation most occurrences are likely to fall within the Carex Sedgelands of the Northern England Tablelands and Nandewar Bioregion. Furthermore, allocating grassland types to Box Gum Grassy Woodland TEC types, Ribbon Gum – Mountain Gum – Snow Gum or neither, is somewhat arbitrary and based on evidence found on ground such as remnant trees, seedlings, landscape features and experience of the surveyor. Areas that may have contained a TEC but which have no remaining native overstorey and have a predominantly introduced understorey have not been mapped as a TEC. As not every location was visited, it is likely that some addition areas may be of the latter type and could be excluded from the current TEC mapping. It should also be noted that a property on the south western corner did not allow a flora assessment to be conducted and as such, the mapping here is purely based on remote imagery analysis. It should be noted that the condition codings given are only a very general rating based on an anecdotal observations made by the surveyor during the field inspections and not based on any analytical data. As areas that would not fall within the determinations have already been excluded from the mapping due to no overstorey and largely introduced understorey the areas mapped as poor would still likely fall within the TEC criteria.

Table 1: Condition and area of threatened ecological communities within the Bolivia Hill Road Re-alignment study area.

TEC	**Condition in Ha**			
	Good	Moderate	Poor	Total
Box Gum Woodland (TSC & EPBC Acts)	23.1	24.5	14.8	62.3
Carex Sedgelands &/or Montane Peatlands of the NET (TSC Act)		5.3	1.5	6.9
Montane Peatlands of the NET (TSC Act)		1.5		1.5
Ribbon Gum - Mountain Gum - Snow Gum of the NET (TSC Act)	7.1	13.3	21.6	42.0
Total	30.2	44.6	37.9	**112.7**

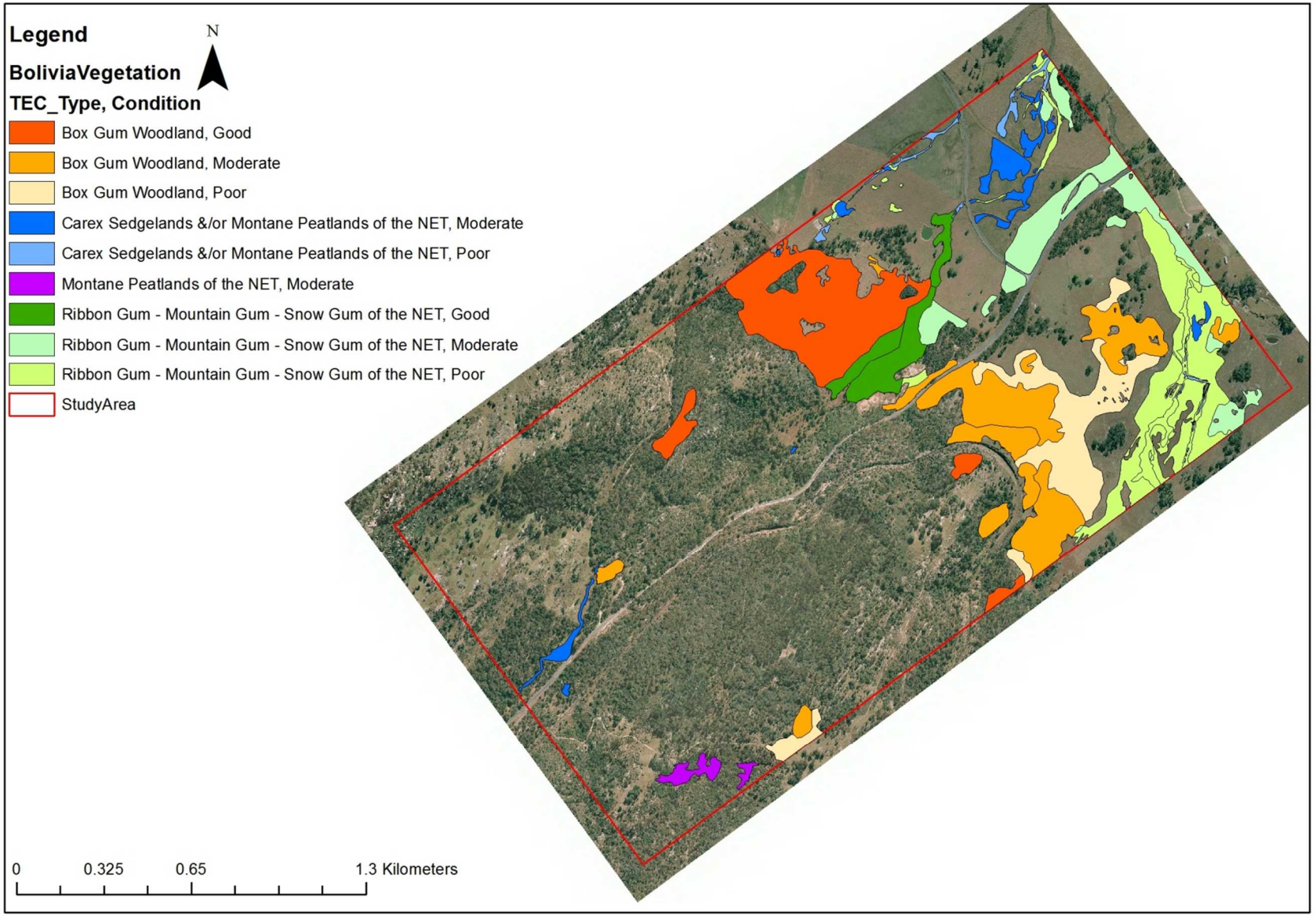

Figure 8: Mapped Threatened Ecological Communities (TEC) and the condition of the stands within the Bolivia Hill study area.

2.5.2 *Communities within close proximity to the study area*

New England Peppermint (*Eucalyptus nova-anglica*) Grassy Woodlands
http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=83&status=Critically+Endangered

> New England Peppermint communities are known within the local area and are found between Deepwater and the southern slopes of the Bolivia Range. A small occurrence is mapped within the Bolivia Hill Nature Reserve (Hunter 2002). No occurrences have been found within the study area or within close proximity to the study area boundary.

Upland wetlands of the Drainage Divide of the New England Tablelands Bioregion
http://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10824
http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=39&status=Endangered

> Though known to occur within the general region, this community type has been thoroughly searched for and locations described within Bell *et al.* (2007) and none are known from the study area or nearby the study area boundary. These wetland types only occur on basalts at the top of the Great Dividing Range and would not be found in the landscapes known from the study area.

2.5.3 *Threatened species found within the Study Region*

3.5.3.1 *Acacia pycnostachya* F.Muell. (Bolivia Hill Wattle)

Current Conservation Status

TSC Act Status: Vulnerable.
http://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10025
EPB&C Act Status: Vulnerable.
http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=13415

Taxonomy

Publication: *Plants Indigenous to the Colony of Victoria* 2: 33 (1863).
Synonym: none.
Type: from New England, *Stuart* (holo: MEL).
Affinities: *Acacia pubifolia; Acacia williamsiana.*
Etymology: in reference to the flattened stems.
Form: variable from low spreading shrub to erect low tree up to 10 m tall. May be very long lived. Flowers in spring and fruits in summer.

Previous known distribution and population

Restricted to the Northern Tablelands of New South Wales in three highly disjunct locations (Fig. 9); Bolivia Hill, Bluff River and Back Creek (north west of Tenterfield). The more resent searches in the Donnybrook area have failed to relocate this species. An erroneous collection from the Macintyre Falls area (*G.P.Guymer*, 9.4.1977) was re-determined to be *Acacia williamsiana*. Searches conducted over the Bolivia Range by Hunter and Earl (1999), Hunter (2000) and Hunter (2002) found the population size extensive and potentially in order of 20,000 individuals. Within the Bluff River Nature Reserve and surrounding areas *Acacia pycnostachya* was found to be a significant component of most of the Nature Reserve with populations likely to be in excess of 30,000 individuals.

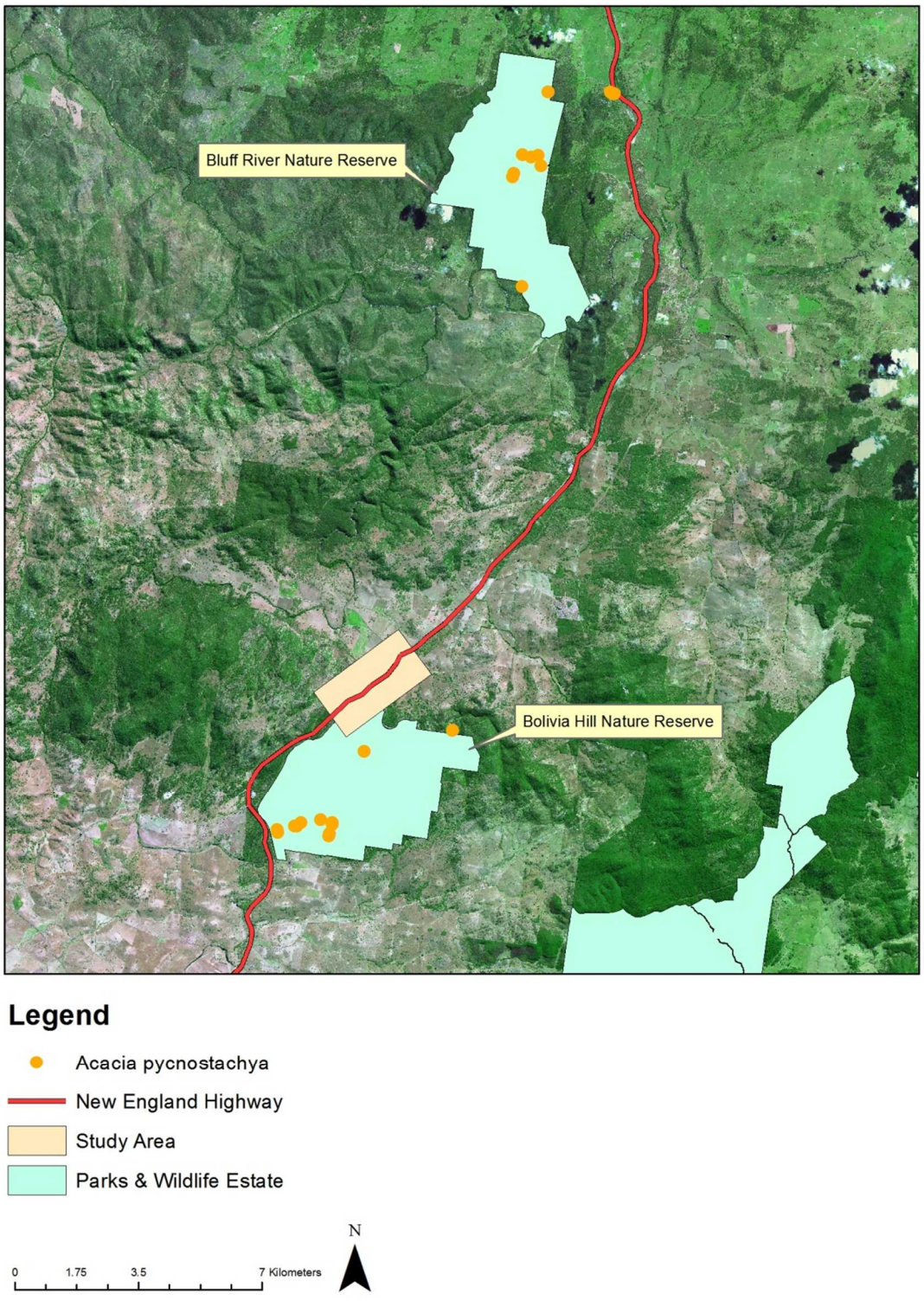

Fig 9: Location of previously known locations of *Acacia pycnostachya*.

Life History & Habitat

Dispersal: elaiosome; seed drop.

Pollination: probably entomophilous**.**

Flowering: September to November.

Fruiting: November to January.

Little known about *Acacia pycnostachya,* unpublished surveys on Bluff Rock south of Tenterfield by Hunter & Croft (1995) found that the species could regenerate on mass after wildfire and seedling densities were found to be as high as 200 per 0.1 ha. The species seems to occur within a wide range of habitats where it does occur and was found to be within 12 vegetation communities described by Hunter (2002). However, the species appears to occur mainly on shallow to skeletal soils. The species has been found to grow to 1.5 m and flower within 3 years (primary juvenile period) and profusely flower within 5 years (Quinn *et al.* 1995) and to sporadically germinate in the absence of fire.

Threatening processes

This species is possibly affected by:

- Agricultural clearing.
- Under-scrubbing for fire reduction and grazing purposes.
- Inappropriate fire regimes.
- Small number of known locations.
- Grazing by domestic stock.
- Browsing by goats, deer and rabbits.
- Combination of drought and fire (Croft *et al.* 2007; 2010).

Locations found within the Study Area

Acacia pycnostachya was found within six of the floristic survey plots placed within the study area (BH53; BH63; BH78; BH79; BH108; BH111). In most instances the observations were only of scattered individuals. However, on a large and exposed granite slab adjoining the southern side of the current highway (BH78 & BH79), a large and significant population of this species was surveyed which was found to encompass at least 235 individuals (Fig. 10). Permission was not given to search some locations within the study area.

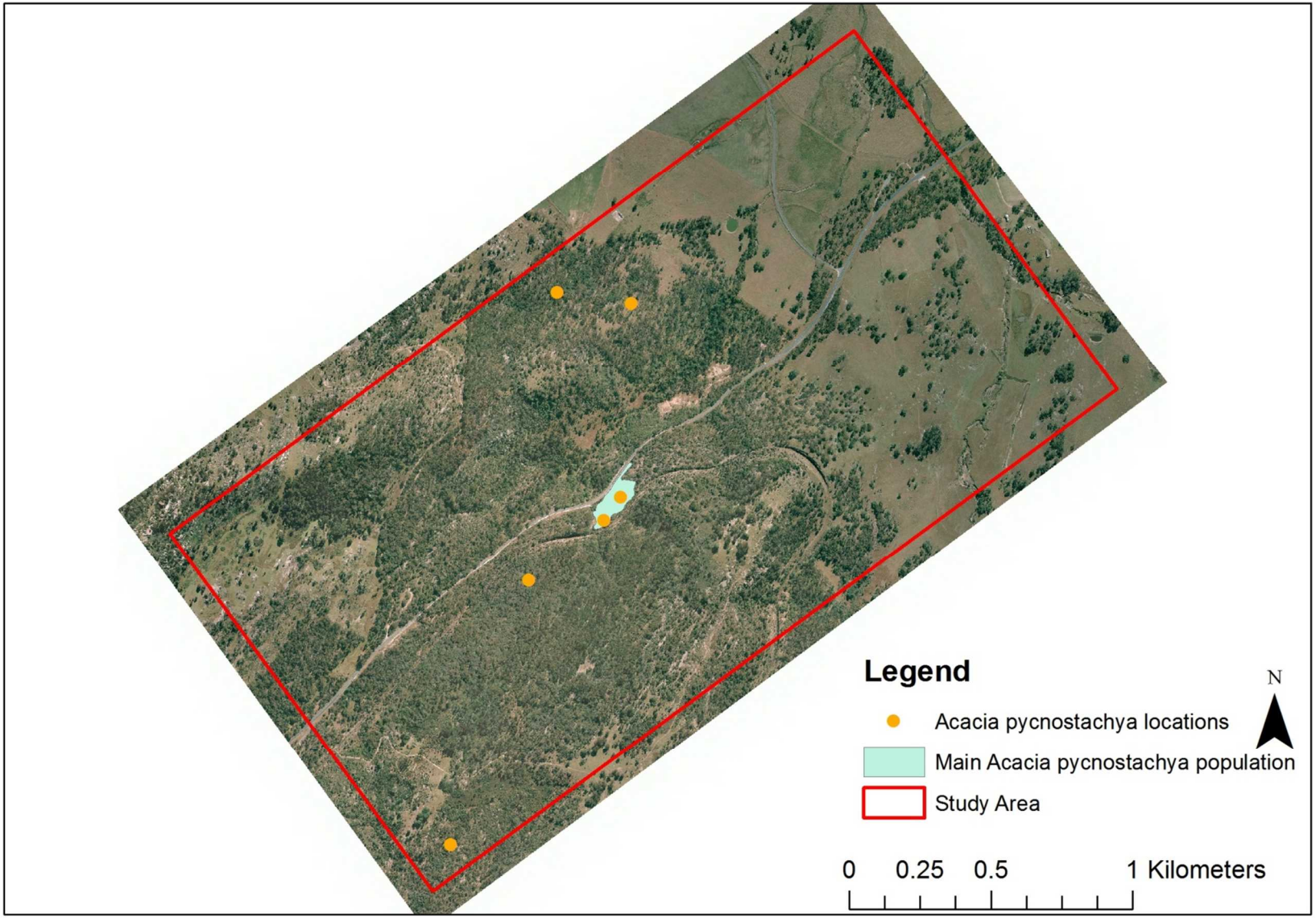

Fig 10: *Acacia pycnostachya* locations within the study area.

Plate 1: *Acacia pycnostachya* flowering stem.

Plate 2: Seedling of *Acacia pycnostachya* above and suckering stems in a rock crevice within the study area appearing drought stressed and browsed by goats.

Plate 3: Stands of *Acacia pycnostachya* within the study area; above on an exposed granite slope and below within Grassy Box Gum Woodland.

2.5.3.2 *Pimelea venosa* Threlfall (Bolivia Riceflower)

Current Conservation Status

TSC Act Status: Endangered.
http://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10633
EPB&C Act Status: Endangered.
http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=16385

Taxonomy

Publication: *Brunonia* 5: 196 (1983).
Synonym: none.
Type: Bolivia, *Betche* 4.ix.1886 (holo: NSW).
Affinities: unknown.
Etymology: in reference to the prominent veinage.
Form: straggly primarily upright to lax shrub with leaves densely covered with whitish, soft and spreading hairs.

Previous known distribution and population

The species has only been recorded from the Bolivia Hill area. A review of collections by Hunter & Earl (1999) found that though several locations appeared on various databases around Bolivia and the Bolivia Range these appeared to be due to the vague original collection locality being entered several times by different authors who used different more specific location points. Thus, most records are due to one or a few individual collections. The species has rarely been seen since its original collection and none have been seen in the last 15 years despite several searches being conducted for this species (Hunter & Earl 1999; Hunter 2002). A single specimen beside an access track was last seen in 1999 but it was missing when a search was conducted a few weeks later by one of the original people to see it at that location. The largest recorded population appears to have been around 13 plants.

Life History & Habitat

Dispersal: unknown.

Pollination: probably entomophilous**.**

Flowering: Spring.

Fruiting: Spring to Summer.

Almost nothing is known about this species and the previous known locations are largely based on collections from last century. Since that time, this species has only been found very rarely and usually as individuals within a high disturbed agricultural landscape.

Threatening processes

This species is possibly affected by:

- Agricultural clearing.
- Under-scrubbing for fire reduction and grazing purposes.
- Inappropriate fire regimes.
- Small number of known locations.
- Grazing by domestic stock.
- Trampling.
- Browsing by goats, deer, rabbits and native macrofauna.

Location found within the Study Area

Pimelea venosa was found within a single location on private property (site BH139). At this location at total of 46 plants ranging from 0.2 to 2.1 m in height were found within an area of approximately 50 x 30 m. The populations was restricted to a small area of large boulders and small outcropping that was both difficult for stock to enter and also protected from recurrent fires. Individuals found on the margins of this habitat which were more accessible by native and exotic animals had been browsed. This is currently the only known extant population. The plants were found within the cadastral boundary of the Stadtmiller family. It is possible that the species may exist in the neighbouring property however permission for a flora investigation was not given for this property.

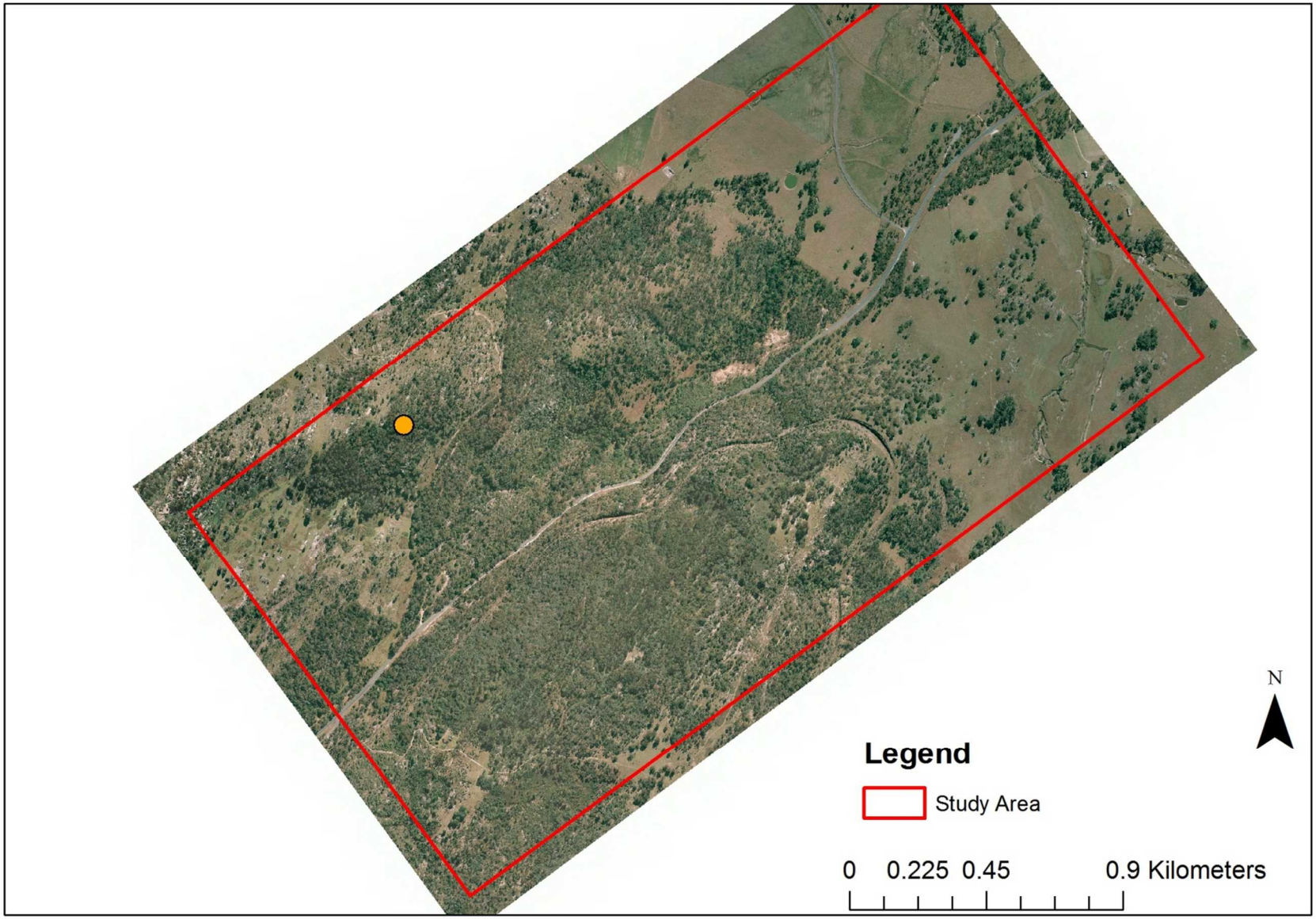

Fig 11: *Pimelea venosa* location within the study area.

Plate 4: *Pimelea venosa* leaf and habitat from the location within the study area.

2.5.4 *Threatened species within close proximity but not found within the Study Region*

2.5.4.1 *Boronia boliviensis* J.B.Williams & J.T.Hunter

http://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10096

Boronia boliviensis is an endangered species (*TSC* Act) known only from the Bolivia Range and is known from between 900 to 1200 m altitude in low shrublands and heaths on granite outcrops and within the woodlands immediately adjacent to these. The current population estimate is around 3,000 individuals in 12 discrete populations (Hunter & Earl 1999; Williams & Hunter 2006) all of which are within the southern slopes of the Bolivia Range within the Bolivia Hill Nature Reserve (Fig. 12). No populations of this species were found within the study area. The habitats contained within the study area are unlikely to contain this species based on the known habitat of the species. It is highly likely that the current botanist would have found the species if it was present. While the presence of this species cannot be completely ruled out, it is of the opinion of the author that no further investigations for this species are required.

Plate 5: Photograph of *Boronia boliviensis*.

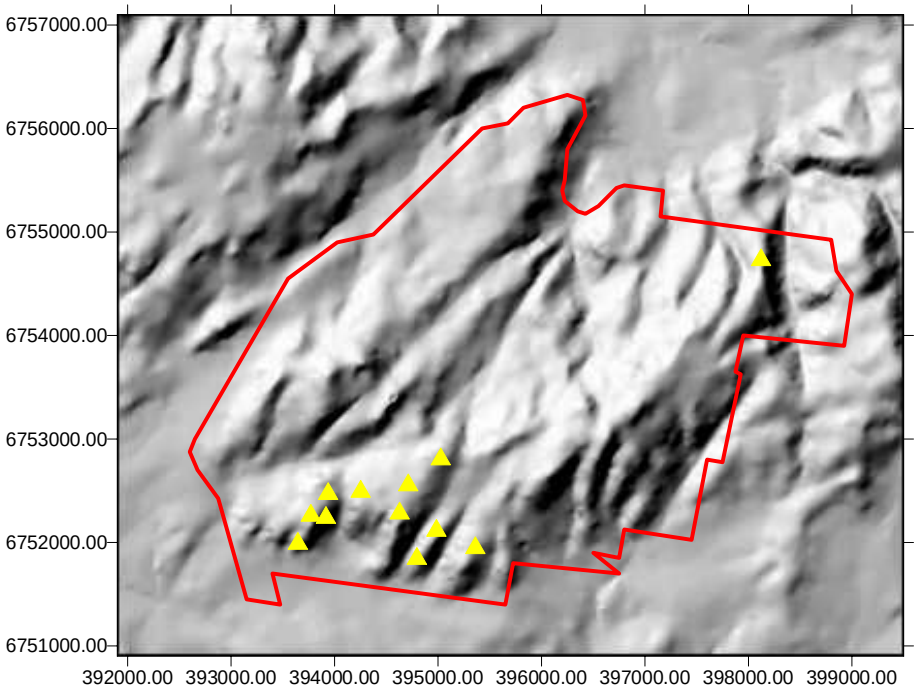

Fig 12: Known locations for *Boronia boliviensis* which is currently only known from Bolivia Hill NR. Red boundary is the Bolivia Hill NR.

2.5.4.2 *Eucalyptus boliviana* J.B.Williams & K.D.Hill

http://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10285

Eucalyptus boliviana is vulnerable species (*TSC* Act) that is currently only known from three locations within the Bolivia Hill Nature Reserve. These locations are restricted to the higher altitude areas at the crest of the Bolivia Range and on the southern slopes. The species is highly distinctive and should not be confused with any others within the district. If this species was present it is highly likely that it would have been found, however none were found within the study area. It is of the opinion of the author that no further searches within the study area are required for this species.

Plate 6: Photographs of the buds and fruit of *Eucalyptus boliviana*.

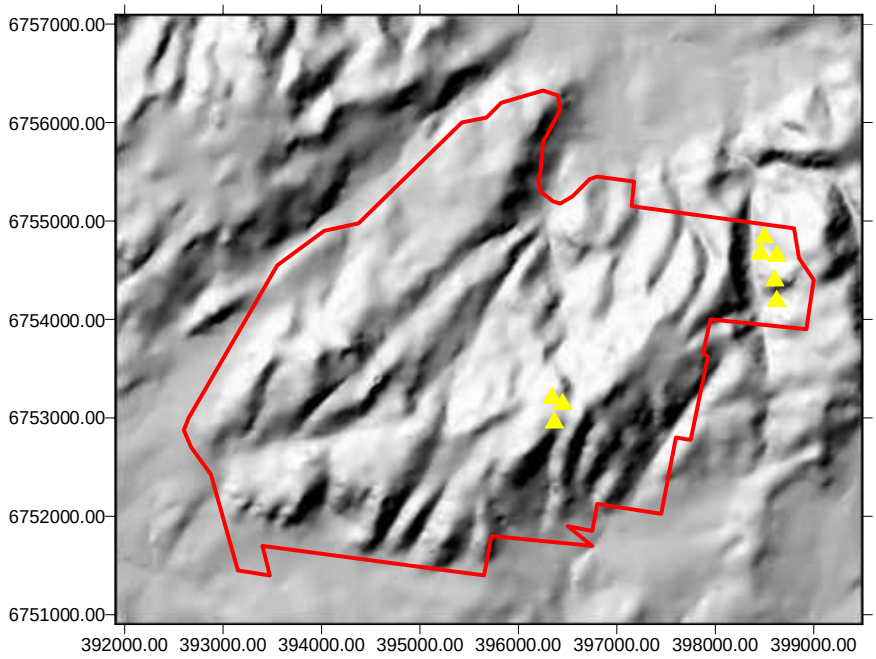

Fig 13: Known distribution of *Eucalyptus boliviana*. Boundary is the Bolivia Hill NR.

2.5.4.3 *Homoranthus croftianus* J.T.Hunter

http://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10408

Homoranthus croftianus is an endangered species (*TSC* Act) that is restricted to two nearby locations on exposed granite surfaces on the southern slopes of the Bolivia Range within Bolivia Hill Nature Reserve. The population size is likely to be below 200 individuals (Hunter 1998). All potential habitat within the study area in which access permission was given was searched for this species. The plant is very distinction and it is unlikely that the author would have missed this species if it was present. It is of the opinion of the author that no further searches are required for this species unless areas previously excluded due to lack of permission become available.

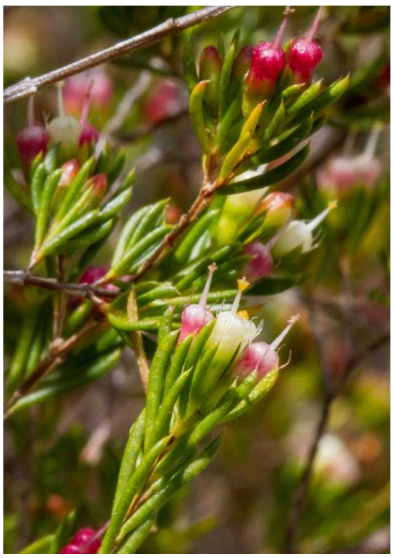

Plate 7: Photograph of *Homoranthus croftianus.*

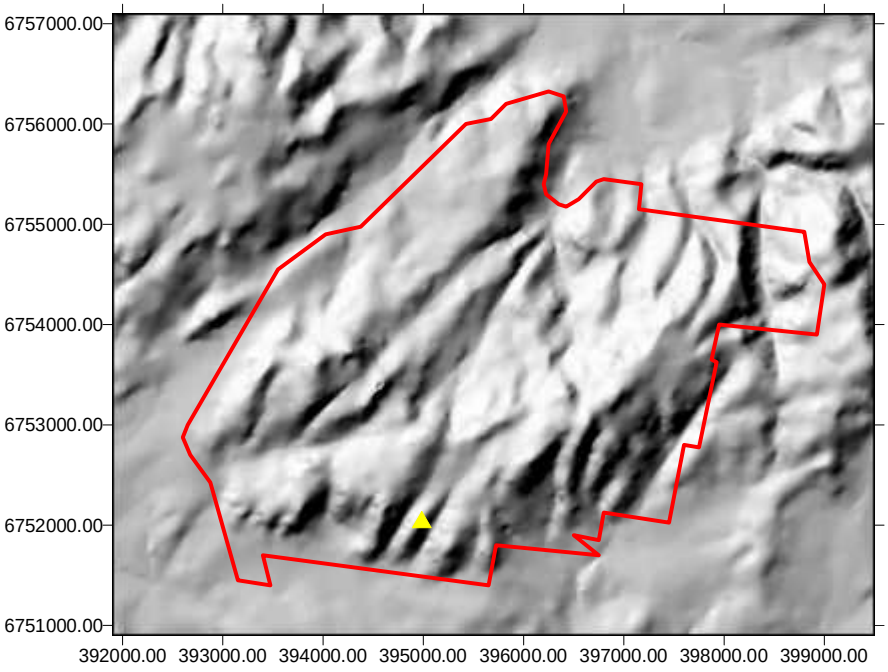

Fig 14: Location of known *Homoranthus croftianus* population. Boundary is of the Bolivia Hill NR.

2.5.4.4 *Thesium australe* R.Br.

http://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10802
http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=15202

Thesium australe is a cryptic hemi-parasitic herb of native and introduced grasses. It has a very widespread distribution and has been found in grassy woodlands throughout their distribution in South-eastern Australia on various rock types except sandstone. The species can have a sporadic boom and bust visible population and it does die back after frosts and may not be seen for a number of years. A single population of approximately 20 individuals was found growing within the rail reserve amongst and over the rail tracks on the southern fall of the Bolivia Range. This population has not re-occurred in recent years. While this species was not found during the current investigation its cryptic nature, sporadic occurrence and the extent of potential habitat means that the presence of this species cannot be ruled out.

Plate 8: Photograph of *Thesium australe*.

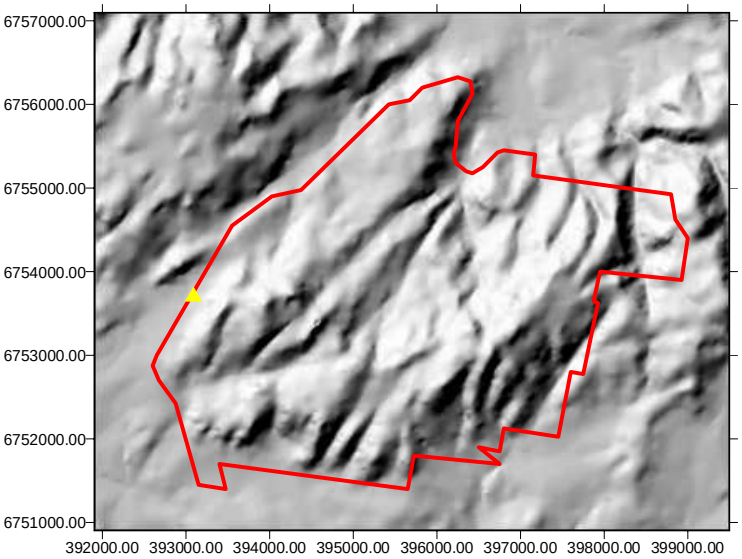

Fig 15: Known distribution of *Thesium australe* within the Bolivia Range. The boundary represents the Bolivia Hill Nature Reserve.

3.6 *Key Threatening processes*

A number of listed key threatening process may need to be taken into consideration during the deliberation of the potential development.

Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands
http://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=20002

Bushrock removal
http://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=20006

Clearing of native vegetation
http://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=20023

Infection of native plants by Phytophthora cinnamomi
http://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=20026

Invasion of native plant communities by exotic perennial grasses
http://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=20018

A number of the key species listed under this threatening process occur abundantly within the study area, in particular *Eragrostis curvula* (African Lovegrass), *Andropogon virginicus* (Whiskey Grass) and *Hyparrhenia hirta* (Coolatai Grass). All of these species are particularly prevalent and dominant along the edges of the current highway and are easily spread by vehicles.

Invasion and establishment of exotic vines and scramblers
http://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=20052

Dolichandra unguis-cati has been found beside the current highway within the study area. This species is one of those listed within this determination. It is easily spread by machinery.

Loss of Hollow-bearing trees
http://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=20079

Removal of dead wood and dead trees
http://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=20011

References

Bell, D.M., Hunter, J.T. & Haworth, R.J. (2008) Montane lagoons of the New England Tablelands Bioregion: vegetation, landuse and dynamics. *Cunninghamia* 10: 475-492.

Croft, P.J., Hunter, J.T. & Reid, N. (2010) Threat of frequent fire and dought for the rare wattle *Acacia williamsiana* J.T.Hunter: an experimental burn highlights implications for fire management. *Ecological Management and Restoration* 11: 217-220.

Croft, P.J., Hunter, J.T. & Reid, N. (2007) Depletion of regenerative bud resources during cyclic drought. What are the implications for fire management? *Ecological Management and Restoration* 8: 187-192.

Hunter, J.T. (2010) Eucalypts of the Northern Tablelands. Northern Rivers Catchment Management Authority & J.T.Hunter. (155 Pages).

Hunter, J.T. (2005) Geographic variation in plant species richness patterns within temperate eucalypt woodlands of eastern Australia. *Ecography* 28: 505-514.

Hunter, J.T. (2005) Floristics and distribution of Wattle Dry Sclerophyll Forests and Scrubs of north eastern New South Wales. *Cunninghamia* 9: 317-323.

Hunter, J.T. (2002) 'Vegetation and Floristics of the Tenterfield Nature Reserves'. Unpublished report to the New South Wales National Parks and Wildlife Service

Hunter, J.T. (2000) Flora of the Bolivia Hill Rail Easement. Unpublished report to Rail Services Australia.

Hunter, J.T. (1998) Two new species of Homoranthus (Myrtaceae) for northern New South Wales. *Telopea* 8: 35-40.

Hunter, J.T. (1995) Multi-species Recovery Plan for Bolivia Hill & Backwater. Report to the NSW NPWS Northern Zone.

Hunter, J.T. & Bell, D. (2009) The Carex Fen vegetation of northern New South Wales. *Cunninghamia* 11 (1): 49-65.

Hunter, J.T. & Bell, (2007) Vegetation of montane bogs in east-flowing catchments of northern New England, New South Wales. *Cunninghamia* 10: 77-92.

Hunter, J.T. & Clarke, P.J. (1998) The vegetation of granitic outcrop communities on the New England Batholith of eastern Australia. *Cunninghamia* 5: 547-618.

Hunter, J.T. & Earl, J. (1999) 'Targeted Survey for *Pimelea venosa'* Report to the NSW, National Parks and Wildlife Service.

Quinn, F.C., Williams, J.B., Gross, C.L. & Bruhl, J.J. (1995) Report on Rare and Threatened Plants of North-eastern NSW. Unpublished report to the NSW NPWS.

Van Diggelen R, Middleton B, Bakker J, Grootjans A & Wassen M. (2006) Fens and floodplains of the temperate zone: Present status, threats, conservation and restoration. *Applied Vegetation Science* 9: 157–162.

Williams, J.B. & Hunter, J.T. (2006) *Boronia boliviensis* (Rutaceae series Erianthae), a new rare granite outcrop endemic from north-eastern New South Wales. *Telopea* 11 (3): 260-264.

Appendix A: Site Record Forms.

Site Name:									
Altitude:						**Assessor(s):**			
Date:						**Aspect:**			
AMG Zone:						**GPS Datum:**			
Site Location	**E: .....**					**N: .....**			
Slope:									
% litter/dead branches:		% bare soil/small rocks:			% cryptogams:			% large rock/boulder:	

Topography: (Circle as appropriate).

Slope	Flat (0°)	Gentle (1-4°)	Moderate (5-14°)	Undulating (Highly Variable)	Steep (≥15°)				
Landform	Ridge-top	Upper Slope	Mid Slope	Lower Slope	Open Plain	River Flat	Creek Line	Valley Floor	Gully
Geology	Sand-stone	Alluvial /Colluvial	Basalt	Meta-sediment	Granite	Shale	Sedi-mentary	Volcanic	Conglo-merate	Meta-morphic
Soil Colour									
Soil Texture	Sand	Sandy Loam	Loam	Sandy Clay	Loamy Clay	Gravelly Loam	Gravelly Clay	Clayey Loam	Clay	Gravel
Depth	Skeletal (<10cm):		Shallow (10-50cm):				Deep(>50cm):			
Drainage	Poorly drained:		Moderately drained:				Well Drained:			

Tenure	Private	Private - Reserve	Public - Reserve	Public - TSR	Other:	
Current land use:	Logging	Grazing	Dryland cropping	Irrigated Cropping	Rural residential	Urban / Industrial
Clearing /Logging	Nil	Light	Moderate	Moderately Extensive	Extensive	Unknown
Grazing:	Nil	Light	Moderate	Intermittently Heavy	Sustained Heavy	Unknown
Planted Vegetation:	Nil	Endemic trees, shrubs and/or groundcover	Native non-endemic trees and/or shrubs	Exotic trees and/or shrubs	Improved Pasture / Pasture Cropping	Crop / Exotic Pasture
Weed Cover:	Nil	Very Low < 5%	Moderate 5-33%	High 34-66%	Very High >66%	Unknown
Fire history:	Never burnt	Rarely burnt (>50yrs)	Infrequently burnt (20-50yrs)	Moderately burnt (6-19yrs)	Frequently burnt (1-5yrs)	Unknown

Age structure	Early regen	Advanced regen	Uneven age	Mature age	Old growth
Mistletoes	None	Occasional	Common	Abundant	
Regenerating Trees	None	Occasional	Common	Abundant	
Shrubs	None	Occasional	Common	Abundant	
Stumps	None	Occasional	Common	Abundant	
Fallen hollow logs (>10cm dbh):	None	Occasional	Common	Abundant	
Fallen logs (>10cm dbh) Length in Meters:	:				

Permanent water on-site:	Spring	Creek	River	Farm dam	Bore drain	Irrigation channel
Permanent water near-by:	River < 5km:			Creek <2km:		
Temporary water on-site:	Soak / Leaking dam		Ephemeral Creek		Ephemeral River	
Surface rock / Rock slabs	Caves/rock fissures on site			Caves/rock fissures < 5km		
Loose barked trees	Known nest/roost trees			Soil cracks		

Canopy species greater than 10 cm DBH and above Breast Height				
All stems over 10 cm DBH recorded separately as for example (10, 15, 22)				
Taxon	**Distance**	**DBH**	**Height**	**Hollows**
Central				
1:				
2:				
3:				
4:				
5:				
6:				
7:				
8:				
9:				
10:				
11:				
12:				
13:				
14:				
15:				
16:				
17:				
18:				
19:				
20:				
21:				
22:				

Appendix A: Site Record Forms.

Floristic Composition: Site No:

No.	Species	C/A	Canopy Spp	Data	No.	Species	C/A	Canopy Spp	Data
1					31				
2					32				
3					33				
4					34				
5					35				
6					36				
7					37				
8					38				
9					39				
10					40				
11					41				
12					42				
13					43				
14					44				
15					45				
16					46				
17					47				
18					48				
19					49				
20					50				
21					51				
22					52				
23					53				
24					54				
25					55				

C/A: Cover Abundance Scale -Modified Braun Blanquet

Data: to be marked when entered into computer database

1 = cover less than 5% of site and uncommon
2 = cover less than 5% of site and common
3 = cover of 6-20% of site
4 = cover of 21-50% of site
5 = cover of 51-75% of site
6 = cover of 76-100% of site

Appendix B: Taxon list with recognised authorities and common names.

Flora Species Found within the Bolivia Hill Road Re-alignment Study Area (Dr John T. Hunter)

Fern & Fern Allies

Adiantaceae
Adiantum atroviride Bostock .....Maidenhair Fern
Adiantum hispidulum Sw. .....Rough Maidenhair
Cheilanthes distans (R.Br.) Mett. .....Hairy Rock Fern
Cheilanthes sieberi Kunze
subsp. *sieberi* .....Narrow Rock Fern

Aspleniaceae
Asplenium flabellifolium Cav. .....Necklace Fern

Blechnaceae
Blechnum cartilagineum Sweet .....Gristle Fern
Doodia aspera R.Br. .....Prickly Rasp Fern
Doodia caudate (Cav.) R.Br. .....Small Rasp Fern

Cyatheaceae
Cyathea australis (R.Br.) Domin .....Black Tree Fern

Davalliaceae
Davallia solida
var. *pyxidata* (Cav.) Noot. .....Hare's Foot Fern

Dennstaedtiaceae
Calochlaena dubia (R.Br.) M.D.Turner & R.A.White .....Common Ground Fern
Pteridium esculentum (G.Forst.) Cockayne .....Bracken Fern

Polypodiaceae
Grammitis billardieri Willd. .....Finger Fern
Platycerium bifurcatum (Cav.) C.Chr.
subsp. *bifurcatum* .....Elkhorn
Pyrrosia rupestris (R.Br.) Ching .....Rock Felt Fern

Psilotaceae
Psilotum nudum (L.) P.Beauv. .....Skeleton Fork Fern

Gymnosperm

Cupressaceae
Callitris endlicheri (Parl.) F.M.Bailey .....Black Cypress Pine

Monocotyledon

Anthericaceae
Arthropodium milleflorum (DC.) J.F.Macbr. .....Vanilla Lily
Dichopogon fimbriatus (R.Br.) J.F.Macbr. .....Nodding Chocolate Lily

Thysanotus tuberosus R.Br.
subsp. *tuberosus*.....Common Fringe-lily
Tricoryne elatior R.Br. .....Yellow Autumn-lily

Asphodelaceae
Bulbine bulbosa (R.Br.) Haw. .....Golden Lily

Commelinaceae
Commelina cyanea R.Br. .....Scurvy Weed
Murdannia graminea (R.Br.) G.Bruckn.....Chocolate Lily

Cyperaceae
Baumea rubiginosa (Forst.) Boeck. .....Twig-rush
Bulbostylis densa (Wall.) Hand.-Mazz. .....Club-rush
Carex appressa R.Br. .....Sedge
Carex breviculmis R.Br. .....Sedge
Carex fascicularis Sol. ex Boott.....Sedge
Carex gaudichaudiana Kunth .....Sedge
Carex inversa R.Br. .....Knob Sedge
Carex sp. nov. .....Sedge
Cyperus flaccidus R.Br. .....Sedge
Cyperus fulvus R.Br.....Sticky Sedge
Cyperus gracilis R.Br. .....Sedge
Cyperus nervulosus (Kuk.) S.T.Blake .....Sedge
Cyperus sanguinolentus Vahl.....Flat Sedge
**Cyperus sesquiflorus* (Torrey) Mattf. & Kuk. .....Sedge
Cyperus sphaeroideus L.A.S.Johnson & O.D.Evans.....Globe Kyllinga
Eleocharis gracilis R.Br. .....Spike Rush
Fimbristylis cinnamometorum (Vahl) Kunth .....Fringe Rush
Fimbristylis dichotoma (L.) Vahl .....Common Fringe Rush
Gahnia aspera (R.Br.) Spreng.....Rough Saw Sedge
Lepidosperma gunnii Boeck.....Little Sword Sedge
Lepidosperma laterale R.Br. .....Variable Saw Sedge
Ptilothrix deusta (R.Br.) K.L.Wilson.....Ptilothrix
Rhynchospora brownii Roem. & Schult. .....Grassy Beak Rush
Schoenoplectus validus (Vahl) A. & D.Love .....River Club-rush
Schoenus apogon Roem. & Schult. .....Common Bog Rush
Scleria mackaviensis Boeck. .....White Head Sedge

Juncaceae
Juncus aridicola L.A.S.Johnson.....Tussock Rush
Juncus falcatus E.Mey. .....Rush
Juncus fockei Buchenau.....Rush
Juncus pauciflorus R.Br.....Rush
Juncus prismatocarpus R.Br. .....Branching Rush
Juncus remotiflorus L.A.S.Johnson.....Rush
Juncus usitatus L.A.S.Johnson.....Common Rush
Juncus vaginatus R.Br. .....Rush
Luzula densiflora (H.Nordensk.) Edgar.....Grass Rush
Luzula flaccida (Buchenau) Edgar .....Grass Rush

Lomandraceae

Lomandra confertifolia
subsp. *pallida* A.T.Lee ..... Mat-rush
Lomandra filiformis
subsp. *flavior* A.T.Lee ..... Wattle Mat-rush
Lomandra filiformis(Thunb.) Britten
subsp. *filiformis* ..... Wattle-leaved Mat-rush
Lomandra longifolia Labill. ..... Spiny-headed Mat-rush
Lomandra multiflora (R.Br.) Britten
subsp. *multiflora* ..... Many-flowered Mat-rush

Luzuriagaceae
Eustrephus latifolius R.Br. ex Ker Gawl. ..... Wombat Berry

Orchidaceae
Cymbidium canaliculatum R.Br. ..... Tiger Orchid
Dendrobium speciosum
var. *hillii* Mast. ..... Rock Lily
Dockrillia linguiformis (Sw.) Brieger ..... Tongue Orchid
Eriochilus cucullatus (Labill.) Rchb.f. ..... Parson's Band
Spiranthes sinensis
subsp. *australis* (R.Br.) Kitam. ..... Ladies' Tresses

Phormiaceae
Dianella caerulea Sims ..... Rough Flax Lily
Dianella longifolia R.Br.
var. *longifolia* ..... Pale Flax Lily
Dianella revoluta R.Br.
var. *revoluta* ..... Spreading Flax Lily
Stypandra glauca R.Br. ..... Nodding Blue Lily
Thelionema caespitosum (R.Br.) R.J.F.Hend. ..... Tufted Blue Lily

Poaceae
**Agrostis capillaris* L. ..... Browntop Bent
**Aira cupaniana* Guss. ..... Silvery Hairgrass
**Andropogon virginicus* L. ..... Whiskey Grass
**Anthoxanthum odoratum* L. ..... Sweet Vernal Grass
Aristida calycina R.Br.
var. *calycina* ..... Kerosene Grass
Aristida jerichoensis
subsp. *subspinulifera* Henrard ..... Jericho Wiregrass
Aristida jerichoensis (Domin) Henrard
var. *jerichoensis* ..... Jericho Wiregrass
Aristida personata Henrard ..... Purple Wiregrass
Aristida vagans Cav. ..... Threeawn Speargrass
Austrofestuca eriopoda (Vickery) S.W.L.Jacobs ..... Snow Fescue
Austrostipa rudis
subsp. *nervosa* (Vickery) S.W.L.Jacobs & J.Everett. ..... Speargrass
Austrostipa scabra (Lindl.) S.W.L.Jacobs & J.Everett
subsp. *scabra* ..... Rough Speargrass
Austrostipa verticillata (Nees ex Spreng.) S.W.L.Jacobs & J.Everett ..... Slender Bamboo Grass
Bothriochloa decipiens (Hack.) C.E.Hubb. ..... Pitted Bluegrass
Bothriochloa macra (Steud.) S.T.Blake ..... Red Grass

**Briza maxima* L. ..... Quaking Grass
**Briza minor* L. ..... Shivery Grass
**Bromus brevis* Steud. ..... Brome
Chloris truncata R.Br. ..... Windmill Grass
**Chloris virgata* Sw. ..... Feathertop Rhodes Grass
Cymbopogon refractus (R.Br.) A.Camus ..... Barbed Wire Grass
Cynodon dactylon (L.) Pers ..... Couch, Bermuda Grass
Deyeuxia parviseta Vickery
var. *parviseta* ..... Bent
Dichelachne crinita (L.f.) Hook.f. ..... Longhair Plumegrass
Dichelachne micrantha (Cav.) Domin ..... Short-haired Plumegrass
Digitaria breviglumis (Domin) Henrard ..... Finger Panic Grass
Digitaria ramularis (Trin.) Henrard ..... Finger Panic Grass
Echinopogon caespitosus C.E.Hubb.
var. *caespitosus* ..... Tufted Hedgehog Grass
Echinopogon mckiei C.E.Hubb. ..... Hedgehog Grass
Echinopogon ovatus (G.Forst.) P.Beauv. ..... Forest Hedgehog Grass
Entolasia marginata (R.Br.) Hughes ..... Bordered Panic
Entolasia stricta (R.Br.) Hughes ..... Wiry Panic
Eragrostis brownii (Kunth) Nees ..... Brown's Lovegrass
**Eragrostis curvula* (Schrad.) Nees ..... African Lovegrass
Eragrostis elongata (Willd.) J.Jacq. ..... Clustered Lovegrass
Eragrostis leptostachya Steud. ..... Paddock Lovegrass
Eragrostis molybdea Vickery ..... Granite Lovegrass
**Festuca elatior* L. ..... Tall Fescue
Glyceria australis C.E.Hubb. ..... Australian Sweetgrass
**Holcus lanatus* L. ..... Yorkshire Fog
**Hyparrhenia hirta* (L.) Stapf ..... Coolatai Grass
Imperata cylindrica
var. *major* (Nees) C.E.Hubb ..... Blady Grass
Isachne globosa (Thunb.) Kuntze ..... Swamp Millet
Lachnagrostis filiformis (Forst.) Trinius ..... Blown Grass
**Lolium perenne* L. ..... Perennial Ryegrass
Microlaena stipoides (Labill.) Druce
var. *stipoides* ..... Weeping Meadow Grass
Oplismenus imbecillis (R.Br.) Roem. & Schult. ..... Small Beard Grass
Panicum simile Domin ..... Two Colour Panic
**Paspalum dilatatum* Poir. ..... Paspalum
Pennisetum alopecuroides (L.) Spreng. ..... Swamp Foxtail
**Phalaris arundinacea*
var. *arundinacea* L. ..... Reed Canary Grass
Poa sieberiana Spreng. ..... Snow Grass
Rytidosperma bipartitum (Link) A.M.Humphreys & H.P.Linder ..... Wallaby Grass
Rytidosperma caespitosum (Gaudich.) Connor & Edgar ..... Ringed Wallaby Grass
Rytidosperma longifolium (R.Br.) Connor & Edgar ..... Long-leaved Wallaby Grass
Rytidosperma pallidum (R.Br.) A.M.Humphreys & H.P.Linder ..... Silvertop Wallaby Grass
Rytidosperma racemosum
var. *obtusatum* (Benth.) Connor & Edgar ..... Wallaby Grass
Rytidosperma racemosum (R.Br.) Connor & Edgar
var. *racemosum* ..... Wallaby Grass
Sacciolepis indica (L.) Chase ..... Indian Cupscale Grass
**Setaria pumila* (Poir.) Roem. & Schult. ..... Pale Pigeon Grass

Sorghum leiocladum (Hack.) C.E.Hubb. ..... Wild Sorghum
Sporobolus creber De Nardi ..... Slender Rat's Tail Grass
Themeda triandra Forssk. ..... Kangaroo Grass
Tripogon loliiformis (F.Muell.) C.E.Hubb. ..... Five Minute Grass
**Vulpia bromoides* (L.) Gray ..... Squirrel Tail Fescue

Restionaceae
Empodisma minus (Hook.f.) L.A.S.Johnson & D.F.Cutler ..... Rush
Lepyrodia leptocaulis L.A.S.Johnson & O.D.Evans. ..... Scale Rush

Xanthorrhoeaceae
Xanthorrhoea johnsonii A.T.Lee. ..... Grasstree

Xyridaceae
Xyris complanata R.Br. ..... Xyris

Dicotyledon

Amaranthaceae
Alternanthera nana R.Br. ..... Hairy Joyweed
**Alternanthera pungens* Kunth ..... Khaki-weed
**Guileminea densa* (Schult.) Mog. ..... Small Mat-weed

Apiaceae
**Ammi majus* L. ..... Bishop's Weed
**Ciclospermum leptophyllum* (Pers.) Sprague ..... Slender Celery
Hydrocotyle laxiflora DC. ..... Stinking Pennywort
Hydrocotyle peduncularis R.Br. ex A.Rich. ..... Small-leaved Pennywort
Trachymene incisa Rudge
subsp. *incisa* ..... Native Parsnip
Xanthosia pilosa Rudge ..... Hairy Xanthosia

Apocynaceae
Parsonsia eucalyptophylla F.Muell. ..... Gargaloo

Araliaceae
Polyscias sambucifolia
subsp. *decomposita* ..... Ferny Panax

Asclepiadaceae
**Gomphocarpus fruticosus* (L.) R.Br. ..... Narrow-leaved Cotton Bush

Asteraceae
**Bidens pilosa* L. ..... Cobbler's Pegs, Pitchforks
**Bidens subalternans* DC. ..... Greater Beggar's Ticks
Brachyscome stuartii Benth. ..... Granite Daisy
Calotis cuneifolia R.Br. ..... Purple Burr-daisy
Calotis lappulacea Benth. ..... Yellow Burr-daisy
Cassinia hewsoniae Orchard ..... Cough Bush
Cassinia quinquefaria R.Br. ..... Rosemary Cassinia
Cassinia straminea (Benth.) Orchard ..... Cassinia
Chrysocephalum semipapposum (Labill.) Steetz. ..... Yellow Buttons

**Cirsium vulgare* (Savi) Ten. ..... Spear Thistle
**Conyza bonariensis* (L.) Cronq. ..... Flaxleaf Fleabane
**Conyza sumatrensis* (Retz.) E.Walker ..... Tall Fleabane
Coronidium scorpioides (Labill.) Paul G.Wilson ..... Button Everlasting
Euchiton gymnocephalus (DC.) Holub ..... Creeping Cudweed
Euchiton sphaericus (Willd.) Holub ..... Cudweed
**Gamochaeta purpurea* (L.) Cabrera ..... Cudweed
Glossocardia bidens (Redtz.) Veldkamp. ..... Cobbler's Tack
**Hypochaeris glabra* L. ..... Smooth Catsear
**Hypochaeris radicata* L. ..... Catsear, Flatweed
Lagenophora stipitata (Labill.) Druce ..... Blue Bottle-daisy
Leptorhynchos squamatus (Labill.) Less
subsp. *squamatus* ..... Scaly Buttons
Olearia ramulosa (Labill.) Benth. ..... Daisy Bush
Senecio diaschides Drury ..... Fireweed
**Senecio madagascariensis* Poir. ..... Fireweed
Senecio quadridentatus Labill. ..... Cotton Fireweed
Sigesbeckia orientalis L.
subsp. *orientalis* ..... Indian Weed
Solenogyne bellioides Cass. ..... Solenogyne
**Tagetes minuta* L. ..... Stinking Roger
**Taraxacum officinale* Weber ..... Dandelion
Vernonia cinerea (L.) Less.
var. *cinerea* ..... Vernonia
Vittadinia cuneata
var. *hirsuta* N.T.Burb. ..... Fuzzweed
Vittadinia cuneata DC.
var. *cuneata* ..... Fuzzweed
Vittadinia dissecta
var. *hirta* N.T.Burb. ..... New Holland Daisy
Vittadinia muelleri N.T.Burb. ..... Fuzzweed
Vittadinia sulcata N.T.Burb. ..... Fuzzweed
**Zinnia peruviana* (L.) L. ..... Zinnia

Bignoniaceae
**Dolichandra unguis-cati* (L.) L.G.Lohmann ..... Cats Claw Creeper
Pandorea pandorana (Andrews) Steenis ..... Wonga Wonga Vine

Boraginaceae
Cynoglossum australe R.Br. ..... Austral Hounds Tongue

Brassicaceae
**Capsella bursapastoris* (L.) Medikus ..... Shepherd's Purse

Cactaceae
**Opuntia stricta* (Haw.) Haw.
var. *stricta* ..... Common Prickly Pear

Campanulaceae
Wahlenbergia ceracea Loth. ..... Waxy Bluebell
Wahlenbergia communis Carolin ..... Tufted Bluebell

Wahlenbergia planiflora
subsp. *longipila* Carolin ex P.J.Sm. .....Bluebell
Wahlenbergia stricta (R.Br.) Sweet
subsp. *stricta*.....Tall Bluebell

Caryophyllaceae
**Arenaria leptoclados* (Rchb.) Guss. .....Arenaria
**Cerastium glomeratum* Thuill. .....Mouse-ear Chickweed
**Paronychia brasiliana* DC. .....Brazilian Whitlow
**Petrorhagia nanteuilii* (Burnat) P.W.Ball & Heywood .....Proliferous Pink
Scleranthus biflorus (G.Forst. & Forst.f.) Hook.f. .....Knawel
Stellaria angustifolia Hook. .....Swamp Starwort
Stellaria flaccida Hook. .....Chickweed

Casuarinaceae
Allocasuarina littoralis (Salisb.) L.A.S.Johnson .....Black She-oak
Allocasuarina torulosa (Aiton) L.A.S.Johnson .....Forest She-oak

Celastraceae
Maytenus silvestris Lander & L.A.S.Johnson ..... Narrow-leaved Orangebark

Chenopodiaceae
Chenopodium carinatum R.Br.....Crowned Goosefoot
Einadia hastata (R.Br.) A.J.Scott.....Berry Saltbush
Einadia nutans (R.Br.) A.J.Scott
subsp. *nutans*.....Climbing Saltbush

Clusiaceae
Hypericum gramineum Forst.f.....Small St. John's Wort
Hypericum japonicum Thunb. .....St. John's Wort

Convolvulaceae
Convolvulus angustissimus
subsp. *fililobus* (Wawra) R.W.Johnson .....Bindweed
Dichondra repens Forst. & Forst.f.....Kidney Weed
Dichondra sp. A .....Kidney Weed

Crassulaceae
Crassula sieberiana (Schult. & Schult.f.) Druce.....Australian Stonecrop

Cucurbitaceae
**Citrullus lanatus* (Thunb.) Matsum. & Nakai .....Bitter Melon

Dilleniaceae
Hibbertia cistoidea (Hook.) C.T.White .....Guinea Flower
Hibbertia obtusifolia DC. .....Grey Guinea Flower

Droseraceae
Drosera burmannii Vahl.....Burman's Sundew

Epacridaceae

Brachyloma daphnoides
subsp. *glabrum* (Blakely) J.T.Hunter ..... Red-Flowered Daphne Heath
Epacris microphylla R.Br.
var. *microphylla*.....Coral Heath
Leucopogon melaleucoides A.Cunn. ex DC.....Melaleuca Beard Heath
Lissanthe strigosa
subsp. *subulata* (R.Br.) J.Powell.....Peach Heath
Melichrus urceolatus R.Br. .....Urn Heath

Euphorbiaceae
Breynia cernua (Poir.) Muell.Arg. .....Coffee Bush
Chamaesyce dallachyana Baillon.....Caustic Weed
Chamaesyce drummondii (Boiss.) D.C.Hassall.....Caustic Weed
Poranthera microphylla Brongn. .....Small Poranthera

Fabaceae
Acacia adunca A.Cunn. ex G.Don. .....Wallangarra Wattle
Acacia filicifolia Cheel & M.B.Welch.....Fern-leaved Wattle
Acacia fimbriata A.Cunn. ex G.Don. .....Fringed Wattle
Acacia implexa Benth. .....Hickory Wattle
Acacia neriifolia A.Cunn. ex Benth.....Silver Wattle
Acacia pycnostachya Benth. .....Bolivia Wattle
Aotus subglauca
var. *filiformis* Blakely & McKie .....Aotus
Aotus subglauca Blakely & McKie
var. *subglauca*.....Aotus
Desmodium brachypodum A.Gray .....Large Tick Trefoil
Desmodium varians (Labill.) Endl.....Slender Tick Trefoil
Glycine clandestina Wendl. .....Twining Glycine
Glycine microphylla (Benth.) Tindale .....Small-leaved Glycine
Glycine tabacina (Labill.) Benth. .....Variable Glycine
Glycine tomentella Hayata .....Woolly Glycine
Hardenbergia violacea (Schneev.) Stearn .....False Sarsaparilla
Hovea linearis (Sm.) R.Br. .....Hovea
Indigofera australis Willd.....Australian Indigo
Jacksonia scoparia R.Br. .....Dogwood
Lespedeza juncea
subsp. *sericea* (Thunb.) Steenis .....Lespedeza
Lotus cruentus Court .....Red-flowered Lotus
**Medicago polymorpha* L.....Burr Medic
**Trifolium campestre* Schreb. .....Hop Clover
**Trifolium dubium* Sibth.....Yellow Suckling Clover
**Trifolium repens* L.....White Clover
**Vicia sativa* L. .....Vetch
**Vicia villosa* Roth
subsp. *villosa* .....Russian Vetch

Gentianaceae
Schenkia spicata (L.) G.Mans. .....Spike Centaury

Geraniaceae

Geranium solanderi Carolin
var. *solanderi*.....Native Geranium

Goodeniaceae
Goodenia bellidifolia Sm.
subsp. *bellidifolia*.....Goodenia
Goodenia gracilis R.Br.....Slender Goodenia

Haloragaceae
Gonocarpus micranthus
subsp. *ramosissimus* Orchard.....Swamp Raspwort
Gonocarpus micranthus Thunb.
subsp. *micranthus*.....Swamp Raspwort
Gonocarpus tetragynus Labill.....Poverty Raspwort
Gonocarpus teucrioides DC.....Raspwort
Haloragis heterophylla Brongn.....Variable Haloragis

Lamiaceae
Ajuga australis R.Br.....Australian Bugal
Mentha diemenica Spreng.....Pennyroyal Mint
Plectranthus graveolens R.Br.....Cockspur Flower
**Prunella vulgaris* L.....Self-heal
Scutellaria humilis R.Br.....Dwarf Skullcap

Lentibulariaceae
Utricularia dichotoma Labill.....Fairy Aprons

Linaceae
Linum marginale A.Cunn. ex Planchon.....Native Flax

Lobeliaceae
Pratia purpurascens (R.Br.) F.Wimmer.....Whiteroot

Loranthaceae
Amyema miquelii (Lehm. ex Miq.) Tiegh.....Drooping Mistletoe
Amyema pendulum
subsp. *longifolium* (Hook.) Barlow.....Drooping Mistletoe
Amyema pendulum (Sieber ex Spreng.) Tiegh.
subsp. *pendulum*.....Drooping Mistletoe
Muellerina celastroides (Sieber ex Schult. & Schult.f.) Tiegh.....Mistletoe

Lythraceae
Lythrum salicaria L.....Purple Loosestrife

Malvaceae
Malvastrum coromandelianum (L.) Garcke.....Prickly Malvestrum
**Sida rhombifolia* L.....Sida

Menispermaceae
Stephania japonica
var. *discolor* (Blume) Forman.....Snake Vine

Moraceae

Ficus rubiginosa Desf. ex Vent. ..... Port Jackson Fig

Myrsinaceae

Myrsine variabilis R.Br. ..... Muttonwood

Myrtaceae

Angophora floribunda (Sm.) Sweet ..... Rough-barked Apple
Callistemon pungens Lumley & R.D.Spencer ..... Pungent Bottlebrush
Eucalyptus andrewsii Maiden ..... New England Blackbutt
Eucalyptus banksii Maiden ..... Tenterfield Woollybutt
Eucalyptus blakelyi Maiden ..... Blakely's Red Gum
Eucalyptus bridgesiana R.Baker ..... Apple Box
Eucalyptus caleyi Maiden
subsp. *caleyi* ..... Caley's Ironbark
Eucalyptus caliginosa Blakely & McKie ..... Broad-leaved Stringybark
Eucalyptus campanulata R.T.Baker & H.G.Sm. ..... New England Blackbutt
Eucalyptus conica H.Deane & Maiden ..... Fuzzy Box
Eucalyptus dalrympleana
subsp. *heptantha* L.A.S.Johnson ..... Mountain Gum
Eucalyptus dealbata A.Cunn. ex Schauer ..... Tumbledown Red Gum
Eucalyptus macrorhyncha F.Muell. ex Benth. ..... Red Stringybark
Eucalyptus melliodora A.Cunn. ex Schauer ..... Yellow Box
Eucalyptus prava L.A.S.Johnson & K.D.Hill ..... Orange Gum
Eucalyptus viminalis Labill. ..... Manna Gum, Ribbon Gum
Eucalyptus youmanii Blakely & McKie ..... Youman's Stringybark
Leptospermum arachnoides Gaertn. ..... Spider Tea-tree
Leptospermum brevipes F.Muell. ..... Grey Tea-tree
Leptospermum gregarium Joy Thomps. ..... Swamp Tea-tree
Leptospermum minutifolium C.T.White ..... Small-leaved Tea-tree
Leptospermum novae-angliae Joy Thomps. ..... New England Tea-tree
Leptospermum polygalifolium
subsp. *montanum* Joy Thomps. ..... Creek Tea-tree
Leptospermum polygalifolium
subsp. *transmontanum* Joy Thomps. ..... Creek Tea-tree

Oleaceae

Notelaea microcarpa R.Br.
var. *microcarpa* ..... Native Olive

Onagraceae

Epilobium billardierianum
subsp. *hydrophilum* Raven & Engelhorn ..... Variable Willow Herb
Epilobium billardierianum Ser.
subsp. *billardierianum* ..... Variable Willow Herb

Oxalidaceae

Oxalis chnoodes Lourteig ..... Wood Sorrel
Oxalis perennans Haw. ..... Wood Sorrel

Pittosporaceae

Billardiera scandens Sm.
var. *scandens* ..... Apple Dumplings
Bursaria spinosa Cav. ..... Native Blackthorn

Plantaginaceae
Plantago debilis R.Br. ..... Small Plantain
**Plantago lanceolata* L. ..... Lamb's Tongues, Plantain
Plantago varia R.Br. ..... Variable Plantain

Polygalaceae
Polygala japonica Houtt. ..... Polygala

Polygonaceae
**Acetosella vulgaris* Fourr. ..... Sheep Sorrel
Persicaria prostrata (R.Br.) Sojak ..... Creeping Knotweed
**Polygonum aviculare* L. ..... Wireweed
Rumex brownii Campd. ..... Swamp Dock

Primulaceae
**Anagallis arvensis* L. ..... Scarlet or Blue Pimpernel

Proteaceae
Banksia integrifolia
subsp. *monticola* K.R.Thiele ..... Mountain Banksia
Hakea microcarpa R.Br. ..... Small-fruited Hakea
Lomatia silaifolia (Sm.) R.Br. ..... Crinkle Bush
Persoonia oleoides L.A.S.Johnson & P.H.Weston ..... Geebung

Ranunculaceae
Clematis glycinoides DC.
var. *glycinoides* ..... Forest Clematis
Ranunculus lappaceus Sm. ..... Common Buttercup

Rhamnaceae
Cryptandra amara Sm.
var. *amara* ..... Common Cryptandra
Pomaderris argyrophylla N.A.Wakef.
subsp. *argyrophylla* ..... Pomaderris
Pomaderris eriocephala N.A.Wakef. ..... Pomaderris

Rosaceae
Acaena novae-zelandiae Kirk ..... Bidgee Widgee
**Rosa rubiginosa* L. ..... Sweet Briar
**Rubus anglocandicans* A.Newton ..... Blackberry
Rubus parvifolius L. ..... Small-leaved Bramble

Rubiaceae
Asperula conferta Hook.f. ..... Common Woodruff
Galium gaudichaudii DC. ..... Rough Bedstraw
Galium migrans Ehrend. & McGillivray ..... Bedstraw
Opercularia aspera Gaertn. ..... Coarse Stinkweed
Opercularia hispida Spreng. ..... Hairy Stinkweed

Pomax umbellata (Gaertn.) Sol. ex A.Rich. ..... Pomax

Rutaceae
Boronia parviflora Sm. ..... Swamp Boronia
Correa reflexa (Labill.) Vent.
var. *reflexa* ..... Green Correa
Zieria cytisoides Sm. ..... Downy Zieria

Santalaceae
Exocarpos cupressiformis Labill. ..... Cherry Ballart

Sapindaceae
Dodonaea triquetra J.C.Wendl. ..... Hop Bush
Dodonaea viscosa
subsp. *angustifolia* (L.f.) J.G.West ..... Hop Bush

Scrophulariaceae
Gratiola peruviana L. ..... Brooklime
**Verbascum thapsus* L.
subsp. *thapsus* ..... Aaron's Rod
**Verbascum virgatum* Stokes ..... Twiggy Mullein
Veronica calycina R.Br. ..... Hairy Speedwell

Solanaceae
Solanum brownii Dunal ..... Violet Nightshade
Solanum campanulatum R.Br. ..... Nightshide
Solanum cinereum R.Br. ..... Narrawa Burr
**Solanum nigrum* L. ..... Black-berry Nightshade
Solanum parvifolium R.Br. ..... Nightshade
**Solanum triflorum* Nutt. ..... Three-flowered Nightshade

Stackhousiaceae
Stackhousia viminea Sm. ..... Slender Stackhousia

Sterculiaceae
Brachychiton populneus (Schott & Endl.) R.Br.
subsp. *populneus* ..... Kurrajong

Thymelaeaceae
Pimelea curviflora
subsp. *divergens* Threlfall ..... Curved Rice Flower
Pimelea linifolia Sm. ..... Rice Flower
Pimelea neo-anglica Threlfall ..... New England Rice Flower
Pimelea venosa Threlfall ..... Boliva Rice Flower

Ulmaceae
Trema tomentosa
var. *aspera* (Brongn.) Hewson ..... Trema

Urticaceae
Urtica incisa Poir. ..... Stinging Nettle

Verbenaceae

**Verbena bonariensis* L.....Purpletop

Violaceae

Viola betonicifolia Sm. .....Long-leaf Violet

Viola hederacea Labill.....Ivy-leaf Violet

Vitaceae

Cayratia clematidea (F.Muell.) Domin .....Slender Grape

Appendix C: Locality and site information.

Plot Type	Site	Date Surveyed	Site Size	Zone	Datum	Easting	Northing	Altitude	Notes	Community Allocation
BH	100	18/10/2012	20x20	56	94	396,061.00	6,756,806.00	825		BH9
BH	101	18/10/2012	20x20	56	94	395,990.00	6,756,814.00	825		BH9
BH	102	18/10/2012	20x20	56	94	395,976.00	6,756,902.00	837		BH8
BH	103	18/10/2012	20x20	56	94	396,243.00	6,756,881.00	826		BH8
BH	104	18/10/2012	20x20	56	94	396,213.00	6,756,956.00	824		BH8
BH	105	18/10/2012	20x20	56	94	396,054.00	6,757,091.00	845	Pig damage.	BH8
BH	106	18/10/2012	20x20	56	94	395,869.00	6,757,156.00	851		BH8
BH	107	18/10/2012	20x20	56	94	395,672.00	6,757,210.00	854		BH8
BH	108	18/10/2012	20x20	56	94	395,583.00	6,757,072.00	862		BH8
BH	109	18/10/2012	20x20	56	94	395,444.00	6,756,983.00	879		BH7
BH	110	18/10/2012	20x20	56	94	395,569.00	6,756,918.00	878		BH7
BH	111	18/10/2012	20x20	56	94	395,845.00	6,757,032.00	900		BH8
BH	112	18/10/2012	20x20	56	94	394,613.00	6,755,577.00	947		BH9
BH	113	18/10/2012	20x20	56	94	394,587.00	6,755,688.00	950		BH9
BH	114	18/10/2012	20x20	56	94	394,684.00	6,755,793.00	957		BH9
BH	115	18/10/2012	20x20	56	94	394,802.00	6,755,821.00	942		BH9
BH	116	23/11/2012	20x20	56	94	396,873.00	6,756,529.00	830		BH1
BH	117	23/11/2012	20x20	56	94	396,831.00	6,756,577.00	842		BH4
BH	118	23/11/2012	20x20	56	94	397,014.00	6,756,562.00	828		BH4
BH	119	23/11/2012	20x20	56	94	397,349.00	6,756,786.00	830		BH1
BH	120	23/11/2012	20x20	56	94	397,311.00	6,756,799.00	827		BH4
BH	121	23/11/2012	20x20	56	94	397,290.00	6,756,899.00	828		BH8
BH	122	23/11/2012	20x20	56	94	397,207.00	6,756,930.00	822		BH6
BH	123	23/11/2012	20x20	56	94	396,781.00	6,756,225.00	846		BH8

Plot Type	Site	Date Surveyed	Site Size	Zone	Datum	Easting	Northing	Altitude	Notes	Community Allocation
BH	124	23/11/2012	20x20	56	94	396,757.00	6,756,162.00	849		BH4
BH	125	23/11/2012	20x20	56	94	396,922.00	6,756,955.00	836		BH8
BH	126	23/11/2012	20x20	56	94	396,767.00	6,757,742.00	812		BH1
BH	127	23/11/2012	20x20	56	94	396,624.00	6,757,736.00	808		BH6
BH	128	23/11/2012	20x20	56	94	396,258.00	6,756,738.00	836		BH8
BH	129	23/11/2012	20x20	56	94	396,198.00	6,756,554.00	876		BH7
BH	130	26/11/2012	20x20	56	94	395,091.00	6,756,135.00	925		BH10
BH	131	26/11/2012	20x20	56	94	395,192.00	6,756,156.00	947		BH9
BH	132	26/11/2012	20x20	56	94	395,172.00	6,756,236.00	922		BH10
BH	133	26/11/2012	20x20	56	94	395,238.00	6,756,287.00	908		BH10
BH	134	26/11/2012	20x20	56	94	395,156.00	6,756,268.00	927		BH9
BH	135	26/11/2012	20x20	56	94	395,167.00	6,756,651.00	987		BH7
BH	136	26/11/2012	20x20	56	94	395,022.00	6,756,751.00	996		BH7
BH	137	26/11/2012	20x20	56	94	394,981.00	6,756,636.00	1,024.00		BH7
BH	138	26/11/2012	20x20	56	94	394,895.00	6,756,497.00	1,036.00		BH9
BH	139	26/11/2012	20x20	56	94	394,928.00	6,756,506.00	1,028.00	Pimelea venosa site 46 in total.	BH9
BH	140	26/11/2012	20x20	56	94	394,922.00	6,755,865.00	933		BH6
BH	19	16/02/2001	20x20	56	66	395,745.00	6,755,356.00	1,010.00	No recent evidence of fire. Some logging. Soil loam, light brown.	BH1
BH	20	16/02/2001	20x20	56	66	395,455.00	6,755,418.00	990	Fire c. 3 yrs previous. Some clearing. Soil peaty, black.	BH3
BH	36	5/03/2001	20x20	56	66	396,243.00	6,756,333.00	980	Fire c. 5-8 yrs previous. Some erosion. Soil loamy course sand,	BH7

Plot Type	Site	Date Surveyed	Site Size	Zone	Datum	Easting	Northing	Altitude	Notes	Community Allocation
									yellow brown.	
BH	37	5/03/2001	20x20	56	66	395,289.00	6,755,307.00	980	Fire c. 5 yrs previous. Soil peaty, black.	BH3
BH	50	15/10/2012	20x20	56	94	394,832.00	6,755,416.00	960	Rabbits	BH7
BH	51	15/10/2012	20x20	56	94	395,052.00	6,755,427.00	969	Pigs.	BH7
BH	52	15/10/2012	20x20	56	94	395,113.00	6,755,242.00	977	Pigs.	BH7
BH	53	15/10/2012	20x20	56	94	395,207.00	6,755,123.00	991		BH7
BH	54	15/10/2012	20x20	56	94	395,164.00	6,755,362.00	977		BH4
BH	55	15/10/2012	20x20	56	94	395,410.00	6,755,331.00	997		BH3
BH	56	15/10/2012	20x20	56	94	395,725.00	6,755,338.00	1,013.00		BH7
BH	57	15/10/2012	20x20	56	94	396,151.00	6,755,805.00	974		BH7
BH	58	15/10/2012	20x20	56	94	396,000.00	6,755,859.00	985		BH7
BH	59	15/10/2012	20x20	56	94	395,889.00	6,755,901.00	969		BH7
BH	60	15/10/2012	20x20	56	94	395,868.00	6,756,101.00	948		BH7
BH	61	15/10/2012	20x20	56	94	395,728.00	6,756,187.00	930		BH7
BH	62	15/10/2012	20x20	56	94	395,596.00	6,756,147.00	948		BH7
BH	63	15/10/2012	20x20	56	94	395,484.00	6,756,055.00	949		BH7
BH	64	17/10/2012	20x20	56	94	395,550.00	6,755,768.00	981		BH7
BH	65	17/10/2012	20x20	56	94	395,641.00	6,755,617.00	992		BH3
BH	66	17/10/2012	20x20	56	94	395,938.00	6,755,638.00	900		BH7
BH	67	17/10/2012	20x20	56	94	396,343.00	6,756,241.00	958		BH10
BH	68	17/10/2012	20x20	56	94	396,447.00	6,756,354.00	930		BH7
BH	69	17/10/2012	20x20	56	94	396,430.00	6,756,061.00	884		BH7
BH	70	17/10/2012	20x20	56	94	396,560.00	6,756,150.00	880		BH8
BH	71	17/10/2012	20x20	56	94	396,469.00	6,756,550.00	904		BH7
BH	72	17/10/2012	20x20	56	94	396,427.00	6,756,532.00	914		BH5

Plot Type	Site	Date Surveyed	Site Size	Zone	Datum	Easting	Northing	Altitude	Notes	Community Allocation
BH	73	17/10/2012	20x20	56	94	396,360.00	6,756,481.00	929		BH7
BH	74	17/10/2012	20x20	56	94	395,202.00	6,755,953.00	938		BH7
BH	75	17/10/2012	20x20	56	94	395,497.00	6,756,198.00	922		BH7
BH	76	17/10/2012	20x20	56	94	395,624.00	6,756,241.00	932		BH10
BH	77	17/10/2012	20x20	56	94	395,651.00	6,756,234.00	945		BH10
BH	78	17/10/2012	20x20	56	94	395,749.00	6,756,267.00	928	Goats. 47 Acacia pycnostachya	BH10
BH	79	17/10/2012	20x20	56	94	395,809.00	6,756,349.00	920	168 Acacia pycnostachya	BH10
BH	80	17/10/2012	20x20	56	94	395,496.00	6,756,289.00	891		BH7
BH	81	17/10/2012	20x20	56	94	395,359.00	6,756,177.00	902		BH7
BH	82	17/10/2012	20x20	56	94	395,279.00	6,756,101.00	914		BH7
BH	83	17/10/2012	20x20	56	94	395,016.00	6,756,041.00	938		BH8
BH	84	17/10/2012	20x20	56	94	395,027.00	6,756,240.00	946		BH7
BH	85	17/10/2012	20x20	56	94	395,079.00	6,756,185.00	940		BH9
BH	86	17/10/2012	20x20	56	94	395,117.00	6,756,434.00	958		BH7
BH	87	17/10/2012	20x20	56	94	395,261.00	6,756,548.00	953		BH7
BH	88	17/10/2012	20x20	56	94	395,266.00	6,756,787.00	942		BH7
BH	89	17/10/2012	20x20	56	94	395,321.00	6,756,787.00	940		BH10
BH	90	17/10/2012	20x20	56	94	395,417.00	6,756,646.00	928		BH10
BH	91	17/10/2012	20x20	56	94	395,491.00	6,756,750.00	929		BH5
BH	92	17/10/2012	20x20	56	94	395,491.00	6,756,750.00	929		BH9
BH	93	17/10/2012	20x20	56	94	396,789.00	6,757,505.00	913		BH2
BH	94	18/10/2012	20x20	56	94	396,892.00	6,757,583.00	812		BH2
BH	95	18/10/2012	20x20	56	94	396,904.00	6,757,430.00	815	Tawny Frogmouth present.	BH2

Plot Type	Site	Date Surveyed	Site Size	Zone	Datum	Easting	Northing	Altitude	Notes	Community Allocation
BH	96	18/10/2012	20x20	56	94	396,820.00	6,757,374.00	819		BH2
BH	97	18/10/2012	20x20	56	94	396,733.00	6,757,300.00	821		BH2
BH	98	18/10/2012	20x20	56	94	396,624.00	6,757,310.00	817		BH2
BH	99	18/10/2012	20x20	56	94	396,529.00	6,757,068.00	822		BH2
BHR	1	15/10/2012	Plotless	56	94	395,113.00	6,755,242.00	900		BH7
BHR	2	15/10/2012	Plotless	56	94	395,843.00	6,755,960.00	958		BH7
BHR	3	15/10/2012	Plotless	56	94	396,484.00	6,756,250.00	906		BH7
BHR	4	15/10/2012	Plotless	56	94	396,575.00	6,756,385.00	893		BH7
BHR	5	17/10/2012	Plotless	56	94	395,251.00	6,755,987.00	944		BH7
BHR	6	17/10/2012	Plotless	56	94	395,700.00	6,756,227.00	933		BH7
BHR	7	18/10/2012	Plotless	56	94	396,143.00	6,757,082.00	831		BH8
BHR	8	18/10/2012	Plotless	56	94	395,986.00	6,757,150.00	873		BH4
BHR	9	18/10/2012	Plotless	56	94	395,824.00	6,757,148.00	850		BH4
BHR	10	18/10/2012	Plotless	56	94	395,672.00	6,757,148.00	857		BH7
BHR	11	18/10/2012	Plotless	56	94	395,752.00	6,756,955.00	900		BH4
BHR	12	23/11/2012	Plotless	56	94	396,925.00	6,756,323.00	834		BH4
BHR	13	23/11/2012	Plotless	56	94	396,947.00	6,757,062.00	827		BH8
BHR	14	23/11/2012	Plotless	56	94	396,647.00	6,757,746.00	809		BH2
BHR	15	23/11/2012	Plotless	56	94	396,567.00	6,757,660.00	810		BH6
BHR	16	23/11/2012	Plotless	56	94	396,695.00	6,757,654.00	810		BH4
BHR	17	23/11/2012	Plotless	56	94	396,143.00	6,756,545.00	874		BH7
BHR	18	26/11/2012	Plotless	56	94	395,226.00	6,756,156.00	941		BH7
BHR	19	26/11/2012	Plotless	56	94	395,169.00	6,756,205.00	939		BH10
BHR	20	26/11/2012	Plotless	56	94	395,231.00	6,756,299.00	910		BH10
BHR	21	26/11/2012	Plotless	56	94	395,278.00	6,756,259.00	908		BH7

Plot Type	Site	Date Surveyed	Site Size	Zone	Datum	Easting	Northing	Altitude	Notes	Community Allocation
BHR	22	26/11/2012	Plotless	56	94	394,984.00	6,756,087.00	930		BH6
FEN	53	4/02/2007	20x20	56	96	394,794.00	6,755,549.00	1,000.00	Soil peaty with sand underneath. E. banksii, Banksia integrifolia, Acacia neriifolia.	BH6

Acknowledgements

Thanks to Graham Lightbody the ranger for Bolivia Hill Nature Reserve for information provided. Thank you to Trish Stadtmiller for assistance on her property. Thanks to Zak Growns and Vanessa Hunter for assistance in the field.

Biodiversity Impact Assessment

APPENDIX B

Fauna Habitat Assessment Proforma

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BASIC SITE INFORMATION

OFFICE USE ONLY **SITEID:** .....

Surveynums:.....

Entered:..... Checked:..... Corrected:.....

SITE ALIAS (field code): .....

PROJECT: .....

DATE: ..../..../....

OBSERVERS .....

SITE INFORMATION (no need to fill this section out if revisiting an established site)

LOCATION (GPS reference)

Datum: ☐ AGD84 ☐ GDA94 (WGS84) OTHER:_____ **Location derivation:** _____

Road: zone: _ _ **easting:** _ _ _ _ _ _ **northing:** _ _ _ _ _ _ _ .

Plot Centre zone: _ _ **easting:** _ _ _ _ _ _ **northing:** _ _ _ _ _ _ _ **Accuracy:** _____ m

Altitude: _____ **Altitude accuracy:** _____ m **Altitude derivation:** _____

Locality description: .....

.....

Tenure: ..... **Reserve or Property Name:** ..... **Reserve number:** ..... **Bioregion:** .....

Map number: ..... **Map name:** ..... **Subregion:** ..... **Parish:** .....

VEGETATION

Habitat Description: .....

.....

Regional Ecosystem (mapped) ..... **Regional Ecosystem (obs):** ..... **Broad veg group:** .....

Dominant/characteristic species

Layer^	Species	Layer^	Species	Layer^	Species

^Layer: Emergent (E), T1, T2, T3, S1, S2, Ground (G)

General Site comments: .....

.....

.....

LANDFORM

Situation:* ..... **Element:*** ..... **Pattern:*** .....

Slope Position:* ..... **Slope Degree:** ..... **Slope Aspect:** .....

SOIL (top soil)

Depth:* ..... **Colour:** ☐☐ · ☐ ☐☐ ☐ / ☐ **Munsell? (y/n):** ..... **Texture:** .....

Soil notes: .....

GEOLOGY

Source: Map / Cutting / Core / Outcrop **Code:** ..... **Geology unit** ..... **Notes:** .....

SITE PHOTOS

	Photo No./s		Photo No./s	Other photo numbers and notes:
North:		South:		
East:		West:		

Current Site visit comments: .....

.....

.....

BASIC SITE INFORMATION CONT.....

DISTURBANCE:

Disturbance Type	Severity 0 - 3 (0=nil, 3= severe)	Date of last event (range ok)	Obs type^	Notes: mean fire scar ht (m)	Notes: (e.g. Info on prior events, treatment type, % of site impacted, clearing technique, weed species, erosion type)
Wildfire					
Prescribed Burn					
Logging					
Treatment					
Grazing					
Clearing					
Weeds					
Erosion					
Storm					
Other (specify):					

^Observation type: 1= visual estimate; 2 = records; 3 = informant

HABITAT CHARACTERISTICS - ABUNDANCE:

Characteristic (Add others as required)	Abundance (0-7)^	Notes:
Hollows in trees & stags		
Fallen logs (>10cm diam.)		
Decorticating bark		
Course litter (>2cm diam.)		
Fine litter (<2cm diameter)		
Bare ground		
Grass		
Soil cracks		
Stones (20-60cm)		
Boulders (61cm-2m)		
Large boulders (>2m)		
Rock crevices		
Exfoliating rock		

^Abundance Key:

0 = Nil
1 = Rare
2 = Rare to Occasional
3 = Occasional
4 = Occasional to common
5 = Common
6 = Common to Abundant
7 = Abundant

CODES

Location derivation

Code	Description
AGPS	Averaged GPS fix (5 min)
ARCGIS	ArcView Map
DGPS	Differential / RTCM corrected GPS
EST	Estimate from known position
GPS00	GPS - type unspecified
GPS04	GPS - 4 station
GPS08	GPS - 6 to 8 station
GPS12	Multichannel GPS (12 station)
KNO	Known position, eg surveyed point
MAP	Map - scale unspecified
MP012	Map - 1:12 500 scale
MP025	Map - 1:25 000 scale
MP050	Map - 1:50 000 scale
MP100	Map - 1:100 000 scale
MP250	Map - 1:250 000 scale
SGPS	GPS survey system

Location accuracy

Code	Description
A	+/- 0.0 m
B	+/- 0-10 m
C	+/- 11-50m
D	+/- 51-100m
E	+/- 101-300m
F	+/- 301-500m
G	+/- 501-1000m
H	+/- 1001-3000m
I	>3000m

Altitude derivation

Code	Description
ALT	Altimeter
DEM	Digital elevation model
EST	Estimate from known height
GPS	Global positioning system
KNO	Known height
OTH	Other
TOP	Topographic map

Situation

Code	Description
Plains	
A	Not otherwise specified, flat gentle slopes; undulating terrain
B	Alluvial plain or flat, alluvium, flood plain
U	Claypan, Playa or Salina(including inland lakes), Salt Flat(inland).
V	Tidal Flat (coastal), Salt Flat (coastal).
Streams, Lakes	
C	Banks of lake, river, stream, watercourse, levees
D	Gully, drainage line, ravine gorge, outwash
E	Channel Bed, distributaries of inland streams
Hills, Mountains, Tablelands	
F	Slope or Hill not specified
L	Cliff (steep rocky faces), rocky ledge, rocky outcrop, scarp, crevice
N	Coastal rocky headland
K	Top, crest of mountain or ridge
Q	Jump Up (Cuesta) and Mesa, Tableland, Plateau,
Dunes	
R	Recent Coastal Dune (low dune less than about 15m) and
S	Fossil Coastal Dune (High Dune greater than about 15m)
T	Inland Dune.
Water	
W	Swamp or Marsh.
X	Fresh Water Aquatic.
Y	Salt Water Aquatic.
Z	Melon Holes, Gilgai, Depressions in Soil, Sink Holes.

Element

Code	Description	Code	Description	Code	Description
HCR	Hillcrest	DUS	Duneslope	STF	Supratidal flat
SUS	Summit Surface	BRK	Breakaway	FIL	Fill-top
DUC	Dunecrest	CFS	Cliff-foot slope	REF	Feef flat
TOR	Tor	SFS	Scarp-foot Slope	ALC	Alcove
TUM	Tumulus	BEN	Bench	GUL	Gully
DUN	Dune	BER	Berm	CIR	Cirque
CON	Cone	PED	Pediment	DDE	Drainage depression
MOU	Mound	FOO	Footslope	STC	Stream channel
LEV	Levee	TAL	Talus	STB	Stream bed
BAR	Bar	PLA	Plain	TDC	Tidal creek
SCR	Scroll	RFL	Rock flat	EST	Estuary
PST	Prior stream	RPL	Rock platform	SWP	Swamp
FOR	Foredune	COS	Cut-over surface	SWL	Swale
LUN	Lunette	SCD	Scald	TRE	Trench
BRI	Beach ridge	FAN	Fan	LAK	Lake
EMB	Embankment	VLF	Valley flat	PLY	Playa
DAM	Dam	TEF	Terrace flat	DOL	Doline
CLI	Cliff	CBE	Channel bench	OXB	Ox-bow
SCA	Scarp	BKP	Backplain	LAG	Lagoon
HSL	Hillslope	SRP	Scroll plain	BOU	Blow-out
CUT	Cut face	FLD	Flood-out	MAA	Maar
LDS	Landslide	TEP	Terrace plain	CRA	Crater
BAN	(Stream) Bank	TDF	Tidal flat	PIT	Pit
BEA	Beach	ITF	Intertidal flat		

Pattern

Code	Description
RM	Rolling mountains
SM	Steep mountains
VM	Very steep mountains
PM	Precipitous mountains
UH	Undulating hills
RH	Rolling hills
SH	Steep hills
VH	Very steep hills
PH	Precipitous hills
UL	Undulating low hills
RL	Rolling low hills
SL	Steep low hills
VL	Very steep low hills
B	Badlands
GR	Gently undulating rises
UR	Undulating rises
RR	Rolling rises
SR	Steep rises
LP	Level plain
GP	Gently undulating plain
UP	Undulating plain
RP	Rolling plain

Slope Position

Code	Description
C	Crest
D	Closed Depression
F	Flat
G	Gully
H	Hillock
L	Lower-Slope
M	Mid-Slope
P	Plateau
R	Ridge
U	Upper-Slope
V	Open Depression
W	Wetland

Soil Depth

Code	Description
D	Deep
S	Shallow
X	Skeletal

Biodiversity Impact Assessment

APPENDIX C

List of fauna species recorded within the Study Area

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APPENDIX C List of fauna species recorded within the Study Area

Family	Scientific Name	Common Name	Status^		Vegetation Community Type				
			TSC Act	EPBC Act	C2	C3	C7	C8	C9
Birds									
Acanthizidae	*Gerygone albogularis*	White-throated Gerygone	-	-	X		X	X	X
Accipitridae	*Elanus axillaris*	Black-shouldered Kite	-	-				X	X
Accipitridae	*Hieraaetus morphnoides*	Little Eagle	V	-				X	
Anatidae	*Chenonetta jubata*	Australian Wood Duck	-	-				X	X
Anatidae	*Anas superciliosa*	Pacific Black Duck	-	-				X	X
Artamidae	*Artamus cyanopterus*	Dusky Woodswallow	-	-			X		
Artamidae	*Cracticus nigrogularis*	Pied Butcherbird	-	-	X		X	X	X
Artamidae	*Strepera graculina*	Pied Currawong	-	-	X		X	X	X
Cacatuidae	*Cacatua roseicapilla*	Galah	-	-	X			X	X
Cacatuidae	*Cacatua galerita*	Sulphur-crested Cockatoo	-	-	X				X
Cacatuidae	*Calyptorhynchus funereus*	Yellow-tailed Black-Cockatoo	-	-	X		X	X	X
Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike	-	-	X		X	X	X
Charadriidae	*Vanellus miles*	Masked Lapwing	-	-	X				X
Climacteridae	*Climacteris picumnus*	Brown Treecreeper	V	-			X		X
Climacteridae	*Cormobates leucophaea*	White-throated Treecreeper	-	-	X		X	X	X
Columbidae	*Phaps chalcoptera*	Common Bronzewing	-	-			X		
Columbidae	*Ocyphaps lophotes*	Crested Pigeon	-	-	X			X	
Columbidae	*Geopelia striata*	Peaceful Dove	-	-	X		X		X
Columbidae	*Streptopelia chinensis*	Spotted Dove	*	*	X		X	X	X
Coraciidae	*Eurystomus orientalis*	Dollarbird	-	-	X		X	X	X
Corvidae	*Corvus coronoides*	Australian Raven	-	-	X		X	X	X
Cracticidae	*Cracticus tibicen*	Australian Magpie	-	-	X		X	X	X
Cuculidae	*Cacomantis variolosus*	Brush Cuckoo	-	-					X
Cuculidae	*Scythrops novaehollandiae*	Channel-billed Cuckoo	-	-	X		X	X	X
Cuculidae	*Eudynamys scolopacea*	Eastern Koel	-	-	X		X	X	X
Cuculidae	*Cacomantis flabelliformis*	Fan-tailed Cuckoo	-	-				X	X
Cuculidae	*Centropus phasianinus*	Pheasant Coucal	-	-			X	X	X
Dicruridae	*Dicrurus bracteatus*	Spangled Drongo	-	-				X	X
Estrildidae	*Stagonopleura guttata*	Diamond Firetail	V	-				X	
Estrildidae	*Taeniopygia bichenovii*	Double-barred Finch	-	-					X
Estrildidae	*Neochmia temporalis*	Red-browed Finch	-	-			X	X	
Falconidae	*Falco berigora*	Brown Falcon	-	-				X	
Falconidae	*Falco cenchroides*	Nankeen Kestrel	-	-	X		X	X	X
Halcyonidae	*Todiramphus macleayii*	Forest Kingfisher	-	-				X	X
Halcyonidae	*Dacelo novaeguineae*	Laughing Kookaburra	-	-	X		X	X	X
Halcyonidae	*Todiramphus sanctus*	Sacred Kingfisher	-	-				X	
Maluridae	*Malurus cyaneus*	Superb Fairy-wren	-	-	X		X	X	X
Meliphagidae	*Acanthorhynchus tenuirostris*	Eastern Spinebill	-	-			X		
Meliphagidae	*Philemon corniculatus*	Noisy Friarbird	-	-				X	X
Meliphagidae	*Manorina melanocephala*	Noisy Miner	-	-	X		X	X	X
Meliphagidae	*Phylidonyris niger*	White-cheeked Honeyeater	-	-				X	X
Meliphagidae	*Lichenostomus chrysops*	Yellow-faced Honeyeater	-	-				X	X
Monarchidae	*Grallina cyanoleuca*	Magpie-lark	-	-	X		X	X	X
Oriolidae	*Oriolus sagittatus*	Olive-backed Oriole	-	-			X		X
Pachycephalidae	*Colluricincla harmonica*	Grey Shrike-thrush	-	-	X		X	X	X
Pachycephalidae	*Pachycephala rufiventris*	Rufous Whistler	-	-	X		X	X	X
Pardalotidae	*Acanthiza reguloides*	Buff-rumped Thornbill	-	-	X		X	X	X
Pardalotidae	*Pardalotus striatus*	Striated Pardalote	-	-					X
Pardalotidae	*Acanthiza lineata*	Striated Thornbill	-	-			X	X	X
Phasianidae	*Coturnix ypsilophora*	Brown Quail	-	-				X	
Psittaculidae	*Alisterus scapularis*	Australian King-Parrot	-	-				X	X
Psittaculidae	*Platycercus elegans*	Crimson Rosella	-	-	X		X		
Psittaculidae	*Trichoglossus haematodus*	Rainbow Lorikeet	-	-	X		X	X	X
Psittaculidae	*Aprosmictus erythropterus*	Red-winged Parrot	-	-	X		X	X	X
Rhipiduridae	*Rhipidura albiscapa*	Grey Fantail	-	-	X		X	X	X
Rhipiduridae	*Rhipidura leucophrys*	Willie Wagtail	-	-	X		X	X	X
Strigidae	*Ninox novaeseelandia*	Southern Boobook	-	-					X
Threskiornithidae	*Threskiornis spinicollis*	Straw-necked Ibis	-	-	X			X	X
Zosteropidae	*Zosterops lateralis*	Silvereye	-	-					X
Native Bird richness by vegetation community					31	0	34	45	48

APPENDIX C List of fauna species recorded within the Study Area

Family	Scientific Name	Common Name	Status^		Vegetation Community Type				
			TSC Act	EPBC Act	C2	C3	C7	C8	C9
		Mammals							
Bovidae	*Capra hircus*	Goat	*	*	X				X
Canidae	*Canis lupus*	Dog	*	*	X		X	X	X
Canidae	*Vulpes vulpes*	Red Fox	*	*				X	
Dasyuridae	*Dasyurus maculatus*	Spot-tailed Quoll	V	E					X
Dasyuridae	*Antechinus flavipes*	Yellow-footed Antechinus	-	-				X	X
Dasyuridae	*Antechinus swainsonii*	Dusky Antechinus	-		X				
Emballonuridae	*Saccolaimus flaviventris*	Yellow-bellied Pouched Bat	V	-	X		X	X	X
Felidae	*Felis catus*	Cat	*	*					X
Leporidae	*Oryctolagus cuniculus*	European Rabbit	*	*	X		X	X	X
Macropodidae	*Macropus giganteus*	Eastern Grey Kangaroo	-	-	X		X	X	X
Macropodidae	*Macropus robustus*	Euro	-	-				X	
Macropodidae	*Macropus rufogriseus*	Red-necked Wallaby	-	-			X	X	X
Macropodidae	*Wallabia bicolor*	Swamp Wallaby	-	-				X	X
Molossidae	*Tadarida australis*	White-striped Freetail Bat	-	-			X	X	X
Molossidae	*Austronomus australis*	White-striped Freetail Bat	-	-	X		X	X	X
Molossidae	*Mormopterus beccarii#*	Beccari's Freetail Bat	V	-				X	X
Molossidae	*Mormopterus ridei*	Eastern Little Free-tailed Bat	-	-	X		X	X	X
Molossidae	*Mormopterus sp4/sp3*		-	-	X		X	X	X
Muridae	*Hydromys chrysogaster*	Water Rat	-	-					X
Muridae	*Rattus rattus*	Black Rat	*	*	X		X		
Muridae	*Mus musculus*	House Mouse	*	*	X				
Phalangeridae	*Trichosurus vulpecula*	Common Brushtail Possum	-	-			X		X
Pseudocheiridae	*Pseudocheirus peregrinus*	Common Ringtail Possum	-	-					X
Rhinolophidae	*Rhinolophus megaphyllus*	Southern Horeshoe Bat	-	-	X		X	X	
Suidae	*Sus scrofa*	Feral Pig	*	*	X		X	X	X
Tachyglossidae	*Tachyglossus aculeatus*	Short-beaked Echidna	-	-	X				X
Vespertilionidae	*Chalinolobus gouldii*	Gould's Wattle Bat	-	-	X		X	X	X
Vespertilionidae	*Chalinolobus morio*	Chocolate Wattle Bat	-	-	X		X	X	X
Vespertilionidae	*Falsistrellus tasmaniensis#*	Eastern False Pipistrelle	V	-	X		X	X	X
Vespertilionidae	*Nycophilus sp.*		-	-	X		X	X	X
Vespertilionidae	*Scrotorepens greyii/ sp.*	Little Broad-nosed Bat	-	-	X		X	X	X
Vespertilionidae	*Scrotorepens orion#*	Eastern Broad-nosed Bat	-	-	X		X	X	X
Vespertilionidae	*Vespadelus darlingtoni*	Large Forest Bat	-	-	X		X	X	X
Vespertilionidae	*Vespadelus pumilus*	Eastern Forest Bat	-	-	X		X	X	X
Vespertilionidae	*Vespadelus regulus*	Southern Forest Bat	-	-	X		X	X	X
Vespertilionidae	*Vespadelus vulturnus*	Little Forest Bat	-	-	X		X	X	X
Vespertilionidae	*Miniopterus orianae oceanensis*	Eastern Bent-winged Bat	V	-	X		X	X	X
Native Mammal richness by vegetation community					25	0	24	27	31
		Reptiles							
Agamidae	*Amphibolurus nobbi*	Nobbi Dragon	-	-				X	X
Agamidae	*Pogona barbata*	Bearded Dragon (juv.)	-	-					X
Agamidae	*Physignathus lesueurii*	Water Dragon	-	-				X	X
Elapidae	*Pseudechis porphyriacus*	Red-bellied Black Snake	-	-				X	X
Scincidae	*Cryptoblepharus plagiocephalus*	A Skink	-	-	X			X	X
Scincidae	*Cryptoblepharus virgatus*	A Skink	-	-	X		X	X	X
Scincidae	*Lampropholis delicata*	Garden Sunskink	-	-	X		X	X	X
Scincidae	*Ctenotus robustus*	Eastern Striped Skink	-	-				X	X
Varanidae	*Varanus varius*	Lace Monitor	-	-	X				X
Native Reptile richness by vegetation community					4	0	2	7	9
		Amphibians							
Bufonidae	*Bufo marinus*	Cane Toad	*	*	X		X		
Hylidae	*Litoria fallax*	Dwarf Green Treefrog	-	-			X		X
Hylidae	*Litoria dentata*	Keferstein's Tree Frog	-	-		X	X		
Hylidae	*Litoria peronii*	Peron's Tree Frog	-	-		X	X		
Hylidae	*Litoria rubella*	Red Tree Frog	-	-		X	X		
Hylidae	*Litoria latopalmata*	Broad-palmed Rocketfrog	-	-		X	X		
Limnodynastidae	*Platyplectrum ornatum*	Ornate Burrowing frog	-	-		X	X		
Limnodynastidae	*Limnodynastes peronii*	Striped Marsh Frog	-	-		X	X		
Myobatachidae	*Pseudophryne bibronii*	Bibron's Toadlet	-	-		X	X		
Native Amphibian richness by vegetation community					1	7	9	0	1
		Crustaceans							
Parastacidae	*Euastacus suttoni*	New England Crayfish	-	-			X		X
Native fauna richness by vegetation community					61	7	69	79	89

Note: ^ - E=Endangered; V=Vulnerable; *=Introduced.
- Species possibly occurs, definite identification not possible through echolocation call only

Biodiversity Impact Assessment

APPENDIX D

Balance Environmental Microbat Call Identification Report

Cardno
Shaping the Future

Microbat Call Identification Report

Prepared for ("Client"):	CARDNO-Chenoweth
Survey location/project name:	Bolivia Hill, NSW
Survey dates:	December, 2012
Client project reference:	David Wassman
Job no.:	CARD1301
Report date:	1 February 2013

Methods

Data receipt and processing

Bat calls were recorded over eight nights, using four Song Meter detectors (Wildlife Acoustics, Concord MA, USA). Data were retrieved from the detectors by the client and saved as full-spectrum sound files (.wav format). Some 4,200 WAV files were submitted to Balance Environmental for further processing and analysis. A small amount of data (10 files) recorded on an Anabat detector (Titley Scientific, Brisbane) was also received for analysis.

Data conversion and zero-crossing analysis

The WAV files were converted to Anabat sequence files (zero-crossing analysis format) using Wildlife Acoustics' *Kaleidoscope* program. A total of 3,275 sequence files were thus generated from the four detectors.

Sonograms for all sequence files were viewed in *AnalookW* (Corben 2009) and a subset of files representative of call types observed for each night on each detector was selected for analysis. Species identification was achieved manually by viewing all calls in the selected subset and comparing them with reference calls from southern Queensland and northern New South Wales, and/or with published call descriptions (Reinhold et al 2001; Pennay et al. 2004).

Determination of species' identity was refined by considering probability of occurrence based on published distributional information (e.g. Churchill 2008; van Dyck & Strahan 2008) and/or on-line fauna database records (e.g. Atlas of Living Australia http://www.ala.org.au/).

Reporting standard

The format and content of this report follows Australasian Bat Society standards for the interpretation and reporting of bat call data (Reardon 2003), available on-line at http://www.ausbats.org.au/.

Species nomenclature follows Churchill (2008).

Results

Data quality and reliability of call identification

The data recorded from this survey included a high proportion of good quality call sequences, which resulted in reliable identification for most species. The known or expected presence of a number of species that have similar call characteristics meant that some calls could only be attributed to a species group (e.g. *Vespadelus* spp., *Falsistrellus tasmaniensis* / *Scotorepens* spp.). Where-ever possible, however, some species from these groups were split out based on characteristics of good quality calls. Further detail on these groups and probability of each species being present is provided in the Discussion.

Species recorded

Tables 1-4 provide a detailed breakdown of species recorded on each night by each of the Song Meter detectors.

At least twelve species were recorded: *Rhinolophus megaphyllus; Chalinolobus gouldii; Chalinolobus morio; Nyctophilus* species*; Scotorepens greyii; Vespadelus darlingtoni; Vespadelus vulturnus; Miniopterus orianae oceanensis; Austronomus australis; Mormopterus ridei; Mormopterus* sp.4*;* and *Saccolaimus flaviventris*.

Up to six additional species were recorded but could not be reliably identified due to similarities between their calls and those of other species. These included: *Falsistrellus tasmaniensis; Scotorepens orion; Vespadelus pumilus; Vespadelus regulus; Mormopterus beccarii;* and *Mormopterus* sp. 3.

The 10 files submitted from the Anabat detector were all recorded between about 7:00-7:30pm on the night of 16/12/2012. These few files included just two call types, representing the following species:

- *Mormopterus ridei*; and
- *Vespadelus regulus* or *Miniopterus orianae oceanensis*.

Discussion

Many calls were reliably attributed to known species, but some species that are likely to occur in the study area can be difficult to distinguish using call data. The number of such species is particularly high for this data set because the study area lies in an overlap zone of species with predominantly coast or range distributions and those with more westerly distributions. Species groupings for these difficult calls are discussed below, including an indication of the likelihood of various group members being present in the study area.

Chalinolobus gouldii and *Mormopterus* species

These bats have calls with characteristic frequency (Fc) in the range 28-35 kHz. *Chalinolobus gouldii* generally produces calls with steep, curved pulses that alternate in characteristic frequency; however, low-quality, fragmented calls often lack the steep initial frequency sweep and can look very like the calls of *Mormopterus* species.

Four *Mormopterus* species that call in this frequency range potentially occur in the study area, including: *M. norfolkensis*; *M. ridei*; *M.* species 4; and *M.* species 3. Some calls were positively attributed to *M. ridei* based on Fc>32 kHz; but the majority of *Mormopterus* calls had Fc of 28-30 kHz and could have been from either *M.* species 4 or *M.* species 3.

Calls from *M. norfolkensis* often have clear frequency alternation between successive pulses; and since there was no evidence of this call pattern in the data set, *M. norfolkensis* was excluded from consideration.

Chalinolobus morio and *Vespadelus* spp.

Calls from *C. morio* have similar shape and frequency to several *Vespadelus* species. Calls were positively attributed to *C. morio* if they had the short, flattish pulse body with downward-sweeping tail that distinguishes this species from the *Vespadelus* spp., which generally have no tail or cup-shaped pulse body with upward-sweeping tail. A number of calls were weak and/or fragmented and/or contained pulses with intermediate characteristics and could not be reliably attributed either way.

Falsistrellus tasmaniensis and *Scotorepens* spp.

The Atlas of Living Australia has records of *F. tasmaniensis* and *S. orion* within 10km of Bolivia Hill, and these species' calls are very difficult to differentiate. Furthermore, it is possible that both little broad-nosed bat (*S. greyii*) and central-eastern broad-nosed bat (*Scotorepens* sp.) are also present. These latter two species cannot be distinguished from each other and their calls overlap significantly with those of *F. tasmaniensis* and *S. orion*.

A few calls with relatively short duration pulses, steep, curved bodies with upward-sweeping tails and Fc around 37-38 kHz were positively attributed to *Scotorepens* sp./*S. greyii*. Similarly, many calls with longer-duration pulses, more gradual curvature, no tails or down-swept tails and Fc around 34.5-36 kHz were attributed to *F. tasmaniensis/S. orion* but could not be further differentiated. In some calls, intermediate pulse shapes and frequencies resulted in identity being possibly attributable to any of these four species.

Nyctophilus spp.

These species' calls are readily distinguished from those of other bats; however, the species within the genus *Nyctophilus* cannot be reliably differentiated from each other. Three *Nyctophilus* species potentially occur in the study area, including *N. bifax, N. geoffroyi* and *N. gouldi* and any or all of them could have been responsible for the recorded calls.

Vespadelus spp.

Up to four *Vespadelus* species potentially occur in the study area, some of which can be difficult to differentiate. Identification for these species was based largely on characteristic frequency differential, as follows:

- *V. darlingtoni* (Fc=41-43 kHz);
- *V. darlingtoni* / *V. regulus* (Fc=43-44 kHz);
- *V. regulus* (Fc=44-46 kHz)
- *V. regulus* / *V. vulturnus* (Fc=46-47 kHz);
- *V. vulturnus* (Fc=47-50 kHz);
- *V. vulturnus* / *V. pumilus* (50-53 kHz); and
- *V. pumilus* (Fc>53 kHz).

In most cases, calls were allocated to one of the species pairs due to significant variation in frequency within the sequence. Consequently, most of the *Vespadelus* species are only shown as "Possible" for the majority of detection sessions (Tables 1-4).

Miniopterus orianae oceanensis

This species overlaps in frequency with *V. darlingtoni* and *V. regulus*, but can sometimes be distinguished by its longer duration pulses with more angled body shape. It was positively identified for many sessions, but in some cases only calls with intermediate pulse characteristics were available.

Mormopterus beccarii

A few calls had pulses similar to those produced by this species (steep and curved with Fc=24-26 kHz); however, it is possible also that these pulses came from *Mormopterus* species 4.

References

Churchill, S. (2008). *Australian Bats*. Jacana Books, Allen & Unwin; Sydney.

Corben, C. (2009). *AnalookW* Version 3.7w. Software for bat call analysis using ZCA data.

Pennay, M., Law, B. and Reinhold, L. (2004). *Bat Calls of New South Wales*. Department of Environment and Conservation, Hurstville.

Reardon, T. (2003). Standards in bat detector based surveys. *Australasian Bat Society Newsletter* **20**, 41-43.

Reinhold, L., Law, B., Ford, G. and Pennay, M. (2001). *Key to the bat calls of south-east Queensland and north-east New South Wales*. Department of Natural Resources and Mines, Brisbane.

van Dyck, S. and Strahan, R. (ed.) (2008). *The Mammals of Australia* (Third Edition). New Holland; Sydney.

Table 1. Microbat species recorded during the Bolivia Hill surveys, December 2012 – **Detector # 009616.**

♦ = species positively identified from call data; □ = species possibly present, but not reliably identified

Date:	18-Dec	19-Dec	20-Dec	21-Dec	22-Dec
SPECIES					
Rhinolophus megaphyllus					
Chalinolobus gouldii	♦	♦	♦	♦	♦
Chalinolobus morio	♦	♦	♦	♦	♦
Falsistrellus tasmaniensis	□	□	□	□	□
Nyctophilus species	♦	♦	♦	♦	
Scotorepens greyii / Scotorepens sp.	□	□			
Scotorepens orion	□	□	□	□	□
Vespadelus darlingtoni	□	□		□	
Vespadelus pumilus	♦	□	□		
Vespadelus regulus	♦	□	□	□	
Vespadelus vulturnus	♦	□	□		
Miniopterus orianae oceanensis	♦	♦		♦	
Austronomus australis	♦	♦	♦	♦	
Mormopterus beccarii					
Mormopterus ridei	♦	♦			
Mormopterus species 4 / species 3	♦	♦			
Saccolaimus flaviventris	♦			♦	

Table 2. Microbat species recorded during the Bolivia Hill surveys, December 2012 – **Detector # 011037.**

♦ = species positively identified from call data; □ = species possibly present, but not reliably identified

Date:	16-Dec	17-Dec	18-Dec	19-Dec	20-Dec	21-Dec	22-Dec	23-Dec
SPECIES								
Rhinolophus megaphyllus	♦						♦	
Chalinolobus gouldii	♦	♦	♦	♦	♦	♦		□
Chalinolobus morio	♦	♦	♦	♦	♦	□	♦	
Falsistrellus tasmaniensis	□	□	□	□	□		□	
Nyctophilus species	♦	♦	♦		♦	♦		
Scotorepens greyii/ Scotorepens sp.		□	♦		□		□	
Scotorepens orion	□	□	□	□	□		□	
Vespadelus darlingtoni	♦	□	□		□	□	□	□
Vespadelus pumilus	□	□	□	□	□	□	□	
Vespadelus regulus	□	□	□		□	□	□	□
Vespadelus vulturnus	♦	♦	♦	♦	♦	♦	♦	□
Miniopterus orianae oceanensis	♦	□	□		♦	♦	□	♦
Austronomus australis	♦	♦		♦	♦	♦		
Mormopterus beccarii								
Mormopterus ridei	□	♦	□	♦	♦	♦	♦	□
Mormopterus species 4 / species 3	♦	♦	♦	□	♦	♦		□
Saccolaimus flaviventris		♦				♦	♦	

Table 3. Microbat species recorded during the Bolivia Hill surveys, December 2012 – **Detector # 011046.**

♦ = species positively identified from call data; □ = species possibly present, but not reliably identified

Date:	16-Dec	17-Dec	18-Dec	19-Dec	20-Dec	21-Dec	22-Dec	23-Dec
SPECIES								
Rhinolophus megaphyllus							♦	
Chalinolobus gouldii	□	♦	□	♦	♦	♦	♦	
Chalinolobus morio		♦	□	♦	♦	♦	♦	♦
Falsistrellus tasmaniensis	□	□	□	□	□	□		
Nyctophilus species	♦	♦	♦	♦		♦		
Scotorepens greyii/ Scotorepens sp.	♦				□			
Scotorepens orion	□	□	□	□	□	□		
Vespadelus darlingtoni	□		□		□	♦	□	
Vespadelus pumilus	□	□	□	□	□	□	□	
Vespadelus regulus	□	□	□	□	□	♦	□	
Vespadelus vulturnus	♦	□	□	□	□	□	□	
Miniopterus orianae oceanensis	□	□	□		♦	♦	♦	
Austronomus australis	♦	♦	♦	♦	♦	♦	♦	
Mormopterus beccarii	□							
Mormopterus ridei	♦	♦	♦	♦	♦		♦	
Mormopterus species 4 / species 3	♦	♦		♦	♦		♦	
Saccolaimus flaviventris	♦		♦	♦			♦	

Table 4. Microbat species recorded during the Bolivia Hill surveys, December 2012 – **Detector # 011213.**

♦ = species positively identified from call data; □ = species possibly present, but not reliably identified

Date:	16-Dec	17-Dec	18-Dec	19-Dec	20-Dec	21-Dec	22-Dec	23-Dec
SPECIES								
Rhinolophus megaphyllus								
Chalinolobus gouldii	♦	♦	♦			□		
Chalinolobus morio	♦	♦	♦	♦	♦		♦	
Falsistrellus tasmaniensis	□		□	□		□		
Nyctophilus species	♦							
Scotorepens greyii/ Scotorepens sp.			□	□				
Scotorepens orion	□		□	□		□		
Vespadelus darlingtoni	♦		♦	♦		♦		
Vespadelus pumilus	□					□		
Vespadelus regulus	□		□	□		□		
Vespadelus vulturnus	□	♦	♦	□	♦	♦		
Miniopterus orianae oceanensis	♦		♦	□	♦	♦		
Austronomus australis	♦	♦		♦		♦		
Mormopterus beccarii						□		
Mormopterus ridei	♦	□	□			□		♦
Mormopterus species 4 / species 3	♦	□	□			□	♦	□
Saccolaimus flaviventris	♦		♦					

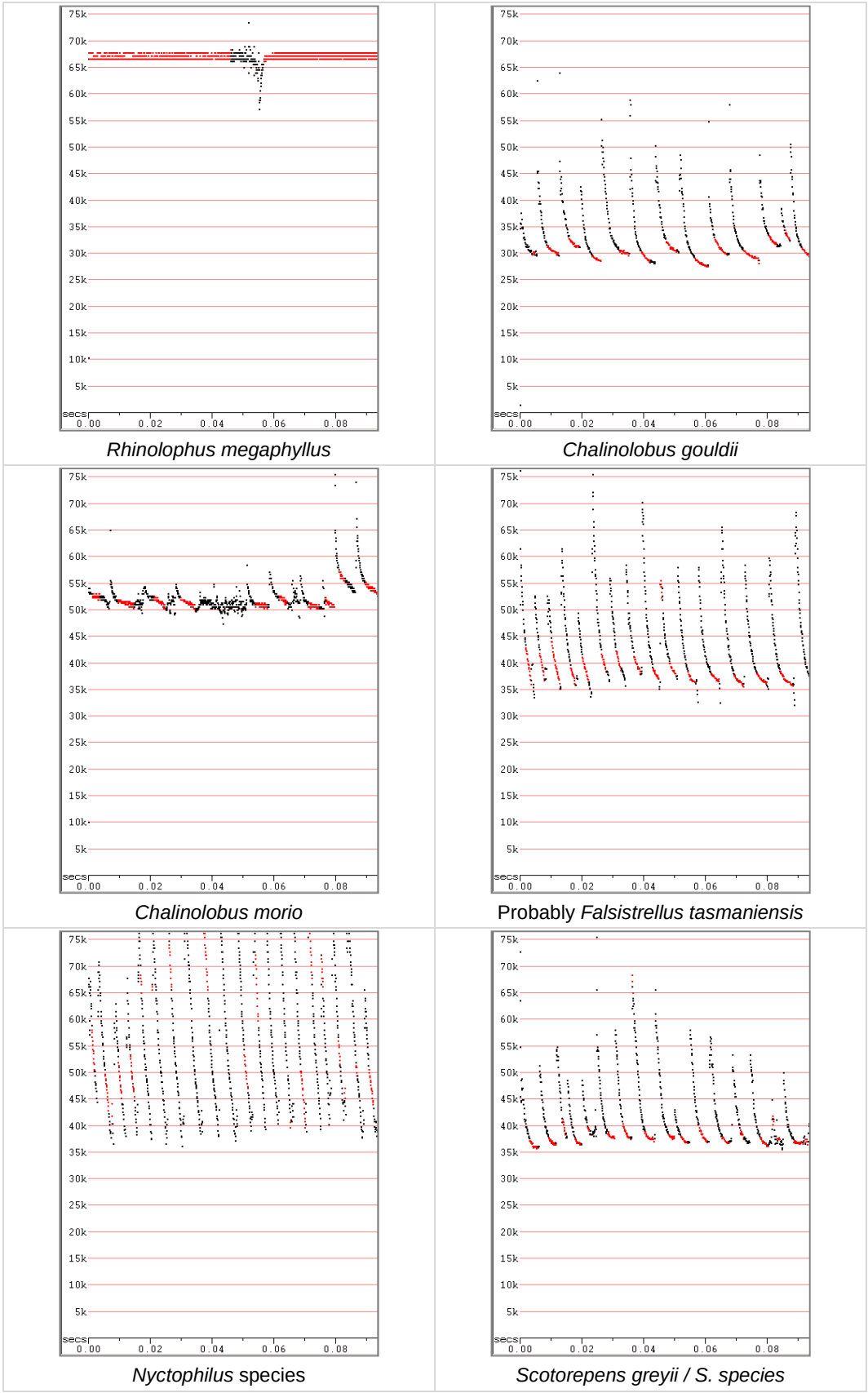


Figure 1 Representative call sequences from the bats recorded at Bolivia Hill, December 2012. (10msec per tick; time between pulses removed)

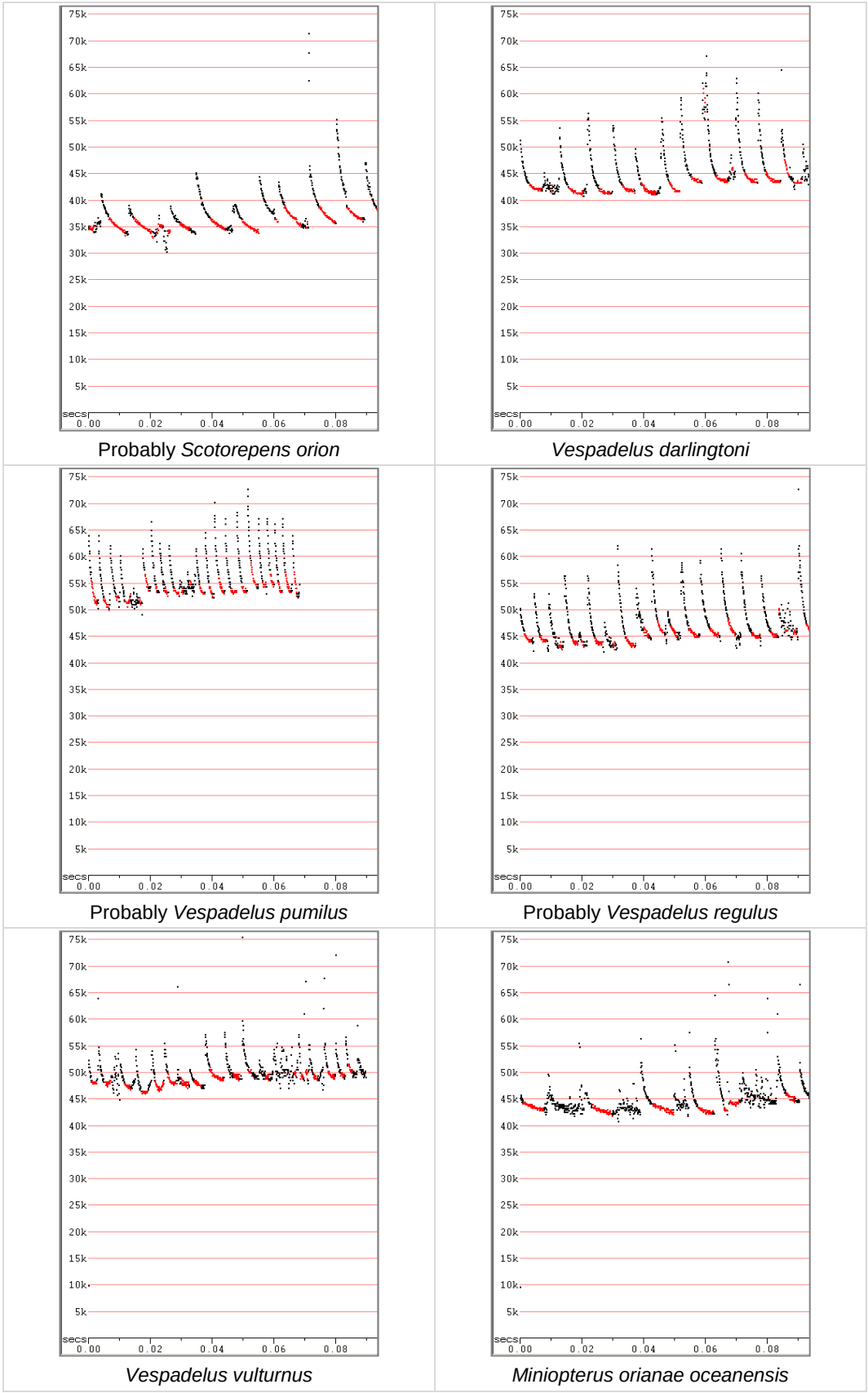
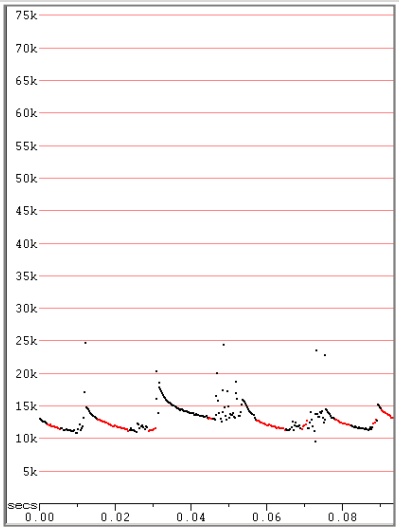
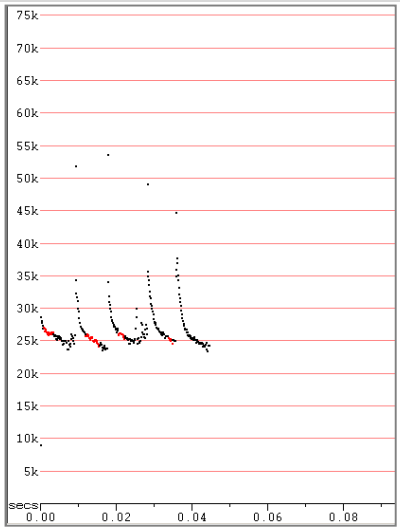


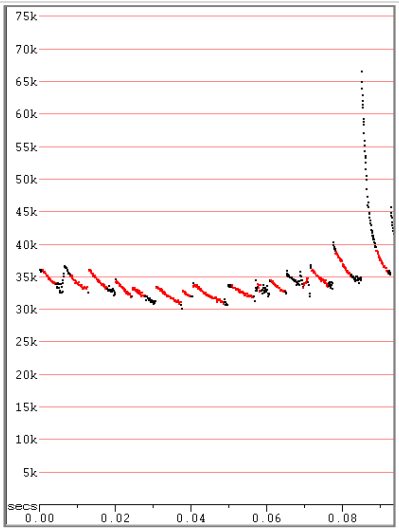
Figure 1 Representative call sequences from the bats recorded at Bolivia Hill, December 2012. (10msec per tick; time between pulses removed)



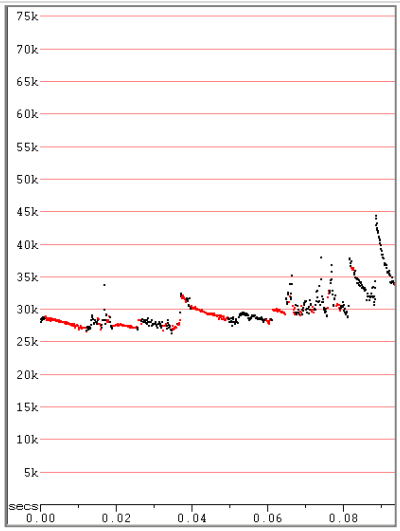
Austronomus australis



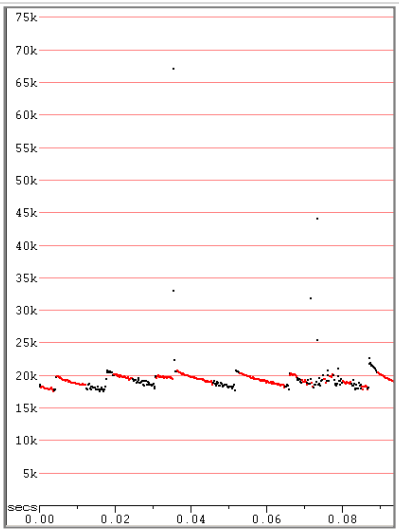
Possibly *Mormopterus beccarii*



Mormopterus ridei



Mormopterus sp. 4 or *M.* sp. 3



Saccolaimus flaviventris

Figure 1 Representative call sequences from the bats recorded at Bolivia Hill, December 2012. (10msec per tick; time between pulses removed)