

10.7 Flora and Fauna

RPS was engaged by Centennial Mandalong to undertake the assessment of the flora and fauna issues associated with the Mandalong Southern Extension Project. The Study Area adopted by RPS for this assessment comprised the Southern Extension Area and an additional area external to the Southern Extension Area covering the 26.5 degree of draw from the edge of proposed mine plan, totalling approximately 4,613 hectares. The remainder of the Project Application Area (to the north of the Study Area) was not assessed given that it comprises existing approved workings and infrastructure and there are no additional activities or disturbance proposed.

The scope of this flora and fauna assessment included:

- Identification and mapping of the vegetation communities;
- Assessment of the status of plant species and vegetation communities under relevant legislation;
- Identification of existing habitat types and assessment of the habitat potential for threatened species, populations and ecological communities known from the proximate area;
- Identification of threatened terrestrial and aquatic fauna and flora;
- Assessment of the potential for the Project to have a significant impact on any threatened species, populations or ecological communities identified during field surveys or as having potential habitat in the area; and
- Recommendations for measures to avoid, reduce or mitigate impacts on biodiversity.

RPS' assessment has been completed in accordance with the applicable legislative framework and guidelines, and to address the DGRs (see **Section 1.7.2**). A copy of the *Flora and Fauna Assessment* (RPS 2013a) is contained within **Appendix G**, with significant findings and recommendations summarised in the below sub-sections.

10.7.1 Methodology

Literature Review

A literature review was undertaken by RPS (2013a) to assist in identifying distributions, suitable habitat and known records of threatened specials to help guide the field survey program. This included a review of available aerial imagery to assist in mapping the vegetation within the Study Area, along with a review of previously prepared ecological assessments for nearby areas.

Field Survey

RPS (2013a) employed a variety of field survey techniques to detect a representative sample of flora species and fauna guilds across the Study Area. Particular attention was given to adhering to the working draft guideline titled *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities* (DECC 2004) (RPS 2013a). The flora surveys included a site inspection, flora quadrats, transects, vegetation community surveys and various fauna survey methods, including trapping, spotlighting, opportunistic sightings and habitat assessments. Targeted searches for threatened flora and fauna species were also undertaken.

Due to access limitations across the Study Area, certain areas could not be surveyed. In these instances the desktop literature review, including previous ecological assessments, were utilised by RPS (2013a).

Vegetation Mapping

A total of 55 quadrats (20 metres by 20 metres) and transects (greater than or equal to 100 metres) were undertaken throughout the Study Area. These quadrats and transects were stratified based on the *Lower Hunter and Central Coast Regional Environment Management Strategy* (NPWS 2003) (LHCCREMS) and Hunter Eco (2008 and 2009) vegetation mapping. Additional ground-truthing was undertaken during site transits throughout all of the flora survey methods.

Threatened Flora Survey

Targeted threatened flora surveys were undertaken throughout the Study Area during vegetation surveys and fauna surveys. Supplementary targeted flora surveys were undertaken over the Study Area between 28 November 2011 and 2 December 2011. Due to the greater potential for impact via direct removal, targeted threatened flora searches were also conducted across and adjacent to the proposed Mandalong South Surface Site on 17 September 2012, 26 to 30 November 2012 and 22 to 23 July 2013.

Targeted flora surveys were undertaken during the flowering period for cryptic flora species. RPS (2013a) advises that all other potential threatened species are non-cryptic or are easily identifiable outside of their flowering period.

Habitat Survey

An assessment of the relative flora and fauna habitat value present within the Study Area was undertaken. This focused primarily on the identification of specific habitat types and resources favoured by known threatened flora and fauna species in the region. The assessment also considered the potential value of the Study Area (and surrounds) for all major guilds of native flora and fauna.

Fauna Survey

Fauna surveys were undertaken over the following periods:

- 28 March to 1 April 2011;
- 4 to 8 April 2011;
- 11 to 15 April 2011;
- 2 to 7 May 2011;
- 9 to 13 May 2011;
- 14 to 15 September 2011; and
- 29 November to 2 December 2011.

Within each week of survey, two sites were selected in different habitats and trapping transects included terrestrial fauna and microchiropteran bats (microbats) trapping, microbat echolocation call recording, avifauna surveys, herpetofauna surveys, call playback, spotlighting, secondary indications (for example, scats, scratches and diggings) and incidental observations.

10.7.2 Vegetation Community Mapping

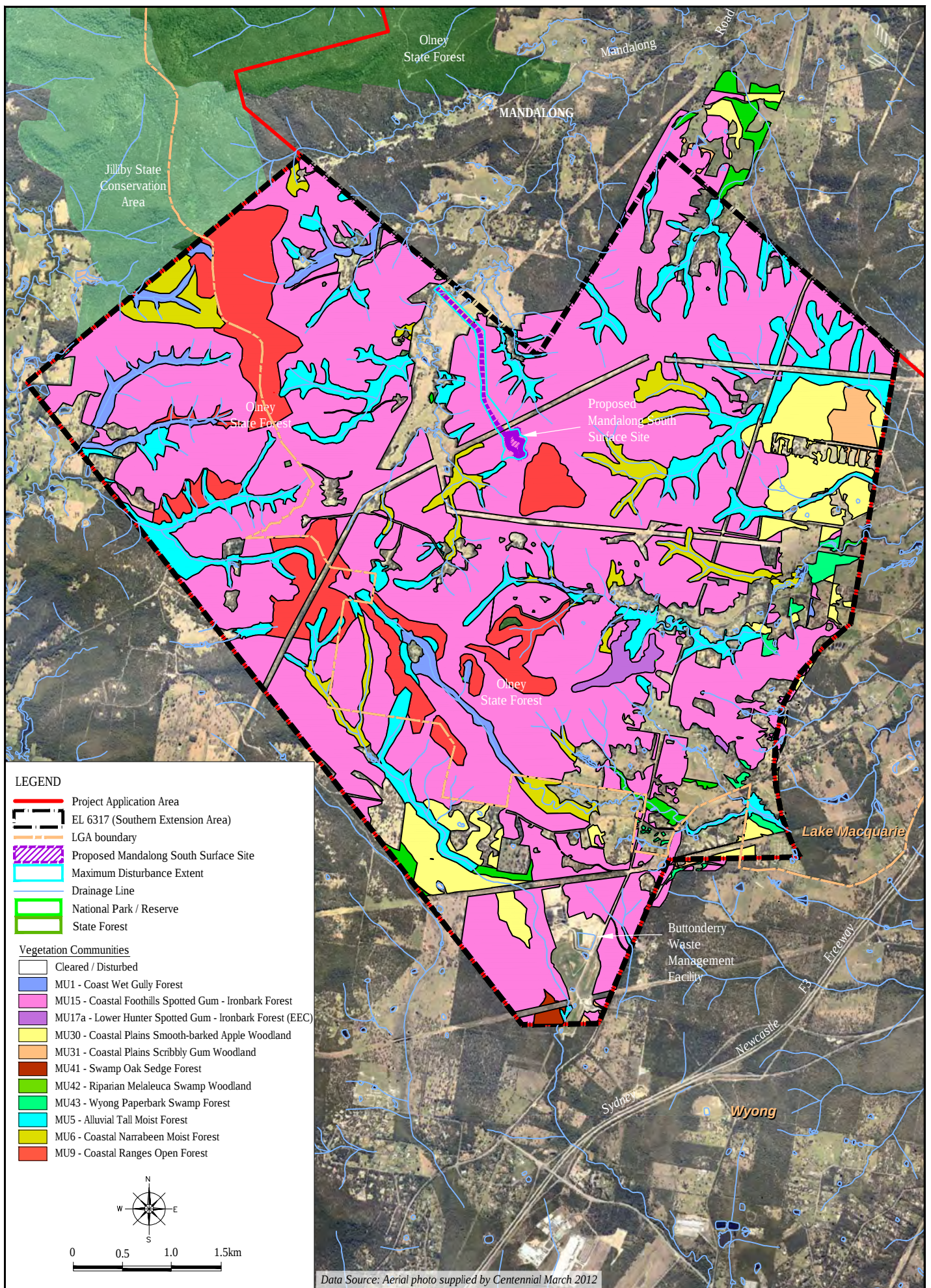
Vegetation surveys and ground-truthing by RPS (2013a) determined that existing mapping by Hunter Eco (2008 and 2009) and the *Lower Hunter and Central Coast Regional Environment Management Strategy* (LHCCREMS) (NPWS 2003) was relatively accurate. Some modifications were made by RPS (2013a) to the boundaries of communities in specific areas using the ground-truthed data and aerial photograph interpretation. In total, 11 native vegetation communities were mapped by RPS (2013a) within the Study Area, with a twelfth community (Cleared / Disturbed Lands) created to encompass areas with highly modified vegetation (including areas of easements and pasture).

Four of the native vegetation communities correspond with endangered ecological communities (EECs) listed under the TSC Act 1995. LHCCREMS (NPWS 2003) terminology for vegetation map units (MU) was adopted by RPS (2013a) to standardise the descriptions of the vegetation communities with respect to previous vegetation mapping in the area and ensure consistence with other Centennial projects. As listed in **Table 31** and illustrated on **Figure 42**, the vegetation communities mapped within the Southern Extension Area are outlined below.

Table 31 – Vegetation Communities within the Study Area

Vegetation Community Name	Analogous LHCCREMS Map Unit (MU)	Corresponding TSC Act EEC	Within Study Area (ha)	Within Surface Disturbance Area* (ha)
Coastal Wet Gully Forest	MU 1	<i>Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions</i>	73.3	0
Alluvial Tall Moist Forest	MU 5	-	379.6	0
Coastal Narrabeen Moist Forest	MU 6	-	154.7	0
Coast Ranges Open Forest	MU 9	-	317.8	0
Coastal Foothills Spotted Gum – Ironbark Forest	MU 15	-	2,495.6	15.6
Lower Hunter Spotted Gum - Ironbark Forest	MU 17a	<i>Lower Hunter Spotted Gum - Ironbark Forest in the Sydney Basin Bioregion</i>	21.5	0
Coastal Plains Smooth-barked Appled Woodland	MU 30	-	202.9	0
Coastal Plains Scribbly Gum Woodland	MU 31	-	26.6	0
Swamp Oak Sedge Forest	MU 41	<i>Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and Southeast Corner Bioregions</i>	5.2	0
Riparian Melaleuca Swamp Woodland	MU 42	<i>Swamp Sclerophyll Forest of the Floodplains of the North Coast, Sydney Basin and Southeast Corner Bioregion</i>	45.1	0
Wyong Paperbark Swamp Forest	MU 43	-	22.3	0
Cleared / Disturbed Land	-	-	868.8	4.4
Total Area			4613.4	20

* Proposed Mandalong South Surface Site and access road



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MU 1: Coastal Wet Gully Forest

This vegetation community is commensurate with the EEC known as *Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions* listed under the TSC Act 1995. It occurs in association with Byrons Gully Creek, which is a western tributary of Morans Creek, and is located to the south of Reynolds Road, Olney State Forest and several tributaries of Jilliby Creek in the southern and north-western portions of the Study Area. This vegetation consists of a tall and dense canopy layer with a dense mid layer composed of mostly mesic species and a ground layer comprised of mostly herbs and forbs with only a few grasses that are dependent on high moisture levels

MU 5: Alluvial Tall Moist Forest

This vegetation community occurs in association with Wyee Creek and several other creeks in the north-eastern portions of the Study Area. It consists of tall canopy trees with a mid layer of drier or sclerophyllous species and a grassy understorey.



Plate 18 – Alluvial Tall Moist Forest

MU 6: Coastal Narrabeen Moist Forest

This vegetation community occurs in association with Buttonderry Creek and several creeks in the north-western and eastern portions of the Study Area. The canopy is generally moderately tall with a mesic understorey dominated by warm temperate rainforest influences. The groundlayer is dominated by ferns with a few forbs, herbs and grasses.

MU 9: Coastal Ranges Open Forest

This vegetation community occurs on slopes in the central and western portions of the Study Area. It consists of large broad trees with a variable density shrub layer and a grassy ground layer.

MU 15: Coastal Foothills Spotted Gum - Ironbark Forest

This vegetation community covers the largest area within the Study Area and occurs extensively on the mid to upper slopes. A moderately tall straight tree canopy covered a variable density shrub layer and a mostly grassy groundlayer.



Plate 19 – Coastal Foothills Spotted Gum – Ironbark Forest

MU 17a: Lower Hunter Spotted Gum - Ironbark Forest

This vegetation community is commensurate with the EEC known as *Lower Hunter Spotted Gum-Ironbark Forest in the Sydney Basin Bioregion* listed under the TSC Act 1995. It occurs in two small areas in the south-eastern parts of the Study Area and consists of straight stemmed trees with a sparse to moderate density shrub layer.

MU 30: Coastal Plains Smooth-barked Apple Woodland

This vegetation community occurs within the southern and eastern most parts of the Study Area. It is a dry shrubby forest with a variable density within the tree and shrub layers. Sparser trees tend to favour a denser shrub layer and vice versa.

MU 31: Coastal Plains Scribbly Gum Woodland

This vegetation community occurs in a single area north of Dyce Road in the north-eastern parts of the Study Area. It is a low open woodland with sclerophyllous shrub layer dominated by Proteaceae.

MU 41: Swamp Oak Sedge Forest

This vegetation community is commensurate with the EEC known as *Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and Southeast Corner Bioregions* under the TSC Act 1995. The extent of this community (as mapped by NPWS 2000) could not be accessed during surveys, however it is possibly present to the south of Buttonderry Waste Management Facility in the south of the Study Area. This community occurs in low lying areas and riparian strips along the coastal plain and alluvial flats, usually in the lower reaches of drainage lines. Whilst this community was not ground-truthed by RPS (2013a), its entire extent occurs outside of the predicted subsidence zone and disturbance footprint for the proposed Mandalong South Surface Site and access road.

MU 42: Riparian Melaleuca Swamp Woodland

This vegetation community is commensurate with the EEC known as *Swamp Sclerophyll Forest of the Floodplains of the North Coast, Sydney Basin and Southeast Corner Bioregions* under the TSC Act 1995. It occurs on riparian flats between Toepfers Road and Woods Road and in association with Buttonderry Creek just north of the Buttonderry Waste Management Facility. This dense vegetation type is commonly found in deltaic floodplains, alluvial flats and drainage lines on the central coast lowlands.

MU 43: Wyong Paperbark Swamp Forest

This vegetation community occurs in association with poorly drained flats in the eastern portions of the Study Area. It can also be found on the swampy floodplains on quaternary sediments and Patonga Claystone of the coastal plain near Wyong, usually on lowland plains less than 25 metres in elevation. The distinctive feature of this community is the abundance of *Melaleuca nodosa* either forming a dense understorey or forming the principal canopy species.

Cleared / Disturbed Land

The community has been created to encompass areas with highly modified vegetation, including areas of easements and pasture.

All areas classified as cleared/disturbed lands are areas where the native tree and shrub cover has been mostly removed. In the case of pasture and paddock lands, these areas were dominated or co-dominated by a variety of introduced exotic or “pasture improvement” species. These areas retain less than three percent canopy cover (i.e. widely spaced isolated trees) and do not include areas of regrowth native vegetation.

RPS (2013a) provides the following examples of areas classified as cleared/disturbed lands within the Study Area:

- Regularly slashed electricity transmission or communication easements;
- Above or underground water, gas, sewer or petroleum pipelines;
- Roads, tracks, fire-trails and associated verges;
- Pastures/paddocks, often with a few remnant trees; and
- Residential and industrial infrastructure.

10.7.3 Threatened Flora and Fauna

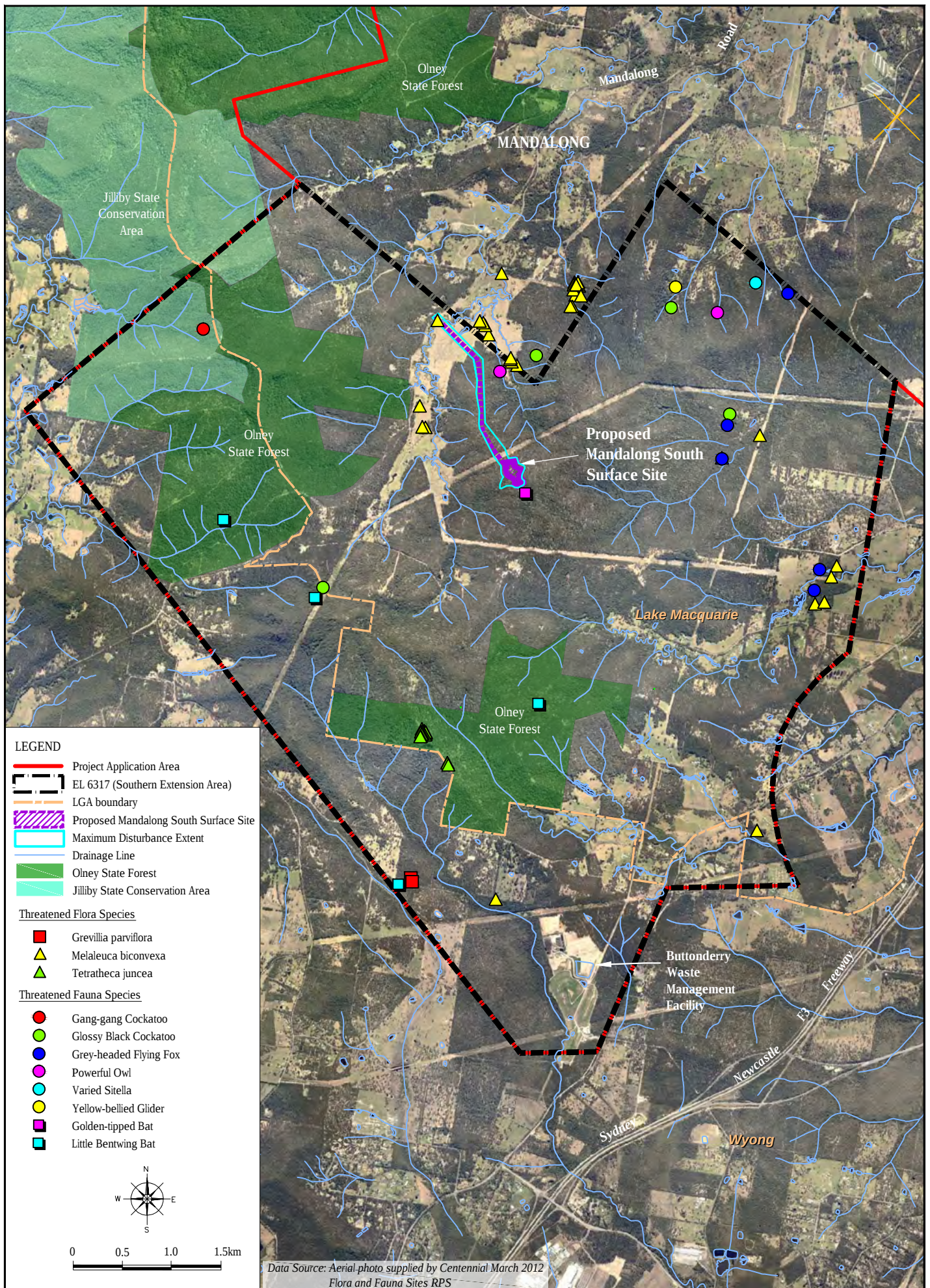
Threatened Flora

Three threatened flora species listed under the TSC Act 1995 and/or the EPBC Act 1999 as “vulnerable” (V) were detected within the Study Area by RPS (2013a) during targeted threatened species surveys or in the course of other vegetation mapping activities:

- Small-flower Grevillea (V) *Grevillea parviflora* subsp. *Parviflora*;
- Biconvex Paperbark (V) *Melaleuca biconvexa*; and
- Black-eyed Susan (V) *Tetratheca juncea*.

Figure 43 shows the locations of these threatened flora species detected by RPS (2013a) in the Southern Extension Area.

Eight individuals of *Grevillea parviflora* subsp. *parviflora* was detected by RPS (2013a) in one location in the south-west of the Study Area. This species was detected within areas mapped as MU 30: Coastal Plains Smooth-barked Apple Woodland, however the species location was also in close proximity to MU 42: Riparian Melaleuca Swamp Woodland. In addition, Centennial staff has noted that a large population of this species was found near the northern end of the Buttonderry Waste Management Facility, which prompted the abandonment of a proposed exploration borehole at this location.



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Within the Study Area 770 individual *Melaleuca biconvexa* trees were detected, with additional plants encountered to the north of the Study Area. The largest detected population (460 individuals) was identified within the east of the Study Area. Due to limited access to some areas, it is likely that not all individuals of this species were encountered and the local population is larger than that currently detected. The habitat preferences for these individuals were mostly within MU 5: Alluvial Tall Moist Forest or MU 43: Wyong Paperbark Swamp Forest.

Tetratheca juncea was detected by RPS (2013a) within several locations along the southern slope of Kiar Ridge Road within Olney State Forest. In excess of 100 clumps were observed at several locations along the road. This species is located on the southern aspects of the ridge within vegetation mapped as MU 15: Coastal Foothills Spotted Gum - Ironbark Forest.

Targeted surveys within dams, creeks and wetlands were undertaken by RPS (2013a) in attempts to detect *Maundia triglochinos*, particularly in proximity to the proposed Mandalong South Surface Site. While no *M. triglochinos* were detected within the survey area, this species is known to occur within wetlands within the bounds of the existing Mandalong Mine to the north. On this basis, RPS (2013a) advise there is potential for this species to occur in wetland habitats within the Study Area.

Targeted surveys during summer and winter did not detect the presence of threatened cryptic orchid species (RPS 2013a).

Threatened Fauna

A total of 134 fauna species were detected within the Study Area by RPS (2013a), including 10 terrestrial mammals, six arboreal mammals, eight confidently identified species of microchiropteran bats, 90 bird, five reptile and 14 frog species. Nine threatened fauna species listed under the TSC Act 1995 as “vulnerable” (V) and/or under the EPBC Act as vulnerable (V*) were detected:

- Glossy Black-Cockatoo (V) *Calyptorhynchus lathami*
- Gang-gang Cockatoo (V) *Callocephalon fimbriatum*
- Little Lorikeet (V) *Glossopsitta pusilla*
- Powerful Owl (V) *Ninox strenua*
- Varied Sittella (V) *Daphoenositta chrysoptera*
- Grey-headed Flying-fox (V, V*) *Pteropus poliocephalus*
- Yellow-bellied Glider (V) *Petaurus australis*
- Little Bentwing-bat (V) *Miniopterus australis*
- Golden-tipped Bat (V) *Phoniscus papuensis*

Figure 43 shows the locations of these threatened fauna species detected by RPS (2013a).

Anabat recordings also determined “possible” results for a further 10 microchiropteran bat species, with six of these species listed as “vulnerable” (V) under the TSC Act 1995 and/or “vulnerable” (V*) under the EPBC Act 1999:

- Large-eared Pied Bat (V, V*) *Chalinolobus dwyeri*
- Eastern False Pipistrelle (V) *Falsistrellus tasmaniensis*
- Eastern Bentwing-bat (V) *Miniopterus schreibersii oceanensis*
- Eastern Freetail-bat (V) *Mormopterus norfolkensis*
- Greater Broad-nosed Bat (V) *Scoteanax rueppellii*
- Eastern Cave Bat (V) *Vespadelus troughtoni*

Available Habitat

Habitats within the Study Area were found by RPS (2013a) to be in good condition, with intact vegetation structures, mixed aged stands supporting both older remnant trees with hollows and younger tree cohorts. Fallen timber and a dense groundcover provides suitable shelter for a wide range of terrestrial species, with hollow-bearing trees providing suitable breeding and roosting/denning habitat for threatened hollow obligates such as microbats and arboreal mammals (RPS 2013a).

The majority of the Study Area is mapped within the *Lake Macquarie Native Vegetation and Corridors Map* (LMCC 2009, cited in RPS 2013a), and provides a variety of internal habitat linkages along creeks, gullies and ridgelines. The Study Area has strong habitat linkages to the north-east through the Watagan Mountains and further into the Great Dividing Range. There is also some partial linkage between the highest parts of the Study Area and the shores of Lake Macquarie to the east, however these partial linkages are broken by corridor features such as the Sydney-Newcastle F3 Freeway and the Main Northern Railway Line (RPS 2013a). In general, linkages to adjacent habitats are limited to those to the north-west and north-east of the Study Area.

The cleared/developed lands occurring within the Study Area are considered to be of low value in terms of providing habitat for native fauna species aside from providing foraging habitat along the ecotone between cleared and forested areas (such as for hunting by microchiropteran bat species) (RPS 2013a).

10.7.4 Impact Assessment

The activities associated with the Project that have been identified by RPS (2013a) to represent a potential impact to flora and fauna are construction of the Mandalong South Surface Site, subsidence and the increased discharge of water (from the underground workings of Mandalong Mine) into Muddy Lake at the Cooranbong Entry Site via LDP001 (see **Section 10.6.3**).

RPS (2013a) concludes that the Project will not significantly impact upon occurring or potentially occurring threatened flora, fauna and/or ecological communities within the Study Area.

Mandalong South Surface Site

Based on the levels of subsidence predicted for the proposed mine plan, RPS (2013a) advises that the main flora and fauna impacts are expected to be caused from the clearance works required to establish the Mandalong South Surface Site and access road. The proposed layout and location of the surface site and access road have been selected in consideration of the existing surface environment, in particular trying to minimise the land area required to be cleared and disturbed and avoiding impact to detected threatened species and ecological communities.

Vegetation

The proposed Mandalong South Surface Site and access road encompass a total area of approximately 20 hectares. This disturbance assessment area is comprised of approximately 4.4 hectares of Cleared / Disturbed Land and 15.6 hectares of MU 15: Coastal Foothills Spotted Gum - Ironbark Forest, which is not commensurate with any threatened ecological community listed under the TSC Act 1995 or EPBC Act 1999 (RPS 2013a). MU 15 is very common and widespread in the locality, occupying approximately 2,502 hectares within the Study Area and approximately 21,094 hectares between Ourimbah and Beresfield (NPWS 2003, cited in RPS 2013a).

All individuals of detected threatened plant species (*Grevillea parviflora* subsp. *Parviflora*, *Melaleuca biconvexa* and *Tretratheca juncea*) were detected outside the proposed Mandalong South Surface Site disturbance footprint.

Habitat and Fauna

The surface infrastructure represents a relatively small impact on vegetation communities and potential habitat. As advised above, the proposed works will remove a proportionally small area of potential habitat within the wider context of the local native vegetation. The retention of the majority of the vegetation within the Study Area will ensure a diverse number of habitat resources associated with the various vegetation communities are retained.

The disturbance footprint for the proposed Mandalong South Surface Site will result in the removal of nine hollow-bearing trees. There is therefore breeding/roosting potential, albeit limited, for a range of hollow dependant fauna, including microbats, arboreal mammals, large forest owls and the Glossy Black-Cockatoo (RPS 2013a).

An increase in vehicles and machinery across the Study Area during construction may adversely increase the threat of injuries to wildlife through collisions.

Threatened Species

Approximately 142 specimens of *Melaleuca biconvexa* were observed by RPS (2013a) in the Morans Creek drainage line near the northern parts of the proposed access road to the Mandalong South Surface Site. Centennial Mandalong has committed to aligning the proposed access road in order to minimise disturbance and avoid removal of any *M. biconvexa* specimens. This will be achieved as part of the detailed design planning phase.

While targeted surveys within the dams and creek line covering the proposed disturbance area did not detect *M. triglochinos*, there is potential for this species to occur. Centennial Mandalong has committed to aligning the proposed access road to avoid all existing potential habitats for *M. triglochinos* and install appropriate sedimentation controls.

RPS (2013a) advises that the construction of the Mandalong South Surface Site and access road is not expected to significantly impact upon threatened species, populations or ecological communities listed under the TSC Act 1995 or EPBC Act 1999.

Subsidence

Surface Cracking

As detailed in **Section 9.5**, DGS (2013) predicts that occasional surface cracking may develop in the Southern Extension Area within the limits of the extracted longwall panels in relatively flat terrain. Cracks may also occur outside the high sides of longwall panels beneath the steep slopes (i.e. greater than 18 degrees) in the south-west of the proposed mine plan.

The main habitat types that are considered to be affected by surface cracking are those that are permanently or semi-permanently waterlogged, either by surface or groundwater influences (RPS 2013a). Based on the findings of the subsidence assessment (DGS 2013) that the creek beds of third and fourth order streams, which would contain these habitats, are very unlikely to develop cracks due to the “strain absorbing” properties of surface alluvium along these streams (RPS 2013a). Therefore, freshwater aquatic or swamp habitats are unlikely to be affected by surface cracking.

Temporary sub-surface runoff diversion may also occur if surface cracks develop and this may temporarily divert surface water from habitats. However, outside of the low lying wetter areas, the majority of habitats within the Study Area are naturally dry and free draining (RPS 2013a).

While cracking may cause changes to the characteristics of the landscape, particularly upon slopes, this would result in only minor modifications to habitats (RPS 2013a). Cracking may divert some surface water flows, however this would be localised. Given that the habitats within sloping areas are drier habitat types, those species reliant on them are unlikely to be significantly affected by minor changes in surface hydrology as a result of cracking (RPS 2013a).

Wetter habitat types, including groundwater dependent ecosystems within third, fourth or higher order streams, are unlikely to be affected by surface or sub-surface cracking, both in terms of water availability and quality (RPS 2013a). This is supported by the maintenance of both groundwater level and quality within previously mined areas of the Mandalong Mine. Therefore, any flora and fauna species that may be reliant on these habitat resources are unlikely to be affected by cracking caused by underground mining (RPS 2013a).

Ponding

As detailed in **Section 10.5**, Umwelt's (2013) assessment of the predicted subsided landform indicates negligible changes to remnant ponding, with a total increase in area of approximately 3.6 hectares (i.e. an increase of less than 2 percent). The analysis indicates that the small areas of increased remnant ponding will be largely confined to the existing flow paths/watercourses.

The impacts of longwall mining subsidence on wetlands has been monitored for the existing Mandalong Mine operations, using floristic diversity and abundance, water analysis and abiotic properties (Hunter Eco 2011, cited in RPS 2013a). The results indicate that despite the wetland being subjected to subsidence for at least 12 months there was no detectable impact when compared to control sites.

Several threatened flora species have been detected or are known to occur within areas that are permanently or semi-permanently waterlogged, such as along creeks or in damp low lying habitats. There is potential that the small areas of increased remnant ponding may alter habitats by expanding the areas of inundation or water logging. For those species that are within or on the edge of damp or waterlogged areas, increased ponding may increase the area of potential habitat outwards and reduce the area of drier habitat around the currently ponded areas (RPS 2013a).

Melaleuca biconvexa, which is listed as vulnerable under the TSC Act 1995 and EPBC Act 1999, was detected in several locations within the Study Area and has a high association with drainage lines and swamps and it could therefore potentially be impacted by ponding. The impacts of subsidence on *Melaleuca biconvexa* has been monitored in an area above the existing Mandalong Mine operations. Whilst the study found that the patch of *Melaleuca biconvexa* had increased in foliage area by about 6 percent, it was most likely due to increased rainfall and not because of increased ponding from subsidence (Hunter Eco 2011, cited in RPS 2013a). Similarly, if present within the extent of ponding, habitat available for the aquatic plant *Maundia triglochoides* may increase (RPS 2013a).

RPS (2013a) concludes that subsidence is expected to have a minor or temporary effect on ponding within the local watercourses and is not likely to significantly affect riparian vegetation, EECs or threatened species or their habitat.

Groundwater Dependent Ecosystems

The vegetation communities within the Study Area that are considered to have the potential to be influenced by groundwater flows and therefore may be considered as GDEs are:

- MU 5: Alluvial Tall Moist Forest;
- MU 6: Coastal Narrabeen Moist Forest;
- MU 41: Swamp Oak Sedge Forest (commensurate with the *Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and Southeast Corner Bioregions* EEC under the TSC Act 1995);
- MU 42: Riparian *Melaleuca* Scrub Woodland (commensurate with the *Swamp Sclerophyll Forest of the Floodplains of the North Coast, Sydney Basin and Southeast Corner Bioregions* EEC under the TSC Act 1995); and
- MU 43: Wyong Paperbark Swamp Forest.

There are no GDEs within the Study Area that are listed in Schedule 4 of the *Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources 2009* (GHD 2013a).

Based on the findings and conclusions of the groundwater impact assessment prepared by GHD (2013a) for the Project (see **Section 10.4**), RPS (2013a) concludes that the potential impacts on GDEs, as a result of subsidence effects (including changes to alluvial groundwater movements and/or water quality) are minor. The extents of these impacts are not expected to significantly alter the vegetation composition of the GDEs or their habitat value for flora and fauna species (RPS 2013a).

Discharge in to Muddy Lake

As outlined in **Sections 10.4.3** and **10.6.3**, over the proposed period of mining in the Southern Extension Area, the total groundwater inflow is predicted to increase from approximately 3 megalitres per day in 2018 to 5.9 megalitres per day in 2035-36. The additional groundwater inflow will be transferred to the Cooranbong Entry Site, which is part of the Northern Coal Logistics Project, and discharged via LDP001 into an unnamed waterway that flows in to Muddy Lake. The water balance results indicate that discharges from LDP001 will increase, on average, from the existing 1.59 megalitres per day to approximately 7.1 megalitres per day. This is proposed to be undertaken in a controlled and stable manner such that both the downstream environment will remain stable and any existing areas of erosion will not be promoted. The current LDP001 discharge is via a stilling pool that acts to dissipate the flow energy before being conveyed downstream of the site. The current discharge configuration will be maintained as part of the Project such that the increased flow energy of the increased discharge is mitigated.

The unnamed waterway is generally well vegetated and stable, with significant lengths consisting of a low capacity channel inset within “swampy” environments, allowing overbank flows to dissipate readily (RPS 2013a). Muddy Lake is an estuarine coastal lagoon/wetland connected to Lake Macquarie via an aqueduct over the Eraring Power Station Inlet Channel.

GHD (2013b) reports that the maximum increase in water level in Muddy Lake from zero LDP001 discharge to the existing peak LDP001 discharge is approximately 70 millimetres, and the maximum increase in water level from the existing LDP001 discharge to the proposed LDP001 discharge is approximately 30 millimetres. As Muddy Lake occurs within a relatively flat coastal plains landscape with a relatively low average channel gradient, an increase of water depth in millimetres will, in some places, potentially result in a lateral increase of metres (RPS 2013a).

RPS (2013a) advises that the increase in discharge will cause a modest change in the natural discharge regime through the upper reaches of the waterway and potentially a low level change further downstream. However, the waterway downstream of LDP001 is generally stable, well-vegetated and of relatively low gradient. This means that discharge flows will be of low energy and would be incapable of generating any significant geomorphic response, and no significant impact on the morphology of the waterway downstream of LDP001 is expected from increased discharge (RPS 2013a).

Estuarine coastal lagoon/wetland ecosystems are highly adaptive to variable water level conditions. Due to the extended duration of the predicted increased water levels there is likely to be a gradient shift within the aquatic and riparian vegetation communities as they adjust to the altered flow regimes predicted (RPS 2013a). The increase in water flow is not large enough to have any significant impact to the aquatic and riparian vegetation within the wetland environment of Muddy Lake (RPS 2013a).

10.7.5 Assessment of Significant Species/Communities

RPS (2013a) undertook an assessment of the likelihood of occurrence of threatened species and communities and an assessment of potential impacts. Threatened flora and fauna species (listed under the TSC Act 1995 and/or EPBC Act 1999) that have been gazetted and recorded within a 10 kilometre radius of the Study Area, along with EECs known from the broader areas, were considered by RPS (2013). This assessment included the following heads of consideration:

- **Species / Community / Population** – lists each threatened species/population/EEC known from the vicinity and, where relevant, their status under the TSC Act 1995 and EPBC Act 1999.
- **Habitat Description** – provides a brief account of the species/community/population and the preferred habitat attributes required for the existence/survival of each species/community.
- **Likelihood of Occurrence within the Study Area** – assesses the likelihood of each species/community to occur along or within the immediate vicinity of the Study Area in terms of the aforementioned habitat description and taking into account local habitat preferences, results of current field investigations, data gained from various sources (such as OEH Atlas of NSW Wildlife) and previously gained knowledge via fieldwork undertaken within other RPS ecological assessments in the locality.
- **Potential for Impact** – assesses the potential of each species/community/population to be impacted within the Study Area.

This assessment identified numerous species/communities deemed to require further detailed assessment via the application of the “7-part test” as described in the *Threatened Species Assessment Guideline – The Assessment of Significance* (DECC 2007) due to the potential levels of impacts likely to result from the Project. In addition, numerous species/communities required further detailed assessment via Assessments of Significance under the EPBC Act 1999.

The 7-part tests and EPBC Assessment of Significance conducted by RPS (2103) for threatened species/communities detected or considered likely to occur within the Study Area concluded that the Project will not have a significant impact on threatened species or ecological communities.

10.7.6 Key Threatening Processes

RPS (2103) identified and addressed 11 key threatening processes (KTPs), listed in schedule 3 of the TSC Act 1995, that have the potential to affect the Study Area as a consequence of the Project.

1. Alteration of the natural flow regimes of rivers, streams, floodplains and wetlands

The Project is likely to incrementally contribute to this KTP due to the expected level of subsidence along the watercourses within the Study Area. However, the level of subsidence is expected to alter stream flow and morphology by an insignificant amount.

2. Loss of hollow-bearing trees

The Project will require the removal of nine hollow-bearing trees and as such will contribute to this KTP.

3. Removal of dead wood and dead trees

The Project will require the removal of approximately 15.6 hectares of native vegetation, which includes dead trees or ground debris, and, as such, will contribute to this KTP in a small capacity.

4. Clearing of native vegetation

The Project will require the removal of approximately 15.6 hectares of native vegetation and, as such, is likely to incrementally contribute to this KTP on a small scale.

5. Invasion, establishment and spread of Lantana (*Lantana camara*)

The Project is unlikely to contribute to this KTP due to the small amount of surface vegetation proposed to be removed. However, some disturbed areas within the Study Area do contain *Lantana camara*. The Project will provide an opportunity to enact a weed control program to ameliorate this KTP.

6. Anthropogenic climate change

The Project will contribute to this KTP, however the contribution and impact is considered to be insignificant.

7. Degradation of native riparian vegetation along NSW watercourses

The Project is unlikely to incrementally contribute to this KTP given it involves relatively minor subsidence of vegetation along streams. It is considered that the Project is unlikely to result in a decline of groundwater dependent species.

8. Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae

The Project may increase the level of stress and lower resistance of some members of the family Myrtaceae due to slight alteration of their habitat within the Study Area. Exotic Rust Fungi may be introduced into the Study Area by increased movement of plant, vehicles and workers. The Project will provide an opportunity to enact an anti-contamination program for personnel and equipment to ameliorate this KTP.

9. Alteration of habitat following subsidence due to longwall mining

The Project is likely to incrementally contribute to this KTP, which may have an effect on a number of species and habitats, in particular GDEs.

10. Predation by feral cats

While feral cats occur in bushland areas in western Lake Macquarie, this Project is unlikely to contribute to an increase in the level of predation by feral cats, thus does not contribute to this KTP.

11. Invasion of native plant communities by exotic perennial grasses

The Project is unlikely to directly contribute to this KTP due to only a small area of surface vegetation proposed to be removed. However, some disturbed areas within the Study Area already contain exotic perennial grasses. The Project will provide an opportunity to enact a weed control program to ameliorate this KTP.

10.7.7 Other Legislative Considerations

SEPP No. 14 - Coastal Wetlands

Porters Creek Wetland is located over 2 kilometres south of the Study Area and is identified as a SEPP 14 wetland (No. 896a – Porters Creek). The major tributary of Porters Creek Wetland is Jilliby Jilliby Creek, which is fed (in part) from small intermittent streams that exit the south-western boundary of the Study Area, along with Buttonderry Creek which discharges into an ill-defined broad floodplain (currently occupied by an industrial development) to the north of Porters Creek Wetland.

Sedimentation of Porters Creek Wetland as a result of the Project is considered highly unlikely due to its location and the implementation of appropriate erosion and sediment controls during and after all surface remediation works. Furthermore, Porters Creek Wetland is well outside the predicted subsidence zone for the Project, being located over 4 kilometres south of the predicted subsidence zone. On this basis, RPS (2013a) concludes that the Project is not expected to impact upon Porters Creek Wetland.

SEPP No. 44 – Koala Habitat Protection

First Consideration – Is The Land “Potential Koala Habitat”?

SEPP No. 44 – Koala Habitat Protection (SEPP 44) defines “potential Koala habitat” as:

areas of native vegetation where the trees of the types listed in Schedule 2 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component.

Several of the Koala feed tree species listed within Schedule 2 of SEPP 44 are present within the Study Area. RPS (2013a) identifies these as *Eucalyptus haemastoma* (Scribbly Gum), *E. microcorys* (Tallowwood), *E. tereticornis* (Forest Red Gum), *E. robusta* (Swamp Mahogany) and *E. punctata* (Grey Gum). Five sub-sites within the Study Area were identified by RPS (2013a) to have densities of at least one of these feed tree species over 15 percent. On this basis, RPS (2013a) concludes that the Study Area does provide areas of “potential Koala habitat” as defined in SEPP 44.

Second Consideration – Is The Land “Core Koala Habitat”?

SEPP 44 defines “core Koala habitat” as:

an area of land with a resident population of Koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings of and historical records of a population.

RPS (2013a) did not make any observations of Koalas within the Study Area and concludes that the Study Area does not constitute “core Koala habitat” under SEPP 44 and no further provisions of the SEPP 44 need apply to the Project.

Considerations under the EPBC Act 1999

An assessment of whether the Mandalong Southern Extension Project may have a significant impact on any matters of National Environmental Significance (NES) or on the environment of Commonwealth land was undertaken by RPS (2103). RPS (2013a) concludes that the Project is not considered to constitute a significant impact to a matter of NES and referral to the SEWPaC is not considered warranted.

10.7.8 Mitigation and Management

As detailed in **Section 10.7.4**, the only ecological constraint to the mine layout is associated with those species reliant on surface water and groundwater within the surface watercourses. The proposed mine plan has been designed with varying longwall widths of between 160 metres and 200 metres to achieve manageable subsidence impacts to watercourses and avoid substantial changes to flows and ponding.

The consideration of the mine design in minimising impacts to watercourses subsequently mitigates potential impacts to those species reliant on the surface water and groundwater within the surface watercourses. Additionally, the orientation of longwalls sub-parallel to Wyee Creek and Mannering Creek will assist in minimising subsidence impacts that could impact on water-dependent species.

To minimise and manage impacts associated with the construction of the Mandalong South Surface Site and access road, the following commitments are made:

- Centennial Mandalong will aim to minimise the area of clearing within the disturbance footprint.
- Vehicles and machinery will travel through a wheel-wash when leaving the construction site to help prevent soil-borne disease (Phytophthora), pathogenic fungus (Myrtle Rust) transmission and weed seed dispersal.

- Erosion and sediment control measures and surface water management controls will be installed, in accordance with *Managing Urban Stormwater Soils and Construction (the Blue Book) Volume 1* (Landcom 2004) and *Volume 2C Unsealed Roads* (DECC 2008), and monitored and maintained to prevent erosion and sedimentation and runoff impact on adjacent areas.
- Vegetation to be removed will be clearly marked using temporary fencing (flagging tape or similar) to delineate boundaries and minimise the potential for equipment to accidentally enter areas to be retained.
- Vegetation adjacent to the disturbance footprint will be fenced (fauna friendly fencing) prior to construction activities to reduce damage from uncontrolled or accidental access.
- Material stockpiles will be established within already disturbed areas and not within areas of retained vegetation.
- Strict weed management, monitoring and control practices will be implemented to minimise the spread of exotic species.
- Revegetation of disturbed areas will be undertaken using locally occurring native plant species.
- Where possible, clearing activities will be timed to avoid removal of hollow-bearing trees during breeding season of threatened species.
- An ecologist will be present to supervise vegetation clearing and ensure vegetation clearing, particularly the removal of hollow-bearing trees, is undertaken in the following manner:
 - Hollow-bearing trees will be clearly marked (spray paint or flagging tape) by a qualified ecologist prior to any vegetation clearing commencing;
 - Non-habitat vegetation will be removed at least one day prior to felling of hollow-bearing trees to encourage resident fauna to self-relocate before felling of remaining habitat trees;
 - Immediately prior to the felling of hollow-bearing trees, trees will be given two sharp taps with the machinery arm/bucket to encourage fauna to escape. After waiting one to two minutes after tapping the tree, the hollow-bearing tree will be felled as gently as possible;
 - An ecologist will inspect each felled hollow-bearing tree (once safe) to recover any injured fauna and seek appropriate treatment and relocate uninjured fauna into vegetation to be retained immediately adjacent to the site; and
 - Felled timber will be left in place for one night after all other vegetation is removed to allow any remaining fauna to vacate hollows.

Exploration Drilling

As advised in **Section 4.14**, Centennial has developed an area-based assessment procedure for exploration activities to ensure that they are conducted in an environmentally responsible manner and with due consideration to the community. This includes a risk-based process for the selection, assessment and environmental management of proposed drill pad sites and access tracks based on environmental, geological, logistical and other operational constraints.

Due-diligence field inspections and targeted surveys of the proposed drill sites and associated access tracks will be undertaken by an appropriate qualified ecologist prior to commencement of works to ensure the potential for localised issues are minimised and, where necessary, appropriately managed. The drill sites and access tracks will be selected to avoid impacts to any threatened species or their habitat (for example, hollow-bearing trees). Upon completion of exploration activities, all boreholes and surface disturbance would be sealed and rehabilitated in accordance with the appropriate guidelines at the time.

10.7.9 Land Management Strategy

The Project proposes to clear approximately 15.6 hectares of MU 15: Coastal Foothills Spotted Gum - Ironbark Forest, which is not commensurate with any threatened ecological community listed under the TSC Act 1995 or EPBC Act 1999 (RPS 2013a). MU 15 is very common and widespread in the locality, occupying approximately 2,502 hectares within the Study Area and approximately 21,094 hectares between Ourimbah and Beresfield (NPWS 2003, cited in RPS 2013a). The proposed clearing, therefore, amounts to approximately 0.6 percent of the total available vegetation community within the immediate area and approximately 0.07 percent of the total available vegetation community within the region. None of the land proposed to be cleared contains threatened flora species or endangered ecological communities.

For these reasons, Centennial Mandalong is not proposing to provide a direct offset strategy. Rather, as a substantial landholder in the Mandalong Valley, Centennial Mandalong will develop a Land Management Plan for land owned by Centennial in the Valley. This plan will include the continuation of the following land management activities:

- Management of weeds and feral animals;
- Establishment and maintenance of suitable fencing for the exclusion of stock from riparian areas;
- Bushfire management;
- A rehabilitation program for riparian areas where an assessment has determined that rehabilitation activities will improve water quality in the creek systems;
- Provision of a nominal funding value towards research over the life of the Project into the habitat values of species likely to be impacted by the Project; and
- Provision of a nominal dollar amount for future maintenance of the land. This is to provide incentive to any future purchaser of the land to continue the land management activities.

Centennial Mandalong will report on the progress of works associated with the Land Management Plan annually in the Annual Review.