

Gales-Kingscliff Pty Ltd

ABN: 75 093 540 080

Cudgen Lakes Sand Extraction Project

Flora Assessment

Prepared by

Idyll Spaces

April, 2008

**Specialist
Consultant
Studies
Compendium**

Part 4

Gales-Kingscliff Pty Ltd

ABN: 75 093 540 080

Cudgen Lakes Sand Extraction Project

Flora Assessment

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April 2008

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FOREWORD

This report is the final of the flora report for the Cudgen Lakes Sand Extraction Project, and should be read in conjunction with the fauna report prepared by Keith Kendall of Kendall & Kendall Ecological Consultants (Part 5 of the *Specialist Consultant Studies Compendium*).

The author is G.N. Elks (Scientific Licence No. S10421), Principal Botanist and Ecologist, Idyll Spaces Consultants, whose qualifications are B.Sc (Botany), M.Litt (Ecology), MECA.

The information presented in this report is, in the opinion of the author, a true and accurate record based on objective studies undertaken in response to briefs provided by the client. Except as noted in the 'Limitations' section of this report, field survey work was carried out in accordance with draft guidelines issued by the DECC. Data from this survey has been supplied to DECC for their Atlas of NSW Wildlife database.

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EXECUTIVE SUMMARY

A flora survey undertaken by G. Elks (BSc, MLitt) utilised random meander searches to target threatened flora, and systematic stratified sampling and 21x0.04ha rectangular survey plots to collect structural and full floristic data in July, August and November 2003 and May 2005. There was no indication that seasonal conditions limited the effectiveness of the survey.

The Study Area was chosen to include all stands of native vegetation in and proximal to the Project Site and includes mature stands of groundwater dependent vegetation communities. Ten vegetation communities were mapped and described in the Study Area. Exotic grassland is the most extensive community, and there are smaller areas of swamp forest.

The land within the extraction sites and processing area is vegetated by exotic grassland, with occasional relict trees and a hierarchy of surface drains. The land within the proposed northern pipeline corridor forms part of the road reserve for Tweed Coast Road, and is vegetated by mowed exotic grassland with occasional relict trees. The land within the proposed eastern pipeline corridor currently consists primarily of Swamp Paperbark forest. The Swamp Paperbark forest within the proposed eastern pipeline corridor has been drained and repeatedly cleared and currently consists of regrowth only.

No Threatened flora species have been detected by surveys in the Study Area. Habitat requirements for the Threatened flora species *Drynaria rigidula*, *Geodorum densiflorum* and *Oldenlandia galioides*, listed as Endangered under the *Threatened Species Conservation Act 1995* (TSC Act), may be met in the Study Area but their occurrence is considered unlikely due to habitat modification.

Swamp Sclerophyll Forest on Coastal Floodplain and Swamp Oak Floodplain Forest, listed as Endangered Ecological Communities under the TSC Act, were assumed to occur in the Study Area. These communities are groundwater dependent.

No Endangered Populations or Critical Habitat are listed for the Study Area under the TSC Act or the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

The Project minimises the need for clearance of native vegetation by locating the preferred pipeline corridors in areas where native vegetation can be avoided. To further minimise clearance of native vegetation, this report recommends that vegetation to be retained is clearly defined and marked for retention prior to the commencement of site establishment activities.

The Project minimises opportunities for erosion and weed invasion by progressive rehabilitation to maximise cover of native vegetation. To further mitigate impacts of the Project, this report also recommends that noxious weeds be controlled within the Project Site, and that progressive rehabilitation and landscaping utilises local native plant species that provide forage opportunities for nectarivorous and frugivorous birds and bats.

Should the Project be conducted as proposed and the suggested recommendations implemented, it is expected that the Project would maintain or improve biodiversity outcomes, and in particular, the Project would not reduce the long-term viability of a local population of any species, population or ecological community, accelerate the extinction of any species, population or ecological community or place it at risk of extinction, or adversely affect critical habitat.

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1 BACKGROUND

1.1 Project Site and Study Area

The Project Site covers an area of 67ha which includes:

- a 9ha extraction site north of Altona Drive ('northern extraction site');
- a 37ha extraction site south of Altona Drive ('southern extraction site'); and
- a processing area north of Altona Drive covering an area of 3.7ha.

Figure 1 shows the location of the Project Site and Study Area while **Figure 2** shows the layout of the Project Site.

Two pipeline corridors are also proposed extending north and east from the southern extraction site (see **Figure 2**). These are referred to as the "northern pipeline corridor" (0.8km in length) and the "eastern pipeline corridor" (1.5km in length). The proposed northern pipeline corridor would be located in the road reserve on the western side of Tweed Coast Road. The proposed eastern pipeline corridor would be located within the road reserve for a proposed subdivision road within land owned by the Proponent. It is acknowledged that the proposed road has not yet been approved. Therefore, an alternative eastern pipeline corridor (see **Figure 2**) has been proposed in the event that the proposed road is not approved within a suitable timeframe. An alternative northern pipeline has also been proposed in the event that suitable agreements are reached with an adjoining landholder.

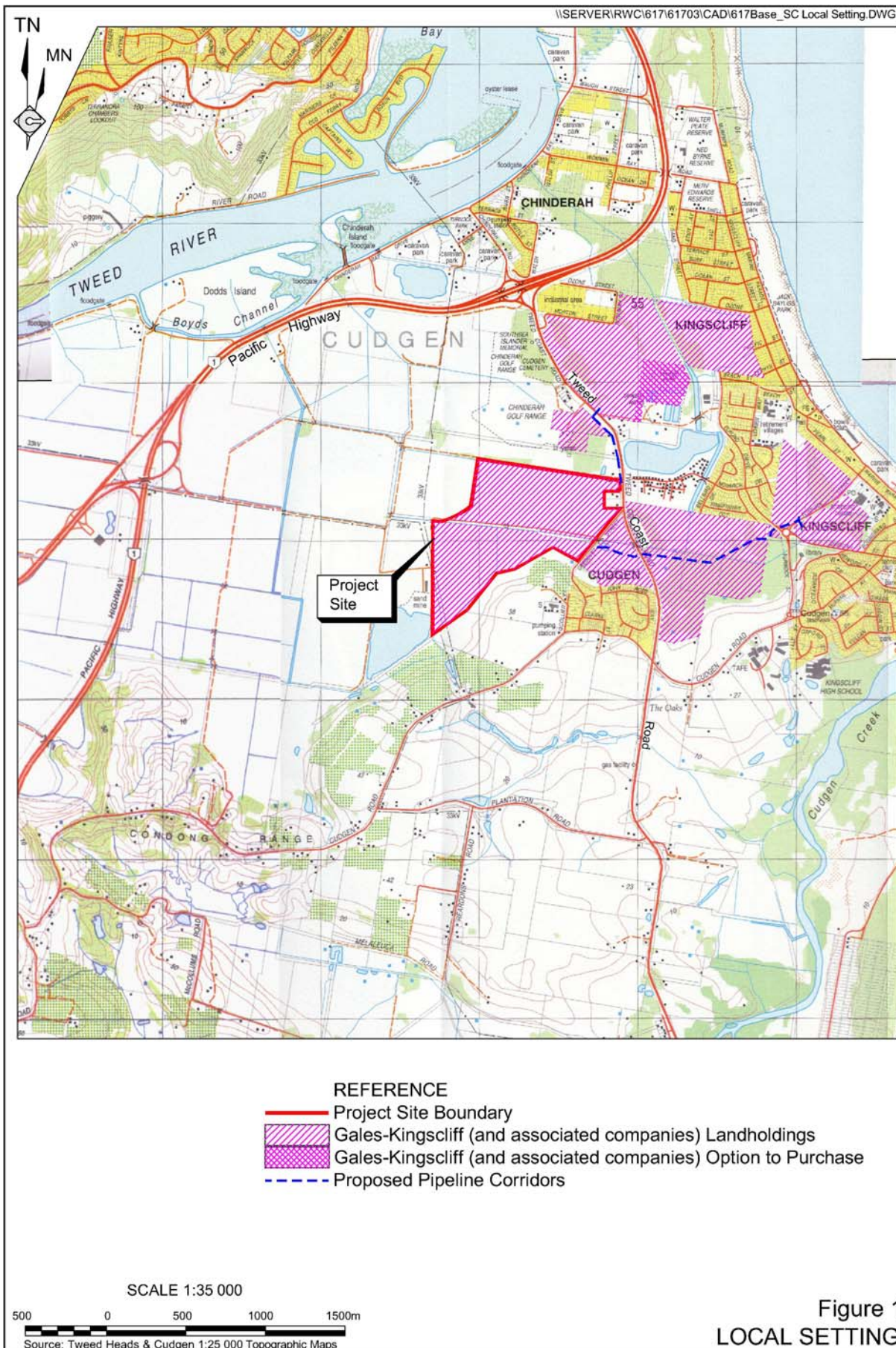
The extraction sites and processing area are located within Lot 21 DP 1082482 and Lot 2 DP 216705 together with the existing road reserve for Altona Drive. The proposed northern pipeline corridor which commences adjacent to the northeastern boundary of Lot 21 DP 1082482, is aligned for a distance of approximately 450m adjacent to the western side of Tweed Coast Road and then crosses Tweed Coast Road ending on the boundary of Lot 1 DP 1075645. The proposed eastern pipeline corridor commences adjacent to the eastern boundary of Lot 21 DP 1082482, crosses Tweed Coast Road and traverses Lots 1 and 3 DP 828298, Lot 26C and 26D DP 10715, Lot 11 DP 871753 and the road reserve situated between Lot 26D DP 10715 and Lot 11 DP 871753 before crossing Elrond Drive and Turnock Street.

The Project Site and Pipeline corridors are located within the County of Rous and the Tweed Local Government Area.

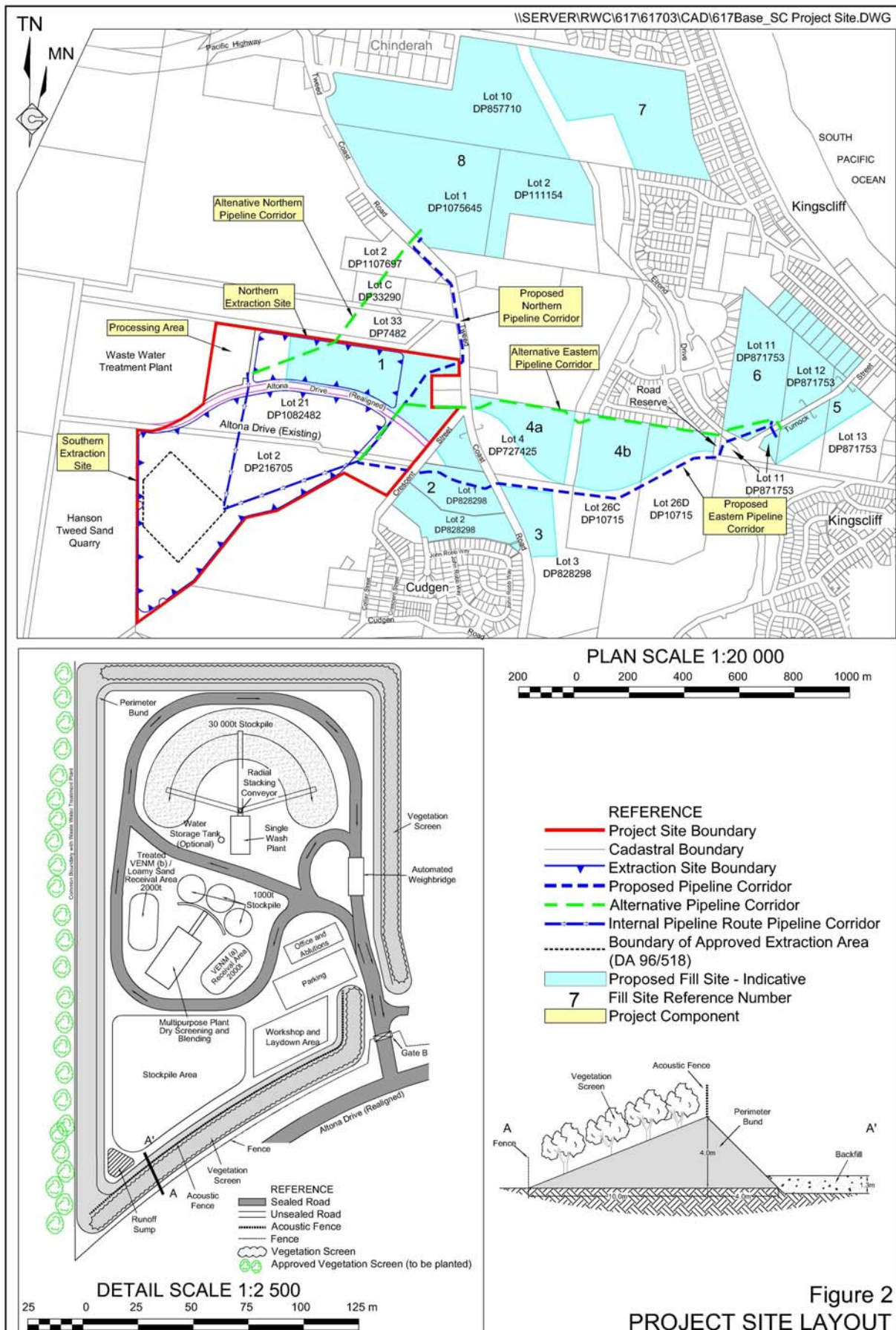
The land within the Project Site was previously used as a wet grazing block until 1964 when the land was partially drained and developed as a tropical grass and legume seed nursery. In 1973, the land was developed as a cane farm. Cane farming ceased in 1984 and since that time the land has been used for grazing of cattle (see HMC 2008 – Part 3 of the *Specialist Consultant Studies Compendium*).

Currently, the Project Site is vegetated by exotic grassland, with occasional relict trees and a hierarchy of surface drains. Stands of Swamp Oak forest occur on the adjoining property to the north.

The land within the proposed northern pipeline corridor forms part of the road reserve for Tweed Coast Road, and is vegetated by mowed exotic grassland with occasional relict trees.



Note: A colour version of this figure is available on the Project CD.



Note: A colour version of this figure is available on the Project CD.

Land within the alternative northern pipeline corridor is exotic grassland, similar to that within the Project Site.

The land within the proposed eastern pipeline corridor currently consists primarily of Swamp Paperbark forest, however, the corridor lies within the road reserve for a proposed road. The alternative eastern pipeline corridor consists of cleared land with patches of Swamp Paperbark forest.

Inspection of aerial photographs from 1949 onwards indicates that native vegetation in the areas surrounding the pipeline corridors has been repeatedly cleared (G. Elks pers. obs.). Current forest vegetation consists of regrowth only. This area has also been drained but its previous uses are unknown.

The Study Area occupies an area of approximately 116ha and was chosen to include all stands of native vegetation in and proximal to the Project Site (**Figure 4**), including mature stands of groundwater dependent vegetation communities.

In this report, Region refers to the North Coast Botanical Subdivision or Bioregion, and Locality refers to those areas within a 10km radius of the Study Area (**Figure 3**).

1.2 Description of the Project

The Proponent proposes to develop and operate a sand extraction operation to supply fill sand to a number of nominated fill sites via two pipeline corridors and to produce a range of sand products for sale to the local construction industry. The Project would also be appropriately licensed to accept virgin excavated natural material (VENM) which would be used in production of saleable sand products, used to backfill the northern extraction pond or interned at the base of the southern extraction pond. The Project would involve the removal of approximately 5 000 000m³ of sand over a period of 15 to 20 years.

The operation has been designed to optimise the recovery of sand whilst at the same time addressing and managing the environmental constraints within and surrounding the Project Site. As the Project proceeds, the northern extraction pond would be progressively backfilled to ultimately form sporting fields and recreational facilities and finalised sections of the southern extraction pond would be progressively rehabilitated in order to form a recreational lake and surrounding parklands.

Construction and site establishment would occur over an approximately 3 month period in which three site entrances and internal roads would be constructed together with the processing plants, offices, workshop and perimeter bunding. The dredge, pipelines to the processing area, pumps and other equipment would also be installed during the construction period. Construction activities would occur between 7:00am and 6:00pm Monday to Friday and 7:00am to 1:00pm Saturday.

The extraction sequence would involve: stripping of topsoil; formation of bunds; and extraction of the sand resource (loamy sand and fine grained sand). Extraction of all material within the northern extraction site would be undertaken over four stages progressing east to west to a depth of approximately 5m using excavator and trucks.

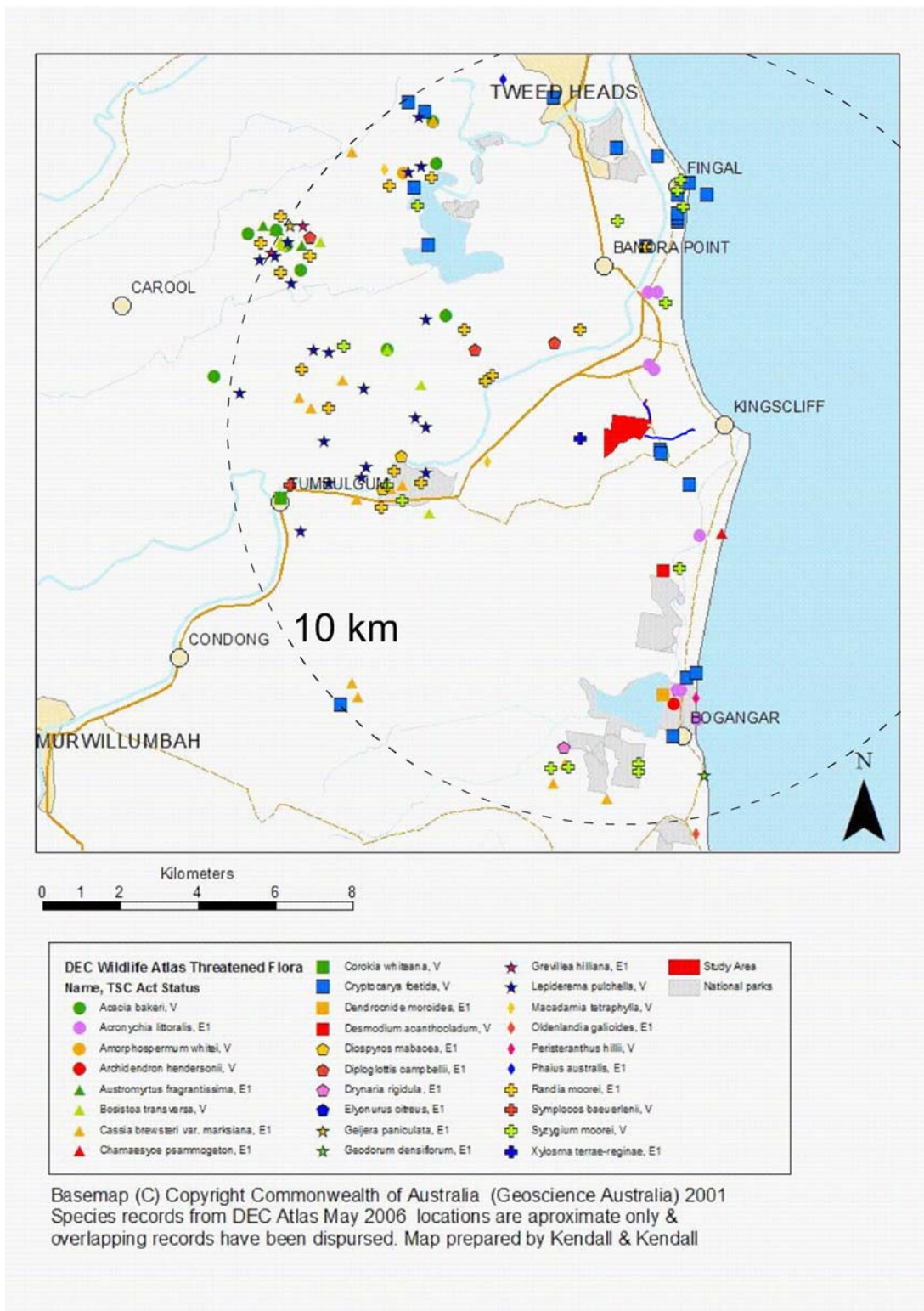


Figure 3
Threatened Flora Records within 10km of the Study Area

Within the southern extraction site, extraction would occur over 10 stages, generally progressing west to east. Extraction would occur to the depth of the resource, typically 20m below current ground level with the upper loamy sand material extracted using an excavator and the remaining fine grained sand material extracted using a cutter-suction dredge.

The upper loamy sand material would be treated using alkaline amendments, such as agricultural lime, prior to being transferred to the processing area for production of various construction materials, such as mortar sand. The fine grained sand material would either be trucked or pumped to the processing area and washed to remove oversize and undersize materials, producing construction grade sand, or be pumped to a nominated fill site for use as fill material. All fines separated during processing or returned from the fill sites would be returned to the base of either the northern or southern extraction pond.

All soil removal and excavation of sand (ie. mechanical removal) would occur between 7:00am and 6:00pm Monday to Friday and 7:00am to 1:00pm Saturday. Dredging and pumping of sand to the processing area, and processing activities, would occur between 6:30am and 10:00pm Monday to Friday and 7:00am to 4:00pm Saturday whilst dredging of sand for pumping to fill sites would occur between 6:30am and 6:30pm Monday to Friday and 7:00am to 1:00pm Saturday.

Sand to be used as a filling material to raise the level of various parcels of land in the Kingscliff, Chinderah and Cudgen areas would be pumped hydraulically to the fill sites from the southern extraction site as a sand / water slurry. Water draining from the sand at the fill sites would be pumped back to the southern extraction pond. The Proponent intends to use up to two enclosed staging pumps beyond the dredge to convey the sand to the fill sites, one located within the Project Site and one within each pipeline corridor. Pumping would only occur along one corridor at a time. Up to 450 000m³ of sand could be pumped annually to the fill sites.

Based on maximum annual sales of 300 000tpa the average number of product truck movements on any weekday or Saturday would be approximately 100 and 60 respectively (50 and 30 loads). As sales would vary from day to day, the 85th percentile number of product truck movements on the local roads on a busy weekday or Saturday would be 130 and 80 respectively (65 and 40 loads). Based on the importation and receipt of up to 45 000tpa of VENM, it is estimated that the incoming VENM would generate approximately 24 truck movements (12 loads) per week. The 85th percentile volume has been estimated at 32 truck movements (16 loads) per day.

In total, it is assumed, once the Project is fully operational, the despatch of products and importation of VENM would generate up to 124 truck movements (62 loads) per day on an average day. All product distribution and VENM receipt would occur between 7:00am to 6:00pm Monday to Friday and 7:00am to 1:00pm Saturday.

Both non acid generating VENM - VENM(a) and acid producing VENM – VENM(b) would be received at the Project Site via road trucks, appropriate details recorded and the material classification verified. VENM(a) would either: be processed to produce saleable products or used to backfill the northern extraction pond or finalised edges of the southern extraction pond. VENM(b) which is suitable for processing would be placed adjacent to the southern extraction pond for treatment, as for the loamy sand material, prior to processing. VENM(b) not suitable for processing would be either used to backfill the northern extraction pond or interned at the base of finalised sections of the southern extraction pond.

All VENM delivered to the Project Site and processed materials despatched from the processing area would be transported via Altona Drive, Crescent Street and Tweed Coast Road. Access to the Project Site would be provided via three entrances off Altona Drive, one to the processing area and northern extraction site and two to the southern extraction site.

The Proponent would adopt a progressive approach to site landscaping and rehabilitation to ensure that, wherever possible, disturbed areas are either temporarily or permanently stabilised to limit erosion and adverse visual impacts. An important component of the rehabilitation of the Project Site would be the progressive backfilling of selected finalised sections of the shore of the southern extraction pond and introduction of native vegetation to create wetland areas and parklands. The construction of recreational facilities such as walking and equestrian / cycling tracks would occur following completion of sand extraction activities. The final lake would have a depth of up to 20m and cover an area of approximately 37ha.

1.3 Previous Studies

Previous flora assessments have been undertaken by Ecograph of the western part of Lot 2 DP 611021 (now Lot 20 & 21 DP 1082482) for the Kingscliff Wastewater Treatment Plant Environmental Impact Statement (EIS) (GHD 2002); and Lot 2 DP 216705 by Austeco (2003) for a proposed sand extraction operation.

To the east of Tweed Coast Road, Planit (2002) undertook quantitative vegetation surveys of the Proponent's landholdings within broad vegetation communities during 450 man hours of traverses, plot surveys, and random meanders over a 3 year period. Subsequently, a comprehensive and systematic flora study of those landholdings was undertaken by Elks and Smith (2004). Previous flora assessments for proposed developments east of Tweed Coast Road have also been undertaken by Idyll Spaces (2004, 2005).

1.4 Records of Threatened Flora Species, Populations, Communities or Habitat

Records of threatened flora species, populations or communities known to occur within 10km of the Study Area were obtained under licence and extracted from the New South Wales Department of Environment and Climate Change (DECC) Wildlife Atlas database for the Tweed Heads and Murwillumbah 1:100,000 map sheets (DECC, 15 February 2006). These records are shown in **Figure 3**.

Records of Endangered Ecological Communities (EEC's) listed as occurring in the Murwillumbah (Qld – Southeast Hills and Ranges) subregion of the Northern Rivers Catchment Management Authority region were down loaded from the DECC Threatened Species website (http://threatenedspecies.environment.nsw.gov.au/tsprofile/cma_subregion).

A list of threatened plant species, communities or species habitat predicted to occur in the Study Area were obtained from the Environment Australia Protected Matter Search Tool (<http://www.ea.gov.au/erin/ert/epbc/index.html>).

Current schedules of the NSW *Threatened Species Conservation Act 1995* (TSC Act) and the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), the existence of any relevant threatened species recovery or threat abatement plans, and preliminary determinations, were reviewed online (<http://www.nationalparks.nsw.gov.au/npws.nsf/Content/Threatened+Species>, and <http://www.deh.gov.au/biodiversity/threatened/index.html>, 2 June 2006, and 22 February 2008).

1.5 Field Surveys

Survey of Lot 21 DP 1082482, the proposed northern pipeline corridor and the alternative eastern pipeline corridor was undertaken over 8 hours on May 9 and 10, 2005. Survey of Lot 2 DP 216705 was undertaken over two hours on November 14, 2003, and survey of land east of Tweed Coast Road was undertaken between July 29 and August 2, 2003.

A total of 21 0.04ha rectangular survey plots located in the Study Area were used to collect structural and full floristic data. Site locations are shown in **Appendix 1**. Plot selection utilised systematic sampling stratified according by vegetation community, as other biophysical attributes of the Study Area were apparently uniform. Plots were selected to sample all native vegetation communities, replicated according to area (DECC, 2004), and the widest geographic spread of exotic communities. Final placement of plots in the field was according to a 25m GPS grid.

Random meander searches targeting plant species of conservation significance were undertaken travelling between plots, along drains, and along the pipeline corridor routes.

1.6 Limitations of this Study

Field surveys were undertaken in late spring, autumn and winter. There was no indication that seasonal conditions limited the effectiveness of the survey. However, during the spring visit, much of Lot 2 DP 216705 was heavily grazed, and during the autumn visit, much of Lot 21 DP 1082482 had been recently slashed, and it is possible that some non-woody plant species were not detected.

As stands of swamp forest vegetation occurring on the adjoining property to the north of the Project Site could not be entered during field studies in May 2005, they were inspected from the boundary fence using binoculars to collect structural data and identify plant species occurring there.

As cover-abundance data was only collected for vegetation dominated by native flora, floristic data presented in the appendices to this report is presence/absence only.

Community 8 in the Study Area was not sampled directly. Rather, data from a previous study for the same map community adjoining the Study Area (Elks & Smith 2004) was utilised.

In accordance with DECC Threatened Species Assessment Guidelines, where there is uncertainty about the presence of a particular Threatened species within the Project Site due to conditions during the survey it has been assumed that, where suitable habitat has been identified, the species is present. The above limitations are therefore not considered likely to compromise the assessment.

2 DESCRIPTION OF VEGETATION COMMUNITIES

2.1 Community 1: *Casuarina glauca* Woodland

2.1.1 Species Composition

Stands of swamp oak *Casuarina glauca* are the dominant species in this community, with other tree species limited to occasional Blackwood Wattle *Acacia melanoxylon*.

Mile-a-minute *Ipomoea cairica* is the only midstratum species and occurs as a climber on trees. The native sedge *Schoenoplectus validus* is the dominant ground layer species in flooded drains, and mats of *Bacopa monniera* occur on exposed mud. Higher land is dominated by exotic pasture grasses.

2.1.2 Structure

This community consists of sparse small stands of trees, or isolated trees, to 12m tall and 30cm diameter, with a sparse to mid-dense ground layer of exotic grasses.

2.1.3 Ecology Disturbance and Dynamics

This relict community occurs as a narrow strip on wet soils on the banks and in shallower waters of the major drain currently running east-west parallel with Altona Drive in the central part of the Project Site, and as several small patches in roadside table drains in the pipeline corridor. It is understood that a portion of this community has been removed by Tweed Shire Council during the widening of the existing Altona Drive to improve safe access during the construction of the new Kingscliff Waste Water Treatment Plant.

Swamp oak often reproduces by means of root suckers, which enables it to form stands in the absence of suitable conditions for seedling reproduction. It is also more tolerant of saline groundwater than other tree species of swamp forests.

Many of the ground layer species in this community also survive disturbance such as grazing by means of asexual reproduction, and are also tolerant of inundation and saline water.

2.1.4 Conservation Status

No Threatened species were detected in Community 1 in the Study Area or are considered likely to occur there.

This community represents a seriously disturbed, isolated and depauperate stand of *Casuarina glauca*. It is categorised as a relict of Forest Ecosystem (FE) 143 (NPWS 2002), a community regarded as Vulnerable in northeastern NSW (RACD 1999), and may fall within the broad definition of Swamp Oak Floodplain Forest, listed as an Endangered Ecological Community under the TSC Act (Scientific Committee 17/12/04).

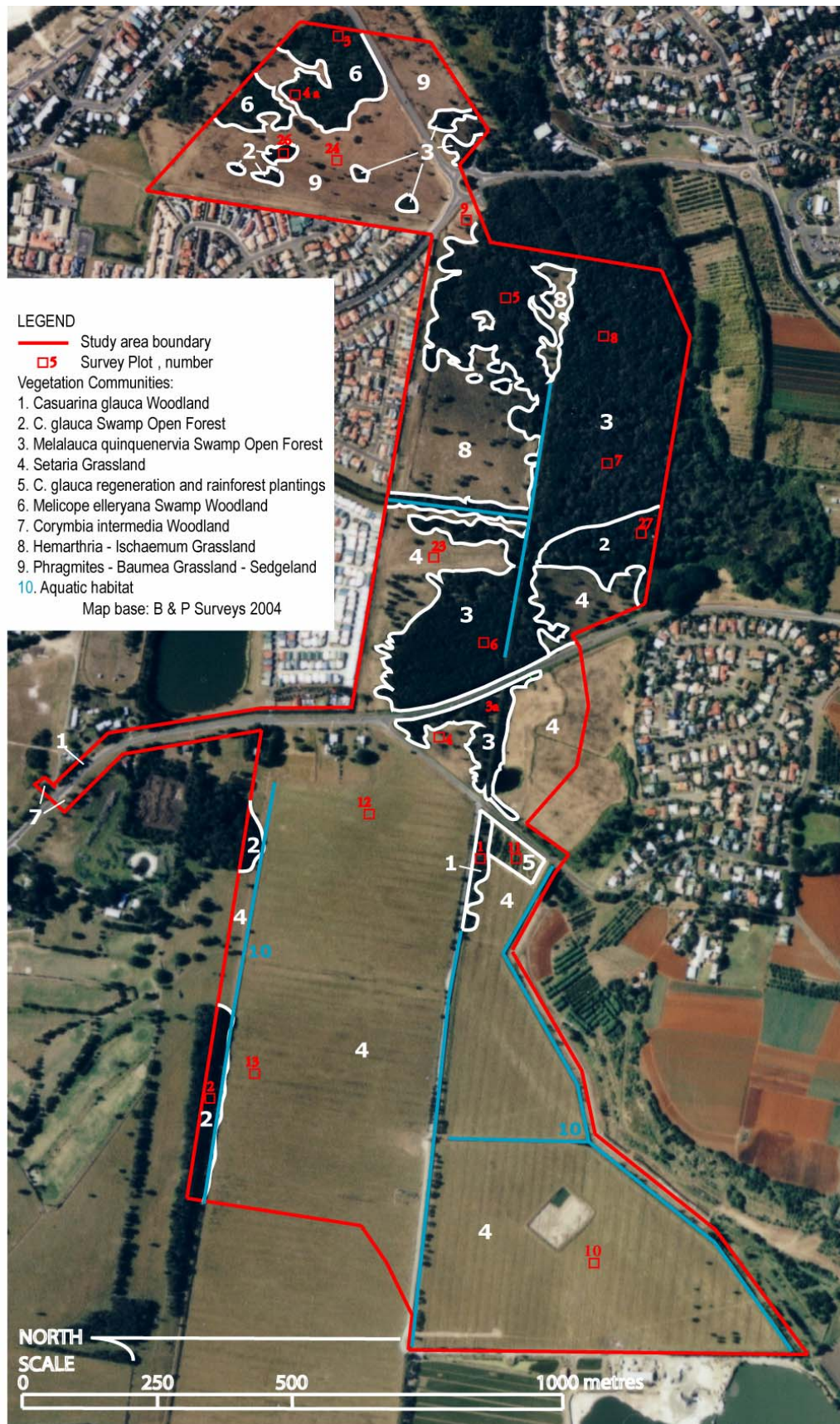


Figure 4
Vegetation Communities of the Study Area

2.2 Community 2: *Casuarina glauca* Swamp Open Forest

2.2.1 Species Composition

Swamp oak *Casuarina glauca* is the dominant species in this community, with Broadleaved Paperbark *Melaleuca quinquenervia* subdominant. Other common tree species include Willow Bottlebrush *Callistemon salignus* and Camphor Laurel *Cinnamomum camphora*.

The lower strata include the common rainforest species including Sandpaper Fig *Ficus coronata*, Cockspur Thorn *Maclura cochinchinensis* and the weed Lantana *L. camara*.

Setaria Grass *S. sphacelata* is the dominant ground cover, at least on the edge of the stand.

2.2.2 Structure

This community consists of a sparse stratum of Swamp Oak to 20m tall and 60cm diameter over a mid-dense upper midstratum of Broadleaved Paperbark, Willow Bottlebrush and Camphor Laurel to 12m tall, and a sparse lower midstratum of Lantana, Sandpaper Fig and Cockspur to approximately 4m tall. The mid-dense ground layer of exotic grasses is around 1m tall.

2.2.3 Ecology Disturbance & Dynamics

This is a groundwater dependent native vegetation community. It occurs as remnants in grazed pasture on flat and low-lying Quaternary coastal alluvium directly north of the processing area and northern extraction site. There are ongoing impacts to understorey vegetation from grazing cattle. It is separated from the Study Area by a flooded drain and a bund. In May 2005, the ground was inundated by local floodwaters to a depth exceeding that in the grassland area south of the bund.

The height and density of the understorey vegetation, particularly of Broadleaved Paperbark, increased towards the east, presumably because of declining influence of saline groundwater with increasing distance from the Tweed River to the west.

2.2.4 Conservation Status

No Threatened species were detected in this community or are considered likely to occur there. Although it meets habitat requirements for the Endangered Basket Fern *Drynaria rigidula* the occurrence of this species is considered unlikely because of small size of the remnant and ongoing disturbance impacts.

This community represents disturbed and isolated remnants of a *Casuarina glauca* Swamp Forest (Community 8 of Elks & Smith 2004). It is categorised as a remnant of Forest Ecosystem (FE) 143 (NPWS 2002), a community regarded as Vulnerable in northeastern NSW (RACD 1999), and may constitute Swamp Oak Floodplain Forest, listed as an Endangered Ecological Community under the TSC Act (Scientific Committee 17/12/04)

2.3 Community 3: *Melaleuca quinquenervia* Swamp Open Forest

2.3.1 Species Composition

In this community Paperbark is the dominant tree species, with occasional Swamp Oak. Silkpod Vine is a common woody climber, otherwise a midstratum is absent.

Ground layer vegetation is dominated by the exotic grasses, especially *Setaria S. sphacelata* and Sourgrass *Paspalum conjugatum*.

2.3.2 Structure

This community consists of open stands of trees to around 12m tall over mid-dense grasses and occasional sedges.

2.3.3 Ecology Disturbance & Dynamics

This is a groundwater dependent native vegetation community. Within the Project Site this community consists of young Paperbark trees over mixed grassland/sedgeland on wet organic soils. The small size of the trees and absence of large old trees, stags or stumps indicates that this community has regenerated relatively recently following catastrophic disturbance such as clearing.

2.3.4 Conservation Values

No Threatened species were detected in this community in the Study Area. It meets described habitat requirements for the Endangered species of orchid *Phaius australis* and the annual herb *Oldenlandia galioides*. As *Phaius australis* is a large distinctive species, its occurrence in the Project Site has been excluded as it has not been detected despite extensive field survey. The occurrence of the Endangered annual herb *Oldenlandia galioides* is considered unlikely because of small size of the remnant and ongoing disturbance impacts.

No ROTAP listed species were detected in this community in the Study Area but *Cordyline congesta* is known to occur in this community elsewhere in the locality.

This community (Communities 7a and 7b of Elks & Smith 2004) is classified as FE 112 Paperbark, a Vulnerable Ecosystem (RACD 1999). It may also be classified as WTF002a, regarded as adequately conserved in northeastern NSW (Hager & Benson 1994) or Swamp Sclerophyll Forest on Floodplain, listed as an Endangered Ecological Community by the Scientific Committee (17 December 2004).

2.4 Community 4: *Setaria sp* Grassland

2.4.1 Species Composition

The exotic species *Setaria* grass was clearly the dominant species in this community during the most recent survey in May 2005, but was co-dominant with Carpet Grass *Axonopus fissifolius* when surveyed in November 2003.

Other common species include the exotic Sourgrass *Paspalum conjugatum*, native forb *Centella asiatica*, grasses common Couch *Cynodon dactylon* and Queensland Blue Couch *Digitaria didactyla*, and the exotics Kikuyu *Pennisetum clandestinum*, Fireweed *Senecio madascariensis*, the rush *Juncus cognatus*, and the sedges *Cyperus brevifolius* and *C. sesquiflorus*.

2.4.2 Structure

This community is a dense to mid-dense sod grassland, from less than 10cm tall when recently mowed or heavily grazed, to over 1m tall elsewhere. Although trees were generally absent, Swamp Oak coppice occurred occasionally.

2.4.3 Ecology Disturbance & Dynamics

This community occupies most of the Project Site, including the ground layer of adjoining forest and woodland communities west of Tweed Coast Road.

Functionally this is a cowpasture, with evidence of pasture improvement (Japanese Clover *Lespedeza striata*, White Clover, *Setaria*) of a low-productivity grassland based on the naturalised exotic Carpet Grass.

The cowpasture occupies land that was apparently developed for sugar cane production *ie*: cleared of native vegetation and modified by the construction of a drainage network to reduce flooding and lower the water table.

2.4.4 Conservation Status

This community is not a native vegetation community and has no intrinsic conservation status.

2.5 Community 5: *Casuarina glauca* and Rainforest tree plantings

2.5.1 Species Composition

In November 1993, the exotic annual *Aster subulatus* and exotic perennial *Cuphea carthagenensis* were the dominant species in this community, but subsequently Swamp Oak coppice present then has grown, together with planted rainforest trees of Blue Fig *Elaeocarpus grandis*, Umbrella Cheese Tree *Glochidion sumatranum* and Macaranga *M. tanarius*.

Other common species include the exotics Setaria Grass and Stinking Pennywort *Hydrocotyle bonariensis*, and the natives *Centella asiatica*, Buttercup *Ranunculus inundatus* and Blue Commelina *Commelina cyanea*.

2.5.2 Structure

A sparse stand of young trees to 6m tall over a dense ground layer to 60cm tall of *Cuphea carthagenensis*, Stinking Pennywort and other weedy broadleaved plants among dead and moribund Setaria Grass to 2m tall.

2.5.3 Ecology Disturbance & Dynamics

This community occurs in a small fenced paddock at the eastern extremity of the Study Area adjoining Crescent Street.

It appears to be a pasture from which grazing has been excluded for several years, and subject to managed tree regeneration to act as a buffer zone.

2.5.4 Conservation Status

No Threatened species were detected in this community in the Study Area or are considered likely to occur there.

This community is a relict community with introduced tree species and has no intrinsic conservation status.

2.6 Community 6: *Melicope elleryana* Swamp Woodland

2.6.1 Species Composition

There is sparse cover of Doughwood *Melicope elleryana*, Umbrella Cheese Tree *Glochidion sumatranum* and Umbrella Tree *Schefflera actinophylla* among numerous dead Blackwood Wattle *Acacia melanoxylon*.

The midstratum flora is dominated by Lantana *L. camara* with occasional stands of other weeds such as Morning Glory *Ipomoea indica* and Pokeweed *Phytolacca americana*.

The ground layer vegetation consists of dense cover of Harsh Ground Fern *Hypolepis muelleri* with occasional Sawsedge *Gahnia sp*, Swamp Fern *Blechnum sp*, and Common Reed *Phragmites australis*. In mowed areas Swamp Ricegrass *Leersia hexandra* and introduced *Setaria sp* and Para Grass *Urochloa mutica* are dominant.

2.6.2 Structure

Woodland of scattered regrowth trees to 8m and a sparse midstratum to 3m over a dense ground layer of grasses, sedges and ferns to 1.5m tall.

2.6.3 Ecology Disturbance & Dynamics

This community occupies waterlogged peaty black soils adjoining the footslopes of the barrier dune west of the main street of Kingscliff. The community is undergoing transition from a drier community dominated by Blackwood Wattle to a wetter swamp forest community. The synchronised death of the once dominant wattles indicates recent environmental change, probably increased ponding associated with construction of the Turnock St. road embankment.

2.6.4 Conservation Values

No Threatened species were detected in this community or are considered likely to occur there.

The ROTAP listed species *Cordyline congesta* is reported from the southeastern corner of this community (Planit 2002).

This community (Community 6 of Elks & Smith 2004) is not recognised as a Forest Ecosystem or Association (NPWS 2002, Griffiths 1993, Hager & Benson 1994, Forestry Commission 1989), and has no intrinsic conservation status.

2.7 Community 7: *Corymbia intermedia* Woodland

2.7.1 Species Composition

There is scattered cover of Pink Bloodwood *Corymbia intermedia* with Brush Box, Coast Banksia, Swamp Oak and Broadleaved Paperbark.

The midstratum flora is absent, and the ground layer consists of mowed exotic grasses and occasional small sedges.

2.7.2 Structure

Scattered regrowth trees to 10m over a mowed mid-dense grassland.

2.7.3 Ecology Disturbance & Dynamics

All woody vegetation is young, apparently being regeneration from a major clearing event ca 30 years ago.

The overstorey species are not known to occur together, and it is likely that this community is an artefact of previous disturbance of ecotonal vegetation.

2.7.4 Conservation Values

No Threatened species were detected in this community or are considered likely to occur there.

This community is not recognised as a Forest Ecosystem or Association (NPWS 2002, Griffiths 1993, Hager & Benson 1994, Forestry Commission 1989), and has no intrinsic conservation status.

2.8 Community 8: *Hemarthria uncinata*-*Ischaemum australe* Grassland

2.8.1 Species Composition

The native grasses Matgrass *Hemarthria uncinata* and *Ischaemum australe* are typically codominant, and Carpet Grass *Axonopus fissifolius* is very common. Other common species include the native grass *Paspalidium sp*, the woody-rooted forb *Gonocarpus chinensis*, and herbs such as *Hydrocotyle laxiflora* and *Velliea spathulata*.

There are occasional seedlings and coppice of *Melaleuca quinquenervia*, and sedges *Baumea spp* in depressions.

2.8.2 Structure

A mid-dense to dense grassland approximately 7cm tall, recently mowed, with smaller shade-tolerant herbs below the grasses and occasional stands of sedges in depressions.

2.8.3 Ecology Disturbance & Dynamics

This community occurs on loam soils of cleared and mowed areas. The presence of woody-rooted forbs, coppicing shoots and depressions with sedges indicate that it has not been cultivated.

2.8.4 Conservation Status

No Threatened species were detected in this community or are considered likely to occur there.

This community (Community 10 of Elks & Smith 2004) has no known flora conservation values. It is not a recognisable community in the Tweed Vegetation Management Plan (Kingston et al 1999) or Griffith (1993).

2.9 Community 9: *Baumea rubiginosa* -*Phragmites australis* Mixed Grassland-Sedgeland

2.9.1 Species Composition

The sedge *Baumea rubiginosa* is generally common and an indicator species for this community. The natives, Common Reedgrass *Phragmites australis* and Swamp Ricegrass *Leersia hexandra*, also occur, as does the Swamp Fern *Blechnum sp* and the sedge *Schoenus brevifolius*. Introduced grasses such as Sourgrass *Paspalum conjugatum*, Vasey Grass *P. urvillei*, Guinea Grass *Panicum maximum*, Para Grass *Urochloa mutica* and Carpet Grass are common, and locally dominant on disturbed areas such as fill batters.

2.9.2 Structure

A sparse mixed grassland and sedgeland, with occasional fern and taller grass up to 60cm tall and isolated young Paperbark Trees.

2.9.3 Ecology Disturbance & Dynamics

This community occurs on inundated peaty mud of cleared and mowed areas. It is likely that it would form a taller and denser community in the absence of mowing, which apparently suppresses taller vegetation such as Swamp Fern, Common Reedgrass, and exotic grasses, and favours shorter grasses and sedges. This community is apparently undergoing change from a drier grassland to a wetter swamp fern/sedge community as a result of increased ponding following construction of the Turnock Street road embankment.

2.9.4 Conservation Status

No Threatened species were detected in this community or are considered likely to occur there. It includes one mature specimen of the Swamp Banksia *B. robur*, regarded as a significant species in the Tweed Vegetation Management Plan.

This community (Community 12 of Elks & Smith 2004) is not a recognisable community in the Tweed Vegetation Management Plan (Kingston et al 1999) or Griffith (1993). Although it has elements of the vegetation community Freshwater Wetlands on Coastal Floodplains, listed as an Endangered Ecological Community by the Scientific Committee (17 December 2004), it is considered here as derived from species characteristic of a swamp forest understorey that have been favoured by artificial ponding.

2.10 Community 10: Drains & Aquatic Vegetation

2.10.1 Species Composition

In larger drains, the native sedge *Schoenoplectus validus* is the dominant ground layer species in flooded drains, and mats of *Bacopa monniera* occur on exposed mud. There are occasional plants of Water Lily *Nymphaea capensis* in deeper areas of water. In smaller drains *Setaria* Grass is the dominant species.

2.10.2 Structure

The structure varies according to water depth, with isolated individual floating aquatics and stands of emergents in deeper water, and mats of low growing species on exposed mud.

2.10.3 Ecology Disturbance & Dynamics

The stands of aquatic vegetation vary according to grazing pressure, competition from tall exotic grasses, and seasonal fluctuations in water level.

2.10.4 Conservation Values

No Threatened species were detected in this community or are considered likely to occur there.

This community is not recognisable as a native vegetation community (Griffiths 1993) and has no intrinsic conservation status.

3 STUDY AREA FLORA CONSERVATION SIGNIFICANCE

3.1 Threatened Flora Species

No Threatened flora species as listed under the TSC Act or the EPBC Act have been detected by numerous field surveys of the Study Area.

Three TSC Act listed threatened flora species have been assessed as potentially occurring in vegetation communities of the Study Area (**Table 1**). These species (and their corresponding communities) are:

- *Drynaria rigidula* (Community 2);
- *Geodorum densiflorum* (Community 3); and
- *Oldenlandia galioides* (also known as *Hedyotis galioides*)(Community 3).

3.2 Endangered Ecological Communities (EEC's)

Two TSC Act listed EEC's are assessed as potentially occurring in the Study Area (**Table 2**). They are:

- Swamp Oak Floodplain Forest, which may occur in the Study Area as Community 2; and
- Swamp Sclerophyll Forest, which may occur in the Study Area as Community 3.

3.3 Endangered Populations, or their Habitats, or Critical Habitat

No Endangered Populations or Critical Habitat are listed for the Study Area under the TSC Act or the EPBC Act.

Table 1
Threatened Species and Likelihood of Occurrence in Study Area

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Scientific name	TSC Act status	EPBC Act status	Records of occurrence	Habitat (DECC Threatened Species website)	Likelihood of occurrence in Study Area
<i>Acacia bakeri</i>	Vulnerable	Not listed	13 records within 10km	Lowland rainforest or adjacent eucalypt forest	Unlikely. Habitat not detected in Study Area.
<i>Acrornychia littoralis</i>	Endangered	Endangered	17 records within 10km. Predicted to occur in Study Area.	Littoral rainforest and adjacent open forest	Unlikely. Habitat not detected in Study Area.
<i>Amorphospermum whitei</i>	Vulnerable	Not listed	1 record within 10km	Rainforest and the adjacent understorey of moist eucalypt forest	Unlikely. Habitat not detected in Study Area.
<i>Archidendron hendersonii</i>	Vulnerable	Not listed	1 records within 10km	Riverine and lowland subtropical rainforest and littoral rainforest	Unlikely. Habitat not detected in Study Area.
<i>Austromyrtus fragrantissima</i>	Endangered	Endangered	8 records within 10km. Predicted to occur in Study Area.	Subtropical, riverine and dry rainforest	Unlikely. Habitat not detected in Study Area.
<i>Bosistoa transversa</i>	Vulnerable	Vulnerable	6 records within 10km	Lowland subtropical rainforest	Unlikely. Habitat not detected in Study Area.
<i>Cassia brewsteri</i> var. <i>marksiana</i>	Endangered	Not listed	19 records within 10km	Littoral and riverine rainforest	Unlikely. Habitat not detected in Study Area.
<i>Chamaesyce psammogeton</i>	Endangered	Not listed	1 record within 10km	Foredunes and exposed headlands	Unlikely. Habitat not detected in Study Area.
<i>Corokia whiteana</i>	Vulnerable	Vulnerable	4 records within 10km	Boundaries between wet eucalypt forest and warm temperate rainforest up to 800m	Unlikely. Habitat not detected in Study Area.
<i>Cryptocarya foetida</i>	Vulnerable	Vulnerable	70 records within 10km. Predicted to occur in Study Area.	Littoral rainforest	Unlikely. Habitat not detected in Study Area.
<i>Dendrocnide moroides</i>	Endangered	Not listed	1 record within 10km	Lowland rainforest, especially in gaps or other disturbed sites	Unlikely. Habitat not detected in Study Area.
<i>Desmodium acanthocladum</i>	Vulnerable	Vulnerable	1 record within 10km	Dry rainforest and fringes of riverine subtropical rainforest	Unlikely. Habitat not detected in Study Area.
<i>Diospyros mabacea</i>	Endangered	Endangered	3 records within 10km	Lowland subtropical rainforest	Unlikely. Habitat not detected in Study Area.
<i>Diploglottis campbellii</i>	Endangered	Endangered	5 records within 10km. Predicted to occur in Study Area.	Lowland subtropical rainforest to drier subtropical rainforest with a Brush Box open overstorey	Unlikely. Habitat not detected in Study Area.
<i>Drynaria rigidula</i>	Endangered	Not listed	1 record within 10km	On plants, rocks or on the ground in rainforest, moist eucalypt and Swamp Oak forest	Possible – not detected by survey but habitat requirements may be met in Community 2 in Study Area.
<i>Elyonurus citreus</i>	Endangered	Not listed	1 record within 10km	Infertile white sands soils in wallum areas or sand dunes	Unlikely. Habitat not detected in Study Area.
<i>Geijera paniculata</i>	Endangered	Not listed	1 record within 10km	Dry subtropical rainforest and vine scrub	Unlikely. Habitat not detected in Study Area.

Table 1 (Cont'd)
Threatened Species and Likelihood of Occurrence in Study Area

Page 2 of 2

Scientific name	TSC Act status	EPBC Act status	Records of occurrence	Habitat (DECC Threatened Species website)	Likelihood of occurrence in Study Area
<i>Geodorum densiflorum</i>	Endangered	Not listed	1 record within 10km	Dry eucalypt forest and coastal swamp forest at lower altitudes, often on sand	Possible – not detected by survey but habitat requirements may be met in Community 3 in Study Area.
<i>Grevillea hilliana</i>	Endangered	Not listed	2 records within 10km	Subtropical rainforest	Unlikely. Habitat not detected in Study Area.
<i>Hicksbeachia pinnatifolia</i>	Vulnerable	Vulnerable	Not recorded within 10km	Subtropical rainforest, moist eucalypt forest and Brush Box forest	Unlikely. Habitat not detected in Study Area.
<i>Lepiderema pulchella</i>	Vulnerable	Not listed	38 records within 10km	Lowland subtropical rainforest	Unlikely. Habitat not detected in Study Area.
<i>Macadamia tetraphylla</i>	Vulnerable	Vulnerable	2 records within 10km	Subtropical rainforest in coastal areas	Unlikely. Habitat not detected in Study Area.
<i>Oldenlandia galioides</i>	Endangered	Not listed	1 record within 10km.	Seasonally inundated paperbark swamps or forest red gum open forest	Possible – not detected by survey but habitat requirements may be met in Community 3 in Study Area.
<i>Marsdenia longiloba</i>	Endangered	Vulnerable	Not recorded within 10km. Predicted to occur in Study Area.	Subtropical and warm temperate rainforest, moist eucalypt forest adjoining rainforest, and rock outcrops	Unlikely. Habitat not detected in Study Area.
<i>Peristeranthus hillii</i>	Vulnerable	Not listed	1 record within 10km	Epiphytic, in lowland subtropical & littoral rainforest	Unlikely. Habitat not detected in Study Area.
<i>Phaius australis</i>	Endangered	Endangered	1 record within 10km	Swampy grassland or swampy forest including rainforest, eucalypt or paperbark forest	Unlikely. Large distinctive species. excluded on the basis of extensive field survey.
<i>Randia moorei</i>	Endangered	Endangered	21 records within 10km. Predicted to occur in Study Area.	Subtropical, riverine, littoral and dry rainforest	Unlikely. Habitat not detected in Study Area.
<i>Symplocos baeuerlenii</i>	Vulnerable	Vulnerable	1 record within 10km	Warm temperate rainforest on less fertile soils derived from rhyolite	Unlikely. Habitat not detected in Study Area.
<i>Syzygium hodgkinsoniae</i>	Vulnerable	Vulnerable	Not recorded within 10km. Predicted to occur in Study Area.	Riverine and subtropical rainforest	Unlikely. Habitat not detected in Study Area.
<i>Syzygium moorei</i>	Vulnerable	Vulnerable	15 records within 10km. Predicted to occur in Study Area.	Subtropical and riverine rainforest	Unlikely. Habitat not detected in Study Area.
<i>Tinospora tinosporoides</i>	Vulnerable	Vulnerable	Not recorded within 10km. Predicted to occur in Study Area.	Wetter subtropical rainforest, including littoral rainforest	Unlikely. Habitat not detected in Study Area.
<i>Xylosma terraereginae</i>	Endangered	Not listed	1 record within 10km	Littoral and subtropical rainforest	Unlikely. Habitat not detected in Study Area.

Table 2
Endangered Communities and Likelihood of Occurrence in Study Area

Community	TSC Act status	EPBC Act status	Description/Habitat (DECC Threatened Species website)	Likelihood of occurrence in Study Areas
Byron Bay Dwarf Graminoid Clay Heath Community	Endangered	not listed	Consists of low-growing (to 50 cm tall) woody shrubs, grasses and grass-like plants with patches of taller shrubs and occasional larger trees. Found only at Byron Bay on gently sloping clay ridges.	Nil. Suitable habitat & characteristic species not detected.
Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions	Endangered	not listed	Dominated by halophytic plants & restricted to the intertidal zone on the shores of estuaries and lagoons that are permanently or intermittently open to the sea.	Nil. Suitable habitat & characteristic species not detected.
Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions	Endangered	not listed	Dominated by herbaceous plants and with few woody species. Occurs on silts, muds or humic loams in low-lying coastal areas subject to periodic flooding and in which standing fresh water persists for at least part of the year in most years.	Unlikely- characteristic elements are species of swamp forest understorey favoured by artificial ponding.
Littoral Rainforest in the NSW North Coast, Sydney Basin and South East Corner Bioregions	Endangered	not listed	Closed forest of predominantly rainforest species. Occurs within reach of the maritime influence, generally within 2km of the sea.	Nil. Suitable habitat & characteristic species not detected.
Lowland Rainforest on Floodplain in the New South Wales North Coast Bioregion	Endangered	not listed	Closed forest of rainforest species occurring on deep fertile alluvial soils in lowland river valleys.	Nil. Suitable habitat & characteristic species not detected.
Sub-tropical Coastal Floodplain Forest of the NSW North Coast bioregion	Endangered	not listed	Tall open forests to woodlands with <i>Eucalyptus tereticornis</i> (Forest Red Gum), <i>E. siderophloia</i> (Grey Ironbark), <i>Corymbia intermedia</i> (Pink Bloodwood) and/or <i>Lophostemon suaveolens</i> (Swamp Turpentine). Occupies clay-loams and sandy loams, on periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains.	Unlikely – limited to small fragments of regrowth overstorey vegetation containing one of the characteristic species.
Swamp Sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions	Endangered	not listed	Dominated by <i>Eucalyptus robusta</i> (Swamp Mahogany) and/or <i>Melaleuca quinquenervia</i> (Paperbark). Occupies humic clay loams and sandy loams, on waterlogged or periodically inundated alluvial flats and drainage lines associated with coastal floodplains.	Possible occurrence Community 3 of the Study Area.
Swamp Oak floodplain forest of the NSW North Coast, Sydney Basin and South East Corner bioregions	Endangered	not listed	Open forests to low woodlands, scrubs or reedlands with scattered trees, dominated by <i>Casuarina glauca</i> (Swamp Oak). Occupies grey-black clay-loams and sandy loams, where the groundwater is saline or sub-saline, on waterlogged or periodically inundated flats, drainage lines, lake margins and estuarine fringes associated with coastal floodplains.	Possible occurrence – Community 2 of the Study Area.

4 MITIGATION MEASURES

4.1 General Measures

The following measures are recommended to minimise and mitigate impacts on native vegetation within the Project Site.

- Vegetation to be retained should be clearly defined and marked prior to the commencement of site establishment to ensure that native vegetation clearing is confined only to those areas required for Project operations.
- Noxious weeds should be controlled in the Project Site.
- Rehabilitation and landscaping should utilise local native plant species that provide forage opportunities for nectivorous and frugivorous birds and bats (see Section 4.2).

The proposed and alternative pipeline corridors have been located to avoid the need for clearance of native vegetation. Completed works within the Project Site would be progressively rehabilitated to maximise cover of native vegetation and minimise opportunities for erosion and weed invasion.

4.2 Rehabilitation and Landscaping

4.2.1 Introduction

The following sub-sections outline specific species recommended for use in rehabilitation and landscaping of various Project components. A more detailed landscaping and rehabilitation plan should also be completed prior to commencement of operations.

4.2.2 Initial Stabilisation of Bund Walls (Grasses)

Season	Common Name	Rate (kg/ha)
Autumn and Winter	Perennial Ryegrass	10
Spring and Summer	Japanese Millet	20

Due to the large seed bank of grasses in topsoil across the Project Site, sowing of other grass species is not expected to be necessary.

4.2.3 Planting of Processing Area Bund Wall (Shrubs and Small Trees, with Surface Mulch)

Scientific Name	Common Name	Final Height (m)
<i>Acacia sophorae</i>	Coast Wattle	3
<i>Allocasuarina littoralis</i>	Black Oak	10
<i>Austromyrtis dulcis</i>	Midyim	1
<i>Banksia integrifolia</i>	Coast Banksia	10
<i>Banksia robur</i>	Swamp Banksia	3
<i>Callistemon pachyphyllus</i>	Thick-leaved Bottlebrush	1

4.2.4 Visual Screening (Trees)

Scientific Name	Common Name	Final Height (mm)
<i>Archontophoenix cunninghamiana</i>	Bangalow Palm	13
<i>Callistemon salignus</i>	Willow Bottlebrush	10
<i>Casuarina glauca</i>	Swamp Oak	30
<i>Glochidion sumatranum</i>	Umbrella Cheese Tree	20
<i>Melaleuca quinquenervia</i>	Broadleaved Paperbark	25

4.2.5 Wetlands

Scientific Name	Common Name	Max Water Depth (m)
<i>Bacopa monniera</i>	Bacopa	0.1
<i>Baumea spp</i>	-	0.3
<i>Carex appressa</i>	-	0.1
<i>Eleocharis sphacelata</i>	Tall Spike-rush	2.0
<i>Leersia hexandra</i>	Swamp Rice-grass	0.1
<i>Lepironia articulata</i>	-	1.5
<i>Phragmites australis</i>	Common Reed	0.5
<i>Schoenus validus</i>	-	0.3

5 ASSESSMENT OF IMPACTS

5.1 Impacts on Vegetation Communities

The Project would involve:

- the clearing of vegetation and stripping and storage of topsoil on the Project Site;
- extraction, processing and stockpiling of sand and other excavated materials on the Project Site; and
- transfer of materials to and from the Project Site via pipelines and road transport.

There would be no need for vegetation clearing within either the proposed or alternative northern pipeline corridors. Tweed Coast Road would provide the necessary access to the pipelines for servicing and a strip approximately 1m wide would be required for the pipelines themselves. Access to the pipelines within the alternative northern pipeline corridor would be provided by existing property access roads off Tweed Coast Road.

In the event that a proposed road running east-west from Tweed Coast Road to Turnock Street is approved prior to the need to pump sand to the eastern fill sites, the Proponent would utilise this corridor for the approved road for the placement of the proposed eastern pipelines. There would be no need for additional vegetation clearing as the pipelines would be laid within the footprint of the proposed road and all servicing would be undertaken using the proposed road.

Within the alternative eastern corridor there would also be no need for clearing. A service track approximately 4m wide would run parallel to the pipelines, however, where necessary the service track and/or pipeline orientation would be adjusted to avoid the need to remove trees and shrubs.

Table 3 summarises the area of each vegetation community that would be disturbed / cleared as a result of the Project.

Table 3
Areas of Vegetation Communities in the Study Area

	Community	Approximate area to be cleared (ha)	Approximate extent in Study Area (ha)
1	<i>Casuarina glauca</i> Woodland	0.5	0.5
2	<i>Casuarina glauca</i> Swamp Open Forest	0.0	3.9
3	<i>Melaleuca quinquenervia</i> Swamp Open Forest	0.0	26.7
4	<i>Setaria sp</i> Grassland (exotic grassland)	50.0	83.9
5	<i>Casuarina glauca</i> and Rainforest tree plantings	0.0	0.6
6	<i>Melicope elleryana</i> Swamp Woodland	0.0	3.6
7	<i>Corymbia intermedia</i> Open Forest	0.0	0.1
8	<i>Hemarthria uncinata</i> - <i>Ischaemum australe</i> Grassland	0.0	7.6
9	<i>Baumea rubiginosa</i> - <i>Phragmites australis</i> Mixed Grassland-Sedgeland	0.0	11.8
10	Drains & Aquatic Vegetation	0.1	0.5
	Total	50.6	139.2

At the completion of the Project all machinery would be removed from the extraction sites and processing area, and the remaining areas rehabilitated.

5.2 Potential Impacts on Threatened Flora Species and Ecological Communities, or their Habitat

As the EEC's Swamp Oak Floodplain Forest and Swamp Sclerophyll Forest on Coastal Floodplains may occur in the Study Area, there is the potential for them to be affected by the Project.

No direct impacts are expected as these communities occur outside of the clearing / direct disturbance envelope of the Project.

The Swamp Oak and Swamp Sclerophyll forests of the Study Area are Groundwater Dependent Ecosystems, defined by the NSW Groundwater Dependent Ecosystems Policy as "communities of plants, animals and other organisms whose extent and life processes are dependent on groundwater". There is potential for indirect impact arising from the Project due to alteration in groundwater regimes, in particular, lowering of the water table and associated oxidation of potential acid sulfate soils or sediments or intrusion of saline groundwater.

However, no indirect impacts on these are expected, as groundwater studies undertaken by AGECC (2008 – see Part 1 of the *Specialist Consultant Studies Compendium*) indicate that groundwater levels under these communities would remain within normal seasonal fluctuations. Additionally, with appropriate management practices, oxidation of acid sulfate soils and sediments is not expected to cause any significant alterations to water quality (HMC, 2008 – see Part 3 of the *Specialist Consultant Studies Compendium*). Water quality monitoring undertaken at the operating sand extraction facility of Tweed Turf and Sand (now Hanson Tweed Sand) on the western boundary of the Project Site also indicates that no significant increase in salinity would be likely occur.

Potential habitat for the following Threatened species occurs in the Swamp Oak and Swamp Sclerophyll forests of the study area.

- *Drynaria rigidula*.
- *Geodorum densiflorum*.
- *Oldenlandia galioides*.

For the reasons outlined above, no direct or indirect impacts on these species are expected .

5.3 Environmental Planning and Assessment Act 1979 - Part 3A Assessment

The draft *Guidelines for Threatened Species Assessment* (DECC 2005) prepared under Part 3A of the *Environmental Planning and Assessment (EP&A) Act 1979* state that:

“The objective of the assessment process is to provide information to enable decision makers to ensure that developments deliver the following environmental outcomes.

- Maintain or improve biodiversity values (ie. there is no net impact on threatened species or native vegetation).
- Conserve biological diversity and promote ecologically sustainable development.
- Protect areas of high conservation value (including areas of critical habitat).
- Prevent the extinction of Threatened species.
- Protect the long-term viability of local populations of a species, population or ecological community.
- Protect aspects of the environment that are matters of national environmental significance.”

The guideline provides a five step assessment process which includes:

- preliminary assessment – to determine the likelihood of the Study Area containing threatened species; (see Sections 1.3, 1.4 and 3);

- field survey and assessment - to ensure that a reliable assessment of the presence or absence of Threatened species can be made; (see Sections 1.5 and 2);
- evaluation of impacts – to identify the magnitude and extent of impacts, and the significance of the impacts as related to the conservation importance of the habitat, individuals and populations likely to be affected; (see Section 5);
- avoid, mitigate and then offset – including the description and justification of measures to mitigate any adverse effects and consideration of offset strategies if necessary; and (see Section 4); and
- key thresholds – justification of the Project based on whether the Project would maintain biodiversity, the long-term viability or accelerate extinction of a species, population or community and any adverse effects on critical habitat. (see Section 4 and 6).

In the absence of specific assessment methodologies, matters of consideration including the '7-part test' as described within the *Threatened Species Assessment Guidelines* (DECC 2007) for assessment under Section 5A of the EP&A Act have been used to evaluate the potential impacts of the Project.

This assessment includes the following considerations.

Pre-construction, construction and occupation/maintenance phases.

It is envisaged that initial construction would occur over a short period, and that occupation would continue for up to 20 years.

On-site and off-site impacts, including location, installation, operation and maintenance of auxiliary infrastructure and fire management zones.

It is expected that the impacts of the Project would be confined to the area of the Project Site, because:

- the extraction sites and processing area would be fenced, bunded, and access would be controlled;
- the extraction sites and processing area would be surrounded by a planted setback area in which weeds would be controlled;
- the extraction sites would be progressively rehabilitated with non-invasive species throughout the life of the Project; and
- there would be no significant changes to the groundwater hydrology underlying Threatened communities or associated Threatened species habitat.

All direct and indirect impacts.

Direct impacts are expected to be limited to periodic loss of exotic vegetation cover and relocation of topsoil and organic material within the extraction sites.

No indirect impacts are expected.

The frequency and duration of each known or likely impact/action.

Direct impacts arising from loss of vegetation cover and relocation of topsoil and organic material predominantly within the extraction sites would be ongoing for the life of the Project, estimated as 20 years.

The total impact which can be attributed to that action over the entire geographic area affected, and over time.

Similar activities are currently being undertaken adjoining the Project Site to the west. A wastewater treatment plant is also being developed on land to the northwest of the Project Site. As these Projects are also on previously cleared land devoid of native vegetation, the total impact in the geographic area over time is not expected to be of any greater magnitude than that currently approved.

The sensitivity of the receiving environment.

The receiving environment lies within the Project Site, and consists of exotic vegetation with isolated relict native flora in land that has been cleared, drained, cultivated and used for sugar cane growing, grazing, exotic seed production and other agricultural pursuits over a long period of time. It is therefore considered unlikely to be sensitive to the impacts of the Project.

The degree of confidence with which the impacts of the action are known and understood

Actions of the type proposed have been undertaken on a site adjoining the Project Site and over a long period, and their impacts are relatively well known and understood. Therefore, due to the similarity between the Project and the adjoining sand extraction operation, the predicted impacts for the Project have been assessed with confidence.

As discussed in Section 1.6, the 7-part test has been applied to Threatened species which, although not detected, have habitat within the Study Area that potentially meets their requirements. The results of the 7-part test are as follows.

- (a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.**

Drynaria rigidula

This species was not detected in the Study Area, habitat assessed as potentially meeting its requirements is outside of the Project Site, and no off-site impacts are considered likely. Similar habitat is widespread and relatively common in the locality. The proposed action (ie. the Project) is therefore not considered likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Geodorum densiflorum

This species was not detected in the Study Area, habitat assessed as potentially meeting its requirements is outside of the Project Site, and no off-site impacts are considered likely.

Similar habitat is widespread and relatively common in the locality. The proposed action (ie. the Project) is therefore not considered likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Oldenlandia galioides

This species was not detected in the Study Area, habitat assessed as potentially meeting its requirements is outside of the Project Site, and no off-site impacts are considered likely. Similar habitat is widespread and relatively common in the locality. The proposed action (ie. the Project) is therefore not considered likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

- (b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.**

Endangered populations as listed on Part 2 of Schedule 1 of the TSC Act do not occur in the Study Area or locality.

- (c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:**
- (i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**
 - (ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.**

Table 4 shows that the extent of the local occurrence of the Swamp Oak and Swamp Sclerophyll forests of the Study Area, which for this assessment were assumed to be the EEC's Swamp Oak Floodplain Forest and Swamp Sclerophyll Forest on Coastal Floodplains, would not be reduced by the Project.

The Project is unlikely to have an adverse effect on the extent of the EEC's, or to substantially and adversely modify their composition such that their local occurrence is likely to be placed at risk of extinction. Groundwater and acid sulfate soil studies also indicate that adverse effects of the Project would be limited to the Project Site.

- (d) in relation to the habitat of a threatened species, population or ecological community:**
- (i) the extent to which habitat is likely to be removed or modified as a result of the action proposed,**

No significant amounts of habitat are likely to be removed or modified (see **Table 4**).

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the Project,

The location of the Project and its scale and spatial arrangement is such that habitat would not become fragmented or isolated from other areas of habitat.

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,

Up to 0.5ha of vegetation classified as *Casuarina glauca* Woodland and 0.1ha of Aquatic vegetation would be removed by the Project (see **Table 3**). These communities have been modified by past clearing, drainage and grazing, are isolated and characterised by young trees, sparse cover, an absence of structural elements such as large trees and woody debris, and a ground layer dominated by invasive exotic grasses.

Because of the amount and distribution of similar vegetation communities remaining in the Study Area and locality, and their demonstrated persistence under past disturbance regimes, the habitat to be removed is assessed as of no importance for the long-term survival of the EEC's Swamp Oak Floodplain Forest and Swamp Sclerophyll Forest on Coastal Floodplains in the locality.

For the above reasons and in view of the absence of threatened flora detected within the Study Area, the habitat to be removed is also assessed as of no importance for the long-term survival of the Threatened species *Drynaria rigidula*, *Geodorum densiflorum*, or *Oldenlandia galioides* in the locality.

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),

Critical habitat as listed in the Register of Critical Habitat kept by the Director General of Department of Environment and Conservation does not occur in the Study Area.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,

No recovery plans or threat abatement plans currently apply to any of the Threatened species or communities known or considered likely to occur in the Study Area (<http://www.nationalparks.nsw.gov.au/npws.nsf/Content/Recovery+planning>, <http://www.nationalparks.nsw.gov.au/npws.nsf/Content/Threat+abatement+planning>).

Table 4
Assessment of the Extent to which Habitat is Likely to be Removed or Modified as a Result of the Action Proposed

Threatened species / community	Habitat	Vegetation Class ¹	Area and Quality of Habitat in the Locality ²	Area and Quality of Habitat in the Study Area	Area and Quality of Habitat to be Impacted	Area and Quality of Habitat in the Region ²	Ecological Integrity of the Habitat Affected / Remaining
Endangered Ecological Communities							
Swamp Sclerophyll Forest on Coastal Floodplain	Waterlogged or periodically inundated alluvial flats and drainage lines associated with coastal floodplains	Coastal Swamp Forests	138ha -1459ha unmodified to modified by clearing, drainage, grazing	24.5ha modified by clearing, drainage, grazing	nil	>10,000ha unmodified to modified by clearing, drainage, grazing	low / moderate
Swamp Oak Floodplain Forest	Waterlogged or periodically inundated flats, drainage lines, lake margins and estuarine fringes associated with coastal floodplains	Coastal Swamp Forests	138ha -1459ha unmodified to modified by clearing, drainage, grazing	3.0ha modified by clearing, drainage, grazing	0.5ha seriously disturbed, isolated and depauperate	>10,000ha unmodified to modified by clearing, drainage, grazing	low / moderate
Threatened Species							
<i>Drynaria rigidula</i>	On plants, rocks or on the ground in rainforest, moist eucalypt and Swamp Oak forest	Coastal Swamp Forests, Subtropical & Littoral Rainforests, North Coast Wet Sclerophyll Forests	1028ha - 8228ha, unmodified to modified by clearing, drainage, grazing	3.0ha modified by clearing, drainage, grazing	nil	>>10,000ha, unmodified to modified by clearing, drainage, forestry, grazing	low / moderate
<i>Geodorum densiflorum</i>	Dry eucalypt forest and coastal swamp forest at lower altitudes, often on sand	Coastal Dune Dry Sclerophyll Forests, North Coast Dry Sclerophyll Forests, Coastal Swamp Forests	148ha - 1868ha unmodified to modified clearing, drainage, grazing	24.5ha modified by clearing, drainage, grazing	nil	>10,000ha unmodified to modified by clearing, drainage, grazing	low / moderate
<i>Oldenlandia galioides</i>	Seasonally inundated paperbark swamps or forest red gum open forest	Coastal Swamp Forests, Coastal Valley Grassy Woodlands	434ha - 4422ha unmodified to modified by clearing, drainage, grazing	24.5ha modified by clearing, drainage, grazing	nil	>10,000ha unmodified to modified clearing, drainage, grazing	low / moderate
Notes: ¹ Sourced from Keith 2004 ² Sourced online from (http:// maps.environment.nsw.gov.au/stateveg)							

- (g) **whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.**

The Project would involve up to 0.6ha of native vegetation clearance.

As no threat abatement plan for native vegetation clearance has yet been prepared by DECC, it is not possible to review the proposed activity in light of that plan. Meanwhile, clearing of native vegetation should be considered as a threatening process in a generic sense *ie*: is the Project likely to have a significant effect on Threatened species, populations or ecological communities, or their habitats, and in particular, would it:

- cause fragmentation of ecological communities;
- reduce the viability of ecological communities by disrupting ecological functions;
- result in the destruction of habitat and loss of biological diversity; and
- lead to soil and bank erosion, increased salinity and loss of productive land.

Based on this assessment, it is considered that, with respect to flora, the removal of vegetation would not be likely to further fragment the communities, result in the loss of biological diversity, disrupt ecological functions or lead to erosion, salinity or loss of productive land.

5.4 EPBC Act Administrative Guidelines

No vegetation communities or flora species detected on the Project Site are listed under the schedules of the EPBC Act. The only such species known to occur in the locality and with potential habitat in the Study Area is the orchid *Phaius australis*.

As *Phaius australis* is a large distinctive species its occurrence in the Project Site has been excluded as it has not been detected despite extensive field survey.

Application of the Administrative Guidelines therefore finds that the Project is not likely to:

- (a) lead to a long-term decrease in the size of a population of Endangered species or an important population of Vulnerable species;
- (b) reduce the area of occupancy of a population of Endangered species or an important population of Vulnerable species;
- (c) fragment an existing population of Endangered species or an important population of Vulnerable species into two or more populations;
- (d) adversely affect habitat critical to the survival of a species;
- (e) disrupt the breeding cycle of a population of Endangered species or an important population of Vulnerable species;
- (f) modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline, or
- (g) result in invasive species that are harmful to a population of Endangered species or an important population of Vulnerable species becoming established in the species' habitat.

5.5 EIS Guideline: Extractive Industries - Dredging and Other Extraction in Riparian and Coastal Areas

5.5.1 Register of Significant Trees

Locally Significant trees have been identified on Crescent Street and Cudgen Road. These are Small-leafed figs (*Ficus obliqua*) and do not occur on the Project Site or Study Area.

5.5.2 NPW Act Schedule 13 - Protected Species

The following protected species occur in the Study Area (in Community 3 only):

- Bangalow palm *Archontophoenix cunninghamiana*.
- Birds-nest fern *Asplenium australasicum*.
- Swamp Banksia *Banksia robur*
- Willow bottlebrush *Callistemon salignus*
- Thicketleaved bottlebrush *Callistemon pachyphyllus*

These protected species would not be impacted by the Project.

5.5.3 Areas Protected under SEPP 14 , SEPP 26 , SEPP 44

Areas protected under State Environmental Planning Policy (SEPP) 14 (Coastal wetlands), SEPP 26 (Littoral Rainforest) or SEPP 44 (Koala habitat) do not occur in the Study Area.

5.5.4 Vegetation Protected under the *Fisheries Management Act 1994*

No areas of marine vegetation occur within the Study Area, and the Project is considered unlikely to impact on marine vegetation occurring in the locality.

6 CONCLUSIONS

The land within the extraction sites and processing area is vegetated by exotic grassland, with occasional relict trees and a hierarchy of surface drains.

The land within the proposed northern pipeline corridor forms part of the road reserve for Tweed Coast Road, and is vegetated by mowed exotic grassland with occasional relict trees. The alternative northern pipeline corridor passes between stands of *Casuarina glauca* Swamp Open Forest, however, it is understood that the pipeline would be restricted to cleared areas and would not require the removal of any native vegetation.

The land within the proposed eastern pipeline corridor consists of patches of Swamp Paperbark forest which has been drained and repeatedly cleared and currently consists of regrowth only. The alternative eastern pipeline corridor consists primarily of cleared land with occasional isolated trees which would be avoided by the pipeline and associated service track.

The Study Area was chosen to include all stands of native vegetation in and proximal to the Project Site and includes mature stands of groundwater dependent vegetation communities.

No Threatened flora species have been detected by surveys in the Study Area. Habitat requirements for the Threatened flora species *Drynaria rigidula*, *Geodorum densiflorum* and *Oldenlandia galioides*, all listed as Endangered under the *TSC Act* may be met in the Study Area, although their occurrence is considered unlikely due to habitat modification.

Swamp Sclerophyll Forest on Coastal Floodplain and Swamp Oak Floodplain Forest, listed as Endangered Ecological Communities under the *TSC Act*, were assumed to occur in the Study Area. These communities are groundwater dependent. It has been assessed that these communities would not be adversely effected by the Project.

No Endangered Populations or Critical Habitat are listed for the Study Area under the *TSC Act* or the *EPBC Act*.

The Project minimises the need for clearance of native vegetation by locating the proposed and alternative pipeline corridors in areas where native vegetation can be avoided. To further minimise clearance of native vegetation this report recommends that vegetation to be retained is clearly defined and marked for retention prior to the commencement of site establishment activities.

The Project would minimise opportunities for erosion and weed invasion by progressive rehabilitation to maximise cover of native vegetation. To further mitigate impacts of the Project, this report also recommends that noxious weeds be controlled in the Project Site, and that rehabilitation and landscaping utilises local native plant species that provide forage opportunities for nectarivorous and frugivorous birds and bats.

Given the implementation of the mitigation measures, the Project as proposed it is expected that the Project would maintain or improve biodiversity outcomes, and in particular, would not reduce the long-term viability of a local population of any species, population or ecological community, accelerate the extinction of any species, population or ecological community or place it at risk of extinction, or adversely affect critical habitat.

Identified limitations of this study are not considered likely to compromise this assessment.

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APPENDICES

(No of pages excluding this page = 22)

- Appendix 1 - Map of survey plot locations and Vegetation Communities**
- Appendix 2 - Flora Species Inventory**
- Appendix 3 - Survey plot coordinates**
- Appendix 4 - Areas of vegetation communities in the locality**
- Appendix 5 - Coverage of Environmental Assessment Requirements**

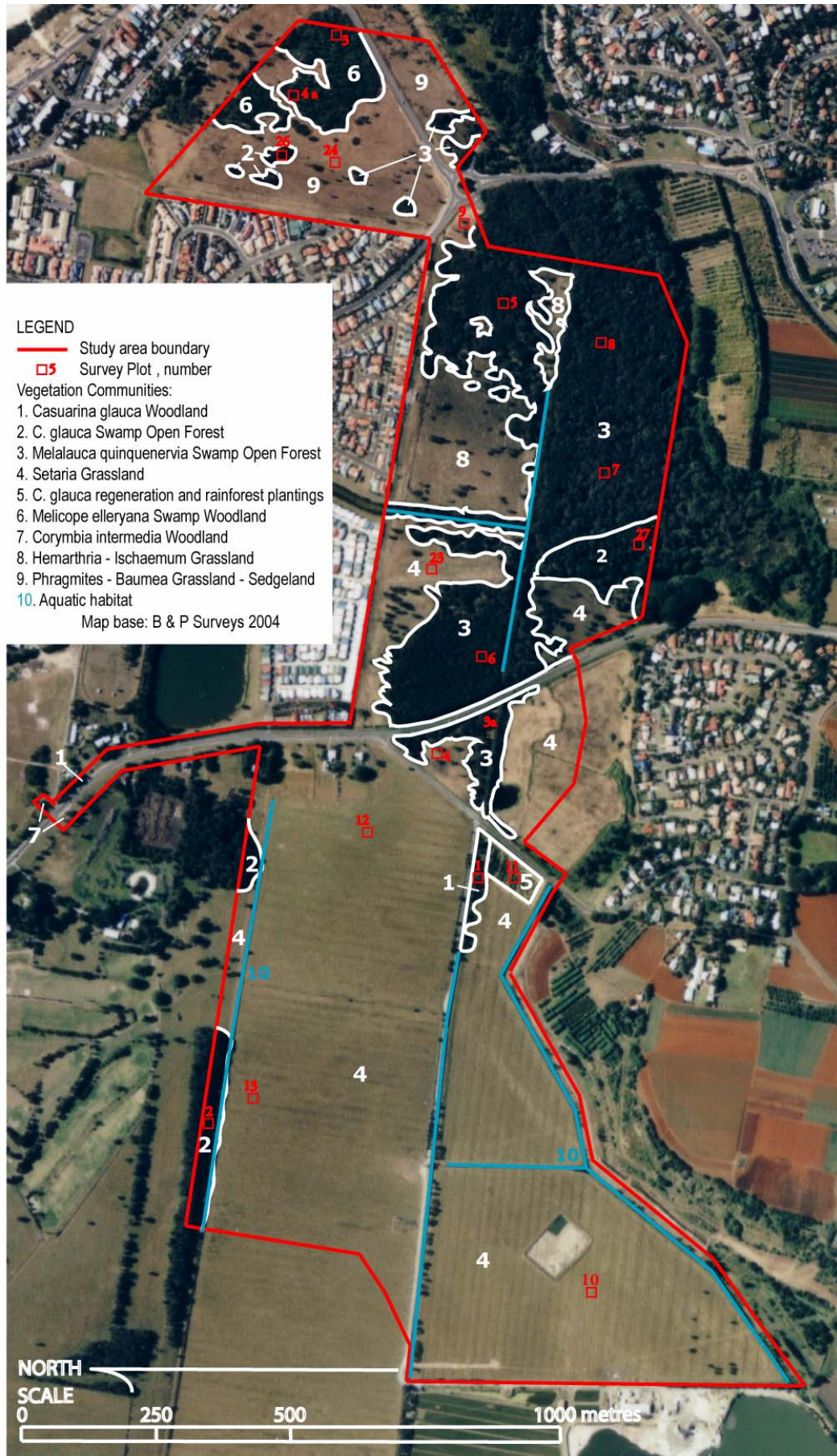
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Appendix 1

Map of Survey Plot Locations and Vegetation Communities

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Appendix 2

Flora Species Inventory

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Flora Species Inventory

Page 1 of 3

		Presence in Community / Plot																	
Scientific name	Status	1	2	2	2	3	3	3	3	3	4	4	4	4	4	5	6	6	7
		1	2	26	27	5	6	7	8	3a	10	12	13	4a	23	11	3	4	14
<i>Acacia melanoxydon</i>	n					1								1		1	1		
<i>Ageratum houstonianum</i>	e				1														
<i>Alocasia brisbanensis</i>	n				1														
<i>Apium leptophyllum</i>	e	1								1	1			1		1			
<i>Archontophoenix cunninghamiana</i>	n					1		1	1										
<i>Asplenium australasicum</i>	n				1											1			
<i>Aster subulatus</i>	e																		
<i>Austromyrtus dulcis</i>	n							1											
<i>Axonopus fissifolius</i>	e	1				1					1	1	1		1	1		1	1
<i>Baccharis halimifolia</i>	W3					1													
<i>Bacopa monniera</i>	n					1			1	1									
<i>Banksia integrifolia</i>	n																	1	1
<i>Banksia robur</i>	n																		1
<i>Baumea articulata</i>	n						1								1				
<i>Baumea juncea</i>	n						1											1	
<i>Baumea rubiginosa</i>	n					1	1		1										1
<i>Bidens pilosa</i>	e	1														1			
<i>Blechnum sp</i>	n		1	1	1	1		1	1								1		1
<i>Callistemon pachyphyllus</i>	n					1													
<i>Callistemon salignus</i>	n	1	1							1				1					
<i>Carex appressa</i>	n				1	1		1	1										
<i>Casuarina glauca</i>	n			1	1		1	1			1			1		1		1	
<i>Centella asiatica</i>	n		1			1				1	1	1	1		1	1		1	1
<i>Cinnamomum camphora</i>	W4				1	1	1	1	1					1					
<i>Commelina cyanea</i>	n		1							1			1			1			
<i>Corymbia intermedia</i>	n																	1	
<i>Crassocephalum crepidioides</i>	e															1			1
<i>Cupaniopsis anacardioides</i>	n	1			1	1			1										
<i>Cuphea carthagenensis</i>	e											1	1	1		1			
<i>Cynodon dactylon</i>	n										1			1		1		1	
<i>Cyperus brevifolius</i>	n										1			1					
<i>Cyperus eragrostis</i>	e																		1
<i>Cyperus flavidus</i>	n																		1
<i>Cyperus sesquiflorus</i>	n									1	1								
<i>Cyperus sp</i>	n												1					1	
<i>Dianella sp</i>	n																		1
<i>Digitaria didactyla</i>	n		1									1							
<i>Drymaria cordata</i>	n				1														
<i>Elaeocarpus grandis</i>	intr															1			
<i>Elaeocarpus reticulatus</i>	n																1		
<i>Epilobium billardierianum</i>	e				1										1				1
<i>Eragrostis elongata</i>	n																	1	1
<i>Ficus coronata</i>	n									1									
<i>Ficus obliqua</i>	n								1										
<i>Gahnia sp</i>	n					1											1	1	

Status: n=native, e=exotic, intr=introduced native, W=weeds as listed on <http://www.agric.nsw.gov.au/ap/weeds/>

		Presence in Community / Plot																				
		1	2	2	2	3	3	3	3	3	4	4	4	4	4	5	6	6	7	8	9	9
Scientific name	Status	1	2	26	27	5	6	7	8	3a	10	12	13	4a	23	11	3	4	14	21	9	24
<i>Glochidion sumatranum</i>	n	1			1	1	1	1	1	1						1	1	1				
<i>Gonocarpus chinensis</i>	n																			1		
<i>Hemarthria uncinata</i>	n					1									1					1	1	1
<i>Hibbertia scandens</i>	n							1														
<i>Histiopteris incisa</i>	n																1					
<i>Hydrocotyle bonariensis</i>	e															1						
<i>Hydrocotyle laxiflora</i>	n																			1		
<i>Hypochoeris radicata</i>	n																			1		
<i>Hypolepis muelleri</i>	n				1	1			1								1	1				
<i>Ipomoea cairica</i>	W4	1			1	1	1	1	1						1						1	
<i>Isachne globosa</i>	n													1								
<i>Ischaemum australe</i>	n					1									1					1	1	
<i>Juncus cognatus</i>	n										1			1								
<i>Juncus polyanthemus</i>	n														1							
<i>Juncus usitatus</i>	n		1							1	1											
<i>Lantana camara</i>	W4		1			1				1							1	1				
<i>Leersia hexandra</i>	n																	1			1	1
<i>Lepironia articulata</i>	n					1	1	1														
<i>Lespedeza striata</i>	e										1			1								
<i>Ligustrum sinense</i>	W4				1																	
<i>Lophostemon confertus</i>	n																		1			
<i>Lophostemon suaveolens</i>	n																			1		
<i>Ludwigia octovalvis</i>	n	1														1						
<i>Lygodium microphyllum</i>	n								1								1				1	
<i>Maclura cochinchinensis</i>	n		1																			
<i>Marsdenia rostrata</i>	n																1					
<i>Melaleuca quinquenervia</i>	n		1	1	1	1	1	1	1	1					1	1			1		1	
<i>Melicope elleryana</i>	n																1	1				
<i>Mimosa pudica var hispida</i>	e									1												
<i>Omalanthus populifolius</i>	n			1	1				1								1					
<i>Panicum maximum</i>	e									1											1	
<i>Parsonsia straminea</i>	n		1	1	1	1	1	1	1	1							1				1	
<i>Paspalidium distans</i>	n																			1		
<i>Paspalum conjugatum</i>	e	1			1	1	1	1	1	1										1	1	
<i>Paspalum orbiculare</i>	n					1	1								1						1	
<i>Paspalum urvillei</i>	e	1								1			1						1		1	1
<i>Paspalum wettsteinii</i>	e	1								1												
<i>Passiflora suberosa</i>	n									1												
<i>Pennisetum clandestinum</i>	e										1			1								
<i>Persicaria strigosa</i>	n				1			1	1								1	1				
<i>Philydrum lanuginosum</i>	n																	1				
<i>Phragmites australis</i>	n	1		1		1											1	1			1	1
<i>Phytolacca americana</i>	e																	1				
<i>Platycerium superbum</i>	n			1	1																	
<i>Polygala paniculata</i>	e									1				1								
<i>Pratia purpurascens</i>	n																			1		
<i>Psilotum nudum</i>	n							1														

Status: n= native, e= exotic, intr= introduced native, W= weeds as listed on <http://www.agric.nsw.gov.au/ap/weeds/>

		Presence in Community / Plot																				
		1	2	2	2	3	3	3	3	3	4	4	4	4	4	5	6	6	7	8	9	9
Scientific name	Status	1	2	26	27	5	6	7	8	3a	10	12	13	4a	23	11	3	4	14	21	9	24
<i>Ranunculus inundatus</i>	n	1														1						
<i>Restio tetraphyllus</i>	n			1																		
<i>Sacciolepis indica</i>	e										1			1								
<i>Schefflera actinophylla</i>	int									1							1					
<i>Schoenus brevifolius</i>	n			1																		1
<i>Senecio madagascariensis</i>	e										1			1		1					1	
<i>Senna pendula</i> var. <i>glabrata</i>	W4					1				1												
<i>Setaria palmifolia</i>	e																				1	
<i>Setaria</i> sp	e	1	1				1			1	1	1	1	1	1	1		1	1			
<i>Solanum mauritianum</i>	n																				1	
<i>Solanum nigrum</i>	e				1																	
<i>Sonchus oleraceus</i>	e															1						
<i>Spiranthes sinensis</i>	n										1			1								
<i>Sporobolus fertilis</i>	W4									1									1			
<i>Tagetes minuta</i>	e									1												
<i>Trifolium repens</i>	e										1			1								
<i>Urochloa mutica</i>	e																1				1	
<i>Villarsia exalata</i>	n					1															1	

Status: n=native, e=exotic, intr=introduced native, W=weeds as listed on <http://www.agric.nsw.gov.au/ap/weeds/>

Appendix 3

Survey Plot Coordinates

(No. of pages excluding this page = 1)

Survey Plot Coordinates

Community	Plot	Community name	Coordinates (agd66)	
1	1	<i>Casuarina glauca</i> Woodland	554425	6874775
2	2	<i>Casuarina glauca</i> Swamp Open Forest	554000	6874300
2	26	<i>Casuarina glauca</i> Swamp Open Forest	555881	6874186
2	27	<i>Casuarina glauca</i> Swamp Open Forest	555150	6873550
3	3a	<i>Melaleuca quinquenervia</i> Swamp Open Forest	554825	6873775
3	5	<i>Melaleuca quinquenervia</i> Swamp Open Forest	555600	6873800
3	6	<i>Melaleuca quinquenervia</i> Swamp Open Forest	554900	6873850
3	7	<i>Melaleuca quinquenervia</i> Swamp Open Forest	555200	6873652
3	8	<i>Melaleuca quinquenervia</i> Swamp Open Forest	555500	6873600
4	4a	<i>Setaria</i> sp Grassland	554800	6873900
4	10	<i>Setaria</i> sp Grassland	553725	6873200
4	12	<i>Setaria</i> sp Grassland	554625	6874025
4	13	<i>Setaria</i> sp Grassland	554125	6874250
4	23	<i>Setaria</i> sp Grassland	555125	6873875
5	11	<i>Casuarina glauca</i> & rainforest plantings	554575	6873750
6	3	<i>Melicope elleryana</i> Swamp Woodland	556100	6874100
6	4	<i>Melicope elleryana</i> Swamp Woodland	556001	6874200
7	14	<i>Corymbia intermedia</i> Open Forest	554575	6874650
8	21	<i>Hemarthria uncinata</i> - <i>Ischaemum australe</i> Grassland	555300	6875150
9	9	<i>Baumea rubiginosa</i> - <i>Phragmites australis</i> Mixed Grassland	555750	6873850
9	24	<i>Baumea rubiginosa</i> - <i>Phragmites australis</i> Mixed Grassland	555875	6874175

Appendix 4

Areas of Vegetation Communities in the Locality

(No. of pages excluding this page = 2)

Areas of Vegetation Communities in the Locality

Page 1 of 2

Area ID	% land cover by area	Formation: Class	Min Area (ha)	Max Area (ha)
16504	(<1%)	DSF(sh):Coastal Dune Dry Sclerophyll Forests	1	32
16517	(<1%)	DSF(sh):Coastal Dune Dry Sclerophyll Forests	1	64
16534	(<1%)	DSF(sh):Coastal Dune Dry Sclerophyll Forests	1	64
		subtotal	3	160
16504	(<1%)	DSF(sh):North Coast Dry Sclerophyll Forests	1	32
16516	(<1%)	DSF(sh):North Coast Dry Sclerophyll Forests	1	64
16517	(<1%)	DSF(sh):North Coast Dry Sclerophyll Forests	1	64
16518	(<1%)	DSF(sh):North Coast Dry Sclerophyll Forests	1	6
16534	(<1%)	DSF(sh):North Coast Dry Sclerophyll Forests	1	64
16535	(1 - 10%)	DSF(sh):North Coast Dry Sclerophyll Forests	2	19
		subtotal	7	249
16504	(<1%)	FOW:Coast and Tableland Riverine Forests		
16504	(1 - 10%)	FOW:Coastal Floodplain Wetlands	32	320
16505	(1 - 10%)	FOW:Coastal Floodplain Wetlands	1	32
16516	(1 - 10%)	FOW:Coastal Floodplain Wetlands	64	640
16517	(1 - 10%)	FOW:Coastal Floodplain Wetlands	64	640
16518	(10 - 50%)	FOW:Coastal Floodplain Wetlands	64	320
16534	(1 - 10%)	FOW:Coastal Floodplain Wetlands	64	640
16535	(10 - 50%)	FOW:Coastal Floodplain Wetlands	19	96
		subtotal	308	2688
16504	(<1%)	FOW:Coastal Swamp Forests	1	32
16516	(<1%)	FOW:Coastal Swamp Forests	1	64
16517	(1 - 10%)	FOW:Coastal Swamp Forests	64	640
16518	(1 - 10%)	FOW:Coastal Swamp Forests	6	64
16534	(1 - 10%)	FOW:Coastal Swamp Forests	64	640
16535	(1 - 10%)	FOW:Coastal Swamp Forests	2	19
		subtotal	138	1459
16504	(1 - 10%)	FRW:Coastal Heath Swamps	32	320
16517	(<1%)	FRW:Coastal Heath Swamps	1	64
16518	(<1%)	FRW:Coastal Heath Swamps	1	6
16534	(1 - 10%)	FRW:Coastal Heath Swamps	64	640
16535	(1 - 10%)	FRW:Coastal Heath Swamps	2	19
		subtotal	100	1049
16504	(1 - 10%)	GW:Coastal Valley Grassy Woodlands	32	320
16505	(1 - 10%)	GW:Coastal Valley Grassy Woodlands	64	640
16516	(1 - 10%)	GW:Coastal Valley Grassy Woodlands	64	640
16517	(1 - 10%)	GW:Coastal Valley Grassy Woodlands	64	640
16518	(1 - 10%)	GW:Coastal Valley Grassy Woodlands	6	64
16534	(1 - 10%)	GW:Coastal Valley Grassy Woodlands	64	640
16535	(1 - 10%)	GW:Coastal Valley Grassy Woodlands	2	19
		subtotal	296	2963

Areas of Vegetation Communities in the Locality

Page 2 of 2

Area ID	% land cover by area	Formation: Class	Min Area (ha)	Max Area (ha)
16504	(<1%)	HL:Wallum Sand Heaths	1	32
16505	(10 - 50%)	HL:Wallum Sand Heaths	32	320
16517	(<1%)	HL:Wallum Sand Heaths	1	64
16518	(10 - 50%)	HL:Wallum Sand Heaths	64	320
16534	(1 - 10%)	HL:Wallum Sand Heaths	64	640
16535	(10 - 50%)	HL:Wallum Sand Heaths	19	96
		subtotal	181	1472
16504	(<1%)	RF:Littoral Rainforests	1	32
16517	(<1%)	RF:Littoral Rainforests	1	64
16518	(<1%)	RF:Littoral Rainforests	1	62
16534	(<1%)	RF:Littoral Rainforests	1	64
16504	(10 - 50%)	RF:Subtropical Rainforests	320	1600
16505	(10 - 50%)	RF:Subtropical Rainforests	32	160
16516	(1 - 10%)	RF:Subtropical Rainforests	64	640
16517	(1 - 10%)	RF:Subtropical Rainforests	64	640
16518	(10 - 50%)	RF:Subtropical Rainforests	32	160
16534	(1 - 10%)	RF:Subtropical Rainforests	64	640
16535	(1 - 10%)	RF:Subtropical Rainforests	2	19
		subtotal	582	4081
16504	(1 - 10%)	WSF(s):North Coast Wet Sclerophyll Forests	64	640
16516	(1 - 10%)	WSF(s):North Coast Wet Sclerophyll Forests	64	640
16517	(1 - 10%)	WSF(s):North Coast Wet Sclerophyll Forests	64	640
16534	(1 - 10%)	WSF(s):North Coast Wet Sclerophyll Forests	64	640
16535	(10 - 50%)	WSF(s):North Coast Wet Sclerophyll Forests	19	96
			275	2656
Source: http://maps.environment.nsw.gov.au/stateveg/default.htm				

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Appendix 5

Coverage of Environmental Assessment Requirements

(No. of pages excluding this page = 2)

Table A5-1
Coverage of Environmental Assessment Requirements and Environmental Issues in the Flora Assessment

Page 1 of 2

ENVIRONMENTAL REQUIREMENTS RAISED BY THE DIRECTOR-GENERAL RELATING TO FLORA (06.01.06)		
		Relevant Section(s)
Key Assessment Requirements , namely: <ul style="list-style-type: none"> <i>Flora</i> - Assess the following potential impacts of the Project (including any potential cumulative impacts that may arise from the combined operation of the Project with the existing or approved operations at the Bolster Quarry), and describe what measures would be implemented to avoid, minimise, mitigate, offset, manage and/or monitor these impacts. 		S4, S5
References Refer to the: <ul style="list-style-type: none"> draft <i>Guidelines for Threatened Species Assessment</i> (Department of Environment and Conservation) 		S5.3
ENVIRONMENTAL REQUIREMENTS RAISED BY GOVERNMENT AGENCIES RELATING TO FLORA		
Government Agency	Paraphrased Requirement	Relevant Section(s)
Department of Environment and Conservation (15 October 2004)	Provide maps showing the locality of the proposed development in a regional and local context. Base local context maps on 1:25 000 topographic plans.	Figure 1
	Provide a description of: <ul style="list-style-type: none"> the existing environment on the subject and surrounding land; the proposed development and ancillary works; and the manner in which the environment will be modified by the proposal. 	S2 S1.1 and 1.2 S5
	Clearly identify on an appropriately scaled plan the area subject to development.	Figure 2
	Consult the general requirements from the EIS Guidelines Extractive Industries – Dredging and other extraction in riparian and coastal areas during the preparation of the EIS.	S5.5
	Document surveys and assessments that have been undertaken by suitably qualified persons and provide the qualifications and experience of the person(s) undertaking the work.	S1.3, 1.5

Table A2-1 (Cont'd)
Coverage of Environmental Assessment Requirements and Environmental Issues in the Flora Assessment

Page 2 of 2

ENVIRONMENTAL REQUIREMENTS RAISED BY GOVERNMENT AGENCIES RELATING TO FLORA		
Government Agency	Paraphrased Requirement	Relevant Section(s)
Department of Environment and Conservation (Cont'd) (15 October 2004)	Describe dates, site locations, design, methodology, analysis techniques, and weather conditions at the time of the assessments and surveys. The limitations of surveys should be identified and the results interpreted accordingly.	S1.5 and S1.6
	Substantiate conclusions drawn in surveys and assessments with evidence resulting from those surveys and assessments.	S4, S5
	Carry out a flora and fauna assessment, including an eight-part test under section 5A of the EP&A Act.	S5
	Provide a comprehensive description of the vegetation on the site. Include an assessment of the condition of the plant communities present, including the designation of conservation significance at a local, regional and State level, an assessment of the likely occurrences of any threatened species, populations or ecological communities listed under Schedules 1 or 2 of the <i>Threatened Species Conservation Act 1995</i> and any Rare or Threatened Australian Plant (ROTAP) species.	S2
	Provide a plan showing the distribution of any threatened or ROTAP species and the vegetation communities on the site, and the extent of vegetation proposed to be cleared at the same scale as the plan of the area subject to development.	Figure 3
	Determine the effect of the proposed development on threatened species, populations or ecological communities, or their habitats should be determined in accordance with the eight part test described in Section 5A of the <i>Environmental Planning and Assessment Act 1979</i> .	S5
	Provide an assessment of the existence or likely occurrence of threatened species, populations or ecological communities, or their habitats on the subject land and where identified assess in accordance with the eight point test described in Section 5A of the <i>Environmental Planning and Assessment Act 1979</i> .	Tables 1 & 2, S4
	Include a rehabilitation plan detailing the location, spatial area, depth and ecology of the wetlands to be created including a comprehensive list of species to be used in the rehabilitation works. Plant species used in the rehabilitation works should be native species indigenous to the local area.	S4.2 and <i>Environmental Assessment</i> S2.14

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