




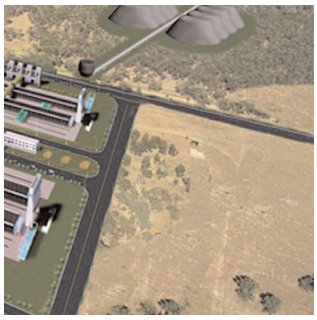

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6.1 Terrestrial Flora

Summary

A terrestrial flora study was undertaken for the Queensland Coke and Power Plant Project (the Project) to identify the current extent of vegetation communities within the project area, determine the conservation values of the flora of the site, assess the potential impacts from the project and develop appropriate management strategies for the mitigation of potential impacts. A desktop review of existing information was conducted, and previous vegetation mapping for the site was updated. A field investigation was also undertaken to examine the current distribution of species of conservation significance.

A total of 233 plant species, representing 170 genera and 68 families of vascular plants were recorded in the broader area of the project site. Fifty-seven exotic or introduced plant species were recorded for the site, nine of which are currently 'declared species' and are identified as being of management concern. Ten primary vegetation communities were described and mapped for the broader study area on the basis of aerial photograph interpretation and field survey results. *Eucalyptus raveretiana* (Black Ironbox) was identified by the flora survey and is listed as "vulnerable" under both State and Commonwealth legislation. Three vegetation communities found within the broader site were identified as holding conservation status under the Queensland *Vegetation Management Act 1999* (VM Act), one of which is also listed as "Endangered" under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act).

An area of approximately 37 ha will potentially be affected by proposed vegetation removal. A relatively small area of two 'Of concern' regional ecosystems (approximately 19 ha), in the context of the bioregion, would be potentially affected by vegetation removal. Approximately 0.6 hectares (ha) of regional ecosystem classified as No Concern at Present at Fisherman's Landing will require clearing for the construction of the western section of the rail load out to shipping berth conveyor system. It is considered that the vegetation removal proposed for the Project will not have any significant impact upon flora species, vegetation communities or habitat connectivity on a regional scale, or the ecosystem function of the integral vegetation communities found on-site. Management measures are outlined for the mitigation of potential impacts on vegetation communities, significant species, control of weed species and air emissions impacts.

6.1.1 Description of Environmental Values

Study Objective

The objective of the terrestrial flora study was to interpret previous vegetation mapping of the study site and identify areas of conservation significance. In meeting this objective, the tasks carried out in the flora survey comprised:

- Review of existing terrestrial vegetation data for the local area and region;

- Identification of the occurrence or expected occurrence of significant plant species (in terms of rarity and habitat value);
- Description of weed species in the study area, with particular regard to 'declared' weeds;
- Assessment of the value of any areas that may be disturbed by the Project for vegetation conservation; and
- Determination of impact of the Project on the surrounding vegetation and develop appropriate management strategies.

Study Approach

In meeting the above objective the overall approach for the terrestrial flora study was to describe the vegetation of the project site with reference to existing studies. This was achieved primarily through a desktop impact study that interpreted previous mapping of vegetation communities of the study site (Dames & Moore, 1999), and a number of other information sources described below. Current aerial photography of the site (Department of Natural Resources and Mines (DNRM), 2004a) was utilised to update previous vegetation mapping to redefine the current extent of communities, and include areas that have since been subject to disturbance since the time of initial mapping. In addition to the desktop study, a site inspection was undertaken to determine current extent of species of conservation significance, with particular regard to potential impacts upon riparian vegetation.

Review of Existing Information

In order to identify the range of species and communities that may inhabit the region and area, reviews of existing data from the Queensland Herbarium (HERBRECS 2005) database were conducted for the area 23°25' - 23°33; 150°16' - 150°24' in June 2005.

Data Sources

Existing data on flora of the study area were compiled through review of the following key references:

- HERBRECS database (HERBRECS 2005);
- Qld Environmental Protection Agency (EPA) 1:100 000 Certified Regional Ecosystems mapping;
- Environment Australia online EPBC database;
- Australian Magnesium Corporation (AMC) Draft EIS (Dames & Moore, 1999);
- Central Queensland information paper to support regional natural resource management planning - Volume 6 Fitzroy Catchment (CRC, 2003); and
- Central Queensland Strategy for Sustainability (CQSS) Fitzroy Basin Association (2004).

It should be noted that the EPA Corveg database was not sourced as a reference, and it was not considered an appropriate resource for the purposes of this literature review. Corveg data is derived from select sites within relatively undisturbed ecosystems and is most commonly utilised as a reference for assessing the structure and floristics of vegetation communities in a pre-disturbed condition.

Target Species Identification

Threatened, significant or otherwise noteworthy flora[1] identified from the HERBRECS database (HERBRECS 2005) are summarised in Appendix G.4. From this list, an assessment of potential presence was made based on habitat present on the site. Species identified as being potentially present in the project area were targeted during the field assessment.

Regional Context

Bioregion

The study site is situated within the northern Brigalow Belt bioregion. The bioregions of Queensland are based on landscape patterns that reflect changes in geology and climate, as well as major changes in floral and faunal assemblages at a broad scale and are used as the fundamental framework for the planning and conservation of biodiversity. Nature conservation of the Brigalow Belt bioregion has received increasing attention due to the rapid and extensive loss of habitat that has occurred. Major impacts upon vegetation of the Brigalow Belt include tree clearing, high grazing pressure and the proliferation of exotic species such as the prickly pear.

Sub-region

The Brigalow Belt bioregion contains 36 sub-regions or provinces that delineate significant differences in geology and geomorphology (Morgan, 1988). The Project is situated within the Mount Morgan Ranges Province. The landscape of this province is predominantly rugged to hilly country formed on the Palaeozoic rocks of the coastal ranges inland of Rockhampton. The steeper areas are dominated by Narrow-leaved Ironbark (*Eucalyptus crebra*) woodlands with Red Bloodwood (*Corymbia erythrophloia*) and Spotted Gum (*C. citriodora*). Silver-leaved Ironbark (*Eucalyptus melanophloia*) woodlands are commonly formed on the erosional lower slopes of the province, while Gum Topped Box (*E. moluccana*) forms woodlands on colluvial slopes. Forest Red Gum (*E. tereticornis*) and Moreton Bay Ash (*C. tessellaris*) occur on the alluvial soils (Sattler and Williams, 1999). Currently there are 96,566 ha of remnant vegetation within the province, of which 4,781 ha currently exists within protected areas (CRC, 2003).

[1] Threatened species relate to species identified by Queensland *Nature Conservation (Wildlife) Regulation 1994* (NC Regulation) under the *Nature Conservation Act1992* (NC Act) and EPBC Act as critically endangered, endangered or vulnerable. Significant species are species that carry other legislation status or those that occur at the extent of their natural geographic range.

Regional Ecosystems

Regional Ecosystems (REs) describe the relationships between major floral species and the environment at the regional scale. They are mostly derived from linking vegetation mapping units recognised at a scale of 1:100,000 to land zones that represent major environmental variables, in particular geology, rainfall and landform. Seventy-six REs are identified for the Mount Morgan Ranges province, of these 27 REs are currently of conservation significance listed as either 'Of concern' (13) or 'Endangered' (14) under the VM Act. REs of relevance to the project area are discussed in Significant Communities below.

Survey Results

This section documents the floristics and vegetation communities of the broader vegetation study area (Figure 6.1). The methodology used for flora field survey and vegetation mapping (Dames & Moore, 1999) is described in detail in Appendix G.1. Detailed community descriptions and quantitative data including floristics and structure for each survey site are detailed in Appendix G.2.

Species Diversity

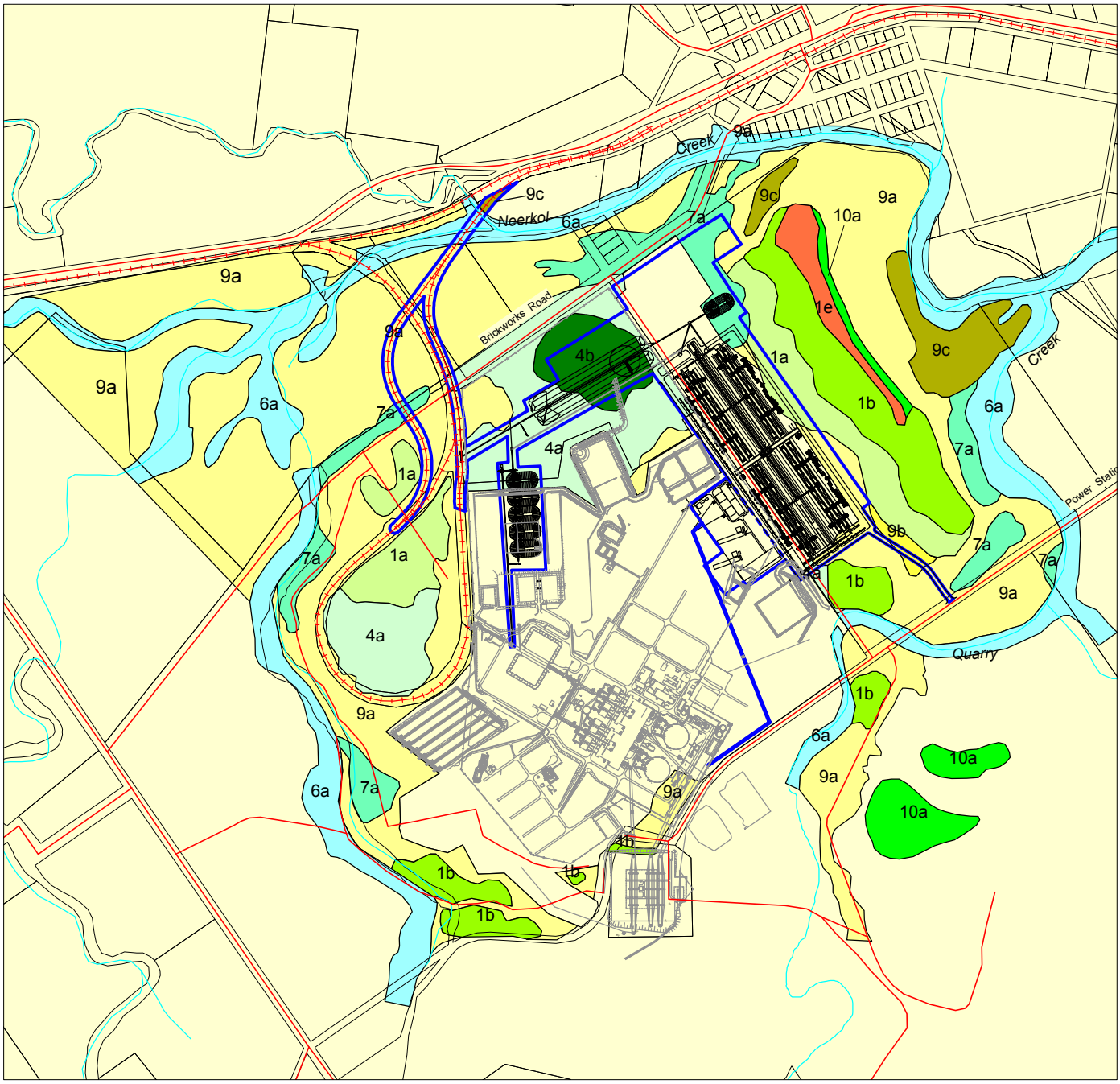
A total of 233 plant species, representing 170 genera and 68 families of vascular plants were recorded in the project area. Plant families represented by four or more were: Poaceae (37); Asteraceae (15); Myrtaceae (15); Fabaceae (14); Euphorbiaceae (10); Malvaceae (10); Mimosaceae (9); Rubiaceae (8); Asclepidacea (7); Apocynaceae (6); Cyperaceae (5); Moracea (5); Rutaceae (5); Capparaceae (4); Myoporaceae (4) and Sapindaceae (4).

Genera represented by three or more species were: *Acacia* (8); *Eucalyptus* (6); *Cyperus* (5); *Aristida* (5); *Capparis* (4); *Corymbia* (4); *Eragrostis* (4); *Ficus* (4); *Panicum* (4); *Sida* (4); *Canthium* (3); *Melaleuca* (3) and *Solanum* (3). A full flora species list by vegetation unit for the project area is included in Appendix G.3.

Vegetation Communities

Ten primary vegetation communities were described and mapped for the broader study area on the basis of aerial photograph interpretation and field survey results (Dames & Moore, 1999). This vegetation mapping has been revised utilising current aerial photography of the site (DNRM, 2004a) to indicate the further extent of clearing that has been undertaken since the initial flora survey (Figure 6.1). The development footprint of the project site overlies a relatively large area of previous disturbance, attributed to clearing associated with the footprint of the former AMC project. The previous area of disturbance associated with the AMC site is approximately 39 ha, as delineated in Figure 6.2.

Table 6.1.1 details total areas for each vegetation community presently found within the broader project site, and the total extent for each vegetation community found within the sub-region (as defined by RE types within the northern Mount Morgan Ranges province). Full ecological descriptions for each community including disturbance notes are given in Appendix G.2.



LEGEND

- 1a Narrow-leaved Ironbark *(E. crebra)* Woodland / Open woodland (RE 11.11.15)
- 1b Narrow-leaved Ironbark *(E. crebra)* with Rosewood *(A. rhodoxylon)* Open forest/ Woodland (RE 11.11.1)
- 1e Ridgeline Narrow-leaved Ironbark *(E. crebra)* / Queensland Peppermint *(E. exserta)* Woodland / Open woodland (RE 11.12.1a)
- 4a Poplar Box *(E. populnea)* / Narrow-leaved Ironbark *(E. crebra)* Open forest / Woodland (RE 11.3.4)
- 4b Mixed Eucalypt *(E. populnea / E. tereticornis / C. tesselleris / E.crebra)* Open forest (RE 11.3.2)
- 6a Forest Red Gum *(E. tereticornis)* / Ironbox *(E. raveretiana)* Riparian woodland (RE 11.3.24A)
- 7a Forest Red Gum *(E. tereticornis)* / Moreton Bay Ash *(C. tesselleris)* Woodland / Open forest (RE 11.3.4)
- 9a Modified Pastoral Grassland
- 9b Shrubby Regrowth
- 9c Cultivated Land
- 10a Semi-evergreen Vine Thicket (RE 11.11.18)

- Existing Stanwell Power Station
- Proposed Coke and Power Plant
- Proposed Development Footprint
- Creek
- Road
- Railway

0 500m 1000m

Scale 1:25 000 (A4)

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ENVIRONMENTAL IMPACT STATEMENT

VEGETATION COMMUNITIES OF THE STUDY SITE

Drawn: VH	Approved: JMcD	Date: 06-01-06	Figure: **6.1**	Rev:B
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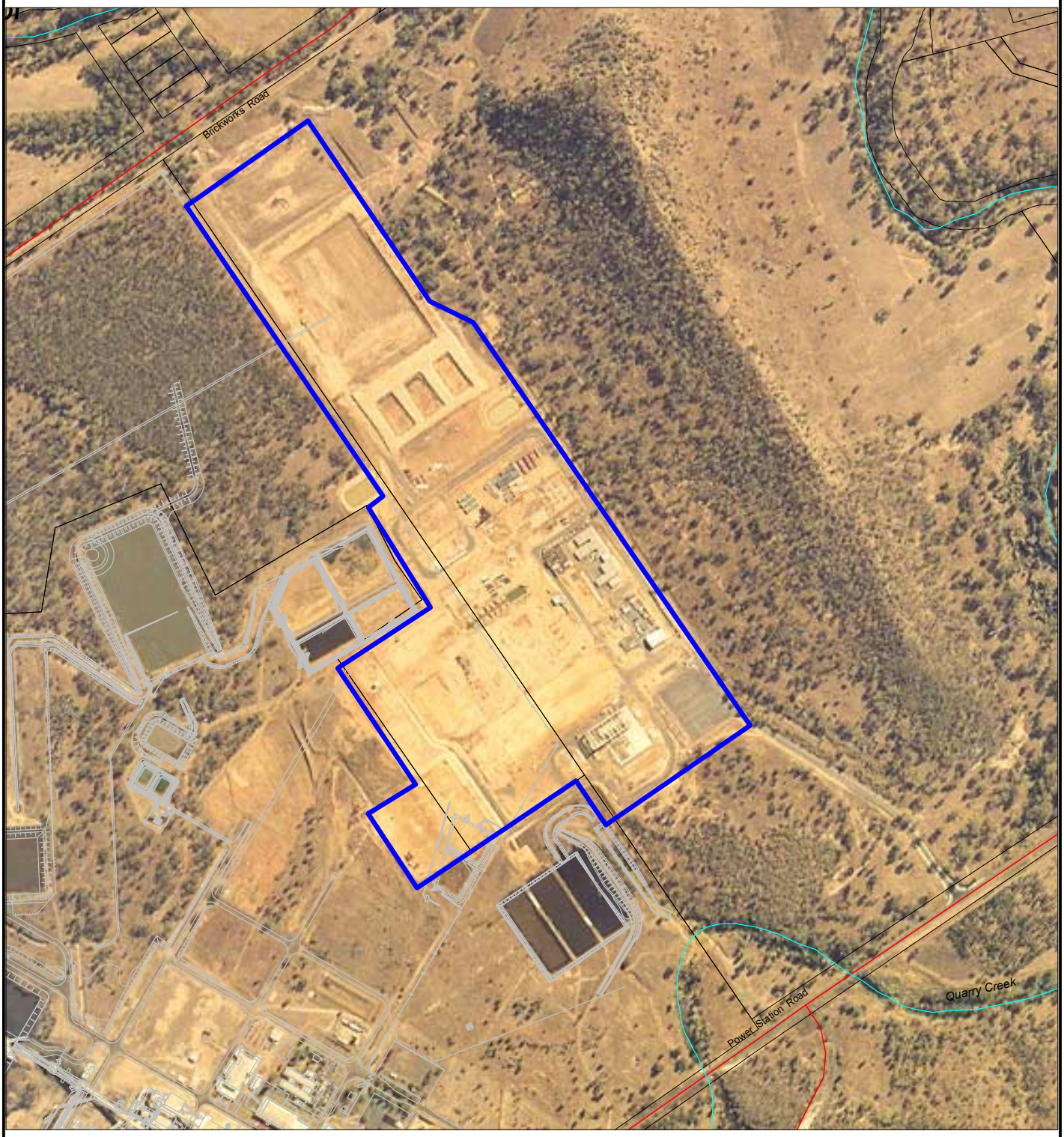

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0 125m 250m
Scale

LEGEND

- Area of disturbance AMC site
- Existing Stanwell Power Station
- Creek
- Road
- Railway

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ENVIRONMENTAL IMPACT STATEMENT

AREA OF DISTURBANCE PREVIOUSLY ASSOCIATED WITH AMC SITE

Drawn: VH	Approved: JMcD	Date: 06-01-06	Figure: **6.2**	Rev:B
Job No: **42625626**	File No: 42625626-g-009b.wor			**A4**

Table 6.1.1 Extent of Vegetation Communities Found within the Broader Study Site and within the Sub-region

Community Description		Landzone	Regional Ecosystem (RE)	Area in Study Site (ha)	Total[1] Area in Sub-region (ha)
1a	*Eucalyptus crebra* woodland / open woodland	Hill slopes and rises on course sedimentary rocks	11.11.15	35.0	112,252
1b	*Eucalyptus crebra I* with *Acacia rhodoxylon* open forest / woodland	Hill slopes and rises on course sedimentary rocks	11.11.1	42.1	2,340
1e	Ridgeline *Eucalyptus crebra* / *E. exserta* woodland / open forest	Hill slopes and rises on course sedimentary rocks	11.12.1a	7.5	40,114
4a	*Eucalyptus populnea* / *E. crebra* open forest / woodland	Alluvial river and creek flats	11.3.4	54.7	16,551
4b	*Eucalyptus populnea* / *E. tereticornis*/ *Corymbia tessellaris*/ *E. crebra* open forest	Alluvial river and creek flats	11.3.2	13.4	1,732
6a	*Eucalyptus tereticornis* / *E. raveretiana* riparian woodland	Alluvial river and creek flats	11.3.25a	120.23	11,869
7a	*Eucalyptus tereticornis / Corymbia tessellaris* woodland / open forest	Alluvial river and creek flats	11.3.4	38.9	16,551
9a	Modified pastoral grassland	Alluvium / fine grained sedimentary rocks	-	314	-
9b	*Acacia harpophylla* shrubby regrowth	Coarse grained sediment	-	2.2	-
9c	Cultivated Land	Alluvial river and creek flats	-	16.7	-
10a	Semi- evergreen vine thicket	Hill crests on coarse grained metamorphosed rocks	11.11.18	15.7	3,705

Note: [1] Derived from RE data for the northern Mount Morgan Ranges Province as per Accad *et. al.* (2003)

Weeds of Concern

At the time of the initial flora survey 57 exotic or introduced plant species were recorded for the study site. These exhibited a moderate to high incidence of occurrence, particularly in areas used more heavily for cattle grazing, cropping or more greatly influenced by previous site disturbances such as clearing, fire, and uncontrolled site access (Dames & Moore, 1999). Subsequent site investigation conducted by URS in April 2005 reveals the presence of Para Grass (*Urochloa mutica*) in relatively high abundance within the riparian vegetation communities of Neerkol Creek and in particularly high density to the south of the site within Quarry Creek (Plates 6.14 and 6.15). Although known to occur in the area, Castor Oil Bush, Chinee Apple, Belly-Ache Bush and Parkinsonia were not found during the site investigation.

Eight of the weed species described for the broader study site were identified as being of current management concern (Table 6.1.2). These are listed as pest species by the Department of Natural Resources and Mines under the *Land Protection (Pest and Stock Route Management) Act 2002* (Qld). The management of these weed species requires coordination and landowners are required to take reasonable steps to keep land free of declared Class 2 and Class 3 species.

Two of these weed species, Parthenium and Rubber vine, are also listed as a Weeds of National Significance (WONS). This is a list of species developed by ANZECC (1997) which identifies weeds causing significant environmental damage on a national scale.

Table 6.1.2 Declared Exotic Species Identified within the Broader Study Site

Scientific Name	Common Name	Vegetation communities	Declared Status[1]
Cryptostegia grandiflora	Rubber vine	1a, 1b, 1e, 4a, 4b, 6a, 7a, 9a, 9b, 9c, 10a	Class 2
Eriocereus martinii	Harrisia cactus	1b	Class 2
Lantana Camara	Lantana	1a, 1b, 1e, 4a, 4b, 6a, 7a, 9a, 9b, 9c, 10a	Class 2
Lantana montevidensis	Creeping lantana	1a, 1b, 1e, 4a, 4b, 6a, 7a, 9a, 9b, 9c, 10a	Class 2
Opuntia aurantiaca	Gracemere prickly pear	1b, 1e, 6a, 10a	Class 2
Opuntia stricta	Common prickly pear	1a, 1b, 1e, 4a, 4b, 6a, 7a, 9a, 9b, 9c	Class 2
Parthenium hysterophorus	Parthenium	6a, 7a	Class 2
Schinus terebinthifolius	Broad-leaved pepper tree	6a	Class 3

Note: [1] Declared under the *Land Protection (Pest and Stock Route Management) Act 2002*

Parthenium

Parthenium exhibits the highest incidence of occurrence of exotic species on site. Incidences of Parthenium were found in the majority of surveyed vegetation communities across the site (except Vegetation Unit 3c: Semi-evergreen vine thicket), with particularly heavy infestation found in the modified open grass land communities to the south of the site, and in the grassy understorey of *Eucalyptus populnea* open woodland associations.

Parthenium grows best on alkaline, clay-loam to heavy black clay soils but tolerates a wide variety of soil types. It aggressively colonises areas with poor groundcover and exposed soil such as wastelands, roadsides and overgrazed pastures. Drought and subsequent reduced pasture cover create the ideal opportunity for Parthenium weed to establish. Flooded country is also very prone to Parthenium infestation. Heavier infestations were particularly evident in areas previously used for intensive cattle grazing and areas prone to flooding. Within the Fitzroy catchment area, Parthenium is formally recognised as a priority for management action (CRC, 2003).

Prickly Pear species

A number of prickly pear species were found in vegetation communities across the study site area, however, densities of this species were low. Prickly pear was previously a major weed problem in central Queensland in the early 1900s. This cactus is now found over a larger area but is rarely a problem. During the 1920s and 1930s various biological control agents were released and now control this cactus in most areas.

Rubber Vine

This species was present in most communities and displayed a high incidence of occurrence within Semi-evergreen vine thicket vegetation and riparian communities. The presence of Rubber vine in these areas at the time of the survey is most likely to be in response to an absence of fire.

Rubber vine generally invades waterways initially, germinating in moist silt layers after rain. The plant smothers riparian vegetation and forms dense, sometimes impenetrable thickets. This species prefers areas where annual rainfall is between 400 and 1,400 mm. Infestations of rubber vine are now found throughout river systems of southern Cape York and the Gulf of Carpentaria, south along the coast to the Burnett River, and isolated infestations occur as far south as Gatton and as far west as the Northern Territory border. Infestations are common throughout central Queensland. Forms of control employed in the management of Rubber vine include mechanical removal and herbicide application. Within the Fitzroy catchment area, Rubber vine is formally recognised as a priority for management action (CRC, 2003).

Harrisia Cactus

Harrisia cactus is a perennial plant introduced to Queensland in the 1980s. Harrisia cactus is mainly a pest of brigalow and associated softwood country, however, infestations are now appearing in box and ironbark stands. The cactus is shade tolerant and reaches its maximum development in the shade and shelter of brigalow scrub, though established infestations can persist once scrub is pulled. Harrisia cactus is found in the Queensland central coast with known infestations in the Rockhampton and Mt Morgan districts. Forms of control employed in the management of Harrisia cactus include biological controls, mechanical removal and herbicide application.

Lantana species

Lantana is distributed throughout most coastal and sub-coastal areas of eastern Australia, from north Queensland to southern New South Wales. Lantana grows in a wide variety of habitats, from exposed dry hillsides to wet heavily shaded gullies. It forms dense thickets that smother and kill native vegetation, and are impenetrable for animals, people and vehicles. Lantana is a woody shrub that significantly contributes to fire loading in the understorey resulting in hotter bushfires. Several forms of control can be employed in the management of lantana including biological controls, mechanical removal, herbicide application and fire.

Broad-leaved Pepper Tree

Broad-leaved pepper tree is a multi-stemmed tree that grows to a height of 15 m. In Australia it is still considered to be in the early stages of spread, although its distribution is growing. It is considered to be a serious ecological threat in riparian vegetation and wetlands The Broad-leaved Pepper Tree contains toxins that are considered poisonous to livestock and humans. Forms of control employed in the management of Broad-leaved Pepper Tree include mechanical removal and herbicide control.

Vegetation of Conservation Significance

Significant Species

A single species, *Eucalyptus raveretiana* (Black Ironbox), was identified in the study area to be of conservation significance under current legislation. It is listed as "vulnerable" under both the EPBC Act, and the NC Regulation. *E. raveretiana* has a scattered and disjunct distribution in central coastal and sub-coastal Queensland, being almost always found along creek banks and river beds. This species is distributed from Dipperu National Park south-west of Mackay, northwards and north-westwards to Charters Towers, Bowen and Ayr, from Rockhampton and westwards, and to the Mackenzie River north of Duaringa (Brooker & Kleinig, 1994).

Regionally, *E. raveretiana* is considered to be relatively common, occurring along most streams within the Rockhampton region and to the north of Rockhampton (Forster *et. al.*, 1991). Within the study area *E. raveretiana* is found along the riparian communities of the Neerkol Creek and Quarry Creek systems within Vegetation unit 6a: *Eucalyptus tereticornis* /*E. raveretiana* riparian woodland (RE 11.3.25a). *E. raveretiana* is distributed along flat river beds and associated river banks of riparian vegetation, but is typically found interspersed with co-dominant species such *E. tereticornis* and *Callistemon* species at relatively wide spacings.

The presence of *E. raveretiana* was addressed in the Commonwealth Referral application under the EPBC Act for the Project. The Commonwealth decided that the proposed action of the development of the Project development was not a controlled action under the EPBC Act (Appendix C).

An investigation of the current presence and distribution of *E. raveretiana* within the riparian vegetation of Neerkol Creek was conducted by URS on the 13 of April 2005. Specifically, the area of vegetation potentially impacted by the proposed rail spur to the north of the site was surveyed. Results of the investigation conclude that the approximate area of the rail spur crossing Neerkol Creek is primarily comprised of banks vegetated with dense grass and Rubber vine, with some individuals of *E. tereticornis* present on the upper banks of the area (Plate 6.14). The area downstream of the rail spur site was found to be thickly wooded with several large *E. raveretiana* trees noted adjacent to the banks (Plate 6.2).

A number of other significant species have been identified within the EPA Wildnet database as existing in the broader region within habitat to the south of the project area. These include *Cycas megacarpa* (Endangered in the NC Act and EPBC Act) and *Capparis humistrata* (Endangered in the NC Act), however, these species were not found within the project site. These species were not identified in the floral survey, nor does habitat for these species currently exist within the project site.

None of the species identified in the flora survey that are present within vegetation associations potentially impacted by the Project, are currently identified as holding significance from a commercial or recreational standpoint.

No cultural values have previously been identified for any species as described in previous flora or cultural heritage studies for the area of the proposed Project (Dames & Moore, 1999). Species of cultural significance that might potentially be present within the broader study area include species traditionally

utilised for food or medicinal purposes, tree species utilised for their bark for painting, and wildflower species traditionally collected for decoration or adornment. Species of cultural value to the Darumbal People are discussed in Section 11 – Cultural Heritage.

Significant Communities

Three vegetation communities found within the broader study site are identified as holding conservation status under the VM Act. One of these communities is also listed as 'Endangered' under the EPBC Act. Primary conservation status of significant vegetation communities is listed in Table 6.1.3

Table 6.1.3 Vegetation Communities of Conservation Significance Surveyed at the Study Site

Community Description		Regional Ecosystem (RE)	Conservation Status
4a	*Eucalyptus populnea* /*E. crebra* open forest woodland on alluvial soils	11.3.4	Of concern[1]
4b	*Eucalyptus populnea* /*E. tereticornis* / *Corymbia tessellaris* /*E. crebra* open forest on alluvial soils	11.3.2	Of concern[1]
10a	Semi- evergreen vine thicket hill crests on coarse grained metamorphosed rocks	11.11.18	Endangered[1] Endangered[2]

Notes: [1] VM Act
[2] EPBC Act

In addition to the above communities of conservation significance, it should be noted that Vegetation unit 6a: *Eucalyptus tereticornis/E. raveretiana* riparian woodland (RE 11.3.25) holds a secondary Biodiversity status listing of 'Endangered' as determined by the EPA. Biodiversity status is similar to the Conservation Status determined under the VM Act and is based on the pre-clearing and remnant extent of a Regional Ecosystem. Unlike the Conservation Status under the VM Act, Biodiversity status is also based on an assessment of the condition of remnant vegetation. RE 11.3.25 is currently listed as 'Not of concern' under the VM Act, however its listing as 'Endangered' as determined by the EPA is cited as being "subject to high total grazing pressure, with more than 70% severely degraded, with the soil surface sealing and scalding with the A horizon removed" (REDD, 2005).

Habitat Connectivity

At a local scale, contiguous tracts of vegetation within the study site representing connectivity of habitat are primarily provided for by the riparian corridors associated with the local river systems. Connectivity to the north-west is primarily provided by the Quarry Creek riparian corridor, while connectivity in the east/west direction is primarily provided by the Neerkol Creek riparian corridor.

On a regional scale, most of the lowland landscapes in the study area and the region have been extensively cleared, although the more elevated/rugged topography of the sub-coastal hills remains relatively undisturbed. In terms of the connectivity of vegetation remnants, the study area is located within a vegetated corridor associated with sub-coastal sandstone and metamorphic hills. These hills retain much of their original open forest cover and provide an important north/south link, linking State Forest remnants to the north (SF 871 and SF 878) with areas of core habitat to the south at Mt Morgan.

They also connect numerous disjunct patches of closed forest in the form of Semi-evergreen vine thicket. The study site is located at the foot of these sub-coastal hills on the alluvial river flats.

Conservation Areas

The Stanwell Nature Refuge lies directly to the south of the project site and provides for conservation and buffering purposes. In addition to this, approximately 1 km to the south of the project site is an area of natural vegetation identified as "Essential Habitat" by the EPA for *Cycas megacarpa*. In addition, *Capparis humistrata* has also been recorded in the area. This area extends approximately 5 km to the south of the project site. Further detail on environmentally sensitive areas of the region is provided in Section 3 – Land Characteristics.

6.1.2 Potential Impacts and Mitigation Measures

Most areas of vegetation potentially impacted by the Project are associated with the proposed development of the Coke Plant at the Stanwell Energy Park (SEP), however, there is some remnant vegetation associated with the rail loop located at Fisherman's Landing. The development footprint of the proposed Power Plant and the reclaimed land at Fisherman's Landing are not vegetated and therefore are not included in the following analysis of vegetation impacts

Vegetation Removal

Impacts

An area of up to approximately 37.32 ha will potentially be affected by vegetation removal associated with the Project. An additional area of approximately 10.47 ha is expected to be removed for the construction of the rail spur. The impact of the vegetation removal associated with the rail spur construction is addressed in this section, however, it will be further assessed in environmental studies conducted by the rail infrastructure providers as detailed designs for the rail spur are finalised. Table 6.1.4 details the extent of specific vegetation communities proposed to be removed by the Project. The extent of each vegetation community as a percentage of that community presently found on the study site is also provided, as is the extent for each community as a percentage within the sub-region, as defined by RE type within the Mount Morgan Ranges Province.

Table 6.1.4 Extent of Vegetation Communities Proposed to be Disturbed by the Project

Community Description		Regional Ecosystem (RE)	Potential Disturbance		
			Area (ha)	Site[1] (%)	Sub-region[2] (%)
1a	*Eucalyptus crebra* woodland / open woodland on course sedimentary rocks	11.11.15	5.07	14.6	0.005
4a	*Eucalyptus populnea* / *E. crebra* open forest / woodland on alluvial soils	11.3.4 Of concern	10.13	18.5	0.06
4b	*Eucalyptus populnea* / *E. tereticornis* / *Corymbia tessellaris* / *E. crebra* open forest on alluvial soils	11.3.2 Of concern	8.99	67	0.52
7a	*Eucalyptus tereticornis / Corymbia tessellaris* woodland / open forest on alluvial soils	11.3.4	6.06	15.5	0.04
9a	Modified pastoral grassland on alluvium / fine grained sedimentary rocks	-	6.07	1.9	-
9b	*Acacia harpophylla* shrubby regrowth on coarse grained sediment	-	0.4	18.2	-
	Eucalyptus crebra/ E. exserta/ Corymbia dallachiana/ C. intermedia /woodland / on broad plains and fans formed from Quaternary alluvium - (Fisherman's Landing - Rail Loop).	11.3.29	0.6	-	-

Notes: [1] Indicates disturbed percentage of vegetation community within the vegetation study area
[2] Indicates disturbed percentage of vegetation community within the Mount Morgan Ranges Province as per Accad *et. al.* (2003).

The largest extent of proposed vegetation removal (10.13 ha) will be within Vegetation Unit 4a: *Eucalyptus populnea* /*E. crebra* open forest / woodland (RE 11.3.4). This vegetation community is listed as an 'Of concern' RE under the VM Act. Proposed disturbance to this community represents 18.5% of the overall area of this community found on site, however, when expressed as a percentage of this vegetation type found within the sub-region, disturbance to this community is much lower, representing 0.06%.

An area of 8.99 ha of Vegetation Unit 4b; *Eucalyptus populnea* /*E. tereticornis* /*Corymbia tessellaris* /*E. crebra* open forest (RE 11.3.2) will potentially be removed. This vegetation community is listed as an 'Of concern' RE. Proposed disturbance to this community represents 67% of this community found on site. However, when viewed in the broader context, overall disturbance to this community constitutes 0.52% percent of the extent found within the sub-region.

Potential impacts upon the habitat connectivity of the site are not considered to be significant. The project site is positioned within a footprint of previously disturbed vegetation, and the woodland vegetation of the site does not represent a significant pathway of habitat connectivity within the corridor system at a local and regional scale (refer to Habitat Connectivity above). Vegetation clearance associated with the proposed development is not considered to be likely to have a measurable impact on local or regional connectivity. Vegetation clearance will not directly affect the current status of any REs under the VM Act.

In summary, it is not considered that any of the proposed vegetation removal will have any significant impact upon floral species, vegetation communities or habitat connectivity on a regional scale, or the ecosystem function of the integral vegetation communities found on site.

Mitigation

All relevant permits for clearing of vegetation required under the VM Act and *Integrated Planning Act 1997* (IPA) will be obtained through the development approvals process. Areas of vegetation to be cleared will be restricted to the minimum area required, with particular attention to be paid to delineating clearing areas in close proximity to 'Of concern' or 'Endangered' vegetation communities. Areas to be cleared will be delineated prior to commencement of clearing with tape, pegs and/or other markers. Any clearing within, or in close proximity to, riparian vegetation shall employ adequate erosion and sedimentation mitigation measures to ensure that riparian vegetation is not unduly effected. Mitigation of potential impacts to riparian vegetation from construction activities will also be in accordance with detailed control measures outlined in the Environmental Management Plans for Flora and Weed Management and Sediment Control during the construction phase (Section 16 – Environmental Management Plan).

The construction and environmental management for the proposed rail spur crossing will be the responsibility of the rail infrastructure provider. Prior to the commencement of construction of the rail spur crossing, a detailed baseline vegetation survey of the riparian community shall be undertaken to assess the floristic and structural values of the vegetation community that may likely be impacted by rail spur construction activities. Areas impacted from the construction of the rail spur across Neerkol Creek will be subsequently rehabilitated in accordance with a Site Rehabilitation Plan. The Site Rehabilitation Plan shall outline detailed methodology for revegetation with the objectives to rapidly reinstate bank stability, reduce sedimentation impacts upon Neerkol Creek and re-establish riparian vegetation to a viable community.

Significant species

Impacts

Potential impacts upon *Eucalyptus raveretiana* posed by the construction of the Project and project infrastructure are expected to be minimal. The presence of *E. raveretiana* within the study area is restricted to the riparian vegetation communities of Neerkol Creek and Quarry Creek. Approximately 0.74 ha of Vegetation Unit 6a: *Eucalyptus tereticornis* /*E. raveretiana* riparian woodland (RE 11.3.25a) is proposed to be cleared for the construction of a rail spur across Neerkol Creek. Within this community, the distribution of *E. raveretiana* is relatively sparse and wide spread, with the species mainly present downstream of the proposed rail spur site (refer to Significant Species above).

Mitigation

The alignment of the rail spur will be positioned so as to avoid disturbance and minimise any potential impacts to mature individuals of *Eucalyptus raveretiana*. Prior to finalisation of the planned alignment of

the rail spur, a survey of riparian vegetation will be conducted to clearly demarcate *E. raveretiana* individuals before any clearing within or in close proximity to riparian vegetation commences.

The construction area for the rail spur will be rehabilitated to reinstate bank stability, reduce sedimentation impacts upon Neerkol Creek and re-establish vegetation to the level of ecological integrity found prior to project disturbance. As part of rehabilitation of the riparian vegetation, *E. raveretiana* will be replanted in appropriate densities utilising seed stock of local provenance. The chosen rail infrastructure provider will be responsible for these rehabilitation works and ongoing control measures associated with the rail spur.

Weeds

Impacts

At the time of survey the study area was evidencing relatively high incidences of weed infestation, with particularly high abundance of Rubber vine present in Vegetation Unit 10a: Semi- evergreen vine thicket (RE 11.11.18) and Vegetation Unit 6a *Eucalyptus tereticornis /E. raveretiana* riparian woodland (RE 11.3.25a). Eight weeds of concern are identified for the site and the impacts of each are discussed in detail above in the section titled Weeds of Concern.

Mitigation

An effective weed control program will be implemented and outlined within the Flora and Weed Control Management Plan for both the construction and operational phases of the Project. The Weed Management Plan will be in keeping with the weed management targets as outlined in the "Central Queensland Strategy for Sustainability" (Fitzroy Basin Association, 2004), and the weed management intent as prescribed for within the "Nature Conservation Agreement for the Stanwell Power Station Nature Refuge" (DoE, 1996).

The Weed Management Plan will include:

- Effective management methods to control spread of "declared" weed species[1] on and off of the project site, in accordance with regional best management practice and current DNRM pest control guidelines (as prepared under section 15 of the *Land Protection* (*Pest and Stock Route Management) Act 2002*);
- Provision of information for project staff on the identification and control of "declared" weeds; and
- Ongoing monitoring of the project site to identify and control any new incidences of weed infestation.

As part of ongoing monitoring, the Weed Management Plan shall include regular maintenance of records to record control methods employed (mechanical, herbicidal, biological), extent of treatment areas,

[1] *Land Protection (Pest and Stock Route Management) Act 2002*

application rates for any herbicidal use, reference to appropriate control guidelines and monitoring for success of control methods.

Air Emissions Effects on Vegetation

Impacts

The Coke Plant will generate a number of air emissions during operations. Sulphur dioxide (SO_2) and nitrogen dioxide (NO_2) are potentially the most harmful airborne substances which could impact upon vegetation communities at high concentrations in the air shed of the Coke Plant. Limited information exists on the impact of elevated levels of SO_2 and NO_2 on vegetation in Australia. However, it is understood that frequent exposure at higher concentrations to these compounds, particularly for continuous periods, is more damaging than less frequent exposure separated by periods of low concentrations, as it reduces the time available for the vegetation to repair any damage (D. Doley, Centre for Mined Land Rehabilitation, UQ. pers. comm. 20.10.05).

Known impacts of SO_2 upon vegetation include desiccation, chlorosis (yellowing of the leaves) and photosynthetic depression (Kropf *et. al.*, 1990; Murray, 2004). Experimental studies on Australian vegetation show that there is a marked range in the responses to SO_2 between species, with some being highly sensitive, some being intermediate and some showing a tolerance to effects (Murray, 2004). In addition, topographical location relative to the source of emissions and the density of vegetation may also impact on the response. Consequentially, any impacts of SO_2 are likely to be spatially patchy depending on the assemblage, distribution and topographical location of species within a community. Studies show that *Eucalyptus tereticornis* (a dominant species in Vegetation Units 4b and 6a) appears to be tolerant to SO_2 at concentrations of up to 130 $\mu g/m^3$. SO_2 may stimulate some aspects of plant function at low levels, but at concentrations of over 260 $\mu g/m^3$ physiological damage is evidenced (Doley *et. al*., 2004).

NO_2 has several known effects on vegetation including direct toxicity of nitrogen gases and aerosols to individual species, soil mediated effects and their resultant effects on vegetation, increased susceptibility to secondary stress factors such as drought, and changes in the competitive relationships between species resulting in loss of biodiversity (World Health Organisation (WHO), 2000). The vegetation communities that may experience elevated concentrations of SO_2 and NO_2 due to the Project and SPS are not considered to be particularly sensitive (D. Doley, Centre for Mined Land Rehabilitation, UQ. pers. comm. 20.10.05).

The *Environmental Protection (Air) Policy 1997* (*EPP (Air)*) contains biological integrity goals for SO_2 and NO_2 (Schedule 1, Part 2). In an averaging time of 24 hours, SO_2 should not exceed 100 $\mu g/m^3$, or 60 $\mu g/m^3$ annually. For NO_2, the goals are expressed as 4-hour and annual goals of 95 $\mu g/m^3$ and 30 $\mu g/m^3$ respectively. There are, however, no recommendations with respect to areas where these goals should be achieved or how often such exceedences can be tolerated.

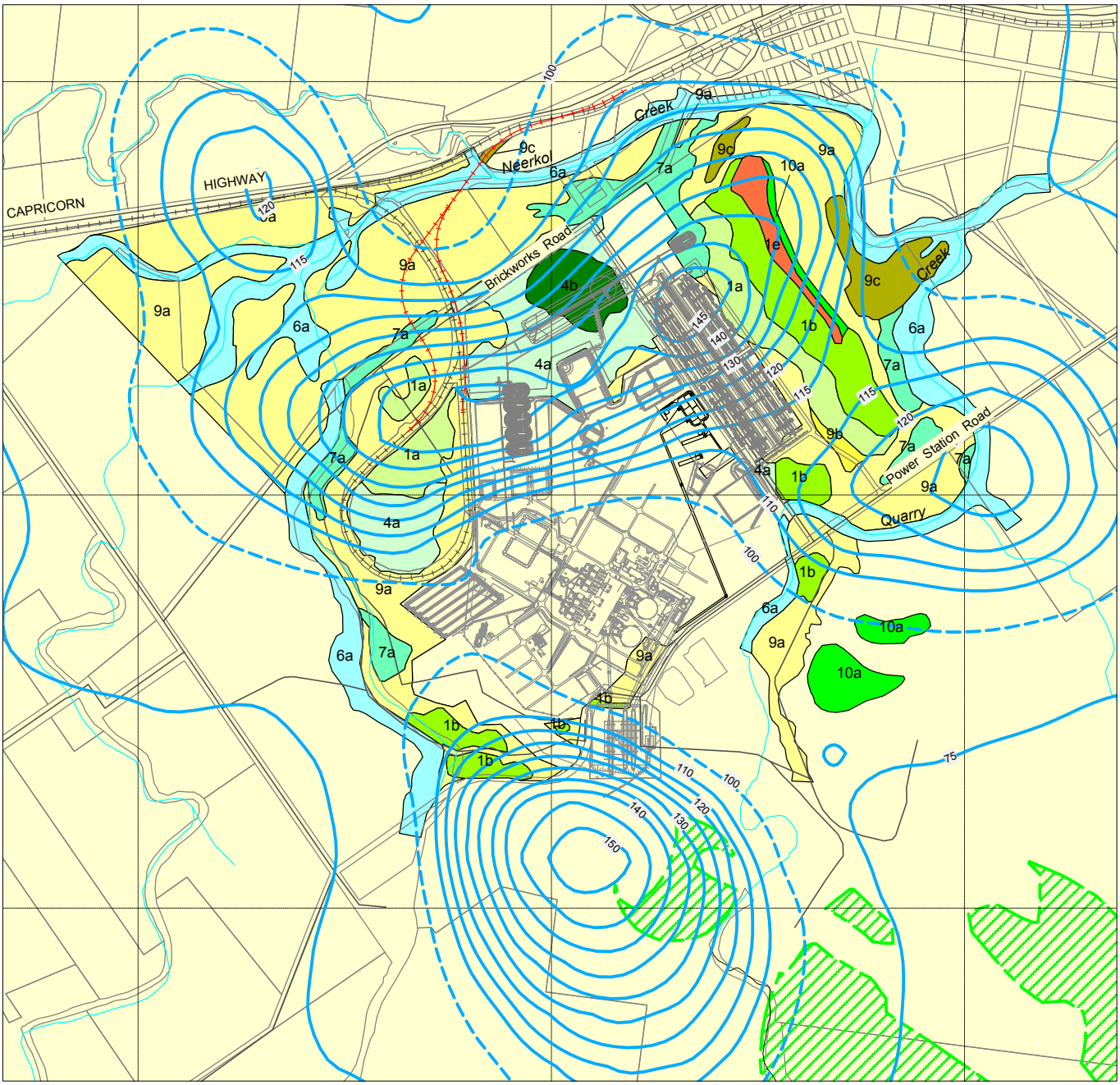
Sulphur Dioxide (SO_2)

The results of air modelling (Section 7 - Air) indicate that maximum SO_2 concentrations resulting from the Coke Plant alone will not exceed the relevant biological air quality goals. However, when emissions from the Coke Plant are combined and modelled with those from the existing SPS, a number of exceedences occur in areas containing significant vegetation communities (Table 6.1.5). It should be noted that the assumed SO_2 emissions of SPS are significantly higher than the actual performance. The assumed emissions are licence limit, 100% capacity factor and therefore some 45% higher than actual levels (refer Section 7 – Air). Due to the patchy nature of the vegetation communities on the project site, the concentration of SO_2 and the number of 24-hour periods that exceed the goal vary (Figure 6.3). For SO_2, the number of periods in which the *EPP (Air)* goals are exceeded are few, and the concentrations of the exceedences are relatively low. The assessment of cumulative impacts of SO_2 due to the Project and the SPS has been based on the following assumptions:

- The emissions of SO_2 are proportional to the amount of sulphur in the coal. SPS operates at the maximum permitted coal sulphur content of 0.8%, and at maximum load throughout the year. This coal sulphur content is significantly higher than the typical coal that is burned at SPS, which will result in an over-estimate of the SO_2 emission rate.

- The emission rates of SO_2 used in the dispersion modelling were shown to over-predict the ground-level concentrations due to SPS when compared to the monitoring data around SPS (Appendix I.1).

Therefore, there is a small but possible risk of damage to vegetation due to emissions of SO_2. The low frequency of exceedences indicates that in the most extreme cases, occasional short-term impacts would manifest as transient leaf injury on the most sensitive vegetation. However, it should be noted that, as discussed and presented in Table 6.1.4 above, the areas of vegetation communities that may be impacted by project SO_2 emissions comprise a very small percentage of that vegetation type in the sub-region and therefore the overall potential impact is considered low.



LEGEND

- 1a Narrow-leaved Ironbark *(E. crebra)* Woodland / Open woodland (RE 11.11.15)
- 1b Narrow-leaved Ironbark *(E. crebra)* with Rosewood *(A. rhodoxylon)* Open forest/ Woodland (RE 11.11.1)
- 1e Ridgeline Narrow-leaved Ironbark*(E. crebra)* / Queensland Peppermlnt *(E. exserta)* Woodland / Open woodland (RE 11.12.1a)
- 4a Poplar Box *(E. populnea)* / Narrow-leaved Ironbark*(E. crebra)* Open forest / Woodland (RE 11.3.4)
- 4b Mixed Eucalypt *(E. populnea / E. tereticornis / C. tesselleris / E.crebra)* Open forest (RE 11.3.2)
- 6a Forest Red Gum *(E. tereticornis)* / Ironbox *(E. raveretiana)* Riparian woodland (RE 11.3.24A)
- 7a Forest Red Gum*(E. tereticornis)* / Moreton Bay Ash *(C. tesselleris)* Woodland / Open forest (RE 11.3.4)
- 9a Modified Pastoral Grassland
- 9b Shrubby Regrowth
- 9c Cultivated Land
- 10a Semi-evergreen Vine Thicket (RE 11.11.18)

- 120 SO_2 Concentration Contours (µg/m³)
- 100 SO_2 Concentration Exceedancel Contour (100µg/m³)
- Proposed Coke and Power Plant
- Existing Stanwell Power Station
- Essential Habitat
- Railway

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Scale 1:30 000 (A4)

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ENVIRONMENTAL IMPACT STUDY

SO_2 - 24hr MAXIMUM CONCENTRATIONS (COMBINED COKE PLANT AND STANWELL POWER STATION)

Drawn: VH	Approved: JMcD	Date: 06-01-06	Figure: **6.3**	Rev:B
Job No: **42625626**	File No: 42625626-g-035b.wor			**A4**

Table 6.1.5 Predicted SO_2 Exceedences from Combined Coke Plant and SPS Modelling

Vegetation Community	Vegetation Description	Status	Concentration of SO_2 (µg/m³)	Number of 24-hour Periods/Year where Average SO_2 Exceeds 100 µg/m³
RE 11.3.4, Vegetation Unit 4a	Poplar Box (*Eucalyptus* populnea)/ Narrow-leaved Ironbark (*E. creba*) Open Forest / Woodland	Of Concern	115 - 145	1-4
RE 11.3.2, Vegetation Unit 4b	Mixed Eucalyptus (*E. populnea/ E. tereticornis/ Corymbia tesselleris/ E. creba*) Open Forest	Of Concern	115 - 140	1-2
RE 11.3.25a, Vegetation Unit 6a	Forest Red gum (*E. tereticornis*) / Ironbox (*E. raveretiana*) Riparian Woodland	Endangered (Biodiversity Status)	<135	1-3
RE 11.11.18, Vegetation Unit 10a	Semi-evergreen Vine Thicket	Endangered	<135	1-5
Essential Habitat	*Cycas megacarpus* and *Capparis humistrata*	Endangered	<150	1

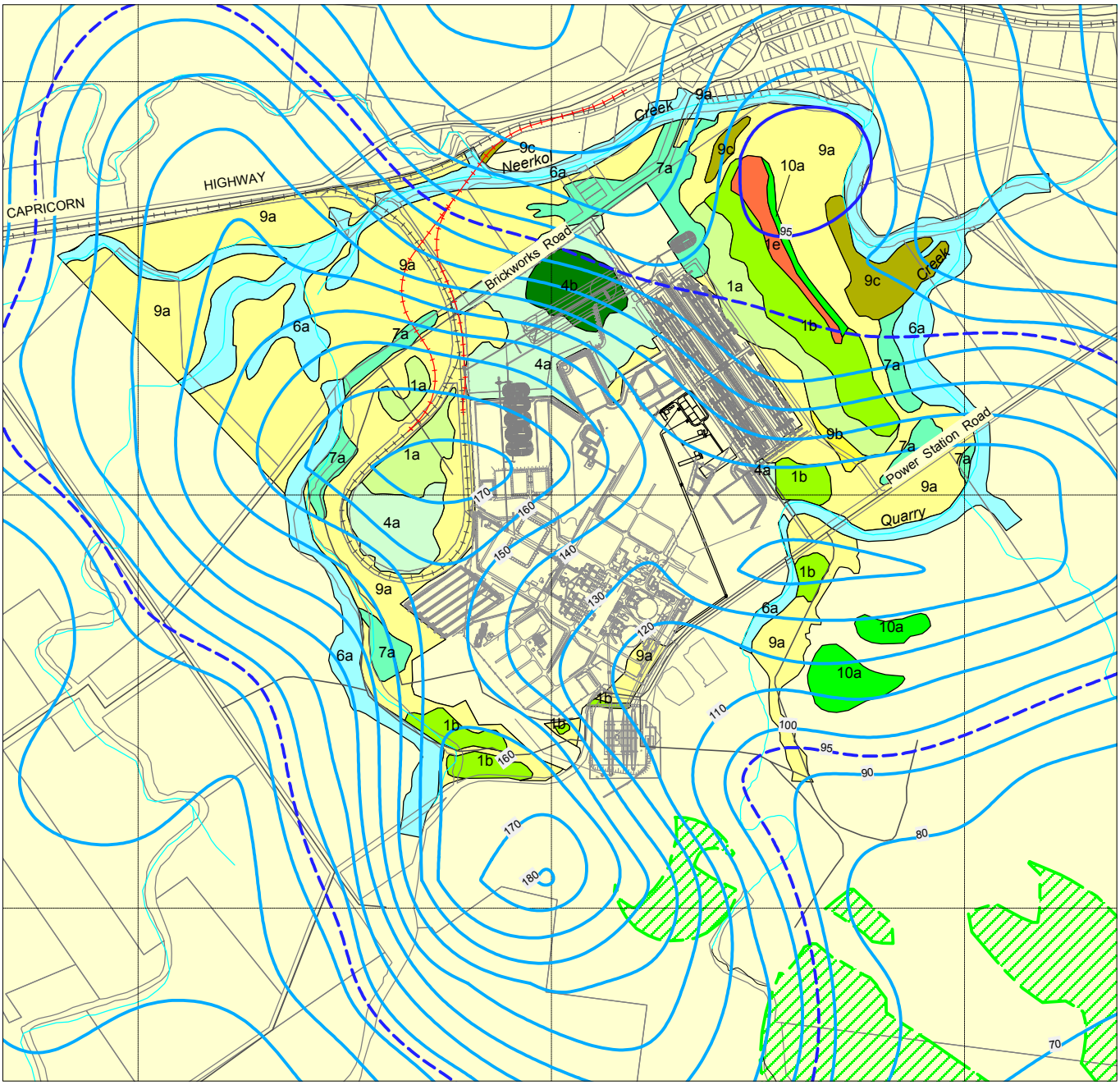
Nitrogen Dioxide (NO_2)

The modelled maximum NO_2 concentrations resulting from the Coke Plant alone does not exceed the relevant biological air quality goals. However, when emissions from the Coke Plant are combined and modelled with those from the existing SPS, exceedences occur in areas containing significant species or vegetation communities (Table 6.1.6). As for SO_2, it should be noted that the assumed NO_2 emissions of SPS are significantly higher than the actual performance. The assumed emissions are licence limit, 100% capacity factor and therefore some 45% higher than actual levels. As with SO_2 concentrations, the patchy nature of the vegetation communities on the project site result in variable concentrations of NO_2 and the number of 4-hour periods that exceed the goal (Figure 6.4). The predicted impacts of NO_2 are conservative for the following reasons:

- Nitrogen oxides (NO_x) are emitted from a combustion source such as the Project or SPS at around 90% to 95% nitric oxide (NO), and the rest as nitrogen dioxide (NO_2) (i.e. conversion ratio of NO_x to NO_2 of 5% to 10%). As the plume travels downwind, the NO gradually reacts with the available ozone to form NO_2. Vegetated areas of concern are between 500 m to 3 km from SPS and the Project. At these distances, the conversion of NO_x to NO_2 is likely to be between 20% and 30%. A constant conversion rate of 30% has been applied in this assessment.

- Operation of SPS was modelled at full capacity, and at a maximum allowable emission rate of NO_x. This results in an emission rate of NO_x that is about 50% higher than typical operating levels.

There is small but possible risk of damage to vegetation. The low frequency of 4-hour period exceedences over one year indicates that in the most extreme cases, occasional short-term impacts would manifest as mild toxicity and stress on the most sensitive vegetation. However, as with SO_2 impacts, it should be noted that the areas of vegetation communities that may be impacted by project NO_2 emissions comprise



LEGEND

- 1a Narrow-leaved Ironbark *(E. crebra)* Woodland / Open woodland (RE 11.11.15)
- 1b Narrow-leaved Ironbark *(E. crebra)* with Rosewood *(A. rhodoxylon)* Open forest/ Woodland (RE 11.11.1)
- 1e Ridgeline Narrow-leaved Ironbark *(E. crebra)* / Queensland Peppermint *(E. exserta)* Woodland / Open woodland (RE 11.12.1a)
- 4a Poplar Box *(E. populnea)* / Narrow-leaved Ironbark *(E. crebra)* Open forest / Woodland (RE 11.3.4)
- 4b Mixed Eucalypt *(E. populnea / E. tereticornis / C. tesselleris / E.crebra)* Open forest (RE 11.3.2)
- 6a Forest Red Gum *(E. tereticornis)* / Ironbox *(E. raveretiana)* Riparian woodland (RE 11.3.24A)
- 7a Forest Red Gum *(E. tereticornis)* / Moreton Bay Ash *(C. tesselleris)* Woodland / Open forest (RE 11.3.4)
- 9a Modified Pastoral Grassland
- 9b Shrubby Regrowth
- 9c Cultivated Land
- 10a Semi-evergreen Vine Thicket (RE 11.11.18)

- 70 — NO_2 Concentration Contour (µg/m³)
- 95 - - NO_2 Concentration Exceedance Contour (µg/m³)
- Proposed Coke and Power Plant
- Existing Stanwell Power Station
- Essential Habitat
- Railway

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Scale 1:30 000 (A4)

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ENVIRONMENTAL IMPACT STUDY

NO_2 - 4hr MAXIMUM CONCENTRATIONS (COMBINED COKE PLANT AND STANWELL POWER STATION)

Drawn: VH	Approved: JMcD	Date: 06-01-06	Figure: **6.4**	Rev:B
Job No: **42625626**	File No: 42625626-g-038b.wor			**A4**

a very small percentage of that vegetation type in the sub-region (Table 6.1.4) and therefore the potential impact is considered low.

Table 6.1.6 Predicted NO_2 Exceedences from Combined Coke Plant and SPS Modelling

Vegetation Community	Description	Status	Concentration of NO_2 ($\mu g/m^3$)	Number of 4-hour Periods over a Year where Average NO_2 Exceeds Goal of 95 $\mu g/m^3$
RE 11.3.4, Vegetation Unit 4a	Poplar Box (*Eucalyptus* populnea)/ Narrow-leaved Ironbark (*E. creba*) Open Forest / Woodland	Of Concern	80-170	1-11
RE 11.3.2, Vegetation Unit 4b	Mixed Eucalyptus (*E. populnea/ E. tereticornis/ Corymbia tesselleris/ E. creba*) Open Forest	Of Concern	95-120	1-4
RE 11.3.25a, Vegetation Unit 6a	Forest Red gum (*E. tereticornis*) / Ironbox (*E. raveretiana*) Riparian Woodland	Endangered (Biodiversity Status)	<165	1-10.5
RE 11.11.18, Vegetation Unit 10a	Semi-evergreen Vine Thicket	Endangered	90-130	1-5
Essential Habitat	*Cycas megacarpus* and *Capparis humistrata*	Endangered	<160	1-7

Mitigation

A program will be established to monitor the impacts of emissions on the vegetation communities above, comprising ambient emission monitoring at sites previously monitored by SPS and regular surveys to determine the extent of damage (if any) to vegetation communities designated as 'Of Concern' or 'Endangered'. The modelled emissions concentrations are based on full production of the Coke Plant. Since the operation of the Coke Plant is to occur in stages reaching full capacity in Stage 2, regular monitoring will identify at what point impacts may be occurring. Should impacts be identified, technologies will be reviewed and strategies will be investigated in consultation with the EPA to ensure any impact is mitigated.

6.2 Terrestrial Vertebrate Fauna

Summary

A terrestrial vertebrate fauna survey of the project area was conducted in April 2005 and included a bird census, pitfall trapping, diurnal reptile searches, night spotlighting, analysis of racks/traces, harp trapping (bats) and Anabat electronic bat detection. The survey results supplemented information obtained in previous surveys of the area.

Natural areas remaining on the project site are small and have been degraded through burning and clearing. Parts of the site are also highly modified through perimeter fencing, construction of water storage dams, vehicle tracks and dumping of topsoil and vegetation. The remaining areas are not

representative of significant fauna habitats. The principle habitat for fauna in the region is open woodland, which is relatively common. Areas surrounding the project site are extensively modified through agricultural activities. Therefore, the project site is not considered to be important for wildlife conservation. The loss of approximately 0.6 ha of regional ecosystem classified as No Concern at Present at Fisherman's Landing is not considered significant as it is within the rail loop and offers limited habitat value. The expected disturbance is in the order of 3% of the total area of remnant vegetation within the rail loop.

A total of 96 native and 3 introduced terrestrial vertebrate species were recorded during the 2005 field surveys in the study area, including 8 amphibian, 16 reptile, 57 bird and 18 mammal species. A complete list of species known from the site includes a total of 13 amphibian, 44 reptile, 133 bird and 38 mammal species, however, many of these species have only been reported from the general area of the project site.

One Threatened species was observed during the 2005 surveys, the Squatter Pigeon (*Geophaps scripta scripta*), listed as Vulnerable under both the *Nature Conservation (Wildlife) Regulation 1994* (NC Regulation) and the EPBC Act. Queensland populations of this species appear to be stable. The Powerful Owl (*Ninox strenua*) is Vulnerable under the *Nature Conservation Act 1992* and has been recorded previously from the area, however, it was not recorded during the 2005 survey.

Three Threatened reptile species which have been previously recorded in the Rockhampton area could potentially be present on the project site: Brigalow scalyfoot (*Paradelma orientalis*); a small species of limbless skink (*Anomalopus brevicollis*) which has been recorded within the project site by the Queensland Museum; and the ornamental snake (*Denisonia maculata*). Four bird species recorded in the area (*Ardea alba*, *Ardea ibis*, *Haliaeetus leucogaster* and *Merops ornatus*) are listed as migratory under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act).

Populations of macropods that may be trapped on-site due to the project layout will be removed from the project site prior to commencement of construction. Advice from EPA will be sought before this aspect of the Project is undertaken.

6.2.1 Description of Environmental Values

Methodology

The terrestrial vertebrate fauna of the project area is described with reference to existing studies, supplemented by additional field surveys conducted as part of the EIS investigations. Previous fauna surveys of the project area have included:

- Surveys of the Stanwell Energy Park (SEP) and surrounds, as part of the original Environmental Impact Statement (EIS) for the Stanwell Power Station (SPS) in 1984 (Houston *et al.*, 1984); and
- Surveys of the AMC project area and surrounds as part of the EIS for that project in 1999 (Dames & Moore, 1999).

Further terrestrial fauna surveys were undertaken in April 2005 as part of this EIS. These surveys focussed on assessing the remnant habitats on the project site and identifying the potential occurrence of threatened species which have been previously identified in the area.

Methodology for the fauna surveys included standard sampling techniques such as bird census, pitfall trapping, diurnal reptile searches, night spotlighting, analysis of racks/traces, harp trapping (bats) and Anabat electronic bat detection. Elliot trapping was not carried out as prior surveys using Elliot traps in the area had not been productive, and based on previous results, no significant species were likely to be caught. Details of the survey methodologies used and sample site locations are provided in Appendix H.1 A map showing locations of fauna sampling sites is presented in Figure 6.5.

The Project's planned activities on and adjacent to Fisherman's Landing are primarily within areas that have been cleared and developed, or constitute land reclaimed from Curtis Bay.

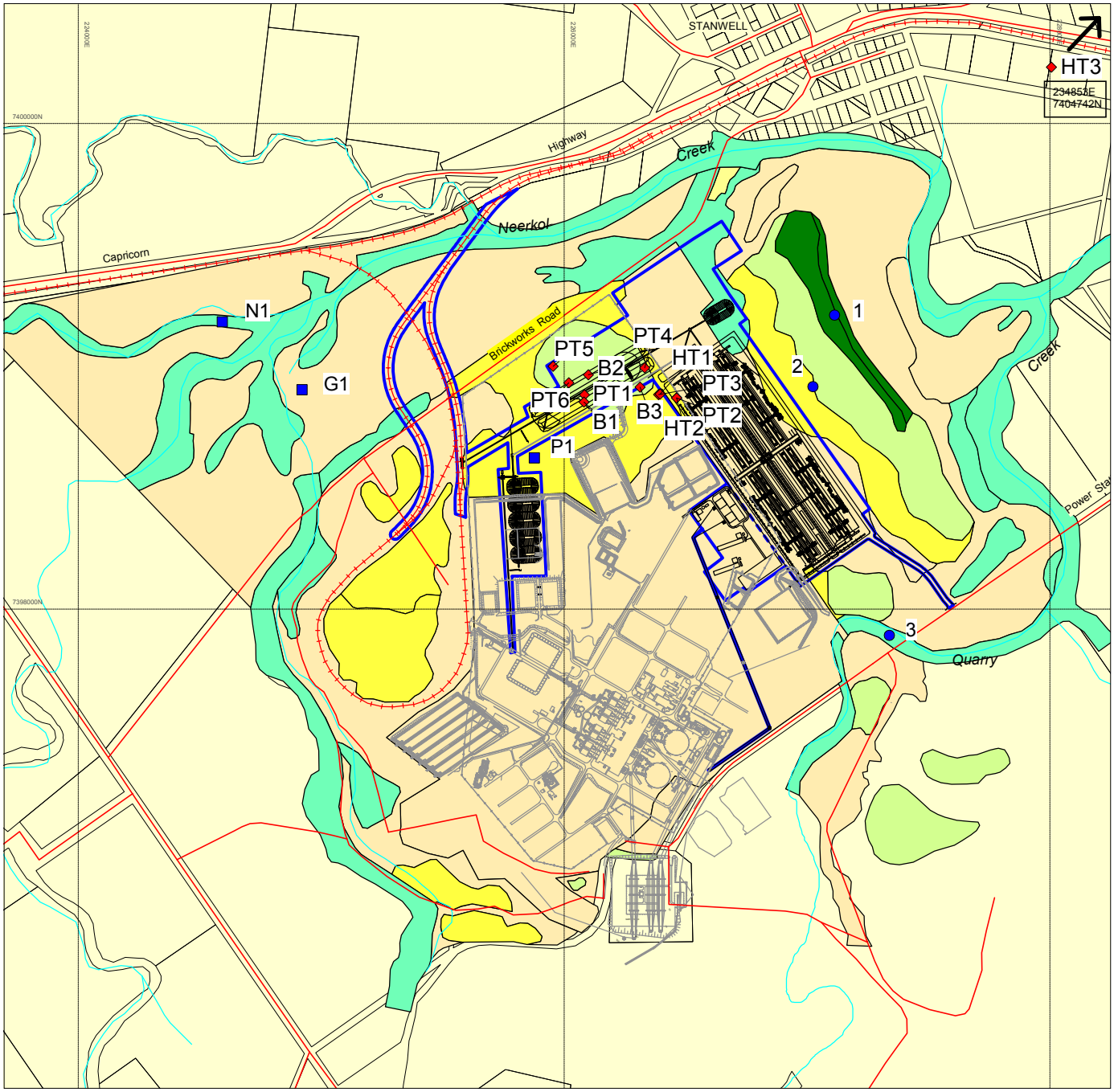
Terrestrial Fauna Habitats

Habitats available for fauna within the project area and surrounds are limited. Most of the area has been previously cleared and the remaining natural habitat has been heavily modified. The site proposed for the Project is almost entirely cleared and offer minimal fauna habitat value. Two separate small areas of natural habitat remain in the vicinity of the site. The first, within the existing SPS boundary, occupies an area of about 25 ha immediately to the north of SPS. The second area is a narrow strip approximately 200 m in width and 1,000 m long along the eastern boundary of the cleared AMC site, at the foot of Flagstaff Hill.

Natural habitat within the SPS area has been mapped (Table 6.1.1 and Figure 6.1) as vegetation units 4a (Poplar Box *Eucalyptus populnea/*Narrow-leafed Ironbark *E. creba* Open Forest/Woodland) and vegetation unit 4b (Mixed Eucalyptus *E. populnea/E. tereticornis/Corymbia. tesselleris/E. creba* Open Forest). Ground surveys of the site indicated that over most of the area, a uniform Open Forest community was present, dominated by *Eucalyptus creba* with trees generally up to 15 m in height. There was very little shrub layer, consisting mainly of immature eucalypts and *Acacia* species. There was a light covering of tussocky grass understorey with light leaf litter cover and extensive areas of bare ground (Plate 6.3). Soil was black/reddish clay. There were a few fallen logs offering ground fauna habitat. In the western part of the block, small stands of taller *Eucalyptus tereticornis* were present. There appeared to be a lack of mature trees, indicating that the area may have been largely cleared for grazing at some time in the past. The area has been subjected to regular fires.

Several artificial water storage dams are located in the south of the area. These provide habitat for waterbirds, turtles and frogs. Habitats within this area are effectively isolated from surrounding areas by a 2.5 m high chain wire fence which surrounds the SPS. Adjacent lands outside the fence are cleared for agriculture, including cropping and cattle grazing (Plate 6.4).

The land adjacent to the previous AMC site has been mapped primarily as vegetation unit 1a (Narrow-leafed Ironbark *E. creba* Woodland/Open Woodland) (Table 6.1.1 and Figure 6.1). This habitat is similar to that discussed above although it is more elevated and thus has stonier soils. The area is dominated by *E. creba* to about 20 m in height, and the woodland in this area is somewhat more mature. This area has



LEGEND

- Ridge Communities
- Woodland
- Open Forest
- Riparian
- Grassland/Disturbed Areas
- Fauna Sampling Site 1998
- Fauna Sampling Site 1984
- Fauna Sampling Site 2005

PT Pit Traps
HT Harp Traps
B Bird Census Transects (start point)

- Existing Stanwell Power Station
- Proposed Coke Coke and Power Plant
- Proposed Development Footprint
- Creek
- Road
- Railway

0 500m 1000m

Scale 1:25 000 (A4)

Horizontal Datum GDA 94, Zone 56

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TERRESTRIAL FAUNA SAMPLING SITES

Drawn: VH	Approved: JMcD	Date: 06-01-06	Figure: **6.5**
Job No: **42625626**	File No: 42625626-g-033b.wor		Rev:B **A4**

been significantly disturbed, with evidence of tracks, topsoil and piles of vegetation, and with a fence bisecting the site (Plate 6.5). The habitat in this area is contiguous with extensive natural vegetation on Flagstaff Hill. A small area of vegetation unit 7a (*E. tereticornis/C. tessellaris* Woodland/Open Woodland) occurs in the northern part of the site. All other areas of the study site have been cleared of vegetation.

Adjacent to the study site, riparian forest (vegetation unit 6a) occurs as a narrow band of forest vegetation within the riparian zone along Neerkol and Quarry Creeks (Plate 6.6). This vegetation is characterised by a discontinuous canopy 10 to 20 m in height with patches of rank grassland within. Although the vegetation within the riparian area is structurally well developed, surrounding vegetation within 30 m of the channel has been extensively cleared or modified. All other lowland areas surrounding the site are generally cleared for cultivation.

Potential fauna habitat in the area of proposed activities at Fisherman's Landing is limited to remnant vegetation inside the rail loop. There is approximately 20 ha of remnant vegetation (RE 11.3.29) located within the rail loop, its biodiversity status is listed as no concern at present. The remnant vegetation offers limited habitat value due to its isolated location within the rail loop and lack of connection with other remaining stands of remnant vegetation located outside the rail loop. The rail loop is not included in the section of State Wildlife Corridor, which is located to the east of the rail loop. However, the western section of the reclaimed land associated with the port facility is included in the corridor.

Migratory birds are known to occur in the area of the Fisherman's Landing facility and the area is contained within the directory of important wetlands, including the reclaimed land and industrial facilities.

Survey Results

A total of 96 native and 3 introduced terrestrial vertebrate species were recorded during the recent field surveys in the study area, including 8 amphibian, 16 reptile, 57 bird and 18 mammal species. The trapping program resulted in the capture of three frog, four lizard and one snake species. Eleven bat species were recorded by electronic bat detection (Appendix H.4).

Species lists from previous surveys of the SPS area were compiled according to sample sites and habitats which are present on or near the project site. A complete list of species known from the site, including previous records, is presented in Appendices H.3 and H.5. This list includes a total of 13 amphibian, 44 reptile, 133 bird and 38 mammal species. Caution should be used when analysing this list as it contains many historical records which did not include the exact location or habitat for most of the species. Many of the species on this list have never been recorded on the project site and their inclusion indicates only that they have been reported from within the general area of the proposed site.

Amphibians

Seven native and one introduced amphibian species were observed within the study area (Appendix H.3). The native species include representatives of two families, Myobatrachidae and Hylidae. Two species (one specimen each) were caught by pitfall trapping (Appendix H.4). The most abundant amphibian

species recorded was the introduced cane toad (*Bufo marinus*). Frogs were mainly concentrated in wetter environments, including the water storage dams within the SPS site, and in natural streamside habitats along Neerkol and Quarry Creeks. Several species were found in the relatively dry open woodland habitat of the project site, including green tree frog (*Litoria caerulea*), ornate burrowing frog (*Limnodynastes ornatus*) (Plate 6.7) and superb collared frog (*Cyclorana brevipes).*

Due to the dry conditions experienced at the time of the survey, frogs were generally inactive, and surveys during periods of rain may record additional species. An additional four species of amphibian have been previously recorded in the area (Appendix H.5.).

Reptiles

Sixteen reptile species were identified within or near the study area, including representatives of seven families (Appendix H.3.).

The reptile taxa identified included one turtle (Chelidae), four gecko (Gekkonidae), three agamid (Agamidae), six skink (Skinkidae), one colubrid snake (Colubridae) and one elapid snake (Elapidae) species. Pitfall trapping in open woodland on the site captured one gecko, three skink and one snake species. Most reptile observations were made during active searches of habitats during the day, during spotlight survey, and incidentally during the course of the trapping and bird census surveys.

One turtle species, Krefft's turtle (*Emydura krefftti*) was recorded from the Neerkol/Quarry creek system, where the species was very common. This species was also reported to occur in the water storage dams within the project area. Other semi-aquatic species recorded along Neerkol Creek include eastern water dragon (*Physignathus lesuerii*) and water skink (*Eulamprus quoyii*).

Skinks of the genus *Carlia* were common in areas of leaf litter and grass cover on the project site, while geckoes such as tree dtella (*Gehyra dubia*) and zigzag gecko (*Oedura rhombifer*) were observed on tree trunks at night. The bearded dragon (*Pogona barbata*) is a common large lizard on the site. The freshwater snake (*Tropidonophis mairii*) is a semi-aquatic species, which also occurs in woodlands. The lesser black whip snake (*Demansia vestigiata*) was the only venomous species recorded (Plate 6.8).

Generally, the lack of mature trees, fallen logs and ground cover on the project site precludes the area as a significant habitat for ground reptile species. Previous surveys of the Stanwell area have recorded a total of 41 reptile species (Appendix H.5).

Birds

Fifty-seven bird species were observed within the study area during the 2005 survey (Appendix H.3). The bird community recorded in natural habitats within the project site was typical of open woodland communities expected in central Queensland. Birds commonly recorded in open woodland situations within the project site included crested pigeon (*Ocyphaps lophotes*), peaceful dove (*Geopelia placida*), sulphur-crested cockatoo (*Cacatua galerita*), white-throated honeyeater (*Melithreptus albogularis*), laughing kookaburra (*Dacelo novaeguineae*), noisy miner (*Manorina melanocephala*) and pied

butcherbird (*Cracticus nigrogularis*). Nesting observations were made for black kite (*Milvus migrans*) (Plate 6.9), sulphur-crested cockatoo and tawny frogmouth (*Podargus strigoides*).

Wetland bird species were numerous on man-made water bodies within and near the study area. These included plumed whistle-duck (*Dendrocyna arcuata*), Australian wood duck (*Chenonetta jubata*), pacific black duck (*Anas superciliosa*), darter (*Anhinga melanogaster*), three cormorant species and great teal (*Anas gracilis*). Wader birds observed included herons, egrets, black-winged stilt (*Himantopus himantopus*) and black-fronted dotterel (*Elseyornis melanops*).

Many bird species were present along natural watercourses near the project site. These included ducks such as pacific black duck and grey teal, black swan (*Cygnus atratus*), egrets, straw-necked ibis (*Threskiornis spinicollis*), and riverine forest species. A full species list of birds recorded in the region of the SPS from previous surveys comprises 125 species (Appendix H.5).

Mammals

Sixteen native mammal species were identified during the survey, while two introduced species were noted (Appendix H.3). No small mammals were caught by pitfall trapping on the project site, although one species of bat (Gould's wattled bat *Chalinolobus gouldii*) was caught by harp netting (Plate 6.10).

Large mammals occurring in the area included eastern grey kangaroo (*Macropus giganteus*) (Plate 6.11) and agile wallaby (*Macropus agilis*), both of which were observed within the fenced area of the site. The whiptail wallaby (*Macropus parryi*) was recorded from an unfenced area near the previous AMC site. Medium-sized mammals were uncommon. Bandicoot (*Isoodon macrourus*) diggings were observed in open woodland habitat within the boundary of the project site, and anecdotal evidence from site employees also indicated the presence of echidna (*Tachyglossus aculeatus*) on the site. No arboreal mammals, such as possums, gliders or koala were observed within the project site and examination of the few examples of large trees on site, such as *Eucalyptus tereticornis* which is suitable for these species, did not reveal the presence of any characteristic scratch markings or other traces.

At least 11 species of microchiropteran bats were recorded by Anabat sampling. In some cases, calls could not be differentiated to species level in the Anabat system, so two of the identifications are probable rather than definite. The most common bat represented in calls was little bent-winged bat (*Miniopterus australis*), with other commonly recorded species including yellow-bellied sheathtail-bat (*Saccolaimus flaviventris*) and Gould's wattled bat (*Chalinolobus gouldii*).

Mammal records from the previous surveys of the area include common planigale (*Planigale maculata*), rufous bettong (*Aepyprymnus rufescens*), common brushtail possum (*Trichosurus vulpecula*), squirrel glider (*Petaurus norfolcensis*) and greater glider (*Petauroides volans*). The water rat (*Hyrdromys chrysogaster*) has been reported from streamside situations along Quarry Creek (Appendix H.5).

Introduced Species

Three introduced vertebrate fauna species were recorded during field surveys within the study area. The fox (*Vulpes vulpes*) and rabbit (*Oryctolagus cuniculus*) both occur within the project site area. The former

species is an active predator of small mammals and reptiles. Rabbits were particularly common in the area. The cane toad (*Bufo marinus*) is a feral amphibian species which is extremely abundant in the project area. Although it was most prevalent near water, it was also found in all other habitat situations.

Previous surveys of the area have recorded the presence of dogs (*Canis familiaris*), cats (*Felis catus*) and cattle *(Bos taurus*).

Significant Species

The conservation status of fauna species occurring within the project area is described according to threatened status in the *Nature Conservation Act 1992* (NC Act) and NC Regulation and the EPBC Act. Under these listings, extant threatened species may be classified as Critically Endangered, Endangered, Vulnerable or Near-threatened (or Rare under Queensland legislation). In addition to threatened species, the EPBC Act also includes a list of migratory species. These species are those which are listed under the following international agreements to which Australia is a signatory nation:

- Japan-Australia Migratory Bird Agreement (JAMBA);
- China-Australia Migratory Bird Agreement (CAMBA); and
- Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention).

Under these international agreements Australia has an obligation to protect significant populations and significant sites for these species.

Threatened Species

No Endangered species were recorded during the surveys, nor have any such species been previously reported from the area.

Only one Threatened species was observed during the 2005 surveys of the project site, the squatter pigeon (*Geophaps scripta scripta*). A group of six of these birds was observed watering at a small waterhole near the northern end of the previous AMC area (Plate 6.12). This species has also been reported in earlier field surveys of the area. The squatter pigeon is listed as Vulnerable under both the NC Regulation and the EPBC Act. Populations in the Rockhampton area represent the southern sub-species of the squatter pigeon (*G. scripta scripta*), which is distributed through inland areas from northern NSW to the Burdekin region of Queensland. It occurs patchily, mainly in grassy eucalypt woodland and gravel ridge habitats, and is a seed-eater. The species has declined significantly in the southern parts of its range (NSW), but appears to be stable in Queensland. Identified threats include cattle grazing and predation by foxes (Garnett and Crowley, 2000).

One Vulnerable (NC Act) bird species has been recorded previously from the area, the powerful owl (*Ninox strenua*), however it was not recorded during the 2005 survey. This species was recorded within open eucalypt forest on the SPS site by Houston *et. al.* (1984). The species preys upon a variety of arboreal mammals such as greater gliders and common brushtail possum.

Three Threatened reptile species which have been previously recorded in the Rockhampton area could potentially be present on the project site. They are:

- Brigalow scalyfoot (*Paradelma orientalis*) which is listed as Vulnerable under both State and Commonwealth legislation. Its former habitat brigalow (*Acacia harpophylla*) forest or woodland with a well developed grassy understorey has been extensively cleared. Cogger *et. al.* (1993) note that the range of the species has declined most likely as a result of grazing and pasture improvement. This species has been identified in rosewood (*Acacia rhodoxylon*) communities within the SPS area;

- A small species of limbless skink (*Anomalopus brevicollis*) (Rare under Queensland legislation) occurs in the region, and has been recorded within the project site by the Queensland Museum. It occurs in a broad range of habitats in Central Queensland where habitats have been disturbed through pasture improvement and grazing; and

- The ornamental snake (*Denisonia maculata*) (Vulnerable under State, National and International listings) has not been recorded from the project area, but is known to occur in the region and may be present in habitats within the site and surrounds. It is a nocturnal species sheltering by day under fallen timber and deep forest litter. Identified threats include overgrazing by stock, clearance of habitat for agriculture and grazing, pasture improvement, crop production, urban development and possibly poisoning by ingestion of cane toads. This species is a specialist frog-feeder (Cogger *et. al.*, 1993).

Species of Special Cultural Significance

One species, the Echidna (*Tachyglossus aculeatus*) is classified in Schedule 5 of the NC Act as 'common wildlife'. The proposed management intent for this species includes "ensuring governments have regard to the special cultural significance of the wildlife and the management requirements needed to conserve existing populations of the wildlife". Echidnas have been recorded in the area previously, and local employees stated that they were present within the site area.

Migratory Species

Four bird species recorded in the area: great egret (*Ardea alba*); cattle egret (*Ardea ibis*); white-breasted sea-eagle (*Haliaeetus leucogaster*); and rainbow bee-eater (*Merops ornatus*) are listed as migratory under the EPBC Act. They are also listed as Common species with additional declared management intent under Schedule 5 of the NC Regulation. These species are generally common in the area although the site contains no significant habitat, such as breeding, feeding or roosting areas for these species.

6.2.2 Potential Impacts and Mitigation Measures

The project area contains limited fauna habitat of any value. The coal stockpile area and power generating facilities will be located on previously cleared areas, so negligible fauna habitat loss will occur through these components of the Project. The proposed coke stockpile area will require approximately 19.12 ha of remnant vegetation (RE 11.3.2 and 11.3.4) to be cleared resulting in loss of habitat The

proposed project infrastructure is mostly located on previously cleared areas and will disturb approximately 17.6 ha of habitat.

Natural areas remaining on the project site are small and have been degraded through burning and clearing. Parts of the site are also highly modified through perimeter fencing, construction of water storage dams, vehicle tracks and dumping of topsoil and vegetation. In addition, the remaining areas are not representative of significant fauna habitats and the principle habitat of open woodland is common within the region. Areas surrounding the project site are extensively modified through agricultural activities. For these reasons, the site is not considered to be important for wildlife conservation.

Despite the disturbed nature of the area, several fauna species live on the site. Larger mammal species, particularly eastern grey kangaroo and agile wallaby are apparently trapped within the SPS site by the perimeter fence. These animals are mainly concentrated in the northern section of the site, adjacent to Brickworks Road. This area will be partially cleared for the Project as a coke stockpile area. It is considered that disturbance and modification of the habitats in this area may stress the existing macropod population and create an increased likelihood of conflict between fauna and machinery, leading to potential for fauna injuries or fatalities.

During construction, noise disturbance from sources such as heavy machinery, vehicles and sirens may cause some temporary disturbance to wildlife. During the operational phase, noise levels are expected to be similar to those already experienced in the vicinity of the SPS. The most intrusive noise for fauna may emanate from the coal conveyor, which would produce a low, constant rumbling. The species groups most likely affected by noise may be birds and larger mammals, such as macropods. Generally, fauna will adapt to noise so long as there is no perceived threat associated with it. There are no known significant bird roosts or nesting sites in close proximity to the Project, and no habitats significant for migratory species. Effects of noise may be felt by individuals, which may either relocate to less disturbed areas nearby or acclimate to the changed conditions.

Potential impacts to fauna at Fisherman's Landing are limited to the loss of habitat within remnant vegetation located inside the rail loop. Approximately 0.6 ha will require clearing for the construction of the western section of the rail load out to shipping berth conveyor system. The remainder of the conveyor system will be constructed on existing reclaimed land. The loss of habitat is not considered significant as the remnant vegetation within the rail loop offers limited habitat value and the expected disturbance is in the order of 3% of the total area of remnant vegetation within the rail loop.

Mitigation

Most mitigation measures for the potential impacts on fauna are related to habitat protection and land management, particularly during construction. Trees will be felled in a manner which reduces potential for fauna injury and access will be restricted to areas outside the site boundary to avoid disturbance to the surrounding habitat. Pests will be monitored and management plans developed if required.

To mitigate the potential problem of macropods within the current SPS site and in the area of the proposed project, populations of macropods on site will be removed prior to commencement of construction. This will most probably be undertaken by removal of a part of the eastern fence, allowing

macropods to move away into similar habitats in the Flagstaff Hill area. However, advice from EPA will be sought before this aspect of the Project is undertaken.

6.3 Aquatic Ecology

Summary

An aquatic ecology survey of the project area was under taken in April 2005 to update survey results from 1998 surveys and gather information on the physical environment, water quality, aquatic plants, macroinvertebrates, fishes and waterfowl.

The main stream of Neerkol Creek passes the project site at its closest point about 350 m to the north. There are no natural aquatic environments draining the site itself. The main creek draining south from the project site is the naturally ephemeral Quarry Creek. It is artificially charged by blowdown water from the Stanwell Power Station (SPS), resulting in a constant flow which provides permanent habitat for native aquatic species and has also led to promotion of weed growth. The creeks have also been modified through clearing of riparian habitats, cattle degradation, chemical application and water extraction. Water quality is generally poor.

A total of 29 aquatic macroinvertebrate families, representing 10 orders were recorded during the 2005 survey. Diversity indices were relatively low. All sites were highly disturbed, and generally inhabited by macroinvertebrate groups which are adaptable to poor conditions.

Surveys of Neerkol and Quarry Creeks both upstream and downstream of the project site have yielded a total of 12 species of freshwater fish, the most abundant and widespread of which were Fly-specked Hardyhead, Eastern Rainbowfish, Agassiz's Glassfish and Midgley's Carp Gudgeon.. Eleven species were recorded in 1998 and 10 in 2005. All of the fish species recorded from the Neerkol Creek system are generally common across eastern and northern Australia. No species is listed in any category under either the *Nature Conservation (Wildlife) Regulation 1994* (NC Regulations) or the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Krefft's Turtle (*Emydura krefftii*) was abundant, recorded at all sample sites in 2005. Other semi-aquatic reptiles found included the Eastern Water Dragon (*Physignathus lesuerii*) and Eastern Water Skink (*Eulamprus quoyii*). The Water Rat (*Hydromys chrysogaster*) has been recorded from a site along Quarry Creek. A total of 22 aquatic plant species have been recorded within the Neerkol and Quarry Creek systems near the project site. Several of these species are introduced, the most prolific and invasive of which is Para grass.

Discharge of blowdown water into Quarry Creek could lead to an increase in creek flow of between approximately 657 ML/year and 1,350 ML/year (Stage 2) (approximate 75% increase during dry periods, considerably less during wet periods) which may result in minor changes to depths in the larger pools, with the possibility of greater species diversity due to increased habitat diversity. It may also lead to a widening of the Quarry Creek channel. Due to the existing high densities of aquatic plants (both native and introduced) in the system, erosion and increased water velocities are not considered to be significant

issues. A reduction of flow to the system (should 10% of SPS's stormwater and blowdown discharge be reused for coke quenching) may result in reduced weed infestation and in-stream habitat diversity, which would be most prominent in the upper parts of Quarry Creek.

Given the highly artificial nature of the current flow regime, the lack of significant aquatic fauna in the area, and the predominance of aquatic weeds, variations in flows such as those described are not expected to significantly change the existing environmental values of the aquatic environment. It is proposed to continue monitoring selected sites for changes in aquatic ecology on an annual basis through the construction and operation of the Project.

6.3.1 Description of Environmental Values

Methodology

The aquatic ecology in the vicinity of the SPS and surrounding areas has been previously documented through a field survey conducted in 1998 (Duivenvoorden and Roberts, 1998). That survey sampled 12 sites in a range of habitats, and included information on the physical environment, water quality, aquatic plants, macroinvertebrates, fishes and waterfowl. Of the 12 sites sampled in the survey, 7 were in natural stream locations (sites 1 to 7) and 5 were in man-made water bodies (sites 8 to 12).

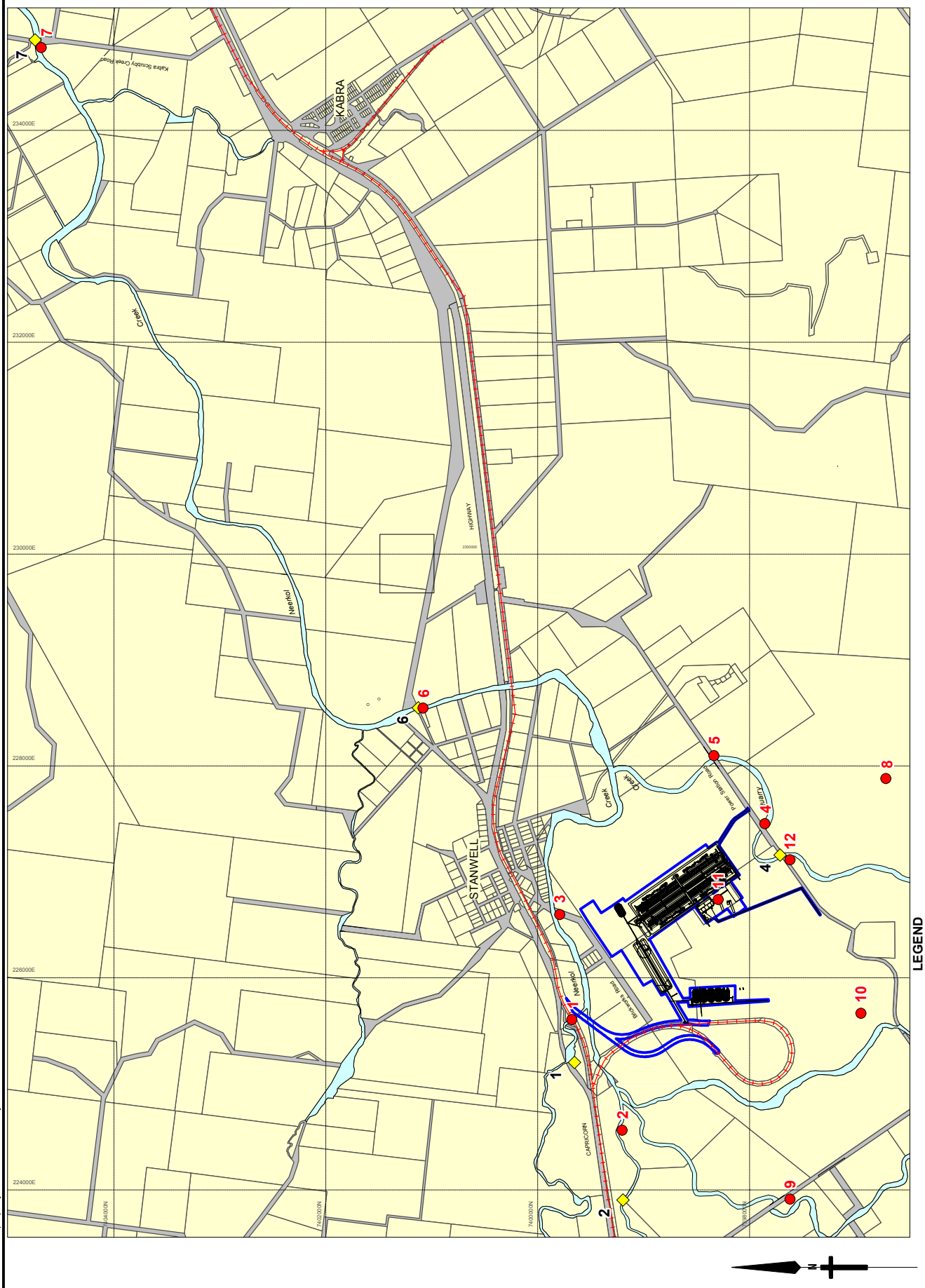
To provide an update on local aquatic conditions, and to compare changes over the past seven years, the seven natural stream sites from the previous study were revisited in April 2005. Five of these sites were re-sampled using methods closely comparable to that survey in order that direct comparisons were possible. Sampling at the other two sites was not possible due to changed conditions. Detailed methodology for the sampling survey is described in Appendix H.2. Locations of sites sampled in the 2005 and 1998 surveys are shown in Figure 6.6.

Aquatic Environment

The project area is located within the lower part of the Fitzroy River catchment. This region is characterised by extensive areas of open woodland converted to cattle grazing. It is intersected by numerous small permanent and ephemeral streams which are generally fringed with a narrow band of low riverine vegetation which includes *Casuarina cunninghamiana, Callistemon* species, *Eucalyptus* species and a number of exotic species, particularly Rubbervine (*Cryptostegia grandiflora*) which is a declared plant under the *Land Protection (Pest and Stock Route Management) Act 2002* (Qld).

The Fitzroy River is Queensland's largest river system, with a catchment area of about 142,450 km^2 (Kowarski and Ross, 1981). Floodplains extend above the lower reaches of the Fitzroy River and streams draining into the floodplains downstream of the project area are susceptible to flooding, thus variations in water quality, especially high turbidity due to high sediment load are not unusual. Soils in the area are typically black alluvial clay.

An extensive wetland and lagoon complex occurs in the area approximately 15 km downstream of the project area. These wetlands, known as the Fitzroy River Floodplain, are of high conservation value and



STANWELL CORPORATION LIMITED

QUEENSLAND COKE & ENERGY

URS

QUEENSLAND COKE
AND POWER PLANT PROJECT
ENVIRONMENTAL IMPACT STATEMENT

AQUATIC FAUNA SAMPLING SITES

Drawn: VH	Approved: JMcD	Date: 06-01-06	
Job No: **42625626**	File No: 42625626-g-034b.wor		

Figure: **6.6**

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are listed in the Directory of Important Wetlands. The area is cited as having significant ecological and hydrological values, and is especially important for waterfowl (Ford, 1995).

The project site is located within the drainage system of Neerkol Creek. This system drains the southern side of Native Cat Range and the northern side of Razorback Range. The catchment area is about 625 km^2. The main stream of Neerkol Creek passes the project site at its closest point about 350 m to the north. The tributaries of Sandy Creek, Stony Creek and Stuart Creek enter Neerkol Creek upstream of the project site. There are no natural aquatic environments draining the site itself.

The main creek draining south from the project site is Quarry Creek. This creek has its headwaters in the extreme south-western corner of the site and is artificially charged by excess blowdown water from the SPS. This discharge has created a constant flow in this otherwise naturally ephemeral creek. This change in flow regime has been evident since SPS commenced operations in 1993. The continuous flow does create an artificial situation and as a result provides additional permanent habitat for native aquatic species. However, it has also created an artificial habitat which has led to promotion of weed growth, especially Para Grass along the creek. Para Grass is widespread in the area, and is also prolific in ephemeral areas of Neerkol Creek upstream of the project area. Quarry Creek is about 5 m wide at the Power Station Road crossing 200 m downstream of the discharge point, with slow flow and dense aquatic vegetation such as the emergent Cumbungi (*Typha* sp.). The narrow band of riverine vegetation is dominated by *Casuarina cunninghamiana, Callistemon* spp. *Eucalyptus* spp. and *Melaleuca* spp. The creek flows north-east away from the project site through grazing land until finally entering Neerkol Creek, approximately 1.5 km upstream of Neerkol Creek's crossing of the Capricorn Highway.

Near the project site, Neerkol Creek is a strongly seasonal flowing stream. The stream has grassy banks with a width of about 20 m. Riverine vegetation along the creek is similar to Quarry Creek, with occasional dense infestations of rubbervine. Upstream of the project site, this creek branches into at least three tributaries, including Stuart and Sandy creeks, all of which are ephemeral in nature. Downstream of the area, the creek becomes enlarged through the artificial charging of Quarry Creek. Neerkol Creek flows through a deeply incised channel up to 20 m below the surrounding open woodland countryside.

As the local streams pass through chiefly agricultural landscapes, they are also subject to other outside modification processes, including clearing of riparian habitats, cattle degradation, chemical application (e.g. fertilizer, herbicides) and water extraction. Water quality is generally poor (Section 5 - Water Resources), with low SIGNAL2 (aquatic macroinvertebrate index) scores.

Aquatic fauna along the creeks are generally characterised by widespread species, none of which are of conservation importance. Sampling studies since 1997 have shown no significant changes in aquatic fauna or flora composition in recent years.

Aquatic Survey Results

Habitats and Water Quality

Aquatic habitat and water quality parameters were recorded at five sites in April 2005 (Table 6.3.1). Locations of sites sampled in the 2005 and 1998 surveys are shown in Figure 6.6.

Water quality parameters noted in the 2005 survey were similar across sites upstream and downstream of the project area. pH was in the range of 6.07 to 7.46, dissolved oxygen was fairly low, between 2.15 and 4.81 mg/l and conductivity was high, between 1,196 and 3,081 µs/cm. These figures are within a similar range to those recorded in the 1998 surveys. While water quality in the area remains good, the incidence of exotic plant infestation was very high. The most serious invader is Para grass (*Urochloa mutica*), which now chokes the waterways in many areas within the region. The most serious effects of this species on the aquatic environment has been to reduce diversity of edge habitat, reduce access to banks for semi-aquatic species, increase shading of the stream, increase detritus levels and reduce the availability of shallow open water habitats. Comparisons of changes due to invasion of Para grass are illustrated in the photographs taken at Site 3 in September 1998 and April 2005 (Plates 6.13 and 6.14).

Because of the extent of Para Grass invasions, it was not possible to sample at Sites 3 and 5. The most serious occurrence of this species is along Quarry Creek, where in many areas, there was 100% coverage of the stream by Para Grass (Plate 6.15). Lantana and rubber vine are also prolific in some areas.

Macroinvertebrates

A total of 29 families of aquatic macroinvertebrates, representing 10 orders were recorded by sweep net sampling during the 2005 survey (Table 6.3.2). The samples contained significant numbers of non-insect taxa at all sites, especially the gastropod family Planorbidae, and the shrimp family Atyidae. The most abundant insect families were Naucoridae (Hemiptera), Protonuridae (Odonata) and Libellulidae (Odonata).

Family variety between sites was similar, ranging from 11 at Site 1 up to 17 at Site 2. Diversity indices, as measured by the Shannon-Wiener Index were relatively low, and ranged from 1.64 at Site 1 to 2.46 at Site 7.

SIGNAL2 scores were calculated for each site. These scores, which always fall between 1 and 10, are an indicator of the habitat quality at each site and are derived from the known sensitivity of particular macroinvertebrate families to environmental pollution or degradation (Chessman, 2003). SIGNAL2 scores for every site were very low (less than 3.62), indicating that these sites are all highly disturbed, and generally inhabited by macroinvertebrate groups which are adaptable to poor conditions.

Apart from the macroinvertebrates collected by netting, freshwater mussels (*Velesunio* sp.) were hand collected from Sites 2 and 4, but the species was not abundant. Long-armed freshwater prawn (*Macrobrachium* spp.) night-time activity was observed at Site 4.

Table 6.3.1 Habitat and Environmental Parameters at Aquatic Sites, 2005

Parameter	Site Number				
	1	2	4	6	7
Site Name	Stuart Creek	Neerkol/Sandy Creek junction	Quarry Creek near Stanwell Gate	Neerkol Creek, old highway	Neerkol Creek
Date	12/04/2005	13/04/2005	13/04/2005	12/04/2005	14/04/2005
UTM Grid	56K	56K	56K	56K	56K
Northing	7399652	7399194	7397713	7401127	7404742
Easting	225203	223904	227159	228548	234853
Altitude (m)	63.8	44.6	42.7	32.6	23.2
Temp	24.4	23.86	23.26	24	24.1
Conductivity us/cm	1196	1945	2571	3081	2661
DO %	26.3	31.2	24.5	16.4	58.2
DO mg/l	2.15	2.57	2.06	1.4	4.81
pH	6.07	6.58	6.94	6.29	7.46
Av. Width (m)	8	6	8	6	6
Max Depth (m)	2	1.5	1	2	2
Length (m)	80	150	50	100	continuous
Visual turbidity (1-5)	2	2	3		2
Substrate	fine clay		sandy		
Shading	50%				
Flow	None	no	no		
Disturbance	some cattle disturbance, but banks too inaccessible	little cattle disturbance	minor cattle disturbance	minor	cattle disturbance
Weather	fine, hot	fine	fine, hot		
Logs/snags present		yes	no logs/snags	few	no log jams
Emergent macrophytes	none	no	no	dense	sparse
Submerged macrophytes	dense	sparse	dense	dense	dense - 60%
Rubber vine	present	no	no	sparse	no
Lantana	present	no	no	sparse	sparse
Castor oil plant	none	no	no	sparse	no
Noogurr Burr	none	no	present	no	no

Table 6.3.2 Macroinvertebrates Recorded by Sweep Sampling at Neerkol/Quarry Creek Sites, April 2005.

Order	Family	Site No.				
		1	2	4	6	7
Hirudinea	Richardsonianidae				2	
Hirudinea	Glossophoniidae				2	
Oligochaeta	Tubificidae		10			
Gastropoda	Planorbidae	36	31	100	18	50
Gastropoda	Viviparidae					4
Gastropoda	Corbiculidae	1				
Gastropoda	Lymneidae	13	2			
Acariformes	Acarina		20	30		
Decapoda	Atyidae	10	4	4	20	34
Ephemeroptera	Baetidae		4	30	40	14
Ephemeroptera	Caenidae					4
Odonata	Coenagrionidae	2	2	32		6
Odonata	Protonuridae	4	26	12	4	6
Odonata	Aeshnidae			2		
Odonata	Gomphiidae		10			
Odonata	Libellulidae		12	8	6	18
Odonata	Cordulliidae			4		
Hemiptera	Corixidae			2	1	46
Hemiptera	Naucoridae	34	103	6	102	26
Hemiptera	Pleidae		7			
Coleoptera	Hydrophilidae	2	1			6
Coleoptera	Dytiscidae	1	1	2		8
Diptera	Culicidae					30
Diptera	Ephydrinae		1			
Diptera	Ceratopogonidae	90	20		40	18
Diptera	Chironomidae	107	46	68	60	28
Diptera	Muscidae				4	
Trichoptera	Leptoceridae					2
Lepidoptera	Pyralidae				1	
Number of Species (29 in total)		**11**	**17**	**13**	**13**	**16**
Total Number of Individuals		**300**	**300**	**300**	**300**	**300**
Shannon-Wiener Diversity Index		**1.64**	**2.14**	**1.92**	**1.87**	**2.46**
SIGNAL2 Score		**2.61**	**3.26**	**3.62**	**3.13**	**2.86**

Fish

Surveys of natural habitat sites along Neerkol and Quarry Creeks both upstream and downstream of the project site have yielded a total of 12 species of freshwater fish (Table 6.3.3). These include 11 species recorded in 1998 (Duivenvoorden and Roberts, 1998) and 10 in 2005. One species recorded in 2005 (Flathead Gudgeon) has not been recorded in previous surveys. Three additional species, Salmon Catfish (*Arius graeffei*), Freshwater Long-tom (*Strongylura kreffti*) and Sleepy Cod (*Oxyeleotris lineolatus*) have been previously recorded in man-made water bodies within the SPS site or on surrounding farm lands (Duivenvoorden and Roberts, 1998). It is possible that these species may have been introduced to these areas.

Table 6.3.3 Fish Species Recorded on Neerkol and Quarry Creek Sites, 1998 and 2005

Common Name	Scientific Name	Site						
		1	2	3	4	5	6	7
Long-finned Eel	*Anguilla reinhardtii*			o				
Bony Bream	*Nematolosa erebi*	x		o	o	o	o	xx
Hyrtl's Tandan	*Neosilurus hyrtlii*		o	o		o	o	o
Fly-specked Hardyhead	*Craterocephalus stercusmuscarum*	o	o	o	xx	o	xxx	xxx
Eastern Rainbowfish	*Melanotaenia splendida splendida*	xx	x	o	xxx	o	xxx	xx
Agassiz's Glassfish	*Ambassis agassizii*	x	o		xxx		xxx	x
Barred Grunter	*Amniataba percoides*		o	o	o	o	o	xx
Spangled Grunter	*Leiopotherapon unicolor*	o	o		x	o	xx	xx
Mouth Almighty	*Glossamia aprion*	o	x	o	o	o		xx
Midgley's Carp Gudgeon	*Hypseleotris sp.*	xxx	x	o	xx		o	xx
Purple-spotted Gudgeon	*Mogurnda adspersa*	xx					xx	o
Flathead Gudgeon	*Philypnodon grandiceps*	xx	xx					
Total (12 species)		**9**	**9**	**8**	**8**	**7**	**9**	**10**

Note: Abundance in samples x=1-5; xx=5-40; xxx=40+
o = recorded at site by Duivenvoorden and Roberts (1998).
Sites 3 and 5 not sampled in 2005 survey.

Most of the species occurring in the Neerkol and Quarry Creek system are relatively small, under 15 cm in total length. The largest species are Long-finned Eel (up to 150 cm), Bony Bream (32 cm) and Hyrtl's Tandan (34 cm) (Allen *et. al.*, 2002). The three species recorded only from artificial water bodies are all relatively large.

The most abundant and widespread species in the system are Fly-specked Hardyhead, Eastern Rainbowfish, Agassiz's Glassfish and Midgley's Carp Gudgeon. These species occur on most sites, often in very large numbers.

Results of the 2005 survey compared to the 1998 survey were very similar in terms of species variety, and the fish communities in these streams appear to have changed very little over the past few years. Noticeably absent from the 2005 surveys was Hyrtl's Tandan, a species which is generally common and

easily observed (especially at night) wherever it is found. The Flathead Gudgeon was found to be common at two upstream sites in 2005, although it was not recorded at all in 1998. There are no clear reasons for these minor changes in species composition over time. They may be due to natural variations, sampling methods, or environmental conditions.

All of the fish species recorded from the Neerkol Creek system are generally common across eastern and northern Australia. No species is listed in any category under either the NC Regulation or the EPBC Act. Midgley's Carp Gudgeon is a common and well known species which is not yet formally described (Allen *et. al*., 2002).

Other Aquatic Vertebrates

Krefft's Turtle (*Emydura kreffti*) is an abundant species which was recorded at all sample sites in 2005 (Plate 6.16). This species is frequently seen on the water surface or basking on exposed logs. It was also caught in both types of traps. Very young individuals were caught at some sites, indicating that the species had successfully bred in recent months.

Other semi-aquatic reptiles found along the streams include the eastern water dragon (*Physignathus lesuerii*) and Eastern Water Skink (*Eulamprus quoyii*). The Water Rat (*Hydromys chrysogaster*) has been recorded from a site along Quarry Creek.

Aquatic Plants

The Neerkol/Quarry creek system has a profusion of aquatic plant life. A total of 22 species have been recorded in natural habitats within the Neerkol and Quarry Creek systems near the project site (Table 6.3.4). Several of these species are introduced, the most prolific and invasive of which is Para Grass. This species has choked the waterway in many areas, especially along Quarry Creek below the SPS outfall, where Para Grass has completely covered the stream in most areas (Plate 6.15). The most common native edge plant is Cumbungi (*Typha* sp.), which was present at most sites, but appears to be out-competed by para grass.

The Native Waterlily was the only floating attached species recorded, with minor occurrences present at several sites. Free floating plants included Ferny Azolla and Duckweed. Ferny azolla was abundant at several sites, especially sites 1 and 6, where it covered up to 80% of the water body.

Dense stands of submerged feathery and non-feathery plants occurred in many areas. The most prolific species were the Hornwort and Blunt Pondweed.

Table 6.3.4 Aquatic Plants Recorded in Neerkol and Quarry Creek Systems

Common Name	Scientific Name	Lifeform	Site Number						
			1	2	3	4	5	6	7
*Smooth Water Hyssop	*Bacopa monniera/montevidensis*	emergent, broad-leaf	x		x			x	X
Knotweed	*Polygonum attenuatum*	emergent, broad-leaf	x						X
Clubbrush	*Bolboschoenus* sp	emergent, narrow leaf		x					
Rice Sedge; Dirty Dora	*Cyperus difformis*	emergent, narrow leaf						x	
*Javan Flatsedge	*Cyperus javanicus*	emergent, narrow leaf	x			x	x		
Sedge	*Cyperus polystachyos*	emergent, narrow leaf	x			x		x	x
*Nutgrass	*Cyperus rotundus*	emergent, narrow leaf				x	x		x
Water Couch	*Paspalum distichum*	emergent, narrow leaf	x			x	x	x	x
Common Reed	*Phragmites australis*	emergent, narrow leaf		x					
Cumbungi	*Typha* sp	emergent, narrow leaf		x	x	x	x	x	x
*Para Grass	*Urochloa mulica*	emergent, narrow leaf	x	x	x	x	x	x	x
Native Waterlily	*Nymphaea gigantea*	floating attached	x		x			x	x
Ferny Azolla	*Azolla pinnata*	free floating	x					x	x
Duckweed	*Spirodela oligorrhiza*	free floating	x	x		x	x	x	x
Hornwort	*Ceratophyllum demersum*	submerged & emergent, feathery	x					x	x
Stonewort	*Chara* sp	submerged & emergent, feathery			x				
Red Watermilfoil	*Myriophyllum verrucosum*	submerged & emergent, feathery			x	x			
Ottelia	*Ottelia alismoides*	submerged, not feathery			x	x		x	
Hydrilla	*Hydrilla verticillata*	submerged, not feathery	x		x				
Blunt Pondweed	*Potamogeton ochreatus*	submerged, not feathery			x				
Sago Pondweed	*Potamogeton pectinatus*	submerged, not feathery	x	x	x	x		x	
Ribbonweed	*Vallisneria gigantea*	submerged, not feathery			x				

Note: *= introduced species
Sources: Duivenvoorden and Roberts (1998); 2005 surveys.

6.3.2 Potential Impacts and Mitigation Measures

Potential impacts of the Project on surface waters are outlined in Section 5 - Water Resources. These may include increased sedimentation, chemical contamination, and a changed flow regime to Quarry Creek due to changes in the current water discharge quantities. Mitigation measures to reduce and contain possible impacts of sedimentation and pollution are also outlined in Section 5 - Water Resources and with these controls in place it is not expected that sedimentation or pollution form the site will reach natural watercourses.

SPS currently has a licence to discharge 18 ML/day (6,570 ML/year) of water into Quarry Creek, but at present, discharge rates are much lower, between 3-5 ML/day (1,095-1,825 ML/year). Any change to current environmental flows in the system will depend on which scenario is finally adopted by the Project in regards to recycling of blowdown waters.

If blowdown from the Power Plant is not re-used for quenching, this water would be discharged to Quarry Creek via settling ponds. This could lead to an increase in creek flow of between approximately 657 ML/year and 1,350 ML/year (Stage 2), an increase of approximately 75%. There is also the possibility that a portion of SPS's combined stormwater and blowdown discharge to Quarry Creek will be re-used for coke quenching. If 10% of this discharge is re-used, then flows to Quarry Creek would be reduced by approximately 180 ML/year, a decrease of about 10%. It is unlikely that this water would be used without the power plant blowdown being re-used as well.

Any variations in water discharges would be well within existing permitted quantities. Water quality of the discharged waters is expected to be similar to that which is currently discharged from SPS.

A 75% increase in flows into Quarry Creek will increase environmental flows through the lower Neerkol Creek system. This may result in minor changes to depths in the larger pools, with the possibility of greater species diversity due to increased habitat diversity. It may also lead to a widening of the Quarry Creek channel. Due to the existing high densities of aquatic plants (both native and introduced) in the system, erosion and increased water velocities are not considered to be significant issues.

A reduction in flows to the system would probably be less than 10%, so changes from the existing situation are expected to be minor. A reduction of flows would probably result in some reduced weed infestation and a reduction in in-stream habitat diversity, which would be most prominent in the shallower parts of the stream, especially in the upper parts of Quarry Creek.

Given the highly artificial nature of the current flow regime, the lack of significant aquatic fauna in the area, and the predominance of aquatic weeds, variations in flows such as those described are not expected to significantly change the existing environmental values of the aquatic environment. Reference data on the aquatic ecology of sites along Neerkol and Quarry creeks have been collected in 1997 and in 2005 and it is proposed to continue monitoring selected sites for changes in aquatic ecology on an annual basis through the construction and operational phases of the Project. The details of the construction and operation monitoring programs will be addressed in the Environmental Management Plan (Section 16) for the Project.

Plates

Plate 6.1 Riparian vegetation found at the vicinity of the proposed rail crossing at Neerkol Creek April 2005.

Plate 6.2 Mature stand of *Eucalyptus raveretiana* on the banks within riparian vegetation community downstream of the proposed rail crossing site on Neerkol Creek, April 2005.

Plate 6.3 *Eucalyptus creba* Open Woodland on project site

Plate 6.4 Fenced boundary of project site.

Plate 6.5 Remnant habitats on old AMC site

Plate 6.6 Riverine habitat along Neerkol Creek

Plate 6.7 Ornate Burrowing Frog (*Limnodynastes ornatus*).

Plate 6.8 Lesser Black Whip Snake (*Demansia vestigiata*).

Plate 6.9 Black Kite (*Milvus migrans*) on nest.

Plate 6.10 Gould's Wattled Bat (*Chalinolobus gouldii*).

Plate 6.11 Eastern Grey Kangaroo (*Macropus giganteus*) on project site.

Plate 6.12 Squatter Pigeon (*Geophaps scripta*) at old AMC site.

Plate 6.13 Site 3, Neerkol Creek September 1998.

Plate 6.14 Site 3, Neerkol Creek April 2005, showing invasion of para grass.

Plate 6.15 Quarry Creek near SPS outfall, showing smothering of the stream by Para Grass (*Urochloa mutica*).

Plate 6.16 *Emydura kreffti*, a common turtle in the Neerkol Creek system.