ATLAS IRON LIMITED

ABYDOS EAST PROJECT
CAMP AND HAUL ROAD CORRIDOR

FLORA AND VEGETATION STUDIES

JULY 2012

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EXECUTIVE SUMMARY

Atlas Iron Limited (Atlas) are proposing to develop and operate the Abydos Direct Shipping Ore (DSO) Project (the Project), located approximately 100 km south south-east of Port Hedland, and 40 km east of the Great Northern Highway. The Project is based on identified iron ore resources totalling 10.1 million tonnes (Mt), with a proposed production level of 2 Mt per annum, and an anticipated minimum mine life of 5-6 years. Ore will be mined from 2 open pits, namely the Trigg and Mullaloo pits. The open cut pits will be mined using conventional drill-and-blast and load-and-haul mining methods. Mining will occur above the water table and therefore dewatering will not be required.

Atlas in association with Venturex Resources Limited (Venturex) are in the process of establishing a Haul Road linking the Atlas DSO mining operation to the existing sealed Marble Bar Road via Venturex's access road route to the proposed Venturex Sulphur Springs Hub site. Under the agreement, Atlas and Venturex will have shared access and capacity rights to the Haul Road to service and support Atlas's Abydos DSO project and Venturex's Sulphur Springs project.

Run-of-Mine (ROM) ore will be crushed and screened, and transported via the Haul Road linking the Atlas DSO project to the Marble Bar Road, and then to port at Port Hedland.

In order to support a mining proposal and Native Vegetation Clearing Permit for the Project, Atlas has commissioned Woodman Environmental Consulting Pty Ltd (Woodman Environmental) to conduct a flora and vegetation survey of an approximately 10km x 200m section of two proposed haul road routes within an area not previously surveyed between the Atlas Abydos surveyed area and the Panorama Project surveyed area and proposed accommodation camp area within the Panorama Project surveyed area.

Detailed site recordings were taken within each identified plant community and at regular intervals in the haul road and camp study area. The detailed recording sites were established in all vegetation types identified following interpretation of aerial photography. A total of 18 detailed recording site locations and 1 observational site were undertaken within the haul road study area. Field observations were also used to define one plant community within the haul road study area. Six detailed recording sites and 2 observational sites were undertaken within the proposed camp study area during the period 11-12th June 2012. Conservation significant flora and introduced flora locations were also recorded during the establishment of detailed recording sites within the study area. Targeted searches for conservation significant flora and introduced flora were not carried out as part of this survey.

A total of 62 dominant discrete vascular flora taxa, were recorded within the haul road and camp study area during surveys in June 2012. Two conservation significant flora taxa are known from within the study area. These were:

- *Eriachne* aff. *festucacea* (potentially undescribed taxon)
- *Euphorbia clementii* (P2)

As specific searches for conservation significant flora were not carried out as part of this survey, it is considered possible that individuals may occur elsewhere within the study area. No Threatened (Declared Rare Flora) taxa or taxa listed as threatened under the *Environmental Protection and Biodiversity Conservation Act* 1999 were recorded.

A total of 4 introduced taxa are known to occur within the study area. These were:

- *Aerva javanica*
- *Cenchrus ciliaris*
- *Citrullus colocynthis*
- *Portulaca oleracea*

Of these, *Aerva javanica* and *Cenchrus ciliaris* are considered to be serious environmental weeds. It also should be noted that, as for the conservation significant flora taxa, detailed surveys for *A. javanica, C. ciliaris, C. colocynthis* and *P. oleracea* at these known locations have not been undertaken to determine the full distribution of individuals, and it is considered possible that individuals may occur elsewhere within the study area, and therefore may be impacted. There may also be indirect disturbance of soil-stored seed of these taxa. The results of impacts to weed taxa or weed propagules are potential re-establishment and proliferation post-disturbance, and potential spread of propagules to other disturbed and undisturbed areas during construction.

Woodman Environmental structural vegetation type descriptions were aligned with Vegetation Alliance descriptions from Mattiske 2007. This has been carried out so that a cumulative impact assessment can be conducted on the proposed Abydos East haul road, camp area and the proposed Venturex haul road route which joins the Marble Bar Road.

A total of 8 vegetation alliances and two mosaic vegetation alliances (as described by Mattiske 2007), from four vegetation formations and a mosaic of two of these vegetation formations were mapped within the camp and haul road corridor study area. The vegetation alliances are based primarily on vegetation structure and topographical locations within the study area.

Of the vegetation alliances mapped within the camp and haul road corridor study areas, vegetation alliances 2a, 6a, 12a and mosaic 12a/13a are well represented within the entire study area (>10% of the study area) and are considered not locally significant. Vegetation alliances 13a, 17a, 18a and mosaic 6a/12a are not so well represented within the entire study area and are considered of moderate local significance (1-10% of the study area). Vegetation alliances 8a and 11a are poorly represented within the entire study area and are considered of higher local significance (<1% of the study area). Although there is no regional vegetation dataset to determine the extent of such vegetation types within the Pilbara, it is highly likely that these vegetation types would be relatively common and widespread outside the study area, as the landforms they occur on are common and widespread. It is therefore considered that none of the vegetation types mapped in the study area are of regional conservation significance as the vegetation systems associations in which

they occur remain almost at their pre-European extents, although they are poorly reserved in conservation estate.

Searches of the DEC TEC and PEC Database have been undertaken, and results showed that no TECs or PECs are known from within the study area. Although 2 TECs are currently known from the Pilbara Bioregion, no TECs are currently listed as occurring within the Pilbara 4 or Pilbara 1 subregions. No vegetation alliances within the study area are equivalent to any state-listed TECs or PECs, or federal-listed threatened ecological communities.

Intact native vegetation of primarily excellent condition was located within the haul road corridor study area and camp study area. Drainage line areas within the haul road corridor study area were ranked as 'Good' and the minor drainage lines and low lying depression within the camp area being ranked as 'Very Good'; these areas generally displayed obvious signs of impacts to structure and species composition, primarily as a result of cattle trampling and grazing, and the presence of moderate to large infestations of invasive weeds, particularly *Cenchrus ciliaris* and *Aerva javanica.*

The following recommendations are given:

- Clearing of vegetation should be minimised as much as practicable, particularly at or in the vicinity of locations of conservation significant flora taxa, with clear definition of areas for clearing with markings such as pegs and flagging tape to prevent over-clearing.
- Clearing of vegetation should be minimised as much as practicable, particularly at or in the vicinity of vegetation alliances 8a and 11a which are poorly represented locally within the study area.
- Management measures should be enacted to prevent indirect impacts to conservation significant flora taxa during the construction and operational phases of the Project, with measures potentially including flagging of individuals prior to construction, and monitoring of individuals during the operational phase.
- The final Project location should seek to minimise impacts to the locally significant vegetation types 8a and 11a.
- A weed hygiene plan and monitoring programme should be developed and implemented for construction and on-going operations, with actions to include control of weed populations following ground disturbance, monitoring of disturbed areas, and machinery hygiene.
- Atlas should attempt to limit dust-creating activities during periods of high wind velocity/duration during construction and operation of the proposed haul road.
- Rehabilitation of borrow areas should occur once construction has ceased.
- Fresh water rather than saline (where possible) should be used for dust control to prevent impacts from saline water on significant flora and vegetation.
- Surface water movement should be managed through the development of appropriately designed drainage control systems in areas where sheet flow is prevalent to avoid water shadowing and ponding.

1. INTRODUCTION

1.1 PROJECT AND STUDY DESCRIPTION

Atlas Iron Limited (Atlas) are proposing to develop and operate the Abydos Direct Shipping Ore (DSO) Project (the Project), located approximately 100 km south south-east of Port Hedland, and 40 km east of the Great Northern Highway. The Project is based on identified iron ore resources totalling 10.1 million tonnes (Mt), with a proposed production level of 2 Mt per annum, and an anticipated minimum mine life of 5-6 years. Ore will be mined from 2 open pits, namely the Trigg and Mullaloo pits. The open cut pits will be mined using conventional drill-and-blast and load-and-haul mining methods. Mining will occur above the water table and therefore dewatering will not be required.

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In order to support a mining proposal and Native Vegetation Clearing Permit for the Project, Atlas has commissioned Woodman Environmental Consulting Pty Ltd (Woodman Environmental) to conduct a flora and vegetation survey of an approximately 10km x 200m section of two proposed haul road routes within an area not previously surveyed between the Atlas Abydos surveyed area and the Panorama Project surveyed area and proposed accommodation camp area within the Panorama Project surveyed area.

The current study area is shown on Figure 1. This flora and vegetation survey is a Level 1 survey as defined by the Environmental Protection Authority's (EPA) Guidance Statement No. 51 (EPA 2004). The Level 1 survey consisted of a background research/desktop study and reconnaissance survey which involved a target area visit by suitably qualified personnel which undertook selective, low intensity sampling. This level of survey was determined to be the appropriate level of survey for the Project, after review of Table 2 of Guidance Statement No. 51 (EPA 2004), where the Bioregion Group is defined as Group 2, and the nature of the impact is considered to be low. The purpose of the background research/desktop study is to review known information relevant to the study area through all sources of literature available (EPA 2004).

The results of the background research/desktop study are presented in Section 2 of this report, with the results of the target area visit of the study area presented in Section 4.

1.2 AIMS

The aim of this study was to determine the flora and vegetation values of the study area. The overall objectives of the study were to:

- Compile an inventory of dominant vascular plant taxa present within the study area;
- Record locations of Threatened (Declared Rare Flora (DRF)) taxa, Priority Flora taxa and introduced taxa that may be present within the study area;
- Define and map Plant Community Types (PCTs) within the study area using plant community descriptions from Mattiske 2007; and
- Prepare a report detailing the results of the survey within the study area

The tasks undertaken to meet this aim were:

- Review all existing literature relating to flora, vegetation and other environmental factors relevant to the study area, including relevant state and federal databases;
- Establish detailed recording sites throughout all discernible plant communities within the study area;
- Map the distribution of PCTs within the study area using a combination of aerial photograph interpretation and field observation;
- Record flora species, including Threatened, Priority Flora and introduced taxa that may be present within the study area in between recording sites;
- Provide a report and map detailing PCTs, conservation significant flora, introduced flora and vegetation condition within the study area.
- Identify management measures to minimise the impact of the Project on the flora and vegetation of the study area.

2. BACKGROUND

2.1 STUDY AREA

The study area for the proposed Haul Road consists of 2 proposed infrastructure corridors linking the Abydos Project Area to the Venturex access road route to the proposed Venturex Sulphur Springs Hub site and further to the north to the sealed Marble Bar Road.

The study area for the proposed camp area lies to the north east of the Haul Road study area within an area previously mapped by Mattiske (2007) using mapping previously conducted by Trudgen (2002, 2006; 2007a; 2007b) for the Panorama Project for CBH Resources.

The western portion of the study area is intersected by the Six Mile Creek, flowing from south to north, while the eastern extremity is commonly referred to as Sulphur Springs Road.

2.2 CLIMATE

The study area is located within the Pilbara region in the Arid Zone of Western Australia, and is classified as desert because of low, erratic rainfall (Beard 1990). The

Pilbara region experiences an arid tropical climate with predominantly summer rainfall (Beard 1990), and is strongly influenced by summer cyclones. The prevalence of such cyclonic events results in the Pilbara receiving slightly higher average annual rainfall (250-300 mm) than the remainder of the Arid Zone. Figure 2 displays the average monthly maximum and minimum temperatures, and average monthly rainfall (data from 2000 – 2012), recorded for Marble Bar, the nearest meteorological station to the study area (Bureau of Meteorology 2012a, b).

The average daily maximum temperatures at Marble Bar peak in December and January (41.7°C), however the average temperature is above 36°C for the period October – April. The lowest average minimum temperature is experienced in July. The average annual rainfall for this station is 347.8 mm (data from 2000-2012). Average monthly rainfall peaks in summer, particularly February – March, with rainfall strongly influence by tropical cyclones, which generally form between December and April.

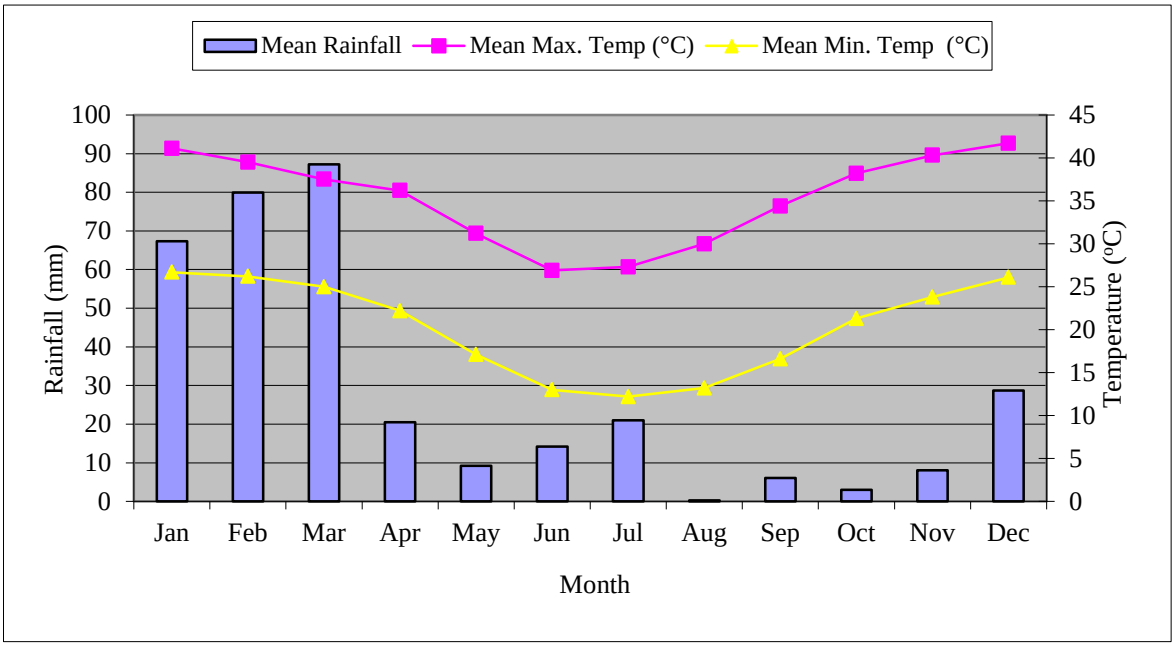

Figure 2: Average Maximum and Minimum Temperatures (°Celsius) and Average Rainfall (mm) for Marble Bar (Bureau of Meteorology 2012a, b)

2.3 Landforms, Geology and Soils

The study area is located in the Pilbara Region (Fortescue Botanical District), which is formed of a basement of Archaean rocks, overlain by massive deposits of Proterozoic sediments and volcanics (Beard 1990). This region is generally mountainous, rising to 1250 m, with hard alkaline red soils on plains and pediments, and shallow and skeletal soils on ranges. The study area traverses 2 physiographic regions as defined by Beard (1975); the Abydos Plain and the Gorge Ranges.

The Abydos Plain is alluvial in origin near the coast, however further inland is of Archaean granite origin. It consists of a variety of features including alluvial plains, pediplains, low stony hills and dissected pediments, low granite outcrops and tors, and

basic dykes. It is divided into a number of isolated sections by the Gorge Ranges. The main soils are hard alkaline red soils, some areas with coarse textured A horizons to 45 cm thick, while other areas have shallow stony A horizons. Patches of calcrete also occur. On the eastern part of the plain near the De Grey River, the soils are chiefly neutral and acidic red earths, while on the inland plains behind the Gorge Ranges, chief soils are earthy loams and coarse sands overlying granite within 90 cm of the soil surface. The alluvial plains along the coast generally consist of red earthy sands with extensive areas of red earths, and hard red soils along creek lines. Deep cracking clays occur in the vicinity of residuals of basic and ultrabasic rocks in the Roebourne area (Beard 1975).

The Gorge Ranges are a rough, steep and abrupt range dissected by a number of rivers through narrow gorges. These ranges consist of Archaean and Lower Proterozoic rocks of sedimentary and volcanic origin, with basic lavas along with dolomites, tuff, banded-iron formations and dolerite dykes, with some narrow valley-plains and high-level gently undulating areas of limited extent (Beard 1975). The soils are generally shallow and stony, with large areas without soil cover. Chief soils are brown loams with significant areas of earthy loams soils, with hard alkaline red soils occurring on lower slopes, and cracking and non-cracking clays on valley floors.

Churchward and McArthur (1980) undertook a study of the soil pattern in relation to physiography and geology in the Pilbara region within 2 areas: the Strelley catchment (east Pilbara, immediately west of the Shaw River) and the Gorge catchment (west Pilbara). In the upland sections, the Strelley catchment consists of shales, cherts, banded jaspilites, sandstones and basalts, whereas in the downstream section it is composed of granite outcropping, or granite at shallow depth overlain by alluvium.

The uplands of the Strelley catchment were described as extensively and deeply incised and mantled by shallow stony red clay soil, with laterite residuals occurring on the dissected uplands, and as isolated residuals from the plain. The piedmont zone has sediments less than 2 m thick; gravelly and stoney red clays are the most common profiles, with some gravelly cracking clays (Churchward and McArthur 1980).

The alluvial terrain of this catchment is restricted to narrow zones, eventually widening out to an extensive plain. The pediplains consist of a gently undulating surface, with low local relief, underlain by granite. The most extensive unit was described as relatively uniform areas of red earths on gentle convex divides. Eroded margins of pediplains occur extensively, with granite outcrops, quartz and dolerite dykes and pockets of calcrete common. Sandy loam sediments are found on shallow drainage lines, and are laterally continuous with terraces of the main streams (Churchward and McArthur 1980).

2.3 REGIONAL VEGETATION

The study area lies within the Eremaean Province, as defined and mapped by Beard (1975; 1990), which is also known as the Arid Zone. The Eremaean Province occupies over 70 % of Western Australia and is technically regarded as a desert due to the low and erratic rainfall, disallowing the production of crops without irrigation (Beard 1990).

The study area is specifically located within the Fortescue Botanical District (Pilbara Region) of the Eremaean Province. The Fortescue Botanical District extends northwards from the *Acacia*-dominated scrub in the south, and on the western and eastern boundaries by the Carnarvon and Canning Basins. The vegetation of this District was described by Beard (1975) as 'tree and shrub-steppe communities, with *Eucalyptus* trees, *Acacia* shrubs, *Triodia pungens* and *Triodia wiseana*, with *Triodia* hummock grasslands the characteristic vegetation type of the region'.

The study area lies on the northern section of the Pilbara Craton within the Fortescue Botanical District, on both the Abydos Plain and Gorge Ranges. Of the 4 main associations described on the Abydos Plain, Shrub Steppe is predominant in the study area (Beard 1975). This is the main community of the granite plain, which is dominated by *Acacia pyrifolia-Triodia pungens* association, with hummock grasses with widely-spaced shrubs. The vegetation of the higher parts of the Gorge Ranges are covered with tree steppe (dominated by *Eucalyptus leucophloia*, *Triodia pungens* and *Triodia wiseana* in the south), with shrub steppe on the valleys and lower slopes (dominated by *Acacia bivenosa*, *Acacia pyrifolia* and *Triodia pungens*). On higher ground *Ficus* and *Terminalia* may dominate the overstorey either with or in replacement of Eucalypt species (Beard 1975).

This Fortescue Botanical District is also known as the Pilbara IBRA (Interim Biogeographic Regionalisation for Australia) (Government of Australia 2005), and the study area is specifically located within the Pilbara 1 (PIL1) Chichester Subregion (Kendrick & McKenzie 2001). The PIL1 Chichester Subregion is comprised of undulating Archaean granite and basalt plains, with significant areas of basaltic ranges. Plains support a shrub steppe characterised by *Acacia inaequilatera* over *Triodia wiseana* hummock grasslands, while *Eucalyptus leucophloia* tree steppes occur on ranges. Grazing of native pastures by stock and impacts from mining are the main impacts on biodiversity within the region (Kendrick & McKenzie 2001).

Shepherd *et al.* (2002) mapped and described vegetation system associations related to physiognomy, expanding on mapping undertaken by Beard (1975). Vegetation associations were described at a scale of 1:250,000. The study area traverses 2 vegetation system associations which are summarised in Table 1. Table 1 also presents the current extent of each vegetation system association in relation to the pre-European extent, and the extent in Department of Environment and Conservation (DEC)-managed lands, including conservation reserves (Government of Western Australia 2011). All vegetation system associations remain almost at their pre-European extents, however only a small percentage of one of the associations is reserved in conservation estate (Table 1).

Table 1: Extent of Vegetation Associations within the Study Area (Shepherd *et. al.* 2002; Government of Western Australia 2011)

Vegetation Association	Description	Current Extent (ha)	Percentage of Pre-European Extent Remaining	Percentage of Current Extent Reserved in DEC-Managed Lands
Abydos Plain – Chichester 93	Hummock grasslands, shrub steppe; kanji over soft spinifex	2,477,408	99.86	1.47
Gorge Ranges 82	Hummock grasslands, low tree steppe; snappy gum over *Triodia wiseana*	316,855	99.9	0.0

In 2004, the Department of Agriculture described vegetation site types within the Pilbara IBRA region considering general ecological information, vegetation physiognomy and composition, patterns of variation, conservation status, gradational association and land system representation (Van Vreeswyk *et al.* 2004). The study area traverses 4 land systems, of which the Rocklea and Macroy are the most regionally dominant (Table 2).

Table 2: Land Systems Located within the Study Area (Van Vreeswyk *et al.* 2004)

Land System	Mapped Extent (ha)	Description of Land System
Boolgeeda	774 800	Stony lower slopes and plains below hill systems supporting hard and soft spinifex grasslands and mulga shrublands.
Capricorn	529 600	Hills and ridges of sandstone and dolomite supporting low shrublands or shrubby spinifex grasslands.
Macroy	1 309 500	Stony plains and occasional tor fields based on granite supporting hard and soft spinifex grasslands.
Rocklea	2 299 300	Basalt hills, plateaux, lower slopes and minor stony plains supporting hard spinifex (and occasionally soft spinifex) grasslands.

The DEC Threatened Ecological Communities (TEC) and Priority Ecological Communities (PECs) database was searched for information regarding any occurrences of TECs or PECs within or in the immediate vicinity of the study area (DEC 2012e). There are no known occurrences of TECs or PECs within a 5 km radius of the study area. Two TECs are known from the Pilbara Region (TEC 46 – Themeda Grasslands and TEC 78 – Ethel Gorge Aquifer Stygobiont Community). Both of these TECs are associated with the Hamersley Range area, located over 100 km to the south of the study area (DEC 2012a), and therefore it is considered highly unlikely that either of these TECs would occur within the study area. Appendix A presents definitions of categories and criteria for TECs and PECs (DEC 2010a).

A search of the Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) database with regard to environmental matters of national significance as listed under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act), was also performed for the study area

(DSEWPaC 2012). The results of this search indicate that no nationally-listed threatened ecological communities are known from the study area.

The DEC has undertaken a biodiversity survey of the Pilbara IBRA biogeographic region, over the years 2002-2007 (McKenzie *et al.* 2009). The project sampled various organisms and included 422 flora sampling sites. The sites were located in such a way that all major geological formations, landform types, soil, climate and vegetation types were included in the study. Currently the floristic data collected in this study is being analysed and interpreted; therefore, no results are available at this stage.

2.4 REGIONAL FLORA

The DEC threatened flora databases, including the Western Australian Herbarium (WAHerb) specimen database and the Threatened and Priority Flora database (Declared Endangered Flora List) database were searched for information regarding conservation significant taxa known from within or in the immediate vicinity of the study area (DEC 2012b). The Declared Rare and Priority Flora list was also interrogated, which provides information on taxa known to occur in the general region of the study area. A total of 26 Priority flora taxa were returned; no Threatened (DRF) taxa were returned (DEC search reference 18-0612FL). A list of these taxa is presented in Appendix B. Appendix C presents conservation codes for Western Australian flora (Smith 2012).

The search of the DSEWPaC database (DSEWPaC 2012) indicated that no nationally-listed threatened flora species are known from the study area. However, the results of this search indicated that 1 significant invasive taxon (or habitat for such taxon) potentially occurs within the study area: *Cenchrus ciliaris*.

C. ciliaris is not listed as a Declared Plant in Western Australia (Department of Agriculture and Food 2011) but is considered by the States and Territories to pose a particularly significant threat to biodiversity, as it is well known to be particularly invasive under certain conditions (Hussey *et al.* 2007; DSEWPaC 2012).

In Western Australia, *C. ciliaris* is listed under the then-Department of Conservation and Land Management's (CALM) (now DEC) Environmental Weed Strategy for Western Australia (CALM 1999). This strategy assessed and rated environmental weeds in terms of their environmental impact on biodiversity. Each weed species was rated according to 3 criteria, namely invasiveness, distribution and environmental impact, and was assigned a score of 'High', 'Moderate', 'Mild' or 'Low'. These ratings were then used to determine an order of priority for control and/funding. *C. ciliaris* was ranked 'High'. Appendix D provides descriptions of each rating in the Environmental Weed Strategy for Western Australia.

A search of the WAHerb specimen database for records of introduced taxa recorded within the study area and surrounds was performed using the online tool NatureMap (DEC 2012c). No introduced taxa were returned.

2.5 LOCAL FLORA AND VEGETATION SURVEYS

Six detailed vegetation and flora surveys have been conducted for the proposed Panorama Project by M. E. Trudgen and Associates (Trudgen). These surveys incorporated the current Venturex haul route survey area and proposed camp area and adjoin the survey area for the Abydos east haul road to the east. These surveys comprised:

- April 2001 – General flora collection survey conducted with 81 quadrats established and recorded along the proposed access road and around the proposed mine and processing areas (including Kangaroo Caves and Bernts areas).
- October 2001 – Vegetation survey of the Project Area (including Kangaroo Caves and Bernts areas) and additional flora collections.
- April 2006 – Rare flora survey of the Project Area.
- May 2006 – Rare flora survey focussing on the proposed infrastructure locations and a vegetation survey of the previously proposed camp site.
- May 2007 – Vegetation and flora survey of new infrastructure areas, around the plant site, that were not covered by previous surveys.
- June 2007 – Vegetation and flora survey of new infrastructure areas, including the airstrip and camp that were not covered by previous surveys.

Trudgen *et al*. (2002) and Trudgen (2006; 2007a; 2007b) document in fine detail the flora and vegetation of the Panorama Project Survey Area. The vegetation survey of the Panorama Project Survey Area involved both flora descriptions and vegetation mapping, in addition to floristic analysis using the PATN computer package; to enable comparison of the vegetation within the Survey Area (Trudgen *et al*. 2002). These reports have not been made available for review for the purposes of this project.

Mattiske Consulting Pty Ltd (Mattiske Consulting) (2007) was commissioned by URS Australia Pty Ltd of behalf of CBH Resources Ltd to review and provide advice on the Trudgen *et al*. (2002) and Trudgen (2006; 2007a; 2007b) reports. The objective of this review was to provide a simplified description of the flora and vegetation of the Panorama survey area for the purpose of supporting environmental approvals processes.

A total of 514 plant taxa (including subspecies and varieties) from 161 genera and 58 plant families were recorded within the Panorama Project Survey Area. The most common families recorded included Poaceae (76 taxa), Papilionaceae (61 taxa), Malvaceae (46 taxa) and Mimosaceae (44 taxa). Ten introduced (exotic) species were recorded within the Panorama Project Survey Area (Mattiske 2007). These were: *Aerva javanica* (Kapok Bush), *Argemone ochroleuca* (Mexican Poppy), *Cenchrus ciliaris* (Buffel Grass), *Cucumis melo* subsp. *agrestis* (Ulcardo Melon), *Cynodon dactylon* (Couch Grass), *Portulaca oleracea* (Purslane), *Ricinus communis* (Castor Oil Plant), *Setaria verticillata* (Whorled Pigeon Grass), *Solanum nigrum* (Black berry nightshade) and *Vachellia farnesiana* (Mimosa Bush) (Mattiske 2007).

No Declared Plant species pursuant to section 37 of the Agricultural and Related Resources Protection Act 1976 [WA] were recorded in the Panorama Project Survey Area. No Declared Rare Flora species pursuant to Subsection 2 of Section 23F of the Wildlife Conservation Act 1950 [WA] and listed by the Department of Environment

and Conservation (2007a) were located during the survey. No Endangered or Vulnerable taxa, pursuant to s179 of the Environment Protection and Biodiversity Conservation Act 1999 [Commonwealth] were located during the survey (Mattiske 2007).

Seven Priority Flora species were recorded within or may occur within the Panorama Project Area: *Euphorbia clementii* (P2), *Gonocarpus ephemerus* (P2), *Olearia fluvialis* (P2), *Abutilon trudgenii* (ms) (P3), *Acacia glaucocaesia* (P3), *Gymnanthera cunninghamii* (P3) and *Ptilotus mollis* (P4) (Mattiske 2007).

Ten Vegetation Formations and 52 Vegetation Alliances were mapped in Trudgen *et al.* (2002) and Trudgen (2007b). No Threatened Ecological Communities (TEC) as defined by the Environment Protection and Biodiversity Conservation Act 1999 [Commonwealth] were observed in the Panorama Project Survey Area (Mattiske 2007).

In general, the vegetation of the Panorama Project Survey Area was categorised as "very good" or "excellent" in condition, except where directly impacted by the existing access road. There was one area of vegetation in "poor" to "very poor" condition along the access road which was infested with **Cenchrus ciliaris* (Buffel Grass) (Mattiske 2007).

Mattiske 2007 summarised Eighteen Vegetation Alliances in six Vegetation Formations from the detailed botanical surveys of the Panorama Project Survey Area (Trudgen *et al*. 2002). Thirteen of these were considered to be locally significant due to the presence of Priority Flora species, species of conservation significance or restricted occurrence in the wider Panorama Project Survey Area. These eighteen vegetation alliances are listed below:

Open Forest to Open Woodland: Flowlines
Vegetation Alliance 1a - Open forest to open woodland of *Eucalyptus camaldulensis, Melaleuca argentea* and *Eucalyptus victrix* with scattered tall shrubs of *Indigofera monophylla* over *Schoenus falcatus, Cyperus vaginatus* and *Triodia longiceps* sedgeland/grasslands in river beds.

Open Forest to Open Woodland: Other
Vegetation Alliance 2a - *Eucalyptus victrix* scattered trees to open woodland which may include *Melaleuca glomerata* and *Melaleuca linophylla* over open to closed scrub in creek beds and low slopes.

Vegetation Alliance 3a - *Corymbia aspera* scattered low trees to low open woodland in creek beds.

Vegetation Alliance 4a - *Acacia tumida* high shrubland to low open forest in creeklines.

Vegetation Alliance 5a - *Eucalyptus leucophloia* scattered low trees over patches of *Acacia* shrubs over hummock grasslands of *Triodia* species, including *T. brizoides, T. wiseana* and *T. epactia* on ridge slopes.

Vegetation Alliance 6a - *Corymbia hamersleyana* scattered low trees to low open woodland over tall shrubs to open shrubland of *Acacia* spp. and *Grevillea wickhamii* over hummock grasslands on creek banks, flood banks and distributing fans.

Vegetation Alliance 7a - *Corymbia zygophylla* and *Corymbia hamersleyana* scattered low trees over hummock grasslands on sandplains.

Vegetation Alliance 8a - *Terminalia canescens* scattered low trees to low woodland on creek banks.

Vegetation Alliance 9a - *Atalaya hemiglauca, Acacia pruinocarpa, Ehretia saligna* var. *saligna, Acacia tumida, Eucalyptus ferriticola* subsp. *ferriticola* and *Ficus platypoda* scattered low trees over high open shrubland on steep, rocky gorge walls.

High Shrublands to Open Scrublands
Vegetation Alliance 10a - Shrubland to open scrubland of *Acacia* species including *A. tumida, A. acradenia* and *A. orthocarpa* over hummock grasslands on upper and steep slopes.

Vegetation Alliance 11a - Shrubland to closed scrubland of *Acacia* species, including *A. acradenia, A. pyrifolia* and *A. tumida* along small creeklines and on the adjacent parts of valley floors and distributing fans.

Vegetation Alliance 12a - *Acacia inaequilatera* scattered tall shrubs to high open shrubland over *Triodia brizoides* hummock grasslands on ridge slopes and low hills.

Vegetation Alliance 13a - *Acacia inaequilatera* scattered tall shrubs to high shrubland over *Triodia wiseana* hummock grasslands occurring mainly on gentle lower slopes.

Vegetation Alliance 14a - *Acacia ancistrocarpa* high open shrubland to open scrub.

Vegetation Alliance 15a - *Acacia trachycarpa* high open shrubland to high shrublands.

Low Shrublands to Low Open Heaths
Vegetation Alliance 16a - Low shrublands to low open heath on gentle slopes and undulating plains.

Hummock Grasslands
Vegetation Alliance 17a - Hummock grasslands on slopes and ridges.

Other Grasslands and Herblands
Vegetation Alliance 18a - Cracking clay alliance on gentle sloping plains and seasonal damplands.

Mattiske 2007 also conducted an assessment of the probability of groundwater dependence of the vegetation within the Panorama Project Survey Area. Vegetation Alliance 1a was rated as having a Very High probability of being a GDE and Vegetation Alliance 2a as having a High probability of being a GDE. All other Vegetation Alliances were rated with a low GDE probability. Locally within the Panorama Project Survey Area, Vegetation Alliance 1a and 2a could be potentially

recognised as spring or river pool systems, given the location of these GDEs along flowlines and on lower slopes. Two ecosystems in the Pilbara Region are recognised nationally as Groundwater Dependent Ecosystems (GDEs) (Sinclair Knight Merz, 2001). These are:

- Pilbara spring systems, which are entirely dependent on groundwater and have a high conservation value; and
- Pilbara river pool ecosystems, which are highly dependent on groundwater and have a moderate conservation value.

In general, the spring ecosystems and river pool ecosystems of the Pilbara are recognised as groundwater dependent ecosystems and are protected under state legislation according to the *Environmental Protection Act 1986* [WA] and the *Rights in Water and Irrigation Act 1914* [WA] (Water and Rivers Commission 2000; Sinclair Knight Merz 2001).

Atlas commissioned Woodman Environmental Consulting Pty Ltd (Woodman Environmental) in 2008 to conduct a flora and vegetation survey and impact assessment of the Abydos DSO Project study area, which was defined by Atlas prior to survey in 2008. Following changes to the Project infrastructure layouts subsequent to survey in 2008, the study area was revised, and further surveys were conducted in 2010 and 2011. The Abydos DSO Project study area joins to the south and south west of the proposed Abydos east haul road study area.

An initial reconnaissance visit to the Abydos DSO Project study area was conducted from the 12th - 16th March 2008. Detailed survey was conducted over 2 visits in 2008, (from the 26th – 30th May, and from the 7th – 11th July), with further detailed survey conducted over 3 visits in 2010 (24th May – 2nd June, 28th July – 4th August, and 16th – 23rd August), and 1 visit in 2011 (22nd September). A total of 133 survey quadrats and 18 detailed recording sites were established over these visits. Data from quadrats established within the study area was used in a floristic analysis, to describe Floristic Community Types (FCTs) in the Abydos study area (Woodman Environmental 2012).

A total of 263 discrete vascular flora taxa, 1 known hybrid and 1 putative hybrid were recorded within the study area. This total is inclusive of data collected during 2008, 2010 and 2011. These taxa represent 40 families and 112 genera. The most well-represented families were Fabaceae (55 taxa, 1 known and 1 putative hybrid), Poaceae (44 taxa), and Malvaceae (27 taxa). A total of 6 conservation significant flora taxa recorded within the study area (Woodman Environmental 2012). These were:

- *Abutilon* aff. *hannii* (potentially undescribed taxon)
- *Eriachne* aff. *festucacea* (potentially undescribed taxon)
- *Euphorbia clementii* (P2)
- *Gymnanthera cunninghamii* (P3)
- *Heliotropium muticum* (P1)
- *Pityrodia* sp. Marble Bar (G. Woodman & D. Coultas GWDC Opp 4) (P1)

A total of 5 introduced flora taxa were recorded in the study area, none are Declared Plants under the ARRP Act (Department of Agriculture and Food 2011), or listed Weeds of National Significance (Thorp & Lynch 2000). These were:

- *Aerva javanica* (kapok)
- *Cenchrus ciliaris* (buffel grass)
- *Citrullus colocynthis* (Colocynth)
- *Malvastrum americanum* (Spiked Malvastrum)
- *Portulaca oleracea* (purslane; pigweed)

Woodman Environmental (2012) conducted a statistical analysis of taxon presence/absence data on 133 quadrats, using 252 vascular taxa which defined 10 Floristic Community Types (FCTs), 1 of which was split further into 2 sub-types. These FCTs comprise 3 super-groups. The split between the 3 super-groups is based primarily on topographical location and associated soil types within the study area, with distinct differences in species composition between the super-groups.

Super-group 1 is comprised of FCTs 1 and 2, with FCT 2 divided into 2 sub-types. It consists of vegetation in broad drainage lines and floodplains on the Abydos plain, and steep, often shaded hill crests, slopes and minor drainage lines in the adjacent Gorge Range. Generally, the vegetation mapped as Super-group 1 consisted of tall open to sparse shrublands dominated by *Acacia* taxa (particularly *A. tumida* var. *pilbarensis*) and often *Grevillea wickhamii* subsp. *hispidula*, over hummock grassland usually dominated by 1 or more *Triodia* species (particularly *T. epactia*). Isolated trees of *Corymbia hamersleyana* were also frequently present. Often a sparse low shrubland layer was also present, consisting of mixed species Woodman Environmental (2012).

Super-group 2 is comprised of FCTs 3 through to 9, and generally consists of vegetation on floodplains, undulating stony plains and hills on the Abydos Plain and the adjacent Gorge Range. Generally, the vegetation consisted of tall open to sparse shrublands dominated by *Acacia* species (particularly *A. ancistrocarpa* and *A. acradenia*) and often *Grevillea wickhamii* subsp. *hispidula*, over hummock grassland usually dominated by 1 or more *Triodia* species (particularly *T. lanigera*, *T. wiseana* and *T. brizoides*). Isolated trees of *Corymbia hamersleyana* and/or *Eucalyptus leucophloia* subsp. *leucophloia* were also frequently present. Often a sparse low shrubland layer was also present, consisting of mixed species Woodman Environmental (2012).

Super-group 3 is comprised of FCT 10, and consists of vegetation related to major drainage features, including rivers, creek lines and large gorges. The structure of the vegetation varied depending on topographical location; major rivers and creeks usually possessed a tall to low woodland dominated by *Eucalyptus, Corymbia* and *Melaleuca* species; while smaller creeks and gorges possessed a tall shrubland dominated by *Acacia* species Woodman Environmental (2012).

Woodman Environmental (2012) conducted searches of the DEC TEC and PEC Database, and results showed that no TECs or PECs are known from within the study area. No FCTs within the study area were equivalent to any state-listed TECs or PECs, or federal-listed threatened ecological communities (Woodman Environmental 2012).

Woodman Environmental (2012) ranked most of the vegetation condition in the study as ‘Excellent’, meaning that there was no or little evidence of impact to vegetation

composition as a result of human activities, with the exception of some minor cattle grazing or trampling impacts, or low levels of introduced (weed) taxa. However, several quadrats located in flow lines, creeklines and rivers were ranked as 'Poor', 'Good' or 'Very Good'; these areas generally displayed obvious signs of impacts to structure and species composition, primarily as a result of cattle trampling and grazing, and the presence of moderate to large infestations of invasive weeds, particularly *Cenchrus ciliaris* and *Aerva javanica.* With regard to mapping the condition of drainage areas, several drainage areas had multiple condition rankings from several quadrats within a single drainage system, while the condition of many drainage areas was unknown. Therefore, a number of drainage areas were mapped as condition mosaics, including 'Excellent/Very Good', 'Very Good/Good' and 'Good/Poor' Woodman Environmental (2012).

3. METHODS

3.1 PERSONNEL AND LICENSING

Table 3 lists the personnel involved in both fieldwork and plant identifications for the study. All personnel have had previous field experience in the Pilbara, with personnel involved in plant identifications having extensive taxonomic experience with the flora of the Pilbara. All plant material was collected under the scientific licences (pursuant to *Wildlife Conservation Act 1950* Section 23C and Section 23F) listed in Table 3.

Table 3: Personnel and Licensing Information

Personnel	Role	Flora Collecting Permit / Permit to take DRF
Kim Kershaw	Fieldwork, Plant identifications	SL009957 147-1112
Teresa Jones	Fieldwork, Plant Identifications	SL009952
Bethea Loudon	Plant Identifications	SL009953 150-1112

3.2 INITIAL AERIAL PHOTOGRAPHY INTERPRETATION

Initial interpretation of vegetation boundaries was conducted with the use of orthorectified aerial photography at a scale of 1:10,000, supplied to Woodman Environmental by Atlas. Preliminary vegetation type boundaries were transcribed onto the aerial photography, to allow for ground-truthing of these boundaries to be conducted in the field. Preliminary detailed recording site locations were also allocated based on these vegetation type boundaries.

3.3 FIELD SURVEY METHODS

Detailed site recordings were taken within each identified plant community and at regular intervals in the haul road and camp study area. A total of 18 detailed recording site locations and 1 observational site were undertaken within the haul road study area. Field observations were also used to define one plant community within the haul road study area. Six detailed recording sites and 2 observational sites were undertaken within the proposed camp study area during the 11-12 June 2012.

At each detailed recording site a standard recording sheet was used to ensure the consistent collection of flora and site data. At each detailed recording site the following information was collected within a 25m radius:

- Personnel
- Date of survey
- Site photograph
- Site location (description and GPS co-ordinates)
- Unique site number
- Topography (including landform type and aspect)
- Soil type and colour(including the presence of any rock outcropping and surface stones)
- Slope
- Vegetation condition (Keighery 1994)
- Approximate time since fire
- Presence of disturbance (if any)
- Percentage foliage cover (for each species)
- Height (m) (for each species, excluding climbers/aerial shrubs)
- Vegetation structure (ESCAVI 2003); and
- Dominant vascular plant species present, and the foliage cover of the dominant species.

Opportunistic recordings of known conservation significant flora taxa and introduced (weed) taxa were also made.

The location of each recording site is shown on the attached figures (Figures 3.1 – 3.2). Structural plant community mapping was undertaken during this survey, and no permanent quadrats were established.

3.4 PLANT COLLECTION AND IDENTIFICATION

Specimens of any unknown taxa were collected and pressed for later identification at the WAHerb. Identifications were undertaken by the experienced taxonomist Bethea Loudon, with assistance from Kim Kershaw and Teresa Jones. Species nomenclature follows *Florabase* (DEC 2012c) with all names checked against the current DEC Max database to ensure their validity. The conservation status of each species was checked against *Florabase*, which provides the most up-to-date information regarding the conservation status of flora taxa in Western Australia.

Specimens of interest (Threatened (DRF) and Priority Flora taxa, range extensions of taxa and potential new taxa) will be vouchered at the WAHerb at the conclusion of the Project. Threatened and Priority Flora Report Forms (TPRFs) will be submitted to the DEC for all locations of Threatened and Priority Flora taxa at the conclusion of the Project.

3.5 VEGETATION MAPPING AND DESCRIPTION

Woodman Environmental structural vegetation type descriptions were aligned with Vegetation Alliance descriptions from Mattiske 2007. This has been carried out so

that a cumulative impact assessment can be conducted on the proposed Abydos East haul road, camp area and the proposed Venturex haul road route which joins the Marble Bar Road.

3.6 VEGETATION CONDITION MAPPING

Vegetation condition was recorded at all detailed recording sites, and also opportunistically within the study area where significant areas of disturbance to vegetation were noted (e.g. weed infestations, areas of heavy grazing or cattle movement). Vegetation condition was described using the vegetation condition scale used during the DEC's Pilbara Biodiversity Survey, which was adapted from Keighery (1994). This scale is presented in Appendix E. Vegetation condition polygon boundaries were developed using this information in conjunction with aerial photography interpretation, and were digitised as for vegetation mapping polygon boundaries. These polygons are displayed on Figure 5.1, 5.2 & 6.

3.7 LIMITATIONS OF SURVEY

Table 11 presents the limitations of the flora and vegetation surveys of the study area in accordance EPA Guidance Statement No. 51 (EPA 2004).

Table 4: Limitations of the Flora and Vegetation Survey of the Study Area

Limitation	Comment
Level of survey.	Level 1 Detailed Survey: A reconnaissance survey, including opportunistic recordings of flora taxa (particularly potentially conservation significant flora and introduced flora), was undertaken in early June 2012, towards the end of the usual peak flowering season in the Pilbara. Detailed Recording sites quadrats were established in each plant community identified over the study area. Field observations were used to define one plant community. The level of survey is deemed suitable to assess the proposed impacts of a haul road.
Competency/experience of the consultant(s) carrying out the survey.	Senior personnel have had experience in conducting similar assessments, including in the Pilbara, with mentoring given to less experienced botanists throughout the surveys.
Scope (floral groups that were sampled; some sampling methods not able to be employed because of constraints?)	Only dominant vascular groups that were present during the reconnaissance survey were sampled. Time constraints prevented sampling all vascular groups that were present.
Proportion of flora identified, recorded and/or collected.	High proportion of perennial vascular taxa recorded based on intensity and method of survey and relative uniformity of vegetation within the study area. Low proportion of ephemeral vascular taxa recorded based on percentage cover, intensity and method of survey, relative uniformity of vegetation and low rainfall totals prior to commencement of survey in June 2012.
Sources of information e.g. previously available information (whether historic or recent) as distinct from new data.	Sources include government databases (DEC, EPBC) and a number of unpublished reports in similar nearby areas.
The proportion of the task achieved and further work which might be needed.	Level 1 survey complete, intensity considered to be adequate.

Limitation	Comment
Timing/weather/season/cycle.	Field survey conducted from 11-12 June 2012, corresponding with the end of the maximum flowering period for the Pilbara.
Disturbances (e.g. fire, flood, accidental human intervention etc.), which affected results of survey.	Previous fire history of the study area influenced patterns discernible from aerial photography and also existing structure and composition of the vegetation, which affected the survey results.
Intensity of survey.	Survey intensity adequate to identify floristic and structural groupings of terrestrial flora as required by a Level 1 survey, with replication of detailed recording sites through plant community types and foot searching. Lower intensity of survey over areas where vehicular access was difficult.
Completeness and mapping reliability.	Survey of study area considered mostly complete. Study area not surveyed for conservation significant flora due to time constraints. Mapping reliability good as high resolution aerial photography was used, 19 detailed recording sites were established within the haul road and 6 detailed recording sites established within the camp study area and foot and vehicle transecting was employed, however fire history affected some vegetation patterns discernible on aerial photography.
Resources and experience of personnel.	Adequate resources including experienced field personnel and taxonomists with appropriate expertise in Pilbara flora were utilised.
Remoteness and/or access problems.	Access to the study was considered adequate, however some parts of the study area were accessible only on foot; sampling was limited to an extent in these areas compared to more easily accessible parts of the study area.

4. RESULTS

4.1 FLORA OF THE STUDY AREA

A total of 62 dominant discrete vascular flora taxa, were recorded within the haul road and camp study area during surveys in June 2012. These taxa represent 20 families and 40 genera. The most well-represented families were Poaceae (19 taxa) and Fabaceae (14 taxa). Vascular plant taxa recorded during the survey that were not easily identifiable were collected and later identified. A list of taxa recorded is presented in Appendix F, and Appendix G presents the dominant vascular plant taxa recorded within each plant community mapped.

A total of 2 conservation significant flora taxa and 4 introduced taxa are known to occur within the study area. The conservation significant taxa, *Eriachne* aff. *festuacea* has been previously recorded once within the haul road corridor study area as part of surveys for the Abydos Direct Shipping Ore Project, Flora and Vegetation Studies (WEC 2012) and *Euphorbia clementii* (P2) was recorded once during surveys in June 2012 within the haul road corridor study area, with further locations recorded in close vicinity to the haul road corridor study area. No Threatened (DRF) taxa or taxa listed as threatened under the EPBC Act were recorded; only 2 Threatened (DRF) taxa are known from the Pilbara (*Lepidium catapycnon* and *Thryptomene wittweri*), both of which are known from the Hamersley Ranges, several hundred kilometres to the south of the study area (DEC 2012b).

4.1.1 Conservation Significant Flora Taxa

Two conservation significant flora taxa are known to occur within the study area, both of these taxa are known to occur within the haul road corridor study area. All locations of conservation significant flora known from both within and in the vicinity of the study area are displayed on Figures 3.1 – 3.2. Locations of conservation significant flora taxa recorded as part of surveys for the Project are presented in Appendix H.

Eriachne aff. *festuacea* is a perennial grass to approximately 0.5 m (Plate 1), and is a potentially undescribed taxon which was previously recorded at 1 location within the study area within the haul road corridor study during survey for the Abydos DSO project (WEC 2012) (Figure 3.1). It was recorded at four locations in the infrastructure corridor, with other locations recorded within the Lalla Rookh area (WEC 2012). It is also known from a further 12 locations recorded within the TRH study area (Woodman Environmental 2011); it is known as *Eriachne* affin. *festucacea* in this study. Several collections from other locations in the Pilbara are lodged as *Eriachne* aff. *festucacea* in the WAHerb (DEC 2012d), and appear to represent the same taxon collected from the study area, however this cannot be confirmed with any certainty.

Further investigation is required to determine whether it is distinct from true *Eriachne festucacea*, which is known only from the central and east Kimberley, and 1 location near Pannawonica (DEC 2012d). Currently it is being treated as having conservation significance, based on the small number of collections. The habitat for this potentially

new taxon is in creeks and drainage lines on red to red brown to orange sand to sandy loam, occasionally with granite outcropping.

Plate 1: ***Eriachne*** **aff.** ***festucacea*** **(Photo: Woodman Environmental 2012)**

The conservation significant flora taxa, *Euphorbia clementii* (P2) was recorded once within the haul road corridor study area. It was recorded within a detailed recording site (Site 16) and recorded on five occasions opportunistically nearby to site 16 in the vicinity of the haul road corridor study area. All locations of *Euphorbia clementii* (P2) known from within the study area are displayed on Figure 3.2. Locations of conservation significant flora taxa recorded as part of this survey for the Project are presented in Appendix H. Numbers of individuals were recorded at all locations, with a total of 729 individuals known from the 6 locations.

Euphorbia clementii (P2) is a herb to 0.6 m in height (Plate 2), and occurs on gravelly hillsides and stony grounds within the Pilbara IBRA region (DEC 2012d). It has a range of approximately 270 km, from near Port Hedland south-east to near Warrawagine Station, however only 5 specimens are lodged in the WAHerb (DEC 2012d).

This taxon was also recorded at 17 locations within the Abydos Direct Shipping Ore project study area during surveys in 2008 and 2010 (WEC 2012). It is also known from a further 83 locations and was mainly recorded within rocky drainage lines, on orange to red sandy-loams, almost always in areas that had been recently burnt within the last 3 years within the Turner River Hub study area (WEC 2011).

Plate 2: *Euphorbia clementii* **(P2) (Photo: Woodman Environmental)**

4.1.2 Distribution Extensions and Distribution Gaps

The recording of *Polycarpaea holtzei* from the haul road corridor study area represents a significant extension to the known distribution of the taxa. This recording fills a large gap within the known distribution, according to *Florabase* (DEC 2012d). This taxa is not threatened.

4.1.3 Introduced Taxa

A total of 4 introduced flora taxa are known to occur within the study area, as listed in Table 5. Locations of introduced taxa recorded during surveys for this project in June 2012 are presented in Appendix H, and presented on Figures 5.1, 5.2 & 6. None are Declared Plants under the ARRP Act (Department of Agriculture and Food 2011), or listed Weeds of National Significance (Thorp & Lynch 2000). Table 5 also presents ratings for each introduced taxa recorded in the study area under the Environmental Weed Strategy for Western Australia (see Section 2.4; Appendix D). All locations of introduced taxa were within drainage features.

Table 5: Summary of Introduced Taxa Known Within the Study Area

Taxon	Number of Locations	Vegetation Alliance Types	Environmental Weeds Rating (CALM 1999)
Aerva javanica	3	2a, 6a, 18a	High
Cenchrus ciliaris	3	2a, 6a	High
Citrullus colocynthis	1	2a	Low
Portulaca oleracea	1	2a	Not assessed

Aerva javanica (kapok) is a widespread weed of the Pilbara region, and is also common throughout the Kimberley. It is often found on sandy soils, along drainage lines or in disturbed areas. It is a short-lived soft-wooded herb to 1.6 m in height (Plate 3) (Hussey *et al.* 2007; DEC 2012c). This taxon was rated as High under the Environmental Weed Strategy for Western Australia, due to its high level of invasiveness, wide current and potential distribution, and high level of environmental impact to structure, composition and function of ecosystems (CALM 1999).

Aerva javanica is known from 4 locations throughout the study area, with two locations recorded within the haul road corridor study area (Figure 5.1). One of these locations is recorded from previous surveys conducted during the Abydos DSO project surveys (WEC 2012). Two locations also occur within the camp area study area (Figure 6). All of which were in drainage line features. The foliage cover of this taxon was 1 % at each detailed recording site.

Plate 3: ***Aerva javanica*** **(Kapok) (Photo: Woodman Environmental 2012)**

Cenchrus ciliaris (buffel grass) (Plate 4) is a widespread weed throughout roadsides, creeklines, river edges and most vegetation types from Geraldton to the Pilbara, Kimberley and adjacent desert. It was originally introduced into pastoral regions as a pasture grass, and alters the fire characteristics of native vegetation by generating a high level of flammable fuel (Hussey *et al.* 2007). As with *Aerva javanica*, this taxon was rated as High under the Environmental Weed Strategy for Western Australia, due to its high level of invasiveness, wide current and potential distribution, and high level of environmental impact to structure, composition and function of ecosystems (CALM 1999).

Cenchrus ciliaris is known from 4 locations distributed throughout the study area, with three locations recorded within the haul road corridor study area (Figure 5.1) and one location within the camp area study area (Figure 6). All of which were in drainage line features. One of the locations recorded within the haul road corridor study area was recorded from previous surveys conducted during the Abydos DSO project surveys (WEC 2012).

The foliage cover of this taxon was 1% at site 23, 10% at site 2, with the highest recording being 12% at site 5.

Plate 4: ***Cenchrus ciliaris*** **(Buffel Grass) (Photo: Woodman Environmental 2012)**

Citrullus colocynthis (Colocynth) is a trailing or climbing perennial herb that is widespread however generally uncommon throughout Western Australia, including the Pilbara (DEC 2012d). It is often found in disturbed areas such as on road verges, however also occurs in moist areas including floodplains and creeks, particularly those frequented by cattle. It is not considered to be a serious environmental weed, with a rating of Low under the Environmental Weed Strategy (Department of Conservation and Land Management 1999). It was previously recorded at 1 location within the haul road study area (Figure 5.1), in a riverbed in the north-east corner of the Lalla Rookh area as part of surveys for the Abydos DSO Project (WEC 2012).

Portulaca oleracea (purslane; pigweed) is a succulent annual (Plate 5) that is common throughout the Pilbara region. Although it is listed as an introduced taxon, it may only be introduced in the south-west of Western Australia (Hussey *et al.* 2007). It was previously recorded at 1 location within the haul road study area (Figure 5.1), in a riverbed in the north-east corner of the Lalla Rookh area as part of surveys for the Abydos DSO Project (WEC 2012).

Plate 5: ***Portulaca oleracea*** **(Purslane) (Photo: DEC 2012d)**

4.2 VEGETATION OF THE STUDY AREA

4.2.1 Vegetation Mapping

Woodman Environmental structural vegetation descriptions were aligned with vegetation alliance descriptions from Mattiske 2007. Vegetation alliance descriptions from Mattiske 2007 have been listed within Section 2.5. Attachment 1 provides the grouping of Mattiske 2007 vegetation alliances with the vegetation alliances from Trudgen *et. al*. 2002 and Trudgen 2007b.

Intact native vegetation of primarily excellent condition (Keighery, 1994) was located within the haul road corridor study area and camp study area. Drainage line areas within the haul road corridor study area and camp study area were ranked as either Very Good or Good due to the impacts from grazing and trampling by livestock.

A total of 8 Vegetation Alliances as described by Mattiske 2007 and two mosaic vegetation alliances were mapped within the haul road corridor study area and camp study area.

Open Forest to Open Woodland: Other

Vegetation Alliance 2a - *Eucalyptus victrix* scattered trees to open woodland which may include *Melaleuca glomerata* and *Melaleuca linophylla* over open to closed scrub in creek beds and low slopes.

Two vegetation alliances from Trudgen *et. al*. 2002 and Trudgen 2007b were grouped together to form Vegetation Alliance 2a (Attachment 1). This vegetation alliance was most extensively mapped within the major drainage lines in the western portion of the haul road corridor study area. It was also mapped in one small creek line in the eastern portion of the haul road corridor study area within the southern fork (Figures 3.1 – 3.2). *Eucalyptus victrix* was the dominant overstorey species ranging from a tall woodland, to sparse isolated trees. Other species present within the overstorey included occasionally *Corymbia hamersleyana*. Species present within a tall shrubland layer included *Acacia pyrifolia*, *Acacia trachycarpa*, *Acacia tumida* var.

pilbarensis and *Melaleuca glomerata*. Species present within the understorey included *Aerva javanica*, *Boehavia coccinea*, *Cenchrus ciliaris*, *Corchorus parviflorus*, *Eriachne mucronata*, *Indigofera monophylla* and mixed *Triodia* species depending on its location within the landscape. A total of 22 dominant plant species, including 2 introduced species were recorded during surveys in June 2012 in this vegetation alliance (Appendix G). It should be noted that in addition 2 other additional weed species have been previously recorded at 1 location within the haul road study area (Figure 5.1), in a riverbed in the north-east corner of the Lalla Rookh area as part of surveys for the Abydos DSO Project (WEC 2012) within this vegetation association.

Plate 6: Vegetation Alliance 2a (Site 5) (Photo: Woodman Environmental)

Vegetation Alliance 6a - *Corymbia hamersleyana* scattered low trees to low open woodland over tall shrubs to open shrubland of *Acacia* spp. and *Grevillea wickhamii* over hummock grasslands on creek banks, flood banks and distributing fans.

Seven vegetation alliances from Trudgen *et. al*. 2002 and Trudgen 2007b were grouped together to form Vegetation Alliance 6a (Attachment 1). This vegetation alliance was extensively mapped over the haul road corridor study area and camp study area and was mapped primarily on creek banks and distributing fans within floodplains (Figures 3.1 – 3.2 & 4). *Corymbia hamersleyana* was the dominant overstorey species with sparse isolated trees. Species present within a tall shrubland layer included *Acacia ancistrocarpa*, *Acacia acredenia*, *Grevillea wickhamii* and *Petalostylis labichioides*. Species present within the understorey included *Corchorus parviflorus, Indigofera monophylla* and mixed *Triodia* species depending on its location within the landscape. A total of 36 dominant plant species, including 2 introduced species were recorded in this vegetation alliance (Appendix G).

Plate 7: Vegetation Alliance 6a (Site 22) (Photo: Woodman Environmental)

Vegetation Alliance 8a - *Terminalia canescens* scattered low trees to low woodland on creek banks.

One vegetation alliance from Trudgen *et. al*. 2002 and Trudgen 2007b was grouped to form Vegetation Alliance 8a (Attachment 1). This vegetation alliance was mapped in a small creekline within the haul road corridor study area within the southern branch in the eastern section of the study area (Figure 3.2). This vegetation alliance was determined from field observation to match vegetation alliance 8a. No detailed recording site was considered necessary and no photo was taken.

High Shrublands to Open Scrublands

Vegetation Alliance 11a - Shrubland to closed scrubland of *Acacia* species, including *A. acradenia, A. pyrifolia* and *A. tumida* along small creeklines and on the adjacent parts of valley floors and distributing fans.

Three vegetation alliances from Trudgen *et. al*. 2002 and Trudgen 2007b were grouped together to form Vegetation Alliance 11a (Attachment 1). This vegetation alliance was mapped in four small areas within the haul road corridor study area, with two of these being mapped in the western section adjacent to one of the major drainage systems and the other two on the northern branch of the haul road corridor to the eastern boundary of the study area. These areas were mapped primarily on small creeklines within floodplains and distributing fans (Figures 3.1 – 3.2). Species present within a tall shrubland layer included *Acacia tumida* var. *pilbarensis*, and *Petalostylis labichioides.* Species present within the understorey included *Eriachne pulchella* subsp. *dominii*, *Indigofera monophylla*, *Paraneurachne muelleri*, and mixed *Triodia* species dominated by *Triodia lanigera*. A total of 17 dominant plant species, including 1 conservation significant species (*Euphorbia clementii* (P2)) were recorded in this vegetation alliance (Appendix G).

Plate 8: Vegetation Alliance 11a (Site 4) (Photo: Woodman Environmental)

Vegetation Alliance 12a - *Acacia inaequilatera* scattered tall shrubs to high open shrubland over *Triodia brizoides* hummock grasslands on ridge slopes and low hills.

One vegetation alliance from Trudgen *et. al*. 2002 and Trudgen 2007b was grouped to form Vegetation Alliance 12a (Attachment 1). This vegetation alliance was mapped over a majority of the haul road corridor study area. These areas were mapped primarily on low rises within floodplains and distributing fans (Figures 3.1 – 3.2). This vegetation alliance consisted of a tall shrubland layer dominated by *Acacia inequilatera* over a *Triodia* hummock grassland dominated by *Triodia briziodes*. A total of 16 dominant plant species were recorded in this vegetation alliance (Appendix G).

Plate 9: Vegetation Alliance 12a (Site 1) (Photo: Woodman Environmental)

Vegetation Alliance 13a - *Acacia inaequilatera* scattered tall shrubs to high shrubland over *Triodia wiseana* hummock grasslands occurring mainly on gentle lower slopes.

Two vegetation alliances from Trudgen *et. al*. 2002 and Trudgen 2007b were grouped together to form Vegetation Alliance 13a (Attachment 1). This vegetation alliance was mapped over central and eastern parts of the haul road corridor study area and western parts of the camp study area. These areas were mapped primarily on low hills and low rises within floodplains and distributing fans (Figures 3.1 – 3.2 & 4). This vegetation alliance consisted of a tall shrubland layer dominated by *Acacia inequilatera* over a *Triodia* hummock grassland dominated by *Triodia wiseana*. A total of 8 dominant plant species were recorded in this vegetation alliance (Appendix G).

Plate 10: Vegetation Alliance 13a (Site 10) (Photo: Woodman Environmental)

Mosaic of Vegetation Alliance 12a/13a - *Acacia inaequilatera* scattered tall shrubs to high open shrubland over *Triodia brizoides* and *Triodia wiseana* hummock grasslands on ridge slopes and low hills.

A mosaic of Vegetation Alliance 12a and 13a was mapped within numerous areas in the eastern section of the haul road corridor study area and northern central area of the camp study area. These areas were mapped primarily on low hills and low rises within floodplains and distributing fans (Figures 3.1 – 3.2 & 4). This vegetation alliance consisted of a tall shrubland layer dominated by *Acacia inequilatera* over a *Triodia* hummock grassland dominated *Triodia brizoides* and *Triodia wiseana*. A total of 12 dominant plant species were recorded in this vegetation alliance (Appendix G).

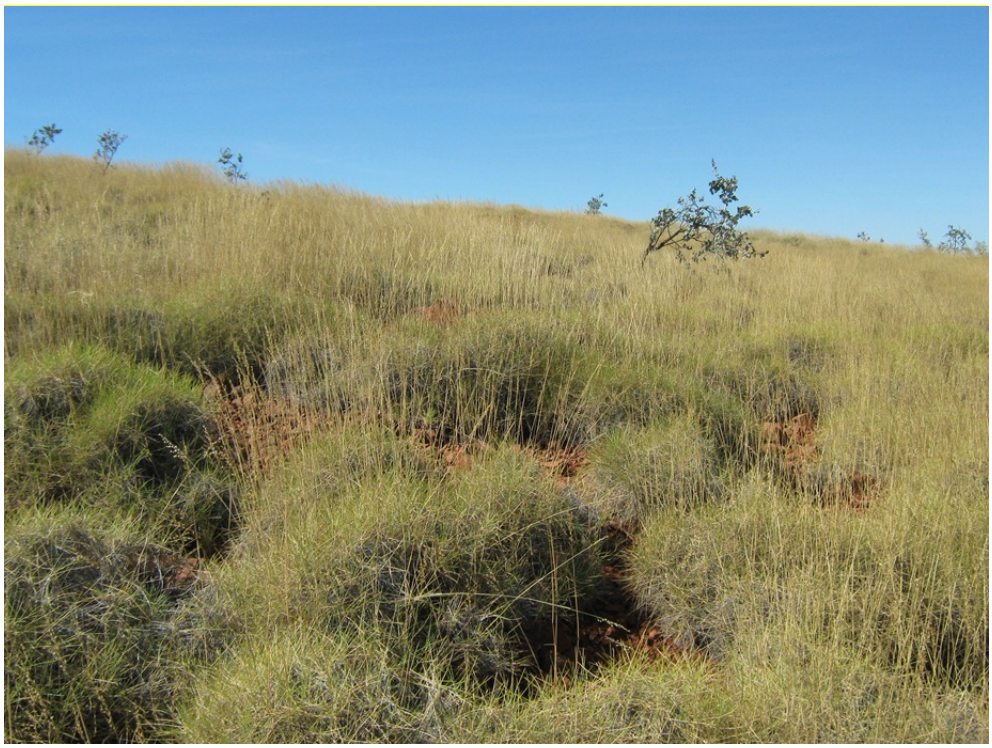

Plate 11: Vegetation Alliance 12/13a (Site 21) (Photo: Woodman Environmental)

Hummock Grasslands
Vegetation Alliance 17a - Hummock grasslands on slopes and ridges.

Four vegetation alliances from Trudgen *et. al*. 2002 and Trudgen 2007b were grouped together to form Vegetation Alliance 17a (Attachment 1). This vegetation alliance was mapped in three areas within the southern branch in the eastern section of the haul road corridor study area. These areas were mapped primarily on slopes, spurs and ridges (Figure 3.2). This vegetation alliance consisted a *Triodia* hummock grassland dominated by *Triodia brizoides* with an open low shrubland layer dominated by *Gossipium australe*. A total of 8 dominant plant species were recorded in this vegetation alliance (Appendix G).

Plate 12: Vegetation Alliance 17a (Site 12) (Photo: Woodman Environmental)

Other Grasslands and Herblands
Vegetation Alliance 18a - Cracking clay alliance on gentle sloping plains and seasonal damplands.

Five vegetation alliances from Trudgen *et. al*. 2002 and Trudgen 2007b were grouped together to form Vegetation Alliance 18a (Attachment 1). This vegetation alliance was mapped in one area within the western section of the camp study area. These areas were mapped on cracking clay seasonal damplands (Figure 4). This vegetation alliance consisted of an open hummock grassland dominated by *Triodia longiceps* and *Triodia epactia* with a tussock grassland dominated by *Brachyachne convergens, Eriachne benthamii* and *Sporobolus actinocladus* over cracking clay in seasonal damplands and low lying depressions. A total of 11 dominant plant species including one introduced species (*Aerva javanica*) were recorded in this vegetation alliance (Appendix G).

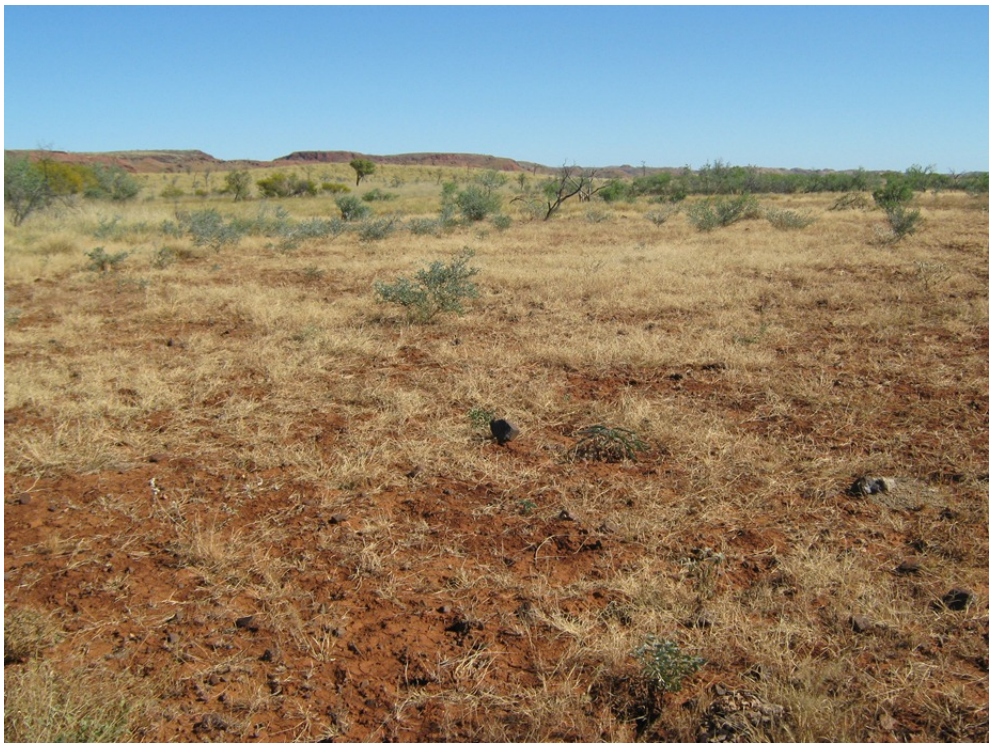

Plate 13: Vegetation Alliance 18a (Site 27) (Photo: Woodman Environmental)

Mosaic of Open Forest to Open Woodland: Other and High Shrublands to Open Scrublands

Mosaic of Vegetation Alliance 6a and 12a was mapped within numerous areas in the central and eastern section of the haul road corridor study area (Figures 3.1 – 3.2).

Within this mosaic vegetation alliance, the boundaries could not be distinctively separated from the aerial photography by landform. Distinctive vegetation alliances could not be determined due to the intergrading of the vegetation alliances through the distributing fans and low lying rises.

4.2.2 Vegetation Condition

In general, most of the vegetation in the camp area and haul road corridor study area was ranked and mapped as 'Excellent' (Keighery 1994; Appendix E), meaning that there was no or little evidence of impact to vegetation composition as a result of human activities, with the exception of some minor cattle grazing or trampling impacts, or low levels of introduced (weed) taxa (Figures 5.1, 5.2 & 6). However, several detailed recording sites located in major drainage lines within the haul road corridor study area were ranked as 'Good' with several detailed recording sites located in minor drainage lines and low lying depression within the camp area were ranked as 'Very Good'; these areas generally displayed obvious signs of impacts to structure and species composition, primarily as a result of cattle trampling and grazing, and the presence of moderate to large infestations of invasive weeds, particularly *Cenchrus ciliaris* and *Aerva javanica.*

4.2.4 Significance of Vegetation

Searches of the DEC TEC and PEC Database have been undertaken, and results showed that no TECs or PECs are known from within the study area (DEC 2012e). Although 2 TECs are currently known from the Pilbara Bioregion, no TECs are currently listed as occurring within the Pilbara 4 or Pilbara 1 subregions (DEC 2012a). No vegetation alliances within the study area are equivalent to any state-listed TECs or PECs, or federal-listed threatened ecological communities (DEC 2012a, 2012f; DSEWPC 2012).

Table 6 shows the extent of the vegetation alliances within the camp and haul road corridor study areas, and a combined total for the entire study area. This shows that vegetation alliances 2a, 6a, 12a and mosaic 12a/13a are well represented within the entire study area (>10% of the study area) and are considered not locally significant and occurred on landforms that were common and widespread locally. Vegetation alliances 13a, 17a, 18a and mosaic 6a/12a are not so well represented within the entire study area and are considered of moderate local significance (1-10% of the study area) and occur on landforms considered to be more locally uncommon. Vegetation alliances 8a and 11a are poorly represented within the entire study area and are considered of higher local significance (<1% of the study area) and occurred on landforms considered locally uncommon, predominately minor drainage line features.

Table 6: Extent of Vegetation Alliances Within Study Area (ha) (% of study area)

Vegetation Alliance	Haul Road Study Area		Camp Study Area		Combined Study Areas	
	hectares	% study area	hectares	% study area	hectares	% study area
2a	43.9885	15.97%	0	0.00%	44.1482484	13.96%
6a	90.8508	32.99%	22.3955	55.99%	113.576233	35.90%
8a	0.5481	0.20%	0	0.00%	0.55009048	0.17%
11a	1.0886	0.40%	0	0.00%	1.09255335	0.35%
12a	71.5788	25.99%	0	0.00%	71.8387451	22.71%
13a	9.0576	3.29%	7.6551	19.14%	16.7455935	5.29%
12a/13a	48.3964	17.58%	4.6763	11.69%	53.2484561	16.83%
6a/12a	6.2643	2.27%	0	0.00%	6.28704939	1.99%
17a	3.5881	1.30%	0	0.00%	3.60113052	1.14%
18a	0	0.00%	5.2729	13.18%	5.2729	1.67%
TOTALS	**275.3612**	**100%**	**39.9998**	**100%**	**316.361**	**100%**

There is currently no regional dataset available to determine the regional extent of vegetation types within the Pilbara Region, and therefore there is no information to directly determine their regional conservation significance. However, it is considered highly likely that all vegetation alliance (vegetation types) mapped in the study area occur outside the study area, and are likely to be regionally widespread and common based on the usual landforms that they occur on. The study area is also located in vegetation associations (as defined by Shepherd *et. al.* (2002)) (Table 1) which are well represented within Western Australia, each having almost 100 % of the pre-European extent currently remaining. Although the current reservation status of each of these vegetation associations is poor, none of these vegetation associations are currently thought to be restricted or threatened.

5. DISCUSSION

5.1 FLORA OF THE STUDY AREA

The flora of the study area does not contain a particularly high level of diversity, with a total of 62 dominant discrete vascular flora taxa, including 2 introduced taxa being recorded within the haul road and camp study area during surveys in June 2012. These taxa represent 20 families and 40 genera. The most well-represented families were Poaceae (19 taxa) and Fabaceae (14 taxa) recorded from within the study area. The vegetation associations within which the vegetation types occur are not restricted locally and are likely to be common regionally. Additionally, the pre-european vegetation associations that occur within this study area have not been extensively cleared or modified and are almost at their pre-european extent. The Pilbara bioregion is not known for a high level of biological diversity, in terms of flora and vegetation, in comparison to other regions of Western Australia, for example the Northern Sandplains region in the vicinity of Eneabba and Dongara.

This total of 62 dominant discrete vascular flora taxa is lower than other studies conducted in the area (see Section 2.5) and is due to the smaller survey area and collecting techniques concentrating on dominant species only. Further reasons for this lower number of vascular taxa recorded is that the other studies also surveyed a much wider variety of topographical features and soil types in the vicinity of the study area. In addition the sampling of flora late in the flowering season may also have influenced the number of taxa, in particular ephemeral taxa, that may have been dominant taxa in the areas surveyed but were not recorded as they had finished flowering and were desiccating. Marble Bar, the nearest meteorological station to the study area, received 339.2 mm of rainfall over the normal 'wet' period of November 2011 – April 2012 (Bureau of Meteorology 2012b) which was higher compared to the long term average of approximately 287 mm over this period but only received 11.4 mm during the months from April – June 2012 (Bureau of Meteorology 2012b) which may explain why ephemeral taxa had finished flowering and were desiccating.

One conservation significant flora taxon has been recorded in the study area, within the haul road corridor study area; *Euphorbia clementii* (P2). This is not listed as Threatened (DRF), however Priority flora taxa are reviewed regularly with the view to either downgrading their status, or elevating them to Threatened (DRF). *Euphorbia clementii* (P2) was recorded at site 16 within the eastern section of the northern branch of haul road corridor survey area. If this particular route is selected as the final route for the haul road then there is a possibility that this location could be directly impacted with 6 plants recorded at this location.

The other potentially new taxa, *Eriachne* aff. *festucacea,* also previously recorded within the haul road corridor study area from previous surveys, under the precautionary principle, should be protected until more information is known on its taxonomic and conservation status. It is highly likely that this taxon is relatively common in the Turner River channel and other major creek systems, however further survey is required to confirm this (WEC 2012).

There is also the potential for indirect impacts to occur to these conservation significant taxa, even if they are not directly impacted. Indirect impacts could include

loss of plants or habitat from altered hydrological regimes (drainage shadow and ponding), introduction of waste products (including hydrocarbons) and increased dust generation and deposition.

With regard to their current overall conservation significance, it is important that individuals of these taxa are managed during the construction and operational phases of the Project for the purposes of preventing destruction of individuals if possible. Management of these taxa may involve flagging of individuals prior to construction and monitoring of individuals during the operational phase.

As mentioned in Section 3.3, not all of the Project area was searched in detail for conservation significant flora. It is considered possible that further populations of conservation significant flora will occur elsewhere in the study area, however any impacts to such populations are unlikely to increase the overall level of impacts to these taxa in a regional context.

Four introduced (weed) taxa are known to occur within the study area, including the serious environmental weeds *Aerva javanica* (Kapok) and *Cenchrus ciliaris* (Buffel Grass. All weed locations occur in drainage features, particularly creeks and rivers. The potential results of disturbance of locations of weed taxa are the potential re-establishment and proliferation post-disturbance, and potential spread of propagules to other disturbed and undisturbed areas during construction. *Aerva javanica* and *Cenchrus ciliaris* in particular are highly invasive, and while they have the ability to spread into undisturbed native vegetation, are particularly adept at colonising recently disturbed areas. It is therefore important that a weed hygiene management programme be developed prior to ground disturbance. Inspection and cleaning of all machinery and vehicles prior to entering the study area should be undertaken, to prevent the introduction of weed propagules. Inspection and cleaning of machinery and vehicles prior to leaving areas suspected to have infestations of weeds within the study area should also be undertaken. It is also recommended that a weed monitoring programme be developed, to ensure that any new infestations, particularly around disturbance areas such as roads, are identified and can be controlled or eradicated.

5.2 VEGETATION OF THE STUDY AREA

A total of 8 vegetation alliances and two mosaic vegetation alliances (as described by Mattiske 2007), from four vegetation formations and a mosaic of two of these vegetation formations were mapped within the camp and haul road corridor study area. The vegetation alliances are based primarily on vegetation structure and topographical locations within the study area.

Intact native vegetation of primarily excellent condition (Keighery, 1994; Appendix E) was located within the haul road corridor study area and camp study area. Drainage line areas within the haul road corridor study area were ranked as ‘Good’ and the minor drainage lines and low lying depression within the camp area being ranked as ‘Very Good’; these areas generally displayed obvious signs of impacts to structure and species composition, primarily as a result of cattle trampling and grazing, and the presence of moderate to large infestations of invasive weeds, particularly *Cenchrus ciliaris* and *Aerva javanica.* This is generally because cattle congregate in these areas, and disturb the soil which allows weed species to colonise.

They may also spread weed propagules via their faeces or attached to their bodies, which allow weeds to spread through these areas. Regular water flows may also serve to disperse weed propagules in these areas. Management of weed taxa in these areas is discussed above in Section 5.1.

Of the vegetation alliances mapped within the camp and haul road corridor study areas, vegetation alliances 2a, 6a, 12a and mosaic 12a/13a are well represented within the entire study area (>10% of the study area) and are considered not locally significant. Vegetation alliances 13a, 17a, 18a and mosaic 6a/12a are not so well represented within the entire study area and are considered of moderate local significance (1-10% of the study area). Vegetation alliances 8a and 11a are poorly represented within the entire study area and are considered of higher local significance (<1% of the study area). Although there is no regional vegetation dataset to determine the extent of such vegetation types within the Pilbara, it is highly likely that these vegetation types would be relatively common and widespread outside the study area, as the landforms they occur on are common and widespread. It is therefore considered that none of the vegetation types mapped in the study area are of regional conservation significance as the vegetation systems associations in which they occur remain almost at their pre-European extents (Table 1), although they are poorly reserved in conservation estate.

There is also the potential for indirect impacts to vegetation types to occur, with altered hydrological regimes (drainage shadow and ponding), introduction of waste products (including hydrocarbons), increased dust generation and deposition and increased fire among the potential indirect impacts that could alter vegetation condition, composition and structure. It is difficult to quantify such impacts however it is important that appropriate management actions such as dust suppression and the installation of drainage control systems to maintain existing surface water patterns be implemented during construction of the Project, to minimise the risk of these indirect impacts occurring.

Methods undertaken during initial clearing of vegetation and topsoil will be crucial to the overall success of rehabilitation of vegetation in disturbed areas such as laydown areas and borrow areas. Topsoil and cleared vegetation should be retained where practicable, each stored separately with the stockpiles protected against direct or indirect impacts during construction and mining. Correct re-spreading of both the topsoil and cleared vegetation over the rehabilitated land form to the correct depth will be vital to achieve the best results during rehabilitation. This may have to be supplemented with seeding of appropriate native taxa. The dominant genus (in terms of total foliage cover) is *Triodia*, which traditionally is difficult to re-introduce into rehabilitation. Appropriate techniques to reintroduce *Triodia* to areas of rehabilitation will need to be implemented. Keystone species should also be identified as part of a comprehensive rehabilitation plan. Keystone species are those which are most common, provide the most cover, and are representative of each stratum within a particular vegetation type. They may also be species that are required to provide for fauna habitat and/or food sources.

6. RECOMMENDATIONS

The following recommendations are given:

- Clearing of vegetation should be minimised as much as practicable, particularly at or in the vicinity of locations of conservation significant flora taxa, with clear definition of areas for clearing with markings such as pegs and flagging tape to prevent over-clearing.
- Clearing of vegetation should be minimised as much as practicable, particularly at or in the vicinity of vegetation alliances 8a and 11a which are poorly represented locally within the study area.
- Management measures should be enacted to prevent indirect impacts to conservation significant flora taxa during the construction and operational phases of the Project, with measures potentially including flagging of individuals prior to construction, and monitoring of individuals during the operational phase.
- The final Project location should seek to minimise impacts to the locally significant vegetation types 8a and 11a.
- A weed hygiene plan and monitoring programme should be developed and implemented for construction and on-going operations, with actions to include control of weed populations following ground disturbance, monitoring of disturbed areas, and machinery hygiene.
- Atlas should attempt to limit dust-creating activities during periods of high wind velocity/duration during construction and operation of the proposed haul road.
- Rehabilitation of borrow areas should occur once construction has ceased.
- Fresh water rather than saline (where possible) should be used for dust control to prevent impacts from saline water on significant flora and vegetation.
- Surface water movement should be managed through the development of appropriately designed drainage control systems in areas where sheet flow is prevalent to avoid water shadowing and ponding.

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Appendix A: Definitions, Categories and Criteria for Threatened Ecological Communities and Priority Ecological Communities (Department of Environment and Conservation 2010a)

2: Definitions and Criteria for Presumed Totally Destroyed, Critically Endangered, Endangered and Vulnerable Ecological Communities

Presumed Totally Destroyed (PD)

An ecological community which has been adequately searched for but for which no representative occurrences have been located. The community has been found to be totally destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future.

An ecological community will be listed as presumed totally destroyed if there are no recent records of the community being extant **and either** of the following applies (A or B):

A) Records within the last 50 years have not been confirmed despite thorough searches of known or likely habitats **or**

B) All occurrences recorded within the last 50 years have since been destroyed

Critically Endangered (CR)

An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated.

An ecological community will be listed as **Critically Endangered** when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future. This will be determined on the basis of the best available information, by it meeting **any one or more of** the following criteria (A, B or C):

A) The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 90% **and either or both** of the following apply (i or ii):

i) geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is imminent (within approximately 10 years);

ii) modification throughout its range is continuing such that in the immediate future (within approximately 10 years) the community is unlikely to be capable of being substantially rehabilitated.

B) Current distribution is limited, **and one or more** of the following apply (i, ii or iii):

i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the immediate future (within approximately 10 years);

ii) there are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes;

iii) there may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes.

C) The ecological community exists only as highly modified occurrences that may be capable of being rehabilitated if such work begins in the immediate future (within approximately 10 years).

Endangered (EN)

An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future.

An ecological community will be listed as **Endangered** when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future. This will be determined on the basis of the best available information by it meeting **any one or more of** the following criteria (A, B, or C):

A) The geographic range, and/or total area occupied, and/or number of discrete occurrences have been reduced by at least 70% since European settlement **and either or both** of the following apply (i or ii):

i) the estimated geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is likely in the short term future (within approximately 20 years);

ii) modification throughout its range is continuing such that in the short term future (within approximately 20 years) the community is unlikely to be capable of being substantially restored or rehabilitated.

B) Current distribution is limited, **and one or more** of the following apply (i, ii or iii):

i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the short term future (within approximately 20 years);

ii) there are few occurrences, each of which is small and/or isolated and all or most occurrences are very vulnerable to known threatening processes;

iii) there may be many occurrences but total area is small and all or most occurrences are small and/or isolated and very vulnerable to known threatening processes.

C) The ecological community exists only as very modified occurrences that may be capable of being substantially restored or rehabilitated if such work begins in the short-term future (within approximately 20 years).

Vulnerable (VU)

An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range.

An ecological community will be listed as **Vulnerable** when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing a high risk of total destruction or significant modification in the medium to long term future. This will be determined on the basis of the best available information by it meeting **any one or more of** the following criteria (A, B or C):

A) The ecological community exists largely as modified occurrences that are likely to be capable of being substantially restored or rehabilitated.

B) The ecological community may already be modified and would be vulnerable to threatening processes, is restricted in area and/or range and/or is only found at a few locations.

C) The ecological community may be still widespread but is believed likely to move into a category of higher threat in the medium to long term future because of existing or impending threatening processes.

3: Definitions and Criteria for Priority Ecological Communities

Possible threatened ecological communities that do not meet survey criteria or that are not adequately defined are added to the Priority Ecological Community List under Priorities 1, 2 and 3. These three categories are ranked in order of priority for survey and/or definition of the community, and evaluation of conservation status, so that consideration can be given to their declaration as threatened ecological communities. Ecological communities that are adequately known, and are rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list, are placed in Priority 4. These ecological communities require regular monitoring. Conservation Dependent Ecological communities are placed in Priority 5.

Priority One: Poorly-Known ecological communities

Ecological communities that are known from very few occurrences with a very restricted distribution (generally ≤5 occurrences are a total area of ≤100 ha). Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) or for which current threats exist. May include communities with occurrences on protected lands. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.

Priority Two: Poorly-Known ecological communities

Communities that are known from few occurrences with a restricted distribution (generally ≤10 occurrences or a total area of ≤200 ha). At least some occurrences are not believed to be under immediate threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.

Priority Three: Poorly-Known ecological communities

(i.) Communities that are known from several to many occurrences, a significant number of area of which are not under threat of habitat destruction or degradation or;

(ii.) Communities known from a few widespread occurrences, which are either large or within significant remaining areas of habitat in which other occurrences may occur, much of it not under immediate threat, or;

(iii.) Communities made up of large, and/or widespread occurrences, that may or not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes.

Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.

Priority Four: Poorly-Known ecological communities

Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring.

(a) Rare. Ecological communities known from a few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These communities are usually represented on conservation lands.
(b) Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close for qualifying for Vulnerable.
(c) Ecological communities that have been removed from the list of threatened communities during the past five years.

Priority Five: Conservation-Dependent ecological communities

Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

Appendix B: Results of the Interrogation of the Department of Environment and Conservation's Threatened Flora Databases and Declared Rare and Priority Flora List (DEC 2012b)

Taxon	Status	Description	Known Nearby Locations
Abutilon pritzelianum	P1	Shrub, 1-1.5 m high, flowers yellow-orange, August. Red sand dunes. Stony undulating shallow soiled granitic plain.	Old main Port Hedland, Wittenoom Road, 16 km WNW of Wallarenya Station Homestead near Port Hedland
Acacia cyperophylla var. *omearana*	P1	Tree, 4-10 m high, 'minni-ritchi' bark, flowers yellow, March to April. Stony & gritty alluvium. Along drainage lines.	Limestone Station, East Pilbara
Acacia glaucocaesia	P3	Dense, glabrous shrub or tree, 1.8-6 m high, flowers yellow, July to September. Red loam, sandy loam, clay. Floodplains.	Karratha, Port Hedland, Mardie, Roebourne, De Grey
Acacia leeuweniana	P1	Tree to 14 m high with minni ritchi bark, flowers yellow, May. Granite outcrops	Spear Hill, Wodgina
Acacia levata	P3	Spreading, multi-stemmed shrub up to 3 m high and 5 m wide, flowers yellow, May. Sand or sandy loam over granite	Marble Bar, Woodstock H/S, Hillside
Acacia sp. Marble Bar (J.G. M. H. Simmons 3499)	P1	Shrub with inflorescence in spikes to 30mm long, flowers yellow, September.	Marble Bar
Atriplex eremitis	P1	Flowers August	De Grey Station
Bulbostylis burbidgeae	P4	Tufted, erect to spreading annual sedge to 0.25 m high, flowers brown, March/June-August. Outcrops, cliff bases, crevices in granite outcrops	Abydos/Woodstock Reserve and Lalla Rookh Homestead, FMG Rail Corridor; Hope Downs Railway Corridor, Gorge Creek, base of Gorge Range
Eragrostis crateriformis	P3	Annual, grass-like or herb, 0.17-0.42 m high, flowers January to May or July. Clayey loam or clay. Creek banks, depressions. Red-brown loam-clay in drainagelines	Two Mile Creek, Warralong Station, 70 kms NE of Port Hedland

Taxon	Status	Description	Known Nearby Locations
Euphorbia clementii	P2	Erect herb to 0.6m high, flowers green/white, May-June. Stony ground	Wodgina LNG pipeline, Abydos DSO Project area, 20 km E De Grey River crossing, access road to Yandeyarra Community, 7.7 km NNE of Mt Tinstone, 109.1 km W of Marble Bar, Kangan Station, Yarrie
Euphorbia inappendiculata	P3	Spreading, procumbent herb, to 0.4 m high, flowers pink, August. Clay soils. Among broken rocky screes. On red loamy depressions interspersed with quartzite on the plains.	Atlas Iron Farrel Well project area, 100 km SE of Port Hedland, Two Mile Creek, Warralong Station
Gomphrena leptophylla	P3	Prostrate or erect to spreading annual, herb, to 0.15 m high, flowers white, March to September. Sand, sandy to clayey loam, granite, quartzite. Open flats, sandy creek beds, edges salt pans & marshes, stony hillsides.	Yandeyarra, Nerrima Station, Marble Bar
Goodenia nuda	P4	Erect herb to 0.5 m high, flowers yellow, April-August. Flood plains, drainage lines	South of Port Hedland; FMG Cloudbreak Mine
Gymnanthera cunninghamii	P3	Erect shrub to 2m high, flowers cream/yellow/ green, January-December. Variety of soils	Port Hedland townsite and Boodarie Station, Woodstock Station, FMG Rail Corridor; Hope Downs Railway Corridor
Heliotropium murinum	P3	Short-lived perennial, herb, up to 0.4 m high, flowers May or September. Red sand. Plains.	Shaw River, Warralong Station
Heliotropium muticum	P1	Ascending to spreading perennial herb to 0.3m high, flowers white, May – August. Rocky plains	Pippingarra Station, Abydos DSO Project study area11.5 km NE of old Tabba Tabba Station Homestead, Port Hedland, 70 km S of Port Hedland
Heliotropium parviantrum	P1	Erect annual, herb, to 0.15 m high, flowers February to June. Sandy soils, flats, plains, rocky slopes.	De Grey River, Derby

Taxon	Status	Description	Known Nearby Locations
Josephinia sp. Marandoo (M.E. Trudgen 1554)	P1	Small, upright shrub, to 0.3 m high, round, woolly, soft spined fruit, flowers pink, August. Gritty soil, granite, plains	13.7 km E of Mt St George, 18.6 km SSE of the De Grey Station Homestead, 25.5 km WNW of Mt Goldsworthy, 72.4 km E of Port Hedland, De Grey Station
Mimulus clementii	P1	Annual, herb, 0.1-0.2 m high, leaves 10-20 mm long, 3-5 mm wide.	Between Ashburton and De Grey Rivers
Nicotiana umbratica	P3	Erect annual or short-lived perennial herb to 0.7 m high, flowers white, April – June and September. Granite outcrops and cliffs	Abydos Station and Woodstock Station, Newman, Karijini N.P., Marble Bar, Woodstock, Spear Hill, 62 km SW of Marble Bar, Dingo Point, Talga River, Eginbah Station
Phyllanthus hebecarpus	P3	Herb	Kangan Station
Ptilotus mollis	P4	Compact, perennial shrub, to 0.5 m high, soft grey foliage, flowers white/pink, May or September. Stony hills and screes	Gorge Range, Warralong Station, Abydos
Pityrodia sp. Marble Bar (G. Woodman & D. Coultas GWDC Opp 4)	P1	Erect shrub to 1.5 m high, flowers white/pink, August-September. Steep ironstone or sandstone slopes	Near Strelley River near Wallareenya Station, Marble Bar
Rothia indica subsp. *australis*	P1	Prostrate annual, herb, to 0.3 m high, densely covered in spreading hairs, flowers April to August. Sandy soils. Sandhills and sandy flats	Two Mile Creek
Tephrosia andrewii	P1	Ascending, multistemmed shrub, to 0.8 m high, flowers orange, April or October. Sand in pindan	Port Hedland-Broome
Tephrosia rosea var. *venulosa*	P1	Erect shrub, to 1.7 m high, flowers red-purple, August to September. Red sand	

Appendix C: Conservation Codes for Western Australian Flora (Smith 2012)

Under the Wildlife Conservation Act, the Minister for the Environment may declare species of flora to be protected if they are considered to be in danger of extinction, rare or otherwise in need of special protection. Schedules 1 and 2 deal with those that are threatened and those that are presumed extinct, respectively.

T: Threatened Flora (Declared Rare Flora – Extant)

Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such (Schedule 1 under the Wildlife Conservation Act 1950).

Threatened Flora (Schedule 1) are further ranked by the Department according to their level of threat using IUCN Red List Criteria:

- CR: Critically Endangered – considered to be facing an extremely high risk of extinction in the wild
- EN: Endangered – considered to be facing a very high risk of extinction in the wild
- VU: Vulnerable – considered to be facing a high risk of extinction in the wild

X: Presumed Extinct Flora (Declared Rare Flora – Extinct)

Taxa that have been adequately searched for and there is no reasonable doubt that the last individual has died, and have been gazetted as such (Schedule 2 under the Wildlife Conservation Act 1950).

Taxa that have not yet been adequately surveyed to be listed under Schedule 1 or 2 are added to the Priority Flora List under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened flora or fauna. Taxa that are adequately known, are rare but not threatened, or meet criteria for Near Threatened, or that have been recently removed from the threatened list for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring. Conservation Dependent species are placed in Priority 5.

1: Priority One – Poorly-known Taxa

Taxa that are known from one or a few collections or sight records (generally less than 5), all on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, Shire, Westrail and Main Roads WA road, gravel and soil reserves, and active mineral leases and under threat of habitat destruction or degradation. Taxa may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes.

2: Priority Two – Poorly-known Taxa

Taxa that are known from one or a few collections or sight records, some of which are on lands not under imminent threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown land, water reserves, etc.

Taxa may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes.

3: Priority Three – Poorly-known Taxa

Taxa that are known from collections or sight records from several localities not under imminent threat, or from few but widespread localities with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Taxa may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and known threatening processes exist that could affect them.

4: Priority Four – Rare, Near Threatened and other taxa in need of monitoring

1. **Rare.** Taxa that are considered to be have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These taxa are usually represented on conservation lands

2. **Near Threatened.** Taxa that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.

3. Taxa that have been removed from the list of threatened species during the past 5 years for reasons other than taxonomy.

5: Priority 5 – Conservation Dependent Taxa

Taxa that are not threatened but are subject to a specific conservation program, the cessation of which would result in the taxon becoming threatened within 5 years.

Appendix D: Environmental Weed Strategy - Criteria for the Assessment and Rating of Weeds in Terms of their Environmental Impact on Biodiversity (Department of Conservation and Land Management 1999)

ENVIRONMENTAL WEEDS RATING

- **Invasiveness-** ability to invade bushland in good to excellent condition or ability to invade waterways (Score as yes or no).
- **Distribution** – wide current or potential distribution including consideration of known history of wide spread distribution elsewhere in the world (Score as yes or no).
- **Environmental Impacts** – ability to change the structure, composition and function of ecosystems; in particular an ability to form a monoculture in a vegetation community (Score as yes or no).

The Rating System used in the Environmental Weed Strategy for Western Australia

High	A weed species would have to score yes for all three criteria. Rating a weed species as high would indicate prioritising this weed for control and/or research.
Moderate	A weed species would have to score yes for two of the above criteria. Rating a weed species as moderate would indicate that control or research effort should be directed to it if funds are available; however it should be monitored (possibly a reasonably high level of monitoring).
Mild	A weed species scoring one of the criteria. A mild rating would indicate monitoring of the weed and control where appropriate.
Low	A weed species would score none of the criteria. A low ranking would mean that this species would require a low level of monitoring.

Appendix E: Vegetation Condition Scale for the Eremaean and Northern Botanical Provinces (adapted from Keighery 1994, for Pilbara Botanical Survey)

Condition Ranking	Description
E (Excellent)	Pristine or nearly so, no obvious signs of damage caused by human activities since European settlement.
VG (Very Good)	Some relatively slight signs of damage caused by human activities since European settlement. For example, some signs of damage to tree trunks caused by repeated fire, the presence of some relatively non-aggressive weeds, or occasional vehicle tracks.
G (Good)	More obvious signs of damage caused by human activities since European settlement, including some obvious impact on the vegetation structure such as that caused by low levels of grazing or slightly aggressive weeds.
P (Poor)	Still retains basic vegetation structure or ability to regenerate to it after very obvious impacts of human activities since European settlement, such as grazing, partial clearing, frequent fires or aggressive weeds.
VP (Very Poor)	Severely impacted by grazing, very frequent fires, clearing or a combination of these activities. Scope for some regeneration but not to a state approaching good condition without intensive management. Usually with a number of weed species present including very aggressive species.
D (Completely Degraded)	Areas that are completely or almost completely without native species in the structure of their vegetation; i.e. areas that are cleared or 'parkland cleared' with their flora comprising of weed or crop species with isolated native trees or shrubs.

Appendix F: Vascular Plant Taxa Recorded in the Abydos East Camp and Haul Road Corridor Project Study Area

Amaranthaceae	**Aerva javanica*
	Ptilotus astrolasius
	Ptilotus auriculifolius
	Ptilotus calostachyus
Apocynaceae	*Carissa lanceolata*
Asteraceae	*Pentalepis trichodesmoides*
	Pluchea tetranthera
Boraginaceae	*Heliotropium tenuifolium*
Caryophyllaceae	*Polycarpaea holtzei*
Cleomaceae	*Cleome viscosa*
Combretaceae	*Terminalia canescens*
Convolvulaceae	*Bonamia rosea*
	Polymeria ambigua
Cyperaceae	*Bulbostylis barbata*
Euphorbiaceae	*Euphorbia australis*
	Euphorbia clementii (P2)
	Euphorbia tannensis
Fabaceae	*Acacia acradenia*
	Acacia ancistrocarpa
	Acacia inaequilatera
	Acacia pyrifolia
	Acacia synchronicia
	Acacia trachycarpa
	Acacia tumida var. *pilbarensis*
	Indigofera monophylla
	Petalostylis labicheoides
	Senna artemisioides subsp. *oligophylla*
	Senna glutinosa
	Senna glutinosa subsp. *pruinosa*
	Senna symonii
	Tephrosia rosea var. *clementii*
Goodeniaceae	*Dampiera candicans*
	Goodenia stobbsiana
Malvaceae	*Corchorus parviflorus*
	Gossypium australe

Molluginaceae	*Mollugo molluginea*
Myrtaceae	*Corymbia hamersleyana* *Eucalyptus victrix* *Melaleuca glomerata*
Nyctaginaceae	*Boerhavia coccinea*
Poaceae	*Brachyachne convergens* **Cenchrus ciliaris* *Chrysopogon fallax* *Cymbopogon ambiguus* *Dichanthium sericeum* subsp. *humilius* *Eragrostis eriopoda* *Eriachne benthamii* *Eriachne ciliata* *Eriachne mucronata* *Eriachne pulchella* subsp. *dominii* *Paraneurachne muelleri* *Sporobolus actinocladus* *Sporobolus australasicus* *Triodia angusta* *Triodia brizoides* *Triodia epactia* *Triodia lanigera* *Triodia longiceps* *Triodia wiseana*
Proteaceae	*Grevillea wickhamii*
Sapindaceae	*Atalaya hemiglauca*
Zygophyllaceae	*Tribulus suberosus*

Total Taxa: 62

Appendix G: Vascular Plant taxa recorded within each Vegetation Alliance within the Abydos East Camp and Haul Road Corridor Project Study Area

	Vegetation Alliance							
Taxon	2a	6a	11a	12a	12a/13a	13a	17a	18a
Acacia acradenia	X	X		X		X		
Acacia ancistrocarpa		X						
Acacia inaequilatera		X		X	X	X		
Acacia pyrifolia	X	X						
Acacia synchronicia	X	X		X				X
Acacia trachycarpa	X							
Acacia tumida var. *pilbarensis*	X	X	X					
**Aerva javanica*	X	X						X
Atalaya hemiglauca	X							
Boerhavia coccinea	X							
Bonamia rosea		X						
Brachyachne convergens								X
Bulbostylis barbata			X	X			X	
Carissa lanceolata	X							
**Cenchrus ciliaris*	X	X						
Chrysopogon fallax		X						
Cleome viscosa		X						X
Corchorus parviflorus	X	X	X	X	X	X	X	
Corymbia hamersleyana	X	X	X					
Cymbopogon ambiguus					X		X	
Dampiera candicans		X		X				
Dichanthium sericeum subsp. *humilius*								X
Eragrostis eriopoda			X					

	Vegetation Alliance							
Taxon	2a	6a	11a	12a	12a/13a	13a	17a	18a
Eriachne benthamii								X
Eriachne ciliata					X		X	
Eriachne mucronata	X	X						
Eriachne pulchella subsp. *dominii*		X	X	X				
Eucalyptus victrix	X							
Euphorbia australis		X						
Euphorbia clementii			X					
Euphorbia tannensis		X						
Goodenia stobbsiana		X	X					
Gossypium australe	X	X			X		X	
Grevillea wickhamii	X	X	X	X		X		
Heliotropium tenuifolium				X				
Indigofera monophylla	X	X	X	X	X		X	
Melaleuca glomerata	X							
Mollugo molluginea		X						
Paraneurachne muelleri			X					
Pentalepis trichodesmoides					X			
Petalostylis labicheoides		X	X					
Pluchea tetranthera		X						
Polycarpaea holtzei		X		X				
Polymeria ambigua		X						
Ptilotus astrolasius		X		X				
Ptilotus auriculifolius					X			
Ptilotus calostachyus			X	X	X			
Senna artemisioides subsp. *oligophylla*		X						X

	Vegetation Alliance							
Taxon	2a	6a	11a	12a	12a/13a	13a	17a	18a
Senna glutinosa subsp. *pruinosa*				X				
Senna glutinosa	X							
Senna symonii		X						
Sporobolus actinocladus		X						X
Sporobolus australasicus		X						X
Tephrosia rosea var. *clementii*		X	X					
Tribulus suberosus					X			
Triodia angusta				X				
Triodia brizoides		X	X	X	X	X	X	
Triodia epactia	X	X	X			X		X
Triodia lanigera		X	X			X		
Triodia longiceps	X							X
Triodia wiseana	X				X	X	X	

Appendix H: GPS Locations of all Conservation Significant Flora and Introduced Flora Recorded during Survey for the Abydos East Project Camp and Haul Road Corridor

Note: All GPS co-ordinates in GDA94 Zone 50

Taxon	Status	GPS E	GPS N	Record Location	Abundance
Euphorbia clementii	P2	726199	7665972	Site 16	6
Euphorbia clementii	P2	726133	7666081	Opportunistic	175
Euphorbia clementii	P2	726157	7666118	Opportunistic	25
Euphorbia clementii	P2	726133	7666174	Opportunistic	58
Euphorbia clementii	P2	726070	7666304	Opportunistic	396
Euphorbia clementii	P2	725997	7666266	Opportunistic	69
Aerva javanica	Weed	721322	7665042	Site 2	-
Aerva javanica	Weed	727407	7667362	Site 23	-
Aerva javanica	Weed	726841	7667258	Site 27	-
Cenchrus ciliaris	Weed	721322	7665042	Site 2	-
Cenchrus ciliaris	Weed	722005	7664659	Site 5	-
Cenchrus ciliaris	Weed	727407	7667362	Site 23	-

Appendix I: Raw Data Recorded within Detailed Recording Sites

Site Name: Site 01

Site Type: AREA

Dimensions: m x m

Survey Date: 12/06/2012

GPS Location: WGS84 (Zone 50) 721091E 7665064N

Landform Type: Lower Slope

Slope Class: Very Gently Inclined (1 degree)

Aspect: S

Soil Type: Sandy Loam

Soil Colour: Brown

Rock Outcrop: No bedrock exposed

Community Code: 12a

Vegetation Condition: E - Excellent

Disturbance: None

Fire: >5

DOMINANT TAXA IN VEGETATION STRATA

SPECIES LIST

Taxon Name	Avg. Height	% Cover Alive
Acacia inaequilatera	3	2
Acacia synchronicia	2	0.3
Triodia angusta	0.6	2
Triodia brizoides	0.4	80

PHOTO

Site Name:	Site 02
Site Type:	AREA
Dimensions:	m x m
Survey Date:	12/06/2012
GPS Location:	WGS84 (Zone 50) 721322E 7665042N
Landform Type:	Drainage Line
Slope Class:	Very Gently Inclined (1 degree)
Soil Type:	Clay Loam
Soil Colour:	Red/Brown (other)
Rock Outcrop:	No bedrock exposed
CF Abundance:	10-20%
CF Sizes:	2-6mm, 6-20mm, 2-6mm, 6-20mm, 2-6mm, 6-20mm
CF Types:	Granite, Ironstone, Quartz (other), Granite, Ironstone, (other), Granite, Ironstone, (other)
Community Code:	2a
Vegetation Condition:	G - Good
Disturbance:	Exotic Weeds, Pig/Animal Disturbance
Fire:	>5yrs

DOMINANT TAXA IN VEGETATION STRATA

SPECIES LIST

Taxon Name	Avg. Height	% Cover Alive
Acacia acradenia	3	1
Acacia pyrifolia	2	7
Acacia synchronicia	1	1
Acacia trachycarpa	2	5
Acacia tumida var. *pilbarensis*	5	4
**Aerva javanica*	0.4	1
Atalaya hemiglauca	2	1
Boerhavia coccinea	0.1	4
Carissa lanceolata	0.8	2
**Cenchrus ciliaris*	0.4	10
Corchorus parviflorus	0.3	3
Corymbia hamersleyana	6	8
Eucalyptus victrix	7	7

PHOTO

Site Name:	Site 03
Site Type:	AREA
Dimensions:	m x m
Survey Date:	12/06/2012
GPS Location:	WGS84 (Zone 50) 721542E 7665045N
Landform Type:	Lower slope (other)
Slope Class:	Very Gently Inclined (1 degree)
Aspect:	N
Soil Type:	Clay Loam
Soil Colour:	Red
Rock Outcrop:	No bedrock exposed
CF Abundance:	>90%
CF Sizes:	2-6mm, 6-20mm, 20-60mm, 60-200mm, 2-6mm, 6-20mm, 20-60mm, 60-200mm, 2-6mm, 6-20mm, 20-60mm, 60-200mm
CF Types:	Granite, Ironstone, Quartz (other), Granite, Ironstone, (other), Granite, Ironstone, (other)
Community Code:	6a
Vegetation Condition:	E - Excellent
Disturbance:	None
Fire:	>5yrs

DOMINANT TAXA IN VEGETATION STRATA

SPECIES LIST

Taxon Name	Avg. Height	% Cover Alive
Acacia acradenia	3	7
Acacia ancistrocarpa	3	12
Corymbia hamersleyana		
Grevillea wickhamii	4	2
Triodia brizoides	0.3	2
Triodia lanigera	0.3	80

PHOTO

Site Name:	Site 04
Site Type:	AREA
Dimensions:	m x m
Survey Date:	12/06/2012
GPS Location:	WGS84 (Zone 50) 721619E 7664853N
Landform Type:	Drainage Line
Slope Class:	Very Gently Inclined (1 degree)
Aspect:	E
Soil Type:	Sandy Loamy Clay (other)
Soil Colour:	Red
Rock Outcrop:	No bedrock exposed
CF Abundance:	2-10%
CF Sizes:	2-6mm, 6-20mm, 2-6mm, 6-20mm, 2-6mm, 6-20mm
CF Types:	Ironstone, Ironstone, Ironstone
Community Code:	11a
Vegetation Condition:	E - Excellent
Disturbance:	N/A (other)
Fire:	>5yrs

DOMINANT TAXA IN VEGETATION STRATA

SPECIES LIST

Taxon Name	Avg. Height	% Cover Alive
Acacia tumida var. *pilbarensis*	3	75
Bulbostylis barbata	0.1	3
Eragrostis eriopoda	0.2	1
Eriachne pulchella subsp. *dominii*	0.1	5
Goodenia stobbsiana	0.3	1
Indigofera monophylla	0.4	2
Paraneurachne muelleri	0.3	5
Petalostylis labicheoides	2	5
Triodia brizoides	0.3	2
Triodia epactia	0.3	2
Triodia lanigera	0.3	4

PHOTO

Site Name:	Site 05
Site Type:	AREA
Dimensions:	m x m
Survey Date:	12/06/2012
GPS Location:	WGS84 (Zone 50) 722005E 7664659N
Landform Type:	Drainage Line
Slope Class:	Very Gently Inclined (1 degree)
Rock Outcrop:	No bedrock exposed
CF Abundance:	>90%
CF Sizes:	2-6mm, 6-20mm, 20-60mm, 60-200mm, 200-600mm, 600-2000mm, 2-6mm, 6-20mm, 20-60mm, 60-200mm, 200-600mm, 600-2000mm, 2-6mm, 6-20mm, 20-60mm, 60-200mm, 200-600mm, 600-2000mm
CF Types:	Granite, Ironstone, Quartz (other), Granite, Ironstone, (other), Granite, Ironstone, (other)
Community Code:	2a
Vegetation Condition:	G - Good
Disturbance:	Exotic Weeds, Pig/Animal Disturbance

DOMINANT TAXA IN VEGETATION STRATA

SPECIES LIST

Taxon Name	Avg. Height	% Cover Alive
Acacia pyrifolia	4	4
Acacia trachycarpa	4	14
**Cenchrus ciliaris*	0.4	12
Corchorus parviflorus	1	3
Eucalyptus victrix	15	17
Melaleuca glomerata	3	5
Triodia epactia	0.3	1
Triodia longiceps	0.8	6

PHOTO

Site Name:	Site 06
Site Type:	AREA
Dimensions:	m x m
Survey Date:	12/06/2012
GPS Location:	WGS84 (Zone 50) 722381E 7664329N
Landform Type:	Lower Slope
Slope Class:	Gently Inclined (3 degrees)
Soil Type:	Clay Loam
Soil Colour:	Red
Rock Outcrop:	No bedrock exposed
CF Abundance:	50-90%
CF Sizes:	2-6mm, 6-20mm, 20-60mm, 60-200mm, 2-6mm, 6-20mm, 20-60mm, 60-200mm, 2-6mm, 6-20mm, 20-60mm, 60-200mm
CF Types:	Ironstone, Calcrete (other), Ironstone, (other), Ironstone, (other)
Community Code:	12a
Vegetation Condition:	E - Excellent

DOMINANT TAXA IN VEGETATION STRATA

SPECIES LIST

Taxon Name	Avg. Height	% Cover Alive
Acacia inaequilatera	3	2
Triodia brizoides	0.3	80

PHOTO

Site Name:	Site 07
Site Type:	AREA
Dimensions:	m x m
Survey Date:	12/06/2012
GPS Location:	WGS84 (Zone 50) 722575E 7664510N
Landform Type:	Drainage Line
Slope Class:	Gently Inclined (3 degrees)
Aspect:	N
Soil Type:	Sandy Loamy Clay (other)
Soil Colour:	Red
Rock Outcrop:	No bedrock exposed
CF Abundance:	>90%
CF Sizes:	2-6mm, 6-20mm, 20-60mm, 60-200mm, 2-6mm, 6-20mm, 20-60mm, 60-200mm, 2-6mm, 6-20mm, 20-60mm, 60-200mm
CF Types:	Ironstone, Quartz (other), Ironstone, (other), Ironstone, (other)
Community Code:	12a
Vegetation Condition:	E - Excellent
Disturbance:	N/A (other)
Fire:	>5yrs

DOMINANT TAXA IN VEGETATION STRATA

SPECIES LIST

Taxon Name	Avg. Height	% Cover Alive
Acacia acradenia	2	1
Acacia inaequilatera	4	3
Senna glutinosa subsp. *pruinosa*	1.5	0.5
Triodia brizoides	0.3	80

PHOTO

Site Name:	Site 08
Site Type:	AREA
Dimensions:	m x m
Survey Date:	12/06/2012
GPS Location:	WGS84 (Zone 50) 723358E 7664727N
Landform Type:	Drainage Line
Slope Class:	Very Gently Inclined (1 degree)
Aspect:	N
Soil Type:	Sand
Soil Colour:	Red
Rock Outcrop:	No bedrock exposed
CF Abundance:	50-90%
CF Sizes:	2-6mm, 6-20mm, 20-60mm, 60-200mm, 2-6mm, 6-20mm, 20-60mm, 60-200mm, 2-6mm, 6-20mm, 20-60mm, 60-200mm
CF Types:	Ironstone, Quartz (other), Ironstone, (other), Ironstone, (other)
Community Code:	6a
Vegetation Condition:	E - Excellent
Disturbance:	Fire (other)
Fire:	3-4yrs

DOMINANT TAXA IN VEGETATION STRATA

SPECIES LIST

Taxon Name	Avg. Height	% Cover Alive
Acacia tumida var. *pilbarensis*	0.5	2
Corchorus parviflorus	0.2	1
Eriachne pulchella subsp. *dominii*	0.1	2
Goodenia stobbsiana	0.4	2
Indigofera monophylla	0.3	4
Petalostylis labicheoides	2	70
Polycarpaea holtzei	0.1	1
Triodia brizoides	0.3	5
Triodia epactia	0.3	15

PHOTO

Site Name:	Site 09
Site Type:	AREA
Dimensions:	m x m
Survey Date:	12/06/2012
GPS Location:	WGS84 (Zone 50) 724163E 7665159N
Landform Type:	Lower Slope (other)
Slope Class:	Very Gently Inclined (1 degree)
Soil Type:	Clay Loam
Soil Colour:	Red
Rock Outcrop:	No bedrock exposed
CF Abundance:	50-90%
CF Sizes:	2-6mm, 6-20mm, 20-60mm, 2-6mm, 6-20mm, 20-60mm, 2-6mm, 6-20mm, 20-60mm
CF Types:	Ironstone, Quartz (other), Ironstone, (other), Ironstone, (other)
Community Code:	6a
Vegetation Condition:	E - Excellent
Disturbance:	Fire (other)
Fire:	3-4yrs

DOMINANT TAXA IN VEGETATION STRATA

SPECIES LIST

Taxon Name	Avg. Height	% Cover Alive
Acacia inaequilatera	4	4
Acacia tumida var. *pilbarensis*		
Corchorus parviflorus	0.3	15
Corymbia hamersleyana	5	1.5
Dampiera candicans	0.4	1
Eriachne pulchella subsp. *dominii*	0.1	2
Euphorbia tannensis	1	7
Grevillea wickhamii	2	2
Indigofera monophylla	0.5	10
Petalostylis labicheoides		
Triodia epactia	0.3	10
Triodia lanigera	0.4	5

PHOTO

Site Name:	Site 10
Site Type:	AREA
Dimensions:	m x m
Survey Date:	12/06/2012
GPS Location:	WGS84 (Zone 50) 724318E 7665278N
Landform Type:	Lower Slope
Slope Class:	Very Gently Inclined (1 degree)
Aspect:	N
Soil Type:	Clay Loam
Soil Colour:	Red
Rock Outcrop:	>2% bedrock exposed
CF Abundance:	>90%
CF Sizes:	2-6mm, 6-20mm, 20-60mm, 60-200mm, 2-6mm, 6-20mm, 20-60mm, 60-200mm
CF Types:	Ironstone, Ironstone
Community Code:	13a
Vegetation Condition:	E - Excellent
Disturbance:	N/A (other)
Fire:	>5yrs

DOMINANT TAXA IN VEGETATION STRATA

SPECIES LIST

Taxon Name	Avg. Height	% Cover Alive
Acacia acradenia	1.5	2.5
Acacia inaequilatera	3	4
Grevillea wickhamii	3	1
Triodia brizoides	0.3	6
Triodia lanigera	0.3	85

PHOTO

Site Name:	Site 11
Site Type:	AREA
Dimensions:	m x m
Survey Date:	12/06/2012
GPS Location:	WGS84 (Zone 50) 724609E 7665402N
Landform Type:	Drainage Line
Slope Class:	Very Gently Inclined (1 degree)
Aspect:	N
Soil Type:	Sand
Soil Colour:	Red
Rock Outcrop:	No bedrock exposed
CF Abundance:	50-90%
CF Sizes:	2-6mm, 6-20mm, 20-60mm, 60-200mm, 2-6mm, 6-20mm, 20-60mm, 60-200mm
CF Types:	Granite, Ironstone, Calcrete (other), Granite, Ironstone, (other)
Community Code:	6a
Vegetation Condition:	E - Excellent
Disturbance:	N/A (other)
Fire:	>5yrs

DOMINANT TAXA IN VEGETATION STRATA

SPECIES LIST

Taxon Name	Avg. Height	% Cover Alive
Acacia ancistrocarpa	2	1
Acacia pyrifolia	3	4
Acacia tumida var. *pilbarensis*	4	1
Cleome viscosa	0.4	1
Corchorus parviflorus	0.3	2
Eriachne mucronata	0.3	5
Grevillea wickhamii	3	1
Indigofera monophylla	0.3	1
Petalostylis labicheoides	2	15
Senna artemisioides subsp. *oligophylla*	1.5	1
Sporobolus actinocladus	0.4	1
Tephrosia rosea var. *clementii*	0.4	2
Triodia brizoides	0.3	1
Triodia epactia	0.4	15

PHOTO

Site Name:	Site 12
Site Type:	AREA
Dimensions:	m x m
Survey Date:	12/06/2012
GPS Location:	WGS84 (Zone 50) 724959E 7665279N
Landform Type:	Mid Slope
Slope Class:	Steep (23 degrees)
Soil Type:	Clay Loam
Soil Colour:	Red
Rock Outcrop:	Granite, 20-50% bedrock exposed
CF Abundance:	>90%
CF Sizes:	2-6mm, 6-20mm, 20-60mm, 60-200mm, 200-600mm, 2-6mm, 6-20mm, 20-60mm, 60-200mm, 200-600mm
CF Types:	Granite, Quartz (other), Granite, (other)
Community Code:	17a
Vegetation Condition:	E - Excellent
Disturbance:	N/A (other)
Fire:	>5yrs

DOMINANT TAXA IN VEGETATION STRATA

SPECIES LIST

Taxon Name	Avg. Height	% Cover Alive
Bulbostylis barbata	0.1	2
Corchorus parviflorus	0.3	3
Cymbopogon ambiguus	0.6	1
Eriachne ciliata	0.1	5
Gossypium australe	1	6
Indigofera monophylla	0.4	1
Triodia brizoides	0.3	20
Triodia wiseana	0.4	5

PHOTO

Site Name:	Site 13
Site Type:	AREA
Dimensions:	m x m
Survey Date:	12/06/2012
GPS Location:	WGS84 (Zone 50) 725093E 7665179N
Landform Type:	Lower Slope
Slope Class:	Gently Inclined (3 degrees)
Soil Type:	Sandy Loamy Clay (other)
Soil Colour:	Red/Brown (other)
Rock Outcrop:	No bedrock exposed
CF Abundance:	>90%
CF Sizes:	2-6mm, 6-20mm, 20-60mm, 60-200mm, 200-600mm, 2-6mm, 6-20mm, 20-60mm, 60-200mm, 200-600mm
CF Types:	Granite, Ironstone, Granite, Ironstone
Community Code:	12a
Vegetation Condition:	E - Excellent
Disturbance:	Fire (other)
Fire:	3-4yrs

DOMINANT TAXA IN VEGETATION STRATA

SPECIES LIST

Taxon Name	Avg. Height	% Cover Alive
Acacia acradenia	0.9	1
Acacia inaequilatera	3	2
Bulbostylis barbata	0.1	2
Corchorus parviflorus	0.4	10
Dampiera candicans	0.5	40
Grevillea wickhamii	1.5	1
Heliotropium tenuifolium	0.1	1
Ptilotus astrolasius	0.3	1
Ptilotus calostachyus	1	7
Triodia brizoides	0.3	50

PHOTO

Site Name:	Site 14 (Observational Site)
Site Type:	AREA
Dimensions:	m x m
Survey Date:	12/06/2012
GPS Location:	WGS84 (Zone 50) 724846E 7665682N
Landform Type:	Drainage Line
Slope Class:	Gently Inclined (3 degrees)
Rock Outcrop:	Other, Calcrete (other), >2% bedrock exposed
CF Abundance:	>90%
CF Types:	Calcrete (other), (other)
Community Code:	6a
Vegetation Condition:	E - Excellent

DOMINANT TAXA IN VEGETATION STRATA

SPECIES LIST

Taxon Name	Avg. Height	% Cover Alive

PHOTO

Site Name:	Site 15
Site Type:	AREA
Dimensions:	m x m
Survey Date:	13/06/2012
GPS Location:	WGS84 (Zone 50) 725604E 7665802N
Landform Type:	Lower Slope
Slope Class:	Very Gently Inclined (1 degree)
Aspect:	N
Soil Type:	Clay Loam
Soil Colour:	Red/Brown (other)
Rock Outcrop:	No bedrock exposed
CF Abundance:	>90%
CF Sizes:	2-6mm, 6-20mm, 20-60mm, 60-200mm, 2-6mm, 6-20mm, 20-60mm, 60-200mm
CF Types:	Granite, Ironstone, Quartz (other), Granite, Ironstone, (other)
Community Code:	12a
Vegetation Condition:	E - Excellent
Disturbance:	Fire (other)
Fire:	3-4yrs

DOMINANT TAXA IN VEGETATION STRATA

SPECIES LIST

Taxon Name	Avg. Height	% Cover Alive
Acacia inaequilatera	3	5
Eriachne pulchella subsp. *dominii*	0.1	5
Indigofera monophylla	0.2	1
Polycarpaea holtzei	0.1	1
Triodia brizoides	0.3	80

PHOTO

Site Name:	Site 16
Site Type:	AREA
Dimensions:	m x m
Survey Date:	13/06/2012
GPS Location:	WGS84 (Zone 50) 726199E 7665972N
Landform Type:	Drainage Line
Slope Class:	Very Gently Inclined (1 degree)
Aspect:	N
Soil Type:	Sand
Soil Colour:	Red/Brown (other)
Rock Outcrop:	No bedrock exposed
CF Abundance:	20-50%
CF Sizes:	2-6mm, 6-20mm, 20-60mm, 60-200mm, 2-6mm, 6-20mm, 20-60mm, 60-200mm
CF Types:	Granite, Ironstone, Quartz (other), Granite, Ironstone, (other)
Community Code:	11a
Vegetation Condition:	E - Excellent
Disturbance:	Fire (other)
Fire:	3-4yrs

DOMINANT TAXA IN VEGETATION STRATA

SPECIES LIST

Taxon Name	Avg. Height	% Cover Alive
Acacia tumida var. *pilbarensis*	3	70
Corchorus parviflorus	0.3	1
Corymbia hamersleyana	4	1
Eriachne pulchella subsp. *dominii*	0.1	5
Euphorbia clementii (2)	0.2	0.1
Goodenia stobbsiana	0.6	10
Grevillea wickhamii	3	1
Indigofera monophylla	0.3	3
Petalostylis labicheoides	1.1	2
Ptilotus calostachyus	0.6	1
Tephrosia rosea var. *clementii*	1	1
Triodia epactia	0.3	15
Triodia lanigera	0.4	20

PHOTO

Site Name:	Site 17
Site Type:	AREA
Dimensions:	m x m
Survey Date:	13/06/2012
GPS Location:	WGS84 (Zone 50) 726392E 7665160N
Landform Type:	Upper slope (other)
Slope Class:	Very Steep (37 degrees)
Soil Type:	Loam
Soil Colour:	Red/Brown (other)
Rock Outcrop:	Granite, 20-50% bedrock exposed
CF Abundance:	>90%
CF Sizes:	2-6mm, 6-20mm, 20-60mm, 60-200mm, 200-600mm, 600-2000mm, >2000mm, 2-6mm, 6-20mm, 20-60mm, 60-200mm, 200-600mm, 600-2000mm, >2000mm, 2-6mm, 6-20mm, 20-60mm, 60-200mm, 200-600mm, 600-2000mm, >2000mm
CF Types:	Granite, Granite, Granite
Community Code:	12a/13a
Vegetation Condition:	E - Excellent
Disturbance:	Fire (other)
Fire:	3-4yrs

DOMINANT TAXA IN VEGETATION STRATA

SPECIES LIST

Taxon Name	Avg. Height	% Cover Alive
Acacia inaequilatera	2	1
Corchorus parviflorus	0.3	0.5
Triodia brizoides	0.2	15
Triodia wiseana	0.3	60

PHOTO

Site Name:	Site 18
Site Type:	AREA
Dimensions:	m x m
Survey Date:	13/06/2012
GPS Location:	WGS84 (Zone 50) 726286E 7665204N
Landform Type:	Drainage Line
Slope Class:	Very Gently Inclined (1 degree)
Aspect:	NE
Soil Type:	Sand
Soil Colour:	Red
Rock Outcrop:	Granite, No bedrock exposed
CF Abundance:	50-90%
CF Sizes:	2-6mm, 6-20mm, 20-60mm, 60-200mm, 200-600mm, 2-6mm, 6-20mm, 20-60mm, 60-200mm, 200-600mm
CF Types:	Granite, Ironstone, Quartz (other), Granite, Ironstone, (other)
Community Code:	2a
Vegetation Condition:	E - Excellent
Disturbance:	Fire (other)
Fire:	3-4yrs

DOMINANT TAXA IN VEGETATION STRATA

SPECIES LIST

Taxon Name	Avg. Height	% Cover Alive
Acacia pyrifolia	1.5	1
Atalaya hemiglauca	1	1
Corchorus parviflorus	0.3	16
Eriachne mucronata	0.2	4
Eucalyptus victrix	11	2
Gossypium australe	1.5	12
Grevillea wickhamii	2	1
Indigofera monophylla	0.3	6
Senna glutinosa	1.5	1
Triodia epactia	0.3	1
Triodia wiseana	0.3	40

PHOTO

Site Name:	Site 19
Site Type:	AREA
Dimensions:	m x m
Survey Date:	13/06/2012
GPS Location:	WGS84 (Zone 50) 726257E 7665071N
Landform Type:	Upper slope (other)
Slope Class:	Steep (23 degrees)
Aspect:	W
Soil Type:	Sandy Clay Loam (other)
Soil Colour:	Brown
Rock Outcrop:	Granite, Quartz (other), 20-50% bedrock exposed
CF Abundance:	>90%
CF Sizes:	2-6mm, 6-20mm, 20-60mm, 60-200mm, 200-600mm, 2-6mm, 6-20mm, 20-60mm, 60-200mm, 200-600mm
CF Types:	Granite, Quartz (other), Granite, (other)
Community Code:	12a/13a
Vegetation Condition:	E - Excellent
Disturbance:	Fire (other)
Fire:	3-4yrs

DOMINANT TAXA IN VEGETATION STRATA

SPECIES LIST

Taxon Name	Avg. Height	% Cover Alive
Acacia inaequilatera	4	2
Corchorus parviflorus	0.3	7
Cymbopogon ambiguus	0.4	0.5
Eriachne ciliata	0.1	5
Gossypium australe	0.6	1
Indigofera monophylla	0.3	1
Pentalepis trichodesmoides	0.7	0.5
Ptilotus auriculifolius	0.3	0.5
Ptilotus calostachyus	0.6	1
Tribulus suberosus	0.5	1
Triodia brizoides	0.3	50
Triodia wiseana	0.4	10

PHOTO

Site Name:	Site 20
Site Type:	AREA
Dimensions:	m x m
Survey Date:	13/06/2012
GPS Location:	WGS84 (Zone 50) 726965E 7667566N
Landform Type:	Low hills (other)
Slope Class:	Gently Inclined (3 degrees)
Soil Type:	Clay Loam
Soil Colour:	Red
Rock Outcrop:	Granite, 2-10% bedrock exposed
CF Abundance:	>90%
CF Sizes:	2-6mm, 6-20mm, 20-60mm, 60-200mm, 200-600mm, 2-6mm, 6-20mm, 20-60mm, 60-200mm, 200-600mm
CF Types:	Granite, Granite
Community Code:	13a
Vegetation Condition:	E - Excellent
Disturbance:	N/A (other)
Fire:	>5yrs

DOMINANT TAXA IN VEGETATION STRATA

SPECIES LIST

Taxon Name	Avg. Height	% Cover Alive
Acacia inaequilatera	2	1
Triodia wiseana	0.3	80

PHOTO

Site Name:	Site 21 (Observational Site)
Site Type:	AREA
Dimensions:	m x m
Survey Date:	13/06/2012
GPS Location:	WGS84 (Zone 50) 727100E 7667566N
Landform Type:	Low hills (other)
Slope Class:	Gently Inclined (3 degrees)
Soil Type:	Clay Loam
Soil Colour:	Red
Rock Outcrop:	Granite, 2-10% bedrock exposed
CF Abundance:	>90%
CF Sizes:	2-6mm, 6-20mm, 20-60mm, 60-200mm, 200-600mm, 2-6mm, 6-20mm, 20-60mm, 60-200mm, 200-600mm, 2-6mm, 6-20mm, 20-60mm, 60-200mm, 200-600mm
CF Types:	Granite, Granite, Granite
Community Code:	12a/13a
Vegetation Condition:	E - Excellent
Disturbance:	N/A (other)
Fire:	>5yrs

DOMINANT TAXA IN VEGETATION STRATA

SPECIES LIST

Taxon Name	Avg. Height	% Cover Alive
Acacia inaequilatera	2	1
Triodia brizoides	0.3	35
Triodia wiseana	0.3	45

PHOTO

Site Name:	Site 22
Site Type:	AREA
Dimensions:	m x m
Survey Date:	13/06/2012
GPS Location:	WGS84 (Zone 50) 727386E 7667530N
Landform Type:	Undulating plain (other)
Slope Class:	Very Gently Inclined (1 degree)
Aspect:	S
Soil Type:	Clay Loam
Soil Colour:	Red/Brown (other)
Rock Outcrop:	No bedrock exposed
CF Abundance:	50-90%
CF Sizes:	2-6mm, 6-20mm, 20-60mm, 60-200mm, 2-6mm, 6-20mm, 20-60mm, 60-200mm
CF Types:	Granite, Ironstone, Quartz (other), Granite, Ironstone, (other)
Community Code:	6a
Vegetation Condition:	E - Excellent
Disturbance:	N/A (other)
Fire:	>5yrs

DOMINANT TAXA IN VEGETATION STRATA

SPECIES LIST

Taxon Name	Avg. Height	% Cover Alive
Acacia acradenia	3	3
Acacia ancistrocarpa	2	4
Acacia synchronicia	2	1
Corymbia hamersleyana	5	1
Eriachne pulchella subsp. *dominii*	0.1	5
Grevillea wickhamii	2.5	1
Senna symonii	1	1
Triodia brizoides	0.3	20
Triodia epactia	0.4	15
Triodia lanigera	0.4	30

PHOTO

Site Name:	Site 23
Site Type:	AREA
Dimensions:	m x m
Survey Date:	13/06/2012
GPS Location:	WGS84 (Zone 50) 727407E 7667362N
Landform Type:	Plain (other)
Slope Class:	Very Gently Inclined (1 degree)
Aspect:	SE
Soil Type:	Sand
Soil Colour:	Red/Brown (other)
Rock Outcrop:	No bedrock exposed
CF Abundance:	0%
Community Code:	6a
Vegetation Condition:	VG - Very Good
Disturbance:	Fire (other)
Fire:	2-3yrs

DOMINANT TAXA IN VEGETATION STRATA

SPECIES LIST

Taxon Name	Avg. Height	% Cover Alive
Acacia acradenia	0.5	3
Acacia pyrifolia	0.5	1
Acacia tumida var. *pilbarensis*	1	1
**Aerva javanica*	0.4	1
Bonamia rosea	0.2	1
**Cenchrus ciliaris*	0.4	1
Chrysopogon fallax	0.4	7
Corchorus parviflorus	0.3	50
Corymbia hamersleyana	6	10
Euphorbia australis	0.1	2
Gossypium australe	0.8	3
Indigofera monophylla	0.3	1
Mollugo molluginea	0.1	2
Pluchea tetranthera	0.3	1
Polymeria ambigua	0.1	2
Sporobolus australasicus	0.1	5
Triodia epactia	0.4	10

PHOTO

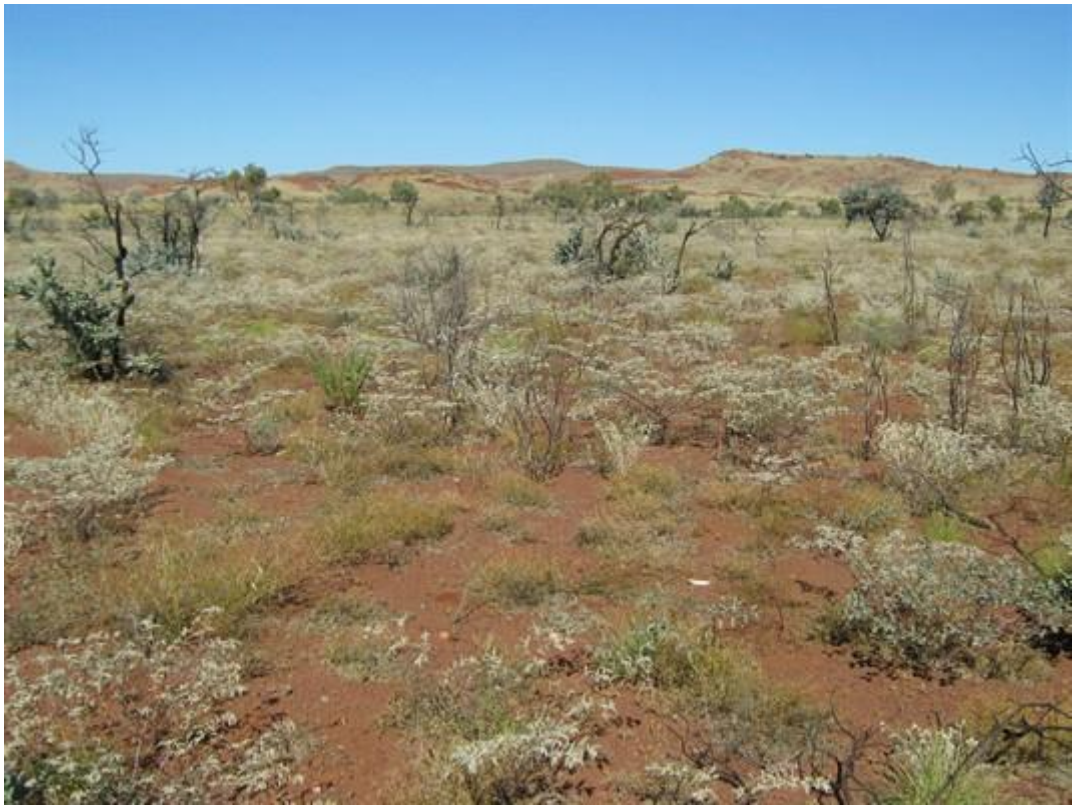
Site Name:	Site 24
Site Type:	AREA
Dimensions:	m x m
Survey Date:	13/06/2012
GPS Location:	WGS84 (Zone 50) 727413E 7667259N
Landform Type:	Flat (other)
Slope Class:	Very Gently Inclined (1 degree)
Aspect:	S
Soil Type:	Sand
Soil Colour:	Red/Brown (other)
Rock Outcrop:	No bedrock exposed
CF Abundance:	20-50%
CF Sizes:	2-6mm, 6-20mm, 2-6mm, 6-20mm
CF Types:	Granite, Ironstone, Quartz (other), Granite, Ironstone, (other)
Community Code:	6a
Vegetation Condition:	E - Excellent
Disturbance:	Fire (other)
Fire:	2-3yrs

DOMINANT TAXA IN VEGETATION STRATA

SPECIES LIST

Taxon Name	Avg. Height	% Cover Alive
Acacia inaequilatera	2	7
Corchorus parviflorus	0.3	60
Indigofera monophylla	0.4	1
Mollugo molluginea	0.1	4
Ptilotus astrolasius	0.3	5
Triodia epactia	0.3	5

PHOTO



Site Name:	Site 25
Site Type:	AREA
Dimensions:	m x m
Survey Date:	13/06/2012
GPS Location:	WGS84 (Zone 50) 727195E 7667288N
Landform Type:	Undulating plain (other)
Slope Class:	Very Gently Inclined (1 degree)
Aspect:	S
Soil Type:	Clay Loam
Soil Colour:	Brown
Rock Outcrop:	Granite, 2-10% bedrock exposed
CF Abundance:	50-90%
CF Sizes:	2-6mm, 6-20mm, 20-60mm, 60-200mm, 2-6mm, 6-20mm, 20-60mm, 60-200mm
CF Types:	Granite, Calcrete (other), Granite, (other)
Community Code:	13a
Vegetation Condition:	E - Excellent
Disturbance:	Fire (other)
Fire:	3-4yrs

DOMINANT TAXA IN VEGETATION STRATA

SPECIES LIST

Taxon Name	Avg. Height	% Cover Alive
Acacia inaequilatera	4	5
Corchorus parviflorus	0.3	10
Triodia epactia	0.3	40
Triodia wiseana	0.3	40

PHOTO

Site Name:	Site 26 (Observational Site)
Site Type:	AREA
Dimensions:	m x m
Survey Date:	13/06/2012
GPS Location:	WGS84 (Zone 50) 727099E 7667300N
Landform Type:	Undulating plain (other)
Slope Class:	Very Gently Inclined (1 degree)
Soil Type:	Sandy Clay Loam (other)
Soil Colour:	Red/Brown (other)
Rock Outcrop:	Granite, 2-10% bedrock exposed
CF Abundance:	50-90%
CF Sizes:	2-6mm, 6-20mm, 20-60mm, 60-200mm, 2-6mm, 6-20mm, 20-60mm, 60-200mm, 2-6mm, 6-20mm, 20-60mm, 60-200mm
CF Types:	Granite, Granite, Granite
Community Code:	13a
Vegetation Condition:	E - Excellent
Disturbance:	Fire (other)
Fire:	3-4yrs

DOMINANT TAXA IN VEGETATION STRATA

SPECIES LIST

Taxon Name	Avg. Height	% Cover Alive
Acacia inaequilatera	4	5
Triodia brizoides	0.3	4
Triodia wiseana	0.3	40

PHOTO

Site Name:	Site 27
Site Type:	AREA
Dimensions:	m x m
Survey Date:	13/06/2012
GPS Location:	WGS84 (Zone 50) 726841E 7667258N
Landform Type:	Plain (other)
Slope Class:	Level (0 degrees)
Soil Type:	Clay Loam
Soil Colour:	Red
Rock Outcrop:	No bedrock exposed
CF Abundance:	10-20%
CF Sizes:	2-6mm, 6-20mm, 20-60mm, 2-6mm, 6-20mm, 20-60mm
CF Types:	Granite, Ironstone, Quartz (other), Granite, Ironstone, (other)
Community Code:	18a
Vegetation Condition:	VG - Very Good
Disturbance:	Grazing, Exotic Weeds, Pig/Animal Disturbance
Fire:	Part 2-3yrs, Part >5yrs

DOMINANT TAXA IN VEGETATION STRATA

SPECIES LIST

Taxon Name	Avg. Height	% Cover Alive
Acacia synchronicia	4	4
**Aerva javanica*	0.4	1
Brachyachne convergens	0.2	50
Cleome viscosa	0.3	1
Dichanthium sericeum subsp. *humilius*	0.1	1
Eriachne benthamii	0.4	10
Senna artemisioides subsp. *oligophylla*	0.6	1
Sporobolus actinocladus	0.3	5
Sporobolus australasicus	0.1	2
Triodia epactia	0.4	3
Triodia longiceps	0.5	8

PHOTO

APPENDIX D: SIMPLIFIED VEGETATION FORMATIONS AND ALLIANCES AND THEIR CORRESPONDING GROUNDWATER DEPENDENT ECOSYSTEM (GDE) PROBABILTY IN THE PANORAMA PROJECT SURVEY AREA

Vegetation Formation	Vegetation Alliance (Mattiske 2007)		Vegetation Alliances (Trudgen *et al.* 2002; Trudgen 2007b)		GDE probability			
	No.	Vegetation Alliance Description	No.	Vegetation Alliance	Low	Medium	High	Very High
Open Forest to Open Woodland - Flowlines	1a	Open forest to open woodland of *Eucalyptus camaldulensis, Melaleuca argentea* and *Eucalyptus victrix* with scattered tall shrubs of *Indigofera monophylla* over *Schoenus falcatus, Cyperus vaginatus* and *Triodia longiceps* sedgeland/grasslands in river beds	1	*Eucalyptus camaldulensis* var. *obtusa* open to closed forest				+
	1a		2	*Eucalyptus camaldulensis, Melaleuca argentea* and *Eucalyptus victrix* open forest over scattered tall shrubs of *Schoenus falcatus, Cyperus vaginatus* and *Triodia longiceps* sedgeland/grasslands				+
	1a		3	*Melaleuca argentea* low woodland to woodland				+
	1a		4	*Eucalyptus camaldulensis* var. *obtusa* open woodland to high open woodland in riverbeds (gravelly and sandy)				+
	1a		38	*Indigofera monophylla* low shrublands to low open heath on lower slopes and valley floor areas				+
Open Forest to Open Woodland - Other	2a	*Eucalyptus victrix* scattered trees to open woodland which may include *Melaleuca glomerata* and *Melaleuca linophylla* over open to closed scrub in creek beds and low slopes	5	*Eucalyptus victrix* scattered trees to open woodland over *Melaleuca glomerata* and *Melaleuca linophylla* over open to closed scrub in creek beds and low slopes			+	
	2a		11	*Eucalyptus victrix* scattered low trees to open woodland along major creeklines			+	
	3a	*Corymbia aspera* scattered low trees to low open woodland in creek beds	6	*Corymbia aspera* scattered low trees to low open woodland in creek beds	+			
	4a	*Acacia tumida* high shrubland to low open forest in creeklines	7	*Acacia tumida* high shrubland to low open forest in creeklines	+			
	5a	*Eucalyptus leucophloia* scattered low trees over patches of *Acacia* shrubs over hummock grasslands of *Triodia* species, including *T. brizoides, T. wiseana* and *T. epactia* on ridge slopes	8	*Eucalyptus leucophloia* scattered low trees over *Triodia brizoides* hummock grasslands on ridge slopes	+			
	5a		9	*Eucalyptus leucophloia* scattered low trees over *Triodia wiseana* hummock grasslands on ridge slopes	+			
	5a		10	*Eucalyptus leucophloia* scattered low trees over *Triodia epactia* hummock grasslands on ridge slopes	+			
	5a		28	*Acacia orthocarpa* shrubland to open scrub over hummock grasslands on steep slopes (gravelly and pebbly)	+			
	5a		34	*Acacia hilliana* low shrublands to low open heath on gentle slopes	+			

APPENDIX D: SIMPLIFIED VEGETATION FORMATIONS AND ALLIANCES AND THEIR CORRESPONDING GROUNDWATER DEPENDENT ECOSYSTEM (GDE) PROBABILTY IN THE PANORAMA PROJECT SURVEY AREA

Vegetation Formation	Vegetation Alliance (Mattiske 2007)		Vegetation Alliances (Trudgen *et al.* 2002; Trudgen 2007b)		GDE probability			
	No.	Vegetation Alliance Description	No.	Vegetation Alliance	Low	Medium	High	Very High
Open Forest to Open Woodland - Other	5a	*Eucalyptus leucophloia* scattered low trees over patches of *Acacia* shrubs over hummock grasslands of *Triodia* species; including *T. brizoides, T. wiseana* and *T. epactia* on ridge slopes	35	*Acacia ptychophylla* low shrubland to low open heath on slopes on a low ridge	+			
	5a		40	*Triodia angusta* (Shaw River form) hummock grasslands on ridges	+			
	5a		44	(scattered tall shrubs over) *Triodia melvillei* hummock grasslands on	+			
	5a		46	*Triodia wiseana* hummock grasslands on mid slopes	+			
	5a		47	*Aristida holathera* var. *holathera* and *Triodia epactia* hummock grassland on sand dunes	+			
	6a	*Corymbia hamersleyana* scattered low trees to low open woodland over tall shrubs to open shrubland of *Acacia* spp. and *Grevillea wickhamii* over hummock grasslands on creek banks, flood banks and distributing fans	12	*Corymbia hamersleyana* scattered low trees to low open woodland over *Acacia acradenia, Cajanus cinereus* and *Petalostylis labicheoides* open scrublands on creek banks, flood banks and distributing fans	+			
	6a		13	*Corymbia hamersleyana* scattered low trees over *Triodia angusta* (Shaw River form) hummock grasslands on low slopes and creeks	+			
	6a		14	*Corymbia hamersleyana* scattered low trees over scattered tall shrubs to high open shrubland over *Triodia epactia* hummock grasslands on valley floor , lower slopes and distrubuting fans	+			
	6a		15	*Corymbia hamersleyana* low scattered trees over *Triodia wiseana* hummock grasslands on mid to lower slopes and valley floors	+			
	6a		27	*Grevillea wickhamii* subsp. *aprica* high open shrubland to high shrubland on gently undulating plains	+			
	6a		29	High shrublands over *Triodia schinzii* hummock grasslands on sandplains	+			
	6a		37	*Acacia stellaticeps* low shrubland to low open heath on undulating plains	+			

APPENDIX D: SIMPLIFIED VEGETATION FORMATIONS AND ALLIANCES AND THEIR CORRESPONDING GROUNDWATER DEPENDENT ECOSYSTEM (GDE) PROBABILTY IN THE PANORAMA PROJECT SURVEY AREA

Vegetation Formation	Vegetation Alliance (Mattiske 2007)		Vegetation Alliances (Trudgen *et al.* 2002; Trudgen 2007b)		GDE probability			
	No.	Vegetation Alliance Description	No.	Vegetation Alliance	Low	Medium	High	Very High
Open Forest to Open Woodland - Other	7a	*Corymbia zygophylla* and *Corymbia hamersleyana* scattered low trees over hummock grasslands on sandplains	16	*Corymbia zygophylla* and *Corymbia hamersleyana* scattered low trees over hummock grasslands on sandplains	+			
	8a	*Terminalia canescens* scattered low trees to low woodland on creek banks	18	*Terminalia canescens* scattered low trees to low woodland on creek banks	+			
	9a	*Atalaya hemiglauca, Acacia pruinocarpa, Ehretia saligna* var. *saligna, Acacia tumida, Eucalyptus ferriticola* subsp. *ferriticola* and *Ficus platypoda* scattered low trees over high open shrubland on steep, rocky gorge walls.	20	*Atalaya hemiglauca, Acacia pruinocarpa, Ehretia saligna* var. *saligna, Acacia tumida* and *Ficus platypoda* scattered low trees over high open shrubland on steep, rocky gorge walls	+			
	9a		17	*Corymbia ferriticola* subsp. *ferriticola* scattered low trees to low open woodland on rocky breakaways	+			
	9a		19	*Acacia coriacea* subsp. *pendens* scattered low trees on rockpiles	+			
High Shrublands to Open Scrubs	10a	Shrubland to open scrubland of *Acacia* species including *A. tumida, A. acradenia* and *A. orthocarpa* over hummock grasslands on upper and steep slopes	21	*Acacia tumida* high shrubland to open scrub on upper slopes of ridges	+			
	10a		22	*Acacia acradenia* high shrubland to open scrub on ridge slopes	+			
	11a	Shrubland to closed scrubland of *Acacia* species, including *A. acradenia, A. pyrifolia* and *A. tumida* along small creeklines and on the adjacent parts of valley floors and distributing fans	23	*Acacia acradenia* shrubland to closed scrub along small creeklines and on the adjacent parts of valley floors and distributing fans	+			
	11a		24	*Acacia pyrifolia* high shrubland to open scrub on flowlines	+			
	11a		26	*Acacia tumida* high shrubland to open scrub over *Triodia lanigera* hummock grassland in creek beds	+			
	12a	*Acacia inaequilatera* scattered tall shrubs to high open shrubland over *Triodia brizoides* hummock grasslands on ridge slopes and low hills	30	*Acacia inaequilatera* scattered tall shrubs to high open shrubland over *Triodia brizoides* hummock grasslands on ridge slopes and low hills	+			

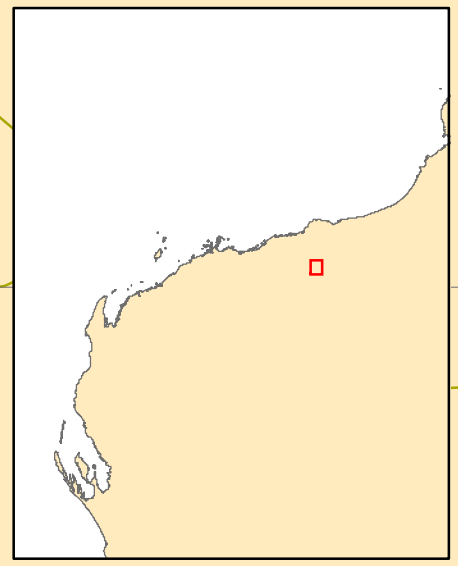
APPENDIX D: SIMPLIFIED VEGETATION FORMATIONS AND ALLIANCES AND THEIR CORRESPONDING GROUNDWATER DEPENDENT ECOSYSTEM (GDE) PROBABILTY IN THE PANORAMA PROJECT SURVEY AREA

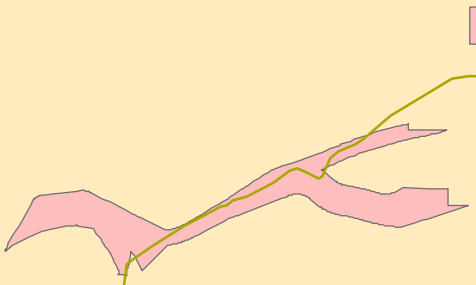
Vegetation Formation	Vegetation Alliance (Mattiske 2007)		Vegetation Alliances (Trudgen *et al.* 2002; Trudgen 2007b)		GDE probability			
	No.	Vegetation Alliance Description	No.	Vegetation Alliance	Low	Medium	High	Very High
High Shrublands to Open Scrubs	**13a**	*Acacia inaequilatera* scattered tall shrubs to high shrubland over *Triodia wiseana* hummock grasslands occurring mainly on gentle lower slopes.	**31**	*Acacia inaequilatera* scattered tall shrubs to high shrubland over *Triodia lanigera* hummock grassland on gentle slopes (gravelly and pebbly)	+			
	13a		**32**	*Acacia inaequilatera* scattered tall shrubs over *Triodia wiseana* hummock grasslands occurring mainly on the slopes of low rises and the colluvial spurs and lower slopes of high ridges	+			
	14a	*Acacia ancistrocarpa* high open shrubland to open scrub	**25**	*Acacia ancistrocarpa* high open shrubland to open scrub on very gentle lower slopes	+			
	15a	*Acacia trachycarpa* high open shrubland to high shrublands	**33**	*Acacia trachycarpa* high open shrubland to high shrublands	+			
Low Shrublands	**16a**	Low shrublands to low open heath on gentle slopes and undulating plain	**36**	*Acacia spondylophylla* low shrublands on mid to upper slopes	+			
	16a		**39**	*Corchorus* aff. *lanifloris* (PAN 76), *Dampiera candicans* and *Ptilotus mollis* low shrubland over *Triodia melvillei* and *Eriachne mucronata* (typical form) very open to open hummock grasslands on mid to upper slopes	+			
Hummock Grasslands	**17a**	Hummock grasslands on slopes and ridges	**41**	Other *Triodia brizoides* hummock grasslands on slopes and spurs of ridges and on low rises	+			
	17a		**42**	*Triodia epactia* hummock grasslands on sandplains and lower slopes of hills	+			
	17a		**43**	Other *Triodia lanigera* hummock grasslands on flat to gentle slopes	+			
	17a		**45**	(Scattered tall shrubs over) *Triodia* sp. Panorama hummock grasslands on flat to gentle slopes	+			

APPENDIX D: SIMPLIFIED VEGETATION FORMATIONS AND ALLIANCES AND THEIR CORRESPONDING GROUNDWATER DEPENDENT ECOSYSTEM (GDE) PROBABILTY IN THE PANORAMA PROJECT SURVEY AREA

Vegetation Formation	Vegetation Alliance (Mattiske 2007)		Vegetation Alliances (Trudgen *et al.* 2002; Trudgen 2007b)		GDE probability			
	No.	Vegetation Alliance Description	No.	Vegetation Alliance	Low	Medium	High	Very High
Other Grasslands and Herblands	18a	Cracking clay alliance on gentle sloping plains and seasonal damplands	48	Cracking clay alliance on gentle sloping plains	+			
	18a		50	*Chrysopogon fallax* tussock grassland on cracking clay	+			
	18a		51	*Triodia* sp. Panorama grasslands on cracking clay (seasonal damplands)	+			
	18a		52	*Iseilema macrantherum* grasslands and herblands on cracking clay (seasonal damplands)	+			
	18a		49	**Cenchrus ciliaris* tussock grassland along creek lines	+			

720000
730000
7680000
7670000
7660000
7650000





Legend

- Abydos East Study Area
- Towns
- Roads and Tracks

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N

This map should only be used in conjunction with WEC report Atlas12-20-02.

Abydos East Project
Study Area Location

Revision: A - July 2012

Author: Kim Kershaw

WEC Ref: Atlas12-20-02

Filename: Atlas12-20-02-f01.mxd

Scale: 1:450,000 (A3) Grid: MGA Zone 50

Figure

1

Abydos East Project - Camp Area and Haul Road Corridor, Legend - Vegetation Alliances (Mattiske 2007)

Open Forest to Open Woodland

- 2a — *Eucalyptus victrix* scattered trees to open woodland which may include *Melaleuca glomerata* and *Melaleuca linophylla* over open to closed scrub in creek beds and low slopes.
- 6a — *Corymbia hamersleyana* scattered low trees to low open woodland over tall shrubs to open shrubland of *Acacia* spp. and *Grevillea wickhamii* over hummock grasslands on creek banks, flood banks and distributing fans.
- 8a — *Terminalia canescens* scattered low trees to low woodland on creek banks.

High Shrublands to Open Scrublands

- 11a — Shrubland to closed scrubland of *Acacia* species, including *A. acradenia, A. pyrifolia* and *A. tumida* along small creeklines and on the adjacent parts of valley floors and distributing fans.
- 12a — *Acacia inaequilatera* scattered tall shrubs to high open shrubland over *Triodia brizoides* hummock grasslands on ridge slopes and low hills.
- 13a — *Acacia inaequilatera* scattered tall shrubs to high shrubland over *Triodia wiseana* hummock grasslands occurring mainly on gentle lower slopes.
- 12a/13a — Mosaic of Vegetation Alliance 12a/13a - *Acacia inaequilatera* scattered tall shrubs to high open shrubland over *Triodia brizoides* and *Triodia wiseana* hummock grasslands on ridge slopes and low hills.

Mosaic of Open Forest to Open Woodland

- 6a/12a — Mosaic of Vegetation Alliance 6a/12a

Hummock Grasslands

- 17a — Hummock grasslands on slopes and ridges.

Other Grasslands and Herblands

- 18a — Cracking clay alliance on gentle sloping plains and seasonal damplands.

720000 721000 722000 723000

7666000

7665000

7664000

Site 1
Site 2
Site 3
Site 4
Site 5
Eaf
Site 6
Site 7
Site 8

Legend

- Sites

Conservation Significant Flora

- Eaf *Eriachne* aff. *festucacea*
- Ecl *Euphorbia clementii* (2)

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N

Abydos East Project - Haul Road Corridor Study Area
Vegetation Mapping, Site Locations,
Conservation Significant Flora Locations

This map should only be used in conjunction with WEC report Atlas-12-20-02.

Author: Kim Kershaw	Filename: Atlas12-20-02-f03.mxd	Scale: 1:10,000 (A3)	**Figure** 3.1
WEC Ref: Atlas12-20-02	Revision: A - July 2012	Grid: MGA Zone 50 (GDA94)	

724000 725000 726000 727000

7666000 7665000 7664000

Ecl Ecl Ecl Ecl Ecl Ecl Site 16

Site 15

Site 14

Site 11

Site 10

Site 12

Site 9

Site 13

Site 18 Site 17

Site 19

Legend

- Sites

Conservation Significant Flora

- Eaf *Eriachne* aff. *festucacea*
- Ecl *Euphorbia clementii* (2)

724000 725000 726000 727000

woodmanenvironmentalconsulting N	**Abydos East Project - Haul Road Corridor Study Area** **Vegetation Mapping, Site Locations,** **Conservation Significant Flora Locations** This map should only be used in conjunction with WEC report Atlas-12-20-02.	Author: Kim Kershaw	Filename: Atlas12-20-02-f03.mxd	Scale: 1:10,000 (A3)	**Figure** 3.2
		WEC Ref: Atlas12-20-02	Revision: A - July 2012	Grid: MGA Zone 50 (GDA94)	

726500 727000 727500

7668000 7667500 7667000

Site 20
Site 21
Site 22
Site 23
Site 24
Site 25
Site 26
Site 27

Legend

- Sites

Open Forest to Open Woodland

6a *Corymbia hamersleyana* scattered low trees to low open woodland over tall shrubs to open shrubland of *Acacia* spp. and *Grevillea wickhamii* over hummock grasslands on creek banks, flood banks and distributing fans.

High Shrublands to Open Scrublands

13a *Acacia inaequilatera* scattered tall shrubs to high shrubland over *Triodia wiseana* hummock grasslands occurring mainly on gentle lower slopes.

12a/13a Mosaic of Vegetation Alliance 12a/13a - *Acacia inaequilatera* scattered tall shrubs to high open shrubland over *Triodia brizoides* and *Triodia wiseana* hummock grasslands on ridge slopes and low hills.

Other Grasslands and Herblands

18a Cracking clay alliance on gentle sloping plains and seasonal damplands.

726500 727000 727500

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N

This map should only be used in conjunction with WEC report Atlas12-20-02.

Abydos East Project - Camp Study Area Vegetation Mapping, Site Locations, Conservation Significant Flora Locations

Revision: A - July 2012

Author: Kim Kershaw

WEC Ref: Atlas12-20-02

Filename: Atlas12-20-02-f04.mxd

Scale: 1:5,000 (A3) Grid: MGA Zone 50

Figure

4

720000 721000 722000 723000

7666000 7665000 7664000

Site 1
CecSite 2
Aej
Site 3
Site 4
CecSite 5
PolCic
Aej
Cec
Site 6
Site 7
Site 8

Legend

- Sites

Condition

- E Excellent
- G Good

Introduced Taxa

- Aej **Aerva javanica*
- Cec **Cenchrus ciliaris*
- Cic **Citrullus colocynthis*
- Pol **Portulaca oleracea*

woodmanenvironmentalconsulting N	**Abydos East Project - Haul Road Corridor Study Area Vegetation Condition Mapping, Site Locations, Introduced Flora Locations** This map should only be used in conjunction with WEC report Atlas-12-20-02.	Author: Kim Kershaw	Filename: Atlas12-20-02-f05.mxd	Scale: 1:10,000 (A3)	**Figure** 5.1
		WEC Ref: Atlas12-20-02	Revision: A - July 2012	Grid: MGA Zone 50 (GDA94)	

724000 725000 726000 727000

7666000

7665000

7664000

Site 16
Site 15
Site 14
Site 11
Site 10
Site 12
Site 9
Site 13
Site 18
Site 17
Site 19

Legend

Sites

Condition

E Excellent

G Good

Introduced Taxa

Aej **Aerva javanica*

Cec **Cenchrus ciliaris*

Cic **Citrullus colocynthis*

Pol **Portulaca oleracea*

724000 725000 726000 727000

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N

Abydos East Project - Haul Road Corridor Study Area
Vegetation Condition Mapping, Site Locations, Introduced Flora Locations
This map should only be used in conjunction with WEC report Atlas-12-20-02.

Author: Kim Kershaw	Filename: Atlas12-20-02-f05.mxd	Scale: 1:10,000 (A3)	**Figure** 5.2
WEC Ref: Atlas12-20-02	Revision: A - July 2012	Grid: MGA Zone 50 (GDA94)	

726500 727000 727500

7668000 7667500 7667000

Site 20
Site 21
Site 22
AejSite 23
Cec
Site 26
Site 25
AejSite 27
Site 24

Legend

- Sites

ConditionCode

- E Excellent
- VG Very Good

Introduced Taxa

- Aej **Aerva javanica*
- Cec **Cenchrus ciliaris*

726500 727000 727500

woodmanenvironmentalconsulting

N

This map should only be used in conjunction with WEC report Atlas12-20-02.

Abydos East Project - Camp Study Area Vegetation Condition Mapping, Site Locations, Introduced Flora Locations

Author: Kim Kershaw

WEC Ref: Atlas12-20-02

Filename: Atlas12-20-02-f06.mxd

Revision: A - July 2012

Scale: 1:5,000 (A3) Grid: MGA Zone 50

Figure

6