Consolidation of Regional Vegetation Mapping

BHP Billiton Iron Ore Pilbara Tenure

Prepared for BHP Billiton Iron Ore Pty Ltd
June 2014



Document Status						
Rev No.	Authors	Reviewer/s	Date	Approved for Issue		
				Name	Distributed To	Date
1	D.Brearley	J.Waters, E.Palmer, J.Bull	29/01/14	D.Brearley	M.Vile	23/02/14
2	D.Brearley	M.Vile	18/03/14	D.Brearley	M.Vile	22/04/14
3	D.Brearley	M.Vile	14/05/14	D.Brearley	M.Vile	21/05/14
4	D.Brearley	M.Vile	28/05/14	D.Brearley	M.Vile	06/06/14

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EXECUTIVE SUMMARY

BHP Billiton Iron Ore Pty Ltd (BHP Billiton Iron Ore) has been undertaking baseline biological surveys on most of its Pilbara tenements since the 1990s. These surveys have generally involved the preparation of vegetation maps, developed using different techniques and/or nomenclature; however they have generally utilised similar field methods. Given the inconsistencies in previous vegetation mapping, BHP Billiton Iron Ore has undertaken to consolidate previous vegetation mapping into one consolidated regional Geographic Information System (GIS) database that provides consistency in methods and nomenclature across its tenure.

This component of the consolidated mapping project includes BHP Billiton Iron Ore's central, eastern and mainline rail tenements. The northern tenements which include the Goldsworthy group of mines and Port Hedland were not included in this phase of the work. It is intended that another phase/s would complete vegetation mapping across the remaining BHP Billiton Iron Ore tenure in the Pilbara.

The consolidated vegetation map will replace all existing vegetation mapping across BHP Billiton Iron Ore tenure, and will become the new baseline dataset. This dataset will be the basis for all future surveys in regard to nomenclature and data management. There will be guidelines developed for the ongoing revision and maintenance of the mapping and associated database when new surveys are undertaken or new information becomes available.

A total of 162 baseline flora and vegetation surveys commissioned by BHP Billiton Iron Ore at its Pilbara based tenements between 2004 and 2013 were reviewed by Onshore Environmental Consultants Pty Ltd (Onshore Environmental) as part of the consolidation of regional vegetation mapping. The consolidated database supports raw data for a total of 8,417 study sites with a total of 176,778 flora records. The total flora included 6,289 records for 57 significant plant taxa, including one Threatened Flora, 14 Priority 1 flora, 11 Priority 2 flora, 26 Priority 3 flora and four Priority 4 flora. There were a total of 7,270 records for 56 introduced weed taxa. Four of the weed taxa are considered to be large range extensions and may require further sampling to confirm identification. Seven of the 56 weed taxa are listed as Declared Pests under the *Biosecurity and Agriculture Management Act 2007* (BAM Act).

Vegetation mapping for BHP Billiton Iron Ore tenure was consolidated from a total of 81 baseline flora and vegetation surveys. It is noted that smaller scale consolidation of vegetation mapping has been completed for a number of the tenements surrounding Mining Area C in the central Pilbara. A total of 218 vegetation associations classified under 53 broad floristic formations were described and mapped from BHP Billiton Iron Ore tenure. Vegetation associations were classified under 15 landform types. Flood plains (50 vegetation associations), hills slopes and low undulating hills (44 vegetation associations) and stony plains (24 vegetation associations) supported the highest number of vegetation associations. Hill slopes and low undulating hills (24%), stony plains (19%), footslopes (12%), flood plains (12%), and hill crests and upper hill slopes (10%) were the dominant landforms represented by area.

Fine-scale vegetation mapping has been completed over 53 percent of the study area, and predominantly covering northern and central sectors. There were ten broad areas where no previous vegetation mapping had been completed (representing 38 percent of the study area), including sections of tenements as well as full tenement areas. Specifically these

areas were an un-named tenement at the northern end of the Mainline Rail, the Roy Hill tenement, the extensive Fortescue Valley tenement, a small area situated between the Marillana tenement and the Mainline Rail, the western fringe of the Mudlark Well tenement[1], the Rocklea tenement, a portion of Orebody 39, an un-named tenement south of Myopic, east of Orebody 35 and fringing areas around the Prairie Downs tenement. The accuracy of vegetation mapping at eight additional tenements was rated as 'broad-scale' (representing nine percent of the study area) and in need of additional field assessment to improve detail and accuracy of vegetation polygon line work and vegetation association description; Upper Marillana and Munjina, Ministers North, Gurinbiddy (south-western sector), Caramulla, South West Jimblebar, Orebody 31, Myopic (northern sector) and Ophthalmia.

Vegetation condition for BHP Billiton Iron Ore's eastern and central Pilbara tenure, situated broadly south of the Marillana lease, was predominantly rated as 'pristine' or 'excellent' (Keighery 1994). A smaller proportion of the area was rated in the lesser categories of 'very good', 'good', degraded' and 'completely degraded'. The southern tenure occurs within the Hamersley Range, with a large proportion of the area occurring on elevated landforms that are distanced from common disturbances observed lower in the landscape. Vegetation with reduced condition generally occurred in areas of lower relief that supported palatable grasses, reliable water supply and shelter for domestic cattle. Landforms included ephemeral drainage lines (of all sizes), flood plains, stony plains and gilgai plains. These landforms were common north of the Marillana tenement, associated with outwash plains of Weeli Wolli Creek and the adjacent Fortescue River Basin, and extending north along the Mainline Rail and intercepting the upper catchment of Yule River and Turner River. Vegetation condition within this northern sector of the study area was predominantly 'very good' to 'good'.

[1] This sits within the boundary of Karijini National Park.

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1.0 PROJECT BACKGROUND

1.1 Strategic Objective

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This component of the consolidated mapping project includes BHP Billiton Iron Ore's central, eastern and mainline rail tenements. The northern tenements which include the Goldsworthy group of mines and Port Hedland were not included in this phase of the work. It is intended that another phase/s would complete vegetation mapping across the remaining BHP Billiton Iron Ore tenure in the Pilbara.

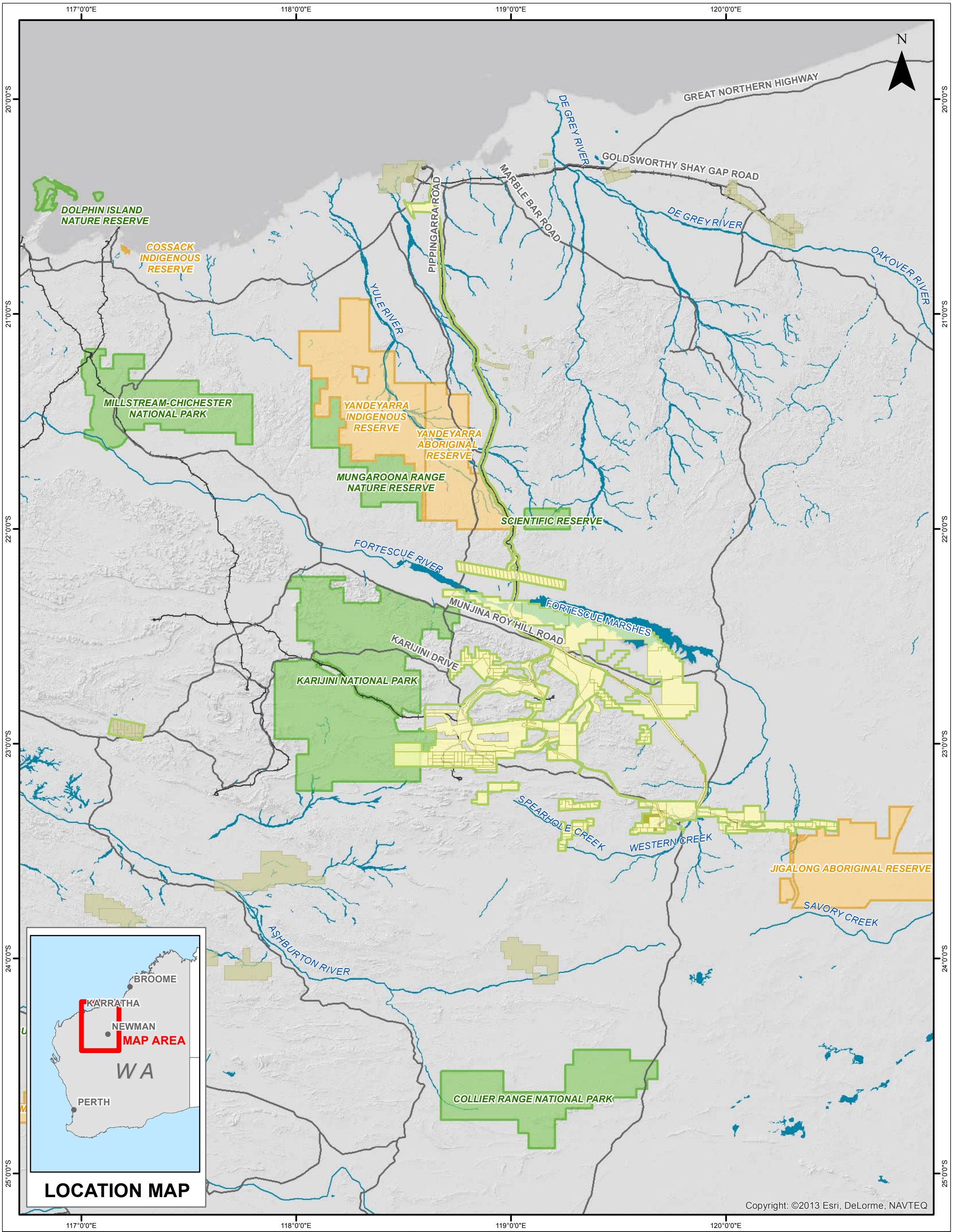
The consolidated vegetation map will replace all existing vegetation mapping across BHP Billiton Iron Ore tenure, and will become the new baseline dataset. This dataset will be the basis for all future surveys in regard to nomenclature and data management. There will be guidelines developed for the ongoing revision and maintenance of the mapping and associated database when new surveys are undertaken or new information becomes available.

1.2 Study Area

This phase of theconsolidated vegetation mapping area is situated broadly between the towns of Port Hedland in the north, Newman in the south, Paraburdoo in the south-west, and Jigalong in the south-east. The study area is encompasses the local governments of Shire of East Pilbara, Shire of Ashburton and Town of Port Hedland, all within the Pilbara region of Western Australia (Figure 1).

The consolidated vegetation mapping is located on mining tenure for which BHP Billiton Iron Ore is the Manager and Agent. Associated infrastructure including rail and access roads occur outside existing mining tenure on miscellaneous licences.

The current use of lands surrounding the proposed mines and associated infrastructure is predominantly for mineral exploration, iron ore mining and dry land agriculture, specifically pastoralism, cattle grazing and rangelands. Conservation lands amount to less than ten percent of the total area of the Pilbara Bioregion, with the major reserves being Karijini and Millstream-Chichester National Parks. These Parks are supplemented by lesser conservation estates such as Cane River and Meentheena Conservation Parks. Wetlands of National significance include the permanent pools of Millstream and Karijini National Parks and the Fortescue Marsh.



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BHPBIO PILBARA

Map of BHP Billiton Iron Ore's tenement boundaries

Figure 1

0 10 20 40 60 80 100
Kilometers
1:1,750,000
Datum: GDA94

ONSHORE ENVIRONMENTAL

FIG:	1	Date:	26 May 2014
Sheet Size:	A3	Status:	Draft
Drawn by GSM	Requested by DB	Internal Reference Pilbara Location 20140429	

Legend

- BHP Billiton Iron Ore tenements Intersecting Study Area
- Other BHP Billiton Iron Ore tenements
- Study Boundary

Reserves

- Nature Conservation Reserve
- Indigenous Reserve
- Watercourses
- Roads
- Railways

1.3 Land System and Land Type Mapping

The Department of Agriculture has conducted inventory and condition surveys of the Pilbara (van Vreeswyk *et al.* 2004) using an integrated survey method involving the land system approach to rangeland description evaluation. The primary objective of the surveys was to provide comprehensive descriptions and mapping of the biophysical resources of the region, as well as an evaluation on the condition of soils and vegetation. The mapping is based on patterns in topography, soils, hydrology and vegetation.

A total of 102 land systems were defined in the Pilbara bioregion at a scale of 1:250,000 (van Vreeswyk *et al*. 2004) (Figure 2). The northern half of this phase of the consolidated vegetation mapping area extends north from the Fortescue Marsh to the southern outskirts of Port Hedland, and incorporates the linear infrastructure corridor supporting BHP Billiton Iron Ore's Mainline Rail. The Uaroo Land System occurs at the northern extent of the corridor, defined by broad sandy plains. Stony plains and occasional granite tor fields of the Macroy Land System are also common at the northern extent, dissected by major drainage lines of the River Land System (linked to Turner River). Increasing elevation around the Chichester Ranges is associated with hills and ranges of the Newman, Capricorn and McKay Land Systems; this area also includes basalt upland gilgai plains of the Wona Land System. Stony alluvial and hardpan plains of the Christmas, Jamindie and Boolgeeda Land Systems occur in closer proximity to the saline clay flats of the Fortescue Marsh (Marsh Land System).

The southern half of this phase of the consolidated vegetation mapping area shows higher consistency of land systems across the landscape, dominated by plateaux, ridges, mountains and hills associated with various ranges (predominantly related to the Newman Land System). These areas support BHP Billiton Iron Ore's existing iron ore mines. The ranges drain onto the stony slopes and flood plains of the Boolgeeda Land System (and other land systems at similar position in the landscape), which are dissected by larger drainage lines and floodplains that form part of the River Land System (e.g. Fortescue River, Weeli Wolli Creek).

Land systems are grouped into land types according to a combination of landform, soil, vegetation and drainage patterns. The amalgamation of 102 land systems into 20 land types provides information at a regional scale (Table 1, Figure 3). The dominant land types are associated with hills and ranges (1 and 2), stony plains (7, 8 and 10), hardpan plains with groved mulga shrublands (12), and river plains associated with the major ephemeral drainage lines (17).

Table 1 Land types as described by van Vreeswyk et al. (2004).

Land Type		Contained Land Systems
1	Hills and ranges with spinifex grasslands	Black, Boolaloo, Capricorn, Granitic, Houndstooth, McKay, Newman, Robertson, Rocklea, Ruth and Talga
2	Hills and ranges with acacia shrublands	Augustus, Charley and Marandoo
3	Plateaux, mesas and breakaways with spinifex grasslands	Callawa, Coongimah, Kumina, Nanutarra, Oakover and Robe
4	Plateaux, mesas and breakaways with acacia shrublands	Laterite and Table

Land Type		Contained Land Systems
5	Dissected plains with spinifex grasslands	Billygoat, Egerton and Platform
6	Stony plains and hills with spinifex grasslands	Adrian, Bonney, Mosquito, Nirran and Tanpool
7	Stony plains and low hills with acacia shrublands	Collier and Prairie
8	Stony plains with spinifex grasslands	Boolgeeda, Lochinvar, Macroy, Paterson, Peedamulla, Pyramid, Satirist, Stuart and Taylor
9	Stony gilgai plains with tussock grasslands and spinifex grasslands	White Springs and Wona
10	Stony plains with acacia shrublands	Dollar, Elimunna, Ford, Kanjenjie, Paraburdoo and Sylvania
11	Sandplains with spinifex grasslands	Buckshot, Divide, Giralia, Gregory, Little Sandy, Nita and Uaroo
12	Wash plains on hardpan with groved mulga shrublands (sometimes with spinifex understorey)	Cadgie, Fan, Jamindie, Jurrawarrina, Nooingnin, Pindering, Spearhole, Three Rivers, Wannamunna, Washplain and Zebra
13	Alluvial plains with soft spinifex grasslands	Mallina, Paradise and Urandy
14	Alluvial plains with tussock grasslands or grassy shrublands	Balfour, Brockman, Horseflat, Pullgarah and Turee
15	Alluvial plains with snakewood shrublands	Christmas, Cowra, Hooley, Marillana, Narbung and Sherlock
16	Alluvial plains with halophytic shrublands	Cundelbar, Mannerie and Talawana
17	River plains with grassy woodlands and shrublands, and tussock grasslands	Cane, Coolibah, Fortescue, Jigalong, River and Yamerina
18	Calcreted drainage plains with shrublands or spinifex grasslands	Calcrete, Lime and Warri
19	Coastal plains, dunes, mudflats and beaches with tussock grasslands, soft spinifex grasslands and halophytic shrublands	Anna, Cheerawarra, Dune, Eighty Mile, Littoral, Onslow and Roebuck
20	Salt lakes and fringing alluvial plains with halophytic shrublands	Marsh, Lake Bed and Weelarrana

117°0'0"E 118°0'0"E 119°0'0"E 120°0'0"E

21°0'0"S 22°0'0"S 23°0'0"S 24°0'0"S 25°0'0"S

Legend

BHP Billiton Iron Ore tenements

Study Boundary

Intersecting Land Systems
Mapping Unit / Land System

- RGEADR, Adrian Land System
- RGEASH, Ashburton land System
- RGEAUG, Augustus Land System
- RGEBGD, Boolgeeda Land System
- RGEBLF, Balfour Land System
- RGEBLG, Billygoat Land System
- RGEBLK, Black Land System
- RGEBOO, Boolaloo Land System
- RGEBRO, Brockman Land System
- RGECAD, Cadgie Land System
- RGECAL, Calcrete Land System
- RGECHA, Charley Land System
- RGECHE, Cheerawarra Land System
- RGECHR, Christmas Land System
- RGECLL, Callawa Land System
- RGECOB, Coolibah Land System
- RGECOR, Collier Land System
- RGECPN, Capricorn Land System
- RGECWA, Cowra Land System
- RGEDIV, Divide Land System
- RGEEDW, Edward Land System
- RGEEGE, Egerton Land System
- RGEELI, Elimunna Land System
- RGEETH, Ethel Land System
- RGEFAN, Fan Land System
- RGEFOR, Ford Land System
- RGEFTC, Fortescue Land System
- RGEHOF, Horseflat Land System
- RGEJAM, Jamindie Land System
- RGEJUR, Jurrawarrina Land System
- RGEKLN, Kooline Land System
- RGELAB, Lake Bed Land System
- RGELAT, Laterite Land System
- RGELIT, Littoral Land System
- RGEMAC, Macroy Land System
- RGEMAL, Mallina Land System
- RGEMCK, McKay Land System
- RGEMLG, Mulgul Land System
- RGEMRA, Marillana Land System
- RGEMSH, Marsh Land System
- RGENAB, Narbung Land System
- RGENEW, Newman Land System
- RGENIT, Nita Land System
- RGENON, Nooingnin Land System
- RGEOAK, Oakover Land System
- RGEPAR, Paraburdoo Land System
- RGEPDG, Pindering Land System
- RGEPDS, Paradise Land System
- RGEPLA, Platform Land System
- RGERBT, Robertson Land System
- RGERIV, River Land System
- RGEROB, Robe Land System
- RGEROC, Rocklea Land System
- RGESPH, Spearhole Land System
- RGESYL, Sylvania Land System
- RGETAB, Table Land System
- RGETAY, Taylor Land System
- RGETLG, Talga Land System
- RGETUR, Turee Land System
- RGEUAR, Uaroo Land System
- RGEURY, Urandy Land System
- RGEWAI, Warri Land System
- RGEWNM, Wannamunna Land System
- RGEWON, Wona Land System
- RGEWSP, Washplain Land System
- RGEW_RIVER, River Bed Land Unit
- RGEX_MINE, Mine
- RGEYAM, Yamerina Land System
- RGEZEB, Zebra Land System

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Land Systems occurring across
BHP Billiton Iron Ore's tenements
(descriptions from van Vreeswyk et al. 2004).

Figure 2.

ONSHORE ENVIRONMENTAL

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Drawn by GSM	Requested by DB	Internal Reference Pilbara Landsys 20140526	

N

0 10 20 40 60 80 100
Kilometers
1:1,750,000
Datum: GDA94

Legend

- BHP Billiton Iron Ore tenements
- Pilbara
- Study Boundary

Landtype

- Alluvial plains with halophytic shrublands
- Alluvial plains with snakewood shrublands
- Alluvial plains with soft spinifex grasslands
- Alluvial plains with tussock grasslands or grassy shrublands
- Calcreted drainage plains with shrublands or spinifex grasslands
- Coastal plains, dunes, mudflats and beaches with tussock grasslands, soft spinifex grasslands and halophytic shrublands
- Dissected plains with spinifex grasslands
- Hills and ranges with acacia shrublands
- Hills and ranges with spinifex grasslands
- Plateaux, mesas and breakaways with acacia shrublands
- Plateaux, mesas and breakaways with spinifex grasslands
- River plains with grassy woodlands and shrublands, and tussock grasslands
- Salt lakes and fringing alluvial plains with halophytic shrublands
- Sandplains with spinifex grasslands
- Stoney plains and hills with acacia shrublands
- Stoney plains and hills with spinifex grasslands
- Stony gilgai plains with tussock grasslands and spinifex grasslands
- Stony plains with acacia shrublands
- Stony plains with spinifex grasslands
- Wash plains on hardpan with grooved mulga shrublands (sometimes with spinifex understorey)

PILBARA

Land Types occurring within the strategic assessment area (descriptions from van Vreeswyk et al. 2004).

Figure 3

0 10 20 30 40 50
Kilometers
Datum: GDA94

Onshore Environmental Consultants		Date:	26 May 2014
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1.4 Consolidation of Flora and Vegetation Data

BHP Billiton Iron Ore has been undertaking baseline biological surveys on most of its Pilbara tenements since the 1990s. These surveys have generally included flora and vegetation surveys to record the total flora present within defined study sites, including significant plant taxa and introduced weed species, as well as mapping the major vegetation associations present. The raw data has generally been collected using similar field methodology, noting that plant nomenclature has been progressively reviewed and updated over the past three decades.

The requirements for environmental survey and reporting of flora and vegetation in Western Australia was standardised by the Environmental Protection Authority (EPA) in 2002 to ensure greater consistency in the methodologies being implemented:

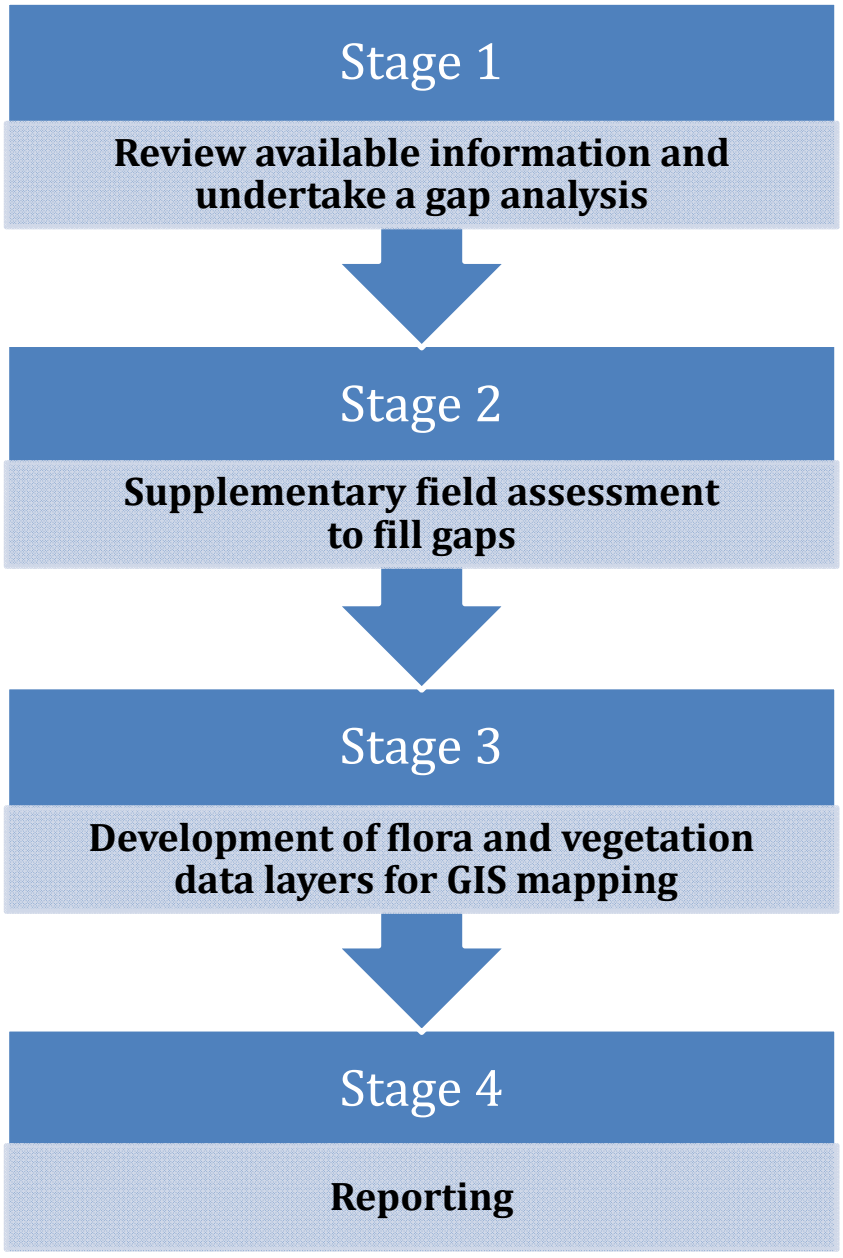
- Terrestrial Biological Surveys as an Element of Environmental Protection. Position Statement No. 3 (EPA 2002); and
- EPA Guidance for the Assessment of Environmental Factors: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia No. 51 (EPA 2004).

The survey methodology was further refined in 2010 with BHP Billiton Iron Ore's *Guidance for Flora and Vegetation Surveys in the Pilbara* (BHP Billiton Iron Ore 2010).

BHP Billiton Iron Ore undertook to consolidate the previous vegetation mapping completed across their Pilbara tenure into one regional database that provided consistency in methods and nomenclature. In April 2013 Onshore Environmental Consultants Pty Ltd (Onshore Environmental) was commissioned by BHP Billiton Iron Ore to review the previous survey work completed within this phase of the consolidated vegetation mapping area, consolidate raw data into one GIS database, and develop a single consolidated vegetation association map.

2.0 SCOPE AND OBJECTIVES

The broad aim of the project was to review, standardise and consolidate flora and vegetation data previously recorded from numerous baseline surveys completed on BHP Billiton Iron Ore tenure within the study area. The project was addressed in four broad stages.



Stage 1. Review available information and undertake a gap analysis

An extensive desktop review of previous flora and vegetation surveys within BHP Billiton Iron Ore tenure was undertaken to identify the extent of existing vegetation mapping and vegetation attribute data. The review included an assessment of methodology, results and data quality to determine the relevance and useability of the information. Data from a total of 162 previous reports were reviewed (Appendix 1).

All of the data were sourced from internal baseline surveys commisioned by BHP Billiton Iron Ore (and its subsidiaries) between 1984 and 2013. Specifically the review of existing information determined:

a) Whether vegetation association mapping had been completed;
b) The scale of vegetation association mapping;
c) The vegetation classification system used to describe and map vegetation associations;
d) The availability of GIS shape files; and
e) The availability of a geodatabase and whether the data complied with current GIS standards required by BHP Billiton Iron Ore.

The majority of the vegetation maps were sourced as hard copy images that were subsequently scanned, georeferenced, and line work digitised and rectified in a GIS. Existing GIS databases were generally available for survey work completed post 2010 following implementation of BHP Billiton Iron Ore GIS standards (BHP Billiton Iron Ore 2013a).

Following the data review of previous baseline survey reports, a gap analysis was completed within the BHP Billiton Iron Ore tenure boundary to determine areas that had not previously been surveyed, where vegetation mapping was absent, and where data did not comply with current assessment standards. The quality of available vegetation mapping data sourced during the review was assessed and rated for each survey area on the basis of scale, line work accuracy (for vegetation polygons), and data (attribute) detail. Apart from providing assurance on vegetation map quality for specific areas of tenure, the quality review will allow BHP Billiton Iron Ore to prioritise future survey work to improve the overall accuracy of the consolidated vegetation mapping database.

Stage 2. Supplementary field assessment

Based on results from the gap analysis completed as part of Stage 1, additional field assessments were planned at selected tenements where vegetation mapping was either absent, or where vegetation mapping quality was rated as ‘broad-scale’, i.e. had not been completed to an acceptable scale or standard. These additional field assessments prioritised the key areas of concern for BHP Billiton Iron Ore, with fine-scale vegetation mapping to be progressively completed across all tenure.

The additional field assessments involved two field trips completed from 24 to 30 July 2013 and 20 to 30 August 2013 by two Senior Botanists from Onshore Environmental; Dr Darren Brearley and Dr Jerome Bull. A total of nine project areas were visited to assess the status of vegetation mapping and requirement to update the vegetation mapping database; Mindy North, Coondiner, Gurinbiddy (north-east), Myopic (north-west), South West Jimblebar, Caramulla, Myopic (east), Upper Marillana / Munjina and Roy Hill.

Stage 3. Development of flora and vegetation data layers

The literature review and gap analysis (Stage 1) and supplementary field assessments (Stage 2) allowed a consolidated vegetation map using compatible data to be produced during Stage 3. The following steps were completed during production of the consolidated vegetation map:

a) for relevant baseline flora and vegetation surveys, raw data relating to formal study sites (quadrats), floristics (including significant flora and introduced weed species), and vegetation mapping was entered into the BHP Billiton Iron Ore raw data template;
b) a review of plant nomenclature was completed and where possible[2], names were updated to reflect the current Western Australian Herbarium (WAH) census;
c) hard copy vegetation maps from previous surveys were digitised (where there were no GIS shape files or geodatabases available);
d) vegetation maps and associated spatial data informing on the reliability, accuracy and comprehensiveness of the botanical/vegetation data were reconciled to generate a single consolidated map supporting a comprehensive spatial dataset;
e) vegetation association descriptions were standardised using BHP Billiton Iron Ore's preferred vegetation classification system, to allow comparison of equivalent attributes across the consolidated dataset; and
f) the detail and accuracy of vegetation polygon line work and vegetation association descriptions for specific tenements was rated to determine inconsistencies and deficiencies that hinder data standardisation and map consolidation.

Stage 4. Reporting

The current report documents background, methodology and results to provide context to the consolidated vegetation map produced for BHP Billiton Iron Ore tenure.

[2] Some of the plant names recorded during previous surveys were not found on the current WAH census, while other changes could not be directly inferred. This included the recent revision for *Acacia aneura* (Mulga). Where changes were not definitive, raw data was not revised.

3.0 METHODOLOGY

3.1 Guidance Statements

The previous flora and vegetation surveys incorporated into the consolidated vegetation mapping database were carried out in a manner that was consistent with EPA requirements for the environmental surveying and reporting of flora and vegetation in Western Australia, including:

- *Terrestrial Biological Surveys as an Element of Biodiversity Protection. Position Statement No. 3* (EPA 2002); and
- *Guidance for the Assessment of Environmental Factors: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia No. 51* (EPA 2004).

Flora and vegetation surveys conducted post-2010 are also in accordance with BHP Billiton Iron Ore's *Guidance for Flora and Vegetation Surveys in the Pilbara* (BHP Billiton Iron Ore 2013b).

3.2 Field Survey Methodology

Flora and vegetation surveys commissioned by BHP Billiton Iron Ore within its Pilbara tenements date back to 1984, with the majority of field work completed over the past decade. During this time numerous independent botanical consultants have been involved with the systematic collection of data, vegetation mapping and reporting, predominantly as part of BHP Billiton Iron Ore's mining approvals process.

Field surveys have typically implemented a systematic sampling procedure using bounded quadrats (study sites), with the procedure being consistent across most surveys since release of *Guidance Statement No. 51 - Assessment of Environmental Factors: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia* (EPA 2004).

Quadrats are generally 50 m by 50 m in dimension or an equivalent area (2,500 m^2) with this area now acknowledged as being standard for the Pilbara bioregion (EPA 2004). Surveys completed prior to 2004 assessed larger sized quadrats up to 100 m by 100 m (10,000 m^2), in line with methodology being used by the Conservation and Land Management Pilbara research programmes at that time (S. van Leeuwen *pers. comm.* 1995).

The number of study sites sampled is typically determined by the size and heterogeneity of the study area, with a minimum density of one quadrat per square kilometre preferred during recent years by BHP Billiton Iron Ore. There is large variation in sampling density between surveys collated within BHP Billiton Iron Ore tenure. The consolidated database supports raw data for a total of 8,214 study sites[3]. The locations of all quadrats reviewed are provided in Figure 4.

[3] This includes approximately 1,700 study sites located outside the study area, predominantly between Port Hedland and Yarrie. There are approximately 2,500 additional study sites (23% of the total number of study sites) within the study area where flora data does not comply with current collection methods.

Location of study sites (quadrats) reviewed as part of the
Consolidated Vegetation Mapping
Figure 4

ONSHORE ENVIRONMENTAL

0 2.5 5 10 15
Kilometers
1:350,000
Datum: GDA94

Department:	--	Date:	26/05/2014
Figure:	4	Status:	Draft

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Legend
- BHP Billiton Iron Ore tenements
- Study Boundary
- Pilbara Vegetation Extents
- Vegetation Sample Site

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The sampling sites have been assessed to provide a list of the total flora present, a description of the vegetation structure and composition, and additional site data covering a range of environmental parameters including:

- landform and habitat;
- aspect;
- soil colour and soil type;
- rock type;
- slope (angle);
- percentage of bare ground, logs, twigs and leaves;
- vegetation condition;
- disturbance (caused by fire, clearing, grazing etc);
- age since fire;
- broad floristic formation;
- vegetation association description; and
- height, form, presence of flowers, and percentage ground cover for individual plant taxa.

Other parameters recorded include:

- study site number and date of assessment;
- names of the botanists undertaking the assessment;
- brief description of the location, and waypoint record using a handheld GPS;
- quadrat dimensions; and
- photograph number.

3.3 Vegetation Mapping

Previous flora and vegetation surveys completed within BHP Billiton Iron Ore tenure mapped vegetation at various levels of detail, determined by factors including scope and objective, size of the study area, availability and quality of aerial imagery, sampling intensity and coverage of the study area, experience and interpretation of field botanists, and ability of GIS personnel to accurately digitise hard copy line work line work from field maps. The above variables have resulted in variation in the scale and accuracy of resultant vegetation maps across the tenure.

The variability posed challenges along project boundaries when merging vegetation polygon line work and consolidating vegetation associations between project areas. The different systems used to code vegetation associations further complicated the consolidation process. As a consequence, a resolution and reclassification of the vegetation association descriptions from previous surveys was required. The approach and methods are summarised below:

1. Vegetation mapping datasets from all previous flora and vegetation surveys were reviewed to determine existing map coverage, and rate the quality and accuracy of each dataset. A total of 81 surveys[4] were confirmed to support vegetation mapping (Appendix 2). The earlier surveys were typically completed

[4] A greater number of previous surveys with vegetation mapping do exist, but the older survey areas are generally smaller in size and have progressively been consolidated and updated as part of larger survey areas completed over recent years. This has occurred for a number of tenements surrounding Mining Area C in the central Pilbara.

over smaller areas and at more refined scales (generally 1:12,500 or less). In the past five years survey areas have increased significantly and the scale of vegetation mapping is typically in the order of 1:20,000.

2. Tenements and gaps between tenements where vegetation mapping has not previously been completed were identified and rationalised for field vegetation mapping as part of the current project. There were a number of tenements (or parts of) identified where vegetation mapping was absent. These include:
   - an un-named tenement at the north-west end of the Mainline Rail;
   - Roy Hill tenement (small disjunct areas of the larger lease previously mapped);
   - Fortescue Valley tenement (a large tenement covering a large proportion of the Fortescue Marsh);
   - a small area situated between the Marillana tenement and the Mainline Rail;
   - the western fringe of the Mudlark Well tenements occurring within Karijini National Park;
   - Rocklea;
   - a portion of Orebody 39;
   - Orebody 19;
   - Ninga;
   - Un-named tenement south of Myopic;
   - east of Orebody 35; and
   - fringes of the Prairie Downs tenement.
3. Differences in vegetation mapping for overlapping datasets (i.e spatial anomalies between datasets) were resolved along project boundaries where possible. Changes to individual polygon boundaries were only made following a review of raw data within the datasets and reference to aerial imagery. Where resolution could not be made either with confidence, or without distorting the larger database, no changes were made. The scope of works did not provide for additional detail in vegetation polygon line work to be added where existing detail in previous survey areas was lacking[5]. There is an opportunity for BHP Billiton Iron Ore to refine vegetation mapping within these areas through ongoing field surveys.
4. The quality of vegetation mapping data for each tenement was assessed and rated using a three point classification (Table 2) made on the basis of mapping scale, line work accuracy, and data (attribute) detail.

Table 2 Classification system used to assess the accuracy of vegetation mapping completed in BHP Billiton Iron Ore tenure.

Data Quality	Description
Fine-scale	Vegetation has been mapped at a scale of 1:20,000 or less, vegetation polygon line work differentiates all shading patterns evident on high quality aerial photography, and vegetation descriptions and other attribute detail is accurate
Broad-scale	The detail and accuracy of vegetation polygon line work and vegetation association description requires revision to provide consistency with tenements currently mapped at fine-scale
Absent	No vegetation mapping completed

[5] Relevé vegetation descriptions are often made to increase the accuracy of vegetation mapping but for the majority of reports this data was not available to review.

5. Vegetation associations from previous vegetation mapping were reviewed in detail to identify similar units across different surveys. These were tabulated into a 'survey by vegetation association' matrix. There were a number of the more widely represented vegetation associations that were consolidated with a high degree of confidence. However, variability in methodology between surveys contributed to lesser confidence levels for a number of the vegetation associations. In these cases a broader level of vegetation classification was used to accommodate for the fine-scale differences. In some cases, this resulted in the merging of vegetation associations from the same study area.
6. For a majority of the surveys completed prior to 2004 there was inconsistency in the method used to record structural and floristic parameters such as plant height, foliage cover, and species dominance. For many surveys there was no referenced vegetation classification system used to describe and map vegetation associations and general inconsistency in the classification system used between surveys. Examples of classification systems used include:
    - Specht (1970);
    - Beard (1975);
    - Muir (1977);
    - Aplin (1979);
    - Heddle *et al. (*1980);
    - Keighery (1994); and
    - National Vegetation Information System (NVIS) (ESCAVI 2003).

    In 2010 BHP Billiton Iron Ore implemented a standardised vegetation classification system for use in the Pilbara (Appendix 3). The classification was based on Specht (1970) with modification by Aplin (1979) and Trudgen (2009), and endorsed by DPaW in 2009 (van Leeuwen 2009). Vegetation associations from surveys completed prior to 2010 were transcribed during the review process to conform to BHP Billiton Iron Ore's preferred classification system (BHP Billiton Iron Ore 2013b), which is equivalent to the level of "association" or Level V of the National Vegetation Information System (NVIS) classification framework[6]. In instances where vegetation descriptions did not adhere to any referenced vegetation classification system, it was often necessary to refer to the raw floristic data to interpret the dominant taxa and structural layers that could then be described according to BHP Billiton Iron Ore terminology. This applied to the majority of surveys completed prior to 2010.
7. A unique code was applied to each new vegetation association. The codes comprised a two letter capital prefix to indicate the landform (HC = hill crests and upper hill slopes, GG = gorges and gullies, HS = hill slopes and low undulating hills, FS = footslopes, SP = stony plains, GR = granite outcrops and rockpiles, FP = flood plains, SD = sand dunes, CP = calcrete plains, MI = minor drainage lines, ME = medium drainage lines, MJ = major drainage lines, GP = gilgai plains, SF = saline flats and marsh)[7], followed by a sequence of two or three letter codes (capital and up to two lower case letters) reflecting the dominant plant taxa. Spaces between plant taxon codes reflect vegetation strata, with a maximum of three strata represented in each code. A maximum

[6] Level V of the NVIS Information Hierarchy, or association level, comprises the dominant growth form, height, cover and species (up to 3 species) for the three traditional strata (i.e. upper, mid and ground). http://www.environment.gov.au/erin/nvis/publications/avam/section-2-1.html#hierarchy

[7] Landform categories were developed by Onshore Environmental on the basis of extensive in-field knowledge of the entire consolidated vegetation mapping area, and records made from formal study sites by consultants over an extended period of sampling.

of three taxa were represented within each stratum. Each vegetation unit was given a unique code, a string of mixed capital and lowercase letters, representing the dominant species of the tallest strata to the shortest strata. The abbreviation comprised the first letter (capital) representing the genus, followed by the species name represented as two (or in some cases three) letters to ensure a unique code. For example, the code 'HC Tbr AiAmm' represents the vegetation association 'Closed Hummock Grassland of *Trioida brizoides* with Scattered Tall Shrubs of *Acacia inaequilatera* and *Acacia marramamba* on red sandy loam on hill crests'.

8. The consolidated vegetation map was created using ArcView GIS software, with point locations of study sites, conservation significant flora and weeds added subsequently. The GIS templates have been produced in ESRI File Geodatabase format.

3.4 Significant Plant Taxa

The location of current Threatened Flora (T) and Priority flora taxa (Appendices 4 and 5) recorded during previous surveys incorporated as part of the consolidated vegetation mapping database were collated[8]. The database provides the distribution of significant plant taxa within the study area. The current database is not exhaustive as it may not include additional records from targeted rare surveys not reviewed as part of the consolidated vegetation mapping database. The 42 targeted significant flora surveys that were not reviewed as part of the current project are listed in Appendix 6. These targeted survey areas provided no additional vegetation mapping data for the project.

3.5 Introduced Weed Taxa

The location of introduced weed taxa recorded during previous surveys incorporated as part of the consolidated vegetation mapping database were collated. The database provides the distribution of introduced species within the study area. The current database is not exhaustive as it may not include additional records from targeted weed surveys not reviewed as part of the consolidated vegetation mapping database. The eleven targeted weed surveys that were not reviewed as part of the current project are listed in Appendix 7. These targeted survey areas provided no additional vegetation mapping data for the project.

3.6 Vegetation Condition

There are many varying definitions for vegetation condition. Vegetation in good condition for one purpose (e.g. conservation) may be considered in poor or degraded condition for other purposes (e.g. grazing of domestic stock). Hence, there are many different approaches used to describe vegetation condition, and each definition will vary with context.

Vegetation condition has been assessed at the majority of study sites (quadrats) sampled during previous flora and vegetation surveys, with two similar rating scales. The first system was a five point condition scale utilised primarily by Ecologia Environment. The more recent system is a six point rating scale (Keighery 2004, see Appendix 8) that has now been adopted by BHP Billiton Iron Ore in the guidance

[8] Rare flora records from the DPaW database were reviewed prior to individual tenements being surveyed.

statement for flora and vegetation surveys (BHP Billion Iron Ore 2013b). The Ecologia Environment rating scale was adapted during raw data entry entry to reflect the six categories defined by Keighery (1994) (Table 3). The resultant vegetation condition map was compiled at the survey level, i.e. detail in vegetation condition maps for each survey was retained in the consolidated database, in preference to assigning consolidated vegetation associations an "averaged" rating score.

Table 3 Adaptation of vegetation condition rating between the Ecologia Environment and Keighery (2004) classification systems.

Ecologia Environment		Keighery 1994	
Pristine	Vegetation pristine; no disturbance evident at all.	Pristine	Pristine or nearly so, no obvious signs of disturbance.
Excellent	Strata essentially intact: some signs of human non-native disturbance; e.g. feral scats, litter, minor tracks.	Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
N/A	N/A	Very Good	Vegetation structure altered; obvious signs of disturbance.
Good	One or more strata significantly impacted; e.g. grazing, some weeds, some vegetation removal.	Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it.
Poor	One or more strata severely impacted; e.g. dense weed invasion, substantial clearing or tracks.	Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching Very Good condition without intensive management.
Degraded	Native vegetation largely or totally removed	Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species.

3.7 Raw Data and Spatial Data Presentation

Since 2010, BHP Billiton Iron Ore has provided guidance for the provision of biological survey data, including raw data and spatial data (BHP Billiton Iron Ore 2013a). Prior to 2010 methods of providing raw data varied between contractors, and in many cases was not provided at all. Data for the current project has been provided under the preferred BHP Billiton Iron Ore format at commencement of the project (SPR-IEN-EMS-015, Issue No. 2.0, 28/04/2011, BHP Billiton Iron Ore 2013a). It is noted that data provision guidelines are continually being updated and at February 2014 the format has been further refined (SPR-IEN-EMS-015, Issue No. 3.10, 22/10/2013).

3.7.1 Raw Data

Raw data is considered to be the data collected as part of the field survey work before being entered into a GIS. This information is collected in spreadsheet format. All raw survey data is entered in Microsoft Excel format into BHP Billiton Iron Ore's Western Australia Projects Biological Survey Data Templates (FRM-IEN-EMS-002) (BHP

Billiton Iron Ore 2013c). There are a number of mandatory fields in the spreadsheet template for flora and vegetation surveys. For the consolidated project, raw data for surveys completed pre-2010 was often not recorded for a number of the mandatory fields, and hence these were left blank or only partially filled. This was identified as a limitation of the project.

3.7.2 Spatial Data

All GIS data is associated with metadata in ESRI ISO format (*.xml format) recorded in the Geocentric Datum of Australia 1994 (GDA94) in decimal degrees (Longitude, Latitude) with an accuracy to five decimal points. The following tags have information entered into them where available:

- date the data was created;
- capture scale (GPS accuracy, or digitised scale, i.e. GPS5m or 25k, 250k, etc.);
- method of capture (e.g. GPS track, digitised mapping, digital field mapping);
- abstract;
- metadata author – data creator;
- point of contact 1 – Person and his/her details who is suppling the data;;
- point of contact 2 – delivery contact name and department at BHP Billiton Iron Ore;
- dataset history – how the data has been created or captured (i.e. manually digitised, imported .xls file, uploaded GPS waypoints, etc.;
- data themes or categories – select relevant themes or categories;
- key words – enter key words associated with the dataset, eg. flora; and
- title – clear title describing the dataset.

Raw data has been entered into five feature classes:

- vegetation mapping;
- sample sites;
- flora;
- significant flora; and
- weeds.

The attributes associated with each feature class are listed in Appendix 9.

4.0 RESULTS AND DISCUSSION

This section outlines the vegetation associations that were described and mapped from within the study area. Description of the physical environment, including landform and soil type, was incorporated into the vegetation descriptions. The accuracy of project data consolidated in the vegetation map was presented as a three point rating scale (Table 2).

Vegetation condition was mapped independently of the consolidated vegetation associations and at a tenement level in order to capture the spatial changes evident within vegetation associations across the study area (Table 3).

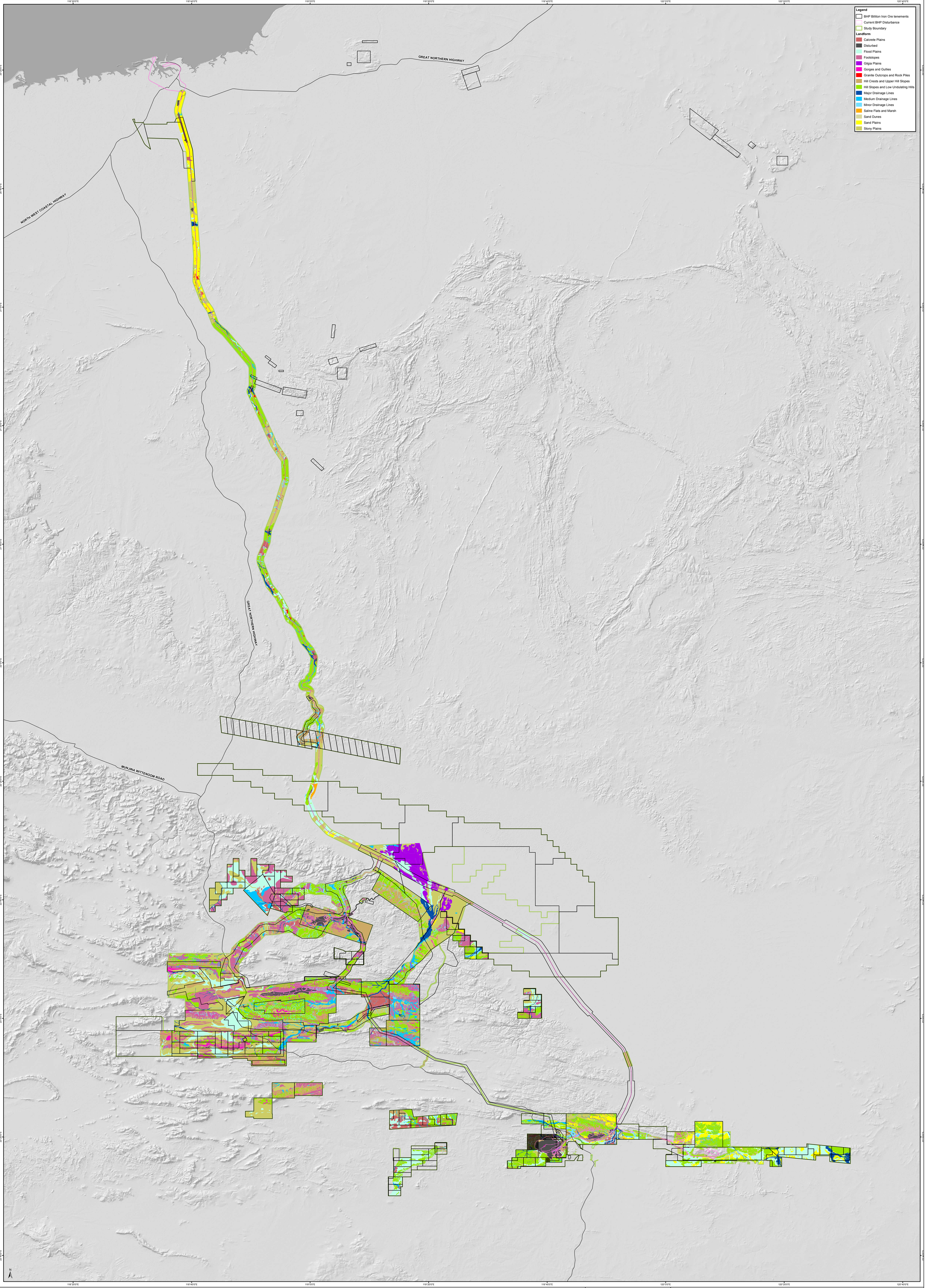
The distribution of formal study sites (quadrats) utilised as an integral component of the vegetation mapping process are presented, along with the significant flora and introduced weed taxa records, as part of the consolidated database.

4.1 Vegetation Mapping

Vegetation associations within the study area were classified under 15 landform types, with between one and 50 vegetation associations occurring within each landform (Table 4). The distribution of the 15 landforms is presented as Figure 5. Flood plains (50 vegetation associations), hills slopes and low undulating hills (44 vegetation associations) and stony plains (24 vegetation associations) supported the highest number of vegetation associations. Hill slopes and low undulating hills (24%), stony plains (19%), footslopes (12%), flood plains (12%), and hill crests and upper hill slopes (10%) were the dominant landforms represented by area (Table 4).

Table 4 Landforms under which vegetation associations within the study area were classified.

Code	Landform	No. Vegetation Associations	Area (ha)	% of Study area
HC	Hill Crests and Upper Hill Slopes	16	43,072	10.0
GG	Gorges and Gullies	7	6,713	1.6
HS	Hill Slopes and Low Undulating Hills	44	101,348	23.6
FS	Footslopes	3	50,668	11.8
SP	Stony Plains	24	82,990	19.3
GR	Granite Outcrops and Rockpiles	2	619	0.1
FP	Flood Plains	50	50,356	11.7
SD	Sand Dunes	1	62	0.01
SA	Sand Plains	15	18,928	4.4
CP	Calcrete Plains	3	11,175	2.6
MI	Minor Drainage Lines	15	11,669	2.7
ME	Medium Drainage Lines	13	17,757	4.1
MA	Major Drainage Lines	16	10,509	2.4
GP	Gilgai Plains	5	10,076	2.3
SF	Saline Flats and Marsh	2	461	0.1
	Cleared / Disturbed	2	13,220	3.1



ONSHORE ENVIRONMENTAL

Overview of broad landforms described as part of the Consolidated Vegetation Mapping

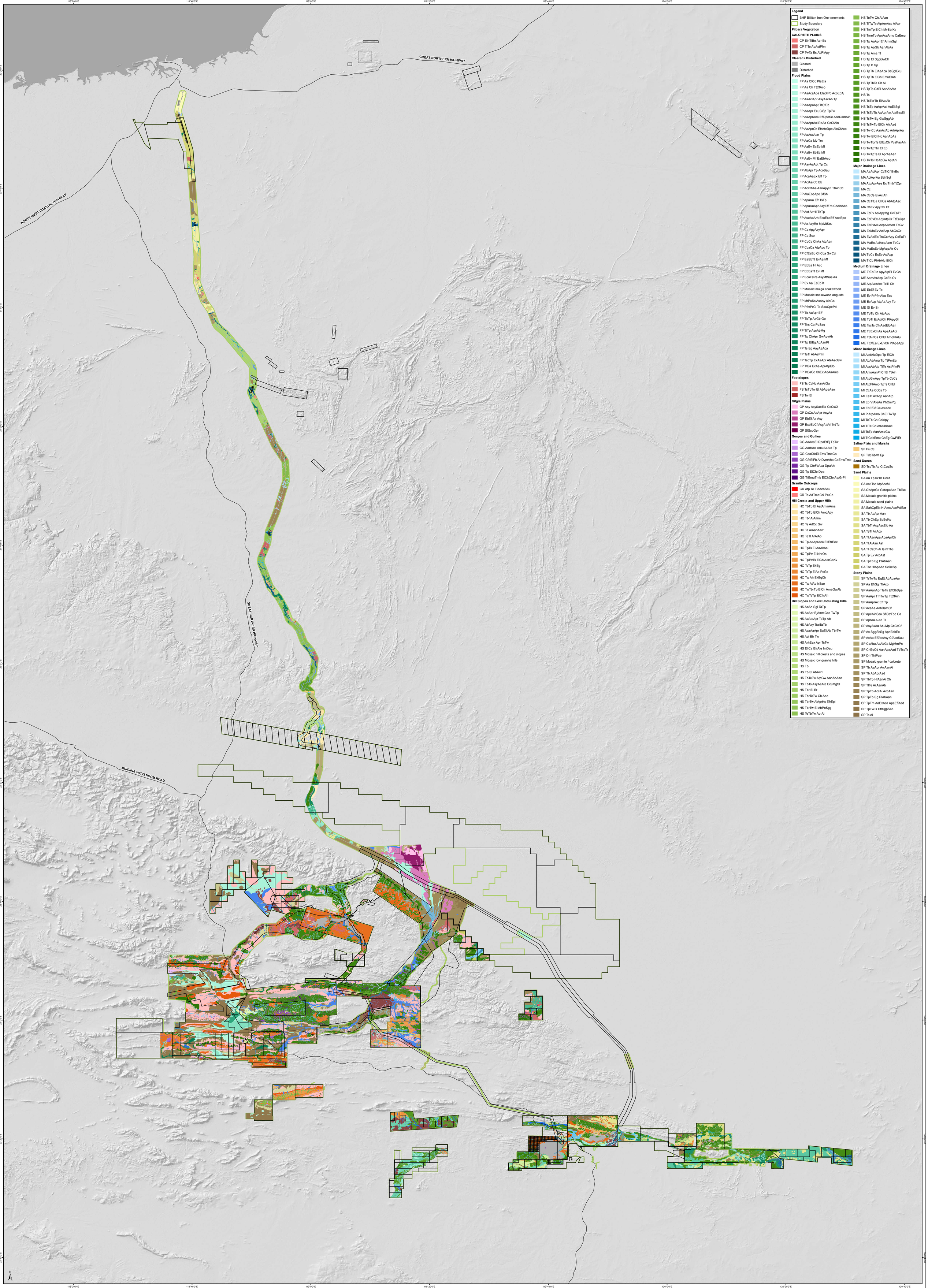
Figure 5

0 2.5 5 10 15
Kilometers
1:350,000
Datum: GDA94

Department:	--	Date:	29/04/2014
Figure:	5	Status:	Draft
Drawn by: GSM	Requested by: Job	Internal Reference: CMP_Landforms_Types	Sheet Size: A0

A total of 218 vegetation associations classified under 53 broad floristic formations were described and mapped from within the study area during this phase of the consolidated mapping project (Appendix 10, Figure 6). It is likely that a number of the vegetations associations can be further consolidated or refined, particularly associations that occur over relatively small areas. Further consolidation and refinement of the vegetation mapping will be undertaken during ongoing field surveys.

Some vegetation polygons were difficult to consolidate, especially for areas where the current line work had not captured the fine scale variability for vegetation associations present. In these cases, the resultant vegetation association was referred to as a mosaic pattern (generally of two or more associations). Mapping of these areas will also be refined through ongoing field surveys.


118°20'0"E
118°40'0"E
119°0'0"E
119°20'0"E
119°40'0"E
120°0'0"E
120°20'0"E
120°40'0"E
20°0'0"S
20°20'0"S
20°40'0"S
21°0'0"S
21°20'0"S
21°40'0"S
22°0'0"S
22°20'0"S
22°40'0"S
23°0'0"S
23°20'0"S
23°40'0"S
GREAT NORTHERN HIGHWAY
NORTH WEST COASTAL HIGHWAY
GREAT NORTHERN HIGHWAY
MUNJINA WITTENOOM ROAD
N
Legend
BHP Billiton Iron Ore tenements
Study Boundary
Pilbara Vegetation
CALCRETE PLAINS
CP EinTlBe Apr Es
CP TlTe AbAstPfm
CP TwTa Es AbPlApy
Cleared / Disturbed
Cleared
Disturbed
Flood Plains
FP Aa CfCc PlaEla
FP Aa Ch TtCfAco
FP AaAcaApa ElaSlPo AcoEdAj
FP AaAciApr AsyAscAb Tp
FP AaApaApt TtCfEb
FP AaApr EcuClSp TpTw
FP AaAprAca EffDpeSe AcoDamAin
FP AaAprAci ReAa CcCfAin
FP AaAprCh EfrAteDpe AinCfAco
FP AaAscAan Tp
FP AaCa Mv Tm
FP AaEv EaEb Mf
FP AaEv EbEa Mf
FP AaEv Mf EaEbAco
FP AayAaApt Tp Cc
FP AbApr Tp AcoSau
FP AcaAaEx Eff Tp
FP AciAa Cc Bb
FP AciChAa AanApyPl TtAinCc
FP AlaEseApe SfSh
FP ApaAa Efr TsTp
FP ApaAaApr AsyEffPo CcAinAco
FP Ast AtrHl TbTp
FP AsuAaArh EcoEcaEff AcoEpo
FP Ax AsyRe MpMtScu
FP Cc ApyAsyApr
FP Cc Sco
FP CcCs ChAa AtpAan
FP CcaCa AtpAcc Tp
FP CfEaEo ChCca GwCci
FP EaEbTt EvAa Mf
FP EbEa Hl Acc
FP EbEaTt Ev Mf
FP EcuFsRe AsyMtSas Aa
FP Ev Aa EaEbTt
FP Mosaic mulga snakewood
FP Mosaic snakewood angusta
FP MtPoSc AxAsy AinCc
FP PfmPrCl Ta SauCpePd
FP Tb AaApr Eff
FP TbTp AaGb Go
FP Ths Ca PoSau
FP TlTp AscAbMg
FP Tp ChApr GwApyAb
FP Tp EtEg AbAanPl
FP Ts Eg AayAaAca
FP TsTl AbAsPfm
FP TscTp ExAaApr AteAscGw
FP TtEa ExAa AprAtpElo
FP TtEaCc ChEx AdAaAmc
Footslopes
FS Ts CdHc AanAiGw
FS TsTpTw El AbApaAan
FS Tw El
Gilgia Plains
GP Asy AsySaoEla CcCsCf
GP CcCs AaApr AsyAa
GP EbEf Aa Asy
GP ExeEbCf AsyAteVf NdTc
GP SfScoGpr
Gorges and Gullies
GG AaAcaEl DpaEtEj TpTw
GG AadAca AmuAaAte Tp
GG CcoCfeEl EmuTmbCa
GG CfeElFb AhDvmAha CaEmuTmb
GG Tp CfeFbAca DpaAh
GG Tp ElCfe Dpa
GG TtEmuTmb ElChCfe AtpGrPl
Granite Outcrops
GR Atp Te TloAcoSau
GR Te AdTmaCci PclCc
Hill Crests and Upper Hills
HC TbTp El AatAmmAma
HC TbTp ElCh AmoApy
HC Tbr AiAmm
HC Te AdCc Gw
HC Te AiAanAarr
HC TeTl ArAiAb
HC Tp AaAprAca ElIEfrEex
HC TpTs El AaAkAsi
HC TpTw El NhrOs
HC TpTwTs ElCh AarGoKv
HC TsTp EkEg
HC TsTp ElAa PcGs
HC Tw Ah EkEgCh
HC Tw AiAb IrSao
HC TwTbrTp ElCh AmaGwAb
HC TwTsTp ElCh Ah
Hill Slopes and Low Undulating Hills
HS AaAh Sgl TaTp
HS AaApr EjAmmCco TwTp
HS AaAteApr TaTp Ab
HS AbAsy TseTaTb
HS AcaAaApr SaElIAb TbrTw
HS Aci Efr Tw
HS ArhEex Apr TsTw
HS ElICa EfrAte ImDau
HS Mosaic hill crests and slopes
HS Mosaic low granite hills
HS Tb
HS Tb El AbAiPl
HS TbTeTw AtpGw AanAbAac
HS TbTs AsyAaAte EcuMgSl
HS Tbr El Er
HS TbrTeTw Ch Aac
HS TbrTw AiAprHc EfrEpl
HS TbrTw El AbPoSgg
HS TeTbTw AorAi
HS TeTw Ch AiAan
HS TlTwTe AtpAerAcc AiAor
HS TmTp ElCh MvSarKv
HS TmeTp AprAcaAmu CaEmu
HS Tp AaApr EfrAmmSgl
HS Tp AaGb AanAbAa
HS Tp Ama Tt
HS Tp El SggGwEll
HS Tp Ir Gp
HS TpTb ElAaAca SsSglEcu
HS TpTb ElCh EmuElAh
HS TpTbTe Ch Ai
HS TpTs CdEl AanAbAte
HS Ts
HS TsTbrTb ElAa Ab
HS TsTp AaAprAci AaEllSgl
HS TsTpTb AaAprAw AteEexEll
HS TsTw Eg GwSggAb
HS TsTwTp ElCh AhiAad
HS Tw Cd AarAsiAb ArhAprAa
HS Tw ElChHc AanAbAa
HS TwTbrTs ElExCh PcaPasAhi
HS TwTpTbr El Ep
HS TwTpTs El AprAaAan
HS TwTs HcAbGw AptAhi
Major Drainage Lines
MA AaAciApr CcTtCf EvEc
MA AciAprAa SahSgl
MA AtpApyAse Ec TmbTtCpr
MA Cc
MA CcCs EvAciAh
MA CcTtEa ChCa AbAtpAsc
MA ChEv ApyCci Cf
MA EcEv AciApyMg CcEaTt
MA EcEvEx ApyAtpGr TtEaCpr
MA EcEvMa AcpAamAh TdCv
MA EcMaEv AciAcp AbGsGr
MA EvAciEc TrcCcrApy CcEaTt
MA MaEc AciAcpAam TdCv
MA MaEcEv MgAcpAtr Cv
MA TdCv EcEv AciAcp
MA TtCc PlAbAlu ElCh
Medium Drainage Lines
ME TtEaEte ApyAtpPl EvCh
ME AamAtrAcp CcEb Cv
ME AtpAanAcc TeTl Ch
ME EbEf Ev Te
ME Ev PrPfmAbu Ecu
ME EvAcp AtpAtrApy Tp
ME Gl Ev Sn
ME TpTb Ch AtpAcc
ME TpTl ExAciCh PlApyGr
ME TscTs Ch AadEloAan
ME Tt ExChAa ApaAaAci
ME TtAinCa ChEl AmoPlAlu
ME TtCfEa ExEvCh PlApaApy
Minor Draiange Lines
MI AadAluDpa Tp ElCh
MI AbAdAma Tp TfPmEa
MI AccAbAtp TlTe AstPfmPt
MI AmoAanPl ChEl TtAin
MI AtpGwApy TpTb CcCs
MI AtpPlAmo TpTs ChEl
MI CcAa CcCs Tb
MI EaTt AxAcp AanAtp
MI Eb VfAteAa PhCmPg
MI EbEfCf Ca AtrAcc
MI PlAtpAmo ChEl TwTp
MI TeTb Ch CciApy
MI TlTe Ch AtrAanAac
MI TsTp AanAmoGw
MI TtCobEmu ChEg GwPlEt
Saline Flats and Marshs
SF Fs Cc
SF TdcTibMf Ep
Sand Dunes
SD TscTb Ad CtCcuSc
Sand Plains
SA Aa TpTwTb CcCf
SA Ast Tsc AtpAccMl
SA ChAprGs GstApaAan TbTsc
SA Mosaic granitic plains
SA Mosaic sand plains
SA SahCpEla HlAmc AcoPclEar
SA Tb AaApr Aan
SA Tb ChEg SpBeKp
SA TbTl AsyAscElo Aa
SA TeTl Ai Aco
SA Tl AanApa ApaAprCh
SA Tl AiAan Ast
SA Tl CzCh Ai IaImTbc
SA Tp Ev AccAst
SA TpTb Eg PlAbAan
SA Tsc HlApaAd ScDcSp
Stony Plains
SP TsTwTp EgEt AbApaApr
SP Aa EfrSgl TtAco
SP AaAanApr TeTs EffGbDpe
SP AaApr TmTwTp TtCfAin
SP AaAprAx Eff Tp
SP AcaAa AobDamCf
SP ApeAinSau SfiCtrTbc Oa
SP AprAa AiAb Ts
SP AsyAxAa AbuMp CcCsCf
SP Ax SggSbSg ApeEobEx
SP AxAa EffAteAsy CfAcoSau
SP CcAbu AaAbGs MgMmPn
SP ChEoCd AanApaAad TbTscTs
SP DrhThiPae
SP Mosaic granite / calcrete
SP Tb AaApr AwAanAi
SP Tb AbAprAad
SP TbTp HlAanAi Ch
SP TlTe Ai AanAb
SP TpTb AccAi AccAan
SP TpTb Eg PlAbAan
SP TpTm AaExAca ApaEffAad
SP TpTwTs EfrSgpSao
SP Ts Ai
0 2.5 5 10 15
Kilometers
1:350,000
Datum: GDA94
ONSHORE ENVIRONMENTAL
Vegetation association map for BHP Billiton Iron Ore's tenements
Figure 6
Department: –
Date: 26/05/2014
Figure: 6
Status: Draft
Drawn by GSM
Requested by DB
Internal Reference Pilbara Vegetation
Sheet Size A0

4.2 Vegetation Data Integrity

The quality of vegetation mapping data for each tenement was assessed and rated using a three point classification (Table 2) made on the basis of mapping scale, line work accuracy, and data (attribute) detail.

Vegetation mapping was predominantly rated as 'fine-scale', particularly for northern and central sectors of the study area (Figure 7). Fine-scale vegetation mapping has been completed over 53 percent of the study area. The longer term aim of the consolidated mapping project is to have fine scale mapping coverage for all BHP Billiton Iron Ore tenure.

There were 12 tenements (or part of tenements) where vegetation mapping data could not be sourced and so was classified as 'absent' (Table 5). These areas covered 38 percent of the study area (Figure 7).

There were eight tenements (or part of tenements) where existing vegetation mapping quality was rated as 'broad-scale', i.e. the detail and accuracy of vegetation polygon line work and vegetation association description requires revision to provide consistency with tenements currently mapped at fine-scale (Table 5). These areas covered nine percent of the study area (Figure 7).

Table 5 BHP Billiton Iron Ore tenements where vegetation mapping is either absent or existing quality is not to required standard (broad-scale).

Data Integrity	Tenement
Absent	Un-named tenement at the north-west end of the Mainline Rail
Absent	Roy Hill tenement (small disjunct areas of the larger lease previously mapped)
Absent	Fortescue Valley tenement (tenement covering a substantial proportion of the Fortescue Marsh)
Absent	A small area situated between the Marillana tenement and the Mainline Rail
Absent	The western fringe of the Mudlark Well tenements occurring within Karijini National Park
Absent	A portion of Orebody 39
Absent	Orebody 19
Absent	Ninga
Absent	Un-named tenement south of Myopic
Absent	East of Orebody 35
Absent	Fringes of the Prairie Downs tenement
Absent	Rocklea
Broad-scale	Upper Marillana and Munjina
Broad-scale	Ministers North
Broad-scale	Gurinbiddy (south-western sector)
Broad-scale	Caramulla
Broad-scale	South West Jimblebar
Broad-scale	Orebody 31
Broad-scale	Myopic (northern sector)
Broad-scale	Ophthalmia

Finucane
Port Hedland
Redbank
Wedgefield
Boodarie
Ider
De Grey
Pardoo
Strelley
Marble Bar
Nullagine
Wittenoom
Karijini
Karijini National Park
Juna Downs
Newman

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ONSHORE ENVIRONMENTAL

Integrity of vegetation mapping for
BHP Billiton Iron Ore's tenements.

Figure 7

0 2.5 5 10 15
Kilometers
1:350,000
Datum: GDA94

Department:	--	Date:	26/05/2014
Figure:	7	Status:	Draft
Drawn by: GSM	Requested by: DB	Internal Reference: Pilbara Integrity	Sheet Size: A0

Legend

- BHP Billiton Iron Ore tenements
- Study Boundary

Data Integrity

- Absent
- Broad Scale
- Fine Scale

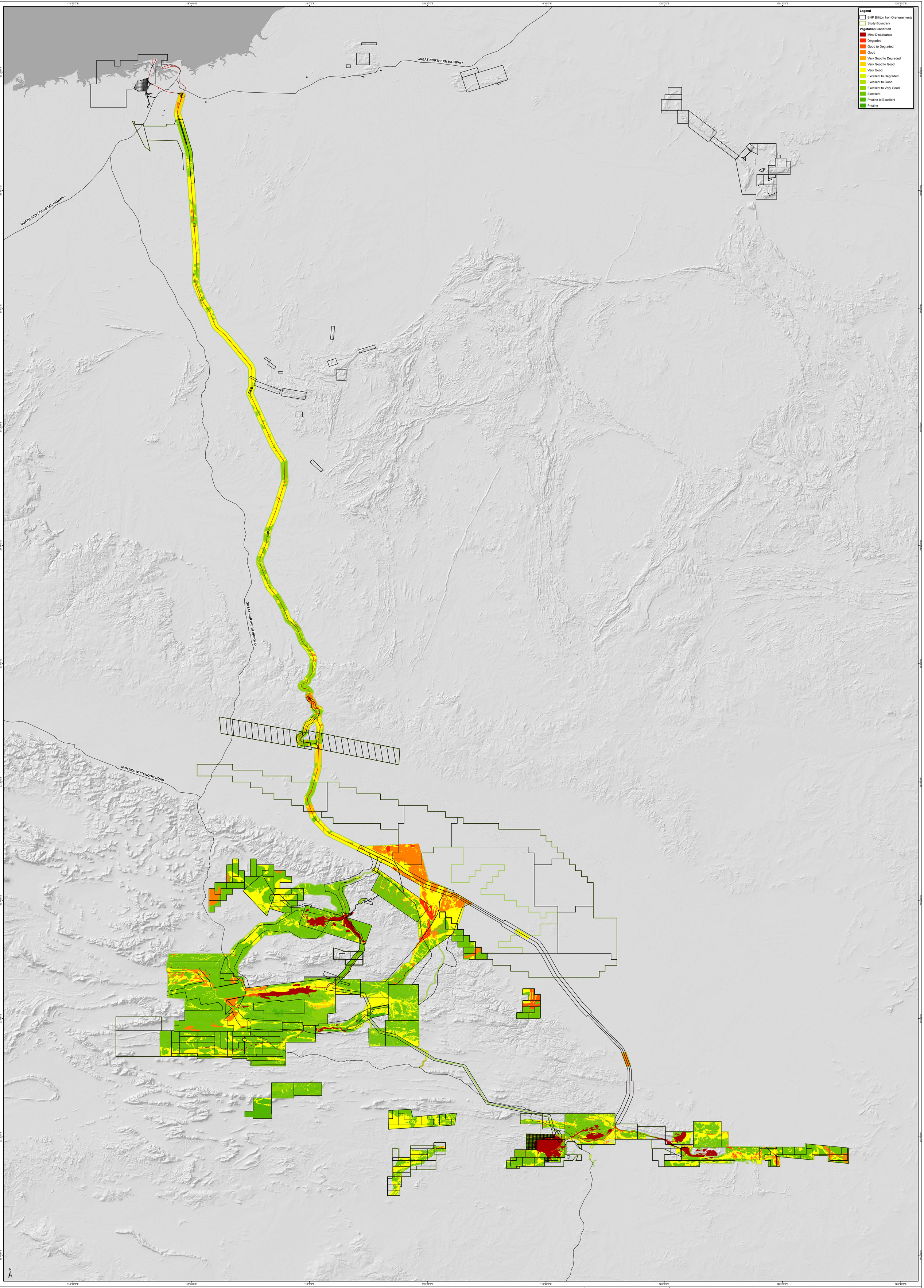
4.3 Vegetation Condition

Vegetation condition for BHP Billiton Iron Ore's eastern and central Pilbara tenure, situated broadly south of the Marillana lease, was predominantly rated in the two top categories of 'pristine' or 'excellent' (Figure 8). A smaller proportion of the area was rated in the lesser categories of 'very good', 'good', degraded' and 'completely degraded' (Figure 8). The southern tenure occurs within the Hamersley Range, with a large proportion of the area occurring on elevated landforms including steep to precipitous cliffs, gorges and gullies, range and hill crests, upper scree slopes and hill slopes. These elevated landforms are generally distanced from the common disturbances observed lower in the landscape, particularly access tracks, grazing by domestic stock and associated introduction of weeds. Vegetation at elevated points of the landscape also supporting less palatable spinifex hummock grass covers. Vegetation rated as pristine was generally restricted to narrow upper gorge habitats which had been protected from fire for prolonged periods and were difficult to access on foot. Vegetation condition was rated as excellent for a larger group of vegetation associations, with minor disturbances typically related to wildfire, scattered weeds and access tracks.

Vegetation with reduced condition generally occurred in areas of lower relief that supported palatable grasses, reliable water supply and shelter for domestic cattle. Habitats included ephemeral drainage lines (of all sizes), flood plains, stony plains and gilgai plains. These landforms were common north of the Marillana tenement, associated with outwash plains of Weeli Wolli Creek and the adjacent Fortescue River Basin, and extending north along the Mainline Rail and intercepting the upper catchment of Yule River and Turner River. Vegetation condition within this northern sector of BHP Billiton Iron Ore's central Pilbara tenements was predominantly very good to good (Figure 8).

Pastoral impacts in areas of lower relief contributed to the most noticeable reduction in vegetation condition. Direct impacts were related to grazing by domestic cattle and included reduction in native plant species richness, trampling of ground vegetation and pugging of surface soils, and introduction of weed species. Vegetation condition was always severely impacted around stock watering points.

Wildfire was another major factor influencing vegetation structure and composition, with high fire intensity and short fire interval both negative factors. Other common disturbances recorded were the presence of access tracks, rail line and service roads, the Great Northern Highway (and edge effects), borrow pits and power transmission lines and associated infrastructure.



ONSHORE ENVIRONMENTAL

Vegetation condition map for BHP Billiton Iron Ore's tenements

Figure 8

0 2.5 5 10 15
Kilometers
1:350,000
Datum: GDA94

Department:	--	Date:	01/05/2014
Figure:	8	Status:	Draft

Drawn by	Requested by	Internal Reference	Sheet Size
CrSw	DB	Pilbara Veg Cond	A0

4.4 Conservation Significant Vegetation

One vegetation community in the study area is currently listed as a State listed Threatened Ecological Community (TEC):

- *Themeda* grasslands on cracking clays (Hamersley Station, Pilbara). Grassland plains dominated by the perennial *Themeda* (kangaroo grass) and many annual herbs and grasses (Vulnerable).

There were 30 Priority Ecological Communities (PECs) occurring within the Pilbara bioregion. Six of these PECs were represented within the study area:

- The Fortescue Marsh PEC (Priority 1);
- The Freshwater claypans of the Fortescue Valley (Priority 1);
- A sub-type of the PEC 'Four plant assemblages of the Wona Land System' described as 'Mitchell Grass *(Astrebla* spp.) on gilgai' (Priority 3iii);
- Weeli Wolli Spring Community (Priority 1);
- Fortescue Valley Sand Dunes (Priority 3);
- Two sub-types of the PEC 'Coolibah-lignum flats: *Eucalyptus victrix* over *Muehlenbeckia florulenta'* described as:
  - Coolibah *(Eucalyptus victrix)* woodland over Lignum (*Muehlenbeckia florulenta*) over Swamp Wandiree *(Eriachne benthamii)* (Priority 1) – Lake Robinson being the only known occurrence; and
  - Coolibah *(Eucalyptus victrix)* and Mulga (*Acacia aneura*) woodland over Lignum (*Muehlenbeckia florulenta***)** and tussock grasses on clay plains (Priority 3) - Coondewanna Flats being one of two known occurrences (the other being Wanna Munna Flats).

4.5 Conservation Significant Flora

There were 6,142 records for a total of 57 significant plant taxa recorded from within BHP Billiton Iron Ore tenements for this phase of the consolidated vegetation mapping (Figure 9), including one Threatened Flora, 14 Priority 1 flora taxa, 11 Priority 2 flora taxa, 26 Priority 3 flora taxa and four Priority 4 flora taxa (Table 6).

Lepidium catapycnon is listed as Threatened (Declared Rare) Flora under the Western Australia WC Act and Vulnerable under the Commonwealth EPBC Act. State conservation significant flora is provided in Table 6.

Table 6 Significant plant taxa recorded within BHP Billiton Iron Ore's tenements.

Genus	Species	subsp. / var.	SCC
Abutilon	sp. Pritzelianum (S. van Leeuwen 5095)		1
Acacia	*effusa*		3
Acacia	*kenneallyi*		3
Acacia	*subtiliformis*		3
Adiantum	*capillus-veneris*		2
Aristida	*jerichoensis*	var. *subspinulifera*	1
Aristida	*lazaridis*		2
Atriplex	*flabelliformis*		3
Brachyscome	sp. Wanna Munna Flats (S. van Leeuwen 4662)		1
Brunonia	sp. Long hairs (D.E. Symon 2440)		1
Bulbostylis	*burbidgeae*		4
Calotis	*latiuscula*		3

Genus	Species	subsp. / var.	SCC
Croton	*aridus*		3
Dampiera	*metallorum*		3
Eragrostis	*crateriformis*		3
Eragrostis	sp. Mt Robinson (S. van Leeuwen 4109)		1
Eremophila	*magnifica*	subsp. *magnifica*	4
Eremophila	*magnifica*	subsp. *velutina*	3
Eremophila	sp. West Angelas (S. van Leeuwen 4068)		1
Euphorbia	*clementii*		2
Euphorbia	*inappendiculata*	var. *inappendiculata*	2
Fimbristylis	? sp. H Kimberley Flora (Carr 3944 & Beauglehole 47722)		1
Fimbristylis	*sieberiana*		3
Gomphrena	*pusilla*		2
Goodenia	*lyrata*		3
Goodenia	*nuda*		4
Goodenia	sp. East Pilbara (A.A. Mitchell PRP727)		3
Grevillea	sp. Turee (J. Bull & G. Hopkinson ONS JJ 01.01)		1
Gymnanthera	*cunninghamii*		3
Heliotropium	*muticum*		1
Hibiscus	sp. Gurinbiddy Range (M.E. Trudgen MET 15708)		2
Indigofera	sp. Gilesii (M.E. Trudgen 15869)		3
Isotropis	*parviflora*		2
Josephinia	sp. Marandoo (M.E. Trudgen 1554)		1
Lepidium	*catapycnon*		T
Nicotiana	*umbratica*		3
Oldenlandia	sp. Hamersley Station (A.A. Mitchell PRP 1479)		3
Olearia	*mucronata*		3
Oxalis	sp. Pilbara (M.E. Trudgen 12725)		2
Phyllanthus	*aridus*		3
Pilbara	*trudgenii*		2
Pterocaulon	*intermedium*		3
Ptilotus	*mollis*		4
Rhagodia	sp. Hamersley (M. Trudgen 17794)		3
Rostellularia	*adscendens*	var. *latifolia*	3
Rothia	*indica*	subsp. *australis*	1
Sida	sp. Barlee Range (S van Leeuwen 1642)		3
Solanum	*kentrocaule*		3
Spartothamnella	*puberula*		2
Stylidium	*weeliwolli*		2
Swainsona	*thompsoniana*		3
Tephrosia	*rosea*	var. Port Hedland (A.S. George 1114)	1
Themeda	sp. Hamersley Station (M.E. Trudgen 11431)		3
Triodia	sp. Karijini (S. van Leeuwen 4111)		1
Triodia	sp. Mt Ella (M.E. Trudgen 12739)		3
Vittadinia	sp. Coondewanna Flats (S. van Leeuwen 4684)		1

SCC denotes State Conservation Code (WC Act)

118°20'0"E
118°40'0"E
119°0'0"E
119°20'0"E
119°40'0"E
120°0'0"E
120°20'0"E
120°40'0"E
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22°0'0"S
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23°20'0"S
23°40'0"S

Pt Dey
Port Hedland
Redbank
Woodstock
Goodiarrie
Strelley
Roebourne
GREAT NORTHERN HIGHWAY
NORTH WEST COASTAL HIGHWAY
Marble Bar
Nullagine
Wittenoom
MUNJINA WITTENOOM ROAD
Karijini
Newman
Capricorn

N

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ONSHORE ENVIRONMENTAL

Significant flora recorded within BHP Billiton Iron Ore's tenements

Figure 9

0 2.5 5 10 15
Kilometers
1:350,000
Datum: GDA94

Department:	--	Date:	26/05/2014
Figure:	9	Status:	Draft
Drawn by: GSM	Requested by: DB	Internal Reference: CMP_Sig_Flora	Sheet Size: A0

Legend

- BHP Billiton Iron Ore tenements
- Study Boundary
- Pilbara Vegetation Extents
- Significant Flora

4.6 Introduced Weeds

There were 6,698 records for a total of 56 introduced weed taxa recorded from within the study area (Table 7, Figure 10). Four of the weed taxa are considered to be large range extensions and may require further sampling to confirm identification. Seven of the 56 weed taxa are Declared Pests under the BAM Act (Table 7).

Table 7 Introduced flora recorded within BHP Billiton Iron Ore's tenements.

Genus	Species	subsp. / var.	Status
**Acetosa*	*vesicaria*		
**Aerva*	*javanica*		
**Agave*	*americana*		
**Alternanthera*	*pungens*		
**Argemone*	*ochroleuca*		DP
**Argemone*	*ochroleuca*	subsp. *ochroleuca*	DP
**Bidens*	*bipinnata*		
**Calotropis*	*procera*		DP
**Cenchrus*	*setaceus*		
**Cenchrus*	*setiger*		
**Chloris*	*barbata*		
**Chloris*	*virgata*		
**Citrullus*	*colocynthis*		
**Citrullus*	*lanatus*		
**Conyza*	*bonariensis*		
**Cucumis*	*melo*	subsp. *agrestis*	
**Cucumis*	*melo*		
**Cucumis*	*myriocarpus*		
**Cynodon*	*dactylon*		
**Cyperus*	*involucratus*		
**Datura*	*leichhardtii*		DP
**Digitaria*	*ciliaris*		
**Echinochloa*	*colona*		
**Eragrostis*	*curvula*		RE
**Flaveria*	*trinervia*		
**Gomphrena*	*celosioides*		
**Indigofera*	*oblongifolia*		
**Jatropha*	*gossypiifolia*		DP
**Lactuca*	*serriola*		
**Lactuca*	*serriola*	forma *serriola*	
**Malvastrum*	*americanum*		
**Melinis*	*repens*		
**Merremia*	*dissecta*		
**Parkinsonia*	*aculeata*		DP
**Passiflora*	*foetida*	var. *hispida*	
**Phoenix*	*dactylifera*		
**Physalis*	*angulata*		
**Polypogon*	*monspeliensis*		
**Portulaca*	*oleracea*		
**Rumex*	*crispus*		RE
**Schinus*	*molle*		RE
**Senna*	*occidentalis*		

Genus	Species	subsp. / var.	Status
**Setaria*	*verticillata*		
**Sigesbeckia*	*orientalis*		
**Sisymbrium*	*orientale*		
**Solanum*	*nigrum*		
**Sonchus*	*oleraceus*		
**Stylosanthes*	*hamata*		
**Symphyotrichum*	*squamatum*		
**Tamarindus*	*indica*		
**Tamarix*	*aphylla*		DP
**Trianthema*	*portulacastrum*		
**Tribulus*	*terrestris*		
**Vaccaria*	*hispanica*		RE
**Vachellia*	*farnesiana*		
**Washingtonia*	*filifera*		

DP denotes Declared Pest (BAM Act); RE denoted range extension.

Introduced flora recorded within BHP Billiton Iron Ore's tenements

Figure 10

ONSHORE ENVIRONMENTAL

0 2.5 5 10 15
Kilometers
1:350,000
Projection: MGA Zone 50 Datum: GDA94

Department:	--	Date:	26/05/2014
Figure:	10	Status:	Draft
Drawn by: GSM	Requested by: DB	Internal Reference: CMP_intro_flora	Sheet Size: A0

Legend

- BHP Billiton Iron Ore tenements
- Study Boundary
- Pilbara Vegetation Extents
- Weed Occurence

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5.0 Limitations

There were a number of limitations encountered during consolidation of the vegetation mapping dataset. These limitations are detailed in Table 8.

Table 8 Limitations identified during consolidation of the vegetation mapping dataset for BHP Billiton Iron Ore's tenements.

Parameter	Limitation	Management of Limitation	Future Requirements
Timing of field surveys	Vegetation mapping data consolidated as part of the current project was sourced from field survey work completed since 2004. At 2014 the data was up to ten years old and may have been influenced by multiple disturbance events over this period, most notably fire and grazing by domestic cattle. Vegetation associations occurring along the boundary of neighbouring tenements were often dis-similar owing to different successional stages present at the date of assessment.	Vegetation associations were described and mapped on the basis of composition and structure at the time of assessment.	Future baseline flora and vegetation surveys completed by BHP Billiton Iron Ore will aim to progressively update vegetation mapping for tenements of interest.
Number of study sites under-estimated	The initial scope of works estimated the number of study sites previously assessed within BHP Billiton Iron Ore's Pilbara tenure was estimated to be in the range 2,000 to 2,500. Following the gap analysis, the actual number was determined to be 8,417 study sites. The four-fold increase in the amount of raw data entered into the GIS data template resulted in the initial resource allocation for this task being significantly exceeded.	Raw data for the additional study sites was entered due to the critical nature of this data on downstream tasks.	None
Detail in raw data lacking	For the pre-2010 baseline surveys, raw data required for a number of fields within the current BHP Billiton Iron Ore GIS data template was typically absent.	Where missing data was not determined to be critical to the integrity of the consolidated vegetation mapping dataset, the baseline survey was included.	Although not critical, additional field surveys could be completed to record raw data for missing fields within the consolidated database. For a number of the missing fields raw data may be sourced from other databases and literature.

Parameter	Limitation	Management of Limitation	Future Requirements
Variability in scope and resources for previous baseline surveys	Previous flora and vegetation surveys mapped vegetation at various levels of detail, determined by factors including scope and objective of the study, size of the study area, availability and quality of aerial imagery, sampling intensity and coverage of the study area, experience and interpretation of field botanists, and ability of GIS personnel to accurately digitise hard copy line work line work from field maps. This variability between the project areas complicated the consolidation of vegetation mapping.	The vegetation data integrity was rated for each baseline survey included in the database (Section 4.2). Vegetation polygons that were poorly delineated were described and mapped as mosaics, and/or or not merged with other polygons. This has resulted in some of the vegetation associations being represented over relatively small areas and representing a small proportion of the study area.	Undertake additional field survey work (or desktop assessment where an appropriate density of quadrats has previously been assessed) to refine vegetation mapping line work (scale) and update vegetation descriptions for specific polygons.
Variability in completeness of raw data for post-2010 surveys	Raw data for baseline surveys completed post-2010 should be in accordance with BHP Billiton Iron Ore's Guidance for Flora and Vegetation Surveys in the Pilbara (WIN-ENV-LAND NW-008). However, these guidelines are not always enforced and there is a high degree of variability in completeness of the datasets.	A review of the datasets was undertaken following incorporation into the consolidated mapping database.	A higher level of scrutiny is required for all baseline survey datasets to ensure consistency in data quality.
Vegetation classification not referenced and/or variable	For a number of the earlier baseline surveys there was no referenced vegetation classification system used to describe and map vegetation associations leading to general inconsistency between project areas.	Reference was made to the raw floristic data to interpret the dominant plant taxa and structural vegetation layers that could then be described according to BHP Billiton Iron Ore terminology.	Ensure consistency of vegetation descriptions in baseline surveys by following *Guidance for Vegetation and Flora Surveys in the Pilbara Region* (BHP Billiton Iron Ore 2013b).

Parameter	Limitation	Management of Limitation	Future Requirements
Vegetation classification variable	Vegetation associations from previous surveys were reviewed in detail to identify similar units. These were tabulated into a 'survey by vegetation association' matrix. There were a number of the more widely represented vegetation associations that were consolidated with a high degree of confidence. However, variability in methodology between surveys contributed to lesser confidence levels for a number of vegetation associations. In these cases a broader level of vegetation classification was used to accommodate for the fine-scale differences. In some cases, this resulted in the merging of vegetation associations from the same study area.	The final scale of vegetation mapping for the consolidated mapping database was based on identifiable patterns from aerial photography evident at a scale of 1:20,000, combined with a level of detail in vegetation descriptions using the preferred classification system documented in the *Guidance for Vegetation and Flora Surveys in the Pilbara Region* (BHP Billiton Iron Ore 2013b). Consistency in the scale of vegetation mapping across the study area was maintained as a priority.	For all future flora and vegetation surveys, BHP Billiton Iron Ore should maintain the current vegetation classification system, based on Specht (1970) with modification by Aplin (1979) and Trudgen (2009). This is equivalent to the level of "association" or Level V of the NVIS classification framework.
Absence of relevé data	Relevé vegetation descriptions are often made to increase the accuracy of vegetation mapping, but this data was not included within appendices of baseline reports and was not available to review.	Vegetation mapping was reliant on data from formal study sites (quadrats). The exception was tenements where vegetation mapping had previously been completed by Onshore Environmental.	Review of any future vegetation mapping to ensure compliance with required scale for consolidation into the larger Pilbara database, with reference to any relevé data recorded.
Inability to address inaccurate vegetation mapping detail	The scope of works did not allow provision for additional detail to existing vegetation mapping line work. This was an issue where the level of mapping detail contrasted between neighbouring survey areas. This issue was encountered at the eastern Pilbara tenements which supported numerous small surveys completed by a variety of consultants.	Where possible, vegetation polygons were merged along survey boundaries and corresponding vegetations associations consolidated (where appropriate).	Future flora and vegetation survey work will aim to update existing vegetation mapping for tenements where the level of detail is currently not at the required standard.
Overlapping vegetation mapping datasets	Differences in vegetation mapping for overlapping datasets i.e spatial anomalies between datasets.	Resolved by retaining the most accurate line work, i.e. vegetation polygon line work that best differentiated shading patterns evident on high quality aerial photography.	None

Parameter	Limitation	Management of Limitation	Future Requirements
Mis-identification of keystone plant taxa	There were instances where likely mis-identification of keystone plant species in vegetation association descriptions could not be challenged or changed as the scope did not provide for recollection of dubious taxa.	Vegetation association descriptions were retained in their existing format.	Future flora and vegetation survey work will aim to confirm the identification of keystone plant taxa within tenements where previous mis-identifications are suspected.
Vegetation associations occurring over small areas	A number of the consolidated vegetation associations occur over a relatively small area, but are not considered to be restricted or conservation significant. It is likely that these vegetation associations could be further consolidated with more widely occurring associations.	Could not be addressed during this phase of the project due to time and resource constraints.	Further refinement of vegetation associations could occur by cross-referencing raw data from study sites occurring within individual map polygons.
Gaps in vegetation mapping dataset	This phase of the consolidated vegetation mapping did not allow for additional field surveys and mapping where it was absent.	These areas have been identified (Table 5) and will be included in the next phase.	Vegetation mapping will be undertaken at tenements where it is currently absent prior to development, and the consolidated vegetation mapping will be updated.
Consolidation of new vegetation mapping data	There were a number of baseline flora and vegetation surveys completed during 2013 and 2014 where vegetation mapping has not been incorporated into the consolidated dataset, e.g Orebody 19, Orebody 31, Ninga, Rocklea. There is currently no agreed procedure for consolidation of future vegetation mapping.	The most recent vegetation mapping finalised from BHP Billiton Iron Ore tenements in 2013 and 2014 was not consolidated with the larger Pilbara database.	The consolidated vegetation mapping will be updated as data becomes available from progressive baseline flora and vegetation surveys.

Parameter	Limitation	Management of Limitation	Future Requirements
Significant flora	The location of current Threatened Flora (T) and Priority flora taxa recorded during previous baseline surveys incorporated as part of the consolidated vegetation mapping database were mapped. This was not part of the original scope of works. The current database is not exhaustive as it does not include additional records from targeted significant flora surveys not reviewed as part of the consolidated vegetation mapping database.	Raw data from targeted significant flora surveys was not incorporated into the consolidated Pilbara database.	Current significant flora records from targeted flora surveys are proposed to be incorporated into the consolidated Pilbara database during the next phase of the consolidated vegetation mapping project.
Introduced weeds	The location of current introduced weed species recorded during previous baseline surveys incorporated as part of the consolidated vegetation mapping database were mapped. This was not part of the original scope of works. The current database is not exhaustive as it does not include additional records from targeted weed surveys not reviewed as part of the consolidated vegetation mapping database.	Raw data from targeted weed surveys was not incorporated into the consolidated Pilbara database.	Targeted weed surveys are proposed to be incorporated into the consolidated Pilbara database during the next phase of the consolidated vegetation mapping project.

6.0 STUDY TEAM

The consolidated mapping project was planned, co-ordinated and executed by the following personnel:

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Mrs Chana Higgins	BBus	Data Analyst
Mr Todd Griffin		GIS Specialist

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Ecologia Environment (2008d) *Rapid Growth Project 5: Paroo, Ethel and Sandhill Proposed Sidings Flora and Vegetation Survey.* Prepared for BHP Billiton Iron Ore.

Ecologia Environment (2008e) *Rapid Growth Project 5: Quarry 8 Drainage Area Flora and Vegetation Survey.* Prepared for BHP Billiton Iron Ore.

Ecologia Environment (2008f) *Rapid Growth Project 5: Quarry 4 Lease Flora and Vegetation Survey.* Prepared for BHP Billiton Iron Ore.

Ecologia Environment (2008g) *Rapid Growth Project 5: Quarry 1 Flora and Vegetation Survey.* Prepared for BHP Billiton Iron Ore.

Ecologia Environment (2008h) *Rapid Growth Project 5: Quarry 3 Lease Flora and Vegetation Survey.* Prepared for BHP Billiton Iron Ore.

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Ecologia Environment (2008n) *Rapid Growth Project 5: Walla to Turner Camp and Repeater 2 Flora and Vegetation Survey.* Prepared for BHP Billiton Iron Ore.

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ENV Australia (2007a) *Area C Deposit R Flora & Vegetation Assessment.* Prepared for BHP Billiton Iron Ore.

ENV Australia (2007b) *Coondiner and Mindy East Exploration Leases Flora and Vegetation Assessment.* Prepared for BHP Billiton Iron Ore.

ENV Australia (2007c) *Jimblebar RPG4 Rail Loop Flora and Vegetation Assessment.* Prepared for BHP Billiton Iron Ore.

ENV Australia (2007d) *Jimblebar West Flora and Vegetation Assessment.* Prepared for BHP Billiton Iron Ore.

ENV Australia (2007e) *Mindy North Exploration Lease Flora and Vegetation Assessment.* Prepared for BHP Billiton Iron Ore.

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ENV Australia (2007g) Ord *Ridley Exploration Lease - Flora and Vegetation Assessment.* Prepared for BHP Billiton Iron Ore.

ENV Australia (2007h) *Prairie Downs Exploration Lease - Biological Assessment.* Prepared for BHP Billiton Iron Ore.

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ENV Australia (2007j) *Roy Hill Flora and Vegetation Survey.* Prepared for BHP Billiton Iron Ore.

ENV Australia (2007k) *Upper Marillana Exploration Lease Flora and Vegetation Assessment.* Prepared for BHP Billiton Iron Ore.

ENV Australia (2008a) *Alligator Jaws Exploration Lease Flora and Vegetation Assessment*. Prepared for BHP Billiton Iron Ore.

ENV Australia (2008b) *Boundary Ridge Exploration Lease Flora and Vegetation Assessment*. Prepared for BHP Billiton Iron Ore.

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ENV Australia (2008d) *Jimblebar Access Road Flora and Vegetation Assessment.* Prepared for BHP Billiton Iron Ore.

ENV Australia (2008e) *Jimblebar Jnctn to Yandi Jnctn Rail Reserve Flora and Vegetation (RGP5 Calibre) Survey.* Prepared for BHP Billiton Iron Ore.

ENV Australia (2008f) *Jimblebar Wye Repeater 9 Access Road Flora and Vegetation Assessment.* Prepared for BHP Billiton Iron Ore.

ENV Australia (2008g) *RGP5 M270SA Flora and Vegetation Assessment.* Confidential report prepared for BHP Billiton Iron Ore.

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ENV Australia (2008j) *South Flank Flora and Vegetation Assessment.* Prepared for BHP Billiton Iron Ore.

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ENV Australia (2009o) *Goldsworthy Rail Duplication Flora and Vegetation Assessment.* Prepared for BHP Billiton Iron Ore.

ENV Australia (2009p) *Orebody 25 to Newman Flora and Vegetation Assessment.* Prepared for BHP Billiton Iron Ore.

ENV Australia (2009q) *Whaleback Creek Culvert Flora and Vegetation Assessment.* Prepared for BHP Billiton Iron Ore.

ENV Australia (2009r) *Newman to Jimblebar Transmission Line and Newman Town Substation Flora and Vegetation Assessment.* Prepared for BHP Billiton Iron Ore.

ENV Australia (2009s) *Whaleback Power Station Flora and Vegetation Assessment.* Prepared for BHP Billiton Iron Ore.

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ENV Australia (2010b) *Jinayri Accommodation Camp and Access Road - Flora and Vegetation Assessment.* Prepared for BHP Billiton Iron Ore.

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ENV Australia (2010d) *Ophthalmia Exploration Tenement Flora, Vegetation and Fauna Assessment.* Prepared for BHP Billiton Iron Ore.

ENV Australia (2010e) *Port Hunt Point Flora and Fauna Assessment.* Prepared for BHP Billiton Iron Ore.

ENV Australia (2010f) *Goldsworthy Rail Duplication Flora and Fauna Desktop Assessment Supplement.* Prepared for BHP Billiton Iron Ore.

ENV Australia (2010g) *Wallwork Road Bridge Flora and Vegetation Assessment.* Prepared for BHP Billiton Iron Ore.

ENV Australia (2010h) *South Flank NVCP Extension Flora, Vegetation and Fauna Assessment.* Prepared for BHP Billiton Iron Ore.

ENV Australia (2010i) *Orebody 35 VCP Area Flora and Fauna Assessment.* Prepared for BHP Billiton Iron Ore.

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Onshore Environmental (2009c) *South Parmelia Exploration Leases - Biological Survey.* Confidential Report to BHP Billiton Iron Ore.

Onshore Environmental (2009d) *Whaleback Flora & Vegetation Survey and Fauna Assessment.* Confidential Report to BHP Billiton Iron Ore.

Onshore Environmental (2010) *Prairie Downs Flora, Vegetation and Fauna Assessment.* Confidential Report to BHP Billiton Iron Ore.

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Onshore Environmental (2012f) *South Flank Study Area Level 2 Flora and Vegetation Survey.* Prepared for BHP Billiton Iron Ore.

Onshore Environmental (2012g) *Weeli Wolli Spring Priority Ecological Community - Flora and Vegetation Survey.* Prepared for BHP Billiton Iron Ore.

Onshore Environmental (2012h) *Yandi Study Area- Review of Flora and Vegetation.* Prepared for BHP Billiton Iron Ore.

Onshore Environmental (2012i) *Barimunya Camp - Flora and Vegetation Survey.* Prepared for BHP Billiton Iron Ore.

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Syrinx Environmental (2012a) *Orebody 37 Flora and Vegetation Assessment.* Prepared for BHP Billiton Iron Ore.

Syrinx Environmental (2012b) *South West Jimblebar Flora and Vegetation Assessment.* Prepared for BHP Billiton Iron Ore.

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APPENDIX 1

Baseline flora and vegetation reports that were reviewed as part of the gap analysis

REPORT NAME	REFERENCE	NO. SITES[9]
Alligator Jaws Exploration Lease Flora and Vegetation Assessment	ENV Australia 2008a	46
Area C and Surrounds - Flora and Vegetation Survey	Onshore Environmental 2011a	221
Area C Deposit A, D, P1 and P3 Flora and Vegetation Assessment	Woodman Environmental 2009	68
Area C Deposit R Flora & Vegetation Assessment	ENV Australia 2007a	72
Area C to Jinayri to Mt Newman Rail Flora and Vegetation Survey	Woodman Environmental 2010	209
Area C to Yandi Vegetation and Flora Survey	Astron Environmental 2011a	20
Area C West NVCP Flora, Vegetation and Fauna Assessment	ENV Australia 2010a	
Area C West to Yandi Flora and Vegetation Survey	Onshore Environmental 2014a	170
Barimunya Camp - Flora and Vegetation Survey	Onshore Environmental 2012i	10
Boodarie Depot Flora and Vegetation Assessment	ENV Australia 2009a	22
Boundary Ridge Flora and Vegetation Assessment	ENV Australia 2008b	40
Callawa Biological Assessment Survey	Ecologia Environment 2005a	52
Callawa Level 2 Flora and Vegetation Survey	Onshore Environmental 2012a	22
Callawa West Flora and Vegetation Survey	Onshore Environmental 2012b	17
Camp Hill Flora, Vegetation and Fauna Report	Onshore Environmental 2011b	138
Carramulla Flora and Vegetation Survey and Fauna Assessment	GHD 2009	26
Central 3 Flora and Vegetation Assessment	ENV Australia 2009t	9
Coondewanna Exploration Tenement Level 2 Flora and Level 1 Fauna Assessment (Gurinbiddy)	GHD 2011a	34
Coondewanna Flats Coolibah-lignum PEC Flora and Vegetation Survey	Pilbara Flora 2008a	3
Coondewanna Flats Flora and Vegetation Assessment	Astron Environmental 2012	56
Coondewanna Flats Vegetation Investigation	Astron Environmental 2010a	
Coondiner and Mindy East Exploration Leases Flora and Vegetation Assessment	ENV Australia 2007b	36
Cundaline and Callawa Mining Operations Flora and Vegetation Assessment	ENV Australia 2008k	22
Eastern Ridge (OB24/25) Flora and Vegetation Report	ENV Australia 2012	56
Finucane Island Causeway Flora and Vegetation Assessment	ENV Australia 2009b	
Finucane Island Project Flora and Fauna Assessment Addendum	ENV Australia 2009c	
Fork South and Parallel Ridge Exploration Lease Flora and Vegetation Assessment	ENV Australia 2008c	82
Goldsworthy Level 2 Flora and Vegetation Survey	Onshore Environmental 2013a	80
Goldsworthy Minesite Flora and Vegetation Assessment	Pilbara Flora 2009a	50

[9] A number of reports had no study site data included. Reasons included; Level 1 survey, review of previous report data, or no inclusion in the appendix.

REPORT NAME	REFERENCE	NO. SITES[9]
Goldsworthy Rail Duplication Flora and Fauna Desktop Assessment Supplement	ENV Australia 2010f	
Goldsworthy Rail Duplication Flora and Vegetation Assessment	ENV Australia 2009o	42
Hashimoto Exploration Project Biological Survey Flora and Vegetation Survey	Ecologia Environment 2007a	55
Homestead Creek Culvert Flora and Vegetation Assessment	ENV Australia 2009d	4
Jimblebar Access Road Flora and Vegetation Assessment	ENV Australia 2008d	32
Jimblebar Ammonium Nitrate Storage Facility Flora and Vegetation Assessment	ENV Australia 2011a	7
Jimblebar Construction Water Supply Pipeline and Ammonium Nitrate Storage Facility Flora and Vegetation Survey	ENV Australia 2009e	23
Jimblebar East Exploration Project - Biological Survey	Ecologia Environment 2005b	45
Jimblebar Eastern Pilbara Accommodation Camp Flora and Fauna Assessment	Outback Ecology 2009a	15
Jimblebar Great Northern Hwy Flora and Fauna Survey	Eco Logical 2012a	8
Jimblebar Iron Ore Project Flora and Vegetation Assessment	Outback Ecology 2010	117
Jimblebar Jnctn to Yandi Jnctn Rail Reserve Flora and Vegetation (RGP5 Calibre) Survey	ENV Australia 2008e	129
Jimblebar Linear Development Flora and Vegetation Assessment	Outback Ecology 2009b	72
Jimblebar Mine Module Flora and Vegetation Survey	Eco Logical 2012b	
Jimblebar RPG4 Rail Loop Flora and Vegetation Assessment	ENV Australia 2007c	4
Jimblebar Spur 2 Flora and Vegetation	ENV Australia 2009f	11
Jimblebar West Flora and Vegetation Assessment	ENV Australia 2007d	29
Jimblebar Wye Rail Junction Borrow Areas Flora and Vegetation Assessment	ENV Australia 2007i	20
Jimblebar Wye Repeater 9 Access Road Flora and Vegetation Assessment	ENV Australia 2008f	6
Jinayri Accommodation Camp and Access Road - Flora and Vegetation Assessment	ENV Australia 2010b	85
Jinayri Flora Report	Ecologia Environment 2009	88
Jinayri Lease Flora and Vegetation Survey	ENV Australia 2010c	328
Jinayri North Flora and Vegetation Survey for Hydrological Drill Targets	Pilbara Flora 2009b	27
Jinayri to Area C Access Corridor Flora and Vegetation Assessment	ENV Australia 2011b	54
Jinidi Flora and Vegetation Survey	Onshore Environmental 2012c	549
Jinidi to Mainline Flora and Vegetation Survey	Onshore Environmental 2012d	395
Jinidi to Mindy Level 1 Flora and Vegetation Survey	Biota Environmental 2012a	9
M270SA RGP5 Flora and Vegetation Assessment	ENV Australia 2008g	7
Mainline Rail Extension Flora and Vegetation Survey	Onshore Environmental 2014b	203
Marillana Creek Western Access Corridor - Biological Assessment	HGM 1999	25
Marillana ML70/270 Flora and Vegetation Survey	Onshore Environmental 2012e	559

REPORT NAME	REFERENCE	NO. SITES[9]
Marillana ML70/270 SA Sec 2 Flora and Vegetation Assessment	Ecologia Environment 2007b	78
Mesa Gap Biological Survey	GHD 2008a	40
Mindy North Exploration Lease Flora and Vegetation Assessment	ENV Australia 2007e	54
Mindy-Coondiner Exploration Project Biological Survey	Ecologia Environment 2005c	14
Ministers North Exploration Lease - Flora and Vegetation Assessment	ENV Australia 2009g	65
MPDJV Area C: Deposits D, E and F Biological Survey	Ecologia Environment 2004c	
MPDJV Area C: Deposits D, E and F Biological Survey Packsaddle Borefield Flora Survey	Ecologia Environment 2004a	
MPDJV Orebody 24 Expansion Biological Survey	Ecologia Environment 2004b	
Mudlark Leases - Flora and Vegetation Survey	Onshore Environmental 2013c	222
Mudlark Well Exploration Project - Biological Survey	Ecologia Environment 2005d	36
Munjina Flora and Vegetation Assessment	ENV Australia 2009h	94
Myopic Exploration Lease - Biological Survey	Onshore Environmental 2009a	74
Myopic Flora and Fauna Assessment	GHD 2008b	119
Newman Hub RGP4 Topsoil Stockpile and Borrow Areas For Construction Flora and Vegetation Associations	ENV Australia 2006a	21
Newman Power Network, Level 2 Flora and Level 1 Fauna Survey	Biologic Environmental 2009	
Newman Powerline Corridor Level 1 Flora and Fauna Survey	Eco Logical 2011	
Newman to Jimblebar Transmission Line and Newman Town Substation Flora and Vegetation Assessment	ENV Australia 2009r	
Newman to Yandi Transmission Line Flora and Vegetation Assessment	ENV Australia 2009i	
Newman Water Pipeline Enhancement Project: Vegetation and Flora Survey	Ecologia Environment 2008a	
Nimingarra, Shay Gap & Sunrise Hill Flora and Vegetation	Astron Environmental 2011b	108
NWP_Vegetation Mapping	ENV Australia 2011c	
OB18 Flora and Vegetation Assessment Phase 2	ENV Australia 2007f	
OB25 to Newman Flora and Vegetation	ENV Australia 2009j	1
OB31 Flora and Vegetation Assessment	Syrinx Environmental 2011	32
OB35 and Surrounds Flora and Vegetation Survey	GHD 2011b	89
OB42 / 43 Flora, Vegetation and Fauna Report and NVCP Letter	ENV Australia 2011d	30
Ophthalmia Exploration Tenement Flora, Vegetation and Fauna Assessment	ENV Australia 2010d	143
Ord Ridley Exploration Lease - Flora and Vegetation Assessment	ENV Australia 2007g	91
Orebody 17 Flora and Vegetation Survey	Pilbara Flora 2008b	
Orebody 25 to Newman Flora and Vegetation Assessment	ENV Australia 2009p	28
Orebody 35 VCP Area Flora and Fauna Assessment	ENV Australia 2010i	

REPORT NAME	REFERENCE	NO. SITES[9]
Orebody 37 Flora and Vegetation Assessment	Syrinx Environmental 2012a	
Outer Harbour_Boodaries Stockyards_Priority Flora Validation Survey	SKM 2011	
Packsaddle West Flora and Vegetation Survey and Fauna Assessment	Astron Environmental 2010b	145
Port A Biodiversity Assessment of the Utah Point Berth Development Port Hedland	Biota Environmental 2008a	
Port A Flora and Fauna Assessment of RGP5 DMMA A Port Hedland Harbour	Biota Environmental 2008b	
Port Hedland Harbour A Flora and Fauna Assessment of RGP5 Spoil Areas A and H	Biota Environmental 2008c	
Port Hedland Life of Mine	ENV Australia 2011e	
Port Hedland Nelson Point Dredging Approvals Flora and Fauna Review of DMMA	Biota Environmental 2009	
Port Hedland Nelson Point Dredging Approvals Flora and Vegetation Assessment of DMMA	ENV Australia 2009k	9
Port Hedland Regional Flora Assessment Final	ENV Australia 2011f	162
Port Hedland Regional Tephrosia rosea var. venulosa Targeted Survey Report	ENV Australia 2009l	
Port Hedland Transmission Lines	ENV Australia 2009m	
Port Hunt Point Flora and Fauna Assessment	ENV Australia 2010e	5
Port Outer Harbour Development Flora and Vegetation Assessment	ENV Australia 2009n	360
Prairie Downs Exploration Lease - Biological Assessment	ENV Australia 2007h	47
Prairie Downs Flora, Vegetation and Fauna Assessment	Onshore Environmental 2010	109
Rail Mooka Vegetation and Flora Survey	Maia Environmental 2012	22
Rail RGP5 Quarry 6 Flora and Vegetation Assessment	ENV Australia 2008h	24
Rail Turner River Camp Flora and Vegetation Assessment	ENV Australia 2008i	5
Rapid Growth Project 5: Chichester DeviationVegetation and Flora Survey	Ecologia Environment 2008b	
Rapid Growth Project 5: Cowra to Kurrajurra Sidings and Cowra Camp Site Flora and Vegetation Survey	Ecologia Environment 2007c	
Rapid Growth Project 5: Newman to Jimblebar Rail Duplication Flora and Vegetation Survey	Ecologia Environment 2008c	
Rapid Growth Project 5: Paroo, Ethel and Sandhill Proposed Sidings Flora and Vegetation Survey	Ecologia Environment 2008d	
Rapid Growth Project 5: Quarry 1 Flora and Vegetation Survey	Ecologia Environment 2008g	
Rapid Growth Project 5: Quarry 2 Flora and Vegetation Survey	Ecologia Environment 2008i	
Rapid Growth Project 5: Quarry 3 Lease Flora and Vegetation Survey	Ecologia Environment 2008h	
Rapid Growth Project 5: Quarry 4 Lease Flora and Vegetation Survey	Ecologia Environment 2008f	
Rapid Growth Project 5: Quarry 8 Drainage Area Flora and Vegetation Survey	Ecologia Environment 2008e	
Rapid Growth Project 5: Redmont Camp Extension Flora and Vegetation Survey	Ecologia Environment 2008j	
Rapid Growth Project 5: Spring Siding to Hesta Siding and Repeater 5 Flora and Vegetation Survey	Ecologia Environment 2008k	
Rapid Growth Project 5: Turner Camp to Spring Siding and Repeaters 3 and 4 Flora and Vegetation Survey	Ecologia Environment 2008l	

REPORT NAME	REFERENCE	NO. SITES[9]
Rapid Growth Project 5: Walla to Bing Sidings and Repeater 1 Flora and Vegetation Survey	Ecologia Environment 2008m	
Rapid Growth Project 5: Walla to Turner Camp and Repeater 2 Flora and Vegetation Survey	Ecologia Environment 2008n	
Rapid Growth Project 5: Yandi Flora Survey and Assessment of Barimunya Airport and a Potential Burrow Area	ENV Australia 2009u	8
Rapid Growth Project 5: Yandi to Kurrajura Siding and Yandi Repeater 1 Flora and Vegetation Survey	Ecologia Environment 2008o	
Rocklea Exploration Project Biological Survey	Ecologia Environment 2005e	60
Ronsard Tenement Biological Review	Biota Environmental 2010	Level 1
Roy Hill Flora and Vegetation Survey	ENV Australia 2007j	40
South Flank Flora and Vegetation Assessment	ENV Australia 2008j	109
South Flank Flora and Vegetation Survey	Onshore Environmental 2012f	220
South Flank NVCP Extension Flora, Vegetation and Fauna Assessment	ENV Australia 2010h	12
South Flank West - R Deposit Vegetation Mapping	Onshore Environmental 2009b	
South Parmelia Exploration Leases Biological Survey	Onshore Environmental 2009c	
South West Jimblebar Flora and Vegetation Assessment	Syrinx Environmental 2012b	19
Southern Flank to Jinidi Level 2 Flora and Vegetation Survey	Biota Environmental 2012b	67
Tandanya - Level 2 Flora and Vegetation Survey	Onshore Environmental 2013d	559
Targeted Survey for *Lepidium catapycnon* at Karijini National Park	Onshore Environmental 2013b	
Upper Marillana and Munjina Flora, Vegetation & Fauna Report & VCP Letter	ENV Australia 2011g	278
Upper Marillana Exploration Lease - Flora and Vegetation Assessment	ENV Australia 2007k	42
Upper Marillana Exploration Project Biological Survey	Ecologia Environment 2005f	34
Wallwork Road Bridge Flora and Vegetation Assessment	ENV Australia 2010g	7
Weeli Wolli Spring PEC Flora and Vegetation Survey	Onshore Environmental 2012g	5
Western 2 & Western 1 Waste Dump Flora Vegetation Assessment	ENV Australia 2009w	3
Western 6, 7 & 8 Flora and Vegetation Assessment	ENV Australia 2009v	5
Western Ridge Exploration Project - Biological Survey	Ecologia Environment 2005g	7
Whaleback AML 7/244 Flora and Vegetation and Vertebrate Fauna Review	Onshore Environmental 2013e	
Whaleback Creek Culvert Flora and Vegetation Assessment	ENV Australia 2009q	4
Whaleback East Flora, Vegetation and Fauna Report and NVCP Letter	ENV Australia 2011h	
Whaleback Flora & Vegetation Survey and Fauna Assessment	Onshore Environmental 2009d	30
Whaleback Life of Mine	ENV Australia 2011i	42
Whaleback Newman Hub Infrastructure Area Flora and Vegetation Assessment	ENV Australia 2006b	9
Whaleback Newman Kurra Village Extension Area Flora and Vegetation Assessment	ENV Australia 2006c	9

REPORT NAME	REFERENCE	NO. SITES[9]
Whaleback Power Station Flora and Vegetation Assessment	ENV Australia 2009s	
Whaleback TSF Flora Vegetation and Fauna Survey	Astron Environmental 2010c	6
Wheelarra Hill Flora and Vegetation Assessment	Outback Ecology 2009c	24
Wheelarra Hill North Flora and Vegetation Assessment	Syrinx Environmental 2012c	73
Yandi Airstrip and Access Road: Rare and Priority Flora Survey	Ecologia Environment 2002	3
Yandi Flora and Vegetation Review	Onshore Environmental 2012h	115
Yandi Stage II Iron Ore Project - Biological Survey	Ecologia Environment 2005h	83
Yandi Vegetation and Soil Survey	Ecologia Environment 1998	26

APPENDIX 2

Datasets that were integrated to vegetation mapping for this study

Report Title	Reference
Alligator Jaws Exploration Lease Flora and Vegetation Assessment	ENV Australia 2008a
Area C and Surrounds Flora and Vegetation Survey	Onshore Environmental 2011a
Area C Deposits A, D, P1 and P3 Flora and Vegetation Assessment	Woodman Environmental 2009
Area C to Jinayri to Mount Newman Railway Flora and Vegetation Survey	Woodman Environmental 2010
Area C to Yandi Vegetation and Flora Survey	Astron Environmental 2011a
Area C West NVCP Flora, Vegetation and Fauna Assessment	ENV Australia 2010a
Boodarie Depot Flora and Vegetation Assessment	ENV Australia 2009a
Camp Hill Flora, Vegetation and Fauna Report	Onshore Environmental 2011b
Carramulla Flora and Vegetation Survey and Fauna Assessment	GHD 2009
Coondewanna Exploration Tenement Level 2 Flora and Vegetation and Level 1 Fauna Assessment (Gurinbiddy)	GHD 2011a
Coondewanna Flats Coolibah Lignum PEC Flora and Vegetation Survey	Pilbara Flora 2008a
Coondewanna Flats Vegetation Investigation	Astron Environmental 2010a
Eastern Ridge (OB24/25) Flora and Vegetation Assessment	ENV Australia 2012
Jimblebar Access Road Flora and Vegetation Assessment	ENV Australia 2008d
Jimblebar Eastern Pilbara Accommodation Camp Flora and Fauna Assessment	Outback Ecology 2009a
Jimblebar Iron Ore Project Flora and Vegetation Survey	Outback Ecology 2010
Jimblebar Linear Development: Flora and Vegetation Assessment	Outback Ecology 2009b
Jimblebar Mine Module Flora and Vegetation Survey	Eco Logical 2012b
Jimblebar Spur 2 Flora and Vegetation Assessment	ENV Australia 2009f
Jimblebar Wye Rail Junction Borrow Areas Flora and Vegetation Assessment	ENV Australia 2007i
Jinayri Accommodation Camp and Access Road - Flora and Vegetation Assessment	ENV Australia 2010b
Jinayri Lease Flora and Vegetation Assessment	ENV Australia 2010c
Jinayri to Area C Access Corridor Flora and Vegetation Assessment	ENV Australia 2011b
Jinidi Flora and Vegetation Survey	Onshore Environmental 2012c
Jinidi to Mainline Flora and Vegetation Survey	Onshore Environmental 2012d
Jinidi to Mindy Level 1 Flora and Vegetation Survey	Biota Environmental 2012a
Marillana ML70/270 Flora and Vegetation Survey	Onshore Environmental 2012e
Mooka Siding Level One Vegetation and Flora Assessment	Maia Environmental 2012
MPDJV Area C: Deposits D, E and F Biological Survey	Ecologia Environment 2004c
MPDJV Area C: Deposits D, E and F Biological Survey Packsaddle Borefield Flora Survey	Ecologia Environment 2004a
MPDJV Orebody 24 Expansion Biological Survey	Ecologia Environment 2004b
Mudlark Leases - Flora and Vegetation Survey	Onshore Environmental 2013c
Myopic Exploration Leases - Biological Survey	Onshore Environmental 2009a
Myopic Flora and Fauna Assessment	GHD 2008b
Newman Power Network, Level 2 Flora and Level 1 Fauna Survey	Biologic Environmental 2009
Newman Powerline Corridor Level 1 Flora and Fauna Survey	Eco Logical 2011
Newman to Jimblebar Transmission Line and Newman Town Substation Flora and Vegetation Assessment	ENV Australia 2009r
Newman to Yandi Transmission Line Flora and Vegetation Assessment	ENV Australia 2009i
Newman Water Pipeline Enhancement Project: Vegetation and Flora Survey	Ecologia Environment 2008a

Report Title	Reference
OB35 and Surrounds Flora and Vegetation Survey	GHD 2011b
Ophthalmia Exploration Tenement Flora, Vegetation and Fauna Assessment	ENV Australia 2010d
Ore Body 31 Flora and Vegetation Assessment	Syrinx Environmental 2011
Orebody 17 Flora and Vegetation Survey	Pilbara Flora 2008b
Orebody 18 Flora and Vegetation Assessment Phase 2 Survey	ENV Australia 2007f
Orebody 35 VCP Area Flora and Fauna Assessment	ENV Australia 2010i
Orebody 37 Flora and Vegetation Assessment	Syrinx Environmental 2012a
Orebody 42/43 Flora, Vegetation and Fauna Report and NVCP Letter	ENV Australia 2011d
Packsaddle West Flora and Vegetation Survey and Fauna Assessment	Astron Environmental 2010b
Prairie Downs Flora and Vegetation Survey and Fauna Assessment	Onshore Environmental 2010
Rapid Growth Project 5: Chichester DeviationVegetation and Flora Survey	Ecologia Environment 2008b
Rapid Growth Project 5: Cowra to Kurrajurra Sidings and Cowra Camp Site Flora and Vegetation Survey	Ecologia Environment 2007c
Rapid Growth Project 5: Newman to Jimblebar Rail Duplication Flora and Vegetation Survey	Ecologia Environment 2008c
Rapid Growth Project 5: Paroo, Ethel and Sandhill Proposed Sidings Flora and Vegetation Survey	Ecologia Environment 2008d
Rapid Growth Project 5: Quarry 1 Flora and Vegetation Survey	Ecologia Environment 2008g
Rapid Growth Project 5: Quarry 2 Flora and Vegetation Survey	Ecologia Environment 2008i
Rapid Growth Project 5: Quarry 3 Lease Flora and Vegetation Survey	Ecologia Environment 2008h
Rapid Growth Project 5: Quarry 4 Lease Flora and Vegetation Survey	Ecologia Environment 2008f
Rapid Growth Project 5: Quarry 8 Drainage Area Flora and Vegetation Survey	Ecologia Environment 2008e
Rapid Growth Project 5: Redmont Camp Extension Flora and Vegetation Survey	Ecologia Environment 2008j
Rapid Growth Project 5: Spring Siding to Hesta Siding and Repeater 5 Flora and Vegetation Survey	Ecologia Environment 2008k
Rapid Growth Project 5: Turner Camp to Spring Siding and Repeaters 3 and 4 Flora and Vegetation Survey	Ecologia Environment 2008l
Rapid Growth Project 5: Walla to Bing Sidings and Repeater 1 Flora and Vegetation Survey	Ecologia Environment 2008m
Rapid Growth Project 5: Walla to Turner Camp and Repeater 2 Flora and Vegetation Survey	Ecologia Environment 2008n
Rapid Growth Project 5: Yandi to Kurrajura Siding and Yandi Repeater 1 Flora and Vegetation Survey	Ecologia Environment 2008o
South Flank Flora and Vegetation Survey	Onshore Environmental 2012f
South Flank NVCP Extension Flora, Vegetation and Fauna Assessment	ENV Australia 2010h
South Parmelia Exploration Leases - Biological Survey	Onshore Environmental 2009c
South West Jimblebar Flora and Vegetation Assessment	Syrinx Environmental 2012b
Southern Flank to Jinidi Level 2 Flora and Vegetation Survey	Biota Environmental 2012b
Tandanya Level 2 Flora and Vegetation Review	Onshore Environmental 2013d
Upper Marillana and Munjina Flora, Vegetation and Fauna Report and NVCP Letter	ENV Australia 2011g
Wallwork Road Bridge Flora and Vegetation Assessment	ENV Australia 2010g
Weeli Wolli Spring PEC Flora and Vegetation Survey	Onshore Environmental 2012g
Whaleback (AML 7/244) Flora, Vegetation and Vertebrate Fauna Review	Onshore Environmental 2013e
Whaleback East Flora, Vegetation and Fauna Report and NVCP Letter	ENV Australia 2011h

Report Title	Reference
Whaleback Flora and Vegetation Survey and Fauna Assessment	Onshore Environmental 2009d
Whaleback Power Station Flora and Vegetation Assessment	ENV Australia 2009s
Whaleback TSF Flora, Vegetation and Fauna Assessment	Astron Environmental 2010c
Wheelarra Hill Iron Ore Mine Modification: Flora and Fauna Assessment	Outback Ecology 2009c
Wheelarra Hill North Flora and Vegetation Assessment	Syrinx Environmental 2012c
Yandi Flora and Vegetation Review	Onshore Environmental 2012h

APPENDIX 3

Conservation Codes for Western Australian Flora.

T: Threatened Flora - Extant Taxa

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.

1: Priority One - Poorly Known Taxa

Taxa that are known from one or a few collections or sight records (generally less than five), 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 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

(a) **Rare.** Taxa 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 taxa are usually represented on conservation lands.
(b) **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.
(c) Taxa that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

5: Priority Five - Conservation Dependent taxa

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

APPENDIX 4

Conservation categories for flora described under the EPBC Act.

CATEGORY	DESCRIPTION
Extinct	A species is extinct if there is no reasonable doubt that the last member of the species has died.
Extinct in the Wild	A species is categorised as extinct in the wild if it is only known to survive in cultivations, in captivity, or as a naturalised population well outside its past range; or if it has not been recorded in its known/expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
Critically Endangered	The species is facing an extremely high risk of extinction in the wild and in the immediate future.
Endangered	The species is likely to become extinct unless the circumstances and factors threatening its abundance, survival, or evolutionary development cease to operate; or its numbers have been reduced to such a critical level, or its habitats have been so drastically reduced, that it is in immediate danger of extinction.
Vulnerable	Within the next 25 years, the species is likely to become endangered unless the circumstances and factors threatening its abundance, survival or evolutionary development cease to operate.
Conservation Dependent	The species is the focus of a specific conservation program, the cessation of which would result in the species becoming vulnerable, endangered or critically endangered within a period of 5 years.

APPENDIX 5

Vegetation Classifications for the Pilbara based on Specht (1970), as modified by Aplin (1979) and Trudgen (2009).

Height Class	Canopy Cover				
	100 - 70%	70 - 30%	30 - 10%	10 - 2%	< 2%
Trees > 30 m	High Closed Forest	High Open Forest	High Woodland	High Open Woodland	Scattered Tall Trees
Trees 10-30 m	Closed Forest	Open Forest	Woodland	Open Woodland	Scattered Trees
Trees < 10 m	Low Closed Woodland	Low Open Forest	Low Woodland	Low Open Woodland	Scattered Low Trees
Mallee	Closed Mallee	Mallee	Open Mallee	Very Open Mallee	Scattered Mallees
Shrubs > 2 m	Closed Scrub	Open Scrub	High Shrubland	High Open Shrubland	Scattered Tall Shrubs
Shrubs 1-2 m	Closed Heath	Open Heath	Shrubland	Open Shrubland	Scattered Shrubs
Shrubs < 1 m	Low Closed Heath	Low Open Heath	Low Shrubland	Low Open Shrubland	Low Scattered Shrubs
Hummock Grass	Closed Hummock Grassland	Hummock Grassland	Open Hummock Grassland	Very Open Hummock Grassland	Scattered Hummock Grass
Tussock Grass	Closed Tussock Grassland	Tussock Grassland	Open Tussock Grassland	Very Open Tussock Grassland	Scattered Tussock Grass
Bunch Grass	Closed Bunch Grassland	Bunch Grassland	Open Bunch Grassland	Very Open Bunch Grassland	Scattered Bunch Grass
Sedges	Closed Sedges	Sedges	Open Sedges	Very Open Sedges	Scattered Sedges
Herbs	Closed Herbs	Herbs	Open Herbs	Very Open Herbs	Scattered Herbs

Source: S. Van Leeuwen (DEC)

APPENDIX 6

Targeted significant flora surveys not included in the Phase 1 consolidated vegetation mapping dataset

Report Title	Reference
ENV- Area C Rail Rare Flora Survey	Biota 2002
ENV- Area C Rail Rare Flora Survey Phase 2	Biota 2003
ENV- Area C Village and Access Road Rare and Priority Flora Survey	Ecologia 2002
ENV- Great Northern Highway to Bing Siding, Goldsworthy Junction, Boodarie Siding Declared Rare and Priority Flora and Weed Assessment	Ecologia 2004
ENV- Jimblebar Wye Targeted Flora Survey	ENV Australia 2010
ENV- Jinidi Lepidium Summary Report	Onshore 2011
ENV- Mudlark Well Priority and Rare Flora Survey	Pilbara Flora 2009
ENV- Newman Hub Rail Corridor Declared Rare and Priority Flora Survey	ENV Australia 2006
ENV- Newman to Hedland PACE Rail Borrow Pits Rare and Priority Flora Survey	Ecologia 2002
ENV- Newman to Hedland PACE Rail Sidings Rare and Priority Flora Survey	Ecologia 2002
ENV- Newman to Yandi Powerline Rare and Priority Flora Survey	Ecologia 2003
ENV- Newman Village Declared Rare Flora Priority Flora and Weed Survey	Ecologia 2004
ENV- Ninga Declared Rare and Priority Flora Survey Letter of Summary Statement	GHD 2008
ENV- OB24 Eriachne tenuiculmis survey	BHPIO 2002
ENV- OB25 Gatehouse Targeted Survey for Rhagodia sp. Hamersley	Onshore 2011
ENV- OB25 Priority Flora Species Survey	BHPIO 2000
ENV- OB25 Rail Spur Siding Declared Rare and Priority Flora Survey	ENV Australia 2007
ENV- Port Hedland Area Targeted Priority Flora Survey	ENV 2009
ENV- Quarry 8 Expansion Declared Rare and Priority Flora and Weed Survey	ENV Australia 2007
ENV- Quarry 8 RGP5 Extension Rare and Priority Flora Survey	Ecologia 2008
ENV- Rail Interim Expansion Project Rare and Priority Flora Survey	Ecologia 2003
ENV- Rail Quarry 8 Expansion Declared Rare and Priority Flora and Weed Survey	ENV 2007
ENV- Rail Rapid Growth Projects Rare and Priority Flora Survey	Ecologia 2004
ENV- Rail RGP2 Great Northern Hwy to Bing Siding, Goldsworthy Junction, Boodarie Siding Declared Rare and Priority Flora and Weed Assessment	Ecologia 2004
ENV- Rail RGP4 Rare and Priority Flora Survey	Ecologia 2004
ENV- Rail RGP5 Borrow Areas (Yandi to Kurrajura Siding) Targeted Rare and Priority Flora Survey	BHPBIO 2008
ENV- Rail RGP5 Borrow Areas Yandi to Kurrajura Siding Targeted Rare and Priority Flora Survey	BHPBIO 2009
ENV- Rail RGP5 Eremophila spongiocarpa Search	ENV Australia 2008
ENV- Rail RGP5 Repeater 9 Extension Rare and Priority Flora Survey	Ecologia 2008
ENV- Rail Targeted Survey of Tecticornia (Chenopodiaceae) in the Nelson Point to Bing Siding Rail Duplication Project Area, Port Hedland	Shepherd (undated)
ENV- Rail Turner River Bridge Extension Chainage 98.8 - 110.9km Declared Rare and Priority Flora and Introduced Species Survey	ENV Australia 2007
ENV- Rail Yandee Line Camp Redevelopment Declared Rare and Priority Flora and Weed Survey	ENV Australia 2008
ENV- South Flank Priority and Rare Flora Survey	Pilbara Flora 2008
ENV- Turner River Bridge Rail DRF and Priority Flora Assessment	Ecologia 2006
ENV- Turner River Bridge Rail Rare and Priority Flora and Declared Weed Survey	Ecologia 2004
ENV- Field Search and observations of Lepidium catapycnon population near Mt Whaleback, Newman	BHPIO 1999
ENV- Regional search for Lepidium catapycnon in the Greater Newman Area (Pilbara), Western Australia	BHPIO 1999
ENV- Follow-up survey of Mt Whaleback Lepidium catapycnon population	Halpern Glick Maunsell 1999

Report Title	Reference
ENV- Mt Whaleback soils and vegetation mapping Addendum A: Lepidium catapycnon survey	Halpern Glick Maunsell 1997
ENV- Whaleback Newman Ammonium Nitrate Facility - Phase 2 Conservation Significant Flora Survey	Ecologia 2006
ENV- Whaleback Newman Ammonium Nitrate Facility Conservation Significant Flora Survey	Ecologia 2006
ENV- Whaleback Newman Hub Rare and Priority Flora Survey	Ecologia 2004

APPENDIX 7

Targeted introduced weed surveys not included in the Phase 1 consolidated vegetation mapping dataset

Report Title	Reference
ENV- Area C to Yandi Rail Line Weed Survey	Ecologia 2001
ENV- Area C Weed Survey Mapping Report	Astron 2011
ENV- Great Northern Highway to Bing Siding, Goldsworthy Junction, Boodarie Siding Declared Rare and Priority Flora and Weed Assessment	Ecologia 2004
ENV- Newman Village Declared Rare Flora Priority Flora and Weed Survey	Ecologia 2004
ENV- Quarry 8 Expansion Declared Rare and Priority Flora and Weed Survey	ENV Australia 2007
ENV- Rail Chichester Deviation Baseline Weed Survey	Ecologia 2010
ENV- Rail Quarry 8 Expansion Declared Rare and Priority Flora and Weed Survey	ENV 2007
ENV- Rail RGP2 Great Northern Hwy to Bing Siding, Goldsworthy Junction, Boodarie Siding Declared Rare and Priority Flora and Weed Assessment	Ecologia 2004
ENV- Rail Turner River Bridge Extension Chainage 98.8 - 110.9km Declared Rare and Priority Flora and Introduced Species Survey	ENV Australia 2007
ENV- Rail Yandee Line Camp Redevelopment Declared Rare and Priority Flora and Weed Survey	ENV Australia 2008
ENV- Turner River Bridge Rail Rare and Priority Flora and Declared Weed Survey	Ecologia 2004

APPENDIX 8

Vegetation condition scale
(as developed by Keighery 1994)

CONDITION	CODE	DESCRIPTION
Pristine	1	Pristine or nearly so, no obvious signs of disturbance.
Excellent	2	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
Very Good	3	Vegetation structure altered; obvious signs of disturbance.
Good	4	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it.
Degraded	5	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching Very Good condition without intensive management.
Completely Degraded	6	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species.

APPENDIX 9

Attributes recorded for feature classes contained within the consolidated mapping database

Vegetation Mapping

Field Name	Table Field Name
Survey Area	STUDY_AREA
Broad Floristic Formation	BROAD_FF
Vegetation Code	VEG_CODE
Vegetation Association	VEG_ASSOC
Vegetation Area (ha)	VEG_AREA
Landform	LANDFORM
Soil Type	SOIL_TYPE
Soil Colour	SOIL_COLOUR
Organisation Sampling	ORGANISATION_SAMPLING
Report title	REPORT_TITLE
Report Author	REPORT_AUTHOR
Publication Date	PUBLICATION_DATE

Sample Sites

Field Name	Table Field Name
Study Area	STUDY_AREA
Date Observed	OBSERVED
Observer Name	OBSERVER
Sampling Round Number	SAMPLING_ROUND
Sampling Method	SAMPLING_METHOD
Quadrat Number	QUADRAT_NUMBER
Quadrat Dimension	QUADRAT_DIMENSION_M_X_M
Quadrat Orientation	QUADRAT_ORIENTATION
GDA94 in Decimal Degrees (Latitude)	GCS_GDA_LATITUDE_DD
GDA94 in Decimal Degrees (Longitude)	GCS_GDA_LONGITUDE_DD
Broad Floristic Formation	BROAD_FLORISTIC_FORMATION
Vegetation Association	VEGETATION_ASSOCIATION
Trees >5m	TREES_GREATER_5m
Trees <5m	TREES_LESS_5m
Shrubs >2m	SHRUBS_GREATER_2m
Shrubs 1-2m	SHRUBS_1m_TO_2m
Shrubs 0.5-1m	SHRUBS_0_5_TO_1m
Shrubs <0.5m	SHRUBS_LESS_0_5m
Spinifex	SPINIFEX
Soft Grasses	SOFT_GRASSES
Sedges	SEDGES
Herbs	HERBS
Mistletoes	MISTLETOES
Vegetation Condition	VEGETATION_CONDITION
Growth Stage	GROWTH_STAGE
Landform	LANDFORM
Slope	SLOPE
Aspect	ASPECT
Soil Type	SOIL_TYPE
Soil Colour	SOIL_COLOUR
Rock Type	ROCK_TYPE
Leaf Litter % Cover	LEAF_LITTER_PERCENT_COVER
Logs % Cover	LOGS_PERCENT_COVER
Disturbance	DISTURBANCE
Comments	COMMENTS
Organisation Sampling	ORGANISATION_SAMPLING
Report Title	REPORT_TITLE
Report Author	REPORT_AUTHOR
Publication Date	PUBLICATION_DATE
Photograph Reference	PHOTO_REFERENCE

Flora

Field Name	Table Field Name
Study Area	STUDY_AREA
Date Observed	OBSERVED
Observer Name	OBSERVER
Sampling Round Number	SAMPLING_ROUND
Sampling Method	SAMPLING_METHOD
Quadrat Number	QUADRAT_NUMBER
GDA94 in Decimal Degrees (Latitude)	GCS_GDA_LATITUDE_DD
GDA94 in Decimal Degrees (Longitude)	GCS_GDA_LONGITUDE_DD
Genus	GENUS
Species	SPECIES
subsp. / var.	SUBSP_VAR
Common Name	COMMON NAME
Specimen Reference Number	SPECIMEN_REFERENCE_NUMBER
Voucher	VOUCHER
Voucher Number	VOUCHER_NUMBER
Native or Introduced	NATIVE_OR_INTRODUCED
% Coverage	COVERAGE_PERCENT
Number of Individuals	NUMBER_INDIVIDUALS
Count or Estimate	COUNT_OR_ESTIMATE
Growth Stage	GROWTH_STAGE
Growth Form	GROWTH_FORM
Perennial or Annual	PERENNIAL_OR_ANNUAL
Dominant Flower Colour	DOMINANT_FLOWER_COLOUR
Plant Height (m)	PLANT_HEIGHT_M
Conservation Status	CONSERVATION_STATUS
Organisation Sampling	ORGANISATION_SAMPLING
Report title	REPORT_TITLE
Report Author	REPORT_AUTHOR
Publication Date	PUBLICATION_DATE

Significant Flora

Field Name	Table Field Name
Study Area	STUDY_AREA
Date Observed	OBSERVED
Observer Name	OBSERVER
Sampling Round Number	SAMPLING_ROUND
Sampling Method	SAMPLING_METHOD
Quadrat Number	QUADRAT_NUMBER
GDA94 in Decimal Degrees (Latitude)	GCS_GDA_LATITUDE_DD
GDA94 in Decimal Degrees (Longitude)	GCS_GDA_LONGITUDE_DD
Genus	GENUS
Species	SPECIES
subsp. / var.	SUBSP_VAR
Common Name	COMMON NAME
Specimen Reference Number	SPECIMEN_REFERENCE_NUMBER
Voucher	VOUCHER
Voucher Number	VOUCHER_NUMBER
Verified by Steve Dillon	VERIFIED_BY_S_DILLON_WAH
Date Verified by Steve Dillon	DATE_VERIFIED_BY_S_DILLON_WAH
Native or Introduced	NATIVE_OR_INTRODUCED
% Coverage	COVERAGE_PERCENT
Population Area (m^2)	POPULATION_AREA_M2
Number of Individuals	NUMBER_INDIVIDUALS
Count or Estimate	COUNT_OR_ESTIMATE
Growth Stage	GROWTH_STAGE
Growth Form	GROWTH_FORM
Perennial or Annual	PERENNIAL_OR_ANNUAL
Dominant Flower Colour	DOMINANT_FLOWER_COLOUR
Plant Height (m)	PLANT_HEIGHT_M
Conservation Status	CONSERVATION_STATUS
EPBC Threatened Flora Listing	EPBC_LISTING
DPaW Priority Flora Listing	DPaW_PRIORITY_LISTING
Broad Floristic Formation	BROAD_FLORISTIC_FORMATION
Vegetation Association	VEGETATION_ASSOCIATION
Plant Width (cm)	PLANT_WIDTH_CM
Threats	THREATS
Reproductive Method	REPRODUCTIVE_METHOD
Specimen Maturity	SPECIMEN_MATURITY
Photograph Reference	PHOTOGRAPH_REFERENCE
Slope	SLOPE
Landform	LANDFORM
Soil Type	SOIL_TYPE
Soil Colour	SOIL_COLOUR
Organisation Sampling	ORGANISATION_SAMPLING
Report title	REPORT_TITLE
Report Author	REPORT_AUTHOR
Publication Date	PUBLICATION_DATE

Introduced Weeds

Field Name	Table Field Name
Study Area	STUDY_AREA
Date Observed	OBSERVED
Observer Name	OBSERVER
Sampling Round Number	SAMPLING_ROUND
Sampling Method	SAMPLING_METHOD
GDA94 in Decimal Degrees (Latitude)	GCS_GDA_LATITUDE_DD
GDA94 in Decimal Degrees (Longitude)	GCS_GDA_LONGITUDE_DD
Genus	GENUS
Species	SPECIES
subsp. / var.	SUBSP_VAR
Common Name	COMMON NAME
Specimen Reference Number	SPECIMEN_REFERENCE_NUMBER
Voucher	VOUCHER
Voucher Number	VOUCHER_NUMBER
Verified by Steve Dillon	VERIFIED_BY_S_DILLON_WAH
Date Verified by Steve Dillon	DATE_VERIFIED_BY_S_DILLON_WAH
Native or Introduced	NATIVE_OR_INTRODUCED
% Coverage	COVERAGE_PERCENT
Population Area (m^2)	POPULATION_AREA_M2
Number of Individuals	NUMBER_INDIVIDUALS
Count or Estimate	COUNT_OR_ESTIMATE
Growth Stage	GROWTH_STAGE
Growth Form	GROWTH_FORM
Perennial or Annual	PERENNIAL_OR_ANNUAL
Dominant Flower Colour	DOMINANT_FLOWER_COLOUR
Plant Height (m)	PLANT_HEIGHT_M
Weeed Importance State	WEED_IMPORTANCE_STATE
Weed of National Significance	WEED_OF_NATIONAL_SIGNIFICANCE
Broad Floristic Formation	BROAD_FLORISTIC_FORMATION
Vegetation Association	VEGETATION_ASSOCIATION
Plant Width (cm)	PLANT_WIDTH_CM
Reproductive Method	REPRODUCTIVE_METHOD
Specimen Maturity	SPECIMEN_MATURITY
Photograph Reference	PHOTOGRAPH_REFERENCE
Slope	SLOPE
Landform	LANDFORM
Soil Type	SOIL_TYPE
Soil Colour	SOIL_COLOUR
Organisation Sampling	ORGANISATION_SAMPLING
Report title	REPORT_TITLE
Report Author	REPORT_AUTHOR
Publication Date	PUBLICATION_DATE
Quadrat Number	QUADRAT_NUMBER

APPENDIX 10

Vegetation associations described and mapped as part of BHP Billiton Iron Ore's Consolidated Vegetation Mapping

Vegetation Map Code	Broad Floristic Formation	Vegetation Association	Area (ha)
		HILL CRESTS AND UPPER HILL SLOPES	
HC Tbr AiAmm	*Triodia* Closed Hummock Grassland	Closed Hummock Grassland of *Trioida brizoides* with Scattered Tall Shrubs of *Acacia inaequilatera* and *Acacia marramamba* on red sandy loam on hill crests	23.90
HC TpTw El NhrOs	*Triodia* Closed Hummock Grassland	Closed Hummock Grassland of *Triodia pungens* and *Triodia wiseana* with Low Open Woodland of *Eucalyptus leucophloia* subsp. *leucophloia* over Scattered Shrubs of *Newcastelia* sp. Hamersley Range (S. van Leeuwen 4264) and *Olearia stuartii* on brown silty loam on high sloping hill crest of Mount Robinson	61.96
HC TeTl ArAiAb	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia epactia* and *Trioida lanigera* with Open Shrubland of *Acacia robeorum, Acacia inaequilatera* and *Acacia bivenosa* on brown sandy loam on low dolerite/basalt hills	121.63
HC Te AiAanAarr	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia epactia* with High Open Shrubland of *Acacia inaequilatera* and *Acacia ancistrocarpa* over Low Open Shrubland of *Acacia arrecta* on brown sandy loam on low undulating hills	161.45
HC Te AdCc Gw	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia epactia* with Open Shrubland of *Abutilon* sp. Dioicum and *Cajanus cinereus* and Scattered Tall Shrubs of *Grevillea wickhamii* subsp. *hispidula* on brown silty loam on dolerite ridges	33.20
HC TpTwTs ElCh AarGoKv	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia pungens, Triodia wiseana* and *Triodia* sp. Shovelanna Hill (S. van Leeeuwin 3835) with Low Open Woodland of *Eucalyptus leucophloia* subsp. *leucophloia* and *Corymbia hamersleyana* over Low Shrubland of *Acacia arida, Gompholobium oreophilum* and *Keraudrinia velutina* subsp. *elliptica* on red brown loam on hills	5,284.70
HC Tw Ah EkEgCh	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia wiseana* with Shrubland of Acacia hamersleyensis and Open Mallee of *Eucalyptus kingsmillii* subsp. *kingsmillii, Eucalyptus gamophylla* and *Corymbia hamersleyana* (mallee form) on red brown loam and silty loam on hill crests	4,757.58
HC TwTbrTp ElCh AmaGwAb	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia wiseana, Triodia brizoides* and *Triodia pungens* with Low Open Woodland of *Eucalyptus leucophloia* subsp. *leucophloia* and *Corymbia hamersleyana* over High Open Shrubland of *Acacia maitlandii, Grevilllea wickhamii* subsp. *hispidula* and *Acacia bivenosa* on red brown sandy loam on hill crests and upper hill slopes	9,186.80
HC TwTsTp ElCh Ah	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia wiseana, Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835) and *Triodia pungens* with Low Open Woodland of *Eucalyptus leucophloia* subsp. *leucophloia* and *Corymbia hamerselyana* over Open Shrubland of *Acacia hamersleyensis* on red brown clay loam on hill crests and upper hill slopes	7,908.09
HC TpTs El AaAkAsi	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia pungens* and *Triodia* sp. Shovelanna Hill with Scattered Low Trees of *Eucalyptus leucophloia* subsp. *leucophloia* over Scattered Tall Shrubs of *Acacia aptaneura, Acacia kempeana* and *Acacia sibirica* on red brown loam on hill crests, hill slopes and breakaway slopes	952.34
HC TsTp EkEg	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia* sp. Shovelanna Hill and *Trioidia pungens* with Very Open Mallee of *Eucalyptus kingsmillii* subsp. *kingsmillii* and *Eucalyptus gamophylla* on red sandy loam on hill slopes and hill crests	1,193.96
HC Tw AiAb IrSao	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia wiseana* with High Open Shrubland of *Acacia inaequilatera* and *Acacia bivenosa* over Low Open Shrubland of *Indigofera rugosa* and *Senna artemisioides* subsp. *oligophylla* on red silty loam on dolerite hill crests	10,642.85

Vegetation Map Code	Broad Floristic Formation	Vegetation Association	Area (ha)
HC TbTp ElCh AmoApy	*Triodia* Open Hummock Grassland	Open Hummock Grassland of *Triodia basedowii* and *Triodia pungens* with Low Open Woodland of *Eucalyptus leucophloia* and *Corymbia hamersleyana* over Open Shrubland of *Acacia monticola* and *Acacia pyrifolia* var. *pyrifolia* on brown sandy loam on hill slopes and hill crests	277.84
HC TbTp El AatAmmAma	*Triodia* Open Hummock Grassland	Open Hummock Grassland of *Triodia basedowii* and *Triodia pungens* with Scattered Low Trees of *Eucalyptus leucophloia* subsp. *leucophloia* over Open Shrubland of *Acacia atkinsiana, Acacia marramamba* and *Acacia maitlandii* on brown sandy loam on hill crests and hill slopes	2,075.68
HC TsTp ElAa PcGs	*Triodia* Open Hummock Grassland	Open Hummock Grassland of *Triodia* sp. Shovelanna Hill and *Triodia pungens* with Low Open Woodland of *Eucalyptus leucophloia* subsp. *leucophloia* and *Acacia aptaneura* and Very Open Herbs of *Ptilotus calostachyus* and *Goodenia stobbsiana* on red brown sandy loam on hill crests and hill slopes	204.06
HC Tp AaAprAca EllEfrEex	*Triodia* Open Hummock Grassland	Open Hummock Grassland of *Triodia pungens* with High Open Shrubland of *Acacia aptaneura, Acacia pruinocarpa* and *Acacia catenulata* subsp. *occidentalis* over Open Shrubland of *Eremophila latrobei* subsp. *latrobei, Eremophila fraseri and Eremophila exilifolia* on orange red sandy loam on laterised hills and rises	185.66
		GORGES AND GULLIES	
GG CcoCfeEl EmuTmbCa	*Callitris* Low Open Forest	Low Open Forest of *Callitris columellaris*, *Corymbia ferriticola* and *Eucalyptus leucophloia* subsp. *leucophloia* over Open Tussock Grassland of *Eriachne mucronata, Themeda* sp. Mt Barricade (M.E. Trudgen 2471) and *Cymbopogon ambiguus* and Very Open Hummock Grassland of *Triodia pungens* on orange brown loam on upper gorges	582.91
GG AadAca AmuAaAte Tp	*Acacia* Low Open Forest	Low Open Forest of *Acacia adsurgens* and *Acacia catenulata* subsp. *occidentalis* over Open Shrubland of *Acacia mulganeura*, *Acacia aptaneura* and *Acacia tenuissima* over Very Open Hummock Grassland of *Triodia pungens* on skeletal red loams in deeply incised gullies	85.63
GG AaAcaEl DpaEtEj TpTw	*Acacia* Low Woodland	Low Woodland of *Acacia aptaneura, Acacia catenulata* subsp. *occidentalis* and *Eucalyptus leucophloia* subsp. *leucophloia* over Open Shrubland of *Dodonaea pachyneura, Eremophila tietkensii* and *Eremophila jucunda* subsp. *pulcherrima* over Open Hummock Grassland of *Triodia pungens* and *Triodia wiseana* on red brown loam on breakaway slopes, cliff lines and minor gorges	1,262.37
GG CfeElFb AhDvmAha CaEmuTmb	*Corymbia* Low Woodland	Low Woodland of *Corymbia ferriticola, Eucalyptus leucophloia* subsp. *leucophloia* and *Ficus brachypoda*over Open Shrubland of *Acacia hamersleyensis, Dodonaea viscosa* subsp. *mucronata* and *Astrotricha hamptonii* over Open Tussock Grassland of *Cymbopogon ambiguus, Eriachne mucronata* and *Themeda* sp. Mt Barricade on red brown loam along clifflines and gorges	3,588.29
GG TtEmuTmb ElChCfe AtpGrPl	*Themeda* Tussock Grassland	Tussock Grassland of *Themeda triandra, Eriachne mucronata* and *Themeda* sp. Mt Barricade with Low Open Woodland of *Eucalyptus leucophloia* subsp. *leucophloia, Corymbia hamersleyana* and *Corymbia ferriticola* over High Shrubland of *Acacia tumida* var. *pilbarensis, Gossypium robinsonii* and *Petalostylis labicheoides* on red brown sandy loam in narrowly incised rocky drainge lines	943.63
GG Tp ElCfe Dpa	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia pungens* with Low Woodland of *Eucalyptus leucophloia* subsp. *leucophloia* and *Corymbia ferriticola* over Open Shrubland of *Dodonaea pachyneura* on red brown sandy clay loam in gullies	53.81

Vegetation Map Code	Broad Floristic Formation	Vegetation Association	Area (ha)
GG Tp CfeFbAca DpaAh	*Triodia* Open Hummock Grassland	Open Hummock Grassland of *Triodia pungens* with Low Open Woodland of *Corymbia ferriticola, Ficus brachypoda* and *Acacia catenulata* subsp. *occidentalis* over High Open Shrubland of *Dodonea pachyneura* and *Acacia hamerselyensis* on red sandy clay loam in gullies and on breakaways	196.14
		HILL SLOPES AND LOW UNDULATING HILLS	
HS AcaAaApr SaEllAb TbrTw	*Acacia* Low Open Forest	Low Open Forest of *Acacia catenulata* subsp. *occidentalis, Acacia aptaneura* and *Acacia pruinocarpa* over Open Shrubland of *Scaevola acacioides, Eremophila latrobei* subsp. *latrobei* and *Acacia bivenosa* over Open Hummock Grassland of *Triodia brizoides* and *Triodia wiseana* on red brown clay loam on breakaways and steep hill slopes	3,137.73
HS AaApr EjAmmCco TwTp	*Acacia* Low Woodland	Low Woodland of *Acacia aptaneura* and *Acacia pruinocarpa* over Shrubland of *Eremophila jucunda* subsp. *pulcherrima, Acacia marramamba* and *Codonocarpus cotinifolius* over Open Hummock Grassland of *Triodia wiseana* and *Triodia pungens* on red brown loam on hill slopes	714.57
HS AaAh Sgl TaTp	*Acacia* High Shrubland	High Shrubland of *Acacia aptaneura* and *Acacia hamersleyensis* over Shrubland of *Senna glutinosa* subsp. *x luerssenii* over Very Open Hummock Grassland of *Triodia angusta* and *Triodia pungens* on red sandy loam on hill slopes	1.43
HS AaAteApr TaTp Ab	*Acacia* High Shrubland	High Shrubland of *Acacia aptaneura, Acacia tetragonophylla* and *Acacia pruinocarpa* over Open Hummock Grassland of *Triodia angusta* and *Triodia pungens* with Open Shrubland of *Acacia bivenosa* on brown sandy loam on rocky hill slopes	177.57
HS Aci Efr Tw	*Acacia* High Open Shrubland	High Open Shrubland of *Acacia citrinoviridis* with Open Shrubland of *Eremophila fraseri* over Very Open Hummock Grassland of *Triodia wiseana* on red brown clay loam with calcrete stones in two small stands on hills fringing the western edge of Weeli Wolli Creek	12.03
HS ArhEex Apr TsTw	*Acacia* Open Shrubland	Open Shrubland of *Acacia rhodophloia* and *Eremophila exilifolia with* High Open Shrubland of *Acacia pruinocarpa* over Open Hummock Grassland of *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835) and *Triodia wiseana* on red brown clay loam on the lower slope on a stony hill	1.86
HS AbAsy TseTaTb	*Acacia* Low Open Heath	Low Open Heath of *Acacia bivenosa* and *Acacia synchronicia* over Hummock Grassland of *Triodia secunda, Triodia angusta* and *Triodia basedowii* on brown sandy loam on stony lower slopes and plains	36.34
HS Tb El AbAiPl	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia basedowii* with Low Open Woodland of *Eucalyptus leucophloia* subsp. *leucophloia* over Open Shrubland of *Acacia bivenosa, Acacia inaequilatera* and *Petalostlyis labicheoides* on red brown sandy loam on hill slopes	146.07
HS TbTeTw AtpGw AanAbAac	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia basedowii, Triodia epactia* and *Triodia wiseana* over High Open Shrubland of *Acacia tumida* subsp. *pilbarensis* and *Grevillea wickhamii* over Low Open Shrubland of *Acacia ancistrocarpa, Acacia bivenosa* and *Acacia acradenia* on red brown silty/sandy loam on undulating low hills and stony plains	5,515.81
HS TbrTw El AbPoSgg	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia brizoides* and *Triodia wiseana* with Scattered Low Trees of *Eucalyptus leucophloia* subsp. *leucophloia* over Scattered Low Shrubs of *Acacia bivenosa, Ptilotus obovatus* and *Senna glutinosa* subsp. *glutinosa* on brown silty loam on scree slopes	156.97
HS TbrTeTw Ch Aac	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia brizoides*, *Triodia epactia* and *Triodia wiseana* with Low Open Woodland of *Corymbia hamersleyana* over High Open Shrubland of *Acacia acradenia* on brown silty loam on hill slopes	41.18

Vegetation Map Code	Broad Floristic Formation	Vegetation Association	Area (ha)
HS TeTw Ch AiAan	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia epactia* and *Triodia wiseana* with Low Open Woodland of *Corymbia hamersleyana* over High Open Shrubland of *Acacia inaequilatera* and *Acacia ancistrocarpa* on red brown sandy loam on granite and quartz hill slopes and footslopes	1,624.88
HS TeTbTw AorAi	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia epactia, Triodia basedowii* and *Triodia wiseana* with High Open Shrubland of *Acacia orthocarpa* and *Acacia inaequilatera* on brown loamy sand on low undulating granite hills	3,974.13
HS TpTb ElCh EmuElAh	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia pungens* and *Triodia basedowii* with Low Open Woodland of *Eucalyptus leucophloia* subsp. *leucophloia* and *Corymbia hamersleyana* over Open Tussock Grassland of *Eriachne mucronata, Eriachne lanata* and *Aristida holathera* subsp. *holathera* on red sandy loam on hill slopes	180.32
HS Tp AaGb AanAbAa	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia pungens* with High Open Shrubland of *Acacia aptaneura* and *Grevillea berryana* over Shrubland of *Acacia ancistrocarpa, Acacia bivenosa* and *Acacia aptaneura* on brown loamy sand on low undulating chert hills	5.59
HS Tp Ir Gp	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia pungens* with Low Shrubland of *Indigofera rugosa* and Scattered Low Trees of *Grevillea pyramidalis* on brown sandy loam on quartz and granite hill slopes	79.00
HS TpTbTe Ch Ai	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia pungens, Triodia basedowii* and *Triodia epactia* with Scattered Low Trees of *Corymbia hamersleyana* over Scattered Tall Shrubs of *Acacia inaequilatera* on brown sandy clay loam on dolerite hill slopes	1,286.71
HS TsTwTp ElCh AhiAad	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835), *Triodia wiseana* and *Triodia pungens* with Low Open Woodland of *Eucalyptus leucophloia* subsp. *leucophloia* and *Corymbia hamersleyana* over Low Open Shrubland of *Acacia hilliana* and *Acacia adoxa* var. *adoxa* on red brown sandy loam on hill slopes	42,184.16
HS Tw Cd AarAsiAb ArhAprAa	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia wiseana* with Low Open Woodland of *Corymbia deserticola* subsp. *deserticola* over Low Shrubland of *Acacia arrecta, Acacia sibirica* and *Acacia bivenosa* in red loamy sand on hill slopes with Low Open Woodland of *Acacia rhodophloia, Acacia pruinocarpa* and *Acacia aptaneura* on red sandy loam on rocky hill crests	908.66
HS Tw ElChHc AanAbAa	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia wiseana* with Low Open Woodland of *Eucalyptus leucophloia* subsp. *leucophloia, Corymbia hamersleyana* and *Hakea chordophylla* and Open Shrubland of *Acacia ancistrocarpa, Acacia bivenosa* and *Acacia aptaneura* on red sandy loam on hill slopes	3,631.58
HS TlTwTe AtpAerAcc AiAor	*Triodia* Hummock Grassland	Hummock Grassland of *Trioida lanigera, Triodia wiseana* and *Triodia epactia* with High Shrubland of *Acacia tumida* var. *pilbarensis, Acacia eriopoda* and *Acacia colei* var. *colei* in swales with High Open Shrubland of *Acacia inaequilatera* and *Acacia orthocarpa* on rises on red brown silty clay/sandy loam on undulating hills and swales	1,202.11
HS Tb	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia basedowii* on red sandy loam on low hills	198.29
HS TbrTw AiAprHc EfrEpl	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia brizoides* and *Triodia wiseana* with High Open Shrubland of *Acacia inaequilatera, Acacia pruinocarpa* and *Hakea chordophylla* over Open Shrubland of *Eremophila fraseri* and *Eremophila platycalyx* subsp. *pardalota* on red loamy sand on lower hill slopes and footslopes	16.82

Vegetation Map Code	Broad Floristic Formation	Vegetation Association	Area (ha)
HS Tbr El Er	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia brizoides* with Scattered Low Trees of *Eucalyptus leucophloia* subsp. *leucophloia* over Open Mallee of *Eucalyptus repullulans* on gently inclined low breakaway hill slope	29.88
HS TpTs CdEl AanAbAte	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia pungens* and *Triodia* sp. Shovelanna Hill with Low Open Woodland of *Corymbia deserticola* subsp. *deserticola* and *Eucalyptus leucophloia* subsp. *leucophloia* over Open Shrubland of *Acacia ancistrocarpa, Acacia bivenosa* and *Acacia tenuissima* on red loamy sand on hill slopes and footslopes	4,479.30
HS Tp Ama Tt	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia pungens* with Shrubland of *Acacia maitlandi*i over Very Open Tussock Grassland of *Themeda triandra* on brown loam on low basalt hills	71.39
HS TsTbrTb ElAa Ab	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835), *Triodia brizoides* and *Triodia basedowii* with Low Open Woodland of *Eucalyptus leucophloia* subsp. *leucophloia* and *Acacia aptaneura* over Open Shrubland of *Acacia bivenosa* on red loamy sand on hill slopes	131.54
HS TwTbrTs ElExCh PcaPasAhi	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia wiseana, Triodia brizoides* and *Triodia* sp. Shovellana Hill with Low Open Woodland of *Eucalyptus leucophloia* subsp. *leucophloia, Eucalyptus xerothermica* and *Corymbia hamersleyana* over Low Open Shrubland of *Ptilotus calostachyus, Ptilotus astrolasius* and *Acacia hilliana* on brown loam on eroded outcroping upper slopes and crests	13,910.33
HS TwTpTs El AprAaAan	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia wiseana, Triodia pungens* and *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835) with Low Open Woodland of *Eucalyptus leucophloia* subsp. *leucophloia* over Open Shrubland of *Acacia pruinocarpa, Acacia aptaneura* and *Acacia ancistrocarpa* on red brown loam on plains and low hills	1,321.63
HS TmTp ElCh MvSarKv	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia melvillei* and *Triodia pungens* with Low Open Woodland of *Eucalyptus leucophloia* subsp. *leucophloia* and *Corymbia hamersleyana* over Low Open Shrubland of *Mirbelia viminalis, Sida arenicola* and *Keraudrenia velutina* subsp*. elliptica* on red skeletal clay loam on steep slopes.	475.16
HS Ts	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835) on red brown sandy loam on hill slopes	1,724.82
HS TsTw Eg GwSggAb	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835) and *Triodia wiseana* with Very Open Mallee of *Eucalyptus gamophylla* over Open Shrubland of *Grevillea wickhamii* subsp. *hispidula, Senna glutinosa* subsp. *glutinosa* and *Acacia bivenosa* on red brown sandy clay loam on hill slopes	1,029.87
HS TsTp AaAprAci AaEllSgl	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia* sp. Shovelanna Hill and *Triodia pungens* with High Open Shrubland of *Acacia aptaneura, Acacia pruinocarpa* and *Acacia citrinoviridis* and Open Shrubland of *Acacia aptaneura, Eremophila latrobei* subsp. *latrobei, Senna glutinosa* subsp. x *luerssenii* on red loamy sand on upper hill slopes	1,535.13
HS TwTs HcAbGw AptAhi	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia wiseana* and *Triodia* sp. Shovelanna Hill with Open Shrubland of *Hakea chordophylla, Acacia bivenosa* and *Grevillea wickhamii* subsp. *hispidula* over Low Open Shrubland of *Acacia pytchophylla* and *Acacia hilliana* on red brown sandy loam on upper hill slopes and hill crests	1,120.26
HS TwTpTbr El Ep	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia wiseana, Triodia pungens* and *Triodia brizoides* with Low Open Woodland of *Eucalyptus leucophloia* subsp. *leucophloia* over Open Mallee of *Eucalyptus pilbarensis* on red brown loam on steep hill slopes	1,569.66

Vegetation Map Code	Broad Floristic Formation	Vegetation Association	Area (ha)
HS Tp El SggGwEll	*Triodia* Open Hummock Grassland	Hummock Grassland of *Triodia pungens* with Scattered Low Trees of *Eucalyptus leucophloia* subsp. *leucophloia* and Scattered Shrubs of *Senna glutinosa* subsp. *glutinosa, Grevillea wickhamii* subsp. *hispidula*and *Eremophila latrobei* subsp. *latrobei* on skeletal orange brown loam on stony hill slopes	379.68
HS TpTb ElAaAca SsSglEcu	*Triodia* Open Hummock Grassland	Open Hummock Grassland of *Triodia pungens* and *Triodia basedowii* with Low Open Woodland of *Eucalyptus leucophloia* subsp. *leucophloia, Acacia aptaneura* and *Acacia catenulata* subsp. *occidentalis* over Open Shrubland of *Senna stricta, Senna glutinosa* subsp. x *luerssenii* and *Eremophila cuneifolia* on orange sandy loam on hill slopes	72.67
HS TbTs AsyAaAte EcuMgSl	*Triodia* Open Hummock Grassland	Open Hummock Grassland of *Triodia basedowii* and *Triodia* sp. Shovelanna Hill with Open Shrubland of *Acacia synchronicia, Acacia aptanerua* and *Acacia tetragonophylla* over Low Open Shrubland of *Eremophila cuneifolia, Maireana georgei* and *Solanum lasiophyllum* on red sandy loam on floodplains and lower hill slopes	530.91
HS Tp AaApr EfrAmmSgl	*Triodia* Open Hummock Grassland	Open Hummock Grassland of *Triodia pungens* with Low Open Woodland of *Acacia aptaneura* and *Acacia pruinocarpa* over Open Shrubland of *Eremophila fraseri, Acacia marramamba* and *Senna glutinosa* subsp. x *luerssenii* on red brown loam on hills	304.60
HS TmeTp AprAcaAmu CaEmu	*Triodia* Open Hummock Grassland	Open Hummock Grassland of *Triodia* sp. Mt Ella and *Triodia pungens* with Low Open Woodland of *Acacia pruinocarpa, Acacia catenulata* subsp. *occidentalis* and *Acacia mulganeura* over Open Tussock Grassland of *Cymbopogon ambiguus* and *Eriachne mucronata* on red bown loam on very steep rivine slopes	632.13
HS TsTpTb AaAprAw AteEexEll	*Triodia* Open Hummock Grassland	Open Hummock Grassland of *Triodia* sp. Shovelanna Hill, *Triodia pungens* and *Triodia basedowii* with Low Open Woodland of *Acacia aptaneura, Acacia pruinocarpa* and *Acacia wanyu* and Open Shrubland of *Acacia tetragonophylla, Eremophila exilifolia* and *Eremophila latrobei* subsp. *latrobei* on red sandy loam on hill slopes	5,138.27
HS EliCa EfrAte ImDau	*Enneapogon* Tussock Grassland	Tussock Grassland of *Enneapogon lindleyanus* and *Cymbopogon ambiguus* with Shrubland of *Eremophila fraseri* and *Acacia tetragonophylla* over Low Shrubland of *Indigofera monophylla* and *Dipteracanthus australasicus* on brown sandy clay loam on mudstone outcrops and boulders on lower slopes of The Governor Range	159.76
HS Mosaic low granite hills	Mosaic: *Triodia* Hummock Grassland / Acacia High Open Shrubland	Mosaic: Hummock Grassland of *Triodia epactia, Triodia basebowii* and *Trioida wiseana* with High Shrubland of *Acacia orthocarpa* and *Acacia inaequilatera* in brown loamy sand on low undulating granite hills; High Open Shrubland of *Acacia tumida* var. *pilbarensis* with Scattered Low Trees of *Terminalia canescens* and *Ficus brachypoda* over Very Open Hummock Grassland of *Triodia epactia* over Very Open Tussock Grassland of *Tripogon loliiformis, Aristida contorta* and *Sporobolus australasicus* on skeletal brown sandy loam on granite plateau / sheet outcrops	497.77
HS Mosaic hill crests and slopes	Mosaic: Triodia Open Hummock Grassland/ Triodia Hummock Grassland	Mosaic: Open Hummock Grassland of *Triodia lanigera, Triodia basedowii* and *Triodia epactia* with Scattered Low Trees of *Eucalyptus leucophloia* subsp. *leucophloia* over Low Open Shrubland of *Acacia atkinsiana* and *Acacia bivenosa* in brown sandy loam on hill crests and hill slopes; Hummock Grassland of *Triodia basedowii* and *Triodia pungens* with Low Woodland of *Acacia aptaneura* on brown sandy clay loam in drainage basins and on plains	999.32
		FOOTSLOPES	
FS Tw El	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia wiseana* with Scattered Low Trees of *Eucalyptus leucophloia* subsp. *leucophloia* on red silty clay on hill slopes and footslopes	18.82

Vegetation Map Code	Broad Floristic Formation	Vegetation Association	Area (ha)
FS Ts CdHc AanAiGw	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835) with Low Open Woodland of *Corymbia deserticola* subsp. *deserticola* and Hakea chordophylla over Open Shrubland of *Acacia ancistrocarpa, Acacia inaequilatera* and *Grevillea wickhamii* subsp. *hispidula* on red brown sandy loam on footslopes and stony plains	43,900.73
FS TsTpTw El AbApaAan	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835), *Triodia pungens* and *Triodia wiseana* with Low Open Woodland of *Eucalyptus leucophloia* subsp. *leucophloia* and Open Shrubland of *Acacia bivenosa, Acacia pachyachra* and *Acacia ancistrocarpa* on red brown loam on footslopes and low undulating hills	6,748.88
		STONY PLAINS	
SP Ax SggSbSg ApeEobEx	*Acacia* Low Open Forest	Low Open Forest of *Acacia xiphophylla* over Low Scattered Shrubs of *Senna glutinosa* subsp. *glutinosa, Streptoglossa bubakii* and *Senna glaucifolia* over Scattered Tussock Grasses of *Astrebla pectinata, Eriachne obtusa* and *Eragrostis xerophila* on red brown medium clay on basalt plains	164.09
SP AaApr TmTwTp TtCfAin	*Acacia* Low Open Forest	Low Open Forest of *Acacia aptaneura* and *Acacia pruinocarpa* over Open Hummock Grassland of *Triodia melvilei, Triodia wiseana* and *Triodia pungens* over Tussock Grassland of *Themeda triandra, Chrysopogon fallax* and *Aristida inaequiglumis* on red brown loam on plains	7,638.46
SP AcaAa AobDamCf	*Acacia* Low Open Forest	Low Open Forest of *Acacia catenulata* subsp. *occidentalis* and *Acacia aptaneura* over Very Open Tussock Grassland of *Aristida obscura, Digitaria ammophila* and *Chrysopogon fallax* on red brown clay loam on stony lower plains	88.65
SP AxAa EffAteAsy CfAcoSau	*Acacia* Low Open Forest	Low Open Forest of *Acacia xiphophylla* and *Acacia aptaneura* over Open Shrubland of *Eremophila forrestii* subsp. *forrestii, Acacia tetragonophylla* and *Acacia synchronicia* over Very Open Tussock Grassland of *Chrysopogon fallax, Aristida contorta* and *Sporobolus australasicus* on red brown sandy clay loam on stony plains	1,701.40
SP AaAanApr TeTs EffGbDpe	*Acacia* Low Open Forest	Low Open Forest of *Acacia aptaneura, Acacia aneura x ayersiana* and *Acacia pruinocarpa* over Hummock Grassland of *Triodia epactia* and *Triodia* sp. Shovelanna Hill with Open Shrubland of *Eremophila forrestii* subsp. *forrestii, Grevillea berryana* and *Dodonaea petiolaris* on red brown loamy sand on stony plains	354.25
SP Aa EfrSgl TtAco	*Acacia* Low Woodland	Low Woodland of *Acacia aptaneura* over High Shrubland of *Eremophila fraseri* and *Senna glutinosa* subsp. x *luerssenii* over Very Open Tussock Grassland of *Themeda triandra* and *Aristida contorta* on red brown clay loam on stony dolerite drainage plains	25.68
SP AprAa AiAb Ts	*Acacia* Low Woodland	Low Woodland of *Acacia pruinocarpa* and *Acacia aptaneura* over Scattered Shrubs of *Acacia inaequilatera* and *Acacia bivenosa* over Open Hummock Grassland of *Triodia* sp. Shovelanna Hill on red brown clay loam on stony plains	2.01
SP ChEoCd AanApaAad TbTscTs	*Corymbia* Low Open Woodland	Low Open Woodland of *Corymbia hamersleyana, Eucalyptus odontocarpa* and *Corymbia deserticola* subsp. *deserticola* over Open Shrubland of *Acacia ancistrocarpa, Acacia pachyacra* and *Acacia adsurgens* over Open Hummock Grassland of *Triodia basedowii, Triodia schinzii* and *Triodia* sp. Shovelanna Hill on red brown sandy loam on footslopes and stony plains	123.41
SP AaAprAx Eff Tp	*Acacia* Low Open Woodland	Low Open Woodland of *Acacia aptaneura, Acacia pruinocarpa* and *Acacia xiphophylla* over Open Shrubland of *Eremophila forrestii* subsp. *forrestii* over Open Hummock Grassland of *Triodia pungens* on red brown sandy clay loam on stony plains	17.87

Vegetation Map Code	Broad Floristic Formation	Vegetation Association	Area (ha)
SP TpTb Eg PlAbAan	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia pungens* and *Triodia basedowii* with Open Mallee of *Eucalyptus gamophylla* and Shrubland of *Petalostylis labicheoides, Acacia bivenosa* and *Acacia ancistrocarpa* on red brown loamy sand on stony plains and footslopes	2,393.65
SP AsyAxAa AbuMp CcCsCf	*Acacia* Open Scrub	Open Scrub of *Acacia synchronicia, Acacia xiphophylla* and *Acacia aptaneura* over Low Shrubland of *Atriplex bunburyana* and *Maireana pyramidata* over Very Open Tussock Grassland of **Cenchrus ciliaris, *Cenchrus setiger* and *Chrysopogon fallax* on brown silty clay loam on stony plains	638.63
SP TbTp HlAanAi Ch	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia basedowii* and *Triodia pungens* with High Open Shrubland of *Hakea lorea* subsp. *lorea, Acacia ancistrocarpa* and *Acacia inaequilatera* and Scattered Low Trees of *Corymbia hamersleyana* on red brown loamy sand on stony plains	2,0562.78
SP Tb AaApr AwAanAi	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia basedowii* with Low Open Woodland of *Acacia aptaneura* and *Acacia pruinocarpa* over Open Shrubland of *Acacia wanyu, Acacia ancistrocarpa* and *Acacia inaequilatera* on red brown silty loam on stony plains	349.30
SP TlTe Ai AanAb	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia lanigera* and *Triodia epactia* with High Open Shrubland of *Acacia inaequilatera* over Low Open Shrubland of *Acacia ancistrocarpa* and *Acacia bivenosa* on orange loamy sand on sandy plains	4,135.84
SP TpTb AccAi AccAan	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia pungens* and *Triodia basedowii* with High Open Shrubland of *Acacia colei* var. *colei* and *Acacia inaequilatera* over Shrubland of *Acacia colei* var. *colei* and *Acacia ancistrocarpa* on red brown sandy loam on stony plains	1,664.14
SP TpTwTs EfrSgpSao	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia pungens, Triodia wiseana* and *Triodia* sp. Shovelanna Hill with Open Shrubland of *Eremophila fraseri, Senna glutinosa* subsp. *pruinosa* and *Senna artemisioides* subsp. *oligophylla* on red brown loamy sand on stony plains and hill slopes	370.00
SP Ts Ai	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835) with High Open Shrubland of *Acacia inaequilatera* on red brown loamy sand on hill slopes and stony plains	1,441.38
SP Tb AbAprAad	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia basedowii* with Shrubland of *Acacia bivenosa, Acacia pruinocarpa* and *Acacia adsurgens* on red loamy sand on stony plains	366.41
SP TsTwTp EgEt AbApaApr	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835), *Triodia wiseana* and *Triodia pungens* with Very Open Mallee of *Eucalyptus gamophylla* and *Eucalyptus trivalva* over Open Shrubland of *Acacia bivenosa, Acacia pachyacra* and *Acacia pruinocarpa* on red brown sandy loam and clay loam on stony plains	4,301.32
SP TpTm AaExAca ApaEffAad	*Triodia* Open Hummock Grassland	Hummock Grassland of *Triodia pungens* and *Triodia melvillei* with Low Open Woodland of *Acacia aptaneura, Eucalyptus xerothermica* and *Acacia catenulata* subsp. *occidentalis* and Open Shrubland of *Acacia pachyacra, Eremophila forrestii* subsp. *forrestii* and *Acacia adsurgens* on red brown clay loam or silty loam on stony plains and floodplains	34,872.97
SP ApeAinSau SfiCtrTbc Oa	*Astrebla* Tussock Grassland	Tussock Grassland of *Astrebla pectinata, Aristida inaequiglumis* and *Sporobolus australasicus* with Low Open Shrubland of *Sida fibulifera, Corchorus trilocularis* and *Tephrosia* sp. Bungaroo Creek (M.E. Trudgen 11601) and Open Herbs of *Operculina aequisepala* on brown medium clay on basalt plains	837.54

Vegetation Map Code	Broad Floristic Formation	Vegetation Association	Area (ha)
SP CcAbu AaAbGs MgMmPn	**Cenchrus* Open Tussock Grassland	Open Tussock Grassland of **Cenchrus ciliaris* and *Aristida burbidgeae* with High Open Shrubland of *Acacia aptaneura, Acacia bivenosa* and *Grevillea striata* and Low Open Shrubland of *Maireana georgei, Maireana melanocoma* and *Ptilotus notabilis* on brown clay loam on stony plains and floodplains	28.41
SP DrhThiPae	*Dysphania* Herbs	Herbs of *Dysphania rhadinostachya, Tribulus hirsutus* and *Ptilotus aervoides* on brown clay on undulating stony plains	17.14
SP Mosaic granite / calcrete	Mosaic: *Triodia* Hummock Grassland/ Acacia High Open Shrubland	Mosaic: Hummock Grassland of *Triodia longiceps, Triodia angusta* and *Triodia wiseana* with Low Open Shrubland of *Acacia bivenosa, Acacia stellaticeps* and *Pluchea ferdinandi-muelleri* on brown sandy clay loam on stony calcrete plains; High Open Shrubland of *Acacia tumida* var. *pilbarensis* with Very Open Hummock Grassland of *Triodia epactia* over Very Open Tussock Grassland of *Tripogon loliiformis* on skeletal brown sandy clay loam on granite plateau / sheet outcrops	894.42
		GRANITE OUTCROPS AND ROCK PILES	
GR Atp Te TloAcoSau	*Acacia* High Open Shrubland	High Open Shrubland of *Acacia tumida* subsp. *pilbarensis* over Very Open Hummock Grassland of *Triodia epactia* and Very Open Tussock Grassland of *Tripogon loliiformis, Aristida contorta* and *Sporobolus australasicus* (with Scattered Low Trees of *Terminalia canescens* and *Ficus brachypoda)* on skeletal brown sandy loam on granite plateaux / sheet outcrops	61.72
GR Te AdTmaCci PclCc	*Triodia* Open Hummock Grassland	Open Hummock Grassland of *Triodia epactia* with Open Shrubland of *Abutilon* sp. Dioicum, *Triumfetta maconochieana* and *Cajanus cinereus* over Very Open Tussock Grassland of *Paspaidium clementii* and **Cenchrus ciliaris* on skeletal brown loamy sand on granite rockpiles	557.63
		FLOOD PLAINS	
FP AaEv EbEa Mf	*Acacia* Closed Forest	Closed Forest of *Acacia aptaneura* and *Eucalyptus victrix* over Open Tussock Grassland of *Eriachne benthamii* and *Eulalia aurea* with Open Shrubland of *Muehlenbeckia florulenta* on red brown clay on low-lying plains	134.57
FP AaEv EaEb Mf	*Acacia* Open Forest	Open Forest of *Acacia aptaneura* and *Eucalyptus victrix* over Open Tussock Grassland of *Eulalia aurea* and *Eriachne benthamii* with Open Shrubland of *Muehlenbeckia florulenta* on red brown clay loam on alluvial plains	1,853.40
FP Aa CfCc PlaEla	*Acacia* Low Closed Woodland	Low Closed Woodland of *Acacia aptaneura* over Very Open Tussock Grassland of *Chrysopogon fallax* and **Cenchrus ciliaris* with Scattered Shrubs of *Psydrax latifolia and Eremophila lanceolata* on red/brown clay loam on plains	102.12
FP AaApr EcuClSp TpTw	*Acacia* Low Open Forest	Low Open Forest of *Acacia aptaneura* and *Acacia pruinocarpa* over with Low Open Shrubland of *Eremophila cuneifolia, Corchorus lasiocarpus* subsp. *parvus* and *Solanum phlomoides* over Hummock Grassland of *Triodia pungens* and *Triodia wiseana* on red brown clay loam on stony flood plain	265.02
FP AaCa Mv Tm	*Acacia* Low Open Forest	Low Open Forest of *Acacia aptaneura* and *Corymbia aspera* over Low Open Shrubland of *Maireana villosa* over Open Hummock Grassland of *Triodia melvillei* on red brown cracking clays and alluvial loams on floodplains	482.00
FP AayAaApt Tp Cc	*Acacia* Low Open Forest	Low Open Forest of *Acacia ayersiana, Acacia aptanerua* and *Acacia pteraneura* over Hummock Grassland of *Triodia pungens* and Open Tussock Grassland of **Cenchrus ciliaris* on red brown silty clay on floodplains	11.63
FP AaApaApt TtCfEb	*Acacia* Low Open Forest	Low Open Forest of *Acacia aptaneura, Acacia paraneura* and *Acacia pteraneura* over Open Tussock Grassland of *Themeda triandra, Chrysopogon fallax* and *Eriachne benthamii* on red brown clay loam on plains	1,0214.10

Vegetation Map Code	Broad Floristic Formation	Vegetation Association	Area (ha)
FP AciAa Cc Bb	*Acacia* Low Open Forest	Low Open Forest of *Acacia citrinoviridis* and *Acacia aptanerua* over Tussock Grassland of **Cenchrus ciliaris* over Open Herbs of **Bidens bipinnata* on red brown loamy sand on floodplains	2.02
FP CcaCa AtpAcc Tp	*Corymbia* Low Woodland	Low Woodland of *Corymbia candida* and *Corymbia aspera* over Shrubland of *Acacia tumida* var. *pilbarensis* and *Acacia colei* var. *colei* over Open Hummock Grassland of *Triodia pungens* on brown medium clay on floodplains	73.50
FP AaAprAci ReAa CcCfAin	*Acacia* Low Woodland	Low Woodland of *Acacia aptaneura, Acacia pruinocarpa* and *Acacia citrinoviridis* over Open Shrubland of *Rhagodia eremaea* and *Acacia aptaneura* over Open Tussock Grassland of **Cenchrus ciliaris, Chrysopogon fallax* and *Aristida ingrata* on red loam on floodplains	599.90
FP ApaAaApr AsyEffPo CcAinAco	*Acacia* Low Woodland	Low Woodland of *Acacia paraneura, Acacia aptaneura* and *Acacia pruinocarpa* over Open Shrubland of *Acacia synchronicia, Eremophila forrestii* subsp. *forrestii* and *Ptilotus obovatus* over Open Tussock Grassland of **Cenchrus ciliaris, Aristida inaequiglumis* and *Aristida contorta* on red brown loam on floodplains	328.22
FP AaAprAca EffDpeSe AcoDamAin	*Acacia* Low Woodland	Low Woodland of *Acacia aptanerua, Acacia pruinocarpa* and *Acacia catenulata* subsp. *occidentalis* over Open Shrubland of *Eremophila forrestii* subsp. *forrestii, Dodonaea petiolaris* and *Sida ectogama* over Open Tussock Grassland of *Aristida contorta, Digitaria ammophila* and *Aristida inaequiglumis* on red orange clay loam on floodplains	1,475.17
FP AcaAaEx Eff Tp	*Acacia* Low Woodland	Low Woodland of *Acacia catenulata* subsp. *occidentalis, Acacia aptaneura* and *Eucalyptus xerothermica* over Open Shrubland of *Eremophila forrestii* subsp. *forrestii* over Open Hummock Grassland of *Triodia pungens* on red sandy loam on floodplains	5,019.73
FP AciChAa AanApyPl TtAinCc	*Acacia* Low Woodland	Low Woodland of *Acacia citrinoviridis, Corymbia hamersleyana* and *Acacia aptanerua* over High Shrubland of *Acacia ancistrocarpa, Acacia pyrifolia* var. *pyrifolia* and *Petalostylis labicheoides* over Very Open Tussock Grassland of *Themeda triandra, Aristida inaequiglumis* and **Cenchrus ciliaris* on brown sandy loam on floodplains and medium drainage lines	456.62
FP Ev Aa EaEbTt	*Acacia* Low Woodland	Woodland of *Eucalyptus victrix* over Low Woodland of *Acacia aptaneura* over Open Tussock Grassland of *Eulalia aurea, Eriachne benthamii* and *Themeda triandra* on orange clay loam on alluvial plains	122.62
FP AaEv Mf EaEbAco	*Acacia* Low Woodland	Low Woodland of *Acacia aptaneura* and *Eucalyptus victrix* with Scattered Shrubs of *Muehlenbeckia florulenta* over Open Tussock Grassland of *Eulalia aurea, Eriachne benthamii* and *Aristida contorta* on orange brown clay loam on alluvial plains	182.22
FP AaAcaApa ElaSlPo AcoEdAj	*Acacia* Low Open Woodland	Low Open Woodland of *Acacia aptaneura, Acacia catenulata* subsp. *occidentalis* and *Acacia paraneura* over Low Open Shrubland of *Eremophila lanceolata, Solanum lasiophyllum* and *Ptilotus obovatus* over Very Open Tussock Grassland of *Aristida contorta, Eragrostis dielsii and Aristida jerichoensis* var. *subspinulifera* on red brown clay loam on hardpan intergrove plains	5,761.48
FP AaAprCh EfrAteDpe AinCfAco	*Acacia* Low Open Woodland	Low Open Woodland of *Acacia aptaneura, Acacia pruinocarpa* and *Corymbia hamersleyana* with Open Shrubland of *Eremophila fraseri, Acacia tetragonophylla* and *Dodonea petiolaris* over Tussock Grassland of *Aristida inaequiglumis, Chrysopogon fallax* and *Aristida contorta* on red sandy loam on floodplains	1,343.83

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FP Ax AsyRe MpMtScu	*Acacia* Low Open Woodland	Low Open Woodland of *Acacia xiphophylla* over High Open Shrubland of *Acacia synchronicia* and *Rhagodia eremaea* over Low Open Shrubland of *Maireana pyramidata, Maireana triptera* and *Sclerolaena cuneata* on red brown sandy clay loam on floodplains	463.57
FP AaAciApr AsyAscAb Tp	*Acacia* Low Open Woodland	Low Open Woodland of *Acacia aptaneura, Acacia citrinoviridis* and *Acacia pruinocarpa* over Open Shrubland of *Acacia synchronicia, Acacia sclerosperma* subsp. *sclerosperma* and *Acacia bivenosa* over Very Open Hummock Grassland of *Triodia pungens* on red brown clay loam on floodplains and medium drainage lines	4,054.54
FP AsuAaArh EcoEcaEff AcoEpo	*Acacia* High Open Shrubland	High Open Shrubland of *Acacia subcontorta, Acacia aptaneura* and *Acacia rhodophloia* over Low Open Shrubland of *Eremophila compacta* subsp. *compacta, Eremophila caespitosa* and *Eremophila forrestii* subsp. *forrestii* over Very Open Tussock Grassland of *Aristida contorta* and *Enneapogon polyphyllus* on red loam on hardpan plains	216.98
FP Aa Ch TtCfAco	*Acacia* High Shrubland	High Shrubland of *Acacia aptaneura* with Low Open Woodland of *Corymbia hamersleyana* over Open Tussock Grassland of *Themeda triandra, Chrysopogon fallax* and *Aristida contorta* on red loamy sand on floodplains	1.81
FP AaAscAan Tp	*Acacia* High Shrubland	High Shrubland of *Acacia aptaneura, Acacia sclerosperma* subsp. *sclerosperma* and *Acacia ancistrocarpa* over Very Open Hummock Grassland of *Triodia pungens* on red brown sandy loam on floodplains and drainage lines	709.03
FP AbApr Tp AcoSau	*Acacia* High Shrubland	High Shrubland of *Acacia bivenosa* and *Acacia pruinocarpa* over Open Hummock Grassland of *Triodia pungens* and Very Open Hummock Grassland of *Aristida contorta* and *Sporobolus australasicus* on brown loam on stony dolerite floodplains and outwash zones	108.58
FP ApaAa Efr TsTp	*Acacia* High Open Shrubland	High Open Shrubland of *Acacia paranerua* and *Acacia aptaneura* over Open Shrubland of *Eremophila fraseri* over Very Open Hummock Grassland of *Triodia* sp. Shovelanna Hill and *Triodia pungens* on red clay loam on floodplains and stony plains	5,804.95
FP Ast AtrHl TbTp	*Acacia* Low Open Heath	Low Open Heath of *Acacia stellaticeps* with High Shrubland of *Acacia trachycarpa* and *Hakea lorea* subsp. *lorea* and Open Hummock Grassland of *Triodia basedowii* and *Triodia pungens* on orange brown sand on floodplains	48.85
FP PfmPrCl Ta SauCpePd	*Pluchea* Low Shrubland	Low Shrubland of *Pluchea ferdinandi-muelleri, Pluchea rubelliflora* and *Carrissa lanceolata* over Open Hummock Grassland of *Triodia angusta* and Very Open Tussock Grassland of *Sporobolus australasicus, Chloris pectinata* and *Panicum decompositum* on grey medium clay on crusting plains	52.62
FP EcuFsRe AsyMtSas Aa	*Eremophila* Low Open Shrubland	Low Open Shrubland of *Eremophila cuneifolia*, *Frankenia* sp. (indet) and *Rhagodia eremaea* with Open Shrubland of *Acacia synchronicia , Maireana ? tomentosa* subsp. *tomentosa* and *Senna artemisioides* subsp. x *sturtii* and Scattered Low Trees of *Acacia aptaneura* on orange sandy clay loam on floodplains	79.43
FP MtPoSc AxAsy AinCc	*Maireana* Low Open Shrubland	Low Open Shrubland of *Maireana triptera, Ptilotus obovatus* and *Sclerolaena cuneata* with Scattered Low Trees of *Acacia xiphophylla* and *Acacia synchronicia* and Scattered Tussock Grasses of *Aristida inaequiglumis* and **Cenchrus ciliaris* on red sandy clay loam on wind scalded plains	75.19
FP Ths Ca PoSau	*Themeda* Closed Tussock Grassland	Closed Tussock Grassland of *Themeda* sp. Hamersley Station (M.E. Trudgen 11431) with Low Open Woodland of *Corymbia aspera* over Low Open Shrubland of *Ptilotus obovatus* and *Salsola australis* on orange light clay on level flood plains	63.38

Vegetation Map Code	Broad Floristic Formation	Vegetation Association	Area (ha)
FP TtEa ExAa AprAtpElo	Themeda *Tussock Grassland*	Tussock Grassland of *Themeda triandra* and *Eulalia aurea* with Low Woodland of *Eucalyptus xerothermica* and *Acacia aptaneura* over Open Shrubland of *Acacia pruinocarpa, Acacia tumida* var. *pilbarensis* and *Eremophila longifolia* on red brown clay loam on unincised drainage lines and floodplains	1,934.84
FP TtEaCc ChEx AdAaAmc	*Themeda* Tussock Grassland	Tussock Grassland of *Themeda triandra, Eulalia aurea* and **Cenchrus ciliaris* with Low Open Woodland of *Corymbia hamersleyana* and *Eucalyptus xerothermica* over High Open Shrubland of *Acacia dictyophleba, Acacia ancistrocarpa* and *Acacia macraneura* on brown silty clay loam on floodplains	53.45
FP TlTp AscAbMg	*Triodia* Closed Hummock Grassland	Closed Hummock Grassland of *Triodia longiceps* and *Triodia pungens* with Shrubland of *Acacia sclerosperma* subsp. *sclerosperma, Acacia bivenosa* and *Melaleuca glomerata* on brown sandy clay loam on undulating floodplains	382.48
FP TbTp AaGb Go	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia basedowii* and *Triodia pungens* with Low Woodland of *Acacia aptaneura* and *Grevillea berryana* over Low Open Shrubland of *Gompholobium oreophilum* on brown sandy clay loam on drainage depressions	206.29
FP Tb AaApr Eff	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia basedowii* with Low Open Woodland of *Acacia aptaneura* and *Acacia pruinocarpa* over Open Shrubland of *Eremophila forrestii* subsp. *forrestii* on red sandy loam on floodplains	2,834.23
FP Tp ChApr GwApyAb	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia pungens* with Scattered Low Trees of *Corymbia hamersleyana* and *Acacia pruinocarpa* over Open Shrubland of *Grevillea wickhamii* subsp. *hispidula, Acacia pyrifolia* var. *pyrifolia* and *Acacia bivenosa* on brown loamy sand on floodplains	145.73
FP Tp EtEg AbAanPl	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia pungens* with Very Open Mallee of *Eucalyptus trivalva* and *Eucalyptus gamophylla* over Shrubland of *Acacia bivenosa, Acacia ancistrocarpa* and *Petalostylis labicheoides* on red brown loam on uninsised drainage tracts on stony plains	332.45
FP TsTl AbAsPfm	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia secunda* and *Triodia longiceps* with Low Open Shrubland of *Acacia bivenosa, Acacia stellaticeps* and *Pluchea ferdinandi-muelleri* on orange sandy clay loam on stony floodplains	1,588.92
FP Ts Eg AayAaAca	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835) with Scattered Mallees of *Eucalyptus gamophylla* over High Shrubland of *Acacia ayersiana*, *Acacia aptaneura* and *Acacia catenulata* subsp. *occidentalis* on red brown loam on floodplains.	9.73
FP TscTp ExAaApr AteAscGw	*Triodia* Open Hummock Grassland	Open Hummock Grassland of *Triodia schinzii* and *Triodia pungens* with Low Open Woodland of *Eucalyptus xerothermica, Acacia aptaneura* and *Acacia pruinocarpa* over Scattered Shrubs of *Acacia tetragonophylla, Acacia sclerosperma* subsp. *sclerosperma* and *Grevillea wickhamii* subsp. *hispidula* on red brown clay loam on floodplains	69.53
FP CcCs ChAa AtpAan	**Cenchrus* Closed Tussock Grassland	Closed Tussock Grassland of **Cenchrus ciliaris* and **Cenchrus setiger* with Low Open Woodland of *Corymbia hamersleyana* and *Acacia aptaneura* and Open Shrubland of *Acacia tumida* var. *pilbarensis* and *Acacia ancistrocarpa* on red brown silty loam on floodplains	38.01
FP Cc ApyAsyApr	**Cenchrus* Tussock Grassland	Tussock Grassland of **Cenchrus ciliaris* with Shrubland of *Acacia pyrifolia* var. *pyrifolia, Acacia synchronicia* and *Acacia pruinocarpa* on brown sand or loamy sand on floodplains	1,288.63
FP EbEa Hl Acc	*Eriachne* Tussock Grassland	Tussock Grassland of *Eriachne benthamii* and *Eulalia aurea* with High Open Shrubland of *Hakea lorea* subsp. *lorea* over Open Shrubland of *Acacia colei* var. *colei* on brown medium clay on floodplains	3.13

Vegetation Map Code	Broad Floristic Formation	Vegetation Association	Area (ha)
FP EbEaTt Ev Mf	*Eriachne* Tussock Grassland	Tussock Grassland of *Eriachne benthamii, Eulalia aurea* and *Themeda triandra* with Woodland of *Eucalyptus victrix* over Open Shrubland of *Muehlenbeckia florulenta* on orange brown loamy clay on alluvial plains	941.29
FP EaEbTt EvAa Mf	*Eulalia* Tussock Grassland	Tussock Grassland of *Eulalia aurea, Eriachne benthamii* and *Themeda triandra* with Woodland of *Eucalyptus victrix* and *Acacia aptaneura* over Open Shrubland of *Muehlenbeckia florulenta* on red brown clay loam on alluvial plains	31.15
FP AlaEseApe SfSh	*Aristida* Open Tussock Grassland	Open Tussock Grassland of *Aristida latifolia, Eragrostis setifolia* and *Astrebla pectinata* with Scattered Low Shrubs of *Senna ferraria* and *Senna hamersleyensis* over Open Herbs on red loam on floodplains	12.30
FP CfEaEo ChCca GwCci	*Chrysopogon* Open Tussock Grassland	Open Tussock Grassland of *Chrysopogon fallax, Eulalia aurea* and *Eriachne obtusa* with Low Open Woodland of *Corymbia hamersleyana* and *Corymbia candida* over High Open Shrubland of *Grevillea wickhamii* subsp. *hispidula* and *Cajanus cinereus* on red silty loam on floodplains	125.39
FP Cc Sco	**Cenchrus* Scattered Tussock Grasses	Scattered Tussock Grasses of **Cenchrus ciliaris* over Scattered Herbs of *Sclerolaena cornishiana* on pale brown sitly clay on floodplains	26.77
FP Mosaic mulga snakewood	Mosaic: Acacia Low Open Woodland/ Acacia Low Woodland	Mosaic: Low Woodland of *Acacia paraneura, Acacia aptaneura* and *Acacia pruinocarpa* over Open Shrubland of *Acacia synchronicia, Eremophila forrestii* subsp. *forrestii* and *Ptilotus obovatus* over Very Open Tussock Grassland of **Cenchrus ciliaris;* Low Open Woodland of *Acacia xiphophila* over High Open Shrubland of *Acacia synchronicia* and *Rhagodia eremaea* over Low Open Shrubland of *Maireana pyramidata, Maireana triptera* and S*clerolaena cuneata* on red loamy sand on plains	160.80
FP Mosaic snakewood angusta	Mosaic: Acacia Low Open Woodland/ Triodia Closed Hummock Grassland	Mosaic: Low Open Woodland of *Acacia xiphophila* over High Open Shrubland of *Acacia synchronica* and *Rhagodia eremaea* over Low Open Shrubland of *Maireana pyramidata;* Closed Hummock Grassland of *Triodia angusta* on red brown sandy clay loam on undulating plains	64.15
		SAND DUNES	
SD TscTb Ad CtCcuSc	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia schinzii* and *Triodia basedowii* with High Open Shrubland of *Acacia dictyophleba* over Low Open Shruland of *Corchorus tectus, Crotalaria cunninghamii* and *Sida cardiophylla* on red sand on linear sand dunes	62.03
		SAND PLAINS	
SA Aa TpTwTb CcCf	*Acacia* Low Open Forest	Low Open Forest of *Acacia aptaneura* over Open Hummock Grassland of *Triodia pungens, Triodia wiseana* and *Triodia basedowii* over Open Tussock Grassland of **Cenchrus ciliaris* and *Chrysopogon fallax* on red brown sandy loam on sandy plains and undulating hills	44.58
SA ChAprGs GstApaAan TbTsc	*Corymbia* Low Open Woodland	Low Open Woodland of *Corymbia hamersleyana, Acacia pruinocarpa* and *Grevillea striata* over High Open Shrubland of *Grevillea stenobotrya, Acacia pachyacra* and *Acacia ancistrocarpa* over Very Open Hummock Grassland of *Triodia basedowii* and *Triodia schinzii* on red sandy loam on sand plains	19.44
SA Ast Tsc AtpAccMl	*Acacia* Low Open Heath	Low Open Heath of *Acacia stellaticeps* over Hummock Grassland of *Triodia schinzii* with High Open Shrubland of *Acacia tumida* var. *pilbarensis, Acacia colei* var. *colei* and *Melaleuca lasiandra* on red brown loamy sand on sandplains	1,170.07

Vegetation Map Code	Broad Floristic Formation	Vegetation Association	Area (ha)
SA SahCpEla HlAmc AcoPclEar	*Senna* Low Open Shrubland	Low Open Shrubland of *Senna artemisioides* subsp. *helmsii, Chrysocephalum pterochaetum* and *Eremophila lanceolata* with Scattered Tall Shrubs of *Hakea lorea* var. *lorea* and *Acacia macraneura* over Scattered Tussock Grasses of *Aristida contorta, Paspalidium clementii* and *Eriachne aristidea* on red brown sandy loam on sandy plains and floodplains	163.12
SA TbTl AsyAscElo Aa	*Triodia* Closed Hummock Grassland	Closed Hummock Grassland of *Triodia basedowii* and *Triodia longiceps* with High Shrubland of *Acacia synchronicia, Acacia sclerosperma* subsp. *sclerosperma* and *Eremophila longifolia* and Low Open Woodland of *Acacia aptaneura* on red brown clay loam on plains	84.79
SA Tb ChEg SpBeKp	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia basedowii* with Low Open Woodland of *Corymbia hamersleyana* and *Eucalyptus gamophylla* over Low Open Shrubland of *Scaevola parvifolia, Bonamia erecta* and *Kennedia prorepens* on red loamy sand on sand plains	5,954.30
SA Tb AaApr Aan	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia basedowii* with Scattered Tall Trees of *Acacia aptaneura* and *Acacia pruinocarpa* over High Open Shrubland of *Acacia ancistrocarpa* on red sand on sand plains	254.32
SA TeTl Ai Aco	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia epactia* and *Triodia lanigera* with Open Shrubland of *Acacia inaequilatera* over Open Tussock Grassland of *Aristida contorta* on red brown sandy clay loam on raised plains and quartz hills	180.35
SA Tl AiAan Ast	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia lanigera* with High Open Shrubland of *Acacia inaequilatera* and *Acacia ancistrocarpa* over Low Open Shrubland of *Acacia stellaticeps* on red orange sandy loam on sandy plains	4,996.59
SA Tp Ev AccAst	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia pungens* with Low Woodland of *Eucalyptus victrix* over Low Shrubland of *Acacia colei* var. *colei* and *Acacia stellaticeps* on grey brown sandy loam on sandy plains	91.49
SA Tsc HlApaAd ScDcSp	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia schinzii* with Open Shrubland of *Hakea lorea* subsp. *lorea, Acacia pachyacra* and *Acacia dictyophleba* over Low Open Shrubland of *Sida cardiophylla, Dicrastylis cordifolia* and *Scaevola parviflora* on red loamy sand on sandy plains	211.47
SA Tl CzCh Ai IaImTbc	*Triodia* Open Hummock Grassland	Open Hummock Grassland *of Triodia lanigera* with Low Open Woodland of *Corymbia zygophylla* and *Corymbia hamersleyana* over Open Shrubland of *Acacia inaequilatera* over Low Open Shrubland of *Isotropis atropurpurea, Indigofera monophylla* and *Tephrosia* sp. Bungaroo Creek (M.E. Trudgen 11601) on orange red loamy sand on sand plains	695.00
SA Tl AanApa ApaAprCh	*Triodia* Open Hummock Grassland	Open Hummock Grassland of *Triodia lanigera* with Open Shrubland of *Acacia ancistrocarpa* and *Acacia pachyacra* and Scattered Low Trees of *Acacia paraneura, Acacia pruinocapra* and *Corymbia hamerselyana* on red sandy loam on stony plains	2206.94
SA Mosaic sand plains	Mosaic: *Triodia* Hummock Grassland	Mosaic: Hummock Grassland of *Triodia secunda* and *Triodia epactia* with Low Open Shrubland of *Acacia stellaticeps* over Scattered Tussock Grasses of *Sporobolus australasicus;* Hummock Grassland of *Triodia epactia* and *Triodia lanigera* with Scattered Low Trees of *Corymbia hamersleyana* over High Open Shrubland of *Acacia inaequilatera, Acacia ancistrocarpa* and *Acacia colei* var. *colei* on red orange sandy clay loam on plains	1,891.39

Vegetation Map Code	Broad Floristic Formation	Vegetation Association	Area (ha)
SA Mosaic granitic plains	Mosaic: *Triodia* Hummock Grassland/Acacia High Open Shrubland	Mosaic: Hummock Grassland of *Triodia lanigera* with High Open Shrubland of *Acacia ancistrocarpa* over Low Open Shrubland of *Acacia stellaticeps;* High Open Shrubland of *Acacia tumida* subsp. *pilbarensis* with Scattered Low Trees of *Terminalia canescens* and *Ficus brachypoda* over Very Open Hummock Grassland of *Triodia epactia* (and Very Open Tussock Grassland of *Tripogon loliiformis*) on orange loamy sand on undulating granitic plains with granitic outcrops	963.82
		CALCRETE PLAINS	
CP TlTe AbAstPfm	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia longiceps* and *Tridoia epactia* with Low Open Shrubland of *Acacia bivenosa, Acacia stellaticeps* and *Pluchea ferdinandi-muelleri* on brown sandy clay loam on stony calcrete plains	1,242.44
CP TwTa Es AbPlApy	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia wiseana* and *Triodia angusta* with Open Mallee of *Eucalyptus socialis* subsp. *eucentrica* and Open Shrubland of *Acacia bivenosa, Petalostylis labicheoides* and *Acacia pyrifolia* var. *pyrifolia* on light brown clay loam on calcrete plains and rises	9,926.13
CP EinTlBe Apr Es	*Enneapogon* Open Tussock Grassland	Open Tussock Grassland of *Enneapogon intermedius, Tripogon loliiformis* and *Bothriochloa ewartiana* with High Open Shrubland of *Acacia pruinocarpa* with Scattered Mallee of *Eucalyptus socialis* subsp. *eucentrica* on light brown loam on low calcrete rises	6.65
		MINOR DRAINAGE LINES	
MI CcAa CcCs Tb	*Corymbia* Low Open Woodland	Low Open Woodland of *Corymbia candida* subsp. *dipsodes* and *Acacia aptaneura* over Open Tussock Grassland of **Cenchrus ciliaris* and **Cenchrus setiger* and Very Open Hummock Grassland of *Triodia basedowii* on red brown loam on floodplains and minor drainage lines	774.68
MI AtpGwApy TpTb CcCs	*Acacia* Open Scrub	Open Scrub of *Acacia tumida* var. *pilbarensis, Grevillea wickhamii* subsp. *hispidula* and *Acacia pyrifolia* var. *pyrifolia* over Hummock Grassland of *Triodia pungens* and *Triodia basedowii* over Open Tussock Grassland of **Cenchrus ciliaris* and **Cenchrus setiger* on brown sandy loam on minor drainage lines and floodplains	2,448.09
MI AtpPlAmo TpTs ChEl	*Acacia* Open Scrub	Open Scrub of *Acacia tumida* var. *pilbarensis*, *Petalostylis labicheoides* and *Acacia monticola* over Open Hummock Grassland of *Triodia pungens* and *Triodia* sp. Shovelanna Hill (S.van Leeuwen 3835) with Low Open Woodland of *Corymbia hamerselyana* and *Eucalyptus leucophloia* subsp. *leucophloia* on red brown sandy loam on minor drainage lines	5,187.88
MI AccAbAtp TlTe AstPfmPt	*Acacia* High Shrubland	High Shrubland of *Acacia colei* var. *colei, Acacia bivenosa* and *Acacia tumida* var. *pilbarensis* over Open Hummock Grassland of *Triodia lanigera* and *Triodia epactia* with Low Open Shrubland of *Acacia stellaticeps, Pluchea ferdinandi-muelleri* and *Pluchea tetranthera* on orange sand on minor drainage lines and floodplains	485.33
MI AadAluDpa Tp ElCh	*Acacia* Open Heath	Open Heath of *Acacia adsurgens, Androcalva luteiflora* and *Dodonaea pachyneura* over Open Hummock Grassland of *Triodia pungens* with Low Open Woodland of *Eucalyptus leucophloia* subsp. *leucophloia* and *Corymbia hamersleyana* on brown loamy sand on minor drainage lines	419.63
MI AbAdAma Tp TtPmEa	*Acacia* Shrubland	Shrubland of *Acacia bivenosa, Acacia dictyophleba* and *Acacia maitlandii* over Open Hummock Grassland of *Triodia pungens* over Open Tussock Grassland of *Themeda triandra, Paraneurachne muelleri* and *Eulalia aurea* on brown sandy loam on minor drainage lines	119.61

Vegetation Map Code	Broad Floristic Formation	Vegetation Association	Area (ha)
MI AmoAanPl ChEl TtAin	*Acacia* Shrubland	Shrubland of *Acacia monticola, Acacia ancistrocarpa* and *Petalostylis labicheoides* with Scattered Low Trees of *Corymbia hamerselyana* and *Eucalyptus leucophloia* subsp. *leucophloia* over Open Tussock Grassland of *Themeda triandra* and *Aristida inaequilatera* on red loamy sand on minor drainage lines	609.40
MI PlAtpAmo ChEl TwTp	*Petalostylis* Shrubland	Shrubland of *Petalostylis labicheoides, Acacia tumida* var. *pilbarensis* and *Acacia monticola* with Low Open Woodland of *Corymbia hamerselyana* and *Eucalyptus leucophloia* subsp. *leucophloia* over Open Hummock Grassland of *Triodia wiseana* and *Triodia pungens* on red brown loam on minor drainage lines	1,069.60
MI EaTt AxAcp AanAtp	*Eulalia* Open Tussock Grassland	Open Tussock Grassland of *Eulalia aurea* and *Themeda triandra* with Low Open Woodland of *Acacia xiphophylla* and *Acacia coriacea* subsp. *pendens* and Open Shrubland of *Acacia ancistrocarpa* and *Acacia tumida* var. *pilbarensis* on red brown clay on minor drainage lines	30.89
MI TlTe Ch AtrAanAac	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia longiceps* and *Triodia epactia* with Scattered Low Trees of *Corymbia hamersleyana* over High Shrubland of *Acacia trachycarpa, Acacia ancistrocarpa* and *Acacia acradenia* on brown loamy sand on minor drainage lines	250.79
MI TsTp AanAmoGw	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835) and *Triodia pungens* with Shrubland of *Acacia ancistrocarpa, Acacia monticola* and *Grevillea wickhamii* subsp. *hispidula* on brown sandy loam on minor drainage lines	64.42
MI TeTb Ch CciApy	*Triodia* Open Hummock Grassland	Open Hummock Grassland of *Triodia epactia* and *Trioida basedowii* with Scattered Low Trees of *Corymbia hamersleyana* over Open Shrubland of *Cajanus cinereus* and *Acacia pyrifolia* var. *pyrifolia* on red sandy loam on minor drainge lines	45.78
MI Eb VfAteAa PhCmPg	*Eriachne* Tussock Grassland	Tussock Grassland of *Eriachne benthamii* with Shrubland of **Vachellia farnesiana, Acacia tetragonophylla* and *Acacia aptaneur*a over Low Open Herbland of *Pimelea holroydii, Centipeda minima* and *Ptilotus gomphrenoides* on red silty loam on basalt parent rock along small drainage lines	95.85
MI TtCobEmu ChEg GwPlEt	*Themeda* Tussock Grassland	Tussock Grassland of *Themeda triandra, Cymbopogon obtectus* and *Eriachne mucronata* with Open Woodland of *Corymbia hamersleyana* and *Eucalyptus gamophylla* over High Open Shrubland of *Grevillea wickhamii* subsp. *hispidula, Petalostylis labicheoides* and *Eremophila tietkensii* on red loamy sand on minor drainage lines	34.51
MI EbEfCf Ca AtrAcc	*Eriachne* Open Tussock Grassland	Open Tussock Grassland of *Eriachne benthamii, Eriachne flaccida* and *Chrysopogon fallax* with Scattered Low Trees of *Corymbia aspera* over High Open Shrubland of *Acacia trachycarpa* and *Acacia colei* var. *colei* on brown loamy sand along minor drainage lines	32.71
		MEDIUM DRAINAGE LINES	
ME EvAcp AtpAtrApy Tp	*Eucalyptus* Low Woodland	Low Woodland of *Eucalyptus victrix* and *Acacia coriacea* subsp. *pendens* over Shrubland of *Acacia tumida* var. *pilbarensis, Acacia trachycarpa* and *Acacia pyrifolia* var. *pyrifolia* over Open Hummock Grassland of *Triodia pungens* on brown loamy sand along minor and medium drainage lines	932.98
ME TtEaEte ApyAtpPl EvCh	*Eucalyptus* Low Woodland	Tussock Grassland of *Themeda triandra, Eulalia aurea* and *Eriachne tenuiculmis* with High Shrubland of *Acacia pyrifolia* var. *pyrifolia, Acacia tumida* var. *pilbarensis* and *Petalostylis labicheoides* and Open Woodland of *Eucalyptus victrix* and *Corymbia hamersleyana* on red brown silty loam on medium drainage lines and flood plains	1,032.77

Vegetation Map Code	Broad Floristic Formation	Vegetation Association	Area (ha)
ME Ev PrPfmAbu Ecu	*Eucalyptus* Low Open Woodland	Low Open Woodland of *Eucalyptus victrix* over Low Open Shrubland of *Pluchea rubelliflora, Pluchea ferdinandi-muelleri*and *Atriplex bunburyana* with Scattered Tussock Grasses of *Eragrostis cumingii* on brown silty clay loam on drainage depressions	11.28
ME AtpAanAcc TeTl Ch	*Acacia* Open Scrub	Open Scrub of *Acacia tumida* var. *pilbarensis, Acacia ancistrocarpa* and *Acacia colei* var. *colei* over Hummock Grassland of *Triodia epactia* and *Triodia lanigera* with Scattered Low Trees of *Corymbia hamersleyana* on brown sandy loam along minor and medium drainage lines	227.03
ME AamAtrAcp CcEb Cv	*Acacia* High Shrubland	High Shrubland of *Acacia ampliceps, Acacia trachycarpa* and *Acacia coriacea* subsp. *pendens* over Open Tussock Grassland of **Cenchrus ciliaris* and *Eriachne benthamii* with Very Open Sedges of *Cyperus vaginatus* on brown sand along medium drainage lines	229.52
ME TscTs Ch AadEloAan	*Triodia* Open Hummock Grassland	Open Hummock Grassland of *Triodia schinzii* and *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835) with Scattered Low Trees of C*orymbia hamersleyana* over Open Shrubland of *Acacia adsurgens, Eremophila longifolia* and *Acacia ancistrocarpa* on red sandy loam on medium drainage lines	10.14
ME TpTb Ch AtpAcc	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia pungens* and *Triodia basedowii* with Low Open Woodland of *Corymbia hamersleyana* over High Open Shrubland of *Acacia tumida* var. *pilbarensis* and *Acacia colei* var. *colei* on red brown loamy sand on levee banks and floodplains	215.40
ME TpTl ExAciCh PlApyGr	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia pungens* and *Triodia longiceps* with Low Woodland of *Eucalyptus xerothermica, Acacia citrinoviridis* and *Corymbia hamerselyana* over High Shrubland of *Petalostylis labicheoides, Acacia pyrifolia var. pyrifolia* and *Gossypium robinsonii* on red brown clay loam on medium drainage lines and surrounding floodplains	1,2126.98
ME Tt ExChAa ApaAaAci	*Themeda* Closed Tussock Grassland	Closed Tussock Grassland of *Themeda triandra* with Low Woodland of *Eucalyptus xerothermica, Corymbia hamersleyana* and *Acacia aptaneura* over High Open Shrubland of *Acacia pachyacra, Acacia aptaneura* and *Acacia citrinoviridis* on red brown clay loam along unincised medium drainage lines	106.21
ME EbEf Ev Te	*Eriachne* Tussock Grassland	Tussock Grassland of *Eriachne benthamii* and *Eriachne flaccida* with Low Woodland of *Eucalyptus victrix* over Hummock Grassland of *Triodia epactia* on brown grey silty loam on drainage depressions	55.35
ME TtCfEa ExEvCh PlApaApy	*Themeda* Tussock Grassland	Tussock Grassland of *Themeda triandra, Chrysopogon fallax* and *Eulalia aurea* with Low Open Woodland of *Eucalyptus xerothermica, Eucalyptus victrix* and *Corymbia hamersleyana* and Shrubland of *Petalostylis labicheoides, Acacia pachyacra* and *Acacia pyrifolia* var. *pyrifolia* on red sandy loam on medium drainage lines	1,230.16
ME TtAinCa ChEl AmoPlAlu	*Themeda* Open Tussock Grassland	Open Tussock Grassland of *Themeda triandra, Aristida inaequiglumis* and *Cymbopogon ambiguus* with Low Open Woodland of *Corymbia hamerselyana* and *Eucalyptus leucophloia* subsp. *leucophloia* over Open Shrubland of *Acacia monticola, Petalostylis labicheoides* and *Androcalva luteiflora* on red brown alluvium on minor and medium drainge lines	1,565.97
ME Gl Ev Sn	*Glinus* Herbs	Herbs of *Glinus lotoides* with Low Open Woodland of *Eucalyptus victrix* and Scattered Low Shrubs of *Senna notabilis* on pale brown loam on medium drainage lines	13.54
		MAJOR DRAINAGE LINES	

Vegetation Map Code	Broad Floristic Formation	Vegetation Association	Area (ha)
MA MaEcEv MgAcpAtr Cv	*Melaleuca* High Open Forest	High Open Forest of *Melaleuca argentea, Eucalyptus camaldulensis* var. *refulgens* and *Eucalyptus victrix* over High Open Shrubland of *Melaleuca glomerata, Acacia coriacea* subsp. *pendens* and *Acacia trachycarpa* over Very Open Sedges of *Cyperus vaginatus* on alluvial gravelly soils on major drainage channels with seasonal pools	2,098.89
MA MaEc AciAcpAam TdCv	*Melaleuca* Open Forest	Open Forest of *Melaleuca argentea* and *Eucalyptus camaldulensis* var. *refulgens* over Low Woodland of *Acacia citrinoviridis, Acacia coriacea* subsp. *pendens* and *Acacia ampliceps* over Open Sedges of *Typha domingensis, Cyperus vaginatus* and *Fimbristylis sieberiana* on immediate banks and within stream channels with permanent water at Weeli Wolli Spring	280.00
MA EcMaEv AciAcp AbGsGr	*Eucalyptus* Open Forest	Open Forest of *Eucalyptus camaldulensis* var. *refulgens, Melaleuca argentea* and *Eucalyptus victrix* over Low Open Woodland of *Acacia citrinoviridis* and *Acacia coriacea* subsp. *pendens* over Shrubland of *Acacia bivenosa, Gossypium sturtianum* and *Gossypium robinsonii* on brown silty sand and clay along Weeli Wolli Creek	179.67
MA EcEvMa AcpAamAh TdCv	*Eucalyptus* Open Forest	Open Forest of *Eucalyptus camaldulensis* var. r*efulgens, Eucalyptus victrix* and *Melaleuca argentea* over Low Open Forest of *Acacia coriacea* subsp. *pendens, Acacia ampliceps* and *Atalaya hemiglauca* over Open Sedges of *Typha domingensis* and *Cyperus vaginatus* on brown sandy clay loam along major rivers with permanent water	32.88
MA EcEv AciApyMg CcEaTt	*Eucalyptus* Woodland	Woodland of *Eucalyptus camaldulensis* subsp. *refulgens* and *Eucalyptus victrix* over High Open Shrubland of *Acacia citrinoviridis, Acacia pyrifolia* var. *pyrifolia* and *Melaleuca glomerata* over Tussock Grassland of **Cenchrus ciliaris, Eulalia aurea* and *Themeda triandra* on brown clay loam on banks of major drainage lines	1,399.21
MA EvAciEc TrcCcrApy CcEaTt	*Eucalyptus* Woodland	Woodland of *Eucalyptus victrix, Acacia citrinoviridis* and *Eucalyptus camaldulensis* subsp. *refulgens* over Low Open Shrubland of *Tephrosia rosea* var. *clementii, Corchorus crozophorifolius* and *Acacia pyrifolia* var. *pyrifolia* over Very Open Tussock Grassland of **Cenchrus ciliaris, Eulalia aurea* and *Themeda triandra* on brown loamy sand on channels of major drainage lines	1,053.37
MA AciAprAa SahSgl	*Acacia* Low Closed Woodland	Low Closed Woodland of *Acacia citrinoviridis, Acacia pruinocarpa* and *Acacia aptaneura* over Open Shrubland of *Senna artemisioides* subsp. *helmsii* and *Senna glutinosa* subsp*. x luerssenii* on brown clay loam on levee banks of major drainage lines	43.32
MA EcEvEx ApyAtpGr TtEaCpr	*Eucalyptus* Low Open Forest	Low Open Forest of *Eucalyptus camaldulensis* subsp. *refulgens, Eucalyptus victrix* and *Eucalyptus xerothemica* over High Shrubland of *Acacia pyrifolia* var. *pyrifolia, Acacia tumida* var. *pilbarensis* and *Gossypium robinsonii* over Open Tussock Grassland of *Themeda triandra, Eulalia aurea* and *Cymbopogon procerus* on red brown clay loam on major drainage lines	2,120.24
MA AaAciApr CcTtCf EvEc	*Acacia* Low Open Forest	Low Open Forest of *Acacia aptaneura, Acacia citrinoviridis* and *Acacia pruinocarpa* ver Open Tussock Grassland of **Cenchrus ciliaris, Themeda triandra* and *Chrysopogon fallax* with Open Woodland of *Eucalyptus victrix* and *Eucalyptus camaldulensis* subsp. *refulgens* on brown loamy sand on major drainage lines with broad and deeply incised drainage channels	197.10
MA ChEv ApyCci Cf	*Corymbia* Low Woodland	Low Woodland of *Corymbia hamersleyana* and *Eucalyptus victrix* over Shrubland of *Acacia pyrifolia* var. *pyrifolia* and *Cajanus cinereus* over Very Open Tussock Grassland of *Chrysopogon fallax* on red brown silty loam along major drainage lines	13.32

Vegetation Map Code	Broad Floristic Formation	Vegetation Association	Area (ha)
MA AtpApyAse Ec TmbTtCpr	*Acacia* High Shrubland	High Shrubland of *Acacia tumida* var. *pilbarensis, Acacia pyrifolia* var. *pyrifolia* and *Acacia sericophylla* with Scattered Trees of *Eucalyptus camaldulensis* subsp. *refulgens* over Open Tussock Grassland of *Themeda* sp. Mt Barricade (M.E. Trudgen 2471), *Themeda triandra* and *Cymbopogon procerus* on brown loam and gravels on major drainage channels	257.85
MA CcCs EvAciAh	**Cenchrus* Tussock Grassland	Tussock Grassland **Cenchrus ciliaris* and **Cenchrus setiger* with Low Woodland of *Eucalyptus victrix, Acacia citrinoviridis* and *Atalaya hemiglauca* on brown sandy loam on major drainage lines and adjacent flood plains	2,198.48
MA Cc	**Cenchrus* Tussock Grassland	Tussock Grassland of **Cenchrus ciliaris* on red brown loam on levee banks of major drainage lines	30.23
MA CcTtEa ChCa AbAtpAsc	**Cenchrus* Tussock Grassland	Tussock Grassland of **Cenchrus ciliaris, Themeda triandra* and *Eulalia aurea* with Low Open Woodland of *Corymbia hamersleyana* and *Corymbia aspera* over High Open Shrubland of *Acacia bivenosa, Acacia tumida* var. *pilbarensis and Acacia sclerosperma* subsp. *sclerosperma* on brown loamy sand on levee banks of major drainage lines	282.91
MA TtCc PlAbAlu ElCh	*Themeda* Tussock Grassland	Tussock Grassland of *Themeda triandra* and **Cenchrus ciliaris* with Shrubland of *Petalostylis labicheoides, Acacia bivenosa* and *Androcalva luteiflora* and Low Open Woodland of *Eucalyptus leucophloia* subsp. *leucophloia* and *Corymbia hamersleyana* on red brown loam on drainage levees	120.35
MA TdCv EcEv AciAcp	*Typha* Sedges	Sedges of *Typha domingensis* and *Cyperus vaginatus* with Open Woodland of *Eucalyptus camaldulensis* subsp. *refulgens* and *Eucalyptus victrix* over Low Open Woodland of *Acacia citrinoviridis* and *Acacia coriacea* subsp. *pendens* on brown clayey sand on permanent pools along major drainage lines	200.91
		GILGAI PLAINS	
GP Asy AsySaoEla CcCsCf	*Acacia* High Open Shrubland	High Open Shrubland of *Acacia synchronicia* over Low Open Shrubland of *Acacia synchronicia, Senna artemisioides* subsp. *oligophylla* and *Eremophila lanceolata* over Very Open Tussock Grassland of **Cenchrus ciliaris, *Cenchrus setiger* and *Chrysopogon fallax* on red light clay on gilgai plains	1,645.94
GP ExeEbCf AsyAteVf NdTc	*Eragrostis* Tussock Grassland	Tussock Grassland of *Eragrostis xerophila, Eriachne benthamii* and *Chrysopogon fallax* with Open Shrubland of *Acacia synchronicia, Acacia tetragonophylla* and **Vachellia farnesiana* over Very Open Herbs of *Neptunia dimorphantha* and *Tephrosia clementii* on red light clay on gilgai plains	2,177.13
GP EbEf Aa Asy	*Eriachne* Tussock Grassland	Tussock Grassland of *Eriachne benthamii* and *Eriachne flaccida* with Low Open Woodland of *Acacia aptaneura* and Open Shrubland of *Acacia synchronicia* on red brown clay on gilgai plains	4.75
GP CcCs AaApr AsyAa	**Cenchrus* Open Tussock Grassland	Open Tussock Grassland of **Cenchrus ciliaris* and **Cenchrus setiger* with Low Open Woodland of *Acacia aptaneura* and *Acacia pruinocarpa* over High Open Shrubland of *Acacia synchronicia* and *Acacia aptaneura* on red sandy clay loam on gilgai plains	6,243.29
GP SfScoGpr	*Sida* Very Open Herbs	Very Open Herbs of *Sida fibulifera, Sclerolaena cornishiana* and *Goodenia prostrata* on brown clay on stony gilgai plain	4.83
		SALINE FLATS AND MARSH	
SF Fs Cc	*Frankenia* Low Open Shrubland	Low Open Shrubland of *Frankenia setosa* with Scattered Tussock Grasses of **Cenchrus ciliaris* on red brown clay loam on saline flats	99.01

Vegetation Map Code	Broad Floristic Formation	Vegetation Association	Area (ha)
SF TdcTibMf Ep	*Tecticornia* Low Open Heath	Low Open Heath of *Tecticornia* sp. Dennys Crossing (K.A. Shepherd & J English KS552)*, Tecticornia indica* subsp. *bidens* and *Muehlenbeckia florulenta* over Very Open Tussock Grassland of *Eragrostis pergracilis* on brown medium clay on saline flats and marsh	362.38
		DISTURBED	
Cleared	Disturbed	Cleared	12,794.41
Disturbed	Disturbed	Highly degraded vegetation: Open Tussock Grassland of **Cenchrus ciliaris* with Scattered Tall Shrubs of *Acacia bivenosa* and *Petalostylis labicheoides* over Scattered Low Shrubs of *Ptilotus nobilis*	425.86