

Species	Conservation Significance	Easting	Northing	Site
<i>Fimbristylis laxiglumis</i>	P2	497572	8293586	16
<i>Goodenia durackiana</i>	P1	496160	8292030	18
<i>Eragrostis schultzii</i>	P3	495563	8293133	20
<i>Fimbristylis pachyptera</i>	P1	495631	8292785	24
<i>Eragrostis schultzii</i>	P3	495631	8292785	24
<i>Eragrostis schultzii</i>	P3	495808	8292728	40
<i>Goodenia malvina</i>	P1	496727	8293239	41
Flora Species of Conservation Significance Outside the Development Boundary				
<i>Goodenia byrnesii</i>	P1	496235	8291240	opp
<i>Diospyros calycantha</i>	P1 & range extension	495549	8290299	17
<i>Goodenia</i> sp. cf. <i>brachypoda</i>	P1 or ?new species	495549	8290299	17
<i>Eragrostis schultzii</i>	P3	495549	8290299	17
<i>Spermacoce</i> aff. <i>leptoloba</i>	?new species	495549	8290299	17
<i>Diospyros calycantha</i>	P1 & range extension	496904	8290739	19
<i>Fimbristylis laxiglumis</i>	P2	496904	8290739	19
<i>Minuria macrorhiza</i>	P2	495600	8291503	21
<i>Polygala triflora</i>	under taxonomic review	495600	8291503	21
<i>Minuria macrorhiza</i>	P2	495552	8290976	23
<i>Fimbristylis pachyptera</i>	P1	495500	8292500	25
<i>Jacquemontia</i> sp. Keep River (J.L. Egan 5051)	P1	496175	8291247	26
<i>Jacquemontia</i> sp. Keep River (J.L. Egan 5051)	P1	496550	8290788	27
<i>Diospyros calycantha</i>	P1 & range extension	495900	8290400	28
<i>Eragrostis schultzii</i>	P3	496447	8290449	29
<i>Eragrostis schultzii</i>	P3	496219	8290714	30
<i>Minuria macrorhiza</i>	P2	495755	8291151	31
<i>Eragrostis schultzii</i>	P3	496435	8291278	31
<i>Eragrostis schultzii</i>	P3	495978	8290894	32
<i>Minuria macrorhiza</i>	P2	495558	8290636	36
<i>Eragrostis schultzii</i>	P3	495558	8290636	36
<i>Croton arnhemicus</i>	P1	495755	8291151	37
<i>Eragrostis schultzii</i>	P3	495755	8291151	37
<i>Polygala triflora</i>	under taxonomic review	495755	8291151	37
<i>Eragrostis schultzii</i>	P3	495827	8291540	38
<i>Eragrostis schultzii</i>	P3	495722	8291903	39
<i>Fimbristylis</i> aff. <i>Carolinii</i>	?new species	495722	8291903	39
<i>Croton arnhemicus</i>	P1	495503	8292997	43
<i>Eragrostis schultzii</i>	P3	495503	8292997	43

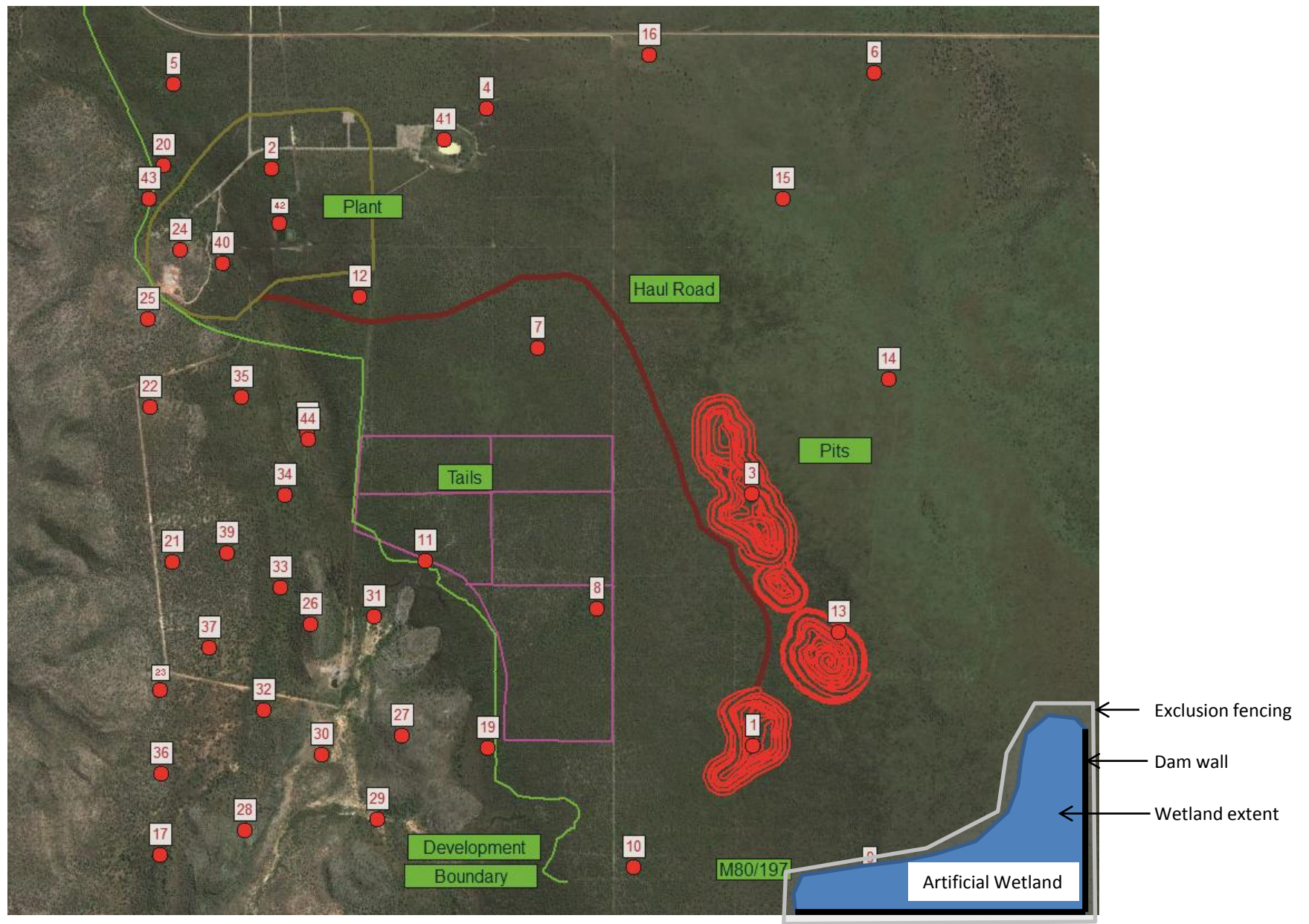


Figure 2--8: Flora survey sites as reference points for flora species of conservation significance

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2.7.1.6 Vegetation Condition

An assessment of the condition of the vegetation was also undertaken during the survey. The methodology of Keighery (1994) was used as the basis for the condition rating. The overall condition of the vegetation within the survey area ranged from Excellent to Completely Degraded.

Figure 2-9: Vegetation Condition shows a map of the project area and the condition ratings.

The main impacts to the vegetation were from weeds, grazing, old earthworks and vehicular disturbance. In total, 31 introduced (weed) species were identified during the survey including three that are listed by the Department of Agriculture and Food as Declared Plants for the Shire of Wyndham-East Kimberley (SWEK). The location of these species has been recorded and is shown in Figure 2-9: Vegetation Condition and the locations are listed in Table 2-6: Weed Species Found on the Sorby Hills Project Area.

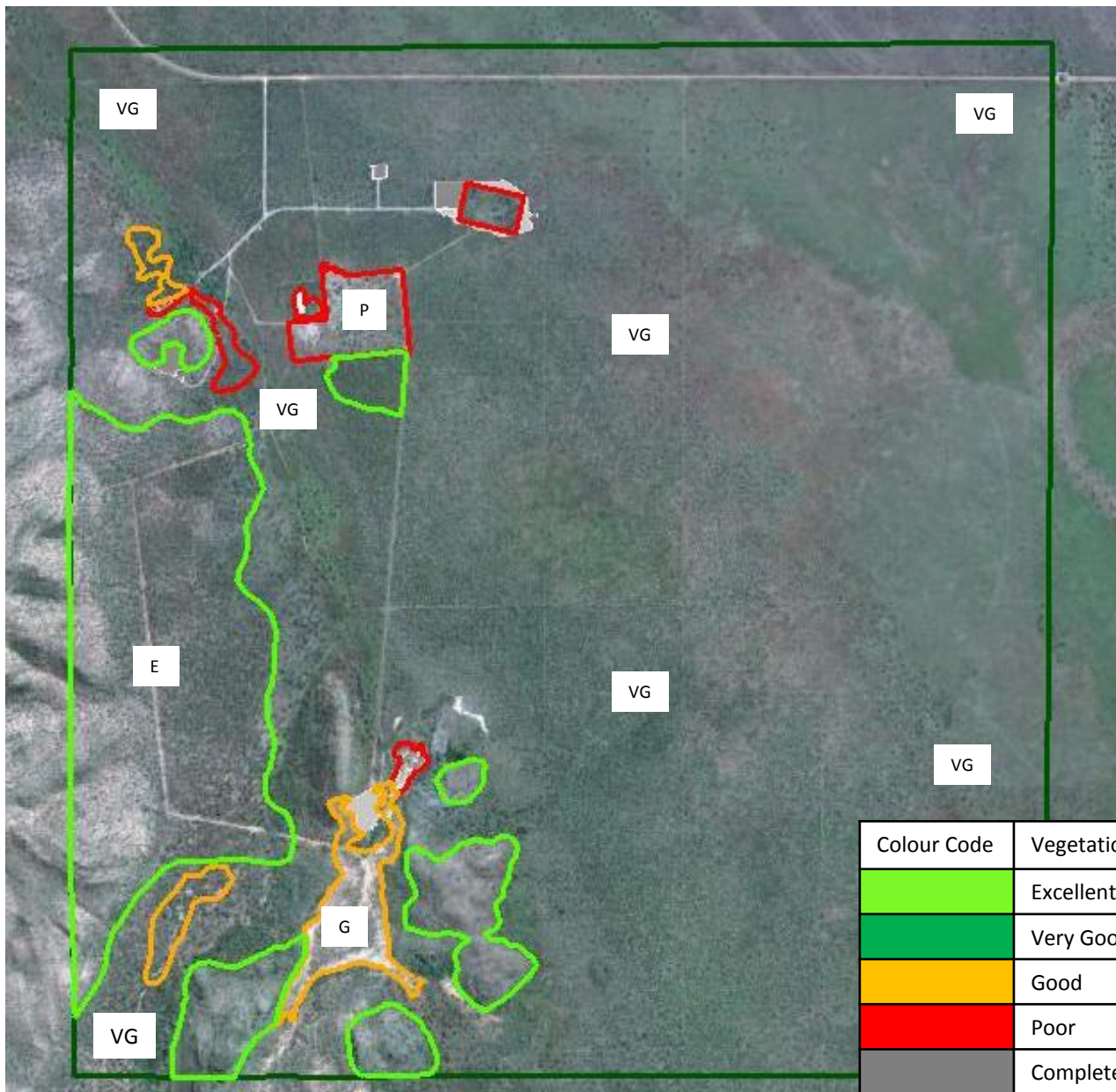
Table 2-6: Weed Species Found on the Sorby Hills Project Area

Species	Easting	Northing	Site
<i>Aerva javanica</i>	496727	8293239	41
<i>Alysicarpus vaginalis</i>	496050	8291398	33
<i>Bidens bipinnata</i>	497354	8291314	8
<i>Calotropis procera</i>	496042	8292895	42
<i>Cardiospermum halicacabum</i> var. <i>halicacabum</i>	495549	8290299	17
<i>Citrullus lanatus</i>			Opportunistic
<i>Corchorus olitorius</i>	497995	8291781	3
<i>Corchorus olitorius</i>	496900	8293366	4
<i>Corchorus olitorius</i>	497111	8292380	7
<i>Corchorus olitorius</i>	498484	8290204	9
<i>Corchorus olitorius</i>	496377	8292592	12
<i>Corchorus olitorius</i>	498357	8291215	13
<i>Crotalaria juncea</i>	496160	8292030	18
<i>Crotalaria juncea</i>	496900	8293366	4
<i>Crotalaria juncea</i>	495604	8293467	5
<i>Crotalaria juncea</i>	498357	8291215	13
<i>Cucumis melo</i>	498500	8293510	6
<i>Cucumis melo</i>	498560	8292254	14
<i>Cucumis melo</i>	498126	8292996	15
<i>Cucumis melo</i>	496900	8293366	4
<i>Cucumis melo</i>	495604	8293467	5
<i>Cucumis melo</i>	498357	8291215	13
<i>Cynodon dactylon</i>	497572	8293586	16
<i>Cynodon dactylon</i>	495549	8290299	17
<i>Cynodon dactylon</i>	495558	8290636	36

<i>Cynodon dactylon</i>	496727	8293239	41
<i>Digitaria ciliaris</i>	495549	8290299	17
<i>Digitaria ciliaris</i>	495563	8293133	20
<i>Echinochloa colona</i>	495549	8290299	17
<i>Echinochloa colona</i>	495604	8293467	5
<i>Echinochloa colona</i>	496645	8291508	11
<i>Echinochloa colona</i>	498357	8291215	13
<i>Echinochloa colona</i>	496042	8292895	42
<i>Emilia sonchifolia</i>	495549	8290299	17
<i>Eragrostis minor</i>	498560	8292254	14
<i>Eragrostis minor</i>	498126	8292996	15
<i>Eragrostis minor</i>	497572	8293586	16
<i>Eragrostis minor</i>	497354	8291314	8
<i>Euphorbia hirta</i>	495549	8290299	17
<i>Euphorbia hirta</i>	496050	8291398	33
<i>Gomphrena celosioides</i>	495558	8290636	36
<i>Gomphrena celosioides</i>	495600	8291503	22
<i>Gomphrena celosioides</i>	495552	8290976	23
<i>Gomphrena celosioides</i>	495827	8291540	38
<i>Hyptis suaveolens</i>	496219	8290714	30
<i>Hyptis suaveolens</i>	496435	8291278	31
<i>Hyptis suaveolens</i>	495978	8290894	32
<i>Hyptis suaveolens</i>	495808	8292728	40
<i>Hyptis suaveolens</i>	495503	8292997	43
<i>Hyptis suaveolens</i>	495631	8292785	24
<i>Hyptis suaveolens</i>	495563	8293133	20
<i>Macroptilium lathyroides</i>	496042	8292895	42
<i>Malvastrum americanum</i>	496447	8290449	29
<i>Malvastrum americanum</i>	496050	8291398	33
<i>Melochia pyramidata</i>	498500	8293510	6
<i>Melochia pyramidata</i>	498126	8292996	15
<i>Melochia pyramidata</i>	497572	8293586	16
<i>Melochia pyramidata</i>	495549	8290299	17
<i>Melochia pyramidata</i>	497995	8291781	3
<i>Melochia pyramidata</i>	496900	8293366	4
<i>Melochia pyramidata</i>	498484	8290204	9

<i>Melochia pyramidata</i>	498357	8291215	13
<i>Mitracarpus ?hirtus</i>	496435	8291278	31
<i>Mitracarpus ?hirtus</i>	495978	8290894	32
<i>Myriophyllum</i> sp.	495563	8293133	20
<i>Passiflora foetida</i>	496175	8291247	26
<i>Passiflora foetida</i>	496050	8291398	33
<i>Passiflora foetida</i>	496727	8293239	41
<i>Senna obtusifolia</i>	498126	8292996	15
<i>Sida acuta</i>	496447	8290449	29
<i>Sida acuta</i>	496219	8290714	30
<i>Sida acuta</i>	496435	8291278	31
<i>Sida acuta</i>	495978	8290894	32
<i>Sida acuta</i>	495549	8290299	17
<i>Sida acuta</i>	495558	8290636	36
<i>Sida acuta</i>	495808	8292728	40
<i>Sida acuta</i>	495563	8293133	20
<i>Sida acuta</i>	496050	8291398	33
<i>Sida acuta</i>	496068	8291780	34
<i>Sida acuta</i>	495755	8291151	37
<i>Sida acuta</i>	495827	8291540	38
<i>Sida cordifolia</i>	496447	8290449	29
<i>Sida cordifolia</i>	496219	8290714	30
<i>Sida cordifolia</i>	496435	8291278	31
<i>Sida cordifolia</i>	495978	8290894	32
<i>Sida cordifolia</i>	495558	8290636	36
<i>Sida cordifolia</i>	495808	8292728	40
<i>Sida cordifolia</i>	495503	8292997	43
<i>Sida cordifolia</i>	496550	8290788	27
<i>Sida cordifolia</i>	496050	8291398	33
<i>Sida cordifolia</i>	496068	8291780	34
<i>Sida cordifolia</i>	495755	8291151	37
<i>Sporobolus jacquemontii</i>	495808	8292728	40
<i>Sporobolus jacquemontii</i>	495503	8292997	43
<i>Sporobolus jacquemontii</i>	496050	8291398	33
<i>Stylosanthes hamata</i>	496447	8290449	29
<i>Stylosanthes hamata</i>	496219	8290714	30

<i>Stylosanthes hamata</i>	496435	8291278	31
<i>Stylosanthes hamata</i>	495978	8290894	32
<i>Stylosanthes hamata</i>	495549	8290299	17
<i>Stylosanthes hamata</i>	495558	8290636	36
<i>Stylosanthes hamata</i>	496550	8290788	27
<i>Stylosanthes hamata</i>	495900	8290400	28
<i>Stylosanthes hamata</i>	495563	8293133	20
<i>Stylosanthes hamata</i>	496050	8291398	33
<i>Stylosanthes hamata</i>	496068	8291780	34
<i>Stylosanthes hamata</i>	495600	8291503	21
<i>Stylosanthes hamata</i>	495552	8290976	23
<i>Stylosanthes hamata</i>	495755	8291151	37
<i>Stylosanthes hamata</i>	495827	8291540	38
<i>Stylosanthes hamata</i>	498357	8291215	13
<i>Stylosanthes hamata</i>	496727	8293239	41
<i>Tribulus terrestris</i>			Opportunistic
<i>Tridax procumbens</i>	495549	8290299	17
<i>Vachellia farnesiana</i>			
<i>Vachellia farnesiana</i>	498560	8292254	14
<i>Vachellia farnesiana</i>	496727	8293239	41



Colour Code	Vegetation Condition	
Light Green	Excellent	E
Green	Very Good	VG
Yellow	Good	G
Red	Poor	P
Grey	Completely Degraded	CD

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Figure 2-9: Vegetation condition

2.7.2 Fauna

The fauna surveys for the Sorby Hills Project were designed to meet the criteria of a Level 2 survey as defined by the EPA *Guidance Statement No. 56 - Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia* (EPA 2004). The fauna surveys and their relevant reports include the following:

- Terrestrial fauna assessment describing non-volant (ground-dwelling) vertebrate fauna (Appendix 9)
- Ornithological assessment describing all avifauna species (Appendix 10)
- Echolocation survey to describe bat species present (Appendix 11)
- Subterranean fauna assessment describing stygofauna and troglifauna (Appendix 12)

Based on a broad habitat assessment conducted at the inception of the Sorby Hills Project, it was determined that no survey work for short range endemic invertebrate fauna was required due to the obvious lack of discontinuous or disjunct fauna habitat types that may promote endemism. This approach was discussed and approved by the Department of Environment and Conservation (DEC) Environmental Management Branch in March, 2011 (pers comm. Brad Durrant).

Sampling for non-volant (ground dwelling) terrestrial vertebrate fauna was undertaken on three occasions, from April to late May 2011. Over this period the conditions in the project area changed from recent post-wet to dry season conditions enabling sufficient sampling of the different faunal groups. Echolocation surveys for bat species were conducted over the same period.

Ornithological assessments were undertaken in April and November 2011, to adequately sample *EPBC Act* listed threatened and migratory bird species. The project specific field data was supplemented with data from a further 23 collection events in the area between the period of May 2009 and November 2011.

A number of other fauna surveys have been conducted in the project area and in the surrounding Weaber and Knox Creek plains in 2009 by Animal Plant Mineral Pty Ltd (APM) and other consultants in 2005 and 1996. In 1996 Ecologia Environmental Consultants undertook a broadscale survey of what was then known as the Ord Expansion and M2 Project. This area encompassed the Keep River floodplain and adjacent parts, Spirit Hills station, Knox Creek Plains, Weaber Plains, Carlton Plains, Mantinea Flats and the Ivanhoe/West Bank area. In 2005, HLA Envirosciences (HLA) was commissioned to undertake follow-up herpetological survey work across many of these areas. The results of these surveys have been integrated into all of the fauna reports produced for the Sorby Hills Project.

2.7.2.1 Fauna Species Richness, Abundance and Diversity

The Kimberley is regarded as being a National Biodiversity Hotspot with 230 plant, 16 fish, 10 frog, 31 reptile, 2 bird and 6 mammal species known to be endemic to the region (McKenzie et al. 2009).

Database searches reveal significant variation in the known species richness in different areas around the East Kimberley, highlighting the limited previous survey work undertaken in the area. Up to 509 vertebrate species are known to occur in the region; however, only 310 species have been reported for the localised area around Sorby Hills. A very high proportion of these expected species are birds.

Approximately 102 species of reptile, amphibian and non-volant (non-flying) mammals are expected to occur in the project area based on known habitat requirements. This represents half

of the known reptiles, amphibians and mammals known to occur across the broader Kimberley (McKenzie et al. 2009), and is a reasonable estimate of expected occurrence given that the project area does not include large areas of rugged and heavily dissected ranges.

Tributaries associated with Keep River and Knox Creek would support at least 15 species of freshwater fishes (mainly catfishes, grunters and gudgeons). However, database searches did not reveal any species that have been previously collected in the Sorby Hills area.

A total of 25 reptile, 15 amphibian, 8 non-volant mammal fauna and 4 fish species were trapped or recorded during the Sorby Hills 2011 survey. The table below (Table 2-7: Richness and Abundance for Fauna Trapped in the Local Area) shows richness and abundance of fauna collected over a number of surveys in the local area and therefore provides a more accurate reflection of what species may occur in the project area.

Table 2-7: Richness and Abundance for Fauna Trapped in the Local Area

	Naturemap	Sorby	Packsaddle	Mantinea	Westbank	HLA	Ecologia
Abundance							
Mammal		14	37	18	14	0	0
Amphibians		370	386	164	49	266	118
Reptiles		160	119	124	102	407	206
Richness							
Mammal	18	7	7	4	5	0	0
Amphibians	21	15	12	8	6	15	16
Reptiles	63	25	22	17	21	43	29

The abundance of frog fauna captured at Sorby Hills was relatively high compared to the other sites sampled, with the 370 records surpassed only by the number of individuals captured at Packsaddle by APM in 2009. The surveys undertaken at Sorby Hills have contributed one new species, *Litoria tornieri*, to the number of frog species previously recorded in the area.

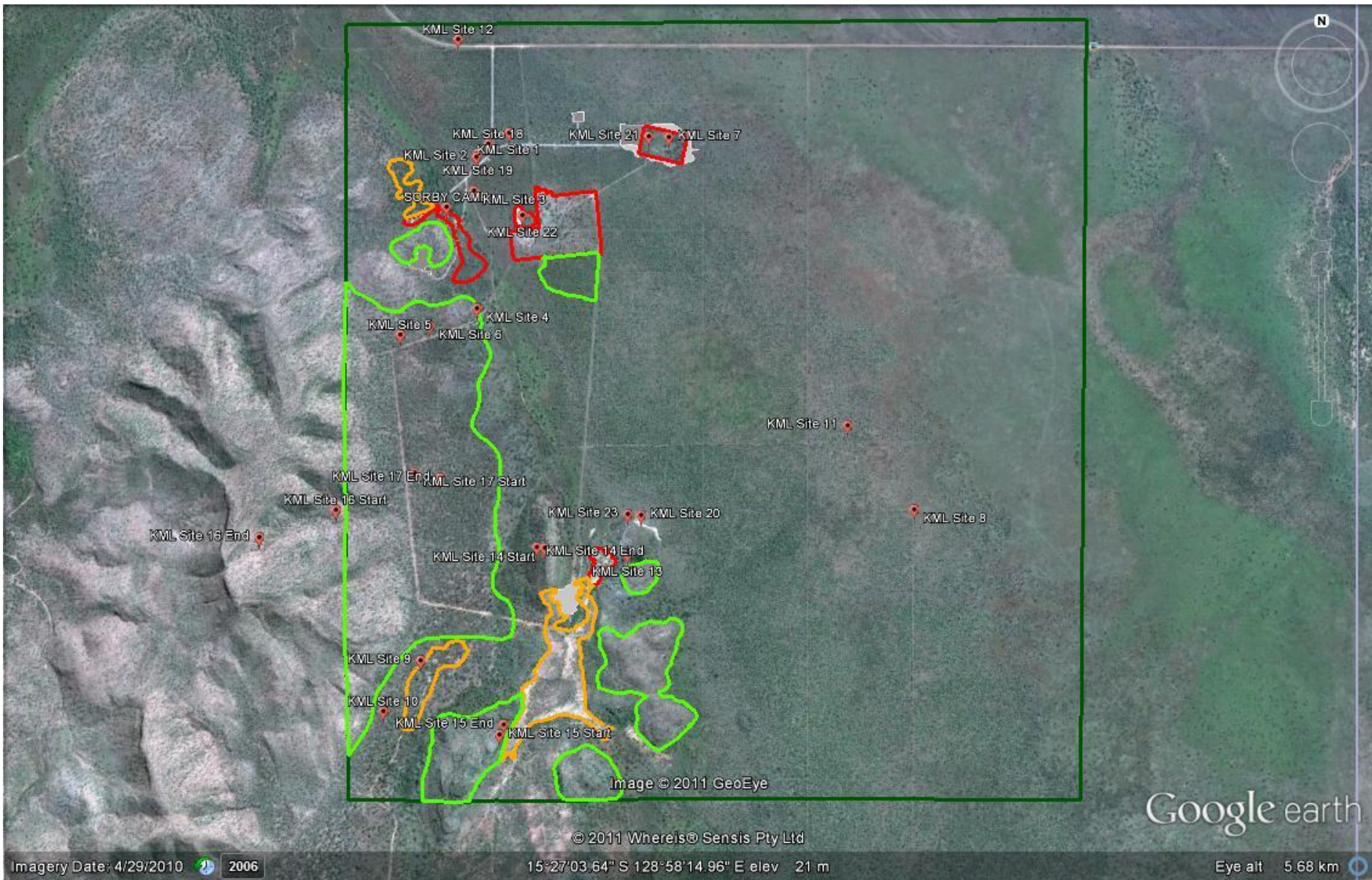
The number of reptiles captured was relatively low compared to other sites. However, the surveys at Sorby Hills contributed seven new records of reptile species not previously recorded in the local area.

Three species of freshwater turtle are known from the area and one of these, *Emydura australis*, is restricted to the Kimberley to Victoria River region. Described as poorly known, *Emydura australis* was easily captured in Packsaddle Creek in 2009 and so is expected to be relatively common in Knox Creek and the upper reaches of the Keep River.

A large number of mammal species that were expected to occur based on historical records were not captured. However, the mammal species richness recorded at Sorby Hills exceeded the richness recorded at Packsaddle, Mantinea and West Bank.

2.7.2.2 Fauna Habitat Value

A total of 23 fauna survey sites were sampled at Sorby Hills across a variety of habitats of varying condition (Figure 2-10: Fauna Survey Sites over Vegetation Condition). However, it is the case that only 11 were systematically trapped with their data able to be analysed. The table below (Table 2-8: Site Rankings Based on Ecological Indices) ranks the 11 sites in relation to fauna species richness, abundance and diversity used to assess the value of the sites for terrestrial vertebrate fauna. The sites were then scored and summed to identify the most valuable fauna sites in the Sorby Hills area based on species richness abundance and diversity (Table 2-9: Habitat Value).



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Figure 2-10: Fauna survey sites over vegetation condition

Table 2-8: Site Rankings Based on Ecological Indices

Rank	Site	Richness	Site	Abundance	Site	Diversity
1	Site 7	15	Site 7	80	Site 7	2.174491
2	Site 4	14	Site 4	70	Site 2	2.147085
3	Site 1	12	Site 1	52	Site 6	2.126473
4	Site 2	12	Site 6	47	Site 3	2.035863
5	Site 6	12	Site 3	43	Site 11	1.873746
6	Site 3	11	Site 2	37	Site 4	1.803761
7	Site 8	8	Site 8	25	Site 8	1.777846
8	Site 11	8	Site 11	24	Site 1	1.750853
9	Site 10	5	Site 9	9	Site 10	1.609438
10	Site 9	4	Site 10	5	Site 9	1.21489
11	Site 5	2	Site 5	2	Site 5	0.693147

Table 2-9: Habitat Value

Site Number	Rank
Site 7	15
Site 4	8
Site 1	6
Site 2	6
Site 6	6

Site 7, shown in Figure 2-11: Vegetation within Fauna Survey Site 7 (Plate A) and Site 4 (Plate B), had the highest habitat value ranking. The site comprised an Open Woodland of *Bauhinia cunninghamii*, *Excoecaria parvifolia* and *Vachellia valida* over mixed Shrubland/Grassland/Forbland of *Sorghum plumosum*, **Calotropis procera*, *Vigna lanceolata* etc. The area, despite being representative of the floodplain habitat, had been subject to earthworks for dam construction and pit excavation in the past. As such the flora was a mix of exotics, native disturbance opportunists and typical cracking clay woodland species. Although the area has previously been disturbed, the exclusion of cattle from the site resulted in a notable increase in tussock grasses when compared to the surrounding area. The presence of a permanent water body adds to the habitat value of the site and contributes to the overall species richness. The fact that the site supports many species in high numbers contributes to its overall diversity, with large numbers of frog species (*Limnodynastes convexiusculus*, *L. depressus*, *Litoria nasuta*, *Cyclorana australis*), skinks (*Carlia munda*), and snakes (*Tropidonophis mairii*). Site 7 most accurately represents the fauna assemblages that the broad floodplains would support in the absence of heavy grazing.

Site 4, shown in Figure 2-11: Vegetation within Fauna Survey Site 7 (Plate A) and Site 4 (Plate B), was the next most valuable habitat within the project area. It had a very similar species richness and similar abundance to Site 7. However, it had lower species diversity due to high numbers of the northern toadlet, *Uperoleia borealis* and the Giant Frog *Cyclorana australis*.



Plate A: Fauna Site 7

Plate B: Fauna Site 4

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Figure 2-11: Vegetation within Fauna Survey Site 7 (Plate A) and Site 4 (Plate B)

Site 4 represents a good example of the very valuable habitat that occurs at the interzone between the undulating plains and foothills of the sandstone ranges and the floodplains. The quality of the habitat has been enhanced by the exclusion of cattle. The area is dominated by Woodland or Open Forest of *Eucalyptus tetradonta*, *Eucalyptus brevifolia* and *Corymbia dichromophloia* over Sparse Shrubland of *Erythrophleum chlorostachys*, *Grevillea refracta*, *Dodonaea hispidula* var. *phylloptera* and *Buchanania oblongifolia* over Grassland of *Chrysopogon* sp., *Sorghum stipoideum*, *Eriachne obtusa*, *Triodia bitextura* and *Eragrostis schultzei* (P3).

2.7.2.3 Non-Volant Fauna Species of Conservation Significance

Database searches and previous surveys reveal approximately 35 ground dwelling fauna species of conservation significance listed under the following three ranks of conservation significance:

1. EPBC Act, Wildlife Conservation Act or DEC Priority, NT Near Threatened
2. NT Department of Infrastructure Planning and the Environment (DIPE)
3. Locally or Regional Significant.

Though not all of the above categories provide statutory protection to the fauna listed, all fauna listed under these categories are included in the table as they represent poorly understood fauna known to occur in the region. Collection records from previous surveys (ecologia, Kinhill and HLA) are also included in Table 2-10: Fauna of Conservation Significance to highlight the relevant occurrence of each of the fauna in the region. Rare or specially protected fauna are not often recorded during single survey events, so their presence and significance can usually only be appreciated in a regional context.

Of those seven species listed under the EPBC Act, Wildlife Conservation Act or the DEC Priority or NT Near Threatened lists, only four have been recorded within any of the surveys undertaken in the area. These four species are the Northern Death Adder *Acanthophis praelongus* (NTNT), the Freshwater Crocodile *Crocodylus johnstoni*, Short-tailed Mouse (S) *Leggadina lakedownensis* (P4) and the Sand Goanna *Varanus panoptes* subsp. *panoptes* (NTNT). All of these species have the potential to occur within the Sorby Hills Project area.

The Northern Death Adder *Acanthophis praelongus* inhabits grasslands, woodlands, rocky ranges and outcrops and would be expected to occur broadly, but in low densities across the project area. Threatening processes from the proposed Sorby Hills Project would relate to loss of individuals during clearing. However populations are more immediately under threat from the Cane Toad *Bufo marinus*.

The Sand Goanna *Varanus panoptes* subsp. *panoptes* is a remarkably resilient species that is not likely to be impacted significantly by the development of the Sorby Hills Project. Individuals are typically recorded in close association with roads or settlements. This species occurs as a transient in many habitats and will very likely forage within the development area once it has become established. Like the death adder, this species is more likely to be threatened by the introduction of the Cane Toad *Bufo marinus*.

Within the project areas, and more specifically, the areas likely to be impacted, there were very few locations where the Freshwater Crocodile *Crocodylus johnstoni* may potentially occur. However, individuals occur ubiquitously throughout the area and will most certainly occur within Knox Creek. Individuals may be attracted to large standing water sources once the project is established.

Table 2-10: Fauna of Conservation Significance

Level of Conservation Significance	Sorby Hills	Ecologia	Kinhill	HLA	APM
EPBC Act, Wildlife Conservation Act or DEC Priority, Northern Territory Near Threatened (NTNT).					
<i>Acanthophis praelongus</i> Northern Death Adder NTNT				√	
<i>Chelosania brunnea</i> Chameleon Dragon NTNT					
<i>Crocodylus johnstoni</i> Freshwater Crocodile S		√			√
<i>Hydromys chrysogaster</i> Water-rat P4					
<i>Leggadina lakedownensis</i> Short-tailed Mouse P4					√
<i>Ramphotyphlops troglodytes</i> P1					
<i>Varanus panoptes</i> subsp. <i>panoptes</i> NTNT		√		√	√
NT DIPE					
<i>Uperoleia trachyderma</i>					
<i>Uperoleia borealis</i>	√	√			√
<i>Uperoleia inundata</i>					
<i>Uperoleia lithomoda</i>				√	
<i>Limnodynastes depressus</i>	√	√	√		√
<i>Limnodynastes tasmaniensis</i>					
<i>Cyclorana australis</i>	√	√		√	√
<i>Cyclorana cryptotis</i>	√				
<i>Cyclorana vagitus</i>		√			
<i>Chelodina</i> sp.		√			
<i>Tympanocryptis uniformis</i>		√			
<i>Ctenotus rimacola camptris</i>	√			√	
<i>Ctenotus inornatus</i>	√	√		√	√
<i>Ctenotus joanae</i>		√			
<i>Menetia</i> sp.					
<i>Morethia</i> nov. sp		√			
<i>Ramphotyphlops</i> sp.		√			
<i>Ramphotyphlops</i> sp. 2					
Locally or Regional Significant					
<i>Pseudantechinus ningbing</i>		√			
<i>Planigale ingrami</i>	√				√
<i>Rattus colletti</i>		√			
<i>Ctenotus tantillus</i>		√		√	√
<i>Suta ordensis</i>					
<i>Notaden melanoscaphus</i>	√	√		√	√
<i>Uperoleia borealis</i>	√	√			√
<i>Uperoleia trachyderma</i>					

The Short-tailed Mouse *Leggadina lakedownensis* is listed as Priority 4 by the DEC, in WA. A total of 179 individuals have been lodged with the WA Museum but none of these have been lodged from the Kimberley in the last 10 years. However, this may only reflect the lack of collection due to lack of survey work in the area. The Short-tailed mouse is generally regarded as occurring in low population densities when compared with other rodents. This makes it vulnerable to disturbance and predation. Moro (2001) also details that this species suffers impact arising from competition with the House Mouse *Mus musculus*. The single capture of this species during the survey of Mantinea Plain in 2009 gives little indication of the distribution of this species across the Ord River flood plains. The habitat from which it was recorded was badly degraded cracking clay with a sparse Bauhinia woodland. It is not described as a habitat specialist so if this species does occur at Sorby Hills, some individuals may be lost during clearing and construction. However, the population will persist regionally.

No suitable habitat is present for the water rat *Hydromys chryogaster* (P4) as there are no heavily vegetated water ways. Insufficient information exists to determine if the blind snake *Ramphotyphlops troglodytes* may potentially occur in the project area. Records are so scant that the species was not included on the expected species list following the database search.

The semi arboreal and very cryptic chameleon dragon *Chelosania brunnea* has not been recorded in the area but is may potentially occur. It is very infrequently recorded due to its cryptic habit of perching on trees, similar to the frilled lizard *Chlamydosaurus kingii*. However, it is a significantly smaller species and thus not as easily spotted during surveys.

All of the remaining fauna species of conservation significance are listed primarily because of poor taxonomic resolution or local/regional significance. HLA lists a total of eight species collected that are poorly described in the literature. This is a direct result of lack of collection and vouchering in the region. Vouchering done during earlier surveys have been lost within the WA and NT museum system. None of these species listed by HLA were recorded during the Sorby Hills survey.

2.7.2.4 Bats

Bat acoustic surveys only give indications of species that are present during the survey but do not allow any assessments of density.

The results of the bat fauna survey identified ten insectivorous species as present within the study area. It was determined that nine of the species are relatively common in the Eastern Kimberley region. The tenth species, the pygmy long-eared bat is at the edge of its range and is not normally recorded. This species is not listed as being of conservation significance under any of the current legislation. However, populations have declined in the area due to the destruction, by cattle, of roosting habitat which comprises pandanus thickets. The pygmy long-eared bat feeds on insects whilst flying low over water bodies and would be utilising the dams and lagoons in the project area as foraging areas.

2.7.2.5 Avifauna

The overall results of the ornithological survey provided a total of 95 species; this figure is slightly lower than anticipated when comparing the size and structure of the project area to similar areas. The majority of these species recorded during the survey have been recorded in surrounding areas, with 85% of the species identified during the survey found in five or more locations.

The bird assemblages recorded in the project area are representative of those communities that would inhabit similar habitats elsewhere. There were no habitats or microhabitats in the proposed impact area that are not well represented elsewhere in the East Kimberley region. However, the Sorby Hills area provides some important fresh water bodies for a number of species, including 8 species of ducks and geese and a large number of finch species despite the fact that three of the four water bodies are artificial (i.e. cattle yards, the Sorby Hills dam).

2.7.2.6 Avifauna of Conservation Significance

The results of the ornithological surveys in the region found the following *EPBC Act* species of conservation significance were recorded within the vicinity of the project area:

- Cattle Egret
- Common Cicadabird
- Eastern Great Egret
- Gouldian Finch
- Rainbow Bee-eater
- Rufous Fantail
- White-bellied Sea-eagle
- Magpie Goose.

Of the above species, three (White-bellied Sea-eagle, Rufous Fantail and Common Cicadabird) were not identified during the recent surveys.

No threatened or migratory birds were observed during four field days of survey work in November 2011. At the same time, an assessment was made of Threatened and Migratory bird species habitat at Parry's Lagoon to provide some comparison of the habitat value between the project area and the nearby conservation reserve (Ramsar Wetland). Where no species were found at Sorby Hills, eight species comprising 821 individuals were recorded from Parry's Lagoon in less than 3Hrs of survey work.

2.7.2.7 Stygofauna and Troglifauna

A troglifauna desktop survey and a field survey of stygofauna at an intensity that will meet the recommendations of EPA *Guidance Statement 54A – Sampling Methods and Survey Considerations for Subterranean Fauna in Western Australia* was undertaken for the Sorby Hills project.

It was determined that there was little or no potential for impact from the Sorby Hills project on troglifauna. Troglobitic fauna would not persist in any of the areas targeted for impact as the majority of these areas are clay based soils that are subject to prolonged inundation.

Stygofauna were sampled in two rounds of sampling: September and November 2011. In each round, 20 bores within the proposed area of groundwater drawdown (impact samples) have been collected, as well as 20 samples from surrounding areas north and south of the drawdown zone (reference samples) (see Appendix 12).

All stygofauna collected were identified to species or morpho-species level and the results are shown in Appendix 12.

Groundwater drawdown is the major potential impact on stygofauna species. An assessment of the drawdown impacts was made in June 2011. The drawdown cone for the central test bore in D pod showed a graduated impact over an area of approximately 700m in all directions from the centre point. However, drawdown from the test bore in the southern end of the project area (over C pod) showed an impact drawdown area of no more than 250m radius from the bore location. Potential impacts to stygofauna from the excavation of the mine and subsequent dewatering over the life of the project will occur across the area of potential water drawdown.

The majority of stygofauna species recorded during both surveys were actually found in the reference sites, well outside the area of impact (Appendix 12).

2.8 Social Environment

The Sorby Hills Project site lies within the traditional lands of the Miriuwung Gajerrong people. Although the tenements pre-date Native Title, a Heritage Protection Agreement was developed between the previous owners of the Sorby Hills tenements and the Miriuwung Gajerrong Corporation (MG Corporation), as part of this agreement SMPL will develop an Indigenous Land Use Agreement (ILUA) with the MG Corporation.

An Aboriginal Heritage Desktop Analysis was undertaken by Land Access Solutions (LAS) for the Sorby Hills Project area in June 2011, this report has been included in Appendix 13 for reference. The Department of Indigenous Affairs (DIA) Heritage Register identifies five sites that lie wholly or partly within the Sorby Hills tenement areas. Of these registered sites, only the buffer zone of Site 15427 (Jingil Complex) will be intersected by the northern edge (approximately 300m) of the relevant tenements (M80/197 and M80/286); there is limited public information for DIA Site 15427 as it is a closed site (refer to Appendix 14).

Detailed archaeological and ethnographic surveys have been conducted of the areas proposed to be impacted by the Sorby Hills Project (Appendix 15). The surveys were conducted concurrently with participants from the Mirriuwung Gajerrong people and were coordinated through the MG Corporation. The archaeological survey was conducted from 19 to 21 October 2011 and the ethnographic survey was conducted with senior men on 20 October 2011 and with senior women on 21 October 2011.

The ethnographic survey was conducted in two parts; the first part had the participation of the older men from the Mirriuwung Gajerrong people and the second part employed the participation of the older women. This ensured that the men were able to determine if there were going to be any "men only" sites within the footprint of the mining and infrastructure area. In consultation and discussion with the Mirriuwung Gajerrong people the disturbance boundary for the project footprint was moved to exclude a small limestone hill. As a result of this boundary change, the Traditional Owners advised that they approved the development of the mine within the new boundary area. The MG Corp also confirmed this position in written correspondence included as Appendix 16.

The archaeological survey incorporated both a desktop analysis of previous survey work conducted in the area and a site inspection of the entire project disturbance footprint. The footprint that was surveyed considered the amendments to the boundaries as a result of discussions with the older men from the Mirriuwung Gajerrong people. No archaeological material was collected in the areas inspected during this survey.

The tenements were not identified in National or World Heritage Lists.

The nearest townships to the Sorby Hills Project are Kununurra and Wyndham. Extensive consultation with key stakeholders, including the local community, has occurred within these towns. Consultation has included meetings and phone conversations, presentations to various groups, distribution of a community information pamphlet to 378 households in Wyndham and 1126 households in Kununurra and inclusion of an informative half-page advertisement in the local newspaper, the Kimberley Echo. Appendix 17 provides the Stakeholder Consultation Register and examples of the community pamphlet and newspaper advertisement.

3 PROJECT DESCRIPTION

3.1 Area of Disturbance

The Sorby Hills Mining tenure area covers 12,612.40ha, with this proposal covering an area of 1,782.27ha (tenements M80/197 and M80/286) and a total disturbance footprint of 639.45ha (excluding firebreak clearing).

The table below (Table 3-1: Indicative Areas of Disturbance*) indicates the clearing requirements for each tenement associated with the Sorby Hills Project Mine Site.

Table 3-1: Indicative Areas of Disturbance*

DISTURBANCES (ha)	M80/197	M80/286
Open Pits	84ha	-
Tailings Facilities	125ha	22ha
Evaporation area	34ha	49ha
ROM Pad	-	4ha
Plant Site and support infrastructure including ROM pad, process plant, office, workshops	-	60ha
Explosives Magazine	-	0.25ha
Hypersaline pipeline corridors (>15, 000TDS)	-	2.2ha (2.2km x 10m)
Fresh water pipeline corridors (<15, 000TDS)	2.5ha (2.5km x 10m)	1ha (1km x 10m)
Haul roads	12.5ha (2.5km x 50m)	5ha (1km x 50m)
Access Tracks	6ha (1.5km x 40m)	12ha (3km x 40m)
Soil Stockpiles	15ha	10ha
Flood Bunds and Diversion Channel	90ha	70ha
Landfill Site	-	2ha
Artificial Wetland	33ha	-
Total	402ha	237.45ha
Tenement Area	993.91ha	788.36ha

*Areas are indicative only and may vary. The total clearing for mine infrastructure however will not exceed 639.45 without the appropriate approvals.

In addition to the above clearing, a 5m wide firebreak will be constructed around the perimeter of the site, which is approximately 20km in length. A firebreak will also be developed around species protection areas within the site. It is anticipated that up to 100ha of clearing may occur as part of this process; 60ha in M80/197 and 40ha in M80/286.

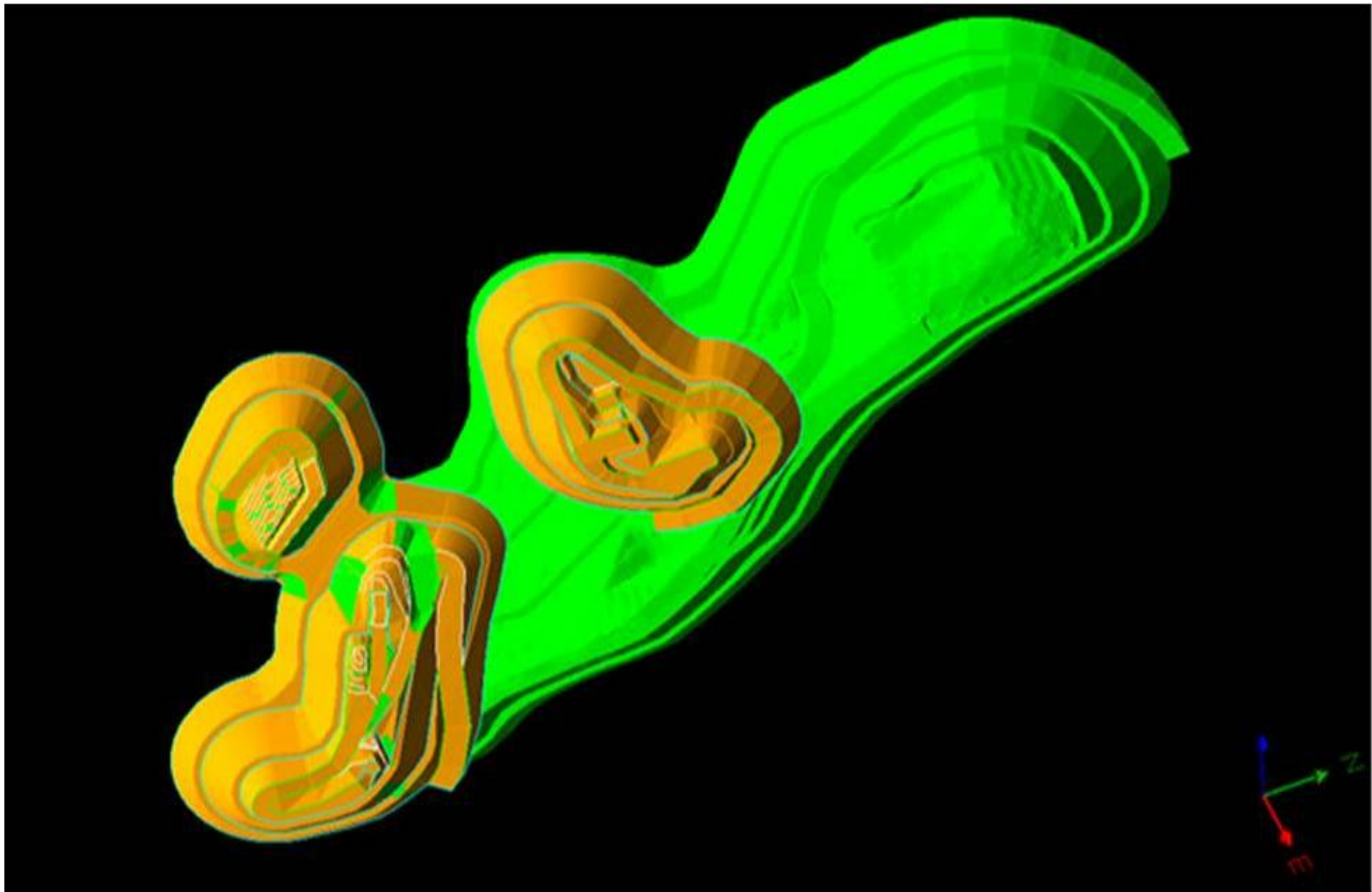
3.2 Mining Operations

The Sorby Hills mining operation for the C, D and E pods is planned over a period of 14 years at an ore production rate of 400,000 to 600,000Tpa. The mining technique will be consistent with a typical open cut, drill and blast operation.

Initially the C, D and E pods will be mined sequentially as separate entities in three small pits commencing with D pod; as mining progresses the three ore bodies will be contained within one larger pit. A 3D modelling image of the final pit design, showing the three separate ore bodies in one pit, is provided in Figure 3-1: Final Pit Design Model. Appendix 18 details the monthly mine schedule for D pod for the first 2 years of operation, including estimated waste and ore tonnages.

Mining will be carried out predominantly during dayshift, with some night operations occurring. The mining technique will consist of:

- Overburden (topsoil and clay) removal; two D10 dozers, four 631 scrapers and one 16H grader will be have been estimated to be required for this purpose.
- Drill and blast operation to drill, load and blast in pre-defined patterns. Drill crew and plant will consist of a single blast hole drill rig (Sandvick DP1100 or similar capacity drill rig) with operator, one bomb ute and shot firer and an explosives mobile manufacturing unit (MMU) with operator. Blasting will only take place at designated blast times during dayshift and only when conditions are favourable. Explosives will be stored in an explosives magazine in compliance with the *Explosives and Dangerous Goods Act 2004*, the *Dangerous Goods Safety (Explosives) Regulations 2007* and *Australian Standard AS 2187.1:1998, Explosives – Storage, transport and use, Part 1*. Explosives will be stored remote from the mining operations.
- Site geologist and pit technicians will assess broken (blasted) ground to identify and delineate ore, low grade material and waste prior to load and haul commencing in the area.
- The load and haul mining fleet will include a 120T excavator loading four 90T haul trucks, which will transfer ore, low grade material and waste to the respective stockpile areas. Extraction will be predominantly carried out using conventional mining technique. Ore and low grade material will be trucked along the haul road and tipped on the ROM pad. Waste material will be used in road and TSF embankment construction, as well as for flood bunds along the western edge of the site and around the perimeter of the open cuts. All waste is anticipated to be consumed during development of these structures therefore no designated waste dumps will be required for this project.
- The mining fleet will also include support machinery; a 35kL water cart will be required for dust suppression, a grader will be utilised for general earthworks and maintenance of the truck circuit and a 40T excavator will be on site to pull and maintain the batters, excavate drains and in pit sumps, and provide backup for the 120T excavator.



Auth: M Ladyman	Project: SMPL Sorby Hills
Date: October 2011	Datum: GDA94 MGA Zone 52



Figure 3-1: Final pit design model