GLOBE ENVIRONMENTS

Iron Hill Deposit

Assessment of the Threatened Taxa Category for *Darwinia masonii* using IUCN (2012) Criteria

August 2014

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1 Purpose

Mount Gibson Mining Limited (MGX) is a supplier of Western Australian iron ore, with mine operations at the Mt Gibson Ranges and Tallering Peak in the Mid-West Region, and at Koolan Island in the Kimberley.

MGX proposes to extend its operations at the Mt Gibson Ranges to include development of the Iron Hill Deposit, located approximately 3km south-east of the existing Mt Gibson Ranges mine operations. The Iron Hill Deposit contains high-grade hematite ore with the potential to extend the operational life of the Mt Gibson Ranges mine operations.

Development of the Iron Hill Deposit will impact the flora taxon *Darwinia masonii*, which is currently recorded only from the area of the Mt Gibson Ranges. *Darwinia masonii* has been declared as "Rare Flora" under the *Wildlife Conservation Act 1950* (WA) and as a "Threatened Species" of flora under the *Environment Protection and Biodiversity Conservation Act 1999* (C'th) as a result of its restricted distribution.

To assist with the environmental assessment of the Iron Hill Deposit, and having regard to the conservation status of *Darwinia masonii*, it is appropriate to undertake an assessment of the significance of impact of the Iron Hill Deposit to *Darwinia masonii* using the internationally accepted conservation criteria of the International Union for Conservation of Nature (IUCN) (IUCN 2012).

This report has been prepared to assess the potential for any change to the threatened taxa category for *Darwinia masonii* as a result of development of the proposed Iron Hill Deposit using the IUCN (2012) criteria. The IUCN (2012) criteria used in this assessment report is consistent with the approach used by the Department of Parks and Wildlife (DPaW) in assessment under the *Wildlife Conservation Act 1950* (WA) and by the Department of the Environment (DoE) in assessment under the *Environment Protection and Biodiversity Conservation Act 1999* (C'th).

2 Taxon Information

Darwinia masonii is an erect shrub to 3m tall with narrow leaves and distinctive tubular pinkish flowers (DPaW 2008). *Darwinia masonii* is currently recorded only from the ironstone hills of the Mt Gibson Ranges, with a total recorded population of 17,818 individuals within an area of approximately 6km^2. Based on survey data identified in ATA Environmental (ATA) (2004), Coffey Environments (Coffey) (2008), MBS Environmental (MBS) (2013) and Maia Environmental Consultancy (Maia) (2014), the *Darwinia masonii* population of 17,818 individuals comprises 15,486 mature individuals (87%), 1,790 juveniles (10%), and 542 dead individuals (3%). Table 1 summarises the current population records for *Darwinia masonii*.

	***Darwinia masonii* Population**			
Data Source	**Mature**	**Juvenile**	**Dead**	**Total**
ATA (2004)	13,931	1,724	541	**16,196**[1]
Coffey (2008)	170[2]	7[2]	0	**177**[3]
MBS (2013)	548[2]	23[2]	0	**571**[4]
Maia (2014)	837	36	1	**874**
Total	**15,486**	**1,790**	**542**	**17,818**

Table 1 Population Records for *Darwinia masonii*. Notes: [1] ATA (2004) records reduced from 16,573 individuals to 16,196 individuals by deletion of 6 records duplicate with Coffey (2008), deletion of 325 records duplicate with Maia (2014) and deletion of 46 records determined to be erroneous by MGX field survey; [2] The mature-juvenile proportions for Coffey (2008) and MBS (2013) are estimated based on the mature-juvenile proportions identified by Maia (2014); [3] Coffey (2008) provides data for 177 records rather than 176 records identified within the report text; [4] MBS (2013) records reduced from 723 individuals to 571 individuals by deletion of 152 records duplicate with ATA (2004).

Darwinia masonii is one of more than 50 Western Australian species of the genus *Darwinia*, with this genus comprising of a number of taxa considered to be naturally rare due to limiting natural factors such as substrate preferences or breeding biology constraints (MGX & Extension Hill Pty Ltd (EHPL) 2013).

Research on *Darwinia masonii* undertaken on behalf of MGX & EHPL by the Botanic Gardens and Parks Authority (BGPA) (BGPA 2010) has identified the following key information regarding the reproductive biology, population genetics and restoration ecology of *Darwinia masonii*:

(a) Germination of fresh *Darwinia masonii* seed is naturally low. Results of seed bank trials indicate a complex germination/dormancy strategy combining a requirement for physical seed coat degradation, environmental (seasonal temperature) curing with cycling in-and-out of dormancy, and heat/smoke-related physiological responses. Seedling survival during the first summer has been recorded at approximately 10%. Germination can be improved artificially by a combination of physical treatments and smoke application (mimicking the effect of fire for post-fire seedling recruitment, as described below).

(b) *Darwinia masonii* are killed by fire, however, fire also results in high post-fire seedling recruitment from long-lived soil-stored seed, with only limited recruitment between fires within older populations.

(c) Reproduction (i.e. flowering, fruiting) commences in *Darwinia masonii* from 6 years of age, with flowering and seed production taking place over an extended period during spring and early summer. Seed production varies, with between approximately 10 to 60 seeds

per plant per year in mature individuals. Pollination of *Darwinia masonii* is predominantly by a species of Honeyeater (a bird), with seed dispersal predominantly by ants. Reduced seed quality can arise from inbreeding and from predation by moth larvae.

(d) *Darwinia masonii* enter a period of physical dormancy during summer drought by reducing transpiration and photosynthetic function, with the capacity to restore tissues following rainfall. Roots of *Darwinia masonii* have the capacity to enter large cracks, pores and fissures in the regolith and may achieve considerable root depth (up to 10m). Whilst mortality is rare amongst mature *Darwinia masonii* (with this taxon being long-lived, to approximately 100 years), drought has been observed to contribute to mortality in both mature individuals and juveniles.

(e) Genetic structuring between groups of *Darwinia masonii* is low, however some groups do not mate randomly, suggesting some weak barriers to gene flow across the Mt Gibson Ranges. Analysis of molecular variance of 7 groups across the Mt Gibson Ranges partitioned approximately 94% of variation within populations, and 6% between populations, indicating weak population structure. Groups sampled in areas of the Mt Gibson Ranges referred to as Extension Hill South and Mt Gibson South were statistically identified as being genetically isolated, in that the *Darwinia masonii* in these groups do not appear to mate randomly with the other groups on the Mt Gibson Ranges, with possible explanations for this including the sampling different generations (due to differing fire histories between the sampled groups).

(f) Successful propagation of *Darwinia masonii* has been demonstrated using green-stock production from cuttings. Survival of *Darwinia masonii* green-stock cuttings transplanted to field sites averaged approximately 10% after 5 years in unwatered plots, whilst cuttings in plots that were irrigated for the first 2 years (but not after) indicated a survival rate of approximately 90% after 5 years[1]. Cuttings that were irrigated were recorded as commencing flowering in the first year.

3 Conservation Status

Darwinia masonii was declared as "Rare Flora" under the *Wildlife Conservation Act 1950* (WA) in November 1980, and listed as a "Threatened Species" of flora under the *Environment Protection and Biodiversity Conservation Act 1999* (C'th) in July 2000 (DPaW 2008).

As outlined by DPaW (2008), assessment using the IUCN (2001) criteria identified *Darwinia masonii* as meeting the category of "Vulnerable" under Criteria D2. The Criteria D2 Vulnerable category applies to taxa with an area of occupancy of <20km^2 and/or occurs at ≤5 locations, and with a plausible future threat that could drive the taxon to the categories of "Critically Endangered" or "Extinct" in a very short period of time (IUCN 2012; IUCN 2014). The basis for the Criteria D2 determination by DPaW resulted from *Darwinia masonii* having a restricted area of occupancy (<6km^2 and 1 location) and with mining considered to be a plausible future threat.

As identified by DoE (2008; 2013), the DPaW (2008) assessment has previously been accepted for the purpose of confirming of the listing of *Darwinia masonii* as a Threatened Species of flora under the *Environment Protection and Biodiversity Conservation Act 1999 (*C'th).

[1] As an update to BGPA (2010), the survival rate after approximately 9 years (2005 to 2014) is approximately 80% within irrigated plots (irrigated for the first 2 years, but not after), with approximately 90% of measured individuals within the irrigated plots recorded as being reproductive during the 2013 year (pers. com. J Sackmann of MGX, March 2014).

4 Assessment

4.1 *Darwinia masonii* Population Impacts

As outlined above, *Darwinia masonii* is currently recorded only from the ironstone hills of the Mt Gibson Ranges, with a total recorded population of 17,818 individuals comprising 15,486 mature individuals (87%), 1,790 juveniles (10%), and 542 dead individuals (3%).

Based on the current *Darwinia masonii* population records (Table 1) and the operational area outlined by the Statement 753 approval under the *Environmental Protection Act 1986* (WA) (WA Minister for Environment 2007), the approved Mt Gibson Ranges mine operations coincide with 2,694 individuals of *Darwinia masonii*, comprising 2,632 mature individuals, 24 juveniles and 38 dead individuals; equating to approximately 15% of the total *Darwinia masonii* population of 17,818 individuals. The environmental assessment of the Mt Gibson Ranges mine operations (ATA 2006; EPA 2006) identified a similar impact at approximately 16% (being 2,493 individuals of 16,038 mature individuals and juveniles, dead individuals excluded using only the ATA (2004) data).

Based on an assessment of the current aerial imagery of the approved Mt Gibson Ranges mine operations, a total of 1,688 individuals of *Darwinia masonii* have been removed to date from within the area of the approved Mt Gibson Ranges mine operations, comprising 1,639 mature individuals, 22 juveniles and 27 dead individuals; equating to approximately 9% of the *Darwinia masonii* population of 17,818 individuals. A further 1,055 individuals of *Darwinia masonii* have yet to be removed from within the area of the approved Mt Gibson Ranges mine operations; equating to approximately 6% of the *Darwinia masonii* population of 17,818 individuals.

MGX proposes to extend its operations at the Mt Gibson Ranges to include development of the Iron Hill Deposit, located approximately 3km south-east of the existing Mt Gibson Ranges mine operations. Based on the *Darwinia masonii* population records (Table 1) and an assessment of the current aerial imagery, development of the Iron Hill Deposit is expected to impact 1,262 individuals of *Darwinia masonii*, comprising 573 mature individuals, 595 juveniles and 94 dead individuals; equating to approximately 7% of the *Darwinia masonii* population.

Table 2 provides a summary of the *Darwinia masonii* population in relation to the impact of the approved Mt Gibson Ranges mine operations under the Statement 753 approval, the proposed Iron Hill Deposit, and the non-impact areas. As identified by Table 2, the cumulative impact of all mining developments will be 3,956 individuals (22%) of the *Darwinia masonii* population, with the remaining 13,862 individuals (78%) occurring within non-impact areas across the Mt Gibson Ranges.

	***Darwinia masonii* Population**		***Darwinia masonii* Population Cumulative Impact**	
	No. Individuals	**% Individuals**	**No. Individuals**	**% Individuals**
Statement 753	2,694 (2,632 mature, 24 juvenile, 38 dead)	15%	3,956	22%
Iron Hill Deposit	1,262 (573 mature, 595 juvenile, 94 dead)	7%		
Non-impact	13,862 (12,281 mature, 1,171 juvenile, 410 dead	78%	13,862	78%
Total	**17,818**	**100%**	**17,818**	**100%**

Table 2 *Darwinia masonii* Population. The total recorded population for *Darwinia masonii* is identified, including the proportional distribution between the areas of the approved Mt Gibson Ranges mine operations, the proposed Iron Hill Deposit, and the non-impact areas.

4.2 *Darwinia masonii* IUCN Population Impacts

This report has been prepared to assess the potential for any change to the threatened taxa category for *Darwinia masonii* as a result of development of the proposed Iron Hill Deposit using the IUCN (2012) criteria. The IUCN criteria are considered to be the international benchmark for assessing the conservation status of flora and fauna taxa, with a summary of the assessment criteria provided in Appendix 1 (IUCN 2014). This assessment report considers the potential for any change to the threatened taxa category for *Darwinia masonii* as a result of the development the approved Mt Gibson Ranges mine operations and the development of the proposed Iron Hill Deposit.

IUCN (2012) defines a population only by mature individuals, such that non-reproductive juveniles and dead individuals are excluded from assessment. As such, based on the population records identified at Table 1, the *Darwinia masonii* population for the purposes of an assessment using the IUCN (2012) criteria (i.e. live and mature, and herein referred to as the "*Darwinia masonii IUCN Population*") is 15,486 individuals. Consistent with this approach, the approved Mt Gibson Ranges mine operations coincide with 2,632 individuals (17%) of the *Darwinia masonii* IUCN Population of 15,486 individuals, with the development of the Iron Hill Deposit expected to impact 573 individuals (4%) of the *Darwinia masonii* IUCN Population.

Noting the majority of the population data for *Darwinia masonii* is now approximately 10 years old (i.e. ATA 2004), in undertaking this assessment, it is appropriate to contemplate potential changes to the *Darwinia masonii* IUCN Population structure across the Mt Gibson Ranges over this time, specifically, the potential for juveniles to have become mature over this period. This consideration is particularly relevant to the area of the Iron Hill Deposit, for which ATA (2004) noted contained the highest proportion of juveniles as a result of a (then) recent fire. Based on the results of BGPA (2010) which identified a seedling survival rate at approximately 10%, it would be reasonable to expect that approximately 10% of the 1,731 juveniles recorded by both ATA (2004) and Coffey (2008) across the Mt Gibson Ranges (Table 1) may survive to reach maturity (noting the recent MBS (2013) and Maia (2014) survey data does not require this same consideration as the mature-juvenile proportions are considered to be current). Accordingly, to account for juveniles that may have reached maturity, for the purposes of this assessment, the *Darwinia masonii* IUCN Population

is adjusted by 173 individuals (i.e. 10% of 1,731 juveniles recorded by ATA (2004) and Coffey (2008)) from 15,486 to 15,659 individuals. This adjustment to the *Darwinia masonii* IUCN Population applies across the Mt Gibson Ranges, and is most pronounced in the general area of Iron Hill due to the greater proportion of juveniles recorded in this area by ATA (2004). To note, the revised *Darwinia masonii* IUCN Population has not been adjusted to account for mature individuals which may have since died, noting the results of BGPA (2010) which identified *Darwinia masonii* to be long-lived (circa 100 years).

In applying the above adjustments to the *Darwinia masonii* IUCN Population, the impact of the approved Mt Gibson Ranges mine operations is adjusted from 2,632 individuals to 2,634 individuals of *Darwinia masonii* IUCN Population (an addition of 2 individuals [10% of 24 juveniles]); which equates to approximately 17% of the 15,659 individuals of the *Darwinia masonii* IUCN Population. Similarly, the impact of the Iron Hill Deposit is adjusted from 573 individuals to 633 individuals of *Darwinia masonii* IUCN Population (an addition of 60 individuals [10% of 595 juveniles]); which equates to approximately 4% of the 15,659 individuals of the *Darwinia masonii* IUCN Population. The non-impact areas are also similarly adjusted from 12,281 individuals to 12,392 individuals of *Darwinia masonii* IUCN Population (an addition of 111 individuals [10% of 1,107 juveniles]); which equates to approximately 79% of the 15,659 individuals of the *Darwinia masonii* IUCN Population occurring within non-impact areas across the Mt Gibson Ranges.

Table 3 provides a summary of the *Darwinia masonii* IUCN Population used by this assessment in relation to the impact of the approved Mt Gibson Ranges mine operations under the Statement 753 approval, the proposed Iron Hill Deposit, and the non-impact areas.

	***Darwinia masonii* IUCN Population (MATURE only, ADJUSTED)**		***Darwinia masonii* IUCN Population Cumulative Impact**	
	No. Individuals	**% Individuals**	**No. Individuals**	**% Individuals**
Statement 753	2,634 (2,632 mature + 2 [10% of 24 juveniles])	17%	**3,267**	**21%**
Iron Hill Deposit	633 (573 mature + 60 [10% of 595 juveniles])	4%		
Non-impact	12,392 (12,281 mature + 111 [10% of 1,107[1] juveniles])	79%	**12,392**	**79%**
Total	**15,659**	**100%**	**15,659**	**100%**

Table 3 *Darwinia masonii* IUCN Population. The total population and calculations for the *Darwinia masonii* IUCN Population records are identified, including the proportional distribution between the areas of the approved Mt Gibson Ranges mine operations, the proposed Iron Hill Deposit, and the non-impact areas. The adjustments to the *Darwinia masonii* IUCN Population to account for juveniles reaching maturity are identified.

[1] Of the total 1,171 juveniles of *Darwinia masonii* recorded in non-impact areas (Table 2), 1,107 juveniles were recorded by ATA (2004) and Coffey (2008) within non-impact areas. The *Darwinia masonii* IUCN Population adjustments are only applicable to the ATA (2004) and Coffey (2008) data.

In applying the adjusted *Darwinia masonii* IUCN Population, it is evident that the approved Mt Gibson Ranges mine operations under the Statement 753 approval of 2,634 individuals equates to approximately 17% of the *Darwinia masonii* IUCN Population. The proposed Iron Hill Deposit will impact an additional 633 individuals; equating to approximately 4% of the *Darwinia masonii* IUCN Population. The cumulative impact of the approved Mt Gibson Ranges mine operations and the proposed Iron Hill Deposit will therefore impact 3,267 individuals; equating to 21% of the *Darwinia masonii* IUCN Population. The remaining 12,392 individuals of the *Darwinia masonii* IUCN Population, equating to 79%, occur within non-impact areas across the Mt Gibson Ranges.

Table 4 provides an assessment using the IUCN (2012) criteria of the potential cumulative impact to the *Darwinia masonii* IUCN Population from the approved Mt Gibson Ranges mine operations and development of the proposed Iron Hill Deposit. Table 4 adopts the IUCN (2014) summary format (Appendix 1), which is consistent with the DPaW (2008) format used for assessment under the *Wildlife Conservation Act 1950* (WA). The assessment using the IUCN (2012) criteria has been undertaken consistent with the relevant guidance contained within both IUCN (2012) and IUCN (2014). The threatened taxa criteria considered applicable have been highlighted in yellow, with a description provided in the right-hand column to identify the basis for the assessment outcome.

5 Results

The IUCN (2012) threatened taxa category of "Vulnerable" is applicable to *Darwinia masonii* based on the cumulative impact meeting Criteria D2. As identified by Table 3, the cumulative impact includes both the approved Mt Gibson Ranges mine operations and the proposed Iron Hill Deposit. As identified by Table 4, Criteria D2 is applicable as *Darwinia masonii* has a restricted area of occupancy of ≤20km^2 and occurs in ≤5 locations, with climate (principally extended drought) posing a risk of increasing this threat category.

No other criteria were met.

6 Discussion

Whilst the proposed development of the Iron Hill Deposit is expected to impact *Darwinia masonii*, the cumulative impact to *Darwinia masonii* is not expected to result in a change or increase to the current threatened taxa category of "Vulnerable" under Criteria D2 of IUCN (2012).

The results of this assessment are consistent with the assessment outcomes identified by DPaW (2008), in which the IUCN (2012) Criteria D2 was also considered to be applicable for the Vulnerable category, with no other criteria being met.

Whilst Criteria D2 was identified by both DPaW (2008) and this assessment as being applicable, the risk basis of future mining outlined by DPaW (2008) for a potential increase in the threat category (i.e. to "Critically Endangered" or "Extinct") is not considered to be applicable, with future mining (i.e. development of the Iron Hill Deposit) demonstrated to not increase the threat category. As identified by Table 4, climate (principally extended drought) is considered to be the risk factor relevant to a potential future increase in the threat category, noting that as the population occurs at only a single location, a single climate event could detrimentally affect the entire population.

Table 4 Assessment of Threatened Taxa Categories for *Darwinia masonii* using IUCN (2012) Criteria. The assessment for *Darwinia masonii* includes consideration of the impact of the approved Mt Gibson Ranges mine operations and the development of the proposed Iron Hill Deposit. The assessment has been undertaken consistent with the relevant guidance contained within IUCN (2012) and IUCN (2014), including in the application of defined terms relevant to interpretation of each criteria. The yellow highlighted criteria are considered to be applicable to the *Darwinia masonii* IUCN Population.

IUCN (2012) CRITERIA	ASSESSMENT
A. Population size reduction. Population reduction (measured over the longer of 10 years or 3 generations) based on any of A1 to A4 Critically Endangered / Endangered / Vulnerable A1: ≥ 90% / ≥ 70% / ≥ 50% A2, A3 & A4: ≥ 80% / ≥ 50% / ≥ 30%	
A1. Population reduction observed, estimated, inferred, or suspected in the past where the causes of the reduction are clearly reversible AND understood AND have ceased, based on any of the following: (a) direct observation (b) an index of abundance appropriate to the taxon (c) a decline in area of occupancy (AOO), extent of occurrence (EOO) and/or habitat quality (d) actual or potential levels of exploitation (e) effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.	**NOT APPLICABLE** This criterion relates to past population reduction that is reversible, understood and has ceased. There is no recorded past population reduction known to be applicable to *Darwinia masonii* that is reversible, understood and has ceased.
A2. Population reduction observed, estimated, inferred, or suspected in the past where the causes of reduction may not have ceased OR may not be understood OR may not be reversible, based on any of the following: (a) direct observation (b) an index of abundance appropriate to the taxon (c) a decline in area of occupancy (AOO), extent of occurrence (EOO) and/or habitat quality (d) actual or potential levels of exploitation (e) effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.	**NOT APPLICABLE** This criterion relates to past population reduction that may not have ceased, may not be understood or may not be reversible. The past population reduction of *Darwinia masonii* of 9% (1,639 of 15,659 individuals) from development of the approved Mt Gibson Ranges mine operations which have not ceased (i.e. impact to date, with some areas of the approved Mt Gibson Ranges mine operations yet to be developed), is less than the ≥30% criteria under A2. The past population reduction of *Darwinia masonii* (existing impact plus the remaining approved impact) of 17% (2,634 of 15,659 individuals) from development of the approved Mt Gibson Ranges mine operations (to completion) is also less than the ≥30% criteria under A2.

A3.	Population reduction projected, inferred or suspected to be met in the future (up to a maximum of 100 years), based on any of the following: (b) an index of abundance appropriate to the taxon (c) a decline in area of occupancy (AOO), extent of occurrence (EOO) and/or habitat quality (d) actual or potential levels of exploitation (e) effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.	**NOT APPLICABLE** This criterion relates to future population reduction. The projected future population reduction for *Darwinia masonii* of 21% (3,267 of 15,659 individuals) from development of the approved Mt Gibson Ranges mine operations and the proposed Iron Hill Deposit is less than the ≥30% criteria under A3.
A4.	An observed, estimated, inferred, projected or suspected population reduction where the time period must include both the past and the future (up to a max. of 100 years in the future), and where the causes of reduction may not have ceased OR may not be understood OR may not be reversible, based on any of the following: (a) direct observation (b) an index of abundance appropriate to the taxon (c) a decline in area of occupancy (AOO), extent of occurrence (EOO) and/or habitat quality (d) actual or potential levels of exploitation (e) effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.	**NOT APPLICABLE** This criterion relates to past and future population reductions that may not have ceased, may not be understood or may not be reversible. The projected future population reduction for *Darwinia masonii* of 21% (3,267 of 15,659 individuals) from development of the approved Mt Gibson Ranges mine operations and the proposed Iron Hill Deposit is less than the ≥30% criteria under A3.

B. Geographic range in the form of either B1 (extent of occurrence) AND/OR B2 (area of occupancy)

		Critically Endangered	Endangered	Vulnerable	
B1.	Extent of occurrence (EOO)	< 100 km²	< 5,000 km²	< 20,000 km²	**NOT APPLICABLE** This criterion relates to the Extent of Occurrence (EOO) and where the locations are severely fragmented or small, there is a continuing decline or there are extreme fluctuations. Whilst the EOO for *Darwinia masonii* meets the occurrence area and number of locations applicable to the Critically Endangered category (i.e. EOO <100km² under B1, and 1 location under B2(a)), *Darwinia masonii* is not subject to a continuing decline (i.e. B2(b)) or extreme fluctuations (i.e. B2(c)) as defined by IUCN (2014).

B2.	Area of occupancy (AOO)	< 10 km²	< 500 km²	< 2,000 km²	**NOT APPLICABLE** This criterion relates to the Area of Occupancy (AOO) and where the locations are severely fragmented or small, there is a continuing decline or there are extreme fluctuations. Whilst the AOO for *Darwinia masonii* meets the occurrence area and number of locations applicable to the Critically Endangered category (i.e. AOO <10km² under B2, and 1 location under B2(a)), *Darwinia masonii* is not subject to a continuing decline (i.e. B2(b)) or extreme fluctuations (i.e. B2(c)) as defined by IUCN (2014).
	AND at least 2 of the following 3 conditions:				
	(a) Severely fragmented OR Number of locations	= 1	≤ 5	≤ 10	
	(b) Continuing decline in observed, estimated, inferred or projected in any of (i) extent of occurrence (ii) area of occupancy, (iii) area, extent and/or quality of habitat, (iv) number of locations or subpopulations; (v) number of mature individuals.				
	(c) Extreme fluctuations in any of (i) extent of occurrence, (ii) area of occupancy, (iii) number of locations or subpopulations; (iv) number of mature individuals.				

C.	**Small population size and decline**				
		Critically Endangered	Endangered	Vulnerable	
	Number of mature individuals	< 250	< 2,500	< 10,000	
	AND at least one of C1 or C2				
C1.	An observed, estimated or projected continuing decline of at least (up to a max. of 100 years in the future)	25% in 3 years or 1 generation (whichever is longer)	20% in 5 years or 2 generations (whichever is longer)	10% in 10 years or 3 generations (whichever is longer)	**NOT APPLICABLE** This criterion relates to the number of mature individuals and a past or future continuing decline in the population. The *Darwinia masonii* population of 15,659 mature individuals is greater than the "Vulnerable" criteria of <10,000 individuals under C.
C2.	An observed, estimated, projected or inferred continuing decline AND at least 1 of the following 3 conditions:				**NOT APPLICABLE** This criterion relates to the number of mature individuals and a past or future continuing decline in the population. The *Darwinia masonii* population of 15,659 mature individuals is greater than the "Vulnerable" criteria of ≤1,000 individuals under C.
	(a)(i) Number of mature individuals in each subpopulation:	≤ 50	≤ 250	≤ 1,000	
	(a)(ii) % of mature individuals in one subpopulation =	90-100%	95-100%	100%	
	(b) extreme fluctuations in the number of mature individuals				

D.	**Very small or restricted population**				
		Critically Endangered	Endangered	Vulnerable	
D	Number of mature individuals	< 50	< 250	**D1.** < 1,000	**NOT APPLICABLE** This criterion relates to the number of mature individuals and a past or future decline in the population. The *Darwinia masonii* population of 15,659 mature individuals is greater than the "Vulnerable" criteria of <1,000 individuals under D.
D2	*Only applies to the VU category* Restricted area of occupancy or number of locations with a plausible future threat that could drive the taxon to CR or EX in a very short time.	-	-	**D2.** typically: AOO < 20 km² or number of locations ≤ 5	**CRITERIA D2 IS APPLICABLE FOR THE 'VULNERABLE' CATEGORY** This criterion relates to where a restricted area of occupancy (AOO) or the number of locations may result in the taxon being driven to the threat categories of "Critically Endangered" or "Extinct" in a very short period of time due to a plausible future threat. The D2 criteria are applicable for both the AOO of < 20 km² and the number of locations being ≤ 5. The AOO of *Darwinia masonii* is <6km² and the number of locations is 1. Climate (principally extended drought) is considered to be a plausible future threat that may have a likelihood of driving *Darwinia masonii* to the threat categories of "Critically Endangered" or "Extinct" in a very short period of time, noting as the entire population occurs at only a single location, a single climate event could detrimentally affect the entire population. Whilst development of the approved Mt Gibson Ranges mine operations and development of the proposed Iron Hill Deposit will have a notable impact to *Darwinia masonii* (21%, being 3,267 of 15,659 individuals), this impact is fixed (i.e. not a continuing decline), such that these mining developments are not expected to have a likelihood of increasing the threat category to "Critically Endangered" or "Extinct" in a very short period of time.

E. Quantitative Analysis				
	Critically Endangered	Endangered	Vulnerable	
Indicating the probability of extinction in the wild to be:	≥ 50% in 10 years or 3 generations, whichever is longer (100 years max.)	≥ 20% in 20 years or 5 generations, whichever is longer (100 years max.)	≥ 10% in 100 years	**NOT APPLICABLE** Sufficient data does not exist to undertake a quantitative analysis of the risk of extinction in the wild for *Darwinia masonii.*

7 References

All references cited within this report are identified below. Where an organisational name has changed since the original date of publication, the new organisational name has been used and the former organisational name noted.

Subject to the provisions of the *Copyright Act 1968* (C'th), a copy of each reference to which MGM has authority to reproduce is provided on the compact disc attached to this report.

Western Australian legislation cited in this report can be obtained from the State Law Publisher at http://www.slp.wa.gov.au. Commonwealth legislation cited in this report can be obtained from the Australasian Legal Information Institute at http://www.austlii.edu.au/au/legis/cth/consol_act/.

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Appendix 1
IUCN criteria (IUCN 2014)

A. Population size reduction. Population reduction (measured over the longer of 10 years or 3 generations) based on any of A1 to A4

	Critically Endangered	Endangered	Vulnerable
A1	≥ 90%	≥ 70%	≥ 50%
A2, A3 & A4	≥ 80%	≥ 50%	≥ 30%

A1 Population reduction observed, estimated, inferred, or suspected in the past where the causes of the reduction are clearly reversible AND understood AND have ceased.

A2 Population reduction observed, estimated, inferred, or suspected in the past where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.

A3 Population reduction projected, inferred or suspected to be met in the future (up to a maximum of 100 years) *[(a) cannot be used for A3]*.

A4 An observed, estimated, inferred, projected or suspected population reduction where the time period must include both the past and the future (up to a max. of 100 years in future), and where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.

based on any of the following:

(a) direct observation *[except A3]*
(b) an index of abundance appropriate to the taxon
(c) a decline in area of occupancy (AOO), extent of occurrence (EOO) and/or habitat quality
(d) actual or potential levels of exploitation
(e) effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.

B. Geographic range in the form of either B1 (extent of occurrence) AND/OR B2 (area of occupancy)

	Critically Endangered	Endangered	Vulnerable
B1. Extent of occurrence (EOO)	< 100 km²	< 5,000 km²	< 20,000 km²
B2. Area of occupancy (AOO)	< 10 km²	< 500 km²	< 2,000 km²
AND at least 2 of the following 3 conditions:			
(a) Severely fragmented **OR** Number of locations	= 1	≤ 5	≤ 10
(b) Continuing decline observed, estimated, inferred or projected in any of: **(i)** extent of occurrence; **(ii)** area of occupancy; **(iii)** area, extent and/or quality of habitat; **(iv)** number of locations or subpopulations; **(v)** number of mature individuals			
(c) Extreme fluctuations in any of: **(i)** extent of occurrence; **(ii)** area of occupancy; **(iii)** number of locations or subpopulations; **(iv)** number of mature individuals			

C. Small population size and decline

	Critically Endangered	Endangered	Vulnerable
Number of mature individuals	< 250	< 2,500	< 10,000
AND at least one of C1 or C2			
C1. An observed, estimated or projected continuing decline of at least (up to a max. of 100 years in future):	25% in 3 years or 1 generation (whichever is longer)	20% in 5 years or 2 generations (whichever is longer)	10% in 10 years or 3 generations (whichever is longer)
C2. An observed, estimated, projected or inferred continuing decline AND at least 1 of the following 3 conditions:			
(a) (i) Number of mature individuals in each subpopulation	≤ 50	≤ 250	≤ 1,000
(ii) % of mature individuals in one subpopulation =	90–100%	95–100%	100%
(b) Extreme fluctuations in the number of mature individuals			

D. Very small or restricted population

	Critically Endangered	Endangered	Vulnerable
D. Number of mature individuals	< 50	< 250	**D1.** < 1,000
D2. *Only applies to the VU category* Restricted area of occupancy or number of locations with a plausible future threat that could drive the taxon to CR or EX in a very short time.	-	-	**D2.** typically: AOO < 20 km² or number of locations ≤ 5

E. Quantitative Analysis

	Critically Endangered	Endangered	Vulnerable
Indicating the probability of extinction in the wild to be:	≥ 50% in 10 years or 3 generations, whichever is longer (100 years max.)	≥ 20% in 20 years or 5 generations, whichever is longer (100 years max.)	≥ 10% in 100 years

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