GOVERNMENT OF WESTERN AUSTRALIA

Department of **Biodiversity, Conservation and Attractions**

Nomination

Current conservation status				
Name of ecological community:	Ethel gorge stygobiont community			
Other names:				
Description:	The community is known from the Ethel Gorge (Ophthalmia Basin) alluvium calcrete aquifer on the Fortescue River in the vicinity of the town of Newman. It comprises a diverse assemblage of stygofaunal species. It includes Oligochaeta and the crustaceans Bathynellacea (Syncarida), cyclopoid and harpacticoid copepods, Candonidae: Candoninae C (Ostracoda: Podocopida), Candonidae: Candoninae D (Ostracoda: Podocopida), Limnocytheridae (Ostracoda: Podocopida), flabelliferan Isopod (Tainisopodidae) and one new genus of Crangonyctoid amphipoda (*Chydeakata*, family Paramelitidae), in which 14 species (13 in this aquifer) have been described on morphological characters. At least one species of *Chydaekata* is known only from this community.			
Nomination for:	Listing under BC Act ☐	Change of status ☒	Delisting ☐	
1. *Is the ecological community currently on any conservation list, either in a State or Territory, Australia or Internationally?* 2. *Is it present in an Australian jurisdiction, but not listed?*	*Provide details of the occurrence and listing status for each jurisdiction in the following table*			

Jurisdiction	**List or Act name**	**Date listed or assessed (or N/A)**	**Listing category eg. critically endangered (or none)**	**Listing criteria eg. B1ab(iii)+2ab(iii) (or none)**
National	EPBC Act			
Western Australia	TEC list: WA Minister ESA list in policy	22/06/2001	Endangered	B) ii)
	Priority list		1 ☐ 2 ☐	3 ☐ 4 ☐
Other State/Territory				

Nominated conservation status: category and criteria (include recommended status for deleted ecological communities)				
Critically endangered (CR) ☒	Endangered (EN) ☐	Vulnerable (VU) ☐	Collapsed (CO) ☐	
Priority 1 ☐	Priority 2 ☐	Priority 3 ☐	Priority 4 ☐	None ☐

What criteria support the conservation status category for listing as a threatened ecological community or collapsed ecological community? *Refer to Section 32 of the Biodiversity Act 2016 for definition of 'Collapsed', and Appendix 3 table 'IUCN Red List Criteria for ecosystems version 2.2'.*		B1c; B2c
Eligibility against the criteria		
*Provide justification for the nominated conservation status; is the ecological community eligible or ineligible for listing against the five criteria. For **delisting**, provide details for why the ecological community no longer meets the requirements of the current conservation status.*		
A.	Reduction in geographic distribution *(evidence of decline)*	☐ **A1** ☐ **A2a** ☐ **A2b** ☐ **A3**
	Justification of assessment under Criterion A.	For criteria A and B, the ecosystem was assumed to collapse when the mapped distribution declines to zero. • A: The thickness of the aquifer has changed over the past 40 years (See appendix 1 for details). Based on available data, it is not possible to measure any declines that may have occurred in the habitat that supports the community. • Available data are not appropriate to determine if a ≥30% reduction at least in geographic distribution has or will occur over any 50-year period, or a ≥50% reduction since 1750 (ie. the minimum requirements to meet the category VU under criterion A). • **Community is data deficient under criterion A**
B.	Restricted geographic distribution *(EOO and AOO, number of locations and evidence of decline)*	☒ **B1** (specify at least one of the following): CR ☐ **a)(i)** ☐ **a)(ii)** ☐ **a)(iii)** ☒ **b)** ☒ **c);** ☒ **B2** (specify at least one of the following): ☐ **a)(i)** ☐ **a)(ii)** ☐ **a)(iii)** ☒ **b)** ☒ **c);** ☐ **B3 (only for Vulnerable Listing)**
	Justification of assessment under Criterion B.	• B1: EOO is 67km^2 (≤2,000km^2, which is the threshold for CR). • B2: AOO is two 10x10 km grid cells (threshold for EN is 20, and for CR is two grid cells). Community meets threshold for rank CR under criterion part B2. • a): No available data available to indicate a measure of decline in spatial extent, environmental quality or disruption to biotic interactions to support ranking under B1a or B2a. • b): Recent water level monitoring data are unsuitable to assess whether the community's potential environmental water requirements are being met and identify potential risk to the stygofaunal assemblage. Therefore it is not determined if hydrological change associated with groundwater abstraction is likely to cause continuing decline in the stygofaunal community in the next 20 years (see

		Appendix 1 for further information on threats). Insufficient data to determine if m**eets CR under B1b, B2b**. • c): Ecosystem exists at one threat-defined location based on the inferred current and ongoing impact from hydrological change (threshold for CR is 1 and for EN is 5 'threat-defined locations' ie. *a geographically or ecologically distinct area in which a single threatening event can rapidly affect all occurrences of an ecosystem type*). **Meets CR under B1c; B2c.** • B3: Known from one threat-defined location which is prone to effects of human activities or stochastic events (for example hydrological change associated with dewatering) within a very short time period in an uncertain future and thus capable of collapse or becoming CR within a very short time period (meets VU as ≤5 threat defined locations). **Meets VU under B3.** • **Meets criteria for Critically Endangered under B1c; B2c. Meets VU under B3.**
C.	Environmental degradation of abiotic variable *(Evidence of decline over 50-year period)*	☐ **C1** ☐ **C2** ☐ **C3**
	Justification of assessment under Criterion C.	• Hydrological change from groundwater abstraction is an abiotic variable that is a significant threat to the community. • The collapse state is considered to be a level of hydrological change (groundwater levels or quality) that result in total loss of faunae that are crucial to the food web in the community. • For criterion C, the assessment of decline in abiotic processes is based on hydrological change. The stygofauna are hosted in shallow (<10m below ground level) alluvial aquifers and their habitat is maintained by saturation of these aquifers. The community is at risk from the changes to groundwater quality associated with abstraction and/or discharge of excess dewatering water into the Ophthalmia Dam. Lowering of the water table below ecologically appropriate levels potentially result from surface operations (sealing or clearing), as well as those below ground (water abstraction, mine dewatering, recharge through the Ophthalmia Dam) (Humphries 2001). • Determining hydrological risk is problematic due to the complexity of the underlying aquifers, and difficulty of obtaining relevant data linking groundwater levels and quality, faunal composition, resilience and persistence (see threats in Appendix 1). • It is not possible to determine a collapse point at which groundwater levels or quality will result in total loss of faunae that are crucial to the food web of the Ethel Gorge groundwater assemblage due to lack of data linking groundwater levels, aquifer thickness, water quality, and the status of the assemblage.

		• There is inadequate evidence to indicate if the community meets the thresholds for minimum proportion of the extent (≥30%) or proportional severity of degradation (≥30%) over any 50-year period to meet VU under these criteria. • Available evidence does not indicate if the community meets criterion C. • **Community is data deficient under Criterion C**
D.	Disruption of biotic processes or interactions *(Evidence of decline over 50-year period)*	☐ **D1** ☐ **D2** ☐ **D3**
	Justification of assessment under Criterion D.	• Iron bacteria (*Leptothrix* spp.) were detected within a water supply bore in the Opthalmia bore field in 2016 (see Appendix 1 for details of threats). • Both the bacterial bloom and the proposed treatment method have potential to impact on the community and may be a biotic threat to the Ethel Gorge assemblage. • The collapse state is considered to be a level of iron bacteria (or the effects of the treatment) that result in total loss of faunae that are crucial to the food web of the Ethel Gorge assemblage. • There are inadequate data to determine the impacts of the iron bacteria, and the current status of faunae that are crucial to the food web of the Ethel Gorge groundwater assemblage in relation to a collapse point. • Based on currently available data, it is not possible to determine if the assemblage or significant components have declined as a consequence of iron bacteria, or the treatment. • It is not possible to determine if the community meets the minimum proportion of the extent (30%) or proportional severity of disruption of biotic processes (30%) over any 50-year period, or since ~1750 (50% disruption of biotic processes / 50% of the extent) to meet VU. • **Community is data deficient under criterion D. Unable to assess**
E.	Quantitative analysis *(statistical probability of ecosystem collapse)*	• No quantitative estimates of the risk of ecosystem collapse. • **Unable to assess**
Reasons for change of status		
Genuine change ☐ New knowledge ☐ Previous mistake ☐ Review/Other ☒		
Provide details: The community was initially ranked Endangered using ranking criteria developed in WA that differ to those in the IUCN Red List Criteria for Ecosystems (version 2.2).		
Summary of assessment information *(provide detailed information in the relevant sections of the nomination form)*		

EOO	67km^2	AOO	Two 10x10 km grid cells (actual measured AOO ~37km^2)
No. occurrences	1	Severely fragmented	Yes ☐ No ☒ Unknown ☐
Justification	All threats apply equally across the single occurrence.		
Current known area			~3,738ha
Pre-industrialisation extent or its former known extent (if known)			~3,738ha
Estimated percentage decline			Unknown but thought to occupy most or all of its former extent

Summary assessment against IUCN RLE Criteria

Criterion	Rank indicated	Overall conclusion
A1	-	• Insufficient evidence to indicate if community meets criterion
A2a	-	• Insufficient evidence to indicate if community meets criterion
A2b	-	• Insufficient evidence to indicate if community meets criterion
A3	-	• Insufficient evidence to indicate if community meets criterion
B1a	-	• No appropriate data are available to measure decline in environmental quality or disruption to biotic interactions. • Does not meet criterion
B1b	-	• EOO is ≤2,000km^2 • Not possible to determine whether observed and inferred threats likely to cause continuing decline within the next 20 years • Plausibly meets criterion for CR
B1c	CR	• EOO is ≤2,000km^2 • Ecosystem exists at one threat-defined location • Meets criterion for CR
B2a	-	• No appropriate data are available to measure decline in environmental quality or disruption to biotic interactions. • Does not meet criterion
B2b	-	• AOO is two grid cells • Not possible to determine whether observed and inferred threats are likely to cause continuing decline within the next 20 years • Plausibly meets criterion for CR
B2c	CR	• AOO is two grid cells • Ecosystem exists at one threat-defined location • Meets criterion for CR
B3	VU	• Known from one threat-defined location • Prone to the effects of human activities or stochastic events within a short time period in an uncertain future • Meets criterion for VU
C1	-	• Inadequate evidence to indicate if the community meets the minimum thresholds for proportion of the extent (≥30%) or proportional severity of degradation (≥30%) over past 50 years to meet VU.
C2	-	• Inadequate evidence to indicate if the community meets the minimum thresholds for proportion of the extent (≥30%) or proportional severity of degradation (≥30%) over any 50-year period to meet VU.
C3	-	• Inadequate evidence to indicate if the community meets the minimum thresholds for proportion of the extent (≥50%) or proportional severity of disruption of abiotic processes (≥50%) since ~1750 to meet VU.
D1	-	• Inadequate evidence to indicate if the community meets the minimum thresholds for proportion of the extent (≥30%) or proportional severity of degradation (≥30%) over any 50-year period to meet VU.
D2	-	• Inadequate evidence to indicate if the community meets the minimum thresholds for proportion of the extent (≥30%) or proportional severity of degradation (≥30%) over any 50-year period to meet VU.
D3	-	• Inadequate evidence to indicate if the community meets the minimum thresholds for proportion of the extent (≥50%) or proportional severity of disruption of biotic processes (≥50%) since ~1750 to meet VU.
E	NA	• No quantitative estimates of the risk of ecosystem collapse.
		Meets criteria for critically endangered under B1c; B2c. Meets VU under B3.

		The highest risk category obtained by any of the assessed criteria will be the overall risk status of the ecosystem' (IUCN RLE Guidelines V1.1 page 42). **Meets CR under B1c; B2c**

Summary of location (occurrence) information *(provide detailed information in the relevant sections of the nomination form)*						
Occurrence	Land tenure	Survey information: date of survey	Condition	Area of occurrence (ha)	Threats *(note if past, present or future)*	Specific management actions
EthelG	Freehold (Department of Planning, Lands and Heritage)	2013	Unknown	3,738.5	Hydrological changes, disease (*past, present, future*)	Ongoing stygofauna and hydrological monitoring undertaken by mining company

APPENDIX 1 THREATS

Hydrological changes

Ethel Gorge and upstream to about 1.5km below the Ophthalmia Dam wall, contain the highest species richness and greatest proportion of localised species of stygofauna in the Newman area (Bennelongia 2015). The stygofauna are hosted in shallow alluvial aquifers (including calcrete) and their habitat is maintained by saturation of these aquifers. The Ophthalmia aquifer is the main habitat for the Ethel Gorge stygobiont community and some riparian vegetation may also be partially groundwater dependent. The high stygofauna abundance may be associated with active creek recharge, infiltration from Ophthalmia Dam and shallower groundwater levels (less than 10 metres below ground level). The three main threatening processes include groundwater drawdown associated with mine dewatering, waterlogging (water saturation within the root zone) and increased groundwater salinity. The latter two processes result from the discharge of surplus dewatering water into Ophthalmia Dam (BHP 2014). Lowering of the water table below ecologically appropriate levels potentially result from surface operations (sealing or clearing), as well as those below ground (water abstraction, mine dewatering, recharge through the Ophthalmia Dam) (Humphries 2001).

The Ophthalmia Borefield was established in the mid-1970s to provide water for mining operations (orebody 23 (mine site) occurs alongside the Ethel Gorge aquifer and the aquifer is being dewatered, and hence, reduced in extent) and the town of Newman. Figure 1 and Table 1 below show the aquifer thickness with a substantial decline in groundwater levels occurring between 1972 to 1982, after extraction began. In 1981, the Ophthalmia Dam was constructed to replenish groundwater levels in the borefield. In the central regions of the borefield the groundwater levels increased by around 10m, while in the northern part of the borefield, close to Ethel Gorge, groundwater levels also increased but were still 3m below baseline levels. Significant above average rainfall occurred from 1999 to 2006, resulting in above average runoff into the Ophthalmia Dam (BHP 2014).

Prior to the construction of Ophthalmia Dam, groundwater salinity was about 1000 mg/L total dissolved solids (TDS). Over the past 40 years, groundwater levels and salinity have been influenced by the Ophthalmia managed aquifer recharge (MAR) system, groundwater abstraction from the Ophthalmia borefield, dewatering activities at OB23 and the expansion of riparian vegetation at Ophthalmia Dam (BHP 2014; Table 2).

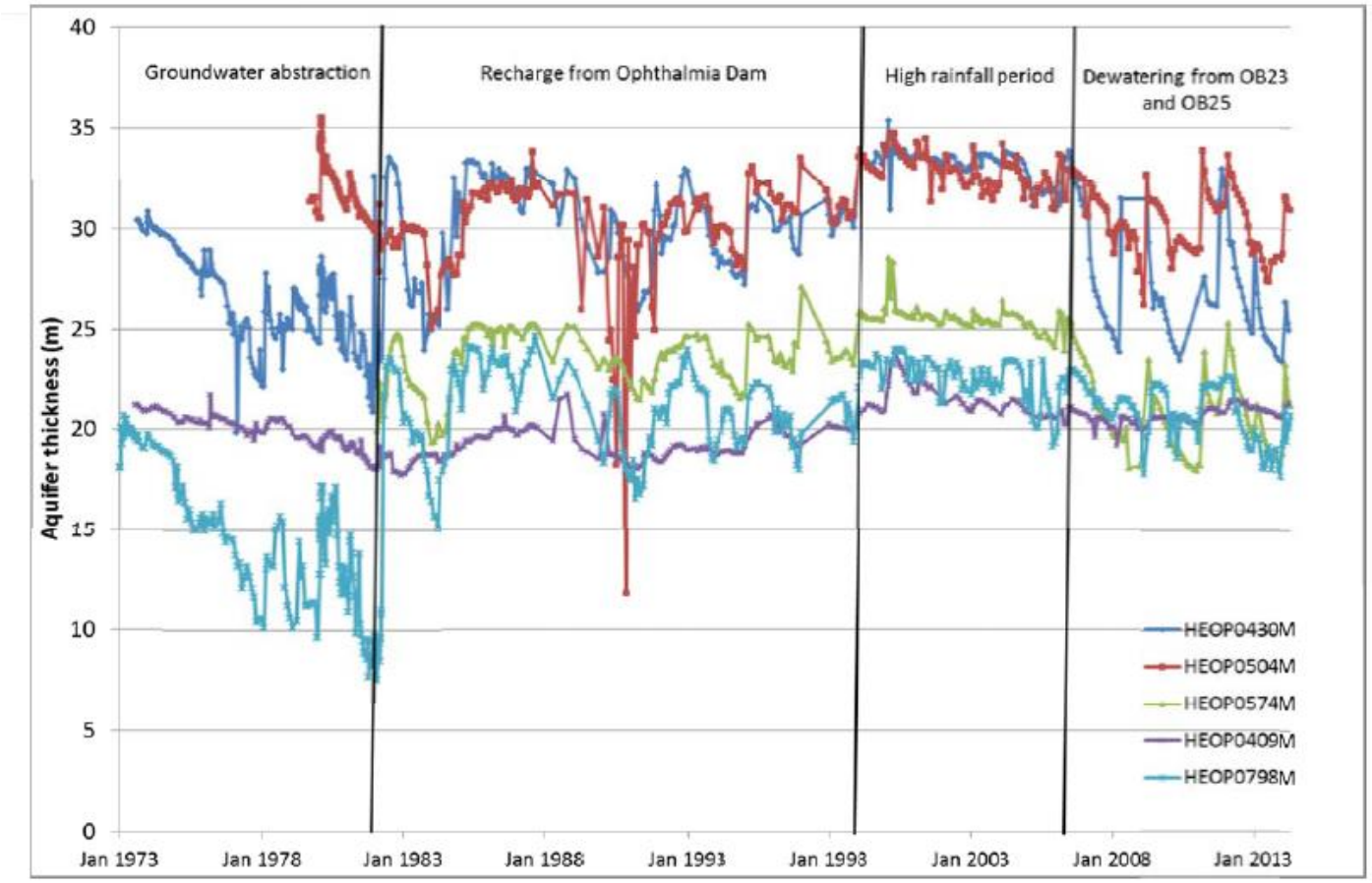


Figure 1. Hydrographs showing the changes in aquifer thickness (graph from BHP 2014).

Period	Description	Aquifer Thickness	Groundwater fluctuations	Rate of groundwater decline
1971-1981	Groundwater abstraction before Ophthalmia Dam	8 to 35 m	1 to 5 m	1 to 12 m over 10 years
1981-1999	Groundwater recovery after Ophthalmia Dam	18 to 34 m	1 to 5 m	0 to 5 m over 3 years
1999-2006	High rainfall and high groundwater levels	21 to 34 m	0 to 2 m	0 to 1 m over 6 years
2006-2014	Groundwater drawdown from OB23 and OB25	18 to 31 m	1 to 6 m	0 to 4 m over 2 years
1971-2014	Entire range	8 to 35 m	0 to 6 m	0 to 2.5 m per year[1]

[1]Represent long-term rate of groundwater decline. The short term rate of groundwater decline could be up to 6 m per year and depends on fluctuations of groundwater abstraction from the production bores.

Table 1. Summary of aquifer thickness and fluctuations (from BHP 2014).

Period	Description	Salinity range (mg/L)	Salinity fluctuations (mg/L)	Rate of salinity concentration increase
1971-1981	Groundwater abstraction before Ophthalmia Dam	800 – 1800	100 – 400	400 mg/l over 3 years
1981-1999	Groundwater recovery after Ophthalmia Dam	200 – 2200	100 – 800	800 mg/l over 3 years
1999-2006	High rainfall and high groundwater levels	200 – 1700	100 – 300	600 mg/l over 4 years
2006-2014	Groundwater drawdown from OB23 and OB25	800 – 2300	100 – 400	700 mg/l over 3 years
1971-2014	Entire range	200 – 2300	100 – 800	130 to 270 mg/l per year

Table 2. Summary of groundwater salinity (from BHP 2014).

Water level monitoring data was provided by BHP (2019). In their current form, available data are not suitable to assess whether the community's potential environmental water requirements are being met and identify potential risk to the stygofaunal assemblage.

The impact zone for BHP's Orebody 31 mine includes the Ethel Gorge stygobiont community (BHP 2015). The 2015 report states that 11 stygofauna species were collected in the area where groundwater drawdown is predicted to be ≥2m. The report also notes that impacts to subterranean fauna from the mine or post-mining environment are not expected to be significant or to warrant specific post-closure management actions.

Disease

A bloom of iron bacteria (Leptothrix spp.) was detected within a water supply bore in the Opthalmia bore field by BHP Billiton Iron Ore in 2016. The naturally occurring bacteria can thrive in a certain suitable chemical and physical environment and convert soluble ferrous iron into its insoluble ferric form. The fouled bore was located within the Ethel Gorge stygobiont community. The bacterial bloom and the proposed treatment method have potential to impact on the Ethel Gorge assemblage.

References

Bennelongia Environmental Consultants (2015). Strategic Environmental Assessment: Description of Regional Subterranean Fauna. Final Report prepared for BHP Billiton Iron Ore.

BHP Billiton Iron Ore (2014). Sea Hydrology. Appendix G: Ethel Gorge Ecohydrological Case Study.

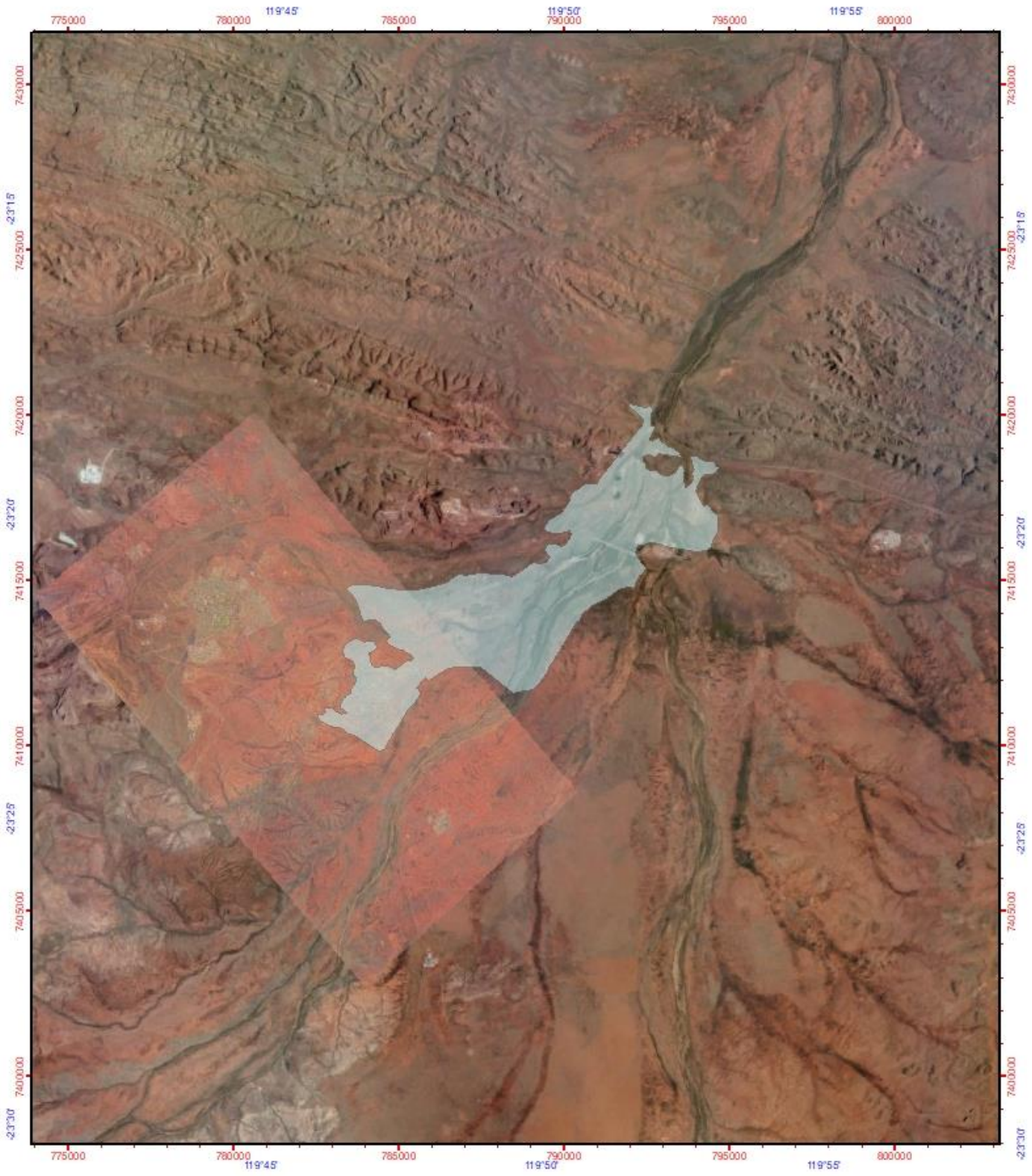
BHP Billiton Iron Ore (2015). Orebody 31 Closure Plan ML244SA Revision 0 (final). August 2015. BHP Billiton Perth.

BHP Billiton Iron Ore (2016). Draft Eastern Pilbara Water Resource Management Plan. BHP Billiton Perth

BHP Billiton Iron Ore (2019). Ophthalmia Borefield *in* Triennial Aquifer Review (TAR). BHP Billiton Perth.

Humphries, W.F. (2001) Groundwater calcrete aquifers in the Australian arid zone: the context to an unfolding plethora of stygal biodiversity. *Records of the Western Australian Museum* Supplement No. 64: 63–83.

APPENDIX 2 Ethel gorge aquifer stygobiont community (green)



APPENDIX 3 IUCN Red List Criteria for ecosystems (version 2.2) (IUCN 2017)

A. Reduction in geographic distribution over ANY of the following time periods:

		CR	EN	VU
A1	Present (over the past 50 years).	≥ 80%	≥ 50%	≥ 30%
A2a	Future (over the next 50 years).	≥ 80%	≥ 50%	≥ 30%
A2b	Future (over any 50 year period including the present and future).	≥ 80%	≥ 50%	≥ 30%
A3	Historic (since 1750).	≥ 90%	≥ 70%	≥ 50%

B. Restricted geographic distribution indicated by EITHER B1, B2 or B3:

		CR	EN	VU
B1	Extent of a minimum convex polygon enclosing all occurrences (Extent of Occurrence)	≤ 2,000 km^2	≤ 20,000 km^2	≤ 50,000 km^2
	AND at least one of the following (a-c):			
	(a) An observed or inferred continuing decline in **EITHER**:			
	i. a measure of spatial extent appropriate to the ecosystem; **OR**			
	ii. a measure of environmental quality appropriate to characteristic biota of the ecosystem; **OR**			
	iii. a measure of disruption to biotic interactions appropriate to the characteristic biota of the ecosystem.			
	(b) Observed or inferred threatening processes that are likely to cause continuing declines in geographic distribution, environmental quality or biotic interactions within the next 20 years.			
	(c) Ecosystem exists at …	1 location	≤ 5 locations	≤ 10 locations
B2	The number of 10 × 10 km grid cells occupied (Area of Occupancy)	≤ 2	≤ 20	≤ 50
	AND at least one of a-c above (same sub-criteria as for B1).			
B3	A very small number of locations (generally fewer than 5) **AND** prone to the effects of human activities or stochastic events within a very short time period in an uncertain future, and thus capable of collapse or becoming Critically Endangered within a very short time period (B3 can only lead to a listing as VU).			VU

C. Environmental degradation over ANY of the following time periods:

C1 The past 50 years based on change in an abiotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table:

	Relative severity (%)		
Extent (%)	≥ 80	≥ 50	≥ 30
≥ 80	CR	EN	VU
≥ 50	EN	VU	
≥ 30	VU		

C2 The next 50 years, or any 50-year period including the present and future, based on change in an abiotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table:

	≥ 80	≥ 50	≥ 30
≥ 80	CR	EN	VU
≥ 50	EN	VU	
≥ 30	VU		

C3 Since 1750 based on change in an abiotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table:

	≥ 90	≥ 70	≥ 50
≥ 90	CR	EN	VU
≥ 70	EN	VU	
≥ 50	VU		

D. Disruption of biotic processes or interactions over ANY of the following time periods:

D1 The past 50 years based on change in a biotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table:

	Relative severity (%)		
Extent (%)	≥ 80	≥ 50	≥ 30
≥ 80	CR	EN	VU
≥ 50	EN	VU	
≥ 30	VU		

D2	(D2a) The next 50 years, or (D2b) any 50-year period including the present and future, based on change in a <u>biotic</u> variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table: OR		≥ 80	≥ 50	≥ 30
		≥ 80	CR	EN	VU
		≥ 50	EN	VU	
		≥ 30	VU		
D3	Since 1750, based on a change in a biotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table:		≥ 90	≥ 70	≥ 50
		≥ 90	CR	EN	VU
		≥ 70	EN	VU	
		≥ 50	VU		
E. Quantitative analysis					
			CR	EN	VU
	… that estimates the probability of ecosystem collapse to be:		≥ 50% within 50 years	≥ 20% within 50 years	≥ 10% within 100 years