

DRAFT Biodiversity Environmental Management Plan

Version 1.0

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Biodiversity Condition Environmental Management Plan

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previous 3 versions – further revisions can be sourced through document control

Biodiversity Condition Environmental Management Plan

Summary

Proponent	Title of proposal / operation	Ministerial Statement Number	EMP Purpose	Key environmental factors and objectives	Key provisions in the plan
BHP Billiton Iron Ore	Mining Area C	TBC	Supporting the Public Environment Review	Terrestrial fauna – to protect terrestrial fauna so that biological diversity and ecological integrity are maintained	<ul style="list-style-type: none"> Avoid direct impacts to ghost bat cave buffer areas. Minimise impacts to ghost bat caves and foraging habitat. Minimise impacts to <i>Antichiropus</i> 'DIP007' habitat (<i>Corymbia hamersleyana</i>). Minimise impacts to inferred habitat of <i>Antichiropus</i> 'DIP006' and <i>Chenistonia</i> 'MYG088'.
				Subterranean Fauna – to protect subterranean fauna so that biological diversity and ecological integrity are maintained	<ul style="list-style-type: none"> Minimise impacts to subterranean fauna (troglifauna) species to which impacts from the Proposal are <i>uncertain</i>, by avoiding clearing for mine pits outside the Modified Indicative Additional Impact Assessment area where practicable.

1. Context, Scope and Rationale

1.1. Proposal

Please refer to [Appendix 2 – Proposal/Operation Summaries](#).

1.2. Key environmental factors

Title of proposal / operation	Ministerial Statement Number	Key environmental factors	Values	Impacts
Mining Area C – Southern Flank	TBC	Terrestrial Fauna	Ghost bats (<i>Macroderma gigas</i>)	Direct <ul style="list-style-type: none"> Land disturbance (roosts) Indirect <ul style="list-style-type: none"> Land disturbance (foraging habitat)
			Short-range Endemic invertebrates	Direct <ul style="list-style-type: none"> Land disturbance (habitat)
		Subterranean Fauna	Troglofauna	Direct <ul style="list-style-type: none"> Land disturbance (pits)

1.3. Condition requirements

Conditions have not yet been applied to this proposal. If the proposal is approved, [Appendix 1 – Index list for Ministerial Statement condition requirements addressed by this Plan](#) will be updated to cross-reference condition requirements to each Schedule.

1.4. Rationale and approach

1.4.1. Purpose and Scope

This draft Biodiversity Environmental Management Plan – Mining Area C (the Plan) is submitted by BHP Billiton Iron Ore to support the Public Environment Review for Mining Area C – Southern Flank (the Proposal). There are a number of key environmental values addressed by this Plan, the management provisions of each is documented in a value-specific Schedule.

Note that the management provisions for Coondewanna Flats and Weeli Wolli Springs Priority Ecological Communities are described in the draft Central Pilbara Water Resource Management Plan.

BHP Billiton Iron Ore applies a regional management approach to its Pilbara operations, through a consolidated BHP Billiton Iron Ore Biodiversity Environmental Management Plan. Draft management provisions relevant to the Proposal are provided in this document, information pertaining to other approved BHP Billiton Iron Ore operations has been removed for the purposes of this assessment.

In developing this Plan, BHP Billiton Iron Ore has considered the guidance provided by the EPA in the *‘Instructions on how to prepare Environmental protection Act 1986 Part IV Environmental Management Plans’* (EPA 2016). Management objectives and outcomes, including management actions and targets, triggers, thresholds and response actions, monitoring and reporting have been developed to manage environmental risks associated with the Proposal, and are also designed to meet the intent of the EPA instructions.

1.4.2. Project Environmental & Aboriginal Heritage Review

BHP Billiton Iron Ore has a Project Environmental Aboriginal Heritage Review (PEAHR) process to manage the implementation of its environmental, Aboriginal heritage, land tenure and legal obligations prior to and during land disturbance activities. All ground disturbance activities will be required to meet the requirements of the PEAHR process, as well as relevant legislative and regulatory requirements and BHP Billiton Iron Ore's Sustainable Development Policy. Additionally, the PEAHR process provides a mechanism whereby technical and professional advice can be provided to the business regarding environmental aspects, land access and Aboriginal heritage planning and management issues. The PEAHR system consists of an electronic workflow process linked to a geographical information system. The objectives of the PEAHR process are to:

- identify the significant environmental*, Aboriginal heritage and legal aspects of proposed activities;
- ensure that, through appropriate environmental Aboriginal heritage and land access planning and management, BHP Billiton Iron Ore activities comply with all legal and other obligations;
- avoid, minimise and mitigate the number and nature of environmental*, Aboriginal heritage and land tenure impacts and ensure adequate environmental performance of BHP Billiton Iron Ore operations; and
- provide a mechanism for continuous improvement.

*In relation to this Plan, environmental aspects particularly consider conservation significant fauna, flora and habitat.

2. EMP provisions

Please refer to the below Schedules.

3. Adaptive Management and review of the EMP

BHP Billiton Iron Ore applies an adaptive management framework for implementing management measures identified in this Plan. Adaptive management is a structured, iterative process to decision making. An integral component is the application of the mitigation hierarchy (avoid, minimise and rehabilitate environmental impacts, prior to applying offsets as a last resort).

The framework embeds a cycle of monitoring, reporting and implementing change where required. It allows an evaluation of the management controls so that they are progressively improved and refined, or alternative solutions adopted, to ensure the outcome-based objectives are achieved. The key steps of the adaptive management approach are outlined in Figure 1.

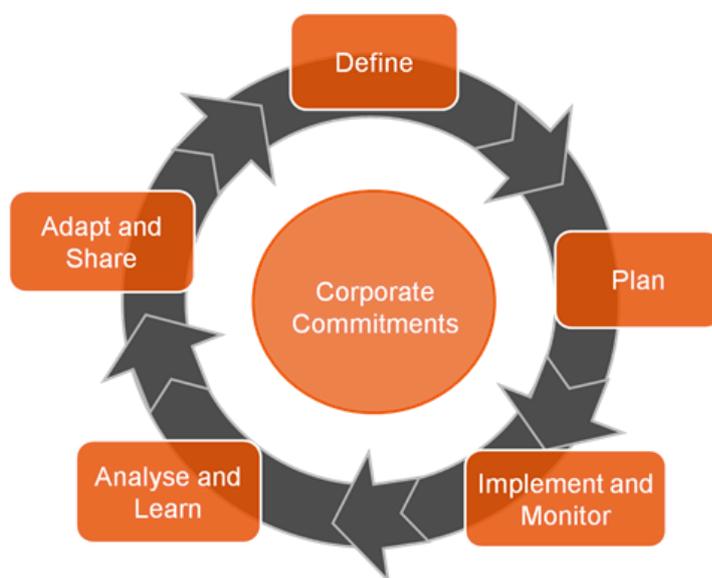


Figure 1 BHP Billiton Iron Ore's adaptive management approach

3.1. Review and update of the Plan

The BHP Billiton Iron Ore Biodiversity Environmental Management Plan will be reviewed and updated to ensure it addresses the relevant conditions and is being implemented effectively. Changes may arise from, but not limited to, a change of scope, request by proponent or regulator for a change to Ministerial Conditions or this plan, stakeholder consultation comments or from opportunities for improvement.

The document amendment record will be updated to include date of review and details of subsequent Schedules. New and/or revised Schedules will be provided to the OEPA for review and endorsement by the Chief Executive Officer (CEO) as per the requirements of the respective Ministerial Statement conditions. It is proposed that the number of conditions included in Appendix 1 will vary in the future including when:

- new Proposals are approved and conditioned through Part IV of the Environmental Protection Act 1986 (EP Act);
- existing Proposals subject to historic EP Act Part IV conditions are revised and brought under this Plan through a section 46 or Revised Proposal process; and/or
- the Chief Executive Officer (CEO) of the Environmental Protection Authority (EPA) has confirmed by notice in writing that it has been demonstrated that the objective in the relevant condition is being and will continue to be met and therefore implementation of commitments or aspects of the Plan are no longer required.

4. Stakeholder consultation

BHP Billiton Iron Ore undertakes regular and ongoing stakeholder engagement as part of its core business activities. BHP Billiton Iron Ore aims to facilitate regular, open and honest dialogue to understand expectations, concerns and interests of stakeholders and incorporate them into business planning to help build strong, mutually beneficial relationships. The main objectives of the consultation programme are to:

- provide information and the opportunity to comment to relevant government agencies, local authorities and to other groups or individuals who may potentially be interested in a Proposal; and
- where relevant, discuss and allow stakeholder comments on Proposals to be incorporated into this Plan.
- BHP Billiton Iron Ore will continue to engage with Traditional Owners through targeted consultation and via administration of Native Title heritage agreements.

Please refer to Appendix 3 – Stakeholder Consultation for details of specific consultation activities, relevant to this plan. Note that for this Plan, no additional stakeholder consultation has been conducted for this plan in addition to Stakeholder Consultation conducted for the Mining Area C Southern Flank Public Environment Review.

Biodiversity Condition Environmental Management Plan

Schedule X – Ghost Bats (*Macroderma gigas*)

To meet the requirements of Condition(s) X of Ministerial Statement(s) X.

EPA Factor and objective:	Terrestrial fauna – to protect terrestrial fauna so that biological diversity and ecological integrity are maintained		
Key environmental values:	Ghost Bats – listed as Vulnerable under both the EPBC Act and WC Act (2015 and 2016, respectively).		
Objective:	Minimise impacts to ghost bats as far as practicable, as a result of BHP Billiton Iron Ore activities.		
Outcome:	Maintain long term viability of ghost bat population in the Development Envelope.		
Key impacts and risks:	Risk to biological diversity and/or ecological integrity of ghost bats, due to direct loss of habitat (roosts) or indirect impacts due to loss of foraging habitat.		
Management-based provisions			
Management Actions	Management Targets	Monitoring	Reporting
<i>Condition clause number and text</i>	<i>Condition clause number and text</i>	<i>Condition clause number and text</i>	<i>Condition clause number and text</i>
Avoid <ul style="list-style-type: none"> Avoid direct impacts to ghost bat buffer areas, by implementing the PEHR process prior to land disturbance. Minimise <ul style="list-style-type: none"> Minimise impacts to all known ghost bat cave locations and foraging habitat, by avoiding direct impacts where practicable and implementing the PEHR process prior to land disturbance. Rehabilitation <ul style="list-style-type: none"> Progressive rehabilitation within foraging range will be undertaken using <i>Eucalyptus leucophloia</i> or other large tree species (<2 km from ghost bat caves). 	No unauthorised disturbance beyond the Development Envelope or within the Ghost Bat cave buffer zones.	Quarterly land disturbance reconciliation (hectares and spatial footprint). Rehabilitation monitoring undertaken in accordance with the Mine Closure Plan and WAIO Rehabilitation monitoring standard.	Notification of management target or objective potential non-compliance will be provided to the OEPA within 7 days of that potential non-compliance being known. A report including any corrective actions identified will be provided to the OEPA via email, once an investigation into the potential non-compliance has been completed. An annual compliance assessment report will be submitted as part of the Annual Environment Report, which will be submitted to OEPA by 1 October each year.
Outcome-based provisions			
Environment criteria:	Response actions:	Monitoring	Reporting
<ul style="list-style-type: none"> Trigger criteria Threshold criteria 	<ul style="list-style-type: none"> Trigger level actions Threshold level actions 		
<i>Condition clause number and text</i>	<i>Condition clause number and text</i>	<i>Condition clause number and text</i>	<i>Condition clause number and text</i>
Trigger criteria – no sign of ghost bat use in High importance caves or artificial roosts (if applicable) within the Proposed Mining Area C Development Envelope, within 5 years of cessation of operations. Threshold criteria – no sign of ghost bat use in High importance caves or artificial roosts (if applicable) within the Proposed Mining Area C Development Envelope, within 10 years of cessation of operations.	Response actions to trigger/threshold criteria exceedance may include, but are not limited to: <ul style="list-style-type: none"> Construction/relocation (as appropriate) of, or alteration to, artificial ghost bat habitat; Reintroduction of ghost bats from captive breeding facilities or other natural colonies within the Pilbara, as appropriate; and/or Remediate foraging habitat to ensure that it contains feeding trees and suitable habitat for prey species within 2 km of cave locations. 	Five yearly monitoring of High value ghost bat roosts in Proposed Mining Area C Development Envelope following cessation of operations. Methods will be informed by the results from the ongoing research programme and may include scat counts and genetic/ hormone analysis.	Notification of threshold criteria or outcome potential non-compliance will be provided to the OEPA within 7 days of that potential non-compliance being known. A report including any corrective actions identified will be provided to the OEPA via email, once an investigation into the potential non-compliance has been completed. An annual compliance assessment report will be submitted as part of the Annual Environment Report, which will be submitted to OEPA by 1 October each year.

Biodiversity Condition Environmental Management Plan

Schedule X – Short Range Endemic Species

To meet the requirements of Condition(s) X of Ministerial Statement(s) X

EPA Factor and objective:	Terrestrial fauna – to protect terrestrial fauna so that biological diversity and ecological integrity are maintained		
Key environmental values:	Habitat for Short Range Endemic species <i>Antichiropus</i> 'DIP007', <i>Antichiropus</i> 'DIP006' and <i>Chenistonia</i> 'MYG088'		
Objective:	Minimise impacts to <i>Antichiropus</i> 'DIP007', <i>Antichiropus</i> 'DIP006' and <i>Chenistonia</i> 'MYG088' habitats as far as practicable.		
Key impacts and risks:	Risk to biological diversity and/or ecological integrity of <i>Antichiropus</i> 'DIP007', <i>Antichiropus</i> 'DIP006' and <i>Chenistonia</i> 'MYG088' due to direct loss of habitat.		
Management-based provisions			
Management Actions	Management Targets	Monitoring	Reporting
<i>Condition clause number and text</i>	<i>Condition clause number and text</i>	<i>Condition clause number and text</i>	<i>Condition clause number and text</i>
Minimise <ul style="list-style-type: none"> Minimise impacts to <i>Antichiropus</i> 'DIP007' habitat (<i>Corymbia hamersleyana</i>), by avoiding direct impacts where practicable and implementing the PEHR process prior to land disturbance. Minimise impacts to <i>Antichiropus</i> 'DIP006' and <i>Chenistonia</i> 'MYG088' inferred habitat, by avoiding direct impacts where practicable and implementing the PEHR process prior to land disturbance. Rehabilitation <ul style="list-style-type: none"> Progressive rehabilitation as described in the Mine Closure Plan will be implemented using local top soil, and include the use of <i>Corymbia hamersleyana</i> material in habitat suitable to support <i>Antichiropus</i> 'DIP007'. 	No unauthorised disturbance beyond the Development Envelope	Quarterly land disturbance reconciliation (hectares and spatial footprint). Rehabilitation monitoring undertaken in accordance with the Mine Closure Plan and WAIO Rehabilitation monitoring standard.	Notification of management target or objective potential non-compliance will be provided to the OEPA within 7 days of that potential non-compliance being known. A report including any corrective actions identified will be provided to the OEPA via email, once an investigation into the potential non-compliance has been completed. An annual compliance assessment report will be submitted as part of the Annual Environment Report, which will be submitted to OEPA by 1 October each year.

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Schedule X – Troglifauna

To meet the requirements of Condition(s) X of Ministerial Statement(s) X

EPA Factor and objective:	Subterranean Fauna – to protect subterranean fauna so that biological diversity and ecological integrity are maintained.		
Key environmental values:	Subterranean fauna (troglifauna) species to which impacts from the Proposal are <i>uncertain*</i> - <i>Hanseniella</i> sp. B08, <i>Symphyella</i> sp. B03, <i>Parajapygidae</i> sp. S03, <i>Prethopalpus</i> sp. B15, <i>Philosciidae</i> sp. B03; and <i>Parajapygidae</i> `DPL024`.		
Objective:	Minimise impacts, as far as practicable, to habitat for subterranean fauna (troglifauna) species to which impacts from the Proposal are <i>uncertain</i> .		
Key impacts and risks:	Risk to biological diversity and/or ecological integrity of subterranean fauna (troglifauna), due to direct loss of habitat (mine pits).		
Management-based provisions			
Management Actions	Management Targets	Monitoring	Reporting
<i>Condition clause number and text</i>	<i>Condition clause number and text</i>	<i>Condition clause number and text</i>	<i>Condition clause number and text</i>
Minimise <ul style="list-style-type: none"> Minimise impacts to subterranean fauna (troglifauna) species to which impacts from the Proposal are <i>uncertain*</i>, by avoiding clearing for mine pits outside the Modified Indicative Additional Impact Assessment area where practicable and implementing the PEHR process prior to land disturbance. 	No unauthorised disturbance beyond the Development Envelope.	Quarterly land disturbance reconciliation (hectares and spatial footprint).	Notification of management target or objective potential non-compliance will be provided to the OEPA within 7 days of that potential non-compliance being known. A report including any corrective actions identified will be provided to the OEPA via email, once an investigation into the potential non-compliance has been completed. An annual compliance assessment report will be submitted as part of the Annual Environment Report, which will be submitted to OEPA by 1 October each year.

*Uncertain: there is insufficient information to assign a probability of the species being restricted. Given that the species is known only from the indicative impact assessment areas, it is treated as likely to be restricted.

Appendices

Appendix 1 – Index list for Ministerial Statement condition requirements addressed by this Plan

Ministerial Statement	Operation	Condition No.	Environmental Factor	Condition Requirements	Schedule	Value

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Appendix 2 – Proposal/Operation Summaries

Ministerial Statement	Operation	Operation/Proposal Description
TBC	Mining Area C - Southern Flank	<p>The key components of the Proposal are:</p> <ul style="list-style-type: none"> • Campaign open-cut mining at the Southern Flank satellite orebody at a nominal base mining rate of 80 Mtpa; • Primary crushing of ore at the Southern Flank satellite orebody; • Transportation of ore mined at Southern Flank via overland conveyor to stockpiles and ore handling facilities located at the Mining Area C Hub; • Use of existing and addition of new ore processing facilities, train loadout and associated infrastructure at the Mining Area C Hub; • Dewatering of the orebody aquifers and the preferential use of the water for operational purposes, with an option to manage the surplus volumes via managed aquifer recharge or infiltration basins, as outlined in the proposed Central Pilbara Water Resource Management Plan (CPWRMP); and • Clearing of 19,671.2 ha Native Vegetation. Of this clearing 13,729.2 ha is related to clearing for the development of the satellite Southern Flank orebody and associated infrastructure and 5,942 ha is related to additional clearing for development of the 14 deposits at Mining Area C located in the currently approved Mining Area C Development Envelope. • Extension of Overburden Storage Areas for current Mining Area C operations (OSA14).

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Appendix 3 – Stakeholder Consultation

Version	Stakeholder	Date of Consultation	Description of Consultation	Topics / Issues Raised	BHP Billiton Iron Ore Response
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Note that the above stakeholder consultation is in addition to that conducted as part of the Environmental Referral process, which is described in relevant submission documentation.

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Biodiversity Condition Environmental Management Plan

Appendix 4 – Rationale and Context

Schedule	Value	Surveys and Studies	Survey and Study Findings	Key assumptions and uncertainties	Rationale for choice of provisions
Schedule X	Ghost Bats	<p>The Biologic Environmental Survey (2016). Mining Area C – Southern Flank. Environmental Impact Assessment for Ghost Bat (<i>Macroderma gigas</i>) summarises the results from all previous surveys and research conducted on ghost bats within the vicinity of Mining Area C, including:</p> <ul style="list-style-type: none"> - Armstrong, K.N. and Anstee, S.D. (2000). The ghost bat in the Pilbara 100 years on. Australian Mammalogy 22: 93 – 101. - Biologic Environmental Survey (2011). Area C and Surrounds Fauna Survey. - Biologic Environmental Survey (2011). Southern Flank Bat Assessment Survey. - Biologic Environmental Survey (2012). Southern Flank Vertebrate Fauna Survey. - Biologic Environmental Survey (2012). Karijini Targeted ghost bat Survey. - Biologic Environmental Survey (2013). Central Pilbara ghost bat Population and Roost Assessment. - Biologic Environmental Survey (2013). Targeted Conservation Significant Fauna Survey – Karijini Tenement E47/17. - Biologic Environmental Survey and BatCall WA (2014). Central Pilbara Regional ghost bat Review. - Biologic Environmental Survey and BatCall WA (2015). Central Pilbara ghost bat Population and Roost Assessment 2014. - Biologic in prep (2016). Hamersley Range Ghost Bat Population Study 2015-2016. - Biota (2012) Southern Flank to Jinidi Level 2 Vertebrate Fauna study. - Biota (2015) Mining Area C Vertebrate Fauna Environmental Impact Assessment. - Specialised Zoological (2008). Area C Environmental Management Plan (revision 4) A, D, P1 and P3 deposits: Bat Survey Assessment. Spencer, P.B., Tedeschi, J. (2016) An initial investigation into the genetic diversity, structure and short-range spatial-use by Ghost Bats in the Hamersley subregion of the Pilbara. 	<p>The Biologic Environmental Survey (2016). Mining Area C – Southern Flank. Environmental Impact Assessment for Ghost Bat (<i>Macroderma gigas</i>) summarises the results from all previous surveys and research conducted on ghost bats within the vicinity of Mining Area C. The key findings from the impact assessment and studies are:</p> <ul style="list-style-type: none"> - The population estimate for the Hamersley subregion is 300-400 individuals, with the estimate for the entire region being 1300-2000 individuals. The Proposed Mining Area C Development Envelope supports approximately 50 individuals. - Ghost bat distribution and abundance is driven by the availability of roosts (caves) suitable to supports day roosting and use for breeding. - There are at least 317 known caves within the Pilbara region. Sixty three caves have been recorded within the Proposed Mining Area C Development Envelope. Twenty five are considered suitable for day roosting (classified as High value caves). A subset of these may also be used for maternity roosting. - Thirteen caves classified as High value may be removed due to mining operations. - Cumulative impacts are difficult to determine due to the lack of detailed survey work across the Pilbara and the recent listing of the species as conservation significant. - It is considered likely that ghost bats will persist in the Proposed Mining Area C Development Envelope over the long term if the Indicative Modified Additional Impact Assessment Area is implemented. Due to limited ecological data it is uncertain if ghost bats will occur within the Proposed Mining Area C Development Envelope during the 30 year period of mining. - Other impacts to ghost bats include: <ul style="list-style-type: none"> - Artificial light - Noise and vibration - Dust - Infrastructure - Invasive species (cane toads) 	<p>Key assumptions and uncertainties outlined in the Mining Area C – Southern Flank. Environmental Impact Assessment for Ghost Bat (<i>Macroderma gigas</i>) (Biologic Environmental Survey, 2016) are:</p> <ul style="list-style-type: none"> - The impact assessment is largely constrained by the lack of information available on the ecology of the ghost bat, its distribution within the Pilbara and in particular the location of roosting habitat, and the species' response to disturbance. The vast majority of information available on the ecology of the ghost bat has been collected from Northern Australia where conditions are different to the arid Pilbara region and the species behave differently. The ghost bat is difficult to study due to the remoteness of roost, and their cryptic nature. Significant effort has been expended during the past six years within, and in the vicinity of, the Proposed Mining Area C Development Envelope to better understand the species, particular in the south eastern and central Pilbara. This has included the trial of a number of survey techniques, of which some failed to record any additional information. - There are limited data available from records outside BHP Billiton Iron Ore tenure, and that which is available is generally limited to a species record rather than information about roosting habitat. Most surveys undertaken outside BHP Billiton Iron Ore tenure have relied on acoustic detectors which are not reliable for detecting ghost bats. Ghost bats in the Hamersley Range move around frequently, with recaptures infrequent (Armstrong and Anstee, 2000); therefore a lack of records from an acoustic detector may not mean that a ghost bat does not use a cave or is present within an area. - As the ghost bat has only recently been listed it may not have been targeted during surveys for conservation significant species prior to late 2015. - Results from genetic and hormone studies are preliminary and need to be interpreted with some caution due to the limited dataset from which the results were generated. The genetic and hormone analysis work is ongoing and the report presents the information available at the time of writing. - Sampling and cave searching is mostly restricted to BHP Billiton Iron Ore tenure; however sampling for the genetic work took place in a few locations across the Hamersley Range, including FMG and API tenure. 	<p>The most significant impact to this value is loss of roost habitat. Therefore the 'Avoid' level of hierarchy has been applied as much as practicable. With mitigation, it is considered likely that ghost bats will persist within the Proposed Mining Area C Development Envelope following the cessation of mining activities.</p> <p>Loss of foraging habitat could result in local individuals being more susceptible to natural disturbances such as fire and extended dry periods, and may prevent ghost bats using roosts that remain available within the Proposed Mining Area C Development Envelope. Therefore progressive rehabilitation of foraging habitat has been selected as a potential response action.</p> <p>There remains a lack of information available on the ecology of the ghost bat, its distribution within the Pilbara and in particular the location of roosting habitat, and the species' response to disturbance. Therefore the ongoing monitoring and construction of artificial roost habitat will continue. If this work demonstrates that artificial roosts can effectively replace lost habitat these may be used to further mitigate impacts over the short and long term.</p>

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Schedule	Value	Surveys and Studies	Survey and Study Findings	Key assumptions and uncertainties	Rationale for choice of provisions
Schedule X <i>Antichiropus</i> 'DIP007' <i>Antichiropus</i> 'DIP006' <i>Chenistonia</i> 'MYG088'		<p>The Biologic (2016) Mining Area C Southern Flank SRE Invertebrate Fauna Impact Assessment considered the results from all previous surveys undertaken within the Proposed Mining Area C Development Envelope and surrounds, and also data housed within the Western Australian Museum, including:</p> <ul style="list-style-type: none"> - Biota (2011), Area C and Surrounds Short Range Endemic Survey; - Biota (2011), Short Range Endemic Invertebrate Fauna Survey - South Flank; - Biologic (2015), Mining Area C – Life of Project EMP Rev 6. Environmental Impact Assessment of Short-range Endemic Invertebrates; - Biologic (2016) South Flank Baseline and Targeted SRE Fauna Survey; - Outback Ecology (2008), Area C Mining Operation Environmental Management Plan (Revision 4) A, D, P1 and P3 Deposits: Terrestrial Invertebrate Short-range Endemic Assessment; and - Outback Ecology (2009), Area C Mine Short-range Endemic Habitat Assessment; - AMBS (2010), Assessment of Terrestrial Short-range Endemic Invertebrates, from Area C to Jinayri to Mount Newman Railway; - Biota (2011), Jinidi Lease and Jinidi to Mainline Rail SRE Review; - Biota (2013a), Targeted Survey for Short Range Endemic Invertebrate Fauna of Area C West; - Biota (2013), A Survey of the Short Range Endemic Invertebrate Fauna of South Flank to Jinidi; - Biota (2013), A Survey of the Short-Range Endemic Invertebrate Fauna of South Parmelia; - Biota (2013), Targeted Survey for Short Range Endemic Fauna in the Mudlark Survey Area; and - Biota (2013), A Survey of Short Range Endemic Invertebrates in the Jinidi to Mainline Rail Corridor 	<p>The Biologic (2016) Mining Area C Southern Flank SRE Invertebrate Fauna Impact Assessment summarises the results from all previous studies and information housed in the WA Museum as follows:</p> <ul style="list-style-type: none"> - Seven habitat zones have been identified based on landform features, drainage features and vegetation features that influence short-range endemic (SRE) fauna occurrence. - Three of these habitat zones are considered to have high value to SRE fauna: <ul style="list-style-type: none"> - South facing Major gorge/ gully systems; - River gorges; and - Hill slopes/ crests containing <i>Corymbia hamersleyana</i> mallee. - Removal of these habitat will likely have a moderate to high impact on SRE species. - Thirteen species have been recorded from invertebrate taxonomic groups known to contain short-range endemic (SRE) species within the Proposed Mining Area C Development Envelope. - Implementation of the Proposal was considered likely to have a high impact on three of these species: <ul style="list-style-type: none"> - <i>Antichiropus</i> 'DIP006'; - <i>Antichiropus</i> 'DIP007'; and - <i>Chenistonia</i> 'MYG088'. - The Environmental Protection Authority's (EPA's) primary objectives for terrestrial fauna are to "maintain representation, diversity, viability and ecological function at the species, population and assemblage level" (EPA 2015). With regards to SRE fauna, it is considered that the Proposal, with the maintenance of current management strategies and the re-establishment of habitat suitable for <i>Antichiropus</i> 'DIP007', will meet the EPA objective for terrestrial fauna. 	<p>Key assumptions and uncertainties outlined in the Mining Area C Southern Flank SRE Invertebrate Fauna Impact Assessment (Biologic 2016) are:</p> <ul style="list-style-type: none"> - The taxonomy for nearly all SRE groups in the Pilbara is incomplete, and in various stages of development, depending upon the group in question. Additional survey work over time has increased the number of groups known to have SRE tendencies (for example, selenopid spiders and isopods), leaving some groups more well-studied than others. - Most SRE fauna taxonomic groups require mature male specimens for positive morphological identifications, while the specimens collected are often females or juveniles. As such, identifications often cannot be verified without the use of DNA analyses, which are recently becoming more widely used, although these have their own limitations. The current assessment has relied on the most recent WAM database data and advice from WAM taxonomists to indicate the most up-to-date list of SRE species that are relevant to the assessment of impacts. Where taxonomy is incomplete, likely species identity has been inferred based on the geographic locality of the collection and other confirmed specimens from the locale. - Many terrestrial invertebrate species in the Pilbara are only known from a handful of locations where intensive sampling has been undertaken. Species distributions are therefore dependent upon the size and extent of targeted surveys, as well as the ecology, behaviour, and natural history of the species in question, much of which remains uncertain, especially where the species is undescribed. Detailed habitat assessment data can be used as a basis for inferring the potential occurrence of species within suitable, connected habitats where sampling has been limited; however, such inference has its own limitations in terms of how much is actually known about a species habitat requirements and dispersal capabilities. - The effects of uneven sampling are exacerbated by differences in the experience of survey personnel, methods, targeted groups, sampling intensities, and survey timing. Collection of habitat data and the classification of suitable habitats for SREs have been inconsistent over time, as most of the previous survey work was undertaken before any formal guidance for assessment of SRE invertebrates and habitats was published. The SRE habitat assessment survey undertaken by Biologic (2015) resolved these inconsistencies, consistent with BHP Billiton Iron Ore's SRE invertebrate fauna assessment methods (BHPBIO, 2009). - The cryptic nature of SRE fauna, along with the effects of uneven sampling, limits our ability to infer a species' presence or absence from a site where it has not been recorded. To alleviate this to some extent, we categorise habitats on the basis of their suitability for SRE fauna, based on our current understanding of SRE fauna requirements and the physical composition of the habitats with respect to these requirements. As such, habitats with moderate to high suitability for SRE fauna will still be regarded as such even if sampling has not recorded any restricted species within the habitat. 	<p>The key impact to SRE fauna and habitats from implementation of the Proposal is land disturbance. The management provisions therefore focus on minimising impacts to known and inferred habitats for the key species, and undertaking progressive rehabilitation using local top soil, and including the use of <i>Corymbia hamersleyana</i> material in habitats suitable for <i>Antichiropus</i> 'DIP007'.</p>

Biodiversity Condition Environmental Management Plan

Schedule	Value	Surveys and Studies	Survey and Study Findings	Key assumptions and uncertainties	Rationale for choice of provisions
Schedule X	Troglofauna species with <i>uncertain</i> restriction	<p>The Bennelongia (2016) Mining Area C – Southern Flank: Troglofauna Assessment summarises the results from all previous surveys undertaken within the vicinity of Mining Area C, including:</p> <ul style="list-style-type: none"> - Bennelongia (2008) Troglofauna Survey: Area C Mine – E and F Deposits. Report 2008/39. Bennelongia Pty Ltd, Jolimont, 35 pp. - Bennelongia (2009) Area C Mining Operation Environmental Management Plan (Revision 4) A, D, P1 and P3 Deposits: troglofauna assessment. Report 2008/48. Bennelongia Pty Ltd, Jolimont, 65 pp. - Bennelongia (2011) Area C mining operation B, R, P4, P5 and P6 deposits: troglofauna assessment. Report 2011/094. Bennelongia Pty Ltd, Jolimont, 37 pp. - Bennelongia (2012) Revision 5 of the mining area C EMP, B and P4 deposits: troglofauna assessment. Report 2012/158. Bennelongia Pty Ltd, Jolimont, 36 pp. - Bennelongia (2013) Mining Area C: Troglofauna assessment for Extensions at P1E and P3 Deposits. Report 2013/200. Bennelongia Pty Ltd, Jolimont, 34 pp. - Bennelongia (2014) Mining Area C: baseline subterranean fauna report. Report 2014/216, Bennelongia Pty Ltd, Jolimont, 82 pp. - Bennelongia (2015) Strategic Environmental Assessment: description of regional subterranean fauna. Report 2015/202. Bennelongia Pty Ltd, Jolimont, 58pp. <p>Information for the document has also been obtained from:</p> <ul style="list-style-type: none"> - Bennelongia (2016) Addendum for modified boundary. Mining Area C and Southern Flank Troglofauna Environmental Impact Assessment - Bennelongia (2017) Addendum for modified boundary. Mining Area C and Southern Flank Troglofauna Environmental Impact Assessment - Bennelongia (2014) Mining Area C, Life of Project: troglofauna assessment. Report 2014/225. Bennelongia Pty Ltd, Jolimont, 62 pp. 	<p>Key findings from the Bennelongia (2016) Mining Area C – Southern Flank: Troglofauna Assessment and the - Bennelongia (2014) Mining Area C, Life of Project: troglofauna assessment are:</p> <ul style="list-style-type: none"> - At least 126 species from 19 orders have been recorded within the Proposed Mining Area C Development Envelope. Eighty eight of these species have not to date been recorded outside of it. - The geology of the Proposed Mining Area C Development Envelope contains four habitat types relevant to troglofauna: <ul style="list-style-type: none"> - 'hardcap zone'; - Detritals; - Mineralised rock; and - BIF host rock. - Direct impacts – mining may potentially impact species that have all or most of their range restricted to proposed pit areas within the Indicative Additional Impact Assessment Area or Mining Area C EMP Rev 6 Impact Assessment Area or cumulatively if all known records occur within these two areas. - Indirect impacts - current scientific knowledge of indirect impacts on troglofauna as a result of mining and associated activities is limited. Bennelongia (2016a) considered it likely that these factors would reduce animal densities rather than threaten species persistence, and therefore none of the below impacts are considered significant to troglofauna. Possible consequences of likely factors are (Bennelongia, 2016a): <ul style="list-style-type: none"> - Percussion from blasting. - Overburden stockpiles and waste dumps. - Contamination of landforms by hydrocarbons. - Lowering the watertable in the vicinity of the mine pits. - There are six subterranean fauna (troglofauna) species to which impacts from the Proposal are <i>uncertain</i> due to limited knowledge of species habitats and distribution (all are only known from single records or holes): <ul style="list-style-type: none"> - <i>Hanseniella</i> sp. B08; - <i>Symphyella</i> sp. B03; - Parajapygidae sp. S03; - <i>Prethopalpus</i> sp. B15; - Philosciidae sp. B03; and - Parajapygidae `DPL024` 	<p>Key assumptions and uncertainties from the Bennelongia (2016) Mining Area C – Southern Flank: Troglofauna Assessment are:</p> <ul style="list-style-type: none"> - Constrained sampling: Subterranean fauna sampling is likely to underestimate the true ranges of most species because it is spatially constrained. Drill holes are usually only available for sampling within the tenements of the proponent company and only in areas considered prospective for mining. - Low abundance species: Reliable definition of the ranges of low abundance species requires extensive sampling (Miller et al., 1989, Guisan et al., 2006). Despite a general trend for low abundance species to have smaller ranges than abundant species (Brown 1984), many low abundance species have widespread, patchy occurrence (Maurer 1990). Thus, few direct inferences can be drawn about the likely ranges of species collected in the impact assessment areas from few samples, especially species collected as singletons. - Incomplete and inconsistent taxonomy: The majority of species recorded within the Proposed Mining Area C Development Envelope are undescribed and are only known from within it. A taxonomic database for undescribed troglofauna species in Western Australia, is largely incomplete and if the same species is collected by different consultancies it is usually given different informal names. This adds to the difficulty of determining accurate species ranges, and a number of species may have larger ranges than described in this report. 	<p>The key impact to troglofauna species is clearing for mine pits, therefore the provision has been added to:</p> <ul style="list-style-type: none"> • minimise impacts to subterranean fauna (troglofauna) species to which impacts from the Proposal are <i>uncertain</i>, by avoiding clearing for mine pits outside the Modified Impact Assessment area, where practicable.

Note that further information on rationale and context can be found in relevant submission documentation.