bhpbilliton

CUNDALINE AND CALLAWA MINING OPERATIONS

Environmental Protection Statement

August 2009

BHP Billiton Iron Ore

GOLDSWORTHY IRON ORE MINING OPERATIONS

CUNDALINE AND CALLAWA IRON ORE MINING OPERATIONS

ENVIRONMENTAL PROTECTION STATEMENT

August 2009

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Background

BHP Billiton Iron Ore Pty Ltd's (BHP Billiton Iron Ore) Goldsworthy Iron Ore Mining Operations are located approximately 200 kilometres (km) east of Port Hedland in the north of the Pilbara region of Western Australia (WA).

The current Goldsworthy Operations are centred at Yarrie, with some mining still taking place at the Nimingarra, Cattle Gorge and Sunrise Hill deposits. The Mount Goldsworthy and Shay Gap mining areas are no longer operational, with the majority of activities at these sites directed towards the monitoring and maintenance of rehabilitated landforms.

BHP Billiton Iron Ore's activities at Goldsworthy are conducted under the *Iron Ore (Goldsworthy) Agreement Act, 1964,* and the *Iron Ore (Goldsworthy-Nimingarra) Agreement Act, 1972*. Environmental requirements are specified in the Goldsworthy Operations Notice of Intent, and the conditions of Ministerial Statement's No. 000303 and No. 000682 issued by the Minister for the Environment under Part IV of the WA *Environmental Protection Act, 1986* (EP Act), and Licences 5561 and 4412 issued under Part V of the EP Act.

BHP Billiton Iron Ore's exploration programme has identified iron ore deposits on the Cundaline and Callawa ridges. In order to continue mining operations at Goldsworthy, BHP Billiton Iron Ore is proposing to develop the Cundaline and Callawa deposits using new and existing Goldsworthy infrastructure.

The Proposal

Proposed infrastructure and mining activities at the Cundaline and Callawa iron ore mining operations (herein referred to as the proposed Cundaline and Callawa mining operations) would include:

- pre-stripping, open pit mining above the watertable and stockpiling of overburden and ore at the Cundaline pits;
- pre-stripping, open pit mining above and below the watertable and stockpiling of overburden and ore at the Callawa pits;
- placement of overburden in mined-out voids and out-of-pit overburden stockpile areas (OSAs) adjacent to the Cundaline and Callawa pits;
- trucking of the Callawa ore to the Yarrie crushing, screening and rail loading facilities, which are located approximately 2 km to the north;
- trucking of the Cundaline ore to the Yarrie crushing, screening and rail loading facilities, which are located approximately 12 km to the south-east, or use of a mobile crushing and screening plant to be located within the Cundaline area;
- stockpiling, crushing, screening and load-up of iron ore at the Yarrie processing facilities and/or the mobile Cundaline facilities;
- continued groundwater abstraction from the Shay Gap Wellfield to meet operational demands, and distribution through the existing water supply system and pipeline extensions to the Cundaline and Callawa areas;
- construction and use of day rooms (e.g. crib room and toilets), workshop facilities and storage areas at the Cundaline and Callawa areas;

- supply of power to the facilities at the Cundaline and Callawa areas either via connecting electricity lines from the existing power network, or use of on-site diesel generators; and
- construction and use of haul and access roads to the Cundaline and Callawa areas.

Table ES-1 provides the key characteristics of the proposed Cundaline and Callawa mining operations.

Table ES-1
Key Characteristics of the Proposed Cundaline and Callawa Mining Operations

Aspect	Description
Proponent	BHP Billiton Iron Ore Pty Ltd, 225 St Georges Terrace, PERTH, WA 6000.
Mine Life	Up to 2016.
Planned Production*	5.6 million tonnes (Mt) of ore from Cundaline (above the watertable) and 4 Mt of ore from Callawa (above and below the watertable).
Ore Processing Rate	Up to 5 million tonnes per annum (Mtpa).
Total Overburden	Approximately 14.5 Mt (Cundaline) and 15.5 Mt (Callawa).
Land Disturbance Area	Approximately 500 hectares (ha).
Area of Pits	Approximately 125 ha (Cundaline) and 16 ha (Callawa).
Ore Crushing and Screening	Crushing and screening of the Callawa ore would be undertaken at the Yarrie processing facilities. Crushing and screening of the Cundaline ore would either be undertaken at the Yarrie processing facilities, or at a mobile crushing and screening plant to be located at the Cundaline deposit.
Overburden Storage	Placement in out-of-pit OSAs to the north of the Cundaline pits and to the east of the Callawa pits. In-pit placement of overburden at Callawa to a minimum of 5 metres (m) above the pre-mining watertable.
Water Supply Source	Continued groundwater abstraction from the Shay Gap Wellfield to meet operational demands.
Water Supply Network	Distribution through the existing water supply system and pipeline extensions.
Water Demand	Up to 1.5 megalitres of water per day (ML/d).
Power Supply Source	Port Hedland gas-fired power station or on-site diesel-fuelled generators.
Power Supply Network	Electricity requirements would be provided by either extending the existing 22 kilovolt electricity line which runs between Cattle Gorge and the Yarrie processing facilities, or by on-site diesel-fuelled generators.
Power Demand	Approximately 7,500 megawatt hours per annum (MWh/yr).
On-site Ore Transport	Ore would be transported from the Cundaline and Callawa areas to the Yarrie processing facilities via trucks, then railed from the Yarrie processing facilities to Port Hedland via the existing rail line, or directly loaded onto trains from Cundaline.
Off-site Transport of Ore	Use of existing rail facilities, with approximately one train per day (on average). Each train would consist of approximately 90 wagons, each carrying up to 75 tonnes (t), and a total train capacity of approximately 6,750 t.
Mine-related Infrastructure	The Cundaline and Callawa mining operations would use existing administration facilities, main workshops, waste facilities and storage areas (i.e. explosives, fuel, oil and ore stockpiles). Personnel would use the accommodation camp and aerodrome also at the Yarrie operations. The infrastructure at the Callawa area would consist of an office, toilet facilities, crib room and a turkey's nest dam. The infrastructure at the Cundaline area would include an office, toilet facilities, crib room, fuel storage, refueling facilities and a turkey's nest dam.
Employment	Approximately 140 to 150 operational personnel. An additional construction workforce of approximately 41 would be required in the initial year of operations.

* The Planned Production information should be read together with and subject to the notes set out in the BHP Billiton Limited Group Combined Financial Statements 2008. This document can be viewed at http://bhpbilliton.com. Resource is inclusive of reserve.

Environmental Protection Statement

This Environmental Protection Statement (EPS) describes the existing environment and the potential environmental impacts resulting from the proposed Cundaline and Callawa mining operations, together with management measures that would be used during the life of the mine to mitigate potential impacts. Visual, surface water, groundwater, flora and fauna, noise and air quality studies have been conducted to assess the proposed activities and are included in Appendices E to L.

BHP Billiton Iron Ore has adopted a risk based approach to assess the relevant environmental factors and potential risks relevant to the proposed activities. The overarching principles of sustainability and biodiversity have been considered within the context of the proposed Cundaline and Callawa mining operations and have been incorporated into the assessment of the identified environmental factors. The factors relevant to the proposal were identified based on BHP Billiton Iron Ore's operational experience at Goldsworthy, the results of environmental studies and monitoring in the region, the findings of previous Environmental Impact Assessments, and consultation with Government stakeholders.

The environmental factors listed in Table ES-2 have been assessed in this EPS and supporting documentation.

Table ES-2
Environmental Factors

Environmental Factors
Soil Resources
Landforms
Surface Water
Groundwater
Flora
Terrestrial Fauna (including Short-range Endemic Fauna)
Subterranean Fauna (including Stygofauna and Troglofauna)
Air Quality
Noise and Blasting
Greenhouse Gas Emissions
Waste Management
Dangerous Goods and Hazardous Materials
Aboriginal Heritage

This EPS provides a detailed assessment of each environmental factor, and demonstrates that the potential impacts can be managed so that residual risk is minimised and relevant objectives can be met.

BHP Billiton Iron Ore has reviewed and revised the existing Goldsworthy environmental management plans to include the proposed mining at Cundaline and Callawa. These revised management plans have been appended to this EPS as key supporting documents and include the Environmental Management Plan (EMP), Decommissioning and Rehabilitation Plan, Significant Species Management Plan (SSMP) and Weed Management Plan (WMP) (Appendices A to D).

The risk assessment process involved the identification of the following:

- EPA environmental objective;
- risk issue/hazard;
- event;
- cause/failure;
- management and mitigation; and
- potential impacts.

A summary of the potential environmental impacts, risk ratings and proposed environmental management measures for the identified environmental aspects is provided in Table ES-3. Where appropriate, references are included to relevant sections of this EPS that contain additional details of the environmental impact assessment for each aspect.

The potential impacts of the proposed Cundaline and Callawa mining operations have been assessed in this EPS and the proposed management measures are considered by BHP Billiton Iron Ore to be best practice and appropriate to minimise potential impacts on the relevant environmental aspects.

Table ES-4 provides a summary of the environmental management actions which BHP Billiton Iron Ore would commit to implementing.

Table ES-3
Summary of Environmental Aspects and Proposed Management Practices

Environmental Objectives	Risk Issue/ Hazard Description	Event	Cause/Failures	Proposed Management and Mitigation	Potential Impacts	Inherent Risk	Further Controls	Residual Risk
Soil Resources								
To maintain the integrity, ecological function and environmental values of the soil.	Loss of soil resources.	- Weather event. - Inadequate salvage of topsoil. - Lack of stockpile co-ordination. - Compaction of soil. - Soil becomes mixed up with waste rock. - Topsoil buried under waste dumps. - Soil is or becomes weed infested.	- Inappropriate stockpiling. - Lack of vegetative cover. - Lack of procedures and systems in place. - Inappropriate design of stockpiles. - Lack of or failure of weed management systems put in place.	- A plan would be prepared showing areas requiring topsoil removal before stripping occurs. - Topsoil and other identified suitable growth medium material would be stripped prior to the commencement of mine operation activities. - Stripped topsoil, subsoil and other materials would be applied to areas being rehabilitated or stored in separate stockpiles for later use. - The stockpiles would be constructed and managed in a manner that encourages the continuation of the soil's biological activity. - Topsoil details would be recorded on the Topsoil Stockpile Datasheet and stored into a central database or spreadsheet. - Locations of topsoil storage stockpiles would be recorded on BHP Billiton Iron Ore's Spatial Mine Planning Programme. - Stockpiles would be signposted in the field. - Regular inspections would be undertaken to assess erosion and sediment migration from topsoil stockpiles. Remedial works would be undertaken as required or the stockpile will be relocated. - Mining contractors would be closely supervised to assess conformance with land and soil management procedures. - A condition prohibiting unauthorised clearing would be included in all relevant contracts. - Measures contained within the Project Environmental and Aboriginal Heritage Review (PEAHR) in regard to vegetation clearance and soil stripping. - Measures contained in WMP in regard to weed management.	Soil erosion by both wind and water.	Minor	-	Minor
					Reduction in the viability of seeds, nutrients, organic matter and micro-organisms.	Minor	- Investigate measures for improving the viability of seed, nutrients and organic matter and micro-organisms in topsoil. - Supervise topsoil management and rehabilitation work.	Minor
					Inappropriate alteration of soil structure and/or chemistry (e.g. through compaction, spillage of hydrocarbons or chemicals).	Minor	-	Minor
					Changes to the natural soil evolution/forming process, caused by stripping and reusing soil from disturbed areas in rehabilitation.	Low	-	Low
					Insufficient soil resource to successfully rehabilitate land.	Moderate	Topsoil movement would be tracked to ensure it is available for rehabilitation.	Minor

Note: Risk issues are described in more detail in Sections 3, 4 and 5 of this document.

Table ES-3 (Continued)
Summary of Environmental Aspects and Proposed Management Practices

Environmental Objectives	Risk Issue/ Hazard Description	Event	Cause/Failures	Proposed Management and Mitigation	Potential Impacts	Inherent Risk	Further Controls	Residual Risk
Landforms								
To ensure as far as practicable, that rehabilitation achieves a stable and functioning landform which is consistent with the surrounding landscape and other environmental values.	Mining operations would adversely affect the stability and aesthetics of the surrounding landscape.	- Re-shaping of the landscape reducing aesthetics. - Design failure of stockpiles and pits causes landform instability.	- Inappropriate shaping leading to loss of soil, unstable landforms and loss of visual amenity. - Lack of procedures and systems. - Poor planning, design and execution of design. - Lack of remedial follow-up.	- New OSAs would be located in existing valleys and as extensions to existing ridges. - Infrastructure and mine landforms would be designed in a manner such that environmental impacts are minimised. - Erosion and sedimentation control measures. - Progressive rehabilitation. - Mine infrastructure areas that are no longer required would be decommissioned and rehabilitated. - Overburden placement would be undertaken in accordance with an overburden storage construction plan. - Visual screens. - Stockpiled materials would be selected and drainage designed to minimise erosion. - Low impact colour infrastructure. - Directional lighting or light shielding. - General housekeeping (e.g. storage of waste in appropriate facilities). - Rehabilitated OSAs would be consistent with the relevant Guiding Closure Principles. - Residual batters in the pit voids would be left as run-of-mine where geotechnically stable, and profiled to achieve long-term closure objectives. - Rehabilitation of borrow pits in accordance with the BHP Billiton Iron Ore's Manual for Borrow Pit Management. - Where necessary, drainage features would be incorporated onto the tops of cuts and dumps.	Change in surface water flow.	Minor	-	Minor
					Loss of visual amenity.	Minor	-	Minor
					Adverse impacts on flora and fauna habitat.	Minor	-	Minor
					Erosion of topsoil and waste materials.	Minor	-	Minor
					Potential for acid rock drainage issues, potentially limiting rehabilitation success.	Low	-	Low

Note: Risk issues are described in more detail in Sections 3, 4 and 5 of this document.

Table ES-3 (Continued)
Summary of Environmental Aspects and Proposed Management Practices

Environmental Objectives	Risk Issue/ Hazard Description	Event	Cause/Failures	Proposed Management and Mitigation	Potential Impacts	Inherent Risk	Further Controls	Residual Risk
Surface Water								
To maintain the quality and quantity of surface water so that existing and potential environmental values are protected.	Changes in surface water flow may affect ecosystem quality and function.	- Misdirection of surface water flows. - Erosion reduces surface water quality. - Contamination of surface water flows.	- Inappropriate planning and management of stockpiles and drainage lines. - Lack of bunding and drainage and/or maintenance of bunds and drains. - Inappropriate management/ lack of bunding of contaminants used on-site.	- Sediment control measures would be designed and implemented as required. - Water quality monitoring. - Water use minimised. - Controlled wastes would be properly handled. - On-site solid waste disposal would be minimised and properly managed. - Hazardous substances would be stored in properly bunded facilities. - Progressive rehabilitation. - Manage drainage and water flows so as to protect water quality and direction of water flow. - Recycling stormwater runoff.	Loss of surface water flow.	Minor	-	Minor
					Loss of water quality through contamination and/or erosion.	Minor	Maintain a life of mine and mine closure topsoil inventory.	Minor
Groundwater								
To maintain the quality and quantity of groundwater so that existing and potential environmental values are protected.	- Drawdown of local groundwater levels adversely affects groundwater ecosystems due to the effects of mine dewatering. - Potential impacts on quality through contamination by chemicals, hydrocarbons and mine wastes adversely impacts groundwater ecosystems.	- Mine dewatering lowers the watertable. - Contaminants seep into the groundwater system.	- Lack of awareness of environmental impact of groundwater drawdown. - Poor management of contaminants.	- Manage groundwater systems so as to minimise adverse impacts outside of disturbance area. - Promote awareness of management procedures for contaminants used on-site. - Monitor abstraction of groundwater volume and levels and quality of groundwater bores. - Store contaminants in appropriately bunded facilities, ensure spills are thoroughly cleaned up.	Drawdown of local groundwater levels.	Minor	Monitor groundwater levels and water quality.	Minor
					Adverse impacts on groundwater quality as a result of potential contamination by hydrocarbons, chemicals or mine waste (i.e. potentially acid forming overburden).	Minor	-	Minor
					Potential to adversely impact on stygofauna populations at the proposed Callawa mining operation.	Minor	Monitor groundwater levels and water quality.	Minor

Note: Risk issues are described in more detail in Sections 3, 4 and 5 of this document.

Table ES-3 (Continued)
Summary of Environmental Aspects and Proposed Management Practices

Environmental Objectives	Risk Issue/ Hazard Description	Event	Cause/Failures	Proposed Management and Mitigation	Potential Impacts	Inherent Risk	Further Controls	Residual Risk
Flora								
To maintain the abundance, species diversity, geographic distribution and productivity of flora at a species and ecosystems level through the avoidance or management of adverse impacts and improvements in knowledge.	Loss of vegetation.	- Mining activities resulting in loss of vegetation through clearing. - Weed species are transported onto site, competing with native flora. - Potential to change flora composition resulting from groundwater drawdown.	- No surveys to understand what will be cleared. - Uncontrolled clearing. - Inappropriate stockpiling of soil causing damage to vegetation. - Machinery may transport weeds and soil pathogens to site affecting remnant flora. - Dust deposition on flora surrounding the mine disturbance area. - Potential to increase risk of bushfires due to increased human activity. - Potential to change flora composition resulting from alterations to groundwater flow.	- Baseline surveys prior to land disturbance. - Land clearing should be minimised. - Vehicles and machinery would be parked in designated locations and off-road recreational activities would be prohibited. - Dust control measures would be implemented. - Minimise disturbance to known significant flora. - Areas of known weed infestation would be shown on mine plans and marked on the ground. - Mobile machinery and equipment would be cleaned on a regular basis, with particular attention to machinery that operates in known weed infestation areas. - Topsoil that is stripped from areas known to be infested with weeds would be treated before use. - Regular inspections for the presence of weeds. - Fire hazard awareness and fire management training. - Fire management equipment and personnel available as required. - Fire breaks constructed surrounding the electricity transmission line and dewatering pipeline. - Measures contained within the PEAHR in regard to minimising vegetation clearance. - Measures contained within the SSMP in regard to significant species management. - Measures contained within the EMP in regard to general vegetation management. - Educate employees about preventing bushfires. - Educate employees about the importance of dust control. - Prepare for bushfire response. - Drainage works to reduce impact to flora.	Removal/ modification of flora and their habitat.	Low	-	Low
					Removal of vegetation communities.	Low	-	Low
					Changing vegetation structure and composition.	Minor	-	Minor

Note: Risk issues are described in more detail in Sections 3, 4 and 5 of this document.

Table ES-3 (Continued)
Summary of Environmental Aspects and Proposed Management Practices

Environmental Objectives	Risk Issue/ Hazard Description	Event	Cause/Failures	Proposed Management and Mitigation	Potential Impacts	Inherent Risk	Further Controls	Residual Risk
Terrestrial Fauna								
To maintain the abundance, species diversity, geographic distribution and productivity of terrestrial fauna at a species and ecosystems level through the avoidance or management of adverse impacts and improvements in knowledge.	Loss of abundance and diversity of fauna through disturbance.	- Direct fauna mortality through vegetation clearing. - Mine development may increase feral animal habitat and increase predation of native fauna. - Mine development increases loss of habitat.	- Uncontrolled disturbance. - Control measures are not proposed and implemented to mitigate feral animal control.	- Baseline fauna assessments prior to land disturbance. - Disturbance footprint to limit land clearing. - Management measures contained within the SSMP in regard to significant species management. - Management measures contained within the EMP in regard to general fauna management. - Vehicles and machinery would be parked in designated locations and off-road recreational activities would be prohibited. - A site induction to raise workforce awareness of local fauna species of interest and relevant conservation issues. - Domestic animals would be prohibited and a clean, rubbish-free environment would be maintained across the site. - Firearms would be prohibited on-site, except by authorised personnel to control declared animals. - The capture of fauna would be prohibited except where required for baseline surveys. - Significant fauna species and their key habitats would be recorded on relevant databases and mine plans, and awareness of these records would be promoted. - Management measures contained within the PEAHR in regard to minimising habitat clearance.	Removal/ modification of fauna and their habitat.	Low	The return of fauna to rehabilitated areas would be promoted.	Low
					Increase in feral animal populations leading to increased threat to native fauna.	Low		Low

Note: Risk issues are described in more detail in Sections 3, 4 and 5 of this document.

Table ES-3 (Continued)
Summary of Environmental Aspects and Proposed Management Practices

Environmental Objectives	Risk Issue/ Hazard Description	Event	Cause/Failures	Proposed Management and Mitigation	Potential Impacts	Inherent Risk	Further Controls	Residual Risk
Subterranean Fauna								
To maintain the abundance, species diversity, geographic distribution and productivity of subterranean fauna at a species and ecosystems level through the avoidance or management of adverse impacts and improvements in knowledge.	Loss of abundance and diversity of subterranean fauna through disturbance.	- Lowering the watertable sufficiently to dry out the zone in which species live, or otherwise artificially changing watertables. - Changing water quality. - Destroying or damaging caves.	- Poor management of contaminants used on-site. - Pollution from chemical/ hydrocarbon spills released into the watertable. - Mine development outside proposed disturbance areas. - Lack of awareness of environmental impact of groundwater drawdown.	- Minimise disturbance areas where required. - Monitor and track disturbance areas. - Measures contained within the SSMP in regard to management of significant species. - Monitor groundwater levels and quality. - Measures contained within the EMP in regard to groundwater management.	Removal/ modification of stygofauna, or their habitat, at the proposed Callawa mining operation.	Minor	- Monitor groundwater levels and water quality. - Manage groundwater at the proposed Callawa mining operation so as to minimise adverse impacts outside of disturbance area.	Minor
					Removal/ modification of troglofauna, or their habitat, at the proposed Callawa mining operation.	Minor	As above.	Minor
					Removal/ modification of stygofauna, or their habitat, at the proposed Cundaline mining operation.	Low	- Monitor groundwater levels and water quality. - Manage groundwater at the proposed Cundaline mining operation so as to minimise adverse impacts outside of disturbance area.	Low
					Removal/ modification of troglofauna, or their habitat, at the proposed Cundaline mining operation.	Minor	As above.	Minor

Note: Risk issues are described in more detail in Sections 3, 4 and 5 of this document.

Table ES-3 (Continued)
Summary of Environmental Aspects and Proposed Management Practices

Environmental Objectives	Risk Issue/ Hazard Description	Event	Cause/Failures	Proposed Management and Mitigation	Potential Impacts	Inherent Risk	Further Controls	Residual Risk
Air Quality								
To ensure that emissions do not adversely affect environment values or the health, welfare and amenity of people and landuses by meeting statutory requirements and acceptable standards.	- Excessive dust emissions impacting the health impacts on the community. - Excessive dust emissions impacting on environmental values of the surrounding area.	- Excessive dust generation.	- Dust suppressants are not used in operations. - Dust collectors/ filters are not maintained or used in fixed plant equipment. - Rehabilitation of disturbed areas is delayed.	- Watering or using chemical suppressants on haul roads and other potential dust generating areas. - Progressive rehabilitation. - Minimising areas of exposed soil. - Maintenance of dust suppression equipment. - Employees and contractors would be informed on minimising dust levels. - Minimising native vegetation clearance.	Dust adversely affecting sensitive receptors.	Low	-	Low
					Dust deposition adversely impacting flora surrounding the mine disturbance area.	Low	-	Low
Noise and Blasting								
To protect the amenity of nearby residents from noise impacts resulting from activities associated with the proposal by ensuring the noise levels meet statutory requirements and acceptable standards.	Potential to effect amenity of nearby residents from noise impacts resulting from activities associated with the proposed operations.	- Excessive noise created from equipment and machinery with no noise mitigating technology present. - Blasting outside of restricted hours. - Excessive noise generated from movement of ore including road and rail.	- Lack of awareness of noise management procedure. - Poor maintenance of equipment and machinery to mitigate excessive noise production. - Poor planning of road and rail movements.	- Blasting would be conducted during daylight hours only. - Use of low noise-generating equipment, silencers, and exhaust mufflers.	Noise affecting sensitive receptors.	Low	- Machinery would be regularly serviced. - Generators would be located in enclosed areas and at a sufficient distance from personnel areas.	Low
					Noise adversely impacting on native fauna.	Low	-	Low
					Breach of noise regulations.	Low	-	Low

Note: Risk issues are described in more detail in Sections 3, 4 and 5 of this document.

Table ES-3 (Continued)
Summary of Environmental Aspects and Proposed Management Practices

Environmental Objectives	Risk Issue/ Hazard Description	Event	Cause/Failures	Proposed Management and Mitigation	Potential Impacts	Inherent Risk	Further Controls	Residual Risk
Greenhouse Gas Emissions								
To minimise emissions to levels as low as practicable on an on-going basis and consider offsets to further reduce cumulative emissions.	Exceedance of the proposed Callawa/ Cundaline mining operations forecast greenhouse gas emissions.	- Excessive amounts of fossil fuels are consumed. - Electricity is not utilised in a conservative manner.	- Lack of awareness of greenhouse gas emissions impact to the environment and production costs. - Poorly maintained plant and equipment. - Inefficient use of energy.	- Restricting the amount of native vegetation that is cleared to a practical minimum. - Progressive rehabilitation. - Regularly maintaining and replacing fixed and mobile equipment. - Minimising haulage distances and grades.	Exceedance of the proposed Callawa/Cundaline mining operations forecast greenhouse gas emissions.	Low	- Educate staff on energy efficiency. - Awareness and operations in accordance with the BHP Billiton Iron Ore Climate Change Policy and energy and greenhouse guidelines.	Low
Waste Management								
To ensure that the disposal of waste does not adversely affect the integrity, ecological function and values of the environment, or the health, welfare and amenity of people and landuses.	Waste materials have the potential to adversely affect the environment (e.g. contamination of soil and water resources).	Waste is dumped in an inappropriate location and not managed according to current legislation and guidelines.	- Lack of awareness of BHP Billiton Iron Ore waste management procedures. - Inadequate resources and/or facilities to manage waste.	- Materials to be recycled would be stored in a designated area until they are removed from the site. - Materials such as batteries and scrap metal would be recycled. - All waste collecting systems would be designed for ease of use and prevention or capture of spillage. - Oily wastes generated at site would be collected and disposed of. - All soil contaminated by hydrocarbons would be removed to the bioremediation landfarm for treatment. - Controlled wastes transported off-site for disposal would be managed.	Site contamination impacting on the environment.	Minor	-	Minor

Note: Risk issues are described in more detail in Sections 3, 4 and 5 of this document.

Table ES-3 (Continued)
Summary of Environmental Aspects and Proposed Management Practices

Environmental Objectives	Risk Issue/ Hazard Description	Event	Cause/Failures	Proposed Management and Mitigation	Potential Impacts	Inherent Risk	Further Controls	Residual Risk
Waste Management (Continued)								
				- Non-controlled solid wastes would be disposed of at the Yarrie Mine landfill in accordance with the licence conditions. - Compliance with all regulations relating to the storage, handling, use and disposal of hazardous materials. - Regular inspections of the on-site landfill site. - Domestic sewage would be collected and contained in underground septic tanks. - All water from potentially contaminated areas would be collected and contained.				
Dangerous Goods and Hazardous Materials								
To ensure that the use of dangerous goods and hazardous materials does not adversely affect the integrity, ecological function and values of the environment, or the health, welfare and amenity of people and landuses.	Inadequate management of dangerous goods has the potential to cause atmospheric, ground or water contamination.	- Spillage may result in soil/water contamination. - Chemical reaction may result in explosion or seepage of contaminants to atmosphere, soil or water.	- Inadequate bunding. - Inappropriate handling of storage and handling regulations.	- Storage of bulk fuel in above ground tanks within impermeable, bunded enclosures and minor storage vessels in accordance with licence conditions and applicable Australian Standards. - Storage of explosives in remote magazines. - Storage of all toxic or hazardous mining or process materials within weatherproof enclosures, with impervious flooring and perimeter bunding. - Transportation of hazardous materials in accordance with a Licence to Transport Dangerous Goods. - Any spill or leaks of chemicals would be removed and disposed.	Release of toxic or polluting gases to the atmosphere.	Low	-	Low
					Surface water contamination.	Minor	-	Minor
					Soil and groundwater contamination.	Minor	-	Minor

Note: Risk issues are described in more detail in Sections 3, 4 and 5 of this document.

Table ES-3 (Continued)
Summary of Environmental Aspects and Proposed Management Practices

Environmental Objectives	Risk Issue/ Hazard Description	Event	Cause/Failures	Proposed Management and Mitigation	Potential Impacts	Inherent Risk	Further Controls	Residual Risk
Aboriginal Heritage								
To ensure that changes to the biophysical and physical environment resulting from the proposed Cundaline and Callawa mining operations do not adversely affect historical and cultural associations and complies with relevant heritage legislation.	Damaging or destroying heritage sites not covered by S18 approvals.	- Unplanned ground disturbance of heritage site. - Collecting or excavating artefacts from heritage sites. - Damaging artefacts by off-road use of vehicles. - Trespassing on sites by unauthorised personnel and culturally inappropriate behaviour.	- Lack of awareness of heritage sites and issues. - Failure to barricade and/or signpost sites near high traffic areas.	- Undertaking Aboriginal heritage surveys at disturbance areas in consultation with the Nyiyaparli cultural heritage custodians and representatives. - Avoiding Aboriginal sites where possible and revising the mine plan if significant Aboriginal heritage sites are identified. - Obtaining appropriate approvals and permits prior to disturbing any sites.	Damage or destruction of heritage sites not covered by S18 approvals.	Minor	-	Minor

Note: Risk issues are described in more detail in Sections 3, 4 and 5 of this document.

Table ES-4
Proposed Environmental Management Actions

Number	Topic	Objective	Action	Timing	Advice
1	Mining Below the Watertable	To minimise the long-term impact of the open pits on groundwater following mine closure.	• All mine voids at the proposed Cundaline and Callawa mining operations which progress below the watertable will be backfilled to above the pre-mining watertable level.	Prior to mine closure.	-
2	Annual Environmental Report	Annually prepare reports on environmental management, monitoring and rehabilitation.	• BHP Billiton Iron Ore will prepare an Annual Environmental Report (AER) that discusses environmental management actions, summarises monitoring results and describes rehabilitation activities at the Goldsworthy Operations over the 12 month reporting period. • The AER will be distributed to key stakeholders and provide copies to other interested parties if requested.	Annually during operations.	DMP DEC
3	Mine Planning Process	Include consideration of key environmental aspects in mine planning process, and adjust designs where possible to minimise environmental impacts.	• BHP Billiton Iron Ore will implement the mine planning process described in Section 3.3 and illustrated on Figure 3-3 of this EPS.	During the life of the mine.	DMP DEC

DEC: WA Department of Environment and Conservation
DMP: WA Department of Mines and Petroleum

1 INTRODUCTION

1.1 BACKGROUND

BHP Billiton Iron Ore Pty Ltd's (BHP Billiton Iron Ore) Goldsworthy Iron Ore Mining Operations are located approximately 200 kilometres (km) east of Port Hedland in the north of the Pilbara region of Western Australia (WA).

Mine development at Goldsworthy has been conducted in phases over the past 50 years. The Mount Goldsworthy Mine was the first mining operation in the mid-1960s. Once it was mined out, the Shay Gap, Sunrise Hill and Nimingarra mining areas were progressively developed between 1972 and 1992. These areas are located approximately 50 to 70 km to the east of Mount Goldsworthy. In 1992, approval was obtained for the development of the Yarrie operations, located a further 20 km to the east. In 2005, approval was obtained for the Cattle Gorge mining area (located between Yarrie and Sunrise Hill), plus extensions to the Nimingarra mining areas (Nim I) and Yarrie (Y10, Y7 and Y4B).

BHP Billiton Iron Ore's current Goldsworthy Operations are centred at Yarrie, with some mining still taking place at the Nimingarra, Cattle Gorge and Sunrise Hill deposits. The Mount Goldsworthy and Shay Gap mining areas are no longer operational, with the majority of activities at these sites directed towards the monitoring and maintenance of rehabilitated landforms.

BHP Billiton Iron Ore's activities at Goldsworthy are conducted under the *Iron Ore (Goldsworthy) Agreement Act, 1964,* and the *Iron Ore (Goldsworthy-Nimingarra) Agreement Act, 1972*. Environmental requirements are specified in the Goldsworthy Operations Notice of Intent (NOI) (Goldsworthy Mining Limited, 1986), and the conditions of Ministerial Statement's No. 000303 and No. 000682 issued by the Minister for the Environment under Part IV of the WA *Environmental Protection Act, 1986* (EP Act), and Licences 5561 and 4412 issued under Part V of the EP Act.

BHP Billiton Iron Ore's exploration programme has identified iron ore deposits on the Cundaline and Callawa ridges. The deposits are located within existing BHP Billiton Iron Ore mining leases shown below in Table 1-1.

Table 1-1
Cundaline and Callawa Deposits - Mining Tenements

Deposit	Mining Tenement
Cundaline	M249SA Sec 4
Callawa	M 45/1016

In addition to M 45/1016, the proposed Callawa mining operation would also involve disturbance (i.e. access roads and possibly powerlines) within the existing BHP Billiton Iron Ore tenements M 45/558, M 45/594, E 45/127 and L 45/140 (Section 3.7).

In order to continue mining operations at Goldsworthy, BHP Billiton Iron Ore is proposing to develop the Cundaline and Callawa deposits using new and existing Goldsworthy infrastructure and facilities.

1.2 LOCATION, OWNERSHIP AND TENURE

Figure 1-1 shows the location of the proposed Cundaline and Callawa mining areas along with BHP Billiton Iron Ore's other iron ore mines in the Pilbara region. Figure 1-2 shows the boundaries of M 45/594, M 45/558, M 45/1016, and M249SA, as well as the existing rail and road infrastructure in the vicinity of Cundaline and Callawa.

Cundaline and Callawa (herein referred to as the proposed Cundaline and Callawa mining operations) would be owned by the Mount Goldsworthy Mining Associates Joint Venture. The joint venture participants are BHP Billiton Minerals Pty Ltd, Itochu Minerals and Energy of Australia Pty Ltd and Mitsui Iron Ore Corporation Pty Ltd. BHP Billiton Iron Ore would manage the Cundaline and Callawa activities on behalf of the Joint Venture participants.

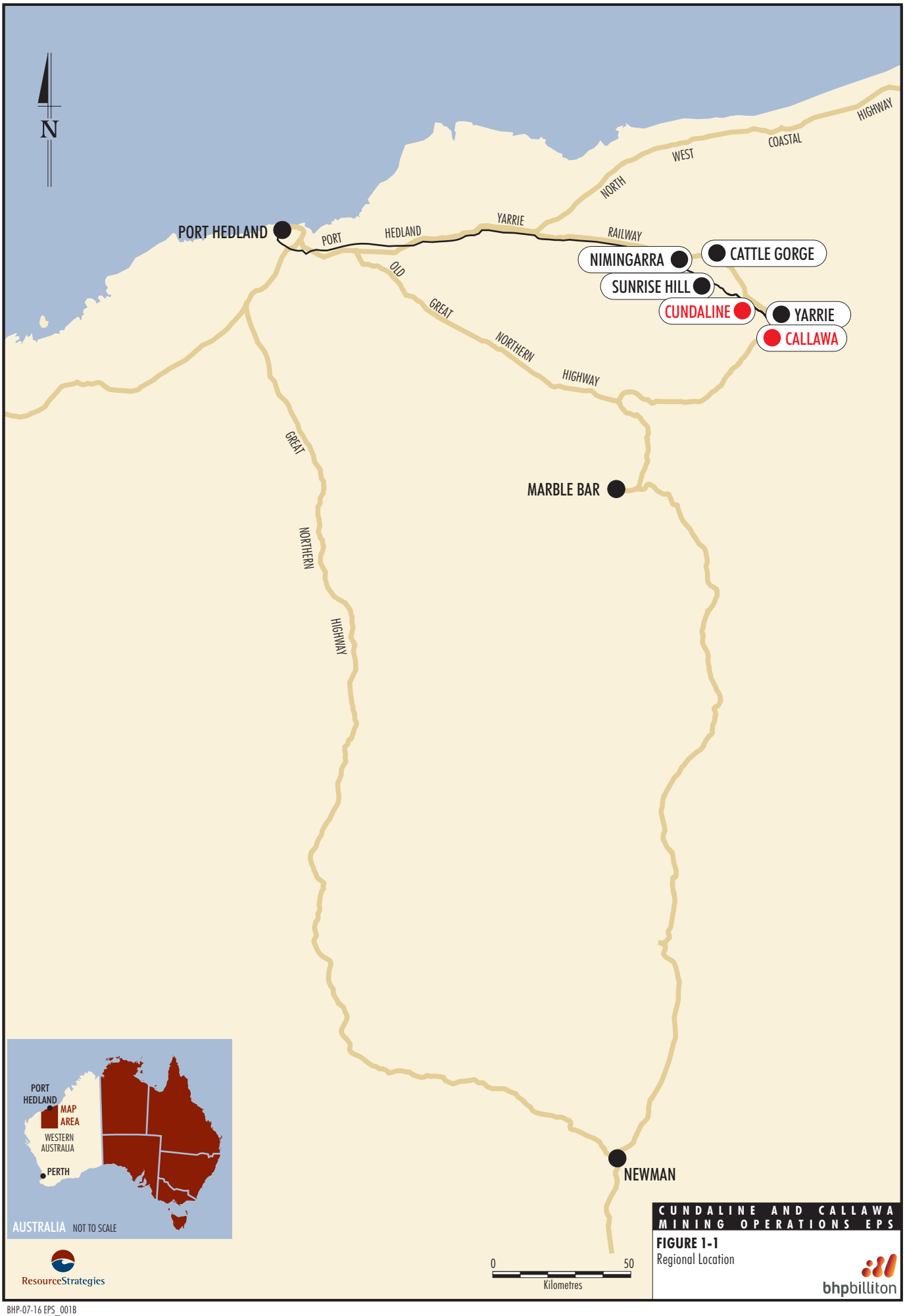
1.3 PURPOSE OF THIS ENVIRONMENTAL PROTECTION STATEMENT

The Environmental Protection Statement (EPS) approval process is a consultation based process, in which the proponent is largely responsible for identifying and consulting with stakeholders and other interested parties during the preparation of the impact assessment document.

Drafts of the Callawa and Cundaline Mining Operations EPS were provided to stakeholders and other interested parties for comment in November 2008 (Draft for Stakeholder Review) and May 2009 (Final Draft) prior to it being finalised and submitted to the WA Environmental Protection Authority (EPA) Service Unit for formal assessment in August 2009. It is intended that the finalised EPS (this document) will demonstrate to the EPA that:

- the community and key stakeholders have been adequately consulted;
- wherever possible the views and issues raised by stakeholders have been taken into account;
- appropriate environmental studies and assessments have been carried out in a competent manner;
- the results of the studies have been incorporated into the design, operation and management of the proposed Cundaline and Callawa mining operations;
- the proposed Cundaline and Callawa mining operations conform with applicable environmental guidelines, policies, standards and procedures;
- the required environmental factors have been adequately addressed;
- appropriate environmental management actions have been included; and
- draft environmental conditions have been provided for consideration by the EPA.

Once the EPA has reviewed and assessed the EPS, it would determine whether it was suitable and whether the proposal is suitable for the EPS level of assessment. If both of these aspects are satisfactory, the EPA would then advertise and make public the EPS along with its own assessment report prepared under Section 44 of the EP Act. During the public review period, any person has the right to appeal against the level of assessment and/or the EPA report to the WA Minister for the Environment.



ResourceStrategies

CUNDALINE AND CALLAWA MINING OPERATIONS EPS

FIGURE 1-1
Regional Location

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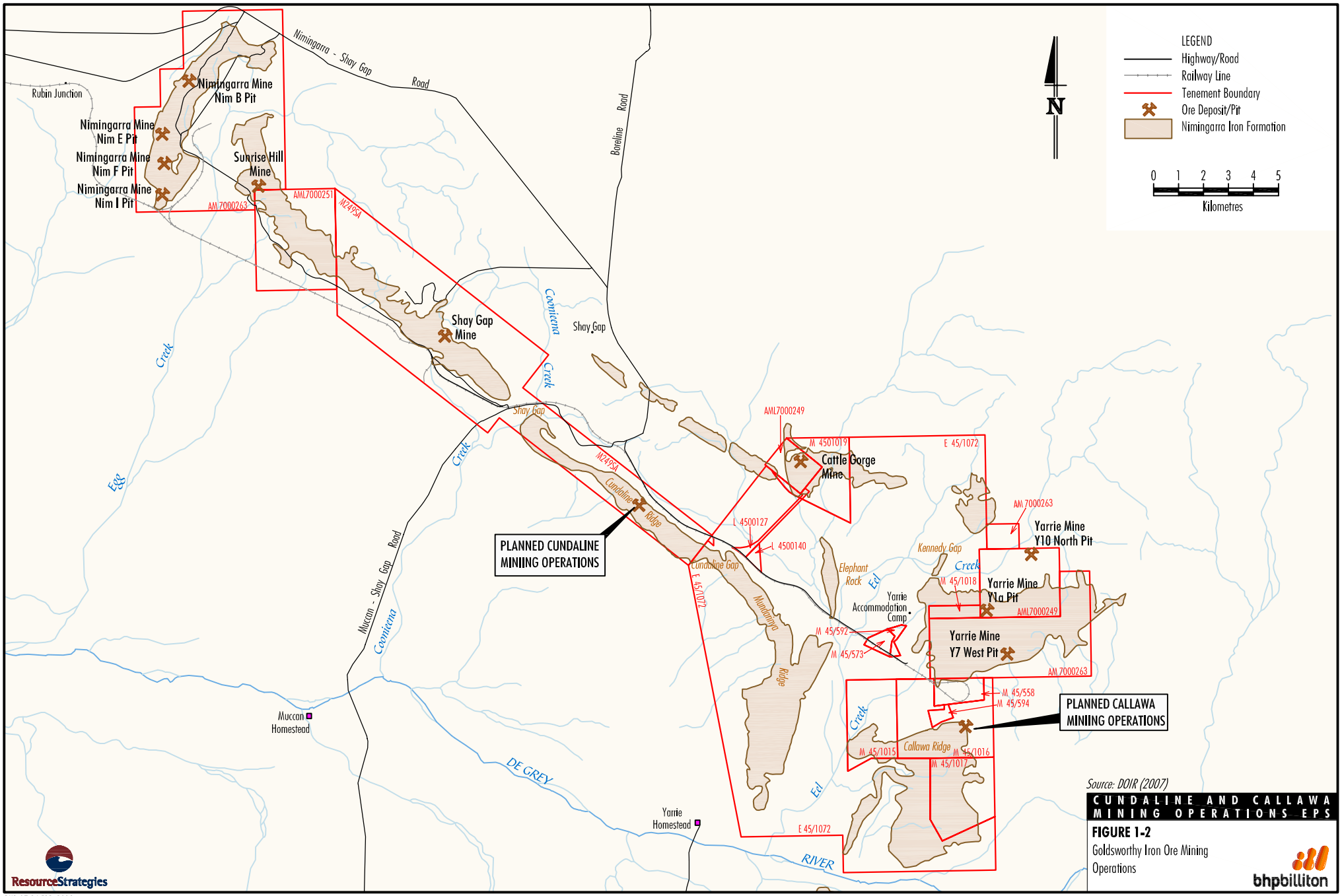
BHP-07-16 EPS_001B



Source: DOIR (2007)

CUNDALINE AND CALLAWA MINING OPERATIONS EPS

FIGURE 1-2

Goldsworthy Iron Ore Mining Operations

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BHP-07-16 EPS_103C

When considering the EPS, the EPA would have regard to the core principles of environmental protection set out in the EP Act and the EPA's *Position Statement No. 7 - Principles of Environmental Protection* (EPA, 2004a). These principles include:

1) The Precautionary Principle

Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.

In the application of the precautionary principle, decisions should be guided by –

(a) careful evaluation to avoid, where practicable, serious or irreversible damages to the environment; and

(b) an assessment of the risk-weighted consequences to various options.

2) The Principle of Intergenerational Equity

The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.

3) The Principle of the Conservation of Biological Diversity and Ecological Integrity

Conservation of biological diversity and ecological integrity should be a fundamental consideration.

4) Principles in relation to Improved Valuation, Pricing and Incentive Mechanisms

(a) Environmental factors should be included in the valuation of assets and services.

(b) The polluter pays principle – those who generate pollution and waste should bear the cost of containment, avoidance or abatement.

(c) The users of goods and services should pay prices based on the full life cycles costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any wastes.

(d) Environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms, which enable those best placed to maximise benefits and/or minimise costs to develop their own solutions and responses to environmental problems.

5) The Principle of Waste Minimisation

All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment.

BHP Billiton Iron Ore has considered the EPA's principles of environmental protection during the preparation of this EPS and these principles have been addressed where relevant throughout this document.

In addition to the above principles of environmental protection, a list of the EPA's generic environmental factors and associated environmental objectives for Environmental Impact Assessment (EIA) is provided in the *Guide to EIA Environmental Principles, Factors and Objectives* (EPA, 2004b). The environmental factors and objectives set out in this guide are broad in their coverage and are often refined for individual projects. The guide states that it is the EPA's responsibility to determine the environmental factors and objectives it considers to be relevant to any proposed assessment. The EPA and proponents generally agree on the factors and objectives through the consultation process.

The environmental factors and objectives considered to be relevant to the proposed Cundaline and Callawa mining operations are included in relevant sub-sections of this EPS (i.e. Sections 5 to 7). The EPA's Guidance Statements have also been used during the preparation of this document. These have included:

- Guidance Statement No. 6, *Rehabilitation of Terrestrial Ecosystems* (EPA, 2006);
- Guidance Statement No. 8, *Environmental Noise* (EPA, 2007a);
- Guidance Statement No. 12, *Guidance Statement for Minimising Greenhouse Gas Emissions* (EPA, 2002);
- Guidance Statement No. 17, *Guidance Statement for Remediation Hierarchy for Contaminated Land* (EPA, 2000);
- Guidance Statement No. 41, *Assessment of Aboriginal Heritage* (EPA, 2004c);
- Guidance Statement No. 51, *Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia* (EPA, 2004d);
- Guidance Statement No. 54, *Consideration of Subterranean Fauna in Groundwater and Caves During an Environmental Impact Assessment in Western Australia* (EPA, 2003);
- Guidance Statement No. 54a, *Sampling Methods and Survey Considerations for Subterranean Fauna in Western Australia* (EPA, 2007b); and
- Guidance Statement No. 56, *Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia* (EPA, 2004e).

The EPA Guidance Statements relevant to the proposal are referred to in this EPS where appropriate.

1.4 STRUCTURE OF THIS ENVIRONMENTAL PROTECTION STATEMENT

The structure of this EPS is as follows.

- Section 1: Describes the location, ownership, tenure, and an overview of the proposal. It also describes the purpose and structure of this EPS, and provides a summary of the consultation that has been undertaken.
- Section 2: Provides an overview of the environmental management and monitoring programme.
- Section 3: Describes the proposed mining operations.
- Section 4: Provides a summary of BHP Billiton's risk based assessment process.
- Section 5: Provides a description of the existing biophysical environmental values of the Cundaline and Callawa areas. Describes the potential impacts of the proposed mining operations and, where applicable, presents BHP Billiton Iron Ore's environmental management actions to minimise, control or ameliorate these impacts.
- Section 6: Provides a description of the potential pollution management issues associated with the proposed mining operations and, where applicable, presents BHP Billiton Iron Ore's environmental management actions to minimise, control or ameliorate these impacts.

- Section 7: Provides a description of the existing social environment at the proposed mining operations. Describes the potential impacts of the proposed mining operations and, where applicable, presents BHP Billiton Iron Ore's environmental management actions to minimise, control or ameliorate these impacts.
- Section 8: Provides an overview of the rehabilitation and mine closure objectives for the proposed mining operations.
- Section 9: Provides a summary of BHP Billiton Iron Ore's environmental management actions for the proposed mining operations.
- Section 10: Provides a list of documents referred to in this EPS.

BHP Billiton Iron Ore has revised the existing Goldsworthy environmental management plans to describe the environmental management practises that would be implemented at the proposed Cundaline and Callawa mining operations. Appendices A to L contain the revised environmental management plans and a number of independent specialist reports:

Appendix A	Environmental Management Plan
Appendix B	Decommissioning and Rehabilitation Plan.
Appendix C	Significant Species Management Plan.
Appendix D	Weed Management Plan.
Appendix E	Visual Assessment.
Appendix F	Surface Water Assessment.
Appendix G	Groundwater Assessment.
Appendix H	Flora and Vegetation Assessment.
Appendix I	Targeted Fauna Assessment.
Appendix J	Stygofauna Assessment.
Appendix K	Troglofauna Assessment.
Appendix L	Air Quality, Noise and Blasting Assessment.

1.5 CONSULTATION

1.5.1 Consultation Objectives

BHP Billiton Iron Ore's Sustainable Development Policy states that wherever the Company operates it will:

> *engage regularly, openly and honestly with people affected by our operations, and take their views and concerns into account in our decision making.*

During the preparation of this EPS, BHP Billiton Iron Ore is conducting a consultation programme with government agencies (both state and local), NGOs, and land users that have expressed interest in, or are directly impacted by the proposed Cundaline and Callawa mining operations. The main objectives of the consultation programme are to:

- confirm the approval process for the proposed Cundaline and Callawa mining operations with relevant government agencies and local authorities;

- provide information and the opportunity to comment to other groups who may potentially be interested in the proposed Cundaline and Callawa mining operations;
- identify the key issues and concerns of stakeholders in regards to the design and management of the proposed Cundaline and Callawa mining operations;
- discuss objectives for the proposed Cundaline and Callawa mining operations and its ultimate rehabilitation and closure; and
- where possible, allow for adjustments to the design and/or management of the proposed Cundaline and Callawa mining operations to accommodate concerns or issues raised by stakeholders.

1.5.2 Consultation Programme

Drafts of the EPS were distributed to stakeholders and other interested parties for comment in November 2008 (Draft for Stakeholder Review) and May 2009 (Final Draft). Table 1-2 provides a summary of key issues discussed and comments received on the drafts of the EPS during this consultation, as well as cross references to the sections of this EPS or other documentation where additional information is provided.

Stakeholders and other interested parties that provided comments were provided the revised Final Draft EPS to confirm that it has been prepared to their satisfaction.

Table 1-2
Key Issues Raised During Stakeholder Consultation

Issue	Summary of Issue Resolution	Further Discussion in Section
WA Wildflower Society and WA Conservation Council – 11 December 2008		
Backfilling	The Wildflower Society of WA inquired into the potential to backfill the Yarrie pit with overburden from Callawa. BHP Billiton Iron Ore explained that hauling overburden material to from Callawa to the Yarrie pit is not economically feasible.	N/A
Greenhouse Gas	The Conservation Council of WA asked how much greenhouse gas would be produced during mining of the Cundaline and Callawa operations. BHP Billiton Iron Ore explained that greenhouse gas emissions are provided in the EPS.	6.3.2
Environmental Protection Authority – 5 December 2008 and 23 June 2009		
Consistency with name	EPA requested consistency of the project name throughout document. BHP Billiton Iron Ore has edited the EPS to provide consistent naming of the project and its components.	EPS
Assessment of Management Plans	EPA stated it would not assess the management plans as adequate management should be included in the EPS. BHP Billiton Iron Ore has included Cundaline and Callawa specific management measures in the EPS and referred to the management plans for general Goldsworthy management measures currently in place.	EPS
Cumulative impacts	EPA raised concern regarding cumulative impacts if the whole of Callawa ridge was mined. In particular in regard to biological and Aboriginal heritage impacts. BHP Billiton Iron Ore is proposing to mine a small section of the north east corner of the Callawa ridge.	3
Troglofauna	EPASU requested further information demonstrating that there is not an unacceptable risk to troglofauna species as a result of the proposal, with particular regard to the Cundaline element of the proposal. BHP Billiton Iron Ore conducted two additional rounds of troglofauna surveys in May and June 2009. BHP Billiton Iron Ore has included the results of the additional surveys and further discussion on the extent of potential troglofauna habitat to demonstrate that there would be minimal risk to SRE species from the mining of Cundaline and Callawa.	
Disposal of Excess Mine Water	EPASU requested clarification of the mine dewatering requirement, and in particular the disposal of excess water to the environment. BHP Billiton Iron Ore is proposing to use all mine dewatered water from the Callawa pits on-site, and as a result is not proposing to release any water to the environment. The EPS has been edited to more clearly reflect this intention.	

Table 1-2 (Continued)
Key Issues Raised During Stakeholder Consultation

Issue	Summary of Issue Resolution	Further Discussion in Section
Department of Environment and Conservation (Perth) – 16 December 2008		
SREs	DEC raised concern regarding the number of mygalomorph spiders collected from Cundaline and Callawa. The DEC suggested that the timing of the autumn survey contained little foraging and recommended that if possible, a further targeted survey be undertaken. BHP Billiton Iron Ore conducted an additional mygalomorph spider survey in May 2009. BHP Billiton Iron Ore has included the results of the additional survey and further discussion on the extent of potential SRE habitat to demonstrate that there would be minimal risk to SRE species from the mining of Cundaline and Callawa.	5.9.1 and 5.9.2
Troglofauna	DEC noted that six morphospecies were collected only from in-pit areas at Cundaline and /or Callawa and requested that the wider survey be undertaken. BHP Billiton Iron Ore conducted two additional rounds of troglofauna surveys in May and June 2009. BHP Billiton Iron Ore has included the results of the additional surveys and further discussion on the extent of potential troglofauna habitat to demonstrate that there would be minimal risk to SRE species from the mining of Cundaline and Callawa.	5.10.2
Stygofauna	DEC requested that the EPS clarify the potential impacts on stygofauna. BHP Billiton Iron Ore conducted two additional rounds of stygofauna surveys in May and June 2009. The EPS has been revised to include the results of the additional surveys and further discussion on potential impacts on stygofauna, including a figure showing the extent of habitat in relation to the proposed disturbance area.	5.10.1, Figure 5-10
Rehabilitation Monitoring	DEC raised concern regarding the use of EFA as a rehabilitation monitoring method in the Pilbara region without also using other methods such as species richness within quadrats and species composition. BHP Billiton Iron Ore uses EFA at several of its sites to track the progression of rehabilitation. BHP Billiton Iron Ore considers that EFA provides useful results for rehabilitation management. BHP Billiton Iron Ore may consider the use of other methods (including species richness and composition), if required, during mine closure to demonstrate that it has achieved the relevant Guiding Closure Principles described in the DRP.	8.2, 8.5.1, Appendix B
Rehabilitation seed source	DEC considers that all seed and other plant material used in rehabilitation of natural areas should be of local provenance, which is seed collected from locations as close geographically in terms of habitat as practicable to the area to be rehabilitated. BHP Billiton Iron Ore will use local provenance native seed (i.e. ideally from the local area, then from the relevant IBRA subregions, but as a minimum from the relevant IBRA regions) consistent with vegetation associations and native species recorded in the Goldsworthy area prior to mining. The DRP has been edited to include BHP Billiton Iron Ore's standard rehabilitation procedures.	8.3, Appendix B

Table 1-2 (Continued)
Key Issues Raised During Stakeholder Consultation

Issue	Summary of Issue Resolution	Further Discussion in Section
Department of Industry and Resources (now Department of Mines and Petroleum [DMP]) – 18 November 2008		
Sterilisation of resource	DoIR requested that BHP Billiton Iron Ore provide a resource sterilisation report due to the commitment made by BHP Billiton Iron Ore to backfill the Callawa pit. BHP Billiton Iron Ore will not be providing a sterilisation report.	N/A
Pit wall failure	DoIR raised concerned regarding potential for pit wall failure on the south side of the Cundaline pit where it abuts the mining lease. BHP Billiton Iron Ore designs its pits to be geotechnically stable during mining and post-mining in accordance with its life-of-mine planning process. Examples of this process include the Nimingarra and Sunrise Hill pits which intersect walls of ridges and have been determined to be geotechnically stable.	3.4
Department of Industry and Resources (now DMP) – 18 November 2008		
OSA closure cross sections	DoIR requested that the EPS include closure plans for the OSAs including cross sections. Cross sections of BHP Billiton Iron Ore's OSA design are provided in the DRP.	Appendix B
Summary of additional approvals required	DoIR requested that Section 4 of the Mining Proposal guidelines is addressed, specifically a description of other approvals that need to be considered (e.g. S18). The Mining Proposal describes other potential approvals that may be required for the mining of the Cundaline and Callawa deposits.	Mining Proposal
Waste rock characterisation	DoIR requested that all issues around waste rock characterisation addressed such as fibrous materials, ARD, dispersal material. No fibrous material has been intersected at the Cundaline and Callawa pits. BHP Billiton Iron Ore has provided additional information in the EPS on waste rock characterisation.	3.6, 5.2 and 5.3
Stand alone Mining Proposal	DoIR requested that the Mining Act proposal is provided as a stand alone document. BHP Billiton Iron Ore has provided the Mining Proposal as a separate document with the EPS for final review.	Mining Proposal

Table 1-2 (Continued)
Key Issues Raised During Stakeholder Consultation

Issue	Summary of Issue Resolution	Further Discussion in Section
Department of Industry and Resources (now DMP) – 21 November 2008		
Mine Dewatering	DoIR requested a sterilisation report due to BHP Billiton Iron Ore's commitment to partially backfill the Callawa pit. BHP Billiton Iron Ore will not be providing a sterilisation report.	N/A
Geochemical Characterisation of overburden	DoIR requested additional information on waste characterisation including consideration of any physically adverse material will be used in the waste dumps, estimated quantities and how it would be managed. Additional information on physical characteristics of material to be placed in OSAs has been provided in the EPS, which is referenced in the Mining Proposal.	3.6, 5.2.2 Mining Proposal
Workforce	DoIR inquired into potential additional environmental impacts in relation to the increased construction/operational personnel numbers and whether the workforce be accommodated within the existing camp facilities. The EPS states that the additional workforce can be accommodated in the existing Yarrie accommodation camp. The EPS has been edited to also clarify that no additional disturbance to accommodate increase in workforce would be required.	3.8
Dewatering	DoIR inquired into the timeframe for the water recovery to near pre mining levels. The EPS and hydrogeological assessment report have been edited to clarify the timeframe for groundwater recovery.	5.6.2, Appendix G
Department of Industry and Resources (now DMP) – 21 November 2008		
Mine and railway weed management	DoIR requested clarification on the link between weed management for the railway side of operations and mining side. Weed management measures for the railway line are described in the Weed Management Plan (WMP). The weed management measures described in the WMP are applicable to the railway line within or in the vicinity of the Goldsworthy mining leases. The WMP has been edited include Proponent Commitment 7-16 in Ministerial Statement of Approval No. 303 in relation to weeds.	5.7.2, Appendix D
Northern Quoll	DoIR noted that the Northern Quoll has been recorded recently at Spinifex Ridge near Coppin Gap (Moly Mines) and Wodgina (Talison Minerals). BHP Billiton Iron Ore has noted this comment.	N/A
Pilbara Leaf Nosed Bat	DoIR inquired into the implications (if any) of a possible emerging pattern of population connection between Goldsworthy and Bamboo Creek populations of the Pilbara Leaf nosed Bat. It noted that the bats were also recorded as part of Moly Mines (Outback Ecology) studies for the Spinifex Ridge project about 15 km from Bamboo Creek. BHP Billiton Iron Ore considers that this is beyond the scope of study for this EPS.	N/A

Table 1-2 (Continued)
Key Issues Raised During Stakeholder Consultation

Issue	Summary of Issue Resolution	Further Discussion in Section
Department of Industry and Resources (now DMP) – 21 November 2008 (Cont.)		
Priority Fauna Species	DoIR requested confirmation on the Priority status of the Long Tailed Dunnart. The species is listed as P3 in the most recent DEC Priority List (5 August 2008).	N/A
Terrestrial Molluscs	DoIR requested clarification on whether the snail species recorded were considered to represent SRE species. BHP Billiton Iron Ore has edited the EPS to clarify that the snails were not considered to be SRE species.	5.9.1
SREs	DoIR requested that Section 3.8.2 should clarify the statement "should SRE occur they are considered unlikely to be restricted to the proposed disturbance areas." The EPS has been edited to clarify the statement.	5.9.2
Stability	DolR noted that the *Mining in Arid Environments* Guideline (DoIR, 2006) referenced in Section 6.1 is not current and has been withdrawn. The EPS has been edited to remove reference to the guideline.	8.1
AER	DoIR noted that an AER may also be a requirement under the Mining Act. The EPS has been edited to refer to conditions under the *Mining Act, 1978*.	2.2.7
Department of Industry and Resources (now DMP) – 21 November 2008		
EMP – Topsoil	DoIR requested that the table on page 1-3 be modified to say "topsoil to a depth of 15 cm *or more* …" as it is considered possible that more topsoil can be recovered in valley floor areas. DoIR noted that as much topsoil should be recovered as possible within the constraints of the machine operator (how safe is it), how much material is present and the effort/time/fuel used to recover the material. The wording in the table cannot be changed as it is a condition in the Ministerial Statement. Soil management measures, including soil and other identified suitable growth medium material, are provided in the EPS.	5.3.2
DRP – Acid Rock Drainage	DoIR suggested that BHP Billiton Iron Ore consider biological factors and natural physical factors (tree roots, termites, shrinking and expansion of clays in cover systems) when designing encapsulation covers to manage PAF material in OSAs. BHP Billiton Iron Ore has noted this comment.	N/A
DRP- Surface Drainage on OSAs	DoIR commented that BHP Billiton Iron Ore's proposed OSA design (i.e. separate 'top' and 'face' with drainage restricted on the top surface) works well when competent non dispersive material is used and the surface water drainage is directed to the centre of the dump. BHP Billiton Iron Ore has noted this comment and it will consider in its OSA design.	N/A

Table 1-2 (Continued)
Key Issues Raised During Stakeholder Consultation

Issue	Summary of Issue Resolution	Further Discussion in Section
Department of Industry and Resources (now DMP) – 21 November 2008 (Cont.)		
Visual - viewpoint	DoIR noted that the visual impact assessment report (Appendix E) does not take into account the impact of the proposal from a viewpoint located on top of the ridge near Shay Gap mentioned in page 39 of a guide published in 2008 by Westate publishers called "Explore the Pilbara in your 4WD". The viewpoint referred to in the comment is situated within the Goldsworthy mining leases and public access is restricted to authorised personnel.	N/A
Visual – OSA colour	DoIR considered that the visual impact assessment should assess the visual impact of OSAs and should also take into consideration the colour of the waste material used as some contrasting colours (black/white or red White) stand out from a long way. The material transferred to OSAs varies in colour due to the geology of the waste rock material. BHP Billiton Iron Ore considers this to be temporary and would be rehabilitated using subsoil and topsoil material with more consistency in colour.	N/A
Department of Water (Perth) – 3 December 2008		
Groundwater cross section	DoW requested a cross section of the mesa at Callawa showing groundwater and the proximity of the project to the De Grey River. A conceptual cross section of the Callawa ridge is provided in the hydrogeological impact assessment report. The EPS describes, the De Grey River as located some 10 km and 5 km to the south of the proposed Cundaline and Callawa mining operations, respectively.	Appendix G
Department of Water (Karratha) – 9 December 2008		
Dewatering	DoW believes that dewatering can be managed by Water Resource Licensing and associated instruments. BHP Billiton Iron Ore has noted this comment.	N/A
Water Supply	DoW noted that the EPS identifies that there will be no change to the groundwater licence volume for the Shay Gap Borefield and to date this borefield has not shown any impacts over 20 years of abstraction. BHP Billiton Iron Ore has noted this comment.	N/A
Surface water impacts	DoW believes that surface water impacts can be managed through Water Resource Licensing. BHP Billiton Iron Ore has noted this comment.	N/A

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2 EXISTING OPERATIONS AND ENVIRONMENTAL MANAGEMENT AND MONITORING PROGRAMME

2.1 EXISTING OPERATIONS

Current activities at the existing Goldsworthy mining operations include:

- mining and overburden placement at the Cattle Gorge hard rock mining area;
- mining and overburden placement at the Nimingarra mining areas;
- mining and overburden placement at Sunrise Hill and Sunrise Hill West;
- mining and overburden placement at Yarrie (Y4A, Y7 west Y10 north, and crustal ore areas); and
- use of Nimingarra and Yarrie rail loading facilities and support infrastructure (i.e. workshops, administration areas, laydown areas, accommodation village, aerodrome, power and water supplies).

Several environmental management conditions and commitments pertaining to these operations are contained in Ministerial Statement of Approval No. 303 and 682 as well as the Goldsworthy Operations NOI. As a result of these approvals, BHP Billiton Iron Ore has developed and implemented an environmental management and monitoring programme, which is described in Section 2.2 below.

2.2 EXISTING ENVIRONMENTAL MANAGEMENT AND MONITORING PROGRAMME

2.2.1 Environmental Management Overview

BHP Billiton Iron Ore has developed and implemented an Environmental Management System (EMS) for its operations that is certified to AS/NZS ISO 14001. The EMS describes the organisational structure, responsibilities, practices, processes and resources for implementing and maintaining environmental objectives at all BHP Billiton Iron Ore sites (including the existing Goldsworthy Operations).

BHP Billiton has also developed a Sustainable Development Policy (Figure 2-1) for its operations. The Sustainable Development Policy is a guiding resource for maintaining an emphasis on Health, Safety, Environment and Community (HSEC) and clarifying a broader commitment to aspects of sustainability including biodiversity, human rights, ethical business practices and economic contributions at all BHP Billiton sites. To interpret and support the Sustainable Development Policy, BHP Billiton has developed a series of HSEC Management Standards. These Management Standards form the basis for the development and application of Sustainable Development management systems at all levels of BHP Billiton operations.

Risk management is recognised as being integral to managing environmental impacts at BHP Billiton Iron Ore operations. BHP Billiton Iron Ore's risk assessment and management system is iterative and consists of a series of steps, which when undertaken in a sequence, enable risk identification, evaluation, and management, as well as allowing continuous improvement in decision making.

In line with its Sustainable Development Policy and charter, BHP Billiton Iron Ore has developed environmental management programmes that apply to all its operations. These manuals provide background on the management of environmental issues across the BHP Billiton Iron Ore operations and detail roles, responsibilities and management procedures.

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SUSTAINABLE DEVELOPMENT POLICY

We aspire to Zero Harm to people, our host communities and the environment and strive to achieve leading industry practice. Sound principles to govern safety, business conduct, social, environmental and economic activities are integral to the way we do business.

Wherever we operate we will develop, implement and maintain management systems for sustainable development that drive continual improvement and ensure we:

- do not compromise our safety values, and seek ways to promote and improve the health of our workforce and the community;
- identify, assess and manage risks to employees, contractors, the environment and our host communities;
- uphold ethical business practices and meet or, where less stringent than our standards, exceed applicable legal and other requirements;
- respect, uphold and promote fundamental human rights within our sphere of influence, respecting the traditional rights of Indigenous peoples and valuing cultural heritage;
- encourage a diverse workforce and provide a work environment in which everyone is treated fairly, with respect and can realise their full potential;
- take action within our own businesses and work with governments, industry and other stakeholders to address the challenge of climate change;
- set and achieve targets, including energy efficiency and greenhouse gas intensity, that promote efficient use of resources and include reducing and preventing pollution;
- enhance biodiversity protection by assessing and considering ecological values and land-use aspects in investment, operational and closure activities;
- engage regularly, openly and honestly with our host governments and people affected by our operations, and take their views and concerns into account in our decision-making;
- develop partnerships that foster the sustainable development of our host communities, enhance economic benefits from our operations and contribute to poverty alleviation;
- work with those involved through the lifecycles of our products and by-products to enhance environmental and social performance along the supply chain and promote their responsible use and management;
- regularly review our performance and publicly report our progress.

In implementing this Policy, we will engage with and support our employees, contractors, suppliers, customers, business partners and host communities in sharing responsibility for meeting our requirements.

We will be successful when we achieve our targets towards Zero Harm, are valued by our host communities, and provide lasting social, environmental and economic benefits to society.

CUNDALINE AND CALLAWA MINING OPERATIONS EPS

FIGURE 2-1
BHP Billiton's Sustainable Development Policy

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BHP Billiton Iron Ore implements Pilbara-wide environmental management programmes for 'land' and 'waste', which describe generic objectives and strategies to manage environmental aspects at its operations. In addition to the Pilbara-wide management programmes, BHP Billiton Iron Ore prepares and regularly revises technical environmental manuals for its Pilbara mining operations which cover specific environmental issues.

BHP Billiton Iron Ore has developed and implemented site-specific environmental management plans for each of its operations in order to document how aspects of particular relevance to each operation would be managed. For most of BHP Billiton Iron Ore's mines, the primary site-specific environmental management document is the EMP. The EMP provides auditable management procedures and performance indicators for each operation. The EMP also includes references to environmental management programmes (e.g. land and waste, and on-site procedures). These are operating documents that reflect month to month targets, issues and goals and they are updated as necessary to reflect changing operational requirements.

Further details of BHP Billiton Iron Ore's environmental management standards, Environmental Management Programme and environmental management plans are provided in Sections 2.2.2 to 2.2.4.

2.2.2 Environmental Management Standards

Environmental Management System

BHP Billiton Iron Ore has developed and implemented an EMS for its operations that is certified to AS/NZS ISO 14001. The EMS describes the organisational structure, responsibilities, practices, processes and resources for implementing and maintaining environmental objectives at all BHP Billiton Iron Ore sites (including the existing Goldsworthy Operations).

The principal components of the EMS include:

- environmental policy;
- planning;
- implementation and operation;
- monitoring and corrective action; and
- management review.

The relationship between the components of the EMS and the proposed Cundaline and Callawa mining operations is described in the EMP (Appendix A).

Risk Assessment and Management System

Risk management is recognised as an integral part of management practices and is integral to managing environmental impacts at BHP Billiton Iron Ore operations. BHP Billiton Iron Ore has developed a risk assessment and management system to be implemented at all operations. The process is iterative and consists of steps, which when undertaken in a sequence, enable continuous improvement in decision making. The main elements of the risk assessment and management process are as follows:

- establish the context;
- identify risks;
- analyse risks;
- evaluate risks;
- control risks;
- monitor and review; and
- communicate and consult.

BHP Billiton Iron Ore's risk assessment and management system would continue to be implemented during the life of the proposed Cundaline and Callawa mining operations. The EMP (Appendix A) describes the risk assessment and management system.

BHP Billiton Iron Ore's risk assessment and management system would continue to be implemented during the life of the proposed Cundaline and Callawa mining operations. The EMP (Appendix A) describes the risk assessment and management system.

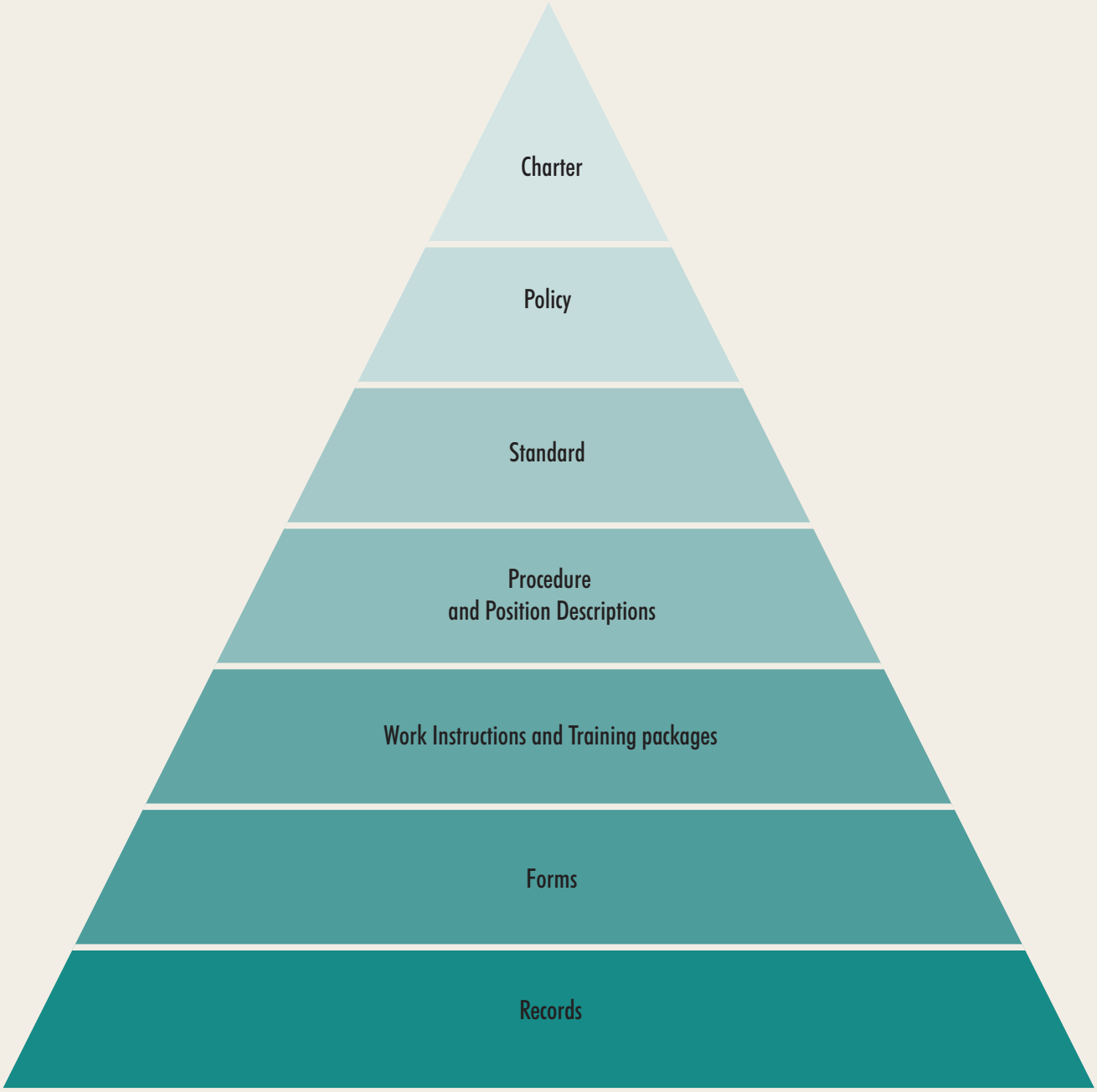
2.2.3 Environmental Management Programme

BHP Billiton Iron Ore Environmental Management Programmes

BHP Billiton Iron Ore manages environmental issues at its mining operations within the BHP Billiton Sustainable Development framework (described in Section 3.2 of the EMP – Appendix A). The Sustainable Development Policy outlines a commitment to sustainable development and to continual improvement in performance, efficient use of natural resources and aspires to zero harm to people and the environment.

The principles of the Sustainable Development framework are implemented across all BHP Billiton Iron Ore operations through the use of the BHP Billiton HSEC Management Standards. The hierarchical structure of BHP Billiton management documents is illustrated in Figure 2-2 and discussed further in the EMP (Appendix A).

BHP Billiton Iron Ore implements Pilbara-wide environmental management programmes for 'land' and 'waste', which describe generic objectives and strategies to manage environmental aspects at its operations. BHP Billiton Iron Ore's operation-based management documents are developed and implemented within the broader BHP Billiton standards and procedures (Figure 2-2). The Land Management Programme and Waste Management Programme are described below.



CUNDALINE AND CALLAWA MINING OPERATIONS EPS

FIGURE 2-2
Health, Safety, Environment and Community Management System Manual - Document Hierarchy

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Land Management Programme

The BHP Billiton Iron Ore Mining Operations Land Management Programme (MOLMP) focuses on the management of land clearing, rehabilitation and mine closure. The objectives of the MOLMP are to:

- ensure all land clearing is proposed, including compliance with the Project Environmental and Aboriginal Heritage Review (PEAHR) Procedure (Section 3.3) described below;
- ensure mine closure plans are developed and finances accounted for;
- ensure rehabilitation is progressive when land becomes available;
- establish and communicate the management structure, including defined roles and responsibilities, in relation to land management;
- establish a framework of continuous improvement in land management; and
- establish key performance indicators and monitoring schedules to measure against targets.

The objectives of the MOLMP are implemented through two components: the Land Management Manual and a site-specific management plan.

The BHP Billiton Iron Ore Land Management Manual outlines the management of clearing and rehabilitation across all of BHP Billiton Iron Ore's mining operations. The manual describes roles and responsibilities, management procedures and performance indicators.

The site-specific management plan is an operational document developed for the particular mine site and is either a stand-alone plan or the EMP (Appendix A).

Waste Management Programme

As part of BHP Billiton Iron Ore waste management commitments, a Mining Operations Waste Management Programme (MOWMP) has been developed. The objectives of the MOWMP are:

- to observe the waste management hierarchy of elimination, reduction, reuse, recycling, treatment and disposal;
- to manage all waste generated in such a manner that minimises any detrimental effects it may have to the environment; and
- to ensure that BHP Billiton Iron Ore mining operations comply with all applicable licence conditions and commitments, at all times.

The objectives of the MOWMP are implemented through two components: the Waste Management Manual and a site-specific management plan.

The Waste Management Manual outlines objectives and strategies for the management of wastes at all BHP Billiton Iron Ore mining operations.

The site-specific management plan is an operational document developed for the particular mine site and is either a stand-alone plan or the EMP (Appendix A).

Environmental Manuals

In addition to the Pilbara-wide management programmes, BHP Billiton Iron Ore prepares and regularly revises technical environmental manuals for its Pilbara mining operations which cover specific environmental issues. The manuals provide environmental personnel and others with easily accessible information regarding the management of specific environmental issues. These manuals are generally applicable to all of BHP Billiton Iron Ore's Pilbara operations and are intended to be used as guiding documents only.

BHP Billiton Iron Ore environmental manuals that would be used at the proposed Cundaline and Callawa mining operations are described in the EMP (Appendix A).

2.2.4 Goldsworthy Operations Environmental Management Plans

Ministerial Statement of Approval No.000682 requires the preparation and implementation of an Environmental Management Plan (EMP), a Decommissioning and Rehabilitation Plan (DRP), a Significant Species Management Plan (SSMP), and a WMP. The Goldsworthy Operations management plans were prepared to the requirements of the Minister for the Environment during 2006 and 2007.

Ministerial Statement of Approval No. 000682 requires that the Goldsworthy Operations management plans be reviewed and revised at intervals of no more than five years, or when significant changes occur at the Goldsworthy Operations. The proposed mining of the Cundaline and Callawa deposits is considered to represent a significant change to the Goldsworthy Operations. In accordance with the Ministerial Statement of Approval No. 000682, BHP Billiton Iron Ore has reviewed and revised the existing Goldsworthy Operations EMP, DRP, SSMP and WMP to incorporate the proposed Cundaline and Callawa mining operations. The revised plans are attached to this document in Appendices A, B, C and D. The principles and management measures from the Pilbara-wide management programmes and environmental manuals have been incorporated into the management plans where appropriate.

BHP Billiton Iron Ore would periodically update the Goldsworthy Operations management plans at least every five years during the life of the Goldsworthy Operations. The content of the management plans is summarised below.

Environmental Management Plan

The EMP is a broad document that describes the overall programme to be used to manage potential impacts of the mining operations on environmental values relevant to the site and contains the following:

- A description of the key characteristics of the Goldsworthy operations (i.e. mining method, overburden management, ore processing, ore loading and transportation, water and power supply and service infrastructure).
- A description of the Environmental Management System, and the Environmental Risk Assessment and management systems which will be used at the Goldsworthy operations. It includes a description of how best practicable environmental measures have been applied to risks which are identified (through Risk Assessment Process) as requiring this level of management to reduce residual risk to an acceptable level.

- A description of the environmental management procedures and practices to be used to minimise impacts on key environmental aspects. These aspects include: soil resources, landforms, surface water, groundwater, flora (including priority species and species of interest), fauna (including priority species and species of interest), air quality, noise, waste, dangerous goods and hazardous materials and Aboriginal heritage.
- For each environmental aspect, the EMP describes the overall management objective, potential impacts, management measures and monitoring programme to track performance.

Decommissioning and Rehabilitation Plan

The DRP has been prepared to guide the rehabilitation and decommissioning works of the Goldsworthy Operations and contains the following:

- A description of the key components of the Goldsworthy operations (i.e. mining method, mine dewatering, overburden management, ore processing, ore loading and transportation, water and power supply and service infrastructure).
- A description of how the Goldsworthy operations will be decommissioned and disturbance areas rehabilitated to fulfil the following guiding closure principles:
  - *There will be no significant, physical off-site impacts.*
  - *No significant impact on surface water quality and flow regimes in Eel Creek and Egg Creek.*
  - *The established vegetative cover will be self-sustaining and show progression towards the surrounding undisturbed vegetation in terms of species diversity and plant density.*
  - *The post-mining landform will be designed to be safe, stable and non-polluting.*
  - *There will be no unsafe areas where members of the general public could inadvertently gain access. Access to potentially unsafe areas will be impeded by safety bunds built to comply with the applicable DMP guidelines.*
  - *The number and size of out of pit overburden storage areas in new mining areas will be minimised.*
  - *Residual pit voids will be left as mined where geotechnically stable, and profiled as necessary to achieve long-term closure objectives.*
  - *Final overburden storage areas will be sympathetic with regional landforms.*
  - *A long-term systems based monitoring approach will be used to track the trajectory of rehabilitated areas towards self-sustaining status.*
  - *The end land use for the area will be determined in consultation with stakeholders, and agreed with the administering authority ongoing during the life of the mine.*

Significant Species Management Plan

The SSMP has been prepared to assist BHP Billiton Iron Ore and its contractors in the implementation of appropriate flora and fauna management measures, on-going monitoring programmes, and reporting procedures for significant flora and fauna species during mining operations.

The SSMP describes the significant identified species of flora and fauna, and significant vegetation associations and habitat areas, and sets out procedures to:

- demarcate identified populations and/or individuals of conservation-significant identified flora and fauna, vegetation associations and habitat areas;
- modify land clearing plans and evaluate alternative mine plans, to mitigate or avoid impacts on the conservation-significant, identified species of flora and fauna, vegetation associations and habitat areas;
- mitigate impacts where proposed mining activities are likely to impact on conservation-significant, identified species of flora and fauna, vegetation associations and habitat areas;
- monitor and record impacts on conservation-significant, identified species of flora and fauna, vegetation associations and habitat areas; and
- implement appropriate contingency measures where impacts on conservation-significant, identified species of flora and fauna, vegetation associations and habitat areas are identified.

Weed Management Plan

The WMP describes general and species-specific measures to monitor, control and prevent the spread of weed species, and contains the following:

- description of the location and area affected for each weed species which occurs in the Goldsworthy operations area; and
- additional weed species which have the potential to occur in the Goldsworthy operations area.

It also sets out procedures to:

- monitor weed species;
- control or eradicate weed species;
- prevent the spread of weed species; and
- prevent the introduction of any additional weed species.

2.2.5 Environmental Monitoring

Environmental monitoring programmes that would be used during the life of the Goldsworthy Operations are documented in the EMP (Appendix A). A summary of environmental monitoring data would be presented annually in the AER and would continue during the life of the Goldsworthy Operations.

2.2.6 Environmental Research Programme

Environmental research programmes and/or trials would be commissioned in instances where baseline environmental surveys and/or on-going monitoring indicate the need for additional studies on specific topics. Where additional research activities are required, the objectives, scope of work, schedule and available results would be summarised in the AER.

2.2.7 Environmental Reporting and Review

Annual Environmental Report

An AER is prepared annually by BHP Billiton Iron Ore for all of its Pilbara mining operations, including the Goldsworthy Operations. Future AERs would include a component that describes activities at the proposed Cundaline and Callawa mining operations. The objectives of the AER are to:

- Address all legislative requirements and commitments applicable to the mining operations (i.e. conditions of the Ministerial Statement of Approval and the DEC operating licence conditions).
- Document the major mining activities for the reporting period and the proposed activities for the upcoming year.
- Record environmental management and rehabilitation activities for the reporting year and proposed activities and developments for the upcoming year.
- Provide a mechanism for BHP Billiton Iron Ore to monitor the environmental performance of the mining operations.
- Provide information to stakeholders about the mining operations and environmental performance of the mining operations.

The AER would be prepared in accordance with the relevant EPA, DEC and DMP guidelines and/or requirements for the preparation of an AER under conditions granted by the *Mining Act, 1978*. Where appropriate, environmental monitoring data would be summarised and/or submitted in full as an appendix to the AER. The AER would be available to non-government stakeholders through the DEC or via the public library at Newman.

BHP Billiton Iron Ore Corporate Sustainable Development Reporting

As part of BHP Billiton Iron Ore's Corporate reporting programme, all BHP Billiton Iron Ore operations (including the Goldsworthy Operations) complete Sustainable Development questionnaires every six months. These questionnaires require each site to report on matters such as environmental management measures, initiatives and events. Annually, BHP Billiton Iron Ore releases a whole-of-enterprise Sustainable Development Report based on the six monthly data provided by each site.

Internal Environmental Event Reporting and Management

BHP Billiton Iron Ore's system for environmental event reporting mechanisms include:

- all employees and contractors are required to report environmental occurrences and hazards via their supervisor for notification and follow-up investigation and assessment;
- non-compliance or emergency events are reported to regulatory authorities as per the requirements of relevant licences and approvals; and
- significant events are reported to BHP Billiton Iron Ore at a corporate level where appropriate.

BHP Billiton Iron Ore uses the First Priority enterprise (FPe) reporting system, which is designed to manage the reporting, investigation, response and sign-off of environmental incidents by appropriate management personnel.

Employees and contractors would continue to be trained in event reporting procedures through the induction programme, and would be encouraged to report all environmental events to the relevant manager(s). The AER would present a summary of all environmental events recorded by the event reporting system.

Notification of Emergencies and Events

As soon as practicable after becoming aware of an emergency or event resulting in a release of contaminants or other potentially harmful effect on the environment (not in accordance with environmental approvals) BHP Billiton Iron Ore would notify the DEC of the event. The notification would include, but not be limited to, the following information:

- the name, position and company of the person reporting the event;
- location of the event or emergency;
- the name and telephone number of the designated company contact person;
- a best estimate of the time the event occurred;
- the time the company or individual became aware of the event;
- the suspected cause of the event;
- relevant conditions at the time of the exceedance (e.g. weather, operational conditions);
- potential contributing factors (including non-mine related factors);
- environmental harm and/or nuisance caused, threatened or thought likely to occur as a result of the event; and
- action to be undertaken to minimise environmental harm and/or nuisance caused by the event.

Within the statutory timeframe, BHP Billiton Iron Ore would provide written advice of the information listed above and in addition:

- proposed actions to prevent recurrence of the event or emergency;
- outcomes of actions taken to minimise environmental harm or nuisance; and
- results of any subsequent environmental monitoring undertaken to ascertain the impacts of the event.

3 PROJECT DESCRIPTION

3.1 PROPOSED PRODUCTION

Approximately 5.6 million tonnes (Mt) of ore would be mined from the Cundaline iron ore deposit and approximately 4 Mt of ore would be mined from Callawa. The disturbance areas and dimensions of pits, OSAs and stockpile areas in this EPS are based on these estimates.

A description of the geology and mineralisation is provided in Section 5.2.

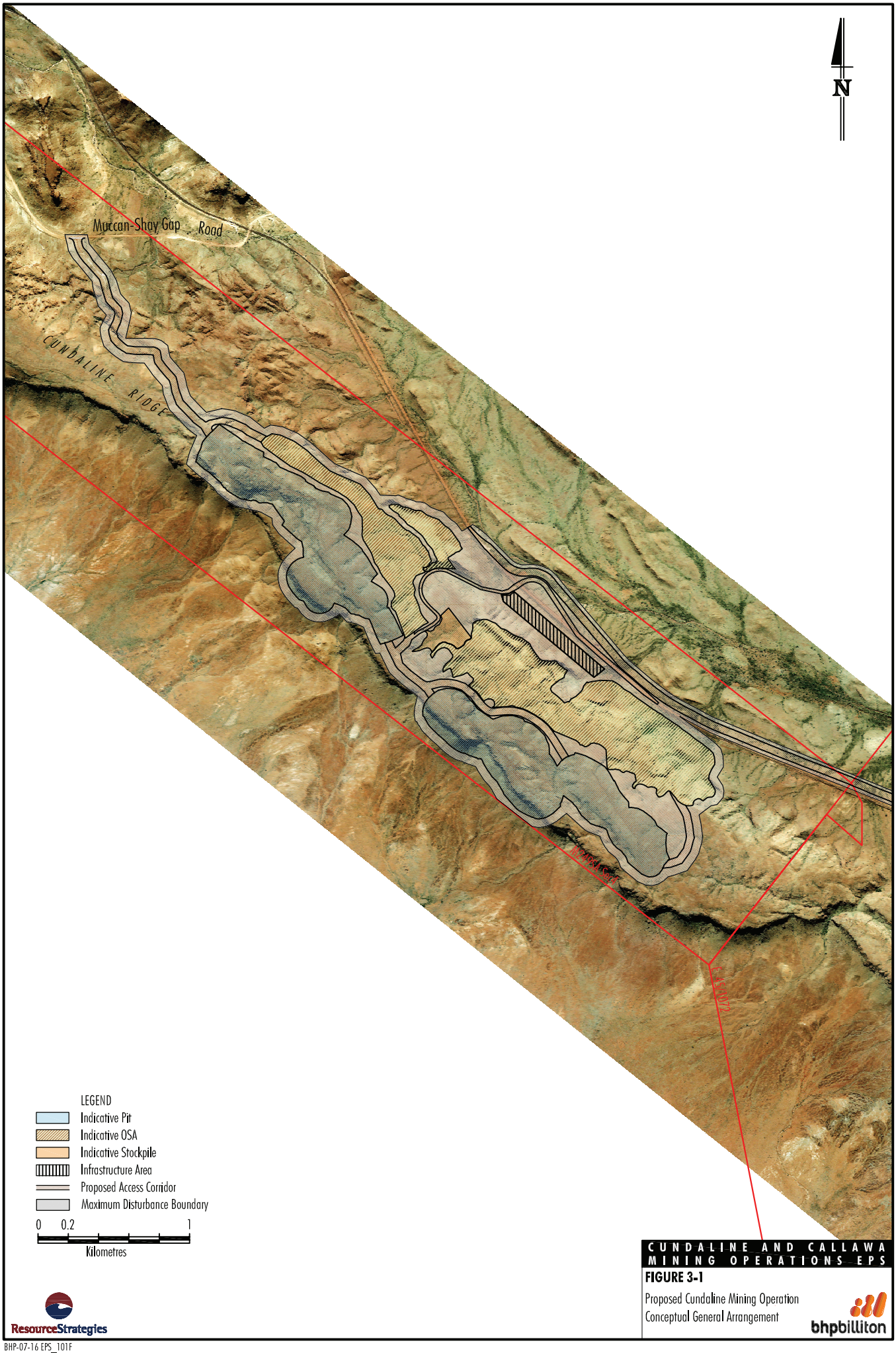
3.2 PROJECT OVERVIEW AND KEY CHARACTERISTICS

Cundaline and Callawa would be mined to provide crushed ore feed for the existing Goldsworthy operations. The proposed operations would use the existing Goldsworthy infrastructure and facilities as far as practicable.

Figures 3-1 and 3-2 show the proposed disturbance areas and general arrangements of the proposed Cundaline and Callawa mining operations, respectively. Major components of mining infrastructure and activities would include:

- pre-stripping, open pit mining above the watertable and stockpiling of overburden and ore at the Cundaline pits;
- pre-stripping of open pit mining above and below the watertable and stockpiling of overburden and ore at the Callawa pits;
- placement of overburden in mined-out voids and out-of-pit OSAs adjacent to the Cundaline and Callawa pits;
- trucking of the Callawa ore to the Yarrie crushing, screening and rail loading facilities, which are located approximately 2 km to the north;
- trucking of the Cundaline ore to the Yarrie crushing, screening and rail loading facilities, which are located approximately 12 km to the south-east, or use of a mobile crushing and screening plant to be located within the Cundaline area;
- stockpiling, crushing, screening and load-up of iron ore at the Yarrie processing facilities and/or the mobile Cundaline facilities;
- continued groundwater abstraction from the Shay Gap Wellfield to meet operational demands, and distribution through the existing water supply system and pipeline extensions to the Cundaline and Callawa areas; and
- construction and use of day rooms (e.g. crib room and toilets), workshop facilities and storage areas at the Cundaline and Callawa areas.

BHP Billiton Iron Ore plans to use the same open pit mining techniques and ore processing methods currently used at Goldsworthy. These aspects are described in Sections 3.3 to 3.8. Table 3-1 provides the key characteristics of the proposed Cundaline and Callawa mining operations.



CUNDALINE AND CALLAWA MINING OPERATIONS EPS

FIGURE 3-1

Proposed Cundaline Mining Operation
Conceptual General Arrangement

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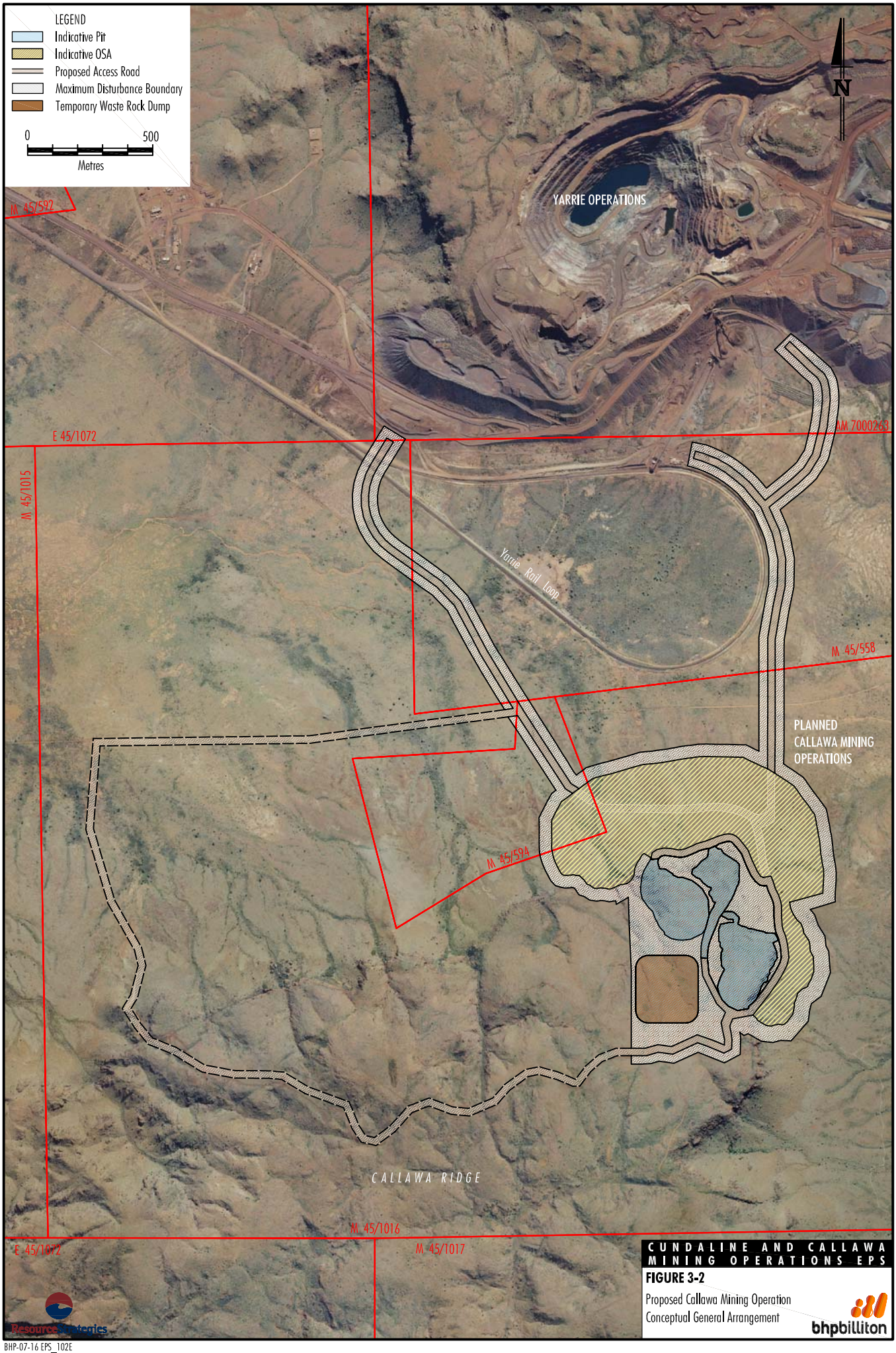


CUNDALINE AND CALLAWA MINING OPERATIONS EPS

FIGURE 3-2

Proposed Callawa Mining Operation
Conceptual General Arrangement

BHP-07-16 EPS_102E

Table 3-1
Key Characteristics of the Proposed Cundaline and Callawa Mining Operations

Aspect	Description
Proponent	BHP Billiton Iron Ore Pty Ltd, 225 St Georges Terrace, PERTH, WA 6000.
Mine Life	Up to 2016.
Planned Production*	5.6 Mt of ore from Cundaline (above the watertable) and 4 Mt of ore from Callawa (above and below the watertable).
Ore Processing Rate	Up to 5 million tonnes per annum (Mtpa).
Total Overburden	Approximately 14.5 Mt (Cundaline) and 15.5 Mt (Callawa).
Land Disturbance Area	Approximately 500 hectares (ha).
Area of Pits	Approximately 125 ha (Cundaline) and 16 ha (Callawa).
Ore Crushing and Screening	Crushing and screening of the Callawa ore would be undertaken at the Yarrie processing facilities. Crushing and screening of the Cundaline ore would either be undertaken at the Yarrie processing facilities, or at a mobile crushing and screening plant to be located at the Cundaline deposit.
Overburden Storage	Placement in out-of-pit OSAs to the north of the Cundaline pits and to the east of the Callawa pits. In-pit placement of overburden at Callawa to a minimum of 5 metres (m) above the pre-mining watertable.
Water Supply Source	Continued groundwater abstraction from the Shay Gap Wellfield to meet operational demands.
Water Supply Network	Distribution through the existing water supply system and pipeline extensions.
Water Demand	Up to 1.5 megalitres (ML) of water per day.
Power Supply Source	Port Hedland gas-fired power station or on-site diesel-fuelled generators.
Power Supply Network	Electricity requirements would be provided by either extending the existing 22 kilovolt (kV) electricity line which runs between Cattle Gorge and the Yarrie processing facilities, or by on-site diesel-fuelled generators.
Power Demand	Approximately 7,500 megawatt hours (MWh) per annum.
On-site Ore Transport	Ore would either be transported from the Cundaline and Callawa areas to the Yarrie processing facilities via trucks, then railed from the Yarrie processing facilities to Port Hedland via the existing rail line, or directly loaded onto trains from Cundaline.
Off-site Transport of Ore	Use of existing rail facilities, with approximately one train per day (on average). Each train would consist of approximately 90 wagons, each carrying up to 75 tonnes (t), and a total train capacity of approximately 6,750 t.
Mine-related Infrastructure	The Cundaline and Callawa mining operations would use existing administration facilities, main workshops, waste facilities and storage areas (i.e. explosives, fuel, oil and ore stockpiles). Personnel would use the accommodation camp and aerodrome also at the Yarrie operations. The infrastructure at the Callawa area would consist of an office, toilet facilities, crib room and a Turkey's Nest Dam. The infrastructure at the Cundaline area would include an office, toilet facilities, crib room, fuel storage, refueling facilities and a turkey's nest dam.
Employment	Approximately 140 to 150 operational personnel. An additional construction workforce of approximately 41 would be required in the initial year of operations.

* The Planned Production information should be read together with and subject to the notes set out in the BHP Billiton Limited Group Combined Financial Statements 2008. This document can be viewed at http://bhpbilliton.com. Resource is inclusive of reserve.

3.3 MAXIMUM DISTURBANCE BOUNDARY AND LIFE OF MINE PLANNING

In the past three to four years, BHP Billiton Iron Ore has sought and obtained new Ministerial approvals and/or modifications to existing approvals for several of its Pilbara mining operations (e.g. Goldsworthy, Wheelarra Hill, Yandi, Orebody 25 and Orebody 18). A key component of these expanded operations has been the adoption of a life-of-mine (LOM) planning approach. This approach has been formalised by the new Ministerial Statements and attendant environmental management plans for each of the mines. The LOM planning approach has been developed and implemented to allow a degree of flexibility in the final positioning of mine landforms such as OSAs, as long as they are constructed within the area defined by the nominated 'Maximum Disturbance Boundary', and they are rehabilitated in a manner that satisfies agreed 'Guiding Closure Principles'. BHP Billiton Iron Ore has formally committed to implementing the LOM planning approvals at the Goldsworthy Operations via Proponent Commitment (No. 3) in the 2005 Goldsworthy Operations EPS (BHP Billiton Iron Ore, 2005). Details of how the process is used at Goldsworthy are provided in the EMP (BHP Billiton Iron Ore, 2009a) (Appendix A). BHP Billiton Iron Ore intends to adopt the same approach for the proposed Cundaline and Callawa mining operations. This approach is described below.

Maximum Disturbance Boundary

The proposed 'Maximum Disturbance Boundary' for the proposed Cundaline and Callawa mining operations is shown on Figures 3-1 and 3-2, respectively. As indicated on the figures, it generally extends by 100 to 200 m from the edge of the currently proposed mine landform designs.

Life-of-Mine Planning Process

By using the LOM planning approach the final layout of infrastructure and mine landforms would be designed so that environmental impacts (including potential changes to existing landforms and drainage channels) are kept to a minimum. Figure 3-3 illustrates the decision-making steps and considerations mine planners would follow during the planning and design process for major mine landforms, such as OSAs. BHP Billiton Iron Ore would implement this mine planning process (as described in the EMP) during the life of the proposed Cundaline and Callawa mining operations. Consequently, the proposed landform designs shown in this document (i.e. Figures 3-1 and 3-2) are indicative, and may be adjusted through the use of the LOM planning approach.

As illustrated in Figure 3-3, once a preliminary design has been developed, BHP Billiton Iron Ore mine planners would then consider aspects such as:

- the coverage and results of baseline flora, fauna and heritage surveys;
- whether the preliminary design complies with tenure and operating conditions and commitments for the proposed Cundaline and Callawa mining operations;
- whether investigations have been conducted to determine if the preliminary design is located at a safe distance from the pit walls;
- whether the preliminary design would sterilise economic resources or future infrastructure;
- potential for acid rock drainage (ARD) and management considerations for any material that has been characterised as potentially acid forming (PAF);
- the compatibility of the preliminary design with the Guiding Closure Principles contained in the DRP for the proposed Cundaline and Callawa mining operations (e.g. shape consistent with regional landforms, impacts on surface drainage, effect on visual amenity); and
- whether infill and backfill alternatives have been considered.

The decision-making hierarchy presented in Figure 3-3 has been established so as to pose questions which may require long lead-time surveys or approvals, ahead of questions which can be evaluated more efficiently. Notwithstanding this, the mine planners must consider all of the decisions and questions posed on the left hand side of Figure 3-3 in equity. The flow diagram, though presented sequentially, is provided as a guideline to ensure all items are covered in the decision-making process for mine plans.

Environmental and Aboriginal Heritage Review (PEAHR) Procedure

The LOM planning process would be supported at the operational level by the use of BHP Billiton Iron Ore's existing PEAHR procedure. The use of this procedure at Goldsworthy is described below and in the EMP. It is used at all of BHP Billiton Iron Ore's Pilbara operations.

BHP Billiton Iron Ore has developed the PEAHR procedure to manage the implementation of its environmental, Aboriginal heritage, land tenure and legal commitments prior to and during land clearing. Additionally, the PEAHR procedure provides a mechanism whereby technical and professional advice provided regarding environmental issues, land access and Aboriginal heritage planning and management issues is sought where necessary.

The objectives of the PEAHR procedure are to:

- Identify the significant environmental, Aboriginal heritage and legal aspects of BHP Billiton Iron Ore operations.
- Ensure that, through appropriate environmental, Aboriginal heritage and land access planning and management, BHP Billiton Iron Ore's Project activities comply with all legislative and regulatory requirements, BHP Billiton Iron Ore's Sustainable Development Policy, industry standards and Codes of Practice.
- Minimise the number and nature of environmental, Aboriginal heritage and land tenure events and improve the environmental performance of BHP Billiton Iron Ore operations.
- Provide improved planning and management at BHP Billiton Iron Ore's operations.

A summary of the PEAHR procedure is presented in Figure 3-4.

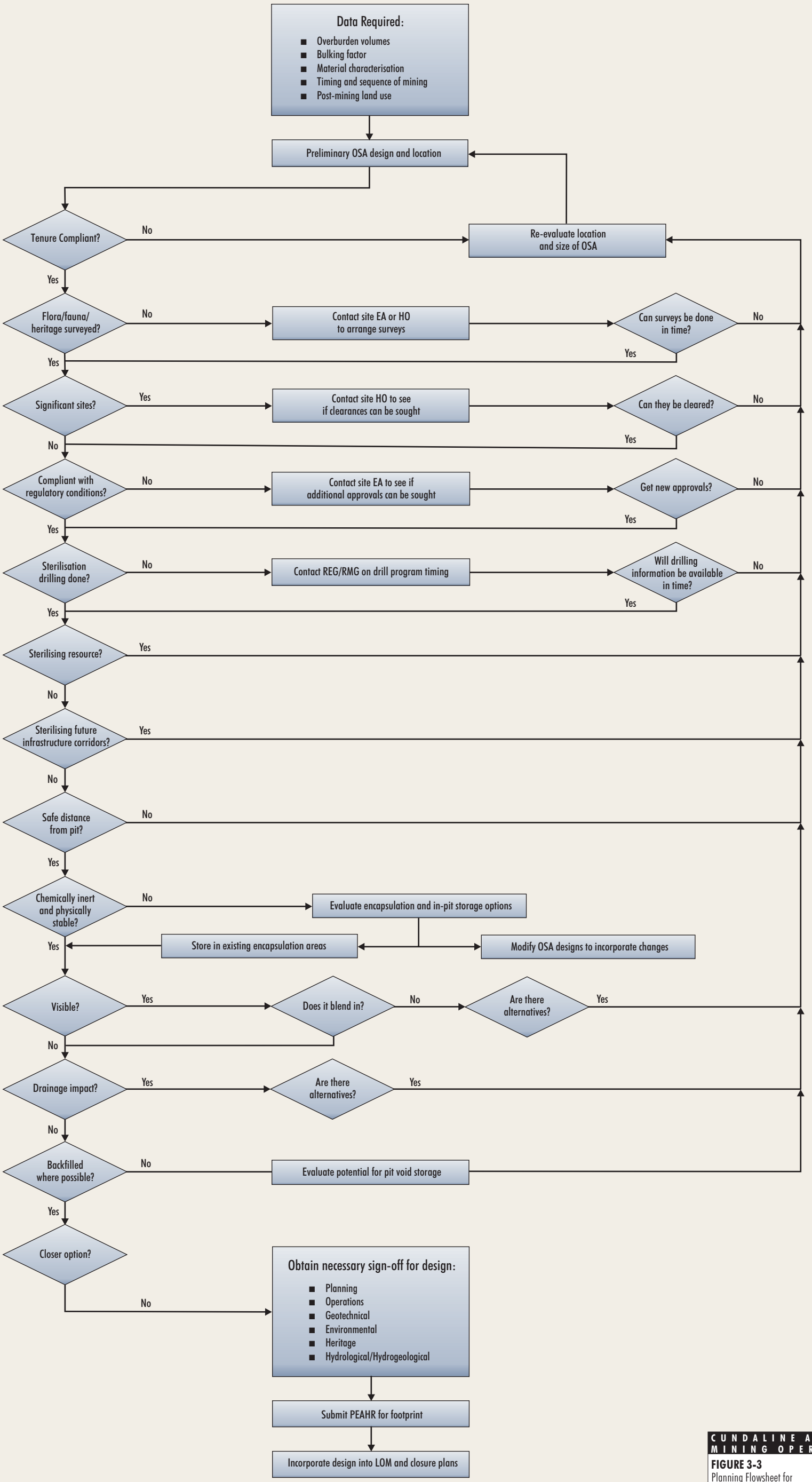
3.4 MINING OPERATIONS

Soil Stripping

Prior to ground disturbance works, vegetation, topsoil and subsoil materials would be stripped, where practicable, and either temporarily stored in nearby stockpiles or used immediately in the rehabilitation programme. Where practicable, the temporary soil stockpiles would be located adjacent to the disturbance areas and would be separated into the main soil types. Section 5.3 of this EPS describes the management measures that would be used to manage the stripping and re-use of soil.

Overburden Removal

Overburden removal from the pits would be undertaken progressively as a drill, blast, load, haul and dump operation. Section 3.5 describes the placement of overburden in out-of-pit OSAs, temporary waste rock dump and pit infill areas.



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CUNDALINE AND CALLAWA MINING OPERATIONS EPS

FIGURE 3-3
Planning Flowsheet for Major Mine Landforms

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Mining Methods

Mining of the Cundaline deposit would occur from two pits and mining of the Callawa deposit would occur from three pits (Figures 3-1 and 3-2). The maximum pit depths at the proposed Cundaline mining operation would range from approximately 150 m Australian Height Datum (AHD) to 234 m AHD, with a total disturbance area of approximately 125 ha. The maximum pit depths at the proposed Callawa mining operation would range from approximately 160 to 211 m AHD, with a total disturbance area of approximately 16 ha.

The process would involve the selective removal of vegetation, soil and overburden, followed by the mining of ore and waste rock using conventional drill, blast and haul mining methods. Mining would be undertaken in benches. Following drilling and blasting, broken ore and waste rock would be loaded by hydraulic excavators or front end loaders to off highway dump trucks for transport to the Yarrie crushing/screening facilities and/or temporary stockpiles, or OSAs.

Mining operations would be conducted 24 hours per day, seven days per week.

Mine Dewatering

No mining below the watertable would be required for the Cundaline pits, therefore no pit dewatering would be required.

Mining at the Callawa pits would extend below the watertable. Pit dewatering would therefore be required in order to enable mining of the lower pit benches.

BHP Billiton Iron Ore would backfill the Callawa pits to at least 5 m above the pre-mine watertable to avoid long-term potential impacts associated with a residual pit lake after mine closure

Blasting

The hard rock deposits would be drilled and blasted to a depth of approximately 8 m and mined selectively in 6 m flitches. The number of holes, quantity and type of explosives would be adjusted according to the rock conditions and design objectives of the blasts. The main explosives that would be used are ammonium nitrate fuel oil (ANFO), Powergel and Titan. Packaged explosives (i.e. detonators and other blasting initiating products) would be used to initiate the blasts. Blasting would occur approximately two times per week during daylight hours only.

3.5 OVERBURDEN MANAGEMENT

Overburden Storage Areas

Approximately 14.5 Mt and 15.5 Mt of overburden would be removed during mining of the Cundaline and Callawa deposits, respectively. Overburden generated during mining operations would be hauled to the temporary waste rock dump or mined-out voids for use as infill, or placed in out-of-pit OSAs.

The proposed Cundaline mining operation may require three OSAs. The indicative location of the OSAs is provided on Figure 3-1. One OSA is proposed for the Callawa mining operation (Figure 3-2).

Out-of-pit OSAs would be designed and constructed to be stable, have a maximum height that is no greater than the natural escarpment features, and have a final rehabilitated profile that is compatible with the surrounding naturally occurring landforms.

The following environmental considerations would be incorporated into the final design of the proposed Cundaline and Callawa OSAs:

- minimisation of land disturbance;
- creation of stable final landforms that incorporate appropriate surface water controls to maximise infiltration and minimise runoff;
- construction of final landforms that are integrated with the local topography, minimise impacts on visual amenity and are similar to other natural landforms found in the area;
- effective temporary storage and re-use of soil resources; and
- progressive rehabilitation of final OSA and pit infill surfaces.

Temporary Waste Rock Dump

A temporary waste rock dump is proposed at Callawa (Figure 3-2). Overburden would be temporarily stored for later backfilling of the Callawa mined-out voids to a minimum of 5 m above the pre-mining watertable.

Further details of the incorporation of environmental considerations into the mine planning and design process for major mine landforms is provided in Section 5.4.2.

Final rehabilitation concepts and revegetation strategies for overburden materials are described in Section 8 of this EPS.

3.6 ORE CRUSHING, SCREENING AND TRANSPORT

Ore mined from the Callawa deposit would be hauled approximately 2 km to Yarrie for processing in the existing Goldsworthy Operations crushing and screen plant. The ore would then be stockpiled in the existing ore stockpiling areas, from where it would be placed into the train loader using front-end loaders. The ore would then be transported from the Yarrie processing facilities to Port Hedland via the existing railway line.

Ore mined from the Cundaline deposit would either be trucked approximately 12 km to the Yarrie processing facilities for processing and rail load-out, or processed in a mobile crushing and screening plant located on-site at the proposed Cundaline mining operation, and then loaded onto trains to the immediate north of the deposit for transport to Port Hedland via the existing rail line.

Infrastructure required for the Cundaline ore processing option would include the following:

- Construction of a new mobile primary, secondary and tertiary crushing and screening plant consisting of:
  - primary crusher apron feeder;
  - grizzly screen;
  - primary jaw crusher;
  - scalping screen;
  - secondary crusher;
  - product screen;
  - gyratory crusher (tertiary crusher); and
  - stockpile feeders.

- Development of new lump and fines reclaimer stockpiles.
- Construction of a train load-out unit (if front-end loaders are not used to direct/load ore onto trains).
- Construction of new lump and fines product stockpiling circuits (if a train load-out unit is used for loading trains).

Ore crushing and screening would continue to occur 24 hours per day, seven days per week. The crushers would produce lump ore of less than 30 millimetres (mm) in diameter and fines of less than 6 mm in diameter.

In order to minimise dust generation and increase the moisture content of the ore, dust curtains, and sprays would be installed where appropriate. The moisture content of material on the conveyor system would be monitored. In the event that the moisture content is outside the required ore moisture range, the water supply will be adjusted to provide adequate dust suppression. Controlling the moisture content of the ore has the flow-on advantage of dust management and reducing water demand at BHP Billiton Iron Ore's ore stockpiling, blending and ship loading facility at Port Hedland.

Ore Haulage Options

Yarrie Processing

The Yarrie-only processing option would involve haulage of the ore from both the Cundaline and Callawa mining areas to the crushing and screening plant located at the Yarrie facilities. Ore would be stockpiled in the existing ore stockpiling areas at Yarrie.

A speed limit of 80 km per hour would be imposed. Road trains and other mine vehicles would use the roads 24 hours a day, seven days a week.

Mined ore would be hauled to the Yarrie crushing and processing facilities via upgraded existing haul roads and new access roads. A new haul road would be constructed between the proposed Cundaline mining area along the existing access road towards Yarrie until it joins to the existing Cattle Gorge to Yarrie haul road. A fleet of road trains would be used to transport the ore. Based on a processing rate of 2 Mtpa, a fleet of three road trains would operate during day shift and would transport ore from the Cundaline deposit (approximately 18 loads per day) and Callawa deposit (approximately six loads per day). At an ore processing rate of 5 Mtpa the number of trains would increase by 2.5 times. To accommodate this, an additional truck would be used, and the haulage operation would be conducted 24 hours per day.

The existing access track to the Callawa ridge would be upgraded and temporarily used until an appropriate haul road is constructed between Yarrie and the proposed Callawa mining operation on the eastern side of the Yarrie rail loop (Figure 3-2).

Bridges would be constructed on the access road across the existing railway line (Figure 3-2).

Yarrie and Cundaline Processing

Ore haulage from the proposed Cundaline mining operation to Yarrie would not be required if the option to use a mobile crushing and screening plant on-site is selected. Ore from the proposed Callawa mining area would be hauled approximately 2 km to the Yarrie facilities for processing as described above.

A water cart would be used for watering the haul road to the Yarrie facilities and for dust suppression on roads in the Cundaline and Callawa areas. Appropriate dust-suppressant technologies would also be used on haul roads (e.g. Dustex is currently used at Cattle Gorge) for dust suppressions purposes.

Approximately one train per day would be required to transport ore from the Goldsworthy Operations to Port Hedland. Each train would comprise approximately 90 ore cars (each ore car having a 75 t capacity), with a total train capacity of approximately 6,750 t.

3.7 ANCILLARY INFRASTRUCTURE

Power Supply

Power supply to BHP Billiton Iron Ore's existing Goldsworthy Operations is provided via a 66 kV overhead electricity transmission line (ETL) from Port Hedland to Shay Gap and reticulation via 22 kV lines. An ETL would be constructed to the Cundaline mining area from the existing ETL which runs between Cattle Gorge and Yarrie or diesel-fuelled generators would be set up at the Cundaline mining area. If an ETL is opted to be constructed it would run through L45/127 (Figure 1-2) and along the existing access road towards the proposed Cundaline mining operation. Power would be supplied to the Callawa mining area via an ETL extension from the existing power supply at the Yarrie operations or diesel-fuelled generators.

The expected electricity demand for the proposed Cundaline and Callawa mining operations would be approximately 7,500 MWh per annum if the Cundaline processing option is used, with the majority of the demand required for the new Cundaline crushing and screening facilities. A similar demand is expected if the Yarrie processing option is used.

Night-lighting would be powered via fuel operated generators.

Water Supply

Raw and Potable Water

The proposed Cundaline and Callawa mining operations would require up to 1.5 ML of water per day. Raw and potable water is currently supplied to Yarrie from the Shay Gap Wellfield. Water supply for the proposed Cundaline mining operation would be provided via a pipeline extension from the water supply system which runs between Cattle Gorge and Yarrie, through L45/127 (Figure 1-2) and along the existing access road towards Cundaline.

Water supply for the proposed Callawa mining operation would be provided via a pipeline extension from the water supply system at the Yarrie operations. Although little dewatering is expected from the proposed Callawa pits that extend below the watertable, the water abstracted would be used to make up raw water (i.e. road watering and dust suppression in the crushing plants) in preference to water pumped from the Shay Gap Wellfield. All water abstracted from the pits would be used and as such no discharge is proposed.

Water sourced from the Shay Gap Wellfield would not exceed the current licensed allocation.

Waste Management

The proposed Cundaline and Callawa mining operations would use the existing designated solid waste landfill (i.e. non-controlled wastes), rubber dump area, sewage treatment system and bioremediation landfarm at the Yarrie operations. Controlled wastes such as batteries and waste oil would be removed from site by a contractor for recycling and/or disposal in accordance with the requirements of the *Environmental Protection (Controlled Waste) Regulations, 2004*.

Section 6.4 provides a description of the waste management process and location of waste disposal areas.

Hydrocarbon Use and Storage

The maximum bulk diesel fuel requirements for the proposed Cundaline and Callawa mining operations are estimated to be 3,850 kilolitres (kL) per annum. Bulk fuel storage facilities are located at the Yarrie operations and are above ground, bunded, and constructed and operated in accordance with applicable Australian Standards. Bulk diesel fuel is currently transported to the Yarrie operations using 100,000 litre (L) capacity triple road train fuel tankers. Up to four trips per fortnight would be required to meet the combined Yarrie, Cundaline and Callawa demand.

Diesel would also be stored on-site in up to four 55,000 L above ground tanks within the proposed Cundaline mining operation area, which would be located within a HDPE lined earthen bund. Oils would be stored at both the Yarrie and proposed Cundaline mining operation facilities in up to three storage tanks located in a concrete bund. The maximum total oil storage capacity would be 50,000 L. Waste oil would be collected and stored at the Yarrie facilities.

Offices, Workshops and Other Amenities

The proposed Cundaline and Callawa mining activities would use the existing administration facilities and main workshops at Yarrie. No major upgrades to these facilities or additional infrastructure would be required. Personnel working at Cundaline and Callawa would make use of the Yarrie accommodation camp and aerodrome.

Infrastructure located at the proposed Cundaline mining area would include an office, toilet facilities, crib room, meeting room, fuel storage, refueling facilities and a turkey's nest dam. The infrastructure at the proposed Callawa mining area would consist of an office, toilet facilities, crib room, ablutions and a turkey's nest dam.

Sewage Treatment

Treatment of domestic sewage would take place at the Yarrie accommodation camp in the small plant located adjacent to the village. Treatment is via two anaerobic septic tanks in series with an aerobic digester. Effluent from the plant is chlorinated and then irrigated into a designated area adjacent to the plant. Sludge from the plant is collected periodically by a contractor and transported to Port Hedland for disposal at a licensed waste facility.

Transport

Access Roads

The existing Yarrie access road would be used to provide access to the Cundaline and Callawa areas. Vehicles using this road for access would include light vehicles, freight trucks, road trains, fuel trucks. It is expected that use of the access road would remain at similar levels to the current situation, although additional road train trips would be required if the Cundaline processing option is implemented. Table 3-2 provides a summary of the predicted access road use.

Table 3-2
Predicted Access Road Use

Vehicle Type	Approximate Number of Trips
Light Vehicles	8 per day
Freight Trucks	1 per week
Fuel Trucks	2 per week
ANFO Deliveries	1 per fortnight

Internal Roads

Internal unsealed roads would be constructed at Cundaline and Callawa to provide access to mine areas and infrastructure. New roads would be designed using the relevant grade and haul distance criteria in order to maintain haulage efficiencies.

The design of the new roads would also include consideration of BHP Billiton Iron Ore's environmental management commitment to minimise land clearing (i.e. where possible, new roads would be constructed in areas that have been previously disturbed) and to avoid known sites of environmental significance (i.e. Aboriginal heritage sites and flora/fauna species of conservation significance).

3.8 WORKFORCE

The operational workforce for the Cundaline and Callawa mining operations is expected to be approximately 140 to 150 personnel. This number is expected to remain constant during the life of the mining operations, however it may increase temporarily during scheduled maintenance work.

Additional personnel are also expected to be required for construction of the following infrastructure components:

- mobile crushing plant (approximately 25 personnel);
- water pipeline (approximately eight personnel); and
- ETL extensions (approximately eight personnel).

Both the additional construction personnel and operational workforce would be accommodated at the Yarrie accommodation camp and therefore no additional disturbance would be required.

4 RISK BASED ASSESSMENT

BHP Billiton Iron Ore has adopted a risk based approach to determine the relevant environmental factors and potential risks of relevance. The overarching principles of sustainability and biodiversity have been considered, and have been incorporated into the assessment of the identified environmental factors. The factors relevant to the proposal were identified based on BHP Billiton Iron Ore's operational experience at Goldsworthy, the results of environmental studies and monitoring in the region, the findings of previous EIAs, and consultation with Government stakeholders.

The risk assessment methodology used to identify and assess the potential risks associated with the proposal based on BHP Billiton's *Methods and Techniques Risk Management Guideline 2* (BHP Billiton, 2008). The identification and assessment of risk is embedded in BHP Billiton Iron Ore's critical business processes and guides the implementation of activities to ensure consistency and comparability across all operations.

This EPS provides a detailed assessment of each environmental factor, and demonstrates that the potential impacts can be managed so that residual risk is minimised and relevant objectives can be met.

The relevant parts of the existing Goldsworthy EMP and DRP (BHP Billiton Iron Ore, 2009a, 2009b) (Appendices A and B) have been revised to accommodate the proposed new mining areas.

The risk assessment process involved the identification of the following:

- EPA environmental objective;
- risk issue/hazard;
- event;
- cause/failure;
- management and mitigation; and
- potential impacts.

The inherent risks were obtained by considering the above, including the management and mitigation measures outlined in the current Goldsworthy EMP and DRP (BHP Billiton Iron Ore, 2009a, 2009b) (Appendices A and B). Tables 4-1 and 4-2 were used to assign a severity factor[1] and likelihood factor[2] to each potential impact. The inherent risk ranking was calculated by multiplying the severity factor and the likelihood factor (Table 4-3).

Further controls which could minimise the inherent risks were considered. The residual risk was obtained by considering the effect of the further controls on the inherent risks.

The outcome of the environment risk assessment is provided in Sections 5, 6 and 7 under each relevant environmental factor. Due to the scale, mine life, and location of the proposed Cundaline and Callawa mining operations and implementation of the existing management controls at the Goldsworthy mining operations, all environmental factors were ranked as either low or minor (i.e. no 'key environmental factors' were identified during the assessment).

1 The severity factor is defined as a measure of the expected degree of gain, harm, injury or loss (impact) from the most severe event associated with a risk issue (BHP Billiton, 2008).

2 The likelihood factor is defined as a measure of the chance of an impact at that selected level of severity actually being incurred (BHP Billiton, 2008).

Table 4-1
Severity Factor

Severity Level	Impact Types						Severity Factor
	Financial Impact	Health and Safety	Natural Environment	Social/Cultural Heritage	Community/ Government Reputation	Legal	
7	> US$1 billion	> 500 fatalities or very serious irreversible injury to > 5000 persons.	Very significant impact on highly valued species, habitat or ecotourism.	Irreparable damage to highly valued items of great cultural significance or complete breakdown of social order.	Prolonged international condemnation.	Potential jail terms for executives and/or very high fines for the company. Prolonged, multiple litigation.	1000
6	US$100 million to US$1 billion	> 50 fatalities, or very serious irreversible injury to > 500 persons.	Significant impact on highly valued species, habitat, or ecosystem.	Irreparable damage to highly valued items of cultural significance or breakdown of social order.	International multi-non-government organisation (NGO) and media condemnation.	Very significant fines and prosecutions. Multiple litigation.	300
5	US$10 million to US$100 million	Multiple fatalities, or significant irreversible effects to > 50 persons.	Very serious, long-term environmental impairment of ecosystem function.	Very serious widespread social impacts. Irreparable damage to highly valued items.	Serious public or media outcry (international coverage).	Significant prosecution and fines. Very serious litigation, including class actions.	100
4	US$1 million to US$10 million	Single fatality and/or severe irreversible disability (> 30%) to one or more persons.	Serious medium-term environmental effects.	On-going serious social issues. Significant damage to structures/items of cultural significance.	Significant adverse national media/public/NGO attention.	Major breach of regulation. Major litigation.	30
3	US$100,000 to US$1 million	Moderate irreversible disability or impairment (< 30%) to one or more persons.	Moderate, short-term effects but not affecting ecosystem function.	On-going social issues. Permanent damage to items of cultural significance.	Attention from media and/or heightened concern by local community. Criticism by NGOs.	Serious breach of regulation with investigation or report to authority with prosecution and/or moderate fine possible.	10
2	US$10,000 to US$100,000	Objective but reversible disability requiring hospitalisation.	Minor effects on biological or physical environment.	Minor medium-term social impacts on local population. Mostly repairable.	Minor, adverse local public or media attention and complaints.	Minor legal issues, non-compliances and breaches of regulation.	3
1	< US$10,000	No medical treatment required.	Limited damage to minimal area of low significance.	Low-level repairable damage to commonplace structures.	Public concern restricted to local complaints.	Low-level legal issue.	1

Table 4-2
Likelihood Factor

Given the Site, Company and Industry experience, it:	Likelihood Factor
Could be incurred once or more during the next year.	10
Could be incurred over the next 1 to 2 year budget period.	3
Could be incurred within the 5 year Strategic Planning period.	1
Could be incurred within a 5 to 10 year time frame.	0.3
Could be incurred in the next 20 to 30 years.	0.1
For a system failure: This consequence hasn't happened in the industry in the last 50 years. *For a natural hazard (earthquake, flood, windstorm, etc.)*: The predicted return period for an event of this strength/magnitude is 1 in 100 years or longer.	0.03

Table 4-3
Risk Rating Classification

		Severity Factor						
		1	**3**	**10**	**30**	**100**	**300**	**1000**
Likelihood Factor	**0.03**	0.03	0.09	0.3	0.9	3	9	30
	0.1	0.1	0.3	1	3	10	30	100
	0.3	0.3	0.9	3	9	30	90	300
	1	1	3	10	30	100	300	1000
	3	3	9	30	90	300	900	3000
	10	10	30	100	300	1000	3000	10000

Low
Minor
Moderate
Major
Critical

5 BIOPHYSICAL FACTORS – IMPACT ASSESSMENT AND MANAGEMENT

5.1 CLIMATE

5.1.1 Existing Environment

The climate of the Pilbara region of WA is described as arid-tropical with two distinct seasons; a hot summer from October to April and a mild winter from May to September (Gentilli, 1972).

The nearest accessible long-term climate data to the proposed Cundaline and Callawa mining operations is the Bureau of Meteorology (BOM) weather station located at Marble Bar, approximately 85 km south-west of the proposed Cundaline and Callawa mining areas. The Marble Bar area experiences a wide range of temperatures. In summer, maximum temperatures may reach 49.2 degrees Celsius (°C), whilst in winter, minimum temperatures may reach 1.1°C (BOM, 2008).

Rainfall in the Pilbara is often sporadic, and can occur in summer and winter. The Marble Bar area has average annual rainfall of 361.7 mm (BOM, 2008). Summer rainfall is typically associated with tropical storms in the north, or tropical cyclones that cross the coast and move inland. Winter rainfall is generally less significant, and is commonly the result of cold fronts moving north-easterly across the State. A summary of climatic data from the Marble Bar BOM weather station is provided in Table 5-1.

5.1.2 Potential Impacts and Mitigation Measures

The proposed Cundaline and Callawa mining operations would involve the generation of greenhouse gases. Section 6.3 discusses the potential impacts of these emissions.

5.2 GEOLOGY

5.2.1 Existing Environment

The Goldsworthy Operations area and surrounds comprise a sequence of banded irons, sandstones, siltstones and tuff. The iron ore mineralisation associated with the Cundaline and Callawa deposits is hosted within the Nimingarra Formation, a steeply dipping sequence of BIF horizons, ferruginous chert and shales.

The Cundaline deposit comprises a series of narrow lode-style orebodies over a strike length of approximately 9 km. Several localised faults are noted throughout the deposits with a variety of orientations which offset stratigraphy and associated mineralisation.

The Callawa deposit contains only one identified lode ore deposit on the north-east corner. This deposit is situated in the Lower or Middle member of the Nimingarra Iron Formation which dips shallowly to the west. This deposit contains post-mineralisation dolerite dykes that cross-cut mineralisation but have little offset and there are no other structural disruptions throughout the deposit to indicate faulting.

Further detail on the local geology and hydrogeology is provided in Appendices G (groundwater) and K (troglofauna).

Table 5-1
Long-term Climate Data – Marble Bar Meteorological Station

Month	January	February	March	April	May	June	July	August	September	October	November	December	Annual
Temperature ^{0}C													
Mean Daily Max.	41	39.8	39	36	30.7	27.1	26.8	29.6	33.9	37.6	40.5	41.6	35.3
Mean Daily Min.	26.1	25.6	24.7	21.4	16.6	13.2	11.7	13.3	16.7	20.3	23.6	25.5	19.9
Relative Humidity (%)													
Mean 9 am	45	51	41	35	39	43	39	33	28	26	27	35	37
Mean 3 pm	26	31	26	23	27	28	24	21	17	16	16	20	23
Rainfall (mm)													
Mean Rainfall	76.3	87.8	56.7	21.9	23	23	12.6	6.4	0.9	3.8	9.1	39.6	361.7
Highest Monthly Rainfall	309.8	347.2	388.6	240.5	186.7	165.3	133.9	88.9	24.1	116.3	71.2	314.9	797.9
Lowest Monthly Rainfall	0	0	0	0	0	0	0	0	0	0	0	0	71.1
Mean No. of Days of Rain (>= 1 mm)	5.8	6.2	3.8	1.5	1.7	1.7	1.1	0.6	0.2	0.4	1	3.6	27.6

5.2.2 Potential Impacts and Mitigation Measures

Potential Impacts

Overburden Characteristics

Mining of the Cundaline deposit would generate approximately 14.5 Mt of overburden, and mining at the Callawa deposit would generate approximately 15.5 Mt of overburden.

In accordance with the guideline *Mine Closure and Completion* (DITR, 2006a), mine materials at Cundaline and Callawa have been characterised to provide a basis for the segregation and selective placement of materials.

Mining of the Cundaline and Callawa deposits is targeting both crustal and lode style mineralised deposits within the Nimingarra Iron Formation (Middle BIF and Lower BIF units).

The main types of overburden have been identified within the Cundaline and Callawa pits include:

- Scree;
- Hardcap;
- Dolerite Dyke intrusions;
- Nimingarra Iron Formation:
  - Middle BIF;
  - Lower BIF;
- Basal Units; and
- Granites.

A brief description of the characteristics of the overburden that would be encountered at Cundaline and Callawa is provided below.

Scree

Waste rock from scree areas would typically occur as loose detritals. The detritals will typically occur as loose, rounded to sub-angular, competent siliceous BIF rock fragments with or within a silty/soil matrix.

Hardcap

Hardcap in the Cundaline and Callawa pits occurs where there has been significant surface weathering, oxidisation or silicification of the Nimingarra Iron Formation BIFs (i.e. the process of replacement by silica). In many cases, the original rock member may no longer be identifiable due to the high degree of alteration.

The occurrence of Hardcap zones in the Callawa and Cundaline areas is typically very shallow (i.e. less than 10 m) and laterally discontinuous.

The waste rock from hardcap would typically occur as hard, blocky and competent rock with few cavities and solution pipes filled with scree or less competent shaley material.

Dolerite Dyke Intrusions

Dolerite Dykes occur within the proposed pit areas, intruding along pre-existing faulted and shear structures. Plunging dyke and sill intrusion are considered to be bounding features to the Nimingarra Iron Formation lode style mineralisation, varying in width and continuity.

The waste rock from Dolerite Dykes would typically increase in competence with depth. Near surface weathering and fluid flow along fault surfaces will produce blocky and moderately friable rock. It would be expected that the majority of the waste rock would be competent rock, which would not easily be deteriorated by surface weathering conditions.

Nimingarra Iron Formation

The Nimingarra Iron Formation comprises three banded iron formation (BIF) units (Upper, Middle and Lower Members) each separated by shallow shale/mudstone horizons. However, only the Middle and Lower Members are present within the Callawa and Cundaline pits.

Lode style ore is typically hosted within the Middle and Lower Members, bound by specific features including shale units, faults or plunging dyke intrusions. Lower grade, nearer surface crustal ores are also present within the Cundaline and Callawa pits and are considered to be the product of regolith development on BIF during the Cainozoic.

The waste rock from the Nimingarra Iron Formation would typically occur as hard, blocky and competent BIFs and cherty BIFs, with few non-competent shale / mudstone horizons.

Basal Units

The basal unit of the Nimingarra Iron Formation Lower Member includes a clastic sequence of competent quartzite from conglomerate materials and sandstones, with shales. A proportion of semi friable to non competent basal shale sequences also occur at the lower boundary of the Lower Member unit.

Granites

Waste material from the granitoid basement of the Muccan/Warrawagine Batholiths would occur as coarse grained, blocky and competent rock.

Overburden Management

The overburden would be hauled to mined-out voids at the respective mines for use as infill (where practicable), or placed in out-of-pit OSAs. The locations of these OSAs are provided on Figures 3-1 and 3-2.

As described in Section 3.3, the final OSA designs would be determined using the LOM Planning Process. Overburden would be selectively placed in order to achieve a stable post-mining landform with sustainable vegetation cover, and to minimise the potential for contamination of surface water and groundwater resources. Overburden management at the proposed Cundaline and Callawa mining operations would be based upon baseline studies and operational experience at the proposed mining operations, as well as studies and operational experience from other BHP Billiton Iron Ore mines.

Typically competent materials (Scree, Hardcap, Nimigarra Iron Formation Middle and Lower Members, granites and portions of the Dolerite Dykes and basal units) make up over 85% of the total overburden expected to be generated from the proposed Cundaline and Callawa mining operations.

Given that the majority of the overburden would consist of typically competent material, end tipping is considered to be the most appropriate construction method and would be used to place this material on the OSAs. When mining overburden, BHP Billiton Iron Ore would identify areas where less competent material is present and would manage its placement in OSAs so that it is distributed evenly, rather than in one area, or on the final outer surfaces. This would minimise the potential for instability within the OSAs or on the outer batters.

Potentially Acid Forming Material

Exploration drilling undertaken by BHP Billiton Iron Ore in the proposed Cundaline and Callawa mining areas has not intersected any PAF material to date.

Results from drilling programmes at the Cundaline deposit revealed that due to deep weathering of the wall rock and orebody horizons, the narrow shale and more extensive BIF/chert horizons appear depleted of pyritic material to a depth consistent with economic extraction.

Results from drilling programmes at the Callawa deposit revealed that no sulphidic or PAF material has been intersected in proximity to iron mineralisation amenable to economic extraction. This is partially due to the lower levels of shale material near mineralisation on the ridge and advanced weathering.

Despite the low risk of PAF materials being encountered, BHP Billiton Iron Ore would continue to conduct routine monitoring of blast holes, including sulphur analysis during the proposed Cundaline and Callawa mining operations. In the unlikely event that PAF material is encountered, management measures would be developed and implemented in consultation with the administering authorities.

5.3 SOIL RESOURCES

5.3.1 Existing Environment

The ridges that form the main topographical features in the Goldsworthy area are remnants of a sedimentary plateau landform (BHP Billiton Iron Ore, 2005). Due to the combination of sparse vegetation and the erosive force of summer rains, much of the soil that develops in these areas is eroded during rain events and transported into creek gullies and down to the surrounding valleys and plains (*ecologia*, 2005a, 2005b). The soil resources on the ridges and plateaus are therefore generally limited to very thin, poorly developed skeletal soils in between rocky outcrops.

The Cundaline and Callawa ridges both lie within a region of soils that have been broadly mapped by Bettany *et al.* (1967) as “gradational soils with a neutral reaction trend through the profile”.

Operational experience from the existing Goldsworthy Operations has shown that where soil resources have been stripped from disturbance areas and used in rehabilitation they generally provide valuable nutrient and seed resources.

5.3.2 Potential Impacts and Mitigation Measures

Potential Impacts

Potential impacts of the proposed Cundaline and Callawa mining operations on soil resources would include:

- an increase in the likelihood of soil erosion by both wind and water due to the clearing of approximately 500 ha of native vegetation;
- a potential reduction in the viability of seeds, nutrients, organic matter and micro-organisms due to inappropriate stockpiling of topsoil and other soil resources;
- alterations of soil structure and/or chemistry beneath infrastructure items, hardstand areas and roads (e.g. through compaction, spillage of hydrocarbons or chemicals); and
- alterations of soil structure and/or chemistry and changes to the natural soil evolution/forming process, caused by stripping and reusing soil from disturbed areas in rehabilitation.

EPA Objective

- To maintain the integrity, ecological function and environmental values of the soil.

Management Measures

BHP Billiton Iron Ore's Pilbara-wide Soil Management Measures

Minimising the impact of mine operations on the surrounding environment (i.e. flora and fauna habitats, landform and drainage systems) is accomplished at BHP Billiton Iron Ore's Pilbara mining operations through the adoption of a policy of minimum disturbance. Where disturbance is unavoidable, it is undertaken in a manner which limits the area cleared to the minimum necessary, reduces the potential for erosion, and uses rehabilitation to promote the natural return of vegetation and fauna consistent with agreed closure criteria and commitments.

BHP Billiton Iron Ore has developed and implemented an internal Topsoil Management Manual which describes the general objectives and strategies relating to the four main components of soil management at its Pilbara operations. These components are:

- baseline soil surveys should be undertaken prior to disturbance;
- stripping of soil resources should be to appropriate depths and at appropriate times;
- stripped soils should be stockpiled in an appropriate manner; and
- appropriate planning should be undertaken so that stripped topsoil can be efficiently and effectively used during rehabilitation.

The Topsoil Management Manual has been prepared to provide BHP Billiton Iron Ore's environmental personnel and others, with easily accessible general information regarding the management of topsoil. The information provided relates to baseline topsoil assessment methodologies, consideration of topsoil resources during mine planning, generic topsoil stripping and stockpiling procedures, topsoil use in rehabilitated areas, and reporting requirements.

BHP Billiton Iron Ore has also developed and implemented an internal Borrow Pit Manual, which includes general management procedures for the planning and construction of proposed borrow pits and rehabilitation of old borrow pits at its Pilbara operations.

The Topsoil Management Manual and Borrow Pit Manual would be used as key reference documents by BHP Billiton Iron Ore personnel and its contractors to guide the management of soil resources at the proposed Cundaline and Callawa mining operations.

Site-specific Soil Management Measures

Site-specific land clearing and soil management measures have been developed and implemented by BHP Billiton Iron Ore at the Goldsworthy Operations and would be applied to the proposed Cundaline and Callawa mining operations. These measures are documented in the EMP (Appendix A) and are summarised below:

- All activities that require land clearance would be authorised by BHP Billiton Iron Ore via its internal PEAHR land clearing procedure (Figure 3-4). For each proposed clearing area the following must be provided in the PEAHR form: a summary of the proposed clearing operation (the 'Proposed Cundaline and Callawa mining operations'), a plan showing the location of the proposed works, the anticipated environmental, land access and Aboriginal heritage impacts and specific management measures where necessary. Land clearing cannot take place until the PEAHR form is authorised by BHP Billiton Iron Ore and the project owner of the land disturbance activity has accepted and understood the conditions associated with the approval.
- Employees and contractors would be advised of the land clearing authorisation processes via the induction.
- Key BHP Billiton Iron Ore personnel undergo additional competency based training in the PEAHR land clearing procedure.

Once proposed land disturbance activities have been authorised, the following site-specific soil resource management practices would be used at the proposed Cundaline and Callawa mining operations to minimise soil loss through erosion, and to maximise the potential for re-using stripped materials in rehabilitation programmes:

- A plan would be prepared showing areas requiring topsoil removal before stripping occurs.
- Where practicable (i.e. subject to the safe operating constraints of the equipment used), topsoil and other identified suitable growth medium material (e.g. subsoil, and deeper alluvial and gravel material from drainage line areas) would be stripped prior to the commencement of mine operation activities.
- Where mine scheduling allows, stripped topsoil, subsoil and other materials would be applied to areas being rehabilitated. Where this is not possible, stripped materials would be stored in separate stockpiles for later use. The stockpiles (both long and short-term) would be constructed and managed in a manner that encourages the continuation of the soil's biological activity.
- Topsoil details would be recorded on the Topsoil Stockpile Datasheet and stored into a central database or spreadsheet.
- Locations of topsoil storage stockpiles would be recorded on BHP Billiton Iron Ore's Spatial Mine Planning Programme (i.e. Vulcan or equivalent). The locations of soil stockpile would be proposed so that potential sites for future mine and infrastructure disturbance areas and sensitive habitat are taken into consideration.

- Stockpiles would be clearly identified on the relevant site plan and, where appropriate, signposted in the field. Plans indicating the location and volume of topsoil and other materials stockpiled would be updated as necessary.
- Investigate measures for improving the viability of seed, nutrients and organic matter and micro-organisms in topsoil.
- Supervise topsoil management and rehabilitation work.
- Topsoil movement would be proposed and tracked to ensure it is available for rehabilitation.
- Regular inspections would be undertaken to assess erosion and sediment migration from topsoil stockpiles. Where unacceptable rates of erosion are identified, remedial works would be undertaken or the stockpile will be relocated.
- Mining contractors would be closely supervised and would be subject to periodic audits by BHP Billiton Iron Ore to assess conformance with these land and soil management procedures.
- A condition prohibiting unauthorised clearing would be included in all relevant contracts.

The management measures provided above and in the EMP (Appendix A) would be used throughout the life of the proposed Cundaline and Callawa mining operations in order to minimise potential impacts on soil resources.

5.3.3 Outcome

As described in Section 4, a risk assessment was completed for the proposed Cundaline and Callawa mining operations. Based on the implementation of the management measures described above, the risk assessment findings for soil resources are summarised below.

Environmental Objectives	Potential Impacts	Management Measures	Severity	Likelihood	Residual Risk*
To maintain the integrity, ecological function and environmental values of the soil.	Soil erosion by both wind and water.	Refer Section 5.3.2.	3	1	Minor (3)
	Reduction in the viability of seeds, nutrients, organic matter and micro-organisms.		3	1	Minor (3)
	Inappropriate alteration of soil structure and/or chemistry (e.g. through compaction, spillage of hydrocarbons or chemicals).		1	0.3	Minor (0.3)
	Changes to the natural soil evolution/forming process, caused by stripping and reusing soil from disturbed areas in rehabilitation.		1	0.1	Low (0.1)
	Insufficient soil resource to successfully rehabilitate land.		10	0.1	Minor (1)

* Low (0.03 to 0.1); Minor (0.3 to 3); Moderate (9 to 30); Major (90 to 1,000); Critical (3,000 to 10,000) (refer Section 4).

5.4 LANDFORMS

5.4.1 Existing Environment

Local Setting

The proposed Cundaline and Callawa mining operations are located on the south-eastern portion of the Cundaline ridge and the north-eastern portion of the Callawa ridge (Figure 1-2). The ridges and plateaus in these areas rise sharply from the surrounding plains, and in many areas cliffs and steep escarpments have formed. Scree slopes typically form below the escarpments, and areas of the ridges and plateaus are dissected with steep V-shaped valleys, gorges and dendritic drainage patterns.

The elevation of the Cundaline and Callawa ridges in the vicinity of the proposed mining operations are 250 m AHD and 270 m AHD, respectively. The elevation of the surrounding plains is approximately 130 m AHD. The elevation of topographical features elsewhere at Goldsworthy Operations range from approximately 280 m AHD at the Yarrie Plateau, to approximately 80 m AHD at the De Grey River south of Nimingarra. The Yarrie accommodation camp lies at approximately 130 m AHD as does the Shay Gap borefield to the north on the edge of the Sandy Desert. Coonieena Creek at Shay Gap is at an elevation of approximately 120 m AHD.

The proposed Cundaline and Callawa mining operations and surrounding areas are comprised of a number of distinct landscape units and landuse types of varying levels of landscape quality. These have been defined as follows:

- Ridges and Plateaus – rocky ridges and plateaus which dominate the Goldsworthy Operations area. These rise sharply from the surrounding plains, with scree slopes typically forming below the escarpments.
- Plains - wide plains and floodplains of the De Grey River and its tributaries which surround the Cundaline and Callawa ridges.
- Yarrie and Muccan Stations – privately owned cattle-grazing properties on which the Goldsworthy Operations are situated. The main station homestead is located at Yarrie and is approximately 11 km south of the proposed Cundaline mining operation.
- De Grey River – located to the south of the proposed Cundaline and Callawa mining operations. The De Grey River flows in a westerly direction and is joined by a number of tributaries in the Goldsworthy area including Egg Creek, Eel Creek and Coonieena Creek.
- Muccan to Shay Gap Road – public road that links the Great Northern Highway to the north with Marble Bar to the south.

5.4.2 Potential Impacts and Mitigation Measures

Potential Impacts

The landforms of the Cundaline and Callawa areas would be affected by the proposed mining operations. The proposed open pits would create permanent excavations in the southern face of the Cundaline ridge and north-eastern face of the Callawa ridge, resulting in localised effects on visual amenity and surface water drainage paths. The maximum depth of the pits below the surrounding ground level would range from approximately 150 m AHD to 234 m AHD at the proposed Cundaline mining operation and from approximately 136 m AHD to 209 m AHD at the proposed Callawa mining operation. Overburden would be used to infill some parts of the pits where mine scheduling allows, which would reduce the depth of the final pit voids at closure. The proposed mining activities at the Cundaline mining operation would not extend below the watertable, and as a result pit lakes would not form. Short-term seasonal ponding may occur after periods of rainfall. The proposed Callawa open pits would extend below the watertable, however these areas would be infilled post-closure to at least 5 m above the pre-mine watertable level.

The overburden generated by the proposed operations would be used as pit infill, where practicable and would be placed in out-of-pit OSAs. The proposed Cundaline mining operation may require three OSAs. The proposed Callawa mining operation would require two OSAs.

Visual sensitivity is a measure of how critically a change to the existing landscape would be viewed from surrounding areas. Potentially sensitive areas identified in the Visual Assessment (Appendix E) consist of the Yarrie homestead and the Muccan to Shay Gap Road. The Yarrie homestead has been classified as having low visual sensitivity due to the distance between it and the proposed mining activities. The Muccan to Shay Gap Road has been classified as having moderate visual sensitivity on the northern side of the Cundaline ridge (due to its close proximity to the proposed mining activities), and having low sensitivity on the southern side of the Cundaline ridge.

The Visual Assessment conducted for the proposed Cundaline and Callawa mining operations concluded that the proposed Cundaline and Callawa mining operations would result in a low visual modification level and impact when viewed from the Yarrie homestead and the Muccan to Shay Gap Road (Appendix E).

The potential visual impacts associated with the service infrastructure (i.e. access and haul roads, run-of-mine [ROM] pads and hardstand areas for buildings) are not expected to be significant as the relative area of these proposed landforms would be moderate and the intervening topography and/or natural vegetation would limit potential views.

EPA Objective

- To ensure, as far as practicable, that rehabilitation achieves a stable and functioning landform which is consistent with the surrounding landscape and other environmental values.

Management Measures

A summary of the management measures that would be used at the proposed Cundaline and Callawa mining operations to minimise potential impacts on landforms and visual amenity are provided below. Further details of the operational control measures and rehabilitation/closure principles are provided in the EMP (Appendix A) and the DRP (Appendix B), respectively. The management measures described below are sub-divided into ‘general’, ‘mine planning’ and ‘overburden storage areas’.

General Landform Management Practices

- Mine infrastructure areas (i.e. access tracks, borrow pits, topsoil stockpiles, buildings, etc.) that are no longer required would be decommissioned, and wherever possible, the disturbed area re-contoured to blend with the surrounding topography, topsoiled, contour ripped (or equivalent) in preparation for seeding with native species as necessary.
- Materials would be selected and drainage designed to minimise erosion of cuts and fills. Materials that have a low resistance to erosion would generally be not used in outer slope fill batters.
- Erosion within and around infrastructure areas would be managed through the minimisation of clearing, rehabilitation, and the installation of appropriate drainage controls, where necessary.
- Where necessary, drainage features such as cut-off drains and bunds would be incorporated onto the tops of cuts and dumps to prevent water filtering down the sides of drains/bunds and causing erosion.
- All employees and contractors involved in establishing and rehabilitating borrow pits would use BHP Billiton Iron Ore's Manual for Borrow Pit Management.
- The layout of infrastructure would be designed to take into account impacts on drainage lines.
- Where possible, the location and layout of infrastructure areas and mine landforms would be designed in a manner such that environmental impacts (including potential changes to existing landforms and drainage channels) are kept to a minimum.
- Residual batters in the pit voids would be left as ROM where geotechnically stable, and profiled as necessary to achieve long-term closure objectives.

Mine Planning

The layout of infrastructure and mine landforms would be designed so that environmental impacts (including potential changes to existing landforms and drainage channels) are kept to a minimum. Figure 3-3 illustrates the decision-making steps and considerations mine planners follow during the planning and design process for major mine landforms, such as OSAs. Section 3.3 describes the LOM planning process. BHP Billiton Iron Ore would implement the LOM planning process during the life of the proposed Cundaline and Callawa mining operations.

Overburden Storage Areas

The following management practices would be employed at each of the proposed Cundaline and Callawa mining operations out-of-pit OSAs:

- An overburden storage construction plan for new OSAs would be developed and incorporated into the LOM plan prior to the commencement of out-of-pit dumping activities. All overburden placement in the new OSAs would be undertaken in accordance with this plan.
- The final rehabilitated designs of OSAs would be similar to the surrounding landforms and consistent with the relevant Guiding Closure Principles (Section 8.2).
- New OSAs would be located in existing valleys and as extensions to the existing ridges rather than new stand-alone emplacements on the valley floor.

Other Visual Impact Management Measures

The following visual impact management measures would be implemented where appropriate:

- designing OSAs to be contiguous with the surrounding ridges;
- progressive rehabilitation;
- visual screens using vegetation and/or earth and rock bunds;
- low impact colour infrastructure (e.g. light yellow, light khaki green, grey, light brown);
- directional lighting or light shielding; and
- general housekeeping (e.g. storage of waste in appropriate facilities).

5.4.3 Outcome

As described in Section 4, a risk assessment was completed for the proposed Cundaline and Callawa mining operations. Based on the implementation of the management measures described above, the risk assessment findings for landforms are summarised below.

Environmental Objectives	Potential Impacts	Management Measures	Severity	Likelihood	Residual Risk*
To ensure as far as practicable, that rehabilitation achieves a stable and functioning landform which is consistent with the surrounding landscape and other environmental values.	Change in surface water flow.	Refer Section 5.4.2.	3	0.3	Minor (0.9)
	Loss of visual amenity.		1	0.3	Minor (0.3)
	Adverse impacts on flora and fauna habitat.		3	0.3	Minor (0.9)
	Erosion of topsoil and waste materials.		3	1	Minor (3)
	Potential for ARD issues, potentially inhibiting rehabilitation success.		1	0.1	Low (0.1)

* Low (0.03 to 0.1); Minor (0.3 to 3); Moderate (9 to 30); Major (90 to 1,000); Critical (3,000 to10,000) (refer Section 4).

5.5 SURFACE WATER RESOURCES

5.5.1 Existing Environment

A description of the surface water features of the Goldsworthy Operations area is contained in the surface water assessment conducted by Aquaterra in 2008 (Appendix F). A summary of the key aspects is provided below.

Regional Hydrology

The Goldsworthy Operations are located in the De Grey River catchment. The De Grey River receives discharges from several large rivers including the Strelley River, Shaw River, Coongan River, Nullagine River and Oakover River, and drains a total catchment area of approximately 50,000 square metres (km^2). (Appendix F). The De Grey River is a major river system with an extensive sediment filled floodplain and numerous tributary rivers and creeks. The river is located some 10 km and 5 km to the south of the proposed Cundaline and Callawa mining operations, respectively (Figure 1-2).

Water quality in the De Grey River is measured at the Coolenar Pool gauging station (WA Department of Water [DoW] gauge S710003) located approximately 100 km west of the Cundaline and Callawa deposits. Monitoring data from this station has indicated typical salinity levels in the river of between 200 and 1,200 milligrams per litre (mg/L) (Appendix F).

Most rivers and creeks in the De Grey basin are ephemeral and only flow following cyclonic activity over the summer months and can have several years of no flow, followed by flood events. The De Grey River has an annual mean flow of around 1,000 gigalitres (GL) per year (Aquaterra, 2005) and is listed in *A Directory of Important Wetlands in Australia* (Environment Australia, 2001).

The coarse and sandy nature of surface soil material in much of the Goldsworthy Operations area (particularly the plains) enable heavy rains to be readily absorbed which limits surface runoff. However, surface water runoff does occur from stony ridges and slopes during heavy rainfall events.

Drainage channels in the Goldsworthy Operations area collect and direct overland flow to the various tributary creeks of the De Grey River including Egg Creek, Eel Creek and Coonieena Creek (Figure 1-2). These creeks are generally dry and sandy with broad channel beds 20 to 100 m wide. Significant flows occur during sustained high intensity rainfall events associated with cyclones and rain depressions. However, on a regional scale Egg Creek, Eel Creek and Coonieena Creek are considered to be very minor tributaries of the De Grey River (Aquaterra, 2008).

Local Hydrology

The Cundaline and Callawa deposits are predominantly located within the Eel Creek catchment which drains southwards into the De Grey River, and drains a total catchment area of approximately 500 km^2 (Appendix F).

The proposed Cundaline and Callawa pits would intercept a combined total catchment area of approximately 1.4 km^2. There are no significant surface drainage features within the proposed disturbance areas.

The proposed Cundaline pits would be located on the crest of the ridge with external drainage around the pit perimeters either draining northwards into the Eel Creek catchment or southwards away from the Eel Creek catchment directly towards the De Grey River via a collection of smaller creeks (Aquaterra, 2008). Locally these smaller creeks have a collective catchment area of around 150 km^2 draining towards the De Grey River (Appendix F). The proposed OSAs, stockpile and associated infrastructure would be located on the northern side of the ridge crest within the Eel Creek catchment. These areas would drain northwards into an eastwards flowing tributary to Eel Creek. The Coonieena Creek lies to the north from the Cundaline deposit and all proposed Cundaline pits and OSAs are located outside of this catchment area.

The proposed Callawa pits would be located on the edge of the ridge with external drainage around the pit perimeters either draining northwards into the Eel Creek catchment or eastwards away from the Eel Creek catchment into an un-named creek (Appendix F). This un-named creek drains southwards to the De Grey River and has a total catchment area of around 80 km^2. External drainage for the OSAs would similarly either discharge northwards into the Eel Creek catchment or eastwards into the same un-named creek.

5.5.2 Potential Impacts and Management Measures

Potential Impacts

Potential impacts on surface water resources include:

- changes to local surface water flow patterns or surface water runoff volumes and quality through the construction of open pits, OSAs and service infrastructure on each of the ridges and adjoining plains;
- adverse impacts on surface water resources due to erosion from disturbed areas and associated downstream sedimentation; and
- adverse impacts on surface water resources due to contamination from chemicals/hydrocarbons.

Due to the small catchment area of the proposed Cundaline and Callawa pits, the potential loss of runoff volume to the downstream creek systems from the pit developments would not be significant when compared to the overall hydrological system, particularly given the natural seasonal variations in catchment runoff (Appendix F). Loss of runoff volume to the downstream catchments from the OSA structures is estimated to be negligible (Appendix F).

The proposed Cundaline and Callawa mining operations would have a localised effect on surface water runoff through the redirection of flow and the development of voids that may intercept minor drainage lines and collect surface water. However, the implementation of surface water management measures is predicted to result in a negligible impact from the proposed operations on local surface water resources (Appendix F).

EPA Objectives

- To maintain the quality and quantity of surface water so that existing and potential environmental values are protected.

Management Measures

Surface water management measures which would be implemented at the proposed Cundaline and Callawa mining operations are described in the EMP (Appendix A) and are summarised below:

- installation of diversion bunding where appropriate along pit perimeters to divert local runoff to the valley floor;
- installation of perimeter safety bunding around all pits to protect against, and potentially divert, any minor nuisance runoff from the surrounding areas;
- installation of perimeter bunding around the proposed OSAs to catch internal potentially sediment laden runoff and divert external runoff, as appropriate;
- installation and maintenance of sediment basin(s) at all potential off-site stormwater discharge points;
- treatment of catchment runoff and internal stormwater collected in pits to remove sediments for use in dust suppression or discharge to the environment in accordance with licence requirements; and
- where required, installation of culverts on haul roads that intercept drainage lines to minimise ponding.

Water management practices that would be implemented at the proposed Cundaline and Callawa mining operations to improve water use efficiency and minimise the potential for sedimentation or contamination are summarised below:

- Sediment control measures (e.g. sediment basins) would be designed and implemented as required downstream of active mine areas, OSAs and other disturbance areas.
- Water quality monitoring and data collection would be conducted during mining operations.
- Wherever practicable, water use would be minimised.
- Controlled wastes, as defined by the *Environmental Protection (Controlled Waste) Regulation, 2004,* would be properly handled prior to removal from the site.
- On-site solid waste disposal would be minimised and properly managed.
- Hazardous substances would be stored in properly bunded facilities to minimise the potential for land, surface water or groundwater contamination.
- Progressive rehabilitation of disturbed areas would be undertaken.
- Maintain a LOM and mine closure topsoil inventory.

5.5.3 Outcome

As described in Section 4, a risk assessment was completed for the proposed Cundaline and Callawa mining operations. Based on the implementation of the management measures described above, the risk assessment findings for surface water are summarised below.

Environmental Objectives	Potential Impacts	Management Measures	Severity	Likelihood	Residual Risk*
To maintain the quality and quantity of surface water so that existing and potential environmental values are protected.	Loss of surface water flow.	Refer Section 5.5.2.	3	0.1	Minor (0.3)
	Loss of water quality through contamination and/or erosion.		3	0.3	Minor (0.9)

* Low (0.03 to 0.1); Minor (0.3 to 3); Moderate (9 to 30); Major (90 to 1,000); Critical (3,000 to 10,000) (refer Section 4).

5.6 GROUNDWATER RESOURCES

5.6.1 Existing Environment

The hydrogeology of the Goldsworthy area is described in the proposed Cundaline and Callawa mining operations Groundwater Assessment undertaken by Aquaterra (2009) (Appendix G). A summary of the key features is provided below.

Overview of the Hydrogeology of the Goldsworthy Area

The local orebody aquifers at the current and previously mined areas at Goldsworthy Operations (i.e. Yarrie, Shay Gap, Sunrise Hill and Nimingarra) are associated with iron ore mineralisation that has developed within distinct BIF horizons. Due to the linear nature of the mineralisation and the tendency for it to be bounded by lower permeability materials such as unmineralised BIF, carbonaceous shales and metamorphosed pillow lavas (e.g. Mount Goldsworthy), granites and mudstones (e.g. Yarrie-Nimingarra), the aquifers are generally of a strip type (along strike) with the main orebodies forming areas of higher permeability (Aquaterra, 2009).

The permeability of the local aquifers varies and is a function of the nature of the mineralisation and the degree of fracturing within each deposit. Generally, the higher the level of mineralisation, the higher the permeability of the orebody aquifer (i.e. the high grade orebodies form zones of higher permeability within the mineralised aquifers).

Recharge is primarily through direct infiltration at the points where the orebodies outcrop. The elevated topography of the mineralised zones and the limited hydraulic connection to the groundwater system on the surrounding plains has resulted in the pre-mining watertable levels in the orebody aquifers commonly being much higher than beneath the surrounding plains (Aquaterra, 2009).

Localised and limited (in areal extent) fractured rock aquifers occur at the Egg Creek, Eel Creek and Cundaline Borefields. These aquifers are likely to be recharged by the infiltration of wet season streamflows into the overlying alluvium at Egg Creek and Eel Creek, and via direct infiltration of runoff into the aquifer at the Cundaline Borefield (Aquaterra, 2009).

The topography to the south of the BIF ridges is dominated by the drainage system of the De Grey River, where a shallow aquifer associated with alluvial sediments within the De Grey River floodplain is located. The topography to the north of the BIF ridges is characterised by flat to gently undulating sand plains with occasional small rocky outcrops and stony hills. Aquifers in this area are associated with hydraulically isolated sedimentary sequences within a broad Jurassic to Cretaceous-aged Canning Basin. This aquifer system is recharged by infiltration of rainfall runoff at the margins of the basin.

Groundwater monitoring at the existing Goldsworthy Operations shows groundwater extracted from mine dewatering bores is typically at or near neutral (i.e. pH 6 to 8) and fresh (Total Dissolved Solids [TDS] of 700 mg/L or less) with little variation recorded over time.

Historical Mine Dewatering Activities at Goldsworthy Operations

Many of the historical Goldsworthy Operations pits have been excavated below the groundwater table and have therefore required the use of dewatering bores and/or sumps. Where mining activities have now ceased, pit lakes have formed in the final voids.

Mine dewatering has been required at Yarrie (e.g. the Y2/3 and Y10 pits), at the Sunrise Hill West 7 pit (SHW7) and the Sunrise Hill 8 pit (SH8), at Shay Gap, and at several pits on the Nimingarra ridge (e.g. Nim A, Nim B, Nim F East, and Nim I). A description of the response of the local groundwater regime to mine dewatering during operations and following the cessation of mining activities at these pits is provided in Appendix G.

In summary, the measured drawdown effect has typically been restricted to the immediate vicinity of the pit (i.e. within several hundred metres), and once dewatering has ceased the groundwater levels have recovered to be at or near the pre-mining levels.

Overview of the Goldsworthy Operations Water Supply Borefields

All current groundwater abstraction at Goldsworthy Operations is conducted in accordance groundwater licences (GWLs) issued under the *Rights in Water and Irrigation Act, 1914* (i.e. GWL107452, GWL153404, GWL107453, GWL107451 and GWL154184), and the GWL Operating Strategy for Goldsworthy Operations. The GWL Operating Strategy is a requirement of the GWLs, and describes the management and monitoring procedures for groundwater at Goldsworthy Operations.

Water supplies for Goldsworthy Operations are currently obtained from the pit dewatering operations and/or licensed borefields. The water supply for Cattle Gorge is provided by a pipeline extension from the existing Yarrie water supply system.

Water supply for the Sunrise Hill and Nimingarra operations is currently sourced from pit dewatering. The Egg Creek Borefield is used to supply make-up water when supply is insufficient at Sunrise Hill and Nimingarra. Where possible, water abstracted from operations that extend below the watertable is also be used as make up raw water (i.e. ore processing and dust suppression) in preference to water pumped from the Shay Gap Borefield.

A review of the existing Goldsworthy borefields (both dewatering and water supply) by Aquaterra (2009) concluded that there have been no significant observed impacts on regional groundwater levels or surface water/groundwater quality as a result of dewatering or dewatering discharge to date (Appendix G).

Hydrogeology of the Cundaline Deposit

The Cundaline deposits lie within the north-west/south-east trending Cundaline ridge, which extends approximately 120 m AHD above the surrounding plain (Section 5.4.1). The geology of the ridge consists of a steeply dipping BIF sequence (Section 5.2.1) unconformably overlying the Muccan Granitoid. The principal aquifer in the area comprises the mineralised zones of the Nimingarra Iron Formation.

Water level information obtained from recent mineral exploration drilling shows groundwater levels ranging between approximately 120 m AHD to approximately 140 m AHD (Appendix G). Water quality sampling undertaken in February and April 2008 as part of the stygofauna survey (Appendix J) showed electrical conductivity was low, averaging 605 microSiemens per centimetre (µS/cm) in February and 530 µS/cm in April. The typical pH of the sampled groundwaters in both February and April was between 6 and 7. The groundwater is hence low in salinity and has a neutral pH.

Hydrogeology of the Callawa Deposit

Hydrogeologically, the Callawa deposit is considered to consist of a mineralised zone of moderate permeability that overlays rock of very low permeability consisting mainly of unmineralised BIF and granite (Aquaterra, 2009). The maximum measured groundwater level was recorded at 227 m AHD, which is approximately 43 m below the ground surface. A steep hydraulic gradient is inferred between the Callawa deposit and the surrounding plain (Aquaterra, 2009), suggesting no connectivity.

Groundwater quality analysis conducted at Callawa in February and April 2008 as part of the stygofauna survey (Appendix J) indicated that the electrical conductivity ranged from 180 µS/cm to 240 µS/cm, and the pH was typically between 5 and 6. The groundwater is hence typically low in salinity and has a neutral to slightly acidic pH.

5.6.2 Potential Impacts and Mitigation Measures

Potential Impacts

Potential impacts on groundwater resources include:

- drawdown of the local watertable at the proposed Callawa mining operation where mine dewatering would be required;
- drawdown of the local watertable at the Shay Gap Borefield; and
- adverse impacts on groundwater quality as a result of potential contamination by hydrocarbons or chemicals.

Potential impacts on groundwater were assessed in the proposed Cundaline and Callawa mining operations Groundwater Assessment undertaken by Aquaterra (2009) (Appendix G). A summary of the findings of the assessment is provided below.

Dewatering

Observed water levels from exploration logs were compared with the proposed pit depth extents for each of the proposed Cundaline pits (Appendix G). Water levels ranged from approximately 120 m AHD to 140 m AHD and proposed pit depths ranged from 150 m AHD to 234 m AHD, indicating that mining at the Cundaline deposit would not intercept the natural watertable and no dewatering would be required (Appendix G).

Observed groundwater levels recorded at the proposed Callawa mining operation ranged from approximately 165 m AHD to 227 m AHD and proposed pit depths ranged from approximately 136 m AHD to 209 m AHD, indicating that all three pits at the proposed Callawa mining operation would intercept the natural watertable and would require dewatering (Appendix G).

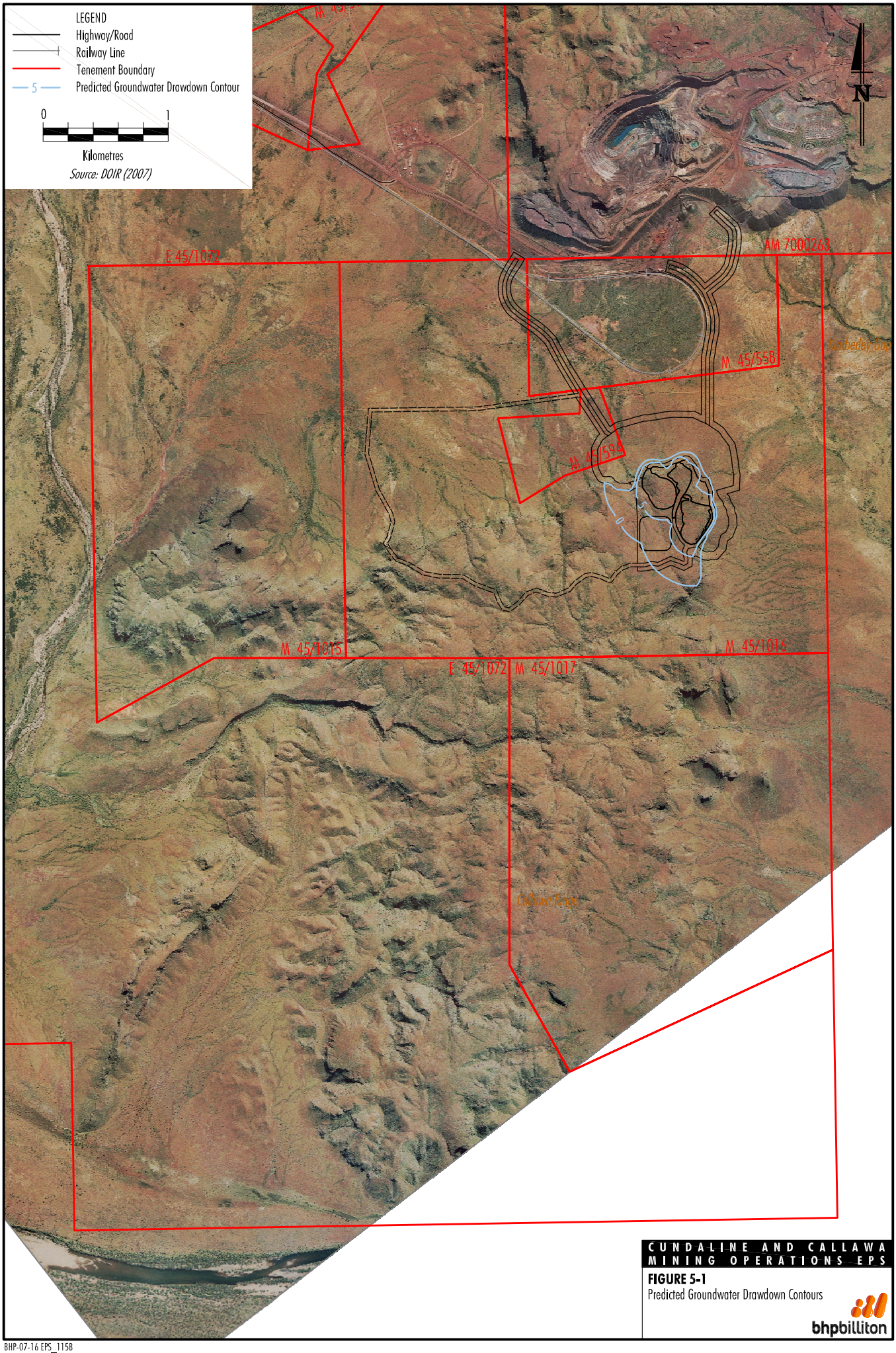
The potential impacts of mining below the groundwater table at the proposed Callawa mining operation were assessed as part of the Groundwater Assessment undertaken by Aquaterra (Appendix G). An analytical model was used to predict the maximum zone of groundwater drawdown as a result of dewatering the proposed Callawa pits. The model indicated that the watertable would decline in the immediate area of each pit as response to dewatering during the period of mining. The depth of drawdown was estimated by Aquaterra (2009) to be less than 5 m at a distance of 100 m from the edge of the pits, and would be less than 0.5 m at a distance of 250 m from the edge of the pits (Figure 5-1).

Water Supply

Water for the proposed Cundaline and Callawa mining operations would be supplied from the Shay Gap Borefield. Water abstracted from dewatering of the proposed Callawa pits would be used for dust suppression in preference to water pumped from the Shay Gap Borefield. All water abstracted from the pits would be used and as such no discharge is required.

No additional impacts on local and regional water resources are predicted as a result of the proposed Cundaline and Callawa mining operations to those which have already been observed to date (Appendix G).

Some minor modifications to the existing Goldsworthy Operations water extraction licences may be required to allow water to be taken and used at the proposed Cundaline and Callawa mining operations (Appendix G).



CUNDALINE AND CALLAWA MINING OPERATIONS EPS

FIGURE 5-1
Predicted Groundwater Drawdown Contours

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Pit Voids

The proposed Callawa pits would be backfilled with overburden to approximately 5 m above the pre-mining watertable upon completion of mining. This would eliminate evaporative losses from the post-mining water balance and the watertable is predicted to recover to near pre-mining levels within five years of cessation of dewatering activities (Aquaterra, 2009). As a result, no long-term impacts on groundwater levels or quality are expected (Appendix G).

EPA Objective

- To maintain the quality and quantity of groundwater so that existing and potential environmental values are protected.

Management Measures

The proposed Cundaline and Callawa mining operations would be managed in accordance with the EMP (Appendix A). Management measures to minimise the potential impacts of the proposed operations on groundwater resources described in the EMP include the following:

- All groundwater abstraction would be managed in accordance with the relevant water extraction licensed under the *Rights in Water and Irrigation Act, 1914* and discharge licensed under Part V of the EP Act.
- Advanced dewatering would be achieved by installing and pumping from dewatering bores and/or from pit sumps. Where possible, the water produced would be used for dust suppression and site water requirements in preference to discharge.
- BHP Billiton Iron Ore would backfill the proposed Callawa pits to at least 5 m above the original groundwater table following the cessation of mining.
- Groundwater levels and water quality would be monitored.

Measures that would be implemented at the proposed Cundaline and Callawa mining operations to minimise the potential for the contamination of groundwater resources are described in the EMP (Appendix A) and are summarised below:

- All storage areas for hazardous substances would be designed and operated in accordance with the relevant legislation and standards.
- Emergency response procedures would be established and used to contain spills and remediate the affected area where necessary.
- Significant release of contaminants would be reported to the WA Department of Environment and Conservation (DEC) in accordance with the emergency notification procedure described in Section 2.2.7.
- Controlled wastes, as defined by the *Environmental Protection (Controlled Wastes) Regulations, 2004,* would be properly handled and stored prior to removal from the site by licensed waste removal contractors.
- Non-controlled wastes would be either collected and temporarily stored prior to being removed for off-site disposal, or disposed in an on-site landfill area.
- Contaminated soil would be appropriately managed in accordance with EP Act Licence Nos. 5611 and 4412 to minimise impacts to groundwater and surface water.

5.6.3 Outcome

As described in Section 4, a risk assessment was completed for the proposed Cundaline and Callawa mining operations. Based on the implementation of the management measures described above, the risk assessment findings for groundwater are summarised below.

Environmental Objectives	Potential Impacts	Management Measures	Severity	Likelihood	Residual Risk*
To maintain the quality and quantity of groundwater so that existing and potential environmental values are protected.	Drawdown of local groundwater levels.	Refer Section 5.6.2.	1	0.3	Minor (0.3)
	Adverse impacts on groundwater quality as a result of potential contamination by hydrocarbons, chemicals or mine waste (i.e. PAF overburden).		3	0.3	Minor (0.9)
	Potential to adversely impact on stygofauna populations at the proposed Callawa mining operation.	-	1	1	Minor (1)

* Low (0.03 to 0.1); Minor (0.3 to 3); Moderate (9 to 30); Major (90 to 1,000); Critical (3,000 to 10,000) (refer Section 4).

5.7 FLORA

Comprehensive flora and vegetation surveys were conducted along the Cundaline and Callawa ridges and slopes by *ecologia* in 2005 (*ecologia*, 2005a, 2005b).

A supplementary survey and assessment for the proposed Cundaline and Callawa mining areas was prepared by ENV Australia in 2008 and is provided in Appendix H.

5.7.1 Existing Environment

Regional and Local Biological Setting

The Interim Biogeographic Regionalisation for Australia (IBRA) divides Australia into 85 bioregions based on major biological and geographical/geological attributes (Thackway and Cresswell, 1995). These bioregions are subdivided into 404 subregions, as part of a refinement of the IBRA framework (Commonwealth Department of the Environment, Water, Heritage and the Arts [DEWHA], 2008a).

The Cundaline and Callawa ridges are located within the north of Chichester IBRA Subregion in the Pilbara IBRA Bioregion (Thackway and Cresswell, 1995; DEWHA, 2008a). While the Great Sandy Desert IBRA Bioregion is approximately 5 km north of the Cundaline ridge (DEWHA, 2008a), the flora of the study area is generally consistent with the flora of the Chichester IBRA Subregion described by Kendrick and McKenzie (2001) as 'plains supporting shrub steppe of *Acacia inaequilatera* and *Triodia wiseana* hummock grasslands, with *Eucalyptus leucophloia* tree steppe on the ranges'.

The Cundaline and Callawa ridges are situated in the Fortescue Botanical District of the Eremaean Botanical Province (Beard, 1980; Van Vreeswyk *et al.,* 2004).

Previous Flora and Vegetation Studies

Broad scale vegetation mapping and descriptions for the Pilbara IBRA Bioregion has been undertaken by Beard (1975). Beard's vegetation mapping has since been digitised and refined by the WA Land Information System (WALIS) (2008). The vegetation within the proposed Cundaline and Callawa mining operations area is broadly mapped as Hummock grasslands: shrub and low tree steppe (after Beard, 1975; WALIS, 2008). Land system mapping for the Pilbara conducted by Van Vereeswyk *et al.* (2004) is discussed in Appendix H.

In addition to the specific flora and vegetation surveys conducted along the Cundaline and Callawa ridges by *ecologia* (2005a, 2005b) and ENV (Appendix H), various other fine-scale flora and vegetation surveys have been conducted over the last 15 years in association with the Goldsworthy Operations. These include the following locations shown on Figure 1-2:

- Yarrie operations, located approximately 2 km north of the proposed Callawa mining operation (Dames and Moore, 1992; Halpern Glick Maunsell, 1998a; *ecologia*, 1994, 1999, 2005c);
- Cattle Gorge operations, located approximately 6 km north-east of the proposed Cundaline mining operation (*ecologia*, 2004a, 2005c);
- Shay Gap operations, located approximately 10 km north-west of the proposed Cundaline mining operation (*ecologia,* 2005c);
- Sunrise Hill operations, located approximately 20 km north-west of the proposed Cundaline mining operation (*ecologia,* 2005c); and
- Nimingarra operations, located approximately 24 km north-west of the proposed Cundaline mining operation (*ecologia,* 2004b, 2005c).

These studies are summarised in Appendix H.

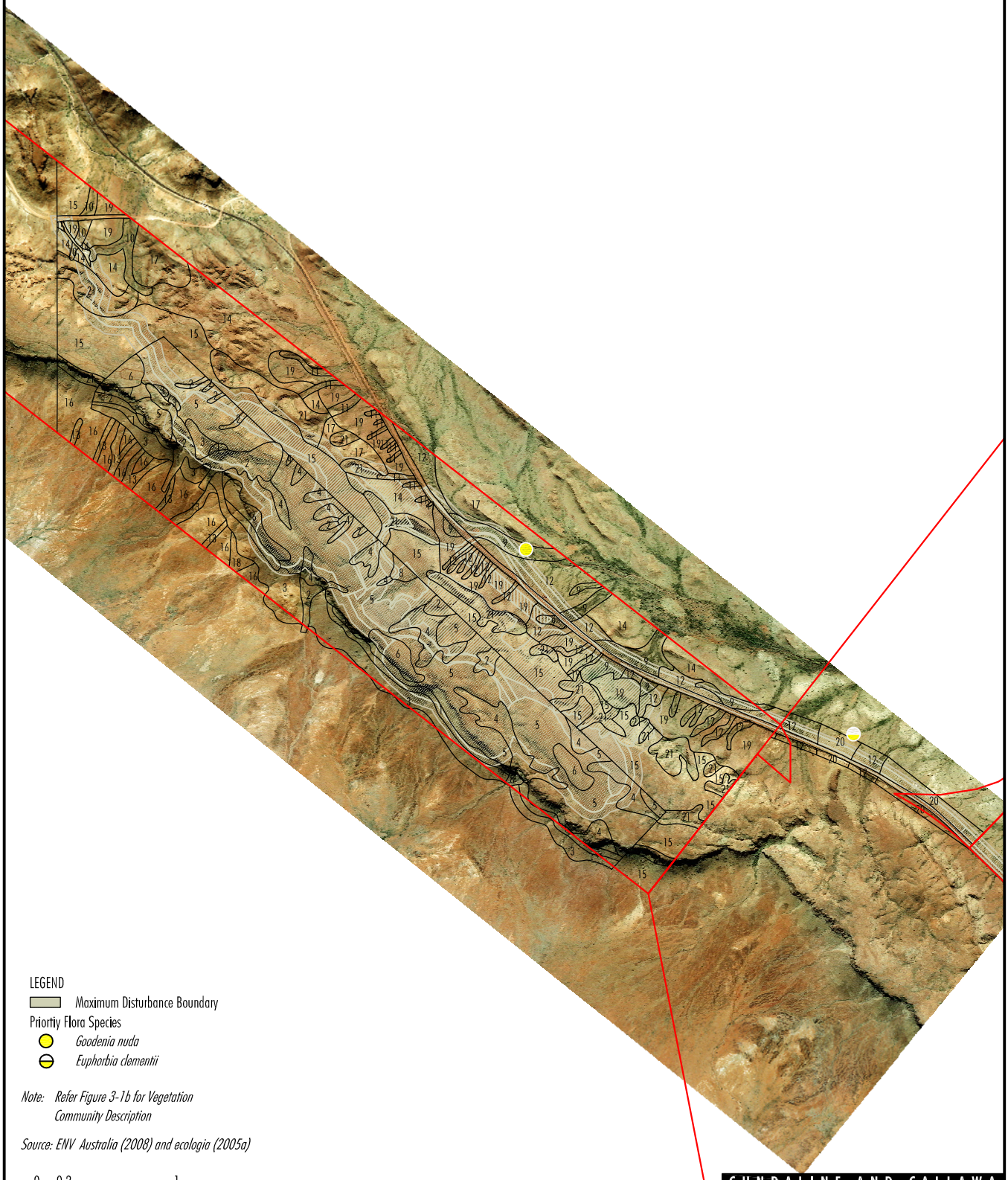
In addition to the above, Ted Griffin and Malcolm Trudgen analysed the floristic variation present in the vegetation quadrat data collected by *ecologia* (2005a, 2005b, 2005c) from Cundaline, Callawa, Nimingarra, Sunrise Hill, Yarrie and Cattle Gorge. The numerical classification package PATN (Belbin, 1987) was used for the analysis (Griffin and Trudgen, 2005). It was found that there were significant similarities between the vegetation communities present at Callawa, Cundaline and Cattle Gorge (Griffin and Trudgen, 2005).

Vegetation Communities

Vegetation communities across the proposed Cundaline and Callawa mining operations area and surrounds were mapped and described by *ecologia* (2005a, 2005b) and ENV Australia (Appendix H). The vegetation communities are represented by grasslands, shrublands and woodlands.

A total of 21 vegetation communities were identified along the Cundaline ridge and surrounding plains (ENV Australia, 2008; *ecologia,* 2005a) (Figures 5-2a and 5-2b). A total of 14 vegetation communities were identified along the Callawa ridge and surrounding plains (ENV Australia, 2008; *ecologia,* 2005b) (Figures 5-3a and 5-3b).

Descriptions of these vegetation communities are provided on Figures 5-2b and 5-3b.



LEGEND

Maximum Disturbance Boundary

Priortiy Flora Species

Goodenia nuda

Euphorbia clementii

Note: Refer Figure 3-1b for Vegetation Community Description

Source: ENV Australia (2008) and ecologia (2005a)

0 0.2 1

Kilometers

ResourceStrategies

CUNDALINE AND CALLAWA MINING OPERATIONS EPS

FIGURE 5-2a

Proposed Cundaline Mining Operation Vegetation Mapping

bhpbilliton

BHP-07-16 EPS_104E

No	Description
1	*Corymbia flavescens* and/or *Atalaya hemiglauca* and/or *Ficus brachypoda* (sometimes with *Eucalyptus leucophloia* subsp. *leucophloia* moderately dense medium forest to sparse low woodland, over medium shrubs such as *Acacia tumida* var. *pilbarensis/Grevillea wickhamii* subsp. *hispidula/G. pyramidalis* subsp. *leucadendron/Petalostylis labicheoides/Flueggea virosa* subsp. *melanthesoides* medium shrubs, over low shrubs such as *Solanum dioicum* and *Indigofera monophylla*, over tussock grasses such as *Cymbopogon ambiguous/Eriachne mucronata* (typical form), over *Triodia epactia* or *T. wiseana* moderately dense to sparse hummock grassland.
2	*Eucalyptus leucophloia* subsp. *leucophloia* (or *Corymbia hamersleyana*) open medium/low woodland or trees (sometimes with *Terminalia canescens* or *C. flavescens*) over *Acacia tumida* subsp. *pilbarensis* (or *Petalostylis labicheoides*) moderately dense to scattered tall/medium shrubland, over medium shrubs such as *A. pyrifolia*, over low shrubs such as *Dampiera candicans/Sida* sp. A Kimberley Flora or *Triumfetta plumigera/T. maconochieana*, over dwarf shrubs such as *Indigofera monophylla* over mixed tussock grass and Spinifex hummock grasses.
3	*Eucalyptus leucophloia* subsp. *leucophloia* open low woodland, over *Hakea chordophylla* scattered tall shrubland, over *Triumfetta maconochieana/Senna glutinosa* subsp. *glutinosa* scattered low shrubland over *Triodia wiseana* moderately dense hummock grassland.
4	*Acacia tumida* var. *pilbarensis* (also with *Grevillea wickhamii* subsp. *hispidula/A. pyrifolia/Petalostylis labicheoides*) moderately dense to open tall/medium shrubland, sometimes with *Corymbia hamersleyana* open low woodland to scattered trees, or with *Eucalyptus odontocarpa* open medium/low mallee, over open to low shrubs such as *Dampiera candicans/A. ptychophylla/Indigofera monophylla* (small calyx form), over tussock grasses and *Triodia epactia* or *T. biflora* hummock grasses.
5	*Grevillea wickhamii* subsp. *hispidula* open to sparse tall/medium shrubland (sometimes with *Corymbia hamersleyana/Acacia pyrifolia/Acacia tumida* var. *pilbarensis*), over *A. ptychophylla/Dampiera candicans* moderately dense to sparse dwarf shrubland (occasionally with *Indigofera monophylla* (small calyx form), over *Goodenia stobbsiana* herbs, over *Triodia epactia* or *T. wiseana* open (to moderately dense) hummock grassland.
6	*Grevillea wickhamii* subsp. *hispidula/Acacia inaequilatera* open medium to tall shrubland, over *Goodenia stobbsiana* scattered herbs, over *Triodia epactia* moderately dense hummock grassland.
7	*Petalostylis labicheoides/Acacia tumida* var. *pilbarensis/Grevillea wickhamii* subsp. *hispidula* moderately dense to sparse medium shrubland (sometimes with *Corymbia hamersleyana* or *C.* aff *hamersleyana*) over *Triodia epactia* moderately dense to sparse hummock grassland.
8	*Grevillea wickhamii* subsp. *hispidula* moderately dense to sparse medium/low shrubland (sometimes with *Eucalyptus leucophloia* subsp. *leucophloia, Petalostylis labicheoides* and *Acacia tumida* var. *pilbarensis* trees and shrubs), over *A. spondylophylla* (and sometimes *Solanum dioicum/Corchorus* spp.)/*A. ptychophylla* moderately dense to scattered low/dwarf shrubland, over *Triodia epactia* moderately dense to sparse hummock grassland.
9	*Corymbia hamersleyana* scattered low trees over *Acacia tumida* var. *pilbarensis*, *A. pyrifolia* and *A. colei* var. *colei* shrubland over *Tephrosia* aff. *rosea* (HD292-37) low shrubland over *Triodia epactia* very open hummock grassland over *Pluchea rubelliflora* and *Stemodia grossa* very open herbland.
10	*Corymbia hamersleyana* scattered low trees over *Acacia tumida* var. *pilbarensis* high shrubland over *Acacia pyrifolia* open shrubland over *A. ptychophylla* and *A. adoxa* var. *adoxa* low scattered shrubs over *Triodia epactia* closed hummock grassland.
11	*Acacia inaequilatera* high open shrubland over *Acacia ptychophylla* low open health over *Triodia epactia* hummock grassland.
12	*Corymbia hamersleyana* low open woodland over *Grevillea wickhamii* subsp. *hispidula* shrubland over *Triodia epactia* hummock grassland.
13	*Grevillea wickhamii* subsp. *hispidula* high open shrubland over *Acacia stellaticeps* open shrubland over *Dampiera candicans* and *Leptosema anomalum* scattered low shrubs over *Triodia epactia* hummock grassland.
14	*Eucalyptus leucophloia* subsp. *leucophloia* low open woodland over *Acacia inaequilatera* open shrubland over *Triodia wiseana* hummock grassland.
15	*Corymbia hamersleyana* and *Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees over *Grevillea wickhamii* subsp. *hispidula* and *Acacia tumida* var. *pilbarensis* high shrubland over *Triodia epactia* hummock grassland.
16	*Grevillea pyramidalis* subsp. *leucadendron* and *G. wickhamii* subsp. *hispidula open* shrubland over *Acacia ptychophylla, A. adoxa* var. *adoxa* and *Tephrosia* aff. *rosea* (HD292-37) low shrubland over *Triodia epactia hummock* grassland.
17	*Corymbia hamersleyana* scattered low trees over *Grevillea wickhamii* subsp. *hispidula* and *Acacia pyrifolia* shrubland over *Triodia epactia* hummock grassland.
18	*Acacia orthocarpa*, *Grevillea pyramidalis* subsp. *leucadendron* and *G. wickhamii* subsp. *hispidula* high shrubland over *Corchorus* aff. *parviflorus* (1)(GLD SRH67-5) and *Acacia adoxa* var. *adoxa* low open shrubland over *Triodia epactia* hummock grassland over *Cymbopogon ambiguus* scattered tussock grasses.
19	*Corymbia hamersleyana* and *Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees over *Acacia ptychophylla* low open shrubland over *A. stellaticeps* low open shrubland over *Triodia epactia* and *T. epactia* closed hummock grassland.
20	*Corymbia hamersleyana* scattered low trees over *Acacia bivenosa* and *A. victoriae* open shrubland over *Triodia wiseana* hummock grassland.
21	*Corymbia hamersleyana*, *C. flavescens* and *Eucalyptus leucophloia* subsp. *leucophloia* low open woodland over *Acacia tumida* var. *pilbarensis* and *Grevillea wickhamii* subsp. *hispidula* open shrubland over *Eriachne mucronata* (typical form) very open tussock grassland over *Triodia biflora*, *T. epactia* and *T. wiseana* hummock grassland.

CUNDALINE AND CALLAWA MINING OPERATIONS EPS

FIGURE 5-2b
Cundaline Vegetation Mapping Description

ResourceStrategies

Source: ENV Australia (2008)

bhpbilliton

CUNDALINE AND CALLAWA MINING OPERATIONS EPS

FIGURE 5-3a

Proposed Callawa Mining Operation
Vegetation Mapping

ResourceStrategies

bhpbilliton

BHP-07-16 EPS_105F

No	Description
1	*Terminalia canescens* and/or *Corymbia flavescens* and/or *Atalaya hemiglauca* and/or *Ficus brachypoda* (sometimes with *Eucalyptus leucophloia* subsp. *leucophloia* or *E. camaldulensis*) moderately dense medium forest to sparse low woodland, over medium shrubs such as *Acacia tumida* var. *pilbarensis*/*Grevillea wickhamii* subsp. *hispidula*/*G. pyramidalis* subsp. *leucadendron*/*Petalostylis labicheoides*/*Flueggea virosa subsp. melanthesoides* medium shrubs, over low shrubs such as *Solanum dioicum* and *Indigofera monophylla*, over tussock grasses such as *Cymbopogon ambiguous*/*Eriachne mucronata* (typical form), over *Triodia epactia*/*T. wiseana* moderately dense to sparse hummock grassland.
2	*Eucalyptus leucophloia* subsp. *leucophloia* (or *Corymbia hamersleyana*) open medium/low woodland or trees (sometimes with *Terminalia canescens* or *C. flavescens*) over *Acacia tumida* subsp. *pilbarensis* (or *Petalostylis labicheoides*) moderately dense to scattered tall/medium shrubland, over medium shrubs such as *A. pyrifolia*, over low shrubs such as *Dampiera candicans*/*Sida* sp. A (Kimberley Flora) or *Triumfetta plumigera*/*T. maconochieana*, over dwarf shrubs such as *Indigofera monophylla*, over mixed tussock grass and Spinifex hummock grasses.
3	*Petalostylis labicheoides*/*Acacia tumida* var. *pilbarensis*/*Grevillea wickhamii* subsp. *hispidula* moderately dense to sparse medium shrubland (sometimes with *Corymbia hamersleyana* or *C.* aff. *hamersleyana*), over *Triodia epactia* moderately dense to sparse hummock grassland.
4	*Grevillea wickhamii* subsp. *hispidula*/*Petalostylis labicheoides*/*Acacia tumida* var. *pilbarensis* open to sparse medium shrubland (sometimes with *Corymbia hamersleyana* [or *C.* aff. *hamersleyana*] or *Eucalyptus leucophloia* subsp. leucophloia low trees), over *Acacia spondylophylla* (or *A. ptychophylla*) sparse dwarf shrubland, occasionally with *Solanum dioicum*/*Goodenia stobbsiana*/*Dampiera candicans*, over *Triodia wiseana* open hummock grassland.
5	Scattered to open medium shrubs such as *Grevillea pyramidalis* subsp. *leucadendron*/*Grevillea wickhamii* subsp. *hispidula*/*Terminalia canescens*/*Atalaya hemiglauca*, over scattered dwarf shrubs such as *Corchorus* aff. *parviflorus* (1)/*Cullen stipulaceum*, over *Triodia wiseana* moderately dense to sparse hummock grassland.
6	*Grevillea wickhamii* subsp. *hispidula* moderately dense to sparse medium/low shrubland (sometimes with *Eucalyptus leucophloia* subsp. *leucophloia*, *Petalostylis labicheoides* and *Acacia tumida* var. *pilbarensis* trees and shrubs), over *A. spondylophylla* (and sometimes *Solanum dioicum*/*Corchorus* spp.)/*A. ptychophylla* moderately dense to scattered low/dwarf shrubland, over *Triodia epactia* moderately dense to sparse hummock grassland.
7	*Corymbia opaca* and *C. flavescens* low woodland over *Grevillea wickhamii* subsp. *hispidula*, *Acacia tumida* var. *pilbarensis* and *A. inaequilatera* high open shrubland over *Hibiscus leptocladus* and *Corchorus elachocarpus* low open shrubland over *Eragrostis cumingii* and **Cenchrus ciliaris* open tussock grassland.
8	*Corymbia hamersleyana* low woodland over *Acacia tumida* var. *pilbarensis*, *A. inaequilatera* and *A. spondylophylla* shrubland over *Triodia epactia* closed hummock grassland.
9	*Grevillea pyramidalis* subsp. *leucadendron* and *G. wickhamii* subsp. *hispidula* shrubland over *Acacia spondylophylla* low shrubland over *Triodia epactia* hummock grassland.
10	*Grevillea wickhamii* subsp. *hispidula* and *G. pyramidalis* subsp. *leucadendron* high open shrubland over *Triodia wiseana* hummock grassland.
11	*Corymbia hamersleyana, C. opaca* and *C. flavescens* low open woodland over *Grevillea wickhamii* subsp. *hispidula* and *G. pyramidalis* subsp. *leucadendron* open shrubland over *Triodia epactia* and *T. wiseana* closed hummock grassland.
12	*Acacia colei* var. *colei*, *A. inaequilatera* and *Grevillea pyramidalis* subsp. *leucadendron* high open shrubland over *Triodia epactia* hummock grassland.
13	*Corymbia flavescens* low woodland over *Acacia tumida* var. *pilbarensis* high shrubland over *Cajanus cinereus* and *Sida rohlenae* subsp. *rohlenae* open low shrubland over *Triodia epactia* open hummock grassland.
14	*Grevillea pyramidalis* subsp. *leucadendron* and *Acacia ptychophylla* open shrubland over *Triodia epactia* open hummock grassland.

ResourceStrategies

Source: ENV Australia (2008)

CUNDALINE AND CALLAWA MINING OPERATIONS EPS

FIGURE 5-3b
Callawa Vegetation Mapping Description

bhpbilliton

BHP-07-16 EPS_008D

No phreatophytic (groundwater dependent) vegetation occurs within the proposed Cundaline and Callawa mining areas.

Conservation Significance of Vegetation Types

No threatened ecological communities under the Commonwealth *Environmental Protection and Biodiversity Conservation Act, 1999* (EPBC Act) have been recorded, or are considered likely to occur, along the Cundaline and Callawa ridges and surrounding plains (*ecologia*, 2005a, 2005b; ENV Australia, 2008).

No priority ecological communities recognised by the DEC have been recorded, or are considered likely to occur, along the Cundaline and Callawa ridges and surrounding plains (*ecologia*, 2005a, 2005b; ENV Australia, 2008).

Flora Species Diversity

During recent surveys, 193 flora taxa were recorded in a study area encompassing the proposed Cundaline mining area and 147 flora taxa were recorded in a study area encompassing the proposed Callawa mining area. The most abundant plant families represented were Poaceae, Papilionaceae, Mimosaceae and Malvaceae (Appendix H).

Threatened and Declared Rare Flora Species

ENV Australia (2008) and *ecologia* (2005a, 2005b) undertook targeted searches in the proposed mining areas and surrounds for threatened flora listed under the EPBC Act and '*Declared Rare Flora*' listed under the WA *Wildlife Conservation Act, 1950* (WC Act).

No threatened flora listed under the EPBC Act or '*Declared Rare Flora*' listed under the WC Act have been recorded along the Cundaline and Callawa ridges and surrounding plains (*ecologia*, 2005a, 2005b; ENV Australia, 2008).

Priority Flora Species

The DEC maintains a list of priority flora taxa, which are considered poorly known, uncommon, or under threat, but for which there is insufficient justification based on known distribution and population sizes for inclusion under the declared rare schedules of the WC Act.

ENV Australia (2008) and ecologia (2005a, 2005b) undertook targeted searches in the proposed mining areas and surrounds for priority flora taxa. Three priority species have been recorded during the surveys, namely, *Euphorbia clementii* (Priority 2), *Euphorbia inappendiculata* (Priority 3), and *Goodenia nuda* (Priority 3). These priority flora species are discussed below.

<u>Euphorbia clementii</u>

Euphorbia clementii is an erect herb which grows to approximately 0.6 m in height, and is usually found on gravelly hillsides and stony grounds (DEC, 2008a). ENV Australia (Appendix H), describe that this species is known to appear particularly after fire.

This species has previously been recorded outside the proposed disturbance areas on the Yarrie plateau (*ecologia*, 1999) and at the Nimingarra mining operation outside disturbance areas (*ecologia,* 2004b).

ENV Australia recorded *Euphorbia clementii* in a stony plain outside the proposed disturbance area for the Cundaline mining operation (Appendix H; Figure 5-2a). It was not recorded by *ecologia* (2005a, 2005b).

Euphorbia inappendiculata

Euphorbia inappendiculata is a herb which grows to approximately 0.4 m in height (DEC, 2008a). It was previously known as *Euphorbia drummondii* subsp. Pilbara until a recent name change (DEC, 2008a). *Euphorbia inappendiculata* is known from rocky screes (DEC, 2008a).

This species was recorded by *ecologia* (1999) on the plains between Yarrie and the proposed Callawa mining operation (Figure 5-3a). It was not recorded in the proposed disturbance area for the proposed Cundaline or Callawa mining operations despite a targeted survey by ENV Australia (Appendix H).

Goodenia nuda

Goodenia nuda is a herb which grows to approximately 0.5 m in height (DEC, 2008a). The species produces yellow flowers from April to August.

ENV Australia recorded *Goodenia nuda* in a drainage line outside the proposed disturbance area for the Cundaline mining operation (Appendix H; Figure 5-2a). It was not recorded by *ecologia* (2005a, 2005b).

This species has not previously been recorded in the Goldsworthy Operations area, with most historical records for this species located in central Pilbara, near Newman (DEC, 2008a).

Other Species of Interest

Specimens of *Stemodia* sp.[3] and *Sida* sp.[4], which are reported to be undescribed, were recorded in the study areas by *ecologia* (2005a, 2005b). A description of the specimens is provided in Appendix H.

Specimens of *Stemodia* were recorded from two locations on the Cundaline ridge and at 13 locations on the Callawa ridge (*ecologia,* 2005a, 2005b). The number of plants at each location was estimated to range up to 100 or more plants (*ecologia,* 2005a, 2005b). A total of 452 plants were recorded on the Callawa ridge and 32 plants were recorded on the Cundaline ridge (*ecologia,* 2005a, 2005b). The *Stemodia* sp. has been recorded at three locations at Sunrise Hill (*ecologia*, 2005c).

Specimens of *Sida* were recorded from one site on the Cundaline ridge and eight sites on the Callawa ridge. The numbers of plants at each location were not reported by *ecologia* (2005a, 2005b).

Ecologia and Malcolm Trudgen have not lodged specimens of the *Stemodia* sp. or *Sida* sp. with the Western Australian Herbarium, so the taxonomy of the species has not been resolved. BHP Billiton Iron Ore contacted Robyn Barker (State Herbarium of South Australia) to confirm the taxonomy of the *Sida* and *Stemodia*. Whether or not the *Sida* and *Stemodia* recorded in the Goldsworthy area are determined to be new species, the assessment provided in Section 5.7.2 would not change.

[3] Referred to by *ecologia* as *Stemodea* sp. Shay Gap.

[4] Referred to by *ecologia* as *Sida* sp. Callawa.

Introduced Flora Species and Declared Weeds

Six introduced flora species were recorded during the surveys, namely, *Cenchrus ciliaris, Portulaca oleracea, Chloris virgata* and *Cucumis melo* subsp. *agrestis* on the plains below the Cundaline ridge (Figure 5-4). *Cenchrus ciliaris, Echinochloa colona*, *Chloris virgata, Portulaca oleracea* and *Passifloria foetida* var. *hispida* were recorded on the plains below the Callawa ridge (Figure 5-5) (Appendix H).

No 'declared plants' listed under the WA *Agriculture and Related Resources, and Protection Act, 1976* (ARRP Act) have been recorded at the Cundaline and Callawa areas (after Appendix H; *ecologia* 2005a, 2005b).

5.7.2 Potential Impacts and Management Measures

Potential Impacts

Vegetation Clearance

The main potential impacts of the proposed Cundaline and Callawa mining operations on flora would be through the direct loss of approximately 500 ha of grassland, shrubland and woodland vegetation.

The vegetation communities which would be cleared for the proposed Cundaline mining operation are shown on Figure 5-2a and described on Figure 5-2b. The vegetation communities which would be cleared for the proposed Callawa mining operation are shown on Figure 5-3a and described on Figure 5-3b.

ENV Australia (2008) report that the proposed Callawa mining operation is unlikely to have a significant impact on these vegetation communities given that they occur more widely and none are of conservation significance.

Bushfire Risk

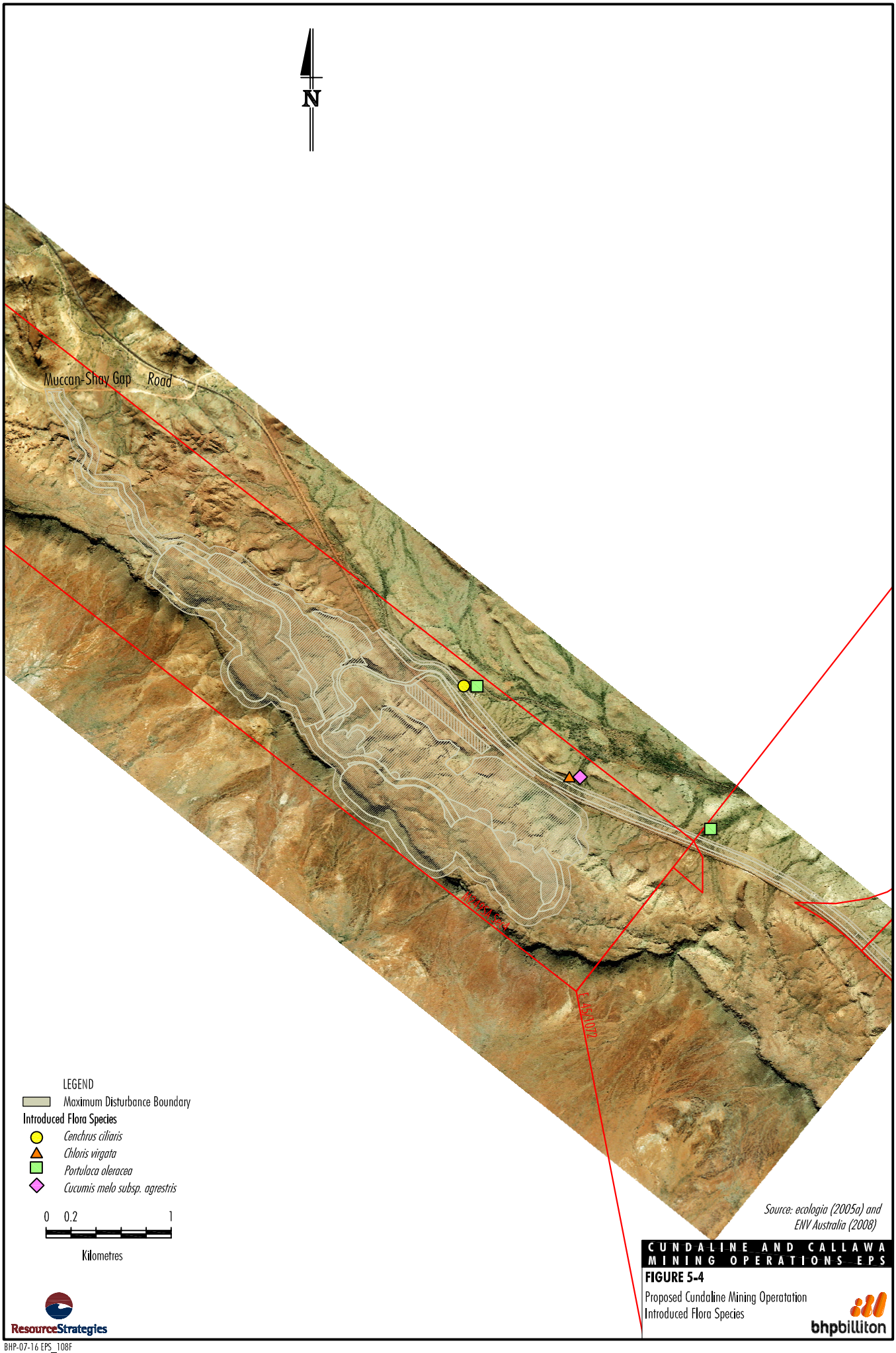
The proposed Cundaline and Callawa mining operations may increase the risk of bushfire due to land clearing and mining operations, which could have a potentially adverse impact on vegetation.

Considering the measures to manage bushfire outlined in the Goldsworthy Operations EMP (BHP Billiton Iron Ore, 2007a) (e.g. fire hazard awareness and management training), it is considered that the continuation of those measures for the proposed Cundaline and Callawa mining operations would minimise potential impacts on flora.

Introduced Flora Species

Introduced flora species may be dispersed during clearing by soil movement or from seeds present on heavy machinery. The increase in traffic associated with mining operations may also aid the spread of introduced flora species.

Considering the measures to manage introduced flora outlined in the Goldsworthy Operations EMP (BHP Billiton Iron Ore, 2007a) (e.g. weed management and monitoring), it is considered that the continuation of those measures for the proposed Cundaline and Callawa mining operations would minimise potential introduced flora impacts on native flora.



CUNDALINE AND CALLAWA MINING OPERATIONS EPS

FIGURE 5-4

Proposed Cundaline Mining Operatation
Introduced Flora Species

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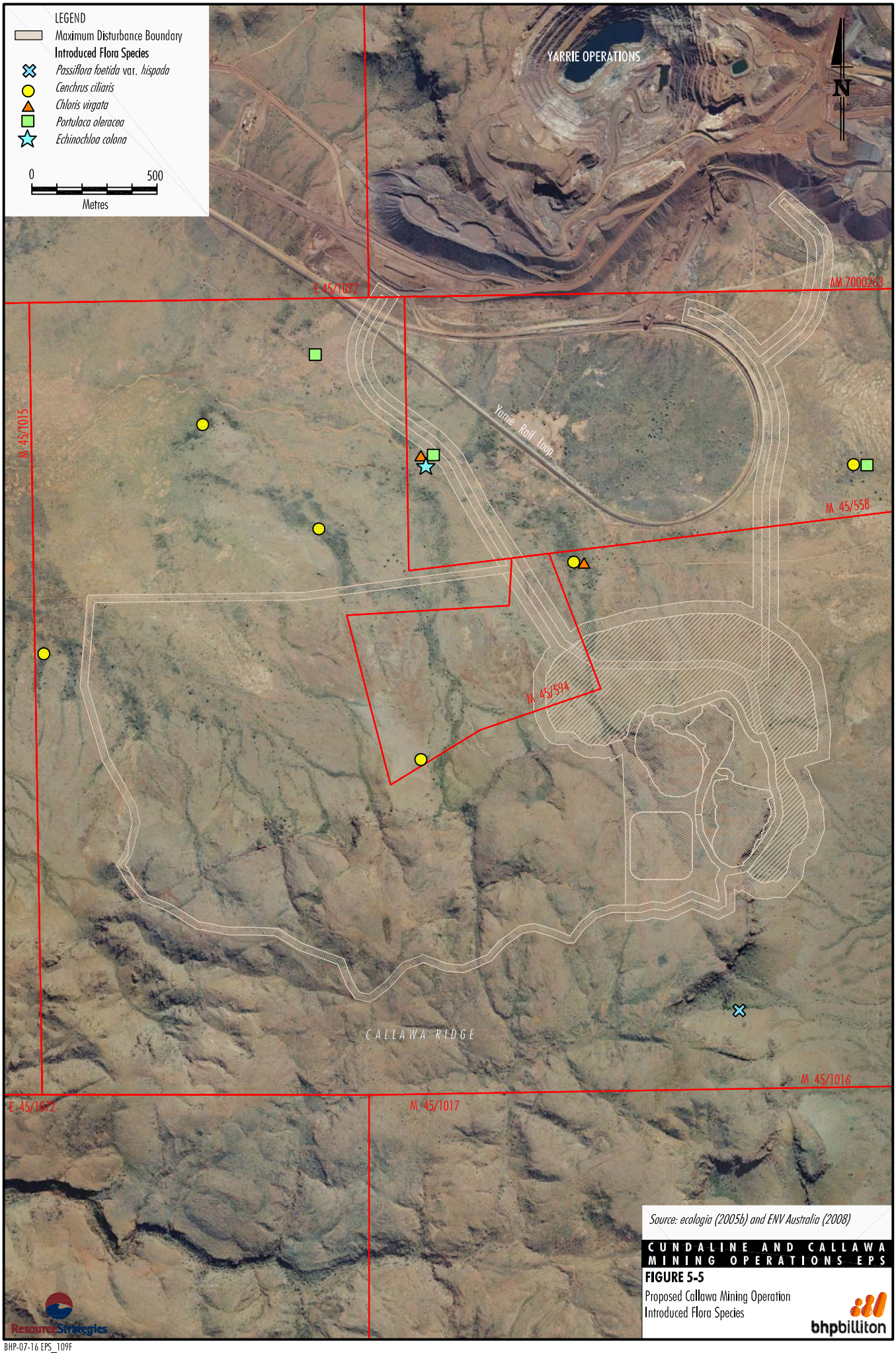

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Dust

Dust caused by clearing and mining activities at the proposed Cundaline and Callawa mining operations may potentially have an adverse impact on surrounding vegetation.

Considering the measures to manage dust outlined in the Goldsworthy Operations EMP (BHP Billiton Iron Ore, 2007a) (e.g. watering of haul roads), it is considered that the continuation of those measures for the proposed Cundaline and Callawa mining operations would minimise potential impacts on flora.

Conservation Significant Flora Species

No threatened species listed under the EPBC Act or 'Declared Rare Flora' listed under the WC Act are likely to be impacted by the proposed Cundaline and Callawa mining operations.

As discussed in Section 5.7.1, three priority species have been recorded in the surrounds, namely, *Euphorbia clementii* (Priority 2), *Euphorbia inappendiculata* (Priority 3) and *Goodenia nuda* (Priority 3). These priority flora species are unlikely to be significantly impacted by the proposed Cundaline and Callawa mining operations. The management of these flora species is addressed within the SSMP (Appendix C).

Flora Species of Interest

As discussed in Section 5.7.1, specimens of *Stemodia* sp. and *Sida* sp., which are reported to be undescribed, were recorded by *ecologia* (2005a, 2005b).

Neither species is formally recognised or catalogued at the WA Herbarium. Although the locations at which the specimens were recorded on the Cundaline ridge would be impacted, a significant impact on these species is unlikely as:

- The survey results over the last four years suggest that both *Stemodia* sp. and *Sida* sp. occur more widely across the ridges in the Goldsworthy area.
- Specimens of *Stemodia* sp. have been recorded outside the proposed disturbance area on the Cundaline ridge and specimens of *Sida* sp. have been recorded outside the proposed disturbance area on the Callawa ridge.
- Potential habitat for these species occurs on Callawa ridge, Cundaline ridge, Cattle Gorge plateau, Mundarinya ridge, Shay Gap ridge and Sunrise Hill ridge.
- Locations of *Stemodia* sp. and *Sida* sp. at Callawa ridge and Sunrise Hill ridge would not be impacted as part of the proposed Cundaline and Callawa mining operations, including a substantial size population of *Stemodia* sp. (in the order of 452 plants) recorded by *ecologia* on the Callawa ridge.

EPA Objectives

- To maintain the abundance, species diversity, geographic distribution and productivity of flora at a species and ecosystems level through the avoidance or management of adverse impacts and improvement in knowledge.

Management Measures

The proposed Cundaline and Callawa mining operations would be managed in accordance with the EMP (Appendix A), SSMP (Appendix C) and WMP (Appendix D). The main aspects of flora and vegetation management described in these management plans are provided below.

Operational Measures

Specific management strategies that would be applied at the proposed Cundaline and Callawa mining operations are described in the EMP (Appendix A) and are summarised below:

- Pits and OSAs would be designed to limit land clearing to the practicable minimum. This would be achieved through the consideration of mine sequencing across the whole lease (i.e. use of mined out scree and hard rock deposits for overburden disposal rather than clearing new areas).
- Vehicles and machinery would be parked only in designated locations and off-road recreational activities would be prohibited.
- Dust control measures such as road watering, use of sprays on the main ore transfer points, and progressive rehabilitation of disturbed areas would be used to minimise dust generation from the site.
- Where possible proposed clearing boundaries would be adjusted to avoid disturbance to known significant flora/fauna species, vegetation associations and/or habitat areas.
- Where it is not practicable to avoid known significant flora/fauna species, vegetation associations and/or habitat areas, BHP Billiton Iron Ore would consult with the DEC regarding the proposed land disturbance.

Management of Fire Regime

While fire is accepted to be a part of the natural Pilbara landscape, BHP Billiton Iron Ore would implement several control measures at the proposed Cundaline and Callawa mining areas to minimise the potential for significant anthropogenic changes to the local fire regime. These would include the following:

- Fire hazard awareness and management training would be provided to BHP Billiton Iron Ore personnel and contractors.
- Fire-fighting equipment would be provided in work areas according to fire hazard.
- Fire-fighting equipment would be regularly inspected and maintained.
- Where necessary, controlled burns would be conducted in consultation with relevant government agencies in order to reduce local fuel loads.
- Fire breaks surrounding the ETL and dewatering pipeline would be graded as required.

Management of Weed Species

Management measures that would be undertaken at the proposed Cundaline and Callawa mining operations to minimise the potential for the spread of weed species include the following:

- Areas of known weed infestation would be shown on mine plans and marked on the ground in order to minimise the potential for inadvertent access and spread of weeds.

- Mobile machinery and equipment would be cleaned on a regular basis, with particular attention being given to machinery that operates in areas of known weed infestation.
- Topsoil that is stripped from areas known to be infested with weeds would be quarantined from clean topsoil stripped from other areas.
- Regular inspections for the presence of weeds within areas of disturbance would be conducted.

Management of Flora Species of Conservation Significance

The SSMP (Appendix C) contains 'general' management practices to be implemented to minimise the impact of the mining operations on flora and fauna, as well as 'specific' management measures for species of conservation significance.

The SSMP includes a three level management hierarchy that has been developed by BHP Billiton Iron Ore to broadly classify and assign the appropriate level of management response for significant species. A summary of the management hierarchy is provided in Table 5-2.

Table 5-2
BHP Billiton Iron Ore's Management Hierarchy for Significant Species at the Proposed Cundaline and Callawa Mining Operations

	BHP Billiton Iron Ore's Management Hierarchy for Significant Species at the Proposed Cundaline and Callawa Mining Operations		
	1	2	3
Summary of Category	Species likely to be impacted in the next five years (i.e. period covered by the SSMP).	Species unlikely to be impacted in the next five years (i.e. period covered by the SSMP).	Species not previously identified at the proposed Cundaline and Callawa mining operations but suitable habitat is available and therefore could potentially occur.

The management measures assigned to significant species within each level of the management hierarchy are described in the SSMP, and are summarised below.

Table 5-3 shows the classification of species recorded in surveys conducted for the proposed Cundaline and Callawa mining operations.

Table 5-3
Management of Significant Flora Species at the Proposed Cundaline and Callawa Mining Operations

Species	Conservation Classification	BHP Billiton Iron Ore Management Hierarchy
Euphorbia clementii	P2[1]	Level 1
Goodenia nuda	P2[1]	Level 2
Euphorbia inappendiculata	P3[1]	Level 2

[1] DEC (2008b).

'Level 1' Significant Species

Species classified as 'Level 1' require the highest degree of management, as they are known to occur in or near to proposed disturbance areas and are therefore more likely to be directly impacted. In order to minimise potential impacts on Level 1 significant species, mine planning, general, and species-specific management measures would be implemented as described in the SSMP. There was one Level 1 significant species identified during surveys conducted for the proposed Cundaline and Callawa mining operations *viz. Euphorbia clementii.* This species was classified as a 'Level 1' priority in the previous SSMP (BHP Billiton Iron Ore, 2007b) on the basis that it was recorded in the vicinity of the Yarrie operations disturbance area.

'Level 2' Significant Species

Species classified as 'Level 2' require specific monitoring, but fewer management measures, as they are considered unlikely to be directly impacted over the next five years. There were two Level 2 significant species identified during surveys conducted for the proposed Cundaline and Callawa mining operations *viz. Euphorbia inappendiculata* and *Goodenia nuda.*

'Level 3' Significant Species

Species classified as 'Level 3' significant species would be managed by implementing the general management measures described in the SSMP. There were no Level 3 significant species identified during surveys conducted for the proposed Cundaline and Callawa mining operations.

5.7.3 Outcome

As described in Section 4, a risk assessment was completed for the proposed Cundaline and Callawa mining operations. Based on the implementation of the management measures described above, the risk assessment findings for flora are summarised below.

Environmental Objectives	Potential Impacts	Management Measures	Severity	Likelihood	Residual Risk*
To maintain the abundance, species diversity, geographic distribution and productivity of flora at a species and ecosystems level through the avoidance or management of adverse impacts and improvements in knowledge.	Removal/modification of flora and their habitat.	Refer Section 5.7.2.	1	0.03	Low (0.03)
	Removal of vegetation communities.		1	0.03	Low (0.03)
	Changing vegetation structure and composition.		3	0.3	Minor (0.9)

* Low (0.03 to 0.1); Minor (0.3 to 3); Moderate (9 to 30); Major (90 to 1,000); Critical (3,000 to 10,000) (refer Section 4).

5.8 TERRESTRIAL VERTEBRATE FAUNA

Comprehensive vertebrate fauna surveys were conducted along the Cundaline and Callawa ridges and slopes by *ecologia* in 2005 (*ecologia*, 2005a, 2005b).

A supplementary survey and assessment for the proposed Cundaline and Callawa mining areas was prepared by Outback Ecology in 2008 and is provided in Appendix I.

5.8.1 Existing Environment

Regional and Local Biological Setting

The regional and local biological setting is described in Section 5.7.1.

Vertebrate Fauna Surveys

Vertebrate fauna surveys of the Cundaline and Callawa areas were conducted in 2005 by *ecologia* (2005a, 2005b). These vertebrate fauna surveys are supported by results from a number of vertebrate fauna surveys that have been conducted in the surrounding Goldsworthy area for mining developments such as:

- Yarrie operations, located approximately 2 km north of the proposed Callawa mining operation (Dames and Moore, 1992; *ecologia*, 1999);
- Cattle Gorge operations, located approximately 6 km north-east of the proposed Cundaline mining operation (*ecologia*, 2004a, 2005d);
- Shay Gap operations, located approximately 10 km north-west of the proposed Cundaline mining operation (*ecologia*,2005c);
- Sunrise Hill operations, located approximately 20 km north-west of the proposed Cundaline mining operation (*ecologia*,2005c); and
- Nimingarra operations, located approximately 24 km north-west of the proposed Cundaline mining operation (*ecologia*, 2005c, 2005d).

These studies are summarised in Appendix I.

Monitoring of the Western Pebble-mound Mouse was undertaken at the Yarrie operations between 1993 and 1998 (Piggot, 1993, 1994a, 1994b, 1995; Halpern Glick Maunsell, 1997a, 1997b, 1997c, 1998b). The monitoring concluded following the delisting of the species under the WC Act and the removal of the commitment from within the Yarrie Mine Ministerial Conditions through consultation with the WA Department of Conservation and Land Management (CALM) (now the DEC).

Quarterly bat monitoring has also been undertaken in the Goldsworthy area since 2004 in accordance with the *Management Plan for Bat Species* (Appendix I) (*ecologia*, 2005e, 2006a, 2006b, 2006c, 2007; ENV Australia, 2007a, 2007b; Specialised Zoological, 2008a, 2008b). This has included monitoring of a cave at the Cundaline ridge and a cave on the Callawa ridge.

BHP Billiton Iron Ore commissioned Mohlar Pty Ltd to conduct genetic studies on the Pilbara Leaf-nosed Bat to increase the understanding of the Pilbara Leaf-nosed Bat at a State and National level through building a genetic database spanning different bat populations. The initial study results are indicating an emerging pattern of population connection between Pilbara Leaf-nosed Bats from Goldsworthy and Bamboo Creek (located 30 km south of the Yarrie Ridge) (Mohlar, 2008).

In 2008, Outback Ecology conducted a vertebrate fauna assessment of the proposed Cundaline and Callawa mining operations using the results from the surveys discussed above as well as conducting a habitat assessment of the Cundaline and Callawa areas (Appendix I).

Vertebrate Fauna Survey Methods

In 2005, *ecologia* (2005a, 2005b) used the following methods during the vertebrate fauna surveys of the Cundaline and Callawa areas:

- trapping (i.e. funnel, pit, cage and Elliot traps);
- bird census;
- bat detection;
- secondary evidence searches;
- spotlighting; and
- opportunistic records (i.e. the presence of species were recorded while traversing the survey area).

The methodology is further described in Appendix I.

In 2008, Outback Ecology conducted a qualitative assessment of the fauna habitat present within the Cundaline and Callawa areas (Appendix I). The assessment considered the landscape features, estimate of litter cover percentage and type, soils, outcropping, estimate percentage of bare ground and types of disturbance (e.g. evidence of fire, tracks); and the levels of disturbance in terms of the effect that it has had on the vegetation (e.g. density of overstorey vegetation, density of shrubs).

Vertebrate Fauna Habitat Resources

Outback Ecology (Appendix I) recorded the following broad fauna habitat types within the Cundaline and Callawa areas:

- *Drainage lines* – consists of steep to moderately rocky slopes, descending down to stony soils and silty to gritty alluvium. Shrubs and grasses dominate, such as *Themeda* sp., *Eragrostis* sp. and *Triodia* sp. This habitat type supports a number of bird, reptile and mammal species that use the embankments, litter layer and caves and surface water rock pools that may be associated with the drainage lines.
- *Hilltops* – generally consist of large rock outcrops and stony skeletal soils, supporting only sparse vegetation, dominated by grasses, such as *Triodia* sp. These habitats support a limited number of fauna species due to the lack of shelter in the form of leaf litter, bark and woody debris.

- *Ridges* - consists of exposed rock and bare skeletal soils overlying large cliffs above vegetated slopes below. Vegetation is generally comprised of *Eucalyptus* sp., *Acacia* sp. and *Ficus* sp. This habitat type supports a number of vertebrate fauna species that use caves and crevices in the cliff face and the sheltered vegetation below the ridge. Ridges also provide the highest potential for bat habitat in the region.
- *Slopes and plains* - consists of sparse eucalypts and fairly dense Spinifex, and generally supports only a moderate number of species.

All habitats present over the study area are widely represented throughout the region, and the vertebrate fauna assemblage recorded is similar to other regional sites (Appendix I).

Fauna Species Composition

A total of 12 mammal species (11 native), 40 birds, 18 reptiles and one amphibian were identified during the Cundaline field survey (*ecologia*, 2005a). The Callawa field survey yielded 13 native mammal species, 42 birds, 18 reptiles and one amphibian (*ecologia*, 2005b).

Introduced Fauna Species and Declared Animals

Four introduced fauna species have been recorded during the various surveys in the Goldsworthy area, namely the House Mouse, Dingo, Feral Cat and European Cattle (*ecologia,* 2005a, 2005b, 2005c). Of these, only the Dingo has been recorded within the Cundaline and Callawa areas (*ecologia,* 2005a, 2005b).

The Dingo is only introduced fauna species previously recorded which is listed as a 'Declared Animal' under the ARRP Act.

Threatened and Specially Protected Fauna Species

Table 5-4 provides a list of threatened fauna species listed under the EPBC Act and/or WC Act which have been recorded in the Cundaline and Callawa areas and wider surrounds.

Four fauna species listed as threatened under the EPBC Act and/or the WC Act have been recorded in the Cundaline and Callawa areas (Table 5-4 and Figures 5-6 and 5-7). An additional species, the Mulgara, has been recorded in the surrounding area. The species listed in Table 5-4 are discussed below.

Table 5-4
Threatened Fauna Species

Scientific Name	Common Name	Conservation Status[1]		Recorded in the Cundaline and/or Callawa Areas	Recorded in the Locality
		EPBC Act	WC Act		
Mammals					
Dasyurus hallucatus	Northern Quoll	EN	-	2,3	4,5,6,7,8,9,11,12
Rhinonicterus aurantius (Pilbara form)	Pilbara Leaf-nosed Bat	VU	S1	2,3,11	5, 6,10
Dasycercus cristicauda	Mulgara	VU	S1	-	5
Birds					
Falco peregrinus	Peregrine Falcon	-	S4	2	-
Reptiles					
Liasis olivaceus barroni	Pilbara Olive Python	VU	S1	2	5,9

1 EPBC Act:
VU Vulnerable, EN Endangered.
WC Act:
Schedule 1: Fauna that is rare or is likely to become extinct.
Schedule 4: Other specially protected fauna.

2 Recorded at the Cundaline area (*ecologia*, 2005a).

3 Recorded at the Callawa area (*ecologia*, 2005b).

4 Recorded at Cattle Gorge, located approximately 6 km north-east of the proposed Cundaline mining operation (*ecologia*, 2004a).

5 Recorded at Cattle Gorge, located approximately 6 km north-east of the proposed Cundaline mining operation (*ecologia*, 2005c).

6 Recorded at Nimingarra, located approximately 5 km north-east of the proposed Cundaline mining operation (*ecologia*, 2005c).

7 Recorded at Sunrise Hill, located approximately 20 km north-west of the proposed Cundaline mining operation (*ecologia*, 2005c).

8 Recorded at Yarrie operations, located approximately 15-20 km north-west of the proposed Cundaline mining operation (*ecologia*, 2005c).

9 Recorded at Yarrie operations, located approximately 2 km north of the proposed Callawa mining operation (Dames and Moore, 1992).

10 Recorded at Cattle Gorge, located approximately 6 km north-east of the proposed Cundaline mining operation and Nimingarra, located approximately 24 km north-west of the proposed Cundaline mining operation (*ecologia*, 2005d).

11 Recorded during quarterly bat monitoring (*ecologia*, 2005e, 2006a, 2006b, 2006c; ENV Australia, 2007b; Specialised Zoological, 2008a, 2008b).

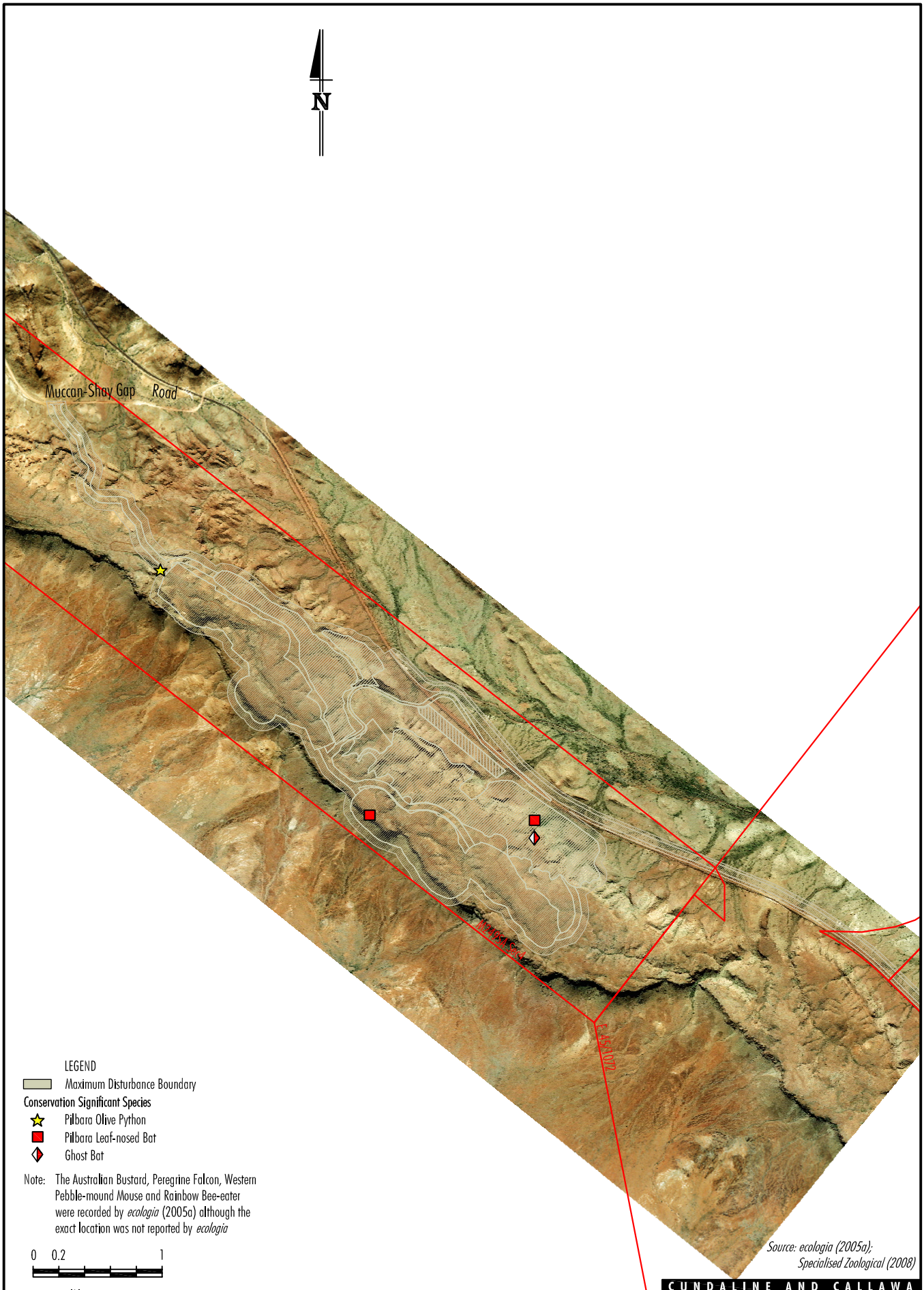
12 Recorded during quarterly bat monitoring at Cattle Gorge (ENV Australia, 2007a).

Northern Quoll

The Northern Quoll is a carnivorous marsupial which is predominantly nocturnal (DEWHA, 2008a). This species occurs in a wide range of habitats (Woinarski *et al.*, 2006), but favours wooded habitats, and rocky escarpments (Van Dyck and Strahan, 2008) where it makes its dens in rock crevices, tree holes or occasionally termite mounds (DEWHA, 2008a). In WA this species is known from multiple islands and on the mainland in the Pilbara and Kimberly regions (DEWHA, 2008a).

The proposed Cundaline and Callawa mining operations occur on the edge of the distribution of the Northern Quoll in the Pilbara (after DEWHA, 2008a). The Northern Quoll was recorded at the proposed Callawa mining operation area in 2005 (*ecologia*, 2005b) (Figure 5-7). This species has also been recorded at Cattle Gorge (approximately 6 km north-east of the proposed Cundaline mining operation) (*ecologia*, 2004a, 2005c), Nimingarra (approximately 24 km north-west of the proposed Cundaline mining operation) and Sunrise Hill (approximately 20 km north-west of the proposed Cundaline mining operation) (*ecologia*, 2005c) and Yarrie operations (approximately 2 km north of the proposed Callawa mining operation) (Dames and Moore, 1992).

The various records of this species across the Goldsworthy Operations area indicate that the wooded habitats and rocky escarpments in the Goldsworthy Operations area provide habitat for resident Northern Quoll.



CUNDALINE AND CALLAWA MINING OPERATIONS EPS

FIGURE 5-6

Proposed Cundaline Mining Operation
Conservation Significant Fauna Species

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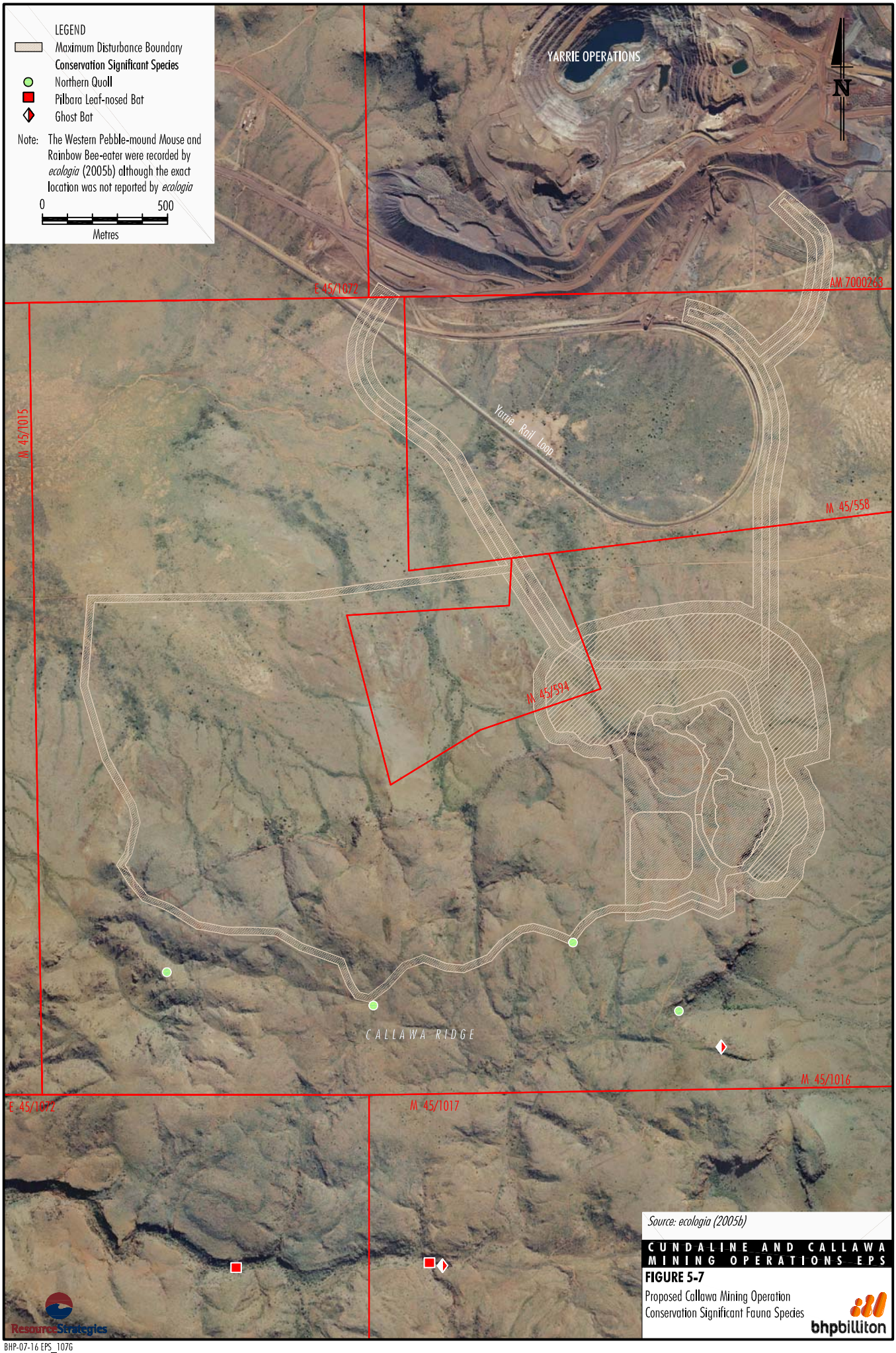

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Pilbara Leaf-nosed Bat

The Pilbara Leaf-nosed Bat is restricted to the Pilbara region, in three subpopulations: (1) eastern Pilbara mines and granite; 2) Hamersley Range; and 3) Upper Gascoyne (DEWHA, 2008a). The Pilbara Leaf-nosed Bat roosts in humid caves, crevices and mine shafts (Van Dyck and Strahan, 2008).

Prior to 2004, no Pilbara Leaf-nosed Bats or calls had been recorded in the Goldsworthy area. In 2004, BHP Billiton Iron Ore commissioned *ecologia* to undertake baseline fauna and flora surveys of the Nimingarra, Sunrise Hill and Cattle Gorge ridges (*ecologia*, 2005c). During the survey, *ecologia* recorded the Pilbara Leaf-nosed Bat on the Nimingarra ridge (approximately 24 km north of the proposed Cundaline mining operation) (*ecologia*, 2005c, 2005d) and to the south-east of Cattle Gorge (approximately 6 km north-east of the proposed Cundaline mining operation) (*ecologia*, 2005c, 2005d).

The Pilbara Leaf-nosed Bat was recorded at both the Cundaline and Callawa areas in 2005 (*ecologia*, 2005a, 2005b) (Figures 5-6 and 5-7).

In 2005, a single call of the Pilbara Leaf-nosed Bat was recorded by *ecologia* (2005a) from a rock-face located within the proposed disturbance area for the proposed Cundaline mining operation (Figure 5-6). *ecologia* (2005a) inferred from the call that the individual may have been passing by or momentarily taking shelter. *ecologia* (2005a) described the rock face as *highly eroded with numerous small caves and cracks situated within the rock, however, none of the caves were of any considerable depth or size*. Quarterly monitoring at the Cundaline ridge since 2005 has only recently recorded calls of the Pilbara Leaf-nosed Bat (Specialised Zoological, 2008a). However, the low number of calls and late time of recording indicates that the cave monitored on the Cundaline ridge is unlikely to be used as a roost (Specialised Zoological, 2008a).

Further surveys and quarterly bat monitoring since 2004 have identified numerous caves in the Goldsworthy region where the Pilbara Leaf-nosed Bat has been recorded (*ecologia*, 2005e, 2006a, 2006b, 2006c, 2007; ENV Australia, 2007a, 2007b). Monitoring also indicates that a stable community uses a monitored bat roost cave, located approximately 1 km south of the proposed Callawa mining operation (ENV Australia, 2007a) (Figure 5-7).

As previously described, a genetic study by Mohlar Pty Ltd (2008) is indicating that there is an emerging pattern of population connection between Pilbara Leaf-nosed Bats from Goldsworthy and Bamboo Creek.

Mulgara

The Mulgara is a small carnivorous nocturnal marsupial that occurs in the arid sandy regions from the eastern Pilbara to central Australia (Van Dyck and Strahan, 2008; Pavey *et al.,* 2007). This species inhabits sand plains dominated by *Triodia* species, where it burrows between low sand dunes (Gibson and McKenzie, 2005).

The Mulgara has been previously recorded near Cattle Gorge, approximately 6 km north-east of the proposed Cundaline mining operation (*ecologia*, 2005c). However, the main distribution of this species is east of the Cundaline and Callawa deposits (e.g. Great Sandy Desert) (Van Dyck and Strahan, 2008). This species has not been recorded at either of the Cundaline or Callawa areas, and it is considered that only marginal potential habitat occurs on the plains.

Peregrine Falcon

The Peregrine Falcon is a large falcon that is widely distributed throughout Australia (Pizzey and Knight, 1998). The species is nomadic to partially sedentary and inhabits cliffs along coasts, rivers and ranges (Pizzey and Knight, 1998). It was recorded flying through the Cundaline area in 2005 (*ecologia*, 2005a). It is possible that the Peregrine Falcon uses habitat resources within the Cundaline and Callawa areas, although this potential habitat is not restricted, but rather occurs along the Goldsworthy ridges.

Pilbara Olive Python

The Pilbara Olive Python prefers rocky escarpments and gorges, often along watercourses (Wilson and Swan, 2003). The subspecies *Morelia olivaceus barroni* is restricted to the Pilbara and Gascoyne regions of WA. Pearson (2003) has reported that the Pilbara Olive Python is widespread across the Pilbara, with many significant populations remaining.

The Pilbara Olive Python was recorded on the Cundaline ridge in 2005 by *ecologia* (2005a) and bones of the species were noted in the same location by ENV in 2008 (ENV, pers. com., 2008) (Figure 5-6). In the Goldsworthy Operations area, it has also been recorded at Cattle Gorge (approximately 6 km north-east of the proposed Cundaline mining operation) (*ecologia*, 2005c) and the Yarrie operations (approximately 2 km north of the proposed Callawa mining operation) (Dames and Moore, 1992).

Habitat for the Pilbara Olive Python within the Cundaline and Callawa areas is represented predominately by the drainage lines. This potential habitat is not restricted, but rather occurs along the Goldsworthy ridges.

Priority Fauna Species

The DEC maintains a list of Priority fauna taxa, which include fauna species removed from the specially protected schedule of the WC Act and other species known from only a few populations or in need of monitoring.

Table 5-5 provides a list of priority fauna species which were recorded within the Cundaline and Callawa ridges and surrounds or in the locality by various sources.

Three Priority fauna species were recorded along the Cundaline and Callawa ridges, namely the Western Pebble-mound Mouse (*Pseudomys chapmani*), Ghost Bat (*Macroderma gigas*), and Australian Bustard (*Ardeotis australis*) (Table 5-5). Table 5-5 also lists other Priority fauna species which are considered to potentially occur along the Cundaline and Callawa ridges. All of the species listed in Table 5-5 are discussed below.

Table 5-5
Priority Fauna Species

Scientific Name	Common Name	Priority Status[1]	Recorded in the Cundaline and/or Callawa Areas	Recorded in the Locality
Mammals				
Pseudomys chapmani	Western Pebble-mound Mouse	P4	2, 3	5
Macroderma gigas	Ghost Bat	P4	2, 3, 12	6, 9, 10, 12, 13
Sminthopsis longicaudata	Long-tailed Dunnart	P3	-	-
Leggadina lakedownensis	Lakeland Downs Mouse	P4	-	5, 7
Birds				
Ardeotis australis	Australian Bustard	P4	2	4, 8
Burhinus grallarius	Bush Stone-curlew	P4	-	4, 11
Falco hypoleucos	Grey Falcon	P4	-	-
Neochmia ruficauda subclarescens	Star Finch (Western)	P4	-	8
Heteromunia pectoralis	Pictorella Mannikin	P4	-	8

1 Priority Status:
P3: Taxa with several, poorly known populations, some on conservation lands.
P4: Taxa in need of monitoring.

2 Recorded at the Cundaline area (*ecologia*, 2005a).

3 Recorded at the Callawa area (*ecologia*, 2005b).

4 Recorded at Cattle Gorge, located approximately 6 km north-east of the proposed Cundaline mining operation (*ecologia*, 2004a).

5 Recorded at Yarrie operations, located approximately 2 km north of the proposed Callawa mining operation (*ecologia*, 2005c).

6 Recorded at Yarrie operations, located approximately 2 km north of the proposed Callawa mining operation (Dames and Moore, 1992).

7 Recorded at Yarrie operations, located approximately 2 km north of the proposed Callawa mining operation (*ecologia*, 1999).

8 Recorded at Cattle Gorge, located approximately 6 km north-east of the proposed Cundaline mining operation (*ecologia*, 2005c).

9 Recorded at Nimingarra, located approximately 24 km north-west of the proposed Cundaline mining operation (*ecologia*, 2005d).

10 Recorded at Cattle Gorge, located approximately 6 km north-east of the proposed Cundaline mining operation (*ecologia*, 2005d).

11 Recorded at Sunrise Hill, located approximately 20 km north-west of the proposed Cundaline mining operation (*ecologia*, 2005c).

12 Recorded during quarterly bat monitoring (*ecologia*, 2005e, 2006a, 2006b, 2006c; ENV Australia, 2007b; Specialised Zoological, 2008a, 2008b).

13 Recorded during quarterly bat monitoring at Cattle Gorge (ENV Australia, 2007a).

Western Pebble-mound Mouse

The Western Pebble-mound Mouse has a widespread though patchy distribution in the west of the Pilbara IBRA region (Van Dyck and Strahan, 2008). Potential habitat for this species occurs in rocky, hummock grasslands with little to no soil cover (Van Dyck and Strahan, 2008).

Inactive pebble mounds of this species have been recorded in the Cundaline and Callawa areas in eucalypt woodland on gravel substrates and hill crests (*ecologia,* 2005a, 2005b). Presence of the Western Pebble-mound Mouse has also been recorded at Nimingarra (approximately 24 and 20 km north-west of the proposed Cundaline mining operation) and Sunrise Hill (approximately 20 km north-west of the proposed Cundaline mining operation) (*ecologia*, 2005c).

Ghost Bat

Ghost Bats are presently, patchily distributed over northern Australia occupying a wide variety of diverse habitats including the arid Pilbara to the rainforests of North Queensland (Van Dyck and Strahan, 2008). This species requires an undisturbed cave, deep fissure or disused mine shaft within which to roost (Van Dyck and Strahan, 2008).

The Ghost Bat was recorded at both the Cundaline ridge (*ecologia*, 2005a) and the Callawa ridge (*ecologia*, 2005b, 2005e, 2006a, 2006b, 2006c; ENV, 2007b; Specialised Zoological, 2008a, 2008b) (Figures 5-6 and 5-7). It has also been recorded at Nimingarra (approximately 24 km north-west of the proposed Cundaline mining operation) (*ecologia*, 2005d, 2006a; Specialised Zoological, 2008a, 2008b), Yarrie operations (approximately 2 km north of the proposed Callawa mining operation) (Dames and Moore, 1992) and Cattle Gorge (approximately 6 km north-east of the proposed Cundaline mining operation) (*ecologia*, 2005d; ENV Australia, 2007a, 2007b). Outback Ecology (2008) report that there is potential for suitable cave environments to exist within the Cundaline and Callawa areas or for this species to roost near and forage within the ridge areas.

Long-tailed Dunnart

The Long-tailed Dunnart inhabits rocky landscapes that support a low open woodland or shrubland of Acacias with an understorey of Spinifex hummocks or perennial grasses (Burbridge *et al.,* 1995; Pavey, 2006).

The Long-tailed Dunnart is found in low densities in the Pilbara, Murchison, North-eastern Goldfields, Ashburton and Gibson Desert regions of WA, and is also found in the Northern Territory. This species has not been recorded in the Cundaline or Callawa areas, however database searches suggest that it may occur in the region. The species may possibly occur in the Cundaline and Callawa areas as suitable habitat exists.

Lakeland Downs Mouse

The Lakeland Downs Mouse is known to occupy a diverse range of habitats including spinifex and tussock grasslands, samphire and sedgelands, *Acacia* shrublands, tropical *Eucalyptus* and *Melaluca* woodlands and stony ranges (Van Dyck and Strahan, 2008). Most habitats are seasonally inundated on red or white sandy-clay soils (Van Dyck and Strahan, 2008).

This species has been recorded at Yarrie operations (approximately 2 km north of the proposed Callawa mining operation) (*ecologia*, 1999, 2005c). Given the nearby record and occurrence of potential habitat it is possible that the Lakeland Downs Mouse uses habitat within the Cundaline or Callawa areas.

Australian Bustard

The Australian Bustard has a wide distribution across Australia. The Australian Bustard is found in areas of open to lightly timbered woodlands and grasslands especially tussock grasses like spinifex, arid scrub and open dry woodlands of mulga (Johnstone and Storr, 1998; Morcombe, 2003).

This species was recorded in 2004 and 2005 at Cattle Gorge, approximately 6 km north-east of the proposed Cundaline mining operation (*ecologia*, 2004a, 2005c). It was also recorded at the Cundaline area in 2005 (*ecologia,* 2005a). Potential habitat for this species is widespread in the Goldsworthy area.

Bush Stone-curlew

The Bush Stone-curlew inhabits open to lightly timbered woodlands of mallee and mulga that has an understorey of small sparse shrubs, grass or litter (Johnstone and Storr, 1998).

The Bush Stone-curlew has been recorded at Cattle Gorge, approximately 6 km north-east of the proposed Cundaline mining operation and Sunrise Hill, approximately 20 km north-west of the proposed Cundaline mining operation (*ecologia*, 2004a, 2005c).

While Mulga does not occur within the Cundaline or Callawa areas, other shrublands are likely to provide potential habitat for the Bush Stone-curlew.

Grey Falcon

The Grey Falcon is a medium-sized falcon which occurs primarily in the northern half of Australia. The species inhabits open woodland areas on coastal and riverine plains in the arid and semi-arid interior of the country (Johnstone and Storr, 1998; Morcombe, 2003). The species requires tall trees for nesting and uses large stick nests built by other birds such as crows and ravens or other raptor species (Morcombe, 2003).

This species has not been previously recorded in the Cundaline or Callawa areas, although it may possibly occur as suitable habitat exists (e.g. Eucalypt woodlands on drainage lines or valley plains).

Western Star Finch

The Western Star Finch inhabits grasslands with sparse vegetation cover near water (Garnett and Crowley, 2000).

The Western Star Finch was recorded in 2005 at Cattle Gorge, approximately 6 km north-east of the proposed Cundaline mining operation (*ecologia*, 2005c). Grasslands with sparse vegetation cover are widespread in the Goldsworthy Operations area.

Pictorella Mannikin

The Pictorella Mannikin is often found near water in acacia shrublands that have a grassy understorey and *Triodia* hummock grassland, where they feed on seeds on the ground, as well as insects (Blakers *et al*., 1984).

The Pictorella Mannikin was recorded at Cattle Gorge, approximately 6 km north-east of the proposed Cundaline mining operation (*ecologia*, 2005c). While this species has not been previously recorded in the Cundaline or Callawa areas, it may use potential habitat which occurs within the areas.

Migratory Species

The EPBC Act online database lists ten migratory species and/or their habitats that may potentially occur in the vicinity of the Cundaline and Callawa areas (Table 5-6).

Table 5-6
EPBC Act Listed Migratory Species

Scientific Name	Common Name	Predicted Occurrence - EPBC Act Online Database [1]	Western Australian Museum (2007)	Birds Australia (2008)	Regional Studies
Haliaeetus leucogaster	White-bellied Sea-Eagle	●	-	-	-
Hirundo rustica	Barn Swallow	●	-	-	-
Merops ornatus	Rainbow Bee-eater	●	-	●	2, 3
Ardea alba	Great Egret	●	-	●	-
Ardea ibis	Cattle Egret	●	-	-	-
Charadrius veredus	Oriental Plover	●	-	-	-
Glareola maldivarum	Oriental Pratincole	●	-	-	-
Numenius minutus	Little Curlew	●	-	-	-
Tringa nebularia	Common Greenshank	-	-	●	-
Actitis hypoleucos	Common Sandpiper	-	-	●	-
Calidris acuminata	Sharp-tailed Sandpiper	-	-	●	-
Rostratula australis	Australian Painted Snipe	●	-	-	-
Gallinago megala	Swinhoe's Snipe	-	●	-	-
Gallinago stenura	-	-	●	-	-
Fregata ariel	Lesser Frigatebird	-	-	●	-
Apus pacificus	Fork-tailed Swift	●	-	●	-

[1] A search of the EPBC Act online database was conducted in January 2008 using the following co-ordinates: -20.41N, 120.06E; -20.41N, 120.43E; -20.78N, 120.43E; -20.78N, 120.06E.

[2] Recorded at the Cundaline area (*ecologia*, 2005a).

[3] Recorded at the Callawa area (*ecologia*, 2005b).

The Rainbow Bee-eater (*Merops ornatus*) was the only migratory species listed under the EPBC Act to be recorded at the Cundaline or Callawa ridges during the surveys (*ecologia*, 2005a, 2005b). The Rainbow Bee-eater was recorded at the Callawa area in 2005 (*ecologia,* 2005b). The Rainbow Bee-eater occupies numerous habitats including open woodlands with sandy loamy soil, sandridges, sandpits, riverbanks, road cuttings, beaches, dunes, cliffs, mangroves and rainforests (Morcombe, 2003). It is unlikely to be dependant on habitat within the Cundaline and Callawa areas.

5.8.2 Potential Impacts and Management Measures

Potential Impacts

Habitat Removal and Modification

The proposed Cundaline and Callawa mining operations have the potential to adversely affect local fauna through direct impacts during land disturbance (i.e. fauna mortalities) and through the loss of fauna habitat. More mobile fauna species such as birds, macropods and larger lizards are considered likely to move away from disturbed areas into adjoining areas of similar habitat, however the proposed Cundaline and Callawa mining operations have the potential to result in the temporary loss of local populations of less mobile species.

Considering the management measures outlined in the existing EMP (BHP Billiton Iron Ore, 2007a) (including minimisation of vegetation clearance, progressive rehabilitation and fire management), it is considered that the continuation of those measures (Appendix A) for the proposed Cundaline and Callawa mining operations would reduce the potential impacts on vertebrate fauna.

Fauna and Light

The proposed Cundaline and Callawa mining operations have the potential to adversely affect local fauna by increasing the exposure of fauna to artificial light. Artificial light generated from the mining operations may have detrimental effects on resident bird, mammal and reptile species, as it may interfere with biological and behavioural activities that are governed by the length of day or photoperiod, including reproduction, dormancy, foraging and migration (Bradshaw and Holzapfel, 2007; Corre *et al.*, 2002).

Fauna and Noise

The proposed Cundaline and Callawa mining operations have the potential to adversely affect local fauna through the generation of constant noise by machinery, heavy and light vehicles and the general presence of people.

General responses to noise across a wide variety of animal species range from interruptions in feeding and resting behaviour to complete abandonment of an area (Attachment I).

Fauna and Introduced Flora

There is the potential for environmental weeds to be brought in by mobile mining equipment at the proposed Cundaline and Callawa mining operations. These may have a negative impact on fauna species as vegetation communities become simplified and out-competed.

Introduced Fauna

There is the potential for feral animals to be attracted to the proposed Cundaline and Callawa mining operations by the creation of new habitat opportunities (e.g. stockpiled timber and/or rocks from cleared mine and OSA areas), discarded food scraps and other rubbish. These factors could result in an increase in the population or the introduction of new feral species in and around the proposed Cundaline and Callawa mining operations.

Fauna Species of Conservation Significance

BHP Billiton Iron Ore referred the proposed Cundaline and Callawa mining operations to the DEWHA under the EPBC Act in order to confirm whether the proposed activities were considered to constitute a controlled action on matters of National Environmental Significance (including the species discussed below). The DEHWA evaluated the referral and notified BHP Billiton Iron Ore that the proposal was not a controlled action on 27 June 2008 (DEWHA, 2008b).

The potential impacts on conservation significant vertebrate fauna species was assessed by Outback Ecology (Appendix I). The potential impacts are as follows:

- *Northern Quoll (EPBC Act – 'Endangered')* - was recorded at multiple locations on the Callawa ridge (Section 5.8.1). While potential habitat would be removed, the proposed Cundaline and Callawa mining operations are not expected to have a significant impact on this species, given this species has only been recorded outside the disturbance areas and the large extent of suitable habitat that would remain outside of the proposed disturbance areas.
- *Pilbara Leaf-nosed Bat (EPBC Act – 'Vulnerable', WC Act – 'Schedule 1')* - The proposed Cundaline and Callawa mining operations may result in disturbance of potential habitat for the Pilbara Leaf-nosed Bat. However, the proposed Cundaline and Callawa mining operations are not expected to have a significant impact on this species, given that quarterly monitoring at the Cundaline ridge has not indicated the presence of a roost cave (Section 5.8.1) and the potential roost cave at monitored at the Callawa ridge is 1 km from the proposed disturbance areas. In addition, the specific management measures implemented for the Goldsworthy Operations (as outlined in the SSMP [Appendix C]) have shown to be effective as ENV Australia (2007a) have reported that the Pilbara Leaf-nosed Bat community using caves within 450 m of the mine is stable.
- *Mulgara (EPBC Act – 'Vulnerable', WC Act – 'Schedule 1')* - The Mulgara has been previously recorded near Cattle Gorge (approximately 6 km north-east of the proposed Cundaline mining operation). The main distribution of this species, however, is in the Great Sandy Desert to the north of the Cundaline and Callawa areas. As such if this species were to use habitat in the area, it is unlikely that the proposed Cundaline and Callawa mining operations would significantly impact this species.
- *Peregrine Falcon (WC Act – 'Schedule 4')* - The Peregrine Falcon was recorded flying across the Cundaline area (*ecologia*, 2005a), however, only marginal habitat for this species occurs within the area (Outback Ecology, 2008). The proposed Cundaline and Callawa mining operations are not expected to have a significant impact on this species, given the mobility and wide ranging nature of the species.
- *Pilbara Olive Python (EPBC Act – 'Vulnerable', WC Act – 'Schedule 1')* – This python is a widespread species in the Pilbara and has been recorded in the most recent biological assessment at Cundaline (*ecologia*, 2005a). The proposed Cundaline and Callawa mining operations may result in the disturbance of potential habitat for this species (i.e. gorge and gully habitat), that is considered to provide refuge for individuals of this species. The proposed Cundaline and Callawa mining operations are not expected to significantly impact this species, given that potentially suitable gorge and gully habitat is present outside the disturbance area along the ridges.
- *Western Pebble-mound Mouse (DEC list – 'Priority 4')* – As discussed in Section 5.8.1, monitoring of this mouse was previously undertaken at Yarrie in the 1980s. The proposed Cundaline and Callawa mining operations may result in disturbance to habitat for this species. It is unlikely that the proposed Cundaline and Callawa operations would result in a significant impact on the species, given wider occurrence of this species and its potential habitat in the Goldsworthy area.
- *Ghost Bat (DEC list – 'Priority 4')* - The proposed Cundaline and Callawa mining operations may result in disturbance to potential suitable habitat for this species. However, it is unlikely that the proposed Cundaline and Callawa mining operations would have a significant impact on this species given the wider occurrence of this species and its potential habitat in the Goldsworthy Operations area.

- *Long-tailed Dunnart (DEC list – 'Priority 3')* – While the Long-tailed Dunnart has not been previously recorded in the Goldsworthy area, potential habitat for the species exists. Were the species to use habitat in the proposed disturbance areas, it is unlikely that the proposed Cundaline and Callawa mining operations would result in a significant impact on this species as potential habitat is not restricted to the proposed disturbance area.
- *Lakeland Downs Mouse (DEC list – 'Priority 4')* - The Lakeland Downs Mouse has been recorded approximately 2 km north of the Callawa ridge (*ecologia,* 1999, 2004a). Were the species to use habitat in the proposed disturbance areas, it is unlikely that the proposed Cundaline and Callawa mining operations would result in a significant impact on this species as potential habitat is not restricted to the proposed disturbance area.
- *Australian Bustard (DEC list – 'Priority 4')* - The Australian Bustard was recorded by *ecologia* in 2005 at the Cundaline area (*ecologia,* 2005a). The Australian Bustard is a wide-ranging species and its potential habitat is common (i.e. open grassland and open woodland [Johnstone and Storr, 1998]). The proposed Cundaline and Callawa mining operations are not expected to have a significant impact on this species, given its wide ranging nature, mobility and the extent of potential habitat that exists for this species outside of the proposed disturbance areas.
- *Bush Stone-curlew (DEC list – 'Priority 4')* - While the Bush Stone-curlew has not been previously recorded in the Goldsworthy area, potential habitat for the species exists. Were the species to use habitat in the proposed disturbance areas, it is unlikely that the proposed Cundaline and Callawa mining operations would result in a significant impact on this species as potential habitat is not restricted to the proposed disturbance area.
- *Grey Falcon (DEC list – 'Priority 4')* - The Grey Falcon has not been recorded within the Cundaline or Callawa areas. This species is wide-ranging and only marginal habitat for this species occurs within the proposed disturbance areas, for which this species is unlikely to be dependent. The proposed Cundaline and Callawa mining operations are not expected to have a significant impact on this species.
- *Western Star Finch (DEC list – 'Priority 4')* - The Western Star Finch has been recorded in the wider vicinity of the Cundaline and Callawa areas (*ecologia*, 2005c). It is unlikely that the proposed Cundaline and Callawa mining operations would result in a significant impact on this species given the species mobility and the extent of potential habitat that exists for this species outside of the proposed disturbance areas.
- *Pictorella Mannikin (DEC list – 'Priority 4')* - The Pictorella Mannikin has been recorded in the wider vicinity of the Cundaline and Callawa areas (*ecologia*, 2005c). It is unlikely that the proposed Cundaline and Callawa mining operations would result in a significant impact on this species given its mobility and the extent of potential habitat that exists for this species outside of the proposed disturbance areas.

The proposed Cundaline and Callawa mining operations are not expected to have a significant impact on migratory species (including the Rainbow Bee-eater) given their general mobility and the type of migratory species habitat which occurs within the proposed disturbance areas is widespread.

EPA Objective

- To maintain the abundance, species diversity, geographic distribution and productivity of terrestrial fauna through the avoidance or management of adverse impacts and improvement in knowledge.

Management Measures

The proposed Cundaline and Callawa mining operations would be managed in accordance with the SSMP (Appendix C) and the EMP (Appendix A). The main aspects of fauna management described in these management plans are provided below.

Management of Fauna Species of Conservation Significance

The SSMP (Appendix C) contains 'general' management practices to be implemented to minimise the impact of the mining operations on flora and fauna, as well as 'specific' management measures for species of conservation significance.

The SSMP describes the management hierarchy that has been developed by BHP Billiton Iron Ore to broadly classify and assign the appropriate level of management response for significant species. A summary of the hierarchy is provided in Section 5.7.2. Table 5-7 shows the conservation classification of species found in surveys conducted for the proposed Cundaline and Callawa mining operations.

Table 5-7
Management of Significant Fauna Species
at the Proposed Cundaline and Callawa Mining Operations

Scientific Name	Common Name	Conservation Classification (see Appendix C)	BHP Billiton Iron Ore Management Hierarchy (see Appendix C)
Dasyurus hallucatus	Northern Quoll	Endangered[1]	Level 1
Rhinonicterus aurantius (Pilbara form)	Pilbara Leaf-nosed Bat	Vulnerable[1] Schedule 1[2]	Level 1
Falco peregrinus	Peregrine Falcon	Schedule 4[2]	Level 3
Liasis olivaceus barroni	Pilbara Olive Python	Vulnerable[1] Schedule 1[2]	Level 1
Pseudomys chapmani	Western Pebble-mound Mouse	P4[3]	Level 1
Macroderma gigas	Ghost Bat	P4[3]	Level 1
Ardeotis australis	Australian Bustard	P4[3]	Level 2

1 Listed as threatened under the EPBC Act.
2 Listed under the *Wildlife Conservation (Specially Protected Fauna) Notice, 2006*.
3 DEC (2007).

The SSMP describes the significant species management measures that would be implemented for the life of the proposed Cundaline and Callawa mining operations, which include:

- The area of land disturbance would be kept to the practicable minimum and rehabilitation would be conducted progressively where mine scheduling allows.
- The location of significant flora and fauna species, their habitat and significant vegetation types would be recorded on the relevant environmental management databases and mine plans (where possible). These records would be updated as necessary, and awareness of these records would be promoted at mine planning and operational levels.
- The BHP Billiton Iron Ore Goldsworthy Operations Environmental Advisor (or nominated delegate) would retain all records of areas that have been disturbed by mining operations in the vicinity of the proposed mining operations, and where possible, record all significant flora populations that have been impacted within these disturbed areas.

- The BHP Billiton Iron Ore Environmental Advisor (or nominated delegate) would determine whether the coverage of the baseline surveys in the proposed clearing area is adequate (in consultation with the DEC where appropriate), and would co-ordinate the undertaking of additional targeted pre-clearance surveys to improve BHP Billiton Iron Ore's knowledge of the distribution of flora and/or fauna species of conservation significance if required.
- The BHP Billiton Iron Ore Environmental Advisor (or nominated delegate) would include any operational flora and fauna management requirements in the PEAHR authorisation form for the relevant proposed clearing area. These management requirements would be determined on a case by case basis and may include, but are not necessarily restricted to, the following:
  - Demarcation and retention of particular mature trees which can reasonably be avoided and may provide on-going habitat during operations and post-closure.
  - Specific timing requirements or clearing methods to be used in order to minimise potential harm to fauna species (i.e. staged clearing to maximise the potential for mobile species to move to adjoining areas).
  - Requirements to salvage and temporarily stockpile particular vegetation types or habitat features (i.e. leafy material, stumps, logs, boulders) for use in rehabilitation programmes.
  - Specific management measures to minimise impacts of species of conservation significance that may occur within or near the proposed clearing area (i.e. identification of a particular species, protocol for reporting, requirements to avoid/collect/record).
- Clearance plans would be prepared prior to clearing taking place to identify the extent of the area authorised to be cleared. The area to be cleared would be identified on the ground (e.g. with pegs and/or flagging tape). The BHP Billiton Iron Ore Environmental Advisor (or nominated delegate) would check the ground markings and regularly monitor clearing operations to assess whether the plans are being adhered to.
- Vehicles and machinery would be parked only in designated locations and off-road recreational activities would be prohibited.
- Weed management measures would be implemented in accordance with the WMP.
- Pest control measures would be implemented in accordance with the EMP.
- The return of fauna to rehabilitated areas would be promoted.
- The induction programme would be used to promote awareness of flora and fauna management measures (including significant species) that are to be used.
- Specific training in flora and fauna management measures (including significant species) would be provided to relevant BHP Billiton Iron Ore personnel and contractors.

Management Plan for Bat Species

A management plan for bat species has also been prepared for the Goldsworthy Operations which provided species specific management measures for the Pilbara Leaf-nosed Bat (*Rhinonicteris aurantius*) and Ghost Bat (*Macroderma gigas*).

The *Management Plan for Bat Species* also describes monitoring that would be undertaken at the proposed Cundaline and Callawa mining operations, including monitoring of one cave south of the Callawa deposit (*ecologia*, 2005e, 2006a, 2006b, 2006c, 2007; ENV Australia, 2007a, 2007b).

The Management Plan for Bat Species (Appendix C) includes the following measures that would be implemented for the proposed Cundaline and Callawa mining operations:

- Blasting activities would occur seven days a week during daylight hours (i.e. between the hours of 7.00 am and 7.00 pm), however in the event that monitoring results suggest that blasting is having an adverse effect on the Pilbara Leaf-nosed Bat, a review of the situation would be conducted and contingency measures would be implemented where necessary.
- A 400 m wide buffer zone would be established around the known caves at the Callawa deposit.
- Conventional night-lighting would be used during operations, however in the event that a monitoring results suggest that night-lighting is having an adverse effect on the Pilbara Leaf-nosed Bat, a review of the situation would be conducted and contingency measures would be implemented where necessary (e.g. use of directional lighting).
- The known caves at the Callawa deposit would be monitored on a quarterly basis during the life of the mining operations.

A cave on the Cundaline ridge has been monitored for the Pilbara Leaf-nosed Bat and Ghost Bat, quarterly since 2005 (including the cave at which a call was recorded in 2005 [*ecologia*, 2005a]). No roosts of the Pilbara Leaf-nosed Bat or Ghost Bat have been recorded (ENV, 2007a; Specialised Zoological, 2008a, 2008b). Considering this, the discontinuation of bat monitoring at the Cundaline ridge is proposed.

Management of Introduced Species

The EMP (Appendix A) describes the pest management practices that would be implemented at the proposed Cundaline and Callawa mining operations, which would include:

- The BHP Billiton Iron Ore Environmental Advisor (or nominated delegate) would conduct pest inspections at least every six months in the active mining areas of the Project, in order to monitor for the presence of pest species.
- The status/declaration of all new and previously recorded pest species would be regularly reviewed and updated, with all new pest species and status changes recorded in relevant databases and mine plans (when appropriate).
- Follow-up inspections would be conducted by the BHP Billiton Iron Ore Environmental Advisor (or nominated delegate) where necessary, to assess the effectiveness of control measures implemented, and if any additional control measures are required.
- A clean, rubbish-free environment would be maintained, particularly around administration and contractor areas in order to discourage scavenging and reduce the potential for colonisation of non-endemic fauna.
- BHP Billiton Iron Ore would regularly consult with the DEC and the Department of Agriculture and Food, WA (DAFWA) for updates on best-practice pest control strategies.
- BHP Billiton Iron Ore would inform relevant government agencies (e.g. DEC, WA Department of Mines and Petroleum [DMP] and DAFWA) of any new pest species identified within the mining lease.

- The need for, and type of control strategies used to manage pest species would be determined in consultation with the DEC and DAFWA. Possible control measures that may be implemented include, but are not necessarily limited to, the following:
  - destruction of pest habitat (i.e. rabbit burrows and rabbit harbour);
  - fencing of pest infested/habitat areas (e.g. for known rabbit infested areas use rabbit proof fences);
  - species-specific baiting; and
  - lure and capture strategies using smells and sounds.

5.8.3 Outcome

As described in Section 4, a risk assessment was completed for the proposed Cundaline and Callawa mining operations. The risk assessment findings for fauna (including terrestrial vertebrate fauna) are summarised below.

Environmental Objectives	Potential Impacts	Management Measures	Severity	Likelihood	Residual Risk*
To maintain the abundance, species diversity, geographic distribution and productivity of fauna (including terrestrial fauna) at a species and ecosystems level through the avoidance or management of adverse impacts and improvements in knowledge.	Removal/modification of fauna and their habitat.	Refer Section 5.8.2.	1	0.03	Low (0.03)
	Increase in feral animal populations leading to increased threat to native fauna.		1	0.03	Low (0.03)

* Low (0.03 to 0.1); Minor (0.3 to 3); Moderate (9 to 30); Major (90 to 1,000); Critical (3,000 to 10,000) (refer Section 4).

5.9 TERRESTRIAL INVERTEBRATE FAUNA

A terrestrial invertebrate short-range endemic survey and assessment was prepared by Outback Ecology for the proposed Cundaline and Callawa mining areas and is provided in Appendix I.

5.9.1 Existing Environment and Background Information

Endemism refers to the restriction of a species to a particular area, whether it is at the continental, national or local scale (Allen *et al.*, 2002). Short-range endemic species have restricted distributional ranges, usually less than 10,000 km^2 (Harvey, 2002).

A number of invertebrate groups have been identified as containing short-range endemic species, such as Mygalomorph Spiders (Mygalomorphae), Pseudoscorpions (Pseudoscorpionida), Scorpions (Scorpionida), Millipedes (Myriopods) and Terrestrial Molluscs (Pulmonata) (Harvey, 2002). SRE species are generally characterised by poor dispersal, heavy reliance on discontinuous habitats, low growth rates, and low fecundity (Harvey, 2002).

Methodology

The short-range endemic surveys were undertaken following consultation between BHP Billiton Iron Ore/Resource Strategies and the DEC, Dr Mark Harvey (Western Australian Museum [WAM]) Shirley Slack-Smith (WAM), Professor Barbara York-Main (University of Western Australia [UWA]) and Professor Mike Johnson (UWA).

Mygalomorph Spiders (Mygalomorphae), Pseudoscorpions (Pseudoscorpionida), Scorpions (Scorpionida), Millipedes (Myriopods) and Terrestrial Molluscs (Pulmonata) were targeted during the surveys (Appendix I).

Four separate surveys were undertaken. ENV Australia conducted the first two surveys from April to May 2008 focusing on the collection of mygalomorph spiders. The third was undertaken by Outback Ecology in July 2008 and focusing on the collection of all of the above listed invertebrate groups. These first three surveys are reported in Appendix I.

Between the 12 – 23 May 2009, an additional targeted mygalomorph spider survey and habitat assessment was undertaken by Outback Ecology in accordance with BHP Billiton Iron Ore's *Central Pilbara Region Short-range Endemic Assessment Scope, Approach and Methods* (BHP Billiton Iron Ore, 2009) which has been endorsed by Dr Mark Harvey from the Western Australian Museum and Brad Durant (DEC).

The weather conditions during the 2009 survey were mainly fine, although rain did fall during the survey on the 16 and 17 May. A total of approximately 1.2 mm was recorded on the 16 May 2009 at the Yarrie Mine and approximately 0.2 mm was recorded on the 17 May 2009. Despite the low rainfall, appropriate targeted searches were undertaken.

Methodology also included pitfall traps, systematic targeted searching, litter collection, soil sieving and ultraviolet light night searching. Specimens collected were identified by Dr Mark Harvey, Volker Framenau and Shirley Slack-Smith.

Habitat Assessment

Outback Ecology conducted a habitat assessment inside and outside of the proposed Cundaline and Callawa mining operations areas, the results of which are provided in Appendix I. Habitat with the potential to support short-range endemic invertebrates was identified at both the Cundaline and Callawa ridges. These potential habitats were associated with the following:

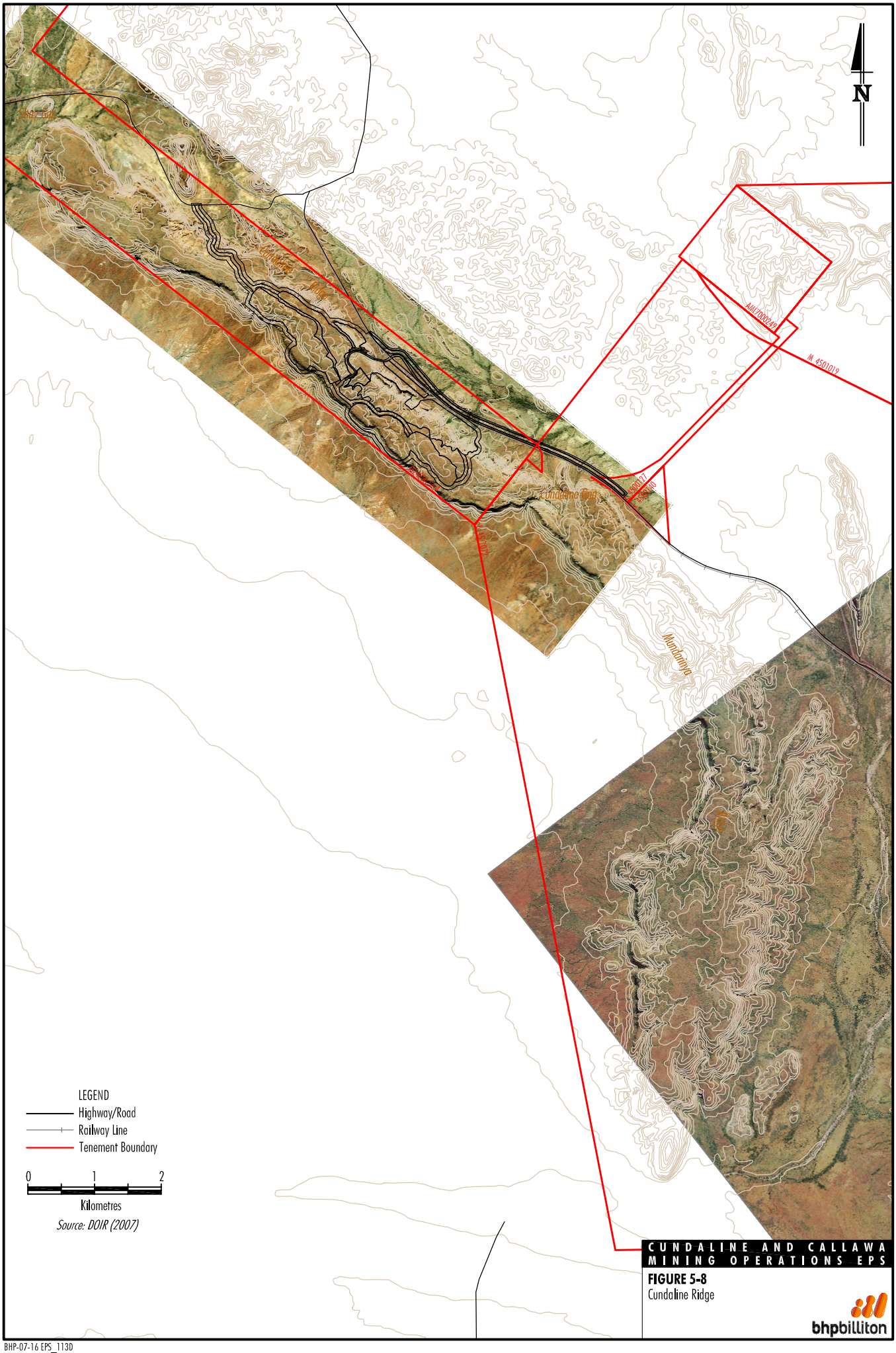
- south-west facing ridges and slopes of the Cundaline ridge; and
- east facing ridges and slopes of the Callawa ridge.

Figures 5-8 and 5-9 show the topography of the two ridges respectively, from which the extent of these potential habitats in relation to the proposed disturbance areas at Cundaline and Callawa ridges can be inferred.

As provided in Appendix I, different landscape features are discussed below in relation to the potential occurrence of SRE invertebrate species.

Hilltop

Hilltops form the upper horizon of the geological formation on the Cundaline and Callawa Ridges. These areas make up a large proportion of the landscape within the study areas. The hilltops are largely flat and exposed with sparse vegetation such as *Grevillea wickhamii* subsp. *hispidula* and Spinifex. They consist of large rock outcrops and stony skeletal soils, and are thus generally unsuitable for burrowing fauna (Appendix I).



CUNDALINE AND CALLAWA MINING OPERATIONS EPS

FIGURE 5-8
Cundaline Ridge

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