BHP

South Walker Creek Mulgrave Resource Access: Stage 2C (MRA2C)

EPBC 2017-7957

Appendix G:
Diversion Revegetation Plan

BHP

SWC Mulgrave Resource Access - Stage 2C

Draft Rehabilitation Management Plan

19 December 2018

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1 Introduction

1.1 Purpose

The primary purpose of this MRA2C Rehabilitation Management Plan is to ensure effective processes and activities are implemented as part of the MRA2C Project to rehabilitate stage 2C of the Walker Creek Diversion and associated infrastructure such as the C2 Dam and Levees, in a manner which meets specific performance objectives as detailed in this document. This plan is produced to accompany the detailed designs of the project.

1.2 Scope

The MRA2C Rehabilitation Management Plan covers rehabilitation objectives, methods and monitoring of rehabilitation. In an integrated approach, it combines both operational and environmental requirements into a single document.

2 Project Description

2.1 Overview of Project

South Walker Creek Mine (SWCM) is an open cut coal mining operation located approximately 35km west of Nebo Township in the Bowen Basin, approximately 125km south-west of Mackay in Central Queensland. The proposed diversion continues on from SWC Stage 2A diversion.

The project works are designed to meet site surface water management and operational requirements, satisfy Queensland Government criteria for watercourse diversions in the Bowen Basin and provide a longterm self-sustaining waterway that is suitable for surrender of approvals and management responsibility in the future. The project designs will be consistent with State and Commonwealth approval requirements

An overview of the diversion components includes:

- An 8km long diversion channel being a progression of the recently constructed MRA2A Walker Creek diversion and commencing at the confluence with Carborough Creek.
- Three levees (two of which over lie diversion plugs).
- A 2GL Dam named the C2 Dam.

A spoil dump has been proposed to accommodate the material from the diversion excavation. The proposed location for the spoil dumps is within a planned mining zone, therefore this material will be moved as part of normal future mining processes. As rehabilitation of this area is temporary, it will not be to the same standard as the rest of the site, and will be focussed on achieving a safe and non-polluting landscape.

2.2 Diversion Description

The proposed MRA Walker Creek Diversion – Stage 2C is a moderately sinuous single thread channel, approximately 8km long. The proposed diversion alignment goes through a sandstone plateau/terrace (likely the historic Carborough Creek floodplain), which has paleo drainage features associated with it, such as a gilgai, and several disconnected paleo-channels. The estimated maximum vertical cut is up to 13m where the proposed diversion cuts through the Carborough Creek Terrace, which contains Permian sandstone, inter-bedded with siltstone capped by tertiary clays. The diversion ties back into Walker Creek, approximately 6.5km downstream of the original confluence and 8km downstream of the existing confluence with the MRA Walker Creek Diversion – Stage 2A.

2.2.1 Diversion Channel Cross-Sectional Geometry

The diversion design replicates cross sectional geometry of the natural channel, including benches, which are inundated by flows around the 2 year ARI event (low flow benches). The typical channel cross-section used in the functional diversion design is presented in Figure 1. Greater flows will engage the floodplain and develop a broad riparian zone. A second bench is present in the section of the diversion with the deepest cut (upstream end) to accommodate the 50yr ARI flow event. The bed of the diversion channel has been designed lower than natural bed level by several meters to accommodate in-channel sand deposition, sediment transport, development of hyporheic zone and riparian vegetation establishment.

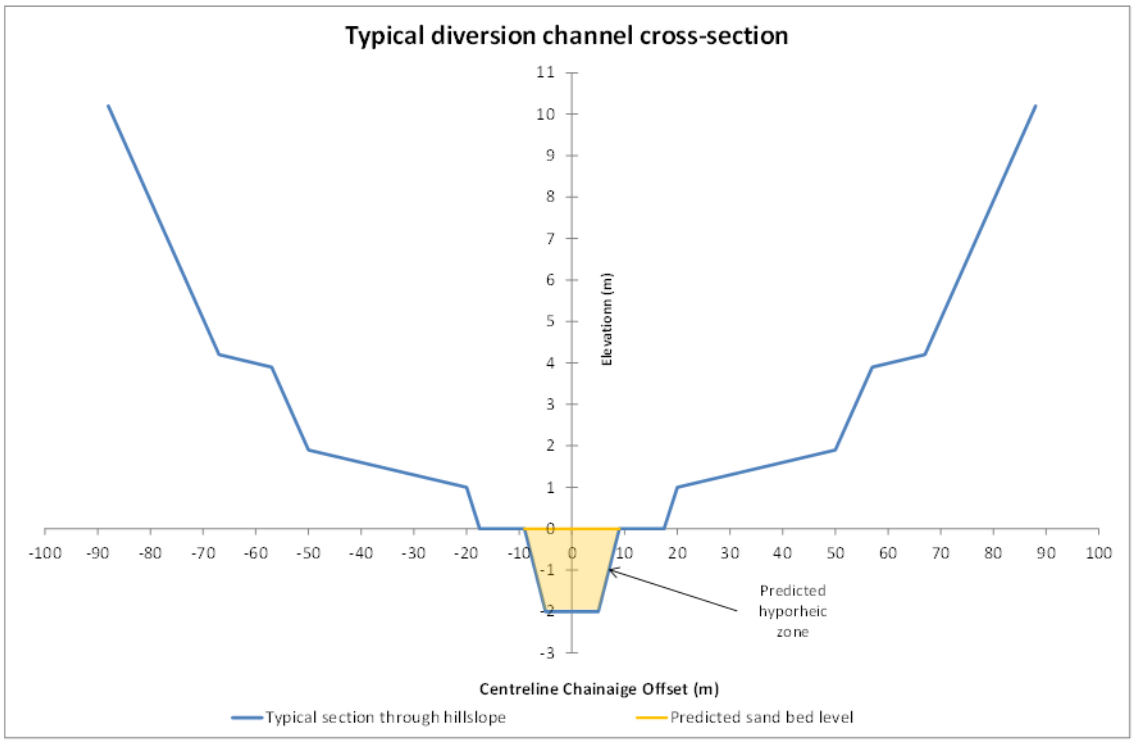

Figure 1 - Typical Diversion Channel Cross-Section

2.3 C2 Dam Description

The C2 Dam is proposed to have a storage capacity of 2GL. The Dam will be located to the NE of the South Walker Creek Mine Industrial Area (MIA). The Dam will be designed in accordance requirements outlined in Environmental Authority EPML00712313.

Figure 2 shows the proposed location and general layout of C2 Dam.

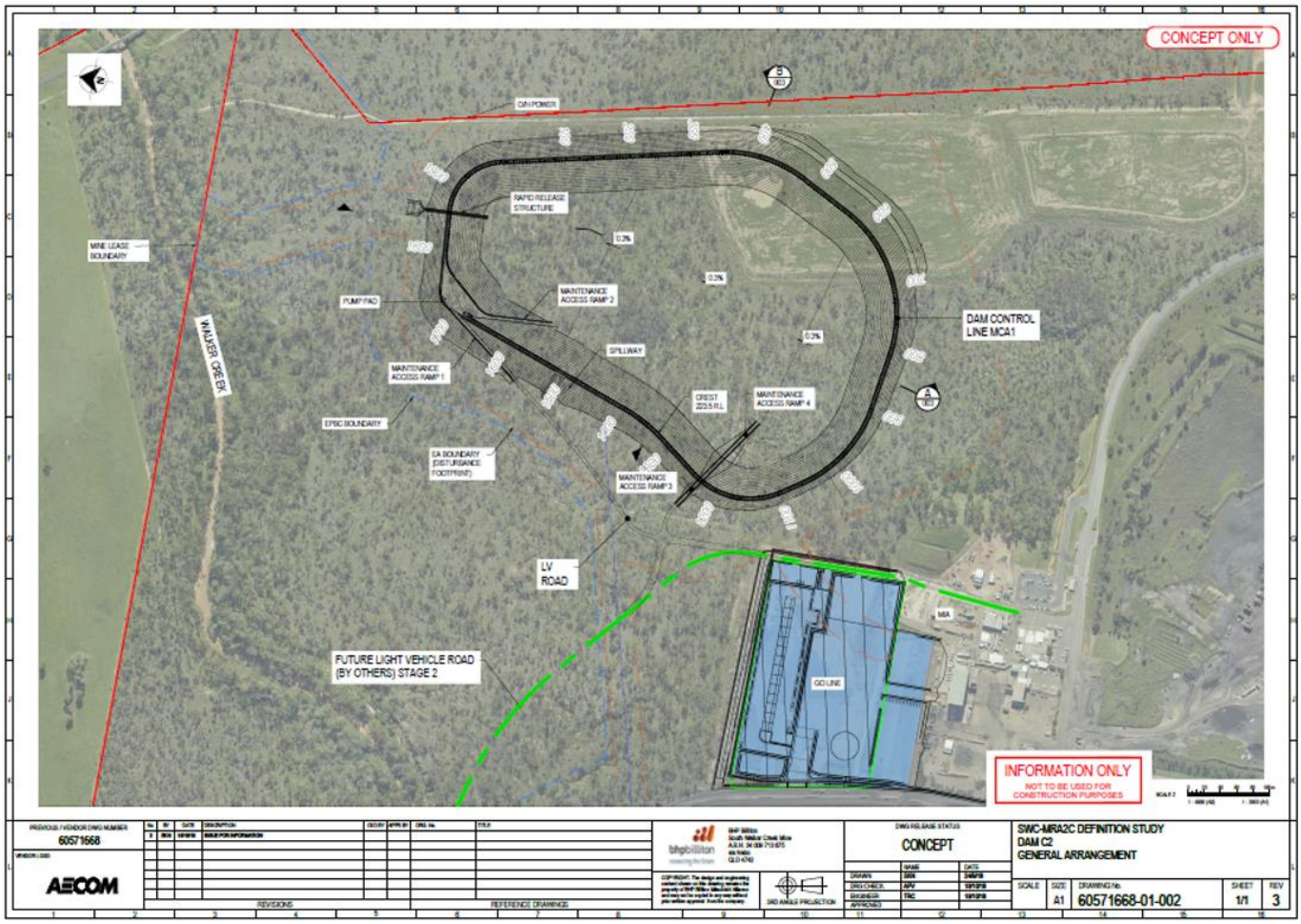

Figure 2 - Proposed C2 Dam Location

3 Existing Environment

3.1 Regional Ecosystems

Version 9.0 of the Queensland EPA Regional Ecosystem (RE) Mapping (2015),which has been updated by Eco Logical (2016) (Figure 3) indicates vegetation communities through the MRA 2C project study area. The relevant vegetation communities present within the project study area are:

The Majority of the Diversion

RE11.5.3 (*Eucalyptus populnea* +/- *E. melanophloia* +/- *Corymbia clarksoniana* woodland on Cainozoic sand plains and/or remnant surfaces) forms the majority of the diversion footprint, and

The Central Areas

RE11.5.8c (*Eucalyptus platyphylla* woodland on white-yellow weathered sands, with grassy ground layer. Occurs on Quaternary sediments) dominating the central areas, and

The Downstream End on Recent Alluvial Surfaces

RE11.3.4/11.3.2 (*Eucalyptus tereticornis* and/or *Eucalyptus* spp. woodland on alluvial plains and *Eucalyptus populnea* woodland on alluvial plains) at the downstream end on recent alluvial surfaces.

Through the Existing Riparian Areas Along Walker Creek

RE11.3.25 (*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines) is consistently dominant through the existing riparian areas along Walker Creek and will form the basis of the riparian revegetation target community along the diversion.

The C2 Dam and Surrounding Areas

RE 11.5.9 Eucalyptus crebra and other Eucalyptus spp. and Corymbia spp. woodland on Cainozoic sand plains and/or remnant surfaces and RE11.5.3 (*Eucalyptus populnea* +/- *E. melanophloia* +/- *Corymbia clarksoniana* woodland on Cainozoic sand plains and/or remnant surfaces) forms the majority of the area surrounding C2 Dam.

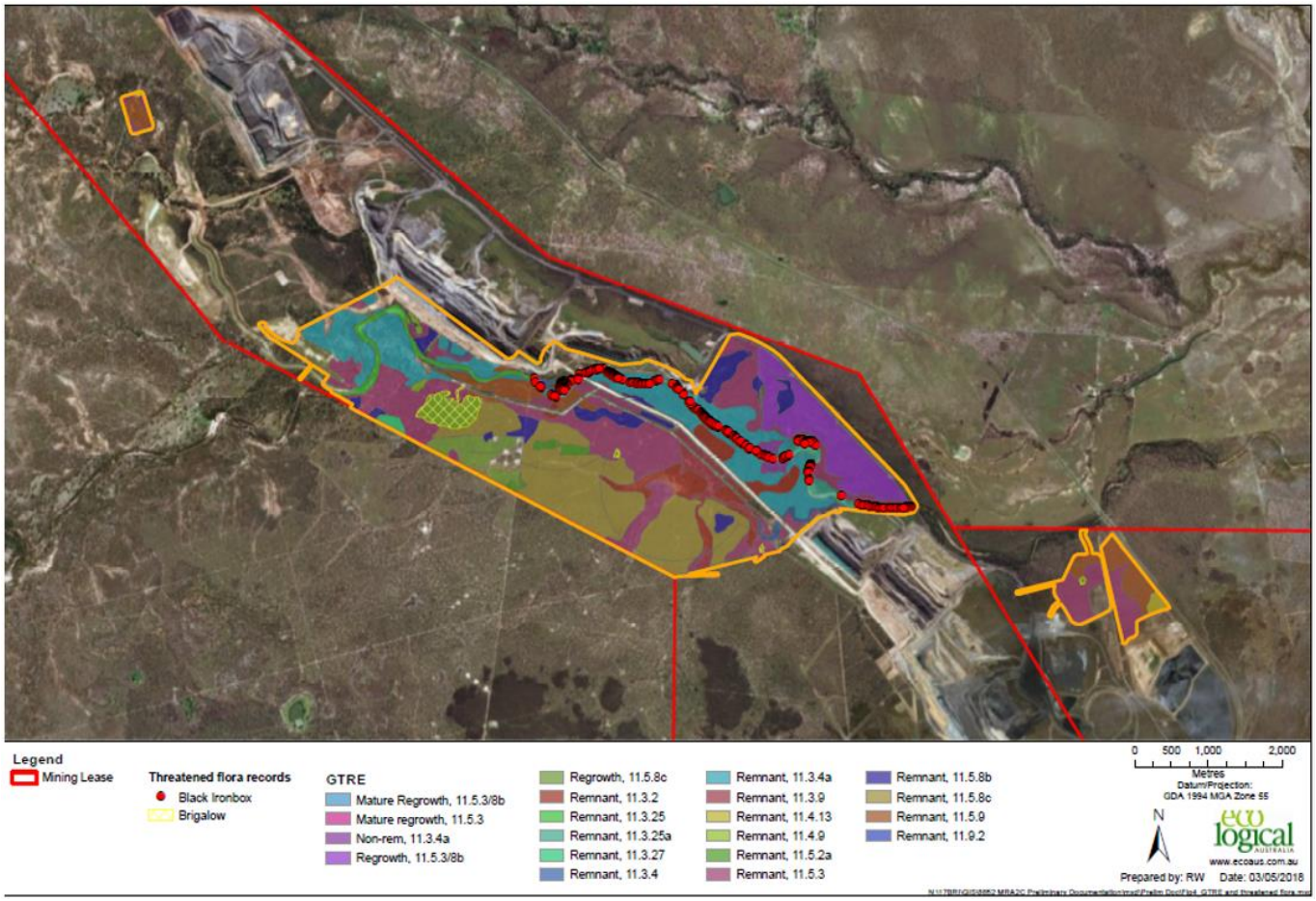

Figure 3 - Stage 2C Overview of Vegetation Communities (data from Eco Logical Australia, 2016)

3.2 Climate

The closest available long-term weather monitoring station to SWCM is at the Moranbah Airport (http://www.bom.gov.au/climate/averages/tables/cw_034038.shtml), which identifies the mean annual rainfall is 613mm with November to March being the wettest months on average.

The wet and dry climate of central Queensland is a challenge to the timing of revegetation activities. Soil erosion is a risk at the site if revegetation isn't successfully established before seasonal rains. Cyclone related storms and localised storms can result in heavy rainfall and rill erosion prior to the establishment of good ground cover. This will require monitoring, especially in the early stages of revegetation works.

Conversely, lack of seasonal rain can limit the establishment and survival of vegetation. This will require monitoring, especially in the first two years following revegetation.

3.3 Matter of National Environmental Significance (MNES) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)

A flora assessment conducted in August 2012 (Cardno, 2012) and more recently in 2016 by Eco Logical Australia have confirmed the MRA2C project (including diversion, dams, mine progression and associated infrastructure) is likely to have significant impacts on the following MNES Values:

- Brigalow (*Acacia harpophylla*) TEC
- Ornamental Snake Habitat
- Koala Habitat
- Greater Glider Habitat
- Black Iron Box (*Eucalyptus raveretiana*) TEC

BMC have developed an offset strategy to mitigate impacts to these MNES values. Additionally, BMC have committed to including mitigation controls into the rehabilitation process. These controls include;

- Re- establishing Black Ironbox (*Eucalyptus raveretiana*) species within suitable locations of the project area
- Re-establishing Eucalypt species critical to the survival of the Koala

3.3.1 Brigalow

The Endangered RE11.4.9 (*Acacia harpophylla* shrubby open forest to woodland with *Terminalia oblongata* on Cainozoic clay plains) within the proposed project footprint consists of four isolated patches, three within the diversion footprint and one within the C2 Dam footprint. The majority however exists within one large patch located in the western portion of the Diversion. A maximum of approximately 32.7 ha of Brigalow TEC will be impacted by the Project, which will adversely affect habitat critical to the survival of the ecological community. Project impacts are likely to be significant on this MNES value.

3.3.2 Black Iron Box

Based on the results of a 2016 ground-truthing survey, approximately 405 Black Ironbox (*Eucalyptus raveretiana*) individuals across 16.8 ha of suitable riparian habitat will be impacted by the project. This habitat has been assessed as not critical for the survival of the species and the occurrence of Black Ironbox within the study area is not considered to be part of an important population. Project impacts are not considered to be significant on Black Ironbox.

3.3.3 Koala

Koala (*Phascolarctos cinereus*) habitat and food source trees are found within the project area. Koala's are known to exist within the project area and there has been previous reported sightings. Suitable vegetation composition, structure and condition to support Koalas was identified within two habitat areas within the project study area – the fringing riparian forest and portions of the floodplain Eucalypt forest habitat. Due to the study area's dominant grazing land use, key existing threats to Koalas such as dog attacks and vehicle strikes are uniformly low. However, the 2018 survey confirmed the occurrence of three Koalas only in riparian and fringing floodplain Eucalypt forests in the study area.

Based on the Koala referral guidelines, the riparian and fringing floodplain Eucalypt forest habitat within the study area is considered to be habitat critical to the survival of the species due to three confirmed sightings in 2018, good connectivity to the west, high vegetation structure and composition value, high recovery value of the habitat and low existing threats. Given the high connectivity value that Walker Creek provides to these areas, as well as numerous recent records, the study area is likely to:

- Contain a key source population for breeding or dispersal; and
- Contain a population large enough that is necessary for maintaining genetic diversity.

A maximum of 212.2 ha of Koala habitat will be impacted by the project. The study area does not contain a population that is near the limit of its range, as Koala are found throughout eastern Queensland and southern states.

Along with undertaking an offset strategy for the impacts to these species, one of the key requirements for the rehabilitation program within the new diversion is to rehabilitate this area with Koala habitat and food source species to ensure re-instatement of habitat and connectivity related values.

3.3.4 Ornamental Snake

Approximately 33.7 ha of Ornamental Snake (*Denisonia maculata*) habitat has been identified within the project disturbance area. Whilst previous ecological assessments did not record the presence of the species within the project area, the habitat assessments have identified known ecological requirements for the species.

As per the *Draft Referral Guidelines for the Nationally Listed Brigalow Belt Reptiles*, the study area would be considered as an area supporting an important population of Ornamental Snake, and hence impacts are likely to be significant to this MNES value.

3.3.5 Greater Glider

Approximately 186.2ha of Greater Glider habitat was identified within the project study area, and is considered to support an important population. The key component of this determination is the identification of 22 individuals across five nights of survey within 153.2 ha of suitable habitat (equating to a density of 0.14 per ha). Additionally, the study area contains a high abundance of important habitat resources such as hollow-bearing trees both within and adjacent to Walker Creek. Based on the habitat requirements, habitat critical to the survival of the species is considered to consist of large vegetation patches containing a high density of hollow bearing trees. The study area is highly connected to vegetation to the west and south creating large tracts of suitable habitat. Riparian and eucalypt floodplain vegetation also contain a high density of hollow bearing trees. As such, the study area is considered to contain habitat critical to the survival of the Greater Glider.

Approximately 149.3 ha of habitat will be removed for the project. Diversion of the creek will reduce the riparian connectivity and the ability of the species to disperse between sink and source populations. The project is therefore likely to have a significant impact on the Greater Glider.

3.3.6 Squatter Pigeon

Approximately 401.6 ha of squatter pigeon habitat was identified within the project study area, of which a maximum of 295.3 ha will be potentially impacted by the project. The project was assessed as not meeting the important population assessment criteria as it does not comprise the attributes defined in the Commonwealth Significant Impact Guidelines. The key component of this determination is that suitable habitat within the project area is small in extent and would not be considered source habitat supporting a source population. (Eco Logical, 2016).

3.3.7 Offset Strategy

The MRA 2C project is likely to have significant impacts on the following MNES values;

- 32.7ha of Brigalow TEC
- 33.7ha of Ornamental Snake Habitat
- 212.2 ha of Koala Habitat
- 149.3ha of Greater Glider Habitat.

Proposed mitigation and management measures will limit the severity and magnitude of significant impacts to the listed above for all MNES values. However, significant residual impacts are unavoidable.

In accordance with the EPBC Act, significant residual impacts to MNES values are required to be offset as per the requirements of the EPBC Act Offset Policy. This requires the delivery of a land based offset that is suitable to offset a minimum of 90% of the significant residual impact (in combination with other offset delivery options).

BMC have established commercial agreements with third party owned properties to secure suitable land for project offset requirements. The properties will legally secure the potential offset areas.

Additional and specific information related to the potential MNES impacts, mitigation and offset strategies is outlined in the BHP South Walker Creek Mulgrave Resource Access: Stage 2C (MRA2C) EPBC 2017-7957 Preliminary Documentation.

4 Rehabilitation Strategy

4.1 Rehabilitation Strategy Objectives

The intention is to rehabilitate the diversion to achieve the objectives and criteria set out in Table 1, 2 &3.

Rehabilitation works will encourage the regeneration of a vegetation community which is representative of surrounding waterway communities.

The intent is to complete rehabilitation works, particularly topsoil placement and soil treatments, as soon as practical after the area becomes available. Re-disturbance of completed rehabilitated areas for future works such as seeding, will be avoided where practical.

The objective of the rehabilitation works is to achieve the desired company objectives applied to all watercourse and water storage rehabilitation works. These completion criteria have been agreed between BHP and the Queensland regulator. The watercourse and Water storage related objectives are outlined in Table 1. The indicators and criteria are outlined in Table 2. The water storage indicators and criteria are outlined in Table 3.

The Long-term strategy related to the potential decommissioning of C2 dam will ultimately be finalised closer to end of mine life. However, the Dam design will consider rehabilitation and completion criteria requirements.

Table 1 - Rehabilitation Objectives - Watercourses

Post Mining Land Use	Safe to Humans and Wildlife	Non-Polluting	Stable	Able to Sustain an Agreed Post Mining Land Use
Watercourse	Safety hazards in rehabilitation are not significantly different to surrounding unmined landscapes subject to the same land use	Rainfall runoff from rehabilitation achieves relevant water quality objectives for receiving waters; AND Deep drainage from rehabilitation achieves relevant water quality objectives for groundwater	Rehabilitation is both geotechnically and erosionally stable	Rehabilitated creek diversions have satisfactory fluvial-geomorphological functionality
Water Storage				Water storages support cattle grazing land uses

Table 2 - Indicators and Criteria for Satisfactory Rehabilitation with an Agreed Post-Mining Land Use of Watercourse

Goal	Objective	Indicator	Criteria
Safe to humans and wildlife	Safety hazards in rehabilitation are not significantly different to surrounding unmined landscapes subject to the same land use	Hazard assessment	No significant difference
Non-polluting	Rainfall runoff from rehabilitation achieves relevant water quality objectives for receiving waters	pH, EC, Turbidity	Not significantly different to upstream values
Stable	Rehabilitation is erosionally stable	Geomorphic index (IDC method)	Not significantly different to upstream and downstream reaches
Able to sustain an agreed post-mining land use	Riparian vegetation	Riparian vegetation index (IDC method)	Not significantly different to upstream and downstream reaches

Table 3 - Indicators and Criteria for Satisfactory Rehabilitation with an Agreed Post-Mining Land Use of Water Storage

Goal	Objective	Indicator	Criteria
Safe to Humans and Wildlife	Safety hazards in rehabilitation are not significantly different to surrounding unmined landscapes subject to the same land use	Hazard assessment	No significant difference
Stable	Rehabilitation is geotechnically stable	Factor of Safety	≥1.5
	Rehabilitation is erosionally stable (banks and immediate surrounds)	Groundcover	>50%
Non-Polluting	Rainfall runoff from rehabilitation achieves relevant water quality objectives for receiving waters	pH, EC, Turbidity	Not significantly different to upstream values
	Deep drainage from rehabilitation achieves relevant water quality objectives for groundwater	EC	Not significantly different to: a) the EPP (Water) schedule documents water quality objectives for relevant groundwater chemistry zones; or, b) local water quality objectives developed in accordance with the Queensland Water Quality Guidelines.
Able to Sustain an Agreed Post-Mining Land Use	Rehabilitation retains water that is a potential resource for cattle grazing, with quality according to ANZECC guidelines version October 2000	TDS Calcium Magnesium Nitrate Nitrite Sulphate	5,000 mg/L ≤1,000 mg/L ≤2,000 mg/L ≤400 mg/L ≤30 mg/L ≤1,000 mg/L

4.2 Zones / Hectares / Locality

The project design has been identified having five zones, which are:

- Revegetation Zone1 (46.3ha) - Is the bench immediately above the water channel. This zone maybe influenced by streambed flows and batter erosion however is possible to drive on with appropriate machinery and is where species requiring additional water will be seeded.
- Revegetation Zone 2 (39.7) - Represents the upper slope of the design. Is likely to be the most difficult to establish due to steepness and the lack of opportunistic seed dispersal from surrounding influences.
- Revegetation Zone 3 - Not shown at this diversion.
- Revegetation Zone 4 (84.8ha) - Is beyond zone 2, above the batter, and will be assisted by natural regeneration from surrounding native vegetation.
- Revegetation Zone 5 (20.5ha) - Is the batter rock chutes, rock works, levee and diversion plugs.
- Revegetation Zone 6 (67ha) - Dam Embankment.

Table 4 - Revegetation Zones

Zone	Name	Size (ha)	Notes
Zone 1	Immediate adjacent to the Riparian zone	46.3	Moist / flood zone
Zone 2	Mid slope Zone	39.7	Dry slope
Zone 4	Top of Batter	84.8	Flat - Wet/ dry
Zone 5	Batter drains	20.5	Dry
Zone 6	C2 Embankment Batters	67	Dry Slope

4.3 Irrigated Rehabilitation

There are two distinctly different pathways for the completion of the rehabilitation. The use of an irrigation system such as through the use of inline drippers and planting tube stock vegetation allows BHP to remove considerable risks associated with the reliance on climatic conditions. An irrigation system also provides greater flexibility with construction schedules. Overall, there are many advantages with using irrigation, however there are also limitations.

BHP is currently undertaking design work to verify the feasibility of using an irrigation system. BHP will endeavour to choose an option which delivers the best result for all stakeholders and is in line with meeting project objectives and criteria. Should irrigation be deemed to be feasible and available, it will be chosen as the preferred method to establish vegetation within Zone 2.

4.4 Dryland Rehabilitation

Dryland rehabilitation refers to the process of rehabilitating the site without the use of irrigation. The project can implement methodologies to rehabilitate the site and achieve the desired outcomes through using seasonal rainfall. The unpredictability, intensity and duration of wet seasons pose several issues to overcome.

Dryland rehabilitation will follow the following key principals:

- Seeding will not occur in autumn or winter.
- The bulk earthworks components such as topsoil cartage and placement for land which is available for rehabilitation prior to the oncoming wet season will aim to be completed by the 1st of December of that year. Other works such as bed preparations, hydromulching and seeding can occur after this date. Land which is not available for rehabilitation prior to the oncoming wet season will have erosion and sediment controls implemented where practical, to allow for bulk earthworks activities to occur prior to the 1st of December.
- Rehabilitation of diversion and Dam embankment batters, will have a surface coverage applied such as hydromulch on an as required basis. The application rates and specifications for this hydromulch will be contained in the Rehabilitation Technical Specification.

4.5 Topsoil

Topsoil is one of the most critical resources for the project. The term “Topsoil” refers to a combination of the organic material contained in the 0 horizon along with the A horizon soil. Topsoil is inherently different from subsoils, the general differences in the region around the stage 2C diversion are:

- Subsoils contain elevated salts and elevated pH, often limiting plant nutrient availability.
- Topsoil contains mycorrhiza, soil biota and organic matter
- Topsoil contains elevated nutrients, and a pH more suitable to plant establishment,
- Topsoil is generally less sodic than underlying tertiary clays.
- Topsoil provides a suitable growth media for seed establishment and contains large quantities of *insitu* seed.

Given its importance, BHP are committed to implementing specific controls for the management of topsoil. Topsoil Controls proposed for the project are provided in the table below.

The quality of topsoil can be significantly impacted if not handled correctly. For example, moisture conditions play a critical role in compaction related risks. Degradation of soil structure will exist if topsoil is handled whilst it has a high

moisture content. Conversely, topsoil which contain high levels of fine (less than 2 microns) and dry particles, if 'overworked' can have the tendency to form 'bulldust', which dramatically impacts soil structure. If topsoil is stored in high and compacted stockpiles, the soil chemistry within the upper layers of this stockpile can alter due to anaerobic conditions. This can impact on soil pH, salinity levels, nutrient levels etc.

Table 5 - Topsoil Management Controls

Activity	Potential Risks	Potential Impacts	Proposed Controls
Topsoil Stripping (Recovery)	Contamination of soil horizons	Decrease in quality and suitability of topsoil	• Identify and demarcate soil boundaries as required, within work area. • Implement QA procedures during construction to ensure correct stripping depths are maintained.
	Handling of topsoil during wet or very dry conditions	Compaction and loss of soil structure will result if topsoil is handled whilst it is wet and whilst it is very dry.	• Site activities will be managed to ensure the most realistically achievable methods of handling topsoil during different climatic conditions are used. • Depending on the machine, the cutting or pushing distances will be minimised to avoid overworking material.
Topsoil Stockpiling (Storage)	Topsoil stockpile	Decline in soil chemistry due to stockpiling in anaerobic and compacted conditions A decline in the beneficial properties of topsoil.	• Double handling and stockpiling topsoil will be avoided where possible • Soil which is stockpiled in elevated and compacted dumps rather than open loose paddock dumps, has the tendency to decline considerably in quality. Therefore in the instance that topsoil requires stockpiling, the preferred approach is to loosely paddock dump topsoil with rear dumps, to increase surface area and oxygen penetration.
Topsoil seed bed preparation	Topsoil used on rehabilitation has unfavourable traits associated with crusting, dispersion, pH, nutrient levels etc.	If topsoil has traits which make it unsuitable for plant growth or stability, the rehabilitation success will be impacted.	• Soil analysis will be undertaken to determine the chemical and physical properties of topsoil, and treatments that are required to improve topsoil quality to support the growth of target vegetation, will be applied.

4.6 Sub-Soil Properties

Soil properties of the sub-soils play a critical role in the establishment and long term viability of vegetation. Current geochemical data indicates that some areas of weathered clay may be high risk soils, with the potential of being sodic and/or saline. Further geochemical investigations are required to determine what soil treatments are required to ensure the stability of the diversion and the short, medium and long-term sustainability of the revegetation. Soil treatment details when defined, will be provided in the technical specification for rehabilitation.

4.7 Subsoils

Tertiary subsoils within the project area are generally sodic, dispersive and have elevated salinity levels. These characteristics make this material difficult to stabilise. Dispersive characteristics can be overcome through the application of gypsum ($CaSO^4$). Gypsum amelioration within subsoils and possibly topsoil material is anticipated to be necessary. The rates, methodology and specific details for application and amelioration will be contained within the technical specification for rehabilitation. The below table is a guide to the required gypsum application rates.

Table 6 - Guide for Gypsum Application Based on Subsoil ESP Values

Subsoil ESP	Rate of Application of Grade 1 Gypsum
<7%	None
7-14%	5T/ha
14-23%	10T/ha
23-35%	15T/ha
>35%	20T/ha

4.7.1 *In-situ* Permian Rock

No significant areas of Permian Rock are likely to be exposed during excavation therefore no special attention is required to this rock type.

4.8 Vegetation Clearing

The project will require the clearing of native vegetation. Windrowing vegetation close to the site, promotes the re-introduction of native fauna to the site. There are considerable advantages to leaving windrows in place, primarily related to habitat reconstruction. Where possible, the preference will be to windrow vegetation to a location which will not need to be disturbed in future.

Re-using vegetation for rehabilitation activities is often a possible option, depending on the size, and nature of the vegetation. Vegetation re-use through re-spreading over batters either as a mulched or whole product will be considered by BHP. The Rehabilitation Technical Specification will provide specific details related to the management of cleared vegetation.

4.9 Soil Conditioning and Seed Bed Preparations

Soil conditioning applies to both topsoil and subsoil. Deep ripping is a critical component of the rehabilitation process. Zones 1,2 & 4 are to be deep ripped after topsoiling to a depth of >600mm.

Zones 1, 2, & 4 will have a seed bed layer prepared in the top 100mm of soil. The seed bed layer will be prepared to ensure ped sizes are small enough for adequate seed/soil contact. Target ped sizes will differ depending on soil chemistry, however target ped sizes will aim to be as small as reasonably practical without overworking the soil and posing issues related to soil loss through wind etc.

Standard, broad scale agricultural equipment such as, fertiliser spreaders, offset disc ploughs, direct drill seeders and press wheel rollers will form some of the fundamental surface amelioration equipment. Equipment specifications and performance criteria will be included in the Rehabilitation Technical Specification.

Fertiliser application will occur in summer. The higher air temperatures pose greater risks associated with Nitrogen volatilisation, to overcome this risk, fertilisers will be incorporated into the top 200mm of soil and will not be applied directly to the soil surface.

Zones 5 & 6 will have topsoil applied, (with the exception of in Rock chute and Rock works areas) , soil conditioning such as ripping applied to levees and dam embankments and soil treatment works undertaken as outlined in the Rehabilitation Technical Specifications.

4.10 Diversion Commissioning

The diversion will be commissioned when construction activities are signed off by the RPEQ as being undertaken in accordance with design specifications. The existing natural section of Walker creek which is to be replaced by this diversion will remain open until commissioned.

4.11 Seeding

The success of planting is dependent on several factors, these include:

- Soil chemistry and plant nutrition
- Soil moisture,
- Planting depth and seed soil contact
- Competition from weed species
- Seed quality
- Seed treatments
- Seed species selection
- Attack from pest invertebrates.
- Predation from large fauna such as cattle, kangaroos etc.

4.12 Soil Chemistry and Plant Nutrition

Soil salinity within the Stage 2C project is not anticipated to be restrictive to plant growth.

Soil sodicity is expected to pose issues related to dispersiveness, surface crusting, hard setting, and nutrition availability to plants. Sodicity issues will be addressed using methods addressed in section 6 (Soil Management)

Plant nutrition issues will be addressed through the use of fertilisers as addressed in section 6 (Soil Management)

A basic guide to target plant nutrition requirements are outlined in the table below.

Table 7 - Guide for Topsoil Nutritional Requirements

Parameter	Units	Ranges
pH WATER	none	5.5 – 8.5
pH CHLORIDE	none	5.0 – 8.0
ECWATER	dS/m	<0.9
ECSAT	dS/m	<4
Chloride	mg/kg	<300
Organic carbon	%	1-3
N nitrate	mg/kg	>10
N ammonium	mg/kg	n/a
P	mg/kg	8 - >20
S	mg/kg	>10
CEC	cmol /kg	>12
ESP	%	<6
Ca/Mg ratio	none	>4
Ca	cmol /kg %	5-10 65-80
Mg	cmol /kg %	1-3 10-15
K	cmol /kg %	0.3-0.7 1-5
Na	cmol /kg %	0.3-0.7 0-1
Zn	mg/kg	0.5-5

Parameter	Units	Ranges
Cu	mg/kg	0.3-5
Fe	mg/kg	2-100
Mn	mg/kg	2-50
B	mg/kg	1-2
Mo	mg/kg	2

4.13 Soil Moisture and Planting Timing

Adequate surface soil moisture is the critical component of successful germination. Adequate subsoil moisture is a critical component of successful growth. When relying on seasonal conditions, the seasonal variations in rainfall intensities and durations is one of the highest risks to a successful rehabilitation program. As outlined in section 8.3 (irrigation), BHP are endeavouring to reduce this risk through the use of an irrigation system. However, under this option, not all areas will be irrigated, irrigation will be applied to high risk areas such as upper batter slopes (Zone 2) For other zones such as Zone 4 which comprises of the largest zone in the project, this area will rely on rainfall for establishment. Planting timing is critical in this and other zones, a percentage of hard coated seeds will be scarified prior to planting. If these seeds do not germinate within approximately 1 month of scarification and planting, the viability of this seed will diminish, therefore the remaining un-scarified seeds provide a risk mitigation technique against this risk.

Most tree seeds take approximately 7-10 days of constant moisture to effectively germinate, often these must be planted within shallow reaches (top 1cm of soil), as they don't have a sufficient energy component within the seed to penetrate through from deeper soil. Having seasonal conditions which result in 7-10 days of constant moisture within the top layers of the topsoil does not occur each year in the Central Queensland area. These conditions do not normally occur during the wet season build up (Oct-Dec), which primarily consists of storm rain.

Planting with subsoil moisture obviously means that the topsoil layer has been also impacted by rain. This moisture has germinated naturally occurring grass and weed seeds, it has also caused surface crusting. Planting directly into soil such as this, without re-working is undesirable due to soil/seed contact and grass/weed competition.

Broadscale herbicide use to control naturally occurring grasses and weeds is an option to encourage tree and shrub growth, but this is undesirable due to the impacts to beneficial seed species within the topsoil.

Planting without any subsoil moisture poses risks associated with a lack of follow up rainfall, and therefore germinated plants perish and seed stocks within the soil profile diminish. Planting without subsoil moisture will occur depending on seasonal outlooks. Should the first germination die off, an option of re-seeding will be explored.

The project will address these risks by implementing a planting strategy as outlined in the Rehabilitation Technical Specifications, some key actions within this strategy include;

- Seeds will be coated where practical.
- Soil will be worked and ready for seeding in December. Planting will occur when forecasts show a high likelihood of adequate rainfall.
- If storms fall within the rehabilitation area prior to planting, A scarifying implement such as harrows will be used to re-work the soil surface, as soon as possible after it is dry enough to access. Ideally when germinating plants are approximately < 1-5cm in height.

4.14 Planting Depth

Planting equipment will be selected based on the species used.

Direct drill seeders will be the preferred method to plant larger hard coated seeders, surface spreaders, scarifiers and press wheels will be the preferred equipment used for smaller seeds, such as Eucalyptus species and grass seed.

Specifications for planting equipment will be outlined in the Rehabilitation Technical Specification

4.15 Declared Weeds

Weeds deemed to be declared weeds are those listed in the *Land Protection, (Pest and Stock Route Management*) *Act 2002* or subsequent legislation.

Normal biosecurity conditions as listed in the *Biosecurity Act 2014* will be applied to the work site. Machinery entering the work site from offsite locations will be washed and inspected prior to entry and use to ensure they are free of weed seeds and reproductive material.

Competition from weed species will be addressed using a combination of spot spraying and application of pre-emergent herbicides around trees where required.

The MRA 2C area has many species of Class 2 weed species which are now endemic to the area. An example of a prevalent weed within this area is *Parthenium hysterophorus*. There is an expectation that this species will be present within the rehabilitated area and there is no expectation that control methods such as herbicides will be used to control this weed. The main reason is that many of these weeds are early colonisers which will be outcompeted by grass growth in future years.

Class 2 woody weeds however will not be outcompeted and will therefore be controlled if they appear. Examples of these types of weeds are, Lantana (*Lantana camara*), Rubber Vine (*Cryptostegia grandiflora*), and Castor oil bush (*Ricinus communis*).

Any species of declared weeds, which are discovered in rehabilitated areas and are not found in the local area, will have control programs implemented.

When growing trees, climbing legumes such as Siratro (*Macroptilium atropurpureum*), cause considerable growth constraints and ultimately kill young trees by smothering them and preventing sunlight penetration. For this reason, no climbing legumes are included in the proposed seed mix. However, this legume will be considered for the seedmix used on the C2 dam embankment, as a long term prevention against tree establishment.

4.16 Seed Quality

Seed supply specifications will be listed in the Rehabilitation Technical Specification. Seed will be sourced from reputable seed merchants. A preference will be applied to local providence seeds where possible. Germination testing will occur on all seed batches. Purity testing will occur on all seed batches to ensure no weed species are introduced with the seed. If seed storage is required onsite for lengthy periods of time, it will be stored in appropriate storage facilities.

4.17 Seed Treatments

Seed treatments will be applied as outlined in the Rehabilitation Technical Specification. Seed treatments include;

- seed coating where required
- scarification for hard coated seeds
- inoculation of legumes as required
- insecticide treatments as required.

4.18 Seed Species Selection

The Rehabilitation Technical Specification will contain the final list of proposed species, as seed availability and irrigation options are yet to be finalised. However, the below table has been provided for the purposes of providing an indicative list.

In order to resemble natural riparian ecosystems within the areas surrounding the diversion, a selection of upper, middle and ground storey species will be used. The estimated quantities per ha provided are indicative only.

Seeding of Zones 1 and 2 to these rates would only apply if tube stock is not used. Should tube stock be used, it would only be proposed in Zones 1 & 2.

The seed list has been designed to enable flexibility depending on seed availability. However, some species are mandatory. These include:

- Black Iron Box (*Eucalyptus raveretiana*) listed as 'vulnerable' under EPBC Act
- Koala food source trees (*Eucalyptus tereticornus*, *Eucalyptus crebra* and *Eucalyptus camaldulensis*)

If it is decided that irrigation and tube stock will be used, a small amount of seed will also be spread for those species that are being planted. The Rehabilitation Technical Specification will outline the exact planting sequences for seeding and planting of tube stock. It will also outline the proposed planting densities. Tube stock will only be planted in Zones 1 and 2. All upper and middle storey species listed in below table would be suitable for growth as tube stock. The minimum species numbers contained in this table would also apply where tube stock is used.

Table 8 - Proposed Species List

Common Name	Species
Upper Storey Species (Total 3kg/ha/seed) (minimum of 8 species to be used)	
Moreton Bay Ash	*Eucalyptus tesselaris*
River Red Gum	*Eucalyptus camaldulensis*
Forest Red Gum	*Eucalyptus tereticornis*
Clarkson's Bloodwood	*Corymbia clarksoniana*
Poplar Box	*Eucalyptus Populnea*
Narrow Leaved IronBark	*Eucalyptus crebra*
Poplar Gum	*Eucalyptus platyphylla*
Black Ironbox	*Eucalyptus raveretiana*
Lemon Scented Gum	*Corymbia citriodora*
Weeping Paperbark	*Melaleuca leucadendra*
River She-oak	*Casuarina cunninghamiana*
Belah	*Casuarina cristata*
Mid Storey Species (Total 3kg/ha) (minimum of 5 species to be used)	
Soap Wattle	*Alphitonia excelsa*
Red flowered Bauhinia	*Lysiphyllum Caronii*
Weeping Bottlebrush	*Melaleuca viminalis*
Black Wattle	*Acacia leiocalyx*
SallyWattle	*Acacia salicina*
Zig-zag Wattle	*Acacia macradenia*
Wilga	*Geijera parviflora*
False Sandalwood	*Eremophilamitchellii*
Ground Species (Total 8kg/ha/seed only) (minimum of 5 species to be used)	
Current Bush	*Carissa ovata*
Kangaroo Grass	*Themeda triandra*
Black Speargrass	*Heteropogon contortus*
Giant Speargrass	*Heteropogon triticeus*
Reed Grass	*Arundinellane palensis*
Forest Bluegrass	*Bothriochloa bladhii*
Forest Mitchel Grass	*Bothriochloa erianthoides*
Tall Windmill Grass	*Chloris ventricosa*

Common Name	Species
Buffell Grass	*Cenchrus cilliaris*
Rhodes Grass	*Chloris gayana cvv Katambora*
Legume Species (Total 1kg/ha) (minimum of 2 species to be used)	
Verano Stylo	Stylosanthes hamata
Seca Stylo	Stylosanthes scabra
Wynn Cassia	*Chamaecrista rotundifolia*

4.19 Predation from Invertebrates

Invertebrate attack on seeds and young seedlings can cause considerable damage to sites undergoing rehabilitation.

Prevention against insect attack can occur through:

- Timing of planting.
- Chemical control either applied to soil or seed at time of planting or when young plants are being attacked.
- Seed colouring.

It is not anticipated that insect attack will be a risk for the Stage 2C diversion rehabilitation, however the rehabilitated areas will be closely monitored to ensure any necessary controls can be implemented.

4.20 Predation from Large Fauna

Due to the destructive nature of cattle on newly rehabilitated areas, the diversion will be fenced with a stock proof fence and all livestock will be excluded from the site during construction. Future grazing on this land will only be undertaken when it is deemed capable of supporting this land use, by an appropriately qualified person.

Native fauna (kangaroo and wallaby) population intensities around the Stage 2C area are not expected to be significant enough to cause major detrimental impacts to rehabilitation, however, monitoring conducted immediately after the works will be required to evaluate this risk.

4.21 Diversion Spoil

As outlined previously, the excavated material from the diversion will be dumped into an area designated for future mining. This material will then be moved as part of this mining and managed according to normal mining rehabilitation works.

The dump has been designed with a focus on pollution prevention. Drainage controls have been designed to adequately treat water with elevated sediment loads prior to entering the Walker Creek diversion. These drainage controls primarily consist of sediment dams. The sediment dams have been designed in accordance with industry guidelines.

Under the definitions provided in EA EPML 00712313. Water leaving this landform, passing through an appropriate erosion and sediment control structure, is not defined as mine affected water and can runoff into Walker Creek.

4.22 Rehabilitation Monitoring

An annual rehabilitation monitoring program will be implemented for a minimum period of 5 years following the completion of the project. The monitoring program will identify any areas which require corrective actions, the site will address these corrective actions in the year following the monitoring or on an as required basis.

5 Erosion and Sediment Controls

5.1 Erosion and Sediment Controls During Construction

The construction of Stage 2C will comply with all Environmental Authority conditions listed in BHP South Walker Creek Environmental Authority – EPML00712313.

Existing conditions related to erosion and sediment controls are provided in Table 9 below.

Table 9 - EPML00712313 Stormwater and water sediment controls during construction

EA	Condition
W38	**Stormwater and Water Sediment Controls** An Erosion and Sediment Control Plan must be developed by an appropriately qualified person and implemented for all stages of the mining activities on the site to minimise erosion and the release of sediment to receiving waters and contamination of stormwater.
W39	Stormwater, other than mine affected water, is permitted to be released to waters from: i) erosion and sediment control structures that are installed and operated in accordance with the Erosion and Sediment Control Plan required by condition **W38**; and ii) water management infrastructure that is installed and operated, in accordance with a Water Management Plan that complies with conditions **W30** to **W35** inclusive, for the purpose of ensuring water does not become mine affected water.

6 References

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