
Rehabilitation monitoring program

Baralaba coal mine | ML 5065, ML 5580, ML 5581, ML 5590, ML 80157,
MLA80169 and MLA 80170

Prepared for Cockatoo Coal Limited | 18 April 2013

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1 Introduction

1.1 General

The Baralaba coal mine includes Baralaba central, Baralaba north and Wonbindi north located on mining lease (ML) 5065, ML 5580, ML 5581, ML 5582, ML 5590, ML 80157, mining lease application (MLA) 80170 and MLA 80169.

Activities at the Baralaba coal mine include:

- continued open cut mining operations on ML 5605 and ML 80157 until the end of mine life (March 2014);
- commence an open cut mine on MLA 80169; and
- commence an open cut mine on MLA80170.

Activities on the land subject to the mineral resource authority are subject to conditions of approval issued under environmental authority (EA) permit numbers MIN100860309 and MIN101813010.

1.2 Scope

This rehabilitation monitoring plan (the plan) relates to key indicators that should be monitored in the post-mining landscape to evaluate whether the post-mining landscape is meeting the success criteria.

This is a progressive plan that will be implemented as areas become available through rehabilitation of mining activities. It is expected that it will be updated periodically to include newly rehabilitated areas.

1.2.1 Environmental authority compliance

Table 1.1 describes relevant environmental authority conditions for the Baralaba coal mine and how they are met within this plan.

Table 1.1 How this plan address the environmental authorities

Condition	Description	Section of this plan and description of how the condition is satisfied
F20	Relevant sections of this condition are: b) identify success factors and completion criteria for each domain; c) identify three reference sites to be used to develop rehabilitation success criteria; and j) describe rehabilitation monitoring and maintenance requirements to be applied to all areas of disturbance	Success criteria are described in Section 2 Reference sites are described in Section 3.3 Reporting and maintenance is described in Section 7.1
F21	Once the rehabilitation has commenced, the holder of the environmental authority must conduct rehabilitation monitoring as proposed in the rehabilitation monitoring program on a yearly basis, which must include sufficient spatial and temporal replication to enable statistically valid conclusions as established under the rehabilitation program.	The monitoring schedule is described in Section 6
F23	Verification of rehabilitation success, determined by the	The monitoring method is described

Table 1.1 How this plan address the environmental authorities

Condition	Description	Section of this plan and description of how the condition is satisfied
F24	<p>rehabilitation success criteria developed as per condition F20 is to be carried out as follows:</p> <ul style="list-style-type: none"> • the minimum sampling intensity must be specified for the monitoring of progressive rehabilitation; • justification of the suitability of the minimum sampling intensity must be provided; • monitoring must include sufficient replication to enable statistical analysis of results as an acceptable power; and • undertaken at 12 monthly intervals. <p>The rehabilitation monitoring program must be included in the <i>Plan of Operations</i> and updated with each subsequent plan of operations, describing:</p> <ul style="list-style-type: none"> • how the rehabilitation objectives as per the <i>Rehabilitation Management Plan</i> will be achieved; and • verification of rehabilitation success as per condition F23. 	<p>in Section 4</p> <p>The rehabilitation objectives and their relationship to success criteria and monitoring are described in Section 2.</p>

2 Success criteria

The goal, objectives and indicators for rehabilitation at the Baralaba coal mine are defined in the environmental authorities.

The goal is to achieve a rehabilitated landform which is:

- safe;
- non-polluting;
- stable; and
- self-sustaining.

The objectives and indicators are described in Table 2.1.

Table 2.1 Rehabilitation objectives and indicators

Objectives	Indicators
Site is safe for humans and animals	A risk assessment of the surface facilities areas is to be undertaken at closure to ensure the site is safe, non-polluting and in a state which is conducive to the desired post-mining land use.
Water quality protected	Water quality is not impacted post-mining
Contaminated land	All areas contaminated by hydrocarbons or other chemicals used during the life of the mine are to be excavated and disposed of appropriately.
Minimise erosion	Topsoil is to be replaced on disturbed areas to the minimum specified depth.
Vegetation cover	A minimum vegetation cover of 70% across all previous surface facility areas will be required. Areas not covered by vegetation will be minimised and vegetation growth is to be promoted if required.
Species composition (flora)	The species composition will be similar to appropriate reference sites chosen based on their current land use, soil type, vegetation community type and health.
Community structure	Vegetation community structure (groundcover, understorey and overstorey) will be similar to appropriate reference sites chosen based on their current land use, soil type, vegetation community type and health.
Species diversity (fauna)	Faunal species diversity at mine closure will be similar to current species diversity as documented in the <i>Baseline Fauna Surveys and Environmental Management Plans for Baralaba north and Wonbindi Coal Mines</i> or representative of similar undisturbed habitats across the site.

The environmental authorities for Baralaba coal mine do not include completion or success criteria for rehabilitation objectives. Success criteria have been prepared by Cockatoo Coal Limited and these have been reported in the *Environmental Management Plan*.

A summary of the closure strategy, success criteria and rehabilitation monitoring for final landforms (ie residual void, elevated landform and infrastructure areas) at Baralaba coal mine is provided in Table 2.2, Table 2.3, and Table 2.4.

Information about the closure strategy and success criteria come from the *Post mine land use plan* and *Environmental management plan* respectively. Information about rehabilitation monitoring is from previous Baralaba coal mine rehabilitation monitoring plans or has been developed through the

preparation of this plan. The rehabilitation monitoring methods in the summary tables are further described in Section 4.

Table 2.2 Residual void – closure strategy, completion criteria and rehabilitation monitoring

Aspect	Closure strategy	Success criteria	Rehabilitation monitoring
Final landform	A residual void adjacent to a backfilled elevated in-pit landform. Final slopes will be less than 15%.	Backfilled void meets design parameters Slope angle and length meets design criteria	As built survey
Hydrology	Void will preferentially receive all site run-off post-mining	No evidence of groundwater contamination No evidence of surface water contamination	Groundwater monitoring Surface water monitoring
Topsoil	The internal void surface will not be topsoiled	None	Topsoil and spoil assessment
Erosion	The residual pit walls will not have erosion control. The adjacent in-pit elevated landform will have erosion control measures	No active soil erosion	Erosion monitoring
Vegetation	Directing seeding to spoil	Vegetation cover at least 70%. A range of native trees and shrubs present with evidence of recruitment occurring Analysis against reference sites for species diversity and vegetation structure	Vegetation monitoring
Land capability	Class 4 There will be no strategic cropping land	Meets criteria	Land capability assessment

Table 2.3 Elevated landforms – closure strategy, completion criteria and rehabilitation monitoring

Aspect	Closure strategy	Success criteria	Rehabilitation monitoring
Final landform	All in-pit and ex-pit spoil dumps will be reshaped at a grade less than 15% Vertical height of final landforms will be no more than 50 m above ground level The top of the dump will be gently sloped and shaped to direct water off the dumps	In-pit and ex-pit meet design parameters Slope angle, length and height meet design criteria	As built survey
Hydrology	Installation of drainage	No evidence of surface	Surface water monitoring.

Table 2.3 Elevated landforms – closure strategy, completion criteria and rehabilitation monitoring

Aspect	Closure strategy	Success criteria	Rehabilitation monitoring
	structures to direct water off the elevated plateau, down the slopes	water or groundwater contamination	Groundwater monitoring
Topsoil	To be spread 0.2 m deep across flat top and sloped surfaces	Low stability and dispersive soil/spoil not on external faces of rehabilitated landforms	Physical properties of topsoil Chemical properties of topsoil
Erosion	Drainage berms (10 m wide) installed on the side slopes to limit effective slope lengths Installation of erosion and drainage structures to direct water off the elevated plateau, down the slopes and around the base of the dumps into sediment collection ponds	No active gullies and low rates of erosion No evidence of sediment being transported off-site	Erosion monitoring
Vegetation	Directing seeding to applied topsoil	Vegetation covers at least 70% A range of native trees and shrubs present with evidence of recruitment occurring Analysis against reference sites for species diversity and vegetation structure	Vegetation monitoring
Land capability	Flat surfaces – Class 4 Sloped surfaces – Class 5 There will be no strategic cropping land	Meets criteria	Land capability assessment

Table 2.4 Infrastructure areas – closure strategy, completion criteria and rehabilitation monitoring

Aspect	Closure strategy	Success criteria	Rehabilitation monitoring methods
Final landform	Infrastructure areas are mostly flat. They will be ripped and seeded	Slope angle and length meet design criteria	As built survey
Hydrology	If appropriate surface water will be routed towards the residual pit or the nearest sediment dam	No evidence of surface water	Surface water monitoring
Topsoil	Direct seeding no topsoil application	Low stability and dispersive soil/spoil not on external faces of rehabilitated	Physical properties of topsoil

Table 2.4 Infrastructure areas – closure strategy, completion criteria and rehabilitation monitoring

Aspect	Closure strategy	Success criteria	Rehabilitation monitoring methods
Erosion	No erosion and sediment control	landforms No active gullies and low rates of erosion No evidence of sediment being transported off-site	Chemical properties of topsoil Erosion monitoring
Vegetation	Directing seeding	Vegetation covers at least 70% A range of native trees and shrubs present with evidence of recruitment occurring Analysis against reference sites for species diversity and vegetation structure	Vegetation monitoring
Land capability	Topsoil stockpile – return strategic cropping land Other areas – Class 4	Meets criteria	Land capability assessment Strategic cropping land assessment

3 Monitoring locations

3.1 Current on-site

Table 3.1 summarises current monitoring locations at Baralaba coal mine. The summary is presented as:

- surface water;
- groundwater; and
- vegetation.

Table 3.1 Current on-site monitoring locations

Analysis type	Northing (GDA 94)	Easting (GDA 94)
Surface water		
Baralaba central pit (CP2)	7326934	784879
Mine Dam 1	783756	7325355
	783702	7325548
	783944	7325436
	783979	7325325
Baralaba Central Pit (CP2)	785310	7325310
	784880	7325290
	784280	7326670
	784790	7326830
Monitoring Point A1	7323969	785939
Monitoring Point DR3	7333836	785706
Groundwater		
PZ07	783667	7325338
PZ08	783560	7325721
PZ09	783460	7326064
PZ07B	783662	7325336
PZ10	784370	7329249
PZ11	783385	7327308
PZ12S	784194	7327528
PZ14S	782822	7331499
PZ12D	784199	7327529
PZ14D	782768	7331493
PZ13	784010	7327324
PZ15	To be provided	To be provided
PZ16	To be provided	To be provided
PZ17-PZ23	To be provided	To be provided
PZ24-PZ26	To be provided	To be provided
PZ27-PZ29	To be provided	To be provided
Vegetation		
1	7325900.761	783675.5156

Table 3.1 Current on-site monitoring locations

Analysis type	Northing (GDA 94)	Easting (GDA 94)
2	7325775.839	783670.2364
3	7325659.952	78759.5069
4	7325659.826	783885.9979
5	7325738.315	783842.9104
6	7325874.046	783796.1584

3.2 Future on-site location

As mining and progressive rehabilitation commences on the Baralaba north/Wonbindi north mine additional monitoring location will be added for the following assessments:

- contaminated land;
- erosion;
- topsoil;
- land capability; and
- vegetation.

The additional items listed above, are currently not monitored on site but are required to evaluate whether progressive rehabilitation is meeting the nominated success criteria listed in Table 2.2, Table 2.3, and Table 2.4.

3.3 Reference sites

In accordance with condition F20 in the environmental authorities, reference site monitoring is to be done at three reference sites. Three reference sites will be selected during the current *Plan of Operations*.

The criteria that will be used to select reference sites are as follows:

- access is permissible;
- close proximity to the rehabilitation area;
- comparable vegetation to the revegetation objectives of the rehabilitated landform; and
- similar landscape conditions (ie soil type, slope and aspect).

The reference sites will be monitored for:

- erosion;
- topsoil; and
- vegetation.

The method to be used for monitoring the reference sites are described in Section 4.

4 Monitoring methods

This section of the plan only describes methods for analysis required to determine whether rehabilitated domains are meeting the success criteria. Responsibility for monitoring assessment of results and reporting is described in Section 5 and the frequency of assessment is described in Section 6.

4.1 As built survey

An as built survey of final landforms will be completed by site survey staff. The survey will be completed with sufficient accuracy to allow the development of a one meter digital elevation model.

4.2 Surface water

Surface water monitoring for the operational mine is described in the *Baralaba Coal Mine Receiving Environment Management Program*.

The surface water monitoring and management program will be reviewed and revised annually during the life of the mine. Under the environmental authorities, Baralaba coal mine is required to report to EHP the outcome of each review including a response to recommended actions. This means that the surface water monitoring and management program will be adapted over time to suit the requirements of monitoring for rehabilitation success criteria.

4.3 Groundwater

Groundwater monitoring for the operational mine is described in the *Baralaba Coal Mine Groundwater Monitoring and Management Program*.

The groundwater monitoring and management program will be reviewed and revised as described for surface water in Section 4.2.

4.4 Contaminated land

The operational site will maintain a contaminated land register. The register will include the location of recorded spills, type of contaminant and the estimated volume of contaminant spilled. The register will be reviewed prior to decommissioning of the infrastructure domain. Contamination clean-up will be included in the decommissioning plan.

4.5 Erosion

4.5.1 Set-up and sampling

Erosion monitoring will be completed on all re-contoured surfaces. This is to be performed along existing sloped transects on rehabilitated spoil dumps or reference sites, at the same time as the vegetation assessment.

The procedure is to be performed across slope. That is along the contour not orientated towards the crest and toe of the slope.

The method involves laying a 150 m tape measure along the ground starting from the first peg of the transect. The tape must be secured at the beginning and pulled firm to ensure that it lies as close as possible to the horizontal. The transect design is illustrated in Figure 4.1.

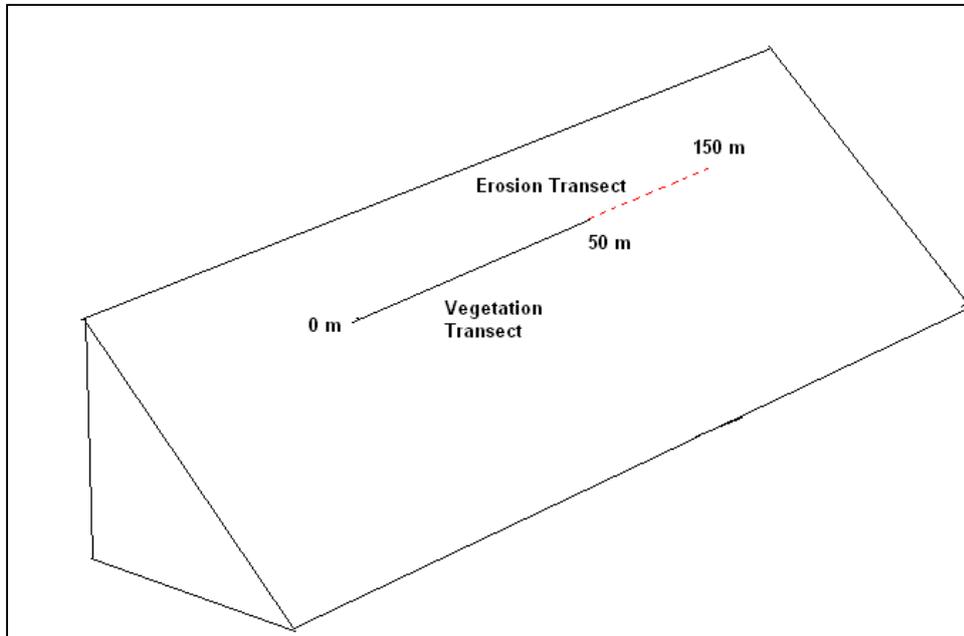


Figure 4.1 Erosion monitoring transect

The density of sampling has not yet been determined but will include a combination of upper slope areas, mid-slope areas and toe slope areas. The density of sampling will be determined by Baralaba coal mine management, based on what is practical to achieve and what EHP will accept.

4.5.2 Procedure

The monitoring procedure is:

- walk along the transect and identify any gullies (ie. rills that are more than 30 cm deep);
- for each gully, measure the deepest point at which the tape crosses the gully (depth) and the distance from the "0" peg at which it occurs;
- measure the total width of the gully (again, where tape crosses the gully); and
- take a photo from the nearest previous peg of the whole gully and record the details in the data sheet.

Where the transect does not cross any gullies, but there are significant gullies elsewhere on the slope, then the following procedure should be followed:

- select a number of gullies. The gully transect should not aim to go through the deepest part of the gully but should be randomly selected;
- five meters prior to the start of a gully and 5 m past the end of a gully (around the slope) a star picket should be inserted. These positions should be logged using GPS;

- for the identified gully, measure the deepest point (depth) and the distance from the starting star picket at which it occurs;
- measure the total width of the gully; and
- take a photo from the star picket of the whole gully and record the details on the erosion data sheet.

4.6 Topsoil and spoil

4.6.1 Sample density

The sample collection density for topsoil and spoil sampling is:

- one sample location per 15ha. If the area is less than 15ha than the minimum number of sample locations is one;
- sample locations should extend to 0.5 m below ground level or to the maximum depth of topsoil. Whichever is deepest; and
- samples should be taken at 0.1 m increments below ground level for the full topsoil thickness.

4.6.2 Analysis of physical properties

The assessment should follow the method described in the *Baralaba Coal Mine Topsoil Management Plan* and include the analysis of:

- electrical conductivity (EC);
- chloride content;
- calcium to magnesium (Ca:Mg) ratio;
- cation exchange capacity (CEC);
- exchangeable sodium percentage (ESP);
- Emerson aggregate stability; and
- particle size distribution.

Particulate size distribution was not included in the *Baralaba Coal Mine Topsoil Management Plan*. It is required for the calculation of plant available water capacity (PAWC). PAWC is a measure of the maximum amount of water that can be held in the pores of the soil and is available for vegetation. It is required for determining land capability class.

Samples will be sent to a NATA accredited laboratory for analysis.

4.6.3 Analysis of chemical properties

Analysis will be as described in Table 4.1. The table also provides justification for why each analysis is required.

Table 4.1 Chemical analysis of topsoil and spoil

Test	Reason for inclusion
pH	Measurement of pH is probably the most commonly made test. It is regarded as a useful indicator of other soil properties (e.g. values >8.5 usually indicate high exchangeable sodium levels and the presence of carbonates) and of the need for amendment with lime. Some plants tolerate a wide range of pH, while some are sensitive to acidity and some to alkalinity. The availability of some nutrients would be affected by soil pH.
Carbonate Content	Carbonate may exist in soil as predominately either calcite or dolomite. Its presence, which may vary from trace amounts to high percentages of the soil, is of significance because of its effect on the general physical condition, especially on consistence. When present in large amounts as fine-earth carbonate it can modify soil texture. It can constitute a potential source of calcium for the replacement of exchangeable sodium, thus improve stability.
Soluble Ca, Mg, Na, K, CO ₃ , HCO ₃ , SO ₄	Knowledge of soluble cations and anions and their relative proportions is valuable in assessing saline and alkaline soils and their response to various treatments. Chloride is usually the principal anion in extracts of soil and it is specifically toxic to some plants. Other anions may also be toxic to plants. Bicarbonate is a normal constituent of saline and sodic soil extracts. Both CO ₃ and HCO ₃ have a tendency to precipitate the divalent cations Ca and Mg, resulting in an increase in the ratio of Na to Ca-Mg in the soil solution. This favours the absorption of Na by the exchange complex and the development of unfavourable sodic-soil conditions.
Bicarbonate Phosphorous (Caldwell method)	If the amount of phosphorous in soil is too small then yield is jeopardised, but increasing reserves to very high levels is an unnecessary expense. Thus the concept of a critical level in soil is necessary.
Nitrogen	As above
Potassium	As above
Organic Matter	Organic matter is important in maintaining soil structure, in slightly increasing the soil's water holding capacity and holding a small store of N, P, S and trace elements in organic forms. These cannot be taken up directly by plant roots but have first to be converted by soil microbes to inorganic (ionic) forms identical to those supplied in fertilisers.
Total digest for molybdenum, manganese, iron, copper, zinc, boron, chloride, sodium, cobalt and selenium	Although only required in small amounts, trace elements (or micronutrients) are essential for plant growth. These nutrients often act as catalysts in chemical reactions. It is possible to have toxicities of trace elements, as well as deficiencies. A deficiency may reduce plant growth. An excess of a trace element, although not common, may be toxic to the plant and may cause an imbalance, reduced yield, impaired quality or increased susceptibility to disease.

4.7 Land capability

4.7.1 Sample density

Land capability is determined from the assessment of physical and chemical properties of soil and spoil as described in Section 4.6.2 and Section 4.6.3. There is no additional sampling required for the assessment of land capability.

4.7.2 Analysis

The analysis used to identify land capability will follow guidelines established by Land Resources Branch (1990), which is the basis for land suitability assessment (DME, 1995). Land capability assessments for each soil type can be undertaken for grazing and/or cropping land uses.

Land capability is assessed applying eleven key indicators (limiting factors). The limiting factors and diagnostic criteria are described in Table 4.2.

Table 4.2 Land capability assessment criteria

Limiting Factor	Diagnostic Criteria	Comment
Plant available water capacity	Cropping <ul style="list-style-type: none"> • pH • Cl- anion concentration 	Table 2.3 from DME (1995)
	Grazing <ul style="list-style-type: none"> • ESP • EC 	
Nutrient deficiency	Cropping <ul style="list-style-type: none"> • Bicarbonate P • Exchangeable K 	Table 2.2 and Table 2.3 from DME (1995)
	Grazing <ul style="list-style-type: none"> • Bicarbonate P 	
Salinity	Cropping <ul style="list-style-type: none"> • EC 	
	Grazing <ul style="list-style-type: none"> • Cl- anion concentration 	
Soil physical factors	Cropping <ul style="list-style-type: none"> • Soil texture 	
	Grazing <ul style="list-style-type: none"> • Ped size 	
Erosion	Cropping <ul style="list-style-type: none"> • Sodocity 	
	Grazing <ul style="list-style-type: none"> • Slope 	
Workability	Cropping <ul style="list-style-type: none"> • Soil texture • Ped size 	
	Grazing <ul style="list-style-type: none"> • Not applicable / no criteria 	
Susceptibility to flooding	Cropping <ul style="list-style-type: none"> • Flood return period 	
	Grazing	
Microrelief	Cropping <ul style="list-style-type: none"> • Presence / absence and size of meloholes 	
	Grazing	
Wetness	Cropping <ul style="list-style-type: none"> • Geomorphology 	
	Grazing <ul style="list-style-type: none"> • ESP 	
Topography	Cropping <ul style="list-style-type: none"> • Presence / Absence of gullies 	
	Grazing	
Rockiness	Cropping <ul style="list-style-type: none"> • Boulder, Cobbles, Gravel % 	
	Grazing	

- Notes:
1. Soil texture is determined from particle size distribution.
 2. Slope is determined from the digital elevation model.
 3. Flood return period is determined from the Baralaba Coal Mine Water Management Plan.
 4. Erosion indicators are determined from the erosion assessment.

4.8 Strategic cropping land

4.8.1 Sample density

Strategic cropping land is determined from the assessment of physical and chemical properties of soil and spoil described in Section 4.6.2 and Section 4.6.3. There is no additional sampling required for the assessment.

This assessment is to be only carried out on the area used for topsoil stockpiling during operation. It is not required to be undertaken until after all topsoil stockpiles have been removed and the area rehabilitated by ripping and seeding.

4.8.2 Analysis

EHP (formerly DERM) have proposed criteria for identifying strategic cropping land in the document *Protecting Queensland's strategic cropping land - Proposed strategic cropping land criteria* (DERM 2011). The criteria were developed to reliably and consistently identify Queensland's best cropping land—land that is suitable for a range of crops in most seasons.

Strategic cropping lands are assessed based on eight criteria. The criteria are described in Table 4.3.

Table 4.3 Strategic cropping land criteria

Criteria	Criteria and thresholds – Western cropping land
Slope	≤3%
Rockiness	≤20% for rocks >60 mm diameter
Gilgai micro-relief	<50% of land surface being Gilgai micro-relief of >500 mm in depth
Soil depth	≥600 mm
Soil wetness	Has favourable drainage (no waterlogged layers within 300 mm of the ground surface)
Soil pH	For non-rigid soils, the soil at 300 mm and 600 mm soil depth must be greater than pH 5.0 For rigid soils, the soil at 300 mm and 600 mm soil depth must be within the range of pH 5.1 to pH 8.9, inclusive
Salinity	Chloride content <800 mg/kg within 600 mm of the soil surface
Soil water storage	≥100 mm to a soil depth or soil physico-chemical limitation of ≤1000 mm

4.9 Vegetation

4.9.1 Set-up and sampling

To ensure consistency and repeatability of the monitoring programme, permanent sites need to be established within the rehabilitation area. Star pickets are a cost effective and durable material to use for this purpose.

The site design is illustrated in Figure 4.2 and the sampling procedure is described in Table 4.4. A field data sheet has been provided as Appendix A.

At each site a central star picket is located and four additional star pickets are located at the four compass points (ie north, east, south and west) five metres from the central star picket. The star pickets should be pushed into the ground up to a permanently visible and unchangeable point (ie a painted line or engraving) so that ground level is at the marked point.

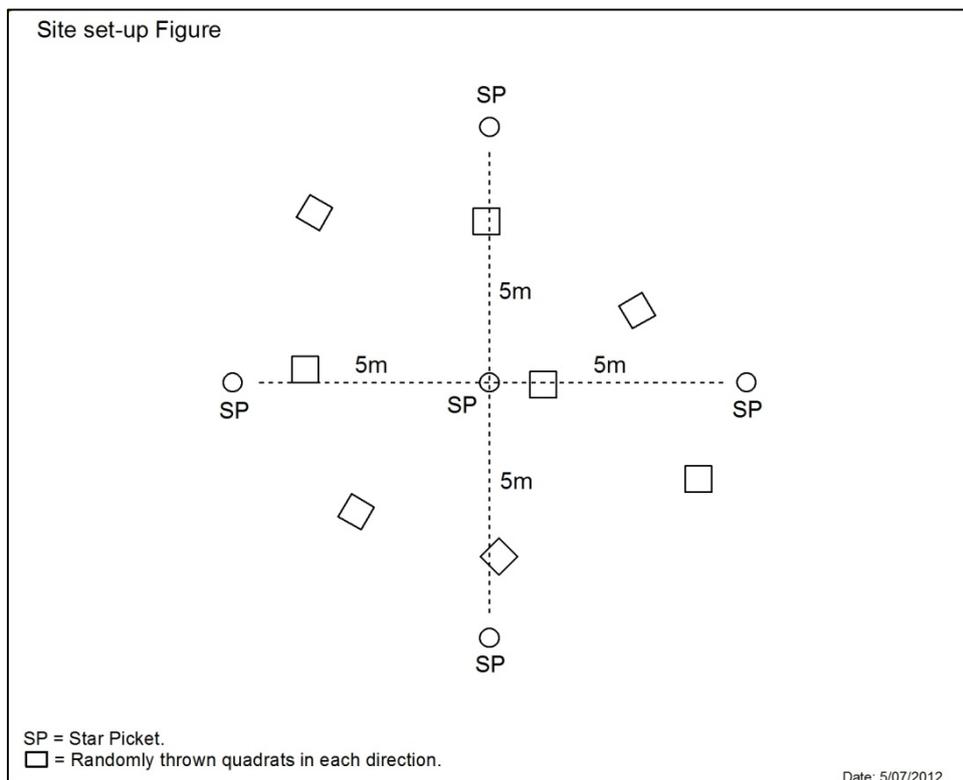


Figure 4.2 Monitoring plot set-up

Eight one square metre quadrats are assessed at each site and the procedure for determining their location is described in Table 4.4. Only one quadrat is required for the process, not eight.

Table 4.4 Vegetation measuring and sampling procedure

Step	Equipment required	Procedure
Step 1 – photographing the site	Camera	<ol style="list-style-type: none"> Stand at the central star picket Take four photos at each compass point (ie facing N, E, S, W) Record photo numbers on field sheet Each star picket can also be numbered with the site number and the first photograph can be taken of the star picket number for ease of referencing photos
Step 2 – general site notes	None	<ol style="list-style-type: none"> Record estimate of overall ground cover Note if any evidence of soil erosion Note if any evidence of use by fauna (ie. sightings of fauna, scats, hair, grazed vegetation) Record any woody vegetation growing in the monitoring plot or in the vicinity of the monitoring plot
Step 3 – measure soil loss	Tape measure	At each of the four compass point star pickets, measure the distance from the ground to the previously determined mark (ie hole). For the first time this is carried out the distances will all be zero and is not necessary to be completed.
Step 4 – measuring ground cover and species	1m quadrat Camera	Measure ground cover and species at eight quadrat locations: <ol style="list-style-type: none"> Stand at the centre star picket, facing north Randomly throw the quadrat towards north (aim to be within the

Table 4.4 **Vegetation measuring and sampling procedure**

Step	Equipment required	Procedure
		external star pickets)
		3. Take a photo of the quadrat and record photo number on data sheet
		4. Within the quadrat measure: <ul style="list-style-type: none"> • estimate total ground cover percentages (vegetation, bare earth, rock, woody debris); • species present and their relative percentage (of the vegetation cover, not the total quadrat); and • repeat at all eight compass points – N, NE, E, SE, S, SW, W, NW.
Step 5 (in conjunction with Step 4) – measuring biomass	Scissors/secateurs Bag Oven	1. Choose a quadrat from Step 4 which is representative of the percentage of groundcover across that site 2. Collect all vegetation within the quadrat 3. back in office/laboratory – dry the vegetation at 105 degrees Celsius for 48 hours 4. Weigh dry vegetation to determine kg/ha dry vegetation mass

Vegetation monitoring will be completed on all re-contoured surfaces. As for erosion monitoring, the density of sampling has not yet been determined but will include a combination of upper slope areas, mid slope areas and toe slope areas. The density of sampling will be determined by Baralaba coal mine management, based on what is practical to achieve and what EHP will accept.

4.9.2 Previous recommendation

The vegetation monitoring method described above is based on the method described in the previous Baralaba coal mine rehabilitation monitoring plan and was considered to be a simplified method suitable for monitoring rehabilitation areas with limited species diversity and structural development.

The previous rehabilitation monitoring plan recommended a more detailed monitoring method be implemented when the rehabilitation area develops a more complex vegetation structure. The method recommended is the *BioCondition monitoring methodology* described by the Queensland Herbarium (DEHP, 2011).

This recommendation should be considered during future review of the rehabilitation monitoring plan which will occur annually.

5 Quality assurance

Monitoring, data assessment and reporting will be done by a suitably qualified person. This could be Baralaba coal mine staff (eg environment officer) or external consultant(s).

All monitoring data files will be stored at the Baralaba coal mine.

Baralaba coal mine will be responsible for reviewing monitoring data, analysis, reports and managing consultants.

Aspects to consider when reviewing the data, analysis and reports include quality assurance/quality control of data, fluctuating trends in data from previous years, accuracy of figures and graphs and general conclusions made about rehabilitation progress.

6 Schedule

In accordance with the Baralaba coal mine environmental authorities rehabilitation monitoring will be undertaken on an annual basis.

Strategic cropping land assessment will only be undertaken on the old topsoil stockpile area and will not commence until the stockpiles are deleted.

Surface water monitoring will be in accordance with the *Receiving environment management plan*.

Groundwater monitoring will be in accordance with the *Groundwater management and monitoring plan*.

The duration of monitoring post-closure will be determined in consultation with EHP.

7 Administration

7.1 Maintenance

The rehabilitation monitoring program will be reviewed annually to align with condition F20 of the environmental authorities. The rehabilitation monitoring program report will identify maintenance issues and contingency for redesign when appropriate. The need for maintenance or redesign will be assessed against the monitoring success criteria.

A schedule for maintenance or redesign will be included in the *Rehabilitation Management Plan*.

7.2 Corrective actions

The following corrective actions are to be employed by the Baralaba coal mine where required:

- revision of construction, operation and rehabilitation activities as required;
- an incident report will be filled out if any non-conformances with this plan are found;
- in the event of an environmental incident, appropriate response measures will be implemented to ensure environmental harm from the event is minimised;
- all non-conformances will be corrected as soon as possible and strategies identified, evaluated and implemented to reduce the likelihood of the non-conformance re-occurring; and
- all non-conformances and corrective actions will be closed out as soon as practicable.

7.3 Records

An inspection checklist will be developed to create an auditable trail of what monitoring has been completed and where.

7.4 Reporting

7.4.1 Internal

All non-conformances with the conditions for rehabilitation in the environmental authorities will be reported to Baralaba coal mine management as soon as possible after becoming aware of the non-conformance. For example, this might include slope failure and exceedance of water quality trigger limits.

7.4.2 Regulatory authority

Baralaba coal mine General manager operations, or his approved delegate, will notify EHP in writing within 24 hours of becoming aware of an incident that has potential to cause or threaten to cause material or serious environmental harm. This notification is required in writing via the EHP form *Duty to Notify of Environmental Harm* EM468.

7.5 Review

This document will be reviewed annually or earlier if circumstances require it. The review will consider:

- evaluation of success criteria listed in Section 2 ;
- opportunities for improvement identified in inspection checklist records;
- reports of environmental incidents;
- any amendments to relevant legislation , policy and guidelines;
- any changes to mine plans, mining activities or construction/mining/rehabilitation works contractors at the site; and
- the findings of new research and trails (eg from Australian Coal Association Research Program (ACARP)).

7.6 Training

Relevant Baralaba coal mine personnel will be trained in rehabilitation monitoring procedures/techniques including the contents of this document and other relevant publications.

7.7 Role and responsibilities

The role and responsibilities for the implementation of the actions in the rehabilitation monitoring program are outlined in Table 7.1.

Table 7.1 Role and responsibilities

Role	Responsibility
General manager operations or representative	Management of Baralaba coal mine Ensure resources are available to implement the contents of this plan Facilitate rehabilitation monitoring program review Report environmental incidents to EHP
Environment manager	Implement the contents of this plan Establish rehabilitation reference monitoring sites in accordance with EA conditions F20 Train staff in environmental awareness, site issues and requirements of the monitoring program Facilitate the monitoring and implementation of measures outlined in this plan Reports non-conformances to General manager operations and ensure corrective actions are closed out Advise General manager operations and other management on EA permit requirements and provide advice to assist with achieving compliance Investigate environmental incidents and liaise with EHP where necessary/as requested by the General manager operations
Employees	Be familiar with the contents of this plan
Contractors	Be familiar with this plan

References

Department of Environment and Resource Management, 2011, *Protecting Queensland's strategic cropping land - Proposed strategic cropping land criteria* [online] Available from: <<http://www.nrm.qld.gov.au/land/planning/pdf/strategic-cropping/scl-guidelines.pdf>> [Accessed: 27 March 2013]

Department of Mines and Energy, 1995, *Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland – Land Suitability Assessment Techniques* [online] Available from: <<http://www.epa.qld.gov.au/register/p01206ae.pdf>> [Accessed: 27 March 2013]

Land Resources Branch, 1990, *Guidelines for agricultural land evaluation in Queensland*. Queensland Department of Primary Industries Information Series QI90005

Appendix A

Vegetation and erosion field data sheets

Rehabilitation Monitoring Field Data Sheet

DATE:	TIME:	SITE:
General Site Notes:		
Soil Level:		
N: _____ mm	E: _____ mm	S: _____ mm
		W: _____ mm

QUADRATS:	
<p>Q1 – Photo:</p> <p>Total Ground Cover %:</p> <ul style="list-style-type: none"> - Vegetation _____% - Rock _____% - Bare _____% - Leaf Litter _____% <p>Species and %:</p> <p>_____</p> <p>_____</p> <p>_____</p>	<p>Q2 – Photo:</p> <p>Total Ground Cover %:</p> <ul style="list-style-type: none"> - Vegetation _____% - Rock _____% - Bare _____% - Leaf Litter _____% <p>Species and %:</p> <p>_____</p> <p>_____</p> <p>_____</p>
<p>Q3 – Photo:</p> <p>Total Ground Cover %:</p> <ul style="list-style-type: none"> - Vegetation _____% - Rock _____% - Bare _____% - Leaf Litter _____% <p>Species and %:</p> <p>_____</p> <p>_____</p> <p>_____</p>	<p>Q4 – Photo:</p> <p>Total Ground Cover %:</p> <ul style="list-style-type: none"> - Vegetation _____% - Rock _____% - Bare _____% - Leaf Litter _____% <p>Species and %:</p> <p>_____</p> <p>_____</p> <p>_____</p>
<p>Q5 – Photo:</p> <p>Total Ground Cover %:</p> <ul style="list-style-type: none"> - Vegetation _____% - Rock _____% - Bare _____% - Leaf Litter _____% <p>Species and %:</p> <p>_____</p> <p>_____</p> <p>_____</p>	<p>Q6 – Photo:</p> <p>Total Ground Cover %:</p> <ul style="list-style-type: none"> - Vegetation _____% - Rock _____% - Bare _____% - Leaf Litter _____% <p>Species and %:</p> <p>_____</p> <p>_____</p> <p>_____</p>
<p>Q7 – Photo:</p> <p>Total Ground Cover %:</p> <ul style="list-style-type: none"> - Vegetation _____% - Rock _____% - Bare _____% - Leaf Litter _____% <p>Species and %:</p> <p>_____</p> <p>_____</p> <p>_____</p>	<p>Q8 – Photo:</p> <p>Total Ground Cover %:</p> <ul style="list-style-type: none"> - Vegetation _____% - Rock _____% - Bare _____% - Leaf Litter _____% <p>Species and %:</p> <p>_____</p> <p>_____</p> <p>_____</p>

