



Centennial Coal

Angus Place



Longwalls 900W and 910 Environmental Monitoring Program

Angus Place Colliery

November 2013



This page has been intentionally left blank.



| | | | |
|--|------------------------|-------------------------|------------------------|
| <p>DOCUMENT OWNER AND ORIGINATOR:</p> <p>Natalie Conroy Angus Place Environment and Community Coordinator</p> | | | |
| <p>APPROVED BY:</p> <p>Brian Nicholls Angus Place Mine Manager</p> <p>Signature:  Date: <u>26/11/2013</u></p> | | | |
| <p>DISTRIBUTION:</p> <p>Lotus Notes (Angus Place), NSW Department of Trade and Investment, Regional Infrastructure and Services – Division of Resources and Energy, SMP Interagency Committee.</p> | | | |
| Title: | Date Effective: | Revision Status: | Planned Review: |
| Longwalls 900W and 910 Environmental Monitoring Program | 26/11/2013 | 1.0 | As per Section 14 |

This page has been intentionally left blank.

TABLE OF CONTENTS

| | |
|--|-----------|
| 1. INTRODUCTION | 1 |
| 2. PURPOSE | 1 |
| 3. SCOPE | 1 |
| 4. REGULATORY REQUIREMENTS | 5 |
| 4.1. Longwalls 930 – 980 SMP Approval | 5 |
| 5. ENVIRONMENTAL MONITORING APPROACH | 6 |
| 5.1. Objectives and Targets | 6 |
| 5.2. Monitoring Program Principles | 6 |
| 6. ENVIRONMENTAL MONITORING SCHEDULE | 6 |
| 6.1. Newnes Plateau Shrub Swamps..... | 6 |
| 6.1.1. <i>Parameters, Monitoring Methods and Frequency</i> | 9 |
| 6.1.2. <i>Data Analysis</i> | 9 |
| 6.2. Flora | 9 |
| 6.2.1. <i>Layout of Monitoring Sites</i> | 9 |
| 6.2.2. <i>Parameters, Monitoring Methods and Frequency</i> | 10 |
| 6.2.3. <i>Data Analysis</i> | 10 |
| 6.3. Fauna | 11 |
| 6.3.1. <i>Layout of Monitoring Sites</i> | 11 |
| 6.3.2. <i>Parameters, Monitoring Methods and Frequency</i> | 11 |
| 6.3.3. <i>Data Analysis</i> | 12 |
| 6.4. Aquatic Ecology | 12 |
| 6.5. Groundwater..... | 13 |
| 6.5.1. <i>Layout of Monitoring Sites</i> | 13 |
| 6.5.2. <i>Parameters, Monitoring Methods and Frequency</i> | 14 |
| 6.5.3. <i>Data Analysis</i> | 14 |
| 6.6. Surface Water | 14 |
| 6.6.1. <i>Layout of Monitoring Sites</i> | 14 |
| 6.6.2. <i>Parameters, Monitoring Methods and Frequency</i> | 14 |
| 6.6.3. <i>Data Analysis</i> | 14 |
| 6.7. Built Features | 15 |
| 6.7.1. <i>Endeavour Energy 66kV Powerline</i> | 15 |
| 6.7.2. <i>Forest Access Tracks</i> | 15 |
| 6.7.3. <i>State Survey Marks</i> | 15 |
| 6.8. Surface Features..... | 15 |
| 6.8.1. <i>Clifflines and Rock Features</i> | 15 |
| 6.8.2. <i>Aboriginal Heritage Site</i> | 16 |
| 6.9. Rainfall | 16 |
| 7. PREDICTED IMPACTS | 16 |
| 7.1. Newnes Plateau Shrub Swamps..... | 16 |
| 7.2. Surface Water | 17 |
| 7.3. Built Features | 17 |

| | | |
|------------|--|-----------|
| 7.3.1. | <i>Endeavour Energy 66kV Powerline</i> | 17 |
| 7.3.2. | <i>Forest Access Tracks</i> | 18 |
| 7.3.3. | <i>State Survey Marks</i> | 18 |
| 7.4. | Surface Features..... | 18 |
| 7.4.1. | <i>Clifflines and Rock Features</i> | 18 |
| 7.4.2. | <i>Aboriginal Heritage Site</i> | 19 |
| 7.5. | Subsidence Assessment Review | 19 |
| 8. | REMEDIAL MEASURES | 19 |
| 9. | CONSULTATION | 20 |
| 10. | ADAPTIVE MANAGEMENT | 21 |
| 11. | CONTINGENCY PLAN | 21 |
| 12. | ROLES AND RESPONSIBILITIES | 26 |
| 13. | REPORTING | 26 |
| 14. | REVIEW | 27 |
| 15. | REFERENCES | 28 |

Tables

| | | |
|-----------|---|----|
| Table 1. | Relevant SMP Approval Conditions | 5 |
| Table 2. | Newnes Plateau Shrub Swamp Photographic Monitoring Sites | 7 |
| Table 3. | Flora Monitoring Locations..... | 9 |
| Table 4. | The Modified Braun-Blanquet Scale..... | 10 |
| Table 5. | Flora Monitoring Condition Scale..... | 10 |
| Table 6. | Fauna Monitoring Locations | 11 |
| Table 7. | Aquatic Ecology Monitoring Program | 13 |
| Table 8. | Groundwater Monitoring Sites..... | 13 |
| Table 9. | Surface Water Monitoring Sites..... | 14 |
| Table 10. | Trigger Action Response Plan for Environmental Monitoring | 22 |
| Table 11. | Key Personnel and Accountabilities..... | 26 |

Figures

| | | |
|----------|--|---|
| Figure 1 | Locality..... | 3 |
| Figure 2 | Environmental Monitoring Locations | 4 |
| Figure 3 | Newnes Plateau Shrub Swamp Photographic Monitoring Sites | 8 |

Appendices

| | |
|------------|------------------------------------|
| Appendix 1 | Environmental Monitoring Flowchart |
| Appendix 2 | Review Schedule |

Abbreviations

| | |
|-----------------|---|
| AEMR | Annual Environmental Management Report (now known as Annual Review) |
| AHIMS | Aboriginal Heritage Information Management System |
| CCL | Consolidated Coal Lease |
| DgS | Ditton Geotechnical Services Pty Ltd |
| DP&I | NSW Department of Planning and Infrastructure |
| DTIRIS | NSW Department of Trade and Investment, Regional Infrastructure and Services – Division of Resources and Energy |
| EEC | Endangered Ecological Community |
| EPA | NSW Environment Protection Authority |
| EPBC Act | <i>Environment Protection and Biodiversity Conservation Act 1999</i> |
| FCNSW | Forestry Corporation of NSW |
| GNSS | Global Navigation Satellite Systems |
| LDP | Licensed Discharge Point |
| ML | Mining Lease |
| Mtpa | Million tonnes per annum |
| nMDS | Non-metric Multi-Dimensional Scaling |
| OEH | NSW Office of Environment and Heritage |
| PAD | Potential Archaeological Deposit |
| RAM | Rapid Assessment Methodology |
| ROM | Run of mine |
| SCA | Sydney Catchment Authority |
| SCIMS | Survey Control Information Management System |
| SMP | Subsidence Management Plan |
| TARP | Trigger Action Response Plan |
| TSC Act | <i>Threatened Species Conservation Act 1995</i> |

This page has been intentionally left blank.

1. INTRODUCTION

Angus Place Colliery (Angus Place) is an underground coal mining operation located approximately five kilometres north of the village of Lidsdale, eight kilometres northeast of the township of Wallerawang and approximately 15 kilometres northwest of the city of Lithgow in the Blue Mountains region of NSW. It is bordered by Springvale Colliery to the south, Ivanhoe Colliery to the northwest and Wolgan Valley and Newnes Plateau to the north and east, respectively. The regional locality of Angus Place is shown on **Figure 1**.

Angus Place has been in operation since 1979 and is operated by Centennial Angus Place Pty Ltd, a joint venture company owned in equal share between the Centennial Coal Company Ltd and SK Kores of Korea. Secondary extraction of coal is currently undertaken at Angus Place utilising the longwall method of mining within Mining Lease (ML) 1424 and Consolidated Coal Lease (CCL) 704.

Project Approval PA 06_0021 was granted by the then NSW Department of Planning (now Department of Planning and Infrastructure (DP&I)) on 13 September 2006. This approval allowed for an extension of underground longwall mining operations (Longwalls 920 – 980) and an increase in run of mine (ROM) coal production to 3.5 million tonnes per annum (Mtpa). PA 06_0021 has been modified on two occasions. Modification 1 (Mod 1) was approved on 29 August 2011 and allowed for the development and extraction of two additional longwall panels (Longwall 900W and 910) as well as an increase in production limit to 4 Mtpa. Modification 2 (Mod 2) was approved in April 2013 and allowed for the development of underground roadways and the construction and operation of a Ventilation Facility (APC-VS2) and supporting infrastructure.

This *Longwalls 900W and 910 Environmental Monitoring Program* (Environmental Monitoring Program) has been developed to satisfy Condition 2d of the Longwalls 930 - 980 Subsidence Management Plan (SMP) Approval issued by the then NSW Department of Primary Industries (now NSW Department of Trade and Investment, Regional Infrastructure and Services – Division of Resources and Energy (DTIRIS)) in December 2005. While the SMP Approval for Longwalls 930 – 980 does not relate to the subject Longwalls 900W and 910, this has been addressed to satisfy the typical conditions associated with an SMP Approval, specifically those already applicable at Angus Place. Regulatory requirements applicable to the development of this Plan are outlined in **Section 4**.

2. PURPOSE

The purpose of this Environmental Monitoring Program is to outline the monitoring and management measures to be implemented to identify and manage potential environmental consequences resulting from the secondary extraction of Angus Place Longwalls 900W and 910. Required actions and responsibilities are defined to ensure detection and remediation of any potential environmental impacts from mining induced subsidence.

Details regarding environmental monitoring undertaken outside the Project Area has been documented within the respective management plans and programs required under Project Approval PA 06_0021 (as modified).

3. SCOPE

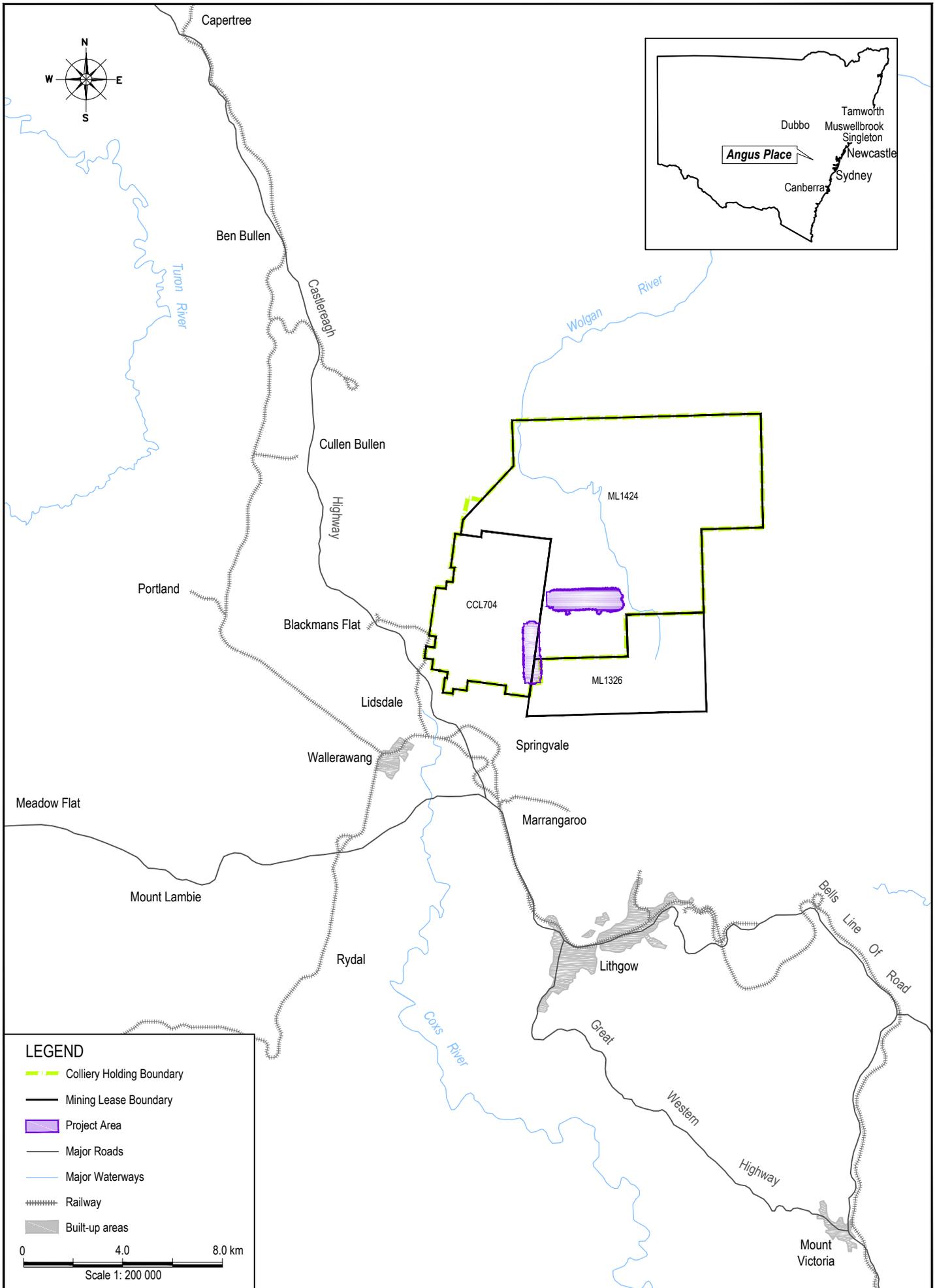
This Environmental Monitoring Program applies to the Longwall 900W and 910 area (herein referred to as the Project Area). In accordance with the requirements of the *Guidelines for Applications for Subsidence Management Approvals* (2003), published by the NSW Department of Mineral Resources (now DTIRIS), this Project Area has been calculated by combining the areas bound by the following limits (see **Figure 2**):

- A 26.5° angle of draw line from the limit of proposed extraction; and
- The predicted limit of vertical subsidence, taken as the 20 mm subsidence contour resulting from the extraction of the Longwalls 900W and 910.

This Environmental Monitoring Program includes monitoring of the following features as relevant to the Project Area:

- Newnes Plateau Shrub Swamps;
- Flora;
- Fauna;
- Surface features;
- Groundwater;
- Surface water flows and quality;
- Endeavour Energy 66kV Powerline;
- Forest access tracks;
- State Survey Marks; and
- Rainfall on the Newnes Plateau.

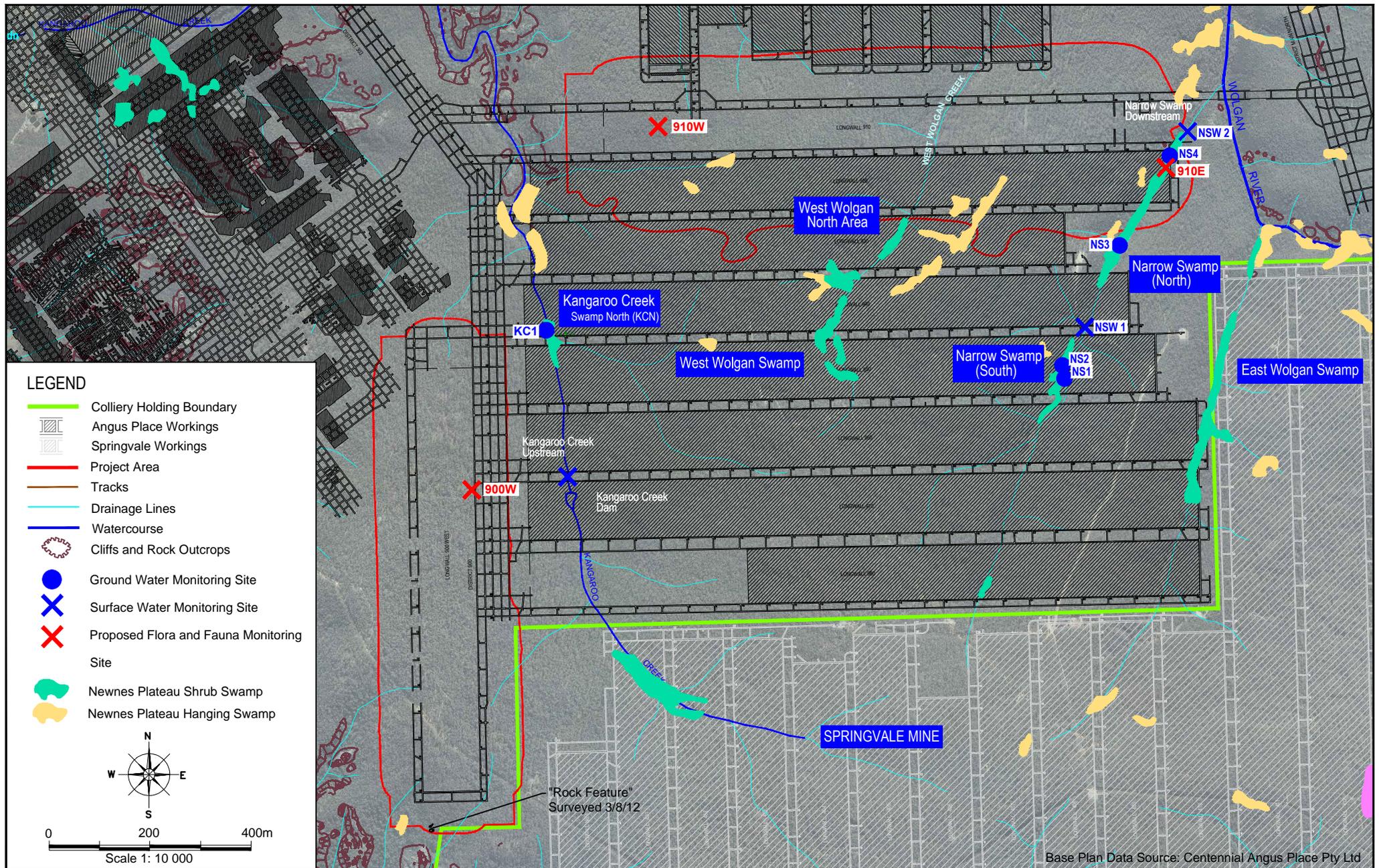
Surface subsidence as a result of longwall mining will be monitored as presented in the *Longwalls 900W and 910 Subsidence Monitoring and Reporting Program*.



To be printed A4

Longwalls 900W and 910 Environmental Monitoring Program
Regional Locality

FIGURE 1



To be printed A4

Longwalls 900W and 910 Environmental Monitoring Program
Environmental Monitoring Locations

FIGURE 2

4. REGULATORY REQUIREMENTS

4.1. Longwalls 930 – 980 SMP Approval

In accordance with the requirements of relevant mining tenements, Angus Place received SMP Approval from the then NSW Department of Primary Industries (now DTIRIS) in December 2005, allowing first workings and secondary extraction within Longwalls 930 – 980. This SMP Approval includes five conditions relevant to environmental monitoring at Angus Place. These conditions and where they have been addressed within this Environmental Monitoring Program are listed in **Table 1**.

While the SMP Approval for Longwalls 930 – 980 does not relate to the subject Longwalls 900W and 910, **Table 1** has been included to demonstrate that the typical conditions associated with an SMP Approval, specifically those already applicable at Angus Place, have been addressed within this document. This section will be reviewed and revised (if necessary) following receipt of SMP Approval for the Project Area.

Table 1. Relevant SMP Approval Conditions

| Condition | Condition Requirement | Section Addressed |
|-----------|--|-------------------|
| 2d | The SMP is approved subject to the conditions set out in this document. The SMP, as modified by these conditions, must be implemented by the leaseholder. If there is any inconsistency between the approved SMP and the following conditions of this approval, the following conditions shall prevail to the extent of inconsistency. The approved SMP also includes: d) Environmental Monitoring Program, dated March 2006. | This document |
| 8 | The leaseholder shall develop and implement a program to ensure on-going baseline data collection, investigation, assessment and regular reviews with the relevant stakeholders. The review schedule shall be submitted to the Director Environmental Sustainability within four months of this approval. The leaseholder shall undertake further reviews if such reviews are requested by the Director Environmental Sustainability or the Principal Subsidence Engineer. | Section 6 |
| 9 | The required on-going baseline data collection, investigation, assessment and reviews shall aim to identify appropriate management measures to mitigate and/or remediate subsidence impacts. The leaseholder shall ensure that management reviews are conducted in consultation with the relevant stakeholders, prior to subsidence of any important surface features or as otherwise determined in the said review schedules as per condition 8. | Section 8 |
| 10 | The leaseholder shall regularly seek advice and/or feedback from the relevant stakeholders, with regard to the adequacy, quality and effectiveness of the implemented management processes and the need for any appropriate management measures, early response actions or emergency procedures to ensure adequate management of any potential subsidence impacts due to longwall mining. | Section 14 |

5. ENVIRONMENTAL MONITORING APPROACH

5.1. Objectives and Targets

The overall implementation of this Environmental Monitoring Program will aim to achieve:

- Compliance with relevant environmental legislation and standards;
- Effective monitoring programs in accordance with and to satisfy early response procedures and appropriate notification requirements;
- The early identification of potential harm to the environment to enable suitable management actions to be undertaken; and
- Minimal impact on the land resulting from Angus Place operations.

5.2. Monitoring Program Principles

The overall strategy for environmental management at Angus Place is:

1. **Measure baseline information** – Establish background data for the surface above the mining area.
2. **Monitor the effects of mining** – Continue monitoring of identified parameters at key positions relating to the longwall position.
3. **Regularly assess and interpret monitoring** – Analyse monitoring data to identify any variations from predictions or unexpected anomalies. This will be carried out by specialist consultants.
4. **Reporting of monitoring results** – As described in **Section 13**.
5. **Re-assess any impacts** – Where variations are greater than predictions made in the *Longwalls 900W and 910 Integrated SMP/Extraction Plan*, undertake additional assessment/investigation of impacts. This will be carried out by specialist consultants and Angus Place personnel where required.
6. **Identify and implement remedial actions** – Additional assessments may indicate a requirement for remedial action. Specialist consultant and stakeholder consultation will be an integral part of determining and implementing appropriate remedial actions.
7. **Refine monitoring techniques** – Regularly review monitoring technology and design to take into account new developments in the science of environmental monitoring and reported research in the field.

6. ENVIRONMENTAL MONITORING SCHEDULE

The Environmental Monitoring Program for 900W and 910 focuses on the Project Area. Monitoring requirements have been defined by the secondary extraction of these longwalls and will continue at the frequency rate for 12 months post mining. If environmental impacts are within the predictions, frequency of monitoring will be reduced.

6.1. Newnes Plateau Shrub Swamps

Newnes Plateau Shrub Swamps and Newnes Plateau Hanging Swamps are listed as being an Endangered Ecological Community (EEC) under the NSW *Threatened Species Conservation Act 1995* (TSC Act). Both of these vegetation communities also correspond with the Temperate Highland

Peat Swamps on Sandstone EEC listed under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Longwalls 900W and 910 do not mine directly under any Temperate Highland Peat Swamps on Sandstone but Longwall 900W does mine adjacent to Narrow Swamp which has been previously undermined (see **Figure 2**).

Narrow Swamp monitoring incorporates the aspects listed below:

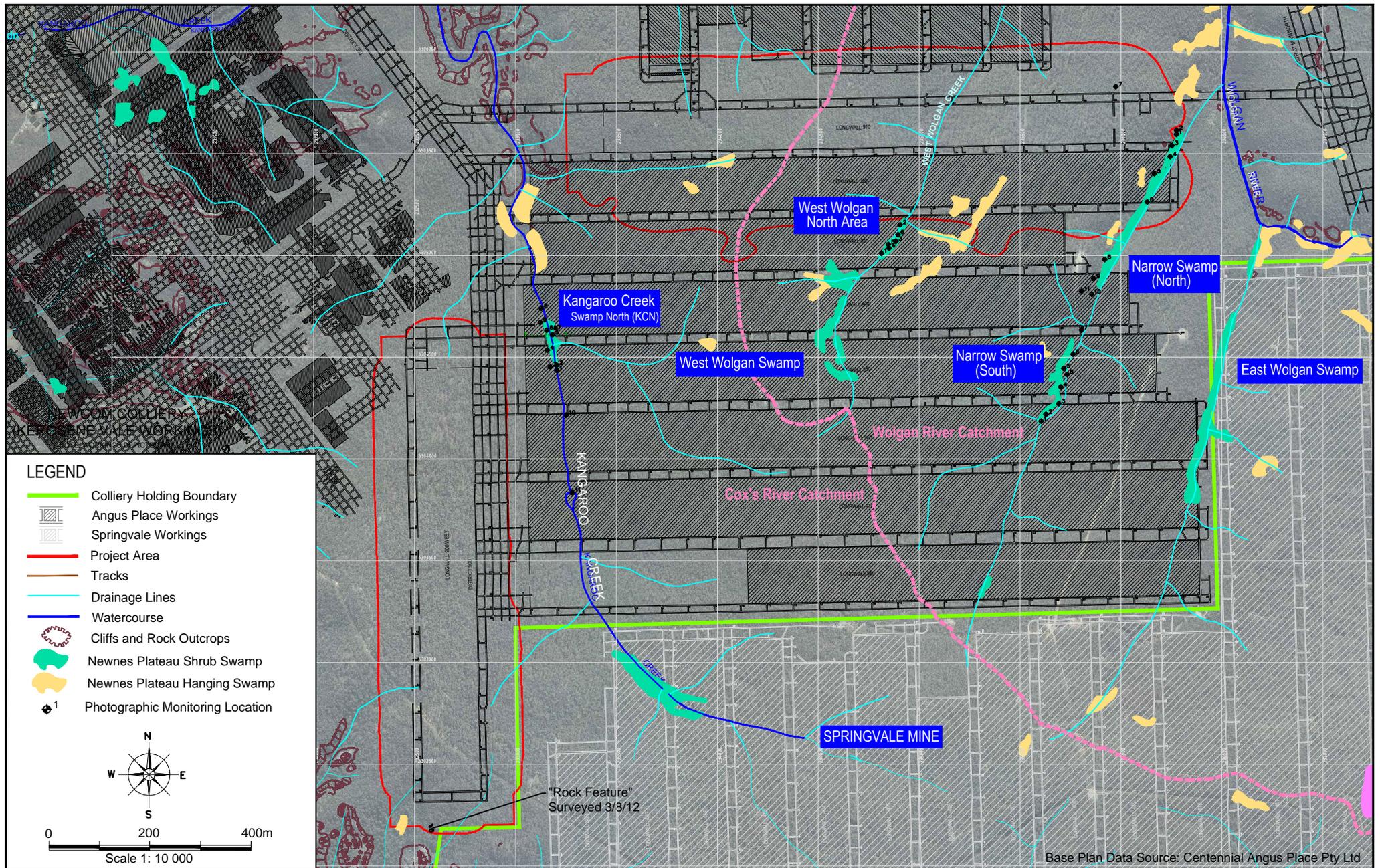
- Subsidence – Used to determine whether predicted subsidence limits and triggers have been exceeded (as presented in the *Longwalls 900W and 910 Subsidence Monitoring and Reporting Program*);
- Flora – To monitor swamp health and to determine whether proposed triggers have been exceeded (as outlined in **Section 6.2**);
- Groundwater level – To monitor the progress of recovery in swamps and extend the current data set to provide a better understanding of the effects of mining (as outlined in **Section 6.5**); and
- Surface water quality and flow - To monitor the progress of recovery in swamps and extend the current data set to provide a better understanding of the effects of mining (**Section 6.6**).

Monitoring outlined in this Environmental Monitoring Program is consistent with the *Temperate Highland Peat Swamps on Sandstone Monitoring and Management Plan* and the *Flora and Fauna Management Plan*.

Additionally photographic monitoring sites have been established for each swamp that is associated with or in close proximity to the Project Area, including Kangaroo Creek Swamp, Narrow Swamp and West Wolgan Swamp and are shown in **Figure 3** and details have been provided in **Table 2**.

Table 2. Newnes Plateau Shrub Swamp Photographic Monitoring Sites

| Longwall | Site | Description |
|----------|---------------------------|---|
| 900W | Kangaroo Creek North Area | A water hole is located at the southern end of the mapped area and drains into the vegetation (as mapped) located in a relatively steep but narrow valley. The water hole is fed by a semi-permanent spring |
| 910 | Narrow Swamp | Narrow Swamp North is located in a relatively steep valley, while Narrow Swamp South is located in gentle topography that enables the distinction of a shallow drainage channel. |
| | West Wolgan North Area | West Wolgan North Area is flat with no valley, rock formations, features or steep slopes. The topsoil material in this area is thin and appears to be a mix of topsoil, sand and some peat material. |



To be printed A4

6.1.1. Parameters, Monitoring Methods and Frequency

During the photographic survey, a general inspection of the drainage line will be undertaken. Where anomalous activity is located, it will be photographed and added on to the photographic schedule and reported as appropriate. Photographic inspections of the swamps will be undertaken when the longwall is undertaking secondary extraction within 500m of the site.

The photographic monitoring techniques have evolved in light of information published by the NSW Nation Parks and Wildlife Service (2003). Key points are presented below:

1. Attempt to take photos on a bright but cloudy day. This allows a clearer picture of vegetation rather than getting confused in too many shadows.
2. Use a permanent marker point which will not change or be hidden. Angus Place standard will be permanent tagging.
3. Take a copy of the previous photo monitoring report during photographic inspections. This will assist in obtaining the same view (photographed area).
4. Use the same camera at the same lens size and same settings.
5. Always record the date, time and location for every photograph.
6. Keep photo record sheets and field notes of every photograph.
7. Always check GPS co-ordinates.
8. Number every photograph taken, and relate these to every image number after downloading from the camera.
9. Keep copies of all notes taken.
10. Keep backup copies of all photographs.

6.1.2. Data Analysis

At the end of each monitoring period, photographs from previous monitoring periods will be compared. Particular attention will be focused on seasonal variation, climatic data and groundwater monitoring data which will be used to assist in the analysis of the results.

6.2. Flora

6.2.1. Layout of Monitoring Sites

Angus Place proposes to establish an additional three flora monitoring sites within the Project Area. The locations of these proposed monitoring sites have been recommended by RPS and are shown in **Figure 2**. Approximate locations have been presented in **Table 3**.

Table 3. Flora Monitoring Locations

| Longwall | Monitoring Site | Approximate Easting MGA Zone 56 | Approximate Northing MGA Zone 56 |
|----------|-----------------|------------------------------------|-------------------------------------|
| 900W | 900W | 232784 | 6303848 |
| 910 | 910W | 233704 | 6305637 |
| | 910E | 236216 | 6305432 |

The proposed Longwall 900W monitoring site is located at the north-eastern end of the panel and is located within Newnes Plateau Narrow-leaved Peppermint – Silver-top Ash Layered Open Forest. Two sites are located above Longwall 910. The proposed Longwall 910 monitoring sites are located

at the western end within the *Newnes Plateau Narrow-leaved peppermint – Silver-top Ash Layered Open Forest*, and at the eastern end of within the *Newnes Plateau Shrub Swamp*.

The first Six-monthly Environmental Monitoring Report will document the actual monitoring location coordinates, and establishment dates.

6.2.2. Parameters, Monitoring Methods and Frequency

Monitoring of the proposed flora monitoring locations within the Project Area will be undertaken in accordance with the methodology outlines in the approved *Flora and Fauna Management Plan*. The sites are permanently marked with 20 m by 20 m plots within which vegetation abundance and condition will be measured.

At each site observers will record all species within the plot, estimate cover/abundance using a modified Braun-Blanquet scale (see **Table 4**) and estimate condition of common species using a pre-determined condition scale (see **Table 5**). Site photographs will also be recorded.

Table 4. The Modified Braun-Blanquet Scale

| Cover/abundance Score | Interpretation |
|-----------------------|---|
| 1 | Cover less than 5% of site and rare |
| 2 | Cover less than 5% of site and uncommon |
| 3 | Cover of less than 5% and common |
| 4 | Cover of 5-20% of site |
| 5 | Cover of 20-50% of site |
| 6 | Cover of 50-75% of site |
| 7 | Cover of greater than 75% |

Table 5. Flora Monitoring Condition Scale

| Condition ranking | Interpretation |
|-------------------|-----------------------|
| 1 | Severe damage/dieback |
| 2 | Many dead stems |
| 3 | Some dead branches |
| 4 | Minor damage |
| 5 | Healthy |

A quantitative assessment of weedy species will also be undertaken. Transects will be established between the diagonal corners of the plots, at approximately 1 m intervals along these transects, a 0.5 m by 0.5 m quadrat is placed on the ground to assess the presence or absence of weeds. Monitoring will be undertaken in Summer, Autumn and Spring by a specialist consultant for 12 months after secondary extraction of the associated longwall is completed.

6.2.3. Data Analysis

Flora monitoring at Angus Place is undertaken to identify trends that have been observed between seasonal monitoring periods throughout the year, and to make comparisons with previous years. Data will be analysed by the specialist consultant with a report and comprehensive summary prepared. If threatened species are located/reported within the quadrats, specific monitoring for each species will be conducted during subsequent surveys.

Analysis of flora data from monitoring plots will be undertaken in accordance with the methodology outlined in the approved *Flora and Fauna Management Plan*. Currently, all cover/abundance and condition data that is collected is entered into Microsoft Excel for basic analysis, as well as being examined with the statistical package Plymouth Routines in Multivariate Ecological Research. This program is designed specifically to analyse multivariate ecological data. To examine plant compositional changes between years or seasons at different sites, cover/abundance scores are transformed using presence/absence transformations as there are few statistical tools for data with unequal measurement classes such as Braun-Blanquet. A Bray-Curtis dissimilarity matrix is calculated with this presence/absence data and non-metric multi-dimensional scaling (nMDS) plots are generated. The axes of nMDS plots cannot be directly compared to the input variables, but basic interpretation is relatively straight-forward in that sites with similar species composition and abundance appear physically closer on the graph. nMDS analysis generates a stress value which relates to the goodness of fit between the distances between points on the plot and the original distances in the dissimilarity matrix.

The stress value shown on the graph are the lowest stress value obtained from all the re-runs of the data. The lower the stress value the better the plot ‘fits’, or represents the distances in the dissimilarity matrix. Stress values of up to 0.2 are considered to show a reasonable fit of data.

6.3. Fauna

6.3.1. Layout of Monitoring Sites

Angus Place proposes to establish an additional three fauna monitoring sites within the Project Area. The location of these proposed monitoring sites were recommended by RPS and are shown in **Figure 2**. Approximate Locations are shown in the **Table 6**.

Table 6. Fauna Monitoring Locations

| Longwall | Monitoring Site | Approximate Easting MGA Zone 56 | Approximate Northing MGA Zone 56 |
|----------|-----------------|------------------------------------|-------------------------------------|
| 900W | 900W | 232784 | 6303848 |
| 910 | 910W | 233704 | 6305637 |
| | 910E | 236216 | 6305432 |

Two sites are located above Longwall 910 with one located above Longwall 900W. The proposed fauna monitoring sites for the Project Area have been selected based on their suitability to provide habitat attributes for a majority of the species which are likely to occur within these areas.

The first Six-monthly Environmental Monitoring Report will be will document the actual monitoring location coordinates, and establishment dates.

6.3.2. Parameters, Monitoring Methods and Frequency

Fauna monitoring will be undertaken in accordance with methodology outlined in the approved *Flora and Fauna Management Plan*. The aim of the fauna monitoring sites will be to identify any potential impacts caused from mining induced subsidence upon native fauna. Information regarding the presence of fauna species, species diversity, population numbers and habitat characteristics will be obtained. The faunal surveys will sample a full range of faunal groups using the following techniques:

- Hair tubes;
- Spotlighting;
- Nocturnal call playback;

- Remote cameras;
- Diurnal bird censuses;
- Bat echolocation recording;
- Herptofauna searches;
- Camera traps; and
- Secondary indications and incidental observations.

The fauna monitoring will be primarily focussed on threatened species listed under the TSC Act and the EPBC Act that are likely to occur within Project Area. Opportunistic pest monitoring will also be undertaken in association with these works.

All monitoring sites will be surveyed during Autumn, Spring and Summer. Inspections will be carried out by a qualified and experienced fauna consultant.

6.3.3. Data Analysis

Data will be analysed and reports generated by a specialist consultant and provided to Angus Place who will compare results to previous monitoring periods. A comparative summary will also be provided by the consultant. Data from the surveys will be analysed to show:

- Species counts;
- Habitat characteristics;
- Species diversity; and
- Species richness.

Repeatable fauna monitoring methodologies are currently utilised to ensure consistency of monitoring approach and to provide a basis for comparative studies. Non-parametric Kruskal-Wallis Analysis of Variance on Ranks tests are undertaken on fauna monitoring data to identify statistically significant differences between each of the sites. Measurements of habitat characteristics derived from trap site descriptions are also used to provide an index of habitat complexity to determine changes over time of the habitats surveyed. The index system currently used is the Habitat Complexity Score developed by Catling and Burt (1995). This system scores parameters including tree cover, tall and short shrub cover, ground cover, logs/rocks and litter cover, from 0 to 3. Statistical analyses (paired t-test and non-parametric Wilcoxon Signed Rank Test) are also used to identify statistically significant differences between groups of indices.

6.4. Aquatic Ecology

Aquatic ecology monitoring will be carried out at two locations on Kangaroo Creek, known as Kangaroo Creek Upstream (KCup) and Kangaroo Creek Downstream (KCdn). The sites are surveyed twice annually. The aquatic invertebrate assemblage for each sample site is described in terms of the site taxa diversity (number of individual Australian River Assessment System (AusRivAS) taxa) and in terms of a site Stream Invertebrate Grade Number Average Level (SIGNAL) score. SIGNAL is a pollution tolerance index for stream macroinvertebrates. The indices are derived by correlation analysis of macroinvertebrate occurrence against water chemical analysis. The water chemistry attributes generally used are temperature, turbidity, conductivity, alkalinity, pH, dissolved oxygen, total nitrogen and total phosphorus (Marine Pollution Research, 2011).

Taxonomic identification of fish species are also made to the levels required by AusRivAS, and a standardised description of site condition is recorded.

Table 7 provides a summary of the aquatic ecology monitoring program for Kangaroo Creek. Additional detail pertaining to aquatic ecology monitoring can be found in the *Flora and Fauna Management Plan*.

Table 7. Aquatic Ecology Monitoring Program

| Longwall | Site | Monitoring Aspect | Easting MGA Zone 56 | Northing MGA Zone 56 |
|----------|-------------------------------------|--|---------------------------|----------------------------|
| 900W | Kangaroo Creek Upstream (KCup) | Aquatic macroinvertebrate data, fish surveys and description of site condition | 232588 | 6306501 |
| | Kangaroo Creek Downstream (KCdn) | Aquatic macroinvertebrate data, fish surveys and description of site condition | 230368 | 6306102 |

6.5. Groundwater

Groundwater monitoring is carried out within the Newnes Plateau Shrub Swamps to monitor shallow aquifers. Deeper piezometers are installed on the plateau/ridges in between the swamps to monitor deeper aquifers.

6.5.1. Layout of Monitoring Sites

Groundwater level monitoring will be carried out using shallow piezometers within Narrow Swamp. The location of these piezometers is shown in **Figure 2** and details are provided in **Table 8**.

Table 8. Groundwater Monitoring Sites

| Longwall | Site | Location | Easting MGA Zone 56 | Northing MGA Zone 56 |
|----------|------|--------------|---------------------------|----------------------------|
| 910 | NS1 | Narrow Swamp | 235719 | 6304396 |
| | NS2 | Narrow Swamp | 235709 | 6304459 |
| | NS3 | Narrow Swamp | 235992 | 6305049 |
| | NS4 | Narrow Swamp | 236242 | 6305490 |

Water quality will be undertaken opportunistically, when adequate water is available to obtain a sample. Determination of adequate water levels is undertaken following a review of the groundwater depth data received every two months

6.5.2. Parameters, Monitoring Methods and Frequency

Groundwater level monitoring is undertaken in Narrow Swamp using water level data loggers installed in shallow boreholes. All swamp piezometers are monitored for water level, and the logged data is downloaded manually every two months..

Angus Place currently engages an external analyse data.

6.5.3. Data Analysis

The results from the monitoring program will identify potential effects from longwall mining and/or rainfall and will be correlated with the results from the relevant subsidence line monitoring results and the relative position of the longwall. This data will assist in explaining any changes in groundwater levels.

An external consultant prepares a short report every two months to present the analysis of the monitoring results. A more detailed report presenting all the data from the year will be prepared on an annual basis.

6.6. Surface Water

6.6.1. Layout of Monitoring Sites

Flow monitoring sites and surface water quality monitoring sites relevant to the Project Area are shown in **Figure 2** and details presented in **Table 9**.

Table 9. Surface Water Monitoring Sites

| Longwall | Locality | Monitoring Aspect | Easting MGA Zone 56 | Northing MGA Zone 56 |
|----------|------------------------------|---|---------------------------|----------------------------|
| 900W | Kangaroo Creek Upstream | Water Quality Monitoring and Flow Monitoring | 230898 | 6306136 |
| | Kangaroo Creek Downstream | Water Quality Monitoring and Flow Monitoring | 230231 | 6306109 |
| 910 | Narrow Swamp Upstream | Water Quality Monitoring and Flow Monitoring | 236329 | 6303600 |
| | Narrow Swamp Downstream | Water Quality Monitoring and Flow Monitoring | 235353 | 6305386 |

6.6.2. Parameters, Monitoring Methods and Frequency

Stream flows are currently monitored fortnightly for flow, pH, total suspended solids, electrical conductivity, manganese, iron, and temperature. If there is no flow, no water quality parameters are monitored.

A Pygmy Stream Flow Meter records the average stream flows in kilolitres per day. Water quality samples are taken manually and analysed in an appropriately registered laboratory.

6.6.3. Data Analysis

Stream flow monitoring results are reported to Angus Place following each monitoring period. These results are analysed and compared to the climatic monitoring results and previous stream flow monitoring results. This usually takes the form of a series of graphs.

6.7. Built Features

6.7.1. Endeavour Energy 66kV Powerline

There is a 66kV suspended powerline located above the commencing (southern) end of Longwall 900W at Angus Place. This powerline runs in a general northwest to southeast direction over the longwall panel and is owned by Endeavour Energy. The powerline is suspended using timber power poles that are approximately 15 m high. There are five poles (204 – 208) located within the Project Area which are separated by distances ranging from 77 m to 266 m.

The powerline will be monitored in accordance with the *Longwall 900W Powerlines Management Plan*, including the use of subsidence survey lines, installation and survey of fixed survey points (reflectors) near the top and base of each power pole associated with the Endeavour Energy 66kV powerline, and visual inspections (including photo monitoring) of the powerline during the longwall extraction period.

6.7.2. Forest Access Tracks

A number of publicly-accessible forest tracks are located within the Project Area including Kangaroos Creek Road, Beecroft Fire Trail, Mayinygu Marragu Trail and Angus Place Trail. These are unsealed roads managed by the Forestry Corporation of NSW (FCNSW).

Forest access tracks will be monitored in accordance with the *Longwalls 900W and 910 Built Features Management Plan*. All tracks will be inspected (including photo monitoring) monthly during the secondary extraction within 500 m of Longwalls 900W and 910. Inspections will continue for four consecutive months following the completion of secondary extraction within Project Area. A final inspection will be undertaken 12 months after the completion of secondary extraction within Longwalls 900W and 910.

6.7.3. State Survey Marks

There are six permanent state survey marks (SSMs) associated with the Project Area. Five of these are associated with Longwall 900W (SSM35265, SSM35268, SSM35269, SSM35273, SSM35274), and one is located above Longwall 910 (SSM21323), however this mark has been destroyed.

Prior to the extraction of these longwalls an up to date search of the Survey Control Information Management System (SCIMS) will be completed and the Surveyor Infrastructure and Geodesy Officer of the Department of Finances and Service's Land and Property Information (LPI) will be advised of the planned mining schedule in relation to these survey marks.

6.8. Surface Features

6.8.1. Clifflines and Rock Features

There are no significant clifflines (i.e. >20 m in height) or rock features (between 5 and 20 m in height) located within the 26.5° angle of draw line from the limit of extraction within Longwalls 900W and 910. The nearest rock feature is located approximately 175 m south of the commencing end of Longwall 900W. This feature is located approximately 17 m within the 20 mm subsidence contour and is subsequently located within the Project Area. The nearest cliffline is located approximately 275 m west of the finishing end of Longwall 910.

The cliffline and rock feature will be monitored in accordance with the *Longwalls 900W and 910 Land Management Plan*, including subsidence survey lines, installation and survey of Global Navigation Satellite Systems (GNSS) stations, and the implementation of a visual inspection program (including photo monitoring).

6.8.2. Aboriginal Heritage Site

A Rock Shelter with Potential Archaeological Deposit (PAD) has been identified to the west of Longwall 910, noting this is situated outside the Project Area. The Rock Shelter with PAD (45-12692) is located approximately 465 m to the west of Longwall 910 and 280 m from the Project Area. All other Aboriginal heritage sites that have been previously registered on the Aboriginal Heritage Information Management System (AHIMS) database are also located outside the Project Area.

The Rock Shelter with PAD will be monitored in accordance with the *Longwalls 900W and 910 Heritage Management Plan*, including subsidence survey lines, installation and survey of GNSS stations, and the implementation of a visual inspection program (including photo monitoring points).

6.9. Rainfall

Rainfall and temperature is monitored continuously on the Newnes Plateau at the Springvale Colliery ventilation shaft (located above the Springvale Colliery). Data is downloaded every two months and is analysed in conjunction with other monitoring parameters.

7. PREDICTED IMPACTS

The focus of the Environmental Monitoring Program at Angus Place is sensitive surface features, including the Newnes Plateau Shrub Swamps, drainage lines and infrastructure. Predicted impacts for relevant features have been outlined below.

7.1. Newnes Plateau Shrub Swamps

There are no Newnes Plateau Shrub Swamps directly above the proposed Longwalls 900W and 910. The closest Newnes Plateau Shrub Swamp is known as Narrow Swamp and it is located approximately 253 m to the south east of the proposed starting position of Longwall 910 with a cover depth of 290 m.

There are no Newnes Plateau Hanging Swamps located directly above the proposed secondary extraction of Longwalls 900W and 910, however there are a number of swamps located within the Project Area. These are located above Longwall 920, which is located to the south of proposed Longwall 910. This longwall panel has previously been extracted.

Predicted final tilts along Narrow Swamp following secondary extraction of Longwall 910 are expected to increase locally by 3 mm/m to 7 mm/m, with final tilts ranging from 2 mm/m to 16 mm/m overall. Predicted horizontal strains along Narrow Swamp may increase locally by +/- 1 mm/m, with final strains ranging from -1 mm/m to 4 mm/m. Valley closure effects may increase the predicted strains locally by 2 to 3 times to give final measured strains of up to 14 mm/m.

The Newnes Plateau Hanging Swamps have already been subsided by 0.25 m to 1.6 m by Longwalls 920 to 970 with no impacts observed to date. The subsidence at the hanging swamps after Longwall 910 is predicted to increase by 0.02 m to 0.8 m depending on their proximity to the chain pillars between Longwall 920 and Longwall 910. The Newnes Plateau Hanging Swamps are expected to experience tilts of 1 mm/m to 9 mm/m, with strains increasing by +/- 1 to 2 mm/m.

Impact to the Newnes Plateau Shrub Swamps and Newnes Plateau Hanging Swamps are predicted to be minor to negligible after secondary extraction of Longwall 910, with only superficial cracking in exposed rock bars (<20 mm wide) and no impact to groundwater regimes. As there are no rock exposures in Narrow Swamp, it is predicted that the peat is likely to absorb the small strains without cracking. However, localised erosion of peat due to the predicted tilts may occur in the short term.

7.2. Surface Water

As outlined in the *Surface Water Assessment* (GHD, 2010) there is one ephemeral drainage line located above Longwall 910, known as West Wolgan Creek. There are two first order tributaries of Kangaroo Creek located above Longwall 900W.

Minor surface cracking and deformation is anticipated to occur within the tributaries of Kangaroo Creek as a result of mining (DgS, 2010). However, the long term geomorphologic impacts as a result of changes to longitudinal gradients and surface cracking are expected to be negligible and therefore no consequences are expected (GHD, 2010).

The only significant drainage line in the Project Area is the tributary of Wolgan River, referred to as West Wolgan Creek, that is associated with Longwall 910. Based on pre- and post-mining terrain change analysis, the *Subsidence Prediction and Impact Assessment* (DgS, 2010) estimates that the section of West Wolgan Creek that overlies Longwall 910 would be subject to grade changes of +0.1% to -0.6%. Predictions also include additional subsidence of between 0.15 m and 0.25 m over Longwalls 920 and 930 as a result of the secondary extraction within Longwall 910 (DgS, 2010). The existing grade of this section of creek is relatively steep (approximately 3%) and these grade change estimates would not have a significant impact on existing erosion rates and therefore no consequences are expected (GHD, 2010).

DgS (2010) predicted that some minor ponding to a depth of 0.1 m may occur towards the downstream extent of the section of West Wolgan Creek overlying Longwall 910. This would potentially result in an increase from the existing depth of 0.67 m to 0.72 m. The estimated volume of predicted ponding based on this depth is 0.05 megalitres and the impact on flow transfers downstream is considered to be negligible (GHD, 2010).

It is also expected that the impact of increased ponding along the creek beds is likely to be contained 'in-channel' and therefore the effects upon existing flora and fauna is likely to be minimal (DgS, 2010).

7.3. Built Features

7.3.1. Endeavour Energy 66kV Powerline

DgS (2010) outlines that the poles of the suspended Endeavour Energy 66kV power line are likely to be subject to subsidence of between 0.0 m and 1.0 m, tilts of up to 8 mm/m and tensile or compressive strains of up to 2 mm/m. Power line conductor clearance has been predicted to decrease between 0.0 m and 0.69 m due to mine subsidence (DgS, 2010).

The power poles above the panels are predicted to be subject to transient movements towards the south as the face retreats towards the north, and then move back towards the east or west after full subsidence develops. The poles are also predicted to be subject to tensile and compressive strains associated with the subsidence 'wave' as it passes underneath the poles. DgS (2010) state that the transient tilts and strains could range from 50% to 70% of the final values, and will be dependent on face retreat rates. The poles outside the mining limits and within the angle of draw are predicted to generally tilt towards the nearest panel rib side as subsidence develops.

Angus Place also engaged Energy Serve to prepare a specific powerline impact assessment titled *Review of Mine Subsidence Impact of Longwall 900W on Endeavour Energy's 66kV Feeder 811/2 – Springvale Colliery – Clarence Colliery* (Energy Serve, 2013). This assessment concluded that *the predicted pole movements and subsidence do not pose a problem with either ground clearance or structural integrity of any poles from 204 – 208, contained within the subsidence footprint. No precautionary action is required and remedial action should not be necessary* (Energy Serve, 2013).

A report titled *Addendum to Review of Mine Subsidence Impact of Longwall 900W on Endeavour Energy's 66kV Feeder 811/2 – Springvale Colliery – Clarence Colliery* (Energy Serve, 2013a) was also prepared to review the potential subsidence impacts resulting from an increased extraction height within Longwall 900W from 3.25 m to 3.425 m. Energy Serve (2013a) concluded that *the predicted pole movements and subsidence, associated with the increased height of Longwall 900W, do not pose a problem with either ground clearance or structural integrity of any poles from 204 to 208, contained within the subsidence footprint. No precautionary action is required and remedial actions should not be necessary.*

7.3.2. Forest Access Tracks

DgS (2010) predict that worst case crack width for forest access tracks within the Project Area is estimated to range between 20 mm and 90 mm. It is expected that approximately 30 m – 50 m long sections of the tracks above each of the longwalls may require repairs to tensile cracking or compressive shear failures through the road after each panel is completed. Post mining inspections of forest access tracks over the previously extracted longwalls have only found 'hairline' cracking (<1 mm wide) which quickly self-heal following a rainfall event or grading activity.

Some erosion damage may also occur due to changes in drainage paths along the sides of the tracks and the installation of new table drains or possibly culverts across the tracks may be necessary after mining or subsidence is completed (DgS, 2010).

7.3.3. State Survey Marks

The six permanent state survey marks associated with the Project Area are expected to experience vertical subsidence ranging from approximately 0.20 m to 1.10 m.

7.4. Surface Features

7.4.1. Clifflines and Rock Features

Angus Place designed Longwalls 900W and 910 to mitigate potential subsidence related risks to significant surface features including the significant rock feature (5 to 20 m in height) located to the south of Longwall 900W and the cliffline (>20 m in height) located to the west of Longwall 910. As outlined within the *Subsidence Prediction and Impact Assessment* (DgS, 2010), there has been no impact to sensitive cliff sites outside the 26.5° design angle of draw associated with the extraction of Longwalls 920 – 950 at Angus Place (DgS, 2010). Accordingly Angus Place ensured that the identified significant cliffline and rock features were located beyond the extent of the 26.5° design angle of draw.

The significant rock formation (>5 m and <20 m high) located approximately 175 m south of Longwall 900W is the equivalent to an angle of draw of 35°, based on a cover depth of 310 m (DgS, 2010). The significant cliffline located approximately 275 m west of Longwall 910 is the equivalent to an angle of draw of 42°, based on a cover depth of 310 m (DgS, 2010).

DgS (2010) state that it is *expected that no impact will occur to the cliffs or rock features outside the 26.5° design angle of draw limit from Longwalls 910 and 900W.*

7.4.2. Aboriginal Heritage Site

No subsidence is predicted in the area of the Rock Shelter with PAD. DgS (2010) stated that *it is very unlikely that cracking of cliff lines associated with the site would occur due to mine subsidence, as all known cliff lines fall outside the predicted area of subsidence.*

All other sites previously registered on the AHIMS database are located well outside the Project Area and will therefore not be liable to potential subsidence impacts resulting from the development and secondary extraction of Longwalls 900W and 910 (RPS, 2010).

7.5. Subsidence Assessment Review

As a component of the *Longwalls 900W and 910 Integrated SMP/Extraction Plan*, DgS completed a review of the *Subsidence Prediction and Impact Assessment* (DgS, 2010) to satisfy the requirements of Schedule 3, Condition 3C(e) of PA 06_0021 (as modified), which requires the proponent to:

Provide revised predictions of the potential subsidence effects, subsidence impacts and environmental consequences of the proposed second workings, incorporating any relevant information obtained since this approval.

The report titled *Subsidence Assessment Review for the Longwalls 900W and 910 Integrated SMP/Extraction Plan, Centennial Angus Place Colliery* (DgS, 2013), incorporated relevant information obtained by Angus Place since the approval of PA 06_0021 (Mod 1) in August 2011, including subsidence monitoring data and observed subsidence effects following the completion of secondary extraction in Longwalls 960 and 970, and a change to the mining height within Longwalls 900W and 910.

The *Subsidence Prediction and Impact Assessment* (DgS, 2010) assessed potential subsidence effects based upon a mining height of 3.25 m. Angus Place will now mine Longwalls 900W and 910 at an extraction height up to 3.425 m. This change has been assessed by DgS (2013) who concluded that *the observed and predicted subsidence impacts and environmental consequences for LWs 960 and 970 have also been consistent with predictions for LWs 900W and 910, and as such, the predicted 'negligible' environmental consequences for LWs 900W and 910 are not expected to change from the previous assessment due to the 5% increase in mining height.*

It is therefore considered that the impact management strategies for the environment and site developments (e.g. access roads and Endeavour Energy 66kV power line) that were outlined in DgS, 2010 are still valid and do not require amendment (DgS, 2013).

8. REMEDIAL MEASURES

Remedial measures may be required to address non-conformances with the predicted subsidence impacts identified by inspections, monitoring or complaints. All incidents shall be investigated to consider:

- The cause of the non-conformance;
- The extent of any damage caused by subsidence on infrastructure
- The extent of any damage caused or the potential for harm to the environment caused by subsidence from Angus Place;
- Identification of the appropriate corrective or preventative action in consultation with the infrastructure owner or relevant government agency; and

- Prompt notification with the relevant infrastructure owner to develop the appropriate control and/or remediation strategies if required.

Remedial measures for the Project Area are discussed in more detail in specific management plans, including

- *Flora and Fauna Management Plan;*
- *Site Water Management Plan;*
- *Longwalls 900W and 910 Kangaroo Creek Management Plan;*
- *Longwalls 900W and 910 Public Safety Management Plan;*
- *Longwalls 900W and 910 Built Features Management Plan;*
- *Longwall 900W Powerline Management Plan;*
- *Longwalls 900W and 910 Land Management Plan;* and
- *Longwalls 900W and 910 Rehabilitation Management Plan.*

The design of identifying remedial measures can be summarised in the following steps:

1. Analyse monitoring data;
2. If monitoring results indicate abnormal conditions (or trigger points are approached as presented in the Trigger Action Response Plan (TARP)), focus resources to determine why the results are abnormal;
3. If abnormal results continue, carry out a field inspection with relevant specialists;
4. Evaluation of the cause to determine if the results was caused by mining (or some other cause either natural or anthropogenic);
5. If mining induced, notify relevant government agencies in accordance with relevant approval conditions;
6. Determine impact – temporary or long term;
7. Investigate existing data;
8. Undertake additional monitoring as required;
9. Undertake remediation if appropriate following consultation with the appropriate government agencies; and
10. Investigate the need to instigate engineering solutions (as a last measure) with relevant specialist consultants and government agencies.

A flow chart of the abovementioned steps as implemented by Angus Place has been provided as **Appendix 1**.

9. CONSULTATION

A review schedule has been developed to provide an opportunity for regular input from relevant stakeholders at six monthly intervals. This schedule is based upon the review schedule that was developed in consultation with the relevant stakeholders for Longwalls 930 - 980. The only change to the review schedule for this Environmental Monitoring Program is a change to the review frequency from four-monthly to six-monthly. This change has been made to align with the amended reporting requirements for the *Longwalls 900W and 910 Integrated SMP/Extraction Plan*, which requires a six-

monthly Environmental Monitoring Report, instead of the previous four-monthly Subsidence Management Status Reports. The review schedule has been provided as **Appendix 2**.

The implementation of the review schedule will enable a minimum of six-monthly updates to relevant stakeholders and create a mechanism for appropriate advice and/or feedback (as required by Condition 10 of the SMP Approval).

Additionally, if any items relating to Condition 13 of the SMP Approval (notification within 24 hours) are reported a meeting of the relevant parties will be arranged to update, advise and discuss where appropriate.

10. ADAPTIVE MANAGEMENT

Angus Place has developed an adaptive management approach that is designed to avoid repetition of any unpredicted subsidence impacts and/or environmental consequences. The monitoring data obtained through the implementation of this Environmental Monitoring Program will be used to assess and periodically evaluate subsidence levels and associated environmental consequences against the performance indicators contained in the relevant management plans. In the event that a performance indicator is exceeded the relevant contingency plan(s) will be implemented by Angus Place (see **Section 11**). Furthermore, review of the respective management plan(s), including this Environmental Monitoring Program, may be required (see **Section 14**).

11. CONTINGENCY PLAN

TARPs have been developed in the specific management plans that have been prepared as components of the *Longwalls 900W and 910 Integrated SMP/Extraction Plan*. All TARPs relevant to the implementation of this Environmental Monitoring Program have been provided in **Table 10**. In the event that subsidence monitoring and/or visual inspections identify that a performance indicator has been exceeded, Angus Place will implement the contingency measures as detailed in the TARP.

Table 10. Trigger Action Response Plan for Environmental Monitoring

| Aspect/Category | Key Element | Trigger Response | Condition Green | Condition Amber | Condition Red |
|-----------------|--------------------------|------------------|---|---|--|
| Subsidence | Subsidence | Trigger | Survey monitoring within the Project Area identifies that subsidence parameters (subsidence, tilt and strain) are less than the limits specified by the prediction model. | Survey monitoring within the Project Area identifies that subsidence parameters (subsidence, tilt and strain) are up to, but do not exceed the limits of the prediction model. | Survey monitoring within the Project Area identifies that subsidence parameters (subsidence, tilt and strain) exceed the limits of the prediction model. |
| | | Response | No response required. Continue monitoring program. | No response required. Continue monitoring program. | If subsidence within the Project Area exceeds the limits of the prediction model, notify the Director-General of DP&I, DTIRIS and relevant stakeholders of exceedance of subsidence predictions. Investigate exceedance of subsidence prediction model. Identify and implement remedial actions in consultation with relevant stakeholders, if necessary (e.g. undertake review of Land Management Plan). |
| Groundwater | Piezometric Head Change | Trigger | No significant fall in piezometric height of aquifers above Mt York Claystone. | A 'stepped', mining related, 5 metre piezometric head loss in any aquifer above the Mt York Claystone. Enduring change in groundwater level in any aquifer above the Mt York Claystone that cannot be explained by climatic conditions and is outside the normal climatic range. | A 'stepped', mining related, 10 metre piezometric head loss in any aquifer above the Mt York Claystone. Total loss of ground water in any aquifer above the Mt York Claystone due to mining with some vegetation loss. |
| | | Response | Continue Groundwater Monitoring Program | Immediately notify DP&I, DTIRIS, Environmental Protection Authority (EPA), Sydney Catchment Authority (SCA) (for catchments within their control), potentially affected landowners and/or existing or future tenants. Field surface inspection by Environment and Community Coordinator to determine any evidence of surface cracking. Undertake geotechnical/hydrogeological investigation of the cause. Continue Groundwater Monitoring Program, with additional monitoring as required. | Immediately notify DP&I, DTIRIS, EPA, SCA (for catchments within their control), potentially affected landowners and/or existing or future tenants. Undertake geotechnical/hydrogeological investigation of the cause. Report to the Principal subsidence Engineer (DTIRIS) on action to rectify. Implement Engineering Solutions as appropriate. Continue Groundwater Monitoring Program with additional monitoring as required. |
| | Swamp Conditions | Trigger | No significant change in groundwater levels. | Minor change in groundwater levels | Major change in groundwater levels or change in flora not explained by weather patterns or mining activities. |
| | | Response | Continue Groundwater Monitoring Program | Undertake geotechnical/hydrogeological investigation of the cause. Continue Groundwater Monitoring Program, with additional monitoring as required. | Initiate a meeting with DTIRIS, relevant agencies and interest groups to consider appropriate actions (e.g. supply mine water to the swamp). |
| Surface Water | Surface Water Monitoring | Trigger | Levels within Surface Water Impact Assessment Criteria. | Isolated exceedance of Impact Assessment Criteria, with no ecological damage evident. | Recurrent exceedance (4 or more times in year). Actual or potential material harm to the environment. |
| | | Response | Continue Surface Water Monitoring Program. | Immediately notify DP&I, DTIRIS, EPA, SCA (for catchments within their control), potentially affected landowners and/or existing or future tenants. Investigation of cause by Environment and Community Coordinator and application of appropriate mitigation measures. Continue Surface Water Monitoring Program, with additional monitoring as required. | Immediately notify DP&I, DTIRIS, EPA, SCA (for catchments within their control) and potentially affected landowners and/or existing or future tenants. Immediate application of remediation measures as required to prevent any actual material harm to the environment or prevent further actual or potential material harm to the environment. Undertake geotechnical/hydrogeological investigation of the cause. Review of Site Water Management Plan and related procedures to prevent reoccurrence. Continue Surface Water Monitoring Program with additional monitoring as required. |

| Aspect/ Category | Key Element | Trigger Response | Condition Green | Condition Amber | Condition Red |
|---------------------|--|---------------------|---|---|---|
| | Surface Flows | Trigger | Surface flows maintained. | Temporary, mining related, loss of flow (<1 month). | Mining related loss of flow for 1 month or more. |
| | | Response | Continue Surface Water Monitoring Program. | Immediately notify DP&I, DTIRIS, EPA, SCA (for catchments within their control), potentially affected landowners and/or existing or future tenants. Field surface inspection by Environment and Community Coordinator to determine any evidence of surface cracking. Undertake geotechnical/hydrogeological investigation of the cause. Continue Surface Water Monitoring Program, with additional monitoring as required. | Immediately notify DP&I, DTIRIS, EPA, SCA (for catchments within their control) and potentially affected landowners and/or existing or future tenants. Undertake geotechnical/hydrogeological investigation of the cause. Report to the Principal Subsidence Engineer (DTIRIS) on action to rectify. Implement Engineering Solutions as appropriate. Continue Surface Water Monitoring Program with additional monitoring as required. |
| | Erosion and Sedimentation | Trigger | Visual inspections identify that there is no evidence of erosion. | Visual inspections identify evidence of minor erosion and sedimentation. | Visual inspections identify evidence of significant erosion and sedimentation. |
| | | Response | No response required. Continue monitoring program. | Field surface inspection by Environment and Community Coordinator to investigate cause. Implement management measures in consultation with FCNSW if deemed to be necessary. Continue monitoring program. | If erosion and sedimentation is threatening or causing material harm to the environment, immediately notify DP&I, DTIRIS, EPA, SCA (for catchments within their control) and FCNSW. Implement management measures in consultation with FCNSW as deemed appropriate. Continue Surface Water Monitoring Program with additional monitoring as required. |
| | Ponding | Trigger | No water ponding. | Temporary water ponding at the surface (<1 month) | Water ponding permanently at the surface. |
| | | Response | No response required. Continue monitoring program. | Immediately notify DP&I, DTIRIS, EPA, SCA (for catchments within their control) and FCNSW. Field surface inspection by Environment and Community Coordinator to investigate cause. Undertake geotechnical/hydrogeological investigation of the cause. Continue Surface Water Monitoring Program, with additional monitoring as required. | If ponding is threatening or causing material harm to the environment, immediately notify DP&I, DTIRIS, EPA, SCA (for catchments within their control) and FCNSW. Undertake geotechnical/hydrogeological investigation of the cause. Report to the Principal Subsidence Engineer (DTIRIS) on action to rectify. Implement Engineering Solutions as appropriate. Continue Surface Water Monitoring Program with additional monitoring as required. |
| Built Features | Survey Monitoring of Endeavour Energy 66kV Powerline | Trigger | Survey monitoring of fixed survey points (reflectors) on relevant power poles identify that measured subsidence and/or relative pole movements are less than the limits specified by the prediction models (DgS 2010, Energy Serve 2013). | Survey monitoring of fixed survey points (reflectors) on relevant power poles identify that measured subsidence and/or relative pole movements are up to, but do not exceed the limits of the prediction models (DgS 2010, Energy Serve 2013). | Survey monitoring of fixed survey points (reflectors) on relevant power poles identify that measured subsidence and/or relative pole movements exceed the limits of the prediction models (DgS 2010, Energy Serve 2013). |
| | | Response | No response required. Continue monitoring program. | No response required. Continue monitoring program. | If subsidence associated with the powerline exceeds the limits of the prediction model, notify the Director-General of DP&I, DTIRIS, Endeavour Energy and the FCNSW of exceedance of subsidence predictions. Investigate exceedance of subsidence prediction model. Identify and implement remedial actions in consultation with relevant stakeholders, if necessary (e.g. undertake review of Built Features Management Plan). |

| Aspect/ Category | Key Element | Trigger Response | Condition Green | Condition Amber | Condition Red |
|---------------------|---|---------------------|--|--|--|
| | Evidence of Damage to Endeavour Energy 66kV Powerline | Trigger | Visual inspections of the Project Area identify that there is no evidence of abnormalities to the powerline. | Visual inspections identify potential evidence of abnormalities to the powerline i.e. changes to powerline ground clearance or pole verticality. | Visual inspections identify evidence of abnormalities to the powerline i.e. obvious changes to powerline ground clearance or pole verticality. |
| | | Response | No response required. Continue monitoring program. | <p>Review previous photographic evidence to identify if there have been visual changes to the powerline since the commencement of secondary extraction in Longwall 900W i.e. pole verticality.</p> <p>If the review of photographic evidence identifies that there are no abnormalities, continue monitoring program.</p> <p>If abnormalities are identified, undertake survey monitoring to identify if measured subsidence and/or relative pole movements are within the limits of the prediction models (DgS 2010, Energy Serve 2013).</p> <p>If measured subsidence and/or relative pole movements are within the limits of the prediction models, report the results to the stakeholders specified in Table 9 of the Longwall 900W Powerline Management Plan. Continue monitoring program.</p> <p>If measured subsidence and/or relative pole movements are beyond the limits of the prediction models, undertake management as outlined for Condition Red responses.</p> | <p>Undertake survey monitoring to identify if measured subsidence and/or relative pole movements are within the limits of the prediction models (DgS 2010, Energy Serve 2013).</p> <p>If measured subsidence and/or relative pole movements are within the limits of the prediction models, report the results to the stakeholders specified in Table 9 of the <i>Longwall 900W Powerline Management Plan</i>. Continue monitoring program.</p> <p>If measured subsidence and/or relative pole movements are beyond the limits of the prediction models, notify the Director-General of DP&I, DTIRIS, Endeavour Energy and the FCNSW of exceedance of subsidence predictions.</p> <p>Erect warning signs and danger tape in immediate area.</p> <p>Investigate exceedance of subsidence prediction model.</p> <p>Identify and implement remedial actions in consultation with relevant stakeholders, if necessary.</p> |
| | Surface Cracking on Roads and Tracks | Trigger | Surface cracking < 5 cm wide. | Surface Cracking 5-10 cm wide. | Surface cracking >10 cm wide. |
| | | Response | Continue monitoring program to confirm that cracks are adequately repaired naturally through sedimentation and infilling of vegetation and surface debris. | <p>Prompt notification of FCNSW.</p> <p>In response to observed impact, erect warning signs or danger tape in the immediate area if considered a public danger.</p> <p>Repair by grading after subsidence is complete if required.</p> <p>Repairs to FCNSW roads/tracks to be completed in consultation with FCNSW.</p> <p>Monitor cracking.</p> | <p>Prompt notification of FCNSW.</p> <p>In response to observed impact, erect warning signs or danger tape in the immediate area if considered a public danger.</p> <p>Repair cracks >20 cm in width with excavation and re-compaction.</p> <p>A field inspection will be carried out by the Environment and Community Coordinator (for FCNSW roads/tracks). Angus Place will provide FCNSW with an invitation to attend relevant inspections.</p> <p>Repairs to FCNSW roads/tracks to be completed in consultation with FCNSW.</p> |
| Surface Features | Clifflines and Rock Features | Trigger | Visual inspections of the site identify that there is no evidence of damage. | Visual inspections identify potential evidence of damage at the site i.e. minor cracking in rock face. | Visual inspections identify evidence of damage at the site i.e. cracking in rock face or rock fall. |
| | | Response | No response required. Continue monitoring program. | <p>Review previous photographic evidence to identify if there have been visual changes to the site since the commencement of secondary extraction in Longwall 900W or 910 i.e. minor cracking.</p> <p>If visual changes are identified, undertake survey monitoring to identify if there is measurable subsidence beyond the design angle of draw or if impacts were the result of natural processes.</p> <p>If there is no measurable subsidence, or subsidence is <20mm, no response required as subsidence is negligible. Continue monitoring program.</p> <p>If measurable subsidence beyond the design angle of draw exceeds 20mm, undertake management as outlined for Condition Red responses.</p> | <p>Undertake survey monitoring to identify if there is measurable subsidence beyond the design angle of draw or if impacts were the result of natural processes.</p> <p>If subsidence beyond the design angle of draw exceeds 20mm, notify the Director-General of DP&I, DTIRIS and relevant stakeholders of exceedance of subsidence predictions.</p> <p>Erect warning signs and danger tape in immediate area.</p> <p>Investigate exceedance of subsidence prediction model.</p> <p>Identify and implement remedial actions in consultation with relevant stakeholders, if necessary.</p> |

| Aspect/ Category | Key Element | Trigger Response | Condition Green | Condition Amber | Condition Red |
|---------------------|--|---------------------|--|--|---|
| | | Trigger | Survey monitoring identifies that there is no measurable subsidence beyond the design angle of draw. | Survey monitoring identifies that measured subsidence beyond the design angle of draw is <20mm (negligible). | Survey monitoring identifies that measured subsidence beyond the design angle of draw is >20mm. |
| | | Response | No response required. Continue monitoring program. | No response required as measured subsidence is negligible. Continue monitoring program. | If subsidence beyond the design angle of draw exceeds 20mm, notify the Director-General of DP&I, DTIRIS and the FCNSW of exceedance of subsidence predictions. Erect warning signs and danger tape in immediate Area. Investigate exceedance of subsidence prediction model. Identify and implement remedial actions in consultation with relevant stakeholders, if necessary. |
| | Subsidence Related Impacts to the Rock Shelter with PAD | Trigger | Visual inspections of the site identify that there is no evidence of damage. | Visual inspections identify potential evidence of damage at the site i.e. minor cracking in rock face. | Visual inspections identify evidence of damage at the site i.e. cracking in rock face or rock fall. |
| | | Response | No response required. Continue monitoring program. | Review previous photographic evidence to identify if there have been visual changes to the site since the commencement of secondary extraction in Longwall 910 i.e. minor cracking. If visual changes are identified, undertake survey monitoring to identify if there is measurable subsidence beyond the design angle of draw or if impacts were the result of natural processes. If there is no measurable subsidence, or subsidence is <20mm, no response required as subsidence is negligible. Continue monitoring program. If measurable subsidence beyond the design angle of draw exceeds 20mm, undertake management as outlined for Condition Red responses. | Undertake survey monitoring to identify if there is measurable subsidence beyond the design angle of draw or if impacts were the result of natural processes. If subsidence beyond the design angle of draw exceeds 20mm, notify the Director-General of DP&I, DTIRIS, NSW Office of Environment and Heritage (OEH), FCNSW and Aboriginal stakeholders of exceedance of subsidence predictions. Erect warning signs and danger tape in immediate Area. Investigate exceedance of subsidence prediction model. Identify and implement remedial actions in consultation with relevant stakeholders, if necessary. |

12. ROLES AND RESPONSIBILITIES

The responsibility for implementation, monitoring and review of the Environmental Monitoring Program lies with the Environment and Community Coordinator. The ultimate responsibility for the implementation of the Environmental Monitoring Program lies with the Mine Manager, who shall make appropriate resources available. The roles and responsibilities for this Environmental Monitoring Program are outlined in **Table 11**.

Table 11. Key Personnel and Accountabilities

| Position | Responsibility |
|---------------------------------------|---|
| Mine Manager | <ul style="list-style-type: none"> • Ensuring that sufficient resources are available to implement and execute the requirements of this Environmental Monitoring Program; and • Reporting triggers/non-conformances to external stakeholders. |
| Environment and Community Coordinator | <p>Implementation, monitoring and review of this plan, including:</p> <ul style="list-style-type: none"> • The carrying out of inspections; • The installation and maintenance of signage; • Reporting triggers/non-conformances internally to the Mine Manager as appropriate; • Consulting with stakeholders on any issues arising from subsidence; • Consultation during the review process with relevant stakeholders and distributing this Environmental Monitoring Program; • Coordinating any remediation work as required; • Inspecting areas susceptible to tensile and compressive strains and potential cracking; • Co-ordinating the generation and submission of formal reporting requirements outlined in this plan (e.g. End of Panel Reports and the Annual Environmental Management Report); and • Reviewing this Environmental Monitoring Program. |

13. REPORTING

In accordance with the requirements of the *Draft Guidelines for the Preparation of Extraction Plans* (DP&I 2012), Angus Place will submit the following reports to the DP&I and DTIRIS during the secondary extraction of Longwalls 900W and 910:

- Bi-monthly Subsidence Impact Reports - These reports will be submitted following the regular monthly inspections if any new subsidence impacts are identified; and
- Six-monthly Environmental Monitoring Report - This report will include:
 - a comprehensive summary of all impacts, including a revised characterisation according to the relevant TARP and any proposed actions resulting from the relevant TARP;
 - an assessment of compliance with relevant performance indicators; and
 - a comprehensive summary of all quantitative and qualitative environmental monitoring results.

The Annual Environmental Management Report (AEMR)/Annual Review will be made available on the Centennial Coal website and will include subsidence monitoring results, performance against subsidence predictions and identification of any subsidence related environmental impacts identified during the 12 month reporting period.

In accordance with the requirements of Schedule 5, Condition 6 of PA 06_0021 (as modified), Angus Place will notify the Director-General of DP&I, FCNSW and any other relevant agencies of any land management related incident resulting from the extraction of Longwalls 900W and 910 as soon as practicable after becoming aware of the incident. Within seven days of the incident, the Proponent shall provide the Director-General of DP&I and any other relevant agencies with a detailed report on the incident.

Angus Place will also prepare an End of Panel Report to encompass all environmental and subsidence monitoring, including a comparison of actual impacts with predicted subsidence impacts. This report will be submitted to DTIRIS within three months of secondary extraction being completed in each longwall panel.

14. REVIEW

This Environmental Monitoring Program will be reviewed every three years, or in the event that the following occur:

- Stakeholders raise issues that necessitate a review;
- There are changes to the management requirements (e.g. a new monitoring site is established within the Project Area, or if there are changes to related approvals);
- Where unpredicted impacts or consequences have required implementation of contingency actions under this plan; or
- Monitoring, incident, or audit processes demonstrate that a review is warranted.

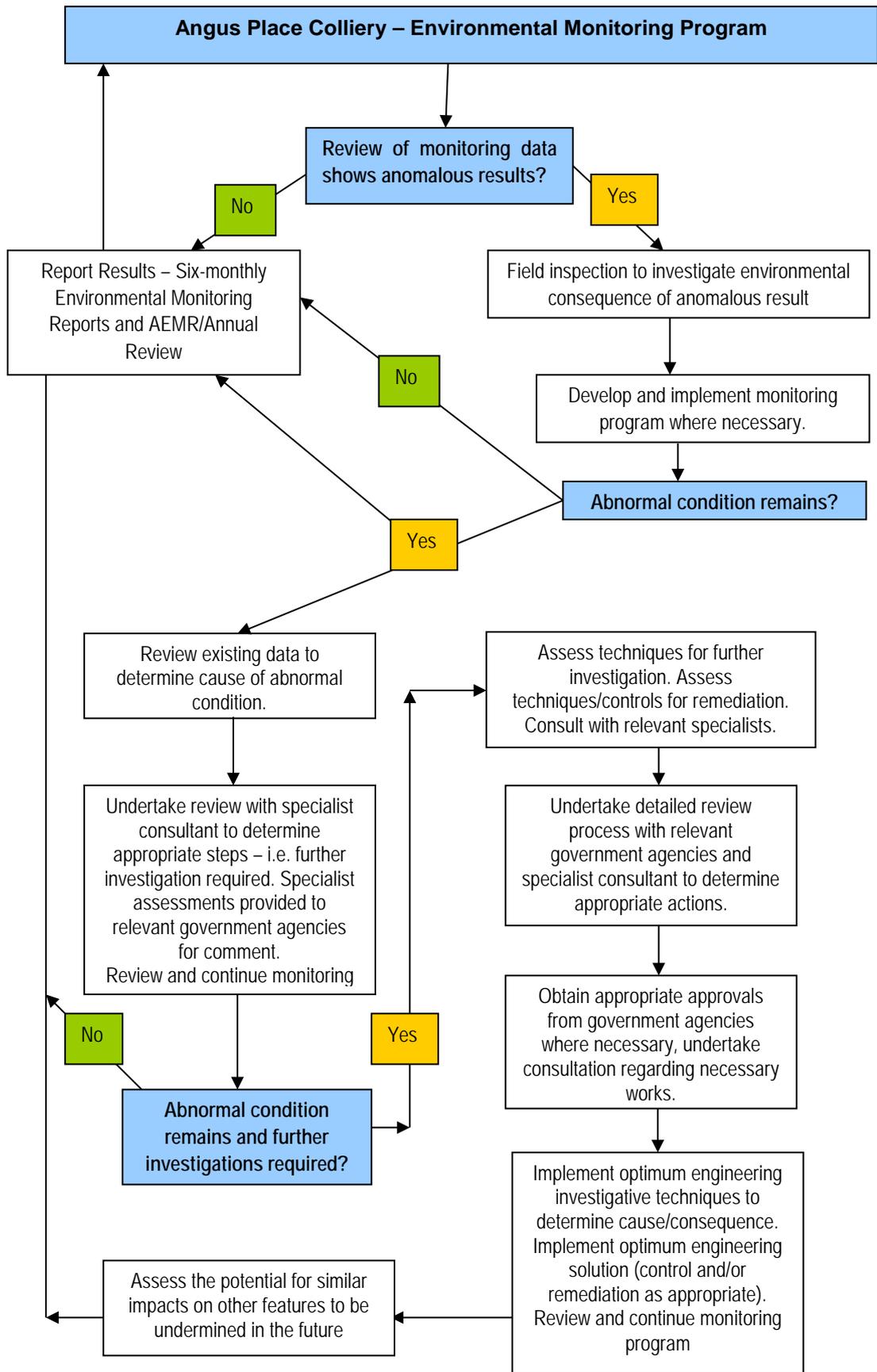
Any amendments to the Environmental Monitoring Program will be undertaken in consultation with relevant stakeholders. Following any changes a copy of the amended Environmental Monitoring Program will be forwarded to DTIRIS for approval.

15. REFERENCES

- Catling, P.C and Burt, R.J (1995). *Studies of the ground-dwelling mammals of eucalypt forests in south-eastern New South Wales: the effect of habitat variables on distribution and abundance*. Wildlife Research 22, 271–288.
- Department of Mineral Resources (2003). *Guideline for Applications for Subsidence Management Approvals*.
- DgS (2010). *Subsidence Prediction and Impact Assessment, Report no ANP_002/1*.
- DgS (2013). *Subsidence Assessment Review for the Longwalls 900W and 910 Integrated SMP/Extraction Plan, Centennial Angus Place Colliery*. Report No. ANP-002/7.
- DP&I (2012) *Draft Guidelines for the Preparation of Extraction Plans*.
- Energy Serve (2013) *Review of Mine Subsidence Impact of Longwall 900W on Endeavour Energy's 66kV Feeder 811/2 – Springvale Colliery – Clarence Colliery*.
- Energy Serve (2013a) *Addendum to Review of Mine Subsidence Impact of Longwall 900W on Endeavour Energy's 66kV Feeder 811/2 – Springvale Colliery – Clarence Colliery*.
- GHD (2010) *Angus Place Colliery 75W Modification Surface Water Assessment*.
- Goldney, D, Mactaggart, B and Merrick, N (2010). *Determining whether or not a significant impact has occurred on Temperate Highland Peat Swamps on Sandstone within the Angus Place Mine lease on the Newnes Plateau*
- National Parks and Wildlife Service (2003). *Photographic Monitoring of Vegetation – Conservation Management Note 9*.
- RPS (2010). *Cultural Heritage Impact Assessment, Angus Place Colliery 75W Modification, Report No.: 26317*.

Appendix 1: Environmental Monitoring Flowchart

This page has been intentionally left blank.



Appendix 1: Review Schedule

This page has been intentionally left blank.

| Stakeholder | Communication Method | Frequency and Date |
|--|--|--|
| <ul style="list-style-type: none"> DP&I DTIRIS Office of Environment and Heritage Lithgow City Council FCNSW Sydney Catchment Authority | AEMR/Annual Return | Annual (March) |
| | Six-monthly Environmental Monitoring Report (if requested) | Six monthly (March, September) |
| | Meeting and site visit | Annual (following submission of AEMR/Annual Review – April/May) |
| <ul style="list-style-type: none"> DP&I | Bi-monthly Subsidence Impact Reports | Bi-monthly (if new subsidence impacts are identified) |
| <ul style="list-style-type: none"> DTIRIS - Director Environmental Sustainability DTIRIS - Principal Subsidence Engineer | End of Panel Report and meeting (Condition 12 of the SMP Approval) | Four months after the completion of each longwall panel (dependent on mining progress) |
| | Six-monthly Environmental Monitoring Report | Six monthly (March, September) |
| | Bi-monthly Subsidence Impact Reports | Bi-monthly (if new subsidence impacts are identified) |
| | Meeting and site visit | Annual (after submission of AEMR/Annual Review – April/May) |
| | AEMR/Annual Review | Annual (March) |
| <ul style="list-style-type: none"> Blue Mountains Conservation Society (1 representative) Colong Foundation (1 representative) Gundungurra Tribal Council (1 representative) Bathurst Local Aboriginal Land (1 representative) Council Community representative (at least 1 representative) | Community Review Process <ul style="list-style-type: none"> Newsletters (included with Six-monthly Environmental Monitoring Report) Update meeting/site visit (if necessary) Six-monthly Environmental Monitoring Report (if requested) | <ul style="list-style-type: none"> Six monthly (March, September) Four months after end of each longwall Six monthly (March, September) |
| <ul style="list-style-type: none"> Community Consultation Committee (CCC) | Bi-annual CCC meetings | <ul style="list-style-type: none"> Bi-annually |
| <ul style="list-style-type: none"> Springvale Coal Mine Subsidence Board | Six-monthly Environmental Monitoring Report | Six monthly (March, September) |

This page has been intentionally left blank.



Centennial Coal

Angus Place

Angus Place Colliery

PO Box 42

Wallerawang NSW 2845

