

Ms Kim Vaux
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External Affairs
South 32-Illawarra Coal
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Via email: kim.vaux@south32.net

4 May 2016

Dear Kim,

RE: Terrestrial ecological assessment for Longwall 38 – West Cliff Colliery End of Panel report

Niche Environment and Heritage Pty Ltd (Niche) has undertaken a review of the predicted and observed impacts on terrestrial ecology values resulting from the extraction of Longwall 38 at West Cliff Colliery. An assessment against the Trigger Action Response Plans (TARPs) toward biodiversity values has also been made. The assessment is attached for inclusion in West Cliff Colliery's End of Panel Report for Longwall 38.

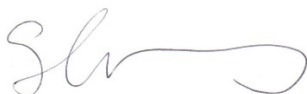
Our assessment is based on results of environmental monitoring undertaken by MSEC and Illawarra Coal Environmental Field Team (ICEFT), and a field survey of the Georges River conducted 17 February 2016 by Sian Griffiths (Niche).

Our assessment concludes that the environmental impacts observed in relation to mining Longwall 38 are within the predicted level assessed in the West Cliff Longwalls 37-38 Extraction Plan Terrestrial Flora and Fauna Assessment (Niche 2013).

The assessment concludes that there were no significant impacts to threatened flora and fauna or their habitats as outlined in the Trigger Action Response Plans (TARPs).

I trust that the following report is adequate for your purposes. Please do not hesitate to contact me should you require any further information.

Yours sincerely



Sian Griffiths

Senior Botanist

West Cliff Colliery, Longwall 38 End of Panel Report: Terrestrial Ecology Assessment

Introduction

South 32 Illawarra Coal (Illawarra Coal) is required to develop an End of Panel (EoP) Report for Longwall 38, to comply with Subsidence Management Plan Approval. Niche Environment and Heritage Pty Ltd (Niche) was commissioned by Illawarra Coal to conduct an EoP assessment of the terrestrial ecological values within the limit of subsidence of Longwall 38.

Background review

This report takes into consideration the predicted and observed impacts on terrestrial ecological values within this area from previous assessments. Previous assessments include:

- Mine Subsidence Engineering Consultants (MSEC) (2016) South 32 Illawarra Coal: West Cliff Colliery Longwall 38 End of Panel Subsidence Monitoring Report for West Cliff Longwall 38.
- Niche (2013) West Cliff Longwalls 37-38 Extraction Plan Terrestrial Flora and Fauna Assessment.
- ICEFT (2015-2016) West Cliff Area 5 Longwall 38 Update Report: 27 March 2015, 27 April 2015, 4 August 2015, 21 August 2015, 28 September 2015, 6 October 2015, 17 November 2015, 11 December 2015, 14 January 2016, 18 February 2016, 17 March 2016.
- ICEFT (2016) West Cliff Longwall 38 End of Panel Landscape Report. Dated 23 March 2016.
- GeoTerra (2016) West Cliff Colliery Longwall 38 End of Panel Surface Wwater and Groundwater Monitoring Report. Draft report, dated 28 April 2016.

Field survey

A field assessment was conducted by Sian Griffiths (Senior Botanist – Niche) 17 February 2016. The field survey targeted areas along Georges River within the limits of subsidence. The field assessment involved traversing the creek habitat, general observation of habitat and vegetation health, threatened flora searches, and any potential impacts as a result of subsidence to habitat.

Subsidence Monitoring Results (MSEC)

The EoP Subsidence Report for Longwall 38 prepared by MSEC (2016 – MSEC807) is a comprehensive report which addresses all aspects of the recorded subsidence parameters resulting from the extraction of Longwall 38.

Subsidence has the potential to impact terrestrial ecological values. Table 1 outlines the predicted subsidence impacts, the actual observed subsidence impacts and the potential consequences for terrestrial ecological values resulting from those observed impacts. Overall, the recorded impacts of subsidence on natural landscape features resulting from the extraction of Longwall 38 did not exceed those predicted in the MSEC report.

Table 1. Observed impacts from Longwall 38 due to subsidence and their correlation to potential terrestrial ecology impacts

Natural feature	Summary of predicted impacts (MSEC 2012)	Subsidence monitoring results (MSEC 2016)	Correlation to Terrestrial Ecological Values	Terrestrial Ecology Impacts Due to Longwall 38
Georges River	Increased levels of ponding, flooding, scouring and desiccation due to tilt.	No reported impacts	Change in water levels due to ponding, flooding and the resultant inundation or desiccation has the potential to alter the distribution of water plant habitat for amphibians, drown riparian vegetation or remove foraging and breeding habitat for any fauna dependant on pools.	No unexpected impacts to terrestrial ecological values. Impacts are consistent with those predicted in terms of the level of hydrological and other environmental changes and so there is no indication of unexpected impacts on the terrestrial ecology.
	Minor fracturing in the bed of the river, with isolated fracturing up to 400 m from the extracted longwalls.	Fracturing identified at Rockbar 49, with the largest fracture 10 metres long and 0.04 metres wide.		
	The potential for surface water flow diversions.	Flow diversion identified upstream of Rockbar 49.		
Tributaries	Increased levels of ponding, flooding and scouring due to tilt.	No reported impacts	Changes in water quality.	No reported changes in water quality, apart from minor iron hydroxide seepage (GeoTerra 2016) within predicted levels.
	Some fracturing could occur in the bedrock beneath the watercourses which are directly mined beneath.	Fracturing and associated uplift observed in tributaries GR104, GR108 and GR110.		
	Possible that mining-induced springs or iron staining could occur.	Iron staining along a 20 metre section of the river downstream of Pool 49.	Change in water levels due to ponding, flooding and the resultant inundation or desiccation has the potential to alter the distribution of water plant habitat for amphibians, drown riparian vegetation or remove foraging and breeding habitat for any fauna dependant on pools.	No unexpected impacts to terrestrial ecological values. Impacts are consistent with those predicted in terms of the level of hydrological and other environmental changes and so there is no indication of unexpected impacts on the terrestrial ecology.
	Some surface water flow diversions into the dilated strata beneath the watercourses which are directly mined beneath.	Surface water flow diversions observed in tributaries GR108 and GR110.		
	Possible that mining-induced springs or iron staining could occur.	Minor iron staining in tributary GR108.	Changes in water quality.	No reported changes in water quality, apart from minor iron hydroxide seepage (GeoTerra 2016) within predicted levels.
	Possible that minor	No reported impacts	Vegetation dieback at	No vegetation dieback

Natural feature	Summary of predicted impacts (MSEC 2012)	Subsidence monitoring results (MSEC 2016)	Correlation to Terrestrial Ecological Values	Terrestrial Ecology Impacts Due to Longwall 38
	isolated gas emissions could occur.		the source of gas emission.	reported or observed.
Cliffs and rock outcrops	Possible that rockfalls could occur along the exposed rock faces.	Zone of fracturing to a rock outcrop adjacent to tributary GR110, 2.1 metres long and 0.03 metres wide.	Cliff instability and rock falls could lead to direct impacts to fauna and fauna (mortality) and disruption of habitats for flora and fauna through erosion and sedimentation.	No reported or observed impacts. No die back of riparian vegetation reported by ICEFT (2016). Impact to terrestrial ecological values not observed and unlikely.
Steep slopes	Potential for soil slippage	No reported impacts.	Cracking may result in erosion causing vegetation loss, direct impacts to fauna and disruption of habitat.	No reported or observed impacts. No die back of riparian vegetation observed. Impact to terrestrial ecological values unlikely.

Environmental Monitoring

Environmental monitoring of watercourses, groundwater, cliffs and steep slopes has been undertaken by ICEFT (2016) to record impacts associated with the extraction of Longwall 38. The monitoring has been undertaken in accordance with the West Cliff Area 5 Longwalls 37 and 38 Extraction Plan.

Grevillea parviflora subsp. *parviflora* was the only threatened plant recorded in the study area by Niche (2013). No threatened fauna were identified in field surveys undertaken by Niche (2013). Impact assessments concluded that mining Longwalls 37-38 would not have a significant impact on any threatened species or an Endangered Ecological Community (EEC) listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act) and/or Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Monitoring by ICEFT (2016) has assessed the following features which relate to terrestrial ecology:

- surface water quality and water level in pools in the Georges River and its tributaries
- groundwater quality and water level in monitoring and private boreholes
- landscape features such as cliffs, steep slopes and all mapped pools in the Georges River and listed tributaries
- changes in vegetation within the Longwall 38 mining area.

Monitoring results

ICEFT (2016) has reported minor impacts from the ongoing monitoring of environmental values within the limit of subsidence of Longwall 38:

- Rock fracturing along Georges River and its tributary, resulting in some loss of surface flow and flow diversion.
- Iron staining in Georges River and Mallaty Creek (staining in Mallaty Creek likely to be associated with previous longwall).
- Soil cracking along tracks adjacent to the Georges River.

Impacts on threatened biodiversity

The following is based on information from the flora and fauna assessment undertaken by Niche (2013), the results of the monitoring undertaken by ICEFT (2016) and a field assessment conducted by Niche 17 February 2016, targeting areas along Georges River within the limits of subsidence.

The impact assessment conducted by Niche (2013) assumed the following impacts as a result of subsidence (based on MSEC (2012) predictions):

- It is unlikely that there would be any significant increases in the levels of ponding, flooding, or scouring of the river banks. It is possible, that there could be some localised small increased levels of ponding or flooding where the predicted maximum tilts coincide with existing pools, steps or cascades along the river, however, any changes are not expected to result in a significant impact.
- Minor fracturing could occur along the Georges River and drainage lines. Where this fracturing coincides with a pool water level controlling feature (e.g. rockbar) this could result in some flow diversion.
- It is possible that minor fractures could occur up to 400 metres from the proposed longwalls.

- It is possible that there could be some localised areas along the drainage lines that experience a small increase in the levels of ponding and flooding. However, any changes are expected to be minor and not result in a significant impact on the drainage lines.
- It is unlikely that there would be any net loss of water from the catchment.
- The incidence of fracturing in the drainage lines is expected to be low and unlikely to result in any significant loss of surface water flows.
- Large cliff instabilities are unlikely to occur.
- Some fracturing of the rock outcrops predominantly where the rock outcrops are located above the existing and proposed longwalls and, where the rock is marginally stable, could then result in instabilities.
- It is likely that only minor cracking would occur near the tops of steep slopes.

Threatened Ecological Communities

Two Threatened Ecological Communities (TECs) were recorded within the vicinity of Longwall 37-38: Cumberland Plain Woodland and Shale Sandstone Transition Forest. These communities are listed as TECs under the TSC Act and EPBC Act. Niche (2013) concluded mining of Longwalls 37-38 is unlikely to have a significant impact on either of these TEC's.

No areas of Cumberland Plain Woodland occur within the study area for Longwall 38 (defined as the surface area that is likely to be affected by the proposed mining of Longwalls 37 and 38) and only a very small area of Shale Sandstone Transition Forest occurs on the very edge of the study area for Longwall 38. Impacts to these vegetation communities as a result of mining Longwall 38 are therefore unlikely. Subsidence associated with the extraction of Longwall 38 is consistent with the subsidence impact assumptions in the Niche (2013) report and no changes in any of these vegetation communities has been reported (ICEFT 2016).

Threatened flora

One threatened flora species was recorded in the study area during the survey conducted by Niche (2013): *Grevillea parviflora* subsp. *parviflora*. Further, potential habitat was determined within the vicinity of Longwall 38 for five threatened flora species that may potentially be impacted by subsidence: *Epacris purpurascens* var. *purpurascens*, *Leucopogon exolasius*, *Melaleuca deanei*, *Pomaderris brunnea* and *Pultenaea aristata*. Niche (2013) concluded mining of Longwalls 37-38 would be unlikely to have a significant impact on any threatened flora, based on the predicted levels of subsidence.

Subsidence associated with the extraction of Longwall 38 is consistent with the subsidence impact assumptions in the Niche (2013) report. *Grevillea parviflora* subsp. *parviflora* was recorded within a ridge line vegetation community, and no impacts to the habitats occurring along the ridgeline have been reported. Therefore, it is unlikely that the mining of Longwall 38 has resulted in an impact on the population of *Grevillea parviflora* subsp. *parviflora* occurring in the study area.

None of the five threatened plant species considered to have potential habitat within the limit of subsidence (Niche 2013) have subsequently been recorded from the study area and therefore it is unlikely that the extraction of coal from Longwall 38 will have led to any impacts on these threatened plant species.

Subsidence associated with the extraction of Longwall 38 is consistent with the subsidence impact assumptions in the Niche (2013) report and the extraction of coal from the longwall is not likely to have had a significant impact on any threatened flora.

Threatened Fauna

Forty-two threatened and/or migratory fauna were considered to have limited potential habitat within the study area (Niche 2013). Fifteen of these species were considered to have potential habitat that may be impacted by subsidence, as they utilise rock outcrops, overhangs, surface rock, riparian vegetation and watercourses which may be impacted by subsidence. These include Green and Golden Bell Frog, Littlejohn’s Tree Frog, Giant Burrowing Frog, Red-crowned Toadlet, Spotted-tailed Quoll, Eastern False Pipistrelle, Eastern Freetail-bat, Grey-headed Flying Fox, Large-eared Pied Bat, Eastern Bentwing-bat, Large-footed Myotis, Yellow-bellied Sheath-tail-bat, Greater Broad-nosed Bat, Broad-headed Snake and Rosenberg’s Goanna. Niche (2013) concluded that the mining of Longwall 38 was unlikely to have a significant impact on a local population of any of these threatened fauna providing the subsidence impacts were within predicted levels.

Subsidence associated with the extraction of Longwall 38 is consistent with the subsidence impact assumptions in the Niche (2013) report and the extraction of coal from the longwall is not likely to have had a significant impact on any threatened fauna.

Assessment of predicted and observed impacts

The predicted and observed impacts on EEC’s and threatened species (and their habitats) resulting from the mining of Longwall 38 is provided in Table 2. The table focuses on the three main ecological values which were the subject of the assessment undertaken by Niche (2013) for the development of Longwalls 37 to 38.

Table 2: Summary of the predicted and observed impacts on general habitat and threatened flora and fauna Associated with Longwall 38

Ecological Values	Predicted Impact*	Observed Impact**	Within Prediction (yes/no)
Endangered Ecological Communities (and other vegetation)	<ul style="list-style-type: none"> Unlikely that riparian vegetation will be impacted as the Georges River is unlikely to experience loss of water or large scale hydrological impacts. Unlikely to alter hydrological processes in shale/sandstone transition soils and clay soils. Surface cracking is expected to be isolated and minor. Impacts to hydrology and flow are likely to be minor and localised. Strata gas release has the potential to result in vegetation die back near the points of emission. It is unlikely that subsidence would impact on vegetation along the ephemeral watercourses. 	<p>No vegetation impacts have been observed or reported.</p> <p>No significant impacts to EECs or vegetation are likely to have occurred.</p>	Yes

Ecological Values	Predicted Impact*	Observed Impact**	Within Prediction (yes/no)
	<ul style="list-style-type: none"> Some cracking may be observed in the soil in ridgetop, woodland and paddock vegetation however it is unlikely to result in a significant impact to vegetation composition. Unlikely to have a significant impact on TECs or other vegetation communities. 		
Threatened flora	<ul style="list-style-type: none"> It is unlikely there would be any biologically significant effect on the habitats of threatened shale sandstone transition and clay species due to soil moisture change. Surface cracking of soils as a result of subsidence movements is expected to be isolated and minor. In alluvial environments mine subsidence has some potential to affect threatened plant species through changes in hydrology impacting on individual plants or groups of plants. However, impacts to hydrology and flow are likely to be minor and localised; Strata gas release has the potential to result in vegetation die back near the points of emission. <i>Grevillea parviflora</i> subsp. <i>parviflora</i> was the only threatened species recorded in the study area and does not occur along riparian zones and on alluvial soils. Unlikely to have a significant impact on threatened flora. 	<p>No vegetation impacts have been observed or reported.</p> <p>No significant impacts to flora and flora habitat.</p>	Yes
Threatened fauna and fauna habitat	<ul style="list-style-type: none"> Open pasture grasslands, woodland and forest habitat types are unlikely to be impacted. Microhabitat features such as tree hollows and exfoliating bark are unlikely to be impacted. Fracturing and cracking of the surface may result in the form of pitfall traps which may cause harm to some fauna. Minor cracking and localised changes to ponding may occur in Georges River, which may cause very small microhabitat impacts. Water quality may be impacted through erosion and loss of soil 	<p>Given the loss of surface water flows, flow diversion and iron staining at some locations along the Georges River and tributaries, impacts to amphibians and their habitat need to be considered. The Niche (2013) report assumed impacts to the potential habitat for threatened frogs (Red-crowned Toadlet, Giant Burrowing Frog, Littlejohn's Treefrog, and Green and Golden Bell Frog) as a result of mining Longwalls 37 to 38 to include: changes to flow regimes, loss of surface flow and deep pools and hydrological changes. Such predictions were considered in the impact assessment (Niche 2013) and the assessment concluded no significant impact on threatened fauna. Given the observed impacts are within those predicted, they are considered not likely to significantly affect threatened fauna.</p>	Yes

Ecological Values	Predicted Impact*	Observed Impact**	Within Prediction (yes/no)
	<p>materials into watercourses as well as some changes to water quality which can impact amphibious fauna and riparian vegetation. However changes to water quality are considered to not be significant.</p> <ul style="list-style-type: none"> • No large scale cliff collapses or slope failures predicted. Small rock outcrops are expected to experience minor impacts. • Unlikely to have a significant impact on threatened fauna. 		

* Based on Niche (2013), MSEC (2012), EcoEngineers (2013)

** Based on Niche (2013), ICEFT (2016) and MSEC (2016) and observations by Niche during field assessment.

Trigger Action Response Plan

TARPs related to terrestrial ecology and responses are provided in Appendix A. No TARPs have been triggered for terrestrial ecology impacts to date. ICEFT (2016) reports the following TARP triggers: -

- Iron staining in Georges River (TARP Trigger Level 1)
- Rock Fracturing in Georges River (TARP Trigger Level 2)
- Soil cracking and fracturing of rock outcrop adjacent to Georges River (TARP Trigger Level 1)

Given the loss of surface water flows, flow diversion and iron staining at some locations along the Georges River and tributaries, impacts to amphibians and their habitat need to be considered. The Niche (2013) report assumed impacts to the potential habitat for threatened frogs (Red-crowned Toadlet, Giant Burrowing Frog, Littlejohn's Treefrog, and Green and Golden Bell Frog) as a result of mining Longwalls 37 to 38 to include: changes to flow regimes, loss of surface flow and deep pools and hydrological changes. Such predictions were considered in the impact assessment (Niche 2013) and the assessment concluded no significant impact on threatened fauna. Given the observed impacts are within those predicted, they are considered not likely to significantly affect threatened fauna.

No other impacts to flora, fauna or their habitats have been observed or reported. The extraction of Longwall 38 is not likely to have led to a significant impact on threatened terrestrial ecological values.

Conclusion

This report compares the observed impacts on terrestrial ecological values of subsidence associated with the extraction of Longwall 38 at West Cliff Colliery against the impacts predicted prior to extraction of coal from the longwall. This assessment is based on a review of monitoring observations and measurements undertaken by MSEC and ICEFT and a field survey undertaken on 17 February 2016.

The impacts which have occurred within the limit of subsidence for Longwall 38 are within the parameters of the predicted impacts outlined in the terrestrial ecological assessment for Longwalls 37 to 38 (Niche 2013). These levels of impact were assessed as not being significant by Niche (2013).

It is concluded that the extraction of Longwall 38 is not likely to have led to a significant impact on threatened terrestrial ecological values.

Recommendations

The Longwall 38 EoP report signifies the completion of longwall mining associated with the West Cliff Area 5 Longwalls 37 and 38 Extraction Plan (BHP Billiton 2014b). Given that the impacts of mining Longwall 38 on terrestrial ecology were within predictions, no further monitoring of terrestrial ecology values is required.

References

- BHP Billiton (2014a) Biodiversity Management Plan. West Cliff Area 5 Longwalls 37 and 38 Extraction Plan. Revision A.
- BHP Billiton (2014b) West Cliff Area 5 Longwalls 37 and 38 Extraction Plan. Revision B.
- MSEC (2016) South32 Illawarra Coal: West Cliff Colliery Longwall 38 End of Panel Subsidence Monitoring Report for West Cliff Longwall 38. Mine Subsidence Engineering Consultants.
- Niche (2013) West Cliff Longwalls 37-38 Extraction Plan Terrestrial Flora and Fauna Assessment.
- ICEFT (2015-2016) West Cliff Area 5 Longwall 38 Update Report: 27 March 2015, 27 April 2015, 4 August 2015, 21 August 2015, 28 September 2015, 6 October 2015, 17 November 2015, 11 December 2015, 14 January 2016, 18 February 2016, 17 March 2016.
- ICEFT (2016) West Cliff Longwall 38 End of Panel Landscape Report. Dated 23 March 2016.
- GeoTerra (2016) West Cliff Colliery Longwall 38 End of Panel Surface Wwater and Groundwater Monitoring Report. Draft report, dated 28 April 2016.

Appendix A: Terrestrial Ecology Subsidence Predictions, TARP Trigger Observations and Impacts associated with Longwall 38

Feature	Performance Measure*	Potential Impacts	Exceeding Prediction	TARP Trigger Level	Observed Impacts (ICEFT 2016)	Additional Comments / Recommendations
Terrestrial Ecology						
General observation of active mining areas	Negligible environmental consequences	<p>Impacts to riparian vegetation are unlikely, and if they occur, are likely to be localised minor floristic changes.</p> <p>Impacts to fauna as a result of surface cracking are likely to be negligible.</p> <p>No significant impacts on threatened flora and fauna species.</p>	<p>Exceeding Performance Measures</p> <ul style="list-style-type: none"> Subsidence impacts or environmental consequences greater than minor More than negligible environmental consequences in respect of threatened species, threatened populations, or endangered ecological communities 	<p>Level 1</p> <ul style="list-style-type: none"> Vegetation impacted by mining (by rockfalls, soil slippage, gas emissions) that naturally regenerates within the monitoring period 	None	No further monitoring required
				<p>Level 2</p> <ul style="list-style-type: none"> Vegetation impacted by mining (by rockfalls, soil slippage, gas emissions) that does not regenerate within the monitoring period 	None	
				<p>Level 3</p> <ul style="list-style-type: none"> Vegetation impacted by mining that is not responding to CMAs 	None	