Centennial Coal

Longwall 411 to 418

Subsidence Management Status Report

Springvale Colliery

March 2018

Approved 07/03/2018
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Mine Manager Springvale

TABLE OF CONTENTS

Appendices

1. INTRODUCTION

Springvale Colliery is an existing underground coal mine producing high quality thermal coal for both domestic and international markets. It is located 15 kilometres to the northwest of the regional city of Lithgow and 120 kilometres west-northwest of Sydney in New South Wales.The regional locality of Springvale Mine is shown on **Figure 1**.

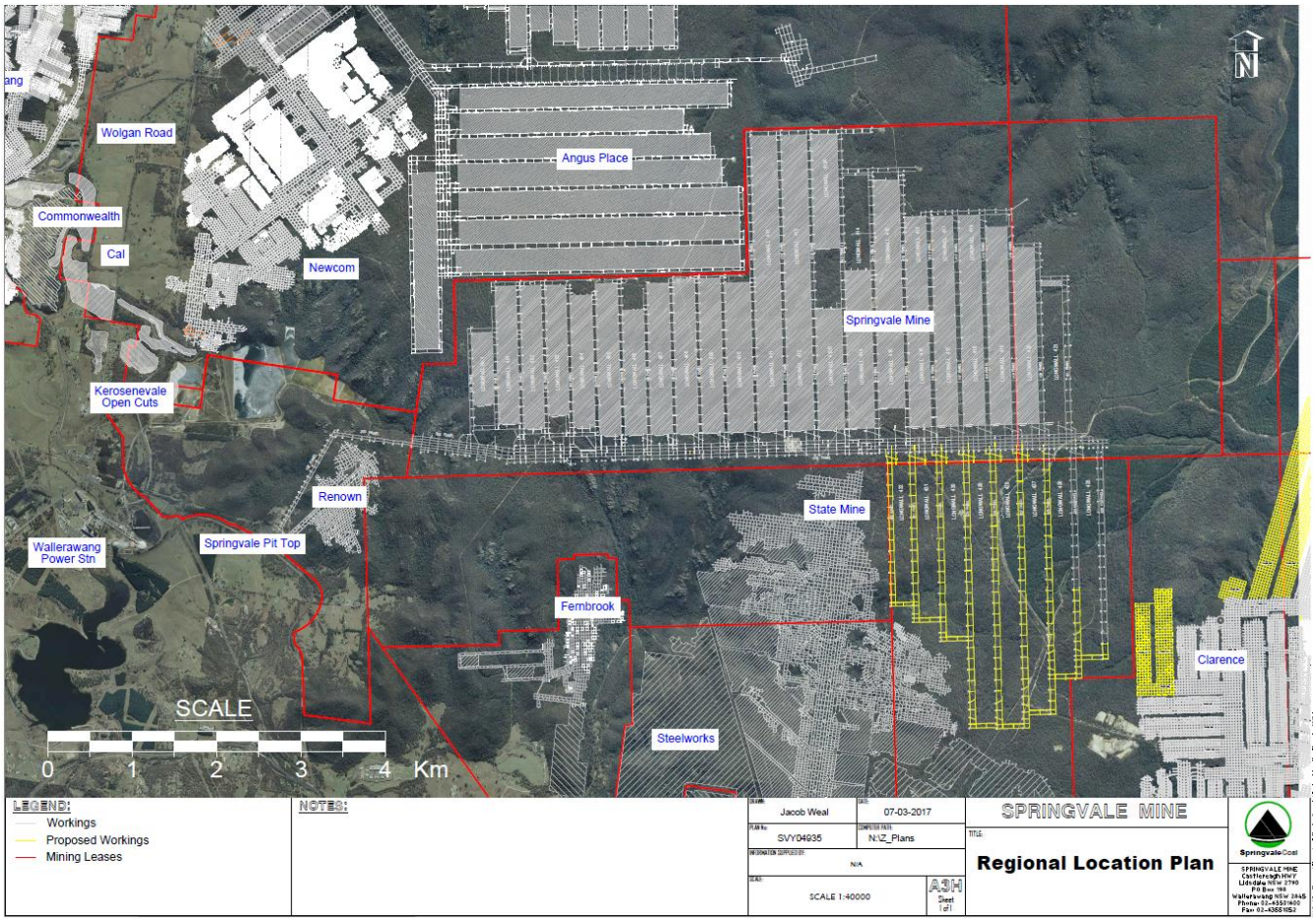


Figure 1 Regional Locality

This Subsidence Management Status Report (SMSR) fulfils the requirement of Condition 14 of the Springvale Mine SMP Approval Conditions for Longwalls 411 to 418. This SMSR covers the monitoring period between the 1st of October 2017 and the 31st of January 2018, with monitoring results available for this period presented in this report. Some results collected during the reporting period may not be included due to the time associated with analysis and presentation of results following field work. These results will however be included in future reports.

Regulatory requirements applicable to the SMP are outlined in Section 2.

2. PURPOSE AND SCOPE

The purpose of this document is to report in accordance with and comply with the requirements of Condition 14 of the Springvale Mine SMP Approval. Table 1 summarises the requirements of this Condition and where they have been addressed in this document.

Table 1. Subsidence Management Status Report Requirements

Condition	Condition Requirement	Section Addressed
17a	The current face position of the panel being extracted;	3
17b	A summary of any subsidence management actions undertaken by the leaseholder;	4
17c	A summary of any comments, advice and feedback from consultation with stakeholders in relation to the implementation of this approval (including the preparation, implementation and review of plans, programmes, reports or strategies required by this approval) undertaken or received and a summary of the leaseholders response to the comments, advice and feedback given by the stakeholders;	4
17d	A summary of any observed and/or reported subsidence impacts, incidents, service difficulties, community complaints, and any other relevant information reported to the leaseholder and a summary of the leaseholders response to these impacts, incidents, service difficulties and complaints	5
17e	A summary of subsidence development based on monitoring information compared with any defined triggers and/or predicted subsidence to facilitate early detection of potential subsidence impacts;	6
17f	A summary of the adequacy, quality and effectiveness of the implemented management processes based on the monitoring and consultation information summarised above; and	7
17g	A statement regarding any additional and or outstanding management actions to be undertaken or the need for early responses or emergency procedures to ensure adequate management of any potential subsidence impacts due to longwall mining	8

This report also provides the opportunity for relevant stakeholders to provide feedback regarding the Springvale Mine monitoring and management measures as required under Condition 9.

3. FACE POSITION OF THE LONGWALL

Extraction of Longwall 418 commenced on the 22nd of October 2015 and was completed on the 27th of May 2016 with a total retreat of 2487m. Extraction of LW419 commenced on the 2nd of August 2016 and was completed on 18th of March 2017 with a total chainage of 2340m. Extraction of LW420 commenced on the 29th of April 2017 and was completed on the 9th of November 2017. LW421 started on the 19th of December 2017 and chainage at 31st of January 2018 was 1472m.

Longwall locations and the face position with reference to subsidence monitoring lines are shown below in Figure 2.

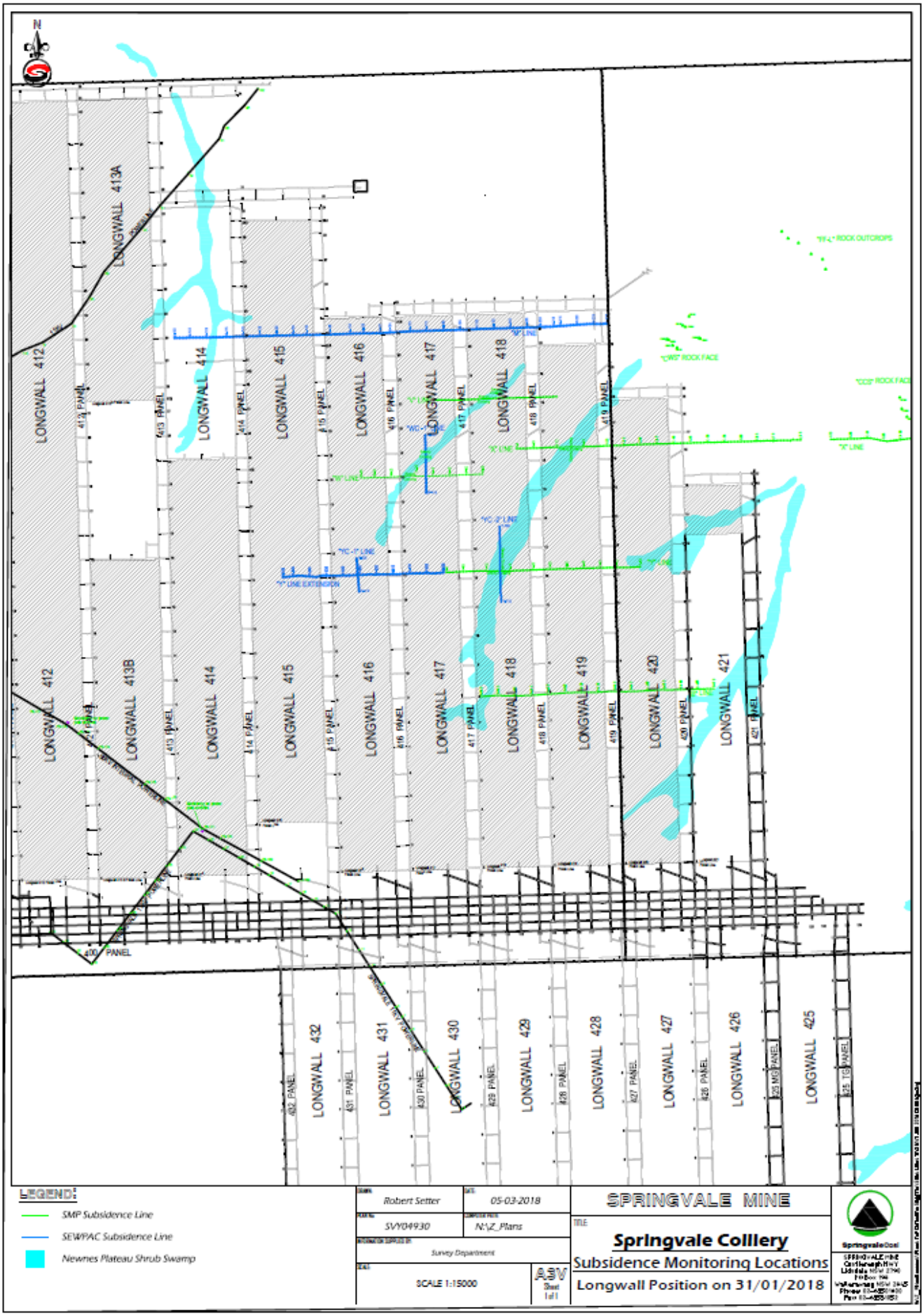


Figure 2 Face Position and Subsidence Monitoring Locations

4. MANAGEMENT ACTIONS AND CONSULTATION

4.1. Management Actions

There has been no management actions required during the reporting period.

4.2. Consultation

The contact details for Springvale personnel responsible for environment management and community relations, along with details for community complaints and enquiries have been provided in Table 2.

Table 2. Primary Contact Springvale Colliery

Contact	Position	Contact Details
Primary Contacts		
Brian Nicholls	Mine Manager	T: (02) 6350 1613
		F: (02) 6355 1502
Catherine Suggate	Environment and Community Co-ordinator	T: (02) 6350 1672
		F: (02) 6355 1502
Community Enquiries/Complaints		
Springvale Enquiries and Community Complaints		T: (02) 6350 1640

Recent consultation with stakeholders is outlined in Table 3 below. No correspondence was undertaken during the reporting period.

Table 3. Correspondence Summary

Date	Topic	Further Details
-	-	-

5. OBSERVED IMPACTS AND NOTIFICATIONS

There were no observed subsidence impacts, incidents or service difficulties during the retreat of Longwall 418. Inspections were conducted by Craven Elliston & Hayes before and after mining. Details regarding the photo-monitoring undertaken are documented in Section 6.8.

6. MONITORING PROGRAM

This section presents the subsidence and environmental monitoring that was undertaken during the reporting period. Subsidence monitoring locations (or subsidence lines) are presented in Figure 2. The environmental monitoring locations are presented in Figure 3. Plans are presented in Appendix 1.

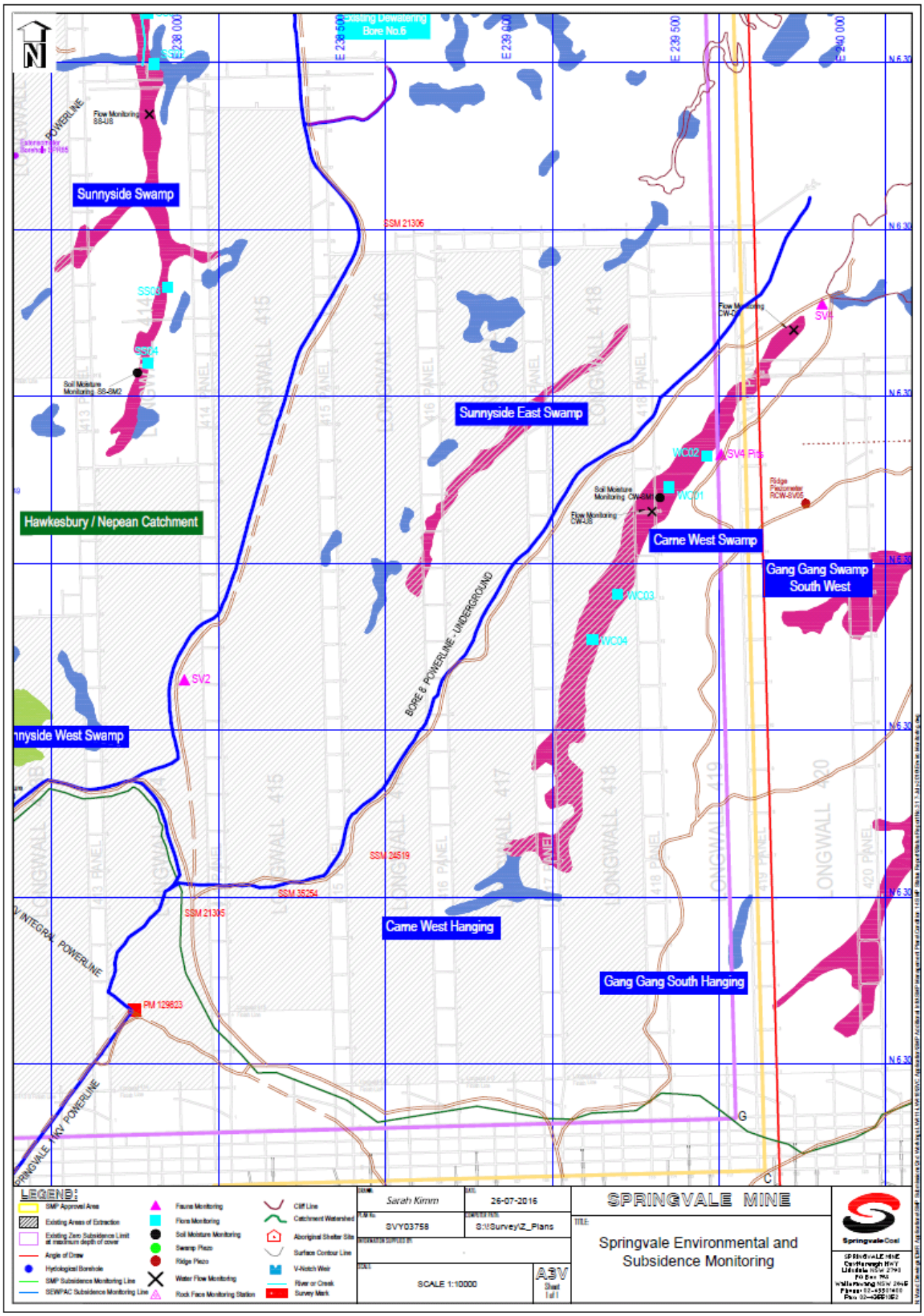


Figure 3 Environmental Monitoring Locations

6.1. Subsidence

All required subsidence monitoring lines have been installed and all pre-mining subsidence surveys completed in accordance with the approved Subsidence Monitoring and Reporting Program. All subsidence, tilt and strain results are within the predicted range.

The maximum recorded subsidence values for each of Springvale's Subsidence Lines since extraction of LW418 commenced are provided below:

B Line – Surveyed 15/05/2016 – Value = -1.275m

Y Line – Surveyed 15/02/2016 – Value = -0.552m

CWS Line – Surveyed 10/8/2015 – Value = -0.005m

X Line – Surveyed 15/02/2016 – Value = -0.224m

V Line – Surveyed 03/02/2016 – Value = -0.556m

W Line – Surveyed 15/02/2016 – Value = -0.815m

6.2. Rainfall

Daily rainfall is measured at the Bureau of Meteorology rain gauge at Maddox lane, Lithgow (BOM Station No. 063132), and the Centennial Newnes Plateau Prison Farm Rain Gauge. Rainfall data is summarised in Table 4 and Figure 4.

Table 4. Rainfall data

	Observed Rainfall		Average Rainfall	
Month	**Newnes Plateau (mm)**	**Lithgow (mm) (Maddox Lane)**	**Newnes Plateau (mm)**	**Lithgow (mm) (Maddox Lane)**
October 2017	78.8	106.0	82.0	67.8
November 2017	74.2	28.8	105.5	71.5
December 2017	87.6	75.2	90.6	73.8
January 2018	38.4	49.0	83.3	84.6
Total	**279.0**	**259.0**	**361.4**	**297.7**

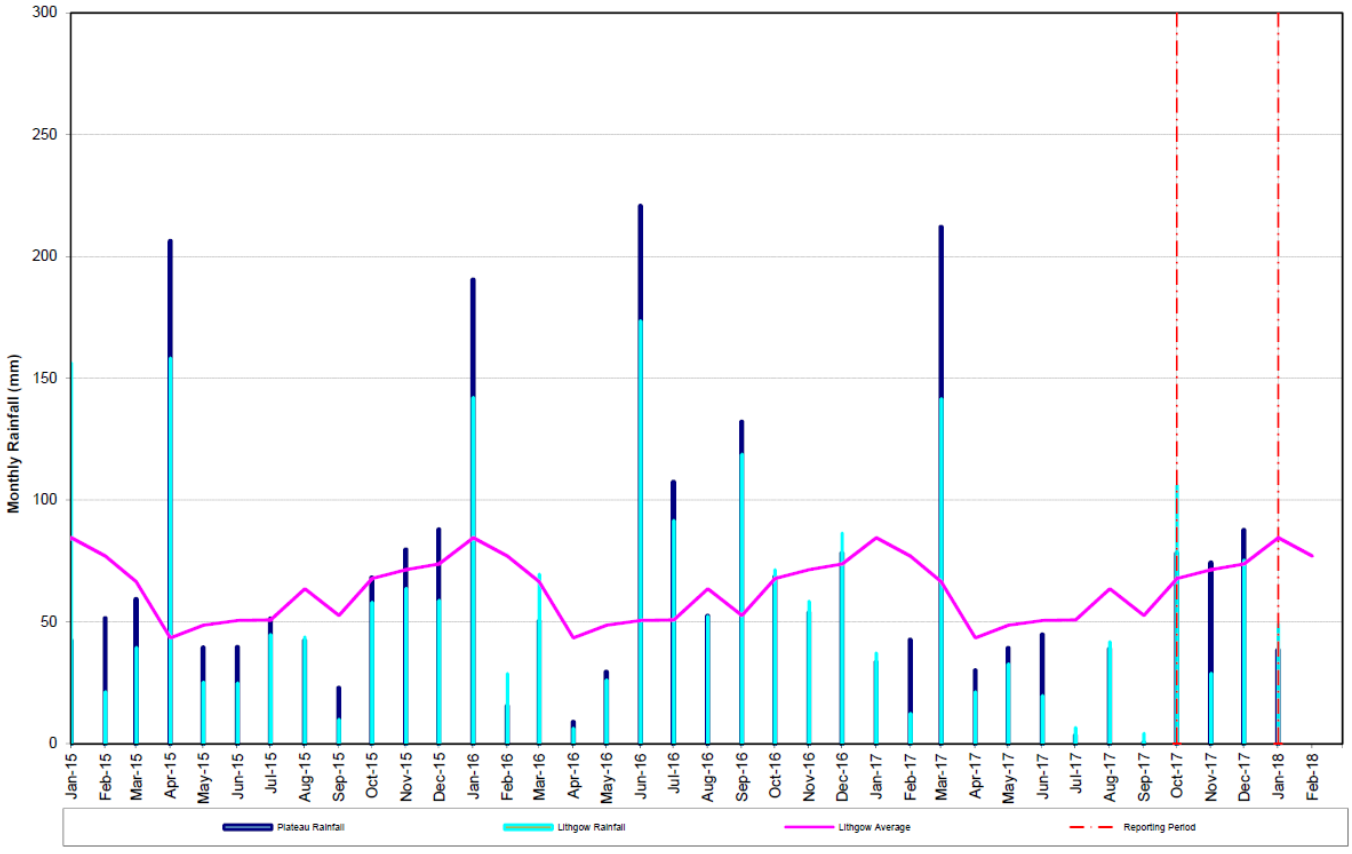


Figure 4 Monthly Rainfall

It is noted that the Newnes Plateau rain gauge spans a period of almost 20 years, from August 1998 to present, whereas the Maddox Lane gauge covers a period of 59 years. The longer term average rainfall from Maddox Lane is therefore included for comparison. It is noted that there are often large

differences between the two sites as the landscape of the Newnes Plateau often creates localised rainfall patterns.

From the rainfall data collected at Newnes Plateau during the monitoring period (1st October 2017 to 31st January 2018), the following general observations can be made:

- Observed rainfall on the Newnes Plateau for the reporting period is below average for all months.
- Total rainfall for the period at Newnes Plateau was 279.0mm, which equates to 77% of the long term average (361.4mm) for the same period.
- At Maddox Lane, total rainfall was above average for October 2017 and below average for November 2017, December 2017 and January 2018.

Calculated cumulative rainfall deficit (CRD) is analysed in conjunction with groundwater monitoring results to correlate the long term impacts of rainfall patterns on groundwater levels. This assists in the interpretation of data undertaken as part of the subsidence environmental monitoring program.

6.3. Groundwater Monitoring Program

6.3.1. Methodology

Groundwater monitoring is carried out within the Newnes Plateau Shrub Swamps in order to monitor the Standing Water Level of shallow aquifers. Deeper piezometers are installed on the plateau/ridges (to monitor depth of aquifers) in between the Shrub Swamps. Groundwater monitoring locations are listed in Tables 5 and 6 below.

Table 5. EMP Monitoring Locations

Monitoring Site	Swamp Name	Site in 2009 EMP?	2009 EMP Reference	Site in 2015 EMP?	Quality Monitoring 2015
WE1	East Wolgan Swamp	Yes	EW-SV6	No	N/A
WE2	East Wolgan Swamp	Yes	EWS-SV7	No	N/A
SS1	Sunnyside Swamp	Yes	SS-SV8	No	N/A
SS2	Sunnyside Swamp	Yes	SS-SV9	No	N/A
SS3	Sunnyside Swamp	No	N/A	No	N/A
SS4	Sunnyside Swamp	No	N/A	No	N/A
SS5	Sunnyside Swamp	No	N/A	No	N/A
CW1	Carne West Swamp	Yes	CW-SV10	Yes	Yes
CW2	Carne West Swamp	Yes	CW-SV11	Yes	Yes
CW3	Carne West Swamp	No	N/A	Yes	No
CW4	Carne West Swamp	No	N/A	Yes	No
SSE1	Sunnyside East Swamp	Yes	SSE-SV12	Yes	No
SSE2	Sunnyside East Swamp	Yes	SSE-SV13	Yes	No
SSE3	Sunnyside East Swamp	Yes	SSE-SV14	Yes	Yes
SW1	Sunnyside West Heath	Yes	SSW1	No	N/A
CC1	Carne Central Swamp	No	N/A	Yes	Yes
MS1	Marrangaroo Swamp	No	N/A	Yes	Yes
TS1	Tri Star Swamp	No	N/A	Yes	No
TG1	Twin Gully Swamp	No	N/A	Yes	No

Table 6. Ridge/Aquifer Piezometer Locations

Monitoring Site	Location	Site in 2009 EMP?	2009 EMP Reference	Site in 2015 EMP?
RSS	Ridge Piezometer over 411 Gateroads	Yes	R-SV3	Yes
RSE	Ridge Piezometer over 415 Longwall Block	Yes	R-SV4	No
SPR1101/SPR1401*	Over Longwall 416	No	N/A	Yes
SPR1104/RCW	Ridge Piezometer over 419 gateroads	Yes	R-SV5	Yes
SPR1107	Over Longwall 420	No	N/A	Yes
SPR1108	South of Longwall 420 over Longwall 427	No	N/A	Yes
SPR1109	Overall Longwall 418	No	N/A	Yes
SPR1110	Over Longwall 416/417	No	N/A	Yes
SPR1111	North of Longwall 422	No	N/A	Yes
SPR1113	Over Longwall 423	No	N/A	Yes
AP5PR	NW of Angus Place Mine	No	N/A	Yes

*Note: SPR1101 water levels dropped below the base of the piezometer in December 2013 and SPR1401 was installed as a replacement in November 2014.

Monitoring and reporting has been undertaken in accordance with the Springvale Colliery Longwalls 411 to 418 Subsidence Management Plan Environmental Management Plan Approval dated 14th of August 2015.

6.3.2. Groundwater Level Results

Monitoring results between October 2017 to January 2018 are summarised in the following section.

East Wolgan Swamp

Water levels at East Wolgan Swamp are monitored at WE1 and WE2 and displayed below in Figure 5.

Water levels at WE1 and WE2 have remained below the base of the piezometer during the period and show no responses to rainfall. Both piezometers have been mostly dry from January 2007, but show peaky and short lived water levels during high rainfall events.

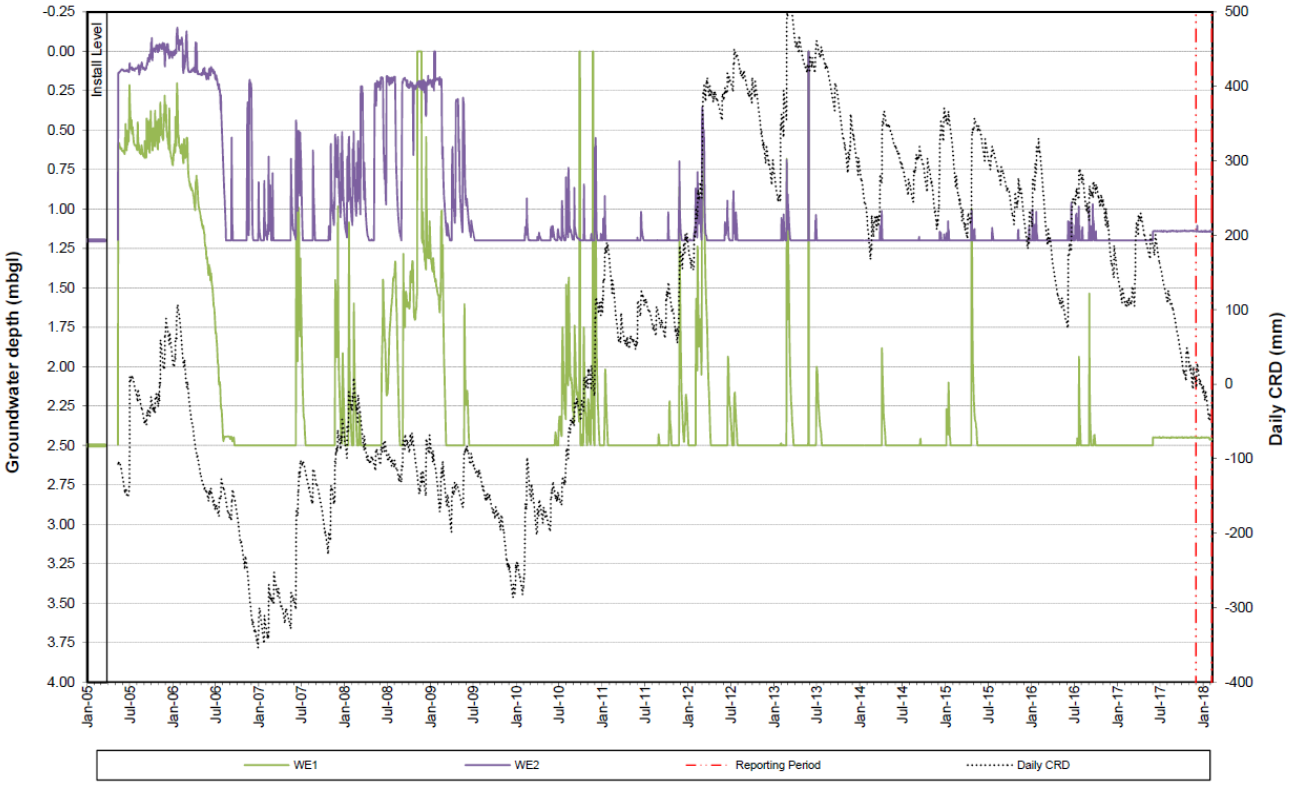


Figure 5 East Wolgan Swamp Hydrograph

Sunnyside Swamp

The water levels at Sunnyside Swamp are monitored by five piezometers, SS1, SS2, SS3, SS4 and SS5. Sites SS1 and SS2 formed part of the monitoring program for the 2009 SMP EMP, as mining of Longwalls 414 progressed below Sunnyside Swamp. No sites were part of the 2014 SMP EMP as mining had passed the swamp area, however monitoring of all five piezometers has continued.

Figure 6 below shows water levels at SS1, SS2, SSE3, SSE4 and SSE5.

Both SS1 and SS2 show a declining trend since May 2017 which continued into the reporting period. SS2 went dry at the start of January 2018 but responded to rainfall towards the end of the month with

a short and sharp peak. Historically, SS2 has not been dry since installation. A similar water level decline at SS1 and SS2 was observed in September 2006 to January 2007 due to similar climatic conditions. However, during this similar observation, the decline observed at SS1 and SS2 was not as significant as the recent event.

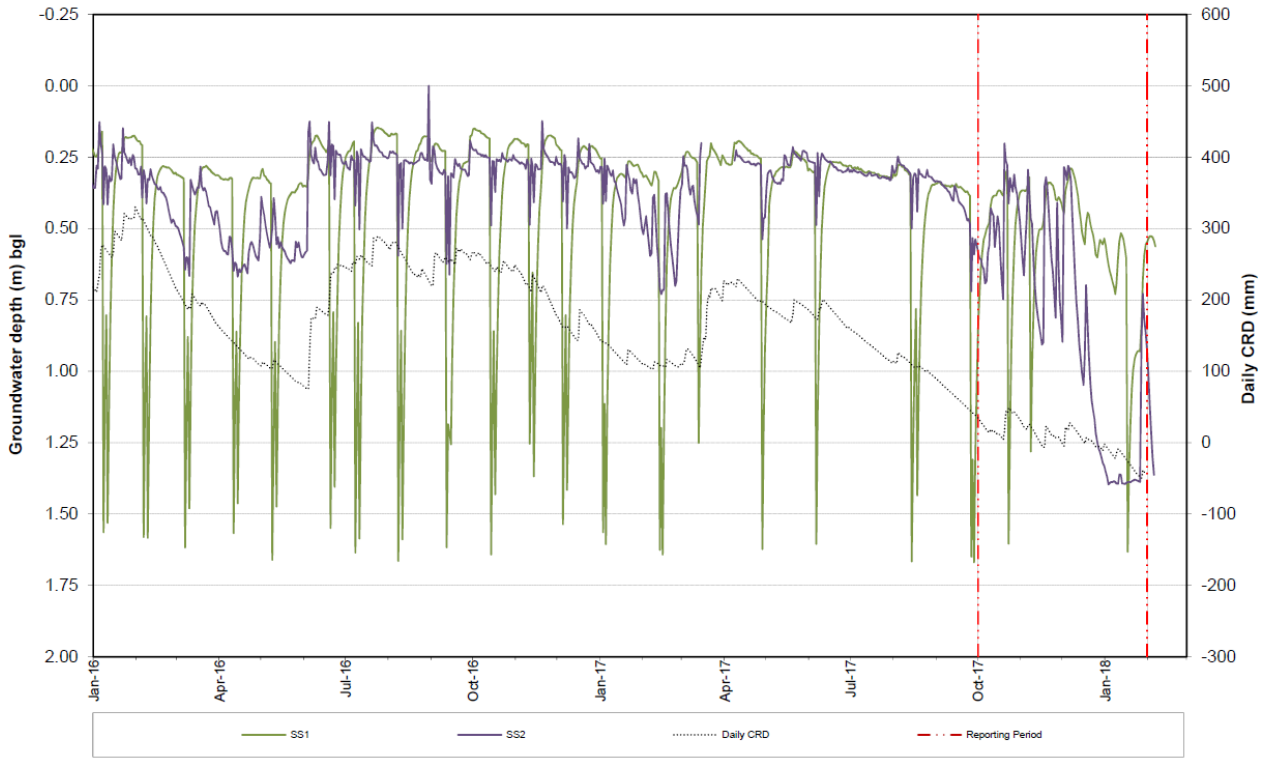


Figure 6 Sunnyside Swamp Hydrograph

Carne West Swamp

The water levels at West Carne Swamp are monitored at piezometers CW1, CW2, CW3 and CW4 (Figure 7).

Water levels at CW1, CW2, CW3 and CW4 have remained at or below the base of the piezometers during the reporting period with no responses to rainfall.

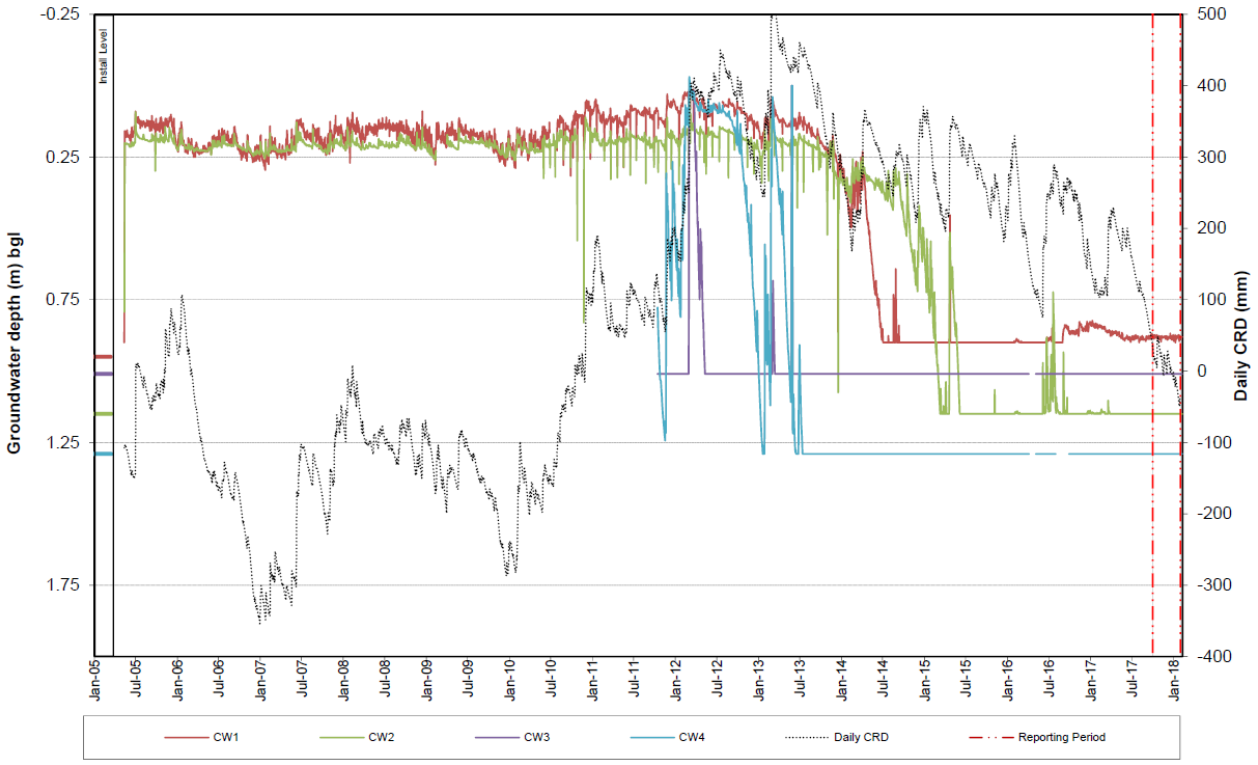


Figure 7 Carne West Hydrograph

CW1 and CW2 were within the angle of draw of Longwall 418. On the 18th of December 2015, RPS notified Springvale of an exceedance of the water level trigger thresholds at CW1 and CW2 under the Temperate Highland Peat Swamps on Sandstone Monitoring and Management Plan for LWs415–417 (THPSS MMP). A trigger notification report was subsequently provided to the Department of Environment and the Department of Resources and Energy on the 22nd of December 2015.

The preliminary investigation indicated that water levels at CW1 and CW2 piezometers now display trends that are more rainfall dependent as opposed to predominantly groundwater dependent, which had been the case for the entire baseline monitoring period from 2005 up to 2014. Further data analysis is required to determine if the changes to water levels in Carne West Swamp are related to mine subsidence or the decline in the regional groundwater table aquifer, which appears to be a delayed response to longer term climatic influences.

CW3 and CW4 were within the angle of draw of Longwall 417 in March and April 2015. On the 29th of July 2015, RPS notified Springvale of an exceedance of the water level trigger thresholds at CW3 and CW4 under the THPSS MMP. A trigger notification report was subsequently provided to the Department of Environment and the Department of Resources and Energy on the 5th of August 2015.

The preliminary investigation indicated that given the trigger level was reached prior to mining within 200m of the monitoring location, a rainfall deficit is likely to have contributed to the reduction in water level at CW3 and CW4. The change in climatic conditions has resulted in a change in pre-mining groundwater levels which is not reflected by the triggers defined in the THPSS MMP. This behaviour is similarly exemplified in the Tri Star reference swamp.

Sunnyside East Swamp

Water levels at Sunnyside East Swamp are monitored at piezometers SSE1, SSE2 and SSE3 (Figure 8).

Water levels have remained at or below the base of the piezometer since June 2013. There are no apparent responses to rainfall over the monitoring period.

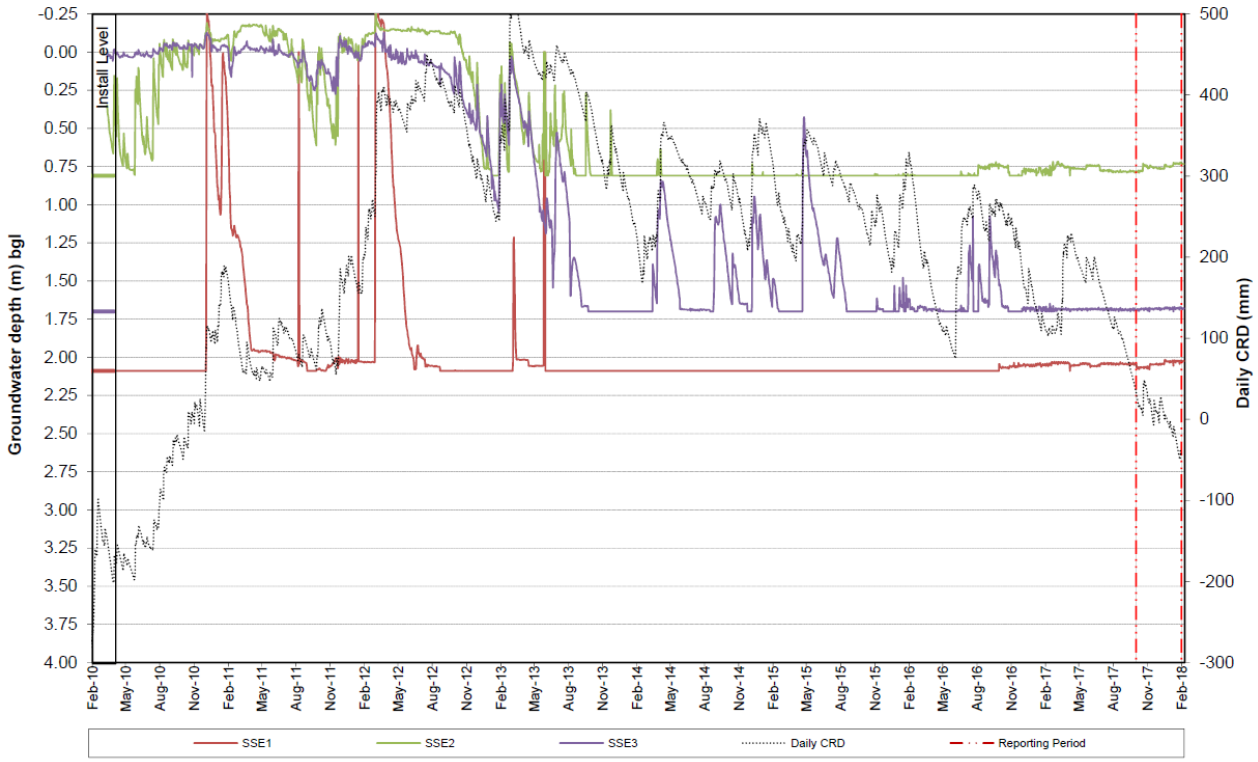


Figure 8 Sunnyside East Hydrograph

SSE1 was within the angle of draw of Longwall 416 in January 2013. On the 24th of March 2014, RPS notified Springvale of an exceedance of the water level trigger thresholds at SSE1 under the THPSS MMP. A trigger notification report was subsequently provided to the Department of Environment and the Department of Resources and Energy on the 28th of March 2014.

The preliminary investigation indicated that the likely cause was an extended period of dry weather, which contributed to the reduction in water level within the reference swamp piezometers (which are located away from mining activities).

Following the implementation of the action plan, reporting was conducted by RPS and Gingra Ecological Surveys.

RPS concluded that “water levels at TS1 and TG1 were both above the 95th percentile when the trigger level was exceeded in SSE1. The statistics for MS1 and CC1 are heavily skewed by sampling events which are displayed as sharp drawdown spikes in the hydrograph. These events are not reflective of mining activities and recover to normal groundwater level relatively quickly. Both these

sites would have exceeded the 95th percentile if the sampling events were not taken into account. The reference sites support the low water levels observed in SSE1."

Gingra concluded that "The patterns of decline observed in vegetation along Sunnyside East Swamp appear, at this stage, to be driven by the combination of the post-fire response of vegetation and climatic conditions which have prevailed since early 2012."

SSE2 and SSE3 were within the angle of draw of Longwall 417 between November 2014 and March 2015. On the 27th of March 2015, RPS notified Springvale of an exceedance of the water level trigger thresholds at SSE2 and SSE3 under the THPSS MMP. A trigger notification report was subsequently provided to the Department of Environment and the Department of Resources and Energy on the 30th of March 2015.

The preliminary investigation indicated a rainfall deficit may have contributed to the reduction in water level at the before mentioned monitoring locations. The change in climatic conditions has resulted in a change in pre-mining groundwater levels which is not reflected by the triggers defined in the THPSSMMP.

At the location of the three piezometer sites, there has been no evidence of mining related impact.

Sunnyside West Heath

Water level at Sunnyside West is monitored at piezometer SW1 (Figure 9).

The swamp around SW1 remained predominately dry during the reporting period due to the declining CRD and below average rainfall in previous months. SW1 is rainfall dependent and extended periods of above average rainfall are required to saturate the swamp. Trends during the monitoring period are consistent with historical observations.

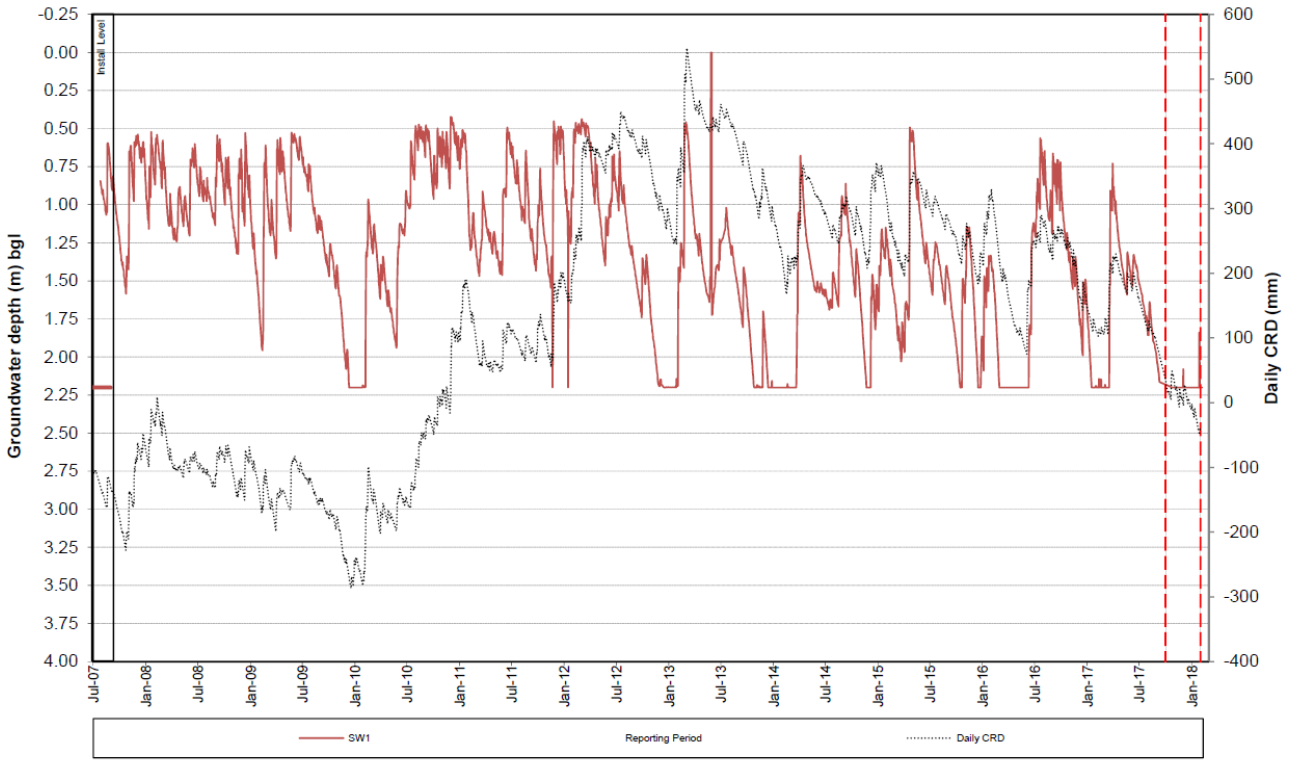


Figure 9 Sunnyside West Hydrograph

Reference Swamps

Carne Central Swamp

The water levels at Carne Central Swamp are monitored at piezometer CC1 (Figure 10).

The water level at CC1 has been steadily declining since June 2017. The gradient of the decline observed during the reporting period is similar to that previously observed however the magnitude of decline has increased. CC1 can be seen almost dry in early January 2018, responding to small rainfall events with short and sharp peaks but largely hovering at the bottom of the piezometer for the most part of January. Below average rainfall for the most part of 2017 and a continuing decline in CRD has seen water levels decline significantly during the reporting period.

Marangaroo Swamps

The water levels at Marrangaroo Swamp are monitored at piezometer MS1 (Figure 11).

As with CC1, the water level at MS1 can be seen steadily declining since June 2017 in response to below average rainfall and a continuing decline in CRD. The water levels at MS1 readily fluctuate in response to climatic variability and the gradient of the decline is similar to that previously observed.

Tristar Swamp

The water levels at Tristar Swamp are monitored at piezometers TS1, TS2 and TS3 (Figure 12).

Only piezometer TS1 is required for compliance by the 2015 EMP. TS1 has remained at or below the base of the piezometer during the reporting period. This is consistent with previous observations.

Twin Gully Swamp

The water levels at Twin Gully Swamp are monitored at piezometer TG1 (Figure 13). Since installation, TG1 has demonstrated relatively stable water levels indicating the swamp is somewhat supported by groundwater base flows which allows TG1 to be buffered during dry periods. However, TG1 also responds readily to climatic variability and corresponds with CRD. As a result, water levels can be seen dropping in response to below average rainfall from October 2017. Despite the gradient and magnitude of the decline being consistent with previous observations it indicates the impact recent dry conditions and declining CRD is having on regional swamp water levels.

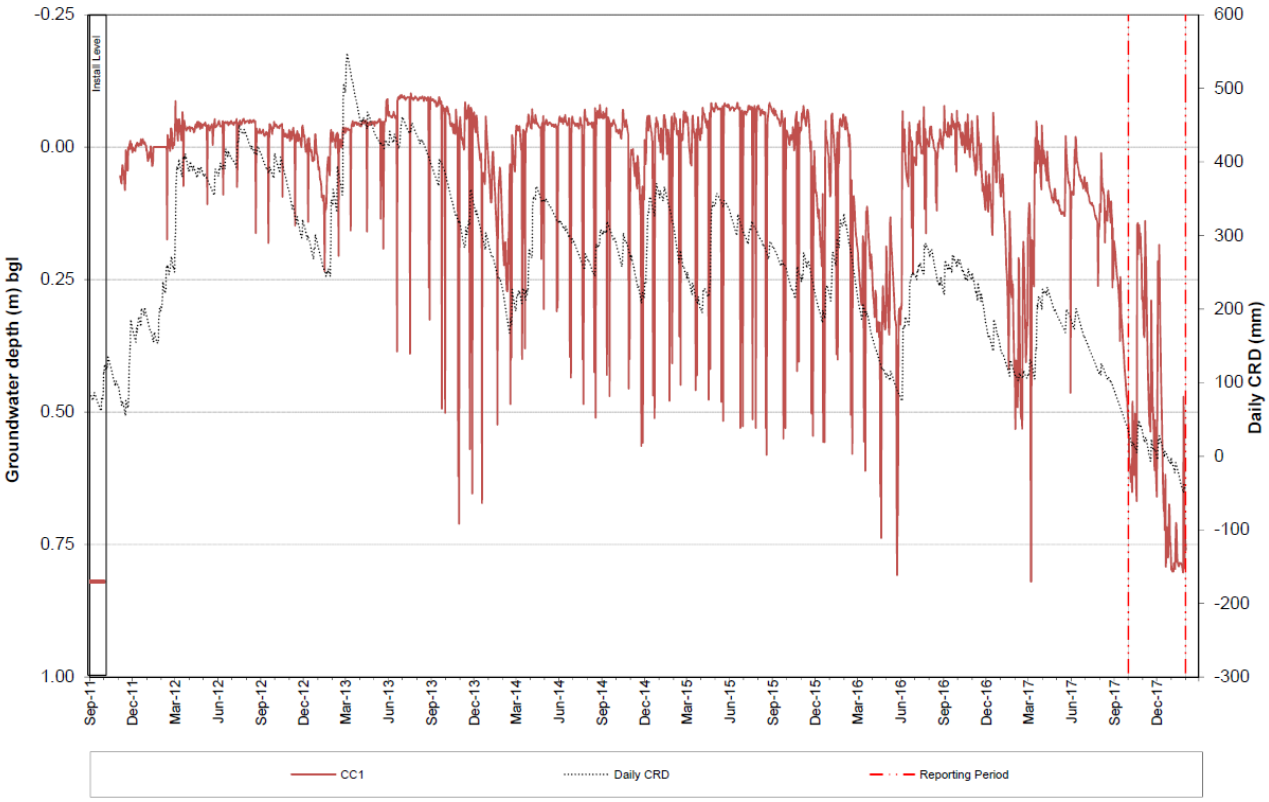


Figure 10 Carne Central Swamp Hydrograph

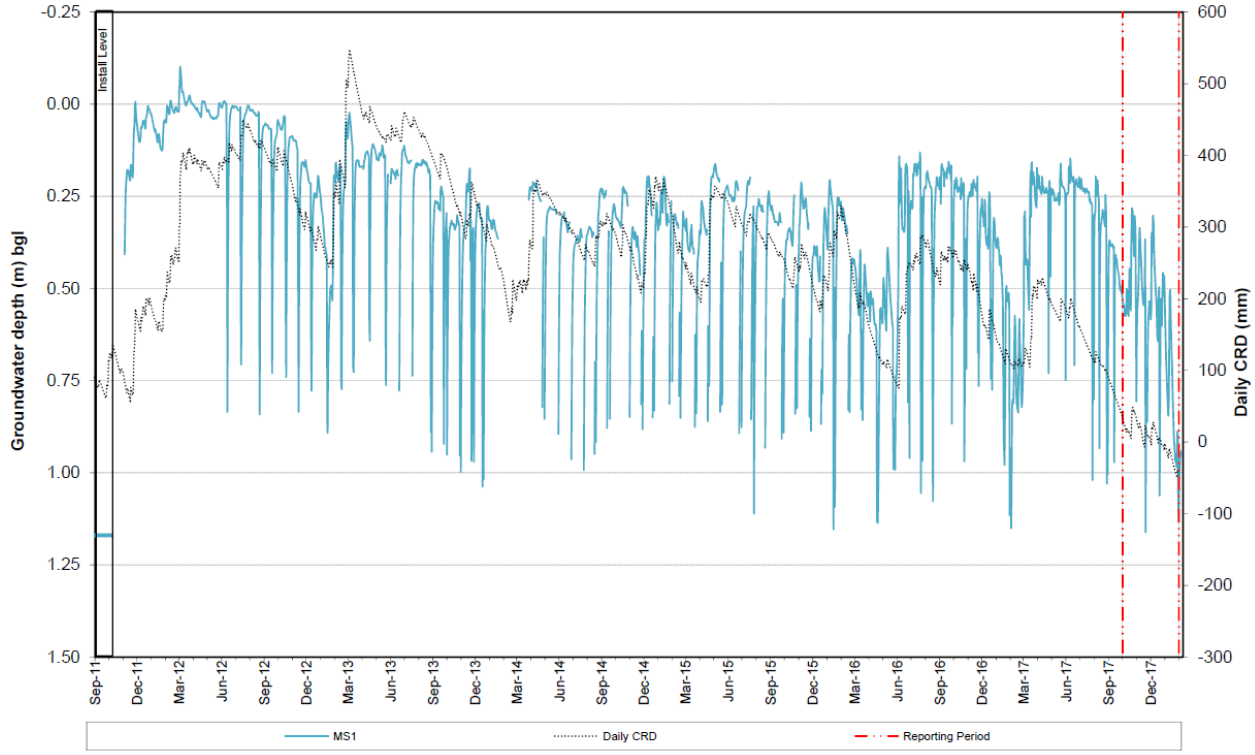


Figure 11 Marrangaroo Swamp Hydrograph

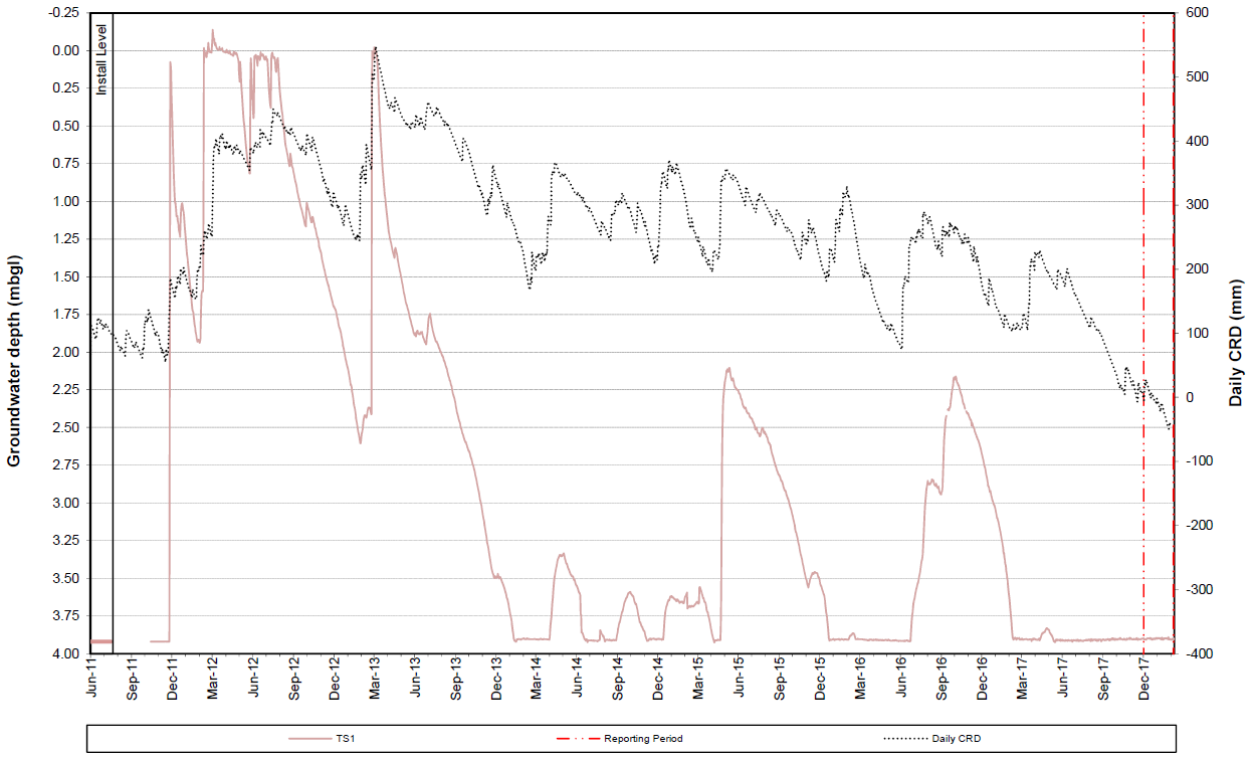


Figure 12 Tri Star Swamp Hydrograph

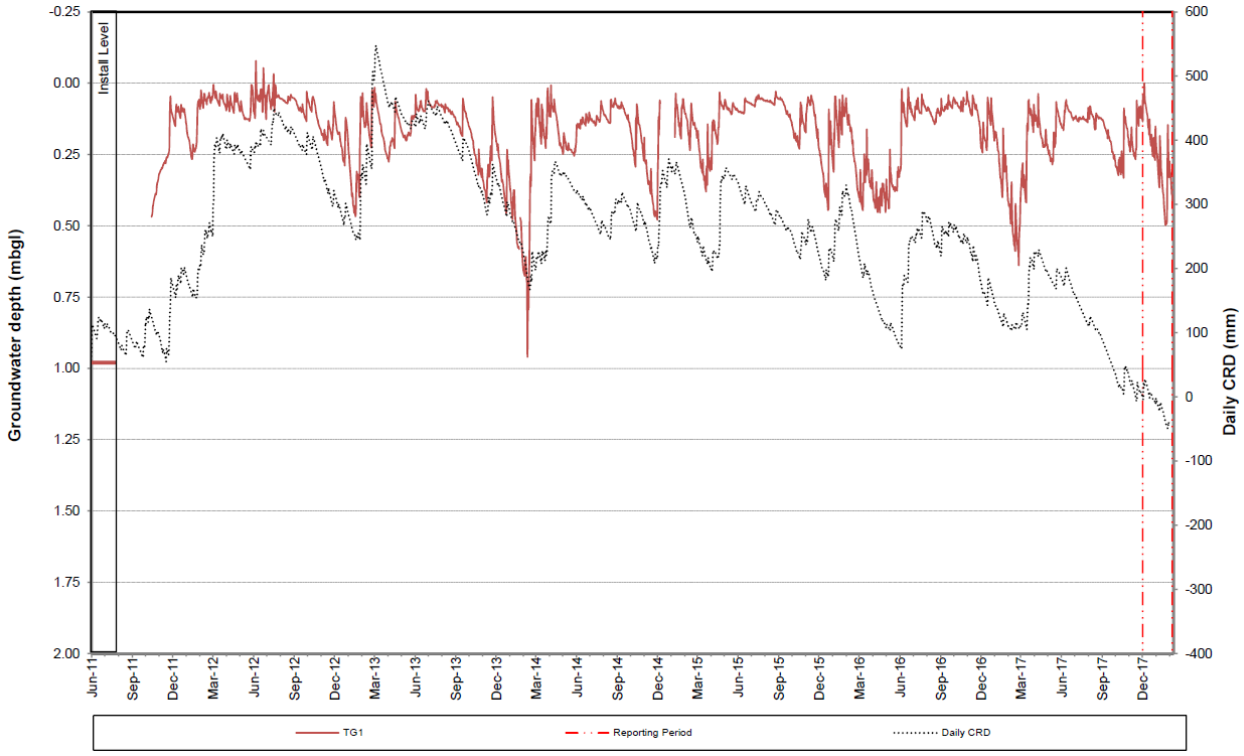


Figure 13 Twin Gully Swamp Hydrograph

Ridge and Aquifer Piezometer Monitoring

As per Section 8 of the 2015 EMP, groundwater monitoring is carried out within the ridge piezometers to monitor the water levels within the deep and shallow groundwater systems. A series of ridge piezometers and VWPs have been established to monitor the groundwater level in the near-surface unconfined aquifer in the Banks Wall Sandstone at Springvale. All ridge piezometers are monitored using water level data loggers besides RSE, which is manually measured during monitoring rounds.

The groundwater levels for ridge piezometers are shown in Figure 14.

The following is noted over the reporting period:

Impact Groundwater Sites

The groundwater levels at the designated impact sites are presented on Figure 14. The following observations can be made for the reporting period:

- Water levels at SPR1101 dropped below the base of the piezometer in December 2013 due to LW416 subsidence. A replacement piezometer (SPR1401) was installed in November 2014 which has equalised to a similar water level as SPR1101 before it was impacted. Over the current reporting period, water levels at SPR1401 have remained stable and show a slight declining trend.
- The groundwater level at SPR1104 shows a gradual decrease when LW419 passed in September 2016. The groundwater level gradually declined until it was undermined by LW420 in June 2017 and has since remained dry.
- A large data gap can be seen at SPR1107 where the water level dropped below the logger between January to September 2017. Despite being undermined in by LW420 in mid-August 2017, the groundwater level continues to decline at a gradient similar to that previously observed.
- The groundwater level at SPR1109 shows a gradual decrease when LW417 passed in December 2014. The groundwater level continued to slowly decline until it was undermined by LW418 in December 2015 which the groundwater level was observed as stepped drops resulting from subsidence. The groundwater level slowly declined and dropped below the logger in early January 2017. The logger was again lowered and now shows a fluctuating and slightly declining trend which continued into the reporting period.
- Groundwater levels in SPR1110 have remained below the base of the piezometer.
- Groundwater levels at RSS show a gradual declining trend consistent with historical observations.

Reference Groundwater Sites

Groundwater levels at groundwater monitoring reference sites are provided on Figure 14. The following observations can be made for the monitoring period:

- The water levels in SPR1108 show a gradual declining trend.

- A sudden drop in groundwater levels was observed at SPR1111 that is possibly related to the dilation of a lineament that was undermined by LW419 in February 2017. Since this decline, groundwater levels can be seen gradually declining at a similar gradient to other ridge piezometers unaffected by mining. However, compared to previous months, the gradient of groundwater decline has increased during the reporting period which is not consistent with the overall groundwater decline observed at unaffected ridge piezometers and is most similar to the gradient observed at SPR1107.
- Groundwater levels at SPR1113 shows a gradual declining trend.
- Groundwater levels at AP5PR are stable.

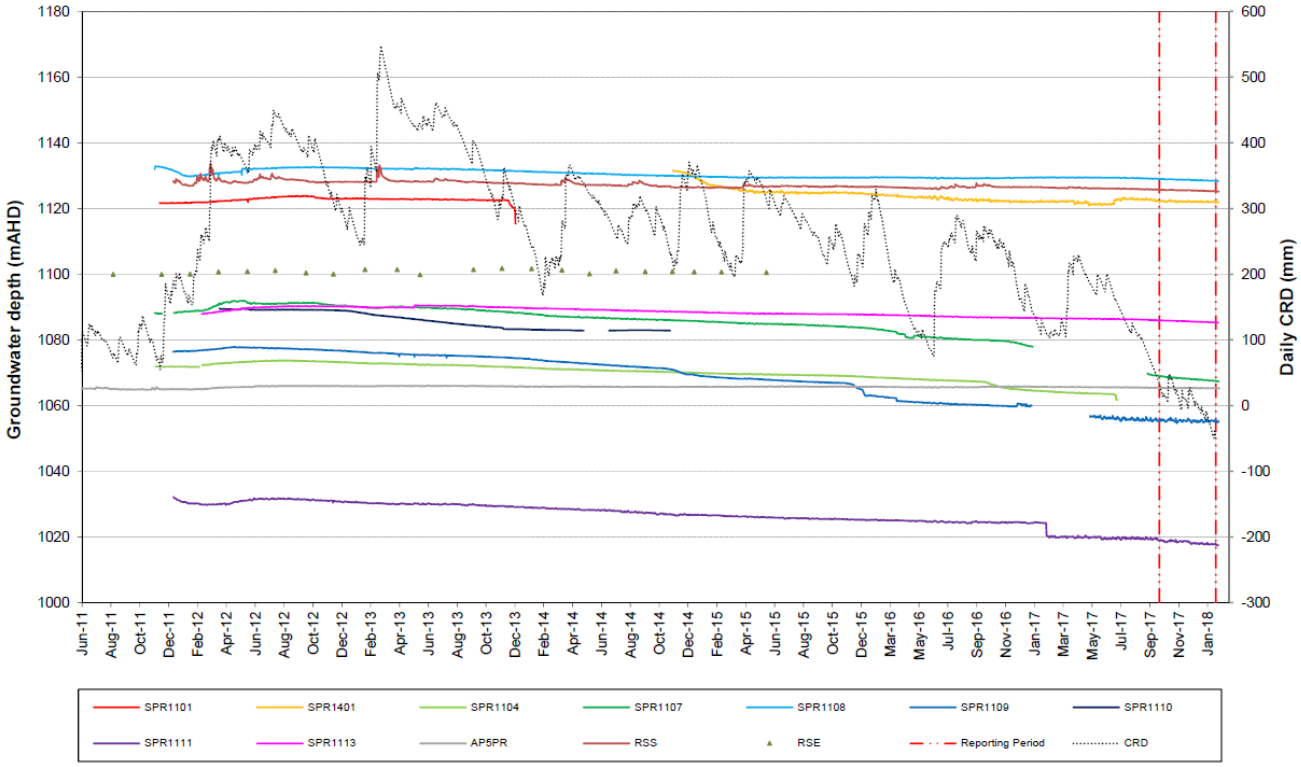


Figure 14 Impact Aquifer Piezometers

SPR1101

SPR1101 was first within the angle of draw of Longwall 416 in September 2013. On the 24th of March 2014, RPS notified Springvale of an exceedance of the water level trigger threshold at the aquifer piezometer SPR1101 under the THPSS MMP. The trigger was based on historical monitoring data which indicated a decline in water level at SPR1101. A trigger notification report was subsequently provided to the Department of Environment and the Department of Resources and Energy on the 28th of March 2014.

The investigation indicated that the likely cause was the depth of drilling of the SPR1101 exploration borehole, which was subsequently inappropriately used as a water level monitoring bore. The drilling of the SPR1101 borehole, was likely to have intersected the zone of discontinuous fracturing (B-Zone) caused by subsidence related to the extraction of Longwall 416 at Springvale.

Historical monitoring indicates that the aquifers which supply groundwater to the swamp have not been impacted by adjacent mining activities. The SPR1101 borehole was drilled to a depth below the aquifers which supply groundwater to the swamp, and it is considered that the decline in water level based on data from this borehole does not represent an impact to the groundwater system which supplies water to the swamp.

SPR1109

SPR1109 was first within the angle of draw of LW418 in November 2015. On the 18th of December 2015, RPS notified Springvale of an exceedance of the water level trigger thresholds at SPR1109 under the THPSS MMP. A trigger notification report was subsequently provided to the Department of Environment and the Department of Resources and Energy on the 22nd of December 2015.

The preliminary investigation indicated that it was likely that the changes to aquifer groundwater levels at SPR1109 were consistent with a delayed response to longer term climatic influences.

6.3.3. Groundwater Quality Results

The 2015 EMP requires swamp groundwater quality monitoring at impact sites SSE3, CW1, and CW2, and at reference sites CC1 and MS1. The swamps are monitored for parameters pH, electrical conductivity (EC) and dissolved iron.

Parameters are used to monitor possible impacts on swamp water quality resulting from subsidence induced cracks and fractures which can cause the oxidation of fresh rock surfaces. Indicators of oxidation are a decrease in pH (increase acidity), an increase in EC and an increase concentration of dissolved iron.
Performance indicators for groundwater quality will be considered to have been exceeded if statistically significant changes are indicated by the data including:

- For short-term change – if any measured parameter is greater than the baseline 80th percentile by two standard deviations for more than two months; and
- For long-term change – if the post-mining 50th percentile level for any analyte exceeds the 80th percentile pre-mining level after a minimum of 12 months.

CW1, CW2 and SSE3 have been dry since 29/04/14, 25/07/16 and 27/10/16 respectively. Water levels at CW1, CW2 and SSE3 now only occur during protracted rainfall events making it difficult to collect routine monthly groundwater samples for analysis.

pH

pH readings from impact sites CW1, CW2 and SSE3; and reference sites MS1 and CC1 are presented in Figure 15. Only measurements from MS1 and CC1 were available for the reporting period because CW1, CW2 and SSE3 were dry.

The pH levels for MS1 and CC1 have not fluctuated greatly and remain within historical limits. MS1 was just below the 80th percentile during October and November but was within the 80th percentiles during December and January. CC1 was within the 80th percentiles during the reporting period.

EC

EC readings from impact sites CW1, CW2 and SSE3; and reference sites MS1 and CC1 are presented in Figure 16. Only measurements from MS1 and CC1 were available for the reporting period because CW1, CW2 and SSE3 were dry.

Two (assumed anomalously) high EC readings of 244 and 1,310 µS/cm were recorded at MS1 in June and August respectively. These readings are not consistent with previously observed data. Furthermore, no large rainfall events (which can spike EC readings due to increased sediment loads and/or flushing of decaying organic matter) were recorded during this time. It is possible that these observations are representative but given historical trends are considered erroneous. Possible reasons for the high observations could be as simple as a laboratory transcription error.

The EC values observed for CC1 were lower than the previous reporting period however were within historical observations.

Fe

Dissolved Iron (Fe) readings from impact sites CW1, CW2 and SSE3 and reference sites MS1 and CC1 are presented in Figure 17. Only measurements from MS1 and CC1 were available for the reporting period because CW1, CW2 and SSE3 were dry.

Concentrations of Fe increased at both MS1 and CC1 during the reporting period. At MS1, concentrations of Fe can be seen successively increasing in October, November and December. The same can be seen at CC1. Fe was not analysed at CC1 in December because the water level was too low for a laboratory sample to be collected. The increasing concentration of Fe during the reporting period is likely due to the prevailing dry conditions lowering water levels and subsequently oxidising available Fe in the swamp soils. Both MS1 and CC1 showed very low concentrations in January because the sample was collected shortly after rainfall in late January.

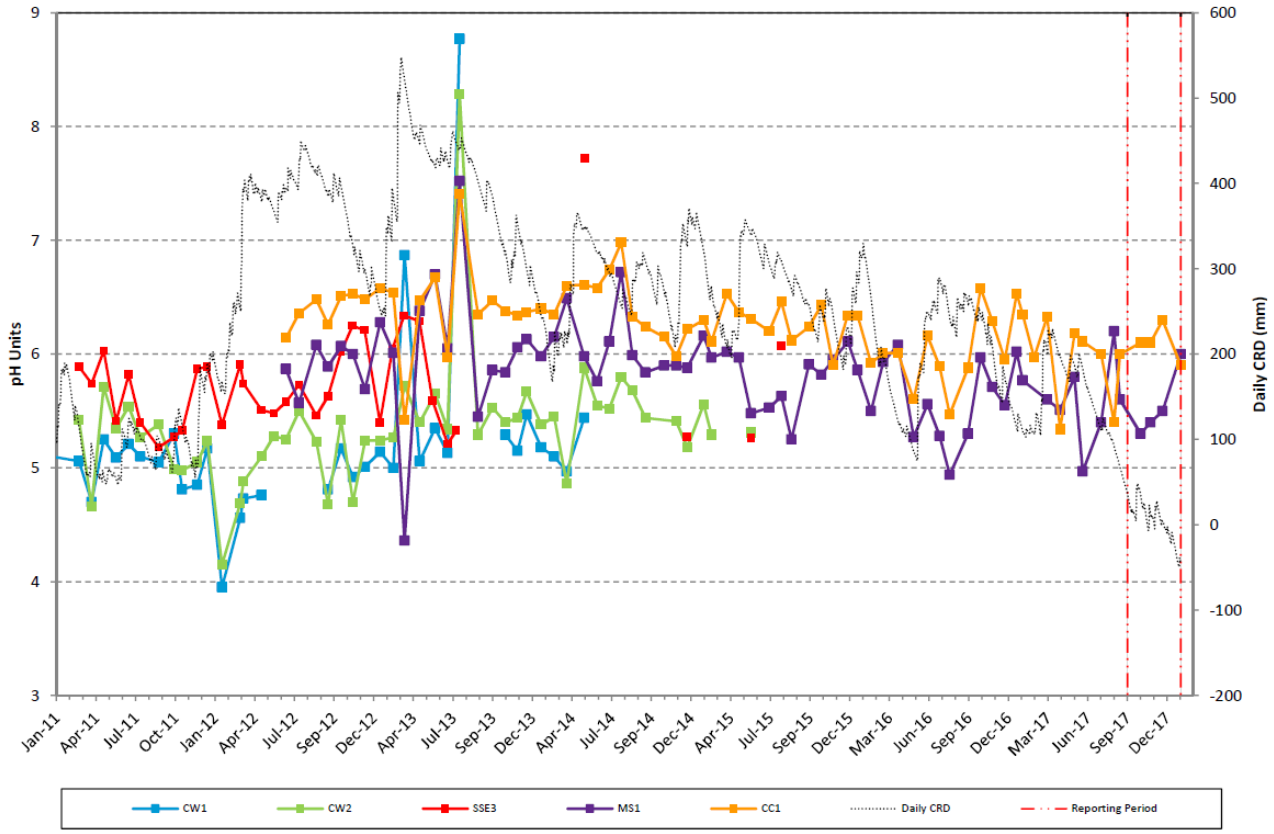


Figure 15 pH Swamp Piezometers

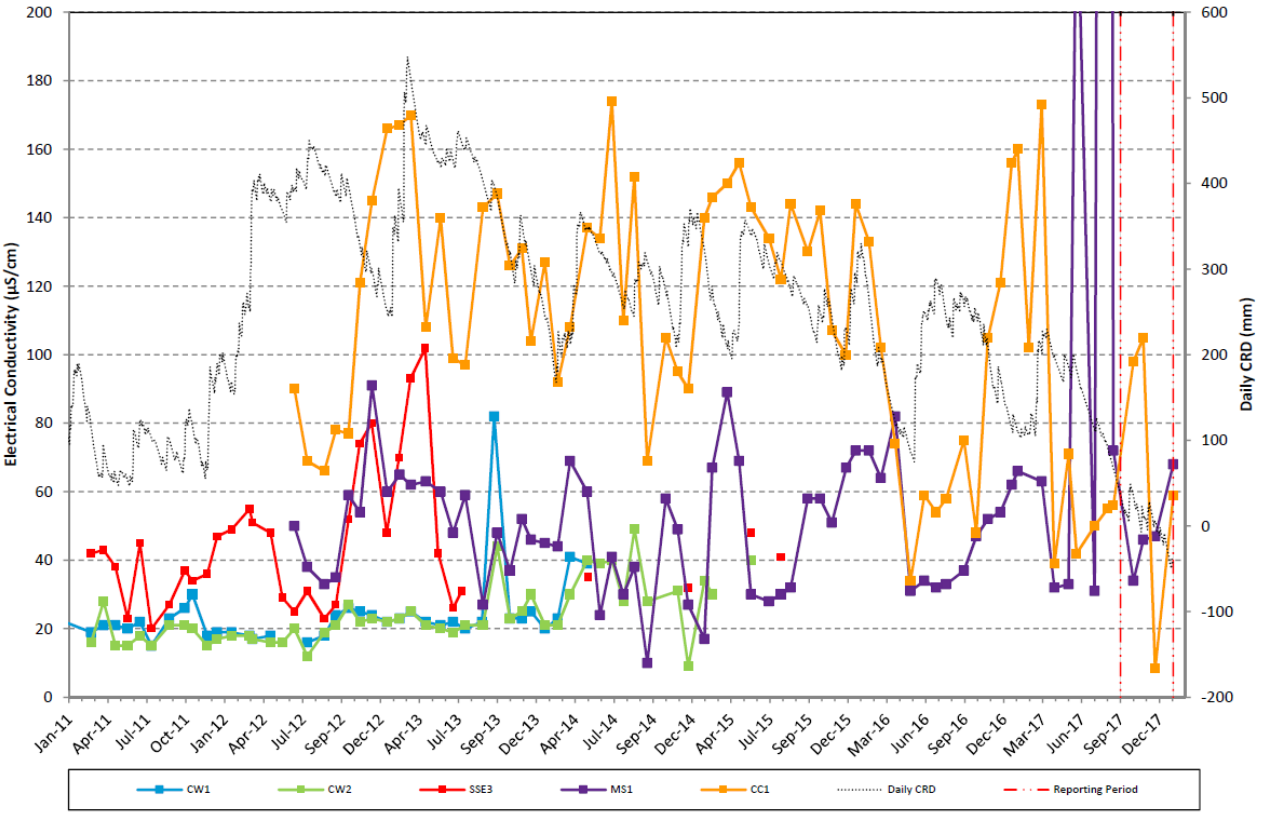


Figure 16 EC Swamp Piezometers

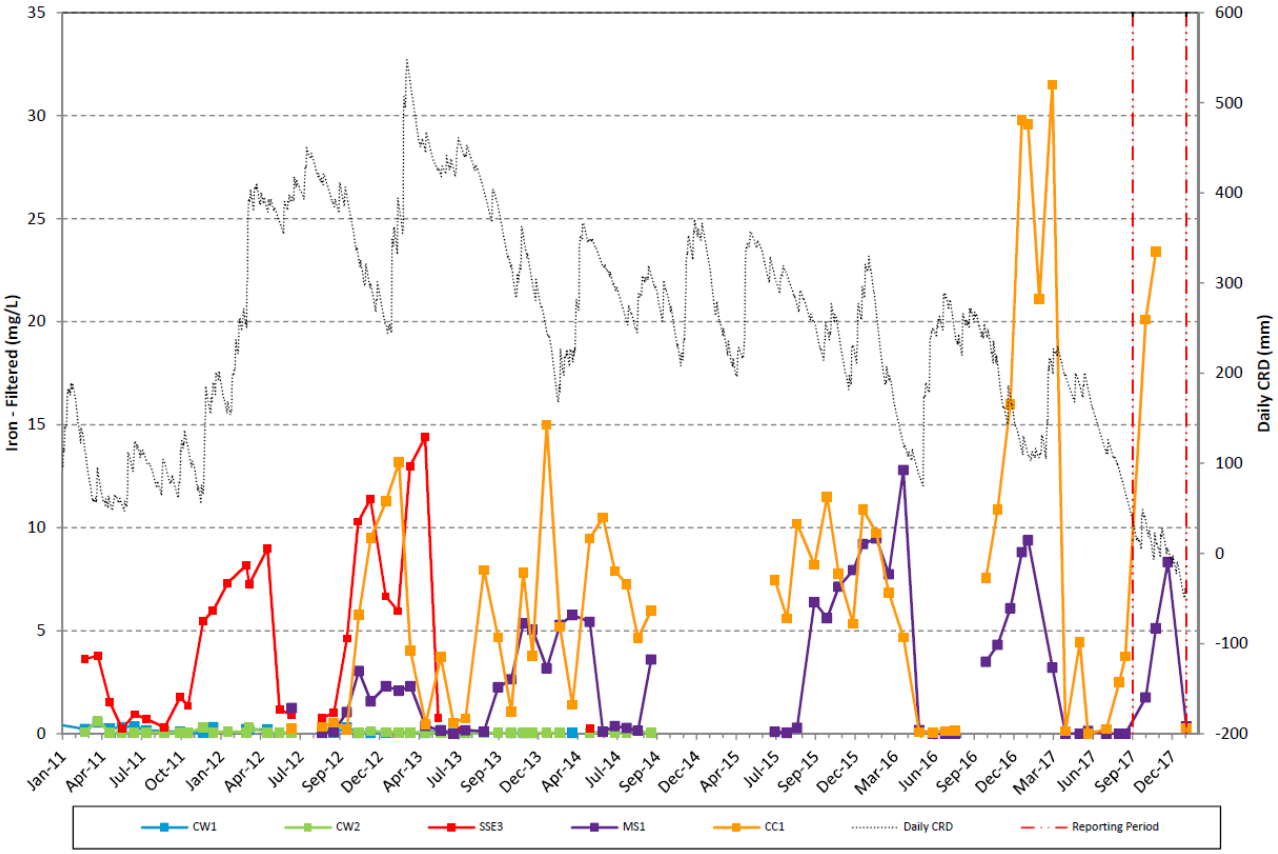


Figure 17 Fe Swamp Piezometers

6.4. Surface Water Monitoring Program

6.4.1. Methodology

Flow monitoring sites and standing water levels (where appropriate) within surface streams above Springvale are located in Table 7 below.

Table 7. Surface Water Monitoring Sites

Monitoring Site	Description	Site in 2009 EMP?	2009 EMP Reference	Site in 2015 EMP?
East Wolgan Upstream	Upstream	Yes	East Wolgan 1	No
East Wolgan Downstream	Downstream	Yes	East Wolgan 2	No
Sunnyside U/S Junction	Upstream	Yes	Wolgan Tributary 1	No
East Wolgan D/S Junction	Downstream	Yes	Wolgan Tributary 2	No
Sunnyside U/S	Upstream	Yes	Sunnyside 1	No
Sunnyside D/S	Downstream	Yes	Sunnyside 2	No
Carne West Upstream	Upstream	Yes	Carne West 1	No
Carne West Downstream/ Carne West	Downstream	Yes	Carne West 2	Yes
CWP	Nth end of Carne West Swamp	No	N/A	Yes
SS3 D/S	Nth end of Sunnyside East Swamp	No	N/A	Yes
Marrangaroo Creek Upstream	Marrangaroo Creek Upstream	No	N/A	Yes

Streams flows are monitored on a fortnightly basis using a pygmy flow meter under the 2009 EMP and monthly under 2015 EMP for flow, electrical conductivity, manganese, iron, temperature and visual inspection of colour. Total suspended solids are monitored monthly. If there is no flow no quality parameters are monitored. The exception is Carne West Pool where water pool monitoring is undertaken to assist in monitoring stream flow.

6.4.2. Surface Water Flows

Wolgan River

Surface flow contributions to the upper Wolgan River are monitored at tributaries at East Wolgan River downstream of the junction with Sunnyside Swamp and at Sunnyside Swamp upstream of the junction. Flows are shown on Figure 18. Flows at both East Wolgan D/S Junction and Sunnyside U/S Junction were too low, or too low to record a flow rate, due to below average rainfall.

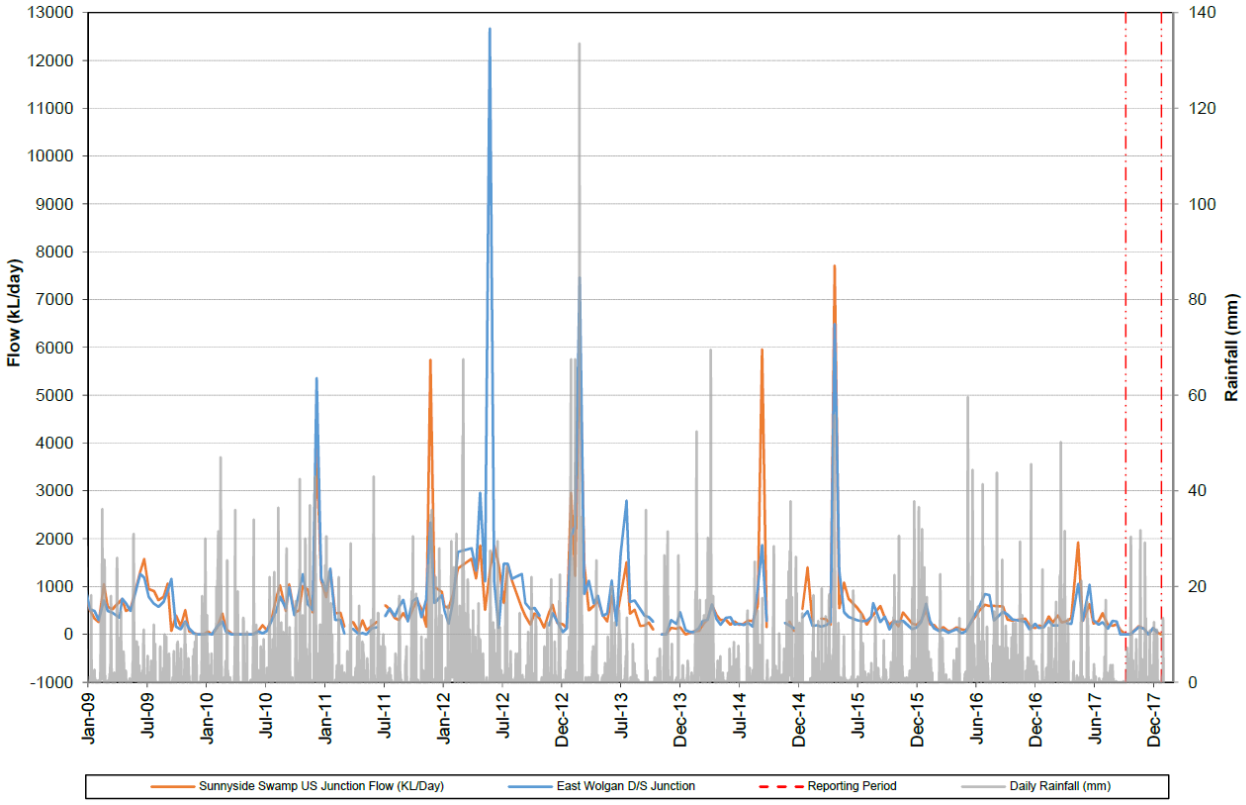


Figure 18 Wolgan River Flow

Table 8 presents the statistical comparison of the historic data and data for the monitoring period of the stream flows. For both East Wolgan D/S Junction and Sunnyside U/S Junction, streamflow was below the historic average due to low rainfall conditions.

Table 8. Wolgan River Flow Statistics

Monitoring Site	Average Stream Flow - All Data (KL/Day)	Average Reporting Period Stream Flow (KL/Day)	Stream Flow Range All data (KL/day)	Comments
East Wolgan D/S Junction	677	114	0 – 12,668	Low flows due to below average rainfall during the reporting period.
Sunnyside U/S Junction	638	116	0 – 8,977	Low flows due to below average rainfall during the reporting period.

East Wolgan

East Wolgan Swamp is located in proximity to Longwall 411. There has been no mining in the vicinity of this site. No emergency discharges have occurred during the reporting period.

Surface flows at East Wolgan swamp are monitored at East Wolgan Upstream and East Wolgan Downstream. Historically, no significant flows are recorded at these locations and the sites were recorded as being dry during the review period.

Historic flows are presented in Figure 19.

Sunnyside East Swamp

Surface flows at Sunnyside East Swamp are monitored at SS3 Downstream. No flows were recorded during the reporting period. SS3 Downstream has been dry since early 2015. Previous to this, flows were too low for gauging.

Historic flows are presented in Figure 19.

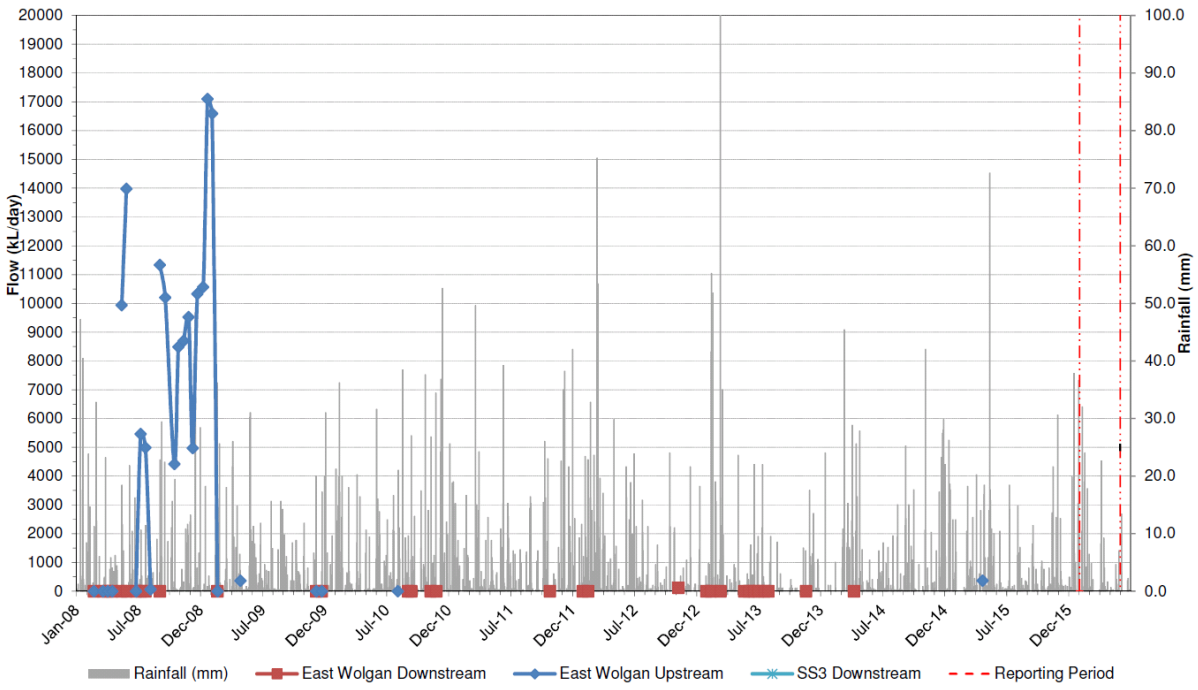


Figure 19 East Wolgan and Sunnyside East Flow

Sunnyside Swamp

Surface flows at Sunnyside Swamp are monitored at Sunnyside Upstream and Sunnyside Downstream. Flows are shown on Figure 20. Flows at both Sunnyside U/S and Sunnyside D/S were either too low to record a flow rate or dry, due to below average rainfall. Only one flow reading was recorded at Sunnyside Swamp D/S on the 28/12/2017 which coincides with rainfall.

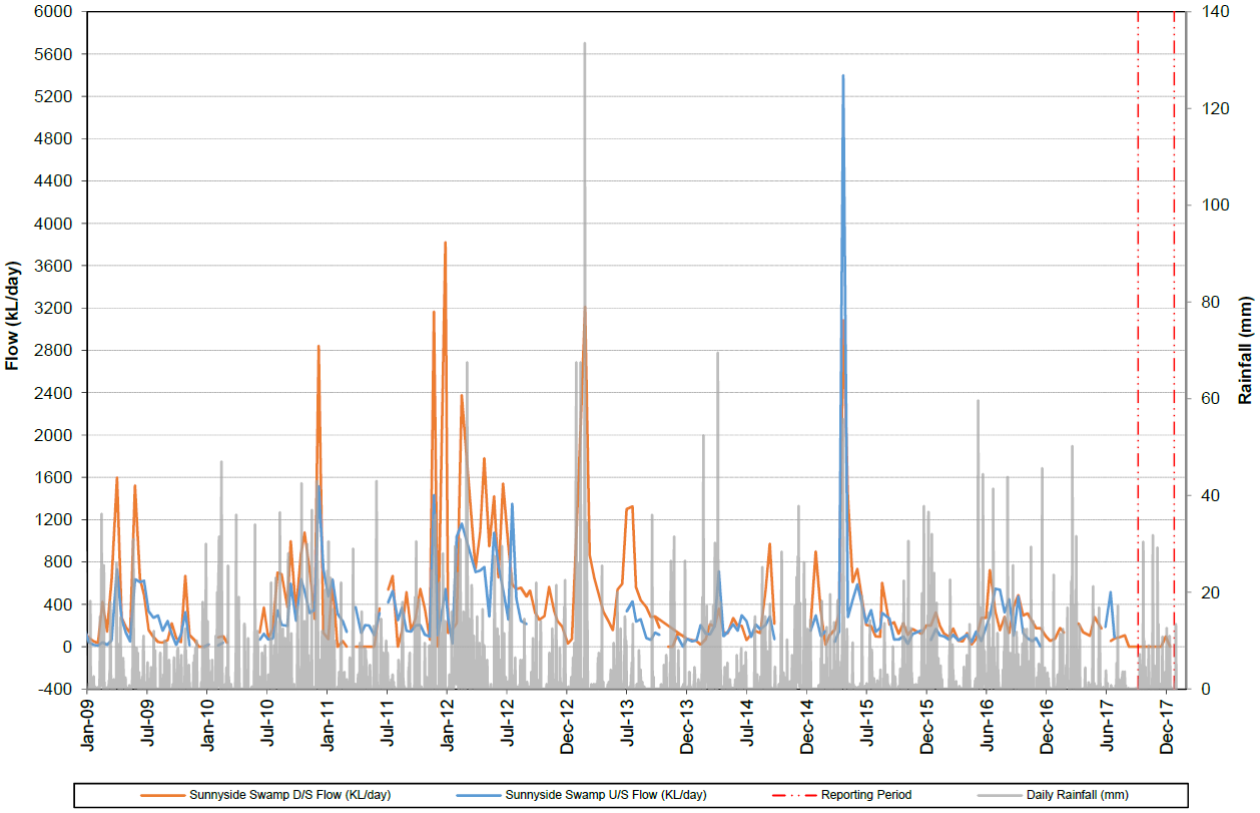


Figure 20 Sunnyside Swamp Flow

Table 9 presents the statistical comparison of historical data and the data for the monitoring period. Flows for both Sunnyside Upstream and Sunnyside Downstream were below historic observed average due to lower than average rainfall during the reporting period.

Table 9. Sunnyside Swamp Flow Statistics

Monitoring site	Average Stream Flow - All Data (KL/Day)	Average Reporting Period Stream Flow (KL/Day)	Stream Flow Range All data (KL/day)	Comments
Sunnyside Swamp U/S	327	No flows recorded	0 – 5,399	Low flows due to below average rainfall during the reporting period.
Sunnyside Swamp D/S	419	Only one flow recorded – no average	0 – 4,252	Low flows due to below average rainfall during the reporting period.

Carne West Swamp

Surface water flows and depths at Carne West Swamp are monitored at Carne West Upstream, Carne West Downstream and a pool depth monitor; Carne West Pool (CWP). CWP is adjacent to Carne West Downstream.

No flow data was recorded for Carne West Upstream, Carne West Downstream or Carne Swamp during the reporting period due to the intermittent nature of flows in the swamp, which has become rainfall dominated.

Pool depths at CWP are presented on Figure 21. CWP was dry during the reporting period.

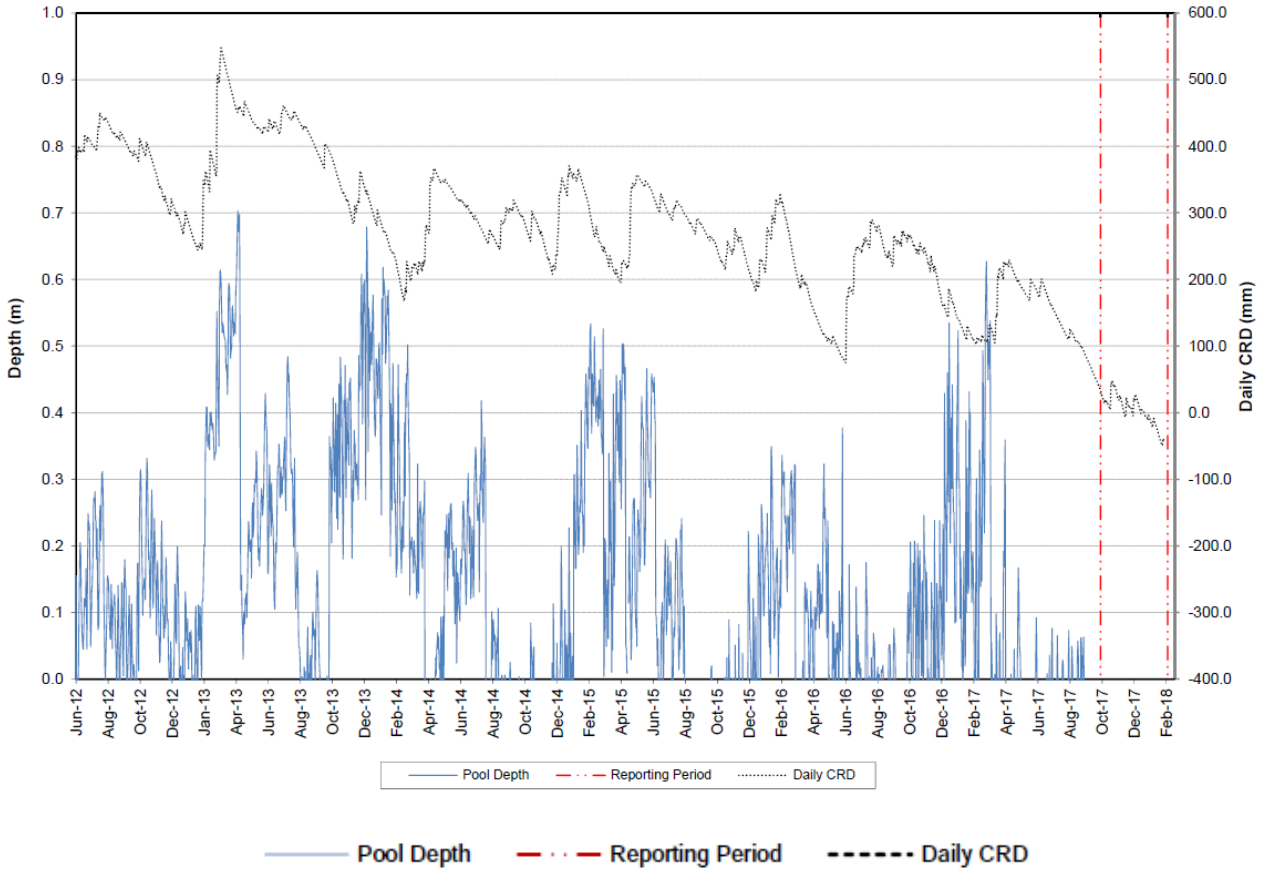


Figure 21 CWP Waterhole

Reference Site – Marrangaroo Creek

Although there was adequate water to take water quality samples from fresh pools near the monitoring point, water levels were too low to measure flow due to below average rainfall during the reporting period.

6.4.3. Surface Water Quality

All surface water monitoring sites are monitored for electrical conductivity (EC), pH, manganese, iron, total suspended solids (TSS) and temperature. The monitoring results are discussed below.

Results for temperature and TSS are driven by climatic influences and can vary greatly depending on the time of day the samples are taken. Temperature fluctuations are dominated by the season and time of day the samples are obtained. TSS measurements are driven by rainfall runoff intensity and fluctuations will vary greatly depending on the time the sample is taken. Spot samples are generally not representative of true maximum and minimum values.

As outlined above in section 6.4.2 Carne West and East Wolgan monitoring sites are not presented in this section as the monitoring sites were either dry or experienced low flow during the reporting period. The monitoring results at Carne West and East Wolgan are therefore unrepresentative of long term trends.

Marrangaroo Creek

A statistical summary of the samples collected during the reporting period are presented in Table 10.

Table 10. Marrangaroo Creek Quality Statistics

Parameter	Statistic	All Data	Reporting Period	95th Percentile (all data)
pH	Range	3.47 – 8.85	5.70 – 6.8	4.53 – 7.31
	Median	5.70	6.2	
	Mean	5.70	6.21	
EC (µS/cm)	Range	7 – 2,438	17 – 32	59
	Median	30	24	
	Mean	45.4	25.6	
Mn (mg/L)	Range	<0.001 – 0.400	0.003 – 0.015	0.02
	Median	0.009	0.005	
	Mean	0.014	0.007	
Fe (mg/L)	Range	<0.05 – 4.34	0.05 – 0.58	0.51
	Median	0.05	0.05	
	Mean	0.16	0.15	

During the reporting period, pH was above the historical average. Previous to the reporting period, pH appears to show an increasing trend but has become more neutral during 2017. An increase in neutrality corresponds with rainfall during the reporting period.

Historically, EC shows a declining trend which continued into the reporting period. EC is observed to increase with rainfall events; likely increased sediments loads during runoff. Mn and Fe show no historic trends and remained in low concentrations during the reporting period.

Parameters measured at Marrangaroo Creek are with consistent with historical observations.

Wolgan River

Table 11 summarizes water quality data for the reporting period.

Table 11. Wolgan River Quality Statistics

Parameter	Statistic	Sunnyside U/S Junction			Wolgan East D/S Junction		
		2006 – Current	Reporting Period	95th Percentile (all data)	2006 – Current	Reporting Period	95th Percentile (all data)
pH	Range	3.87 – 8.49	5.80 – 7.10	5.97 – 7.85	3.66 – 9.74	5.80 – 6.90	5.99 – 7.70
	Median	6.90	6.10		6.89	6.33	
	Mean	6.92	6.33		6.89	7.30	
EC (µS/cm)	Range	5 – 390	22 – 42	64	4 – 350	22 - 39	71
	Median	34	34		33	29	
	Mean	39	30		39	31	
Mn (mg/L)	Range	0.001 – 0.300	0.003 – 0.015	0.012	0.001 – 0.472	0.003 – 0.010	0.012
	Median	0.006	0.004		0.005	0.006	
	Mean	0.007	0.006		0.009	0.007	
Fe (mg/L)	Range	0.11 – 1.76	0.22 – 0.52	1.30	0.05 – 3.13	0.25 – 0.51	1.26
	Median	0.52	0.30		0.51	0.29	
	Mean	0.61	0.31		0.61	0.34	

During the reporting period, pH was above average for East Wolgan D/S Junction. Remaining parameters were below average.

pH and EC corresponded closely at both sites peaking at similar magnitudes in response to rainfall. Mn and Fe do not show a similar relationship but continued trends previously observed.

Parameters measured at Wolgan River D/S Junction and Sunnyside U/S Junction are with consistent with historical observations.

Sunnyside Swamp

Table 12 summarizes water quality data for the reporting period.

Table 12. Sunnyside Swamp Quality Statistics

Parameter	Statistic	Sunnyside Swamp U/S			Sunnyside Swamp D/S		
		2006 – Current	Reporting Period	95th Percentile (all data)	2006 – Current	Reporting Period	95th Percentile (all data)
pH	Range	5.31 – 8.94	5.50 – 7.40	5.70 – 7.30	5.55 – 11.29	5.10 – 6.80	6.11 – 7.76
	Median	6.63	5.85		6.85	6.25	
	Mean	6.55	6.05		6.89	6.20	
EC (µS/cm)	Range	1 – 820	24 – 40	75	1 – 840	24 - 41	192
	Median	45	35		42	42	
	Mean	52	33		64	34	

Parameter	Statistic	Sunnyside Swamp U/S			Sunnyside Swamp D/S		
Mn (mg/L)	Range	0.002 – 0.071	0.004 – 0.026	0.019	0.001 – 2.500	0.006 – 0.039	0.013
	Median	0.007	0.019		0.005	0.007	
	Mean	0.01	0.017		0.015	0.015	
Fe (mg/L)	Range	0.11 – 2.15	0.20 – 0.45	1.43	0 – 5	0.26 – 0.86	1.93
	Median	0.50	0.39		0.66	0.49	
	Mean	0.61	0.35		0.87	0.56	

During the reporting period, Mn was above average at Sunnyside Swamp U/S. Remaining parameters were below average.

Sunnyside Swamp U/S was slightly more acidic than Sunnyside Swamp D/S and both show an increase in neutrality with rainfall in January. EC at both sites correspond closely with little response to rainfall events.

Mn was consistently higher at Sunnyside Swamp U/S and can be seen peaking with rainfall during the reporting period. Conversely, Fe was higher at Sunnyside Swamp D/S during the reporting period, also peaking in response to rainfall. Both Mn and Fe concentrations where higher at Sunnyside Swamp D/S, peaking with rainfall in late January.

Parameters measured at Sunnyside Swamp U/S and Sunnyside Swamp D/S are with consistent with historical observations.

6.5. Fauna Monitoring Program

6.5.1. Methodology

As part of the on-going monitoring program at Springvale, fauna monitoring is undertaken three times per year, during spring, summer and autumn. Monitoring is undertaken at five locations throughout the year, as outlined in Table 13. Spring monitoring was conducted between the 25th and 29th of September 2017.

Table 13. Fauna Monitoring Sites

Location	Site
Newnes Plateau Woodland	F-SV2
Sunnyside Swamp	F-SV3
Carne West Swamp	F-SV4
Carne West Swamp South	F-SV5
East Wolgan Swamp	F-AP3

The faunal surveys sample a range of faunal groups with a specific emphasis on threatened and endangered species. Targeted searches are carried out for threatened species during the season within which they are most active.

Data from the surveys is then analysed to show:

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

Results presented in Section 6.5.2 are from the 2017 Spring Fauna Monitoring Report for the Springvale SMP area.

6.5.2. Results

Habitat Measurements

Habitat characteristics are presented below in Table 14.

There are some differences between the habitat characteristics from the five sites. Tall shrub, fern and reed cover were lower at SV2 which, unlike the other sites, is woodland. Low sapling, forb, grass, log and rock cover were higher at SV2 as well. Low sapling, grass, and rock cover was higher at SV3, which samples more woodland than SV4, SV5 and AP3. SV2 contains vegetation that was burned during a management burn prior to the “State Mine” fire. Overall the lower storey and ground cover is high at all swamp sites.

SV3 and AP3 swamps may be indirectly affected by drawdown from the longwall mining. Therefore they can be used as 'impact' data for assessing the impacts from mining on swamp habitat. SV4 and SV5 swamps can be used as 'control' sites as they remain outside the influence of potential drawdown. There is no significant difference between any of the impact and control site habitat cover characteristics, though statistical power was low due to the small number of sites in each group (series of t-tests). A series of Two-way Repeated Measures ANOVAs conducted over year by undermining treatment also showed no significant difference in any habitat parameter with mining impact.

It is now possible to compare the results from the surveys undertaken in 2017 with that from the surveys in spring 2008 to 2016. There are significant differences in tall shrub, fern, grass, forb and rock cover over time (Two-way Repeated Measures ANOVA; $p=0.001$, $p=0.01$, $p<0.001$, $p=0.006$ and $p=0.042$ respectively), but not with mining impact. Tree, vine and reed cover were significantly different over time, but had significant interaction terms.

Cover parameters have varied over the years for all sites, with some parameters increasing and others falling. With the exception of tree and tall shrub cover showing some reduction around 2009, most upper and mid strata characteristics show a neautral trend over the long term. About half the lower and ground strata characteristics show a neutral trend. Fern cover shows great variability, but has increased since the low in 2010. Forb and grass cover seem to have declined slowly since 2009. Reed cover has increased since it started being measured in 2012.

Variation was only significant over year, not with treatment (mining impact). This suggests that the variaiton in these characteristics reflects changes in environmental conditions on Newnes Plateau rather than impacts from mining.

Table 14. 2017 Spring Habitat Characteristics

% Cover	SV2	SV3	SV4	SV5	AP3	Mean
Tree	32	12	24	12	24	21
Tall shrub	8	48	36	36	24	30
Tall sapling	12	8	8	4	4	7
Low shrub	100	84	76	80	72	82
Low sapling	36	12	4	4	4	12
Fern	12	56	76	88	88	64
Cutting grass	44	44	24	52	28	38
Grass	48	56	16	0	16	27
Forb	76	36	48	16	16	38
Vine	0	4	8	0	4	3

% Cover	SV2	SV3	SV4	SV5	AP3	Mean
Reed (sedge)	4	64	32	72	44	43
Litter	100	100	100	100	100	100
Log	44	12	48	12	8	25
Rock	20	16	0	0	0	7
Tree hollow	4	0	0	8	4	3

Habitat complexity scores are used to provide an index of habitat complexity that can be used to determine changes in habitats over time. The system scores the following parameters: tree cover, tall and short shrub cover, ground cover, logs/rocks and litter cover. The scores range from 0 to 3, hence the maximum score is 18. Spring habitat complexity scores for monitoring sites over time are provided in Table 15. Tracking habitat complexity scores over time provides insight into changes in habitat value.

The scores indicate moderate habitat complexity. Habitat Complexity Scores differed significantly over the years (Two-way Repeated Measures ANOVA, p=0.007), but not with mining impact. Scores in 2014 were significantly lower than those from 2008 to 2012 and 2017, but not to other years. Again this suggests variation in habitat complexity reflects changing environmental conditions across Newnes Plateau rather than mining impacts. 2017 has seen a recovery from the low scores in 2014. These scores show that all sites still provide good habitat for ground-dwelling mammals and woodland birds.

Table 15. Spring Habitat Complexity Scores for Monitoring Sites over Time

Site	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
SV2	16	17	13	15	14	15	-	16	15	14
SV3	14	15	15	14	14	14	10	13	13	14
SV4	14	15	16	16	16	15	12	14	13	15
SV5	-	-	-	-	-	-	9	11	12	13
AP3	15	14	14	14	14	13	12	13	12	13
Overall mean	14.8	15.3	14.5	14.8	14.5	14.3	10.8	13.4	13.0	13.8

Biodiversity

Seven threatened species were located (Gang-gang Cockatoo, Scarlet Robin, Flame Robin, Eastern Pygmy-possum, Greater Glider, Yellow-bellied Sheath-tailed Bat and Eastern Bentwing Bat), as well several bird species dependent upon woodland habitats. Biodiversity indices are provided in Table 16.

Table 16. Spring 2017 Biodiversity Indices for Fauna in Springvale SMP Area

Fauna Group	Evenness	Simpson's Index of Diversity	Abundance	Species Richness
Birds	0.83	0.94	955	54
Native Mammals (non-bat)	0.90	0.88	48	11
Reptiles	0.92	0.90	23	10

Overall, the biodiversity indices are similar to that found elsewhere in Newnes Plateau and indicate a representative base-line sample to be used for on-going monitoring.

6.6. Flora Monitoring Program

Flora Monitoring sites in the 2009 EMP and 2015 EMP are listed in Table 17.

Table 17. Flora Monitoring Sites

Monitoring Site	Description	Site in 2009 EMP?	Site in 2015 EMP?
NP07	Sunnyside West Heath	Yes	No
KC01	Kangaroo Creek Swamp	Yes	No
KC02	Kangaroo Creek Swamp	Yes	No
NO005	Junction Swamp	Yes	No
NP006	Junction Swamp	Yes	No
WE01	Sunnyside Swamp	Yes	No
WE02	Sunnyside Swamp	Yes	No
CLA03	Prickly Swamp	Yes	No
CLA04	Prickly Swamp	Yes	No
WC01	Carne West Swamp	Yes	Yes
WC02	Carne West Swamp	Yes	Yes
WC03	Carne West Swamp	Yes	Yes
WC04	Carne West Swamp	Yes	Yes
SSE01	Sunnyside East	No	Yes
TG01	Twin Gully	No	Yes
TG02	Twin Gully	No	Yes
TRI01	Tristar	No	Yes
TRI02	Tristar	No	Yes
LGG01	Lower Gang Gang Swamp	No	Yes
UGE01	Upper Gang Gang East Swamp	No	Yes
BS01	Barrier Swamp	No	Yes
CCS01	Carne Central Swamp	No	Yes

The following parameters are measured at each quadrate during the monitoring period:

- Species Composition Cover/abundance;
- Condition of Swamps and associated vegetation;
- Plant species diversity;
- Discussion on comparative monitoring results; and
- Indicator species including eucalypts, sphagnum cristatum.

Monitoring is carried out in summer, autumn, winter and spring.

The following sections summarises results from the Spring 2017 monitoring results report.

THPSS MMP Sites

6.6.1. Native Species Diversity

A modified Braun-Blanquet scale was used to visually estimate cover abundance for species occurring within each site.

Total native plant species richness for impact and reference sites is shown in Table 18. Results from the quadrat (400 m^2) and four 20 m transects are tabulated for comparison between sampling methods and reference/impact sites.

Table 18. Total native plant species richness and Shannon Wiener Index with eveness

Site	Species Richness		Shannon-Wiener Index (point intercept method)	Evenness
	400m^2 Quadrat	Point Intercept Method		
Impact sites				
WC01	13	12	1.87	0.75
WC02	**12**	10	1.74	0.76
WC03	14	12	1.95	0.76
WC04	12	12	2.01	0.81
SSE01	22	10	1.99	0.83
Mean±SD	14.6 ± 1.7	11.2 ± 0.4		
Reference sites				
TG01	20	20	2.22	0.74
TG02	**17**	16	2.17	0.78
TRI01	**20**	18	2.27	0.79
TRI02	33	17	1.98	0.70
BS01	20	16	2.16	0.78
CCS01	27	23	2.31	0.74
Mean±SD	22.8 ± 2.2	18.3 ± 1.0		
Reference sites excluded from analysis				
LGG01	32	25	2.41	0.75
UGE01	28	18	2.13	0.74

Species richness at most sites was below the baseline means. Mean species richness using the point intercept method was lower at impact sites (11.2 ± 0.4) than reference sites (18.3 ± 1.0). A similar difference was found within 400m2 quadrats where species richness at impact sites (14.6 ± 1.7) was lower than reference sites (22.8 ± 2.2). A trigger for species richness is reported for WC02 and represents a repeat trigger within 12 months. Two trigger level observations were also recorded for a reference sites (TG02 and TRI01).

The continued exceedance of the trigger level at reference site TRI01 is predominantly related to the lack of detection of graminoid species previously identified. These species can be cryptic during non-flowering periods making detection unreliable during non-flowering seasons, such as winter. Conversely, the exceedance of the trigger level at reference site TRI02 is likely a function of terrestrial dry species being observed within the fringes of the monitoring plot. The reasons for this are not yet known.

6.6.2. Eucalypt Recruitment

Non-swamp eucalypt presence was estimated by summing incidence recorded in each 0.5 m x 0.5 m quadrat centred on sequential 1 metre intervals along each of the four parallel transects. This provided a total of approximately 80 quantitative measurements of eucalypt presence per monitoring quadrat.

Eucalypt recruitment over seasonal monitoring is shown in Table 19 below.

Table 19. Eucalypt Recruitment over Time

Site	Seasons				
	Spring '16	Summer '16/'17	Autumn '16	Winter '17	Spring '17
Impact					
WC01	-	-	-	-	-
WC02	-	-	-	-	-
WC03	-	-	-	-	2
WC04	-	1	-	-	-
SSE01	1	**3**	**1**	**2**	**2**
Reference					
TG01	-	1	-	1	-
TG02	-	-	-	-	-
TRI01	-	1	-	-	-
TRI02	1	1	**1**	**1**	-
BS01	-	-	-	-	-
CCS01	-	-	-	-	-
Reference sites excluded from analysis					
LGG01	2	1	**2**	**2**	**-**
UGE01	-	-	-	-	-

Continued eucalypt recruitment above trigger thresholds was observed in SSE01 (an impact site). No continued triggers occurred in reference swamp TRI02 and the excluded site LGG01. Eucalypt recruitment below trigger thresholds was noted for the first time in WC04 (i.e. summer 2016/17), with no re-occurrence of this observation in the proceeding 2017 monitoring events. Eucalyptus count data for transects was pooled for each monitoring site as the occurrences were not high enough to warrant displaying the values separately.

6.6.3. Species Condition Scores

Four parallel transects were established to measure species condition scores. The starting points of these transects were positioned randomly along a predetermined edge of the 400 m^2 permanent monitoring quadrat. A condition score was estimated for each plant species intersected every 0.5 m along the transects.

Overall mean species condition scores for impact and reference sites are shown in Table 20.

Table 20. Mean Species Condition Scores for the current and previous four monitoring rounds

Site	Mean Condition for all Species				
	Spring 2016	**Summer 2016/2017**	**Autumn 2017**	**Winter 2017**	**Spring 2017**
Impact					
WC01	3.6	**2.6**	3.5	2.4	2.3
WC02	2.9	**2.7**	3.7	2.5	2.6
WC03	3.5	2.8	3.2	2.4	2.3
WC04	3.4	3.0	3.6	2.5	2.0
SSE01	4.2	3.3	4.5	3.6	3.2
Mean condition	-	-	3.7	2.7	2.5
Reference					
TG01	4.3	4.5	4.5	3.5	3.4
TG02	4.2	4.2	4.3	3.4	3.6
TRI01	4.2	4.5	4.5	3.9	3.3
TRI02	2.9	4.5	4.5	4.1	3.2
BS01	4.1	3.7	4.2	3.4	3.3
CCS01	4.3	3.5	4.1	3.4	2.9
Mean condition	-	-	4.4	3.6	3.2
Reference sites excluded from analysis					
LGG01	4.3	4.5	4.4	3.5	3.3
UGE01	4.0	3.9	4.2	2.9	2.7

'All species' mean condition score for impact sites was 2.5 (range 2.0 – 3.2) compared with 3.2 at reference sites (range 2.9 – 3.6). No impact sites were below the 'all species' condition threshold. However, one impact site in West Carne (WC04) had a repeat condition trigger threshold for the important swamp species *Gleichenia dicarpa* and *Baumea rubiginosa*. Triggers have previously occurred within all the West Carne monitoring locations over the previous twelve months for the chosen important swamp species conditions.

No further species conditions are presented here as the chosen species occur in most sites at reasonably high frequencies and are considered amphibious species. The condition trigger at UGE01 for *Gleichenia dicarpa* in autumn 2017 has not continued; however, the condition is still relatively low. Furthermore, the site is no longer used for analysis as long wall mining has progressed into the area of the swamp.

6.6.4. Non Live Ground Cover

Bare earth scoring was estimated at each of the 0.5 m intervals inspected for species condition.

Percent of non-live ground cover was estimated using both the Braun-Blanquet cover abundance scale for the entire 400 m^2 quadrat and the point intercept method.

Results are tabulated in Table 21. An increase of 25% or greater represents a greater than 100m_2 increase in non-live cover.

Table 21. Non-live ground cover (cover abundance and point intercept methods)

Site	Non-live ground cover (%) Spring 2016	Non-live ground cover (%) Summer 2016/2017	Non-live ground cover (%) Autumn 2017	Non-live ground cover (%) Winter 2017	Non-live ground cover (%) Spring 2017	% Change between Spring 2016 and 2017
Impact Sites						
WC01	0	3.75	15	5.625	1.875	1.874
WC02	0	2.5	10	4.375	0	0
WC03	12.5	8.125	21.875	6.25	8.75	-3.75
WC04	28.8	8.125	**37.5**	5	11.25	-17.55
SSE01	5.6	4.375	6.875	0	3.125	2.475
Reference Sites						
TG01	8.1	0.625	4.375	2.5	0.625	-7.475
TG02	3.1	0.625	0.625	3.75	0	-3.1
TRI01	0	0.625	0	0.625	0	0
TRI02	0	0.625	0	0	3.75	3.75
BS01	1.3	0.625	0	1.25	0	-1.3
CCS01	0	0.625	0	0	5	5
Reference Sites excluded from analysis						
LGG01	0	7.5	16	0.625	1.25	1.25
UGE01	2.3	10	6.875	3.75	5	2.7

The trigger criterion for non-live ground cover requires an increase of bare ground of more than 100m$_2$ over a three-year period. Consequently, the performance criterion for non-live ground cover was not triggered in the spring 2017 monitoring period. One recurring trigger was recorded during the autumn 2017 monitoring event; however, the trigger has not continued subsequently and no further investigation has occurred.

6.6.5. Establishment of Non-native Weeds

The results this monitoring event indicates a weed free status for all sites. This is consistent with results from each monitoring event in 2017.

SEMP Sites

The results for the previous three seasons on SEMP monitoring are provided in the sections below. The requirement for the SEMP monitoring is currently under review. Longwall mining has progressed well beyond the extent of the monitoring program and confounded the independent reference sites. The following results are provided for compliance, understanding the results cannot be used to determine impacts and triggers as intended. Data for sites KC01, KC02, CLA03 and CLA04 was not collected for spring 2017.

6.6.6. Species Richness

Table 22 reports the species richness observed for all SEMP monitoring plots.

Table 22. Native plant species richness in SEMP sites

Site	Summer 2016/2017	Autumn 2017	Spring 2017
NP007	23	21	24
KC01	-	17	-
KC02	20	22	-
NP005	23	28	35
NP006	18	19	21
SS01	25	20	23
SS02	19	18	20
WC01	11	13	13
WC02	11	14	12
WC03	11	13	14
WC04	14	13	12
CLA03	28	36	-
CLA04	22	25	-

6.6.1. Eucalypt Recruitment

No increase in eucalypt recruitment was detected in any of the SEMP sites for the 2017 survey periods.

6.6.1. Species Condition Score

Table 23 reports the average condition for all species observed in SEMP monitoring plots.

Table 23. Average condition for all species in SEMP sites

Site	Summer 2016/2017	Autumn 2017	Spring 2017
NP007	3.7	3.7	4.0
KC01	4.6	4.4	-
KC02	4.7	3.8	-
NP005	4.7	3.8	4.0
NP006	4.4	3.5	3.3
SS01	4.2	3.5	3.5
SS02	4.5	3.4	3.7
WC01	2.6	3.8	2.8
WC02	2.7	3.9	3.3
WC03	2.8	3.7	3
WC04	3.0	3.1	2.6
CLA03	4.0	4.8	-
CLA04	4.1	4.8	-

6.6.1. Non-live ground cover

No detectable change in non-live groundcover has been observed in the SEMP monitoring sites since 2013, the extent of data available.

6.6.1. Exotic Plant Species

One monitoring site was observed to contain an exotic plant species within this monitoring period. Cats Ear (*Hypochaeris radiata*) was observed at NP005 first in summer 2016/17 and again in the current survey. The species has been identified in KC01 in summer 2016/17 and autumn 2017 monitoring as well. Incidence was relatively low and has remained stable for over two years in KC01.

6.6.2. Conclusions

Monitoring results were compared with the flora trigger levels specified in the THPSS MMP. The results of this comparison are provided in Table 24.

Table 24. Monitoring results and flora trigger levels

Performance indicator	Parameter measured	Trigger level	Spring 2017
Change in species assemblage	Change in diversity of native species	A change in the number of species of greater than 30 % for a given site within a three year period.	One impact site (WC02) had a repeat trigger for species richness. Two reference sites were also below the 30% lower threshold (TG02 & TRI01).
	Recruitment of eucalypt species	An increase in eucalypts in an impact site compared to reference sites of more than three individual plants within a one year period.	One impact sites (SSE01) has displayed a repeat trigger for eucalypt recruitment.
Change in condition	Condition of key species	A decline in condition score at an impact site of more than 1.5 compared to the average condition score at reference sites within a one year period.	One impact site (WC04) showed a repeat trigger for decrease in condition beyond the trigger level for *Gleichenia dicarpa* and *Baumea rubiginosa*.
	Non-live ground cover	An increase of bare ground of more than 100m^2 in a site within a three year period.	No sites triggered in spring 2017.
	Non-native weeds	An increase in non-native weed species of more than 4 in a monitoring site (each having a cover of greater than 5%) compared to the average number in reference sites within a one year period.	No impact sites showed an increase in weed species beyond the trigger level.

Reoccurring triggers in native species diversity occurred within West Carne Swamp (WC02). Regular triggers have been recorded for this measure in West Carne Swamp throughout the previous twelve months as well as in the previous year. The persistence of the trigger at WC02 is expected and is likely a result of swamp drying.

One continued trigger occurred in an impact site (SSE01) for an increase in Eucalypt seedling detection within a one year period. This trigger represents a steady state for the site with no large increases detected and no real change in state. A previous investigation has been conducted in Sunnyside Swamp East as a result of a previous trigger and concluded the increase in eucalypt detection was likely due to the persistent dry and hot conditions that were prevailing at the time, combined with the geomorphology and the prevalence of overhanging eucalypt trees.

Continued trigger exceedances were detected at an impact site (WC02) for *Gleichenia dicarpa* and *Baumea rubiginosa*. The decrease in condition likely reflects the continued effect of a recent drop in groundwater levels that otherwise sustains swamp vegetation. Uncharacteristic weather conditions over the past 12 months may also have negatively influenced vegetation condition, as a steady decline in condition across all species as well as for the chosen important swamp species has occurred from autumn 2017 to the current monitoring period.

No new notifications are required as a result of the Spring 2017 flora monitoring.

6.7. Photo-monitoring

6.7.1. Surface Features

Photographic inspections are conducted pre and post mining. The surveys target surface features which may include rock formations, drainage lines, roads, Forests NSW tracks, waterholes, steep slopes and rock beds within the watercourses.

Table 25 summarises the photographic survey monitoring undertaken as relevant to Longwall 418 extraction.

Table 25. Longwall 418 Photographic Monitoring Summary

Area Photographed	Date Photographed	Resurvey Number
LW418 Areas 1,2, (Pre-mining)	2/2/2014 and 4/4/2014	Baseline Survey
LW418 Areas 1,2, (Pre-mining)	20/8/2014 and 29/8/2014	Resurvey 2*
LW 418 Areas 1, 2 (Pre-mining)	25/2/2015 and 26/2/2015	Resurvey 3
LW418 Areas 1, 2,	6/8/2015	Resurvey 4
LW418 Undermining	23/10/2015	Resurvey 5
LW418 Undermining 1	11/11/2015	Resurvey 6
LW418 Area 1 Undermining	21/12/2015	Resurvey 7
LW418 Undermining	27/01/2016	Resurvey 8
LW418 Undermined	10/02/2016	Resurvey 9
LW418 Undermined	8/3/2016	Resurvey 10
LW418 Undermined	6//04/2016	Resurvey 11
LW418 Areas 1, 2	6//04/2016	Resurvey 12
LW418 Undermined	10+11/05/2016	Resurvey 13
LW418 Undermined	3/06/2016	Resurvey 14
LW418 End of Panel	15/7/2016	End of Panel

* Second survey

Photos from the last survey of the features are presented in Table 26.

Table 26. Comparison of Key Surface Features above Longwall 418

Sunnyside East Swamp	
Baseline survey	End of Panel
	
LW418-2_Photo 033_2014_Feb04_IMG 033	LW418-2_Photo 033_2016_Jul15_IMGP0005
Carne West Swamp	
Baseline survey	End of Panel
	
LW418-1_Photo 046_2014_Feb02_IMG 0050	LW418-1_Photo 046_2016_Jul15_IMGP0052

Tracks	
Baseline survey	End of Panel
	
LW418-1_Photo 004_2014_Feb02_IMG 0004	LW418-1_Photo 004_2016_Jul15_IMGP0063
Rock Feature	
Baseline	End of Panel
	
LW418-1_Photo 037_2014_Feb02_IMG 0041	LW418-1_Photo 037_2016_Jul15_IMGP0099

Subsidence Lines	
Baseline	End of Panel
	
LW418-2_Photo 043_2014_Feb04_IMG 043	LW418-2_Photo 043_2016_Jul15_IMGP0014

Photos are considered consistent with previous photographic records.

6.7.2. Newnes Plateau Shrub Swamps

Photographic monitoring sites have been established for each swamp overlying the SMP area.

Relevant to the extraction of Longwall 417 and 418 is Sunnyside East Swamp.

Table 27 summarises the photographic survey monitoring undertaken in reference to Sunnyside East Swamp.

Table 27. Sunnyside East Swamp photographic Monitoring Summary

Date Photographed	Resurvey Number
14/4/2009	Baseline
28-30/10/2009	Resurvey 1
21/5/2010	Resurvey 2
17/11/2010	Resurvey 3
24/5/2011	Resurvey 4
24/1/2012	Resurvey 5
25/7/2012	Resurvey 6
25/1/2013	Resurvey 7
3/4/2013	Resurvey 8
20/6/2013	Resurvey 9
19/9/2013	Resurvey 10
3/12/2013	Resurvey 11
15/1/2014	Resurvey 12
14/3/2014	Resurvey 13
22/4/2014	Resurvey 14
22/7/2014	Resurvey 15
27/10/2014	Resurvey 16
19/1/2015	Resurvey 17
16/4/2015	Resurvey 18
6/7/2015	Resurvey 19
2/10/2015	Resurvey 20
28/01/2016	Resurvey 21
4/4/2016	Resurvey 22

Date Photographed	Resurvey Number
19/07/2016	Resurvey 23
26/10/2016	Resurvey 24
23/01/2017	Resurvey 25
26/04/2017	Resurvey 26
11/07/2017	Resurvey 27
10/10/2017	Resurvey 28
25/01/2018	Resurvey 29

The following images compare baseline to the last survey undertaken. The monitoring tool is used as a visual tool and data collected is used in combination with other monitoring methodology e.g. flora, groundwater, climatic data to assist in interpretation.

Photos from the last survey of the features are presented in Table 28.

Table 28. Comparison of Sunnyside East Swamp Photographic Monitoring

Baseline	Resurvey 29
 Photo_003_2009_0414Image0049	 SSES_Photo 003_2018_Jan 25_IMGP0008

Baseline	Resurvey 29
 Photo_006_2009_0414Image0052	 SSES_Photo 006_2018_Jan 25_IMGP0011
 Photo_022_2009_0414ImageSSE_Stitch2	 SSES_Photo 022_2018_Jan 25_IMGP0065-66
 Photo_067_2009_0414Image2407	 SSES_Photo 067_2018_Jan 25_IMGP0032

Baseline	Resurvey 29
	
Photo_073_2009_0414Image0104	SSES_Photo 073_2018_Jan 25_IMGP0021

Photos are considered consistent with previous photographic records.

Table 29 summarises the photographic survey monitoring undertaken in reference to Carne West Swamp.

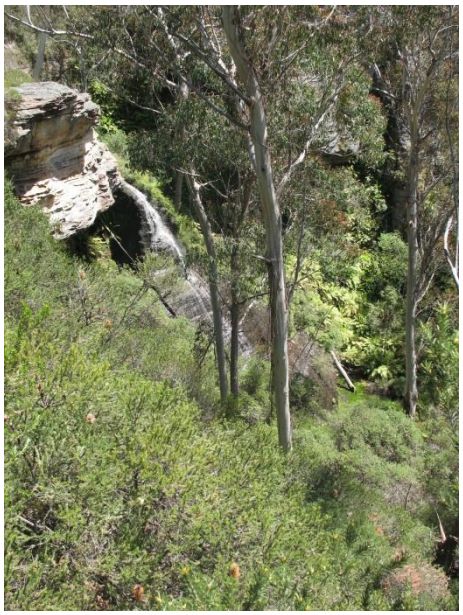
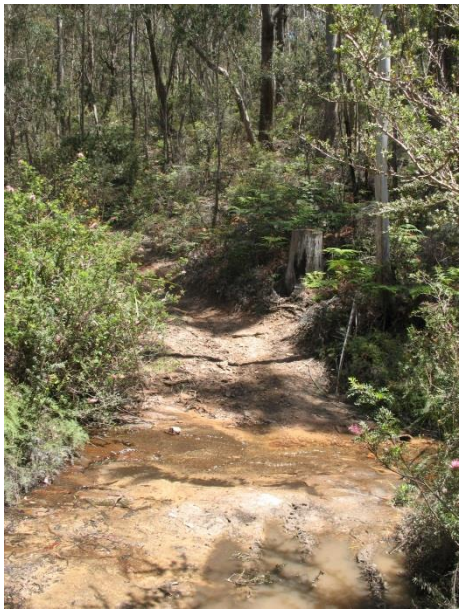
Table 29. Carne West Swamp photographic Monitoring Summary

Date Photographed	Resurvey Number
24/11/2008	Baseline
22/12/2009	Resurvey 1
25/6/2010	Resurvey 2
25/3/2011	Resurvey 3
3/6/2011	Resurvey 4
25/10/2011	Resurvey 5
3/4/2012	Resurvey 6
30/10/2012	Resurvey 7
30/4/2013	Resurvey 8
11/12/2013	Resurvey 9
23/4/2014	Resurvey 10
23/7/2014	Resurvey 11
10/10/2014	Resurvey 12
16/1/2015	Resurvey 13
10/4/2015	Resurvey 14
8/7/2015	Resurvey 15
6/10/2015	Resurvey 16
17/01/2016	Resurvey 17
5//04/2016	Resurvey 18
28/7/2016	Resurvey 19
13/10/2016	Resurvey 20
6/1/2017	Resurvey 21
26/04/2017	Resurvey 22
11/07/2017	Resurvey 23
09/10/2017	Resurvey 24
29/01/2018	Resurvey 25

The following images compare baseline to the last survey undertaken. The monitoring tool is used as a visual tool and data collected is used in combination with other monitoring methodology e.g. flora, groundwater, climatic data to assist in interpretation.

Photos from the last survey of the features are presented in Table 30.

Table 30. Comparison of Carne Swamp Photographic Monitoring

Baseline	Resurvey 25
 CWS_Photo_002_2008_1124Image0004	 CWS_Photo 002_2017_July 11_IMGP0001
 CWS_Photo_006_2008_1124Image0006	 CWS_Photo 006_2018_Jan 29_IMGP0037

Baseline	Resurvey 25
 CWS_Photo_013_2008_1124Image0013	 CWS_Photo 013_2018_Jan 29_IMGP0091
 CWS_Photo_020_2008_1124Image0020	 CWS_Photo 020_2018_Jan 29_IMGP0084
 CWS_Photo_048_2008_1124Image0065	 CWS_Photo 048_2017_July 11_IMGP0048

Photos are considered consistent with previous photographic records.

7. ADEQUECY, QUALITY AND EFFECTIVENESS

The adequacy, quality, effectiveness of the implemented management processes based on monitoring and consultation is considered to be satisfactory to date.

There were no non-compliances with the conditions of the SMP approval during the reporting period.

8. PROPOSED MANAGEMENT ACTIONS

There are no outstanding management actions requiring an update.

9. THPSS MMP PERFORMANCE TRIGGERS

No THPSS MMP performance measures were triggered during the reporting period.

10. CONCLUSIONS

Extraction of Longwall 418 commenced on the 22nd of October 2015 and was completed on the 27th of May 2016 with a total retreat of 2487m. The current longwall (421) started on the 19th of December 2017 and chainage at 31st of January 2018 was 1472m.

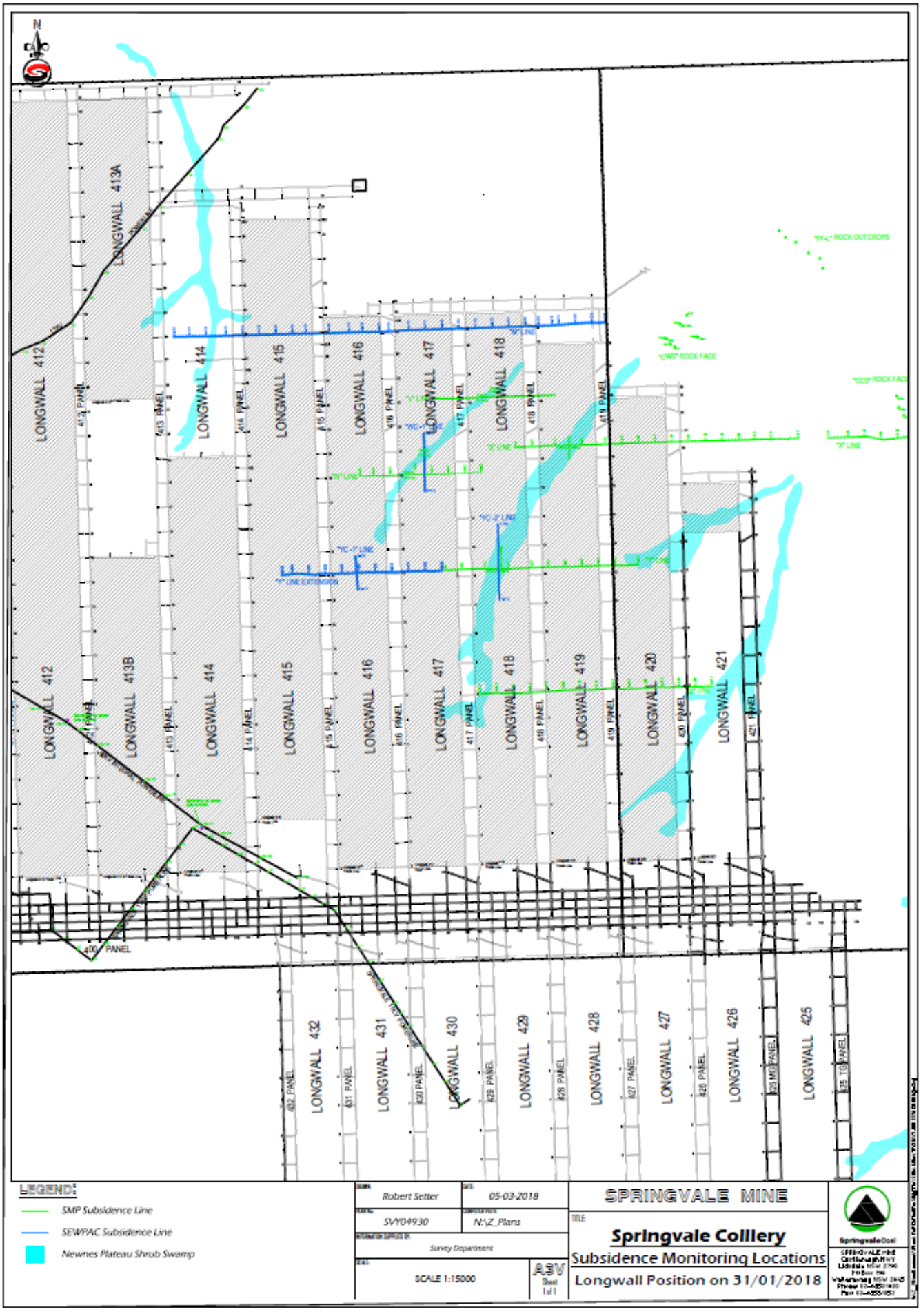
There were no observed subsidence impacts, incidents or service difficulties during the retreat of Longwall 418. Subsidence results have been within predications.

Threatened species continue to be recorded within the SMP Area. Fauna monitoring results show that the assemblages found are typical of that found throughout Newnes Plateau and are similar to that obtained in the remainder of Springvale Colliery.

No THPSS MMP performance measures were triggered during the reporting period.

Centennial Coal
Springvale

Appendix 1
Plans


N
LONGWALL 412
LONGWALL 413A
LONGWALL 413B
LONGWALL 414
LONGWALL 415
LONGWALL 416
LONGWALL 417
LONGWALL 418
LONGWALL 419
LONGWALL 420
LONGWALL 421
LONGWALL 425
LONGWALL 426
LONGWALL 427
LONGWALL 428
LONGWALL 429
LONGWALL 430
LONGWALL 431
LONGWALL 432
400 PANEL
"W" LINE
"X" LINE
"Y" LINE
"YC-2" LINE
"YC-1" LINE
"Y" LINE EXTENSION
"W1" ROCK FACE
"C22" ROCK FACE
"X" LINE
LEGEND:
SMP Subsidence Line
SEWPAC Subsidence Line
Newnes Plateau Shrub Swamp
Robert Setter
05-03-2018
SVY04930
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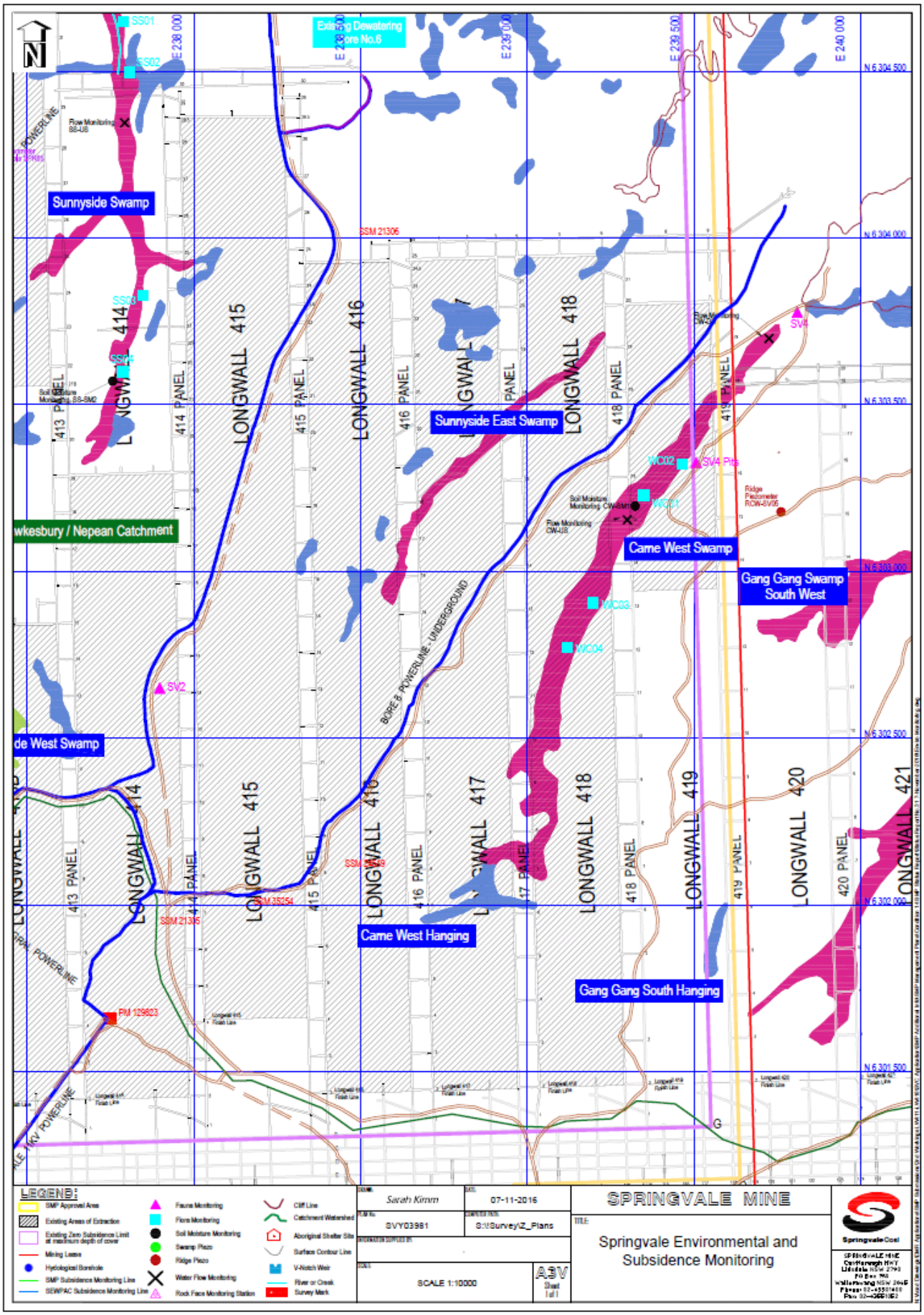
Survey Department
SCALE 1:15000
SPRINGVALE MINE
Springvale Colliery
Subsidence Monitoring Locations
Longwall Position on 31/01/2018


Existing Dewatering Bore No.6
Sunnyside Swamp
Sunnyside East Swamp
Came West Swamp
Gang Gang Swamp South West
Came West Hanging
Gang Gang South Hanging
wkesbury / Nepean Catchment
de West Swamp
LONGWALL 414
LONGWALL 415
LONGWALL 416
LONGWALL 417
LONGWALL 418
LONGWALL 419
LONGWALL 420
LONGWALL 421
413 PANEL
414 PANEL
415 PANEL
416 PANEL
418 PANEL
419 PANEL
420 PANEL
SS01
SS02
SS03
SS04
SV2
SV4
SV4 Pipe
WC01
WC02
WC03
WC04
SSM 21306
SSM 35154
SSM 21385
PM 129823
BORE 6 POWERLINE - UNDERGROUND
POWERLINE
E 238 000
E 238 500
E 239 000
E 239 500
E 240 000
N 6 304 500
N 6 304 000
N 6 303 500
N 6 303 000
N 6 302 500
N 6 302 000
N 6 301 500
LEGEND:
SMP Approval Area
Existing Areas of Extraction
Existing Zero Subsidence Limit at maximum depth of cover
Mining Lease
Hydrological Borehole
SMP Subsidence Monitoring Line
SEWPAC Subsidence Monitoring Line
Fauna Monitoring
Flora Monitoring
Soil Moisture Monitoring
Swamp Piezo
Ridge Piezo
Water Flow Monitoring
Rock Face Monitoring Station
Cliff Line
Catchment Watershed
Aboriginal Shelter Site
Surface Contour Line
V-Notch Weir
River or Creek
Survey Mark
Sarah Kirwin
07-11-2016
SVY03981
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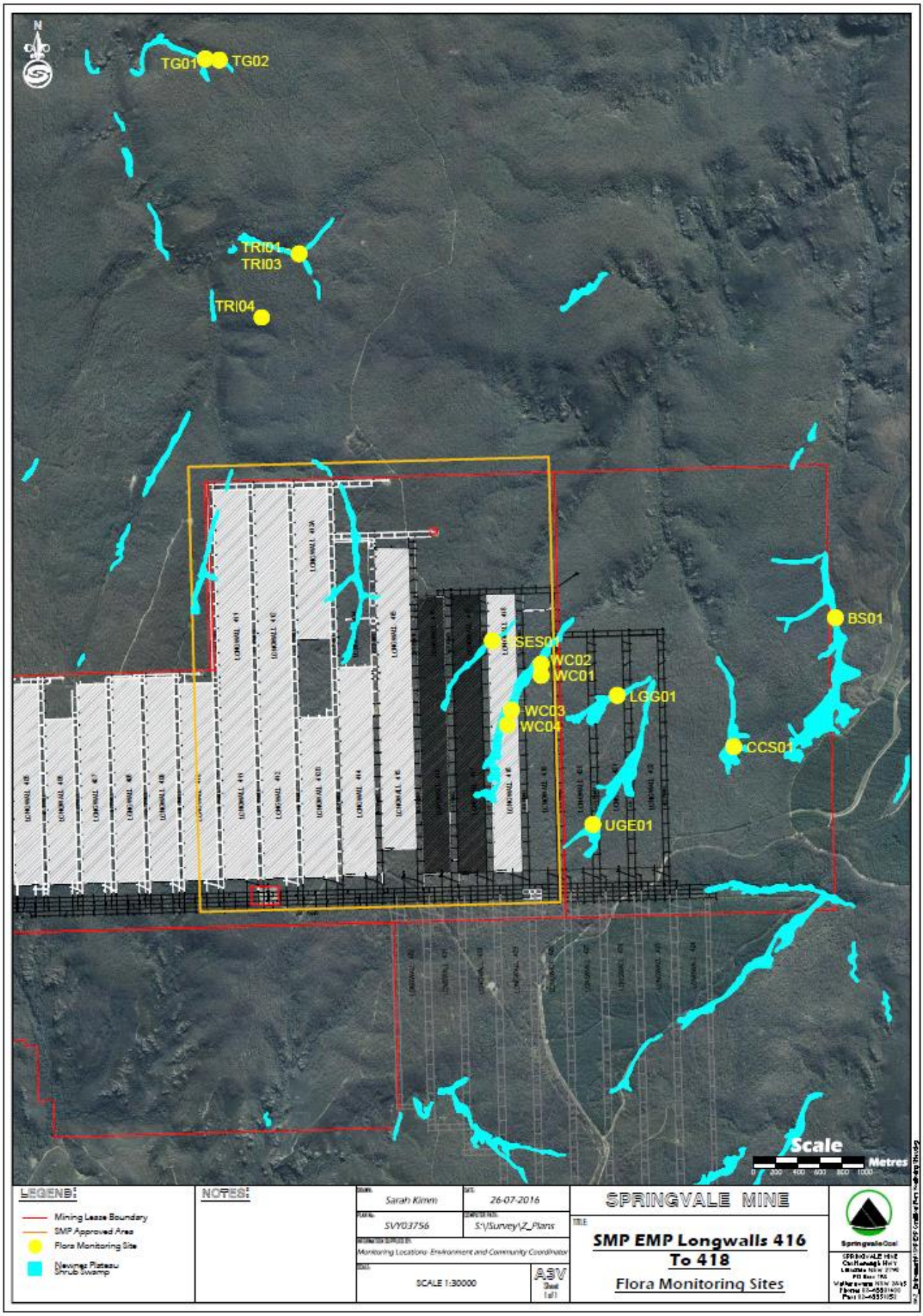
Sheet 1 of 1
SPRINGVALE MINE
Springvale Environmental and Subsidence Monitoring
Springvale Coal


TG01
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TRI03
TRI04
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WC02
WC01
WC03
WC04
LGG01
BS01
CCS01
UGE01
Scale
Metres
LEGEND:
Mining Lease Boundary
SMP Approved Area
Flora Monitoring Site
Newnes Plateau Shrub Swamp
NOTES:
Sarah Kimm
26-07-2016
SVY03756
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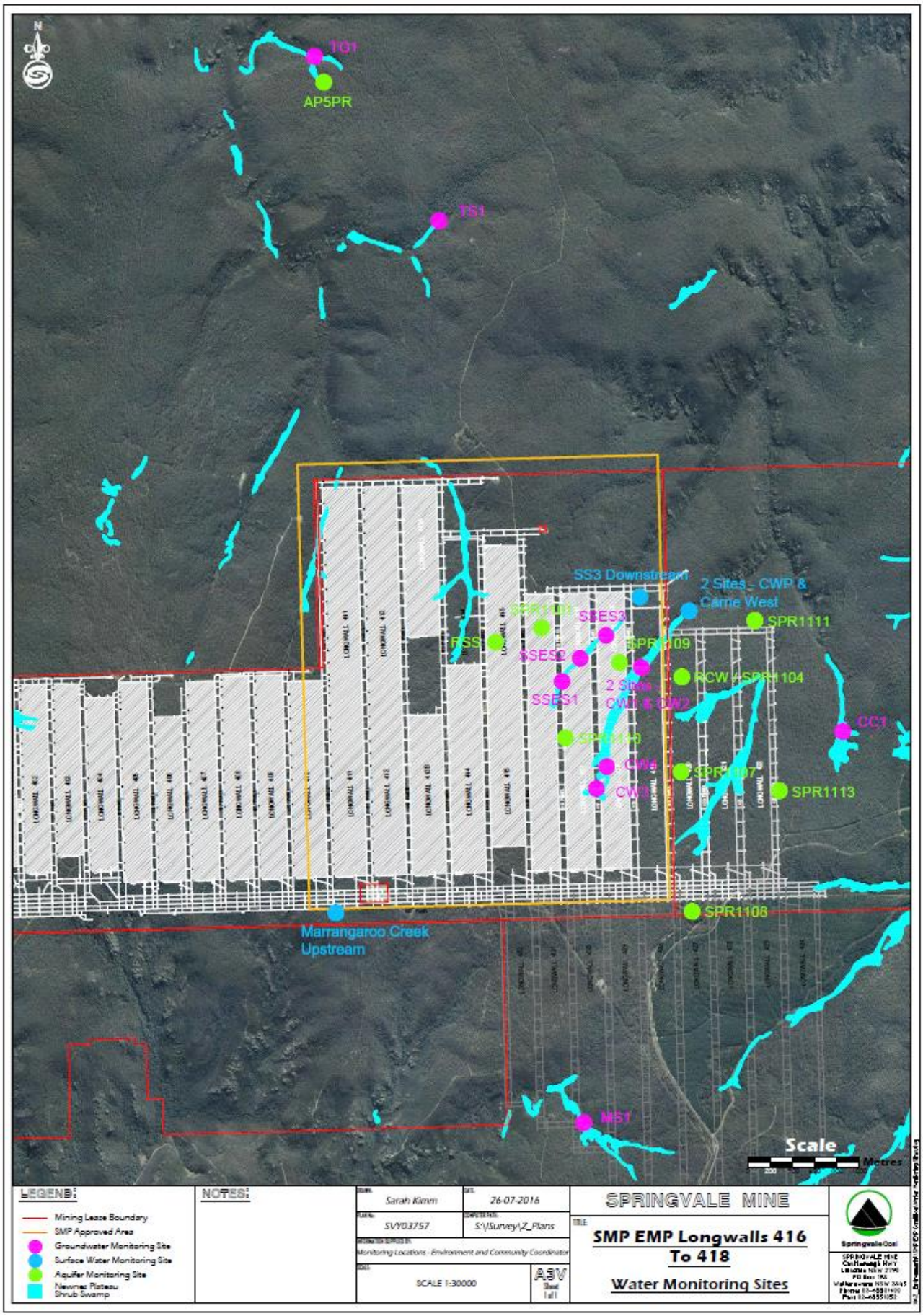
SMP EMP Longwalls 416 To 418
Flora Monitoring Sites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TS1
SS3 Downstream
2 Sites - CWP & Carrie West
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SSES3
SPR1109
SSES2
RCW / SPR1104
SSES1
2 Sites - CWP1 & CWP2
CC1
CWP4
SPR1107
SPR1113
CWP3
SPR1108
Marrangaroo Creek Upstream
MS1
Scale
Metres
LEGEND:
Mining Lease Boundary
SMP Approved Area
Groundwater Monitoring Site
Surface Water Monitoring Site
Aquifer Monitoring Site
Newnes Plateau Shrub Swamp
NOTES:
Sarah Kimm
26-07-2016
SVY03757
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Monitoring Locations - Environment and Community Coordinator
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A3V
SPRINGVALE MINE
SMP EMP Longwalls 416 To 418
Water Monitoring Sites
SpringvaleCoal

Centennial Coal

Springvale Colliery

Castlereagh Highway

Lidsdale NSW 2790