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Dear Keith

INTEGRA UNDERGROUND: LONGWALL 15 BI-MONTHLY SUBSIDENCE REPORT FOR **FEBRUARY AND MARCH 2020**

HV Coking Coal Pty Ltd (HVCC) are currently mining Longwall 15 in the Middle Liddell (ML) Seam at the Integra Underground (IUG) Mine near Camberwell, 12km northwest of Singleton in the Hunter Valley of NSW. The approved Extraction Plan (EP) for Longwalls 15 and 16 requires IUG to monitor and report subsidence impacts on a bi-monthly, six-monthly and annual basis. HVCC commissioned SCT Operations Pty Ltd (SCT) to review and analyse the subsidence monitoring conducted and prepare reports suitable for submission to the Department of Planning, Industry and Environment (DPIE) and the Resources Regulator, if required. This report presents the results of our review and analysis of subsidence monitoring for the mining in Longwall 15 during February and March 2020.

Our review indicates:

- No significant subsidence impacts to natural or built features have been • observed.
- Subsidence effects at the Mt Owen Railway Line/Bettys Creek bridges • and associated infrastructure have been generally consistent than those predicted in the asset management plan for this infrastructure. Subsidence impacts have been minor and have been effectively managed by the Technical Committee to maintain this infrastructure in a safe and serviceable condition.
- No significant subsidence effects or impacts to the Mt Owen North Pit open cut mining operations have been recorded.

Minor subsidence impacts recorded from the mining of Longwall 15 during this reporting period are consistent with or less than expectations presented in SCT Report INT4852 - "Integra Underground Mine: Subsidence Assessment for LW15 and LW16 Extraction Plan" (SCT 2018).

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Our review considers the available monitoring data for February and March 2020 including:

- Weekly inspections for subsidence impacts from Longwall 15 conducted by IUG personnel during the two-month period in accordance with the IUG Subsidence Monitoring Program in the Longwalls 15 and 16 Extraction Plan.
- Subsidence reports by Mine Subsidence Engineering Consultants Pty Ltd (MSEC) for the monitoring and management of subsidence impacts to the Mt Owen Railway Line, Bettys Creek bridges and associated infrastructure.
- Survey monitoring and observations of subsidence effects and impacts from longwall mining by the Geotechnical Engineer at Mt Owen North Pit.

On this basis, the observed subsidence effects and impacts are considered compliant with the performance indicators and subsidence performance measures for the EP required under modified IUG Project Approval (PA08_0101) however, it should be recognised that assessment of compliance requires input from other specialists.

1. BACKGROUND AND SITE DESCRIPTION

Consent for the current mining of Longwalls 15 and 16 in the ML Seam at IUG is provided by Modification 8 (MOD8) to Project Approval (PA) 08_0101 for the Integra Underground Project. As required by PA08_0101, the Extraction Plan for Longwalls 15 and 16, with supporting subsidence management plans for natural and built features, was approved in August 2019.

Figure 1 shows the longwall mining areas, superimposed onto a Google Earth image of the surface from August 2018 (the Mt Owen - North Pit has not extended over the extracted longwall panels since this time). This figure is a copy of Figure 4 from SCT (2018) amended to show the completed mining in Longwall 14 and the mining in Longwall 15, during the bi-monthly reporting periods, up to the end of March 2020.

Longwall 15 commenced production on 19 September 2019 at CH1825m.

During the February and March 2020 reporting period, Longwall 15 mined from CH917m to approximately CH162m, a total of 755m. This distance represents a significant increase in longwall retreat rate compared to previous monitoring periods.

At the end of March 2020, the void length for Longwall 15, including the 9m installation roadway width, was approximately 1672m.

The void width for Longwall 15 is 257m.



Figure 1: Locations of surface features and Bi-monthly mining areas.

The overburden thickness is approximately 500m at the start line of Longwall 15 and is approximately 450m, including 25m of waste rock fill material, at the face position as of the end of March 2020.

Longwall 15 has now retreated almost 1700m. Full caving and subsidence movements over Longwall 15 void area and the adjacent Longwall 14-15 chain pillar are expected to be developing by this stage of mining.

The surface above Longwall 15 comprises areas modified by surface mining and items of mining related infrastructure. Natural features are limited to small sections of native and planted vegetation adjacent to the remaining upper reaches of the Bettys Creek middle diversion channel (MDC), small farm dams and the natural ground along the Mt Owen Railway Line corridor.

A section of open void and capped portion of the ERP, a section of the Mt Owen Railway Line with associated infrastructure and parts of the open void and filled portion of the Mt Owen Stage 5 Tailing Dam (also known as TP2) are located above Longwall 15. Sections of the rehabilitated Mt Owen West Dump and Ravensworth East/Glendell emplacement areas are located above the area to be mined by Longwall 15. Sections of the surface water management installations including the eastern storm water dam for the West Dump and ERP sediment dam with associated pumping and power supply equipment are located above Longwall 15. Water supply and transfer pipelines, an overhead powerline, gas drainage boreholes and related equipment associated with IUG, are also located above or cross the surface above Longwall 15.

Other natural or built features within the EP Assessment Area for Longwalls 15 and 16, but generally above the area mined by Longwall 14, include natural dams (ponds), minor drainage lines, Aboriginal and historical (European) heritage sites, survey control stations, the natural section of Bettys Creek and adjacent floodplain, and an area of natural land set aside as the Bettys Creek Habitat Management Area (BCHMA). The rail and road bridges over Bettys Creek are positioned between Longwalls 13 and 14.

During February and March 2020, Longwall 15 mined below:

- A section of the ERP. This includes a part of the open void, a filled area and part of the exposed western high wall.
- A section of the causeway formed in the natural ground surface between the ERP and TP2 excavations.
- A section of the Mt Owen Railway Line and associated infrastructure.
- A section of the open void and filled area of TP2. The open void is used for water storage and treatment and includes a section of the exposed eastern highwall. The filled section of TP2 is largely a waste rock emplacement area that is rehabilitated and joined to the rehabilitated area of the Ravensworth East/Glendell emplacement.
- Surface infrastructure including an overhead powerline, water supply and water transfer pipelines and pumping installations as part of the surface water management system for the site.
- Gas drainage installations and equipment.
- Other minor built features such as access roads and four-wheel drive tracks.

As at the end of March 2020, the Longwall 15 face line was below the Ravensworth East/Glendell emplacement area with 162m left to mine to the end of this panel.

2. MONITORING AND REVIEW

The Subsidence Monitoring Programs for Longwalls 15 and 16 require a minimum of weekly visual inspections for the various surface features above and in the vicinity of these panels. IUG personnel reported no significant subsidence impacts from the mining in Longwall 15 in the weekly inspections during February and March 2020.

No significant subsidence impacts from longwall mining have been reported to:

- the ERP
- the causeway
- the Mt Owen Railway Line and associated infrastructure including the rail embankment
- TP2
- Ravensworth East/Glendell emplacement area
- surface infrastructure and built features
- gas drainage equipment.

Minor subsidence impacts have been reported from Longwall 15. These impacts are less than and consistent with expectations presented in SCT (2018).

Changes to the landform such as minor ponding after rainfall, minor holes from settlement in emplacement areas and areas of erosion have been reported.

However, these are unlikely to be directly related to subsidence from longwall mining. These changes were reported in areas in advance of the Longwall 15 face line. The ponding may have increased slightly after the passage of Longwall 15, but this is not considered significant or out of character with the landform and land use.

Ongoing monitoring and management of subsidence impacts to the Mt Owen Railway Line, Bettys Creek bridges and associated infrastructure has continued during the reporting period.

Summaries from MSEC reports for the mining of Longwall 15 during this reporting period, are included in Appendix 1. Monitoring, inspections, reporting and meetings of the Technical Committee continued during this reporting period with weekly surveys and other inspections undertaken consistent with the asset management plan for this infrastructure.

Subsidence effects for ground movements, rail geometries and rail status have been generally consistent with the low values predicted in the asset management plan. Impacts have been minor, even with the increased longwall retreat rate, with only blue or yellow level trigger action response plan (TARP) triggers activated. The Technical Committee has planned maintenance activities to effectively mitigate subsidence impacts and maintain this infrastructure in a safe and serviceable condition to avoid operating restrictions during this reporting period.

Monitoring of subsidence effects and potential impacts from Longwalls 14 and 15 on the North-Pit by Mt Owen operations (MTO) continued into this reporting period. In addition to regular visual inspections, the monitoring using fixed prism measurements to record highwall and slope/bench stability.

The Geotechnical Engineer at MTO advises "there has been no change in observed prism measurement trend over the last 3 month period. We also haven't observed any highwall or bench cracking near LW15 during this same period".

To assist with formal reporting requirements, a summary of the monitoring for the reporting period has been prepared. This summary uses a pro-forma checklist for all features assessed for subsidence impacts in the preparation of the EP for Longwalls 15 and 16 and comparison with forecasts in SCT (2018). This data is arranged in the order of impact assessment in SCT (2018) and is recorded as a reference for reporting or auditing purposes. The checklist is provided in Table 1.

Observations of subsidence effects or impacts and management measures in Table 1 cover the area above the active panel, as well as the previous panel. Where features are currently outside the subsidence zone of the active panel longwall face position (within half overburden depth, for Longwalls 15 and 16 this is 200-250m) they are marked 'n/a' (not applicable).

If you have any queries, or require further clarification of any of these issues, please don't hesitate to contact me directly.

Yours sincerely

Stephen Wilson <u>Mine Planner</u>

REFERENCES

SCT 2018 'Integra Underground Mine: Subsidence Assessment for LW15 and LW16 Extraction Plan' SCT Report INT4852 – 24 December 2018.

February – March 2020			
Longwall 15 Bi – Monthly Subsidence Monitoring			
Surface feature, subsidence effect or management measure	New effect or impact observed Yes/No	Exceedance of predictions Yes/No	Exceedance within performance measure and/or performance indicator Yes/No
Bettys Creek	n/a	n/a	n/a
-natural drainage line tributaries	n/a	n/a	n/a
Bettys Creek (MDC)	NO	no	n/a
Bettys Creek (natural)	n/a	n/a	n/a
Natural Dams (Ponds)	n/a	n/a	n/a
Natural Vegetation	NO	no	n/a
BC Habitat Management Area	NO	no	n/a
Aboriginal Heritage	NO	no	n/a
Historical Heritage	n/a	n/a	n/a
Mt Owen Railway Line	YES	NO	n/a
Bettys Creek Bridges	YES	NO	n/a
Communication Cables	YES	NO	n/a
Maintenance Road	YES	NO	n/a
Embankments/Cuttings	YES	NO	n/a
-causeway ERP-TP2	YES	NO	n/a
Water Supply Pipeline	YES	NO	n/a
Water Transfer Pipeline	YES	NO	n/a
Powerlines	YES	NO	n/a
Mt Owen – North Pit	NO	no	n/a
Ravensworth East - West Pit	n/a	n/a	n/a
Glendell haul road	n/a	n/a	n/a
ERP (and 500m past)	NO	no	n/a
TP2 (to End of Panel)	NO	no	n/a
Emplacement area (West dump)	NO	no	n/a
Emplacement area (Ravensworth/Glendell)	NO	no	n/a
Sediment Dam	NO	no	n/a
Storm Water Dam	NO	no	n/a
Gas Drainage equipment	NO	no	n/a
Agricultural land	NO	no	n/a
General:			
Fences/Gates	NO	no	n/a

Table 1: Surface Features and Subsidence Impact Monitoring

February – March 2020				
Longwall 15 Bi – Monthly Subsidence Monitoring				
Surface feature, subsidence effect or management measure	New effect or impact observed Yes/No	Exceedance of predictions Yes/No	Exceedance within performance measure and/or performance indicator Yes/No	
Access Roads	NO	no	n/a	
Farm dams	NO	no	n/a	
Forest Road	NO	no	n/a	
Shaft 3 & infrastructure	n/a	n/a	n/a	
Subsidence Impacts:				
Surface cracks or steps	NO	no	n/a	
Surface humps	NO	no	n/a	
Slope instability	NO	no	n/a	
Surface water (ponding)	YES	NO	n/a	
Management measures:				
Warning signage	NO	no	n/a	
Remediation measures:	NO	no	n/a	

APPENDIX 1

Subsidence monitoring review report for the Mt. Owen Railway due to the extraction of Integra Longwall 15

Monitoring Report No.	MSEC1079-R01
Latest survey date	10 February 2020
Longwall chainage	802 m on the 10 February 2020
Extracted length since previous report	96 m since the 3 February 2020
Closest distance of extraction face from the railway	130 m from railway above the longwall maingate 325 m from the railway above the longwall tailgate
Closest distance of the extraction face from the bridges	685 m from bridges at closest point

Measured ground movements for the railway

PH-Line	Current measured value	Predicted final value	Comments
Maximum incremental subsidence (mm)	16	650	Low level vertical subsidence
Additional subsidence since last survey (mm)	< 3	-	Low level additional subsidence
Maximum incremental tensile strain (mm/m)	0.9	1.0*	Strains largely due to survey tolerance,
Maximum incremental comp. strain (mm/m)	0.9	2.0*	no irregular movements identified
Maximum opening over 100m long bays (mm)	7	50	Low level changes in 100 m long bays
Maximum shortening over 100m long bays (mm)	10	80	

<u>Note</u>: * denotes maximum predicted conventional strains. The measured strains could exceed these values due to localised irregular ground movements or due to disturbed survey marks. Refer to the main report for further discussions.

Measured ground movements for the bridges

Bridges monitoring points	Current measured value	Monitoring review trigger	Comments
Maximum incremental subsidence (mm)	8	NI/A	l ow lovel vertical subsidence
Maximum total subsidence (mm)	679	IN/A	Low level vertical subsidence
Total differential long. horizontal movement between abutments (i.e. extension, mm)	+9	+40 -75	Minor changes (less than ±1 mm) similar to the order of survey tolerance
Total differential transverse horizontal movement between abutments (i.e. shear, mm)	4	25	Minor changes (less than ±1 mm) similar to the order of survey tolerance
Total differential vertical movement between abutments (i.e. vertical step, mm)	< 3	25	No measurable change during the reporting period
Total differential transverse tilt between abutments (i.e. longitudinal twist, mm/m)	< 1	1	No measurable change during the reporting period
Total differential horizontal movement across expansion joint at southern abutment (mm)	+7	+20 -10	Minor changes (less than ±1 mm) similar to the order of survey tolerance

Inspections, geometry and status for the railway and bridges

Parameter	Status	Comments
Visual inspection	N/A	Only minor visual changes
Track geometry survey	\bigcirc	Minor changes
Rail stress monitoring	\bigcirc	Rail stresses are currently within the green zone
Signal line	\bigcirc	Measured strains are less than the triggers
Bridges geometry	\bigcirc	Bridges are within the design parameters

Parameter	Comments
Alarms or real-time monitoring system faults	No alarms during the reporting period
Ground monitoring	Only low level movements due to LW15
Visual and track geometry survey	Minor changes
Rail stress	No track adjustments recommended this week
Bridges geometry	No temporary works recommended this week

Subsidence monitoring review report for the Mt. Owen Railway due to the extraction of Integra Longwall 15

Monitoring Report No.	MSEC1079-R02
Latest survey date	17 February 2020
Longwall chainage	720 m on the 17 February 2020
Extracted length since previous report	83 m since the 10 February 2020
Closest distance of extraction face from the railway	47 m from railway above the longwall maingate 243 m from the railway above the longwall tailgate
Closest distance of the extraction face from the bridges	615 m from bridges at closest point

Measured ground movements for the railway

PH-Line	Current measured value	Predicted final value	Comments
Maximum incremental subsidence (mm)	29	650	Low level vertical subsidence
Additional subsidence since last survey (mm)	13	-	Low level additional subsidence
Maximum incremental tensile strain (mm/m)	0.8	1.0*	Strains largely due to survey tolerance,
Maximum incremental comp. strain (mm/m)	1.0	2.0*	no irregular movements identified
Maximum opening over 100m long bays (mm)	3	50	Low level changes in 100 m long bays
Maximum shortening over 100m long bays (mm)	13	80	

<u>Note</u>: * denotes maximum predicted conventional strains. The measured strains could exceed these values due to localised irregular ground movements or due to disturbed survey marks. Refer to the main report for further discussions.

Measured ground movements for the bridges

Bridges monitoring points	Current measured value	Monitoring review trigger	Comments
Maximum incremental subsidence (mm)	22	NI/A	Low level incremental vertical
Maximum total subsidence (mm)	694	IN/A	subsidence due to LW15
Total differential long. horizontal movement between abutments (i.e. extension, mm)	+9	+40 -75	Minor changes (less than ±1 mm) similar to the order of survey tolerance
Total differential transverse horizontal movement between abutments (i.e. shear, mm)	3	25	Minor changes (less than ±1 mm) similar to the order of survey tolerance
Total differential vertical movement between abutments (i.e. vertical step, mm)	< 3	25	No measurable change during the reporting period
Total differential transverse tilt between abutments (i.e. longitudinal twist, mm/m)	< 1	1	No measurable change during the reporting period
Total differential horizontal movement across expansion joint at southern abutment (mm)	+8	+20 -10	Minor changes (less than ±1 mm) similar to the order of survey tolerance

Inspections, geometry and status for the railway and bridges

Parameter	Status	Comments
Visual inspection	N/A	Only minor visual changes
Track geometry survey	\bigcirc	Minor changes
Rail stress monitoring	\bigcirc	Rail stresses are currently within the green zone
Rail switch monitoring	\bigcirc	Rail switches are currently within the green zone
Signal line	\bigcirc	Measured strains are less than the triggers
Bridges geometry	\bigcirc	Bridges are within the design parameters

Parameter	Comments
Alarms or real-time monitoring system faults	No alarms during the reporting period
Ground monitoring	Only low level movements due to LW15
Visual and track geometry survey	Minor changes
Rail stress	No track adjustments recommended this week
Bridges geometry	No temporary works recommended this week

Subsidence monitoring review report for the Mt. Owen Railway due to the extraction of Integra Longwall 15

Monitoring Report No.	MSEC1079-R03
Latest survey date	24 February 2020
Longwall chainage	608 m on the 24 February 2020
Extracted length since previous report	111 m since the 17 February 2020
Closest distance of extraction face from the railway	65 m beyond the railway above the longwall maingate 130 m from the railway above the longwall tailgate
Closest distance of the extraction face from the bridges	525 m from bridges at closest point

Measured ground movements for the railway

PH-Line	Current measured value	Predicted final value	Comments
Maximum incremental subsidence (mm)	69	650	Subsidence developing above LW15
Additional subsidence since last survey (mm)	40	-	Rate of subsidence is increasing
Maximum incremental tensile strain (mm/m)	0.9	1.0*	Strains largely due to survey tolerance,
Maximum incremental comp. strain (mm/m)	1.0	2.0*	no irregular movements identified
Maximum opening over 100m long bays (mm)	6	50	Changes in 100 m long bays
Maximum shortening over 100m long bays (mm)	21	80	developing above LW15

<u>Note</u>: * denotes maximum predicted conventional strains. The measured strains could exceed these values due to localised irregular ground movements or due to disturbed survey marks. Refer to the main report for further discussions.

Measured ground movements for the bridges

Bridges monitoring points	Current measured value	Monitoring review trigger	Comments
Maximum incremental subsidence (mm)	19	NI/A	Low level incremental vertical
Maximum total subsidence (mm)	690	IN/A	subsidence due to LW15
Total differential long. horizontal movement between abutments (i.e. extension, mm)	+10	+40 -75	Minor changes (less than ±1 mm) similar to the order of survey tolerance
Total differential transverse horizontal movement between abutments (i.e. shear, mm)	3	25	Minor changes (less than ±1 mm) similar to the order of survey tolerance
Total differential vertical movement between abutments (i.e. vertical step, mm)	< 3	25	No measurable change during the reporting period
Total differential transverse tilt between abutments (i.e. longitudinal twist, mm/m)	< 1	1	No measurable change during the reporting period
Total differential horizontal movement across expansion joint at southern abutment (mm)	+8	+20 -10	Minor changes (less than ±1 mm) similar to the order of survey tolerance

Inspections, geometry and status for the railway and bridges

Parameter	Status	Comments
Visual inspection	N/A	Only minor visual changes
Track geometry survey	\bigcirc	Increased cant and tight gauge from 258.45 km onwards, exceedance in short twist between 257.810 km and 258.812 km. Continue monitoring
Rail stress monitoring	\bigcirc	Rail stresses are currently within the green zone
Rail switch monitoring	\bigcirc	Rail switches are currently within the green zone
Signal line	\bigcirc	Measured strains are less than the triggers
Bridges geometry	\bigcirc	Bridges are within the design parameters

Parameter	Comments
Alarms or real-time monitoring system faults	No alarms during the reporting period
Ground monitoring	Rate of development of subsidence is increasing
Visual and track geometry survey	Minor changes
Rail stress	Raise SFT between 258.275 km and 258.475 km (both rails)
Bridges geometry	No temporary works recommended this week

Subsidence monitoring review report for the Mt. Owen Railway due to the extraction of Integra Longwall 15

Monitoring Report No.	MSEC1079-R04
Latest survey date	2 March 2020
Longwall chainage	520 m on the 2 March 2020
Extracted length since previous report	88 m since the 24 February 2020
Closest distance of extraction face from the railway	155 m beyond the railway above the longwall maingate 45 m from the railway above the longwall tailgate
Closest distance of the extraction face from the bridges	465 m from bridges at closest point

Measured ground movements for the railway

PH-Line	Current measured value	Predicted final value	Comments
Maximum incremental subsidence (mm)	146	650	Subsidence developing above LW15
Additional subsidence since last survey (mm)	77	-	Rate of subsidence is increasing
Maximum incremental tensile strain (mm/m)	0.9	1.0*	Strains largely due to survey tolerance,
Maximum incremental comp. strain (mm/m)	0.8	2.0*	no irregular movements identified
Maximum opening over 100m long bays (mm)	12	50	Changes in 100 m long bays developing above LW15
Maximum shortening over 100m long bays (mm)	40	80	

<u>Note</u>: * denotes maximum predicted conventional strains. The measured strains could exceed these values due to localised irregular ground movements or due to disturbed survey marks. Refer to the main report for further discussions.

Measured ground movements for the bridges

Bridges monitoring points	Current measured value	Monitoring review trigger	Comments
Maximum incremental subsidence (mm)	21	NI/A	Low level incremental vertical
Maximum total subsidence (mm)	691	IN/A	subsidence due to LW15
Total differential long. horizontal movement between abutments (i.e. extension, mm)	+11	+40 -75	Minor changes (less than ±1 mm) similar to the order of survey tolerance
Total differential transverse horizontal movement between abutments (i.e. shear, mm)	3	25	Minor changes (less than ±1 mm) similar to the order of survey tolerance
Total differential vertical movement between abutments (i.e. vertical step, mm)	< 3	25	No measurable change during the reporting period
Total differential transverse tilt between abutments (i.e. longitudinal twist, mm/m)	< 1	1	No measurable change during the reporting period
Total differential horizontal movement across expansion joint at southern abutment (mm)	+8	+20 -10	Minor changes (less than ±1 mm) similar to the order of survey tolerance

Inspections, geometry and status for the railway and bridges

Parameter	Status	Comments
Visual inspection	N/A	Only minor visual changes
Track geometry survey	\bigcirc	Increased cant and tight gauge from 258.45 km onwards, elevated in short twist between 257.810 km and 258.812 km. Continue monitoring
Rail stress monitoring	0	Blue alarm on 1 March and Yellow trigger exceeded on 2 March. Rail stresses currently in the green zone
Rail switch monitoring	\bigcirc	Rail switches are currently within the green zone
Signal line	\bigcirc	Measured strains are less than the triggers
Bridges geometry	\bigcirc	Bridges are within the design parameters

Parameter	Comments
Alarms or real-time monitoring system faults	One Blue alarm and two Yellow triggers during the reporting period
Ground monitoring	Rate of development of subsidence is increasing
Visual and track geometry survey	Minor changes
Rail stress	No track adjustments recommended this week
Bridges geometry	No temporary works recommended this week

Subsidence monitoring review report for the Mt. Owen Railway due to the extraction of Integra Longwall 15

Monitoring Report No.	MSEC1079-R05
Latest survey date	9 March 2020
Longwall chainage	447 m on the 9 March 2020
Extracted length since previous report	73 m since the 2 March 2020
Closest distance of extraction face from the railway	225 m beyond the railway above the longwall maingate 30 m beyond the railway above the longwall tailgate
Closest distance of the extraction face from the bridges	420 m from bridges at closest point

Measured ground movements for the railway

PH-Line	Current measured value	Predicted final value	Comments
Maximum incremental subsidence (mm)	254	650	Subsidence developing above LW15
Additional subsidence since last survey (mm)	108	-	Rate of subsidence is increasing
Maximum incremental tensile strain (mm/m)	1.0	1.0*	Strains largely due to survey tolerance,
Maximum incremental comp. strain (mm/m)	1.2	2.0*	no irregular movements identified
Maximum opening over 100m long bays (mm)	21	50	Changes in 100 m long bays developing above LW15
Maximum shortening over 100m long bays (mm)	72	80	

<u>Note</u>: * denotes maximum predicted conventional strains. The measured strains could exceed these values due to localised irregular ground movements or due to disturbed survey marks. Refer to the main report for further discussions.

Measured ground movements for the bridges

Bridges monitoring points	Current measured value	Monitoring review trigger	Comments
Maximum incremental subsidence (mm)	26	NI/A	Low level incremental vertical
Maximum total subsidence (mm)	697	IN/A	subsidence due to LW15
Total differential long. horizontal movement between abutments (i.e. extension, mm)	+11	+40 -75	Minor changes (less than ±1 mm) similar to the order of survey tolerance
Total differential transverse horizontal movement between abutments (i.e. shear, mm)	3	25	Minor changes (less than ±1 mm) similar to the order of survey tolerance
Total differential vertical movement between abutments (i.e. vertical step, mm)	< 3	25	No measurable change during the reporting period
Total differential transverse tilt between abutments (i.e. longitudinal twist, mm/m)	< 1	1	No measurable change during the reporting period
Total differential horizontal movement across expansion joint at southern abutment (mm)	+9	+20 -10	Minor changes (less than ±1 mm) similar to the order of survey tolerance

Inspections, geometry and status for the railway and bridges

Parameter	Status	Comments
Visual inspection	N/A	Only minor visual changes
Track geometry survey	\bigcirc	Increased cant and tight gauge from 258.45 km onwards, elevated in short twist between 257.810 km and 258.812 km. Continue monitoring
Rail stress monitoring	\bigcirc	Rail stresses currently in the green zone. The Blue trigger was exceeded on 11 March 2020
Rail switch monitoring	\bigcirc	Rail switches are currently within the green zone
Signal line	\bigcirc	Measured strains are less than the triggers
Bridges geometry	\bigcirc	Bridges are within the design parameters

Parameter	Comments
Alarms or real-time monitoring system faults	No alarms during the reporting period
Ground monitoring	Rate of development of subsidence is increasing
Visual and track geometry survey	Minor changes
Rail stress	Raise SFT to 40°C between 258.075 km and 258.325 km and lower SFT to 38°C between 258.375 km and 258.675 km
Bridges geometry	No temporary works recommended this week

Subsidence monitoring review report for the Mt. Owen Railway due to the extraction of Integra Longwall 15

Monitoring Report No.	MSEC1079-R06
Latest survey date	16 March 2020
Longwall chainage	356 m on the 16 March 2020
Extracted length since previous report	92 m since the 9 March 2020
Closest distance of extraction face from the railway	315 m beyond the railway above the longwall maingate 120 m beyond the railway above the longwall tailgate
Closest distance of the extraction face from the bridges	375 m from bridges at closest point

Measured ground movements for the railway

PH-Line	Current measured value	Predicted final value	Comments
Maximum incremental subsidence (mm)	440	650	Subsidence developing above LW15
Additional subsidence since last survey (mm)	186	-	Rate of subsidence is increasing
Maximum incremental tensile strain (mm/m)	1.1	1.0*	Compression developing above LW15,
Maximum incremental comp. strain (mm/m)	1.9	2.0*	no irregular movements identified
Maximum opening over 100m long bays (mm)	36	50	Net contraction above LW15 greater
Maximum shortening over 100m long bays (mm)	114	80	than predicted

<u>Note</u>: * denotes maximum predicted conventional strains. The measured strains could exceed these values due to localised irregular ground movements or due to disturbed survey marks. Refer to the main report for further discussions.

Measured ground movements for the bridges

Bridges monitoring points	Current measured value	Monitoring review trigger	Comments
Maximum incremental subsidence (mm)	39	NI/A	Low level incremental vertical
Maximum total subsidence (mm)	710	IN/A	subsidence developing due to LW15
Total differential long. horizontal movement between abutments (i.e. extension, mm)	+12	+40 -75	Minor changes (less than ±1 mm) similar to the order of survey tolerance
Total differential transverse horizontal movement between abutments (i.e. shear, mm)	3	25	Minor changes (less than ±1 mm) similar to the order of survey tolerance
Total differential vertical movement between abutments (i.e. vertical step, mm)	< 3	25	No measurable change during the reporting period
Total differential transverse tilt between abutments (i.e. longitudinal twist, mm/m)	< 1	1	No measurable change during the reporting period
Total differential horizontal movement across expansion joint at southern abutment (mm)	+9	+20 -10	Minor changes (less than ±1 mm) similar to the order of survey tolerance

Inspections, geometry and status for the railway and bridges

Parameter	Status	Comments
Visual inspection	N/A	Only minor visual changes
Track geometry survey	\bigcirc	Increased cant and tight gauge from 258.45 km onwards, elevated in short twist between 257.810 km and 258.812 km. Continue monitoring
Rail stress monitoring	0	Rail stresses currently in the green zone, except at 258.400 km which is in the blue zone. The Blue and Yellow triggers were exceeded on 11 to 13 March
Rail switch monitoring	\bigcirc	Rail switches are currently within the green zone
Signal line	\bigcirc	Measured strains are less than the triggers
Bridges geometry	\bigcirc	Bridges are within the design parameters

Triggers, forecasts and actions

Parameter	Comments
Alarms or real-time monitoring system faults	9 Blue alarms and 1 Yellow alarm during the reporting period
Ground monitoring	Rate of development of subsidence is increasing
Visual and track geometry survey	Minor changes
Rail stress	Lower SFT to 38°C between 258.325 km and 258.625 km and raise SFT to 40°C between 258.075 km and 258.275 km
Bridges geometry	No temporary works recommended this week

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Subsidence monitoring review report for the Mt. Owen Railway due to the extraction of Integra Longwall 15

Monitoring Report No.	MSEC1079-R07
Latest survey date	23 March 2020
Longwall chainage	284 m on the 23 March 2020
Extracted length since previous report	72 m since the 9 March 2020
Closest distance of extraction face from the railway	390 m beyond the railway above the longwall maingate 195 m beyond the railway above the longwall tailgate
Closest distance of the extraction face from the bridges	355 m from bridges at closest point

Measured ground movements for the railway

PH-Line	Current measured value	Predicted final value	Comments
Maximum incremental subsidence (mm)	533	650	Subsidence developing above LW15
Additional subsidence since last survey (mm)	92	-	Rate of subsidence is decreasing
Maximum incremental tensile strain (mm/m)	1.0	1.0*	Possible localised compressive strain
Maximum incremental comp. strain (mm/m)	2.1	2.0*	developing near 258.101 km
Maximum opening over 100m long bays (mm)	33	50	Rate of change in long bays decreasing,
Maximum shortening over 100m long bays (mm)	130	80	net contraction greater than predicted

<u>Note</u>: * denotes maximum predicted conventional strains. The measured strains could exceed these values due to localised irregular ground movements or due to disturbed survey marks. Refer to the main report for further discussions.

Measured ground movements for the bridges

Bridges monitoring points	Current measured value	Monitoring review trigger	Comments
Maximum incremental subsidence (mm)	42	NI/A	Low level incremental vertical
Maximum total subsidence (mm)	712	IN/A	subsidence developing due to LW15
Total differential long. horizontal movement between abutments (i.e. extension, mm)	+12	+40 -75	Minor changes (less than ±1 mm) similar to the order of survey tolerance
Total differential transverse horizontal movement between abutments (i.e. shear, mm)	3	25	Minor changes (less than ±1 mm) similar to the order of survey tolerance
Total differential vertical movement between abutments (i.e. vertical step, mm)	< 3	25	No measurable change during the reporting period
Total differential transverse tilt between abutments (i.e. longitudinal twist, mm/m)	< 1	1	No measurable change during the reporting period
Total differential horizontal movement across expansion joint at southern abutment (mm)	+9	+20 -10	Minor changes (less than ±1 mm) similar to the order of survey tolerance

Inspections, geometry and status for the railway and bridges

Parameter	Status	Comments
Visual inspection	N/A	Only minor visual changes
Track geometry survey	\bigcirc	Increased cant and tight gauge from 258.45 km onwards, elevated in short twist between 257.810 km and 258.812 km. Continue monitoring
Rail stress monitoring	\bigcirc	Rail stresses currently in the green zone. The Blue trigger was exceeded on the 18 to 20 March 2020
Rail switch monitoring	\bigcirc	Rail switches are currently within the green zone
Signal line	\bigcirc	Measured strains are less than the triggers
Bridges geometry	\bigcirc	Bridges are within the design parameters

Parameter	Comments
Alarms or real-time monitoring system faults	6 Blue alarms during the reporting period
Ground monitoring	Possible localised (i.e. anomalous) movement developing near 258.101 km
Visual and track geometry survey	Minor changes
Rail stress	Recommended track adjustment to raise SFT to 40°C between 258.025 km to 258.225 km
Bridges geometry	No temporary works recommended this week

Subsidence monitoring review report for the Mt. Owen Railway due to the extraction of Integra Longwall 15

Monitoring Report No.	MSEC1079-R08
Latest survey date	30 March 2020
Longwall chainage	191 m on the 30 March 2020
Extracted length since previous report	93 m since the 23 March 2020
Closest distance of extraction face from the railway	485 m beyond the railway above the longwall maingate 285 m beyond the railway above the longwall tailgate
Closest distance of the extraction face from the bridges	345 m from bridges at closest point

Measured ground movements for the railway

PH-Line	Current measured value	Predicted final value	Comments
Maximum incremental subsidence (mm)	606	650	Subsidence developing above LW15
Additional subsidence since last survey (mm)	74	-	Rate of subsidence is decreasing
Maximum incremental tensile strain (mm/m)	1.1	1.0*	Possible localised compressive strain
Maximum incremental comp. strain (mm/m)	2.4	2.0*	developing near 258.101 km
Maximum opening over 100m long bays (mm)	41	50	Rate of change in long bays decreasing, net contraction greater than predicted
Maximum shortening over 100m long bays (mm)	140	80	

<u>Note</u>: * denotes maximum predicted conventional strains. The measured strains could exceed these values due to localised irregular ground movements or due to disturbed survey marks. Refer to the main report for further discussions.

Measured ground movements for the bridges

Bridges monitoring points	Current measured value	Monitoring review trigger	Comments
Maximum incremental subsidence (mm)	52	NI/A	Low level incremental vertical
Maximum total subsidence (mm)	721	- IN/A	subsidence developing due to LW15
Total differential long. horizontal movement between abutments (i.e. extension, mm)	+12	+40 -75	Minor changes (less than ±1 mm) similar to the order of survey tolerance
Total differential transverse horizontal movement between abutments (i.e. shear, mm)	4	25	Minor changes (less than ±1 mm) similar to the order of survey tolerance
Total differential vertical movement between abutments (i.e. vertical step, mm)	< 3	25	No measurable change during the reporting period
Total differential transverse tilt between abutments (i.e. longitudinal twist, mm/m)	< 1	1	No measurable change during the reporting period
Total differential horizontal movement across expansion joint at southern abutment (mm)	+10	+20 -10	Minor changes (less than ±1 mm) similar to the order of survey tolerance

Inspections, geometry and status for the railway and bridges

Parameter	Status	Comments
Visual inspection	N/A	Only minor visual changes
Track geometry survey	\bigcirc	Increased cant and tight gauge from 258.45 km onwards, elevated in short twist between 257.810 km and 258.812 km. Continue monitoring
Rail stress monitoring	igodol	Rail stresses currently in the green zone. The Blue trigger was exceeded on the 28 and 31 March 2020
Rail switch monitoring	\bigcirc	Rail switches are currently within the green zone
Signal line	\bigcirc	Measured strains are less than the triggers
Bridges geometry	\bigcirc	Bridges are within the design parameters

Parameter	Comments
Alarms or real-time monitoring system faults	Two Blue alarms during the reporting period
Ground monitoring	Possible localised (i.e. anomalous) movement developing near 258.101 km
Visual and track geometry survey	Minor changes
Rail stress	Recommended track adjustments to lower SFT to 38°C between 257.725 km and 257.875 km and between 258.325 km and 258.575 km
Bridges geometry	No temporary works recommended this week