

Site: Mandalong
Title: Mandalong Extraction Plan LW 30-31 PSMP
Stature ID:1001285007
Version: 1
Lifecycle State:

1 of 72



Stature for Risk Management

Administration:

Risk Assessment Title: Mandalong Extraction Plan LW 30-31 PSMP

Revision: 1

Region: North

Site: Mandalong

Department: ZZZZ Whole Site

Equipment / Process: Community

Stature Risk Assessment No.: 1001285007

Study Lifecycle State: Risk Assessment Made Effective

Potential Hazard No.:

PULSE Actions Required URL:

Site Risk Assessment Ref. No. (Optional):

Study Approval

Approver	Approved / Rejected	Date	Comments
1. Col Macdonald [Colin.Macdonald]	Approved	February 15, 2021	

1. Background

An Extraction Plan is required by the Department of Planning, Industry and Environment (DPIE) as specified Development Consent SSD-5144 and Mining Lease conditions.

This Risk Assessment will identify and manage the health and safety risks associated with subsidence caused by the extraction for LW30-31 on private property.

Subsidence prediction and assessment of impacts for LW30-31 Extraction Plan has been conducted by Ditton Geotechnical Services (DgS).

The predictions method is based on the DgS modified ACARP 2003 subsidence model and subsidence effects data from Mandalong Mine LW1 to 27.

The reliability of the subsidence model has been assessed using regression analysis techniques and estimates of the mean and standard deviation (error) of the data set.

The mean subsidence predictions represent the expected subsidence and the Upper 95% Confidence Limits represents the worst-case subsidence effects.

2. Objective

The following Hierarchy of Controls offers a framework for considering the effectiveness of controls. Note that the effectiveness of a control that is intended to reduce a risk decreases from top to bottom of the list. In other words, the closer the control type is to the top of the hierarchy, the more potentially effective the control.

- Eliminate the hazard or energy source (do not use the energy)
- Minimise or replace the hazard or energy source (reduce the amount of energy to a less damaging level or replace the energy with another that has less potential negative consequences)
- Control the hazard or energy using engineered devices (ex. Lock outs, chemical containers, mechanical roof support, gas monitors, etc.)
- Control the hazard or energy by using physical barriers (ex. machine guarding, fences or enclosures, etc.)
- Control the hazard or energy with procedures (ex. Isolation procedures, standard operating procedures, etc.)
- Control the hazard or energy with personal protective equipment (ex. hard hats, boots with toe caps, gloves, safety glasses, welding gear, etc.)
- Control the hazard or energy with warnings and awareness (ex. posters, labels, warning signs, verbal warnings, etc.)

To identify, assess and control the health and safety risks associated with subsidence caused by the extraction for LW30-31 on private property

3. Potential Hazards

Predicted subsidence
and
Subsidence at the worst-case, Upper 95% Confidence Limits

4. Risk Assessment Boundary Definition

The extraction of LW30-31

5. Risk Assessment Methods

Risk Assessment Methods:

Workplace Risk Assessment and Control (WRAC): Yes

Fault Tree Analysis (FTA):

Safety Integrity Level Analysis to Australian Standard 61508 (SIL):

Bow Tie Analysis (BTA):

Failure Modes and Effects Analysis (FMEA):

Hazard and Operability Analysis (HAZOP):

6. Previous Risk Assessment and other documents to be used and/or referenced

Document Name	Title	Version	Referenced Document Date
Extraction Plan Risk Assessment LW25-31 Built Features			
Extraction Plan Risk Assessment LW25-31 PSMP			
Extraction Plan Risk Assessment LW25-31 Environment			
Draft Guidelines for the Preparation of Extraction Plans V5			
Managing Risk of Subsidence, Guide:WHS (Mines and Petroleum Sites Legislation) (NSW Department of Industry - Resources Regulator, 2017)			
Subsidence Prediction and Impact Assessment LW30-31 - MAN-005/2 (Ditton Geotechnical Services, 2021)			
Mandalong South Flood Assessment LW1 to LW33 (Umwelt, 2020)			
Dwelling Structural Assessments - Leigh Appleyard Consulting Engineer			
Telstra Communications Assessment Report for Extraction Plan LW30-33 (Comms Network Solutions, 2020)			
Land and Agricultural Resource Assessment LW30-33 Extraction Plan (SLR, 2020)			
PSMP subsidence prediction Figures			
Plan MG14065 and MG14066 Proposed workings LW30-31 - Surface Features and Infrastructure			

7. Venue and Time

Date	Description	Location	Start Time	End Time	Comment
1. 03-Feb-2021	Scoping	Mandalong	12:30 PM	3:00 PM	
2. 04-Feb-2021	Risk Assessment	Mandalong	10:00 AM	12:00 PM	

9. Risk Assessment Team Selection

Name	Position	Company	Industry Start Date	E-Mail Address	Role	Experience relevant to the role in the risk assessment	Pulse User No.	Attendance	
								1. 03-Feb-2021	2. 04-Feb-2021
Phil Enright	Subsidence Management Coordinator	Centennial Mandalong	23-Aug-1982	phil.enright@centennialcoal.com.au	Risk Assessment Owner	38	60001	P	P
Jeffrey Dunwoodie	Environmental & Community Coordinator	Centennial Mandalong	02-Dec-2002	jeffrey.dunwoodie@centennialcoal.com.au	Team Member	16	80084		P
Col Macdonald	Compliance Manager	Centennial Mandalong	06-Dec-1977	colin.macdonald@centennialcoal.com.au	Facilitator	44	80094	P	P
Iain Hornshaw	Approvals Coordinator Approvals Manager	Centennial Coal		iain.hornshaw@centennialcoal.com.au	Team Member	11	100066		P
Kieran Fiatarone	Environmental Graduate	Centennial Coal		kieran.j.fiatarone@centennialcoal.com.au	Team Member	1	100450		P
Stuart Macdonald	Safety Health Representative (SHR)	Centennial Mandalong	21-Jan-1985	stumac61@bigpond.com	Team Member	36	82111		P
Dominic Neylan	Approvals Graduate	Centennial Coal			Team Member	1			P
Mark Harrower	Subsidence Surveyor	Centennial Mandalong	14-Jan-1985		Team Member	36	80013		P

WRAC Analysis Worksheet

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extension
1. MS0107 Laruffa	There is a risk to Mandalong from ::: predicted subsidence tilting the dwelling ::: Caused by: ▪ expected geotechnical conditions Resulting in: ▪ damage to structure causing a risk to health and safety.	1.1.a. Geology defined by surface and underground exploration programs	D (D)	1 (PI)	2 (L)		
		1.1.b. Subsidence Prediction and Impact Assessment prepared by DgS					
		1.1.c. Subsidence prediction below SSR criteria					
		1.1.d. Structural engineer confirmed dwelling tolerance to predicted subsidence					
		1.1.e. Structural inspection and assessment of buildings by Structural Engineer					
		1.1.f. SA NSW pre-mining inspection					
		1.1.g. Subsidence monitoring					
		1.1.h. PSMP					
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits tilting the dwelling ::: Caused by: ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ damage to structure causing a risk to health and safety.	1.2.a. Structural inspection and assessment of buildings by Structural Engineer	D (D)	1 (PI)	2 (L)		
		1.2.b. PSMP					
		1.2.c. Geology defined by surface and underground exploration programs					
		1.2.d. Subsidence Prediction and Impact Assessment prepared by DgS					
		1.2.e. Subsidence prediction below SSR criteria					
		1.2.f. Structural engineer confirmed dwelling tolerance to predicted subsidence					
		1.2.g. SA NSW pre-mining inspection					
		1.2.h. Subsidence monitoring					
	There is a risk to Mandalong from ::: predicted subsidence placing strains on the dwelling ::: Caused by:	1.3.a. Geology defined by surface and underground exploration programs	D (D)	1 (PI)	2 (L)		
		1.3.b. Subsidence Prediction and Impact Assessment prepared by DgS					
		1.3.c. Subsidence prediction below SSR criteria					

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Exten sion
	- expected geotechnical conditions Resulting in: - damage to structure causing a risk to health and safety.	1.3.d. Structural engineer confirmed dwelling tolerance to predicted subsidence					
		1.3.e. SA NSW pre-mining inspection					
		1.3.f. Subsidence monitoring					
		1.3.g. Structural inspection and assessment of buildings by Structural Engineer					
		1.3.h. PSMP					
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits placing strains on the dwelling ::: Caused by: - geotechnical conditions being worse than anticipated Resulting in: - damage to structure causing a risk to health and safety.	1.4.a. Geology defined by surface and underground exploration programs					
		1.4.b. Structural inspection and assessment of dwelling by Structural Engineer					
		1.4.c. Structural engineer confirmed dwelling tolerance to predicted subsidence					
		1.4.d. Subsidence prediction below SSR criteria					
		1.4.e. SA NSW pre-mining inspection					
		1.4.f. Subsidence monitoring					
		1.4.g. PSMP					
		1.4.h. Structural inspection and assessment of buildings by Structural Engineer					
	There is a risk to Mandalong from ::: predicted subsidence on buildings and structures ::: Caused by: - expected geotechnical conditions Resulting in: - damage to building and structures causing a risk to health and safety.	1.5.a. Structural inspection and assessment of buildings by Structural Engineer					
		1.5.b. No hazards identified in structural inspection					
		1.5.c. Subsidence prediction below SSR criteria					
		1.5.d. SA NSW pre-mining inspection					
		1.5.e. Subsidence monitoring					
		1.5.f. PSMP					
		1.5.g. Structural inspection and assessment of buildings by Structural Engineer					
			D (D)	1 (PI)	2 (L)		
			E (D)	1 (PI)	1 (L)		

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extension
	There is a risk to Mandalong from ∴ subsidence at the worst- case, Upper 95% Confidence Limits on buildings and structures ∴ Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ damage to building and structures causing a risk to health and safety.	1.6.a. Structural inspection and assessment of buildings by Structural Engineer 1.6.b. No hazards identified in structural inspection 1.6.c. Subsidence prediction below SSR criteria 1.6.d. SA NSW pre-mining inspection 1.6.e. Subsidence monitoring 1.6.f. PSMP 1.6.g. Structural inspection and assessment of buildings by Structural Engineer	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ∴ predicted subsidence on communication lines ∴ Caused by: ▪ expected geotechnical conditions Resulting in: ▪ interruption to communications causing a risk to health and safety.	1.7.a. Communications Management Plan 1.7.b. Mobile coverage	E (Pj)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ∴ subsidence at the worst- case, Upper 95% Confidence Limits on communications lines ∴ Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ interruption to communications causing a risk to health and safety.	1.8.a. Communications Management Plan 1.8.b. Mobile coverage	E (Pj)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ∴ subsidence at the worst- case, Upper 95%	1.9.a. Powerline Management Plan 1.9.b. Subsidence monitoring	E (Pj)	1 (PI)	1 (L)		

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extension
	Confidence Limits on power lines ::: Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ interruption to power supply causing a risk to health and safety.						
	There is a risk to Mandalong from ::: predicted subsidence on farm dams ::: Caused by: ▪ expected geotechnical conditions Resulting in: ▪ dam failure and increased risk to health and safety.	1.10.a. Subsidence monitoring 1.10.b. 2 out of 3 dams below dwelling	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on farm dams ::: Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ dam failure and increased risk to health and safety.	1.11.a. Dams located below dwelling 1.11.b. 2 out of 3 dams below dwelling 1.11.c. Subsidence monitoring	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: predicted subsidence on fences ::: Caused by: ▪ expected geotechnical conditions Resulting in: ▪ damage to fence and escape of livestock	1.12.a. pre-mining inspection 1.12.b. communication with landowner during mining 1.12.c. post-mining inspection 1.12.d. No livestock 1.12.e. Partial fencing	C (D)	1 (PI)	4 (L)		

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Exten sion
	resulting in a risk to health and safety.						
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on fences ::: Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ damage to fence and escape of livestock resulting in a risk to health and safety.	1.13.a. pre-mining inspection 1.13.b. communication with landowner during mining 1.13.c. post-mining inspection 1.13.d. No livestock 1.13.e. Partial fencing	C (D)	1 (PI)	4 (L)		
	There is a risk to Mandalong from ::: predicted subsidence on property access roads ::: Caused by: ▪ expected geotechnical conditions Resulting in: ▪ damage to road(s) and increased risk to health and safety.	1.14.a. pre-mining inspection 1.14.b. Limited access to private property 1.14.c. communication with landowner during mining 1.14.d. low speed roads 1.14.e. post-mining inspection 1.14.f. 2 x access roads	D (D)	2 (PI)	5 (L)		
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on property access roads ::: Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ damage to road(s) and increased risk to health and safety.	1.15.a. Limited access to private property 1.15.b. communication with landowner during mining 1.15.c. low speed roads 1.15.d. pre-mining inspection 1.15.e. post-mining inspection 1.15.f. 2 x access roads	D (D)	2 (PI)	5 (L)		
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95%	1.16.a. Flood modelling and assessment 1.16.b. Potential remnant ponding locations identified in Flood modelling and	E (D)	1 (PI)	1 (L)		

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Exten sion
	Confidence Limits resulting in remnant ponding ::: Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ risk to health and safety.	assessment 1.16.c. Property located above floodplain 1.16.d. Land Management Plan 1.16.e. Flood path inspections 1.16.f. Subsidence monitoring					
	There is a risk to Mandalong from ::: predicted subsidence on land ::: Caused by: ▪ expected geotechnical conditions Resulting in: ▪ increased soil or tunnel erosion resulting in a risk to health and safety.	1.17.a. Land and Agricultural Resource Assessment 1.17.b. Land Management Plan 1.17.c. pre-mining inspection 1.17.d. post-mining inspection	E (Pi)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on land ::: Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ increased soil or tunnel erosion resulting in a risk to health and safety.	1.18.a. Land and Agricultural Resource Assessment 1.18.b. Land Management Plan 1.18.c. pre-mining inspection 1.18.d. post-mining inspection	E (Pi)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: predicted subsidence on steep slopes ::: Caused by: ▪ expected geotechnical conditions Resulting in:	1.19.a. Subsidence Prediction and Impact Assessment prepared by DgS - slope stability and erosion 1.19.b. Public Safety Management Plan 1.19.c. Land Management Plan 1.19.d. Slope stability inspections 1.19.e. Subsidence monitoring	D (D)	4 (PI)	14 (S)		

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extension
	- Overhang collapse - risk to health and safety - rock roll-out - slope instability - surface cracking.	1.19.f. Dwelling and buildings not exposed to rock roll out potential. 1.19.g. communication with landowner during mining 1.19.h. Controlled and limited access to the property	D (D)	4 (PI)	14 (S)		
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on steep slopes ::: Caused by: - expected geotechnical conditions - geotechnical conditions being worse than anticipated Resulting in: - risk to health and safety - rock roll-out - slope instability - surface cracking.	1.20.a. Subsidence Prediction and Impact Assessment prepared by DgS - slope stability and erosion 1.20.b. Public Safety Management Plan 1.20.c. Land Management Plan 1.20.d. Slope stability inspections 1.20.e. Subsidence monitoring 1.20.f. Dwelling and buildings not exposed to rock roll out potential. 1.20.g. communication with landowner during mining 1.20.h. Controlled and limited access to the property					

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extension
2. MS0137 Campbell	There is a risk to Mandalong from ::: predicted subsidence tilting the dwelling ::: Caused by: ▪ expected geotechnical conditions Resulting in: ▪ damage to structure causing a risk to health and safety.	2.1.a. Geology defined by surface and underground exploration programs	E (D)	1 (PI)	1 (L)		
		2.1.b. Subsidence Prediction and Impact Assessment prepared by DgS					
		2.1.c. Dwelling located over Main Headings					
		2.1.d. Dwelling located near 20mm limit of predicted subsidence					
		2.1.e. Subsidence prediction below SSR criteria					
		2.1.f. SA NSW pre-mining inspection					
		2.1.g. Communication with landowner during mining					
		2.1.h. pre-mining inspection					
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits tilting the dwelling ::: Caused by: ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ damage to structure causing a risk to health and safety.	2.2.a. Geology defined by surface and underground exploration programs	E (D)	1 (PI)	1 (L)		
		2.2.b. Subsidence Prediction and Impact Assessment prepared by DgS					
		2.2.c. Dwelling located over Main Headings					
		2.2.d. Dwellings located near 20mm limit of predicted subsidence					
		2.2.e. Subsidence prediction below SSR criteria					
		2.2.f. SA NSW pre-mining inspection					
		2.2.g. pre-mining inspection					
		2.2.h. Communication with landowner during mining					
	There is a risk to Mandalong from ::: predicted subsidence placing strains on the dwelling ::: Caused by: ▪ expected geotechnical conditions Resulting in: ▪ damage to structure causing a risk to health	2.3.a. Geology defined by surface and underground exploration programs	E (D)	1 (PI)	1 (L)		
		2.3.b. Dwelling located over Main Headings					
		2.3.c. Subsidence Prediction and Impact Assessment prepared by DgS					
		2.3.d. Subsidence prediction below SSR criteria					
		2.3.e. Dwellings located near 20mm limit of predicted subsidence					

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extension
	and safety.	2.3.f. SA NSW pre-mining inspection 2.3.g. Communication with landowner during mining					
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits placing strains on the dwelling ::: Caused by: ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ damage to structure causing a risk to health and safety.	2.4.a. Geology defined by surface and underground exploration programs 2.4.b. Subsidence Prediction and Impact Assessment prepared by DgS 2.4.c. Dwelling located over Main Headings 2.4.d. Dwellings located near 20mm limit of predicted subsidence 2.4.e. Subsidence prediction below SSR criteria 2.4.f. SA NSW pre-mining inspection 2.4.g. Communication with landowner during mining	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits at the dwelling ::: Caused by: ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ a change in the flood hazard category at a 1 in 100 year ARI storm event ▪ reduction in dwelling freeboard to less than 500mm above 100 year ARI storm event.	2.5.a. Subsidence Prediction and Impact Assessment prepared by DgS 2.5.b. Flood modelling and assessment 2.5.c. Dwelling located outside floodplain 2.5.d. Flood modelling - No increase to pre-mining flood hazard category at dwelling at 100 year ARI storm event 2.5.e. Flood modelling - dwelling freeboard remains higher than 0.5m above the 100 year ARI storm event	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: predicted subsidence on buildings and structures ::: Caused by: ▪ expected geotechnical conditions Resulting in: ▪ damage to building and structures causing a	2.6.a. Subsidence Prediction and Impact Assessment prepared by DgS 2.6.b. Sheds are single storey steel structures 2.6.c. Buildings located over Main Headings 2.6.d. Buildings located near 20mm limit of subsidence 2.6.e. SA NSW pre-mining inspection	E (D)	1 (PI)	1 (L)		

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extension
	risk to health and safety.						
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on buildings and structures ::: Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ damage to building and structures causing a risk to health and safety.	2.7.a. Subsidence Prediction and Impact Assessment prepared by DgS 2.7.b. Sheds are single storey steel structures 2.7.c. Buildings located over Main Headings 2.7.d. Buildings located near 20mm limit of subsidence 2.7.e. SA NSW pre-mining inspection	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on communications lines ::: Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ interruption to communications causing a risk to health and safety.	2.8.a. Communications Management Plan 2.8.b. Mobile coverage	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on power lines ::: Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ interruption to power supply causing a risk to health and safety.	2.9.a. Powerline Management Plan	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from	2.10.a. Dams located over Main Headings	E	1	1		

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extension
	::: predicted subsidence on farm dams ::: Caused by: ▪ expected geotechnical conditions Resulting in: ▪ dam failure and increased risk to health and safety.	2.10.b. Subsidence monitoring	(D)	(PI)	(L)		
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on farm dams ::: Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ dam failure and increased risk to health and safety.	2.11.a. Dams located over Main Headings 2.11.b. Subsidence monitoring	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: predicted subsidence on fences ::: Caused by: ▪ expected geotechnical conditions Resulting in: ▪ damage to fence and escape of livestock resulting in a risk to health and safety.	2.12.a. Communication with landowner during mining 2.12.b. Limited access to private property 2.12.c. low speed roads 2.12.d. pre-mining inspection 2.12.e. post-mining inspection	D (IF)	2 (PI)	5 (L)		
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on fences ::: Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated	2.13.a. Communication with landowner during mining 2.13.b. Limited access to private property 2.13.c. low speed roads 2.13.d. pre-mining inspection 2.13.e. post-mining inspection	D (IF)	1 (PI)	2 (L)		

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extension
	Resulting in: ▪ damage to fence and escape of livestock resulting in a risk to health and safety.						
	There is a risk to Mandalong from ::: predicted subsidence on property access roads ::: Caused by: ▪ expected geotechnical conditions Resulting in: ▪ damage to road(s) and increased risk to health and safety.	2.14.a. Gravel access road 2.14.b. Limited access to private property 2.14.c. low speed roads 2.14.d. pre-mining inspection 2.14.e. post-mining inspection 2.14.f. communication with landowner during mining	D (D)	2 (PI)	5 (L)		
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on property access roads ::: Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ damage to road(s) and increased risk to health and safety.	2.15.a. Gravel access road 2.15.b. Limited access to private property 2.15.c. low speed roads 2.15.d. pre-mining inspection 2.15.e. post-mining inspection 2.15.f. communication with landowner during mining	D (D)	2 (PI)	5 (L)		
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on property access roads ::: Caused by: ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ a change in the flood hazard category at a 1 in 1 year ARI storm event.	2.16.a. Property located outside floodplain 2.16.b. Flood modelling and assessment	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95%	2.17.a. Property located outside floodplain 2.17.b. Flood modelling and assessment	E (D)	1 (PI)	1 (L)		

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Exten sion
	Confidence Limits on property access roads ::: Caused by: ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ a change in the flood hazard category at a 1 in 100 year ARI storm event.						
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on culvert ::: Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ damage to bridge and increased risk to health and safety.	2.18.a. Flood modelling and assessment 2.18.b. Property located outside floodplain 2.18.c. SA NSW pre-mining inspection 2.18.d. communication with landowner during mining 2.18.e. Subsidence monitoring 2.18.f. post-mining inspection	D (D)	1 (PI)	2 (L)		
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on Creek ::: Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ risk to health and safety.	2.19.a. Flood modelling and assessment 2.19.b. Property located outside floodplain 2.19.c. Water Management Plan 2.19.d. Land Management Plan 2.19.e. Flood path inspections 2.19.f. Subsidence monitoring	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits resulting in remnant ponding ::: Caused by: ▪ geological anomaly	2.20.a. Flood modelling and assessment 2.20.b. Potential remnant ponding locations identified in Flood modelling and assessment 2.20.c. Water Management Plan 2.20.d. Flood path inspections 2.20.e. Land Management Plan	E (D)	1 (PI)	1 (L)		

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Exten sion
	- geotechnical conditions being worse than anticipated Resulting in: - risk to health and safety.	2.20.f. Subsidence monitoring					
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on land ::: Caused by: - geological anomaly - geotechnical conditions being worse than anticipated Resulting in: - increased soil or tunnel erosion resulting in a risk to health and safety.	2.21.a. Land and Agricultural Resource Assessment 2.21.b. Flood modelling and assessment 2.21.c. Land Management Plan 2.21.d. pre-mining inspection 2.21.e. post-mining inspection 2.21.f. communication with landowner during mining	D (D)	1 (PI)	2 (L)		
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on steep slopes ::: Caused by: - expected geotechnical conditions - geotechnical conditions being worse than anticipated Resulting in: - overhang collapse - risk to health and safety - rock roll-out - slope instability - surface cracking.	2.22.a. Subsidence Prediction and Impact Assessment prepared by DgS - slope stability and erosion 2.22.b. Dwelling and buildings not exposed to rock roll out potential. 2.22.c. Controlled and limited access to the property 2.22.d. communication with landowner during mining 2.22.e. Slope stability inspections 2.22.f. Public Safety Management Plan 2.22.g. Land Management Plan	D (D)	4 (PI)	14 (S)		

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Exten sion
3. MS0025 Saunders	There is a risk to Mandalong from ::: predicted subsidence tilting the dwelling ::: Caused by: ▪ expected geotechnical conditions Resulting in: ▪ damage to structure causing a risk to health and safety.	3.1.a. Subsidence Prediction and Impact Assessment prepared by DgS 3.1.b. Dwelling - caravan with supplementary verandahs 3.1.c. Dwellings located near 20mm limit of predicted subsidence 3.1.d. Subsidence prediction below SSR criteria 3.1.e. Structural inspection and assessment of dwelling by Structural Engineer 3.1.f. Structural engineer confirmed dwelling tolerance to predicted subsidence 3.1.g. No hazards identified in dwelling structural inspection 3.1.h. SA NSW pre-mining inspection 3.1.i. communication with landowner during mining 3.1.j. Subsidence monitoring	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits tilting the dwelling ::: Caused by: ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ damage to structure causing a risk to health and safety.	3.2.a. Subsidence Prediction and Impact Assessment prepared by DgS 3.2.b. Dwelling - caravan with supplementary verandahs 3.2.c. Dwellings located near 20mm limit of predicted subsidence 3.2.d. Subsidence prediction below SSR criteria 3.2.e. Structural inspection and assessment of dwelling by Structural Engineer 3.2.f. Structural engineer confirmed dwelling tolerance to predicted subsidence 3.2.g. No hazards identified in dwelling structural inspection 3.2.h. SA NSW pre-mining inspection 3.2.i. communication with landowner during	E (D)	1 (PI)	1 (L)		

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Exten sion
		mining					
	There is a risk to Mandalong from ::: predicted subsidence placing strains on the dwelling ::: Caused by: ▪ expected geotechnical conditions Resulting in: ▪ damage to structure causing a risk to health and safety.	3.3.a. Subsidence Prediction and Impact Assessment prepared by DgS 3.3.b. Dwellings located near 20mm limit of predicted subsidence 3.3.c. Subsidence prediction below SSR criteria 3.3.d. Dwelling - caravan with supplementary verandahs 3.3.e. Structural inspection and assessment of dwelling by Structural Engineer 3.3.f. No hazards identified in dwelling structural inspection 3.3.g. SA NSW pre-mining inspection 3.3.h. communication with landowner during mining	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits placing strains on the dwelling ::: Caused by: ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ damage to structure causing a risk to health and safety.	3.4.a. Geology defined by surface and underground exploration programs 3.4.b. Subsidence Prediction and Impact Assessment prepared by DgS 3.4.c. Dwellings located near 20mm limit of predicted subsidence 3.4.d. Dwelling - caravan with supplementary verandahs 3.4.e. Subsidence prediction below SSR criteria 3.4.f. Structural inspection and assessment of dwelling by Structural Engineer 3.4.g. No hazards identified in dwelling structural inspection 3.4.h. SA NSW pre-mining inspection 3.4.i. communication with landowner during mining	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from	3.5.a. Flood modelling and assessment 3.5.b. Property located outside floodplain	E (D)	1 (PI)	1 (L)		

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extension
	∴ subsidence at the worst- case, Upper 95% Confidence Limits at the dwelling ∴ Caused by: - geotechnical conditions being worse than anticipated Resulting in: - a change in the flood hazard category at a 1 in 100 year ARI storm event - reduction in dwelling freeboard to less than 500mm above 100 year ARI storm event.	3.5.c. Flood modelling - dwelling freeboard remains higher than 0.5m above the 100 year ARI storm event 3.5.d. Flood modelling - No increase to pre-mining flood hazard category at dwelling at 100 year ARI storm event					
	There is a risk to Mandalong from ∴ subsidence at the worst- case, Upper 95% Confidence Limits on buildings and structures ∴ Caused by: - geological anomaly - geotechnical conditions being worse than anticipated Resulting in: - damage to building and structures causing a risk to health and safety.	3.6.a. Buildings located outside EP Area 3.6.b. Buildings are converted shipping containers 3.6.c. Structural inspection and assessment of buildings by Structural Engineer 3.6.d. No hazards identified in structural inspection	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ∴ predicted subsidence on communication lines ∴ Caused by: - expected geotechnical conditions Resulting in: - interruption to communications causing a risk to health and safety.	3.7.a. Communications Management Plan 3.7.b. Mobile coverage	D (Pj)	1 (PI)	2 (L)		
	There is a risk to Mandalong from ∴ subsidence at the worst- case, Upper 95% Confidence Limits on communications lines ∴ Caused by:	3.8.a. Communications Management Plan 3.8.b. Mobile coverage	D (Pj)	1 (PI)	2 (L)		

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Exten sion
	- geological anomaly - geotechnical conditions being worse than anticipated Resulting in: - interruption to communications causing a risk to health and safety.						
	There is a risk to Mandalong from ::: predicted subsidence on power lines ::: Caused by: - expected geotechnical conditions Resulting in: - interruption to power supply causing a risk to health and safety.	3.9.a. Powerline Management Plan 3.9.b. Property not connected to grid 3.9.c. Power supplied by solar panels, batteries and generator	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on power lines ::: Caused by: - geological anomaly - geotechnical conditions being worse than anticipated Resulting in: - interruption to power supply causing a risk to health and safety.	3.10.a. Powerline Management Plan 3.10.b. Property not connected to grid 3.10.c. Power supplied by solar panels, batteries and generator	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: predicted subsidence on farm dams ::: Caused by: - expected geotechnical conditions Resulting in: - dam failure and increased risk to health and safety.	3.11.a. Dams located at limit of subsidence zone 3.11.b. Dam located below dwelling 3.11.c. Pre-mining structural inspection by structural engineer 3.11.d. No hazards identified in structural inspection 3.11.e. Subsidence monitoring	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from	3.12.a. Dams located at limit of subsidence zone	E (D)	1 (PI)	1 (L)		

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extension
	::: subsidence at the worst- case, Upper 95% Confidence Limits on farm dams ::: Caused by: - geological anomaly - geotechnical conditions being worse than anticipated Resulting in: - dam failure and increased risk to health and safety.	3.12.b. Dam located below dwelling 3.12.c. Pre-mining structural inspection by structural engineer 3.12.d. No hazards identified in structural inspection 3.12.e. Subsidence monitoring					
	There is a risk to Mandalong from ::: predicted subsidence on fences ::: Caused by: - expected geotechnical conditions Resulting in: - damage to fence and escape of livestock resulting in a risk to health and safety.	3.13.a. communication with landowner during mining 3.13.b. pre-mining inspection 3.13.c. post-mining inspection	D (Pj)	1 (PI)	2 (L)		
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limitson fences ::: Caused by: - geological anomaly - geotechnical conditions being worse than anticipated Resulting in: - damage to fence and escape of livestock resulting in a risk to health and safety.	3.14.a. pre-mining inspection 3.14.b. communication with landowner during mining 3.14.c. post-mining inspection	D (Pi)	2 (PI)	5 (L)		
	There is a risk to Mandalong from ::: predicted subsidence on property access roads ::: Caused by: expected geotechnical conditions	3.15.a. Gravel access road 3.15.b. low speed roads 3.15.c. Limited access to private property 3.15.d. pre-mining inspection 3.15.e. communication with landowner during mining	D (D)	1 (PI)	2 (L)		

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Exten sion
	Resulting in: ▪ damage to road(s) and increased risk to health and safety.	3.15.f. post-mining inspection					
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on property access roads ::: Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ damage to road(s) and increased risk to health and safety.	3.16.a. Gravel access road 3.16.b. low speed roads 3.16.c. Limited access to private property 3.16.d. pre-mining inspection 3.16.e. communication with landowner during mining 3.16.f. post-mining inspection	D (D)	1 (PI)	2 (L)		
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on property access roads ::: Caused by: ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ a change in the flood hazard category at a 1 in 1 year ARI storm event.	3.17.a. Property located outside floodplain 3.17.b. Flood modelling - no increase in flood hazard category along access route at 1 year ARI storm event	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on property access roads ::: Caused by: ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ a change in the flood hazard category at a 1 in 100 year ARI storm event.	3.18.a. Property located outside floodplain 3.18.b. Flood modelling - no increase in flood hazard category along access route at 100 year ARI storm event	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from	3.19.a. Flood modelling and assessment	E	1	1		

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Exten sion
	::: predicted subsidence on Creek ::: Caused by: ▪ expected geotechnical conditions Resulting in: ▪ risk to health and safety.	3.19.b. Potential remnant ponding locations identified in Flood modelling and assessment 3.19.c. Water Management Plan 3.19.d. Land Management Plan 3.19.e. Flood path inspections 3.19.f. communication with landowner during mining 3.19.g. Subsidence monitoring	(D)	(PI)	(L)		
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limitson Creek ::: Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ risk to health and safety.	3.20.a. Flood modelling and assessment 3.20.b. Potential remnant ponding locations identified in Flood modelling and assessment 3.20.c. Water Management Plan 3.20.d. Land Management Plan 3.20.e. Flood path inspections 3.20.f. communication with landowner during mining 3.20.g. Subsidence monitoring	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits resulting in remnant ponding ::: Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ risk to health and safety.	3.21.a. Flood modelling and assessment 3.21.b. Potential remnant ponding locations identified in Flood modelling and assessment 3.21.c. Land and Agricultural Resource Assessment 3.21.d. Land Management Plan	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: predicted subsidence on land ::: Caused by: ▪ expected geotechnical conditions	3.22.a. Land and Agricultural Resource Assessment 3.22.b. Limited access to private property 3.22.c. Land Management Plan 3.22.d. pre-mining inspection	E (D)	1 (PI)	1 (L)		

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Exten sion
	Resulting in: ▪ increased soil or tunnel erosion resulting in a risk to health and safety.	3.22.e. post-mining inspection					
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on land ::: Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ increased soil or tunnel erosion resulting in a risk to health and safety.	3.23.a. Land and Agricultural Resource Assessment 3.23.b. Limited access to private property 3.23.c. Land Management Plan 3.23.d. pre-mining inspection 3.23.e. post-mining inspection 3.23.f. communication with landowner during mining	E (D)	2 (PI)	3 (L)		
	There is a risk to Mandalong from ::: predicted subsidence on steep slopes ::: Caused by: ▪ expected geotechnical conditions Resulting in: ▪ risk to health and safety ▪ rock roll-out ▪ slope instability ▪ surface cracking.	3.24.a. Subsidence Prediction and Impact Assessment prepared by DgS - slope stability and erosion 3.24.b. Dwelling and buildings not exposed to rock roll out potential. 3.24.c. Limited access to private property 3.24.d. Land Management Plan 3.24.e. Slope stability inspections 3.24.f. communication with landowner during mining	D (D)	4 (PI)	14 (S)		
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on steep slopes ::: Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ risk to health and safety ▪ rock roll-out	3.25.a. Subsidence Prediction and Impact Assessment prepared by DgS - slope stability and erosion 3.25.b. Dwelling not located in the vicinity of steep slopes 3.25.c. Limited access to private property 3.25.d. Land Management Plan 3.25.e. Slope stability inspections 3.25.f. communication with landowner during mining	D (D)	4 (PI)	14 (S)		



Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Exten sion
	▪ slope instability ▪ surface cracking.						

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extension
4. MS0138 Gaydon	There is a risk to Mandalong from ∴ subsidence at the worst- case, Upper 95% Confidence Limits tilting the dwelling ∴ Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ damage to structure causing a risk to health and safety.	4.1.a. Dwelling located outside EP area 4.1.b. Subsidence Prediction and Impact Assessment prepared by DgS	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ∴ subsidence at the worst- case, Upper 95% Confidence Limits placing strains on the dwelling ∴ Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ damage to structure causing a risk to health and safety.	4.2.a. Dwelling located outside EP area 4.2.b. Subsidence Prediction and Impact Assessment prepared by DgS	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ∴ subsidence at the worst- case, Upper 95% Confidence Limits at the dwelling ∴ Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ a change in the flood hazard category at a 1 in 100 year ARI storm event ▪ reduction in dwelling freeboard to less than 500mm above 100 year ARI storm event.	4.3.a. Dwelling located outside EP area 4.3.b. Dwelling located outside floodplain 4.3.c. Flood modelling - dwelling freeboard remains higher than 0.5m above the 100 year ARI storm event 4.3.d. Flood modelling - No increase to pre-mining flood hazard category at dwelling at 100 year ARI storm event	E (D)	1 (PI)	1 (L)		

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Exten sion
	There is a risk to Mandalong from ::: predicted subsidence on buildings and structures ::: Caused by: ▪ expected geotechnical conditions Resulting in: ▪ damage to building and structures causing a risk to health and safety.	4.4.a. Buildings located outside EP Area	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on buildings and structures ::: Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ damage to building and structures causing a risk to health and safety.	4.5.a. Buildings located outside EP Area	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: predicted subsidence on communication lines ::: Caused by: ▪ expected geotechnical conditions Resulting in: ▪ interruption to communications causing a risk to health and safety.	4.6.a. Communication lines located outside EP Area 4.6.b. Communications Management Plan	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limitson communications lines ::: Caused by: ▪ geological anomaly	4.7.a. Communication lines located outside EP Area 4.7.b. Communications Management Plan	E (D)	1 (PI)	1 (L)		

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Exten sion
	- geotechnical conditions being worse than anticipated Resulting in: - interruption to communications causing a risk to health and safety.						
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on power lines ::: Caused by: - geological anomaly - geotechnical conditions being worse than anticipated Resulting in: - interruption to power supply causing a risk to health and safety.	4.8.a. Powerlines located outside EP Area 4.8.b. Powerline Management Plan	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: predicted subsidence on farm dams ::: Caused by: - expected geotechnical conditions Resulting in: - dam failure and increased risk to health and safety.	4.9.a. Dams located outside EP Area	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on farm dams ::: Caused by: - geological anomaly - geotechnical conditions being worse than anticipated Resulting in: - dam failure and increased risk to health and safety.	4.10.a. Dams located outside EP Area	E (D)	1 (PI)	1 (L)		

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extension
	There is a risk to Mandalong from ::: predicted subsidence on fences ::: Caused by: ▪ expected geotechnical conditions Resulting in: ▪ damage to fence and escape of livestock resulting in a risk to health and safety.	4.11.a. communication with landowner during mining	E (IF)	1 (PI)	1 (L)		
		4.11.b. pre-mining inspection					
		4.11.c. post-mining inspection					
		4.11.d. subsidence only eastern boundary fence in bushland					
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on fences ::: Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ damage to fence and escape of livestock resulting in a risk to health and safety.	4.12.a. communication with landowner during mining	E (D)	1 (PI)	1 (L)		
		4.12.b. pre-mining inspection					
		4.12.c. post-mining inspection					
		4.12.d. subsidence only eastern boundary fence in bushland					
	There is a risk to Mandalong from ::: predicted subsidence on property access roads ::: Caused by: ▪ expected geotechnical conditions Resulting in: ▪ damage to road(s) and increased risk to health and safety.	4.13.a. Access road located outside EP Area	E (D)	1 (PI)	1 (L)		
		4.13.b. tracks only					
		4.13.c. pre-mining inspection					
		4.13.d. post-mining inspection					
		4.13.e. communication with landowner during mining					
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limitson property access roads ::: Caused by: ▪ geological anomaly	4.14.a. Access road located outside EP Area	E (D)	1 (PI)	1 (L)		
		4.14.b. tracks only					
		4.14.c. slow traffic speed					
		4.14.d. pre-mining inspection					
		4.14.e. post-mining inspection					

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extension
	- geotechnical conditions being worse than anticipated Resulting in: - damage to road(s) and increased risk to health and safety.	4.14.f. communication with landowner during mining					
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limit on property access roads ::: Caused by: - geological anomaly - geotechnical conditions being worse than anticipated Resulting in: - a change in the flood hazard category at a 1 in 1 year ARI storm event.	4.15.a. Property located outside floodplain 4.15.b. Flood modelling - no increase in flood hazard category along access route at 1 year ARI storm event	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: predicted subsidence on property access roads ::: Caused by: - expected geotechnical conditions Resulting in: - a change in the flood hazard category at a 1 in 100 year ARI storm event.	4.16.a. Property located outside floodplain 4.16.b. Flood modelling - no increase in flood hazard category along access route at 100 year ARI storm event	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on property access roads ::: Caused by: - geological anomaly - geotechnical conditions being worse than anticipated Resulting in: - a change in the flood hazard category at a 1 in	4.17.a. Property located outside floodplain 4.17.b. Flood modelling - no increase in flood hazard category along access route at 100 year ARI storm event	E (D)	1 (PI)	1 (L)		

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Exten sion
	100 year ARI storm event.						
	There is a risk to Mandalong from ::: predicted subsidence on Creek ::: Caused by: ▪ expected geotechnical conditions Resulting in: ▪ risk to health and safety.	4.18.a. Property located outside floodplain 4.18.b. Flood modelling and assessment 4.18.c. Water Management Plan 4.18.d. Flood path inspections 4.18.e. Subsidence monitoring	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limitson Creek ::: Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ risk to health and safety.	4.19.a. Property located outside floodplain 4.19.b. Flood modelling and assessment 4.19.c. Water Management Plan 4.19.d. Flood path inspections 4.19.e. Subsidence monitoring	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: predicted subsidence resulting in remnant ponding ::: Caused by: ▪ expected geotechnical conditions Resulting in: ▪ risk to health and safety.	4.20.a. Flood modelling and assessment 4.20.b. Potential remant ponding locations identified in Flood modelling and assessment 4.20.c. Land Management Plan 4.20.d. Biodiversity Management Plan 4.20.e. Flood path inspections 4.20.f. Subsidence monitoring	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits resulting in remnant ponding ::: Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated	4.21.a. Flood modelling and assessment 4.21.b. Potential remant ponding locations identified in Flood modelling and assessment 4.21.c. Land Management Plan 4.21.d. Biodiversity Management Plan 4.21.e. Flood path inspections 4.21.f. Subsidence monitoring	E (D)	1 (PI)	1 (L)		

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Exten sion
	Resulting in: ▪ risk to health and safety.						
	There is a risk to Mandalong from ::: predicted subsidence on land ::: Caused by: ▪ expected geotechnical conditions Resulting in: ▪ increased soil or tunnel erosion resulting in a risk to health and safety.	4.22.a. Land and Agricultural Resource Assessment 4.22.b. Land Management Plan 4.22.c. pre-mining inspection 4.22.d. post-mining inspection	E (Pj)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on land ::: Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ increased soil or tunnel erosion resulting in a risk to health and safety.	4.23.a. Land and Agricultural Resource Assessment 4.23.b. Land Management Plan 4.23.c. pre-mining inspection 4.23.d. post-mining inspection	E (Pj)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: predicted subsidence on steep slopes ::: Caused by: ▪ expected geotechnical conditions Resulting in: ▪ overhang collapse ▪ risk to health and safety ▪ rock roll-out ▪ slope instability ▪ surface cracking.	4.24.a. Subsidence Prediction and Impact Assessment prepared by DgS - slope stability and erosion 4.24.b. Dwelling located outside EP area 4.24.c. Dwelling not located in the vicinity of steep slopes 4.24.d. Low level of subsidence on property 4.24.e. Land Management Plan 4.24.f. Slope stability inspections 4.24.g. Subsidence monitoring	E (D)	4 (PI)	10 (M)		
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95%	4.25.a. Subsidence Prediction and Impact Assessment prepared by DgS - slope stability and erosion	E (D)	4 (PI)	10 (M)		

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Exten sion
	Confidence Limits on steep slopes ::: Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ overhang collapse ▪ risk to health and safety ▪ rock roll-out ▪ slope instability ▪ surface cracking.	4.25.b. Dwelling not located in the vicinity of steep slopes					
		4.25.c. Low level of subsidence on property					
		4.25.d. Land Management Plan					
		4.25.e. Slope stability inspections					
		4.25.f. Subsidence monitoring					

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extension
5. MS0139 Brereton	There is a risk to Mandalong from ::: predicted subsidence tilting the dwelling ::: Caused by: ▪ expected geotechnical conditions Resulting in: ▪ damage to structure causing a risk to health and safety.	5.1.a. Dwelling located over proposed Main Headings	E (D)	1 (PI)	1 (L)		
		5.1.b. Subsidence Prediction and Impact Assessment prepared by DgS					
		5.1.c. Dwellings located near 20mm limit of predicted subsidence					
		5.1.d. Subsidence prediction below SSR criteria					
		5.1.e. SA NSW pre-mining inspection					
		5.1.f. communication with landowner during mining					
		5.1.g. Subsidence monitoring					
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits tilting the dwelling ::: Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ damage to structure causing a risk to health and safety.	5.2.a. Dwelling located over proposed Main Headings	E (D)	1 (PI)	1 (L)		
		5.2.b. Subsidence Prediction and Impact Assessment prepared by DgS					
		5.2.c. Dwellings located near 20mm limit of predicted subsidence					
		5.2.d. Subsidence prediction below SSR criteria					
		5.2.e. SA NSW pre-mining inspection					
		5.2.f. communication with landowner during mining					
	There is a risk to Mandalong from ::: predicted subsidence placing strains on the dwelling ::: Caused by: ▪ expected geotechnical conditions Resulting in: ▪ damage to structure causing a risk to health and safety.	5.3.a. Dwelling located over proposed Main Headings	E (D)	1 (PI)	1 (L)		
		5.3.b. Subsidence Prediction and Impact Assessment prepared by DgS					
		5.3.c. Dwellings located near 20mm limit of predicted subsidence					
		5.3.d. Subsidence prediction below SSR criteria					
		5.3.e. SA NSW pre-mining inspection					
		5.3.f. communication with landowner during mining					
	There is a risk to Mandalong from	5.4.a. Dwelling located over proposed Main Headings	E (D)	1 (PI)	1 (L)		

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Exten sion
	::: subsidence at the worst- case, Upper 95% Confidence Limits placing strains on the dwelling ::: Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ damage to structure causing a risk to health and safety.	5.4.b. Subsidence Prediction and Impact Assessment prepared by DgS 5.4.c. Dwellings located near 20mm limit of predicted subsidence 5.4.d. Subsidence prediction below SSR criteria 5.4.e. SA NSW pre-mining inspection 5.4.f. communication with landowner during mining					
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits at the dwelling ::: Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ a change in the flood hazard category at a 1 in 100 year ARI storm event ▪ reduction in dwelling freeboard to less than 500mm above 100 year ARI storm event.	5.5.a. Dwelling located outside floodplain 5.5.b. Flood modelling and assessment 5.5.c. Flood modelling - dwelling freeboard remains higher than 0.5m above the 100 year ARI storm event 5.5.d. Flood modelling - No increase to pre-mining flood hazard category at dwelling at 100 year ARI storm event	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: predicted subsidence on buildings and structures ::: Caused by: ▪ expected geotechnical conditions Resulting in: ▪ damage to building and structures causing a risk to health and safety.	5.6.a. Buildings located over proposed Main Headings 5.6.b. Subsidence Prediction and Impact Assessment prepared by DgS 5.6.c. Buildings located near 20mm limit of subsidence 5.6.d. SA NSW pre-mining inspection 5.6.e. Subsidence monitoring	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on buildings and structures :::	5.7.a. Buildings located over proposed Main Headings 5.7.b. Buildings located near 20mm limit of subsidence	E (D)	1 (PI)	1 (L)		

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extension
	Caused by: - geological anomaly - geotechnical conditions being worse than anticipated Resulting in: - damage to building and structures causing a risk to health and safety.	5.7.c. SA NSW pre-mining inspection 5.7.d. Subsidence monitoring					
	There is a risk to Mandalong from ::: predicted subsidence on communication lines ::: Caused by: - expected geotechnical conditions Resulting in: - interruption to communications causing a risk to health and safety.	5.8.a. Communication service not connected 5.8.b. Communications Management Plan	E (Op)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limitson communications lines ::: Caused by: - geological anomaly - geotechnical conditions being worse than anticipated Resulting in: - interruption to communications causing a risk to health and safety.	5.9.a. Communication service not connected 5.9.b. Communications Management Plan	E (D)	2 (PI)	3 (L)		
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on power lines ::: Caused by: - geological anomaly - geotechnical conditions being worse than anticipated	5.10.a. Power supplied by solar panels and batteries 5.10.b. Powerline Management Plan	E (D)	1 (PI)	1 (L)		

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extension
	Resulting in: ▪ interruption to power supply causing a risk to health and safety.						
	There is a risk to Mandalong from ::: predicted subsidence on farm dams ::: Caused by: ▪ expected geotechnical conditions	5.11.a. Dams located over proposed Main Headings 5.11.b. Dams located at limit of subsidence zone 5.11.c. Dam located below dwelling 5.11.d. SA NSW pre-mining inspection 5.11.e. post-mining inspection 5.11.f. Subsidence monitoring	E (D)	1 (PI)	1 (L)		
	Resulting in: ▪ dam failure and increased risk to health and safety.						
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on farm dams ::: Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated	5.12.a. Dams located over proposed Main Headings 5.12.b. Dams located at limit of subsidence zone 5.12.c. SA NSW pre-mining inspection 5.12.d. post-mining inspection 5.12.e. Subsidence monitoring	E (D)	1 (PI)	1 (L)		
	Resulting in: ▪ dam failure and increased risk to health and safety.						
	There is a risk to Mandalong from ::: predicted subsidence on fences ::: Caused by: ▪ expected geotechnical conditions	5.13.a. Majority of fencing over Main Headings - limited subsidence 5.13.b. Communication with landowner during mining 5.13.c. pre-mining inspection 5.13.d. post-mining inspection	D (IF)	2 (PI)	5 (L)		
	Resulting in: ▪ damage to fence and escape of livestock resulting in a risk to health and safety.						
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on fences :::	5.14.a. Majority of fencing over Main Headings - limited subsidence 5.14.b. pre-mining inspection 5.14.c. Communication with landowner	D (IF)	2 (PI)	5 (L)		

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Exten sion
	Caused by: - geological anomaly - geotechnical conditions being worse than anticipated Resulting in: - damage to fence and escape of livestock resulting in a risk to health and safety.	during mining 5.14.d. post-mining inspection					
	There is a risk to Mandalong from ::: predicted subsidence on property access roads ::: Caused by: - expected geotechnical conditions Resulting in: - damage to road(s) and increased risk to health and safety.	5.15.a. Property access road located over proposed Main Headings - limited subsidence 5.15.b. low speed roads 5.15.c. pre-mining inspection 5.15.d. post-mining inspection 5.15.e. communication with landowner during mining	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on property access roads ::: Caused by: - geological anomaly - geotechnical conditions being worse than anticipated Resulting in: - damage to road(s) and increased risk to health and safety.	5.16.a. Property access road located over proposed Main Headings - limited subsidence 5.16.b. low speed roads 5.16.c. pre-mining inspection 5.16.d. post-mining inspection 5.16.e. communication with landowner during mining	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on property access roads ::: Caused by: geotechnical conditions being worse than anticipated	5.17.a. Flood modelling and assessment 5.17.b. Property located outside floodplain 5.17.c. pre-mining inspection 5.17.d. post-mining inspection 5.17.e. communication with landowner during mining	E (D)	1 (PI)	1 (L)		

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extension
	Resulting in: ▪ a change in the flood hazard category at a 1 in 1 year ARI storm event.						
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits ::: Caused by: ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ a change in the flood hazard category at a 1 in 100 year ARI storm event.	5.18.a. Flood modelling and assessment 5.18.b. Property located outside floodplain 5.18.c. pre-mining inspection 5.18.d. post-mining inspection 5.18.e. communication with landowner during mining	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: predicted subsidence on Creek ::: Caused by: ▪ expected geotechnical conditions Resulting in: ▪ risk to health and safety.	5.19.a. Flood modelling and assessment 5.19.b. Property located outside floodplain 5.19.c. Water Management Plan 5.19.d. Land Management Plan 5.19.e. Flood path inspections 5.19.f. Subsidence monitoring	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on Creek ::: Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ risk to health and safety.	5.20.a. Flood modelling and assessment 5.20.b. Property located outside floodplain 5.20.c. Water Management Plan 5.20.d. Land Management Plan 5.20.e. Flood path inspections 5.20.f. Subsidence monitoring	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits resulting in remnant ponding :::	5.21.a. Flood modelling and assessment 5.21.b. Land Management Plan 5.21.c. Potential remnant ponding locations identified in Flood modelling and assessment	E (D)	1 (PI)	1 (L)		

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extension
	Caused by: - geological anomaly - geotechnical conditions being worse than anticipated Resulting in: - risk to health and safety.	5.21.d. Flood path inspections 5.21.e. Subsidence monitoring					
	There is a risk to Mandalong from ::: predicted subsidence on land ::: Caused by: - expected geotechnical conditions Resulting in: - increased soil or tunnel erosion resulting in a risk to health and safety.	5.22.a. Land and Agricultural Resource Assessment 5.22.b. Land Management Plan 5.22.c. pre-mining inspection 5.22.d. post-mining inspection	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on land ::: Caused by: - geological anomaly - geotechnical conditions being worse than anticipated Resulting in: - increased soil or tunnel erosion resulting in a risk to health and safety.	5.23.a. Land and Agricultural Resource Assessment 5.23.b. Land Management Plan 5.23.c. pre-mining inspection 5.23.d. post-mining inspection	D (D)	1 (PI)	2 (L)		
	There is a risk to Mandalong from ::: predicted subsidence on steep slopes ::: Caused by: - expected geotechnical conditions Resulting in: - overhang collapse - risk to health and safety	5.24.a. Subsidence Prediction and Impact Assessment prepared by DgS - slope stability and erosion 5.24.b. Dwelling and buildings not exposed to rock roll out potential. 5.24.c. Slope stability inspections 5.24.d. Land Management Plan 5.24.e. communication with landowner during mining	D (D)	4 (PI)	14 (S)		

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extension
	- rock roll-out - slope instability - surface cracking.	5.24.f. Limited access to private property					
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on steep slopes ::: Caused by: - expected geotechnical conditions - geotechnical conditions being worse than anticipated Resulting in: - overhang collapse - risk to health and safety - rock roll-out - slope instability - surface cracking.	5.25.a. Subsidence Prediction and Impact Assessment prepared by DgS - slope stability and erosion 5.25.b. Dwelling and buildings not exposed to rock roll out potential. 5.25.c. Slope stability inspections 5.25.d. Land Management Plan 5.25.e. communication with landowner during mining 5.25.f. Limited access to private property	D (D)	4 (PI)	14 (S)		

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extension
6. MS0068 Rogers	There is a risk to Mandalong from ::: predicted subsidence tilting the dwelling ::: Caused by: ▪ expected geotechnical conditions Resulting in: ▪ damage to structure causing a risk to health and safety.	6.1.a. Dwelling located over proposed Main Headings	E (D)	1 (PI)	1 (L)		
		6.1.b. Dwelling located outside 20mm limit of subsidence					
		6.1.c. Subsidence prediction below SSR criteria					
		6.1.d. Subsidence Prediction and Impact Assessment prepared by DgS					
		6.1.e. Communication with landowner during mining					
		6.1.f. Subsidence monitoring					
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits tilting the dwelling ::: Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ damage to structure causing a risk to health and safety.	6.2.a. Dwelling located over proposed Main Headings	E (D)	1 (PI)	1 (L)		
		6.2.b. Dwelling located outside 20mm limit of subsidence					
		6.2.c. Subsidence prediction below SSR criteria					
		6.2.d. Subsidence Prediction and Impact Assessment prepared by DgS					
		6.2.e. Communication with landowner during mining					
		6.2.f. Subsidence monitoring					
	There is a risk to Mandalong from ::: predicted subsidence placing strains on the dwelling ::: Caused by: ▪ expected geotechnical conditions Resulting in: ▪ damage to structure causing a risk to health and safety.	6.3.a. Dwelling located over proposed Main Headings	E (D)	1 (PI)	1 (L)		
		6.3.b. Dwelling located outside 20mm limit of subsidence					
		6.3.c. Subsidence Prediction and Impact Assessment prepared by DgS					
		6.3.d. Communication with landowner during mining					
		6.3.e. Subsidence monitoring					
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits placing strains on the dwelling	6.4.a. Dwelling located over proposed Main Headings	E (D)	1 (PI)	1 (L)		
		6.4.b. Subsidence Prediction and Impact Assessment prepared by DgS					

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Exten sion
	∴ Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ damage to structure causing a risk to health and safety.	6.4.c. Dwelling located outside 20mm limit of subsidence					
		6.4.d. SA NSW pre-mining inspection					
		6.4.e. Communication with landowner during mining					
		6.4.f. Subsidence monitoring					
	There is a risk to Mandalong from ∴ subsidence at the worst- case, Upper 95% Confidence Limits at the dwelling ∴ Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ a change in the flood hazard category at a 1 in 100 year ARI storm event ▪ reduction in dwelling freeboard to less than 500mm above 100 year ARI storm event.	6.5.a. Flood modelling and assessment					
		6.5.b. Dwelling located outside floodplain					
		6.5.c. Flood modelling - dwelling freeboard remains higher than 0.5m above the 100 year ARI storm event					
	There is a risk to Mandalong from ∴ predicted subsidence on buildings and structures ∴ Caused by: ▪ expected geotechnical conditions Resulting in: ▪ damage to building and structures causing a risk to health and safety.	6.6.a. Buildings located over Main Headings					
		6.6.b. Subsidence Prediction and Impact Assessment prepared by DgS					
		6.6.c. Buildings located near 20mm limit of subsidence	E (D)	1 (PI)	1 (L)		
		6.6.d. Subsidence monitoring					
		6.6.e. Communication with landowner during mining					
	There is a risk to Mandalong from ∴ subsidence at the worst- case, Upper 95% Confidence Limits on buildings and structures ∴	6.7.a. Buildings located over Main Headings					
		6.7.b. Subsidence Prediction and Impact Assessment prepared by DgS	E (D)	1 (PI)	1 (L)		
		6.7.c. Buildings located near 20mm limit of					

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extension
	Caused by: - geological anomaly - geotechnical conditions being worse than anticipated Resulting in: - damage to building and structures causing a risk to health and safety.	subsidence 6.7.d. Subsidence monitoring 6.7.e. Communication with landowner during mining					
	There is a risk to Mandalong from ::: predicted subsidence on communication lines ::: Caused by: - expected geotechnical conditions Resulting in: - interruption to communications causing a risk to health and safety.	6.8.a. Communications Management Plan 6.8.b. Communication with landowner during mining	E (Pj)	1 (R)	1 (L)		
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limitson communications lines ::: Caused by: - geological anomaly - geotechnical conditions being worse than anticipated Resulting in: - interruption to communications causing a risk to health and safety.	6.9.a. Communications Management Plan 6.9.b. Communication with landowner during mining	E (Pj)	1 (R)	1 (L)		
	There is a risk to Mandalong from ::: predicted subsidence on power lines ::: Caused by: - expected geotechnical conditions Resulting in: - interruption to power supply causing a risk to health and safety.	6.10.a. Powerline Management Plan	E (Pj)	1 (PI)	1 (L)		

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Exten sion
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on power lines ::: Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ interruption to power supply causing a risk to health and safety.	6.11.a. Powerline Management Plan	E (Pi)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: predicted subsidence on farm dams ::: Caused by: ▪ expected geotechnical conditions Resulting in: ▪ dam failure and increased risk to health and safety.	6.12.a. Dams located below dwelling 6.12.b. Subsidence monitoring 6.12.c. pre-mining inspection 6.12.d. post-mining inspection	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on farm dams ::: Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ dam failure and increased risk to health and safety.	6.13.a. Dams located below dwelling 6.13.b. pre-mining inspection 6.13.c. Subsidence monitoring 6.13.d. post-mining inspection	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: predicted subsidence on fences ::: Caused by:	6.14.a. Limited fencing 6.14.b. No livestock 6.14.c. pre-mining inspection 6.14.d. post-mining inspection	E (D)	1 (PI)	1 (L)		

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Exten sion
	- expected geotechnical conditions Resulting in: - damage to fence and escape of livestock resulting in a risk to health and safety.	6.14.e. communication with landowner during mining					
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on fences ::: Caused by: - geological anomaly - geotechnical conditions being worse than anticipated Resulting in: - damage to fence and escape of livestock resulting in a risk to health and safety.	6.15.a. Limited fencing 6.15.b. No livestock 6.15.c. pre-mining inspection 6.15.d. communication with landowner during mining 6.15.e. post-mining inspection	E (D)	2 (PI)	3 (L)		
	There is a risk to Mandalong from ::: predicted subsidence on property access roads ::: Caused by: - expected geotechnical conditions Resulting in: - damage to road(s) and increased risk to health and safety.	6.16.a. Gravel access road 6.16.b. low speed roads 6.16.c. Limited access to private property 6.16.d. pre-mining inspection 6.16.e. post-mining inspection 6.16.f. communication with landowner during mining	D (D)	1 (PI)	2 (L)		
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on property access roads ::: Caused by: - geological anomaly - geotechnical conditions being worse than anticipated Resulting in: - damage to road(s) and increased risk to health and safety.	6.17.a. Gravel access road 6.17.b. low speed roads 6.17.c. Limited access to private property 6.17.d. pre-mining inspection 6.17.e. post-mining inspection 6.17.f. communication with landowner during mining	D (D)	1 (PI)	2 (L)		

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Exten sion
	There is a risk to Mandalong from ::: predicted subsidence on Creek ::: Caused by: ▪ expected geotechnical conditions Resulting in: ▪ risk to health and safety.	6.18.a. Flood modelling and assessment	E (D)	1 (PI)	1 (L)		
		6.18.b. Property located outside floodplain					
		6.18.c. Water Management Plan					
		6.18.d. Land Management Plan					
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on Creek ::: Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ risk to health and safety.	6.18.e. Flood path inspections	E (D)	1 (PI)	1 (L)		
		6.18.f. Subsidence monitoring					
		6.19.a. Flood modelling and assessment					
		6.19.b. Property located outside floodplain					
	There is a risk to Mandalong from ::: predicted subsidence resulting in remnant ponding ::: Caused by: ▪ expected geotechnical conditions Resulting in: ▪ risk to health and safety.	6.19.c. Water Management Plan	E (D)	1 (PI)	1 (L)		
		6.19.d. Land Management Plan					
		6.19.e. Flood path inspections					
		6.19.f. Subsidence monitoring					
	There is a risk to Mandalong from ::: predicted subsidence resulting in remnant ponding ::: Caused by: ▪ expected geotechnical conditions Resulting in: ▪ risk to health and safety.	6.20.a. Flood modelling and assessment	E (Pi)	1 (PI)	1 (L)		
		6.20.b. Property located outside floodplain					
		6.20.c. Land Management Plan					
		6.20.d. Potential remant ponding locations identified in Flood modelling and assessment					
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits resulting in remnant ponding ::: Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated	6.20.e. pre-mining inspection	E (Pi)	1 (PI)	1 (L)		
		6.20.f. post-mining inspection					
		6.21.a. Flood modelling and assessment					
		6.21.b. Property located outside floodplain					
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits resulting in remnant ponding ::: Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated	6.21.c. Potential remant ponding locations identified in Flood modelling and assessment	E (Pi)	1 (PI)	1 (L)		
		6.21.d. Land Management Plan					
		6.21.e. pre-mining inspection					
		6.21.f. post-mining inspection					

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extension
	Resulting in: ▪ risk to health and safety.						
	There is a risk to Mandalong from ::: predicted subsidence on land ::: Caused by: ▪ expected geotechnical conditions Resulting in: ▪ increased soil or tunnel erosion resulting in a risk to health and safety.	6.22.a. Land and Agricultural Resource Assessment 6.22.b. Land Management Plan 6.22.c. pre-mining inspection 6.22.d. post-mining inspection	D (Pi)	1 (PI)	2 (L)		
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on land ::: Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ increased soil or tunnel erosion resulting in a risk to health and safety.	6.23.a. Mine design providing low levels of subsidence 6.23.b. Land and Agricultural Resource Assessment 6.23.c. Land Management Plan 6.23.d. pre-mining inspection 6.23.e. post-mining inspection	D (Pi)	1 (PI)	2 (L)		
	There is a risk to Mandalong from ::: predicted subsidence on steep slopes ::: Caused by: ▪ expected geotechnical conditions Resulting in: ▪ overhang collapse ▪ risk to health and safety ▪ rock roll-out ▪ slope instability ▪ surface cracking.	6.24.a. Subsidence Prediction and Impact Assessment prepared by DgS - slope stability and erosion 6.24.b. Dwelling and buildings not exposed to rock roll out potential. 6.24.c. Limited access to private property 6.24.d. Slope stability inspections 6.24.e. communication with landowner during mining	D (D)	4 (PI)	14 (S)		
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95%	6.25.a. Subsidence Prediction and Impact Assessment prepared by DgS - slope stability and erosion	D (D)	4 (PI)	14 (S)		

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Exten sion
	Confidence Limits on steep slopes ::: Caused by: ▪ expected geotechnical conditions ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ overhang collapse ▪ risk to health and safety ▪ rock roll-out ▪ slope instability ▪ surface cracking.	6.25.b. Dwelling and buildings not exposed to rock roll out potential.					
		6.25.c. Limited access to private property					
		6.25.d. Slope stability inspections					
		6.25.e. communication with landowner during mining					

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Exten sion
7. MS0021 Hyde	There is a risk to Mandalong from ∴∴ subsidence at the worst- case, Upper 95% Confidence Limits tilting the dwelling ∴∴ Caused by: ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ damage to building and structures causing a risk to health and safety.	7.1.a. Dwelling located outside EP area	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ∴∴ subsidence at the worst- case, Upper 95% Confidence Limits placing strains on the dwelling ∴∴ Caused by: ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ damage to building and structures causing a risk to health and safety.	7.2.a. Dwelling located outside EP area	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ∴∴ subsidence at the worst- case, Upper 95% Confidence Limits on buildings and structures ∴∴ Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ damage to building and structures causing a risk to health and safety.	7.3.a. Buildings located outside EP Area	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ∴∴ subsidence at the worst- case, Upper 95% Confidence Limitson communications lines ∴∴	7.4.a. Communication lines located outside EP Area 7.4.b. Communications Management Plan	E (Op)	1 (PI)	1 (L)		

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Exten sion
	Caused by: - geological anomaly - geotechnical conditions being worse than anticipated Resulting in: - interruption to communications causing a risk to health and safety.						
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on power lines ::: Caused by: - geological anomaly - geotechnical conditions being worse than anticipated Resulting in: - interruption to power supply causing a risk to health and safety.	7.5.a. Powerlines located outside EP Area 7.5.b. Powerline Management Plan	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on farm dams ::: Caused by: - geological anomaly - geotechnical conditions being worse than anticipated Resulting in: - dam failure and increased risk to health and safety.	7.6.a. Dams located outside EP Area	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: predicted subsidence on fences ::: Caused by: expected geotechnical conditions	7.7.a. Only eastern boundary affected by subsidence 7.7.b. Low level of subsidence on property 7.7.c. pre-mining inspection 7.7.d. post-mining inspection 7.7.e. communication with landowner	E (D)	1 (PI)	1 (L)		

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extension
	Resulting in: ▪ damage to fence and escape of livestock resulting in a risk to health and safety.	during mining					
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on fences ::: Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ damage to fence and escape of livestock resulting in a risk to health and safety.	7.8.a. Only eastern boundary affected by subsidence 7.8.b. Low level of subsidence on property 7.8.c. pre-mining inspection 7.8.d. post-mining inspection 7.8.e. communication with landowner during mining	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: predicted subsidence on property access roads ::: Caused by: ▪ expected geotechnical conditions Resulting in: ▪ damage to road(s) and increased risk to health and safety.	7.9.a. Access road located outside EP Area 7.9.b. Low level of subsidence on property 7.9.c. post-mining inspection	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on property access roads ::: Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ damage to road(s) and increased risk to health and safety.	7.10.a. Access road located outside EP Area 7.10.b. Low level of subsidence on property 7.10.c. post-mining inspection	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from	7.11.a. Property access road located outside EP Area	E (D)	1 (PI)	1 (L)		

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extension
	::: subsidence at the worst- case, Upper 95% Confidence Limits on property access roads ::: Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ a change in the flood hazard category at a 1 in 1 year ARI storm event.						
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on Creek ::: Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ risk to health and safety.	7.12.a. Flood modelling and assessment 7.12.b. Water Management Plan 7.12.c. Land Management Plan 7.12.d. Flood path inspections 7.12.e. communication with landowner during mining 7.12.f. Subsidence monitoring	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits resulting in remnant ponding ::: Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ risk to health and safety.	7.13.a. Flood modelling and assessment 7.13.b. Potential remnant ponding locations identified in Flood modelling and assessment 7.13.c. Land Management Plan 7.13.d. post-mining inspection 7.13.e. communication with landowner during mining	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: predicted subsidence on land ::: Caused by: ▪ expected geotechnical conditions	7.14.a. Flood modelling and assessment 7.14.b. Land and Agricultural Resource Assessment 7.14.c. Land Management Plan 7.14.d. post-mining inspection	E (PI)	1 (PI)	1 (L)		

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extension
	Resulting in: ▪ increased soil or tunnel erosion resulting in a risk to health and safety.	7.14.e. communication with landowner during mining					
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on land ::: Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ increased soil or tunnel erosion resulting in a risk to health and safety.	7.15.a. Flood modelling and assessment 7.15.b. Land and Agricultural Resource Assessment 7.15.c. Land Management Plan 7.15.d. post-mining inspection 7.15.e. communication with landowner during mining	D (D)	1 (PI)	2 (L)		
	There is a risk to Mandalong from ::: predicted subsidence on steep slopes ::: Caused by: ▪ expected geotechnical conditions Resulting in: ▪ overhang collapse ▪ risk to health and safety ▪ rock roll-out ▪ slope instability ▪ surface cracking.	7.16.a. Subsidence Prediction and Impact Assessment prepared by DgS - slope stability and erosion 7.16.b. Low level of subsidence on property 7.16.c. Land Management Plan 7.16.d. Public Safety Management Plan 7.16.e. Limited access to private property 7.16.f. communication with landowner during mining	E (D)	4 (PI)	10 (M)		
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on steep slopes ::: Caused by: ▪ expected geotechnical conditions ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ overhang collapse	7.17.a. Mine design providing low levels of subsidence 7.17.b. Subsidence Prediction and Impact Assessment prepared by DgS - slope stability and erosion 7.17.c. Limited access to private property 7.17.d. Land Management Plan 7.17.e. communication with landowner during mining	E (D)	4 (PI)	10 (M)		



Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Exten sion
	▪ risk to health and safety ▪ rock roll-out ▪ slope instability ▪ surface cracking.						

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Exten sion
8. MS0045 Wyee Holdings	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on buildings and structures ::: Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ damage to building and structures causing a risk to health and safety.	8.1.a. No dwellings and buildings on property	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on communications lines ::: Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ interruption to communications causing a risk to health and safety.	8.2.a. No communications to property 8.2.b. Communications Management Plan	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: predicted subsidence on farm dams ::: Caused by: ▪ expected geotechnical conditions Resulting in: ▪ dam failure and increased risk to health and safety.	8.3.a. Subsidence monitoring 8.3.b. pre-mining inspection 8.3.c. post-mining inspection	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on farm dams ::: Caused by:	8.4.a. Subsidence monitoring 8.4.b. pre-mining inspection 8.4.c. post-mining inspection	E (D)	1 (PI)	1 (L)		

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Exten sion
	- geological anomaly - geotechnical conditions being worse than anticipated Resulting in: - dam failure and increased risk to health and safety.						
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limitson fences ::: Caused by: - geological anomaly - geotechnical conditions being worse than anticipated Resulting in: - damage to fence and escape of livestock resulting in a risk to health and safety.	8.5.a. No fences on property 8.5.b. No livestock	E (D)	2 (PI)	3 (L)		
	There is a risk to Mandalong from ::: predicted subsidence on property access roads ::: Caused by: - expected geotechnical conditions Resulting in: - damage to road(s) and increased risk to health and safety.	8.6.a. Limited access to private property 8.6.b. Gravel access road 8.6.c. low speed roads 8.6.d. pre-mining inspection 8.6.e. post-mining inspection 8.6.f. communication with landowner during mining	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limitson property access roads ::: Caused by: - geological anomaly - geotechnical conditions being worse than anticipated Resulting in:	8.7.a. Limited access to private property 8.7.b. Gravel access road 8.7.c. low speed roads 8.7.d. pre-mining inspection 8.7.e. post-mining inspection 8.7.f. communication with landowner during mining	E (D)	1 (PI)	1 (L)		

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Exten sion
	damage to road(s) and increased risk to health and safety.						
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limitson property access roads ::: Caused by: - geotechnical conditions being worse than anticipated Resulting in: - a change in the flood hazard category at a 1 in 1 year ARI storm event.	8.8.a. Property located outside floodplain	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on property access roads ::: Caused by: - geological anomaly - geotechnical conditions being worse than anticipated Resulting in: - a change in the flood hazard category at a 1 in 100 year ARI storm event.	8.9.a. Property located outside floodplain	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on Creek ::: Caused by: - geological anomaly - geotechnical conditions being worse than anticipated Resulting in: - risk to health and safety.	8.10.a. Flood modelling and assessment 8.10.b. Property located outside floodplain 8.10.c. Water Management Plan 8.10.d. Flood path inspections 8.10.e. Subsidence monitoring	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from	8.11.a. Flood modelling and assessment 8.11.b. Potential remant ponding locations	E (D)	1 (PI)	1 (L)		

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Exten sion
	∴ subsidence at the worst- case, Upper 95% Confidence Limits resulting in remnant ponding ∴ Caused by: - geological anomaly - geotechnical conditions being worse than anticipated Resulting in: - risk to health and safety.	identified in Flood modelling and assessment 8.11.c. Land and Agricultural Resource Assessment 8.11.d. Land Management Plan 8.11.e. Flood path inspections 8.11.f. Subsidence monitoring					
	There is a risk to Mandalong from ∴ predicted subsidence on land ∴ Caused by: - expected geotechnical conditions Resulting in: - increased soil or tunnel erosion resulting in a risk to health and safety.	8.12.a. Land Management Plan 8.12.b. Limited access to private property 8.12.c. pre-mining inspection 8.12.d. post-mining inspection 8.12.e. communication with landowner during mining	D (Pj)	1 (PI)	2 (L)		
	There is a risk to Mandalong from ∴ subsidence at the worst- case, Upper 95% Confidence Limits on land ∴ Caused by: - geological anomaly - geotechnical conditions being worse than anticipated Resulting in: - increased soil or tunnel erosion resulting in a risk to health and safety.	8.13.a. Land Management Plan 8.13.b. Limited access to private property 8.13.c. pre-mining inspection 8.13.d. post-mining inspection 8.13.e. communication with landowner during mining	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ∴ predicted subsidence on steep slopes ∴ Caused by: expected geotechnical conditions Resulting in:	8.14.a. Subsidence Prediction and Impact Assessment prepared by DgS - slope stability and erosion 8.14.b. Controlled and limited access to the property 8.14.c. Slope stability inspections 8.14.d. Public Safety Management Plan	E (D)	1 (PI)	1 (L)		

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extension
	▪ overhang collapse ▪ risk to health and safety ▪ rock roll-out ▪ slope instability ▪ surface cracking.	8.14.e. communication with landowner during mining					
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on steep slopes ::: Caused by: ▪ expected geotechnical conditions ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ overhang collapse ▪ risk to health and safety ▪ rock roll-out ▪ slope instability ▪ surface cracking.	8.15.a. Subsidence Prediction and Impact Assessment prepared by DgS - slope stability and erosion 8.15.b. Controlled and limited access to the property 8.15.c. Slope stability inspections 8.15.d. Public Safety Management Plan 8.15.e. communication with landowner during mining	E (D)	1 (PI)	1 (L)		

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extension
9. MS0128 Siekaup	There is a risk to Mandalong from ∴∴ subsidence at the worst- case, Upper 95% Confidence Limits tilting the dwelling ∴∴ Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ damage to structure causing a risk to health and safety.	9.1.a. Dwelling located outside EP area	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ∴∴ subsidence at the worst- case, Upper 95% Confidence Limits placing strains on the dwelling ∴∴ Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ damage to structure causing a risk to health and safety.	9.2.a. Dwelling located outside EP area	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ∴∴ subsidence at the worst- case, Upper 95% Confidence Limits on buildings and structures ∴∴ Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ damage to building and structures causing a risk to health and safety.	9.3.a. Buildings located outside EP Area	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from	9.4.a. Communication lines located outside EP Area	E (D)	1 (PI)	1 (L)		

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Exten sion
	::: predicted subsidence on communication lines ::: Caused by: ▪ expected geotechnical conditions Resulting in: ▪ interruption to communications causing a risk to health and safety.	9.4.b. Communications Management Plan					
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on communications lines ::: Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ interruption to communications causing a risk to health and safety.	9.5.a. Communication lines located outside EP Area 9.5.b. Communications Management Plan	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on power lines ::: Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ interruption to power supply causing a risk to health and safety.	9.6.a. Powerline Management Plan	E (Pj)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on farm dams ::: Caused by: ▪ geological anomaly	9.7.a. Dams located outside EP Area	E (D)	1 (PI)	1 (L)		

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extension
	- geotechnical conditions being worse than anticipated Resulting in: - dam failure and increased risk to health and safety.						
	There is a risk to Mandalong from ::: predicted subsidence on fences ::: Caused by: - expected geotechnical conditions Resulting in: - damage to fence and escape of livestock resulting in a risk to health and safety.	9.8.a. Property located near 20mm subsidence limit 9.8.b. Limited fencing 9.8.c. No livestock 9.8.d. Communication with landowner during mining 9.8.e. pre-mining inspection 9.8.f. post-mining inspection	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on fences ::: Caused by: - geological anomaly - geotechnical conditions being worse than anticipated Resulting in: - damage to fence and escape of livestock resulting in a risk to health and safety.	9.9.a. Property located near 20mm subsidence limit 9.9.b. Limited fencing 9.9.c. No livestock 9.9.d. pre-mining inspection 9.9.e. post-mining inspection 9.9.f. Communication with landowner during mining	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: predicted subsidence on property access roads ::: Caused by: - expected geotechnical conditions Resulting in: - damage to road(s) and increased risk to health and safety.	9.10.a. Property access road located outside EP Area 9.10.b. Property located near 20mm subsidence limit 9.10.c. Gravel access road 9.10.d. low speed roads 9.10.e. pre-mining inspection 9.10.f. post-mining inspection 9.10.g. Communication with landowner during mining	E (PI)	1 (PI)	1 (L)		

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extension
		9.10.h. Property access road located outside EP Area					
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits on property access roads ::: Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ damage to road(s) and increased risk to health and safety.	9.11.a. Property access road located outside EP Area 9.11.b. Property located near 20mm subsidence limit 9.11.c. Gravel access road 9.11.d. pre-mining inspection 9.11.e. low speed roads 9.11.f. post-mining inspection 9.11.g. Subsidence monitoring	E (Pj)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: subsidence at the worst- case, Upper 95% Confidence Limits resulting in remnant ponding ::: Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ risk to health and safety.	9.12.a. Property located outside floodplain 9.12.b. Property located near 20mm subsidence limit 9.12.c. Flood modelling and assessment 9.12.d. Potential remnant ponding locations identified in Flood modelling and assessment 9.12.e. Land Management Plan 9.12.f. communication with landowner during mining 9.12.g. post-mining inspection	E (D)	1 (PI)	1 (L)		
	There is a risk to Mandalong from ::: predicted subsidence on land ::: Caused by: ▪ expected geotechnical conditions Resulting in: ▪ increased soil or tunnel erosion resulting in a risk to health and safety.	9.13.a. Property located near 20mm subsidence limit 9.13.b. Flood modelling and assessment 9.13.c. Land and Agricultural Resource Assessment 9.13.d. Land Management Plan 9.13.e. pre-mining inspection 9.13.f. communication with landowner during mining 9.13.g. post-mining inspection	E (Pj)	1 (PI)	1 (L)		
	There is a risk to Mandalong from	9.14.a. Property located near 20mm	E	1	1		

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extension
	∴∴∴ subsidence at the worst- case, Upper 95% Confidence Limits on land ∴∴∴ Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ increased soil or tunnel erosion resulting in a risk to health and safety.	subsidence limit 9.14.b. Flood modelling and assessment 9.14.c. Land and Agricultural Resource Assessment 9.14.d. Land Management Plan 9.14.e. pre-mining inspection 9.14.f. communication with landowner during mining 9.14.g. post-mining inspection	(Pj)	(PI)	(L)		
	There is a risk to Mandalong from ∴∴∴ predicted subsidence on steep slopes ∴∴∴ Caused by: ▪ expected geotechnical conditions Resulting in: ▪ overhang collapse ▪ risk to health and safety ▪ rock roll-out ▪ slope instability ▪ surface cracking.	9.15.a. Subsidence Prediction and Impact Assessment prepared by DgS - slope stability and erosion 9.15.b. Property located near 20mm subsidence limit 9.15.c. Dwelling located outside EP area 9.15.d. Limited access to private property 9.15.e. Slope stability inspections	E (D)	4 (PI)	10 (M)		
	There is a risk to Mandalong from ∴∴∴ subsidence at the worst- case, Upper 95% Confidence Limits on steep slopes ∴∴∴ Caused by: ▪ geological anomaly ▪ geotechnical conditions being worse than anticipated Resulting in: ▪ overhang collapse ▪ risk to health and safety ▪ rock roll-out ▪ slope instability ▪ surface cracking.	9.16.a. Subsidence Prediction and Impact Assessment prepared by DgS - slope stability and erosion 9.16.b. Property located near 20mm subsidence limit 9.16.c. Limited access to private property 9.16.d. Slope stability inspections	E (D)	1 (PI)	1 (L)		

Site: Mandalong
Title: Mandalong Extraction Plan LW 30-31 PSMP
Stature ID:1001285007
Version: 1
Lifecycle State:

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CEY Risk Matrix Page 1

CENTENNIAL RISK MATRIX							Likelihood					Description (D)
Rating	Consequence						A Certain	B Probable	C Possible	D Remote	E Improbable	Probability (Pb)
	Note: Consequence may result from a single event or may represent a cumulative impact over a period of 12 months. Use the worst case reasonable consequence if there is more than one.						Common	Has Happened within Centennial	Could Happen & has happened in non-CEY operations	Not Likely	Practically impossible	
	Financial Impact to Annual Business Plan (F)	Personal Injury (PI)	Business Interruption (BI)	Legal (L)	Reputation (R)	Environment (E)	Frequent incidents	Regular incidents	Infrequent incidents	Unlikely to occur. Very few recorded or known incidents	May occur in exceptional circumstances. Almost no recorded incidents.	Incident Frequency (IF)
							Operations – within 3 months	Operations – within 2 years	Operations – within 5 years	Operations – within 10 years	Operations – within 30 years	Operations (Op)
							Project – Every project	Project – Every 2 projects	Project – Every 5 projects	Project – Every 10 projects	Project – Every 30 projects	Project (Pr)
5. Catastrophic	>\$50m	Multiple Fatalities	> 1 month	Prolonged litigation, heavy fines, potential jail term	Prolonged International media attention	Long term impairment habitats/ ecosystem	25 (E)	24 (E)	21 (H)	19 (H)	15 (S)	
4. Major	\$10m - \$50m	Single Fatality	1 week to 1 month	Major breach/ major litigation	International media attention	Long term effects of ecosystem	23 (E)	22 (E)	18 (H)	14 (S)	10 (M)	
3. Moderate	\$1m - \$10m	Serious/ Disabling Injury	1 day to 1 week	Serious breach of regulation, prosecution/ fine	National media attention	Serious medium term environmental effects	20 (H)	17 (H)	13 (S)	9 (M)	6 (L)	
2. Minor	\$100k - \$1m	Lost Time Injury	12 hrs to 1 day	Non-compliance, breaches in regulation	Adverse local public attention	Minor effects to physical environment	16 (S)	12 (S)	8 (M)	5 (L)	3 (L)	
1. Insignificant	<\$100k	First Aid Treatment Only	< 12 hrs	Low level compliance issue	Local complaints	Limited physical damage	11 (S)	7 (M)	4 (L)	2 (L)	1 (L)	

CEY Risk Matrix Page 2

Risk Rating	Risk Category		Generic Management Actions
22 to 25	E	Extreme	Action is required to eliminate or reduce the risk. If the risk is considered to be ALARP then the decision to accept the risk is to be made by Centennial Coal Chief Executive
17 to 21	H	High	Action is required to eliminate or reduce the risk. If the risk is considered to be ALARP then the decision to accept the risk is to be made by the relevant Centennial Coal Executive General Manager
11 to 16	S	Significant	Action is required to eliminate or reduce the risk. If the risk is considered to be ALARP then the decision to accept the risk is to be made by the Manager of the Centennial Coal Operation
7 to 10	M	Moderate	Action is required to eliminate or reduce the risk. If the risk is considered to be ALARP then the decision to accept the risk is to be made by the Manager of the Centennial Coal Operation
1 to 6	L	Low	Actions to eliminate or further reduce the risk should be considered. If risk is considered to be ALARP then the decision to accept the risk is to be made by the risk assessment owner (no recommended control is required to be created for this)

CEY Risk Matrix Page 3

BOW TIE ANALYSIS - Control Effectiveness Matrix									
TYPE OF CONTROL	Examples	Description	Rank	Control Category	CONTROL – Impact / Status / Quality				
					A ≥ 80%	B 50 – 80%	C 50 / 50%	D 50 – 20%	E ≤ 20%
	Replace electric hand tools with compressed air alternatives in wet conditions	Eliminates a hazard by removal	1.	Elimination of hazard	100	45.0	40.0	14.0	10.0
	Replace large diameter, heavy cables with smaller ones that are easier to handle manually	Replace element with less risky alternative	2.	Substitution	85.0	40.0	35.0	13.0	8.5
	Automatic fire fighting sprinkler systems, Earth Leakage protection devices	An automatic device that operates without intervention by personnel	3.	Engineered without people	70.0	30.0	25.0	12.0	7.0
	Fire alarm that sounds & the operator then has to initiate an evacuation	A device that requires personnel to respond to a stimulus	4.	Engineered with people	50.0	20.0	14.0	10.0	5.0
	Inspection, maintenance and repair of machinery	A process carried out by personnel	5.	Procedural	20.0	15.0	10.0	6.5	2.0
	Employee made aware of dangers of large moving equipment where the operators have limited vision	Induction training programs	6.	Awareness	5.0	3.0	2.5	1.5	1.0