SIMEC

MEMBER OF GFG ALLIANCE

Response to Submissions

Prepared for Tahmoor Coal Pty Ltd

February 2020

T: (02) 4640 0100 **E:** tahmoorenquiries@simecgfg.com **W:** www.tahmoorcoal.com.au

www.simec.com/mining

SIMEC Mining Site Address: 2975 Remembrance Drive, Bargo | Postal Address: PO Box 100, Tahmoor NSW 2573, Australia

Response to Submissions

Client: Tahmoor Coal Pty Ltd

ABN: 97 076 663 968

Prepared by

AECOM Australia Pty Ltd
Level 21, 420 George Street, Sydney NSW 2000, PO Box Q410, QVB Post Office NSW 1230, Australia
T +61 2 8934 0000 F +61 2 8934 0001 www.aecom.com
ABN 20 093 846 925

20-Feb-2020

Job No.: 60588857

AECOM in Australia and New Zealand is certified to ISO9001, ISO14001 AS/NZS4801 and OHSAS18001.

Table of Contents

Executive Summary i
1.0 Introduction 1-1
1.1 Overview of the Project 1-1
1.2 Overview of Approval Process and Exhibition 1-3
1.3 Purpose of this Report 1-4
1.4 Structure of this Report 1-4
2.0 Project Amendments 2-1
2.1 Mine Plan 2-1
2.2 REA Extension 2-1
2.3 REA operations 2-2
2.4 Power Line Easement 2-2
2.5 Mine Ventilation 2-2
3.0 Stakeholder Engagement 3-1
4.0 Summary of Submissions 4-1
4.1 Submissions Received 4-1
4.2 Matters Raised – Commonwealth and State Government Agencies 4-1
4.3 Matters Raised – Local Councils 4-1
4.4 Matters Raised –Organisations 4-1
4.5 Matters Raised – Community Submissions 4-2
4.6 DPIE identified key issues 4-4
5.0 Response to Government Agency and Council Submissions 5-1
5.1 Commonwealth Independent Expert Scientific Committee 5-1
5.1.1 Subsidence, Surface Water and Groundwater: Modelling Context 5-1
5.1.2 Subsidence: Modelling IPM Method 5-3
5.1.3 Subsidence: Consistency with Geotechnical Assessments 5-4
5.1.4 Subsidence: Height of Fracture Zone 5-6
5.1.5 Groundwater: Modelling of drawdown 5-7
5.1.6 Groundwater: water losses and impacts to watercourses/ GDES 5-8
5.1.7 Groundwater: modelling adequacy 5-8
5.1.8 Groundwater: additional assessment/ monitoring 5-9
5.1.9 Groundwater: Uncertainty Analysis 5-9
5.1.10 Surface and groundwater: ecosystem impacts 5-10
5.1.11 Surface and groundwater: additional information 5-11
5.1.12 Surface Water: AWB Model 5-12
5.1.13 Surface Water: Flooding assessment 5-13
5.1.14 Surface Water: Water quality changes from surface cracking 5-14
5.1.15 Surface Water: Water quality exceedances 5-15
5.1.16 Aquatic Ecology: Adequacy of assessment 5-16
5.1.17 Terrestrial and Aquatic Ecology: Impacts and offsets 5-18
5.1.18 Surface Water: Overflow from Sediment dams 5-18
5.1.19 Surface and groundwater: water storage in mine goaf 5-19
5.1.20 Thirlmere Lakes and Metropolitan Special Area 5-20
5.1.21 Geology: Impacts of Nepean Fault 5-21
5.1.22 Thirlmere Lakes: Impacts of mining 5-22
5.1.23 Thirlmere Lakes: future models based on ongoing research 5-23
5.1.24 Groundwater: Modelling of bore users 5-23
5.1.25 Groundwater: Aquifer Interference Policy 5-24
5.1.26 Groundwater: Far-field non-conventional impacts 5-24
5.1.27 Groundwater: Regional drawdown 5-25
5.1.28 Surface and Groundwater: NorBE Predictions 5-25
5.1.29 Mine Layout: Longwall placement 5-26
5.1.30 Eco-hydrological conceptual model to underpin management plans 5-27
5.1.31 Subsidence and Surface Water: Creek Remediation 5-27
5.1.32 Surface and groundwater: water quality mitigation recommendations 5-30
5.1.33 Subsidence: Monitoring and mitigation recommendations 5-30

5.1.34 Groundwater Monitoring: Recommendations 5-32
5.1.35 Surface Water Monitoring: Recommendations 5-34
5.1.36 Terrestrial and Aquatic Ecology: Monitoring recommendations 5-35
5.1.37 Aquatic Ecology: Sydney Hawk Dragonfly surveys 5-35
5.1.38 Aquatic Ecology: Baseline information gathering 5-35
5.2 Department of Industry (Lands and Water Division) 5-36
5.2.1 DPI - Agriculture 5-36
5.2.2 DPI - Fisheries 5-36
5.2.3 DoI - Lands 5-38
5.2.4 DoI - Water and Natural Resources Access Regulator (WNRAR) 5-38
5.3 DPIE (Division of Resources and Geoscience) 5-59
5.3.1 Resources and Economic Assessment 5-59
5.3.2 Existing Mining Titles 5-59
5.3.3 Additional Mining Titles 5-59
5.4 Environment Protection Authority 5-59
5.4.1 Noise and vibration: Low frequency noise 5-59
5.4.2 Noise and vibration: Operational modelling scenarios 5-61
5.4.3 Noise and vibration: Operational modelling assumptions 5-61
5.4.4 Noise and vibration: Church and College Receivers 5-63
5.4.5 Noise and vibration: Presentation of findings 5-63
5.4.6 Noise and vibration: Model Validation 5-64
5.4.7 Noise and vibration: Impacts during all time periods 5-64
5.4.8 Noise and vibration: Mitigation and VLAMP 5-64
5.4.9 Noise and vibration: Existing Mine Noise 5-66
5.4.10 Noise and vibration: Sleep Disturbance 5-67
5.4.11 Noise and vibration: Background Noise Levels 5-68
5.4.12 Noise and vibration: Vibration assessment 5-68
5.4.13 Noise and vibration: Additional assessment 5-69
5.4.14 Surface Water: Water quality impacts of LDP1 discharge 5-69
5.4.15 Surface Water: Metals discharges via LDP1 5-70
5.4.16 Surface Water: Salinity Concentrations 5-71
5.4.17 Surface Water: Ionic Impacts 5-72
5.4.18 Surface Water: Other Pollutants 5-72
5.4.19 Surface Water: Mixing Zone Policy and Principles 5-73
5.4.20 Surface Water: Additional Assessment 5-73
5.4.21 Surface Water: Storage Liners 5-75
5.4.22 Surface Water: Underground Water Storage in Goaf 5-75
5.4.23 Surface Water: Trigger Values 5-76
5.4.24 Surface Water: Water Quality Criteria 5-76
5.4.25 Surface Water: Controlled discharges and managed overflows 5-77
5.4.26 Surface Water: Sewage Management and Assessment 5-80
5.4.27 Reject Disposal Assessment: Rejects Disposal Options Assessment 5-81
5.4.28 Reject Disposal Assessment: REA AMD and SCA 5-81
5.4.29 Reject Disposal Assessment: Reject Disposal Impact Assessment 5-83
5.4.30 Air Quality: Impact Assessment 5-86
5.4.31 Air Quality: Management and Mitigation 5-86
5.4.32 Subsidence: Bargo Waste Management Centre 5-86
5.5 Heritage Council of NSW 5-88
5.5.1 Wirrimbirra Sanctuary Impacts 5-88
5.6 NSW Health 5-91
5.6.1 Health Impact Assessment 5-91
5.6.2 Air Quality 5-91
5.6.3 Noise 5-92
5.6.4 Water Quality 5-94
5.6.5 Social Impact assessment 5-94
5.7 Office of Environment and Heritage 5-94
5.7.1 Biodiversity: Biodiversity and Offsets 5-94
5.7.2 Biodiversity: Avoidance of impacts 5-96

5.7.3 Biodiversity: Hollow-bearing Trees and Further Loss of EEC 5-100
5.7.4 Biodiversity: Impacts for Further Consideration 5-101
5.7.5 Biodiversity: Subsidence impacts 5-102
5.7.6 Biodiversity: Threatened species survey and assessment 5-102
5.7.7 Biodiversity: Matters of National Environmental Significance 5-104
5.7.8 Biodiversity: MNES Offsets 5-104
5.7.9 Biodiversity: Offsets within mining leases 5-106
5.7.10 Biodiversity: Staged Offset Strategy and Retiring of Credits 5-106
5.7.11 Biodiversity: Species to be offset 5-106
5.7.12 Biodiversity: Options for MNES offsetting 5-107
5.7.13 Biodiversity: Offset site surveys 5-108
5.7.14 Biodiversity: Biodiversity Management Plan 5-108
5.7.15 Biodiversity: Biobanking Credit Calculator Data 5-108
5.7.16 Aboriginal Cultural Heritage: Test excavation and management plan 5-108
5.7.17 Aboriginal cultural heritage: Aboriginal Community Consultation 5-109
5.7.18 Aboriginal Heritage: Sites at Dog Trap Creek 5-110
5.7.19 Aboriginal Heritage: OEH recorded an Aboriginal object 5-110
5.7.20 Aboriginal Heritage: Additional Information 5-111
5.7.21 Aboriginal Heritage: Impacts to Aboriginal Heritage 5-112
5.7.22 Aboriginal Heritage: Subsidence Impacts 5-112
5.7.23 Aboriginal Heritage: Dust and Vibration 5-115
5.7.24 Aboriginal Heritage: Proposed Mitigation 5-115
5.7.25 Aboriginal Heritage: Ancillary sites 5-116
5.7.26 Aboriginal Heritage: AHIMS site cards 5-116
5.7.27 Surface Water and Subsidence: Mine Layout & Impacts to streams 5-116
5.7.28 Surface Water and Subsidence: Thirlmere Lakes 5-118
5.7.29 Surface Water and Subsidence: Bargo River 5-118
5.7.30 Surface Water and Subsidence: Dendrobium Mine 5-119
5.7.31 Flood Modelling 5-120
5.8 Resource Regulator (NSW DPIE) 5-124
5.8.1 Rehabilitation – Adequacy of Information 5-124
5.8.2 Rehabilitation of Watercourses 5-124
5.8.3 Rehabilitation Criteria 5-126
5.8.4 Rehabilitation – Additional Information 5-126
5.8.5 Conceptual Mine Plan 5-126
5.8.6 Resource Regulator Role 5-127
5.8.7 Mine Safety Risk 5-127
5.9 Transport for NSW (formerly Roads and Maritime Services) 5-127
5.9.1 Hume Highway 5-127
5.9.2 Roads Authority 5-128
5.10 Subsidence Advisory NSW 5-128
5.10.1 Predicted Mine Subsidence Impacts 5-128
5.10.2 Impacts to Buildings/ Residences 5-129
5.10.3 Social Impacts 5-129
5.10.4 Non-Conventional Subsidence Impacts 5-129
5.10.5 Mine Layout to Reduce Impacts to Bargo Township 5-130
5.10.6 Damage Category Assessment 5-130
5.10.7 Management of Impacts to Infrastructure 5-131
5.10.8 Amendments to the Active Coal Mines Map 5-132
5.11 Sydney Water 5-132
5.11.1 Subsidence Impacts to Sydney Water Infrastructure 5-132
5.11.2 Mine Design: Longwall Layout 5-133
5.12 Transport for New South Wales 5-134
5.13 WaterNSW 5-134
5.13.1 Drinking Water Catchments 5-134
5.13.2 Cumulative impacts 5-135
5.13.3 Groundwater management plan 5-135
5.14 Wingecarribee Council 5-135

5.14.1 Objection to Longwall Mining in the Wingecarribee Shire 5-135
5.14.2 Rail Transport 5-136
5.14.3 Railway Maldon to Dumbarton 5-137
5.15 Wollondilly Shire Council 5-137
5.15.1 Position on longwall Mining 5-137
5.15.2 Existing Tahmoor Mine 5-138
5.15.3 Supported Aspects of the Application 5-138
5.15.4 Identified shortcomings in the Project Application 5-138
5.15.5 SSD Framework 5-139
5.15.6 Reforms to the planning framework 5-139
5.15.7 Review and Determination Process for SSD 5-140
5.15.8 Community Consultation: Adequacy of Community Engagement 5-140
5.15.9 Community Consultation: DPIE draft Community Participation Plan 5-141
5.15.10 Adequacy Against SEARs 5-141
5.15.11 Independent Expert Scientific Committee (IESC) Advice 5-142
5.15.12 Consistency with Current Research 5-143
5.15.13 REA: Consideration of Alternatives 5-143
5.15.14 Location of Ventilation Shafts: Air Quality 5-144
5.15.15 Subsidence: Level of Assessment 5-145
5.15.16 Subsidence: Trigger Action Response Plans 5-146
5.15.17 Subsidence: Impacts to Residential Housing 5-147
5.15.18 Subsidence: Impacts to Council Infrastructure 5-148
5.15.19 Subsidence: Impacts to Bargo Waste Management Centre 5-149
5.15.20 Groundwater and Surface Water Assessment approach 5-150
5.15.21 Groundwater: Modelling 5-151
5.15.22 Groundwater: Height of Fracture Study 5-151
5.15.23 Groundwater: Assessment and Information 5-152
5.15.24 Groundwater: Detailed Geological Model 5-153
5.15.25 Groundwater: Drawdown Impacts to Aquifers 5-154
5.15.26 Groundwater: Aquifer Interference Licence 5-155
5.15.27 Surface Water: Independent Expert Panel 5-156
5.15.28 Surface Water: Assessment and Information 5-157
5.15.29 Surface Water: Redbank Creek Water Quality 5-158
5.15.30 Surface Water: Impacts to 3rd Order Streams 5-159
5.15.31 Surface Water: Mitigation and TARPs 5-160
5.15.32 Surface Water: Watercourse Rehabilitation 5-162
5.15.33 Surface Water: Licensed Discharge 5-162
5.15.34 Surface Water: Dr Ian Wright Peer Review 5-163
5.15.35 Thirlmere Lakes: Assessment 5-166
5.15.36 Thirlmere Lakes: Monitoring and Research 5-167
5.15.37 Aquatic Ecology: Impacts 5-167
5.15.38 Aquatic Ecology: Mitigation 5-167
5.15.39 Aquatic Ecology: Dr Ian Wright Peer Review 5-169
5.15.40 Biodiversity: Mapping and Surveys 5-169
5.15.41 Biodiversity: REA Vegetation Clearance 5-169
5.15.42 Biodiversity: Impact assessment 5-170
5.15.43 Biodiversity: Koalas 5-171
5.15.44 Biodiversity: Mitigation Measures 5-171
5.15.45 Biodiversity: Offset Credit Calculations 5-171
5.15.46 Biodiversity: Adequacy of Offsets 5-172
5.15.47 Biodiversity: Offset stewardship 5-173
5.15.48 Land Use: New and Future Development 5-173
5.15.49 Traffic: Impacts (Tahmoor Mine's Access) 5-174
5.15.50 Traffic: Rail overpass 5-175
5.15.51 Social Impact Assessment: Social Involvement Plan 5-176
5.15.52 Amenity Impacts 5-176
6.0 Response to Organisations and Community Submissions 6-1
6.1 Organisation – Ironlaw Pty Ltd 6-1

6.1.1 Statutory Planning: Wollondilly LEP provisions 6-1
6.1.2 Land Use: existing, approved and preferred land use 6-3
6.1.3 Statutory Planning: Land Use 6-8
6.1.4 Subsidence: Impact to future land use 6-8
6.1.5 Land Use: Property Rights 6-10
6.1.6 Land Use: Comparative benefit of mine vs other land use 6-11
6.1.7 Land Use: Social impacts 6-12
6.1.8 Social: Social-economic impacts 6-13
6.1.9 Social: Social Impact Assessment 6-13
6.1.10 Greenhouse Gas: Rocky Hill Coal Mine decision 6-14
6.1.11 Greenhouse Gas: Mitigation 6-15
6.1.12 Statutory Planning: Ecological Sustainable Development 6-15
6.1.13 Statutory Planning: Inconsistency with EP&A Act 6-16
6.1.14 Subsidence: Additional assessment 6-17
6.2 Endeavour Energy 6-18
6.2.1 Network capacity/ connection 6-18
6.2.2 Subsidence Management 6-18
6.2.3 Earthing 6-19
6.2.4 Safety Clearances 6-19
6.2.5 Vegetation Management under lines 6-19
6.2.6 Dial-Before-You-Dig 6-20
6.2.7 Excavation 6-20
6.2.8 Public Safety & emergency contact 6-20
6.3 Undermined Inc. 6-21
6.3.1 Thirlmere Lakes: Impacts 6-21
6.3.2 Thirlmere Lakes: OEH Research 6-21
6.3.3 Groundwater: Dewatering Impacts to watercourses 6-21
6.3.4 Surface Water: Redbank Creek 6-22
6.3.5 Subsidence: Impacts to Watercourses 6-23
6.3.6 Surface Water: Remediation of creeks 6-24
6.3.7 Surface Water: Monitoring data 6-24
6.3.8 Greenhouse Gas: Climate Change 6-25
6.3.9 Cumulative Impacts: Assessment 6-25
6.3.10 Environmental Management Commitments: Risk Framework 6-25
6.3.11 Mine Closure and Rehabilitation: Rehabilitation 6-26
6.3.12 Mine Closure and Rehabilitation: Rehabilitation Funds 6-26
6.3.13 Mine Closure and Rehabilitation: Rehabilitation criteria 6-26
6.3.14 Responsibility after operations cease 6-26
6.3.15 Economic: Economic value 6-26
6.3.16 Terrestrial ecology: Biodiversity 6-28
6.4 National Trust 6-28
6.4.1 Impacts to natural features within the Wirrimbirra Sanctuary 6-28
6.4.2 Terrestrial ecology: Biodiversity Impacts 6-29
6.4.3 Terrestrial ecology: Offset strategy 6-29
6.4.4 Non-Aboriginal heritage: Wirrimbirra Sanctuary 6-30
6.5 Greater Blue Mountains World Heritage Area Advisory Committee 6-31
6.5.1 Thirlmere Lakes: Impacts 6-31
6.5.2 Thirlmere Lakes: COA - negligible impacts and monitoring 6-32
6.6 National Parks Association of NSW 6-32
6.6.1 Surface Water: Subsidence impacts 6-32
6.6.2 Surface Water: Watercourse remediation 6-33
6.6.3 Surface and Groundwater: Dewatering of landscape 6-33
6.6.4 Thirlmere Lakes: Accuracy of predictions given incomplete research 6-33
6.6.5 Terrestrial Ecology: REA Extension 6-34
6.6.6 Project Need and Alternatives: REA 6-34
6.6.7 Surface Water: Wastewater Treatment Plant 6-35
6.6.8 EIS Formatting: EIS Numbering 6-36
6.7 RStar Mining 6-36

6.7.1 Economic/Social: Project benefits 6-36
6.8 Doctors for the Environment Australia 6-37
6.9 Response to Community Submissions 6-38
6.9.1 Subsidence 6-39
6.9.2 Groundwater 6-43
6.9.3 Surface water 6-44
6.9.4 Thirlmere Lakes 6-47
6.9.5 Terrestrial Ecology 6-48
6.9.6 Aboriginal Cultural Heritage 6-49
6.9.7 Non-Aboriginal Heritage 6-50
6.9.8 Noise and Vibration 6-50
6.9.9 Air Quality 6-51
6.9.10 Greenhouse Gas 6-52
6.9.11 Mine Safety 6-53
6.9.12 Economic 6-54
7.0 Revised Management Measures 7-1
7.1 Environmental Management 7-1
7.1.1 Environmental Management System 7-1
7.1.2 Environmental Monitoring and Reporting 7-2
7.2 Summary of Management and Mitigation Measures 7-2
8.0 Conclusions and Next Steps 8-1
9.0 References 9-1

Appendix A
Summary Table for Community Submissions A

List of Tables

Table 1 Key issues raised in submissions that oppose the Project. ii
Table 4-1 Summary of submissions received 4-1
Table 4-2 Organisations that made a submission on the EIS 4-2
Table 4-3 Locations of Submissions Received 4-2
Table 4-4 Summary of DPIE Identified Key Issues 4-5
Table 5-1 Response to DoI- WNRAR 5-44
Table 5-2 Key Changes to the Groundwater Model following Agency Meeting 5-58
Table 5-3 LOP Overflow Volumes 5-79
Table 5-4 Upgraded WWTP Treated Water Quality 5-80
Table 5-5 Development footprint for the surface infrastructure applicable to biodiversity 5-96
Table 5-6 Reduction in impacts to threatened flora 5-96
Table 5-7 Comparison of updated credits generated from the proposed offset sites compared to credit liability for the Project 5-104
Table 5-8 3rd order streams in the SSA 5-117
Table 5-9 Summary of impacts to overland flow paths 5-121
Table 5-10 Maximum predicted subsidence results for EIS and Amended Project mine plans (Table 4.4 of the revised Subsidence Assessment report) 5-130
Table 5-11 Conventional subsidence parameters 5-133
Table 5-12 Response to Dr Ian Wright Peer Review 5-163
Table 6-1 Assessment against Wollondilly LEP zones 6-5
Table 6-2 Project contribution to NSW, Australian and Global GHG emissions 6-15
Table 6-3 Indirect environmental costs of the Project ($ Million[1]) 6-27
Table 6-4 Maximum Predicted Total Subsidence, Subsidence and Closure for the lengths of the Bargo River within the Subsidence Study Area due to extraction of the amended longwall panels 6-43
Table 7-1 Tahmoor Coal Environmental Management System Document Directory 7-1
Table 7-2 Summary of Mitigation Measures 7-3

List of Figures

Figure 1-1	Tahmoor South Project area	1-2
Figure 2-1	Comparison of EIS mine plan (2018) and Amended Project mine plan (2019)	2-3
Figure 2-2	Comparison of EIS REA (2018) and Amended Project REA (2019)	2-4
Figure 2-3	Confirmed power line easement for TSC1	2-5
Figure 5-1	Transient Sensitivities – Groundwater Model	5-51
Figure 5-2	Groundwater monitoring around the REA	5-85
Figure 5-3	REA extension and impacts to threatened flora	5-99

Executive Summary

Introduction

Tahmoor Coal is seeking development consent for the continuation of mining at Tahmoor Mine, extending underground operations and associated infrastructure south, within the Bargo area (the Project). The Project would use the existing surface infrastructure at the Tahmoor Mine surface facilities area, minimising surface level disruption. Some of the surface infrastructure would be upgraded, including the Coal Handling and Preparation Plant (CHPP), existing bathhouses and associated access ways, offsite service infrastructure, and extending the existing rejects emplacement area (REA).

Coal extraction of up to 4 million tonnes of Run of Mine (ROM) coal per annum is proposed with up to 43 million tonnes of ROM coal proposed over the life of the Project. Longwall mining would be used to extract from the Bulli seam within the bounds of Consolidated Coal Lease 716 (CCL716) and Consolidated Coal Lease 747 (CCL747). This technique for coal extraction has been used by Tahmoor Mine for over 30 years.

Once the coal has been extracted and brought to the surface, it would be processed at Tahmoor Mine's existing CHPP and coal clearance facilities, before being transported via the existing rail loop, the Main Southern Railway and the Moss Vale to Unanderra Railway to Port Kembla, and from time to time, Newcastle for Australian and international markets. Up to 0.2 million tonnes per annum of either product coal or reject material is proposed to be transported to customers via road.

Purpose of this Response to Submissions Report

An Environmental Impact Statement (EIS) was prepared for the Project. The EIS was placed on public exhibition from 23 January 2019 to 5 March 2019, to allow Government agencies, local councils, organisations and the community the opportunity to comment on the Project and the findings of the EIS by lodging a submission with the Department of Planning, Industry and Environment. This Response to Submissions Report has been prepared to address issues raised in the submissions received during and after the EIS exhibition period.

Several amendments have been made to the proposed Project design in response to issues raised in agency, local Council, stakeholder and community submissions on the EIS. The environmental impacts of the Amended Project have been assessed and presented in a Project Amendment Report. The responses and recommendations made in this Response to Submissions Report are supported by updated technical reports prepared by specialists and included as part of the Project Amendment Report.

Submissions

During the exhibition of the EIS, a total of 106 submissions were received: 15 from Government agencies and local Councils, eight from organisations and 83 from the general public. Each submission has been individually examined and responses to the issues addressed. Submissions received in response to the EIS include:

- One from a Commonwealth Government agency;
  - Commonwealth Independent Expert Scientific Committee;
- Twelve from State Government agencies;
  - NSW Department of Industry Lands and Water Division;
  - Department of Planning and Environment (Division or Resources and Geoscience);
  - Environment Protection Authority;
  - Heritage Council of NSW;
  - NSW Health;

  - NSW Environment, Energy and Science (formerly Office of Environment and Heritage);
  - Resource Regulator (NSW Department of Environment, Planning and Industry);
  - Roads and Maritime Services;
  - Subsidence Advisory NSW;
  - Sydney Water;
  - Transport of NSW; and
  - WaterNSW.
- Two from Local Councils;
  - Wollondilly Shire Council; and
  - Wingecarribee Shire Council.
- Eight from Interest groups / organisations;
  - Ironlaw Pty Ltd (objects);
  - Endeavour Energy (comments);
  - Undermined Inc. (objects);
  - National Trust (objects);
  - Greater Blue Mountains World Heritage Area Advisory Committee (comments);
  - National Parks Association of NSW (objects);
  - RStar Mining (supports); and
  - Doctor for the Environment Australia (objects).
- 83 from Individual public / community members. Of these a total of 73 submissions indicated support for the Project and 10 raised objections to the Project.

The key themes in the opposing submissions that require further consideration are presented in **Table 1**.

Table 1 Key issues raised in submissions that oppose the Project.

Key concerns	Relevant sections
Subsidence	
• Potential impacts on built features in particular the modelled scale of impacts to residences within Bargo, and the potential impacts this may have on property values;	5.10.1; 5.10.2; 6.9.1.1.
• Potential subsidence impacts on Bargo Waste Management Centre;	5.4.32; 5.15.19; 6.9.1.4.
• Potential impacts to natural resources including: - Surface water: ▪ Subsidence impacts on water quality; ▪ Watercourse hydraulics and stability; ▪ Localised changes in surface ponding; ▪ Changes to flows in Dog Trap Creek and the upstream section of Tea Tree Hollow; ▪ Proposed self-remediation and/or active remediation of stream beds; ▪ Water levels in Thirlmere Lakes. - Biodiversity; - Heritage; and - Cliffs and steep slopes.	 5.1.14; 5.1.28; 5.15.29; 6.3.4. 5.1.33 5.7.31 5.7.27 5.1.31; 5.8.2-4. 5.1.20; 5.1.22; 5.7.28; 5.15.35. 5.1.16; 5.15.34; 5.15.37-9. 5.5.1; 5.7.18; 5.7.22; 6.9.6-7. 5.7.22.

Key concerns	Relevant sections
Groundwater	
• Groundwater model used for the assessment;	5.1.5; 5.1.7; 5.1.9; 5.2.4.4; 5.15.21-4.
• Groundwater licence allocations;	5.2.4.2; 5.15.25-6.
• Modelling used to determine impacts to Thirlmere Lakes;	5.1.5; 5.1.20; 5.1.22-23; 5.2.4.4; 5.15.24-25; 6.6.4;
• The treatment of geological features such as faults and lineaments in the Groundwater Assessment, in particular the Nepean Fault zone;	5.1.2-3; 5.2.4.4; 5.2.4.6.
• Proposed management of mine inflows;	5.1.25; 5.2.4.4; 5.15.26; 6.6.3;
• Predicted impacts to privately-owned groundwater bores (considered significant but manageable); and	5.1.24; 5.2.4.6-7.
• Extension of the REA and its potential impacts on groundwater quality.	5.4.28
Surface Water	
• Flooding characteristics for the full range of flood events;	5.1.13; 5.7.31.
• Flood model was based on regional information without calibration and with no information provided on some key modelling assumptions;	5.1.13.
• REA rehabilitated in accordance with the Guidelines for Working on Waterfront Land;	5.2.4.1
• Site water management including consideration of recommendations regarding: - Surface wastewater storage liners; - Goaf storage: assessment of underground water storage within goaf areas if near watercourses or adjacent to geology with cracking or high permeability; - Potential water quality impacts arising from site discharges, including impacts of wastewater discharge on Tea Tree Hollow and the Bargo River; - Sewage treatment; - Trigger values and expansion of surface monitoring network to improve monitoring of stream flow and pool water levels; and - Ability to obtain the necessary authorised water entitlement to account for the maximum take of surface water	 5.4.21 5.1.19; 5.4.22. 5.1.15; 5.1.18; 5.4.14-20; 5.4.25; 5.15.33; 6.9.3.1. 5.4.26; 6.6.7. 5.1.35; 5.2.4.5. 5.2.4.2.
Terrestrial Biodiversity	
• Direct clearing of CEEC and threatened species;	5.7.2; 5.7.4; 5.15.41; 6.6.5;
• Lack of information regarding fauna species inhabiting the area;	5.1.16; 5.7.6; 5.15.40; 5.15.43; 6.4.2.
• Concerns regarding impacts on water quality and the need to protect instream flora and fauna;	5.1.16; 5.2.2.1.
• Concerns that the potential impacts of mine subsidence, in terms of hydrology and water quality, will cause irreversible damage to aquatic habitat; and	5.1.14; 5.1.28; 5.1.31; 5.7.27; 5.8.2-4; 5.15.29; 6.3.4.
• Potential impacts on UNESCO World heritage listed National Park.	5.7.28; 6.3.1; 6.5.1-2; 6.9.4.

Key concerns	Relevant sections
Aboriginal Cultural Heritage	
• Longwalls located near Dog Trap Creek causing impacts from vibration, bed rock fracturing and changes in hydrological patterns; and	5.7.18; 5.7.22; 6.9.6;
• Assessment of all recorded sites.	5.7.18; 5.7.26.
Non- Aboriginal Heritage	
• Lack of engagement by Tahmoor Coal to arrange access to Wirrimbirra Sanctuary and that there had been no engagement to arrange access to remediate the Project's potential subsidence impacts.	6.4.4
• Heritage assessment, including lack of detailed condition reports and inadequate consideration of adverse impacts or detailed monitoring and mitigation measures.	6.4.4; 6.9.7.
Noise and Vibration	
• Resolving historical noise issues at the mine	5.4.9
• Applying the current policy context: Tahmoor Coal was requested to assess the Project under the *Noise Policy for Industry* (NPfI), including relevant meteorological conditions and background noise levels, including establishing criteria for the existing operations then converting these criteria to contemporary criteria.	5.4.1; 5.4.13
• Consideration of low frequency noise, including addressing historic low-frequency noise issues at the site. Priority should be placed on mitigating low-frequency noise emissions from the CHPP rather than only focussing on the expected overall noise reductions.	5.4.1
• Refinement of technical inputs	5.4.11
• Further justification and clarification for the proposed mitigation and management measures.	5.4.8
Greenhouse Gases	
• Project's contribution to Australia's carbon footprint; and • Australia's ability to meet its Paris commitments while also allowing the continuation of coal mining and exports.	6.1.10-11; 6.3.8; 6.8; 6.9.10.
Economic	
• Justification of the project to the economy in terms of disutility of working in mining, the sensitivity analysis scenario results and local environmental, social and transport impacts.	6.1.8; 6.3.15; 6.9.12.
Human Health	
• Health impacts to residents located close to the proposed ventilation shafts,	5.6.2
• Noise impacts; and	5.6.3
• Impacts from greenhouse gases and climate change.	6.8
Social	
• Mining beneath houses;	5.10.3
• Aboriginal heritage;	5.7.21

Key concerns	Relevant sections
• Impacts to groundwater bores; and	5.2.4.6-7
• Impacts on people with a connection to natural features, especially Thirlmere Lakes.	6.9.4

Changes to the Project since EIS Exhibition

Key issues raised in submissions included concerns relating to the proposed extent of longwall mining, the associated subsidence impacts, greenhouse gas emissions and the extent of vegetation clearing required for the extension of the REA. In response to these and other issues raised in submissions, and as a result of ongoing mine planning, several amendments have been made to further reduce the predicted environmental impacts of the Project. Key amendments to the Project are include:

- Amended mine plan including:
  - Removal of LW109, which was directly beneath Dog Trap Creek;
  - Reconfiguration of the longwall layout to comprise two series of shorter longwall panels;
  - Reduction in the proposed longwall width, from approximately 305 metres (m) to approximately 285 m;
  - Reduction to the height of extraction within longwall panels from up to 2.85 m to up to 2.6 m; and
  - Extraction of up to 43 Mt ROM coal over the life expectancy of the Project.
- Reduced REA footprint including:
  - Reduction of estimated volume of rejects from approximately 14.3 million tonnes (Mt) to 11.6 Mt;
  - Increased height of the REA from RL 305 m to RL 310 m; and
  - Reduced REA extension footprint from 43 ha to 11.06 ha.
- Amend REA operations including:
  - Operation of haulage production hours from 24 hours to occur during the daytime and evening hours (7 am to 10 pm);
  - Transport rejects via conveyer to the load out point where rejects would be stockpiled for haulage to the REA during daytime and evening hours; and
  - Updated operations to include an additional haul truck (for a total of two trucks) and a front-end loader to transport rejects during the day, to replace night-time haulage of rejects.
- Update ancillary infrastructure to include:
  - Inclusion of a 66-kV overhead powerline easement from the pit top to the proposed ventilation shafts; and
  - Continuation of existing upcast ventilation shaft (T2), with operation reducing usage from two fans to one fan.

Revised Environmental Management Measures

The EIS included a summary of the management measures that would be incorporated into the construction and operation of the Project. Following the receipt and consideration of submissions these management measures were reviewed and additional mitigation measures have been recommended in this Response to Submissions Report.

Project Benefits

Employment and Economic Benefit

Tahmoor Coal has been a major employer in Wollondilly for over 40 years, employing approximately 400 people with around half being local residents. The Project is predicted to generate a net benefit of up to $784 million over its life; $162 million of which would flow through to the local Wollondilly region (in Net Present Value terms).

Carbon Neutral Commitment

Tahmoor Coal recognises the constructive role it can play in reducing the impact of greenhouse gas emissions on climate change as Australia transitions to renewable energy. Tahmoor Coal is a subsidiary of Liberty Steel Group, part of the GFG Alliance, which has made a global commitment to be carbon neutral across its operations by 2030, including its mining activities. This will be achieved through a combination of investment in renewable energy such as solar and pumped hydro as well as process improvements and carbon offsets.

Steel Industry

The type of coal mined at Tahmoor is predominately a premium quality coking coal, which is a key ingredient in primary steelmaking. Steel is an important part of society, used in healthcare, telecommunications, transport, infrastructure, construction and agricultural equipment. Tahmoor Coal provides product coal for Australian steel production at Port Kembla and Whyalla, as well as for export.

Community

Tahmoor Coal's commitment to the community and environment is multi-faceted:

- Following feedback from the community and Government during exhibition of the EIS, Tahmoor Coal made the decision to revise the Project in order to reduce the environmental impacts while still protecting the commercial viability of the project and economic benefit to the state.
- Tahmoor Coal and its employees contribute to the local community in numerous ways, including volunteering, fundraising and donations. For example, in September 2018 when a temporary outage forced the mine to cease operations, the decision was made to deploy workers into the community to provide improvement and maintenance assistance to local projects and initiatives across the Wollondilly Shire.

Summary

The Project would allow continuation of mining and employment of around 400 people at Tahmoor Mine for a further 13 years until approximately 2035. Tahmoor Coal is committed to continuing to work constructively with all stakeholders to achieve a balanced outcome for the community, environment and business, as demonstrated by the amendments made to the Project in response to submissions.

Conclusions and Next Steps

This Response to Submissions Report has provided additional information to address the issues raised in the submissions relating to the key issues associated with the Project including: subsidence, groundwater, surface water, terrestrial and aquatic ecology, historic and Aboriginal cultural heritage, noise and vibration, air quality, traffic, rehabilitation and mine closure, social and economic impacts, land use, and the reject emplacement area.

The DPIE will now assess the Amended Project in consultation with other relevant agencies, and the assessment process will include review of the EIS, the Project Amendment Report and this Response to Submissions Report. The DPIE will then prepare a draft assessment report for consideration by the Minister for Planning (Minister) or delegate.

1.0 Introduction

1.1 Overview of the Project

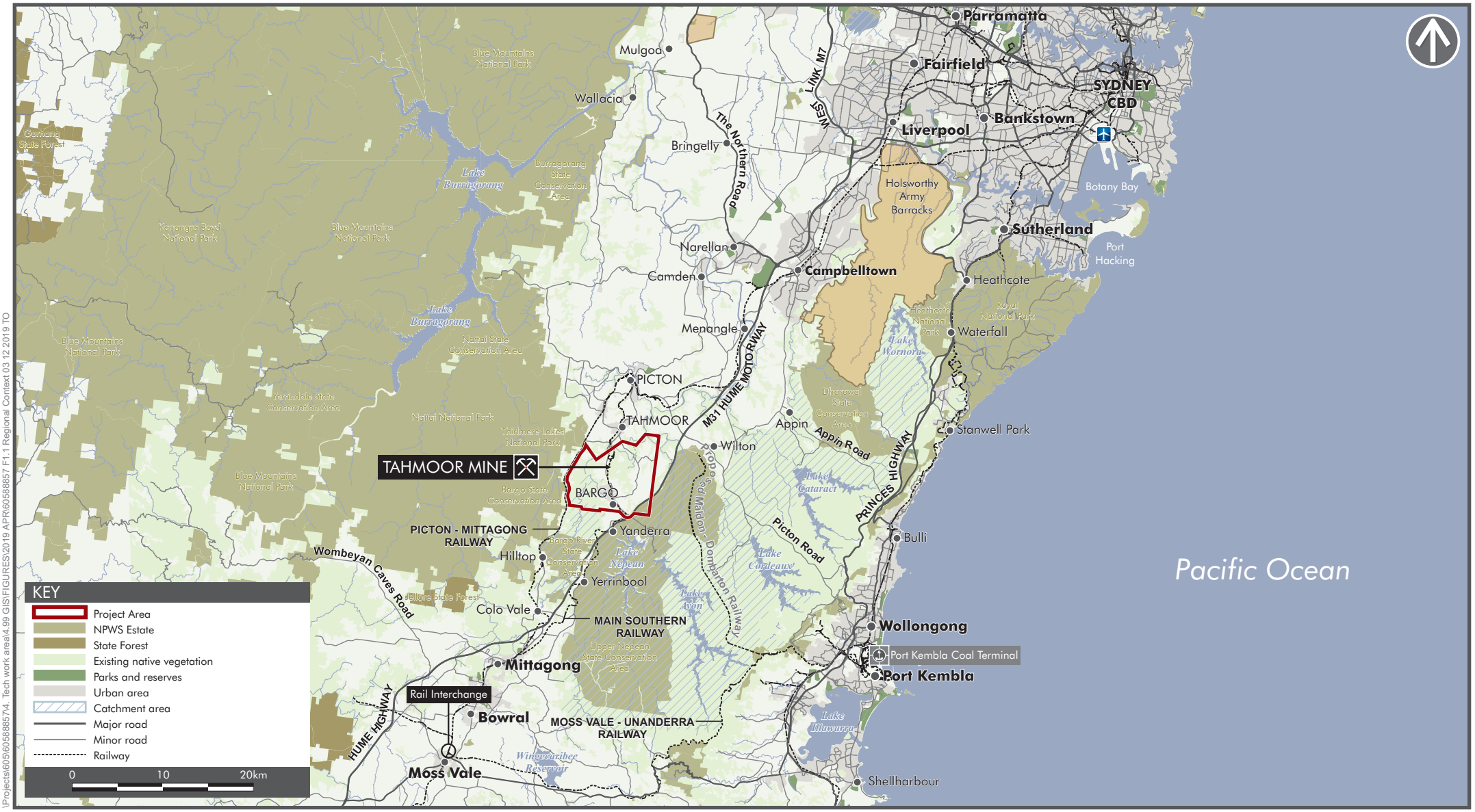
Tahmoor Coal is seeking development consent for the continuation of mining at Tahmoor Mine, extending underground operations and associated infrastructure south, within the Bargo area (the Project). The Project seeks to extend the life of underground mining at Tahmoor Mine for an additional 13 years until approximately 2035.

The Project would use longwall mining to extract coal from the Bulli seam within the bounds of Consolidated Coal Lease 716 (CCL716) and Consolidated Coal Lease 747 (CCL747). A map illustrating the location of the Project is shown **Figure 1-1**. Once the coal has been extracted and brought to the surface, it would be processed at Tahmoor Mine's existing coal handling and preparation plant (CHPP) and coal clearance facilities, and then transported via the existing rail loop, the Main Southern Railway and the Moss Vale to Unanderra Railway to Port Kembla and, from time to time, Newcastle for Australian and international markets. Up to 200,000 tonnes per annum of either product coal or reject material is proposed to be transported to customers via road.

In summary the components of the Project comprise:

- Longwall mining in the Central Domain including underground redevelopment, ventilation shaft construction, pre-gas drainage and service connection;
- Upgrades to the existing surface facilities area including:
  - Upgrades to the CHPP;
  - Extension of the existing REA;
  - Additions to the existing bathhouses and associated access ways; and
  - Upgrades to onsite and offsite service infrastructure, including electrical supply.
- Rail transport of product coal to Port Kembla and from time to time, Newcastle;
- Up to 200,000 tonnes per annum of either product coal or reject material transported to customers by road;
- Mine closure and rehabilitation; and
- Environmental management.

Several amendments have been made to the Project in response to issues raised in Government agency, local Council, organisation and community submissions, and as a result of ongoing mine planning. These amendments are detailed in **Chapter 2.0**.



\Projects\605\605885574. Tech work area\4.99 GIS\FIGURES\2019 APR\605885857 F1.1 Regional Context 03 12 2019 TO

SIMEC

TAHMOOR SOUTH PROJECT AREA

Tahmoor South Project
Response to Submissions Report

FIGURE 1.1

1.2 Overview of Approval Process and Exhibition

Approval for the Project is being sought as a State Significant Development under Division 4.7, Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The Project meets the State Significant Development requirements set out in Schedule 1, Clause 5 of the *State Environment Planning Policy (State and Regional Development) 2011,* being a development for the purpose of coal mining. The Project is declared to be a State Significant Development for the purposes of the EP&A Act and the Minister is the consent authority for the development application.

Secretary's Environmental Assessment Requirements (SEARs) for the Tahmoor South Project (Project) were issued on 9 June 2017 and revised SEARs were issued on 20 June 2018 (in relation to social impact assessment requirements).

The Project was determined to be a controlled action, under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act), by the Department of Environment and Energy on 12 January 2018 and supplementary SEARs were issued for the Project on 14 February 2018 to include Commonwealth environmental assessment requirements. The Commonwealth Government has accredited the NSW environmental assessment process under the EP&A Act in a bilateral agreement between the Commonwealth and State governments. As such, the Project is subject to assessment under the provisions of the EP&A Act in accordance with the bilateral agreement.

In accordance with the requirements of the EP&A Act, an EIS was prepared to assess the potential environmental impacts of the Project and address the SEARs and supplementary SEARs issued for the Project. The EP&A Act and the *Environmental Planning and Assessment Regulation 2000* (the Regulation), required the EIS to be placed on exhibition for not less than 30 days. The EIS for the Project was placed on public exhibition by the Department of Planning, Industry and Environment (DPIE) (formerly the Department of Planning and Environment (DPE)) between 23 January 2019 and 5 March 2019.

The EIS was made available on the DPIE web site (http://majorprojects.planning.nsw.gov.au/) and in hard copy for public viewing at the following places:

- Wollondilly Shire Council office in Picton;
- Picton Library;
- Wingecarribee Shire Council office in Bowral; and
- Bowral Central Library.

The Minister has sought advice from the NSW Independent Planning Commission (IPC) to support the consideration of the application for the Project and on 15 January 2019, the Minister in accordance with Section 2.9(1)(d) of the EP&A Act requested that the IPC:

1. *Conduct a public hearing into the carrying out of the Tahmoor South project in multiple stages.*
2. *Conduct the preliminary stages of the public hearing as soon as practicable after the public exhibition of the EIS for the Project.*
3. *Consider the following:*
    a. *EIS for the project;*
    b. *Submission of the Project;*
    c. *Any relevant expert advice; and*
    d. *Any relevant information.*
4. *Publish a report on its website, and provide a copy to the Department of Planning and Environment, within 10 weeks of the Department's Preliminary Issues Report being published on the Department's website, unless otherwise agreed with the Planning Secretary, that:*
    a. *Sets out the actions taken by the Commission in conducting the preliminary stage of the public hearing;*

b. Summarises the submissions made during public exhibition on the EIS and the preliminary stage of the public hearing, and any other relevant information provided to the Commission during the public hearing; and

c. Identifies the key issues requiring detailed consideration by the Department in preparing its assessment report under the EP&A Act.

The Project is therefore subject to assessment by the IPC under Section 2.9 of the EP&A Act.

The IPC deferred its review of the Project following confirmation from Tahmoor Coal that the Project would be amended in response to submissions. The DPIE has directed Tahmoor Coal to respond to submissions on the Project (this document).

1.3 Purpose of this Report

During the exhibition of the EIS, 106 submissions were made: 15 from Government agencies and local Councils, eight from organisations and 83 from the general public. In accordance with clause 85A of the EP&A Regulation, the DPIE provided copies of the submissions to Tahmoor Coal, and requested the preparation of a report detailing a response to the issues raised in the submissions (this report).

This Response to Submissions Report provides responses to issues raised in the submissions received during the EIS exhibition period.

1.4 Structure of this Report

The Response to Submissions Report has been set out to address each of the issues raised in the submissions and is structured as follows:

- **Chapter 1.0 -** provides an overview of the Project, the EIS process and the Response to Submissions Report purpose and structure;
- **Chapter 2.0 -** provides a description of amendments made to the Project subsequent to the public exhibition of the EIS;
- **Chapter 3.0 -** provides a summary of the stakeholder engagement activities that were undertaken during the preparation and exhibition of the EIS;
- **Chapter 4.0 -** provides a summary of the submissions received, and an outline of the issues raised by Government agencies, local council, key stakeholders (interest groups / organisations) and individuals;
- **Chapter 5.0 -** provides responses to the issues raised in submissions received from Government agencies and local councils;
- **Chapter 6.0 -** provides responses to the issues raised in submissions received from community stakeholders (organisations and individuals);
- **Chapter 7.0 -** presents a revised set of Project management and mitigation measures that have been reviewed following consideration of the submissions as detailed in this report; and
- **Appendix A -** Summary table for community submissions.

2.0 Project Amendments

The Project has been amended as a result of ongoing mine planning and in order to further reduce the predicted environmental impacts of the Project, in response to the following key issues raised in submissions made on the EIS:

- The extent of longwall mining (mine plan) and magnitude of subsidence impacts;
- The extent of vegetation clearing required for the extension of the reject emplacement area (REA);
- The REA operating during night-time hours causing sleep disturbance; and
- Amendments to the Project are outlined in **Sections 2.1** to **Section 2.5**, with an assessment of impacts provided in the Project Amendment Report. Key issues raised in submissions are detailed in **Chapter 4.0**.

2.1 Mine Plan

The following amendments have been made to the mine plan to reduce the extent and magnitude of anticipated surface subsidence:

- Removal of LW109, which was directly beneath Dog Trap Creek;
- Reconfiguration of the longwall layout to comprise two series of shorter longwall panels (refer **Figure 2-1**);
- Reduction in the proposed longwall width, from approximately 305 m to approximately 285 m; and
- Reduction in the height of extraction within longwall panels from up to 2.85 m to up to 2.6 m.

Notably, the revised longwall geometry (longwall width and height of extraction) now proposed as part of the Amended Project is consistent with the longwall mining currently undertaken in Tahmoor North.

The updated Subsidence Assessment undertaken for the Amended Project indicates that the revised longwall extent would reduce predicted levels of subsidence. The results of the revised Subsidence Assessment are detailed in Section 7.1 and Appendix B of the Project Amendment Report.

The above changes would reduce the estimated production volume of the Project from approximately:

- 48 Mt to 43 Mt of ROM coal;
- 35 Mt to approximately 30 Mt of coking coal product; and
- 3.5 Mt to approximately 2 Mt of thermal coal product.

The revised Economic Assessment undertaken for the Amended Project (refer Section 7.11 and Appendix L of the Project Amendment Report) demonstrates that the Project would still generate significant economic benefits to the local and State economy, with a net benefit of $784 million.

2.2 REA Extension

During exhibition of the EIS, concerns regarding the proposed management of coal rejects were raised in submissions.

The EIS proposed to extend the existing REA by 43 ha, which would have required the clearing of a total of 39.7 ha of native vegetation, mainly comprising the Shale Sandstone Transition Forest (SSTF) endangered ecological community (34 ha). Government agency and community concerns related to the impacts of the proposed extension to the REA on native vegetation, and whether alternatives to extending the REA had been properly explored. In response to these concerns, Tahmoor Coal has:

- Undertaken further investigations into alternatives to surface emplacement of rejects; and
- Amended the Project to reduce the REA extension footprint from 43 ha to 11.06 ha, resulting in a reduced extension area of approximately 74% (refer **Figure 2-2**).

Changes to the longwall extent as identified in **Section 2.1** have allowed the estimated volume of rejects to be generated by the Amended Project to be reduced from approximately 14.3 Mt (Table 11-101 of the EIS) to 11.6 Mt. In addition, it is proposed that the height of the REA final landform be increased by 5 m from RL 305 m to RL 310 m to further minimise the REA footprint. These combined changes have resulted in a reduction of the required extension area for the REA from 43ha to 11.06 ha. This results in a significant reduction in required vegetation clearing and associated terrestrial ecology impacts (including required biodiversity offsets).

The increase in proposed REA height by 5 m (from EIS height of 305 to 310 m AHD) has the potential to result in increased amenity impacts (noise, air quality and visual) to some receptors in the vicinity of the REA. These impacts have been assessed in revised technical assessments undertaken for the Amended Project and discussed further in Sections 7.8, 7.9 and 7.12 of the Project Amendment Report.

2.3 REA operations

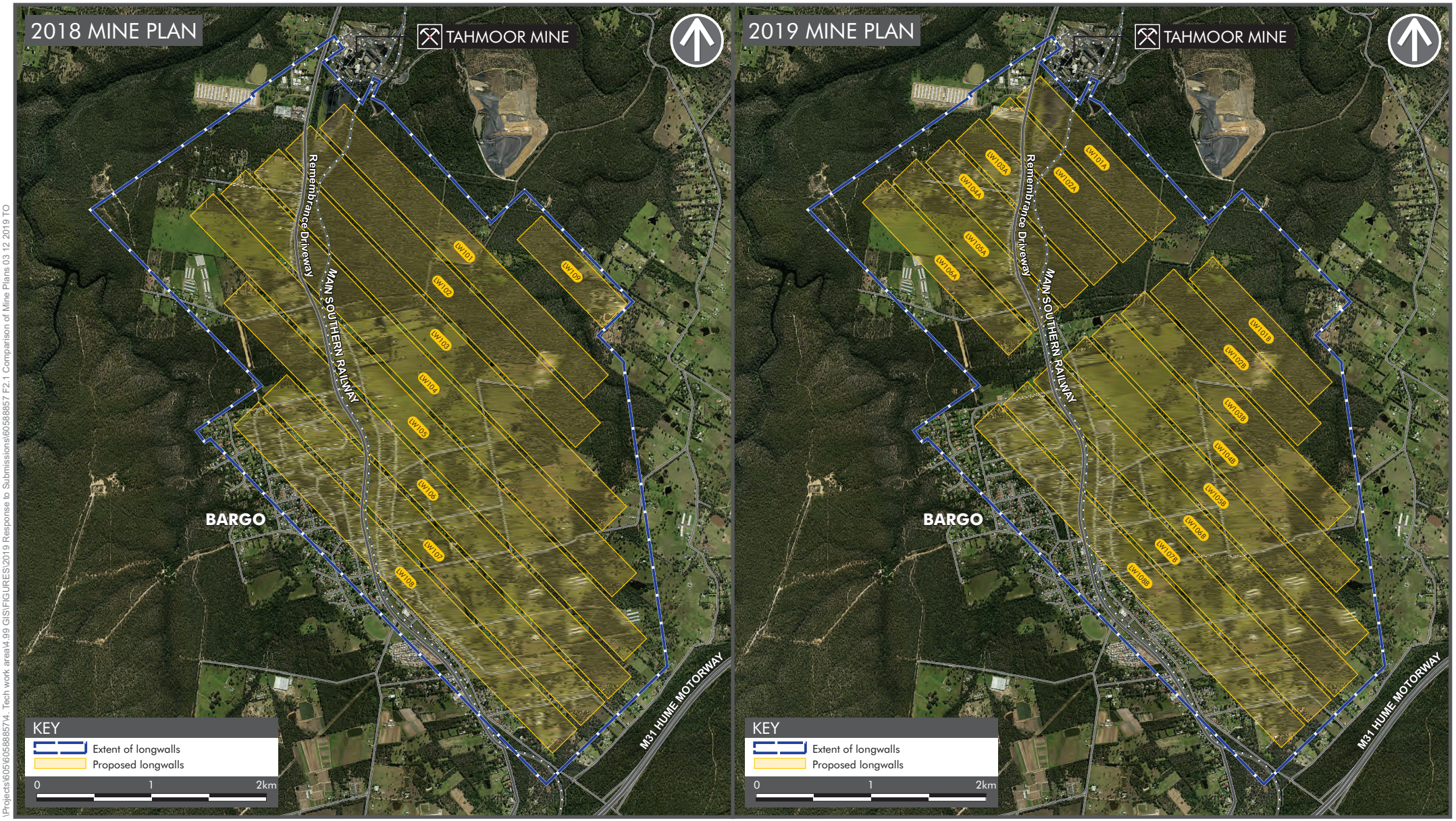
The NSW Environment Protection Authority (NSW EPA) raised concerns regarding night-time noise impacts on receivers, including sleep disturbance impacts. Tahmoor Coal proposes to amend the Project so that the haulage of rejects at the REA would occur during daytime and evening hours (7am to 10pm). Rejects would continue to be conveyed to the load-out. A front-end loader would then load the stockpile of reject material into a haul truck for transport around the REA. To manage the stockpiled volume, as well as the daytime conveyed volume of rejects, two haul trucks would be required to operate during the day-time and evening periods.

2.4 Power Line Easement

Since the exhibition of the EIS, the location and footprint of the power line easement for ventilation shaft site TSC1 has been confirmed (refer **Figure 2-3**). Therefore, the construction and operation of the powerline would be included in the Amended Project for which approval is sought under Part 4 of the EP&A Act. Additional assessments have been completed for this Project component. The results of these assessments are summarised in Chapter 7 of the Project Amendment Report and demonstrate that the proposed ancillary infrastructure has been designed to avoid and minimise impacts wherever possible. Mitigation measures as detailed in the relevant assessments would be implemented to minimise and manage impacts during construction.

2.5 Mine Ventilation

A review of the ventilation strategy for the Project has been undertaken and concluded that the Project would require continued use of the existing upcast shaft (T2). Importantly, the operation will reduce from two fans during Tahmoor North operations to one fan once the new ventilation shafts and fans (TSC1 and TSC2) are in operation in Tahmoor South. The continued use of T2 as part of the Amended Project has been considered as part of an updated air quality assessment, which is discussed in Section 7.9 of the Project Amendment Report.



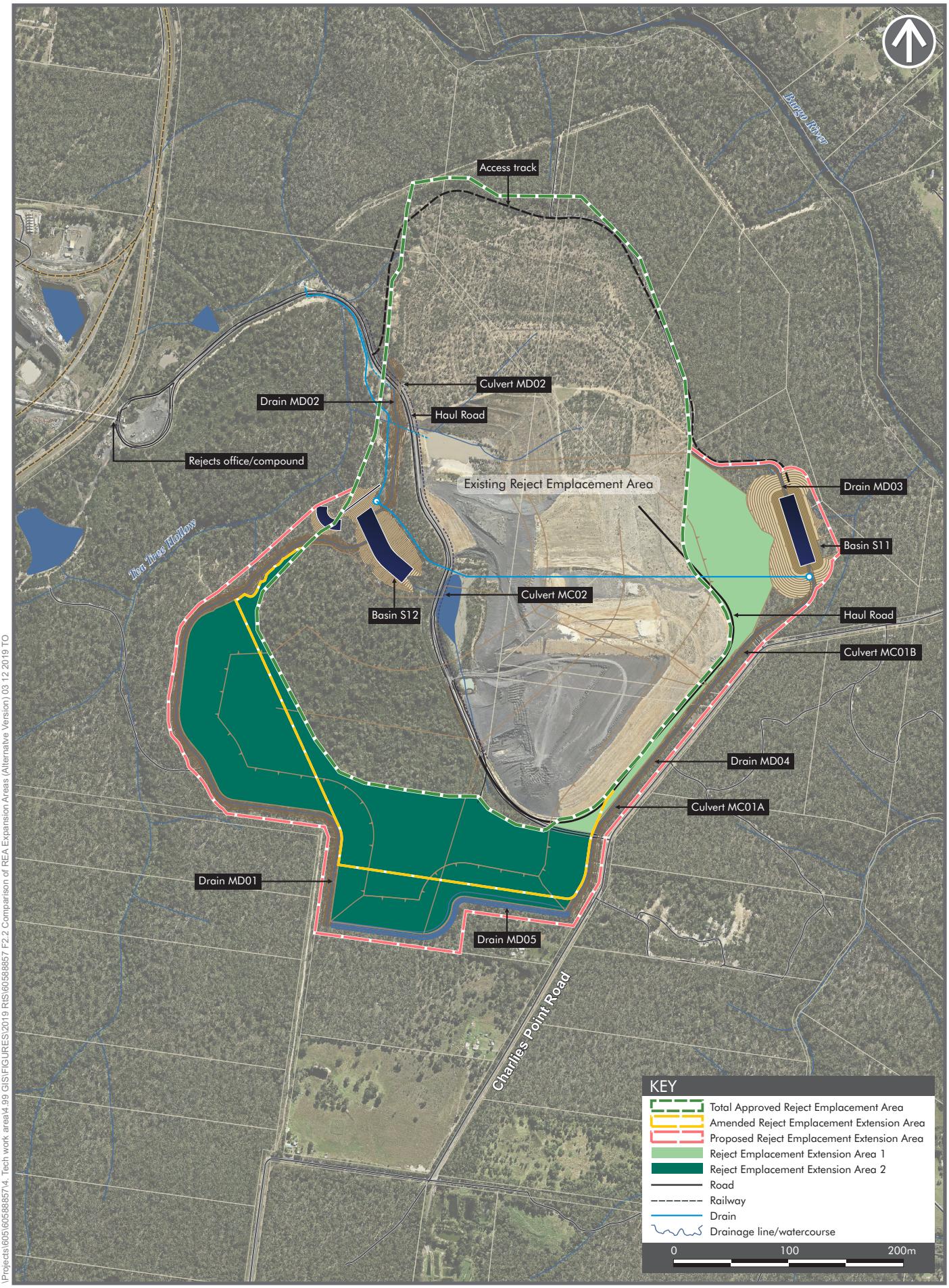
\Projects\605\605888574. Tech work area\4.99 GIS\FIGURES\2019 Response to Submissions\60588857 F2.1 Comparison of Mine Plans 03 12 2019 TO

SIMEC

COMPARISON OF EIS MINE PLAN (2018) AND AMENDED PROJECT MINE PLAN (2019)

Tahmoor South Project
Response to Submissions Report

FIGURE 2.1



\Projects\605\605888574. Tech work area\4.99 GIS\FIGURES\2019 RtS\605888857 F2.2 Comparison of REA Expansion Areas (Alternative Version) 03 12 2019 TO

SIMEC MINING

COMPARISON OF REA EXPANSION AREA (2018) AND AMENDED REA EXPANSION AREA (2019)

Tahmoor South Project
Response to Submissions Report

FIGURE 2.2

\Projects\605\605888574. Tech work area\4.99 GIS\FIGURES\2019 Response to Submissions\60588857 F2.3 Confirmed Powerline Easement for TSC1 03 12 2019 TO

SIMEC

CONFIRMED POWERLINE EASEMENT FOR TSC1

Tahmoor South Project
Response to Submissions Report

FIGURE 2.3

3.0 Stakeholder Engagement

Stakeholder engagement has been undertaken throughout the project planning and environmental impact assessment process, including consultation with local and State Governments, industry regulators, near neighbours (including specifically property owners along Charlies Point Road with regards to property acquisition agreements), the local Aboriginal community and the wider local community.

The EIS for the Project was placed on public exhibition from the 23 January 2019 until 5 March 2019 for a total of 42 days. The community was invited to comment on the EIS by the NSW Department of Planning via newspaper advertisements and a media release on 23 January 2019.

Tahmoor Coal has consulted with stakeholders about the Project via:

- Newsletters;
- Tahmoor Coal's website which includes project updates;
- Community Information Days: 4 September 2018, 30 October 2018,19 February 2019;
- Community drop-in sessions held at the Picton Bowling Club on 11 June 2019 and17 October 2019;
- Community Information stands at Tahmoor Town Centre, Bargo IGA, Community Pantry speaking to over 100 people;
- Stakeholder engagement activities with the following groups:
  - Elected State and federal representatives;
  - Wollondilly Shire Council and Wingecarribee Shire Council;
  - Bargo Progress Association, Picton Chamber of Commerce;
  - Government agencies;
  - TCCCC; and
  - The wider community including local schools, property developers and residents.
- Tahmoor Coal/SIMEC Complaints and Enquiries line and email:
  - (02) 46 400 100;
  - 1800 154 415 (24-hour contact number); and
  - Tahmoorenquiries@simecgfg.com.
- Media statements and newspapers including:
  - Sydney Morning Herald;
  - Daily Telegraph;
  - The Australian;
  - Southern Highland News;
  - Macarthur Chronicle; and
  - Wollondilly Advertiser.

4.0 Summary of Submissions

4.1 Submissions Received

During the EIS public exhibition period, and for a short period thereafter, submissions in relation to the Project were accepted by DPIE. Submissions were provided to Tahmoor Coal for response. All submissions were reviewed, and issues raised have been addressed in this Response to Submissions Report.

A total of 106 submissions were received in response to the EIS, as summarised in **Table 4-1**.

Table 4-1 Summary of submissions received

Submission group type	Number of Separate submitters*
Commonwealth Government agencies	1 – Commonwealth Independent Expert Scientific Committee
State government agencies	12 - State Government Agencies
Local councils	2 – Wollondilly Shire Council and Wingecarribee Shire Council.
Interest groups / organisations	8 - Organisations (1 supporting the Project, 5 objecting and 2 making comments to the Project).
Individual public / community members	83 - Individual/community members made submissions (73 supporting the Project and 10 objecting to the Project).
Total	106

Each submission has been individually examined with issues collated, and responses to the issues provided in **Chapters 5.0** and **Chapter 6.0** of this document.

Authors of community submissions have not been identified in this report and have instead been assigned a unique identification number which is referred to in this report as a 'submission identification number'.

4.2 Matters Raised – Commonwealth and State Government Agencies

One Commonwealth government agency and 12 State government agencies made submissions, raising a range of issues relevant to their respective areas of interest and responsibility. Responses to each issue raised by government agencies are provided in **Chapter 5.0**.

4.3 Matters Raised – Local Councils

Wollondilly Shire Council and Wingecarribee Shire Council each made a submission. Responses to each issue raised by local councils are provided in **Chapter 5.0**.

4.4 Matters Raised –Organisations

Eight submissions were received from organisations, as summarised in **Table 4-2**. Responses to issues raised by organisations are provided in **Chapter 6.0**.

Table 4-2 Organisations that made a submission on the EIS

Organisation	Location	Nature of submission
The National Trust of Australia (NSW)	Sydney, NSW	Objects
RStar Mining	Bargo, NSW	Supports
Undermined Inc	Oakdale, NSW	Objects
Ironlaw Pty Ltd	Sydney, NSW	Objects
Greater Blue Mountains World Heritage Area Advisory Committee	Glenbrook, NSW	Comments
National Parks Association of NSW	Campbelltown, NSW	Objects
Endeavour Energy	Huntingwood, NSW	Comments
Doctors for the Environment Australia	College Park, SA	Objects

4.5 Matters Raised – Community Submissions

In total, 83 community submissions were received. Of these a total of 73 submissions indicated support for the Project and 10 raised objections to the Project. The submissions received were from the areas shown in **Table 4-3**. Responses to issues raised in community submissions are provided in **Chapter 6.0**.

Table 4-3 Locations of Submissions Received

LGA	Suburbs	No. of Submissions	Supporting Submissions	Objecting Submissions
Wollondilly	• Bargo; • Wilton; • Thirlmere; • Tahmoor; • The Oaks; • Razorback; • Picton; • Oakdale; and • Pheasants Nest.	27	21	6

LGA	Suburbs	No. of Submissions	Supporting Submissions	Objecting Submissions
Wollongong	• Fairy Meadow; • Tarrawanna; • Dapto; • Coledale; • Wollongong; • Thirroul; • Horsley; • Unanderra; • Figtree; • Towradgi; • East Corrimal; • Cordeaux Heights; and • Woonona.	19	18	1
Camden	• Harrington Park; • Elderslie; and • Narellan.	3	3	-
Campbelltown	• Rosemeadow; and • Leumeah.	2	2	-
Canterbury-Bankstown	• Padstow Heights; • Picnic Point; • Punchbowl; and • Yagoona.	5	5	-
Sydney	• Camperdown.	1	-	1
Goulburn Mulwaree	• Windellama.	1	1	-
Mid-Western Regional	• Round Swamp.	1	1	-
Liverpool	• Moorebank.	2	2	-
Ku-ring-gai	• St Ives.	1	1	-
Canada Bay	• Rhodes.	1	1	-
Lake Macquarie	• Cardiff; • Eleebana; • Charlestown; and • Balmoral.	5	5	-
Cessnock	• Bellbird.	2	2	-
Kiama	• Kiama.	1	1	-
City of Parramatta	• Rydalmere.	1	1	-
Wingecarribee	• Moss Vale; • Robertson; and • Bundanoon.	5	4	1
Burwood	• Croydon Park.	1	1	-
The Hills Shire	• Baulkham Hills.	1	1	-

LGA	Suburbs	No. of Submissions	Supporting Submissions	Objecting Submissions
Inner West	• Dulwich Hill.	1	1	-
Canberra (ACT)	• Canberra	1	-	1
N/A	• N/A	2	2	-
Total	-	**83**	**73** (87.95%)	**10** (12.05%)

The main issues raised in the individual community submissions that objected to the Project, were:

- **Subsidence Impacts** – Concerns regarding longwall mining under the Bargo area and the potential impacts this may have on property values and natural features;
- **Economy** – Concerns that money in the region is being spent incorrectly, as new roads and infrastructure within the Bargo area should be a priority;
- **Surface Water** – Concerns regarding the impacts that the current discharge of wastewater from Tahmoor Mine may be having on Tea Tree Hollow and the Bargo River. There is a perception that desalination or other methods should be used to reduce the high levels of salt and heavy metals which currently pollute the water quality. There is also a perception that management measures regarding erosion and sediment control require significant improvement;
- **Biodiversity** – issues raised included:
  - Concerns regarding impacts on water quality and the need to protect instream flora and fauna;
  - Concerns that the potential impacts of mine subsidence, in terms of hydrology and water quality, will cause irreversible damage to waterways;
  - Potential impacts on UNESCO World heritage listed National Park; and
  - The perception that management measures proposed as part of the Project would not be able to protect the environment.
- **Greenhouse Gas and Climate Change** – Concerns regarding the Project's contribution to Australia's carbon footprint, and Australia's ability to meet its Paris commitments while also allowing the continuation of coal mining and exports.

4.6 DPIE identified key issues

DPIE undertook a preliminary review of the development application, EIS and submissions received on the Project. It also engaged an independent groundwater specialist to review key groundwater aspects of the Project.

Based on its preliminary review, DPIE identified several key issues that required further consideration, which are summarised in the report *Tahmoor South Coal Project: Preliminary Issues Report (DPIE, June 2019)*. **Table 4-4** provides a summary of key issues and identifies where these have been addressed in this report.

Table 4-4 Summary of DPIE Identified Key Issues

Key concerns	Relevant sections	Summary response
Subsidence		
• Potential impacts on built features in particular the modelled scale of impacts to residences within Bargo, and the potential impacts this may have on property values;	5.10.1; 5.10.2; 6.9.1.1.	• The mine plan was amended to reduce cut height of the long walls from 2.85 m to 2.6 m, reduction in longwall width from approximately 305 m to 285 m, and revision to the spatial extent of longwalls.
• Potential subsidence impacts on Bargo Waste Management Centre;	5.4.32; 5.15.19; 6.9.1.4.	• A revised Subsidence Assessment was prepared, which included the Bargo Waste Management Centre (Appendix B of the Project Amendment Report). The revised Subsidence Assessment identified impacts to natural features and built infrastructure remain manageable and can be controlled by the preparation and implementation of Subsidence Management Plans (or Extraction Plans).
• Potential impacts to natural resources including: - Surface water: ▪ Subsidence impacts on water quality; ▪ Watercourse hydraulics and stability; ▪ Localised changes in surface ponding; ▪ Changes to flows in Dog Trap Creek and the upstream section of Tea Tree Hollow; ▪ Proposed self-remediation and/or active remediation of stream beds; ▪ Water levels in Thirlmere Lakes. - Biodiversity; - Heritage; and - Cliffs and steep slopes.	5.1.14; 5.1.28; 5.15.29; 6.3.4. 5.1.33 5.7.31 5.7.27 5.1.31; 5.8.2-4. 5.1.20; 5.1.22; 5.7.28; 5.15.35. 5.1.16; 5.15.34; 5.15.37-9. 5.5.1; 5.7.18; 5.7.22; 6.9.6-7. 5.7.22.	• The mine plan was amended to reduce cut height of the long walls from 2.85 m to 2.6 m, reduction in longwall width from approximately 305 m to 285 m, and revision to the spatial extent of longwalls; • An Extraction Plan, Trigger Action Response Plans, adaptive water monitoring program and corrective management plans would be adopted to minimise and manage the impacts of the Amended Project on natural resources; • Receiving environments will be monitored as part of the surface water monitoring and management plan. A TARP for those environments will also be incorporated; • Additional water level monitoring sites have also been implemented, or are proposed to be implemented, on Hornes Creek (four additional sites), Dog Trap Creek (four additional sites), Tea Tree Hollow (four additional sites) and Eliza Creek (one additional site). These monitoring sites will provide baseline water level data necessary to enable the assessment of potential impacts to pool water levels as a result of the Project. • Further enhance methods for remediating creek beds in the Southern Coalfields. Determine the long-term effectiveness of remediation implemented, and develop corrective management action plans for remediation of creeks; and • The systems and programs currently in place to monitor and manage subsidence would continue during the Amended Project and would be augmented to monitor the effects of mining within the Central Domain. Additional subsidence monitoring points would be installed before any mining of second workings for all longwalls in each Extraction Plan.

Key concerns	Relevant sections	Summary response
Groundwater		
• Groundwater model used for the assessment;	5.1.5; 5.1.7; 5.1.9; 5.2.4.4; 5.15.21-4.	• An updated Groundwater Assessment has been prepared (Appendix C of the Project Amendment Report) which addresses comments made by Government agencies regarding the groundwater model for the Project.
• Groundwater licence allocations;	5.2.4.2; 5.15.25-6.	• Tahmoor Coal would obtain necessary water entitlements to cover the flow reduction. Additional groundwater licence(s) would be secured to account for the increased groundwater inflows for the Amended Project in consultation with Natural Resource Access Regulator and in accordance with the requirements of the Aquifer Interference Policy prior to the commencement of the development;
• Modelling used to determine impacts to Thirlmere Lakes;	5.1.5; 5.1.20; 5.1.22-23; 5.2.4.4; 5.15.24-25; 6.6.4;	• The IESC recommendation to revise and update future models for the Project with the findings of ongoing studies at Thirlmere Lakes (NSW OEH, 2019) has been incorporated into the revised management measures for the Amended Project (refer **Chapter 7.0**).
• The treatment of geological features such as faults and lineaments in the Groundwater Assessment, in particular the Nepean Fault zone;	5.1.2-3; 5.2.4.4; 5.2.4.6.	• Additional geological characterisation has been undertaken to better understand the hydrological influence of the fault zones and lineaments in the geology. This work has been used to inform the revised Groundwater Assessment for the Amended Project (refer Appendix C of the Project Amendment Report).
• Proposed management of mine inflows;	5.1.25; 5.2.4.4; 5.15.26; 6.6.3;	• Tahmoor Coal propose to develop an underground storage within goafed areas of the Tahmoor North underground mine into which mine dewatering from the Amended Project would be pumped at times when there is insufficient capacity to treat the dewatering stream through the upgraded WWTP. Water would be pumped into and out of the storage via the existing drift and no new surface infrastructure is envisaged outside the pit top area. At times of lower inflow, water could be recovered from the underground storage, treated within the upgraded WWTP and released via LDP1. Refer Appendix D of the Project Amendment Report.
• Predicted impacts to privately-owned groundwater bores (considered significant but manageable); and	5.1.24; 5.2.4.6-7.	• Updated bore census commenced (November 2018) • The existing Tahmoor Mine Groundwater Management Plan would be updated for the Amended Project to define a groundwater monitoring strategy, groundwater level triggers, and include a TARP. • Make-good measures would be implemented.

Key concerns	Relevant sections	Summary response
• Extension of the REA and its potential impacts on groundwater quality.	5.4.28	• Surface water and groundwater monitoring for AMD and spontaneous combustion would continue at the existing monitoring frequency as part of the sites surface and groundwater management plan.
Surface Water		
• Flooding characteristics for the full range of flood events;	5.1.13; 5.7.31.	• Response provided in **Section 5.1.13** and **Section 5.7.31**.
• Flood model was based on regional information without calibration and with no information provided on some key modelling assumptions;	5.1.13.	• A revised Flood Study has been prepared (Appendix D of the Project Amendment Report).
• REA rehabilitated in accordance with the Guidelines for Working on Waterfront Land;	5.2.4.1	• The existing management, rehabilitation and monitoring plan for the REA would be updated in consultation with the Natural Resource Access Regulator to cover the extension of the REA for the Amended Project; • Rehabilitation of the Amended Project would be undertaken using a staged approach comprising: - Progressive rehabilitation of the REA; and - Mine closure and rehabilitation of the surface facilities area and ventilation shafts. • Based on the Project amendments, the REA is now proposed to be progressed in six stages. Where practicable, each stage of the REA will be progressively rehabilitated when it is no longer in use. This process would involve capping the reject material with topsoil and establishing vegetation; and • The water management plan will contain an ongoing monitoring plan for the site including contingencies if parameters are exceeded and an outline of a Trigger Action Response Plan.

Key concerns	Relevant sections	Summary response
• Site water management including consideration of recommendations regarding: - Surface wastewater storage liners; - Goaf storage: assessment of underground water storage within goaf areas if near watercourses or adjacent to geology with cracking or high permeability; - Potential water quality impacts arising from site discharges, including impacts of wastewater discharge on Tea Tree Hollow and the Bargo River; - Sewage treatment; - Trigger values and expansion of surface monitoring network to improve monitoring of stream flow and pool water levels; and - Ability to obtain the necessary authorised water entitlement to account for the maximum take of surface water	5.4.21 5.1.19; 5.4.22. 5.1.15; 5.1.18; 5.4.14-20; 5.4.25; 5.15.33; 6.9.3.1. 5.4.26; 6.6.7. 5.1.35; 5.2.4.5. 5.2.4.2.	• The existing Waste Water Treatment Plant (WWTP) will be upgraded, separately to the Project; • As part of the Project, Tahmoor Coal would develop an underground storage within goafed areas of the Tahmoor North underground into which mine dewatering from the Tahmoor South underground would be pumped; • Surface water runoff from operational areas and stockpiles would continue to be captured by the existing stormwater treatment dams at the surface facilities area. Following treatment, the water would continue to be discharged to Tea Tree Hollow at LDP1; • Water management during operation of the Amended Project would be governed by the water management plan currently in place at Tahmoor Mine. The Water Management Plan would be updated to encompass the operations associated with the Amended Project. Mine water would be treated and recycled for non-potable underground use, or passed through the stormwater treatment dams and be discharged via the licensed discharge point (LDP) and licensed wet weather licensed overflow points (LOPs); • Improvement of Tahmoor Coal's existing operation facilities such as the WWTP. • Develop an adaptive monitoring program and Trigger Action Response Plans for surface water which include triggers for water quality exceedances, unexpected flow loss based on analysis of baseline (pre-subsidence) streamflow data and unexpected loss of pool water holding capacity based on analysis of baseline (pre-subsidence) pool water level data. • Obtain necessary water entitlements to cover the flow; and reduction. Additional groundwater licence(s) would be secured to account for the increased groundwater inflows for the Project in consultation with Department of Industry Lands and Water Division and in accordance with the requirements of the Aquifer Interference Policy prior to the commencement of the development.
Terrestrial Biodiversity		
• Direct clearing of CEEC and threatened species;	5.7.2; 5.7.4; 5.15.41; 6.6.5;	An updated Biodiversity Assessment has been prepared for the Amended Project. Key amendments to terrestrial ecology include: • Confirmed a reduced risk of seam-to-surface connection;

Key concerns	Relevant sections	Summary response
• Lack of information regarding fauna species inhabiting the area;	5.1.16; 5.7.6; 5.15.40; 5.15.43; 6.4.2.	• The reduction of the REA extension has resulted in an approximately 50% reduction in area, from 49.2 hectares to 23.57 hectares, of native vegetation to be directly impacted when compared to the EIS project design; and • Reduction in credit requirement for Shale Sandstone Transition Forest. Additional monitoring commitments include: • Monitor and enhance the success of rehabilitation methods for creeks; • Further survey for adult and larval Sydney Hawk Dragonflies in summer (2019-20) in the Bargo River; and • Further monitoring of aquatic habitats in spring 2019 and autumn 2020 to update the baseline data.
• Concerns regarding impacts on water quality and the need to protect instream flora and fauna;	5.1.16; 5.2.2.1.	
• Concerns that the potential impacts of mine subsidence, in terms of hydrology and water quality, will cause irreversible damage to aquatic habitat; and	5.1.14; 5.1.28; 5.1.31; 5.7.27; 5.8.2-4; 5.15.29; 6.3.4.	
• Potential impacts on UNESCO World heritage listed National Park.	5.7.28; 6.3.1; 6.5.1-2; 6.9.4.	
Aboriginal Cultural Heritage		
• Longwalls located near Dog Trap Creek causing impacts from vibration, bed rock fracturing and changes in hydrological patterns; and	5.7.18; 5.7.22; 6.9.6;	• The mine plan for the Project has been amended to reduce subsidence and remove longwall 109 to avoid Dog Trap Creek; • A total of thirty (30) Aboriginal heritage sites were identified within the Subsidence Study Area (SSA). There are three less Aboriginal cultural heritage sites identified within the 20 mm subsidence contour associated with the amended mine plan when compared to the 20 mm subsidence contour. In response to the issues received: - AHIMS cards for all recorded sites will be submitted to OEH; and - Detailed avoidance, mitigation and management measures have been developed to reduce potential impacts on Aboriginal heritage.
• Assessment of all recorded sites.	5.7.18; 5.7.26.	

Key concerns	Relevant sections	Summary response
Non- Aboriginal Heritage		
• Lack of engagement by Tahmoor Coal to arrange access to Wirrimbirra Sanctuary and that there had been no engagement to arrange access to remediate the Project's potential subsidence impacts.	6.4.4	• Tahmoor Coal has requested access to Wirrimbirra Sanctuary to assess the potential impacts of the Project. The National Trust has agreed to a site visit by technical specialists in early 2020 to complete the assessment. A Statement of Heritage Impact will be prepared and issued to DPIE as an addendum to the Project Amendment Report; • The Subsidence Assessment for the Amended Project (Appendix B of the Project Amendment Report) discusses subsidence impacts on Wirrimbirra Sanctuary; and • As part of the Project, water levels up and downstream of Wirrimbirra Sanctuary would be monitored so that potential impacts are identified and corrected as soon as practically possible. A Trigger Action Response Plan would be implemented comprising management and remediation measures.
• Heritage assessment, including lack of detailed condition reports and inadequate consideration of adverse impacts or detailed monitoring and mitigation measures.	6.4.4; 6.9.7.	
Noise and Vibration		
• Resolving historical noise issues at the mine	5.4.9	• It is expected that both the frequency and level of maximum noise events from the Amended Project will be lower compared to the existing operation due to the mitigation measures to be implemented; including as a result of restricting operation of all equipment in the REA to day and evening only.
• Applying the current policy context: Tahmoor Coal was requested to assess the Project under the *Noise Policy for Industry* (NPfI), including relevant meteorological conditions and background noise levels, including establishing criteria for the existing operations then converting these criteria to contemporary criteria.	5.4.1; 5.4.13	• A revised Noise and Vibration Assessment (NVIA) Report (Appendix I of the Project Amendment Report) has been prepared to assess the noise and vibration impacts of the Amended Project on the existing noise-sensitive receptors in the Amended Project area. The following key changes are reflected in the revised assessment: - The Amended Project has been assessed against the *Noise Policy for Industry* (NPfI); - Additional investigations regarding mitigation for the CHPP; - Controls specific to the reduction of maximum noise would be implemented; and - Noise mitigation initiatives in the purchase and/or design of all new equipment as well as any new site buildings and access roads.

Key concerns	Relevant sections	Summary response
• Consideration of low frequency noise, including addressing historic low-frequency noise issues at the site. Priority should be placed on mitigating low-frequency noise emissions from the CHPP rather than only focussing on the expected overall noise reductions.	5.4.1	• Tahmoor Coal will continue to investigate options for further noise mitigation into the future including, but not limited to the following: - Consideration of a new haul truck for use in the REA with the inclusion of noise attenuation and/or noise specification in the supply contract; - Additional investigations regarding mitigation for the CHPP; and - Consideration of noise mitigation initiatives in the purchase and/or design of all new equipment as well as any new site buildings and access roads.
• Refinement of technical inputs	5.4.11	• Additional attended noise monitoring was undertaken to inform the revised NVIA Report (Appendix I of the Project Amendment Report).
• Further justification and clarification for the proposed mitigation and management measures.	5.4.8	• Tahmoor Coal would implement noise controls specific to the reduction of maximum noise during operations such as Laminated transfer chutes at conveyor transfer points, Installation of an onsite real-time noise monitor, Increased height of barrier adjacent to the north-western side of the rail loop and Improvement to feed chute into rail wagons.
Greenhouse Gases		
• Project's contribution to Australia's carbon footprint; and • Australia's ability to meet its Paris commitments while also allowing the continuation of coal mining and exports.	6.1.10-11; 6.3.8; 6.8; 6.9.10.	• Tahmoor Coal is a subsidiary of the Liberty Steel Group, which recently announced its commitment to achieve carbon neutrality by 2030; and • Impacts would be in proportion with its contribution to global GHG emissions. Average annual Scope 1 emissions from the Project (0.75 Mt CO2-e) would represent approximately 0.175% of Australia's commitment under the Paris Agreement (431 Mt CO2-e by 2030) and 0.0023% of global GHG emissions (DoEE, 2019; IEA, 2019).

Key concerns	Relevant sections	Summary response
Economic		
• Justification of the project to the economy in terms of disutility of working in mining, the sensitivity analysis scenario results and local environmental, social and transport impacts.	6.1.8; 6.3.15; 6.9.12.	An Economic Impact Assessment was prepared to determine the revised net economic impact as a result of the Amended Project. The LEA considers the costs and benefits of the Amended Project on residents of the Wollondilly region of NSW. The analysis shows an estimated net benefit of $162.0 million to the Wollondilly region in NPV terms. This is driven largely by: • Benefits to local workers of $122.3 million in NPV terms based on the assumption that 45 per cent of the mine's direct employees continue to be drawn from Wollondilly; • Benefits to local suppliers of $34.5 million in NPV terms which assumes that 12.9 per cent of the inputs to production are from the region; and • The payment of local Council rates totalling $5.2 million in NPV terms. The report shows that the estimated local effects are robust under the sensitivity analysis conducted with a lower bound estimate of net benefits to the Wollondilly region of $153.6 million and upper bound estimate of $171.4 million in NPV terms.
Human Health		
• Health impacts to residents located close to the proposed ventilation shafts,	5.6.2	• The Health Impact Assessment (HIA) was undertaken and used information from the Air Quality Impact Assessment presented in Appendix J of the Project Amendment Report; • Installation of additional real-time PM10 monitors to target the most sensitive receptors likely to be affected by dust; and • The potential impacts on the health of the community have been assessed in the HIA in relation to emissions of dust, as well as emissions from the operation of the methane flare (nitrogen dioxide, carbon monoxide and VOCs as hydrocarbons). The impact assessment concluded that the Amended Project would not create health risk issues of concern.
• Noise impacts; and	5.6.3	• The HIA (Appendix N of the Project Amendment Report) evaluated of operational noise impacts associated with the existing Tahmoor Mine, the Amended Project before incorporating mitigation measures and the Amended Project before incorporating mitigation measures with mitigated measures. • Based on the predicted noise levels and recommended mitigation measures, the potential for adverse health impacts to occur as a result of noise generated during construction and operations is considered to be low.
• Impacts from greenhouse gases and climate change.	6.8	• Refer above "Greenhouse gases"

Key concerns	Relevant sections	Summary response
Social		
• Mining beneath houses;	5.10.3	• Tahmoor Coal subsidence management process includes communication processes with residents, pre-mining inspections and resolution of claims in accordance with SA NSW requirements; and • Tahmoor Coal would implement measures to monitor potential social impacts on the community for the duration of the project. Tahmoor Coal would continue to hold community information days which would allow feedback from the community.
• Aboriginal heritage;	5.7.21	• The original SIA for the Project (Appendix Q of the EIS) has been updated via preparation of an SIA Addendum (Appendix R of the Project Amendment Report), to include an assessment of the social impacts of the Project on the Aboriginal community, as it is recognised that Aboriginal communities also have inherent and broadscale connections to Country beyond individual heritage sites, including spiritual, social and cultural connections.
• Impacts to groundwater bores; and	5.2.4.6-7	• The original SIA for the Project (Appendix Q of the EIS) has been updated via preparation of an SIA Addendum (Appendix R of the Project Amendment Report), to include an assessment of the social impacts of the Project on groundwater bore users. • Tahmoor Coal has committed to implementing 'make-good' provisions for affected groundwater users. with the 'make-good' plan to be finalised in consultation with the Natural Resources Access Regulator. Relevant measures could include lowering pumps within groundwater bores or providing an improved pump, deepening a bore or drilling a new bore, or providing an alternative water supply. Pre-longwall mining bore census surveys would be undertaken to establish baseline conditions of bores predicted to be affected, so that 'make-good' measures can be implemented in the event that the bores are impacted (determined by monitoring pre, during and post longwall mining).
• Impacts on people with a connection to natural features, especially Thirlmere Lakes.	6.9.4	• The original SIA for the Project (Appendix Q of the EIS) has been updated via preparation of an SIA Addendum (Appendix R of the Project Amendment Report), to include an assessment of the social impacts of the Project on community with ties to surrounding natural features.

Key concerns	Relevant sections	Summary response
Traffic		
Tahmoor Coal requested to clarify the mine design used as the basis of the TIA and address concerns including: • reductions to the Level of Service at some intersections; and • increased traffic in morning and afternoon peak periods around the Wollondilly Anglican College and potential damage to infrastructure from additional heavy vehicles.	Sections 5.9; 5.12; 5.15.49; 5.15.50	• Responses to these issues have been provided in **Section 5.15.49** and **Section 5.15.50**.
Rehabilitation and Final Landform		
Tahmoor Coal requested to provide additional information regarding the final landform, rehabilitation of watercourses and rehabilitation completion and performance criteria. Concerns over provision of a rehabilitation bond to ensure that funds are available to complete rehabilitation.	Sections 5.8; 6.3.12-15	• A detailed Mine Closure Plan will be prepared at least five years before expected mine closure and submitted to the Resource Regulator; and • Update the Water Management Plan to include specific monitoring of Acid and Metalliferous Drainage and contaminants of concern.

5.0 Response to Government Agency and Council Submissions

5.1 Commonwealth Independent Expert Scientific Committee

5.1.1 Subsidence, Surface Water and Groundwater: Modelling Context

Issue Description

In relation to mining induced ground movement, surface water and groundwater the IESC was asked to provide advice on model accuracy. It considered models are necessarily based on imperfect information and are simplified representations of reality. In this sense, models cannot be perfectly accurate, and the IESC considers that questions of accuracy should be framed in terms of confidence in model predictions. Evidence to support the degree of confidence in model estimates must be supported by analyses of uncertainty. In a high-risk environment, this should include many simulations to explore how model parameters and assumptions influence the likely upper and lower bounds of model predictions. There are two main drivers that need explanation to provide context for the responses to the questions that follow: mining-induced ground movement and groundwater drawdown.

Response

The IESC's comments regarding accuracy, model confidence, and analyses of uncertainty are noted.

With respect to groundwater, surface water and mining induced ground movement the following models were developed and used to inform the assessment:

- Ground movement:
  - Incremental profile method;
    - The predicted conventional subsidence parameters due to the extraction of the proposed longwalls were determined using the Incremental Profile Method (IPM), which was developed by MSEC in 1994, when formally known as Waddington Kay and Associates. This method is an empirical model based on a large database of observed subsidence monitoring data from previous mining within the Southern, Newcastle, Hunter and Western Coalfields of New South Wales and the Bowen Basin in Queensland;
  - Calibration of Incremental Profile Method, outside the increased subsidence area;
    - The IPM was previously refined or calibrated using the extensive monitoring data that had been collected during the extraction of Longwalls 22 to 25 at Tahmoor Mine to predict the subsidence parameters for Longwalls 27 to 30;
  - 2002 ACARP Upsidence and Closure Prediction Method;
  - 2002 ACARP prediction method (Waddington and Kay, 2002);
  - 2002 ACARP valley closure prediction model; and
  - Simulation exercise to forecast the potential impacts if an additional 2000 houses are present when the proposed longwalls are extracted
- Groundwater:
  - Hydrogeological conceptual model;
    - Developed to assess impacts of mining on the permeability of caved and deformed overburden;
    - The SCT (2014) report on the 'Height of Fracturing' (HoF') hole is particularly important in the development of the conceptual model of this process at Tahmoor Mine, because it shows *in situ* behaviour of groundwater levels in response to mining at Tahmoor at a location that is only a few hundred metres from the proposed Tahmoor South longwalls;
  - Groundwater Simulation Model

- Developed for impact assessment purposes, including the software chosen, the model extent and layering, the types of boundary conditions used to represent the significant hydrogeological processes, and then details of the 'history-matching' or calibration of model output to observed water levels, baseflows and mine inflows;
- Used groundwater flow modelling: developed for impact assessment purposes, including the software chosen, the model extent and layering, the types of boundary conditions used to represent the significant hydrogeological processes, and then details of the 'history-matching' or calibration of model output to observed water levels, baseflows and mine inflows;
- Used numerical modelling: Numerical modelling was undertaken using MODFLOWUSG, which is distributed by the United States Geological Survey (USGS). MODFLOW-USG is a relatively new version of the popular MODFLOW code;
- Used Impact assessment modelling: the impact assessment modelling has been achieved by simulating contrasts in hydraulic properties and hydraulic gradients; and
- Predictive Modelling: Developed using the calibrated groundwater model.

- Surface water
  - Catchment modelling of local water courses
    - Undertaken using deterministic models which are configured to simulate catchment characteristics that are important to the environmental assessment; and
    - Used the Australian Water Balance Model (AWBM) (Boughton, 2004), which is a nationally-recognised catchment-scale water balance model for simulating surface runoff and baseflow processes on gauged and un-gauged catchments.
  - Hydrological modelling of local drainages
    - The flood study comprised hydrologic and hydraulic modelling to predict flood levels for flood events up to the probable maximum flood (PMF) level in areas affected by mine subsidence before and after mining. The flood study report documents where flooding risks will change as a result of subsidence; and
    - Flood hydrographs for the assessed flood events were generated using the rainfall routing model RORB (Laurenson, et al, 2010) which is a commonly used and well-established model for generating flood hydrographs from design rainfall.
  - Hydraulic modelling of local drainages
    - The hydraulic modelling to estimate areas that would be affected (i.e. inundated) as a result of flooding was undertaken using the 2-dimensional hydrodynamic model TUFLOW™. TUFLOW (BMTWBM, 2010) is an accepted 2-dimensional numerical, finite difference model which simulates the hydraulic conditions throughout the modelled watercourse by solving the free surface flow equations of momentum and conservation.
  - Water balance simulation modelling
    - A water balance model of the Tahmoor Mine water management system has been developed to simulate the management of water over the remaining Tahmoor North life and Project life (i.e. from 2018 to 2035). The model simulates the water balance of all water management storages, the generation of runoff from rainfall over mine surface facility catchments, recovery of water from underground mining operations and supply of water to meet the demands of the CHPP, the underground mine and for dust suppression; and
    - Model calibration was undertaken using a two-year period of recorded data for 2014 and 2015 to attempt to match recorded and simulated release from the four historical release points on site (from M4, S4, S8 and S9).
  - Changes in flow velocity and bed shear stress due to subsidence.

- The potential effect of predicted subsidence movements on the hydraulic characteristics of overlying watercourses have been assessed using a two-dimensional hydraulic model: TUFLOW™ (BMT WBM, 2010).

5.1.2 Subsidence: Modelling IPM Method

Issue Description

The key physical driver of concern is the extent to which mining-induced ground movement causes surface cracking and near-surface fracturing, which has important consequences for the interactions between groundwater and surface waters and their resources. The estimates of surface subsidence are largely based on the use of a single empirical method (Incremental Profile Method (IPM)). While this method might be appropriate to estimate subsidence across the broader landscape, it is noted that the model materially underestimates observations of ground movement within watercourses and near the Nepean Fault (EIS, Appendix F subsidence assessment, and Appendix G geotechnical assessment). Accordingly, the IESC has little confidence in the estimates of subsidence (and other associated ground movements) in these locations. Additional geological characterisation, groundwater level analysis and targeted seismic surveys across fault zones may help to understand the hydrological influence of the fault zones.

Response

The IESC's concerns regarding the use of the IPM to predict ground movement within watercourses and near the Nepean Fault are noted. However, the IPM is not designed to predict non-conventional movements. Predicted valley closure and upsidence movements (those movements that affect watercourses) must be added to the IPM. This process was undertaken to inform subsidence impacts of the Project (refer Subsidence Technical Report, Appendix F of the EIS).

In the case of watercourses, the Subsidence Technical Report (Appendix F of the EIS) provides predictions of conventional vertical subsidence along watercourses using the IPM and then, additionally, provides separate predictions of non-conventional valley closure and upsidence along the watercourses using the 2002 ACARP valley closure prediction model. When assessing potential impacts on watercourses, it is important to consider predictions of conventional and non-conventional movements together. Both the subsidence assessment in Appendix F of the EIS and the geotechnical assessment in Appendix G of the EIS adopted this approach and are considered to be conservative and robust. This approach has also been adopted in the updated subsidence assessment for the Amended Project provided in Appendix B of the Project Amendment Report.

The IPM is used to predict the overall conventional vertical subsidence of valleys, using the same methods that are applied to predict conventional subsidence over the surrounding broader landscape. However, in isolated locations within the valley the ground surface is observed to lift upwards relative to the valley sides, forming voids within the near surface bedrock. This is described as upsidence and is frequently observed from surveys of ground monitoring lines. For any given cross-section across a valley, it is difficult to predict exactly where upsidence will occur as it is controlled by the response of the near surface geology. Upsidence usually occurs in the base of the valley but it can sometimes be observed within the sides of the valley and it can sometimes develop in two isolated locations within the valley cross-section rather than focussing at one location.

For any given cross section, therefore, it is expected that there will be a reasonable correlation across the valley between the observed and the predicted vertical subsidence using the IPM but a reduction in subsidence may be observed in isolated locations usually near the floor of the valley where upsidence has occurred. Put simply, there is a reasonable correlation between predicted and observed subsidence across valleys at a macro level, but at a micro level, it is difficult to accurately predict the location and magnitude of upsidence that occurs.

In comparison, groundwater assessments are modelled at the macro level, not micro level and the assessments typically consider the overall effects of subsidence on hydraulic properties of near-surface strata within the valleys and broader landscape.

Where valley closure and upsidence occurs in valleys, it has been researched, published and generally understood that surface and near-surface fracturing will occur within the base of the valley, particularly where upsidence occurs. As discussed above with respect to upsidence, it is expected that fracturing will occur within the valley, but it is difficult to exactly predict its nature and location at a micro level.

The Groundwater Assessment and numerical model for the Amended Project (Appendix C to the Project Amendment Report) considers the effect of fracturing of the surface and near surface bedrock at a macro level by simulating zones of increased hydraulic conductivity to a depth of 10 times the coal cut height above extracted panels. The effects are applied, conservatively across the entire panel footprint, not just valleys. The representation in the model is based on available packer testing and water level data, including pre- and post-mining data near Longwalls 31-32, from Tahmoor North and literature from other mines in the Southern Coalfield. This approach is considered reasonable and conservative. Should micro-level impacts occur they would be subject to monitoring and adaptive management as part of the Extraction Plan process.

The Nepean Fault zone is located to the east of the extent of longwalls, and as in the historical operations of the Tahmoor Mine, forms a constraint on the extent of the Project. In the case of the ground surface in the vicinity of the Nepean Fault, the Subsidence Assessment (Section 4.4 of Appendix F of the EIS) advised that increased subsidence may occur above the south-eastern ends of Longwalls 101B to 108B where they are located near the mapped locations of the Nepean Fault. This is based on experiences observed during mining within the Tahmoor North lease including specific seismic surveys and groundwater monitoring.

Additional geological characterisation has been undertaken to better understand the hydrological influence of the fault zones and lineaments in the geology. This work has been used to inform the revised Groundwater Assessment for the Amended Project (refer Appendix C of the Project Amendment Report).

From a macro groundwater assessment perspective, the area of land that may experience increased subsidence is likely to be restricted to a relatively small area and would be a small proportion of the overall surrounding landscape. While some allowance for increased subsidence directly above the south-eastern ends of Longwalls 101B to 108B could be included in groundwater assessments, it is unlikely to materially influence the results. The Nepean Fault zone has been represented in the groundwater modelling as a more permeable zone, both in the Groundwater Assessment for the EIS and in the assessment for the Amended Project.

5.1.3 Subsidence: Consistency with Geotechnical Assessments

Issue Description

It is difficult to resolve the implications of the differences in results presented in the Subsidence Report (EIS, Appendix F) and the Geotechnical Report (EIS, Appendix G). The former presents the results of the subsidence observations and predictions, whereas the latter presents data, observations and geotechnical modelling to evaluate changes in hydraulic conductivity and subsidence, including at Longwall 10A. There are also differences between the reports in reporting of maximum subsidence in some areas. For example, Appendix F (Figure 3.11) indicates maximum subsidence for longwall panel LW26 was approximately 900 mm whereas in Appendix G (section 3.2) it is reported as 1382 mm. Also, in Appendix F the largest subsidence in Figure 3.9 is not represented in Figure 3.6. The proponent should explain whether these differences are likely to be the result of changes in conditions such as depth of cover, strata lithology or weathering and what the implications are for mining-induced ground movements from the current project. Maps clearly showing depth from ground surface to the predicted height of fracturing (both vertical and horizontal) would help to identify the areas in which topography causes increased risks. These discrepancies and omissions make it difficult to assess potential impacts on surface water and groundwater environments, especially as actual subsidence can often be greater or lower than predicted due to differences in the expected geological conditions particularly, in this case, near the Nepean Fault and possibly, the Central Fault.

Response

The different values presented in the results of the Subsidence Assessment (Appendix F of the EIS) and the Geotechnical Reports (Appendix G of the EIS) are due to discussion of different metrics in each of those reports. Specific responses to the feedback and examples used by the IESC are provided in sections below.

IESC comment: "For example, Appendix F (Figure 3.11) indicates maximum subsidence for longwall panel LW26 was approximately 900 mm whereas in Appendix G (section 3.2) Figure 3.11 of Appendix F shows measured incremental subsidence due to the extraction of LW 26 only along the centreline of Longwall 26."

Section 3.2 of Appendix G quotes maximum measured total subsidence after the mining of LW 26. At this stage of mining, the maximum measured total subsidence was measured at Peg HRF10, which is located directly above LW 24A (refer Fig. G.12 of Appendix F). The quoted value in Appendix F refers to the measured maximum total subsidence included subsidence that developed during the mining of LWs 24A, 25 and 26.

The authors of each report have independently focussed on different measurements when describing the same subsidence event and are both reporting measured values that are consistent with the survey results.

IESC comment: "Also, in Appendix F the largest subsidence in Figure 3.9 is not represented in Figure 3.6."

Figure 3.6 is included as part of Section 3.7 of Appendix F, which is titled "*Calibration of Incremental Profile Method, outside the increased subsidence area*".

Figure 3.9 is included as part of Section 3.8 of Appendix F, which is titled "*Areas where increased subsidence, compared to predictions, have been observed*"

The data in Figure 3.9 was not intended to be included in Figure 3.6 as it related to a different subsidence event.

The increase in subsidence occurred in a small area and was outside the normal levels of subsidence experienced at Tahmoor Mine.

IESC comment: "The proponent should explain whether these differences are likely to be the result of changes in conditions such as depth of cover, strata lithology or weathering and what the implications are for mining-induced ground movements from the current project. Maps clearly showing depth from ground surface to the predicted height of fracturing (both vertical and horizontal) would help to identify the areas in which topography causes increased risks. These discrepancies and omissions make it difficult to assess potential impacts on surface water and groundwater environments, especially as actual subsidence can often be greater or lower than predicted due to differences in the expected geological conditions particularly, in this case, near the Nepean Fault and possibly, the Central Fault."

The cause of the increased subsidence has been attributed to the proximity of the subject area to geological structures associated with the Nepean Fault and proximity of the Bargo River Gorge. This is discussed in Appendix F of the EIS (Section 3.8) and Appendix G of the EIS (Section 3.2).

The implications of the experiences of increased subsidence from a surface subsidence perspective were discussed in Section 4.4 of Appendix F of the EIS. These potential impacts were revisited as part of the revised subsidence assessment for the Amended Project. As discussed in Section 4.4 of Appendix B to the Project Amendment Report, there is potential for increased subsidence above the south-eastern ends of Longwalls 101B to 108B where they are located near the mapped locations of the Nepean Fault. It was noted, however, that when compared to the Tahmoor North area, the Nepean Fault is less defined in the Tahmoor South area, the proposed longwalls are not near a major regional stream and the observed groundwater gradients are less than those measured near Longwalls 24A to 26 of Tahmoor North. Consequently, subsidence anomalies are not anticipated in these locations.

The comments above also apply to the Central Fault, though it is noted that longwalls for the Project are located further away from this fault than the Tahmoor North longwalls are from the Nepean Fault.

5.1.4 Subsidence: Height of Fracture Zone

Issue Description

There is also a discrepancy in the assumed height of the fracture zone above the longwall panels and available observations. From the observations presented in EIS Appendix G, the zone of vertically connected fractures was observed in an open-rock bore to be approximately equal to the width of the longwall panel at the Tahmoor North project. Given the longwall panels for the Tahmoor South project are generally to be 305 m wide, these observations strongly suggest that the vertically connected fractures could extend to approximately 300 m above the seam. However, the Tammetta (2013) method used to calculate the height of fracturing for the groundwater model predicts a fracturing height of 61 to 256 m (EIS, Appendix I, section 4.6.1). It was acknowledged in Appendix I that the Tammetta method was developed to estimate the height of complete drainage above the seam. A model sensitivity run to test a greater height of fracturing resulted in predicted mine inflow water volumes greater than that shown in the base model run (EIS, Appendix I, p. 80). This has implications for predictions of groundwater drawdown and the possibility of connectivity between surface water and deep strata via tortuous flow paths.

Response

In preparation of the groundwater model, consideration was given to the following reviews of effects and processes relevant to longwall mining:

- Advisian, 2016. *Literature Review of Underground Mining Beneath Catchments and Water Bodies*. Report for WaterNSW by Advisian, John Ross, PSM, Mactaggart and Grant Sutton & Assoc. December 2016;
- PSM, 2017. *Height of cracking - Dendrobium Area 3B, Dendrobium Mine (No. PSM3021– 002R)*, Report commissioned by the NSW Department of Planning and Environment;
- Galvin, J.R., 2017a. *Review of PSM report on height of fracturing - Dendrobium Area 3B*, Review commissioned by the NSW Department of Planning and Environment; and
- IEPMC 2018. *Initial report on specific mining activities at the Metropolitan and Dendrobium coal mines*. 12 November 2018.

Of these, IEPMC (2018) identifies the use of the more conservative Tammetta method along with site-specific geotechnical modelling as being an appropriate method for representing the Height of Connected Fracturing (HoCF). The statements received from the IESC regarding the simulated HoCF zone are contrary to the findings from the IEPMC (2018). The statements by IESC were also refuted by DPIE's Independent Peer Reviewer (HydroGeoLogic, 2019).

The use of the Tammetta method for estimating the HoCF is supported by extensive baseline calibration to geotechnical and hydrogeological data. Geotechnical data and advice received from SCT (2013 and 2014) were utilised in conjunction with FLAC numerical modelling to support the assumptions made regarding the simulation of the subsidence induced height of connected fracturing within the groundwater model. These assumptions were validated against the significant set of pre and post mining groundwater level data. Due to site geological drill data and mapping the sequence and structure of the local geology at Tahmoor is well-known. This data allowed the groundwater model to be calibrated to observed groundwater levels and historic mine inflows using data on natural permeability, recharge and known fracture zone parameters. In addition, there has been appropriate calibration to specific HoF borehole data.

The remarks from the DPIE Independent Peer Reviewer support the "conservative assumptions" and methodology employed in estimating and simulating the HoCF zone, identifying that the model has "sound calibration performance to multiple criteria: … including excellent data on 'height of fracturing (HoF)' effects at Tahmoor TBF040c above longwall 10A." (HydroGeoLogic, 2019). This review states that the IESC assumption that the HoCF is equivalent to the longwall panel width is a "misrepresentation" and ignores other key factors that influence this process.

As acknowledged by the IESC, a sensitivity scenario, whereby the simulated Tammetta HoCF was increased by 1.5 times, was undertaken in order to assess the influence of such a change on inflows to the mine and surface connectivity. The IESC has correctly stated that this scenario led to higher mine inflows (7-10 ML/d compared to base case predictions of 4-6 ML/d). However, the statement that this increase would have implications for "connectivity between surface water and deep strata via tortuous flow paths" is not supported by the available data. This view is also supported by the DPIE Independent Peer Reviewer who identified that both the groundwater assessment and the geotechnical report present evidence that show "a clear separation between the potential shallow surface cracking horizon and the fractured zone above longwalls." (HydroGeoLogic, 2019).

5.1.5 Groundwater: Modelling of drawdown

Issue Description

The likely underestimation of the height of the fracture zone above longwall panels in the base case of the groundwater model means that the estimated extent of groundwater drawdown presented in Appendix I of the EIS is likely to be under predicted. While the sensitivity analysis included a run with the height of fracturing increased by 50 percent, the proponent did not provide all the results for this run, nor accompanying drawdown maps. The IESC does not have a high level of confidence in the modelled water balance and predicted drawdown, particularly for shallow model layers because extraction from non-mining bores is unknown and so was not modelled. When a revision of modelling is undertaken, it would further aid assessment of potential impacts to GDEs if an ecologically relevant drawdown map was provided that shows the extent of the 0.2 m water table drawdown contour at the time of maximum impact for both the base case and uncertainty analysis. The EIS only includes mapping showing the base case 2 m drawdown contour, which is predicted to occur almost entirely within the project boundary (EIS, Appendix I, Fig. 5-8).

Response

As outlined above (**Section 5.1.4**) the method used for estimating the HoCF zone is supported by the findings of the IEPMC (2018) and is considered conservative, with mine effects likely being overestimated (HydroGeoLogic). The exclusion of drawdown maps for the sensitivity scenarios (including that simulating an increase of the HoCF by 1.5 times) was a choice made considering the relative similarity of the hydrographs for the sensitivity results (e.g. Figure 5-3 of the revised Groundwater Assessment, Appendix C of the Project Amendment Report).

The revised Groundwater Assessment (Appendix C of the Project Amendment Report) includes revisions of the model and figures to include better representation of spatial drawdown uncertainty, as well as including illustration of the 0.2 m water table drawdown contour. The exclusion of extraction due to non-mining bores was done in order to isolate the effects of mining in the predictive model scenarios. If this component is included in predictions, the assessment of impact of mining on 'available drawdown' at each pumping bore becomes difficult to assess. It is also noted that there is high uncertainty regarding the extraction volumes from each pumping bore due to the lack of continuous and effective monitoring of this data. The decision on this matter was supported by DPIE's Independent Peer Reviewer (HydroGeoLogic, 2019).

To better capture actual private bore extraction, up-to-date groundwater extraction data from WaterNSW was requested. WaterNSW was able to supply entitlement information, but not estimates of actual usage, for which the NSW Water Register holds only short records and not for individual users. Because of the uncertainty surrounding actual historical usage, a single model predictive scenario has been run to estimate the effects of bore pumping selected key predictions.

The accuracy of the groundwater model in simulating groundwater levels within the shallow strata (Hawkesbury Sandstone and alluvium) is considered high, with differences between modelled and observed groundwater levels (residual error) of -0.3 m (as stated in Table 4-4 of the revised Groundwater Assessment, Appendix C of the Project Amendment Report).

The revised Groundwater Assessment prepared to support the Project Amendment Report (Appendix C of the Project Amendment Report) predicted drawdown (project induced and cumulative) at the most significant GDEs (i.e. Thirlmere Lakes), indicating incremental drawdown due to the project is in the order of 0.02 m, while drawdowns due to cumulative mining activities at the Thirlmere Lakes range between 0.08 to 0.48 m (see Section 5.6 of Appendix C of the Project Amendment Report). As per the assessment required by the AIP, these cumulative drawdowns are approximately 3 to 12% of water level fluctuations in the alluvium, so represent Level 1 at 3 or 4 of the lakes, and Level 2 at Gandangarra, and possibly at Couridjah. This finding of Level 2 effects is consistent with that in the EIS. Hydrographs depicting predicted drawdown due to the base case and sensitivity scenarios is presented for a bore (GW075409) near to the Thirlmere Lakes in Figure 5-6 of the Appendix I of the EIS). These hydrographs indicated that shallow-aquifer drawdown at the GDE was unlikely to exceed base case predictions.

The revised Groundwater Assessment report provided in Appendix C of the Project Amendment Report includes contours of the areas that are predicted to experience 0.2 m of drawdown and further supports the conclusions of the EIS (see also Figures 5-9 and 5-10 of the Groundwater Assessment, Appendix C of the Project Amendment Report).

5.1.6 Groundwater: water losses and impacts to watercourses/ GDES

Issue Description

There is an unknown quantity of water losses through delayed flow via tortuous flow paths including fractures and bedding plane separations and shears in deeper strata overlying longwall panels (see PSM 2017 and associated peer reviews including Mackie 2017 for a discussion of such processes). Due to these processes it is possible that a component of surface water flows may not be returned to the catchment. The implications of this potential water loss for creeks and groundwater dependent ecosystems during long-term operations and recovery of water levels after closure need to be considered in a manner that bounds the likely upper and lower range of impacts.

Response

There will be some loss of flow from surface systems as a result of the Amended Project. Estimates of this are included in the Groundwater and Surface Water Assessments provided in the EIS (Section 5.7 of Appendix I and Section 7.3 of Appendix J). These estimates have been revised in the revised Groundwater Assessment (Appendix C of the Project Amendment Report) via the improved representation of watercourses and surface cracking effects, as well as the new mine plan. The revised surface water loss estimates include losses due to groundwater depressurisation or drawdown as well as more persistent changes that may occur due to changes in near-surface permeability due to surface cracking.

5.1.7 Groundwater: modelling adequacy

Issue Description

The groundwater model developed by the proponent is focussed on simulating regional groundwater flows under the assumption of porous media flow (i.e. continuum model). This model does not incorporate the impacts of surface cracking and near-surface fracturing. This means the groundwater model does not address what is likely to be the main impact pathway on baseflow in nearby watercourses, and this has implications for assessing likely impacts on riverine biota and ecological function. Accordingly, the IESC has a low level of confidence in the proponent's estimates of mining impacts on surface water and groundwater interactions.

The type of models employed in the EIS also cannot simulate the dynamic changes in hydraulic properties associated with mining-induced ground movement. Continuum models (EIS Appendix G and Appendix I) are not currently suitable for predicting changes in groundwater flow and storage due to mining-induced ground movement. For example, the possibility of turbulent groundwater flows through fractures are not considered. Also, specific storage values are assumed to be constant over time, whereas it is known that this hydraulic parameter changes in strata overlying a longwall panel extraction (David et al. 2017).

Response

It is agreed that the groundwater model developed to inform the Groundwater Assessment (Appendix I of the EIS) did not incorporate near-surface cracking or fracturing. This element has been incorporated into the revised groundwater model used to assess the Amended Project (Section 4.6 of Appendix C to the Project Amendment Report).

The statement concerning the inability of the model to simulate dynamic changes in hydraulic properties is incorrect. The groundwater model (used in the assessments for the EIS and the Project Amendment Report) employs the MODFLOW-USG time-variant materials (TVM) package, which is accepted as a standard method for the simulation of fracturing and deformation above longwalls.

A constant specific storage (Ss) value was implemented in this model as it is considered the least sensitive of the four hydraulic parameters, given that it occurs within or above the connected fracture zone of which the lower 'half' is at low or zero pressure. The conclusions by David *et al*. (2017) along with comments from the DPIE's Independent Peer Reviewer (HydroGeoLogic, 2019) demonstrate that a constant Ss can overestimate drawdown and inflows and is therefore considered to be conservative for the purposes of assessment. The Peer Reviewer also stated that calibrated Ss values for the Tahmoor Mine groundwater model lie within the plausible range of confined Ss indicated by Rau *et a*l. 2018 (HydroGeoLogic, 2019).

5.1.8 Groundwater: additional assessment/ monitoring

Issue Description

To assist in providing more confidence in impact predictions, further investigations and monitoring supported by the further analysis of existing data should be focused on quantifying losses of surface water into near-surface fracture zones and the possibility of partial or complete returns of these flows to surface water at some point and time to support GDEs.

Response

Data for the subsidence impacted Redbank Creek has recently been collected and analysed by SCT (2018). This report highlighted increased hydraulic conductivity within the bore P9 in the presence of subsidence-induced surface cracking. The findings from this assessment were used to calibrate the groundwater modelling done to support the Extraction Plan for Tahmoor Western Domain Longwalls W1-W2 (HydroSimulations, 2019) as well as in the revised modelling for the revised Groundwater Assessment (Appendix C of the Project Amendment Report).

In addition, a recent publication from Morrison *et al*. (2019) studied the changes in surface water quality along Redbank Creek and provided a list of key analytes to monitor in order to identify watercourses that may be affected by surface cracking. These analytes (iron, manganese, barium etc), would be included in the adaptive monitoring program for surface water for the Project (refer **Chapter 7.0**).

The surface water assessment for the Amended Project has been informed by the revised Groundwater Assessment (Groundwater and Surface water assessments can be found in Appendices C and D respectively of the Project Amendment Report) thereby providing greater confidence to predicted impacts in relation to surface water losses and potential return of flows in watercourses.

5.1.9 Groundwater: Uncertainty Analysis

Issue Description

Notwithstanding several crucial modelling issues noted above, the groundwater model does not include an adequate uncertainty analysis and thus cannot be used to evaluate cumulative impacts. The impact of model assumptions and limitations noted above should be quantified and demonstrated. Key physical processes that are excluded must either be justified or rectified. Thus, an uncertainty analysis must rigorously test and quantify uncertainties in model conceptualisation, parameters, physics and assumptions. The proponent notes that the complexity of the model and its regional focus result in long model run times, making uncertainty analysis difficult. This difficulty suggests that future modelling of local scale processes should be designed to facilitate uncertainty analysis. For example, a revised version of the current groundwater model could be used to provide boundary conditions for a local model of surface-groundwater interactions.

Response

Responses to specific modelling issues raised by the IESC have been provided in earlier sections including where these matters have been refuted by the DPIE's Independent Peer Reviewer. A revised Groundwater Assessment has been included in Appendix C of the Project Amendment Report.

It is considered that the Groundwater Assessment for the Project (Appendix I of the EIS) included an adequate and robust uncertainty analysis. As identified in **Section 5.1.4** above, the model is considered to be well-calibrated to multiple criteria (mine inflow flux and groundwater levels) which provides confidence that the simulation quantification of cumulative impacts can be performed with appropriate accuracy.

This was confirmed in the Independent Peer Review, with the reviewer highlighting that the uncertainty analysis performed in the assessment, while limited, is appropriate given the calibration to the available data sets and "mature conceptualisation" of the groundwater system (HydroGeoLogic, 2019). However, revision of the model to take further advantage of unstructured mesh capabilities would be undertaken in the future. Preliminary testing indicates that a model cell count of 15% of the current cell count is achievable, and this would probably be sufficient for more rigorous uncertainty assessment to be carried out in future. Such a model revision would begin once the OEH Thirlmere Lakes Research Program has been completed, in order to incorporate conceptual developments from that program.

5.1.10 Surface and groundwater: ecosystem impacts

Issue Description

The deficiencies in the groundwater modelling of potential impacts to surface water systems affect the predictions of reductions in stream flow (especially during low-flow periods) and pool persistence in the surface water assessment (EIS, Appendix J).

While induced near-surface fractures may not cause a net loss of water from the catchments it is expected that local impacts on pools and low flows will occur for sections of the river that lie upstream of where lateral sub-surface flows return. There is also the possibility of net loss of water from the catchment if the near-surface fractures are also connected to deeper tortuous flow paths. The impacts on stream and pool persistence from this flow loss, altered depth and change in storage below the creek bed, and implications for loss from baseflow capture, are not quantified. The extent of this region, and thus the local and cumulative impacts on riverine biota and ecological processes, cannot therefore be assessed adequately. The proponent appears to assume that the lateral extent of impacted subsurface flow paths is limited to the extent of the subsidence zone. The near-surface impacts could extend a considerable distance beyond the subsidence zone along geological structures such as fault zones.

Response

The accuracy of the subsidence and groundwater models are discussed in detail in **Sections 5.1.4, 5.1.5, 5.1.7** and **5.1.9**. As identified in **Section 5.1.2** in the case of watercourses, the Subsidence Technical Report (Appendix F of the EIS) provides predictions of conventional vertical subsidence along watercourses using the IPM as well as separate predictions of non-conventional valley closure and upsidence along the watercourses using the 2002 ACARP valley closure prediction model to consider impacts beyond the extent of the longwalls. This approach has also been adopted in the updated subsidence assessment for the Amended Project, provided in Appendix B of the Project Amendment Report, and is considered to be conservative and robust. **Section 5.1.2** explains how the Nepean Fault was considered in subsidence modelling.

With respect to the groundwater model, a meeting was held on 2 April 2019 with agencies including DoI – Water, NRAR, DPIE and the DPIE Independent groundwater Peer Reviewer. At the meeting it was determined what areas of the model required revision and based on these discussions a revised Groundwater Assessment was prepared for the Amended Project (Appendix C of the Project Amendment Report). It is noted that overall, the Peer Reviewer for DPIE found the EIS Groundwater Assessment to be based on "conservative assumptions" with "sound calibration performance to multiple criteria." The Peer Review also identified that the uncertainty analysis conducted for the model provides suitable information to perform an impact assessment and assist in the development of management plans and licensing decisions and that the classification of the model as having a Class 2/3 confidence level was justified, with the model having sound performance to multiple calibration criteria (i.e. groundwater levels and mine inflows) (HydroGeoLogic, 2019).

Based on the above it is considered that the EIS and revised subsidence and Groundwater Assessments provide a sound basis for impact prediction including on surface water systems.

Both the EIS subsidence assessment (Appendix F of the EIS) and revised subsidence assessment (Appendix B of the Project Amendment Report) identified that the likelihood of fracturing and surface flow diversions reduces substantially compared to stream sections located directly above the proposed longwalls. The furthest distance of an observed fracture from longwall mining was at the base of Broughtons Pass Weir, which was located approximately 415 metres from Appin Colliery Longwall 401. Another minor fracture was also recorded in the upper Cataract River, approximately 375 metres from Appin Colliery Longwall 301. This fracture occurred in a large rock bar, which was formed in thinly bedded sandstone, which had experienced movements from nearby previously extracted longwalls. These are the furthest most recorded fractures from longwall mining in the NSW Coalfields.

The revised groundwater modelling (Appendix C of the Project Amendment Report) includes a representation of the surface cracking effects, specifically for areas above extracted panels. This, along with a revision to the model representation of watercourses is incorporated in the assessment of surface water losses.

The likelihood for seam-to-surface cracking is very low, based on the estimates of the height of connected fracturing provided by SCT's (2013 and 2014) geomechanical modelling and the estimates made using the Tammetta (2013) approach, as recommended by the IEPMC (2018). The Amended Project includes a revised mine plan which includes narrower longwall panels (285 m compared to 305 m), so the risk of seam-to-surface connection will be even less than that presented in the EIS, as demonstrated by the revised predictions.

5.1.11 Surface and groundwater: additional information

Issue Description

Regulator Question[1]: Does the IESC agree that the predicted impacts on surface water resources have been accurately modelled and assessed in the EIS?

The IESC does not have confidence in the predictions of impacts on surface water resources that are modelled and assessed in the EIS because of:

a. *inconsistencies between modelled and observed subsidence and mining-induced ground movements near watercourses and the Nepean Fault;*

b. *limitations in the ability of the groundwater model to adequately consider the effects of fracturing, particularly in the near-surface zone;*

c. *a paucity of baseline data to substantiate assumptions regarding impacts of existing mining activities; and*

d. *a general lack of information about the influence of modelling assumptions on the likely upper and lower bounds of estimates on surface and water impacts.*

[1] IESC response to a question raised by the Commonwealth Department of the Environment and Energy and/or the NSW Department of Planning, Environment and Industry (question provided in italics).

Response

The IESC comments are noted. Responses to the above comments are as follows:

a. As outlined in the above sections the groundwater model has been calibrated to mine inflow and groundwater levels; is well constrained by permeability data; and employs a conservative HoCF estimate along with the MODFLOW-USG TVM package to simulate subsidence induced effects over the mined area and surrounds. The Nepean Fault has been conceptualised and simulated in this model as having higher permeability than the surrounding strata. This has been confirmed by geotechnical data collected by SCT.

b. The adequacy of the method adopted to represent the HoCF has been addressed in detail in **Section 5.1.4** of this report. It was agreed that there was a need to represent surface cracking in the revised groundwater model in order to provide a holistic representation of potential mining impacts. This has been undertaken in the revised Groundwater Assessment (Appendix C to the Project Amendment Report), and subsequent groundwater model calibration, and predictions of drawdown and surface water losses reflect this update.

c. There is a substantial collection of baseline data showing pre-and post-mining effects of the Tahmoor Mine on the groundwater system which has been utilised in the calibration of the model utilised in the EIS and Project Amendment Report. The baseline data used to inform the model is summarised in Section 11.3.2 of the EIS. Furthermore, Tahmoor Coal is in the process of installing and carrying out further pre- and post-mining monitoring and investigation (e.g. new piezometers, packer testing) around recent and upcoming longwalls within Tahmoor North, and some of this data (e.g. pre- and post-mining field data from the P9 bore) has already been incorporated in conceptual and numerical modelling. As further data becomes available, it will be incorporated into future revisions of the conceptual and numerical model, as part of the Extraction Plan following completion of the Western Domain portion of Tahmoor North and the OEH Research Program.

d. The Surface Water Baseline Study (Appendix D of the Project Amendment Report) has been updated since submission of the EIS to incorporate additional streamflow and surface water quality monitoring. The additional streamflow monitoring data has been adopted in the re-calibration of the catchment models (AWBM) for Dog Trap Creek Downstream, Eliza Creek and Bargo River Upstream. Statistical metrics for the re-calibrated models are provided in Table 14 of the revised Surface Water Baseline Study (Appendix D of the Project Amendment Report).

e. Sufficient uncertainty analysis has been undertaken for the Groundwater Assessment in order to test modelling assumptions and gain an understanding of the extent and range of cumulative impacts predicted to occur due to mining at Tahmoor South (Refer **Section 5.1.9** of this report). Comments from the Independent Peer Reviewer state that the uncertainty analysis conducted for this model provides suitable information to perform an impact assessment and assist in the development of management plans and licensing decisions.

5.1.12 Surface Water: AWB Model

Issue Description

To conclude that mining activities have had little impact on streamflow, the proponent has used the Australian Water Balance Model (AWBM). However, the use of simple visual comparisons of modelled versus observed flow behaviour is not compelling as the simulations are influenced by limitations in model calibration that could impact on different components of the flow regime. More defensible insights could be drawn by undertaking a trend analysis on the differences between model simulations and observed flows over time (i.e. by analysing the modelled residuals), but without such evidence it is not possible to have confidence in the current conclusions.

Response

An Australian Water Balance Model (AWBM) was developed and calibrated to simulate streamflow for Redbank Creek catchment as detailed in the revised Surface Water Impact Assessment (Appendix D of the Project Amendment Report). Sites R4 and R11 were used in this assessment of mining impacts on flow in Redbank Creek. Site R4 has a reliable low flow rating and is within the potentially affected reaches of Redbank Creek. Site R11 is the site which is furthest downstream of the potential impacts of longwall mining – located approximately 300 m downstream of LW32.

Following exhibition of the EIS, the model has been reviewed and updated as part of an assessment of the Amended Project (Appendix D to the Project Amendment Report), with additional streamflow monitoring data adopted in the re-calibration of the catchment model. Model parameters affecting surface water runoff were selected to be similar at both locations with parameters affecting baseflow and transmission loss being varied to obtain fits to low flows and low flow recession. The model parameters used in the assessment of flows at R4 and R11 were altered slightly from those given in the SWIA submitted for the EIS in order to improve the model fit during the earlier period of available recorded data (Dec 2009 to the end of 2012 – up to the end of mining of longwall 26).

The examination of the flow record from monitoring site R4 and monitoring site R11 on Redbank Creek was updated to assess impacts from mining of longwalls 27 to 31. The flow record from December 2009 to March 2013, assessed for the EIS, identified that mining of longwalls 25, 26 and 27 within the Redbank Creek catchments, including mining directly beneath Redbank Creek itself, had not affected flows and low flows at site R11 downstream. There was some evidence that flows at site R4 may have been reduced during the period of low flow recorded between October 2012 and January 2013.

Assessment of the flow record at site R4, based on updated monitoring data acquired since submission of the EIS, identified that there has been a change in the flow behaviour at site R4 with time, likely associated with longwall mining beneath the site. It seems likely that the control for the streamflow gauging station has been affected at this site.

The flow record at site R11 examined for the revised assessment suggests a change in the flow regime from the mining of longwall 27, with greater prevalence of baseflow. This is considered likely associated with subsidence-induced fracturing causing underflow and delayed drainage of flow reporting to the downstream site R11. A second change in the flow regime is apparent, from the period during the mining of longwall 31, with the prevalence of baseflow diminishing and ephemeral flow prevailing. The recent change to a more ephemeral flow regime may be related to natural 'healing' behaviour and/or closure of subsidence cracking due to the mining of additional longwalls.

5.1.13 Surface Water: Flooding assessment

Issue Description

The IESC has some confidence in assessment of the relative impacts on the flood risks estimated by the modelling and agrees that the likely impacts on flooding risk due to mining activities is low. However, the degree of confidence regarding the absolute estimates of the flood risks is low because the configuration of the adopted flood model was based solely on regional information without calibration, and no information is provided on some of the key modelling assumptions (e.g. whether the flood estimates were derived using deterministic or ensemble rainfall patterns). Accordingly, it is suggested that the results of this modelling be reviewed if further analysis of the uncertainty in mining-induced ground movements indicate the relative impacts on surface water resources may be greater than that currently estimated. Surface water resources identified within the predicted area of subsidence include water quality and aquatic habitats in Tea Tree Hollow, Dog Trap Creek and their tributaries, as well as riparian corridors including potentially groundwater-dependent vegetation.

Outside the predicted area of subsidence, there may be impacts on Thirlmere Lakes and streams of the Metropolitan Special Area (MSA) (see responses to questions 2 and 5). However, these impacts cannot be assessed because of the inadequacies of the modelling of surface-water/ groundwater interactions.

Response

As detailed in the Flood Study report for the Amended Project (Appendix D of the Project Amendment Report), calibration of the flood modelling was not possible due to a lack of recorded significant flood levels for Tea Tree Hollow and Dog Trap Creek. As stated in Chapter 4.0 of the Flood Study, flood hydrographs for the assessed flood events were generated using the rainfall routing model RORB (Laurenson, et al, 2010) which is a commonly used and well-established model for generating flood hydrographs from design rainfall.

The design rainfall data were estimated using the procedures as described in the 2019 version of Australian Rainfall and Runoff (Ball et al, 2019). Modelling was undertaken for eight design rainfall events – 0.2%, 0.5%, 1%, 10%, 50% AEP and the probable maximum flood (PMF). In line with the ARR 2016 guidelines, there are 10 'ensemble' temporal patterns applicable to each design rainfall event, with separate patterns for different durations. Different temporal patterns apply within each of four (AEP) categories of severity. For each AEP and duration, the RORB model was run using the ten temporal patterns for the range of applicable event durations. For each duration, the modelled hydrograph which produced the closest peak flow to the median peak flow (of 10) at the downstream boundary of the catchment was selected as the hydrograph for that duration. For each AEP, the rainfall duration which gave the highest peak flow rate (i.e. the 'critical duration') was selected for use in subsequent hydraulic modelling. This process was repeated for all design AEPs.

Results of modelling indicate that predicted subsidence would result in some localised minor changes to flooding in creeks within the Project Area for events up to the 1% AEP level. As Thirlmere Lakes is outside the predicted subsidence zone, the flood risks for Thirlmere Lakes will not change as a result of the Amended Project.

5.1.14 Surface Water: Water quality changes from surface cracking

Issue Description

It is noted in the EIS (Appendix I, p. 49) that surface cracking can result in subsurface flow and, where flow re-emerges downstream, water quality is affected. This change in water quality is not assessed further in the EIS. The proponent should use existing data from Tahmoor North to provide an assessment of the likely impacts of this process on water quality and the implications for ecosystems dependent on this water.

Response

Section 5.2.2 of the Surface Water Impact Assessment (SWIA) (Appendix D of the Project Amendment Report) provides an updated assessment of surface water quality in Redbank Creek. Water quality data monitored between February 2005 and August 2019 for water quality sampling sites RC1 (upstream), RC2 (mid) and RC5 (downstream) is presented and assessed. The key outcomes of the assessment are as follows:

- Recorded electrical conductivity (EC - a measure of salinity) increased at the downstream site RC5 following the mining of longwall 26, reaching a peak during the mining of longwall 27 and 28. Thereafter EC levels at RC5 have fallen;
- Longwall mining in the Redbank Creek catchment has not affected pH levels in the creek to any significant extent;
- Periodic and localised pulses of iron, zinc and sulphate concentrations have been recorded at site RC2; and
- Relatively high manganese concentrations have been recorded at site RC2 and RC5. The elevated manganese concentrations at site RC2 may be, at least in part, unrelated to mining of longwalls 25 to 29 and possibly relate to pre-existing groundwater inflows (ferruginous springs) reported in Redbank Creek. It appears likely that increased manganese concentrations at site RC5 are related to mining, although concentrations have diminished with time.

As stated in Section 9.3 of the SWIA (Appendix D of the Project Amendment Report), based on past experience in the Southern Coalfields, including experience at the existing Tahmoor operation, it is likely that upsidence induced fracturing may lead to releases of aluminium, iron, manganese, sulphate and zinc. These releases will occur as transient spikes which would be relatively localised.

5.1.15 Surface Water: Water quality exceedances

Issue Description

Water quality monitoring during 2012 - 2015 found that water from all impacted and reference sites exceeded multiple water quality parameters when compared to ANZG (2018) guidelines for aquatic ecosystem protection. Although increased salinity, metals and barium precipitate identified downstream of the wastewater discharge sites are attributed to mine water, explanations are not provided for the observed exceedances of national and site-specific guideline values across most sites. More recent monitoring data should be used to confirm that the contaminant concentrations have been reduced with improvements to the Waste Water Treatment Plant (WWTP).

Response

The EIS (Appendix J - Surface Water assessment), summarised water quality data collected between September 2012 and June 2015 from a series of baseline and control sites across the Project Area. Additional surface monitoring data up to September 2019 has also been collated and is summarised in the Surface Water Baseline Study (Appendix D of the Project Amendment Report). For comparative purposes and to provide an indication of baseline conditions, the baseline water quality data has been compared with the ANZECC (2000) and ANZG (2018) default guideline trigger levels for the protection of aquatic ecosystems and recreational use in accordance with the perceived principal beneficial uses of the surface water resources in the area.

Site specific trigger values (SSTVs) has also been derived in accordance with the ANZECC (2000) Guidelines and the revised Water Quality Guidelines (ANZG, 2018) which are progressively superseding the ANZECC (2000) Guidelines. SSTVs have been established to compare against future project impacts as the adoption of default ANZECC (2000) and ANZG (2018) default guideline trigger values would, for many parameters, result in frequent 'false triggering' because the existing (baseline) conditions already exceed the default guideline values, as demonstrated by the monitoring results.

Analysis of water quality data from September 2012 to September 2019 (refer revised SWIA in Appendix D of the Project Amendment Report) indicates that concentrations of aluminium, cadmium, copper, selenium, zinc and iron and pH values in excess or outside the range of the ANZECC aquatic ecosystem and recreational use guidelines at the majority of sites within the vicinity of the Project Area, including control and baseline sites. This suggests that the elevated concentrations of these constituents are typical to the surface water systems within the region, and likely due to increased urbanisation and runoff from agricultural activities across the catchment.

Median concentrations of bicarbonate, sodium, arsenic, barium, zinc and electrical conductivity (EC) were notably higher at sites downstream of LDP 1 (SW-22 on Tea Tree Hollow and SW-14 on Bargo River at Rockford Bridge) in comparison with control and baseline sites. This reflects the effects of licensed releases from LDP 1 at the Tahmoor pit top via Tea Tree Hollow based on review of the water quality records at LDP 1.

The concentration of arsenic released at LDP1 has greatly declined since improvements have been made to the WWTP. Consequently, the arsenic concentrations monitored at SW-14 on Bargo River at Rockford Bridge in 2019 did not exceed the default guideline trigger value for protection of aquatic ecosystems.

As stated in Section 2.1 of the Water Management System and Site Water Balance (refer SWIA in Appendix D of the Project Amendment Report), the existing WWTP has had continued performance issues and as a result, Tahmoor Coal has been exploring alternative approaches to meeting the discharge water quality requirements (Tahmoor Coal, 2019). Tahmoor Coal has issued a specification for design and construction of an upgraded WWTP to provide further treatment of mine water prior to release via LDP1. The specified WWTP target water quality is to meet the 95th percentile ANZECC default guideline trigger values for the protection of aquatic ecosystems (ANZG, 2018). The specific targets are as follows:

- pH: 6.5-9;
- Electrical Conductivity: <500 µS/cm;
- Suspended Solids: <30 mg/L;
- Turbidity: <150 NTU;

- Oil and grease: <10 mg/L;
- Iron: <0.7 mg/L;
- Manganese: <1.9 mg/L;
- Nickel: <0.011 mg/L;
- Zinc: <0.008 mg/L;
- Arsenic (V): <13 µg/L; and
- Arsenic (III): <24 µg/L.

5.1.16 Aquatic Ecology: Adequacy of assessment

Issue Description

Streams and their associated riparian corridors are the predominant surface water resources in the project area. Five will be undermined for substantial lengths (Dog Trap Creek: 3.1 km; Tributary 1 of Dog Trap Creek: 2.6 km; Tributary 2 of Dog Trap Creek: 2.4 km; Tea Tree Hollow: 1.9 km; tributary of Tea Tree Hollow: 2.4 km (Table 18, EIS Appendix K)). The proponent states that in these undermined stream reaches, fracturing is likely to result in complete or partial loss of surface water, hydrological connections along the streams will be less frequent, pools will overflow less often and there will be less aquatic habitat available. Water quality is predicted to deteriorate and where cracking promotes emergence of ferruginous groundwater, iron flocs are likely to smother benthic biota. There will also be subsidence-induced changes to stream gradients that will increase potential ponding in some reaches (e.g. upstream of the tailgate of LW103 in Dog Trap Creek) whereas erosion will increase in other reaches where subsidence troughs form (EIS, Appendix K). Where little sediment is present, fracturing and surface water loss may persist for years and the proponent states that remediation may be required when mining is completed, although it is unclear whether this is likely to succeed.

Collectively, these impacts on surface water hydrology, pool persistence, water quality and hydrological connectivity over some twelve stream-kilometres are predicted to adversely affect aquatic biota such as small native fish, tadpoles and aquatic macroinvertebrates. Total biomass will be reduced (EIS, Appendix K). Bats, birds and other fauna that feed on these animals are also likely to be impacted but these impacts have not been assessed by the proponent.

Response

The IESC's summary of potential aquatic impacts is noted. Bats, birds and other fauna that may feed on aquatic species have been assessed as part of the Biodiversity Assessment Report (Appendix K of the EIS - Table 20 and Section 7.5). The Biodiversity Assessment Report has been updated to reflect the impacts of the Amended Project (Appendix E to the Project Amendment Report) and to include an assessment of hollow-bearing trees. The Aquatic Ecology Impact Assessment which was included as part of Appendix K in the EIS has also been updated and is included as Appendix F in the Project Amendment Report.

The revised Aquatic Ecology Impact Assessment (Appendix F in the Project Amendment Report) concluded that loss due to drawdown is likely to be imperceptible and the quality and quantity of available aquatic habitat in the Bargo River is unlikely to be impacted by the Amended Project.

As described in Section 6.5 of the revised SWIA (Appendix D of the Project Amendment Report) and Section 6.5.1 of the revised Aquatic Ecology Impact Assessment, the creation of subsidence depressions and associated containment of runoff could reduce flows downstream. There is potential for this impact to affect flows in Tea Tree Hollow, Dog Trap Creek and Hornes Creek with possible in direct effects to downstream watercourses.

An examination of the predicted post-subsidence topography indicates that there is only one location in which subsidence induced depressions may occur. There is a predicted reversal of grade along a naturally flat section of Dog Trap Creek, and as such there is increased potential for ponding up to 0.2 metres deep and 150 m long upstream of this location. This may have a minor impact on flows downstream of this location. In the absence of any significant surface ponding created by subsidence, there should be no effect on flows in other local watercourses.

It is possible that there could be some localised areas along the streams, which could experience small increases in the levels of ponding; where the predicted maximum tilts occur in the locations where the natural gradients are low. As described in Section 5.3.4 of the revised Subsidence Assessment (Appendix B of the Project Amendment Report) predicted changes in grade are typically less than 1 %, any localised changes in ponding are expected to be minor and not result in adverse impacts on these streams.

The potential for ponding may increase the availability of foraging habitat. Increased ponding is likely to provide a localised increase in available habitat for aquatic macroinvertebrates. Additionally, if there is stream connectivity in the area of ponding, it may also provide additional habitat for fish and macrophytes. Not all foraging pools within the watercourse of the Study Area (which consists of the amended project area and areas outside including downstream water courses and control seams), would be impacted or completely drained. As such, the potential impacts to pools in Tea Tree Hollow and Dog Trap Creek may not disrupt the life cycle of the species such that the population would decline.

Based on the previous experience at Tahmoor Mine, it is likely that fracturing, and surface flow diversions will occur in the sandstone bedrock along the streams; particularly for streams that are located directly above the proposed longwalls. These streams include:

- Dog Trap Creek;
- Tributary 1 and 2 to Dog Trap Creek;
- Tea Tree Hollow; and
- Tributary to Tea Tree Hollow.

At these locations, the fracturing could impact the holding capacity of the standing pools, particularly those located directly above the proposed longwalls. It is unlikely, however, that there would be any net loss of water from the catchment.

Fracturing and the partial or total loss of water could result in loss of aquatic habitat in sections of Dog Trap Creek and Tea Tree Hollow, and subsequently loss of aquatic biota inhabiting pools. Native fish recorded in these waterways may be subject to desiccation and a range of macroinvertebrates will also suffer mortalities in areas where pools are drained while hardier species such as freshwater yabbies (*Cherax destructor*) and freshwater crayfish (*Euastacus spinifer*) may be able to relocate to other areas of aquatic habitat or retreat into their burrows.

For water quality, as discussed in Section 9.0 of the SWIA presented in Appendix D of the Project Amendment Report, it is expected that the Amended Project would not result in adverse water quality impacts due to releases and overflows from the site water management system. Changes may occur to the chemical composition of surface flows due to either increased or decreased groundwater fed baseflow contribution to watercourses.

These types of water quality impacts have the potential to affect Tea Tree Hollow, Dog Trap Creek and downstream watercourses. Historically these impacts have been found to be temporary and over time have reduced. Although there have been known cases where these impacts have taken longer than anticipated to return back to similar conditions which existed prior to being impacted, it is not expected that these potential impacts would be permanent.

These creeks have substrate consisting of sand, mud and cobbles upstream of the areas of impact and as such, there may be some natural infilling during subsequent flow events that will return some aquatic habitat over time. Considering the ability of aquatic fauna to recolonise intermittent waterways, there is expected to be some recovery of stream fauna once pool holding capacity and habitat is re-established.

5.1.17 Terrestrial and Aquatic Ecology: Impacts and offsets

Issue Description

Riparian habitats in the project area include groundwater-dependent vegetation. The proponent does not appear to have assessed the likely groundwater dependence of vegetation in areas where drawdown is predicted. This may be particularly relevant for threatened flora such as Rufous Pomaderris (Pomaderris brunnea) which was recorded along Tea Tree Hollow. The proponent reports about 300 individuals in the study area, a significant find as the known total population of this species in NSW in 2011 was about 600 individuals (Sutter, 2011). Most of the plants in the project area occur on the mid-bank to higher banks of Tea Tree Hollow (EIS, Appendix K, p. 102) and it was inferred that the drying of pools or predicted changes to the flow regime as a result of subsidence was therefore unlikely to result in die-back of this P. brunnea population. However, the proponent needs to assess whether this EPBC Act-listed species is occasionally dependent on groundwater and therefore might be affected by groundwater drawdown. No offset has been proposed for P. brunnea, because the proponent considers that the species will not be impacted by the project. Similar investigations of groundwater-dependence and potential risks from drawdown would be appropriate for other flora likely to be found near creek lines in the project area as well as vegetation used by threatened fauna such as koalas.

Response

The potential for the Amended Project to impact on *P. brunnea* is discussed in Section 8.4.2 of the Biodiversity Assessment Report (Appendix E to the Project Amendment Report).

The assessment concluded that it could be reasonably assumed that there is a disconnection of *P. brunnea* to the water within the creek given the species persistence during periods where water in the creek was absent. The drying of pools or predicted changes to the hydrological regime as a result of subsidence is therefore unlikely to result in die back of the *P. brunnea* population. Notwithstanding, Tahmoor Coal has installed a groundwater monitoring well nearby to monitor fluctuations in groundwater at this location while also monitoring the health of the *P. brunnea* population.

5.1.18 Surface Water: Overflow from Sediment dams

Issue Description

The proponent intends to increase water storage capacity by construction of additional sediment dams and storage of excess water in the goaf. Overflow from sediment dams is proposed to be released into the Bargo River and Tea Tree Hollow. There are no volumetric limits in place for the release of overflow water, although conditions are prescribed for the existing mine. Potential impacts to the surface water receiving environment from overflow discharges are not considered. Condition of the current receiving environment and the extent to which it is impacted by existing activities are not adequately discussed and require information from a more robust monitoring program.

Response

The revised Surface Water Baseline Study (Appendix D of the Project Amendment Report) provides an updated summary of baseline water quality for the Project to September 2019, including an assessment of licensed release water quality data. The condition of the current receiving environment and the water quality impacts associated with the existing mine activities are discussed in the revised Surface Water Baseline Assessment (Appendix D of the Project Amendment Report).

Licensed Overflow

Section 7.1 of the revised Surface Water Baseline Assessment (Appendix D of the Project Amendment Report), presents a summary of the potential water quality of release water via the licensed overflow points (LOPs). It should be noted that water quality data is monitored on a monthly basis whereas the monitoring of overflow volumes is event based. Therefore, the water quality data summarised below is not necessarily indicative of the water quality during overflow periods. Overflow volumes to the LOPs, refer Section 2.4 of the revised Water Management System and Site Water Balance (Appendix D of the Project Amendment Report), have typically been low, ranging from 9.8 ML/annum to 187.1 ML/annum between 2014 and 2018 (inclusive).

As described in Sections 3.1 and 3.2 of the revised Water Management System and Site Water Balance Report for the Amended Project (Appendix D of the Project Amendment Report), two new sediment dams, S11 and S12, will be required to collect runoff from the REA. These sediment dams have been designed in accordance with Landcom (2004) and DECC (2008) guidelines.

S12 will replace the existing sediment ponds S7 and S7b in Stage 6 of the amended REA. Overflow from S12 will be released to Tea Tree Hollow via a LOP. Based on the Amended Project, overflow to the LOPs (including from S12) is predicted to average 128 ML/annum which is within the range of previous overflow volumes for the existing mine (refer HEC [2020d]) (Appendix D of the Project Amendment Report) to Tea Tree Hollow via the LOPs. This is less than the maximum discharge via the LOPs to Tea Tree Hollow of 187 ML/annum recorded in 2016. As such, it is expected that the Amended Project would not result in adverse water quality impacts due to releases and overflows from the site water management system to Tea Tree Hollow.

Overflow from the additional sediment pond, S11, will be released to the Bargo River at a LOP. The simulated annual release to Bargo River from dam S11 is predicted to average 4.5 ML/annum or 0.01 ML/day. Given that the mean daily flow rate in Bargo River at Site 13 is 30.1 ML/day, an average release rate of 0.01 ML/day represents an inconsequential volume that would likely be indistinguishable from natural variability in catchment conditions. A conservative assessment of the potential constituent concentrations in Bargo River due to overflow from dam S11 indicated that the proposed release may result in a very slight increase in the concentration of sodium and total dissolved solids at Bargo River downstream (refer Section 9.1 of HEC, 2020d). The estimated concentration of sodium and total dissolved solids would remain below the ANZECC guideline default trigger values for aquatic ecosystems (ANZG, 2018) and recreational use (ANZECC, 2000).

Licensed Discharge

The results of predictive modelling (HEC, 2020b) (Appendix D of the Project Amendment Report) of the water management system over the remaining mine life (including Tahmoor South) indicate that release to LDP1 is unlikely to increase above the EPL 1389 volume limits. Additionally, Tahmoor Coal proposes to upgrade the existing WWTP to reduce the concentrations of constituents discharged via LDP1. On this basis, it is expected that the Amended Project would not result in adverse water quality impacts due to releases and overflows from the site water management system.

Surface Water Monitoring

Volumetric and water quality monitoring would continue to be undertaken as per existing EPL conditions and Tahmoor Coal erosion and sediment control processes at LDP1 and at sediment dams. To increase spatial representation of water quality sites downstream of LDP1, a water quality monitoring site would be installed on the Bargo River downstream of the conjunction with Tea Tree Hollow and upstream of SW14. Further details of proposed surface water monitoring are provided in **Chapter 7.0** (Revised Management Measures).

5.1.19 Surface and groundwater: water storage in mine goaf

Issue Description

If it is intended to store the waste water from coal washing and groundwater from dewatering activities in the goafed areas, the IESC considers further information is needed on the underground storage proposal. This should include:

a. *further information on the water quality of the water being stored underground with a full risk assessment of the potential contamination caused by untreated water leaking into the groundwater (potential impacts to the receiving environment);*

b. *assurance that the lack of water storage does not lead to releases of untreated water into Tea Tree Hollow and the Bargo River; and*

c. *updating the groundwater model to reflect water storage in the goafed area.*

Response

As described in the revised Water Management System and Site Water Balance (Appendix D of the Project Amendment Report), it is proposed to develop an underground storage within goafed areas of the Tahmoor North underground mine into which mine dewatering from the Amended Project would be pumped at times when there is insufficient capacity to treat the dewatering stream through the upgraded WWTP. Water would be pumped into and out of the storage via the existing drift and no new surface infrastructure is envisaged outside the pit top area. At times of lower inflow, water could be recovered from the underground storage, treated within the upgraded WWTP and released via LDP1.

The Groundwater Assessment (HydroSimulations, 2020) identified that, based on the groundwater salinity data available, as mining progresses in Tahmoor South, salinity of the mine dewatering stream is unlikely to rise significantly and may potentially fall slightly. Therefore, it is expected that the quality of mine dewatering from Tahmoor South will be similar to that of the groundwater inflow to Tahmoor North. As such, impacts to groundwater quality due to underground storage are unlikely to occur.

5.1.20 Thirlmere Lakes and Metropolitan Special Area

Issue Description

Regulator Question: Does the IESC agree with the project EIS's conclusion that Thirlmere Lakes and the Metropolitan Special Area would not be significantly impacted by mining operations?

The IESC does not have confidence in the EIS's conclusion that Thirlmere Lakes and the Metropolitan Special Area would not be significantly impacted by mining operations. Of greatest concern are the potential risks from regional groundwater drawdown and mining-induced ground movements that could occur along geological structures beyond the subsidence zone.

Response

As discussed in earlier sections of this report the approach to subsidence and groundwater assessment in the EIS and Project Amendment Report are considered to be robust and appropriate. Impacts to Thirlmere lakes were assessed in the EIS and the revised groundwater and surface water assessments (Appendix C and D of the Project Amendment Report).

The Amended Project is approximately 4 km from Thirlmere Lakes. Tahmoor North is located between the lakes and the Project, with the nearest historical longwall panels being approximately 600 m from the lakes. The risk of Tahmoor South having an appreciable effect on the lakes is minimal.

By far the most significant outflow component from the Lakes is evaporation/evapotranspiration, comprising approximately two-thirds of outflows. Groundwater recharge by contrast comprises approximately a quarter of outflows. The Project only has the potential to affect the groundwater recharge component.

There is a modelled 330 ML (or 2.6 ML/year average) increase in groundwater recharge as a result of the Amended Project and a 107 ML (or 0.8 ML/year average) decrease in discharge to Blue Gum Creek (from Lake Nerrigorang). This level of change would be very small compared to natural variability in downstream catchment conditions, and in the context of the potential impacts on inflow to downstream Lake Burragorang (Warragamba Dam), it would be imperceptible.

Modelling predicts that average Lake water levels would decrease by between 0.01 m and 0.06 m. The predicted average number of weeks per decade that the Lakes were without any discernible ponded water increases by between 3 and 5.2 weeks. These levels of change would again be imperceptible and very small compared to natural variability and are therefore considered negligible.

Losses from the Metropolitan Special Area have been estimated using the groundwater model. As detailed in Section 6.3, of the revised Groundwater Assessment (Appendix C of the Project Amendment Report) a maximum baseflow reduction rate of 0.018 ML/day and a long-term baseflow reduction rate of 0.014 ML/day is predicted at Cow Creek due to the Amended Project. A maximum baseflow reduction rate of 0.019 ML/day and a long-term baseflow reduction rate of 0.015 ML/day have been predicted based on cumulative impacts. The estimated level of change to streamflow in Cow Creek, as a result of the predicted baseflow reduction, may be detectable during normal periods of low flow and distinguishable from natural variability in catchment conditions.

Although the above changes are predicted for flow in Cow Creek, the combined effects of the Amended Project, consumptive groundwater extraction and the effects of other existing mining projects are predicted to have a negligible impact on Sydney's water supply sources. As summarised in Section 10.1 of the SWIA (Appendix D of Project Amendment Report), a predicted maximum reduction in mean daily flow at Pheasants Nest Weir of 0.01% (due to the Project) to 0.012% (cumulative effect) is predicted. This represents an immeasurably small and likely indiscernible impact to flows at Pheasants Nest Weir. In the long-term, the reduction in baseflow, either due to the Amended Project or the cumulative effect, is estimated to have negligible observable impact on mean daily flow at Pheasants Nest Weir. For Stonequarry Creek at Picton and Maldon Weir, the reduction in baseflow, either due to the Amended Project or the cumulative effect, is estimated to have negligible observable impact on mean daily flow at these locations.

Based on previous experience, in the unlikely event that fracturing were to occur in Cow Creek it is not expected to result in a detectable change to water quality. The predicted impact to streamflow at Pheasants Nest Weir, Stonequarry Creek at Picton and Maldon Weir, as a result of the predicted reduction in baseflow, is immeasurably small and likely to be indiscernible. Based on the above it is concluded that it is unlikely that there would be any identifiable water quality impacts to surface water resources in the Metropolitan Special Area.

In relation to geological structures, the IESC convened a workshop in March 2019 attended by mine operators to discuss the risk of structures. As discussed at that workshop, investigation of geological structures is a routine part of mine operations, however detailed exploration and investigation of these features is typically carried out as the mine approaches a new area, allowing techniques such as horizontal drilling to be employed. As such, detailed data on structures is not available at this time and will be gathered in future. This data gathering will also incorporate relevant findings from the OEH Research Program.

Also discussed at that workshop were the differences between near-surface structures in the Western Coalfield (e.g. lineaments at Springvale mine) and those in the Southern Coalfield.

5.1.21 Geology: Impacts of Nepean Fault

Issue Description

The potential role of the Nepean Fault and other geological structures in influencing unconventional subsidence and ground movement is acknowledged (EIS, Appendix F, p. 28) but not assessed.

a. *The Nepean Fault is located in the eastern section of the project area. The presence of the fault increases the probability of impacts in the MSA, particularly to Cow Creek, located approximately 1000 m from the nearest longwall. It may also act as a conduit for enhanced groundwater drawdown.*

b. *The location of the geological structure T2, close to the proposed project area and extending towards Thirlmere Lakes, may also increase the probability of unconventional mining-induced ground movements and associated impacts to groundwater. It could also act as a conduit for localised increases in mine water inflow, based on reports from a longwall panel in existing Tahmoor North. Nevertheless, it is noted that cumulative impacts from the currently proposed project are likely to be less than the possibility of impact from the drained longwall panels of the existing Tahmoor North project which are closer to the lakes. This existing impact has not been quantified, and it is unclear whether it is likely to be material.*

Response

Responses to the issues raised are provided below:

a. The Nepean Fault has been conceptualised to be a conductive feature. A discussion of these conceptual assumptions is included in Appendix I of the EIS (Groundwater Assessment - Section 3.10.3), and it has been simulated in the numerical model based on these assumptions (see Section 4.5 of the Groundwater Assessment - Appendix I of the EIS). It is noted that the Independent Peer Reviewer appointed by DPIE to review the groundwater model commented that the treatment of the Nepean Fault under the base case scenario allows the impacts predicted by the model to be considered conservative (HydroGeoLogic, 2019). On this basis it is considered that the impacts predicted at the Metropolitan Special Area (<0.1 ML/d) and Cow Creek (<0.02 ML/d) are robust and conservative.

b. The influence of the T2 fault has been considered in the sensitivity scenarios undertaken alongside the predictive modelling. Under this scenario the T1 and T2 faults were simulated as being more permeable (refer to Section 5.2 of Appendix I of the EIS). The Independent Peer Reviewer commented that assessing impacts under a scenario where these faults were more transmissive reinforces the conservative nature of model predictions (HydroGeoLogic, 2019). In addition, the Peer Reviewer stated that the simulation of more transmissive faults addresses "the potential causal pathway for impacts, contrary to the IESC suggestion that it 'has not been quantified' and confirming that it is indeed not material."

5.1.22 Thirlmere Lakes: Impacts of mining

Issue Description

Given variable water levels in the Thirlmere Lakes, the potential influence of coal mining on lake water levels relative to the influence of pumping by non-mining groundwater bores and various other factors needs to be considered (Riley et al. 2012; Pells and Pells 2016; Schädler and Kingsford 2016; Banerjee et al. 2016). Overall, there is a lack of clarity about the volume of groundwater use by production bores in the region, and the influence of the geological structure T2 and whether the structure extends from the coal seam to the ground surface. This structure is known to extend at coal seam level to the edge of the proposed Tahmoor South project. There is a possibility that the T2 structure influences groundwater and that it may continue within the Tahmoor South project between the Nepean Fault (which is known to influence groundwater) and the Central Fault (for which influence on groundwater is apparently unknown).

Response

The Independent Peer Reviewer appointed by DPIE found that the representation of the Thirlmere Lakes system required minor revision in order to allow a more appropriate simulation of water level fluctuations within the Lakes (HydroGeoLogic, 2019). This has been incorporated in the revised modelling (refer Groundwater Assessment in Appendix C of the Project Amendment Report).

As stated previously, there is a lack of available and reliable data pertaining to groundwater extraction at non-mining production bores which led to this process being omitted from the numerical simulations presented in the EIS. In addition, the exclusion of drawdown impacts associated with non-mining production bores allows for mining-related impacts to be isolated. Up-to-date groundwater usage data has been requested from WaterNSW and analysis of the available groundwater pumping data is outlined in Section 3.8.1 of the revised Groundwater Assessment (Appendix C of the Project Amendment Report). Because of the uncertainty associated with the groundwater usage (compared to entitlement), groundwater pumping has been included in a single deterministic scenario presented in the revised Groundwater Assessment.

In relation to the concerns regarding the T2 fault, detailed responses have been provided above in **Section 5.1.21**. It is the opinion of the Peer Reviewer that the representation of the T2 fault in the base case and sensitivity scenarios allows a conservative assessment of predicted impacts due to the features of this structure (HydroGeoLogic, 2019).

5.1.23 Thirlmere Lakes: future models based on ongoing research

Issue Description

The findings of ongoing studies at Thirlmere Lakes (NSW OEH, 2019) should be used to revise and update future models for the Tahmoor South project. For example, the conceptual model of each individual lake as variably connected or disconnected with regional groundwater should be reviewed and included in model updates. The potential indirect influence of mining, particularly during periods of higher lake water levels and for the two lakes that are located furthest to the west, should also be considered. Once updated predictions of potential impacts of mining on each lake are available, the results should be viewed in the context of historical fluctuations in lake water levels, including periods when the lakes are known to have dried.

Response

The IESC recommendation to revise and update future models for the Project with the findings of ongoing studies at Thirlmere Lakes (NSW OEH, 2019) has been incorporated into the revised management measures for the Amended Project (refer **Chapter 7.0**).

The effects of variable lake levels (and wetted areas) have already been considered within groundwater model predictions of groundwater-surface water interaction. The outcomes of this assessment were provided for inclusion in the surface water model (see Appendix C Groundwater and Appendix D Surface Water in the Project Amendment Report).

5.1.24 Groundwater: Modelling of bore users

Issue Description

Regulator Question: Noting that the project is predicted to exceed the Level 1 minimal impact considerations under the Aquifer Interference Policy at a limited number of groundwater bores, does the IESC consider the impacts to bores to be accurately modelled and assessed in the EIS?

Given modelling issues already identified, the IESC does not consider that the potential impacts to groundwater bores have been appropriately modelled and assessed. The historic and current volumes of pumping from non-mining groundwater bores have not been included in the model, meaning that the calibrated water balance may not be reliable for predicting groundwater drawdown. There was no attempt to test the sensitivity of the model to low and high estimates of pumping from these bores. An uncertainty analysis is required to quantify conceptual and parametric uncertainty on groundwater drawdown and hence potential impacts on groundwater bores.

Response

As noted above (**Section 5.1.5** and **5.1.22**) there is insufficient data available to constrain the pumping volumes from non-mining production bores. As such, performing sensitivity analysis on upper and lower pumping estimates would not be able to be done without a high degree of uncertainty. As noted previously, up-to-date groundwater usage data was requested from WaterNSW, and is discussed in Section 3.8.1 of the revised Groundwater Assessment. The lack of reliable 'actual use' data means that the groundwater pumping component of the water balance is uncertain, so it has only been considered in a model scenario, rather than the base case groundwater model.

The inclusion of pumping at production bores will cause cumulative drawdown estimates at private bores to be significant due to the drawdown imposed by the pumping of the bores themselves. As a result, this will make the assessment of groundwater drawdown due to cumulative activities vs mining activities more difficult (and impractical) to assess. However, an estimate of possible drawdown effects on alluvial groundwater levels at Thirlmere Lakes has been made, showing that there is potential for significant drawdown due to pumping, and greater than that of predicted mining effects.

5.1.25 Groundwater: Aquifer Interference Policy

Issue Description

In addition to the issues described above that result in low confidence in groundwater model predictions, the model calibration residual is high. The model's absolute mean is 21 m, which is an order of magnitude higher than the impact threshold under the NSW Aquifer Interference Policy of 2 m for groundwater bores. It is unclear how this calibration residual affects the prediction that the 2 m drawdown threshold will be exceeded in approximately 120 non-mining bores due to cumulative mining impacts. Of this total number of bores, approximately 28 would be impacted for the first time by mining during the Tahmoor South project according to model predictions with the most severe drawdown.

Response

The statement indicates the reviewer is reading absolute average residual as average residual. The two statistics are different. Full discussion on the calibration statistics (low residuals and sRMS) and sources of error, plus calibration to mine inflow and to groundwater pressures above LW10a is provided within Section 4.8.2 of the revised Groundwater Assessment in Appendix C of the Project Amendment Report.

It should be noted that the higher residuals occur in model layers where there are no receptors that need to be assessed against the 2 m AIP threshold. In addition, as outlined within the AGMG, the sRMS is a good descriptor of goodness of fit to water levels at specific locations but is less useful when automated calibration methods are used and does not account for other performance measures such as fluxes or goodness of fit to prior estimates of parameters.

The Independent Peer Reviewer found that the classification of the model as having a Class 2/3 confidence level was justified, with the model having sound performance to multiple calibration criteria (i.e. groundwater levels and mine inflows) (HydroGeoLogic, 2019).

The revised groundwater model presented in the revised Groundwater Assessment has been re-calibrated, with new data also added to the calibration dataset. The revised model achieves an SRMS of 2.8% (acceptable according to the AGMG, and an absolute residual mean of 10.8 m (effectively half that of the EIS groundwater model). Residuals in the shallow layers have, in general, been improved, while the residuals in the Bulli Coal Seam have also improved from 21.8 to 6.2 m. This is discussed in more detail in Section 5.8 of the revised Groundwater Assessment. The revised model is considered an appropriate tool for carrying out groundwater impact assessment.

5.1.26 Groundwater: Far-field non-conventional impacts

Issue Description

Regulator Question: Have the likely far-field non-conventional groundwater impacts been accurately modelled and assessed in the EIS, including consideration of possible basal plane movements and consequential potential impacts on the Thirlmere Lakes and the Metropolitan Special Area?

The IESC has low confidence in the proponent's modelling of groundwater impacts as described above. The IESC has particular concerns regarding prediction of far-field (outside the predicted area of conventional subsidence) groundwater impacts. This is because the subsurface processes are poorly understood when it comes to inferring potential impacts on Thirlmere Lakes and the MSA.

Response

Refer to **Sections 5.1.4, 5.1.5, 5.1.7** and **5.1.9** for detailed responses to issues raised by the IESC in relation to subsidence and groundwater modelling adequacy including in relation to the prediction of far-field subsidence (and associated groundwater) impacts. As identified above, the modelling undertaken as part of the EIS is generally robust and conservative as identified by the Independent Peer Reviewer. Revised subsidence and groundwater assessments have been prepared for the Amended Project based on the modelling approach identified in the EIS. These indicate negligible drawdown at the Thirlmere Lakes due to the Project, in the context of minor effects due to historical mining and groundwater pumping that have occurred in closer proximity.

Effects on the Metropolitan Special Area have been assessed with predictions of low rates of baseflow capture outlined in Section 6.3.3 of the revised Groundwater Assessment and are also discussed in the SWIA (Appendix D of the Project Amendment Report).

With respect to far-field groundwater impacts, it is also noted that the nearest longwall panels (at Tahmoor North) to Thirlmere Lakes (approx. 600 m away) were extracted in the 1990s. The Amended Project longwalls are over 3 km away, beyond historical longwalls. The 'subsurface processes' relevant to the interaction between Tahmoor Mine and Thirlmere Lakes have very likely played out and are extremely unlikely to be exacerbated or affected by the Project.

5.1.27 Groundwater: Regional drawdown

Issue Description

Although the mechanisms by which mining-induced ground movements (basal plane movements, bedding plane separations, upsidence, valley closure and shears) influence groundwater drawdown are also poorly understood, these movements primarily occur in the project area rather than the far field. However, these project-specific ground movements could contribute to regional groundwater drawdown, which may impact on the MSA and Thirlmere Lakes. There are potential groundwater and baseflow impacts on Cow Creek in the MSA which is located relatively close to the Tahmoor South project as discussed in paragraph 25.

Response

Impact assessments (baseflow depletion) were carried out for Cow Creek in the Groundwater Assessment (refer Tables 5-4 and 6-2 of the Groundwater Assessment in Appendix I of the EIS for results). These impacts have also been re-assessed for the Amended Project (Refer Appendix C of the Project Amendment Report). The results of the updated assessments indicate low rates of baseflow capture from Cow Creek and the Metropolitan Special Area, as outlined in the response in **Sections 5.1.20** and **5.1.21** of this document.

5.1.28 Surface and Groundwater: NorBE Predictions

Issue Description

Regulator Question: Does the IESC consider that the project would comply with the neutral or beneficial effect of development on water quality within the Metropolitan Special Area?

As the IESC has low confidence in the predictions of the groundwater model, and as there may also be other unidentified processes that could alter or exacerbate potential impacts on water quality, it is not possible to evaluate whether the project would comply with development intent in the MSA.

Response

Previous responses have addressed the issues that the IESC identified with respect to the model. The Independent Peer Reviewer (HydroGeoLogic, 2019) came to a different conclusion than the IESC regarding the groundwater modelling and its adequacy as identified in previous sections. A revised Groundwater Assessment has been prepared for the Amended Project (Refer Appendix C of the Project Amendment Report) based on the groundwater modelling approach used in the EIS.

As per Section 11.0 of the revised Surface Water Impact Assessment (Appendix D of the Project Amendment Report), the Amended Project would involve mining adjacent to but not beneath the Metropolitan Special Area. The main channel of Cow Creek, which is within the Metropolitan Special Area, is located approximately 1 km from the nearest Amended Project longwall. MSEC reports that, at this distance, the maximum predicted subsidence, upsidence and valley closure are less than 20 mm. Accordingly, the potential for localised impacts on Cow Creek such as fracturing, and surface water flow diversion are extremely low.

As detailed in Sections 6.3 and 11.0, of the revised Surface Water Impact Assessment (Appendix D of the Project Amendment Report) a maximum baseflow reduction rate of 0.018 ML/day and a long-term baseflow reduction rate of 0.014 ML/day is predicted at Cow Creek due to the Amended Project. A maximum baseflow reduction rate of 0.019 ML/day and a long-term baseflow reduction rate of 0.015 ML/day have been predicted based on cumulative impacts. The estimated level of change to streamflow in Cow Creek, as a result of the predicted baseflow reduction, may be detectable during normal periods of low flow and distinguishable from natural variability in catchment conditions.

Although the above changes are predicted for flow in Cow Creek, the combined effects of the Project, consumptive groundwater extraction and the effects of other existing mining projects are predicted to have a negligible impact on Sydney's water supply sources. As summarised in Section 10.1 of the SWIA (Appendix D of Project Amendment Report), a predicted maximum reduction in mean daily flow at Pheasants Nest Weir of 0.01% (due to the Amended Project) to 0.012% (cumulative effect) is predicted. This represents an immeasurably small and likely indiscernible impact to flows at Pheasants Nest Weir. In the long-term, the reduction in baseflow, either due to the Amended Project or the cumulative effect, is estimated to have negligible observable impact on mean daily flow at Pheasants Nest Weir. For Stonequarry Creek at Picton and Maldon Weir, the reduction in baseflow, either due to the Amended Project or the cumulative effect, is estimated to have negligible observable impact on mean daily flow at these locations.

Based on previous experience, in the unlikely event that fracturing was to occur in Cow Creek it is not expected to result in a detectable change to water quality. The predicted impact to streamflow at Pheasants Nest Weir, Stonequarry Creek at Picton and Maldon Weir, as a result of the predicted reduction in baseflow, is immeasurably small and likely to be indiscernible. Based on the above it is concluded that it is unlikely that there would be any identifiable water quality impacts to surface water resources in the Metropolitan Special Area.

5.1.29 Mine Layout: Longwall placement

Issue Description

Regulator Question: Does the EIS provide reasonable strategies to effectively avoid, mitigate or reduce the likelihood, extent and significance of impacts (including cumulative impacts with the existing Tahmoor mine) to significant water- related resources?

Would the IESC recommend any additional or varied strategies to avoid, mitigate or reduce the likelihood, extent and significance of impacts (including cumulative impacts with the existing Tahmoor mine) on water - related resources? If so, why?

Where mitigation is not feasible, avoidance is the most effective management strategy. Given that empirical observations from Tahmoor North suggest that impacts from mining-induced ground movements are likely to be more severe than modelled, further redesign of the mine plan should be considered to avoid impacts. In particular, connective cracking and extensive surface cracking and near-surface fracturing should be avoided at mapped GDEs, Dog Trap Creek and Tea Tree Hollow.

These impacts may be avoided by, for example, altering the longwall placement or orientation so that creeks are not undermined or by other alterations to the mine design and geometry of panels and pillars.

Response

The initially proposed mine plan for the Project (as identified in the EIS) was developed following an extensive risk assessment process which incorporated the:

- Recommendations and findings of the Southern Coalfields Enquiry (refer Section 5.3.1 and Table 5.1 of the EIS) including streams of 3rd order or above within the mine subsidence area being considered as Risk Management Zones (RMZ); and
- Extensive collaboration between technical specialists to determine risk management zones (RMZs) and inform the extent of longwall mining and proposed mitigation measures.

Several revisions to the initially proposed original mine plan were made including shortening the commencing ends of longwalls 105 to 108 such that they do not encroach into the Metropolitan Special Area and Cow Creek and no longer proposing mining in the Eastern Domain to avoid impacts to Eliza Creek. The amended Proposed mine plan avoids mining beneath Bargo River and Hornes Creek and the project's subsidence study area does not extend to: Carters Creek, Cow Creek, Dry Creek, Eliza Creek or Sugar Loaf Gully. Furthermore, the Amended Project's subsidence study area does not extend to the Thirlmere Lakes National Park World Heritage area.

Since the exhibition of the EIS, additional changes as described below, were made to the initially proposed mine plan to further reduce the extent and magnitude of anticipated surface subsidence impacts to natural features and built infrastructure:

- An amended longwall panel layout and the removal of LW109;
- Reduction to the height of extraction within longwall panels from up to 2.85 metres to up to 2.6 metres; and
- Reduction in the proposed longwall width, from up to 305 metres to approximately 285 metres.

These changes are described in detail in the Project Amendment Report.

Ongoing subsidence monitoring throughout extraction will inform updates and refinements to the mine plan as required.

5.1.30 Eco-hydrological conceptual model to underpin management plans

Issue Description

The IESC presumes that details of mitigation strategies are, or will be, provided in management plans. As these management plans have not been provided, the IESC is unable to provide comment. To underpin these plans and associated risk assessment, an eco-hydrological conceptual model is needed that illustrates potential pathways and mechanisms of the effects of altered surface flows, and of the effects on groundwater exchanges and in-stream water quality on surface and groundwater ecosystems. This conceptual model would help the proponent justify strategies proposed to mitigate and manage potential impacts.

Response

The IESC's recommendation is noted. Detailed mitigation strategies would be prepared as part of the Extraction Plan. Subsidence engineers, hydrologists and ecologists would collaborate through a series of workshops and site visits so that the monitoring and management plans that support the Extraction Plan are prepared in a holistic manner and consider the interrelationship between hydrology and ecology.

5.1.31 Subsidence and Surface Water: Creek Remediation

Issue Description

The proponent states that cracks will naturally remediate through sediment infilling. However, the creek beds in this area are mainly bedrock or rock bars where suitably fine sediment is unlikely to collect. Moreover, much of the sediment is sandy and infilled cracks would retain some permeability. Although the proponent indicates that grouting may be employed, the IESC is unaware of any successful deployment of this method at a large scale (e.g. along a creek line) in a natural system that has been verified by appropriate stream gauge data over both the short and long term. The proponent has not provided detailed and independently peer-reviewed evidence that streambed subsidence impacts can be remediated.

Response

Concerns regarding the recovery potential of bedrock creeks following longwall mining are acknowledged. Methods for remediating creek beds in the Southern Coalfields are currently being monitored to determine their long-term effectiveness and so that the industry can continue to improve remediation techniques.

If pool / stream remediation measures are required during mining, they will be implemented in consultation with key Government agencies. Where there is limited ability for fractures to seal naturally, they will be sealed with an appropriate and approved grout. Tahmoor Coal has recently developed corrective management action plans for Redbank and Myrtle Creeks to remediate subsidence impacts caused by mining of Longwalls 27 to 30. The corrective management action plans propose pool remediation and rock bar grout curtain wall works which would be undertaken along Myrtle and Redbank Creeks via a staged approach.

Stage 1 of the Myrtle Creek corrective management action plan is underway as a trial project (November 2019). On completion of the Myrtle Creek corrective management action plan Trial Project, outcomes will be assessed to determine the best approach for a future Stage 2 remediation works in Myrtle and Redbank Creek. Outcomes from each stage will be assessed to provide the best approach for the next stage. The purpose of this approach is to provide a strategy of continuous improvement from the staged outcomes. The findings from the staged approach for Myrtle and Redbank Creek will be applied to develop an effective and appropriate remediation strategy for Tea Tree Hollow and Dog Trap Creek in the event that the streambed or pools are impacted due to the Amended Project.

Following completion of Stage 1 of the Myrtle Creek corrective management action plans, Stage 2 would include these additional works:

- Stage 2 grout curtain walls at an additional 6 sites; and
- Stage 2 pool remediation at an additional 15 sites.

The proposed corrective management action plan for Redbank Creek includes:

- Review and update of the plan to leverage the successful outcomes and learnings of the Myrtle Creek corrective management action plan Stage 1 remediation works;
- Investigation works including stream and pool mapping and stream bed characterisation;
- Remediation works including up to 6 grouting sites and up to 15 pool remediation sites;
- Ongoing water flow and water quality monitoring at Redbank Creek to provide adequate data for subsidence impact analysis and close out of completion criteria;
- Aquatic ecology monitoring at Redbank Creek to provide adequate data for subsidence impact analysis and close out of completion criteria; and
- Stakeholder and community consultation strategy to keep interested parties informed on the progress of the remediation works.

To ensure continual improvement based on the monitoring and effectiveness Tahmoor Coal would complete the following reports for the corrective management action plans:

- Quarterly Progress Report (31 March, 30 June, 30 September; 31 December)
- Remediation Stage Completion Reports; and
- Final Completion Report.

These reports would be submitted to the following stakeholders:

- NSW Resources Regulator;
- DPI;
- Tahmoor Coal Community Consultative Committee;
- Wollondilly Shire Council; and
- Other stakeholders as directed by NSW Resources Regulator.

The Quarterly corrective management action plan Progress Report would include the following information:

- Work completed in the previous period;
- Work proposed in the next period including:
    - Detailed program for next period for review and approval by Resources Regulator;
    - Schedule of works proposed in next period for review and approval by Resources Regulator;
- Review against program;

- Community and stakeholder consultation undertaken;
- Monitoring results;
- Assessment against Completion Criteria; and
- Complaints and incident management.

On completion of each remediation stage, a Stage Completion Report will be prepared. These reports act as a system of continual improvement based on the monitoring and what was identified in the monitoring program in terms of effectiveness. The Stage Completion Reports would include:

- Definition and description of Remediation Stage (the section of waterway to be remediated);
- Work completed during Remediation Stage;
- Results of work completed during Remediation Stage;
- Monitoring Results;
- Materials and methods used, and outline of procedures used/developed;
- Assessment against Completion Criteria;
- Complaints and incident management; and
- Recommendations and conclusions.

At the completion of the final remediation works, a Final Completion Report will be prepared and will outline:

- Definition and description of remediation works;
- Results of work completed;
- Monitoring Results;
- Materials and methods used, and outline of procedures used/developed;
- Assessment against Completion Criteria;
- Complaints and incident management; and
- Recommendations and conclusions.

These reports will be prepared and submitted to the following stakeholders:

- NSW Resource Regulator;
- DPIE – DRG;
- Wollondilly Shire Council;
- Tahmoor Coal Community Consultative Committee; and
- Other stakeholders as directed by NSW Resource Regulator.

This approach was reviewed and endorsed by DPIE as a component of the Mining Operation Plan for Tahmoor Mine. The plan is currently being implemented along Myrtle Creek and will be updated/ enhanced for Redbank. Tahmoor Coal would build on the experience at Redbank and Myrtle Creeks, as well as at other mines in the Southern Coalfields, to monitor and enhance the success of rehabilitation methods.

5.1.32 Surface and groundwater: water quality mitigation recommendations

Issue Description

As described above, potential impacts to surface and groundwater quality from the proposed project could occur through impacts associated with water discharges, water storage and mining-induced ground movements. To mitigate these potential impacts, the IESC considers that:

a. the Proponent's existing operation facilities would be improved by ensuring:

i. the WWTP is operating as intended to mitigate metal concentrations in water prior to discharge. There is no evidence in the EIS that the WWTP is achieving the required water quality objectives since its 2014 upgrade as no recent data has been provided. It is also noted that no water quality data is provided for LPO3, LPO4, and LPO5; and

ii. the water treatment system has the capacity to store and treat contaminated mine water during storm events or during periods of high groundwater inflows. The IESC considers that if the additional water balance work finds a high risk of untreated water discharges, additional storage capacity should be installed so that untreated water is not released or allowed to overflow to Tea Tree Hollow or the Bargo River.

b. the proponent should develop a Receiving Environment Management Plan that provides actions to ensure that the downstream environment is not adversely affected by discharges or storage overflows from the proposed mine. Collectively, these plans should:

i. provide a trigger action response plan (TARP) in line with ANZG 2018 guidelines; and

ii. incorporate appropriate spatial and temporal representation to detect impacts from mine-induced ground movement and mine-water discharge. This redesign should take account of the investigations into reference and impact sites and the water quality guideline value exceedances described above.

c. this Receiving Environment Management Plan should be integrated with the existing Water Management Plan and the Biodiversity Management Plan so that the mitigation and management measures will adequately protect environmental values within and downstream of the project area.

Response

The revised water balance assessment for the Amended Project (HEC, 2020b) (Appendix D of the Project Amendment Report) indicates that the stored water volume in the underground is predicted to increase from 2025 and is likely to reach the storage capacity by 2033 based on the median model results. The 95th percentile results indicate that the stored water volume may reach the storage capacity by mid-2032. Once the underground storage capacity is reached, water in excess of the upgraded WWTP capacity would be discharged to LDP1. As such, an upgraded WWTP capacity upgrade of between 1.5 to 3 ML/day is likely to be required prior to 2032, dependent on actual groundwater inflow and climatic conditions experienced at the mine.

The IESC recommendations in relation to surface water mitigation have been incorporated into the revised environmental management measures for the Amended Project (refer **Chapter 7.0**).

5.1.33 Subsidence: Monitoring and mitigation recommendations

Issue Description

Regulator Question: Would the IESC recommend any additional monitoring or management measures to address any residual impacts on water-related resources?

The IESC considers the following mining-induced ground movement monitoring should be undertaken to confirm the spatial extent and magnitude of potential impacts.

a. The proponent should adopt the monitoring recommendations for a 5-yearly catchment-wide geomorphology survey to complement monitoring of subsidence at each longwall, as described in the geomorphology report (EIS, Appendix H).

b. Subsidence monitoring points should be installed before any mining of second workings for all longwalls in each Extraction Plan. The IESC acknowledges that there is an adaptive management plan for longwall mining. This would be enhanced by a commitment to re-evaluate the subsidence and biodiversity monitoring after mining of each longwall. This would then inform monitoring for subsequent longwall panels.

c. Data from subsidence monitoring needs to be used to provide better calibrated predictions of subsidence within each consecutive Extraction Plan, particularly within fault zones. Additional geological characterisation, and targeted seismic surveys across fault zones should be designed to improve the knowledge of fault zones. For high risk fault zones, drilling across core and fault damage zones, and studies of the spatial variability and changes over time in response to mining-induced stresses should be undertaken.

d. Monitoring should be undertaken to determine if leakage from shallow near-surface fractures is occurring and if the flows through fractures are returning to the watercourses. Such monitoring should be undertaken before mining commences to assess the baseline conditions above each longwall, and should include:

i. detailed monitoring to determine geomorphological conditions, including creek mapping and high-resolution photography (before, during and after mining beneath each longwall) of any rock bars, shallow alluvium (i.e. less than 2 m deep) and permanent or semipermanent pools within the subsidence impact area;

ii. geophysical logging of boreholes that allow changes in groundwater storage and fracture apertures to be quantified and depth of rock deformation to be identified (i.e. observations of non-deformed ground which could be at least 10-30 m below surface). Both open-rock and multi-level piezometers will support assessment of changes to hydraulic gradients between different hydrogeological units (such as between alluvium and the underlying sequences); and should also be used for environmental water tracer studies to provide an additional line of evidence for hydraulic connection and disconnection;

iii. time-series cross-sections using suitable geophysical techniques (before, during and after mining beneath each longwall). This should include profiles across the creek channel and either side of the flood plain, with depth penetration exceeding the depth of alluvium to bedrock, but with metre or sub-metre scale resolution of data in the zone from, at least, 10-30 m of the surface.

Response

The IESC recommendations in relation to subsidence monitoring and mitigation are noted. The following measures would be adopted for the Amended Project (also refer **Chapter 7.0**):

a. A geomorphology survey (baseline and post mining) of waterways overlying each longwall would be undertaken to complement monitoring of subsidence at each longwall;

b. Subsidence monitoring points would be installed before any mining of second workings for all longwalls in each Extraction Plan. The adaptive management plan for the Amended Project would include re-evaluation of the monitoring techniques for subsidence and biodiversity after mining of each longwall. This would then inform monitoring for subsequent longwall panels;

c. Monitoring would be undertaken as part of the Extraction Plan to determine if leakage from shallow near-surface fractures is occurring and if the flows through fractures are returning to the watercourses. Monitoring would be undertaken before mining commences to assess the baseline conditions above each longwall, and would include:

   i. detailed monitoring to determine geomorphological conditions, including creek mapping and high-resolution photography (before, during and after mining beneath each longwall) of any rock bars, shallow alluvium (i.e. less than 2 m deep) and permanent or semi-permanent pools within the subsidence impact area; and

ii. geophysical logging of boreholes that allow changes in groundwater storage and fracture apertures to be quantified and depth of rock deformation to be identified (i.e. observations of non-deformed ground which could be at least 10- 30 m below surface). Both open-rock and multi-level piezometers will support assessment of changes to hydraulic gradients between different hydrogeological units (such as between alluvium and the underlying sequences); and would also be used for environmental water tracer studies to provide an additional line of evidence for hydraulic connection and disconnection.

5.1.34 Groundwater Monitoring: Recommendations

Issue Description

The IESC considers the following improvements should be made to the groundwater monitoring network.

a. *As recommended in the groundwater report (EIS Appendix I, pp. 22 24, 100 101), a review of vibrating-wire piezometers should be undertaken to identify piezometers that have ceased to function or are providing suspect data. As also noted in the groundwater report, it is expected that a number of replacements may be needed following this review.*

b. *Multi-level piezometers and open rock holes should be installed in the following areas:*

   i. *within the subsidence zone at key locations above longwall panels that are early in the mining sequence proposed for Tahmoor South to verify the height of complete drainage, the height of vertical connected fracturing and the height of horizontal fracturing above the coal seam as a function of longwall panel geometry, overburden thickness and other factors;*

   ii. *beyond the mine subsidence zone between the mine and the MSA, located in an appropriate manner to quantify the influence of the Nepean fault zone on near-field and far field strata and groundwater conditions;*

   iii. *beyond the mine subsidence zone on the topographic high between the mine and the Thirlmere Lakes (e.g. replacement of site TBC039 if it is not suitable or functional);*

c. *These monitoring points should be targeted at key depths within each strata overlying the coal seam, with detailed analysis of water level data. Downhole geophysical logs and camera logs in open rock holes should be repeated before and after longwall extraction in a manner similar to that demonstrated in EIS Appendix G. In addition, environmental water tracer studies at these sites should provide another line of evidence of hydraulic connection and disconnection over the short term and long term.*

d. *The proponent should also seek to include reliable groundwater head data from all public and private bores. This will allow verification of the depth of near-surface fracturing and connective fracturing.*

e. *To measure any impacts to sensitive areas, additional multi-level piezometers and open rock holes should be installed as close as practicable to creeks to monitor:*

   i. *ecologically sensitive areas, including Cow Creek in the MSA (placed between the mine and Cow Creek) and the P. brunnea population along Tea Tree Hollow;*

   ii. *sections of streams identified as being of at high risk from mining-induced ground movement;*

f. *Detailed investigations and monitoring at these points including downhole geophysics and environmental water tracer studies should be designed to identify and quantify mining impacts as discussed in paragraph 37 part d-ii) and d-iii).*

g. *To provide an indication of background groundwater quality, the proponent should reinstate groundwater quality monitoring upstream of the REA.*

Groundwater quality monitoring is needed to determine whether groundwater that has travelled through shallow subsidence fractures increases the concentration of metals or other contaminants. Results from this monitoring should be compared to those from groundwater monitoring of reference sites upstream and outside the predicted subsidence impact zone.

Response

The groundwater management plan for the Amended Project will be expanded/ updated with consideration to the IESC recommendations.

In 2018-19, Tahmoor Coal installed a number of piezometers in and around Longwalls 31-32 and the Western Domain longwalls in the northern part of the mine. These have already, and will in future, provide useful information for future conceptualisation and model calibration/ verification. If the Amended Project is approved, a full review of the existing bore network would be undertaken. The following recommendations regarding monitoring of groundwater levels, provided in the revised Groundwater Assessment for the Amended Project, would be implemented as part of the Amended Project:

- Conduct a condition assessment of bores and monitoring equipment (VMPs) of 'TBC' bores around Amended Project area, with a specific update of the GWMP. The revised GWMP would then include a proposal to replace some of the Tahmoor South TBC bores or re-instate piezometers as necessary prior to the commencement of mining;
- Re-install at least one bore in the footprint of a Tahmoor North longwall (e.g. at TNC029) to monitor post-mining groundwater level and groundwater quality;
- Monitoring in longwall centre-lines of pre- and post-mining conditions for the Amended Project. This would be undertaken for the longwall (101A), and then every two or three after that. Packer testing would also be undertaken, followed by installing VMPs at four elevations in the Hawkesbury Sandstone and then two in the Bulgo Sandstone to assist in defining a profile of fracturing and depressurisation above longwalls;

The following items have been incorporated into the revised environmental management measures for the Amended Project (refer **Chapter 7.0**), in response to the submission:

- A bore census of the groundwater monitoring network and surrounding private bores is currently being undertaken for the Amended Project. A review of vibrating wire piezometer data was carried out in 2019. Pending approval of the Amended Project, appropriate replacement bores and piezometers will be identified for the Amended Project bore monitoring network;
- Five additional shallow bores (P12-P17), each with, multi-level, open hole piezometers were recently installed in the area surrounding the Western Domain mining area at the Tahmoor North mine site to support the LW W1-W2 extraction management plan (HydroSimulations, 2019). Monitoring results from this area will (along with monitoring data from the existing Tahmoor network) will continue to inform the operation of the Amended Project;
- Geophysical assessments (using camera logs) have been conducted using boreholes that intersect the strata surrounding Redbank Creek to monitor the effects of mining induced surface fracturing in this area (SCT, 2018) and will continue to inform TARP and remediation processes for Amended Project in relation to creek-bed fracturing; and
- There was no historical evidence of groundwater quality impacts from leaching at the REA (Geoterra, 2013). However, as a precaution, Tahmoor Coal has reinstated groundwater monitoring bore TGW5 and will monitor into the future.

Further details of the surface water and groundwater monitoring proposed for the Amended Project is provided in **Section 5.2.4.5**.

5.1.35 Surface Water Monitoring: Recommendations

Issue Description

An effective monitoring program needs to justify the selection of reference, baseline and impacted sites. This is especially critical for sampling water quality because water from the reference sites exceeded multiple water quality parameters when compared to the ANZG (2018) guidelines for aquatic ecosystem protection. Sometimes, the same sites have been used inconsistently. For example, sites serving as controls for water discharge also served as impact sites for mine subsidence. This inconsistency needs justification and an explanation of how the potential contributing factors between changes to hydro-geochemistry due to mine subsidence (should it occur) and those caused by mine discharge waters are to be partitioned when interpreting results from future monitoring.

The IESC considers the proponent should re-install gauging stations and monitoring at surface-water sites as recommended in the proponent's documentation (EIS, Appendix J, Surface Water Impact Assessment Report, p. 79). Monitoring sites should also be expanded to include high-risk and ecologically sensitive sites.

To address gaps in surface water quality information, the proponent should:

a. *provide an explanation for the source of high contaminant concentrations at reference sites. If high contaminant concentrations are found to be anthropogenic, the proponent should identify the magnitude of impact at control sites to enable an understanding of cumulative impacts;*
b. *where water quality guidelines are consistently exceeded for individual contaminants, undertake direct ecotoxicity testing of the discharge, upstream water and water immediately downstream of the licenced discharge point, to determine any mixture toxicity; and*
c. *increase spatial representation of water quality sites, particularly downstream of LDP1.*

Response

Tahmoor Coal has established gauging stations and water quality monitoring sites on surface water systems upstream, within and downstream of the Subsidence Study Area for the Amended Project. In accordance with Section 4.2 of the revised Surface Water Baseline Assessment (Appendix D of the Project Amendment Report), the sites were categorised as either:

Control / Reference site:	a site which is to provide control / reference data against which future Project impacts could be compared; or
Baseline / Impact site:	a site which is to be used to compare conditions before, during and after the Project.

Site selection was undertaken in accordance with ANZECC (2000). As the Amended Project is located within a modified ecosystem i.e. urban, agricultural, industrial and resource development has been undertaken previously in the catchment area, the 'best available' reference sites have been adopted. The sites enable water quality reference conditions to be developed for control and baseline sites against which water quality data collected at impact sites can be assessed following project commencement. It should be noted that the control sites are independent of the baseline / impact sites i.e. sites serving as controls for water discharge do not serve as impact sites for mine subsidence.

Section 7.2 of the revised Surface Water Baseline Assessment (Appendix D of the Project Amendment Report) provides a summary of the baseline water quality data, including discussion of the source of high contamination concentrations identified at some sites. As baseline conditions exceed the default guideline values for some constituents, the adoption of ANZECC (2000) and ANZG (2018) default guideline trigger values would, for many parameters, result in frequent 'false triggering'. As such, site specific trigger values (SSTV) have been developed in accordance with ANZECC (2000) and ANZG (2018) to provide a baseline against which to compare future monitored water quality in order to assess if an impact may be occurring. It is intended that the SSTVs will be incorporated into water quality Trigger Action Response Plans (TARPs) for sites downstream of the Amended Project area.

To increase spatial representation of water quality sites downstream of LDP1, a water quality monitoring site would be installed on the Bargo River downstream of the conjunction with Tea Tree

Hollow and upstream of SW14. The IESC recommendations in relation to surface water monitoring have been incorporated into the revised environmental management measures for the Amended Project (refer **Chapter 7.0**).

5.1.36 Terrestrial and Aquatic Ecology: Monitoring recommendations

Issue Description

Based on the information provided in the EIS, the IESC considers that additional monitoring is needed to identify water regime and groundwater requirements of threatened species (e.g. P. brunnea) and keystone GDE and water-dependent species within the project area and where drawdown impacts are predicted downstream. This additional work will identify whether further management measures are needed to avoid or mitigate potential impacts of groundwater drawdown or altered flows on these species.

Response

The IESC recommendation is noted.

The potential for the Project to impact on *P. brunnea* is discussed in Section 7.4.2 of the Biodiversity Assessment Report (Appendix K of the EIS).

The assessment concluded that it could reasonably assume that there is a disconnection of *P. brunnea* to the water within the creek given the species persistence during periods where water in the creek was absent. Die back of the *P. brunnea* population is therefore unlikely to result from drying of pools or predicted changes to the hydrological regime caused by subsidence.

Notwithstanding the finding of the Biodiversity Assessment Report, a piezometer has been installed in the gully where *P. brunnea* has been found and Tahmoor Coal is currently, and will continue, monitoring ground water levels at this location.

5.1.37 Aquatic Ecology: Sydney Hawk Dragonfly surveys

Issue Description

Although the ecological survey methods were generally appropriate and followed standard protocols, survey timing was sub-optimal for the Sydney Hawk Dragonfly (Austrocordulia leonardi) listed as threatened under the NSW Biodiversity Conservation Act 2016. It is recommended that further surveys are needed during warmer months, when dragonflies are likely to be larger and more active. Summer sampling of adults at sites identified as suitable larval habitats is also needed.

Response

The Sydney Hawk Dragonfly (SHD) (*Austrocordulia leonardi*) is listed as an endangered species under the NSW *Fisheries Management Act 1994*. While it is not likely that SHD occurs in the study area, Tahmoor Coal will resurvey for adult and larval dragonflies in summer (2019-20) in the Bargo River to address this concern. The results would be made available to DPIE following the survey. The survey for SHD will focus on larvae and exuviates because 'the majority of the life cycle of the SHD is spent as an aquatic larva, while adults are present for only a few weeks.

Most of the habitat in the Amended Project area is considered marginal, however these areas were surveyed and *Austodorulia refracta* (a similar species) was found in Eliza Creek, which can coexist in similar habitat (DPI, 2016). However, *A. refracta* can occur in smaller systems, intermittent streams and shallow pools, whereas *A. leonardi* are found in deep riverine pools which are only present in some sections of Bargo River downstream.

5.1.38 Aquatic Ecology: Baseline information gathering

Issue Description

There may be a need to collect more up-to-date baseline data against which to judge potential ecological impacts of the proposed project. For example, the macroinvertebrate monitoring was done in 2012 and 2013, but there may have been changes in community composition that should be identified to provide a reliable pre-mining baseline data set. Samples should also be collected from the three tributaries that are to be undermined as these have not been sampled for aquatic invertebrates.

Response

It is acknowledged that the baseline data needs to be updated for future monitoring purposes. However, the two-year baseline collected in 2012/2013 is adequate for impact assessment because:

- The sites selected were representative of the system that had available aquatic habitat (3rd order streams);
- It was conducted in multiple seasons and years;
- A variety of techniques were used – AUSRIVAS and quantitative sampling;
- It covered wet and dry rainfall periods which are a controlling factor in aquatic communities in intermittent streams;
- AUSRIVAS was sampled twice in each season in each year;
- The process affecting macroinvertebrates remains unchanged; and
- The predicted impact to invertebrate communities is unchanged despite temporal variation in community composition.

However, further monitoring has been undertaken in spring 2019 and is scheduled for autumn 2020 to update the baseline data for future monitoring purposes. This will involve sampling of potential impact sites and non-impacted locations at locations that are representative of the system present in the study area.

5.2 Department of Industry (Lands and Water Division)

5.2.1 DPI - Agriculture

Issue Description

DPI Agriculture is satisfied that the strategies and measures, outlined in the EIS prepared by AECOM Australia Pty Ltd (December 2018), adequately address the potential impacts of subsidence on rural infrastructure, local waterways and groundwater relevant to agricultural operations and/ or infrastructure.

Response

Noted.

5.2.2 DPI - Fisheries

5.2.2.1 Baseflow and Iron-floc Monitoring

Issue Description

DPI Fisheries requires the monitoring program for water quality to include baseflow monitoring in the creeks and monitoring of iron floc entering the Bargo River. This is due to the potential impacts of poor water quality entering the downstream end of the Bargo River and the Nepean River. Poor water quality may occur from cracking the rock bases of the tributary creeks of the Bargo River allowing water to percolate through the bedrock and potentially generating iron floc. Iron floc has a smothering effect on the eggs of Macquarie Perch laid in the interstices in gravel riffles. This is of particular importance in the area of the Bargo River downstream of Mermaid Pools.

Response

Baseflow and water quality monitoring would be carried out as part of the Amended Project. Since the EIS was publicly exhibited, streamflow monitoring has recommenced on Hornes Creek, Dog Trap Creek, Eliza Creek and Carters Creek in order to expand baseline data (up to the period of mining within these catchments) and allow for the assessment of impacts to flows post mining (refer updated SWIA - Baseline Study included in the Project Amendment Report).

Additional water level monitoring is also proposed to be implemented, on Hornes Creek, Dog Trap Creek, Tea Tree Hollow and Eliza Creek. These monitoring sites will provide baseline water level data necessary to enable the assessment of potential impacts to pool water levels as a result of the Project.

The Water Management Plan for the Tahmoor Mine will be updated to reflect changes to the baseline monitoring program.

In summary, the following baseflow and water quality monitoring (including for iron floc) is proposed:

Surface Water Monitoring (refer updated SWIA included in the Project Amendment Report).

- Ongoing streamflow monitoring at Hornes Creek, Dog Trap Creek, Eliza Creek and Carters Creek in order to expand baseline data of these waterways up to the period of mining within these catchments;
- Additional water level monitoring at Hornes Creek, Dog Trap Creek, Tea Tree Hollow and Eliza Creek to establish baseline water level data to enable the assessment of potential impacts to pool water levels;
- In order to increase the spatial representation of water quality sites downstream of LDP1, a new water quality monitoring site would be established on the Bargo River downstream of the confluence with Tea Tree Hollow and upstream of SW14;
- Install an additional stream flow gauging station at Tea Tree Hollow, downstream of the edge of the longwall and upstream of Licensed Discharge Point (LDP) 1;
- Streamflow gauging activities would be continued. Enhanced low flow control weirs would be established at the existing gauging station at Dog Trap Creek downstream and the proposed new gauging station at Tea Tree Hollow to support the generation of reliable continuous flow data (including reliable low flow data) at the stations. Routine water level and water quality monitoring at the stations would also be continued;
- Establishment of Trigger Action Response Plans (TARPs) for water quality exceedances which incorporate both baseline and control monitoring data. Site specific trigger values have been developed in accordance with ANZECC (2000) and ANZG (2018) for baseline sites which may potentially be affected by the Project – refer HEC (2020);
- Establishment of TARPs for unexpected flow loss based on analysis of baseline (i.e. pre-subsidence) streamflow data, post-subsidence streamflow data and contemporaneous data from control sites. Catchment flow modelling should also be used in the analysis; and
- Establishment of TARPs for unexpected loss of pool water holding capacity based on analysis of baseline (i.e. pre-subsidence) pool water level data, post-subsidence pool water level data and contemporaneous data from control pool sites. Pool water balance modelling should also be used in the analysis particularly during unusual climatic/hydrological conditions.

When longwall mining is within 200 m of any watercourse, weekly inspections, photographic reconnaissance and field-based water quality monitoring would be undertaken in that watercourse(s) at sites upstream and downstream of the potentially affected area. Water quality samples would be collected and analysed monthly and increased to weekly if field monitoring results indicate a change from background (e.g. exceedance of the site-specific trigger value). Results of monitoring would be analysed in relation to action response triggers on a monthly basis when longwall mining is within 200 m of a watercourse.

Aquatic Ecology (refer updated Aquatic Ecology Impact Assessment - included in the Project Amendment Report).

- Monitoring of macroinvertebrates be conducted two years prior to longwall extraction to establish baseline conditions. The monitoring program would use the same sampling methods as used in this monitoring conducted to date. A BACI (Before After Control Impact) designed monitoring program would be implemented to compliment the baseline information collected and to assess potential impacts following commencement of longwall extraction, in an adaptive management framework;
- Investigation of Tea Tree Hollow downstream of LDP1 to determine methods of potential remediation of the creek to remove the impacts of the barium precipitate on the aquatic habitat; and

- Establishment of an aquatic ecology monitoring program aimed at assessing aquatic health from the discharge at LDP, focusing on barium precipitate at Tea Tree Hollow including quantitative benthic suction sampling of benthos in-situ, benthic algae and inorganic benthic precipitate.

These measures would be carried out as part of the implementation of the Project to establish baseline conditions prior to the commencement of longwall operations. These measures would also be used to monitor the effects of longwall operations and inform management and remediation measures where required, including the generation of iron flocs through bed rock fracture.

The Surface Water and Aquatic Ecology assessments undertaken for the EIS (Sections 11.4 and 11.7 and Appendices J and K) and updated assessments included as part of the Project Amendment Report identified that there may be transient, localised spikes in metal concentrations at Tea Tree Hollow, Dog Trap Creek and downstream watercourses while subsidence is active and that potential impacts to aquatic fauna would be localised, with fauna able to recover from transient spikes in concentrations (Niche, 2018, 2020).

Impacts to Macquarie Perch are considered unlikely as the Aquatic Ecology assessment concluded the creeks within the Amended Project Area have a 'None' to 'Low' likelihood of containing Macquarie Perch habitat. This was based on available habitat being highly fragmented with rock bars and other barriers to fish movement, the ephemeral nature of the 1st and 2nd order streams within the Amended Project Area, and the lack of suitable spawning habitat. While some sections on the Bargo River within the Amended Project Area were noted to contain suitable habitat for Macquarie Perch, the assessment identified that they occur above Mermaid Falls and below Picton Weir. It is therefore considered unlikely that a viable population of Macquarie Perch exists in this limited range. It is noted that there are no recorded occurrences of this species within this section of the Bargo River, confirmed by surveys conducted as part of this assessment and by NSW DPI. As such, the assessment concluded that, due to their absence from the study area, impacts to this species are unlikely.

5.2.3 DoI - Lands

5.2.3.1 Crown Land and Crown Roads

Issue Description

All Crown Land and Crown Roads within a Mining Lease must be subject to a Compensation Agreement issued under Section 265 of the Mining Act 1992, to be agreed and executed prior to any mining activity taking place and within 12 months of Project/ Modification Approval. The Compensation Agreement may include conditions requiring the Mining Lease Holder to purchase Crown land impacted on by mining activity.

All Crown Land and Crown Roads located within an Exploration Licence, where subject to exploration activity, must be subject to an Access Arrangement issued under Section 141 of the Mining Act 1992, to be agreed and executed prior to any exploration activity taking place.

Response

Prior to the commencement of any works on Crown Land and/ or Crown Roads Tahmoor Coal would, obtain all relevant compensation and/ or access agreements under the *Mining Act 1992* to enable works within Crown Lands/ Roads.

5.2.4 DoI - Water and Natural Resources Access Regulator (WNRAR)

5.2.4.1 Waterfront Land

Issue Description

The Rejects Emplacement Area covers waterfront land and should be rehabilitated in accordance with the Guidelines for Working on Waterfront Land https://www.industry.nsw.gov.au/water/licensing-trade/approvals/controlled-activities. The Rehabilitation Management Plan is to be developed in consultation with the Natural Resources Access Regulator.

Response

The *Rehabilitation and Mine Closure Strategy* prepared for the Amended Project (SLR 2020) includes a commitment to undertaking rehabilitation of the REA with consideration of the *Guidelines for Working on Waterfront Lands* (the guideline) and in consultation with the relevant government agency/s, where applicable. Mitigation measure RD1 has been revised to reflect this in **Chapter 7.0**.

5.2.4.2 Water Entitlements

Issue Description

The proponent should clearly demonstrate the ability to obtain the necessary authorised entitlement to account for the maximum take of water from both surface water and groundwater sources in accordance with the Aquifer Interference Policy. This is because:

- *The Surface Water Impact Assessment identifies daily losses that amount to a maximum surface water flow reduction of 172 ML/y for the Bargo River, Tea Tree Hollow and Dog Trap Creek combined. The project will require additional surface water licences to account for this predicted incidental take. The details (magnitude, timing and frequency) of the incidental surface water take caused by underground mining and dewatering should be clarified and the volumes confirmed.*
- *The groundwater modelling indicates that a maximum take of 2,850 ML/y will occur, which is substantially greater than the volume currently authorised by licences held by Tahmoor Mine. However, the accuracy of this estimate is reliant on the modelled predictions of groundwater level drawdown which are subject to a 21m absolute residual mean error. A robust analysis of the maximum potential groundwater take based on a revised modelling effort is therefore necessary to confirm the accuracy of the predicted volume.*

Response

Surface Water

The surface water assessment has been revised for the Amended Project (Appendix D of the Project Amendment Report). The revised assessment identifies that the combined maximum baseflow reduction for the Bargo River, Tea Tree Hollow, Dog Trap Creek, Eliza Creek, Carters Creek and Cow Creek as a result of the Amended Project would be approximately 73.1 ML/annum.

The Amended Project falls under the regulation of the Greater Metropolitan Region Unregulated Water Sources Water Sharing Plan 2011 (WSP) – Upper Nepean Water Source. The combined effects of the Amended Project, consumptive groundwater extraction and the effects of other existing mining projects may result in a reduction in baseflow in three management zones in the Upper Nepean River water source, namely Pheasants Nest Weir, Stonequarry Creek at Picton and Maldon Weir. The revised SWIA (Appendix D of the Project Amendment Report) includes the following estimates of the maximum reductions in mean daily flow at the three management zones:

- Pheasants Nest Weir - 0.01% (due to the Project) to 0.012% (cumulative effect);
- Stonequarry Creek at Picton – 0.05% (due to the project) to 0.56% (cumulative effects); and
- Maldon Weir – 0.10% (due to project) to 0.27% (cumulative effects).

The revised assessment identified that this would represent a small and likely indiscernible impact to flows with likely negligible observable impact on mean daily flows at these locations. Notwithstanding Tahmoor Coal will obtain necessary water entitlements to cover the incidental flow reduction in consultation with DoI – WNRAR.

Groundwater

The groundwater sharing plan covering the Amended Project is the 'Greater Metropolitan Region Groundwater Sources' Plan 2011. Under the WSP, the groundwater source relevant to the Amended Project is the Sydney Basin – Nepean Sandstone groundwater source.

The revised Groundwater Assessment undertaken for the Amended Project (Appendix C of the Project Amendment Report) predicts maximum annual inflow volumes of 2,850 ML/a (with average annual inflows of between 500-1,900 ML/a). Tahmoor Coal holds an existing groundwater licence entitlement of 1,642 ML/a; meaning a shortfall of a maximum of 1,208 ML/a (based on the maximum predicted inflow of 2,850 ML in 2029).

Additional groundwater licence(s) would be secured to account for the increased groundwater inflows for the Project in consultation with DoI Water and in accordance with the requirements of the *Aquifer Interference Policy* prior to the commencement of longwall mining in the Amended Project. Licences are available for purchase to cover the shortfall.

The *Nepean Sandstone Groundwater Source* has an annualised limit on entitlement (LTAAEL) of 99,568 ML (NOW, 2011), while the current entitlement is 28,841 ML (based on the WaterNSW *Water Register*). The volume of 'Unassigned Water' is not publicly available and requires confirmation with DoI – WNRAR, however it is expected based on current entitlements that allocations would be available to cover the Project's requirements.

With regards to the accuracy of inflow predictions (and therefore licence demand predictions), the groundwater model is considered to be well calibrated to historical inflow (refer Figure 4-14 of the revised Groundwater Assessment – Appendix C of the Project Amendment Report), which provides confidence in inflow predictions. With respect to 'take', this outweighs any calibration based on heads, given that the model is calibrated to the same type of prediction. Peer reviewers have stated that calibration is appropriate and predicted fluxes are plausible (HydroGeoLogic, 2019).

The average absolute residual is not often reported in modelling reports. The reported error is dominated by the error associated with groundwater levels in the Bulli Seam. See response in **Section 5.1.25** and pages 67-68 of the Groundwater Assessment (Appendix I of the EIS) for further discussion.

5.2.4.3 Surface Water Model

Issue Description

Clarification and validation of the surface water modelling undertaken for the EIS is required with respect to the modelling approach used particularly when predicting changes to low baseflows, including the following:

a. *The Australian Water Balance Model (AWBM) models used in the Surface Water Baseline Study should be reviewed and validated.*

b. *Metrics should be provided from the model validation to identify the uncertainty in the AWBM models with specific reference to the Guidelines for rainfall-runoff modelling: towards best practice model application.*

c. *Calculations for the catchment area of Lake Gandangarra should be reviewed and confirmed.*

d. *Lake-aquifer interaction assessment should be undertaken to assess not only changes in lake water levels, but also bed conductance and other relevant parameters.*

Response

Section 5.0 of the revised Surface Water Baseline Study (Appendix D of the Project Amendment Report) presents the revised catchment modelling undertaken for Dog Trap Creek Downstream, Eliza Creek and Bargo River Upstream. The models have been re-calibrated using additional streamflow data collected since submission of the EIS. Additional discussion on the approach to model development and calibration has also been provided in **Section 5.1.12** above.

Statistical metrics are presented in the revised Surface Water Baseline Study Report (Appendix D of the Project Amendment Report) illustrating the model 'goodness-of-fit' in accordance with the *Guidelines for rainfall-runoff modelling: Towards best practice model application* (eWater Cooperative Research Centre, 2011). The statistical metrics show that modelled streamflow volumes versus recorded streamflow volumes match to within 2.7% for Dog Trap Creek, 2.8% for Eliza Creek and 5% for Bargo River Upstream. The Nash Sutcliffe coefficient of efficiency (NSE) for Dog Trap Creek and Eliza Creek indicates a very good performance rating between recorded and modelled flows while a satisfactory performance rating has been achieved for Bargo River Upstream. The coefficient of determination on monthly flows (r^2) indicates that the Dog Trap Creek model explains 77% of the variability in the recorded data, the Eliza Creek model explains 76% and the Bargo River Upstream model explains 72%. Values of r^2 greater than 0.5 are generally considered acceptable (Moriasi et al., 2007).

Calculations for the catchment area of Lake Gandangarra have been reviewed and confirmed with additional detail of the calculation method provided in Section 7.1 of the SWIA (Appendix D of the Project Amendment Report).

Within the groundwater model, lake bed conductance was refined to improve the prediction of lake-aquifer interaction. Initially, the lake bed conductance was too high, with excessively high losses to groundwater meaning that when these fluxes (obtained from the groundwater model) were incorporated into the Surface Water Thirlmere Lakes model, the lakes drained far too quickly. A series of iterations were made investigating lake bed conductance and wetted area (at differing lake levels) in the groundwater model until the fluxes estimates from that model allowed better match to historical lake levels in the surface water model.

5.2.4.4 Groundwater Model

Issue Description

The groundwater model should be revised and predictive scenarios re-run to confirm the magnitudes of potential impacts currently estimated in the EIS. As the model has a large error range in simulated historical groundwater levels, the Department believes the model is incapable of making reliable impact predictions. The Department considers that the groundwater model should be revised and predictive scenarios re-run to confirm the magnitudes of potential impacts currently estimated in the EIS.

a. *A detailed list of the limitations and assumptions in the techniques used to inform the modelling should be provided.*

b. *Once the model is redeveloped, the sensitivity and uncertainty of the model should be characterised in line with the Explanatory Note, Uncertainty Analysis in Groundwater Modelling, Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining, 2018.*

c. *Impact predictions should be given using the P90 of the outcome of the sensitivity and uncertainty analysis.*

d. *Justification should be provided as to why bore abstraction was not included in the model, including detailed sensitivity and uncertainty analysis of the inclusion or exclusion of the effects of pumping.*

e. *Steady-state results and calibration data should be provided to identify the transient model sensitivity to initial conditions and compare how the model behaves without storage terms.*

f. *Explanation of why the surface water stage (elevation) was not used in calibration.*

g. *Clarification of the effects of weights that were assigned to observations on transient model performance.*

h. *Justification of the overestimated evapotranspiration (ET) from the water table (e.g. 40%, Table 5-2) despite this effect being included in the recharge (RCH) component (which represents a form of double counting). Sensitivity and uncertainty analyses for this parameter should be provided.*

i. *Justification of the potentially underestimated recharge. Sensitivity and uncertainty analyses for this parameter should be provided.*

j. *Clarification of the calibration targets for steady-state modelling.*

k. *Provision of the steady-state simulation water balance is required.*

l. *Provision of the relative parameter sensitivity assessments is needed for both the steady-state and transient models.*

m. *Documentation of the hydraulic conductivity anisotropy (KH/KV) data based on project domain field data and discussion of the significance of this characteristic is required.*

n. *Verification of the geological layering uncertainty noted in the groundwater impact assessment (Section 4.11) is required based on borehole logs and other project intrusive investigation data.*

o. *Discussion of the consequences of changes in aquifer storage presented in the water balance accounts for surface water and groundwater systems around the project domain is required.*

p. Quantification of the error in the estimation of project area rainfall and subsequently recharge component of the groundwater model, as well as justification of the approach of combining the rainfall records from two separate weather stations. The data combination method is not described and the resultant synthetic rainfall estimates may not be realistic, particularly in representing the Millennium Drought.

q. Inclusion of improved sensitivity and uncertainty analysis to clarify the representation of faults as either flow barriers or conduits within the model.

r. Enhance the model to reduce SRMS (Scaled Root Mean Squared) error for all layers within the model to rectify the high values presented for the current version (Table 4-3 shows that SRMS>5% for all units except layer 1).

s. Reconstruct the model to address the model calibration error (21 m absolute residual mean) and reduce the uncertainty in predicted outcomes.

t. Improve model zonation or undertake pilot point calibration to correct the single zone per layer representation of hydraulic properties and improve model calibration.

u. Undertake and report on a detailed sensitivity and uncertainty analysis of the exclusion of the eastern area of the model domain resulting from the placement of a no flow boundary.

v. Explanation of the counter intuitive results obtained from running different lake level scenarios, how this affects model confidence level and possible reasons (e.g. numerical instability) which can impact on model performance and predictions.

w. Reconstruction of the model to utilise the unstructured grid capability of the Modflow USG platform to address the excessive run time and disk space requirements of the current version.

x. Clarification of how the groundwater model has simulated changes in the lakes wetted area as a result of changes in water levels.

y. Explanation of the discrepancy between the surface water bodies mainly being conceptualised as losing whereas they are implemented as gaining features in the numerical model as suggested in the presented water budgets.

z. Undertake of particle tracking or another suitable method to define zones affected by mining activities (capture zone extent) for licencing purposes.

aa. Clarification of the drain cell inactivation to represent change from open space to goaf

bb. Discussion of the possibility that mine inflows (2.1% of water budget) may be an underestimation as a result of the overestimation of ET and discharge to surface water.

cc. Justification of the adopted bed conductance (C) values (e.g. 100 m2/d for drain cells representing longwalls).

dd. As the effects on baseflow may be underestimated, especially in low flow conditions, transient analysis should be undertaken to identify the magnitude of depletion and possible length of dry periods.

ee. Justification for the use if the Modflow River Package rather than the MODFLOW lake package to represent the Thirlmere Lakes and use the most appropriate package based on the analysis.

ff. Provide more detailed information on the natural variability or a base case of ponded water levels in Thirlmere Lakes to justify the statements made within the EIS. A stochastic sensitivity analysis would allow the department to identify the uncertainty in the model used for Thirlmere Lakes.

Response

Tahmoor Coal met with DPIE, DoI - WNRAR, DoI Water and DPIE's Independent Reviewer on 2 April 2019, and the key items identified in DoI's submission were discussed. Further details of the meeting are provided in **Section 5.2.4.9**. The groundwater model was revised for the Amended Project to reflect the agreed actions from that discussion, as noted in **Table 5-1** below, which responds to each of the matters identified in DoI's submission in relation to the groundwater model.

In summary it is noted that the EIS groundwater model had an overall sRMS of 3.7% for calibration to groundwater levels which have been classified as satisfactory by the Independent Peer Reviewer (HydroGeoLogic, 2019). The statement that there is a large error range is incorrect, as was discussed at the meeting in April 2019 (refer to **Section 5.2.4.9** below). Following the EIS, the groundwater model has been revised to incorporate some additional processes, as well as incorporating new data into the calibration dataset.

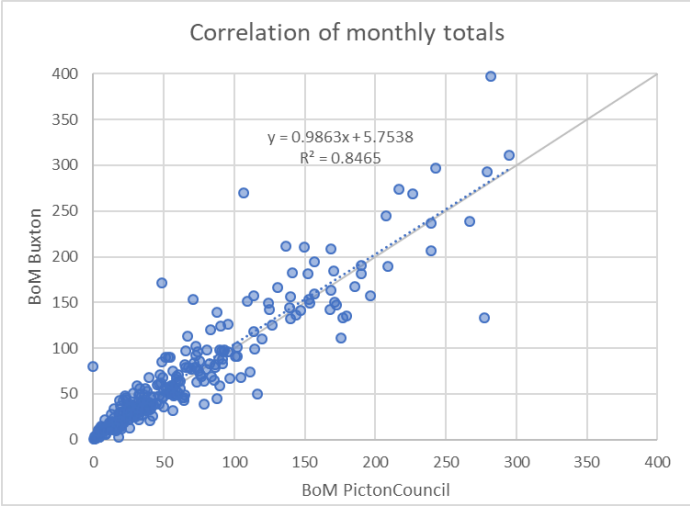
As with the original EIS groundwater model, the Amended Project model matches historical inflow data well (Section 4.8 and Figure 4-14 of Appendix C of the Project Amendment Report), while the calibration to estimated baseflow has also improved. Table 4-4 of the revised Groundwater Assessment outlines the layer-by-layer residual and sRMS, as requested by the Peer Reviewer. This table identifies smaller errors in the shallower units (i.e. Hawkesbury Sandstone and alluvium), which is where the significant receptors are located. Larger errors are in the coal seams (see above) and in the deeper Narrabeen Group. Sources of error have been discussed within Section 4.8.2 of the revised Groundwater Assessment in Appendix C of the Project Amendment Report. In general, and specifically for the Bulli Coal seam, these layer-by-layer residuals or errors have been reduced in the Project Amendment Report groundwater model. Refer detailed responses in **Table 5-1** below.

Table 5-1 Response to DoI- WNRAR

Sub issue		Response
a	A detailed list of the limitations and assumptions in the techniques used to inform the modelling should be provided.	The assessment has provided detailed discussion of recharge and baseflow estimation, how groundwater levels were processed, estimation of Kh and Kv hydraulic conductivity from packer and core testing and assessment of the height of fracturing via geotechnical investigation. Model assumptions are included in discussion in relevant subsections in Section 4, and limitations discussed in Section 4.11 of the revised Groundwater Assessment (Appendix C of Project Amendment Report). Refer to the opinion of the Independent Reviewer (HydroGeoLogic, 2019) about the standard of reporting and documentation of modelling.
b	Once the model is redeveloped, the sensitivity and uncertainty of the model should be characterised in line with the Explanatory Note, Uncertainty Analysis in Groundwater Modelling, Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining, 2018.	A set of deterministic scenarios has been carried out, focussing on major conceptual processes and impact pathways. Refer to the opinion of the Independent Reviewer (HydroGeoLogic, 2019) about the deterministic scenarios carried out. The Groundwater Assessment recommends that the model undergo revision only once the findings of the OEH Research Program are available for incorporation. At that time, additional uncertainty analysis can be carried out.
c	Impact predictions should be given using the P90 of the outcome of the sensitivity and uncertainty analysis.	Characterisation of 90%ile is useful at greenfield sites where the hydrology of the system in response to stresses are not well understood. Tahmoor Mine has been operating for almost 40 years, and the groundwater model is calibrated against groundwater levels and inflow. Refer to the opinion of the Independent Reviewer (HydroGeoLogic, 2019) about the deterministic scenarios carried out.
d	Justification should be provided as to why bore abstraction was not included in the model, including detailed sensitivity and uncertainty analysis of the inclusion or exclusion of the effects of pumping.	There is significant uncertainty in the groundwater abstraction dataset, and this remains. Refer to Section 3.8.1 of the revised Groundwater Assessment (Appendix C of Project Amendment Report) for discussion of the available data, and Section 5.2.1 for discussion of how this process is incorporated into a single predictive scenario.
e	Steady-state results and calibration data should be provided to identify the transient model sensitivity to initial conditions and compare how the model behaves without storage terms.	This issue was discussed with DoI – W, NRAR and DoI Water staff in the April 2019 meeting. An appropriate steady state calibration, using the same model parameters as the transient model, was presented and discussed with attendees at the meeting.

Sub issue		Response
f	Explanation of why the surface water stage (elevation) was not used in calibration.	The representation of surface water stage was deficient in the EIS groundwater model. Surface water stages for watercourses have been modified in the revised Groundwater Model (Section 4.4.4 of Appendix C of the Project Amendment Report). Lake stages for Thirlmere lakes have been modified in the revised Groundwater Model (Section 4.4.5).
g	Clarification of the effects of weights that were assigned to observations on transient model performance.	Discussion of target weightings is provided in Section 4.8.2 of the revised Groundwater Assessment (Appendix C of Project Amendment Report).
h	Justification of the overestimated evapotranspiration (ET) from the water table (e.g. 40%, Table 5-2) despite this effect being included in the recharge (RCH) component (which represents a form of double counting). Sensitivity and uncertainty analyses for this parameter should be provided.	Evapotranspiration (ET) occurs above the land surface, at the land surface, within the soil zone, and also from shallow water tables. The first three of those components are considered when making estimates of recharge, as per Doble and Crosbie (2016). If the water table is within ~20cm of bare soil or within the root zone of plants, it can be subject to evapotranspiration, as such modelling is considered to be appropriate in relation to this parameter.
i	Justification of the potentially underestimated recharge. Sensitivity and uncertainty analyses for this parameter should be provided.	Refer to detailed review and analysis of recharge in Section 3.8.4 of the revised Groundwater Assessment (Appendix C of Project Amendment Report). The Nepean Sandstone GW Source extends from areas of rain ~1800 mm/yr and PE 1500 mm/yr in the south/east to rain 800-850 and PE 1400 mm/yr in the north and west. LTA rainfall at Tahmoor is 1000 mm/yr. Crosbie (2015) includes estimate of average recharge around Tahmoor of 5-21 mm/a, higher (20-100 mm/a near escarpment/Dendrobium). Therefore, it is reasonable to expect lower recharge at Tahmoor than the average 6% estimated by NOW (2011). The model uses recharge zones (Figure 4-3 within Section 4.8.2 of the revised Groundwater Assessment in Appendix C of the Project Amendment Report) applied consistent with broad rainfall zones and consistent with Crosbie estimates (i.e. higher at the escarpment, lower in the north and west).
j	Clarification of the calibration targets for steady-state modelling.	Steady state simulation was used for initialising the transient simulation. Mining has occurred since ~1980 at this site, while the first available groundwater level from a monitoring bore is from 2005 (and from 2008 in VWPs), so calibration to 'steady state' groundwater levels is not viewed as critical. However, model calibration to 'steady state' water levels was presented at the meeting in April 2019 and considered satisfactory.

<table>
<tr><th colspan="2">Sub issue</th><th>Response</th></tr>
<tr><td>k</td><td>Provision of the steady-state simulation water balance is required.</td><td>As per the previous comments about steady state modelling, there is an over-emphasis on the importance of the steady state model. However, the following steady state mass balance was presented at the meeting in March 2019, noting 0.04% mass balance error.
Tah_045 (SS Sp1)
Units: m^3
<table><tr><th>Component</th><th>IN</th><th>OUT</th></tr><tr><td>RECHARGE</td><td>182,768</td><td>0</td></tr><tr><td>RIVER LEAKAGE</td><td>39,086</td><td>54,884</td></tr><tr><td>DRAINS</td><td>0</td><td>0</td></tr><tr><td>ET</td><td>0</td><td>163,006</td></tr><tr><td>HEAD DEP BOUNDS</td><td>757</td><td>4,640</td></tr><tr><td>STORAGE</td><td>0</td><td>0</td></tr><tr><td></td><td>222,611</td><td>222,531</td></tr></table></td></tr>
<tr><td>l</td><td>Provision of the relative parameter sensitivity assessments is needed for both the steady-state and transient models.</td><td>Refer Figure 5-1 (Transient Sensitivities) below. This was discussed at the meeting in April 2019.
Kh parameters generally more sensitive, as well as some like Sy6 (Bulgo Sandstone) in response to fracturing and drawdown (and observations) in that unit.</td></tr>
<tr><td>m</td><td>Documentation of the hydraulic conductivity anisotropy (KH/KV) data based on project domain field data and discussion of the significance of this characteristic is required.</td><td>The field data is presented alongside modelled results in the assessment. The model has been parameterised via independent inputs of Kh and Kv, rather than relying on anisotropy ratios.
Packer and core testing results are summarised for each stratigraphic unit on Figure 4-6 of the Project Amendment Report revised Groundwater Assessment (Appendix C of the Project Amendment Report). The modelled parameters are well constrained by field data.</td></tr>
<tr><td>n</td><td>Verification of the geological layering uncertainty noted in Section 4.11 is required based on borehole logs and other project intrusive investigation data.</td><td>In accordance with the recommendations in the revised Groundwater Assessment (Appendix C of the Project Amendment Report), the geological model and groundwater model would be revised to into account any developments from the OEH Thirlmere Lakes research program once detailed findings are available. This would include more detailed assessment of geological structure around Tahmoor South – something best achieved once development begins underground on site.</td></tr>
</table>

Sub issue		Response
o	Discussion of the consequences of changes in aquifer storage presented in the water balance accounts for surface water and groundwater systems around the project domain is required.	The storage components reported in Table 4-6 of the revised Groundwater Assessment are representative of lowering or increasing groundwater levels through time across the model domain. These changes in groundwater levels are a response to recharge, evapotranspiration, baseflow, mine inflow. There is an imbalance between the IN and OUT between 1980-2019 (an overall decline in groundwater level), related to generally dry conditions in the second half of that period, as well as an increasing amount of mining across the model domain.
p	Quantification of the error in the estimation of project area rainfall and subsequently recharge component of the groundwater model, as well as justification of the approach of combining the rainfall records from two separate weather stations. The data combination method is not described, and the resultant synthetic rainfall estimates may not be realistic, particularly in representing the Millennium Drought.	As discussed at the meeting in April 2019, this was agreed to be a secondary issue. It was demonstrated that the rainfall records used in the EIS Groundwater Assessment were appropriate. The comparison of monthly total rainfall at the two sites is presented below, showing good correlation (R2 = 0.84). Rainfall totals vary by 7% at the two sites across months where records are available for both. The model uses a number of recharge zones, representing broad variance in long-term average rainfall. There are uncertainties associated with the rainfall, but near-surface groundwater system response to recharge is not the focus of this study.  In any case, rainfall records from SILO Data Drill are now relied on, given their longer history (Section 3.2 of the EIS Groundwater Assessment).

Sub issue		Response
q	Inclusion of improved sensitivity and uncertainty analysis to clarify the representation of faults as either flow barriers or conduits within the model.	Broadly, the Nepean Fault zone is known to be more permeable, enhancing groundwater inflow to mine workings that intersect it. This is represented as such in the groundwater model. Other mapped faults are considered possible conduits, and this is investigated in deterministic scenarios. Parameterisation of faults is presented in Sections 4.5 and 5.2.1 of the revised Groundwater Model (Appendix C of the Project Amendment Report).
r	Enhance the model to reduce SRMS (Scaled Root Mean Squared) error for all layers within the model to rectify the high values presented for the current version (Table 4-3 shows that SRMS>5% for all units except layer 1).	Model improvement is desirable; however, this point is not critical for current predictions. The “high values” include all layers above SBSS having SRMS <10%, with detailed discussion of model errors in Section 4.8 of the revised Groundwater Model (Appendix C of the Project Amendment Report). It is also unusual to report layer-by-layer sRMS –this was done on the request of the Independent Reviewer, who considered the reported statistics to be acceptable. The Australian Groundwater Monitoring Guidelines states: “a target SRMS of 5% or 10% is only meaningful when those setting the target know that it is achievable for a particular kind of problem and a particular environment with a known density of informative data.” Refer to comments by the Independent Reviewer (HydroGeoLogic, 2019) regarding model calibration.
s	Reconstruct the model to address the model calibration error (21 m absolute residual mean) and reduce the uncertainty in predicted outcomes.	See discussion of sources of error (Section 4.8.2 of revised Groundwater Assessment), which are dominantly in the coal seam and up to the lower Narrabeen Fm (Table 4-4). The model has overall sRMS <3% and is well calibrated to mine inflow. The mine inflow metric overrides the stated residual for an individual layer.
t	Improve model zonation or undertake pilot point calibration to correct the single zone per layer representation of hydraulic properties and improve model calibration.	There is no basis for a more “advanced” calibration method when the %RMS metric conforms to Australian modelling guidelines. Uniform properties per lithology is standard practice for difficult mining models. Further, the AGMG states (p.74): “The number of parameters can be increased in such a way that calibration appears to be robust and the SRMS becomes negligibly small, but there may be no rational hydrogeological basis to support the degree of detail (the number of parameters) added to the model. This phenomenon is known as ‘overfitting‘. Overfitting should not be preferred relative to a larger SRMS with rational relationships between model parameters”.
u	Undertake and report on a detailed sensitivity and uncertainty analysis of the exclusion of the eastern area of the model domain resulting from the placement of a no flow boundary.	The area where the no flow boundary was extended occurs around MINE, which is located beyond Appin/West Cliff Mines, and approximately 15 km from Tahmoor South. Cumulative impact assessment of this area should be accounted for in Bulli Seam Operations modelling or Russell Vale modelling.

Sub issue		Response
v	Explanation of the counter intuitive results obtained from running different lake level scenarios, how this affects model confidence level and possible reasons (e.g. numerical instability) which can impact on model performance and predictions.	An explanation was provided in the meeting in April 2019. The error occurred because of model numerical error (imprecision) when dealing with very small fluxes (typically 5-30 m^3 at each lake), when the model solver tolerance is 4 cm and the area of a lake (e.g. Couridjah) is 15,000-45,000 m^2.
w	Reconstruction of the model to utilise the unstructured grid capability of the Modflow USG platform to address the excessive run time and disk space requirements of the current version.	The model layering and extent were developed in response to the cumulative impact requirements of the Aquifer Interference Policy. That is, to represent mines and watercourses with relative detail, incorporate geomechanical changes, transient recharge and ET, carry out cumulative assessment in an area where there are not clear hydrological boundaries (to the north/south/east) and then have a model that runs quickly. Given the more contemporary focus on uncertainty, it is recommended that the model be revised (re-built) once the findings of the OEH Research Program are available and use this revised model to carry out more complete assessment of uncertainty.
x	Clarification of how the groundwater model has simulated changes in the lakes wetted area as a result of changes in water levels.	This was done via steady state models and passed to the Surface Water model. The open water area of each lake was estimated for a 4 or 5 specified water levels (as recommend by the Surface Water technical specialist - HEC). The wetted area was estimated from LiDAR data, and then translated into model cells.
y	Explanation of the discrepancy between the surface water bodies mainly being conceptualised as losing whereas they are implemented as gaining features in the numerical model as suggested in the presented water budgets.	The main surface water features mentioned and conceptualised as being ‘losing’ are the Thirlmere Lakes and reservoirs. Thirlmere Lakes are small features on a regional scale or in water balance sense, although important ecologically. Baseflow to watercourses is analysed in the EIS Groundwater Assessment, and watercourses as described as losing or switching between gaining and losing. It was agreed that that the model could be modified to include an estimate of watercourse stage (transient or otherwise) applied to modelled watercourses to simulate variable or losing watercourses. This has occurred and is discussed in Section 4.4.4 and 4.4.5 of the revised Groundwater Assessment (Appendix C of Project Amendment Report).
z	Undertake of particle tracking or another suitable method to define zones affected by mining activities (capture zone extent) for licencing purposes.	Particle tracking is not necessary nor is it appropriate for licensing. Zone budget has been used to partition the ‘take’ from different sources.

Sub issue		Response
aa	Clarification of the drain cell inactivation to represent change from open space to goaf.	Section 4.4.9 of the EIS Groundwater Assessment describes the activation and inactivation of MODFLOW Drains representing dewatering in the workings. It also states: “Hydraulic parameters were also changed with time in the goaf and surrounding enhanced permeability zone (EPZ) directly after mining of each longwall panel (see Section 4.6 for details)”. Section 4.6 of the EIS Groundwater Assessment describes how K and Sy were changed in mine seam.
bb	Discussion of the possibility that mine inflows (2.1% of water budget) may be an underestimation as a result of the overestimation of ET and discharge to surface water.	See earlier discussion re: ET (point #h). See also discussion of recharge (point #i). 2.1% may be an underestimate or an overestimate. The actual value, be that 1-3%, is not the critical point. The water balance highlights that mine inflow has been a small part of the overall regional groundwater balance.
cc	Justification of the adopted bed conductance (C) values (e.g. 100 m²/d for drain cells representing longwalls).	Conductance = k.x.y/t. Conductance of longwall Drains is difficult, and there is no clear calculation of what the t (thickness term) should be, i.e. vertical thickness or horizontal distance. In fact, it should be a combination of both. We applied k = 0.01 m/d for 100 x 100 m cells, and a thickness of 1 unit. This conductance has achieved desaturation of the mine workings, and the mine inflow is well calibrated.
dd	As the effects on baseflow may be underestimated, especially in low flow conditions, transient analysis should be undertaken to identify the magnitude of depletion and possible length of dry periods.	Regional groundwater models are not the tool for estimating change to length of dry periods – that is the role of the SWIA.
ee	Justification for the use of the Modflow River Package rather than the MODFLOW lake package to represent the Thirlmere Lakes and use the most appropriate package based on the analysis.	The RIV package is appropriate for use in the groundwater model. It would be ideal to use the Lake package in a local-scale model. But the groundwater model is already dealing with competing objectives: regional simulation for cumulative effects geomechanical changes trying to accommodate watercourse/lake-scale detail. To add the Lake package would mean that short-term dynamics like runoff, direct rainfall, open water evaporation would all need to be added. Further, the Lake package is notoriously difficult to achieve convergence with. The Surface Water model by HEC accounts for those processes, allowing the regional groundwater model to concentrate on simulating the ~40 years of historical mining and the proposed/future mining at appropriate scales while providing estimates of GW-SW flux to/from the lakes.

Sub issue		Response
ff	Provide more detailed information on the natural variability or a base case of ponded water levels in Thirlmere Lakes to justify the statements made within the EIS. A stochastic sensitivity analysis would allow the department to identify the uncertainty in the model used for Thirlmere Lakes.	Detailed modelling of surface water stages (lake levels) is described in the Surface Water Assessment by HEC (Appendix D of Project Amendment Report). However, we note that Tahmoor South is >3.6 km from Thirlmere Lakes.

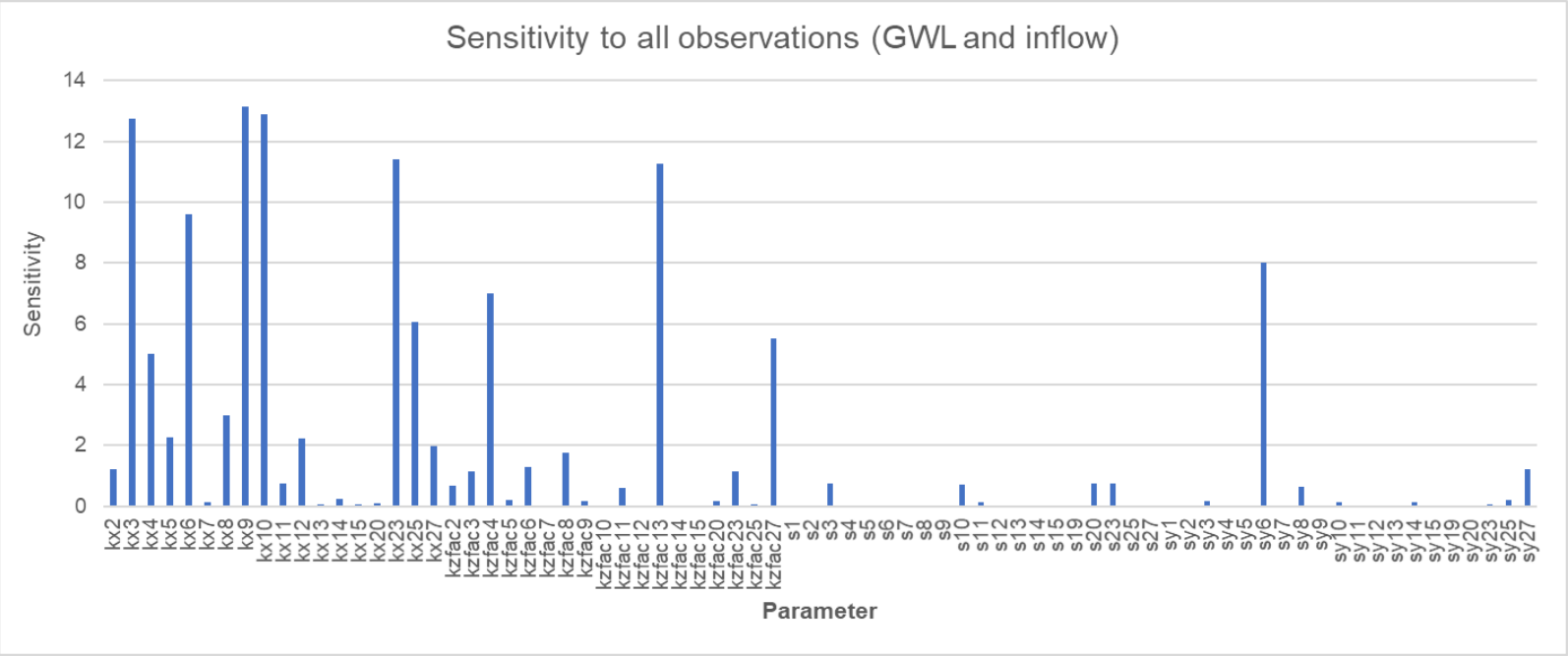


Figure 5-1 Transient Sensitivities – Groundwater Model

5.2.4.5 Surface and Groundwater Monitoring

Issue Description

Expansion of the existing surface water monitoring network should be undertaken to improve monitoring of stream flow and pool water levels. Expansion of the existing surface water monitoring network should be undertaken to achieve the following.

a. Support the reinstatement of surface stream flow monitoring gauges as well as enhancing the reliability of recorded low flows.

b. Address the number of pool water level monitoring sites as there are too few. Three in Dog Trap Creek and Two in Tea Tree Hollow are insufficient to detect changes across the project area.

c. Review the proposed number of pool water level monitoring sites and increase them to at least six pools per creek and have water level loggers installed.

d. River flow monitoring should be implemented as soon as possible and persist throughout the life of the mine and include 5 years of post-project monitoring to assess the long-term impacts.

Expansion of the groundwater monitoring network in consultation with the Department is required to address the uncertainty identified in section 4.10 of the groundwater modelling report. This should involve:

a. Shallow groundwater monitoring within Hawkesbury Sandstone (in association with surface water monitoring), comprising at least 25 purpose built cased and screened monitoring bores to approximately 20 m depth alongside the rivers and streams most likely to be impacted.

b. Deep groundwater monitoring at each of at least five separate sites between the mining domain and Thirlmere Lakes of the Hawkesbury Sandstone, upper and lower Bulgo Sandstone and Scarborough Sandstone in isolation using purpose-built cased and screened monitoring bores.

c. Deep monitoring bores at each of the five sites are to be fully cored and comprehensively packer tested throughout.

d. Groundwater level monitoring should be implemented as soon as possible using water level loggers recording at a minimum daily frequency and continuing for an agreed period after the cessation of mining.

Response

Tahmoor Coal has an existing monitoring network that would be expanded/ augmented with consideration of DoI - WNRAR recommendations to include monitoring requirements for Tahmoor South.

The Tahmoor Mine has an existing well-established groundwater and surface water monitoring network which was built upon to provide baseline data for the EIS assessment. This is described in Section 11.3 and 11.4 of the EIS and includes:

- two years of baseline monitoring at 12 watercourse locations across the project area;
- five bore installations within the Existing Tahmoor Approved Mining Area, each with between six and eight vibrating wire piezometers installed at different locations within the stratigraphic sequence;
- multiple piezometers installed in bore TBF040c, located above longwall 10A of the existing operations;
- nine shallow bores within the Hawkesbury Sandstone above the existing operations, labelled as piezometers P1 to P9 (of these P5 and P6 are no longer active);
- four DI Water monitoring bores at Thirlmere Lakes that monitor the shallow Hawkesbury Sandstone and/or alluvium;
- thirty monitoring bores installed across the Project Area, 17 with dual piezometer installations and 13 with multi piezometer installations;

- a bore census (survey) of standing water levels and geochemistry from 23 private, DI Water registered bores located across the Project Area and six Tahmoor Coal monitoring bores (GeoTerra, 2013a);
- a deep horizon water sampling bore (TBC035) for EC, oxygen, deuterium and tritium isotope sampling; and
- two piezometers monitoring groundwater at the REA: TGW5 (up-gradient) and TGW4 (down-gradient).

Since the EIS, streamflow monitoring has recommenced on Hornes Creek, Dog Trap Creek, Eliza Creek and Carters Creek in order to expand baseline data (up to the period of mining within these catchments) and assess impacts to flows post mining (refer updated Surface Water Baseline Assessment included in the Project Amendment Report). Additional water level monitoring sites have also been implemented, or are proposed to be implemented, on Hornes Creek (four additional sites), Dog Trap Creek (four additional sites), Tea Tree Hollow (four additional sites) and Eliza Creek (one additional site). These monitoring sites would provide baseline water level data necessary to enable the assessment of potential impacts to pool water levels as a result of the Amended Project. The Water Management Plan for the Tahmoor Mine would be updated to reflect changes to the baseline monitoring program

Streamflow gauging activities would be continued to support the development and maintenance of viable gauging station ratings and the generation of reliable continuous flow data at all stations. The gauging station on Dog Trap Creek downstream and the recommended new gauging station on Tea Tree Hollow would be established with enhanced low flow control weirs in order to reliably record low flows. Routine water level and water quality monitoring would be continued.

In order to increase the spatial representation of water quality sites downstream of LDP1, a water quality monitoring site would be established on the Bargo River downstream of the confluence with Tea Tree Hollow and upstream of SW14.

Since the exhibition of the EIS, additional groundwater monitoring has also been undertaken in the vicinity of the REA. Two open standpipe piezometers (TGW4 and TGW5, now re-named REA1 and REA2) were originally installed in the vicinity of the REA to enable groundwater level and water chemistry monitoring in June-July 2013. Subsequently a further five piezometers were installed in August 2019 (REA3 – 7) to enable assessment of the hydrogeological characteristics of the Hawkesbury Sandstone and its upper phreatic groundwater surface upstream and downstream of the REA (further details of this monitoring and results are provided in Appendix P of the Project Amendment Report). Ongoing monitoring of the REA piezometers is proposed as part of the Amended Project.

It is proposed that the existing monitoring would be continued, and additional monitoring would be undertaken to inform ongoing baseline data gathering for the Amended Project and operational environmental performance management.

In summary, the following groundwater and surface water monitoring is proposed (refer Appendix C and D or the Project Amendment Report for further details):

- Ongoing streamflow monitoring at Hornes Creek, Dog Trap Creek, Eliza Creek and Carters Creek in order to expand baseline data of these waterways up to the period of mining within these catchments;
- Additional water level monitoring at Hornes Creek, Dog Trap Creek, Tea Tree Hollow and Eliza Creek to establish baseline water level data to enable the assessment of potential impacts to pool water levels;
- In order to increase the spatial representation of water quality sites downstream of LDP1, a new water quality monitoring site would be established on the Bargo River downstream of the confluence with Tea Tree Hollow and upstream of SW14;
- Install an additional stream flow gauging station at Tea Tree Hollow, downstream of the edge of the longwall and upstream of Licensed Discharge Point (LDP) 1;

- Streamflow gauging activities would be continued. Enhanced low flow control weirs would be established at the existing gauging station at Dog Trap Creek downstream and the proposed new gauging station at Tea Tree Hollow to support the generation of reliable continuous flow data (including reliable low flow data) at the stations. Routine water level and water quality monitoring at the stations would also be continued;
- Tahmoor Coal would monitor the water quality of groundwater inflows to Tahmoor North at a suitable collection point (e.g. sump/pump) in order to establish baseline groundwater quality data for assessment of underwater storage impacts;
- Establishment of TARPs for water quality exceedances which incorporate both baseline and control monitoring data. Site specific trigger values have been developed in accordance with ANZECC (2000) and ANZG (2018) for baseline sites which may potentially be affected by the Project – refer HEC (2020);
- Establishment of TARPs for unexpected flow loss based on analysis of baseline (i.e. pre-subsidence) streamflow data, post-subsidence streamflow data and contemporaneous data from control sites. Catchment flow modelling would also be used in the analysis;
- Establishment of TARPs for unexpected loss of pool water holding capacity based on analysis of baseline (i.e. pre-subsidence) pool water level data, post-subsidence pool water level data and contemporaneous data from control pool sites. Pool water balance modelling would also be used in the analysis particularly during unusual climatic/hydrological conditions;
- When longwall mining is within 200 m of any watercourse, weekly inspections, photographic reconnaissance and field based water quality monitoring would be undertaken in that watercourse(s) at sites upstream and downstream of the potentially affected area. Water quality samples would be collected and analysed monthly and increased to weekly if field monitoring results indicate a change from background (e.g. exceedance of the site specific trigger value). Results of monitoring would be analysed in relation to action response triggers on a monthly basis when longwall mining is within 200 m of a watercourse;
- Monitoring of streamflow, pool water levels and water quality would continue for two years following cessation of longwall subsidence related movement in a watercourse or following completion of any stream/pool remediation. Monitoring data would be reviewed at annual intervals over this period. Reviews would involve assessment against long term performance objectives which would be based on the pre-mine baseline conditions or an approved departure from these;
- The regional groundwater monitoring network would continue to be developed and maintained, including monitoring of Thirlmere Lakes and to existing users' water supply. Monitoring sites would be reviewed and sites requiring repair, replacement or augmentation to improve confidence would be addressed in the next revision of the Groundwater Management Plan. This would include consideration of:
    - additional bores to sample groundwater quality from the mid/lower Hawkesbury Sandstone and Bulgo Sandstone within the project area;
    - shallow groundwater monitoring within Hawkesbury Sandstone (in association with surface water monitoring around Dog Trap, Hornes Creek, Eliza Creek, Bargo River;
    - ongoing groundwater monitoring at the REA (including at the additional installed five piezometers);
    - Following review of any groundwater monitoring sites installed as part of the Thirlmere Lakes Research Program, Tahmoor Coal would consider an additional groundwater monitoring site (bore) at or near the Thirlmere Lakes to assess any effects of the Tahmoor South Project and monitor groundwater level recovery once mining ceases; and
    - Monitoring sites would be positioned near to features around the Amended Project area in order to distinguish between impacts of the Amended Project and historic mining effects.

- Monitoring (including daily groundwater level logging) would begin as soon as possible post-development consent to maximise the available baseline dataset and until an agreed period following the cessation of mining;
- Additional reviews of groundwater monitoring data would be conducted on an annual basis in order to compare actual groundwater drawdown levels to those predicted by the numerical model;
- Monitoring in longwall centre-lines of pre and post-mining conditions would be conducted to assist in defining a profile of fracturing and depressurisation above longwalls; and
- The volumetric take (total mine inflow) metering method, including improved monitoring of inflows to the drift and different areas within the underground mine, would continue to be employed. The data from this monitoring would be periodically used, in conjunction with the regional monitoring network data, to verify the numerical modelling and the potential risks of mining activity identified in this assessment. This would include revision of the modelling and identified risks as required.

The surface water and groundwater monitoring programs will be finalised in consultation with the Department of Primary Industries and/or other relevant government agencies and this has been reflected in the revised Mitigation Measures for the project (**Chapter 7.0**).

5.2.4.6 Groundwater Bore Census

Issue Description

The proponent should establish an inventory (census) of all bores in the project model domain (which is to be maintained throughout the project), showing their status (water level and quality), any make good measures implemented as well as their timing, or any other mitigation approaches used.

Response

A bore census was completed by Geoterra in 2013 covering 41 private bores to inform the Groundwater Assessment and modelling for the EIS. This census data was added to groundwater bore information obtained via the DoI PINNEENA database to inform the EIS Groundwater Assessment.

An updated bore census for the Amended Project has commenced (November 2019) covering the areas predicted to be affected by the Amended Project in excess of the 2 m drawdown criterion of the Aquifer Interference Policy under the revised Groundwater Assessment for the Amended Project (Appendix C of the Project Amendment Report). That is, the area within the 2 m drawdown contour, as shown on Figure 6-1 of Appendix C in the Project Amendment Report. This updated census would establish the baseline conditions of bores predicted to be impacted by the Amended Project in order that 'make-good' measures can be implemented should monitoring following the commencement of longwall mining at the Amended Project indicate impacts at the bores. It is expected that further surveys would also be undertaken as part of the Extraction Plan process for the Amended Project prior to the commencement of mining at a particular longwall or longwalls. Further details on 'make good' measures are provided in the next **Section 5.2.4.7**.

It should be noted that since mining commenced in 1979 Tahmoor Coal has only been called upon to provide 'make-good' provisions at two groundwater bores, despite over 70 being predicted to be affected by the operations at Tahmoor North. This demonstrates the highly conservative nature of the groundwater modelling and provides further weight to the modelling for the Amended Project being able to be relied upon, and/or that the drawdown previously experienced did not affect the ability of bore owners to use the water from their bore.

The revised Groundwater Assessment for Amended Project estimates that 46 registered bores would be affected in excess of the 2 m drawdown criterion of the Aquifer Interference Policy, as well as a further 6 registered bores that are already predicted to be affected by historical mining effects. This would increase to up to 228 registered bores when taking into account the cumulative effects of all simulated mines. When taking into account uncertainty analysis via deterministic scenarios, including conservative representations of the height of fracturing, transmissivity of fault zones and high horizontal permeability of the Hawkesbury Sandstone, the modelling indicates that impacts could occur to up to 73 registered bores for the project-only scenario and 264 registered bores when considering cumulative impacts of other mines.

As noted above, these results should be seen in the context of the conservative nature of the modelling, whereby in practice, make-good provisions have only been required at two bores despite over 70 being predicted to be affected by the operation of Tahmoor North.

On this basis, it is not proposed that the pre-mining bore census cover the entire groundwater modelling domain but rather would focus on areas in and around the zone predicted to be affected by the Amended Project (and as confirmed in the Extraction Plan). Longwall mining would be undertaken on a progressive basis with Extraction Plans covering a particular longwall or set of longwalls. The groundwater bores to be targeted for pre-mining surveys would be confirmed as part of the Extraction Plans, informed by monitoring data and information on actual mining conditions from any Extraction Plan(s) that came before (to check against sensitivity analysis assumptions).

5.2.4.7 Groundwater Drawdown Impacts

Issue Description

A number of water supply works are predicted to have greater than 2 metre drawdown, which is considered a Level 2 impact under the Aquifer Interference Policy. A 'make good' plan for all potentially affected groundwater users (including ecosystems) should be prepared and commented upon by the Department to provide DPE the confidence that adverse impacts can be successfully addressed.

Further, due to the level of uncertainty in the groundwater model, the Department does not consider that the proponent can demonstrate that impacts to other water users or groundwater dependent ecosystems are Level 1 impacts, and accordingly should be considered Level 2 impacts, unless the model is improved. This requires 'make good' plans for all potentially affected groundwater users, along with appropriate studies to demonstrate that the variation will not prevent the long-term viability of the dependent ecosystem. It is recommended that these studies be undertaken in consultation with the Office of Environment and Heritage.

Response

As discussed in **Sections 5.2.4.4** and **5.2.4.9**, the accuracy of the model was discussed in detail at a meeting on 2 April 2019 with agencies including DoI – WNRAR, DPIE and the DPIE Peer Reviewer. At the meeting it was determined what areas of the model required revision and based on these discussions a revised Groundwater Assessment was prepared for the Amended Project (Appendix C of the Project Amendment Report). It is noted that overall, the Independent Reviewer for DPIE found the EIS Groundwater Assessment to be based on "conservative assumptions" with "sound calibration performance to multiple criteria." The Independent Reviewer also identified that the uncertainty analysis conducted for the model provides suitable information to perform an impact assessment and assist in the development of management plans and licensing decisions and that the classification of the model as having a Class 2/3 confidence level was justified, with the model having sound performance to multiple calibration criteria (i.e. groundwater levels and mine inflows) (HydroGeoLogic, 2019).

Based on the above it is considered that the EIS and revised Groundwater Assessments provide a sound basis for impact prediction. It is noted that in both the EIS and revised Groundwater Assessment, predicted impacts to water users and groundwater dependent ecosystems (Thirlmere Lakes) as Level 2 impacts and have identified mitigation and monitoring strategies (including 'make-good' provisions) accordingly. Neither assessment have identified Level 1 impacts to water users or groundwater dependent ecosystems. The groundwater monitoring program proposed for the Amended Project including monitoring at Thirlmere Lakes and TARP commitments is summarised in **Section 5.2.4.5** and **5.2.4.8** and detailed in the EIS (Appendix I) and Project Amendment Report (Appendix C). It is also proposed that the groundwater model will be updated once the OEH studies on Thirlmere Lakes are published to provide for further certainty regarding impact to the lakes.

With respect to C. As discussed in **Section 5.2.4.6**, pre-longwall mining bore census surveys would be undertaken to establish baseline conditions of bores predicted to be affected in order that 'make-good' measures can be implemented should monitoring following the commencement of longwall mining indicate impacts associated with the Project.

As noted in **Section 5.2.4.6**, since mining commenced in 1979, Tahmoor Coal has only been called upon to provide 'make-good' provisions at two groundwater bores, despite over 70 being predicted to be affected by the operation of Tahmoor North. This demonstrates the highly conservative nature of the groundwater modelling and provides further weight to the modelling for the Amended Project being able to be relied upon.

5.2.4.8 Surface and Groundwater Impact Mitigation

Issue Description

A trigger action response plan to address all criteria exceedances to be prepared in consultation with the Department to provide confidence that adverse impacts can be successfully identified should they occur.

Response

TARPs would be prepared as part of the Extraction Plan process for the Amended Project in consultation with DoI – WNRAR.

The Environmental Management Commitments (Section 12 of the EIS) and relevant assessment sections of the EIS for groundwater and surface water (Sections 11.3 and 11.4 and the revised assessments appended in Appendix C and D of the Project Amendment Report) include initiatives for the implementation of TARPs to address any exceedances of performance criteria. This includes:

- Groundwater (Section 11.3 of the EIS and Appendix C of the Project Amendment Report) - the existing Tahmoor Mine Groundwater Management Plan would be updated for the Amended Project to define a groundwater monitoring strategy, groundwater level triggers, and include a TARP;
- Surface Water (Section 11.4 of the EIS and Appendix D of the Project Amendment Report):
  - Establishment of TARPs for water quality exceedances which incorporate both baseline and control monitoring data. Site specific trigger values have been developed in accordance with ANZECC (2000) and ANZG (2018) for baseline sites which may potentially be affected by the Amended Project – refer HEC (2020);
  - Establishment of TARPs for unexpected flow loss based on analysis of baseline (i.e. pre-subsidence) streamflow data, post-subsidence streamflow data and contemporaneous data from control sites. Catchment flow modelling should also be used in the analysis; and
  - Establishment of TARPs for unexpected loss of pool water holding capacity based on analysis of baseline (i.e. pre-subsidence) pool water level data, post-subsidence pool water level data and contemporaneous data from control pool sites. Pool water balance modelling should also be used in the analysis particularly during unusual climatic/hydrological conditions.

These initiatives would be undertaken in consultation with the Department of Industry (refer **Chapter 7.0)**.

5.2.4.9 Consultation

Issue Description

The Department (DPI - Water and Natural Resources Access Regulator (WNRAR)) recommends a meeting with the proponent's consultants to discuss the above surface water and groundwater issues associated with this development.

Response

A meeting between DoI Water, WNRAR, DPIE, the Independent Peer Reviewer appointed by DPIE, Tahmoor Coal and Hydrosimulations (who prepared the groundwater model and assessment for the project) was held on 2 April 2019 to discuss the outcomes of the Independent Review, and the groundwater-related issues raised by DoI Water/NRAR and some of those raised by the IESC.

Tahmoor Coal prepared for this discussion a response to each of the issues raised by the agencies and the Independent Reviewer. Agreement was reached between the parties on some points, while some points were left for the Independent Reviewer to consider further. Following the meeting, the

Independent Reviewer submitted further questions to Tahmoor Coal, to which Tahmoor Coal responded, following which a final review report was prepared by the Independent Reviewer (HydroGeoLogic, 2019).

Overall the HydroGeoLogic (2019) Independent Review found the Project EIS Groundwater Assessment to be based on "*conservative assumptions*" with "*sound calibration performance to multiple criteria: … including excellent data on 'height of fracturing (HoF)' effects at Tahmoor TBF040c above longwall 10A.*" The Independent Review also identified that the uncertainty analysis conducted for the model provides suitable information to perform an impact assessment and assist in the development of management plans and licensing decisions and that the classification of the model as having a Class 2/3 confidence level was justified, with the model having sound performance to multiple calibration criteria (i.e. groundwater levels and mine inflows) (HydroGeoLogic, 2019).

Areas where the Independent Review considered further work was required were:

- Representation of surface cracking in the groundwater model;
- Inclusion of transient river stages in the groundwater model;
- Slight modification of the representation of Thirlmere Lakes elevations;
- Update to calibration, if possible, for specific bores (e.g. the government bores near Thirlmere Lakes); and
- Various items of reporting (inclusion of new monitoring locations on maps, typographical errors).

The above issues have been addressed in the revised Groundwater Assessment for the Amended Project (Appendix C of the Project Amendment Report). A summary of the key changes made to the model are summarised in the table below and detailed responses are provided in the sections above.

Table 5-2 Key Changes to the Groundwater Model following Agency Meeting

Requested amendments	Comment
Incorporate a representation of surface cracking in the numerical modelling, relying on literature and recent investigation at Redbank Creek, and incorporating this effect in estimated surface water losses.	This has been incorporated in the model, based on literature and local monitoring data.
Account for transient river stages and river leakage in estimated surface water losses.	This has been incorporated in the model, based on available monitoring data.
Revise the representation of lake bed and stage elevations at Thirlmere Lakes. Improve calibration to groundwater levels in Thirlmere Lakes bores.	This has been revised based on data from the revised Water Management System and Site Water Balance. Calibration to local groundwater levels at Thirlmere Lakes is much the same as in the EIS (revised Groundwater Assessment – Appendix C of the Project Amendment Report).
Improve the overall model performance in matching historical groundwater levels and mine inflows at Tahmoor;	The history match to groundwater inflow is good, and overall calibration performance to groundwater levels has improved
Include groundwater pumping from private bores in the modelling.	Recent entitlement data from WaterNSW has been obtained, however estimates of actual groundwater pumping data are limited. As a result, a single predictive scenario incorporating an estimate of groundwater use at local bores has been run for assessment of key impacts.

5.3 DPIE (Division of Resources and Geoscience)

5.3.1 Resources and Economic Assessment

Issue Description

The Division has reviewed and assessed the information supplied in relation to the Project. In view of the constraints outlined in the Proponent's EIS, the Division considers the Project meets the section 3A objects of the Mining Act 1992 (NSW) (the Act) and the requirements of cl 15 of the State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007 to be an efficient development and utilisation of coal resources which will foster significant social and economic benefits. The Division is satisfied that, given the Proponent's mine design and mining method submissions, the Project adequately recovers coal resources and provides an appropriate return to the state. A resource and economic assessment was undertaken by the Division which details the resource utilisation and economic benefits of the Project and is appended as Attachment A.

Response

Noted.

5.3.2 Existing Mining Titles

Issue Description

As coal is a prescribed mineral under the Act, the proponent is required to hold appropriate mining titles from the Division to undertake mining. In addition, section 380AA provides that an application for development consent (or modification to consent) to mine for coal cannot be made or determined unless the applicant is also the holder of a title under the Act or has the written consent of the holder of a title, where the parties are different.

Based on current title information the Division advises that the Proponent holds the appropriate titles as required for mining operations as relating to the Project and satisfies the requirements of section 380AA.

Response

Noted.

5.3.3 Additional Mining Titles

Issue Description

Expansion of the REA: In order to undertake these activities specified in the EIS, the Division advises that the Proponent is required to hold an additional Mining Lease for ancillary mining activities or an 'off title' designated ancillary mining activity as defined by clause 7 of the Mining Regulation 2016 (the Regulation).

Additional upcast and downcast ventilation shafts: In order to undertake these works, as specified in the EIS, the Division will consider the use of section 81 of the Act, subject to satisfying its requirements, allowing for surface activities to be undertaken by the holders of subsurface leases (drainage of gas and ventilation) as prescribed by clause 27 of the Regulation.

Response

As identified in Section 8.1.5 of the EIS, following determination of the Amended Project, Tahmoor Coal would obtain all required leases under the *Mining Act 1992.*

5.4 Environment Protection Authority

5.4.1 Noise and vibration: Low frequency noise

Issue Description

The noise impact assessment for the Project has not fully applied the Noise Policy for Industry (NPfI) Fact Sheet C method for analysis of low frequency noise. The noise impact assessment should assess if low frequency noise corrections are applicable at all receivers.

Details on proposed mitigation and management of low frequency noise are required. The noise impact assessment states that mitigation of the coal handling and processing plant will achieve up to 10 dBA overall reduction. The noise impact assessment should state what C—weighted noise level reduction will be achieved.

Low frequency noise and other modifying factors should be assessed at all receivers. For example, more evidence should be provided for not applying the low frequency noise adjustment at measurement location M8. The noise source identified at 40 and 50 Hz should be identified as either existing mine noise or extraneous noise.

Response

Additional operator-attended noise monitoring data has been provided in the revised Noise and Vibration Impact Assessment for the Amended Project (Appendix I of the Project Amendment Report) and analysed with regard to existing low frequency noise (LFN) emissions. Based on the results of the quarterly noise compliance monitoring undertaken at Tahmoor Coal, LFN modifying factors have been applied to predict mine noise emissions in accordance with the methodology outlined in the NPfI Fact Sheet C. These results indicate that low frequency noise above the current relevant NPfI thresholds is present in the vicinity of Olive Lane (quarterly noise monitoring locations M3 and M4) and the Wollondilly Anglican Church and College (location M2, refer to Figure 3.1 in the Noise and Vibration Impact Assessment, (Appendix I of the Project Amendment Report). The measured LFN levels at these locations indicate that a current modifying factor (i.e. for existing operations) of +2dB applies during the day and +5dB applies during evening and night at assessment locations in these areas. These modifying factors have been included in the noise emission predictions.

In relation to the proposed mitigation and management of LFN, additional investigations have been undertaken, including an investigation by Recognition Research Pty Ltd into potential cladding for the CHPP. The work undertaken by Recognition Research Pty Ltd indicates that an overall reduction in CHPP noise could be achieved by building a new CHPP building envelope and that LFN could be reduced in Olive Lane. Being one of the main contributors to off-site mine noise emissions, controls to the CHPP will have the benefit of reducing mine noise at all neighbouring residences. Further investigations are still underway into the most appropriate noise reduction methods for the CHPP. However, in consideration of the investigation by Recognition Research, for the purpose of assessing noise from a mitigated CHPP an overall reduction in sound power level of 10dB was conservatively adopted for the northern, western and southern facades in the revised noise model. Further, it has been assumed that the LFN modifying factor would be reduced from +2 for day and +5dB for evening and night to 0 dB in the daytime period and +2dB for evening and night.

Quarterly noise monitoring results were analysed for the period between Q1 2014 and Q3 2019 (i.e. 23 rounds of monitoring) at measurement location M8 which is near the existing ventilation shaft site T2, as described in Section 3.2 of the Revised Noise and Vibration Impact Assessment, Appendix I of the Project Amendment Report. Results of quarterly noise monitoring surveys indicate that noise levels are generally in compliance with the existing noise limits (i.e. within 2 dB) at the relevant residential monitoring locations i.e. M3, M5, M6, M7, M8 and M9.

Measured night-time L_{Aeq} one-third octave band centre frequency levels (10-160 Hz), LFN threshold levels (NPfI) and C-A weighted levels for the quarterly attended noise monitoring periods from Quarter 4 2017 to Quarter 3 2019 indicate that LFN above the current relevant NPfI thresholds is present in the vicinity of Olive Lane and the Wollondilly Anglican Church and College. The measured LFN levels at these locations indicate that a modifying factor of +2 dB and +5dB would apply at assessment locations in these areas during day and evening/night periods, respectively.

For the same monitoring periods, levels marginally above the relevant thresholds were also measured at quarterly monitoring locations including M8 on occasion. It is not expected that these exceedances of the LFN threshold levels were due to operation of the Tahmoor Mine or the ventilation shaft alone since exceedances were not consistent across all surveys. Hence, modifying factors for LFN have not been applied in these areas.

5.4.2 Noise and vibration: Operational modelling scenarios

Issue Description

The noise impact assessment has only considered one assessment scenario over the proposed 11-year project lifetime. The noise impact assessment should provide a worst—case analysis for different stages or modes of operations, including but not limited to:

a. The initial 3 years of Project where it has assumed that no mitigation will be implemented.

b. The total noise levels from mine operation, existing vent operation and proposed vent fan construction.

c. Progressive development of the Rejects Emplacement Area (REA).

d. Use of haul trucks instead of conveyors to move product and run-of mine (ROM) coal.

e. Operation of the existing upcast vent fan (T2) as part of the Project.

Response

The noise model was rerun for a number of scenarios, as requested by the EPA, to consider both an unmitigated scenario, as well as staged progression of the REA. Various stages of the REA were considered to identify worst case scenarios in terms of noise impacts. Accordingly, the Noise and Vibration Impact Assessment for the Amended Project considered the following stages:

- Existing Tahmoor Mine operations: where it is assumed that no additional noise mitigation will be implemented;
- Stage 2 of the REA (approximately 2023): representative of an acoustically worst-case for residences to the north and some to the east of the REA;
- Stage 4 of the REA (approximately 2026): representative of an acoustically worst-case for residences to the south-east of the REA; and
- Stage 5 of the REA (approximately 2029): representative of an acoustically worst-case for residences to the south of the REA. Stages 2, 4 and 5 include operation of the existing upcast ventilation shaft (T2). Noise associated with construction of the new ventilation shaft sites south of the REA has also been considered during Stage 2 of the REA.

Coal will continue to be conveyed to the rejects bin, and stockpiled overnight, from where it is loaded onto trucks using front end loaders during the day and hauled to the REA. Two trucks will undertake the haulage during the day (rather than one, as is the case now) and there will be no haulage at night-time.

The Amended Project will maintain the continuous operation of the existing upcast ventilation shaft (T2), although operation will reduce from two fans during Tahmoor North operations to one fan once the new ventilation shafts and fans (TSC1 and TSC2) are in operation for the Amended Project.

5.4.3 Noise and vibration: Operational modelling assumptions

Issue Description

Construction of vent fans should be assessed as an operational noise source in accordance with the industrial Noise Policy (INP). EPA considers that the vent site establishment works will utilise similar equipment to that used on the REA and is sufficiently close enough to the REA that the character of the noise will be similar to operational noise from the REA at receivers to the south.

An accurate representation of the locations of equipment on the extended REA should be included in the modelling. The use of a single modelled location of equipment on the REA does not represent operations across the area of the extended REA and there is significant potential for noise levels to be higher at receivers than reported.

Appendix B noise source modelling maps should be accurately labelled to identify equipment and the dozers and on—site haul trucks moving on and between the stockpiles (product and ROM). This should be included in the revised model to derive a worst—case scenario at receivers.

All new equipment, buildings and processes should be included in the TSP noise prediction scenario, such as additional plant and new belt filter press building. This includes the:

a. Additional mobile plant required for coal handling;

b. Upgrades to the onsite and offsite service infrastructure (such as belt filter press building, vacuum pumps and gas plant); and

c. Mine closure and rehabilitation activities.

The NIA does not indicate if the additional mobile plant, rehabilitation or service infrastructure upgrades have been considered. The NIA should confirm and if appropriate, include these sources in the model.

The lists of plant and equipment (Tables 7.1 and 7.3) should indicate how many of each item were included in the model. The model should include water carts that are likely to be used on the site (at stockpiles and REA).

The proponent should provide clarification on the following matters:

a. Source heights used in the modelling;

b. How the conveyor sound power levels were reported (e.g. per metre or total);

c. How directionality of noise sources was accounted for in the noise modelling;

d. The modelled truck and train speeds;

e. How wagons were accounted for in the model; and

f. Why the noise source for rail loop only covers less than half of loop and references to validate the sound power level of plant and equipment (for example, if they are derived from on—site measurements or from other sources).

Response

Noise associated with construction of the ventilation shafts has been modelled and assessed during Stage 2 of the REA in accordance with the NPfI (Section 7.0 of the NVIA, Appendix I of the Project Amendment Report).

Three separate stages of REA development have been considered representative of likely acoustically worst-case scenarios, including worst-case scenarios for residences to the north, east, south-east and south during the mine life expectancy. Figures showing the indicative locations of assumed noise sources across the site for the existing operations and the three REA stages considered for the Amended Project are provided in Appendix D of the NVIA (Appendix I of the Project Amendment Report).

Coal will continue to be conveyed to the rejects bin, and stockpiled overnight, from where it is loaded onto trucks using front end loaders during the day and hauled to the REA. Two trucks will undertake the haulage during the day (rather than one, as is the case now) to enable no haulage at night-time. No additional mobile plant equipment is anticipated for the Amended Project. Therefore, no changes have been applied to the Amended Project predicted scenario. Progressive mine rehabilitation activities have been modelled and assessed in the REA.

A revised table of plant and equipment has been included in the Noise and Vibration Impact Assessment (Table 6.2 of Appendix I of the Project Amendment Report) to clarify how many of each item have been considered and water cart operation has been included.

The following information regarding modelling parameters is provided below, as well as being described in further detail in the Noise and Vibration Impact Assessment for the Amended Project (Appendix I of the Project Amendment Report):

- A source height of 2 m has been adopted for all mobile equipment on site. Heights of fixed plant were adopted from site drawings and observations made on site;
- Most sources on site are not direction in their nature. Where sources may have a higher noise component in one particular direction an omni-directional source has been assumed at a sound power level equivalent to the higher noise component;

- The truck speed limit on site is 15 km/h. Trains are also generally limited to 15 km/h, however can only travel at a maximum of 10 km/h whilst loading;
- The noise from wagons is negligible relative to the noise from locomotives, whilst a train is on the loop and being loaded; and
- Noise from two locomotives moving around the rail loop has been assumed as a line source.

5.4.4 Noise and vibration: Church and College Receivers

Issue Description

The assessment of the Church and College receivers should:

a. Include passive or active recreation areas as required by the INP;

b. Provide justification for the assumed 25 dB outside to inside correction for the Church and College buildings;

c. Indicate if the predicted noise levels at the assessment point, 50 m to the south of the Church is representative; and

d. Identify and, if appropriate, assess the other buildings on the College grounds.

Response

The sporting field of the College has been assessed as an active recreation area and the Church as a place of worship (internal), consistent with the definitions of the NPfI.

The assumed external-to-internal reduction for the College and Church buildings is due to the following:

- Brick construction of the buildings;
- Minimal openings on the facades of all buildings facing the road and, hence, the mine;
- The church is surrounded by a solid concrete wall approx. 1.8 m high;
- The school administration building, nearest to the road and the mine, also includes a veranda around the whole building; and
- Mine noise emissions have been predicted to the nearest classrooms.

Further, the assessment locations relevant to the Church and school have been revised, and the nearest school classroom has been added to the assessment.

5.4.5 Noise and vibration: Presentation of findings

Issue Description

The assessment location maps (Figure 5.1) should have the assessment location defined as per the INP; i.e. is the most-affected point on or within the residential property boundary - or, if that is more than 30 m from the residence, at the most-affected point within 30 m of the residence and not closer than 3 m.

Noise contour maps in Appendix D should show the extent of the TSP areas of activity — not only the existing footprint.

Response

Assessment locations have been approximated from aerial photography and Lidar surveys and are considered representative of the most-affected point within 30 m of each residence. At the separation distances between the mine noise sources and each receiver, changes of up to 30 m, if relevant, will not alter the final noise impact outcomes.

In relation to the noise contour maps, the footprint of the proposed REA extension has been included so as to show the extent of areas of activity for the Amended Project (refer to the revised NVIA, Appendix I of the Amended Project).

5.4.6 Noise and vibration: Model Validation

Issue Description

A description of the modelling calculation method used in the NIA should be provided. A validation of the model's performance should be provided by comparing the predicted levels against measured existing levels (broadband and low frequency noise). Any calibration factors applied to the model should be stated and fully justified.

Response

Further validation of the noise model was undertaken as part of the updated noise assessment and is described in Section 6.4 of the updated Noise and Vibration Impact Assessment Report (Appendix I of the Project Amendment Report). In summary, noise from existing operations was modelled and compared to the results of operator-attended noise surveys undertaken in Olive Lane. Results of the model validation indicated that the model over-predicts impacts by approximately 2 dB(A). Calibration factors were not applied within the model thus providing a conservative assessment approach.

5.4.7 Noise and vibration: Impacts during all time periods

Issue Description

The NIA should demonstrate the impacts for each day, evening and night period. Because predicted noise levels are significantly greater than the project specific noise levels (PSNL) and the mitigation differs depending on the time period, the impacts need to be described for each period

Response

The results of the noise assessment are presented for the day, evening and night-time periods in Section 6.8 of the Noise and Vibration Impact Assessment Report for the Amended Project (Appendix I of the Project Amendment Report).

5.4.8 Noise and vibration: Mitigation and VLAMP

Issue Description

1. *Justification should be provided for the 3-year timeframe to implement all mitigation during which time substantially higher impacts were predicted.*
2. *The definition of residual impacts, mitigation and application of VLAMF rely on the predicted difference between noise from the existing mine and the predicted impact of the Project. The noise contribution from the operation of the existing mine should be provided.*
3. *The VLAMP states that at-receiver mitigation should be considered where impacts are greater than negligible. There are 131 receivers predicted to have a greater than negligible impact, but the NIA proposes mitigation at only two residential receivers. The proponent should provide justification for not considering more than two receivers for at-receiver mitigation.*
4. *The proposed mitigation scenario is contingent on ceasing REA operations during the night. A residual impact analysis should be provided for other time periods. In addition, the proponent needs to clarify why the source location map in Appendix B for the mitigated scenario (Figure 8.3) includes sources in the REA, which is intended to be operated during daytime period only. Figure 8.3 should also illustrate the proposed extent of the TSP REA.*
5. *The barrier mitigation (increased height of the northern bund and a proposed barrier adjacent to the stockpiles) described in Table 7.2 should indicate the assumed attenuation provided by the barriers. in addition, the proponent should review and, if appropriate, amend the source location maps (Appendix B), which indicate the northern bund running parallel to the rail line. Satellite maps of the surface infrastructure (Figure 3.3 in the EIS) indicate that the bund runs behind the water recycling paint and vent shaft 3, not parallel to the rail line, which will impact the effectiveness of the assumed barrier attenuation.*
6. *Additional compliance/achievable noise levels for the purposes of VLAMP should be nominated for receivers immediately south of the mine in the vicinity of Coolah Road and for receivers located adjacent to the proposed new vent shafts. The NIA states that negotiation is ongoing with two properties near to the new vent shafts, however these negotiations have not been completed.*

The NIA should state the residual impact and achievable noise level. Note: The VLAMP is administered by the DPE. However, the NIA relies on the implementation of the VLAMP to manage potential noise impacts from the development.

Response

1. The implementation of all noise mitigation measures proposed for the Amended Project will require significant operational planning, engineering design and, in some cases, significant capital investment. Tahmoor Coal would require three years to coordinate and implement all these measures. Further, without the additional mitigation measures proposed as part of the Amended Project, then the continuation of operations would involve a continuation of noise levels as they are now. Therefore, during the time it takes to implement the proposed mitigation measures, the noise levels will not be 'substantially higher' as stated by the EPA but will continue predominately as they are now. As stated in the NVIA, the noise compliance reports prepared quarterly conclude that the site is within compliance of existing consent limits.
2. The noise contribution from the operation of the existing mine is provided in Section 4.0 of the NVIA (Appendix I of the Project Amendment Report). Background noise levels from existing mining operations were derived from the existing quarterly noise compliance monitoring locations (M1 to M10) and additional unattended noise monitoring completed by EMM at five locations surrounding the site in June 2019. A summary of the background and ambient noise monitoring results is provided in Table 4.1 of the NVIA Report (Appendix I of the Project Amendment Report).
3. The NVIA has been significantly revised to assess the Amended Project against the new NPfI. Table 6.4 of the NVIA refers to receptor mitigation and states that Tahmoor Coal will negotiate with receptors identified as being significantly impacted by mine noise. The type of mitigation measures that could be implemented at the residences will depend on the outcomes of relevant negotiations.
4. Figures showing the indicative locations of assumed noise sources across the site for the existing operations and the three REA stages considered for the Amended Project are provided in Appendix D of the NVIA (Appendix I of the Project Amendment Report). All sources modelled as part of the operational assessment were assumed to operate continuously during all periods (day, evening and night) for both the existing and unmitigated operational Amended Project scenarios.
5. A noise barrier comprising shipping containers would be located along the western side of the existing stockpile area (indicative extents are shown in Appendix D, NVIA) and be in the form of 3 shipping containers stacked on each other. The barrier would have maximum benefit to reduce noise from the dozer when the dozer is operating in the northern section of the stockpile area (refer above) by up to 5dB under noise- enhancing weather conditions. The required height of the barrier to provide any material acoustic benefit around the southern end of the coal stockpile area would not be feasible to build. A feasible height (e.g. 4 shipping containers stacked on each other) would provide negligible acoustic benefit. The barrier/ bund to shield the northern section of the rail loop would have the benefit of further reducing locomotive engine noise and noise from wheel/track interaction when rail loading is occurring. Indicative locations for noise barriers are shown in Appendix D of the NVIA (Appendix I of the Project Amendment Report).
6. The location of the noise barriers provided in the NVIA should be viewed as indicative only and will be subject to detailed engineering design. The attenuation of the barriers is not assumed, but rather is in accordance with modelling using ISO9613.
7. An additional compliance monitoring location has been proposed in the vicinity of Coolah Road and the existing compliance monitoring location south of the REA has been revised. Tahmoor Coal has purchased 215 Charlies Point Road, the closest residential property to the south of the REA. It is also finalising negotiations to purchase 185 Charlies Point Road, the closest residential property to the north of the new ventilation shaft. The residual impact has been determined for this property and presented in Section 6.0 of the NVIA (Appendix I of the Project Amendment Report).

5.4.9 Noise and vibration: Existing Mine Noise

Issue Description

1. *Justification should be provided for the discrepancies of existing mine noise in the NIA. For example, at 7 Olive Lane;*

a. *Table 7.6 (night) states the existing mine noise is LAeq(15minutes) 58 dBA (including low frequency noise modifying factor) under enhancing meteorological conditions, equivalent to 53 dBA without the modifying factor;*

b. *Table 4.1 states that the existing L10 is between 40 to 48 dBA at M3 but no meteorological conditions or measurement period are provided;*

c. *Table 5.2 states the existing LAeq(15minutes) is 44 dBA with no meteorological conditions or measurement period provided; and*

d. *Chapter 4.1 states that the mine is generally in compliance with the existing consent limit of L10 45 dBA.*

These discrepancies indicate a difference of up to, a 13 dB in the reported level of noise for existing operations. The predicted noise levels are at least 5 dB above measured levels for existing noise at most impacted receivers. The Noise and Vibration Impact Assessment relies on the predicted reduction in noise level based on the difference between existing noise levels from current operation and the predicted noise levels from the Project to support the proposal and mitigation strategy. Based on the evidence in the NIA, the EPA considers that the proposed mitigation has been overestimated.

Response

Project intrusive noise levels were established based on the results of recent ambient noise monitoring. Ambient and background noise levels were measured at five locations surrounding the mine representative of the nearest noise-sensitive receptors. Noise-sensitive receptors were categorised into noise-catchment areas with similar acoustic environments.

Project Noise Trigger Levels (PNTLs) were established as the most stringent of either the project intrusiveness or amenity noise levels. It is noted that the PNTLs are not to be applied as mandatory noise limits but are used to assess the potential level of impact and drive the process of assessing all feasible and reasonable noise control measures. The assessment locations from the original NVIA (EMM, 2018) have been updated.

An additional noise monitoring event was undertaken with loggers in place from 19 June to 4 July 2019. Loggers were programmed to record statistical noise level indices continuously in 15-minute intervals. Table 6.6 of the Noise and Vibration Impact Assessment provides a summary of the number of assessment locations for each operational scenario (existing mine and each of the Stages considered) where predicted noise emissions were in three categories (no more than 2 dB above PNTL; 3-5 dB above PNTL and more than 5dB above PNTL).

Key points from the operational noise assessment are summarised as follows:

- As per the results presented in Appendix F of the NVIA (Appendix I of the Project Amendment Report), the Amended Project is expected to reduce noise emissions at all assessment locations compared to existing levels by at least 2 dB and up to 18 dB at some assessment locations during the night-time period.
- Predicted noise levels from the Amended Project show a significant reduction in the number of privately-owned dwellings affected by mine noise emissions more than 5 dB above the relevant PNTL compared to existing mine noise; a maximum of six residences for operation of the mitigated, Amended Project compared to 33 for existing Tahmoor Mine operations. Categorising residual noise impacts in accordance with the VLAMP noise impact categories results in three residential properties classified as significantly affected (refer Appendix G of the NVIA).
- Mine noise at the Anglican Church and school is predicted to reduce by at least 3 dB (mitigated scenario) compared to existing mine noise emission levels. Further, mine noise including mitigation measures are predicted to achieve the relevant amenity noise levels at these locations.

- In some cases, locations categorised as significant are relatively further from the mine than those with a moderate or marginal impact category. This is due to several factors including rounding of noise predictions, local topographical features and the relative PNTLs for these locations (intrusive and amenity).

Table 6.7 of the NVIA provides a summary of the predicted noise levels at 10 locations around the mine including the western end of Olive Lane. Predicted 'achievable' noise levels (noise enhancing) at this location as a result of the project are above the PNTL in the evening and night-time periods.

5.4.10 Noise and vibration: Sleep Disturbance

Issue Description

1. *The proponent should provide predicted LAmax noise levels;*
2. *The NIA states that the existing LAmax was measured as 53 dBA at Olive Lane, but the existing LAeqminutes) at 6 Olive Lane in Appendix C is 57 dBA. This requires clarification;*
3. *The existing maximum noise level of LAmax 53 dBA from dozers and coal loading into wagons exceeds the screening criteria at Olive Lane. The extent of exceedance of the screening criteria at other locations should be provided. The noise contours presented in Figure D.1 show that LAeq minutes) noise levels are above 45 dBA at a number of receivers, therefore the extent of the screening criteria could be much larger;*
4. *Evidence should be provided to support the claim that the frequency and level of noise events will reduce under the TSP; and*
5. *Further details are required on mitigation measures to reduce maximum noise level events, including the predicted reduction.*

Response

A revised NVIA has been prepared for the Amended Project (Appendix I of the Project Amendment Report). This includes updated assessment results for properties in Olive Lane.

Operator–attended noise surveys undertaken in Olive Lane demonstrated maximum noise levels from Tahmoor Mine in the order of LAmax 53dB from general dozer activity or loading coal into rail wagons.

Maximum noise levels from existing operations have previously been the subject of a Pollution Reduction Program (PRP) relevant to the site. As described in the previous NVIA (EMM, 2018), engineered mitigation controls have been effectively implemented as part of the Tahmoor Mine's PRPs to reduce and control maximum noise events.

Maximum noise levels have been predicted from the Amended Project including the feasible and reasonable mitigation measures described below. Maximum noise level predictions from activities such as dozer operation or rail loading are provided in Section 8.3 of the NVIA (Appendix I in the Project Amendment Report) for all residential assessment locations where maximum noise levels are predicted to be higher than 50dB including Olive Lane. Results indicate that the maximum noise level is not predicted to be above that which would trigger the need for a detailed assessment of maximum noise events (i.e. the NPfI LAmax 52dB) at any residential assessment location.

It is expected that both the frequency and level of maximum noise events from the Amended Project will be lower compared to the existing operation due to the mitigation measures to be implemented; including as a result of restricting operation of all equipment in the REA to day and evening only.

Noise reduction measures that have been considered as part of the mitigated Project will have the effect of further reducing maximum noise levels from site. These measures include the following as described in Section 8.2 (Appendix I in the Project Amendment Report):

- Increased height of barrier adjacent to the north-western side of the rail loop;
- Improvement to feed chute into rail wagons to reduce impact noise when loading of coal commences into each wagon;
- Improvements to the CHPP cladding and/or plant and equipment within it;

- Noise-suppression kit for dozers; and
- No activity (haulage or dozer) will occur in the REA during the night-time.

5.4.11 Noise and vibration: Background Noise Levels

Issue Description

1. *Justification should be provided to demonstrate that measurements from 2012 used in the MA are appropriate. The 2012 EIS was not submitted to the DPE and is not available for review. Monitoring graphs and summaries in Appendix A should be included for all measurements used to set rating background level (RBL);*
2. *Further details should be provided for how the mine noise was excluded from the long-term noise measurements presented in Table 5.1, and what contribution the "limited operations" had on the background noise measurements. Unattended measurements at risk of being influenced by the mine should be sufficiently supported by attended measurements or other methods during the day, evening and night periods to demonstrate the influence of the mine;*
3. *The monitoring data should be consistently reported. For example, M13 and M24 should be reported in Table 5.1, Locations M2 and M8 should be shown in Figure 5.1 and the reasons for using M2 to represent M8 and not M24, which appears to be further away from the road; and*
4. *Justification should be provided as to why the existing meteorological stations on the site and at the Tahmoor South site were not used to monitor meteorological conditions during the noise monitoring and that the location used at L2 is suitable.*

Response

1. To complement the long-term noise monitoring undertaken for the original NVIA (EMM 2018), additional unattended noise monitoring was completed by EMM in June 2019. Table 4.1 of the revised NVIA (Appendix I of the Project Amendment Report) lists the locations of all relevant long-term noise logger and short-term operator- attended noise monitoring locations as well as the background (RBL) and ambient noise levels. Appendix C of the NVIA contains detailed graphs.
2. The 2012 measurements are now not utilised in the assessment. Notwithstanding, it is important to note that an NPfI approach has been adopted and hence the existing mine noise can be included in determining the existing background noise levels, once compliance with existing noise limits is established.
3. Monitoring data utilised for the purpose of establishing relevant noise criteria has been updated in the Table 4.3 of the revised NVIA for the Amended Project.
4. The purpose of the meteorological station at L2 was to determine when noise data should be excluded due to high wind speeds and/or rainfall. Data captured at (or near) the microphone is far more relevant for this purpose than the onsite weather station. The existing meteorological station was used for the purpose of data exclusion for the ambient monitoring conducted in June 2019.

5.4.12 Noise and vibration: Vibration assessment

Issue Description

1. *Specification of what type of drill will be used for the drill sites should be provided and an assessment of vibration impact of this drill should be undertaken, or justification provided for why it is not necessary; and*
2. *The EPA's input to the SEARS identifies that complaints have been issued relating to vibration from existing vents shafts. The vibration impact from existing vents should be included in the NIA as a worst—case scenario and the potential for vibration from the proposed vent shafts addressed.*

Response

1. The specific drill type is not yet known. Notwithstanding, given the separation distance between the sites where drilling is proposed and the nearest residences (>200 m), it is not expected that vibration from drilling activity will be noticeable at the nearest residences and vibration levels will not exceed well documented vibration criteria.

2. Results of operator-attended vibration monitoring on 19 June 2019 in close proximity to the existing ventilation shaft (some 30 metres) are presented in Section 9.2 of the Noise and Vibration Impact Assessment for the Amended Project. The peak vibration levels during the survey did not exceed 0.035 mm/s which is significantly below the level of human perception.

5.4.13 Noise and vibration: Additional assessment

Issue Description

1. Note that the EPA considers the NIA is inadequate because of significant technical deficiencies to allow the EPA to evaluate the extent of potential noise and vibration impacts from the project, and the adequacy of the proposed mitigation measures; and

2. Request the proponent provide further assessment and details as described in this advice.

Response

The noise assessment methodology used in the NVIA for the Amended Project reflects current practice using the Noise Policy for Industry (EPA, 2017) as requested by the EPA.

Other updates include provision of additional information regarding noise model validation and low frequency noise and consideration of a variety of stages of the REA development over the duration of the Amended Project. Additional unattended noise monitoring was also completed by EMM at five locations surrounding the site in June 2019.

5.4.14 Surface Water: Water quality impacts of LDP1 discharge

Issue Description

Overall the EIS does not adequately assess the potential water quality impacts of discharges via Licence Discharge Point (LDP) 1.

The EPA's EIS Requirements for the Project (letter dated 24/04/17, DOC 17/269642—01), include the following:

1. In developing the Environmental Impact Statement (EIS) the proponent should describe the improvements achieved in water treatment and discharges at the site in recent years. This includes the performance of the new treatment plant constructed under PRP 22. The EIS should determine whether environmental values for the Bargo River are now being met downstream of the discharge or will be met following full commissioning of the plant. The EIS should assess whether additional treatment may be required to meet environmental values; and

2. The EIS should integrate the results of the aquatic health study in the Bargo River (PRP 23) as well as previous aquatic studies undertaken by the mine. An assessment should also be made of the possible increase in groundwater make and changes in quality from the new Tahmoor South area and whether additional treatment capacity will be needed.

These two requirements have not been adequately addressed in the EIS.

An impact assessment for controlled surface water discharges of mine water (with potentially elevated levels of salinity, metals or other pollutant impacts) is not included in the EIS for LDP 1. The EIS discharge assessment is limited to referring to past and current PRPs related to the existing development and provision of water quality data and discussion for an ambient site downstream of the discharge. The status of PRP investigations and any further assessment related to the new proposal also should be integrated into the development assessment process.

Response

The revised Surface Water Baseline Study (Appendix C of the Project Amendment Report) provides a summary of the water quality discharge via LDP1 and at surface water monitoring locations downstream of the release point, including Bargo River.

Tahmoor Coal is licensed to release treated water from the water management system in accordance with EPL 1389 release limits. Under the current licence there is also a requirement to enhance treatment of water prior to release via Pollution Reduction Program 22 which involves the development and commissioning of an upgraded WWTP to reduce the concentrations of constituents released via LDP1. Section 9.1 of the revised Surface Water Impact Assessment states that the water quality target

at the WWTP is to meet the 95th percentile ANZECC default guideline trigger values for the protection of aquatic ecosystems (ANZG, 2018). The results of predictive modelling (HEC, 2020b) of the water management system over the remaining mine life indicate that release to LDP1 is unlikely to increase above the EPL 1389 volume limits. As a result, it is expected that the Amended Project would not result in adverse water quality impacts due to releases and overflows from the site water management system.

Section 6.7 of the revised Surface Water Impact Assessment states that discharge via the Licensed Overflow Points (LOPs) in EPL 1389 and the proposed dam S12 to Tea Tree Hollow is predicted to be less than the maximum discharge via the LOPs to Tea Tree Hollow recorded in 2016. As such, it is expected that the Amended Project would not result in adverse water quality impacts due to releases and overflows from the site water management system to Tea Tree Hollow.

The simulated annual release to Bargo River from dam S11 for the life of the mine is predicted to average 3.7 ML/annum based on the median model results and 11.6 ML/annum based on the 95th percentile model results (HEC, 2020b). A conservative assessment of the potential constituent concentrations in Bargo River due to overflow from dam S11 has been undertaken based on the median water quality records for the Bargo River Upstream and the highest median concentration discharged in overflow to the LOPs.

Table 14 in Section 9.1 of the revised Surface Water Impact Assessment (Appendix D of the Project Amendment Report) presents the estimated constituent concentrations in comparison with the ANZECC (2000) default guideline trigger values for protection of aquatic ecosystems and recreational use. It illustrates that overflow to Bargo River from dam S11 is estimated to result in a very slight increase in the concentration of sodium and electrical conductivity at Bargo River Downstream. The estimated concentration of sodium and electrical conductivity would remain below the ANZECC (2000) and ANZG (2018) default guideline trigger values for protection of aquatic ecosystems and recreational use.

5.4.15 Surface Water: Metals discharges via LDP1

Issue Description

The EIS refers to pollution reductions programs (PRP) 22 for metals that is currently in progress. PRP 22 aims to develop and commission a Waste Water Treatment Plant (WWTP) to reduce the concentrations of arsenic, nickel and zinc in mine water released from LDP1 based on the current operation. A WWTP was constructed in June 2015 to treat up to 6 ML/d of mine water to achieve the following metal concentration limits in the Bargo River:

- *Arsenic: 0.013 mg/L;*
- *Nickel: 0.011 mg/L; and*
- *Zinc: 0.008 mg/L.*

Based on a recent PRP report submitted to the EPA, the wastewater treatment plant has not achieved the above water quality criteria and the current PRP suggests changes to the current WWTP to achieve the limits or, if unsuccessful, consider a reverse osmosis treatment plant, accounting for any constraints of brine or crystallised salt management at the site.

The EIS states that two sites downstream of the Tahmoor Mine licensed discharge point LDP 1 (SW-22 Tea Tree Hollow and SW-14 Bargo River Rockford Bridge) indicated elevated barium levels not identified at other locations. At this site there has also been 26 exceedances of the aquatic ecosystem guideline for selenium. No further impact assessment of selenium or barium is provided.

Response

Section 9.1 of the revised Surface Water Impact Assessment discusses the proposal to commission an upgraded WWTP to reduce the concentrations of constituents discharged via LDP1. The specified upgraded WWTP target water quality is to meet the 95th percentile ANZECC (ANZG 2018) Guideline values. Specific targets are:

- pH 6.5-9;
- Electrical Conductivity <500uS/cm;

- Suspended Solids <30 mg/L;
- Turbidity <150 NTU;
- Oil and grease <10 mg/L;
- Iron <0.7 mg/L;
- Manganese <1.9 mg/L;
- Nickel <0.011 mg/L;
- Zinc <0.008 mg/L;
- Arsenic (V) <13 ug/L; and
- Arsenic (III) <24 ug/L.

Table 14 in Section 9.1 of the revised Surface Water Impact Assessment (Appendix D of the Project Amendment Report) presents the estimated constituent concentrations in comparison with the ANZECC (2000) default guideline trigger values for protection of aquatic ecosystems and recreational use.

As stated above, the results of predictive modelling of the water management system over the remaining mine life indicate that with the operation of the upgraded WWTP, the Amended Project would not result in adverse water quality impacts due to releases and overflows from the site water management system.

The ANZECC (2000) lower bound guideline values for barium and selenium are 1 mg/L and 0.01 mg/L respectively (water quality guidelines for recreational purposes) while an aquatic ecosystem guideline value of 0.011 mg/L is given for selenium. The recreational guideline values are based on the Australian drinking water guideline values and are therefore highly conservative. The Guidelines for Managing Risks in Recreational Water (NHMRC, 2008) state that when applying the values to recreational water exposure, consumption of 100-200 mL per day should be taken into consideration. The median concentration of barium exceeded the ANZECC recreational use default guideline trigger value at LDP 1, SW-22 and SW-14, although the median concentration at SW-14 was notably lower (1.24 mg/L) than at SW-22 (3.38 mg/L). However, when modifying the guideline value to account for the consumption of 200 mL per day (as opposed to 2 L per day for which the drinking water guideline values have been derived), this equates to a modified guideline value of 18.7 mg/L for barium.

A maximum barium concentration of 6.47 mg/L was recorded at SW22 and a maximum concentration of 4.56 mg/L at SW14; both of which are well below the modified guideline value of 18.7 mg/L for recreational use. Selenium has not been detected in LDP1 samples however only 5 results are available since 2015. Selenium has only been detected at the ANZECC guideline values in 7 of 31 samples (22%) from SW22 (Tea Tree Hollow) since 2012 and 14 of 43 samples (33%) at Rockford Road Bridge (SW14). Note that selenium has also been detected above the ANZECC guideline values in control sites on Bargo River and Hornes Creek (revised Surface Water Baseline Assessment, Appendix D of the Project Amendment Report).

5.4.16 Surface Water: Salinity Concentrations

Issue Description

The EIS refers to PRP 23 that did not recommend any changes to existing discharge licence limits to electrical conductivity/salinity. This assessment is not incorporated in the EIS. The additional tonnes of salt that will be discharged to the river system over the life of the new proposal and its fate downstream were not assessed in PRP 23.

Reference to the findings of a prior PRP does not provide a contemporary assessment of the potential impact of the ongoing saline discharge related to the proposed development and does not consider:

- *Any current or emerging issues with salinity, including new research;*
- *An additional salinity loads from extending the mining period and increasing discharge volumes; and*
- *Any potential changes to the salinity or related impacts.*

The information provided does not justify the statement in the EIS that the existing salinity limit of 2600 pS/cm is acceptable for the new development.

It is unclear if a limit of 2600 pS/cm would achieve the NSW Water Quality Objectives (WQO) for salinity of 350 pS/cm at the edge of a near-field mixing zone (it is also noted that a site—specific trigger value of 193 pS/cm was calculated for Site SW1). The EIS indicates that PRP 23 found localised effects to aquatic ecology at Tea Tree Hollow and Bargo River, downstream of the licensed discharge point, comprising a reduction in pollution sensitive invertebrates and an increase in pollution tolerant invertebrates. The study found the effects of the discharge to be localised within a few kilometres downstream of the discharge point. A few kilometres downstream is unlikely to relate to near-field mixing.

Response

Tahmoor Coal has issued a specification for design and construction of an upgraded WWTP, in response to PRP22, which would also treat Electrical Conductivity to <500uS/cm. Table 14 in Section 9.1 of the revised Surface Water Impact Assessment (Appendix D of the Project Amendment Report) presents the estimated constituent concentrations in comparison with the ANZECC (2000) default guideline trigger values for protection of aquatic ecosystems and recreational use. Overflow to Bargo River from dam S11 is estimated to result in a very slight increase in the concentration of sodium and electrical conductivity at Bargo River Downstream. The estimated concentration of sodium and electrical conductivity would however remain below the ANZECC (2000) and ANZG (2018) default guideline trigger values for protection of aquatic ecosystems and recreational use.

5.4.17 Surface Water: Ionic Impacts

Issue Description

Salinity is a surrogate measure for the range of specific salinity ions. Each ion and mix of ions can have different impacts on receiving waters and aquatic ecosystems. Surface waters, groundwaters and coal mine discharges can often have very different ionic compositions meaning that salinity measurement alone is not an adequate basis for assessing all potential salinity-related impacts.

Different ions (sodium, calcium, magnesium, potassium, chloride, bicarbonate, sulfate and the salts they form) can induce varying degrees of toxicity to aquatic life.

To appropriately assess the impact of the proposed discharge an assessment would need to include consideration of potential ionic mix impacts and any risk of concentrations of specific salinity ions such as bicarbonate. For example, the EIS states that two sites downstream of the Tahmoor Mine licensed discharge point LDP 1 (SW—22 Tea Tree Hollow and SW—14 Bargo River Rockford Bridge) indicated elevated levels of bicarbonate and sodium which was not identified at other locations. The potential impact and mitigation measures have not been assessed in the EIS.

Response

Tahmoor Coal has issued a specification for design and construction of an upgraded WWTP, in response to PRP22, which would also treat Electrical Conductivity to <500uS/cm.

5.4.18 Surface Water: Other Pollutants

Issue Description

The EIS does not provide an adequate characterisation of the discharge or assessment of the potential for pollutants other than salinity and selected metals to be present in discharges, e.g. Coal seams.

The potential for increases in pH downstream of the discharge is not assessed. Potential levels of methane in mine water discharges are also not assessed, however, the EIS states that methane is not likely to be a significant issue.

Response

The updated assessment of Redbank Creek water quality provided in Section 5.2.2 of the revised Surface Water Impact Assessment indicates that longwall mining in the Redbank Creek catchment has not affected pH levels in the creek to any significant extent. Drainage of strata gas and expression to the surface through surface water has occurred to varying degrees in the Southern Coalfields. It is most readily detectable in permanent slow-moving pools. Studies of the phenomena have shown that the gas flow does not affect the quality of surface waters through which it drains, due to the very low solubility of methane and the short residence time in the water column (MSEC, 2020). There have been rare instances of reported vegetation die back (MSEC, 2020).

The predicted increase in releases to LDP1 and LOPs, and from the proposed sediment dams S11 and S12, as a result of the Amended Project are discussed in the Water Management System and Site Water Balance (HEC, 2020b). The potential impacts to water quality are discussed in Section 9.1 of the revised Surface Water Impact Assessment.

5.4.19 Surface Water: Mixing Zone Policy and Principles

Issue Description

A lack of near—field dilution in Tea Tree Hollow and at the point of confluence with the Bargo River are likely to be relevant to the Tahmoor proposed discharge, however, this is not considered in the EIS.

Where a mixing zone is used, the EPA's policy is that the NSW WQOs should be met at the edge of the area where initial mixing occurs or "near—field" mixing. If the discharge volume from a licensed discharge point dominates flows in the system under most conditions the dilution effects within a near field mixing zone could be relatively minimal. The EPA would, therefore, examine the pollutant concentrations at the point of discharge relative to the appropriate water quality guideline values.

Response

The specified wastewater treatment plant has a water quality target to meet the 95th percentile ANZECC (ANZG 2018) Guideline values as stated in EPL1389. Specific targets are:

- pH 6.5-9;
- Electrical Conductivity <500 uS/cm;
- Suspended Solids <30 mg/L;
- Turbidity <150 NTU;
- Oil and grease <10 mg/L;
- Iron <0.7 mg/L;
- Manganese <1.9 mg/L;
- Nickel <0.011 mg/L;
- Zinc <0.008 mg/L;
- Arsenic (V) <13 ug/L; and
- Arsenic (III) <24 ug/L.

5.4.20 Surface Water: Additional Assessment

Issue Description

EPA recommends that the Department of Planning and Environment request the following be completed:

- *A surface water quality discharge assessment for LDP1 be provided on contaminants and salinity and salinity—related risks based on current scientific knowledge, including pH, metals, salinity loads, toxicity of various specific ions and potential ionic mix related risks;*

- *Relevant information from the PRP process that can inform the impact assessment is included and, where appropriate, updated in the EIS;*

The discharge impact assessment be based on:

- *Comparison to either the relevant guideline values for aquatic ecosystem protection or numerical values derived from a suitable slightly-modified ecosystem reference site selected and sampled in accordance with the Australian Water Quality Guidelines:*
  - *all potential pollutants that could cause non—trivial harm in discharges; and*
  - *available dilution from receiving water flows that occur when discharges will occur.*

The full range of metal, salinity and other potential pollutants to be assessed should include, at a minimum:

- *Organics (total recoverable hydrocarbons, including BTEX);*
- *Radionuclides, including: combined radium-226l—228, gross alpha and gross beta;*
- *A full suite of metals;*
- *Non—metallic inorganics: ammonia, nitrate, nitrite;*
- *Salinity concentrations and loads, major ions, alkalinity and hardness, including: total dissolved solids, sodium, chloride, potassium, magnesium, fluoride, sulfate, calcium, bromide, bicarbonate, carbonate, hydroxide, hardness; and*
- *Dissolved oxygen, electrical conductivity, pH, redox potential, turbidity, total suspended solids, methane.*
- *All practical measures are assessed and implemented to achieve the NSW WQO by the edge of the near—field mixing zone consistent with the mixing zone policy and principles;*
- *The overall treatment system is reviewed based on an updated discharge water quality assessment provided as part of the EIS process which considers the full range of potential contaminant and salinity—related risks and the relevant mixing zone policy and principles;*
- *A target set of discharge criteria are established at this stage where the WWTP is under review and the new project is being proposed.*

It is also recommended that any water quality assessment separates:

- *Discharge trigger values or criteria (which should be based on guideline values in for slightly to moderately disturbed aquatic ecosystems or site—specific trigger values from slightly modified reference sites selected and sampled in accordance with the Australian Water Quality Guidelines); and*
- *Trigger values or criteria that may be used to assess ambient water quality differences upstream and downstream of the development. In this case site-specific trigger values from some sites (that are not based on Australian Water Quality Guideline reference site requirements) may be used to compare upstream water quality to downstream water quality using appropriate statistical comparisons. These upstream waters, however, if degraded, do not provide a basis for deriving site—specific discharge criteria.*

Note the assessment could consider literature on metals that can assist in defining the bioavailable fractions of metals as a basis for adjusting the conservative guideline values, for example, as a minimum, zinc and nickel have hardness—modified trigger values that could be calculated to refine the proposed limits (see Warne, et. al. 2018). There also is the potential for further assessment on zinc, nickel and arsenic that may reduce the conservative aspects of the default trigger values, e.g. arsenic III has a lower trigger value of 24 ug/L compared to the PRP limit of 13 ug/L.

Response

The updated Surface Water Baseline Study for the Amended Project (Appendix D of the Project Amendment Report) provides a summary of the water quality discharge via LDP1 and at surface water monitoring locations downstream of the release point, including Bargo River.

Details of the derivation of site-specific trigger values for baseline and impact sites are also provided in the Surface Water Baseline Study.

Section 9.1 of the revised Surface Water Impact Assessment (Appendix D of the Project Amendment Report) discusses the proposal to commission an upgraded WWTP to reduce the concentrations of constituents discharged via LDP1.

A series of PRPs have been implemented on site since 2005. There are currently two active programs relating to site water management. Stage 3 of PRP 22 involves the development and commissioning of the upgraded WWTP to improve the quality of mine water released from LDP1 (refer Section 2.1). PRP 26 involves an aquatic health assessment in Tea Tree Hollow and the Bargo River to assess the effects of the mine water discharge through LDP1. PRP 26 is to be completed within 9 months of completion of PRP 22.

5.4.21 Surface Water: Storage Liners

Issue Description

Information on storage liners for mine water do not appear to be provided in the EIS. All practical measures to mitigate the risk of seepage of mine water from storages into the surrounding aquifers or watercourses should be considered. Wastewater storage ponds should be lined to a permeability equivalent to a 900 mm clay liner with permeability not less than 10^{-9} ms^{-1}.

It is recommended that mine water storages are lined to a permeability equivalent to a 900 mm clay liner with permeability not less than 10‘9 mall. A more permeable liner may be acceptable if a detailed justification is provided, including demonstration that the likely long- term fate of salt will not impact the beneficial use and environmental values of surrounding ground and surface waters.

Response

The EPA’s recommendation in relation to storage liner requirements (permeability standards) is noted. However, analysis of the geochemistry downstream of the storages indicates that the water storages are not currently having an impact on groundwater quality.

5.4.22 Surface Water: Underground Water Storage in Goaf

Issue Description

The EIS describes development of an underground storage within goafed areas of the Tahmoor North underground for storage of water pumped from sediment dam M3 at times when inflow to dam M3 is more than the WVVTP capacity. At times of lower inflow, water could be recovered from the underground storage treated within the WWTP and released via LDP1. The underground storage would be formed within the void space of the mined longwall panels up to and including LW30. A storage capacity of 4,751 ML has been estimated within this area.

There may be potential risk to groundwater if these storages are near water courses or have a geology with cracking or low permeability. Relevant hydrogeology expertise would be required to assess any potential impacts.

Response

The underground water storage proposal has been modified such that mine dewatering from the Amended Project will be transferred directly to the proposed Tahmoor North underground storage, rather than from dam M3. It is proposed to develop an underground storage within goaf areas of the Tahmoor North underground mine into which mine dewatering from the Amended Project would be pumped at times when there is insufficient capacity to treat the dewatering stream through the upgraded WWTP. At times of lower inflow, water could be recovered from the underground storage, treated within the upgraded WWTP and released via LDP1.

The revised Groundwater Assessment (Appendix C of the Project Amendment Report) identified that, based on the groundwater salinity data available, as the Amended Project mining progresses, salinity of the mine dewatering stream is unlikely to rise significantly and may potentially fall slightly. Therefore, it is expected that the quality of mine dewatering from Tahmoor South will be similar to that of the groundwater inflow to Tahmoor North. As such, impacts to groundwater quality due to underground storage are unlikely to occur.

5.4.23 Surface Water: Trigger Values

Issue Description

Water quality data from various ambient sites have been assessed against ANZECC (2000) guideline trigger levels for the protection of Aquatic Ecosystems, however, a range of analytes have not been assigned guideline values (e.g. interim values from Volume 2 of ANZECC (2000) or by referencing international literature).

The purpose of site—specific trigger values in Tables 19 to Table 30 is also unclear. The ANZECC (2000) site specific trigger value methodology is used to modify the default trigger values based on high quality reference sites, e.g. use of slightly-disturbed site to derive trigger values for a slightly to moderately disturbed level of protection.

Response

Section 7.0 of the revised Surface Water Baseline Assessment (Appendix D of the Project Amendment Report) presents a summary of the water quality monitoring data for various sites within the Amended Project area and surrounding region which has been updated to include data recorded since submission of the EIS. Where possible, the water quality data has been compared with the ANZECC (2000) and ANZG (2018) default guideline trigger levels for the protection of Aquatic Ecosystems in accordance with the perceived principal beneficial uses of the surface water resources in the area.

SSTVs have also been derived in accordance with the ANZECC (2000) Guidelines and the revised Water Quality Guidelines (ANZG, 2018) which are progressively superseding the ANZECC (2000) Guidelines. SSTVs have been established to compare against future project impacts as the adoption of ANZECC (2000) and ANZG (2018) default guideline trigger values would, for many parameters, result in frequent 'false triggering' because the existing (baseline) conditions already exceed the default guideline values, as demonstrated by the monitoring results. It is intended that the SSTVs will be incorporated into water quality TARPs for sites downstream of the Amended Project area.

5.4.24 Surface Water: Water Quality Criteria

Issue Description

EPA recommends that the Department of Planning and Environment request the following be completed:

- *Where available, all analytes are assigned trigger values for aquatic ecosystem protection;*
- *The purpose of the site-specific trigger values is clarified, noting that there are different uses of trigger values including:*
  - *As a basis for setting controlled discharge criteria; or*
  - *As a basis for measuring changes in existing water quality due to the development.*

Response

Water quality monitoring has been conducted at, or at sites adjacent to, all baseline flow gauging station sites in the Amended Project Area. Additionally, water quality monitoring has been undertaken at Licenced Discharge Point (LDP) 1 and at site water storages which discharge to a Licensed Overflow Point (LOP) (refer Section 7.0 of the revised Surface Water Baseline Assessment, Appendix D of the Project Amendment Report).

The derivation of appropriate water quality guideline trigger values for each site has been undertaken in accordance with the ANZECC (2000) Guidelines and the revised Water Quality Guidelines (ANZG, 2018) default guideline trigger levels for the *protection of aquatic ecosystems* and *recreational use; and* in accordance with the perceived principal beneficial uses of the surface water resources in the area.

The “reference-site data” approach detailed in the ANZG (2018) was used to assess baseline water quality conditions and develop site specific trigger values for which to assess potential water quality impacts against. The ANZG (2018) states that, for modified ecosystems, ‘best available’ reference sites should be adopted for providing reference conditions. If the water quality monitored at the assessment or impact site following Amended Project development departs in a meaningful way from the reference condition, then the site is assessed to be affected in some way.

As the Amended Project is located within a modified ecosystem i.e. urban, agricultural, industrial and resource development has been undertaken previously in the catchment area, the ‘best available’ reference sites have been adopted. The sites, listed in Table 11 of Section 4.2 of the revised Surface Water Baseline Assessment, enable water quality reference conditions to be developed for control and baseline sites. Site specific trigger values (SSTVs) have been derived from the monitored data as the 80th percentile of monitored values where sufficient monitored data are available to derive this statistic (a minimum of ten records).

The aim of the SSTVs is to provide a baseline against which to compare future monitored water quality in order to assess if an impact may be occurring. The measured data following each monitoring event, in addition to the annual median of measured data, would be compared with the SSTVs. Should an exceedance be identified, this would lead to the gathering of additional information or further investigation to determine whether an impact has occurred and if there is a risk to the environment. It is intended that the SSTVs would be incorporated into water quality TARPs for sites downstream of the Project Area prepared prior to the commencement of Amended Project longwall mining.

The adoption of ANZECC (2000) and ANZG (2018) default guideline trigger values would, for many parameters, result in frequent ‘false triggering’ because the existing (baseline) conditions already exceed the default guideline values, as demonstrated by the monitoring results.

5.4.25 Surface Water: Controlled discharges and managed overflows

Issue Description

It is unclear if there are any managed overflows of mine water from licensed discharge point (LDP) 1, e.g. flows above pumping rates/timing of pumping to underground storage. This should be clarified and if necessary, the frequency, volume and potential impacts assessed in the EIS.

The EIS indicates drainage from the product coal stockpile area into retention dams 82 and 83 where wastewater overflows from these storages and flows into the larger retention dam 84 from where water is automatically dosed with a flocculant prior to discharge to Tea Tree Hollow via licensed overflow point (LOP) 4. The potential impact of this discharge is not assessed in the EIS and its sizing and frequency of overflow is not clear. If pollutants other than clean sediments are present, then sizing and overflow frequency in accordance with the Managing Urban Stormwater (Blue Book) Volume 2E may not be adequate.

Controlled discharges from sediment basins

It appears that there are no controlled discharges from the REA. It is unclear how storage capacity of basins in this area are restored in the required management period so that subsequent rainfall events are adequately captured and settled, e.g. it is noted that Dam S4 is pumped to Dam M3, however the management periods for these dams is unclear. This information may have been included in a PRP report, however, it is not available for assessment in the EIS.

Flocculants

The potential impact of sediment settling agents are not assessed in the EIS. It is the responsibility of licence holders to ensure their licence regulates the discharge of all pollutants that pose a risk of non—trivial harm.

Managed overflows

Managed overflows are assumed to be consistent with the requirements of the Blue Book Volume 2E, however a specific managed overflow assessment is not provided.

While overflows are likely to be diluted, the overflow frequency from the Blue Book relates to ‘clean’ sediment, i.e. that does not contain elevated levels of other pollutants.

EPA recommends that the Department of Planning and Environment request the following be completed:

- *The potential for any managed overflows from LDP 1 is clarified and if necessary, the frequency, volume and potential impacts assessed in the EIS;*
- *Further information is provided on the methods for returning sediment basin capacities based on design management periods set out in Blue Book Volume 2E;*
- *The potential impact of sediment settling agents in discharges from the site are assessed;*
- *For site discharges, monitoring should occur initially for a full range of potential pollutants during controlled discharges and managed overflows. This discharge monitoring should include:*
  - *A full suite of metals;*
  - *Sulfate, total dissolved solids and electrical conductivity, major ions;*
  - *Total suspended solids and turbidity;*
  - *Any residual settling agent risks (flocculants or coagulants); and*
  - *Volume and frequency of controlled discharges and frequency of managed overflows.*

This initial monitoring should occur until it is demonstrated that mitigation measures are effective (e.g. measures may include placement of inert material on the outer surfaces of the waste rock emplacement.) Subject to initial results, a reduced suite of key indicators may be able to be developed, however, periodic monitoring of a wider suite of analytes may be required.

Response

The management of sediment dams is discussed in Section 2.4 of the revised Water Management System and Site Water Balance (Appendix D of the Project Amendment Report). Sediment basins have been designed and are managed generally in accordance with the *Managing Urban Stormwater (Blue Book) Volume 2E* (DECC, 2008). The current discharge/overflow volumes to LDP1 are specified in Section 2.5 of the revised Water Management System and Site Water Balance and the predicted discharge/overflow volumes to LDP1 for the Amended Project are discussed in Section 6.3 of the revised Water Management System and Site Water Balance. The existing volumetric discharge limit from LDP1 in accordance with EPL 1389 is 15.5 ML/day. EPL 1389 also permits wet weather release of water in excess of this limit, defined to be when there has been in excess of 10 mm of rainfall in a 24-hour period at the premises - "provided all practical measures are taken to minimise additional pollution caused by wet weather". On average, discharge from LDP1 was approximately 4.7 ML/d in 2016, 4.9 ML/d in 2017 and 3.9 ML/d in 2018 (SIMEC, 2019).

The predicted discharge/overflow volumes at LDP1 for the Amended Project are discussed in Section 6.3 of the revised Water Management System and Site Water Balance Report. Discharge /overflow volumes released via LDP1 to Tea Tree Hollow are predicted to peak in 2033 at 3,148 ML/ annum based on the 95th percentile result, and 2,595 ML/annum based on the median result. On average, based on the results for the full simulation period (16 years), on – going controlled releases of treated water via LDP1 is predicted at 2,029 ML/annum for much of the Project life.

The current discharge/overflow volumes to the LOPs are also specified in the revised Water Management System and Site Water Balance report . The predicted discharge/overflow volumes to the LOPs for the Amended Project are discussed in Section 6.3. Overflows to tea tree Hollow from LOPs are predicted during higher rainfall climatic conditions. Simulated overflows to Tea Tree Hollow with the Amended Project via the LOPs are predicted to peak in 2024 at 144 ML based on the median result and 456 ML for the 95th percentile results. For the 95th percentile results, simulated overflows varied from 405 ML in 2020, to 456 ML in 2024 and 72 ML in 2035. The reduction in predicted overflow from 2024 to 2035 is indicative of changes to the REA catchment areas, including rehabilitation of portions of the REA and subsequent redirection of the surface runoff off-site. On average, based on the results for the full simulation period (16 years), release from the LOPs is predicted at 115 ML/annum.

The revised Surface Water Baseline Assessment summarises the discharge water quality at LDP1 and LOP 3, 4 and 5. The revised Surface Water Impact Assessment discusses the potential changes in water quality to the LOPs and LDP1 based on the predicted discharge volumes. The sediment settling agent is specified in Section 2.0 of the revised Water Management System and Site Water Balance, with details provided of the settling agent composition. In short, the pit top area dams are dosed with Magnasol® 572 which is a low molecular weight, highly cationic coagulant to enhance sediment settling and improve discharge water quality. Magnasol 572 is comprised of 98% polyaluminium chloride (PAC) and 2% quaternary ammonium cationic organic polymer of 8% nitrogen content (EcoEngineers, 2012). As such, Magnasol 572 may contribute to aluminium in discharge waters dependent on the volume used.

Erosion and sediment control are managed via a documented sediment and erosion control plan (Xstrata Coal, 2011). Sediment basins have been designed and are managed generally in accordance with the *Managing Urban Stormwater (Blue Book) Volume 2E* (DECC, 2008). There are no volumetric or water quality limits for the LOPs specified in EPL 1389, though overflow volume and water quality monitoring of the dams is undertaken by Tahmoor Coal. **Table 5-3** presents the total monitored overflow volume discharged via each LOP between 2014 and 2018.

Table 5-3 LOP Overflow Volumes

Year	Overflow Volume (ML)		
	LOP3	LOP4	LOP5
2014	51.6	23.7	2.3
2015	2.4	32.8	1.6
2016	113.3	70.0	3.8
2017	0.0	27.0	0.8
2018	9.7	0.0	0.1

Table 5-3 illustrates that overflow to the LOPs has typically been low though peaked in 2016. Section 6.5 of the revised Surface Water Impact Assessment concludes that based on the 95th percentile model result, a peak annual overflow from dam S11 to Bargo River of 29 ML/annum is predicted and a peak annual overflow from dam S12 to Tea Tree Hollow would be 51 ML/annum.

The 6 ML/day capacity upgraded WWTP in combination with a 4,752 ML capacity underground water storage is predicted to provide sufficient capacity to ensure continued treatment of water discharged via LDP1 until 2032. Thereafter an upgraded WWTP capacity increase of between 1.5 to 3 ML/day is likely to be required, dependent on actual groundwater inflow and climatic conditions experienced at the mine.

Section 12.2 of the revised Surface Water Impact Assessment addresses operational monitoring. Prior to the commencement of longwall mining for the Amended Project an adaptive monitoring and TARP would be developed. The following surface water elements would be incorporated into the plan:

- TARPs for water quality exceedances which incorporate both baseline and control monitoring data. SSTV have been developed in accordance with ANZECC (2000) and ANZG (2018) for baseline sites which may potentially be affected by the Project – refer to HEC (2020).
- TARPs for unexpected flow loss based on analysis of baseline (i.e. pre-subsidence) streamflow data, post-subsidence streamflow data and contemporaneous data from control sites. Catchment flow modelling would also be used in the analysis.
- TARPs for unexpected loss of pool water holding capacity based on analysis of baseline (i.e. pre-subsidence) pool water level data, post-subsidence pool water level data and contemporaneous data from control pool sites. Pool water balance modelling would also be used in the analysis particularly during unusual climatic/hydrological conditions.

- Weekly inspections, photographic reconnaissance and field-based water quality monitoring undertaken when longwall mining is within 200 m of any watercourse at sites upstream and downstream of the potentially affected area. Water quality samples would be collected and analysed monthly and increased to weekly if field monitoring results indicate a change from background (e.g. exceedance of the site-specific trigger value). Results of monitoring would be analysed in relation to action response triggers on a monthly basis when longwall mining is within 200 m of a watercourse.
- The pit top water management system performance would be assessed annually against its predicted performance range. This would entail monitoring the climatic conditions on site, the main water transfers, including off site discharges and changes in stored water volumes. The performance of the water management system would be assessed by comparing the monitored water balance with water balance model predictions.
- Revision of the water management plan would be undertaken if the performance review indicates the water management system has, or is likely to be, unable to meet its regulatory performance requirements. The water management plan revision would document the measures to be implemented and their effectiveness in meeting regulatory requirements.
- The discharge monitoring would include:
  - A full suite of metals;
  - Sulfate, total dissolved solids and electrical conductivity, major ions;
  - Total suspended solids and turbidity;
  - Any residual settling agent risks (flocculants or coagulants); and
  - Volume and frequency of controlled discharges and frequency of managed overflows.

5.4.26 Surface Water: Sewage Management and Assessment

Issue Description

Section 4.5 of Appendix J states that "a sewage water treatment plant upgrade is proposed at the pit top to treat sewage on site for additional proposed bathhouses. The discharged effluent would be treated by the upgrade plant and would flow into two maturation ponds, which flow through to and are discharged via LDP1. Water quality tests would be carried out periodically on the water discharging from LDP1 to test for any elevated levels of faecal coliforms."

The potential impact of the proposed sewage discharge is not assessed in the EIS and details of the upgrade are not provided, including potential impacts on downstream aquatic ecosystems and water users, e.g. recognised swimming sites. The practical measures that could be taken to prevent, control, abate or mitigate that pollution are not considered, including reuse of effluent onsite.

Response

An upgrade is proposed at the pit top STP to treat sewage on site. The upgraded STP is proposed to have a peak capacity of 61 kL/day (Cardno, 2019). The STP upgrade will be designed and constructed to produce effluent of a suitable quality to enable discharge via LDP1 or to be used in the future for irrigation of the REA. The treated water quality to be achieved at the discharge outlet is presented in **Table 5-4**.

Table 5-4 Upgraded WWTP Treated Water Quality

Parameters	Treated Water Quality	
	50th Percentile	90th Percentile
Biological Oxygen Demand (mg/L)	5	10
Total Suspended Solids (mg/L)	10	15
Total Nitrogen (mg/L)	6	1
Ammonia (mg/L)	1	2

Parameters	Treated Water Quality	
	50th Percentile	90th Percentile
Total Phosphorus (mg/L)	0.3	0.5
pH	6.5-8.5	6.5-8.5
Oil and grease (mg/L)	-	5
Escherichia Coli (CFU/100 mL)	-	200

* Source: Cardno (2019)

In accordance with the requirements of the *Australian Guidelines for Water Recycling* (NHMRC, 2006), the upgraded STP would achieve a validated 1 log virus removal.

Discharge to LDP1 would continue to occur in accordance with EPL 1389. Water quality monitoring of faecal coliforms at LDP1 would continue to be undertaken in accordance with the existing water monitoring program.

5.4.27 Reject Disposal Assessment: Rejects Disposal Options Assessment

Issue Description

SKM undertook an options study and cost benefit analysis for management of mine reject materials. SKM determined that surface disposal at an expanded REA is the preferred strategy for disposing of reject material associated with the project. The proposed REA will expand upon the existing REA. The new areas (Areas 1 and 2) will measure a total of 803,666 m^2, to accommodate up to 9,900,990 m^3 of fill, and with a total capacity of 20,000,000 tonnes.

Response

Noted.

Changes to the longwall extent have allowed the estimated volume of rejects generated by the Amended Project to be downgraded from approximately 14.3 Mt to 11.6 Mt. In addition, the Project has been amended such that the height of the REA extension would be increased from RL 305 m as proposed in the EIS to RL 310 m. These combined changes have resulted in the required extension area for the REA to be reduced from 43 ha to 11.06 ha.

5.4.28 Reject Disposal Assessment: REA AMD and SCA

Issue Description

The Geoterra assessment did not provide specific details on how the REA material and leachate would be monitored for AMD and contaminants of concern or specify what contingency measures would be adopted if monitoring parameters are exceeded. Similarly, the assessment did not include specific details on how potential impacts to the surrounding environment around the emplacement area, would be monitored.

Recommendation:

The EPA generally agrees with the recommendations presented in the EIS Appendix W, that any REA fill materials brought onto the site, along with AMD runoff, should be required to be monitored, and tested for contaminant compounds, acid potential, and spontaneous combustion.

It is recommended groundwater should also be continued to be monitored for water quality parameters and contaminant compounds. The existing well network is considered to be limited, and consideration needs to be given to expanding this network to account for the expansion of the REA, so to adequately monitor groundwater down hydraulic gradient of the REA.

All monitoring of the proposed REA expansion, AMD runoff and groundwater in vicinity of the expanded REA, should be ensured under an ongoing monitoring plan for the site, to include contingencies to be adopted if monitoring parameters are exceeded. This plan should be developed in consultation with the EPA in consideration of the Environment Protection Licence requirements.

Response

GeoTerra was commissioned to review the REA monitoring plan and provided an update of groundwater and surface water monitoring, conducted in the vicinity of the REA (Appendix P in the Project Amendment Report).

A surface and groundwater quality monitoring network is in place around the REA. Monitoring of runoff is also undertaken, via monitoring in sediment basins S8 and S9.Groundwater would continue to be monitored for water quality parameters and contaminant compounds via an extended quality monitoring network.

The existing water management plan for Tahmoor Mine would be updated to include specific monitoring of AMD and contaminants of concern from the REA material and leachate. The water management plan would specify contingency measures if monitoring parameters are exceeded, and how impacts to the environment surrounding the REA would be monitored.

Contingency measures would be developed as required, with the measures to be developed being dependent on the issue that requires addressing. A monitoring and management strategy along with an outline of a TARP would be prepared to provide guidance on the procedures and actions required in regard to the surface water and groundwater systems in the proposed REA.

Potential surface water contingency measures may include:

- Convene Tahmoor Coal Environmental Response Group to review response;
- Immediately undertake additional water quality sampling and analysis of the site where the trigger has occurred and relevant control sites to confirm results and that the trigger exceedance is continuing;
- Undertake an investigation to assess if the change in behaviour is related to impacts from the REA, other catchment changes, unrelated pollution or the prevailing climate;
- Report to DPIE within 7 days of investigation completion; and
- If it is concluded that there has been a REA related impact, then implement a corrective management action plan.

Potential groundwater contingency measures may include:

- Convene Tahmoor Coal Environmental response Group to review response;
- Notify within 7 days to the NSW Resource Regulator – Director Compliance Operations, NRSAR, OEH, and Wollondilly Shire Council of exceedance;
- Provide written Status Report to NSW Resource Regulator – Director Compliance Operations within 4 weeks of notification reviewing requirement, assess the need for and potential cost/ benefit of preparation and implementation of a corrective action management plan;
- Investigate the potential source/s of any water quality trigger exceedance; and
- Report notification in EOP report and AEMR.

Potential spontaneous combustion contingency measures may include:

- Convene Tahmoor Coal Environmental Response Group to review response;
- Immediately undertake additional spontaneous combustion monitoring where the trigger has occurred and relevant control sites to confirm results and that the trigger exceedance is continuing;
- Undertake an investigation to assess if the change in behaviour is related to the REA or other sources;
- Report to DPIE within 7 days of investigation completion; and
- If it is concluded that there has been a mining-related impact, then implement a corrective management action plan.

5.4.29 Reject Disposal Assessment: Reject Disposal Impact Assessment

Issue Description

EPA recommends that the Department of Planning and Environment request the following:

The assessment of options for underground emplacement of coal wash reject was undertaken with information and costings obtained prior to 2013. The EPA recommends that to properly assess the feasibility of the underground emplacement, the EIS be updated using knowledge acquired from currently operating underground emplacement paste plants. One such plant that has moved from a trial to a fully operational and permanent plant is at Metropolitan Colliery. The plant now emplaces up to 20% of reject principally consisting of fine material in the goaf. The EIS should examine the technology and costs of production, and an assessment should be done of the reduction in the area of the proposed REA footprint with various amount of material emplaced underground.

Response

Reject Management Alternatives

In response to concerns regarding the consideration of alternatives to the REA, Tahmoor Coal commissioned a Rejects Management Options Gap Analysis (Palaris, 2019) (Appendix A of the Project Amendment Report), which involved:

- A review of the reject management options presented in the 2014 SKM Reject Strategy Report; and
- A gap analysis to identify technological advancements (areas of new industry knowledge gained from recent work at other coal mine sites) or areas where the original 2014 SKM report could be updated.

The Gap Analysis concluded that the only option that could be technically implemented in an active longwall goaf setting (requiring favourable geological dip and sufficient goaf porosity) is the underground emplacement of fines and ultrafines (around 20% of rejects) with the surface emplacement of all coarse fractions (around 80% of rejects). In Tahmoor South the Bulli seam dips regionally in a north east direction (perpendicular to longwall retreat direction) and is very flat (between 1-2 degrees) which is unfavourable in achieving effective emplacement of fines and ultrafines. In addition to the uncertainty around whether this option would be feasible for a material volume of fines and ultrafines, an estimated net cost of greater than A$34.7 M (2019 dollars) renders this option financially unviable.

The potential benefits of an option where some 20% of the material is emplaced underground are outweighed by a ratio of 11:1 by the increase in capital costs of this option alone. This does not consider the additional costs associated with resource sterilisation (of the Wongawilli Seam), plant reliability, increased operational complexity and operating costs arising from underground emplacement.

Tahmoor Coal acknowledges the comments made by Government and the community with respect to surface emplacement of coal rejects and has therefore amended the Project to significantly reduce the REA extension by 31.94 ha (from 43 ha to 11.06 ha). The reduction in area would be made possible by the proposed amendments to the EIS mine plan, which would reduce the total coal production from the Amended Project, and by increasing the proposed height of the REA (from RL 305 m proposed in the EIS to RL 310 m).

Amending the proposed mine plan and REA scope has also reduced the impacts to native vegetation as a result of the REA extension by around 74%. The overall design of the REA carefully considered balancing the impacts between vegetation removal and amenity. This reduction in vegetation clearance would allow Tahmoor Coal to achieve the required offset liability.

Monitoring

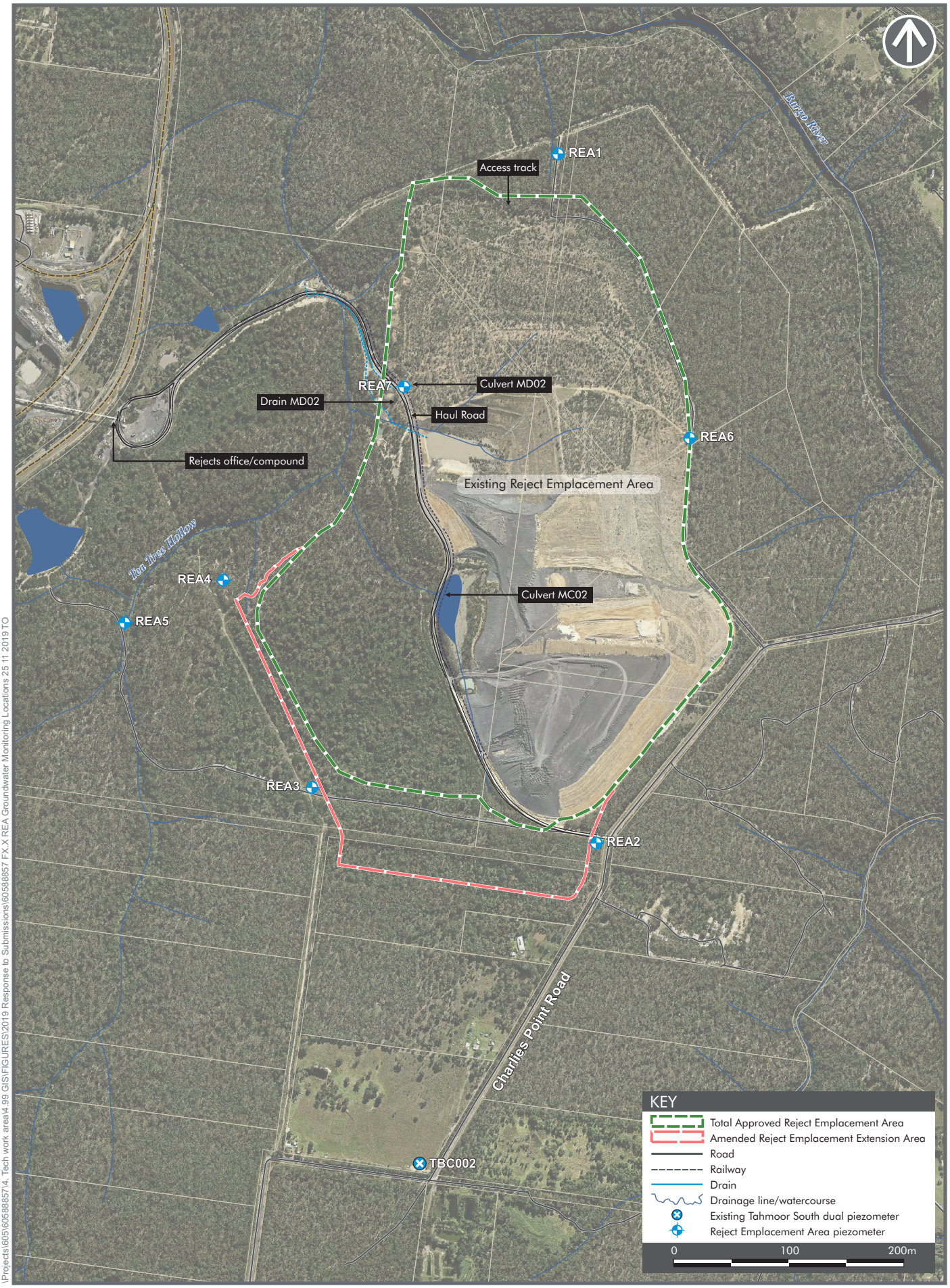
As noted in the EIS, measures implemented to manage contamination and spontaneous combustion include:

- Ongoing acid and metalliferous drainage testing during the REA construction process;

- Monitoring water quality during active placement of rejects at the REA to identify any variation in acid and metalliferous drainage;
- Adiabatic Self Heating testing throughout the REA construction process; and
- Regular visual inspections of the REA for the presence of spontaneous combustion.

Further, surface water and groundwater monitoring in August 2019 resulted in the installation of five additional piezometers (REA3 – 7) to monitor groundwater around the REA. Locations of the Piezometers are shown in **Figure 5-2**. Groundwater in the vicinity of the REA from piezometers completed within Hawkesbury Sandstone indicate a pH range from 5.04 (up gradient) to 6.25 – 7.49 (down-gradient), whilst the conductivities range from 477µS/cm (up gradient) to 477 - 583µS/cm (down-gradient). The results do not indicate any AMD influence from the REA on the underlying groundwater system.

The existing water management plan for Tahmoor North would be updated to include the monitoring of groundwater for water quality parameters and contaminant compounds. The water management plan would contain an ongoing monitoring plan for the site including contingencies if parameters are exceeded and an outline of a TARP to provide guidance on the procedures and actions required regarding the surface water and groundwater systems in the proposed REA. Tahmoor Coal to monitor will monitor spontaneous combustion with regular inspections observing any visible signs of smoke or any other obvious signs of heat production in the REA.



\Projects\605\605888574. Tech work area\4.99 GIS\FIGURES\2019 Response to Submissions\605888574 FX.X REA Groundwater Monitoring Locations 25 11 2019 TO

SIMEC

GROUNDWATER MONITORING LOCATIONS

Tahmoor South Project
Amended Project Report

FIGURE 5.2

5.4.30 Air Quality: Impact Assessment

Issue Description

The EPA acknowledges that the air quality impact assessment was undertaken in accordance with EPA's Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (EPA. 2016) (Approved Methods). The air quality impact assessment predicts minimal exceedances of project specific air quality criteria. Operation of the Project is not predicted to result in exceedances of air quality criteria for annual average PM2.5, annual average PM10, annual average TSP or annual average deposited dust under the worst-case scenario, when considering project only contributions or when including cumulative (background) contributions.

Response

The EPA's comments are noted.

5.4.31 Air Quality: Management and Mitigation

Issue Description

The EPA recommends that any approval, if given, should incorporate conditions requiring a construction Air Quality Management Plan and an updated operational Air Quality and Greenhouse Gas Management Plan.

Tahmoor Coal should develop and implement its proposed trigger action response plan relating to meteorological triggers for dust generation for receptors in close proximity to the Surface Facilities Area.

The EPA recommends additional real-time PM10 monitors be installed to monitor impacts and enable adaptive real-time management of air quality impacts. The network should target the most sensitive receptors likely to be affected by dust and specifically those on Remembrance Driveway such as the Anglican school and nearby residences. It is recommended that the monitoring network also be able to reasonably differentiate and quantify particulate emissions from the Surface Facilities Area sources in order to prioritise dust control measures.

Response

The EPA's recommendations in relation to air quality management and mitigation (including the requirements for an Air Quality Management Plan, TARP, and additional real time PM_{10} monitors) have been incorporated into the revised Environmental Management Measures for the Amended Project (refer **Chapter 7.0**).

5.4.32 Subsidence: Bargo Waste Management Centre

Issue Description

The Subsidence Impact Assessment submitted in support of the proposed development states that the BWMC "is located directly above the proposed longwall mining area" and "is expected to experience the full range of predicted subsidence movement". This report also indicates that the full potential impacts of subsidence on the BWMC are unknown at this stage and further study into such impacts is required. The EPA supports this recommendation, particularly given the facility's proximity to Dog Trap Creek.

Wollondilly Shire Council holds Environment Protection Licence No. 6061 for the BWMC. In Council's draft submission they have raised concerns that subsidence from the proposed development may cause damage to critical infrastructure such as leachate collection systems and landfill batters. Their concerns are particularly related to the fact that the facility is adjacent to Dog Trap Creek which is within the catchment of the Nepean River. They have also raised concerns that subsidence may interfere with the calibration of the weighbridge that is being installed at the facility. Council state that these potential impacts may lead to repercussions from the EPA such as revocation of their licence and expensive mitigation measures.

Whilst revoking of licences is rare, it is a regulatory tool available to the EPA for facilities that continually fail to meet their environmental and licence obligations. Generally, the EPA would require the remediation of any environmental impacts from licenced premises, which would include BWMC.

The costs of remediation have the potential to be high, particularly in situations where leachate impacts groundwater or where there are landfill gas issues that need to be managed.

Prior to determining the proposal, we recommend that the full impacts of mine subsidence on BWMC be thoroughly assessed and considered. Mitigation measures will need to be implemented to address any potential impacts to ensure the surrounding environment is protected.

Response

The concerns regarding the subsidence impacts to the Bargo Waste Management Centre (BWMC) are noted. Since the exhibition of the EIS, additional revisions have been made to the mine plan to further minimise predicted levels of subsidence as detailed in the Project Amendment Report. MSEC have included a more detailed assessment of the potential impacts on the BWMC in Section 9.3 of the Subsidence Predictions and Impact Assessment Amendment Report for Longwalls 101A to 108B (Appendix B of the Project Amendment Report). Whilst the likelihood of slope instability due to mining-induced is considered to be low, potential impacts can be controlled by selecting and implementing a range of feasible measures, depending on the nature and condition of the slopes prior to mining, in consultation with Wollondilly Shire Council, including:

- Ensuring the slopes are well compacted with drainage structures well maintained prior to and during mining;
- Constructing additional strengthening measures, such as gabion walls, or geotextile mats, if required;
- Revegetation of permanent slopes, if required;
- Monitoring during periods of active subsidence, including visual inspections and the natural valley slopes adjacent to the landfill site; and
- Providing additional support to the slopes in the unlikely event that instability is observed, including recompacting of material, reshaping the batter slopes and placement of geotextile mats, if required.

It is possible that surface cracking could occur on BWMC land. While the cracks themselves are unlikely to impact on the safety and serviceably of the BWMC, an assessment would be undertaken of the potential for leakage of polluted water into the near surface groundwater system when preparing the Extraction Plan for the relevant longwalls undermining the BWMC. The surface water treatment ponds may potentially experience impacts as a result of the proposed mining. Despite the low likelihood, it is recognised that the BWMC is located in close proximity to a tributary to Dog Trap Creek. Tahmoor Coal would assess the potential for impacts on the surface water treatment pond in consultation with Wollondilly Shire Council prior to the BWMC experiencing mine subsidence movements due to the extraction of the proposed longwalls. The consequences of leakage from the pond can be minimised by dewatering the pond prior to active subsidence and the likelihood of impacts could be reduced by installing a flexible waterproof liner in the pond.

There are a number of storage containers in the BWMC that are used for storing waste liquids. These structures are considered likely to be flexible and can most likely tolerate differential subsidence movements. Tahmoor Coal would assess the potential for impacts on the liquid waste containers in consultation with Wollondilly Shire Council prior to the BWMC experiencing mine subsidence movements due to the extraction of the proposed longwalls.

A new weighbridge is currently being designed by Council. Wollondilly Shire Council has advised that it is important that the weighbridge be functioning properly during and after mining. Tahmoor Coal has extensive experience in managing potential subsidence impacts on sensitive equipment. Whilst the likelihood of impact (due to subsidence) to the weighbridge is low due to the small footprint of the weighbridge, potential impacts can be managed by selecting and implementing a range of feasible measures, such as:

- Conducting a maintenance inspection prior to, during and after the weighbridge experiences periods of active subsidence;
- Regularly monitoring mining-induced subsidence movements at the weighbridge;

- Regularly monitoring the condition of the weighbridge during mining, including monitoring for non-planar subsidence of the platform supports;
- Adjusting the supports to the weighbridge, if required;
- Recalibrating the load cells on the weighbridge during mining, if required; and
- Repairing the weighbridge foundations, if required.

Tahmoor Coal would in consultation with Wollondilly Shire Council, study the potential for impacts to the BWMC and develop management measures to ensure that the BWMC remains safe and serviceable, as well as ensure that impacts on the BWMC do not result in environmental consequences on the adjacent Dog Trap Creek catchment. The management measures may include a combination of:

- Mitigation or strengthening measures prior to mining, particularly to the landfill slopes and surface water treatment ponds;
- Installation of a monitoring systems, which includes, among other things, the monitoring of ground movements, and condition of the landfill slopes, leachate collection system, the storage ponds, storage containers and the weighbridge;
- Conduct regular visual inspections of the BWMC; and
- Implement planned response if triggered by monitoring and inspections.

With appropriate management plans in place, it is considered that the BWMC would remain safe and serviceable at all times during mining within the extent of longwalls boundary for the Project, even if actual subsidence movements were greater than the predictions or substantial non-conventional movements occurred.

5.5 Heritage Council of NSW

5.5.1 Wirrimbirra Sanctuary Impacts

Issue Description

The Historic Heritage Assessment (HHA) concludes that potential impacts are primarily limited to subsidence associated impacts and that subsidence effects on pre-Sanctuary features are not expected. However, it does not discuss whether there is any potential for heritage impact on the post 1960s features. It notes that full site condition assessment was not possible due to access restrictions and recommends additional assessment including a detailed site inspection of historic heritage items and their contribution to the significance of the place. The HHA report was not informed by prior site inspection, enabling accurate current condition of structures, nor of bushland areas, to be recorded. The HHA report also notes that constraints meant no research was done into historic associations of any of these structures. Both these aspects are problematic, in informing a meaningful impact assessment, given the HHA's recommended 'detailed site inspection prior to mining' action.

The HHA notes that the Sanctuary's natural features are of heritage significance and (page 50) (that there) 'will be detrimental effects' on the stream, until it is remediated. Tea Tree Hollow is expected to experience fracturing of bedrock and draining of pools at times of low flow. These adverse impacts on these natural heritage values do not appear to be adequately considered in terms of framing mitigative measures, detailed monitoring procedures and thus informing the site-specific Heritage Management Plan, Extraction Plan and Groundwater Management Plans cited elsewhere as needed and to be prepared. This is inadequate heritage impact assessment, needing further revision and enhancement.

It is noted that the EIS/HHA does not fully address the following OEH input to SEARs in relation to Historic Heritage, dated 23/05/2017:

- *outline the proposed mitigation and management measures (including measures to avoid significant impact and an evaluation of the effectiveness of the mitigation measures) generally consistent with the NSW Heritage Manual (1996).*

- *include a statement of heritage impact for all heritage items (including significance assessment. This would seem contingent with an onsite inspection, condition assessment of all built items on Wirrimbirra Sanctuary, bush condition assessment and stream bedrock, Teatree Hollow and pools condition assessment, to inform mitigative measures, impact avoidance and monitoring measures at later stages).*

Accordingly, it is recommended that the following documentation be prepared and submitted to the Department of Planning, Industry and Environment for assessment prior to issue of any approval:

- *Detailed assessment of the condition, significance and associations of all historic heritage items within the Sanctuary (including post-1960s structures) and preparation of a detailed site-specific Heritage Management Plan;*
- *Consideration and refinement of mitigative measures to ensure adverse subsidence or other impacts on Wirrimbirra Sanctuary are avoided or minimised; and*
- *Preparation of a site-specific Statement of Heritage Impact (SoHI) report for Wirrimbirra Sanctuary in consultation with land owners and the NSW Heritage Council.*

The above documentation should include mitigation measures including a site inspection to report on condition, further research into associations and thus heritage values of all historic heritage items in the Sanctuary to inform a revised EIS/HHS; a further pre-mining inspection, detailed regular condition monitoring during the mining process and necessary staged restoration if subsidence or other damage occurs, to be implemented at appropriate stages of the project and subject to future, separate approvals as necessary. Impacts of the proposed borehole program within the Sanctuary should be considered in detail once the borehole locations have been finalised.

Response

Tahmoor Coal has sought access to the Wirrimbirra Sanctuary to conduct a detailed assessment of the potential impacts of the Amended Project on the built and natural heritage features of the site. The National Trust has agreed to provide access for specialists to assess the impacts for Wirrimbirra Sanctuary in early 2020. Tahmoor Coal is committed to completing a site-specific Statement of Heritage Impact report, in consultation with land owners and the NSW Heritage Council, that would be prepared and submitted to DPIE. Prior to the commencement of longwall mining associated with the Amended Project, Tahmoor Coal would prepare a site-specific Heritage Management Plan for Wirrimbirra Sanctuary.

The potential impacts of the Amended Project on Wirrimbirra Sanctuary have been assessed in the following revised technical assessments for the Amended Project:

- Subsidence Assessment (Appendix B of the Project Amendment Report). Refer Sections 5.14, Table D.08, Table D.12;
- Surface Water Impact Assessment (Appendix D of the Project Amendment Report). Refer Section 6.6;
- Aquatic Ecology Assessment (Appendix F of the Project Amendment Report, Table 20, impacts to Tea Tree Hollow); and
- Biodiversity Assessment Report (Appendix E of the Project Amendment Report, Section 8.7).

Further detail in relation to each potential impact is provided below.

Subsidence

The Wirrimbirra Sanctuary is located above Longwalls 103A and 104A near Tea Tree Hollow and the Main Southern Railway Line and will be directly mined beneath by the proposed longwalls. A specific management plan will be developed for the Sanctuary as part of the development of the Extraction Plan for these longwalls, prior to longwall mining commencing.

Surface Water

Three pools have been identified on Tea Tree Hollow tributary within Wirrimbirra Sanctuary – TTH-PO2, TT-PO3, TTH-PO4. Based on the rock bar impact model for the Southern Coalfield, while there is a chance that TTH-PO2 may be impacted if subsidence occurs, it is unlikely as less than 10% of pools are expected to be impacted at the level of predicted total closure. At pools TTH-PO3 and TTH-PO4, the predicted total closure after all longwalls is 300 mm and 325 mm, respectively. As such, there is a moderate chance that pools TTH-PO3 or TTH-PO4 may be impacted (30% of rock bars or upstream pools are expected to be impacted at this level of predicted total closure).

Water level monitoring is proposed to be conducted upstream and downstream of Wirrimbirra Sanctuary and at TTH-PO2 and TTH-PO4. The proposed pool level monitoring would complement stream flow monitoring undertaken on Tea Tree Hollow downstream of the Wirrimbirra Sanctuary. The monitoring network would enable assessment of any changes in pool water level and streamflow in Tea Tree Hollow as a result of the Amended Project. Should impacts be identified, a TARP, as documented in the water management plan to be prepared for the Amended Project would be implemented comprising management and remediation measures.

Aquatic Ecology

Two pools are located in an area of moderate risk of impact to flow holding capacity. Thus, there may be loss of aquatic pool habitat in these two pools in Tea Tree Hollow as a result of the Amended Project. In addition, there may be changes to the quality of the aquatic habitat through subsidence related impacts on water quality. It is possible however that cracking would be naturally infilled over time due to the nature of the substrate upstream of this area. Should impacts be identified, a TARP, as documented in the environmental management plan to be prepared for the Amended Project, would be implemented comprising management and remediation measures.

Biodiversity

No vegetation clearing is proposed within Wirrimbirra Sanctuary.

Subsidence related impacts towards threatened biodiversity are likely to be minor in nature or negligible, notably due to the following:

- The revised Subsidence Assessment (Appendix B of the Project Amendment Report) has not predicted any significant gas emission releases along any of the water courses within the biodiversity study area, and such occurrences are rare within the Southern Coalfields. As such, vegetation communities that occur along watercourses are unlikely to experience such impacts, and if it did occur, would be highly localised and regenerate following the event;
- Vegetation communities which are independent of groundwater and not closely associated with the water levels and hydrology of the creeks are unlikely to be impacted by subsidence due to underground mining;
- The creeks within the biodiversity study area (including that of Tea Tree Hollow located adjacent to the Wirrimbirra Sanctuary) are ephemeral in nature. It is highly likely that the vegetation along the water courses are accustomed to periodically dry conditions. The riparian vegetation is not solely reliant upon groundwater for its survival and regularly experiences dry conditions. As such, should water diversion occur as a result of subsidence, it is unlikely to result in significant alterations to the composition of the community or vegetation die back;
- Impacts to vegetation as a result of earth and rock-face instability will be highly localised and relatively minor in nature. Large-scale impacts to vegetation as a result of large-scale slope failures are highly unlikely based on the subsidence predications for the Amended Project; and
- Threatened flora, including that of *Pomaderris brunnea*, which occurs along Tea Tree Hollow near Wirrimbirra Sanctuary, for the most part, typically occur on the mid-bank to higher banks, away from the creek bed. The creek was dry for much of its traverse during the survey and monitoring years, with intermittent shallow pools occurring in the area where the majority of the population resided. As such, it could be reasonably assumed that there is a disconnection of *Pomaderris brunnea* to the water within the creek given the species' persistence during periods where water in the creek was absent. Any potential drying of pools or predicted changes to the hydrological regime as a result of subsidence is therefore unlikely to result in die back of the *Pomaderris brunnea* population.

The Statement of Heritage Impact for Wirrimbirra Sanctuary will include further consideration of these aspects. Recommended management and mitigation measures would be captured in a Heritage Management Plan for the site.

5.6 NSW Health

5.6.1 Health Impact Assessment

Issue Description

The proposal would continue to access existing facilities with some additional surface infrastructure upgrades. We note that there are established monitoring processes in place that will continue and be scaled up for the construction phase with mitigation measures proposed for air pollution, noise pollution and water quality. Whilst these factors suggest the risk to the health of the community is unlikely to increase significantly with the current proposal, the EIS notes exceedances to air and noise pollution standards without a reliable way of assessing the current and future health impacts. It is therefore suggested that a more detailed health impact is included as part of the EIS, preferably through the implementation of a formal Health Impact Assessment (HIA). Whilst the Social Impact Assessment includes a section on 'Health and Wellbeing', it is not comprehensive enough. HIAs are used to systematically identify and assess health impacts of an activity and would provide more detail about the health impacts of both current and future mining activity.

Response

NSW Health's concern regarding potential impacts to human health are noted.

A Health Impact Assessment (HIA) has been prepared for the Amended Project to provide an additional and holistic assessment of these issues (refer Appendix N of the Project Amendment Report). The HIA assessed potential impacts to human health in relation to air quality, noise, water and social wellbeing arising from the Amended Project, finding there would be low to negligible impacts. Further discussion on each of these individual aspects is provided in the response below.

5.6.2 Air Quality

Issue Description

The effect of construction of two mine ventilation shafts has the potential to result in dust deposition, visible dust plumes and elevated PM_{10} concentrations. These impacts are stated to be short term and temporary in nature. The worst-case scenario indicates that PM_{10} concentration is likely to be exceeded for between one and nine days a year for a single monitoring site. It is stated in the EIS that 'incorporation of the TARP and other dust management practices, [that] these exceedances would be well managed', however, it is not possible from the EIS to estimate the likely health impacts on any residents nearby. The proposal includes ongoing monitoring of air quality and odour and mitigation measures such as the Construction Air Quality Management Plan.

Response

The revised Air Quality Impact Assessment (AQIA) prepared for the Amended Project (Appendix J of the Project Amendment Report) included consideration of the following applicable criteria as they relate to human health:

- NSW EPA assessment criteria;
- National Health and Medical Research Council (NHMRC) criteria; and
- National Environment Protection Measures (NEPM) reporting criteria.

The outcomes of the AQIA were then used in the assessment of potential human health impacts in the Project HIA.

The AQIA demonstrated compliance with all relevant air quality criteria at nearby receivers taking into account both project-only and cumulative (project plus background) impacts, in relation to:

- Total suspended solids (annual average);
- Deposited dust (annual average);

- $PM_{2.5}$ (annual average and 24-hour – project only); and
- PM_{10} (annual average).

Importantly, the AQIA demonstrated very low contributions from the Amended Project to cumulative annual average $PM_{2.5}$ concentrations (equal to less than 1.1 µg/m^3 at each receiver, noting the annual average NEPM standard of 8µg/m^3). When other sources are considered, predicted total annual average $PM_{2.5}$ levels are predicted to be less than the NEPM standard of 8µg/m^3. This is significant as reviews of the health effects of particulate matter have generally identified that the smaller PM are of greater health concern as these particles can penetrate further into the respiratory tract. In addition, the assessment also indicates low contributions from the Amended Project of PM_{10} to cumulative annual average levels (less than 8.4 µg/m^3, noting the annual average EPA PM_{10} criterion of 25 µg/m^3). Project particulate matter contributions at receivers are further detailed in Tables 10.1 and 10.2 of Appendix J of the Project Amendment Report.

Some exceedances of 24-hour PM_{10} concentrations have been predicted. The AQIA estimated the probability of a cumulative 24-hour PM_{10} exceedance as being between one and five days during a year at up to six receivers using the Monte Carlo Simulation approach, including both project and background contributions to PM_{10}. Additional management may be required to reduce potential dust impacts at these properties. The additional management measures would be included in the TARP in place at Tahmoor Mine for air quality management (TAH-HSEC-264) and detailed in the Air Quality Management Plan for the Project. The AQIA considered that with the ongoing implementation of the TARP these potential impacts would be well managed.

Importantly, Tahmoor Coal has a reactive and predictive Air Quality Control System in place to manage dust impacts, which would continue to be implemented during operation of the Amended Project. The system includes daily alerts for site personnel of meteorological conditions and predicted daily dust risk over the Amended Project and at nominated receptors around the Amended Project Area to manage air quality and particulate matter risks early and proactively, by informing site activities (based on background conditions) in real-time and thereby reducing the likelihood of exceedances arising from the Amended Project. This process has been successfully implemented at Tahmoor Mine and it is expected that this process would manage air quality from the Amended Project and associated impacts on receivers.

In relation to the construction of the new mine ventilation shafts as raised by NSW Health, the AQIA and HIA considered potential impacts associated with the construction of these ventilation shafts, which have the potential to result in dust deposition, visible dust plumes and elevated PM_{10} concentrations. To assess construction related air quality impacts, the AQIA conservatively assumed that construction activities (including installation of the new ventilation shafts, construction of the amended REA and upgrades to surface facilities), would occur at the same time and during the worst-case operational year. While this will not be the case, it ensures a conservative assessment is presented. Under this scenario, dust generated from construction would increase the modelled dust impacts by 10% to 12%. The HIA concluded that, based on the assessment of health impacts from modelled dust emissions, such an increase in dust would not change the outcomes of the assessment undertaken. On this basis the HIA concluded there are no health impacts of concern in relation to dust generated during construction.

Notwithstanding, dust management practices including the operation of a TARP, ongoing monitoring of air quality (including PM_{10}) and odour and other mitigation measures to be outlined in the Construction Air Quality Management Plan would minimise impacts further.

5.6.3 Noise

Issue description

Noise from the existing Tahmoor mine was found to be above the Project-specific noise levels at a number of locations but the levels are predicted to reduce for most receptors during the day and evening periods. Mitigation measures and monitoring are included in the plan. It is again not possible from the EIS to assess what the impact from these noise exceedances are for the health of residents.

Construction noise is predicted to be below the sleep disturbance screening criteria at all nearby assessment locations. Two properties affected by construction noise levels outside of standard hours are being negotiated with for the purpose of acquisition. The EIS states that 'Tahmoor Coal will continue to monitor and actively manage construction noise and vibration as part of the proposal'.

Response

The revised Noise and Vibration Impact Assessment undertaken for the Amended Project (Section 11.10 and Appendix I of the Project Amendment Report) was used as a basis for the assessment of potential noise related human health impacts in the HIA.

The HIA (Appendix N of the Project Amendment Report) evaluated of operational noise impacts associated with the existing Tahmoor Mine, the Amended Project before incorporating mitigation measures and the Amended Project before incorporating mitigation measures with mitigated measures. Under all of these scenarios there are a number of locations where there is predicted to be an exceedance of the Amended Project specific noise level by varying levels (no more than 2 dB, 3 to 5 dB and more than 5 dB) under worst-case meteorological conditions described as either noise enhancing or calm. Based on the assessment undertaken, where the Amended Project is operational and mitigation measures are implemented:

- There would be a significant reduction in the number of private dwellings affected by night-time noise, under noise enhancing conditions, that exceed the criteria by more than 5 dB (reduction from 33 dwellings for the existing Tahmoor mine to 6 dwellings);
- Night-time noise levels at the community receptors would be expected to be reduced by 2 to 18 dB; and
- Day and evening noise levels would be expected to be reduced by up to 7 dB at most community receptors.

Exceedances of the noise criteria that are categorised as negligible, marginal, moderate or significant are illustrated on Figure 6.3 and 6.4 in the revised HIA (Appendix N of the Project Amendment Report). Ultimately, the assessment of potential impacts on sleep disturbance determined that the operation of the Amended Project was unlikely to result in maximum noise events that would result in sleep disturbance.

Assessment of construction noise impacts during standard operating hours identified some areas where exceedance of the guidelines is predicted, however no noise levels exceed the criteria for highly noise affected. While such outcomes are not uncommon for construction projects, noise mitigation measures have been identified to minimise impacts during construction. Where these mitigation measures are implemented, it is expected that potential impact on community health are minimised. It should be noted that even where noise mitigation measures are implemented, noise levels during construction may be noticeable at times.

For works outside of standard operating hours, impacts equal to or in excess of the adopted criteria were identified at the two nearest properties on Charlies Point Road (this includes 215 Charlies Point Road), which is now owned by Tahmoor Coal. Noise during these activities is likely to be below the relevant sleep disturbance criteria at all locations and hence at night-time is unlikely to result in health impacts.

Based on the predicted noise levels and recommended mitigation measures, the potential for adverse health impacts to occur as a result of noise generated during construction and operations is considered to be low. The current noise management plan for Tahmoor North mine would be revised to include the noise mitigation measures relevant to the Amended Project, including any additional mitigation measures identified by Tahmoor Coal to address operational noise levels from the existing mine and proposed Amended Project.

5.6.4 Water Quality

Issue Description

Additional water quality impacts due to releases and overflows from the site water management system are likely to be low. Any impacts to private bore users (groundwater quality or quality) would be subject to make good provisions by Tahmoor Coal. Surface water monitoring of quality will continue during mining, with remediation measures and post-mining monitoring programs in place.

Response

Additionally, based on the assessments undertaken, the HIA concluded the potential for adverse health impacts to the community associated with impacts to surface water and groundwater as a result of the Amended Project is considered to be negligible.

5.6.5 Social Impact assessment

Issue Description

A social impact statement is included in the EIS, which concludes that the social impacts of the Project are likely to be generally consistent with those of the existing operations at Tahmoor Mine. However, the Health and Wellbeing section within the SIA report (3.2.2 page 41) is not very comprehensive.

Response

The health and wellbeing Section of the SIA provides a high-level qualitative summary of the potential health and wellbeing impacts of the Amended Project.

A HIA has now been prepared for the Amended Project (refer to Appendix N of the Project Amendment Report), which further considers social impacts. The HIA included reference to the technical reports which contain quantitative impact assessments in relation to potential noise, air quality and water impacts as they relate to human health. The HIA concluded that there would be no to low probability of health-related social impacts arising from the Amended Project. Rather, the Amended Project would result in benefits such as employment and associated positive feedbacks that would occur in the local community.

5.7 Office of Environment and Heritage

5.7.1 Biodiversity: Biodiversity and Offsets

Issue Description

- *The proponent should thoroughly demonstrate how the "avoid" principle of biodiversity assessment policy, guidelines and the SEARs has been met with regard to the site's biodiversity constraints. This is particularly critical given the quantum of critically endangered native vegetation and threatened species including primary koala habitat proposed to be cleared for the purposes of an expanded reject emplacement area;*
- *Consideration should be given to reducing the quantum of clearing and resultant impacts upon listed threatened entities, with offsets limited to residual impacts only. The proponent should also undertake a hollow-bearing tree survey to quantify impacts to potentially occurring hollow dependent threatened species, and to determine high habitat value site constraints so impacts to these areas can be avoided and/or minimised;*
- *Impacts for Further Consideration (IFFC) for Persoonia bargoensis in accordance with 3.9.2 of the NSW Framework for Biodiversity Assessment (FBA) needs to further demonstrate that the local population will not be put at risk of extinction or have its viability significantly reduced as a result of this development. In the absence of further surveying, the eastern pygmy—possum should also be assumed present and included as a species to be offset; and*
- *Further development of the Biodiversity Offset Strategy (BOS) is required to demonstrate that required offsetting, after all avoidance measures have been applied, can be achieved. Further clarification regarding some species not identified to be offset as described at Attachment A must also be addressed.*

Response

The 'avoid' principle has been central to mine planning for the Amended Project from the pre-feasibility stage all the way through to the mine plan presented in the EIS, and now in the Amended Project, as follows:

- Pre-feasibility: an environmental constraints analysis was completed with inputs from subsidence engineers, ecologists, hydrogeologists, hydrologists and heritage specialists. During the analysis, the key sensitive environmental features in the landscape were identified and considered in development of the prefeasibility mine plan. In particular, the Bargo River gorge and Hornes Creek were avoided.
- EIS mine plan: the mine plan was further refined during preparation of the EIS via a series of collaborative workshops between the technical specialists, and the identification of risk management zones along the Bargo River, Hornes Creek, Dog Trap Creek, Eliza Creek and waterways in the Metropolitan Special Area. The mine plan was revised several times during preparation of the EIS to avoid impacts to the Metropolitan Special Area (by shortening and removing longwalls from the Metropolitan Special Area), to Eliza Creek (by removing Eastern Domain longwalls) and to Dog Trap Creek (shortening longwalls).
- Amended Project mine plan: the mine plan has been amended to further reduce subsidence movements across the whole Project (by reducing the cut height and longwall width) and to Dog Trap Creek in particular (through the removal of Longwall 109) (refer to **Chapter 2.0**), in response to Government agency and community submissions.

With respect to assessing and avoiding environmental impacts related to the surface disturbance footprint of the Project, following public exhibition of the EIS, amendments to the Project include:

- Reduce the footprint of the REA extension from 43 ha to 11.06 ha. As a result of the amended REA footprint extension, impacts to biodiversity are reduced. This amendment would result in an approximately 50% reduction in area of previously undisturbed native vegetation to be directly impacted when compared to the EIS project design, from 49.2 hectares to 23.57 hectares, noting that 14.2 ha of the vegetation to be cleared by the Amended Project is mine rehabilitation vegetation.
- Hollow-bearing tree assessments were completed with results discussed in Section 6.1 of the revised Biodiversity Assessment Report (Appendix E of the Project Amendment Report). A total of 14 hollow-bearing trees were recorded in the Study Area.
- The redesign of the REA has avoided a significant impact under the EPBC Act for *Persoonia bargoensis,* by reducing the removal of 96 individuals down to 8 individuals.
- The Biodiversity Offset Strategy has been detailed in Section 12.1 of the revised Biodiversity Assessment Report (Appendix E of the Project Amendment Report). Offsets have been proposed for all threatened species impacted by the Amended Project as per the requirements of the FBA, and for those threatened species that may have a significant impact under the EPBC Act (i.e. Shale Sandstone Transition Forest).
- Include the powerline required to supply power to the proposed ventilation shafts. At the time the EIS and supporting Biodiversity Assessment Report was completed, the detailed design of the powerline had not been completed and the route was not known. Approval of the powerline is now being sought as part of the Amended Project and the powerline and easement required are assessed in the revised Biodiversity Assessment Report (Appendix E of the Project Amendment Report).

Vegetation clearing footprints for the various Project elements are shown in **Table 5-5.**

Direct impacts on the following threatened flora have also been reduced and are presented in **Table 5-6.**

Table 5-5 Development footprint for the surface infrastructure applicable to biodiversity

Project element	Native vegetation disturbance (ha) - Shale Sandstone Transition Forest (EEC)	Native Rehabilitated Vegetation (ha) - Plantings	Non-native / cleared land (ha)	Total development footprint (ha)
REA	11.06	14.20	41.90	67.16
TSC 1 Ventilation shaft site	6.05	0.00	3.58	9.63
TSC 2 Ventilation shaft site	3.47	0.00	0.01	3.47
Powerline	2.99	0.00	0.85	3.84
Total	**23.57**	**14.20**	**46.34**	**84.10**

Table 5-6 Reduction in impacts to threatened flora

Aspect	EIS	Amended Project	Notes
Expanded REA footprint	43 hectares	11.06 hectares	74% reduction. Increase in height to reduce footprint.
Disturbance of native vegetation	49.2 hectares	23.57 hectares (not including 14.2 hectares of mine rehabilitation).	52% reduction
Shale Sandstone Transition Forest (EEC)	43.4 hectares	23.57 hectares	46% reduction
Persoonia bargoensis	96	8	REA design to avoid population and no longer likely to result in a 'significant impact
Grevillea parviflora subsp. *Parviflora* (individuals)	2,324	491	Avoided core population and remains unlikely to result in a 'significant impact'
Pomaderris brunnea (individuals)	40	1	Remains unlikely to result in a 'significant impacts'

Further detail regarding avoiding and minimising impacts is provided in Section 9 of the Biodiversity Assessment Report for the Amended Project (Appendix E - Biodiversity of the Project Amendment Report). Offsets have been calculated for residual impacts to threatened biodiversity (Section 10 and Section 11 of Biodiversity Assessment Report).

5.7.2 Biodiversity: Avoidance of impacts

Issue Description

The site's biodiversity values are comprehensively documented in the BAR and considered to be high, given the quantum of critically endangered native vegetation and known site values as threatened species habitat. In February 2019, OEH undertook a site inspection of the two REAs where most of the clearing is to take place and concur with these findings.

The NSW Biodiversity Offsets Policy for Major Projects and FBA requires that before offsets are considered, impacts must first be avoided, with avoidable impacts minimised through mitigation measures, and only then offsets considered for residual impacts. We acknowledge that the proponent has taken certain steps to avoid and minimise biodiversity impacts, as addressed in the BAR, the EIS and the reject disposal options study (Appendix U).

However, there is limited discussion about alternative locations that were investigated, such as the area to the north of REA 2 which does not contain the SSTF CEEC. Although briefly mentioned in the EIS, the extent to which mitigating factors such as noise, dust and light spill to residential properties to the north have informed the REA expansion proposal warrants further examination to re-orientate the proposed REA.

The preferred option for surface disposal (expanded REA) as opposed to co-disposal (underground disposal as paste and surface REA) has also not been addressed in terms of biodiversity constraints of the site. It is noted that co—disposal would reduce impacts on vegetation in comparison to the proposed surface disposal option.

Undergrounding of reject material as paste was discounted in the options report on the basis of technical complexity. However, we note that the analysis dates from 2013 and since this time, undergrounding 20% of reject material has been successfully implemented at another longwall coal mine in the Southern Coalfields. This may suggest an improved feasibility for undergrounding reject material since the options study was completed. Furthermore, other alternate options such as material reuse or off—site disposal have not been addressed in terms of biodiversity constraints. DPE should revisit and appraise the cost feasibility of alternate disposal options that may result in reduced impacts on vegetation. As such, we recommend that alternatives be further considered with regard to biodiversity constraints, particularly given:

- *the extent of impact proposed by way of CEEC clearing*
- *the impact is for reject or waste emplacement, a purpose secondary to coal extraction itself*
- *advancements in undergrounding of rejects disposal since the options study was completed*

This concern has also been raised with the proponent prior to EIS lodgement. An option discussed was to re-orientate the REA slightly to avoid impacting upon a small linear track area to the east that had considerable biodiversity significance. A limiting factor to re-orienting the REA and to reduce direct impacts to SSTF CEEC was the existing consent conditions about noise, dust and light-spill on nearby landowners. Consideration could be given to reviewing and possibly fine-tune such conditions to re-orientate the REA to the north and retain areas of higher biodiversity significance.

Response

The surface footprint of the REA is proposed to be reduced, Tahmoor Coal has undertaken further investigations into alternatives to surface emplacement of rejects, as discussed in the Section 7.4 of the revised Biodiversity Assessment Report (Appendix E of the Project Amendment Report).

In addition, a revised Rejects Disposal Options Study (Palaris, 2019) (Appendix A of the Project Amendment Report) was prepared to review alternative reject disposal options considering technical issues, risks and economics of the various options. The options that were identified for further detailed investigation were:

- Surface disposal at an extended existing reject emplacement area; and
- Underground disposal as paste material (active goafs via a trailing pipe).

These two options were considered in a cost-benefit analysis and options analysis. Based on the economic decision criteria used to evaluate the cost-benefit analysis, the extension of the existing REA was determined to be the preferred option. When assessed in the options analysis, it was found that the extension of the existing REA performed better than the co-disposal option against the following criteria:

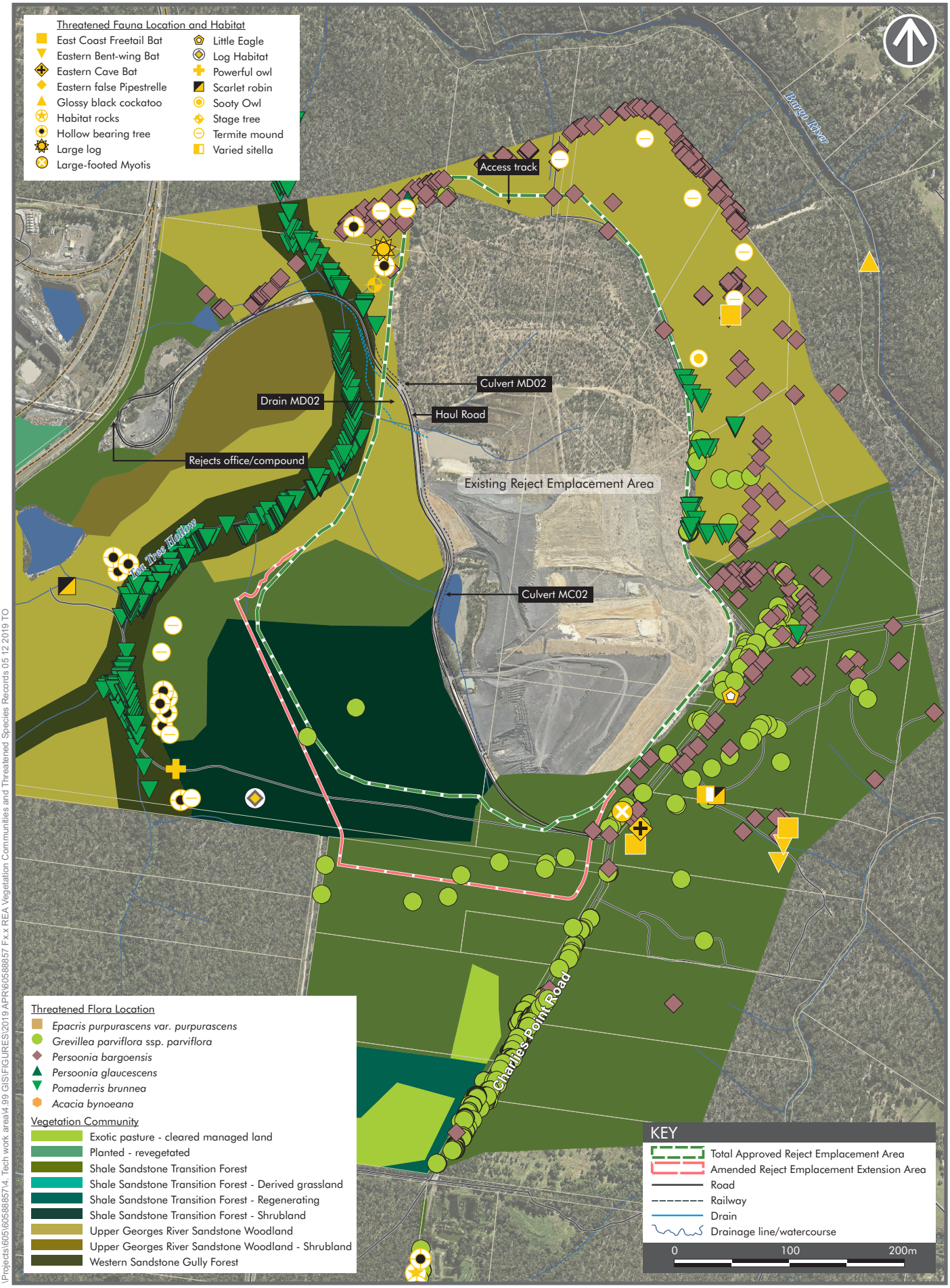
- Benefit to cost ratio;
- Impact on available coal reserves;

- Impact on production;
- Minimal processing of rejects;
- Water usage;
- Risk of surface/groundwater and subsurface water chemical contamination; and
- Control of spills.

Tahmoor Coal commissioned a Rejects Management Options Gap Analysis (Palaris, 2019) (Appendix A of the Project Amendment Report). The Gap Analysis concluded that the only option that could be technically implemented in an active longwall goaf setting (requiring favourable geological dip and sufficient goaf porosity) is the underground emplacement of fines and ultrafines (around 20% of rejects) with the surface emplacement of all coarse fractions (around 80% of rejects). Tahmoor Coal has amended the Project to reduce the REA extension by 31.94 ha (from 43 ha to 11.06 ha). The reduction in area would be made possible by the proposed amendments to the EIS mine plan, which would reduce the total coal production from the Amended Project.

The REA was re-designed to avoid the corridor of *Persoonia bargonensis* to the east of the existing REA, to avoid *Grevilliea parviflora* and to reduce the impact on Shale Sandstone Transition Forest by approximately 74%. This was achieved by increasing the height of the REA (from RL 305 m to RL 310 m), and subsequently reducing the REA footprint, while retaining the same emplacement volume. This rehabilitation is not EEC and therefore on balance it was decided that the removal of the rehabilitation was a better outcome for biodiversity values than the removal of Shale Sandstone Transition Forest.

To account for a quantitative measure of indirect impacts, a 100 m buffer has been placed around the Amended Project Area. This buffer would likely encapsulate the potential spread of weeds, edge effects in surrounding vegetated areas, erosion, dust, intensive light spill, and sedimentation during construction and operation. The overall design of the REA carefully considered balancing the impacts between vegetation removal and amenity. This reduction in vegetation clearance would allow Tahmoor Coal to achieve the required offset liability. **Figure 5-3** shows the EIS REA and the amended REA footprint.



\Projects\605\605888574. Tech work area\4.99 GIS\FIGURES\2019 APR\605888574 F.x.x REA Vegetation Communities and Threatened Species Records 05 12 2019 TO

SIMEC

REJECT EMPLACEMENT EXTENSION AREA VEGETATION COMMUNITIES

Tahmoor South Project
Response to Submissions Report

FIGURE 5.3

5.7.3 Biodiversity: Hollow-bearing Trees and Further Loss of EEC

Issue Description

Hollow—bearing trees are a key habitat feature for a variety of threatened and non-threatened species. Removal of these trees is difficult to mitigate given the time it takes for hollows to form and so therefore it is preferable that impacts on hollow-bearing trees are avoided and/or minimised.

Given the large number of hollow dependent threatened fauna species which occur, or have potential to occur in the area, we recommend that a comprehensive assessment of hollow-bearing trees in all areas proposed to be impacted be undertaken. This assessment could be used to quantify impacts to potentially occurring hollow dependent threatened species and to determine high habitat value site constraints, so that further avoidance may be considered.

Section 6.5.1 of the FBA requires species credit species which cannot withstand further loss to be identified in the BAR. Persoonia bargoensis and Grevillea parviflora are both species which are listed as not able to withstand further loss within the NSW Threatened Species Profile Database, however this has not been addressed in the BAR. This further underlines the rationale for avoidance and as such, we recommend this matter be considered further for this project (i.e. re-orientation potential for the REA).

Response

Hollow Bearing Trees

Hollow-bearing tree surveys were undertaken within revised footprint impact areas in September 2019, with a total of 14 hollow-bearing trees being recorded in the Study Area. Impacts to hollow-dependent fauna have been reduced due to amendments made to the Project which would result in avoiding clearance of hollow-bearing trees. As discussed in Section 6.3 of the revised Biodiversity Assessment Report (Appendix E of the Project Amendment Report), no evidence of breeding pairs of threatened fauna was found in the hollow bearing trees, located in the Study Area, which indicates that breeding habitat is unlikely. The assessment also determined that subsidence impacts on hollow-bearing trees would be unlikely.

Hollow-bearing trees are identified on Figure 17 of the updated Biodiversity Assessment Report for the Amended Project.

Reduced Impact to EEC

A statement confirming that these two species (*Persoonia bargoensis* and *Grevillea parviflora*) cannot sustain further loss has been included in the revised Biodiversity Assessment Report (Section 7.4.1). In response, the Project footprint has been amended to reduce impacts to both species as follows:

- *Persoonia bargoensis*; from 96 to 8 individuals; and
- *Grevillea parviflora* subsp. *parviflora:* from 2,324 to 491 individuals.

The Amended Project is considered unlikely to result in a significant impact to *Persoonia bargoensis* based on the following:

- The important population would be reduced by only 1.2 percent based on the removal of eight of 692 known plants; and
- The seed bank and viability of the population are unlikely to be impacted by the removal of 1.2 percent of the individuals in the population.

Whereas, the Project is unlikely to result in a significant impact to *Grevillea parviflora* subsp. *parviflor*a as:

- The proposed disturbance would result in direct impacts to 491 plants within an important population, however over 10,000 plants would not be impacted by the Project and would remain viable;
- Larger populations supporting tens of thousands of plants would not be impacted by the Amended Project. The populations located within the Nepean State Conservation Area and within Tahmoor Coal land to the west of Bargo would not be impacted by the Amended Project;

- The species is unlikely to be impacted by subsidence; and
- Mitigation measures proposed would reduce the likelihood of indirect impacts to the retained proportion of the important population within the Study Area and surrounds.

Re-Orientation Potential for the REA

Re-orientation of the REA is not practical due to the presence of existing infrastructure, as well as the increased potential of creating amenity impacts for residents along Rockford Road (including noise and air quality impacts).

5.7.4 Biodiversity: Impacts for Further Consideration

Issue Description

Section 9.2 of the FBA states that certain impacts require further consideration by the consent authority.

Impacts for Further Consideration (IFFC) for the SSTF are considered on page 112 of the BAR. This assessment found that 5% of the mapped occurrence of SSTF will be cleared, stating that this patch is "quite large in comparison to other ground truthed patches of the community in the locality". The assessment states that "given SSTF is listed as Critically Endangered, all areas containing this community are important, particularly larger patches". Some fragmentation of the vegetation community is expected from clearing both REAs.

In addition to the above, this vegetation type provides habitat for a large number of potentially occurring threatened species including the Koala. The importance of this vegetation for hollow dependent microbats, bird and mammal species is unknown as an assessment of hollow bearing trees has not been provided.

IFFC for Persoonia bargoensis are also considered in the BAR, which identifies that the Project will remove approximately 14% of the known population. The report states that despite this, the population is likely to remain viable, however there is no clear description what the local population comprises, and how this was determined. If impacts are uncertain, the Precautionary Principle should be considered. Further avoidance of impacts on this species should also be considered.

Detailed discussion on threats to the species, such as response to fire, disease etc and quantification of indirect impacts on adjoining land is also required. The assessment does not adequately address how the proposed offsets will contribute to the recovery of the species in the IBRA region. The existing area of habitat available for the Persoonia bargoensis may be overstated, as not all the areas described contain the species. For example, suitable habitat occurs in REA 1, however no Persoonia bargoensis were recorded in that area.

Response

The Amended Project footprint has resulted in a reduction in impact to:

- SSTF: from 43.5 hectares to 23.57; and
- *Persoonia bargoensis*: In total, 692 individuals of *Persoonia bargoensis* were recorded during the biodiversity surveys. The project has been footprint revised to reduce impact on *Persoonia bargoensis* from 96 Individuals to eight (8) (14% of known population to 1.2%).

It is noted that not all areas identified as potentially suitable offset habitat in the locality have been confirmed as suitable for *Persoonia bargoensis* (as detailed in Section 8.3.1 of the Biodiversity Assessment Report).

In the relation to the appropriate management of *Persoonia bargoensis* and SSTF impacts in the Interim Biogeographic Regionalisation for Australia (IBRA) region, the Amended Project would require a like-for-like offset to satisfy the requirements of the Framework for Biodiversity Assessment (FBA). As such, this would result in the establishment of a conservation area that would protect and enhance both the *Persoonia bargoensis* and SSTF. Given *Persoonia bargoensis* and SSTF are both limited in its range, much of the land the community occupies is in the Cumberland IBRA region, and as such, it is likely that the conservation area would be established there, and thus contribute to their recovery within the IBRA subregion.

5.7.5 Biodiversity: Subsidence impacts

Issue Description

The FBA does not prescribe assessment of direct impacts of a project that are not associated with the clearing of native vegetation, including subsidence and cliff falls associated with mining developments. Separate assessment of these impacts not covered by the FBA may be required if incorporated in the SEARS. The SEARS state that the EIS must address subsidence, including impacts on the natural environment.

Although subsidence—related impacts upon biodiversity are generally addressed in the BAR in accordance with the SEARS requirements, it is noted that not all private properties having flora and fauna potentially impacted by subsidence were inspected. The BAR states that a Biodiversity and Subsidence Management Plan with active monitoring will be implemented to reduce impacts on biodiversity. Further detail on how this will be achieved, and adaptive management strategies will need to be elaborated in the Plan. In preparing these post—approval plans, reference could also be made to the monitoring protocols under the Addendum to NSW Biodiversity Offsets Policy (Swamp Offsets Policy).

Response

Potential impacts as a result of subsidence are included within the revised Biodiversity Assessment Report prepared for the Amended Project (Appendix E of the Project Amendment Report). A specific biodiversity management plan will be prepared as part of the Extraction Plan for each series of longwall panels, which will describe in detail the adaptive management strategies to be adopted. In summary, the following strategies specific to biodiversity would include:

- Detailed pre-mining assessment of the potential impacts on surface infrastructure, including an assessment of potential impacts to biodiversity in the unlikely event that actual subsidence is greater than predicted subsidence;
- Describe the biodiversity monitoring (amphibians and riparian monitoring) that occurs;
- Results of biodiversity monitoring; and
- Details of any procedures for the implementation of planned responses if triggered by monitoring and inspections.

5.7.6 Biodiversity: Threatened species survey and assessment

Issue Description

Our review of the threatened species survey and assessment in the BAR focused on species credit entities. In general, survey effort and assessment were considered adequate unless otherwise mentioned in these comments. We also offer the following additional comments on threatened species survey and assessment.

i. Koala habitat & movement corridor

The Biobanking Credit Calculator and the BAR state that the area to be cleared contains 43.4 hectares of Koala habitat, however koalas are expected to utilise all vegetation types within this area. The area of impact for koalas should therefore be amended to 49.10 hectares in both the BAR and the Credit Calculator.

In addition to the removal of high—quality habitat, the proposal will impact on a primary movement corridor for the koala (see Figure 1; OEH 2019). All 49.1 ha of koala habitat is within a major regional koala link. The locality is also at the nexus of three primary koala linkages, the Bargo Corridor, Tree Hollow Corridor and Dog Trap Corridor, as mapped by OEH. These corridors are critical north—south and east-west links for the expanding koala population of south-west Sydney. The vegetation communities proposed for removal are higher fertility woodlands which are considered the most important vegetation types in the region for koalas.

While the survey conducted in the BAR found no evidence of koalas, their presence has been assumed and an offset derived accordingly on the basis of the site being suitable habitat for the species. A site visit by OEH officers in February 2019 confirmed this to be the case, as known koala feed trees were located at every site visited. Koala scratches on Grey Gum (Eucalyptus punctata) were observed at multiple sites, including three separate locations within the primary impact area. Some trees showed evidence of use by koalas over many years.

Scratches on Grey Gum were also observed in Dog Trap Creek and it is expected that koalas use the entirety of the site. Koalas are notoriously difficult to locate in the vegetation types on site, and nearby (Wilton/Appin) GPS tracking shows that koalas have home ranges of between 20-100ha (OEH unpublished data), meaning that a koala is more often than not absent from any particular point within its home range and importance needs to be inferred. As such, we are supportive of the decision to assume the site is koala habitat. However, the impact on local as well as regional koala connectivity needs to be further addressed.

ii. Eastern Pygmy—possum

A record for the eastern pygmy-possum exists approximately 3 km west of REA 2. Habitat modelling undertaken across the region (DECC 2007) predicted this area to be moderate—good habitat for the eastern. pygmy—possum and suitable habitat occurs on site. Survey effort for this species relied mostly on infra—red camera traps. Nest tubes and pit fall trapping generally results in better success for detecting this species, and these were not used in fauna surveys for the Project. The eastern pygmy-possum can be a difficult species to detect regardless of the survey method used and given the proximity of the previous record and suitability of the habitat, we recommend that the species be assumed present and included as a species to be offset.

iii. Large—eared Pied Bat

The large-eared pied bat is expected to roost in the sandstone overhangs within the subsidence zone and forage in the higher fertility woodlands of the surface impact area. This species requires both suitable foraging and roosting habitat to persist in an area. Section 7.5.2 of the BAR states that the proposal will not impact on important foraging habitat. We are of the view there will be an impact. Also, large—eared pied bats generally roost in cracks and overhangs in Sydney Sandstone rather than the dome shaped caves as noted in the report. It is entirely possible that 20 mm of subsidence could impact on the roosting habitat of this species by collapsing fissures or overhangs. Although not required by the FBA, we recommend offsets be considered for this species particularly given the potential impacts of subsidence and its listing under both Commonwealth and State legislation.

iv. Pomaderris brunnea

Figure 11.7 of the EIS shows numerous records for Pomaderris brunnea within the area to be cleared for REA 1, despite Table 11.35 stating that there will be no direct clearance of Pomaderris brunnea habitat. This needs to be clarified. If Pomaderris brunnea is to be impacted, an offset will be required in accordance with the FBA and the EPBC Act as Pomaderris brunnea is listed as "vulnerable" under that Act.

Response

OEH's concerns regarding impacts to threatened fauna habitat are noted. Specifically:

i. Impacts on Koala habitat are noted. In order to reduce impacts to vegetation, Tahmoor Coal has amended the Project to reduce the extension of the REA. The area of impact to Koala habitat, as a result of the Amended Project, is presented in the revised Biodiversity Assessment Report and Credit Calculator (Appendix E of the Project Amendment Report). The area of potential Koala habitat to be cleared has been reduced from 43.5 to 17.26 ha. The vegetation clearing would result in minor fragmentation of potential habitat; however the clearing is unlikely to impede Koala movement as no large barriers or hostile barriers to Koala dispersal would be erected as part of the Amended Project. Further discussion on the impact on local as well as regional koala connectivity has been included in Section 8.5.1 of the revised Biodiversity Assessment Report (Appendix E of the Project Amendment Report).

ii. As advised by OEH and without evidence to the contrary, the Eastern Pygmy-possum has been assumed present and included as a species to be offset.

iii. The BAR for the Amended Project includes an updated discussion of impacts of the project on the Large-eared Pied Bat (Section 8.5.2 of the Biodiversity Assessment Report). Offsets for impacts to Large-eared Pied Bat potential foraging habitat (17.26 ha) have now been included (noted in Section 11 and Section 12 of the Biodiversity Assessment Report).

iv. *Pomaderris brunnea* has been re-assessed for the Amended Project. The amended footprint of the REA would result in impact to one individual. Section 8.4 of the updated Biodiversity Assessment Report (Appendix E of the Project Amendment Report) includes an assessment of this impact and offsets have been calculated in accordance with the FBA (refer Section 10 and Section 11 of Appendix E of the Project Amendment Report).

5.7.7 Biodiversity: Matters of National Environmental Significance

Issue Description

OEH has undertaken an assessment of EPBC listed threatened entities in accordance with the Bilateral Agreement between the Commonwealth and State governments. Outcomes of this assessment are consistent with the FBA assessment, except where otherwise noted above. Commonwealth offsetting requirements are addressed below.

Response

Noted. Refer responses below.

5.7.8 Biodiversity: MNES Offsets

Issue Description

The Biodiversity Offset Strategy (BOS) as detailed at Chapter 11 of the BAR in accordance with the FBA and the Offsets Policy provides a preliminary assessment of several potential offset sites, including credits generated for these sites. Table 47 in the BAR describes the following credit shortfalls for threatened entities:

- *Shale Sandstone Transition Forest (1847)*
- *Red Bloodwood — Grey Gum woodland (40)*
- *Persoonia bargoensis (5953)*
- *Cumberland Plain land snail (6) (based on the proposed offset sites).*

The large number of credits still required for Commonwealth listed entities (i.e. large credit shortfalls for SSTF and Persoonia bargoensis) is of considerable concern and further certainty that these credits can be sourced should be required.

Response

Credit calculations have been updated for the Amended Project. An update to the proposed credit requirements and shortfall is outlined in **Table 5-7**.

Table 5-7 Comparison of updated credits generated from the proposed offset sites compared to credit liability for the Project

Species	EIS Project Credit Shortfall	Amended Project Credit Shortfall	
		Credit shortfall for Stage 1	Credit shortfall for Project offset liability
PCT1395 Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest (HN556) (Shale Sandstone Transition Forest)	1,847	0	532

Species	EIS Project Credit Shortfall	Amended Project Credit Shortfall	
		Credit shortfall for Stage 1	Credit shortfall for Project offset liability
PCT1081 Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin (HN564) (Red Bloodwood — Grey Gum woodland)	40	0	82
Persoonia bargoensis	5,953	0	0
Cumberland Plain land snail (*Meridolum corneovirens*)	6	No longer requires offset	No longer requires offset

The proposed offset sites would satisfy the credit offset liability for Stage 1 of the staged offset. A short-fall would occur for the overall Project liability in relation to the following:

- Shortfall of approximately 532 x PCT1395 credits using the FBA would occur for the entire Amended Project offset liability; and
- Shortfall of approximately 82 x PCT1081 credits using the FBA would occur for the entire Amended Project offset liability.

To approach this shortfall of credits, Tahmoor Coal proposes to purchase the required credits for PCT1395 Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest (HN556) on the BioBanking public register. The updated offset strategy is discussed in Section 12 of the revised Biodiversity Assessment Report (Appendix E of the Project Amendment Report).

In order to satisfy the Commonwealth offset requirement for Shale Sandstone Transition Forest, credits would be purchased that meet the threshold criteria for the TEC as defined in the EPBC Act Approved Conservation Advice (including listing advice) for Shale Sandstone Transition Forest of the Sydney Basin Bioregion. At present, 3,710 BioBanking credits for PCT1395 Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest (HN556) are available on the public register.

It is highly likely that with the establishment of the Cumberland Conservation Plan (envisaged for approval in 2020), large areas of Stewardship Sites would be established within Western Sydney which would increase the credit availability in the next few years. This would allow for sufficient credits to offset the impacts of the Amended Project.

To approach the shortfall of credits for the remaining PCT1081 Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin (HN564), Tahmoor Coal may pay into the Biodiversity Conservation Trust (BCT) Fund. The formalisation of the proposed sites to a Biodiversity Stewardship Agreement site, and the purchasing of credits and/or payment into the BCT Fund would occur following the grant of development consent for the Amended Project, and would be progressive in two stages to match the impact to vegetation and threatened flora during the life of the mine.

Following the issue of development consent for the Amended Project, the following tasks would be completed by Tahmoor Coal:

- Formal establishment of the proposed Stewardship Sites (this includes detailed surveys, reporting management plan etc. as per the requirements of the BAM);
- Retirement of the required credits generated from the Stewardship Sites;
- Purchase and retire credits for PCT1395 Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest (HN556) which are available on the public register. Note that the credits purchased to satisfy the Shale Sandstone Transition Forest requirement would meet the EPBC listing criteria; and
- Payment into the BCT Fund for outstanding PCT1081 Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin (HN564).

5.7.9 Biodiversity: Offsets within mining leases

Issue Description

Several of the proposed offset sites are covered by a current mining lease, and therefore would require steps to remove the mining lease over the portion containing the future offset site to give certainty to in perpetuity conservation outcomes. The BAR does not provide certainty this will occur. Confirmation that these lots will be available as offset sites is required particularly given the credit shortfalls described above if consent is granted for the project, the BOS will require further development and conditioned accordingly. Timing for development of the final B08 is crucial to achieving appropriate offset outcomes and we recommend that the 808 be developed in consultation with, and to the satisfaction of, OEH. We remain available to discuss appropriate conditions of consent in this regard.

Response

Comments are noted. As the mining lease holder, Tahmoor Coal would have full responsibility for the management of the offset sites. As discussed in the revised Biodiversity Assessment Report (Appendix E of the Project Amendment Report), stewardship agreements will be established for these sites.

5.7.10 Biodiversity: Staged Offset Strategy and Retiring of Credits

Issue Description

We are also supportive in principle of the final offset strategy using a staged approach, as suggested in the BAR. However, credit retirement is preferred over a maximum of three stages, commensurate to key milestones and offset outcomes, rather than more complex multi—staged offsetting as currently indicated. Staging of offsets and credit retirement will require further development in consultation with OEH as the project assessment progresses.

If the staged approach is not pursued, credits are to be retired prior to the commensurate impact occurring. This can be addressed by condition of consent should approval be granted. If this is not possible, then as per the Offsets Policy, a voluntary planning agreement is required to ensure that credits are retired as soon as practical following impacts occurring. Particular attention should be given to achieving strategic conservation outcomes for the threatened entities being offset.

Response

The comments are noted. The Biodiversity Offset Strategy has been amended to include three stages:

- The Stage 1 offsets will cover the clearing required for ventilation shaft TSC1 site;
- The Stage 2 offsets will cover the clearing required for ventilation shaft TSC 2, the powerline and part of the REA; and
- Stage 3 offsets will reflect the remaining REA extension area.

Options for retiring credits have been proposed in the Biodiversity Offset Strategy (refer Section 12 of the revised Biodiversity Assessment Report, Appendix E of the Project Amendment Report). The offset sites have also been re-considered as part of the Project Amendment Report with several additional sites identified and others removed due to the small area of some of the originally proposed sites. Implementation of the staged biodiversity offset strategy in accordance with a relevant condition of consent, will negate the requirement of capturing these offsets under a VPA.

5.7.11 Biodiversity: Species to be offset

Issue Description

We note that the following threatened entities will be offset:

Plant Community Types (PCTs):

- *Narrow-leaved ironbark — Broad—leaved lronbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin; and*
- *Red Bloodwood — Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin.*

Threatened plants:

- *Persoonia bargoensis;*
- *Grevillea parviflora subsp. parviflora*

Threatened fauna:

- *Large—footed myotis; and*
- *Koala.*

Clarification of whether the Red—crowned toadlet and the Cumberland land snail are to be offset is required as impacts on these species are expected, and the BAR and EIS do not address these species consistently. For example, Page 11-144 of the EIS states that no offset is required for the Red-crowned toadlet despite the credit report stating that 2.4 ha will be impacted. Similarly, 0.5 ha of habitat for the Cumberland land snail will be impacted, requiring 6 credits (Table 47 of the BAR) however this species is not described as requiring an offset in the Executive Summary or elsewhere in the BAR. Any species to be impacted must be offset in accordance with the FBA.

Response

In addition to the plant community types, threatened plants and threatened fauna listed above, the following additional species would require offsets, which are included in the revised Biodiversity Assessment Report for the Amended Project:

- Fauna - Large-eared Pied Bat, Eastern Pygmy Possum and Eastern Cave Bat; and
- Flora - *Pomaderris brunnea*.

With respect to the Red-crowned Toadlet, the 20 mm subsidence impact area has changed as a result of the amendments made to the mine plan. The 20 mm subsidence impact area now mostly avoids Hornes Creek where the presence of the Toadlet was previously recorded. As a result, impacts to the Red-crowned Toadlet are considered unlikely. The Biodiversity Assessment Report has been revised accordingly, with no offset requirements being required in relation to the Red-Crowned Toadlet.

With respect to the Cumberland Plain Land Snail, no individuals were located during targeted surveys and it is not considered likely to be impacted by the Amended Project. Therefore, offsets would not be required.

5.7.12 Biodiversity: Options for MNES offsetting

Issue Description

All Commonwealth listed species will require "like—for—like" offsetting in accordance with the Bilateral Agreement for offsetting between the NSW and Commonwealth governments. Payment to the Biodiversity Conservation Fund is not an available option for these Commonwealth listed species. Hence, the need to provide further certainty in the EIS that such credit offsets can be sourced.

Response

Noted. Tahmoor Coal would seek to purchase credits that align with the Commonwealth definition of 'Shale Sandstone Transition Forest'. In order to satisfy the Commonwealth offset requirement for Shale Sandstone Transition Forest, only credits that meet the threshold criteria for the TEC as defined in the EPBC Act Approved Conservation Advice (including listing advice) for Shale Sandstone Transition Forest of the Sydney Basin Bioregion, would be purchased.

Currently, 3,710 BioBanking credits for PCT1395 Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest (HN556) are available on the public register. It is highly likely that with the establishment of the Cumberland Conservation Plan (envisaged for approval in 2020), large areas of Stewardship Sites would be established within Western Sydney which would increase the credit availability in the next few years.

5.7.13 Biodiversity: Offset site surveys

Issue Description

We note that some vegetation plots have been carried out in proposed offset sites (BAR, page 138). It should be noted that all future vegetation plots in offset areas should be done in accordance with the Biodiversity Assessment Method (BAM), using the BAM Calculator to derive credit values. Plots done using the BBAM will need to be updated to include all BAM requirements. This is required to develop Biodiversity Stewardship Agreements at offset sites, as new Biobanking Agreement applications are no longer being considered by OEH.

It should be noted that all offset sites will require targeted survey for species credit species to confirm the species is present at that particular offset site. Presence cannot be assumed for Biodiversity Stewardship sites as per Section 6.5.1.9 of the FBA.

Response

Noted.

5.7.14 Biodiversity: Biodiversity Management Plan

Issue Description

Should the project be approved, a "Biodiversity Management Plan" which addresses additional environmental management requirements should be prepared in consultation with relevant NSW agencies including OEH. This Plan should include a monitoring component for indirect impacts, and potential impacts on biodiversity resulting from subsidence (as addressed in the BAR). Adaptive management of any indirect or subsidence related impacts should also be included.

Response

The recommendation in relation to a Biodiversity Management Plan (including monitoring and adaptive management requirements) has been incorporated into the Revised Management Measures for the Amended Project (refer **Chapter 7.0**). The plan would be prepared in consultation with OEH.

5.7.15 Biodiversity: Biobanking Credit Calculator Data

Issue Description

We have reviewed the data within the Biobanking Credit Calculator and determined that there are several minor issues with the data which need to be resolved to ensure that credit calculations are accurate. We will provide this feedback directly to the Proponent and we recommend that these issues be resolved prior to the Response to Submissions.

Response

The Biobanking Credit Calculator was re-run to reflect the revised footprint for the Amended Project, and the assessment updated. Therefore, the calculator was completely updated, and will be made available to OEH.

5.7.16 Aboriginal Cultural Heritage: Test excavation and management plan

Issue Description

Concerned that test excavation and preparing the Heritage Management Plan (HMP) are proposed as post—approval works. The decision maker is better informed about the extent of impacts to Aboriginal heritage if test excavation occurs before approval. Similarly, required management actions are best negotiated pre-approval. Test excavation is required before the HMP is finalised.

Response

The HMP would be prepared in consultation with the RAPs and DPIE before any surface disturbance associated with the Amended Project commences and will also be applied once longwall mining under the Amended Project is operational. Should monitoring detect the early development of potentially severe differential movements at these archaeological sites during the extraction of Longwalls 101B and 102B, adaptive management techniques would be applied.

An additional assessment in the form of archaeological test excavations and additional surveys was undertaken and is presented in the revised Aboriginal Cultural Heritage Assessment (Appendix G of the Project Amendment Report). Archaeological test excavation of the disturbance footprint of TSC 2 where Aboriginal site Charlies Point Road OCS-1 is located was conducted based on previous assessment confirming a total of 13 open camp sites, including 6 artefact scatters and 7 isolated finds within the area. The test excavation program was undertaken over three days from 1 October to 3 October 2019. The test excavation concluded that there was no further subsurface deposit associated with the three artefacts eroding out of the access track. The site was determined to be of low scientific significance due to the site comprising of three stone artefacts.

The archaeological potential for the area was deemed as low to moderate. Based on the predictive model and results outlined in the Aboriginal Cultural Heritage Assessment (Appendix G of the Project Amendment Report), archaeological resources of the area are more likely to be concentrated in closer proximity to a water source (i.e. within 200 m) and in association with rock outcrop areas (i.e. shelter sites). The closest water source to the test site is located at Dog Trap Creek, 500 m from the excavation area; and is situated on a featureless, plain landform within which focal points for past activity cannot be readily defined.

5.7.17 Aboriginal cultural heritage: Aboriginal Community Consultation

Issue Description

Niche (2018) consulted with the Aboriginal community by following the Aboriginal Community Consultation Requirements for Proponents 2010 in accordance with the 2017 SEARS. Comments from the Registered Aboriginal Parties (RAPs) have been received between 2014 and 2018. The comments emphasised the overarching Aboriginal cultural heritage significance of the subject area and provided specific management recommendations.

The majority of these comments have been addressed by Niche (2018). However, we recommend that the applicant address:

- *Whether all areas of surface impact have been surveyed (Cubbitch Barta Native Title Claimants);*
- *Which sites are proposed to be included in the HMP (Cubbitch Barta 2014);*
- *The comments provided by Duncan Falk Consultancy (19 September 2017);*
- *Historical Indigenous Research comment that some of the art along Dog Trap Creek indicates 'men's business sites' (Niche 2018, p.71); and*
- *Whether the scarred tree was relocated during the Niche assessment (2018, p.71).*

Response

Noted. The above comments have been addressed in the revised Aboriginal Cultural Heritage Assessment and addendum Aboriginal Cultural Heritage Assessment (Appendix G of the Project Amendment Report) with the key concerns summarised as follows:

- The survey program achieved a high level of effective survey coverage, owing to the 100% coverage of the areas of Eliza, Dog Trap, Dry creeks and Tea Tree Hollow that may be affected by the proposed works (Section 10.2 of the Aboriginal Cultural Heritage Assessment). Additional archaeological surveys were undertaken in 2019 to consider the impacts associated with the connection of 66 kV electrical power to ventilation shaft and fan site TSC 1 (Section 3.0 of the Addendum Aboriginal Cultural Heritage Assessment). Access was not permitted to Lot 2016 DP751250 and Lot 2231 DP787222. The survey was therefore conducted within the adjacent road corridor, and observations of the areas within the lots were made from publicly available areas.
- Within the Subject Area there were 41 Aboriginal cultural heritage sites identified. Whereas, a total of 30 Aboriginal heritage sites have been identified within the 20 mm subsidence contour associated with the Amended Project. There are 30 Aboriginal cultural heritage sites, and the majority (24 of 30) have low scientific significance. Two of these sites were assessed to be of moderate archaeological or scientific significance. Four of these sites were assessed to be of high archaeological or scientific significance. The remaining 24 are considered to be of low

archaeological significance. Whilst it is unlikely that there will be adverse effects to any of the shelter and axe grinding groove sites within close proximity to the proposed longwalls and surface infrastructure the assessment concluded that a Heritage Management Plan be developed for the shelter sites along Dog Trap Creek to ensure this is the case. As discussed in Section 15 of the Aboriginal Cultural Heritage Assessment (Appendix G of the Project Amendment Report) an HMP would be developed in consultation with the RAPs.

- As discussed in Section 13.3.4 of the Aboriginal Cultural Heritage Assessment in Appendix G of the Project Amendment Report, one scarred tree (52-2-1530) is located within approximately 125 m east of the proposed longwall 102B. Further assessment of this scarred tree was undertaken by EMM Consulting (2020), which determined the scar as unlikely to be of Aboriginal origin. However, the assessment recommended the need for specialist assessment in the event the tree could not be avoided. As such, an arborist was engaged to clarify the origin of the tree and further management measures required. The assessment concluded that the tree was not of Aboriginal origin and may be removed without further constraints on the project. The revised Aboriginal Cultural Heritage Assessment (Appendix G of the Project Amendment Report) has been updated to reflect this. There are no further recommendations relating to this tree.

5.7.18 Aboriginal Heritage: Sites at Dog Trap Creek

Issue Description

A high proportion of the recorded sites occur at Dog Trap Creek (Niche 2018, p.35). Niche reports that there are no similar concentrations of sites in the surrounding area, which increases the archaeological significance. The site complex includes rock art, shelters and artefact scatters. Across the broader study area, a rich and diverse range of sites was recorded, including rock shelters, art sites, axe grinding grooves, artefact scatters, a scarred tree and a Dreaming story.

Response

As described in Section 11.8.1 of the EIS, assessment and survey of sensitive heritage features along Dog Trap Creek has been undertaken as part of baseline monitoring and preparation of this EIS. The results of this assessment have fed into an analysis of the risk of potential impacts to these sensitive surface features due to subsidence, and into the mine planning process, resulting in modification to the extent of longwalls and the location of ventilation shafts in these areas. Longwall 102 and Longwall 103 have been designed to avoid mining beneath four rock shelter sites along Dog Trap Creek which have artwork that is of high cultural and archaeological significance.

The mine plan has been designed to avoid direct impacts to the archaeological heritage sites along Dog Trap Creek and avoid direct impacts to archaeological heritage sites in the south east section of the Project Area south of the Hume Highway.

With the removal of LW109, there are three Aboriginal cultural heritage sites (comprising of stone artefacts) that are now outside of the limit of subsidence, and therefore no longer have the potential to be impacted by the Amended Project. These are listed below:

- SW Corner Bargo Sports Ground (52-2-4034);
- Dog Trap Creek (52-2-1532); and
- Bargo Isolated Find 1 (52-2-3976).

5.7.19 Aboriginal Heritage: OEH recorded an Aboriginal object

Issue Description

During the OEH site visit on 14 February 2019, a previously unrecorded Aboriginal heritage site was identified. We recommend that this site is incorporated into the EIS. Any necessary management measures should be determined in consultation with the RAPs.

Response

Site TC 14-02-19 was discovered on an existing dirt track running parallel to the electricity line and has since been registered on Aboriginal Heritage Information Management System (AHIMS). It should be noted that a revised search of the AHIMS was completed for the Amended Project due to the data having expired since the last search. An additional seven (7) Aboriginal cultural Heritage sites (including TC 14-02-19) were identified as a result of this search. These sites will not be impacted by the Amended Project.

This site has been incorporated into the revised assessment for Aboriginal Heritage undertaken for the Amended Project and appended of the Project Amendment Report (Appendix G).

5.7.20 Aboriginal Heritage: Additional Information

Issue Description

A map showing the survey transects from the combined field surveys in relation to the proposed surface infrastructure and long walls is required. It is concerning that infrastructure such as transmission lines and gas pipelines is identified as potentially requiring Aboriginal heritage survey and assessment (AECOM 2018, p.11-174). Comprehensive assessment before project approval is required so that the extent of the harm is understood to assist appropriate management.

A methodology for the proposed test excavation at TSC 2 ventilation shaft and fan site is required (Niche 2018, p.95). We recommend that the test excavation occur before project approval. At present, there is no information about the archaeological deposit at the proposed test excavation locations.

Response

The Project has been amended to include the addition of a proposed powerline route to ventilation shaft site TSC 1.

Assessment of the area included an additional archaeological survey which was conducted on 3 October 2019 by two archaeologists and two RAP representatives across the proposed and existing power line easement. The survey identified one ironbark tree with scarring and deemed the scar as unlikely to be of Aboriginal origin and with low archaeological potential. Further assessment of this scarred tree was undertaken by EMM Consulting (2020), which determined the scar as unlikely to be of Aboriginal origin. However, the assessment recommended the need for specialist assessment in the event the tree could not be avoided. As such, an arborist was engaged to clarify the origin of the tree and further management measures required. The assessment concluded that the tree was not of Aboriginal origin and may be removed without further constraints on the project. The revised Aboriginal Cultural Heritage Assessment (Appendix G of the Project Amendment Report) has been updated to reflect this. There are no further recommendations relating to this tree.

Access was not permitted to Lot 2016 DP751250 and Lot 2231 DP787222. Survey was conducted within the adjacent road corridor, and observations of the areas within the lots were made from publicly accessible areas. Preliminary assessments of the archaeological potential of these areas have been made based on these observations and of the survey results of the surrounding properties which share the same environmental values (i.e. landform and levels of disturbance).

An archaeological test excavation was conducted of the disturbance footprint of TSC 2 where Aboriginal site Charlies Point Road OCS-1 was located and based on previous assessment confirmed a total of 13 open camp sites, including 6 artefact scatters and 7 isolated finds within the area.

The test excavation program was undertaken over three days from 1 October to 3 October 2019 involving four EMM archaeologists and four RAP representatives on each day. The methodology involved the following:

1. Five linear transects (TR) were set out across the TSC 2 ventilation shaft location;
2. A total of 38 50 cm x 50 cm test pits were spaced at 20 m intervals along each transect;
3. The first test pit at each site was dug manually with hand tools in 5 cm spits to identify the nature of the soils and to identify if a stratigraphic sequence existed. The remaining pits were dug in 10 cm spits as no stratigraphic sequence was identified;

4. Each pit was excavated until basal clay or impenetrable parent rock (i.e. ironstone and/or shale) was reached. The majority of test pits were excavated to a depth of 20 cm, with a sample of test pits excavated to 30 cm;
5. All excavated soil was sieved on-site using a dry sieving technique. The soil was sieved through 5 mm aperture mesh sieves; and
6. All test pits were backfilled by the excavation team after each pit was recorded.

The archaeological potential for the area was deemed as low to moderate. Based on the predictive model and results outlined in the revised Aboriginal Cultural Heritage Assessment (Appendix G of the Project Amendment Report), archaeological resources of the area are more likely to be concentrated in closer proximity to a water source (i.e. within 200 m) and in association with rock outcrop areas (i.e. shelter sites). The closest water source to the test site is located at Dog Trap Creek which is 500 m from the excavation area and situated on a featureless, plain landform within which focal points for past activity cannot be readily defined.

An updated map has been provided in the revised Aboriginal Cultural Heritage Assessment (Appendix G of the Project Amendment Report).

5.7.21 Aboriginal Heritage: Impacts to Aboriginal Heritage

Issue Description

The EIS (AECOM 2018, p.11-286) shows impact to Aboriginal cultural heritage as having a 'moderate' level of harm after mitigation. Impact to Aboriginal objects through mining is often direct, permanent and irreversible. This does not reflect the provided definition of moderate impacts as 'short term to medium duration' (AECOM 2018, p.11—274).

The conclusion that the Dreaming site will have no loss of value is not discussed. The proposed changes to the landscape and potential changes to hydrology may impact the cultural landscape connected to these site values. The applicant should provide further justification for this conclusion (Niche 2018, p.88). Clarification of why sites 52—2—3968 and 52—2—4194 are considered to have no impact given the location above longwalls is required (see Figure 9, Niche 2018).

Response

As a result of the mine planning process for the Amended Project, impacts to Site 52-2-3968, an Open Camp Site that comprises of two red silcrete artefacts, have been reduced. As stone artefacts are on the ground surface it is highly unlikely this site would be adversely affected by the Amended Project.

Aboriginal cultural heritage site 52-2-4194 comprises an axe grinding groove. Based on the subsidence predictions the assessment was that this site would unlikely be impacted by subsidence effects (Section 13.3.3 of Appendix G of the Project Amendment Report).

The Dreaming site is located outside of the 20 mm subsidence contour and therefore would not be impacted by the Amended Project.

5.7.22 Aboriginal Heritage: Subsidence Impacts

Issue Description

Dog Trap Creek site complex

We support the proposal to reduce longwalls 102 and 103 so that sites at Dog Trap Creek that have high Aboriginal cultural heritage significance will not be undermined (Niche 2018, p.77). An improved Aboriginal heritage outcome could be achieved by further reducing longwalls 102 and 103. This would remove longwall mining under sites and the northern and southern ends of the Dog Trap Creek site complex (52-2-1520, 52-2-1521, 52-2-1533 and 52-2-1534).

Despite reducing the longwalls, Niche (2018, p.76) and MSEC (2018) explain that risks from subsidence remain. Niche (2018, p.76) overall assesses this risk as low. However, the predicted maximum movements could harm the Aboriginal heritage sites. The Dog Trap Creek site complex is predicted to have a maximum upsidence of 325 mm and valley closure of 400 mm (MSEC 2018, p.169). These predictions are higher for Tributary 1, Dog Trap Creek, that contains a rock shelter with art (although this site has been assessed as having low archaeological significance).

If the adaptive management approach suggested (AECOM 2018, p.11-27 and MSEC 2018, p.173) is adopted, this must be incorporated into the management plan. However, it would be preferable to take a precautionary approach and reduce the length of Longwall 103 rather than risk this damage occurring to the rock art.

We recommend the Extent of Longwalls boundary is revised so that the Dog Trap Creek Site complex is outside the permissible area of the longwalls. Figure 10.1 of the MSEC (2018, p.172) report and Figure 11 in the ACHAR (Niche 2018) show these sites inside the Extent of Longwalls boundary. This will provide more effective and enforceable protection for the Dog Trap Creek site complex.

The impact of changed hydrological patterns on the water levels at Dog Trap Creek has not been considered. This may impact the intangible Aboriginal cultural heritage values. The modelled baseflow reductions are highest at Dog Trap Creek (AECOM 2018, pp.11-105 and 11-78). We are also mindful about indirect impacts on this site as a result of the existing adjoining residential lots and in the context of the broader urban expansion into the Tahmoor area. We suggest this is considered in the HMP generally.

Open artefact scatters and isolated artefacts

We are concerned that subsidence is not considered harm to stone artefacts (Niche 2018, p.41; MSEC 2018, p.169 and reflected in AECOM 2018, p.11-170). The language of 'less susceptible' used elsewhere in the ACHAR (Niche 2018, p. 75) is more appropriate. The MSEC report fails to consider the impact of cracking on the archaeological context of the artefacts, and only considers harm to the actual stone artefact. Further analysis of the risk of subsidence to the open archaeological sites is required. We agree that remediation of Longwall subsidence also has potential to harm Aboriginal objects on the surface (Niche 2018, p.74). Appropriate management and mitigation measures are required.

Scarred tree (site 52-2-1530)

Subsidence impacts to the scarred tree (site 52—2—1530) are assessed as low (MSEC 2018, p.169). However, we also request clarification of the impact that changes to water hydrology is likely to have on the scarred tree.

Grinding grooves

We appreciate the discussion provided by Niche (2018, p.75) and MSEC (2018, p.170) that potential mitigation measures for grinding groove sites can also cause harm. The RAPs must be consulted about these management options. A staged monitoring program could be developed through the HMP that allows cutting only if cracking is identified.

Response

Dog Trap Creek site complex

As referred to in Section 13.3.2 of the revised Aboriginal Cultural Heritage Assessment Report (Appendix G of the Project Amendment Report), there are four rock shelter sites along Dog Trap Creek with artwork that is of high cultural and archaeological significance (52-2-1523, 52-2-1525, 52-2-1528 and 52-2-1529). These sites are located beyond the end of Longwall 102B and the side of Longwall 103B and will not be mined beneath by the Amended Project.

The closest distance of site 52-2-1523 to longwall 103B is 135 metres. The closest distance of site 52-2-1525 to Longwall 102B is approximately 230 metres. The closest distance of site 52-2-1528 to Longwall 103B is 210 metres. The closest distance of site 52-2-1529 to longwall 102B is 125 metres.

The sites are predicted to experience between 90 mm and 150 mm of vertical subsidence due to the extraction of the proposed longwalls. As outlined in drawing no. MSEC1060-22 the predicted conventional subsidence contours are more widely spaced around the staggered ends of the proposed longwalls and, as a result, the predicted valley closure in the section of Dog Trap Creek where the sites are located is in the order of 250 mm.

The sites are located along small cliffs and a detailed visual inspection has been undertaken by Dr Ken Mills of Strata Control Technologies (SCT 2013). The small cliffs are orientated in a roughly north-south direction and consist of relatively short lengths of intact rock faces (less than 50 metres).

Given the setback distances of the proposed longwalls to the sites, it is considered that the likelihood of impacts is low. It is extremely unlikely that major cliff instabilities will occur based on the experience of mining near cliffs at similar depths of cover elsewhere in the Southern Coalfield. It is possible that minor deformations of the cliff faces could occur. It is possible that particular bedding planes could slide relative to each other as the valley closes. While the chances are very low, if these bedding planes were to coincide with where the artwork is located, some impacts could occur to an archaeological site (MSEC 2020:175).

The sites of high archaeological significance will not be mined directly beneath even if the Amended Project longwalls were shifted, reorientated, extended or shortened within the extents of the longwall boundaries. For reasons discussed in Section 10.1.5 of the revised Subsidence Assessment (Appendix B of the Project Amendment Report), while the offset distances and predicted movement would change, the impact assessments are unlikely to change substantially, and the same management measures would apply (MSEC 2020:175).

Open artefact scatters and isolated artefacts

There are four open sites (Open Camp Sites and Isolated Finds) located within the SSA. The maximum predicted final tilt for the open camp sites is 6.0 mm/m (i.e. 0.6%), which represents a change in grade of 1 in 167. It is unlikely that these sites would experience any adverse impacts resulting from the mining induced tilts.

The maximum predicted curvatures for the open camp sites are 0.09 km^{-1} hogging and 0.03 km^{-1} sagging, which represents minimum radii of curvature of 11 km and 33 km, respectively. The maximum predicted conventional strains for these sites, based on applying a factor of 15 to the maximum predicted conventional curvatures, are 1.4 mm/m tensile and 0.5 mm/m compressive.

These open camp sites can potentially be affected by cracking of the surface soils as a result of mine subsidence movements. It is unlikely, however, that the scattered artefacts or isolated fins themselves would be impacted by surface cracking. It is possible however, that if any remediation of the surface was required after mining, that these works could potentially impact the open camp sites. Subsidence monitoring prior to and after longwall mining would be implemented for Aboriginal heritage sites within the underground investigation area subject to impacts from mining induced subsidence. The subsidence monitoring program should be in accordance with the relevant approved Extraction Plan and HMP. Monitoring should be undertaken by a suitably qualified archaeologist and representatives of the RAPs.

Scarred tree (site 52-2-1530)

There is one scarred tree (52-2-1530) which is located approximately 125 m east of the proposed longwall 102B. Further assessment of this scarred tree was undertaken by EMM Consulting (2020), which determined the scar as unlikely to be of Aboriginal origin. However, the assessment recommended the need for specialist assessment in the event the tree could not be avoided. As such, an arborist was engaged to clarify the origin of the tree and further management measures required. The assessment concluded that the tree was not of Aboriginal origin and may be removed without further constraints on the project. The revised Aboriginal Cultural Heritage Assessment (Appendix G of the Project Amendment Report) has been updated to reflect this. There are no further recommendations relating to this tree.

Notwithstanding, the scarred tree within the Subsidence Study Area is located away from the proposed longwalls. It is unlikely, therefore, that this site would be adversely impacted by the Amended Project (MSEC, 2020:173).

Grinding grooves

The point has been noted in relation to cutting the platform if cracking related to subsidence has been identified. However, the recommendation that relief slots be cut into the sandstone platform would only occur prior to extraction as it would alleviate pressure from subsidence related tilts and strains. Notwithstanding, an HMP would be developed for the Amended Project that details and schedules (for the life of the Amended Project) the mitigation and management measures presented in the report. The HMP would be developed in consultation with the RAPs.

5.7.23 Aboriginal Heritage: Dust and Vibration

Issue Description

We recommend impacts from dust and vibration are considered in the impact assessment (Niche 2018). There is no assessment of the risk of dust damaging art panels, nor of vibrations damaging shelters and grinding groove sites (Niche 2018, chapter 13 and EMM 2018).

Response

There are five dust deposition gauges located off-site for Tahmoor Mine. Review of the monitoring data on a month by month basis illustrates where elevated dust deposition levels are detected in certain months at DDG3 and DDG4. However, the annual average dust deposition levels at all monitors are below the EPA criterion of 4 g/m^2/month. The average across all off-site gauges is 1.4 g/m^2/month, which is also below the assessment criterion. As such, it is unlikely that dust would adversely impact any of the identified Aboriginal art panels located in the vicinity and as a result of the Amended Project.

Vibration impacts from operational activity is not expected to change and given the separation distance between the nearest panel, ground borne vibration from existing equipment is not expected to be perceptible. Notwithstanding, EMM has undertaken operator-attended vibration monitoring in close proximity to the existing ventilation shaft fan (at a distance of approximately 30 m from the southern side of the existing vent fan building) during normal operation of the facility. Tri-axial vibration levels were monitored for approximately 15-minute on 19 June 2019 using an INFRA v12 vibration monitor. Given the constant nature of operation of the vent it is considered that the 15-minute survey captured vibration levels during typical operations.

The peak vibration levels during the survey did not exceed 0.035 mm/s, which is significantly below the level of human perception. As a result, it is not expected that vibration levels from the existing or proposed operation would determinately impact shelters or grinding grooves within the vicinity of the Amended Project.

5.7.24 Aboriginal Heritage: Proposed Mitigation

Issue Description

We support the proposed Heritage Management Plan (Niche 2018, pp.95—96 and AECOM 2018, p.11-175). The HMP should be prepared as soon as possible, ideally before project approval. The HMP must be prepared in consultation with the RAPs, and we request that the draft is referred to OEH for comment before being adopted.

- *In addition to the Niche (2018, pp.95—96) recommendations we suggest the HMP also includes:*
- *Monitoring methodology that includes the triggers for reducing longwalls as described in the EIS (AECOM 2018, p.11-176);*
- *Detailed archaeological test excavation and salvage excavation methodology as required;*
- *Detail of the long-term management of Aboriginal objects recovered through test excavation;*
- *Methodology for community collection of surface artefacts if required;*
- *Process for reassessment if the Longwall design or surface impact footprint changes;*
- *Aboriginal heritage management requirements for the remediation of the mine site;*
- *Considerations for protecting the Dog Trap Creek site complex from impacts from adjacent residential properties;*
- *Controls for goats, noting comments by Niche (2018, p.65) of goats damaging artwork; and*
- *Procedure for updating AHIMS site cards throughout the project.*

Response

Tahmoor Coal would consult with OEH (now DPIE) during preparation of the HMP.

5.7.25 Aboriginal Heritage: Ancillary sites

Issue Description

The applicant must ensure that any ancillary impact areas such as temporary vehicle tracks, service installations, stockpile locations and lay down areas have been appropriately assessed for Aboriginal cultural heritage impacts in accordance with OEH guidelines.

Response

As identified in Section 11.8.5 of the EIS, the final locations of all ancillary infrastructures (e.g. transmission lines, gas pipelines, temporary vehicle tracks, service installations, stockpile locations and lay down areas etc.) would be confirmed during detailed design with the aim of avoiding identified Aboriginal sites as far as possible. This would include a systematic survey of the relevant area(s) (in consultation with the RAPs) if the area has not already been surveyed. Any previously unidentified sites would be managed in accordance with the management measures described in the Heritage Management Plan for the Amended Project and in consultation with the RAPs. If impacts to any existing (or newly identified) sites cannot be avoided, additional management, mitigation and archival recording measures would be determined in consultation with the RAPs and statutory agencies. This process will be undertaken in accordance with OEH guidelines.

This requirement has been incorporated into the Revised Environmental Mitigation Measures for the Amended Project (refer **Chapter 7.0**).

5.7.26 Aboriginal Heritage: AHIMS site cards

Issue Description

AHIMS site cards must be submitted and updated for all sites recorded as part of this assessment. The appendix of site recordings (Niche 2018 Appendix and Figure 9), EIS (AECOM 2018, p.11-174) require updated AHIMS numbers for recently recorded sites.

Response

AHIMS cards for all recorded sites will be submitted to OEH and this requirement has been incorporated into the Revised Environmental Mitigation Measures for the Amended Project (refer **Chapter 7.0**).

5.7.27 Surface Water and Subsidence: Mine Layout & Impacts to streams

Issue Description

The depths of cover and width-to-depth ratios for the Tahmoor South mine proposal are quite similar to those for Dendrobium Mine. The subsidence report lacks any detailed discussion of Dendrobium or its impacts to swamps, streams, aquifers, water loss and connective fracturing.

The avoidance of comparisons with the Dendrobium mine in the Subsidence Assessment (and other specialist reports), despite its similar width-to—depth ratios, is concerning considering the major impacts that have recently occurred over Dendrobium Mine. Given the similarity in longwall layouts and depth of cover there is a potential risk of surface to seam connective fracturing above the mine. If this occurs, surface water and groundwater could drain into the mine.

Third order and above streams under the Strahler characterisation are considered to be highly significant features in the landscape, since they are likely to be permanent streams providing a wide range of environmental and social values, including important habitat for threatened and endangered species. All creeks within the Project Area have been mapped as 'key fish habitat'.

Significant environmental impacts (direct and indirect) on 'key fish habitat' are to have habitat rehabilitated or offset by environmental compensation. Rehabilitation is very uncertain and the cumulative loss of 3rd order streams in the Southern Coalfields is emerging as a serious issue which compromises the environmental and social values of many of these streams (often in perpetuity). The cumulative loss of tributary flows to the Upper Nepean river is also of growing concern.

It is highly likely that Dog Trap Creek (3rd order stream), Teatree Hollow (3rd order stream) and a number of 1st and 2nd order tributaries will be fractured and drained for their entire length above the longwalls. Much of the land surrounding Dog Trap Creek is Crown land, extensively covered by native vegetation. The riparian corridor is in very good condition and various recreational trails exist within the Crown land corridor. Approximately 70% of mapped pools in Dog Trap Creek will experience upsidence 2100 mm and valley closure 2200 mm and are therefore likely to be fractured and drained. There are also an extensive number of Aboriginal cultural heritage sites located in the upper drainage lines of Dog Trap Cree, as discussed in detail at Section 2 above.

A large number of Remediation Plans are currently being developed for streams affected by mining in the Southern Coalfields, however, they usually lack any objective measures to assess the success of any remediation applied. In all cases, it is highly uncertain that remediation will be a success or that flows and pool holding capacities will be restored. There is no objective scientific or peer—reviewed evidence that impacted areas above longwall mining operations have self—remediated as suggested in the EIS.

Under such circumstances, avoidance is the only effective solution to maintaining the social and environmental values of 3rd order and above streams as highly significant features in the landscape. Given the high environmental and associated social/cultural values of Dog Trap Creek in particular, it is recommended that LW101, LW103 and LW104 are reduced to avoid directly under the 3rd order sections of Dog Trap Creek or within its angle of draw. Consideration should also be given to redesigning LW109 so as not to impact the 3 ml order sections of Dog Trap Creek.

Response

The locations of the streams within the SSA are shown in Drawing No. MSEC1060-07 (Appendix B of the Project Amendment Report). A summary of the 3rd order streams located in the SSA is provided below.

Table 5-8 3rd order streams in the SSA

Location	Description
Dog Trap Creek	Located directly above the proposed LW101B, and LW103B to LW108B, with a total length of 2.8 km directly mined beneath. LW12 and LW13 have been previously mined beneath a 1.0 km section downstream of LW101B.
Tea Tree Hollow	Located directly above the proposed LW101A to LW106A, with a total length of 2.1 km directly mined beneath. LW1 and LW2 have been previously mined beneath a 0.5 km section downstream of LW101A.

The mine plan for the Amended Project was developed following an extensive risk assessment process, which incorporated:

- Recommendations and findings of the Southern Coalfields Inquiry (refer Section 5.3.1 and Table 5.1 of the EIS) including streams of 3rd order or above within the mine subsidence area being considered as Risk Management Zones (RMZ); and
- Extensive collaboration between technical specialists to determine risk management zones (RMZs) and inform the extent of longwall mining and proposed mitigation measures.

Several revisions were made to the mine plan including shortening the commencing ends of longwalls 105 to 108 such that they do not encroach into the Metropolitan Special Area and Cow Creek.

The mine plan for the Amended Project avoids mining beneath the Bargo River and Hornes Creek and the Amended Project's subsidence study area does not extend to: Carters Creek, Cow Creek, Dry Creek, Eliza Creek or Sugar Loaf Gully. Furthermore, the Amended Project's subsidence study area does not extend to the Thirlmere Lakes National Park World Heritage area.

Following exhibition of the EIS, in order to reduce the potential subsidence impacts of the Amended Project, the mine plan was amended further to reduce the longwall width, cut height and number of longwalls.

Ongoing subsidence monitoring throughout extraction will inform updates and refinements to the mine plan as required.

5.7.28 Surface Water and Subsidence: Thirlmere Lakes

Issue Description

The Tahmoor South EIS is predicting there will be an impact on the Thirlmere Lakes National Park World Heritage Area as a result of the proposed mine expansion. Predicted impacts are a decrease in the Lakes' average water levels of 0.01-0.06 m over the life of the project. We note that the Thirlmere Lakes Research Program being led by OEH, which aims to investigate the sensitivity of the Lakes to external influences including mining activity over a four-year period, is currently ongoing.

Response

The Thirlmere Lakes are approximately 3.5 km from the Amended Project at the nearest proposed longwalls. Based on available information, including the investigations undertaken as part of the Thirlmere Lakes Inquiry, the Thirlmere Lakes appear to act as a naturally 'losing' system under both dry and wet conditions. Therefore, there is limited dependence on groundwater for the water levels and associated ecosystems of the Thirlmere Lakes.

The water balance model (see Section 11.5.3 of the EIS) determined that the most significant outflow component from the Thirlmere Lakes is evaporation/evapotranspiration, comprising approximately two-thirds of outflows. Groundwater recharge by contrast comprises approximately a quarter of outflows. The Amended Project would only affect the groundwater recharge component, albeit to a very minor extent.

It has been determined that the Amended Project would have negligible groundwater and surface water impacts on the Thirlmere Lakes. Comparable to levels of natural variability (i.e. changes to lake levels of 0.01 m and 0.06 m on average) these would be imperceptible in many circumstances. Potential impacts to terrestrial and aquatic ecology within the Thirlmere Lakes were also determined to be minor to negligible(see Appendix C Groundwater Assessment and Appendix D SWIA of the Project Amendment Report).

The revised management measures for the Amended Project would include:

- Relevant reviews of the proposed monitoring and management plans; and
- The groundwater and surface water models would be updated in relation to impacts to the Thirlmere Lakes, as findings from the OEH research project become available.

5.7.29 Surface Water and Subsidence: Bargo River

Issue Description

Tahmoor Colliery currently discharges waste mine water to Teatree Hollow, a tributary of the Bargo River, under EPL 1389. The quality of the discharge is however poor and represents a significant point source of pollution to the Bargo River. This discharge dominates flow in the Bargo River; potentially due in large part to the fracturing and water diversions from previous mining underneath the Bargo River. Relative to other sites, the LDP1 discharge is high in levels of bicarbonate alkalinity, sodium, calcium, magnesium, potassium, arsenic, barium, selenium and zinc.

The electrical conductivity of the discharge is also high and the pH alkaline. Many of the contaminants are being discharged at levels that exceed the ANZECC guidelines including a number of contaminants (e.g. bicarbonate, barium) which are not specifically included on EPL1389. Cardno Ecology Lab (2010) previously undertook a study into the effects of saline mine water discharges on freshwater biota finding the Tahmoor Colliery discharge had the greatest effect on mayflies and water fleas. Given the levels of bicarbonate in the discharge waters it is likely to be toxic to sensitive aquatic fauna. This has not been assessed or addressed in the EIS.

The increasing salinisation of Australia's freshwater streams and rivers is of significant concern. Scientific experts in this area (e.g. Cafiedo—ArgUelles et al 2016) have recently argued that salinity standards for specific ions and ion mixtures, not just for total salinity, should also be developed and legally enforced to protect freshwater life and ecosystem services. The salt load from the discharge has largely been ignored in the EIS but is likely to be of the order of 2000 to 3000 tonnes per annum. This is potentially 20—30 times background salt loads to the Bargo River.

The impacts from the discharge are transferred downstream into the Bargo River and for approximately 5-6 km downstream until the Bargo River joins the Nepean River. If the mine expansion is approved there is a need to review EPL1389 and address issues surrounding contaminants above ANZECC guidelines, toxicity of the discharge and the amount of salt being discharged into an important freshwater river.

Response

While the EIS does not specifically discuss bicarbonate impact to aquatic ecology, it does address the overall impact of the mine water discharge (that is the combined effect of all contaminants) to the downstream environment. Since the EIS was submitted, an upgrade to the WWTP has been proposed that aims to remove contaminants including salts, metals and bicarbonates to meet the EPL 1389 discharge criteria. The assessment has been updated to reflect this new water management strategy (refer to the Water Management System and Site Water Balance report and Surface Water Impact Assessment in Appendix D of the Project Amendment Report).

5.7.30 Surface Water and Subsidence: Dendrobium Mine

Issue Description

Likely impacts of the Tahmoor South proposal can be assessed by considering the impacts associated with previous mining at Tahmoor Colliery, as well as other sites in the Southern Coalfields. Since the depth of cover at Tahmoor South is shallower than at Tahmoor North and panel widths have been increased, the risk of surface impacts is potentially increased further for the Tahmoor South longwalls. Much of the detail in the EIS appears somewhat dated (often over 4—5 years old) and does not adequately consider the more recent impacts of mining LW29-32 in the Tahmoor North area of operations.

The cumulative impacts of past longwalls at Tahmoor Colliery have had significant impacts on the Bargo River, Myrtle Creek and Redbank Creek. Mining has now drained approximately 2.8 km of Redbank Creek, caused extensive iron staining and emptying of the weir pool on Redbank Creek. It is highly unlikely that these impacts will ever be successfully restored, despite the current requirement to remediate Redbank Creek.

The mine layout and depth of cover to the coal seam are very similar to Dendrobium Mine, but the impacts at Dendrobium mining operations have largely been ignored in the EIS. As such, it is likely the Tahmoor South proposal will cause similar adverse impacts to those already experienced in the Southern Coalfields. The cumulative impacts across the broader area arising from the current proposal should be carefully considered as part of the current proposal.

Response

Past subsidence impacts (Appendix B of the Project Amendment Report, MSEC, 2020) and surface water impacts (Appendix D of the Project Amendment Report HEC, 2020) address historical impacts to Redbank Creek's structure, water quality and hydrology. The aquatic impact assessment in the EIS utilised this information to predict likely impacts to aquatic ecology.

It is acknowledged that the impacts to Redbank Creek from past mining are extensive, however extensive work has been undertaken on the implementation of a corrective management action plan for the Redbank and Myrtle Creeks. These plans form part of the MOP, which has been accepted by the DPIE, and remediation works have commenced. Learnings from this remediation process will be incorporated into the management and remediation plans for the Amended Project.

Recent aquatic ecological monitoring by Tahmoor Coal has found that the aquatic ecology has been impacted by longwall mining resulting in cracking of bedrock, diversion of flow and draining of pools. This has resulted in less aquatic habitat, poor water quality (electrical conductivity, pH and iron floc) which has led to a change in the composition of macroinvertebrates. This change was the presence of more pollution tolerant organisms and lack of sensitive species (mayflies). Tahmoor Coal is currently in the process of rehabilitating sections of Myrtle Creek. The Redbank Creek corrective management action plan will draw upon the experiences and resources of the Myrtle Creek corrective management action plan and develop environmental control similar to those used for the Myrtle Creek corrective management action plan.

The cumulative groundwater impacts were assessed through numerical modelling and included review of data from several mines in the regional area (Appendix C of the Project Amendment Report). The modelling included assessment of the cumulative impacts from the existing Tahmoor Mine and other mines within the Southern Coalfields (including Appin, West Cliff Tower and Dendrobium coal mines as shown in Appendix I of the Groundwater Assessment (Appendix C of the Project Amendment Report) and simulation of the 'full recovery' of groundwater levels well in excess of the required minimum simulation of 100 years post-mining.

5.7.31 Flood Modelling

Issue Description

The report indicates utilising a RORB hydrologic model and a TUFLOW hydraulic model for the flood assessment. These models can provide adequate information on flooding behaviour. However, the report has only depicted the extent of flooding for pre and post development conditions, which is considered inadequate to satisfy the project's SEARs. The SEARS required the proponent to address flooding behaviour in the vicinity of the project which includes information on flood characteristics for pre and post development scenarios (i.e. extent, depth, velocity, hydraulic and hazard categories etc).

Accordingly, to satisfy the SEARs, it is prudent to address flooding characteristics for the full range of floods in order to:

- *Determine the impact of the project on flooding behaviour;*
- *Determine the impact of flooding on the project;*
- *Address the risk to people and infrastructure associated with various flood events;*
- *Address the impacts on existing downstream areas for the full range of flooding; and*
- *Prepare an emergency response plan to ensure risk to personnel and damages to infrastructure during larger flood events is minimised and managed. The plan would include a flood evacuation strategy to ensure that safe evacuation from the site can be achieved.*

Response

The flood assessment prepared for the EIS has been updated to reflect the Amended Project. Flooding has been characterised across the full range of events (50%, 10%, 1%, 0.5%, 0.2% and PMF), as detailed in Section 5.0 of the Flood Study (Appendix D of the Project Amendment Report). Velocity and bed shear have been assessed for the 50% AEP only as this is representative of channel forming events (refer Section 8.1 of the SWIA). Lower AEP events are not considered representative. The change in flood extent as a result of the Amended Project has been assessed for all events (Appendix D of the Project Amendment Report). Changes are predicted to be very limited. Whereby, predicted subsidence would result in some localised minor changes to flooding in creeks in the Project Area for events up to the 1% AEP level. Due to the very limited changes, an emergency response plan is not considered justified.

Section 6.0 of the Flood Study (Appendix D of the Project Amendment Report) addresses potential impacts to overflow flow paths within the Bargo Township as a result of predicted subsidence impacts for the Amended Project. A summary of the impacts to overland flow paths has been provided below.

Table 5-9 Summary of impacts to overland flow paths

No.	Identification	Description
1	Northern side of Bargo Township	Three overland flow paths were identified on the northern side of Bargo overlying the proposed gate road between longwalls 105A and 106A and one overlying the proposed gate road between longwalls 104A and 105A. The area comprises timbered terrain where overland flow would follow a steep, incised natural creek line. There is no predicted ponding upslope of the gate road as a result of subsidence. The average slope of the overland flow path upslope of the gate road in this area would reduce from approximately 5.5% to 5.2% due to predicted subsidence. It is considered unlikely the slightly reduced gradient would have any observable effect on flow depth in the creek line.
2		The area comprises an open grassed paddock were overland flow would follow a depression downstream of a small farm dam overflow. There is no predicted ponding as a result of subsidence. The average slope of the overland flow path upslope of the gate road would reduce from approximately 3.5% to 3.3% due to predicted subsidence. It is considered unlikely that this slight reduction in gradient would pose any significant risk of increased flooding outside the existing overland flow path area.
3		The area comprises an open grassed paddock area where overland flow would follow a shallow swale which flows into a small farm dam. There is no predicted ponding as a result of subsidence. The average slope of the overland flow path upslope of the gate road would reduce from approximately 4.1% to 3.9% due to predicted subsidence. It is considered unlikely the slightly reduced gradient would pose any significant risk of increased flooding outside the swale.
4		The site is located on the northern side of Bargo between longwalls 104A and 105A. The area comprises an open grassed paddock where overland flow would follow an ill-defined flow path upslope of a residential area. There is no predicted ponding as a result of subsidence. The average slope of the overland flow path upslope of the gate road in this area would reduce from about 4.0% to 3.7% due to predicted subsidence. It is considered unlikely the slightly reduced gradient would increase flooding outside the overland flow path area.
5	Northern side of Wellers Road	Overland flow path 5 is located on the northern side of Wellers Road, in an area overlying the proposed gate road between longwalls 106B and 107B. The catchment upstream of this location is estimated to be about 17.6 ha. The average slope of the overland flow path upslope of the gate road would reduce from approximately 2.8% to 2.4% due to predicted subsidence. There is no ponding within the overland flow path as a result of subsidence and it is considered unlikely the reduced gradient would pose a risk of significant increased flooding within the existing overland flow path area.

No.	Identification	Description
6	Western side of Great Southern Road	The overland flow path overlies the proposed gate road between longwalls 105B and 106B. The area comprises an open, partially timbered drainage corridor where overland flow would follow a natural depression. There is no predicted ponding as a result of subsidence. The average slope of the overland flow path upslope of the gate road in this area would reduce from approximately 3.3% to 3.2% due to predicted subsidence. It is considered unlikely the slightly reduced gradient would pose a significant risk of increased flooding outside the existing drainage corridor
7	East of the Great Southern Road	The overland flow path overlies the proposed gate road between longwalls 104B and 105B. The area comprises an open grassed paddock and an established tree break where overland flow would follow a natural depression. There is no predicted ponding as a result of subsidence. The average slope of the overland flow path upslope of the gate road in this area would reduce from approximately 2.4 % to 2.2% due to predicted subsidence. It is considered unlikely the slightly reduced gradient would pose a significant risk of increased flooding outside the overland flow path area.
8	Between Hogans Drive and Remembrance Drive	Overland flow path 8 comprises a drainage corridor between two housing allotments on Hogans Drive. The drainage corridor overlies the proposed gate road between longwalls 106B and 107B. The area comprises an open, vegetated swale. There is no ponding predicted to occur as a result of subsidence. The average slope of overland flow path upslope of the gate road in this area would reduce from approximately 4.1% to 3.8% as a result of the predicted subsidence. It is considered that the slightly reduced gradient would not pose a risk of significant increased flooding outside the drainage corridor.
9	Between Scot Street and Hogans Drive	Overland flow path 9 comprises a drainage corridor located in an open relatively steep confined swale on Hogans Drive upslope of a residential building. The swale overlies the proposed gate road between longwalls 107B and 108B. The catchment area contributing to this overland flow path is estimated to be some 4.8 ha. There is no ponding predicted to occur as a result of subsidence. The average slope of overland flow path upslope of the gate road in this area would reduce from approximately 5.4% to 5.1% as a result of the predicted subsidence. It is considered that the slightly reduced gradient would not pose a significant risk of increased flooding within or outside the swale.
10	Between Great Southern Road and Hawthorne Road	There is an existing ill-defined overland flow path which passes through two housing allotments fronting Hawthorne Road. The overland flow path, which overlies the proposed gate road between longwalls 106B and 107B, has a surface catchment of some 4.5 ha. There is no ponding predicted to occur along the overland flow path as a result of subsidence. The average slope of overland flow path upslope of the gate road in this area would reduce from approximately 2.9% to 2.6% as a result of the predicted subsidence. It is considered that the reduced gradient would not pose a risk of significant increased flooding within the overland flow path area.

No.	Identification	Description
11	Between Great Southern Road and Hawthorne Drive	Overland flow path 11 passes through two housing allotments located between Hawthorne Road and Great Southern Road. The overland flow path overlies the proposed gate road between longwalls 107B and 108B. There is no ponding predicted to occur along the overland flow path as a result of subsidence. The average slope of the overland flow path upslope of the gate road in this area would reduce from approximately 4.1% to 3.9% as a result of the predicted subsidence. It is considered that the slightly reduced gradient would not pose a significant risk of increased flooding within the overland flow path area.
12	Dymond Street	Overland flow path 12 comprises a small channel within a large open area on the northern side of Dymond Road which overlies the proposed gate road between longwalls 106B and 107B. The area comprises an undeveloped, partially timbered area with a farm dam in the flow path upslope of the gate road. The average slope of the overland flow path upslope of the gate road in this area would reduce from approximately 2.5 % to 2.1 % as a result of the predicted subsidence. Subsidence would not cause surface ponding in this area and it is considered that the reduced gradient would not pose a significant risk of increased flooding outside the overland flow path area.
13	East of Hawthorne Road	Overland flow path 13 comprises a shallow swale within in a large open area on the east of Hawthorne Road and south of Dymond Road. The overland flow path overlies the proposed gate road between longwalls 107B and 108B. The area comprises an undeveloped, sparsely timbered paddock upslope of the gate road. The average slope of the overland flow path upslope of the gate road in this area would reduce from approximately 2.6 % to 2.3 % as a result of the predicted subsidence. Subsidence would not cause ponding of the surface in this area and it is considered that the reduced gradient would not pose any significant risk of increased flooding outside the open area.
14	Bargo Road	Overland flow path 14 comprises a large low-lying, open area between two buildings on the southern side of Bargo Road. The area overlies the proposed gate road between longwalls 106B and 107B. The average slope of the overland flow path upslope of the gate road in this area would reduce from approximately 2.2 % to 1.9 % as a result of the predicted subsidence. Subsidence would not cause ponding of the surface in this area and it is considered that the reduced gradient would not pose a significant risk of increased flooding outside the open area.
15	Johnston Road	Overland flow path 15 comprises a small swale within an open area on the northern side of Johnston Road which overlies the proposed gate road between longwalls 107B and 108B. The area comprises a mix of grassed and timbered areas. The average slope of the overland flow path upslope of the gate road in this area would reduce from approximately 5.3 % to 5.0 % as a result of the predicted subsidence. Subsidence would not cause ponding of the surface in this area and it is considered that the reduced gradient would not pose any significant risk of increased flooding.

No.	Identification	Description
16	North of Hawthorne Road	Overland flow path 16 comprises a shallow swale in a large open area on the northern side of Hawthorne Road which overlies the proposed gate road between longwalls 107B and 108B. The average slope of the overland flow path upslope of the gate road in this area would reduce from approximately 2.3 % to 2.1 % as a result of the predicted subsidence. Subsidence would not cause ponding of the surface in this area and it is considered that the slightly reduced gradient would not pose a significant risk of increased flooding outside the open area.
17	South of Reservoir Road	Overland flow path 17 comprises a low-lying open upslope of several houses on the southern side of Reservoir Road which overlies the proposed gate road between longwalls 107B and 108B. The area comprises a minor drainage corridor in the headwaters of Dog Trap Creek. The average slope of the overland flow path upslope of the gate road in this area would reduce from approximately 2.5 % to 2.1 % as a result of the predicted subsidence. Subsidence would not cause ponding of the surface in this area and it is considered that the reduced gradient would not pose a significant risk of increased flooding outside this open area.

5.8 Resource Regulator (NSW DPIE)

5.8.1 Rehabilitation – Adequacy of Information

Issue Description

Additional information is required to demonstrate that sustainable rehabilitation outcomes can be achieved as a result of the project. The "Final Landform" Plan (Figure 9 of the Conceptual Mine Closure Plan) has no contours and no indication of the Final Landform. The Plan also only covers the Reject Emplacement Area, not Domains 1, 2, 4 and 5 which would also be applicable. A more detailed "Final Landform" Plan, covering all applicable Domains is required.

Response

A more detailed Final Landform Plan, covering all applicable domains, has been prepared for the project, and is presented as Figure 9 in the Rehabilitation and Mine Closure Strategy prepared for the Amended Project (Appendix Q of the Project Amendment Report). This plan presents contour information for rehabilitated areas.

Additional information relating to the demonstration of achievable rehabilitation outcomes is provided as responses to the issues raised in **Sections 5.8.2** to **5.8.5**.

5.8.2 Rehabilitation of Watercourses

Issue Description

There is inadequate commitment to Rehabilitation of impacts to watercourses. Section 11.7.1 Subsidence of Watercourse and Drainage Lines) refers to existing Management Plans regarding "potential impacts to streams resulting from the mining of longwalls" but these are not provided as part of the EIS and there is inadequate information provided to give confidence that remediation will occur to a satisfactory standard.

At minimum, general commitments and completion criteria regarding remediation of impacts to watercourses and drainage channels should be included in the EIS. (Should the project be approved, Development Approval conditions should be applied which set minimum Performance Standards / Remediation commitments to ensure no unacceptable impacts on watercourses and drainage channels occur as a result of the project).

Response

Concerns regarding the recovery potential of creeks following longwall mining are acknowledged. Methods for remediating creek beds in the Southern Coalfields are currently being monitored by Tahmoor Coal to determine their long-term effectiveness and to ensure that the industry can continue to improve remediation techniques.

If pool / stream remediation measures are required during mining, they would be implemented in consultation with the relevant government authorities, including DPIE – Water. Where there are substantial sediment accumulations upstream of areas affected by subsidence cracking, it is expected that some of the fractures would be naturally filled over time with sediment during subsequent flow events. Where little sediment is present, the impacts are likely to remain for longer periods and remediation may be required after the completion of mining, which could include sealing these fractures and voids with grout.

Tahmoor Coal has recently developed corrective management action plans for Redbank and Myrtle Creeks to remediate subsidence impacts caused by Longwalls 27 to 30. The corrective management action plans form part of the approved 2019/2020 MOP for Tahmoor Coal. The corrective management action plans propose pool remediation and rock bar grout curtain wall works which will be undertaken along Myrtle and Redbank Creeks via a staged approach.

Stage 1 of the Myrtle Creek corrective management action plan is underway as a trial project. On completion of the Myrtle Creek corrective management action plan Trial Project, outcomes will be assessed to determine the best approach for a future Stage 2 remediation works in Myrtle and Redbank Creek. Outcomes from each stage will be assessed to provide the best approach for the next stage. The purpose of this approach is to provide a strategy of continuous improvement from the staged outcomes. Learnings from rehabilitation works in Myrtle and Redbank Creek will be applied to develop an effective and appropriate remediation strategy for Tea Tree Hollow and Dog Trap Creek if the streambed or pools are impacted due to the Amended Project.

Following completion of Stage 1 of the Myrtle Creek corrective management action plan, Stage 2 will include these additional works:

- installation of grout curtain walls at an additional 6 sites; and
- pool remediation at an additional 15 sites.

The proposed corrective management action plan for Redbank Creek includes:

- Review and update of the plan to leverage the successful outcomes and learnings of the Myrtle Creek corrective management action plan Stage 1 remediation works;
- Investigation works including stream and pool mapping and stream bed characterisation;
- Remediation works including up to 6 grouting sites and up to 15 pool remediation sites;
- Ongoing water flow and water quality monitoring at Redbank Creek to provide adequate data for subsidence impact analysis and close out of completion criteria;
- Aquatic ecology monitoring at Redbank Creek to provide adequate data for subsidence impact analysis and close out of completion criteria; and
- Implementation of a stakeholder (including local community) consultation strategy to keep interested parties informed on the progress of the remediation works.

To ensure continual improvement based on the outcomes of creek remediation monitoring, Tahmoor Coal will complete the following reports for the corrective management action plans:

- Quarterly Progress Report (31 March, 30 June, 30 September; 31 December)
- Remediation Stage Completion Reports; and
- Final Completion Report.

These reports would be submitted to the following stakeholders:

- Tahmoor Coal Community Consultative Committee;
- DPIE - Resources Regulator;
- Wollondilly Shire Council; and
- Other stakeholders as directed by NSW Resources Regulator.

On completion of each remediation stage, a Stage Completion Report will be prepared. These reports act as a system of continual improvement based on the monitoring and what was identified in the monitoring program in terms of effectiveness.

At the completion of the final remediation works, a Final Completion Report will be prepared by Tahmoor Coal.

This approach has been reviewed and endorsed by DPIE as a component of the MOP for Tahmoor Mine. As mentioned above, the plan is currently being implemented along Myrtle Creek, and will be updated/ enhanced for Redbank. Tahmoor Coal would build on the experience at Redbank and Myrtle Creeks, as well as at other mines in the Southern Coalfields, to monitor and enhance the success of rehabilitation methods for creeks affected by the Amended Project.

5.8.3 Rehabilitation Criteria

Issue Description

In Table 8, "Preliminary Rehabilitation Success Criteria"

- *It is noted there is a 'Slope Gradient' indicator for Domains 1 and 2, but no equivalent for Domains 3, 4, 5 or 6. It is recommended that Phase 2 of this Table be expanded to cover all Domains;*
- *For Infrastructure, Domains 1 and 2, the Land Use in the Indicator Column is 'proposed industrial'. This is inconsistent with the default position of returning all lands to native bushland and should be changed; and*
- *There are no criteria specified for watercourses and drainage channels in terms of ensuring flows are maintained and/or reinstated.*

Table 8 should be updated to address these 3 points.

Response

The Rehabilitation and Mine Closure Strategy (SLR 2020) has been revised to include the above points in Table 11 (refer Appendix Q of the Project Amendment Report).

5.8.4 Rehabilitation – Additional Information

Issue Description

In summary, the EIS as submitted has insufficient detail regarding rehabilitation commitments and completion criteria in relation to certain aspects of Rehabilitation. Other than the above points, the Rehabilitation related sections of the EIS are considered to be satisfactory.

Response

Noted. Refer to **Sections 5.8.1** to **5.8.3** where these issues are addressed.

5.8.5 Conceptual Mine Plan

Issue Description

The Conceptual nature of the Mine Closure Plan is noted and is considered to be acceptable. Further detail regarding rehabilitation can be provided in Mining Operations Plan / Rehabilitation Management Plan documents, which will be required by the Resources Regulator, and in the more detailed Mine Closure Plan to be developed approximately 5 years before expected mine closure.

Response

As identified in Section 11.23.5 of the EIS, a detailed Mine Closure Plan will be prepared at least 5 years before expected mine closure and submitted to the Resources Regulator. This requirement has been incorporated into the revised Environmental Management Measures for the Amended Project (**Chapter 7.0**).

5.8.6 Resource Regulator Role

Issue Description

It should be noted that this review does not represent the Resources Regulator's endorsement of the proposed rehabilitation methodologies as presented in the EIS. Under the conditions of a mining authority granted under the Mining Act 1992, the Resources Regulator, requires an authority holder to adopt a risk-based approach to achieving the required rehabilitation outcomes. The applicability of the controls to achieve effective and sustainable rehabilitation is to be determined based on the site-specific risk assessments conducted by an authority holder. This risk assessment should be used to not only establish a basis for managing risk when planning an activity, but it should also be used and updated (as required) to continuously evaluate risk and the effectiveness of controls used to prevent or minimise impacts. An authority holder may also be directed by the Resources Regulator to implement further measures, where it is considered that a risk assessment and associated controls are unlikely to result in effective rehabilitation outcomes.

Response

Tahmoor Coal will undertake the final closure and rehabilitation of the mine in accordance with the requirements of the Resources Regulator and any relevant conditions of relevant mining leases and the development consent for the Project.

5.8.7 Mine Safety Risk

Issue Description

It is relevant to note that the Resource Regulator Mine Safety Operations is responsible for ensuring mine operators manage the risk to worker health and safety though compliance with the Work Health and Safety (Mines and Petroleum Sites) Act 2013 and the subordinate mining legislation. In particular the effective management of risk associated with the principal hazards as specified in the Work Health and Safety (Mines and Petroleum Sites) Regulation 2014.The Resource Regulator Mine Safety Operations have not identified any risk that would require comment in relation to this matter.

Response

Noted.

5.9 Transport for NSW (formerly Roads and Maritime Services)

5.9.1 Hume Highway

Issue Description

Prior to any activity relating to the development, the developer must clearly demonstrate to the satisfaction of RMS, that implementation of its Subsidence Management Plan will assure that mining impacts on RMS infrastructure, functionality, and road user safety will be proactively managed and effectively reduced to levels acceptable to RMS.

Response

The Amended Project would not mine under any TfNSW (formerly RMS) controlled roads. The Avon Dam Road Overbridge over the M31 Hume Motorway is located 520 m from the longwall boundaries and may experience some low levels of vertical subsidence.

Tahmoor Coal would consult with RMS as part of the Extraction Plan approval process in relation to subsidence impacts to any RMS regulated road infrastructure including any required monitoring, mitigation and management measures. This requirement has been incorporated into the revised Mitigation Measures for the Amended Project (refer **Chapter 7.0**).

5.9.2 Roads Authority

Issue Description

RMS highlights that in determining the DA under Part 4 of the EP&A Act, it is the consent authority's responsibility to consider the environmental impacts of any road works which are ancillary to the development. This includes any works which form part of the proposal and/or any works which are deemed necessary to include as requirements in the conditions of development consent. Depending on the level of environmental assessment undertaken to date and nature of the works, the consent authority may require the developer to undertake further environmental assessment for any ancillary road works.

Response

Should any works be required on RMS regulated roads, RMS would be consulted, and works would be carried out in accordance with RMS requirements. Currently no works are proposed on RMS regulated roads.

5.10 Subsidence Advisory NSW

5.10.1 Predicted Mine Subsidence Impacts

Issue Description

The EIS shows proposed longwall extraction under the Bargo Township. This area is densely populated compared to other extraction areas in the proposal. The predicted ground movements for the Bargo Township are significantly higher than those measured in the Tahmoor North Project area and the proposal will result in a significantly higher levels of damage to residential structures than that experienced in Tahmoor North.

Response

Tahmoor Coal has amended the mine plan for the Project in a direct response to concerns relating to subsidence, including reducing the proposed extraction height (from 2.85 m to up to 2.6 m) and longwall width (from up to 305 m to up to 285 m) to be consistent with what is currently mined in Tahmoor North (refer **Chapter 2.0** of this report). In addition, other changes to the mine plan relevant to subsidence impacts, particularly in the populated areas of Bargo are:

- Splitting of panels into two LW groups, with a central heading accessway;
- Extension of the footprint at the northern end of LWs 101A to LW 106A within semi-rural areas north of the Bargo township; and
- A reduction in the underground mine footprint along the main gate of LW108B, which is predominantly beneath urban areas of the Bargo township.

The new mine layout, compared to the layout presented in the EIS, is presented in **Figure 2-1**.

The reduction in subsidence impacts, as a result of these amendments, is detailed in the Subsidence Assessment prepared by MSEC for the Amended Project (Appendix B of the Project Amendment Report). Overall, the changes to the mine design and layout have resulted in a reduction in the subsidence, tilt and curvature by approximately 15%. The reduction in footprint, predominantly due to the reduced longwall panel width, also means that 180 fewer houses will be directly mined beneath, compared to the mine plan proposed in the EIS.

It is also relevant to note that, in relation to mining beneath houses in the Bargo township, there are forecast to be nine longwalls extracted prior to mining beneath the more densely populated areas. This enables an opportunity to review the observed versus predicted curvatures and associated impacts leading up to mining LW 107B and LW 108B, where the majority of houses are located. Further, there have been areas within the Tahmoor North mining area where the magnitude and level of subsidence impacts experienced is higher than or similar to the levels predicted for Tahmoor South. Risk controls have been implemented to ensure that houses have remained safe and serviceable within these areas.

5.10.2 Impacts to Buildings/ Residences

Issue Description

The 1998 Tahmoor North Underground Extension EIS predicted 82% of houses in Tahmoor would be negligibly affected by mine subsidence. A report commissioned by Subsidence Advisory in 2016 found extraction of Tahmoor Coal's Longwalls 22 to 29 resulted in subsidence damage to approximately 40% of properties in Tahmoor and Thirlmere with an average repair cost of $75,000.

Response

The methods used to predict impacts to houses in 1998 were based on conventional subsidence movements, with an acknowledgement that the subsidence prediction model could not predict high ground strains due to non-conventional ground movements. Regardless of this, the 1998 assessment was consistent with impact data that had been gathered by Tahmoor Coal at the time, where a total of 21 houses out of 244 houses had reported impacts since mining commenced in 1979.

The results of the 2016 study commissioned by Subsidence Advisory NSW (SA NSW) were used by MSEC in conducting the Subsidence Assessment for Tahmoor South (as described in Section 11.1.3 of the Subsidence Assessment for the Amended Project (MSEC 2020)), and in particular using observations of impacts from the extraction of Longwalls 22 to 29. The predictions are therefore based on a comprehensive understanding of subsidence behaviour and impacts.

5.10.3 Social Impacts

Issue Description

There are significant social impacts for communities affected by mine subsidence. The timeframe over which a property is influenced by active subsidence can vary greatly due to a number of variables including extraction height and width, and ground conditions. Properties can be influenced by subsidence from multiple longwalls resulting in active subsidence periods over several years. This results in significant delays before compensation claims can be assessed and paid.

Response

Social impacts associated with subsidence impacts assessed in Section 11.15.4 of the EIS found longwall mining related subsidence impacts to private residences and privately-owned structures (including farm infrastructure such as farm dams and fences) have the potential to increase anxiety and stress in the community. This can arise from the timing and duration of mining and the process for accessing any reparations for subsidence impacts to property.

Tahmoor Coal has extensive experience to-date in managing subsidence related impacts from the Tahmoor Mine, including in investigating and closing out subsidence claims in accordance with the most up to date SA NSW requirements. Tahmoor Coal would apply the same process for the Project in consultation with people who are affected, with the aim of minimising stress and anxiety associated with the process as far as possible. To provide property owners with ongoing, transparent and timely support in relation to mining impacts to their property, Tahmoor Coal will commit to dedicated personnel (e.g. Bargo Community Relations Coordinator) to engage and support each property owner prior to, during, and after the active subsidence period. Sections 3.2.9, Section 11.1.5 and Section 11.1.7 of the EIS and Section 7.13.3 of the Project Amendment Report, provide details of the Tahmoor Coal subsidence management process including communication processes with residents, pre-mining inspections and resolution of claims in accordance with SA NSW requirements. These requirements are reflected in the revised Environmental Management Measures for the project (refer **Chapter 7.0**).

5.10.4 Non-Conventional Subsidence Impacts

Issue Description

It is unclear how the potential for impacts resulting from non-conventional anomalous movements (NCAM) to surface improvements have been determined.

NCAM have resulted in significant damage in the Tahmoor North area. As noted above, it is difficult to mitigate subsidence damage from anomalous subsidence movement through design.

Response

Information on the methodology for assessment of impacts on houses is provided in the Subsidence Assessment (MSEC, 2020, refer to Appendix B of the Project Amendment Report). The results gathered from the 2016 study commissioned by SA NSW were analysed with respect to the observed subsidence movements and structure types. Impacts to houses due to both conventional and non-conventional movements were included in the analysis. The likelihood of houses experiencing non-conventional movements is linked to the magnitude of observed mining-induced curvatures. Put simply, the higher the level of curvature, the higher the likelihood of impacts due to both conventional and non-conventional movements.

5.10.5 Mine Layout to Reduce Impacts to Bargo Township

Issue Description

Subsidence Advisory recommends the proposal is modified to substantially reduce the predicted subsidence impact underneath the Bargo Township where most residential structures are concentrated. This may require changes to the proposed longwall widths, chain pillar dimensions and extraction heights in the area.

Response

As described in detail in the response in **Section 5.10.1**, Tahmoor Coal has amended the proposed mine compared to that presented in the EIS, which has reduced the longwall panel width, extraction height and mining footprint. This has resulted in a reduction in the number of houses that will be directly mined beneath (by 180), and has reduced the maximum incremental subsidence, tilts and curvatures that will be experienced due to LW extraction compared to the mine layout and LW design presented in the EIS. **Table 5-10** shows the overall reduction in predicted mine subsidence impact between the mine plan presented in the EIS and the Amended Project.

Table 5-10 Maximum predicted subsidence results for EIS and Amended Project mine plans (Table 4.4 of the revised Subsidence Assessment report)

Layout	Longwalls	Maximum predicted total conventional subsidence (mm)	Maximum predicted total conventional tilt (mm)	Maximum predicted total conventional hoggin curvature (mm)	Maximum predicted total conventional sagging curvature (mm)
Amended Layout (MSEC1060)	LW101A to LW106A	1,350	8.7	0.13	0.23
	LW101B to LW108B	1,650	10.5	0.16	0.28
EIS Layout (MSEC997)	LW101 to LW108	1,900	13.0	0.19	0.33
	LW109	1,000	8.0	0.09	0.24

5.10.6 Damage Category Assessment

Issue Description

At present, tilts greater than 7 mm/m are not included in the repair categories. Relevelling buildings requires residents to be accommodated elsewhere whilst works are carried out. Subsidence Advisory recommends that residences subject to final tilts of 7 mm/m or greater are assessed under repair category R4.

Response

A total of 159 houses are predicted to experience final tilts that are greater than or equal to 7 mm/m. This represents 11% of the total number of houses within the Study Area, and 28% of the total number of houses that are located directly above the proposed longwalls in the Amended Layout for the Project.

The predicted curvatures at these houses are also relatively high, such that their likelihood of experiencing Repair Category R4 impacts is at the higher end of the range. Information is required from SA NSW regarding the number of houses that have experienced mining-induced tilts that are greater than or equal to 7 mm/m, and what proportion of these houses have made a claim and have been relevelled.

Houses located above previously extracted longwalls at Tahmoor Mine have experienced mining-induced tilts within the predicted range for the Amended Layout. This includes tilts at magnitudes of 10 mm/m and greater, which were observed above Tahmoor Mine Longwall 24A and above the south-eastern ends of Longwall 25 and 26, in the areas of increased subsidence.

5.10.7 Management of Impacts to Infrastructure

Issue Description

Tahmoor Coal undermined several pieces of infrastructure during the Tahmoor North Project, including local roads, utility infrastructure and services and the Main Southern Railway. During this project, performance measures were applied ensuring infrastructure was always safe and serviceable or serviceability should be maintained wherever practicable.

Subsidence Advisory recommends the application of these conditions is continued, including maintaining the relevant management groups, which have proved successful in the mitigation, identification and response to mining impacts.

Response

Since 2004, Tahmoor Mine has mined under the entire township of Tahmoor, safely and competently managing subsidence impacts to approximately 1,890 residential dwellings and commercial premises and on major built infrastructure such as:

- The Main Southern Railway rail line;
- Tahmoor Town Centre shopping centre;
- Wollondilly Shire Council road, bridges and drainage structures;
- Gas, electricity, water, sewer and drainage infrastructure;
- A poultry processing plant;
- Aboriginal cultural heritage sites; and
- post-European settlement heritage structures.

Tahmoor Coal would continue to use the Extraction Plan process to successfully manage subsidence impacts on built infrastructure as part of the Amended Project. The Extraction Plans and associated sub plans would be developed through consultation with the infrastructure owners and would be subject to approval by DPIE - Division of Resources and Geoscience, prior to implementation.

Sections 3.2.9, 11.1.5 and 11.1.7 of the EIS provide details of the Tahmoor Coal subsidence management process including communication processes, pre-mining inspections and monitoring requirements. These requirements are reflected in the revised Environmental Management Measures for the Project (refer **Chapter 7.0**).

5.10.8 Amendments to the Active Coal Mines Map

Issue Description

Subsidence Advisory is responsible for compensating subsidence claims within the defined 'inactive underground coal mining area' on the Active Coal Mines Map under the Coal Mine Subsidence Compensation Act 2017 (the Act). Mine operators are financially liable for subsidence damage in active mining areas.

Generally, inactive areas were mined prior to enactment of the Act on 1 January 2018. There are inactive mining areas within the proposed mining layout. Subsidence Advisory intends to modify the Active Coal Mines Map to reflect the final mining layout resulting in Tahmoor Coal being liable for any impacts from the proposed Tahmoor South Coal Project.

Response

Noted.

5.11 Sydney Water

5.11.1 Subsidence Impacts to Sydney Water Infrastructure

Issue Description

In relation to potable water, the most significant infrastructure risk from the proposal is the potential impact to the 450 mm trunk water main that runs south/ north through the area along Remembrance Driveway. This is a single main with no alternate supply. Smaller reticulation mains in and around the Bargo area are also at risk.

Sydney Water has an old reservoir at Bargo which may be impacted by the proposal. It is not currently in use but has the potential to be repurposed for use as a storage facility for the pressure sewer system.

The area is currently serviced by the Bargo and Buxton wastewater scheme which is a low-pressure sewer system. The sewer is conveyed from the villages along Remembrance Driveway to the Picton Wastewater Treatment Plant. A variety of assets that are critical to the wastewater system's hydraulic operations may be impacted. They include: transfer mains from the Bargo/ Buxton system, barometric loop, vent shafts. aqueducts along the local bridge crossing and valves that control the day-to-day operations of the wastewater system.

Response

Section 11.1.6 of the EIS identified that local potable and wastewater infrastructure have the potential to experience the full range, or close to the full range, of predicted subsidence movements within the Subsidence Study Area. Longwall mining in the Southern Coalfield has occurred directly beneath water infrastructure in the past and the subsidence impacts of the Project are anticipated to be consistent with those observed to occur from previous longwall mining. Subject to management under the Extraction Plan process, impacts are expected to be manageable and readily remediated where damage occurs.

As identified in **Section 5.10.7**, since 2004 Tahmoor Mine has mined under the entire township of Tahmoor, safely and competently managing subsidence impacts to approximately 1,890 residential dwellings and commercial premises as well as to major built infrastructure such as:

- the Main Southern Railway rail line;
- local roads, bridges; and
- gas, electricity, water, wastewater and drainage infrastructure.

The maximum predicted conventional subsidence parameters for the 450 mm diameter watermain along Avon Road, Great Southern Road and Remembrance Drive is provided in **Table 5-11**.

Table 5-11 Conventional subsidence parameters

Location	Maximum predicted subsidence (mm)	Maximum predicted tilt along alignment (mm/m)	Maximum predicted hogging curvature in any direction (km^{-1})	Maximum predicted sagging curvature in any direction (km^{-1})
450 mm dia. Watermain along Avon Dam Road, Great Southern Road and Remembrance Drive	1500	7.5	0.13	0.25

The maximum predicted conventional strains for the rising main, based on applying a factor of 15 to the maximum predicted conventional curvatures, are 2.0 mm/m tensile and 3.7 mm/m compressive.

Previous operations at Tahmoor Mine have directly mined beneath smaller reticulation mains with only minor impacts recorded in older cast iron concrete lined pipes. Water leaks have been repaired by Sydney Water. The predicted systematic curvatures and strains for the water pipelines within the project area would be of a similar order and magnitude. It is expected that some minor leaks could occur at isolated locations, as a result of extraction of the longwalls, however the incidence of impacts is expected to be low and easily remediated. Management strategies as discussed below would be implemented to manage impacts to water infrastructure.

Tahmoor Coal has successfully mined beneath the gravity sewers consisting mainly of PVC pipes at Tahmoor and Thirlmere. The sewerage system at Bargo operates using hydraulic pressure in welded polyethylene pipes and will be able to accommodate substantially greater subsidence movements. Any impacts are expected to be of a minor nature and will be easily remediated in accordance with management strategies as set out below. With the appropriate management plans in place, MSEC (Appendix B of the Project Amendment Report) considers that potential impacts on sewer lines can be managed for mining within the extent of longwalls boundary for the Project.

It is noted that the 22-metre diameter reservoir on Radnor Road has been decommissioned.

Consultation with infrastructure owners has underpinned the successful management of subsidence impacts. Tahmoor Coal would continue to use the Extraction Plan process to successfully manage subsidence to ensure infrastructure is built to withstand subsidence impacts. The Extraction Plans and associated sub plans would be developed through consultation with the infrastructure owners such as Sydney Water and would be subject to approval by DPIE - Division of Resources and Geoscience, prior to implementation. Sections 3.2.9, 11.1.5 and 11.1.7 of the EIS provide further details of the Tahmoor Coal subsidence management process including communication processes, pre-mining inspections and monitoring requirements.

These requirements are reflected in the revised Environmental Management Measures for the project (refer **Section 7.0**).

5.11.2 Mine Design: Longwall Layout

Issue Description

The longwall layout should avoid Sydney Water critical infrastructure where possible. Where this is unable to be avoided, risk analysis studies will need to be conducted for the impact on Sydney Water assets once the final layout of the long walls has been determined.

Response

The proposed mine plan for the project was developed following an extensive risk assessment process which incorporated:

- Recommendations and findings of the Southern Coalfields Inquiry (refer Section 5.3.1 and Table 5.1 of the EIS) including streams of 3rd order or above within the mine subsidence area being considered as Risk Management Zones (RMZ);
- Extensive collaboration between technical specialists to determine risk management zones (RMZs) and inform the extent of longwall mining and proposed mitigation measures;
- Focus on avoiding or minimising impacts to significant natural features; and
    - Significant service infrastructure including: the 450 mm diameter watermain along Avon Road, Great Southern Road and Remembrance Drive.

Following layout refinements several key built infrastructure and utilities were located outside of the predicted Subsidence Study Area for the Project. Ongoing subsidence monitoring, throughout extraction, will inform updates and refinements to the mine plan as required to further minimise impacts to natural and built infrastructure where possible. Unavoidable impacts would be managed in accordance with the Extraction Plan process described in **Section 5.11.1**.

5.12 Transport for New South Wales

Issue Description

The exhibited documents have been reviewed and no further comment is provided at this stage of the planning process.

Response

Noted.

5.13 WaterNSW

5.13.1 Drinking Water Catchments

Issue Description

WaterNSW acknowledges that the revised mining area is no longer within the Sydney Drinking Water Catchment (SDWC). However, given the proximity of the proposed longwalls to the Metropolitan Special Area, WaterNSW has assessed whether the potential impacts may extend to the SDWC, with particular consideration of WaterNSW's Mining Principles. The Mining Principles that are most relevant to the Project are 'protection of water quantity', and 'sound and robust evidence regarding environmental impacts'. The Principles can be found at https:/fwww.waternsw.com.au/water-qualitv/catchment/mining/principles. The EIS provides predictions for groundwater drawdown, baseflow reduction and associated reduction in flows to Pheasant's Nest Weir. Based on the information in the EIS, WaterNSW considers that groundwater drawdown and baseflow reduction from the Project would pose a low risk to water quantity in the SDWC.

Response

The revised SWIA for the Amended Project supports the EIS conclusion of negligible impacts to the Metropolitan Special Area and associated watercourses (refer Section 10.1 of Appendix D of the Project Amendment Report).

Groundwater drawdown resulting from the Amended Project is predicted to reduce baseflow in Cow Creek, which is within the Metropolitan Special Area. This reduction in baseflow may be detectable during normal periods of low flow.

Although the predicted baseflow reduction in Cow Creek, which is within the Metropolitan Special Area, may be detectable during normal periods of low flow, the combined effects of the Amended Project, consumptive groundwater extraction and the effects of other existing mining projects are predicted to have a negligible impact on Sydney's water supply sources, including at Pheasants Nest Weir. A maximum reduction in mean daily flow at Pheasants Nest Weir of 0.01% (due to the Amended Project) to 0.012% (cumulative effect) is predicted based on the revised SWIA (Appendix D of the Project Amendment Report).

The predicted maximum reduction in mean daily flow represents an immeasurably small and likely indiscernible impact to flows at Pheasants Nest Weir. In the long-term, the reduction in baseflow, either due to the Amended Project or the cumulative effect, is estimated to have negligible observable impact on the mean daily flow at Pheasants Nest Weir.

5.13.2 Cumulative impacts

Issue Description

WaterNSW notes that the potential for future mining at the Dendrobium coal mine has not been included in relation to cumulative impacts in the Metropolitan Special Area. WaterNSW considers that the groundwater assessment for the Project should be updated to include potential cumulative impacts from any future mining at Dendrobium when the EIS for such mining is submitted.

Response

The cumulative groundwater impacts were assessed through numerical modelling, and the Groundwater Assessment included review of data from several mines in the regional area. The modelling included assessment of the cumulative impacts from the existing Tahmoor Mine and other mines within the Southern Coalfields (including Appin, West Cliff, Tower and Dendrobium coal mines as presented in Sections 6.4.2 and 6.7.2 of the Groundwater Assessment, Appendix I of the EIS); and simulation of the 'full recovery' of groundwater levels, in excess of the required minimum simulation of 100 years post-mining. The revised Groundwater Assessment for the Amended Project (Appendix C to the Project Amendment Report) includes a representation of the proposed Dendrobium Expansion (Areas 5, 6 and 3C).

5.13.3 Groundwater management plan

Issue Description

The EIS states that a groundwater management plan for Project will be developed. WaterNSW requests that the groundwater management plan should be developed in consultation with WaterNSW. WaterNSW also requests that it remains as a stakeholder for the Project and would appreciate having further opportunities to comment on the Project as the assessment progresses.

Response

A Groundwater Management Plan (GWMP) would be developed for the Project in consultation with WaterNSW, using the existing GWMP as a basis.

The Project Amendment Report and Response to Submissions Report will be provided to WaterNSW by DPIE as part of the assessment process, prior to the determination of the development application for the Amended Project.

5.14 Wingecarribee Council

5.14.1 Objection to Longwall Mining in the Wingecarribee Shire

Issue Description

Since 2010, Wingecarribee Shire Council (Council) has adopted a policy of opposition to longwall mining and any new coal mine in the Shire because of the concerns it has over potential impacts on groundwater, water catchments, agricultural land and tourism. Council acknowledges that although the project area extends into our Shire, no component of the mine or subsidence zone appear to occur in our region. The EIS identifies constraints to mining in the Southern Domain (which extends into Wingecarribee Shire), and Council acknowledges the efforts by the proponent to avoid activity in this area. We request that mining activity in this domain remain restricted into the future.

Response

No longwall mining or mining activity is proposed within the Wingecarribee Local Government Area as part of the Amended Project.

5.14.2 Rail Transport

Issue Description

The transport of coal product by rail to Port Kembla is proposed to continue through the Wingecarribee Shire, cutting through the Shire's main population centres of Mittagong, Bowral and Moss Vale and a number of the Shire's villages including Yerrinbool, Aylmerton, Balaclava, and Robertson. Council requests for covered rail wagons to be considered for this project to minimise the effect of coal dust on these growing population centres.

Response

To ensure fugitive dust emissions from coal transportation are kept to a minimum, Tahmoor Coal is committed to water spraying of the coal surface during train loading, as well as best practice load profiling. To demonstrate the effectiveness of water spraying of coal during train loading, Tahmoor Coal has carried out a review of relevant studies relating to fugitive dust emissions associated with rail transport of coal. A summary of the findings of these studies is provided below.

A study of dust emissions from rail transport at Duralie Coal mine near Stroud, NSW found that the water spray system in place at the train loading facility was very effective in controlling dust emissions from rail transport, achieving 99% control of emissions (Katestone, 2012).

Two studies have also been completed for the Australian Rail Track Corporation (ARTC), assessing particulate emissions from coal trains on the Hunter Valley network (Environ, 2012 and Katestone, 2013). Both studies investigated particulate matter (PM) emissions from coal trains (loaded and unloaded) compared with emissions from passenger and freight trains. The Environ study found that at one site there was no statistical difference in concentrations across all particulate size fractions for all train types. At the other site, it was concluded that concentrations coinciding with loaded and unloaded coal train passes are statistically higher for PM_{10}, but not other size fractions, compared with concentrations recorded during passenger train passes. There was no statistical difference between loaded coal train and unloaded coal trains.

The Katestone study concluded that loaded coal trains were not associated with a statistically significant difference in PM_{10} and $PM_{2.5}$ emissions compared with concentrations when no train passed. Unloaded coal trains were associated with a statistically significant difference in PM_{10} and $PM_{2.5}$ emissions compared with concentrations when no train passed.

As discussed in Section 9.6 of the revised Air Quality Assessment (Appendix J to the Project Amendment Report, ERM, 2020), it is noted that for both studies, PM concentrations were recorded at short distances from the track and for short averaging periods to coincide with train passes, therefore no quantification of impact at residential areas can be inferred from the studies.

Glencore Coal has also conducted a series of wind tunnel tests on various coal types across its mines in NSW, to determine the potential for coal dust being emitted from loaded coal wagons. The testing of simulated travel times, travel speeds and conditions experienced during rail transport from different mines to ports. The research indicated that the moisture content of the coal types tested makes dust emissions from the surface of loaded coal wagons unlikely during transport from the mine to the port.

The research indicates that the emission of coal dust from the surface of loaded coal wagons is unlikely to be a significant source of dust along the rail corridor. Notwithstanding this, Tahmoor Coal is committed to making sure exposed coal in loaded wagons is moistened when loaded to minimise the potential for emission of PM from wagons.

To put the potential fugitive emissions from loaded coal trains into context, an estimate has been made as to the levels of PM that may occur. Assuming a loaded train contains a maximum of 45 wagons, each 16.1 m in length and 2 m in width, the total surface area of exposed coal would be just under 1,500 m2 (0.15 ha). Katestone (2012) suggests that if the product is watered as it is loaded to trains, then emissions can be controlled by up to 99%.

Assuming a conservative control factor of 50% (allowing time for the coal to dry somewhat en route to Port Kembla), and an emission factor of 0.1 kg/ha/y (USEPA, 1985), then the total windblown dust emissions from loaded coal trains may be of the order of 66 kg/y. Even if no control factor was considered this would be approximately 131 kg/y, which constitutes less than 0.1 % of the total annual emissions calculated for the project and would be spread across a large area between Tahmoor Coal and Port Kembla. Any resulting ground level concentrations due to this source would therefore be extremely low.

Tahmoor Coal operates a manual train loading facility that produces a very consistent load profile that meets the Rolling Stock Operators (RSO) (Pacific National) Coal Loading Procedure NWSCO-005 coal train wagon loading specifications. The procedure stipulates that coal should be approximately 100 mm inside the wagon gunwale (outer top edge of the wagon) and at a maximum rail network height of 4270 mm. These requirements are achieved at the Tahmoor Coal rail loading facility. The manually operated loading facility allows the operator to view the loading of the trains directly, while loading.

Tahmoor Coal's attended train loading facility is designed and operated to prevent the spillage of coal through the wagon doors onto the track, with a sump sitting below the loading point. In the event of wagon doors opening during loading; product would fall into the sump with the operator able to immediately observe and react instantly.

5.14.3 Railway Maldon to Dumbarton

Issue description

The proposed Maldon to Dumbarton railway line is mentioned in the EIS as a potential future rail path. Council would support this alternative and encourages a government commitment to complete this project.

Response

Noted.

5.15 Wollondilly Shire Council

5.15.1 Position on longwall Mining

Issue description

Council does not oppose underground mining provided it can occur without adverse impacts to the natural, cultural and built environment. Council also recognises the economic related benefits of mining to the local and broader economy. It further recognises the importance of mining (with the associated multiplier effect) to employment both in a local and broader context.

Council has however taken a proactive approach in advocating the concerns of the local community over impacts associated with mining operations as well as the management of these impacts by State and Commonwealth Agencies. The applicable Council resolutions that define Council's formal position in regard to mining operations is presented in Attachment 3 to this submission.

Response

Noted. The Project will provide a net benefit to NSW. This net benefit is estimated to be $783.8 million in net present value comprising of $272.1 million and $511.8 million in direct and indirect benefits respectively, and an incremental cost of $0.1 million (EY 2020, refer to Appendix L of the Project Amendment Report). This includes economic benefits to local and regional economies, including continued provision of employment for Tahmoor Mine's existing workforce of approximately 400 employees, as well as providing employment for additional employees (up to around 175 additional staff at peak employment), until 2035.

Concerns raised in Attachment 3 to Council's submission have been addressed in the sections below.

5.15.2 Existing Tahmoor Mine

Issue Description

Council has not adopted a formal position in regard to existing operations associated with the Tahmoor Colliery Project. However, the position outlined in regard to mining projects and the State Significant Development framework is directly transferrable to this Project. Council has previously provided submissions on Subsidence Management Plans related to the approved Tahmoor North Project with the most recent being in 2017. This draft submission, while supporting aspects of the Plan, raised shortcomings in the assessment and management of potential impacts to the natural, cultural and built environment.

Response

The operation of the existing Tahmoor mine is regulated by the mine's existing development consents and associated approvals and mining leases. The impacts of the existing mine and existing management measures and protocols have been considered in the assessment of the Project (as relevant) as part of the cumulative impact assessments undertaken for various issues including subsidence, groundwater and surface water, noise and air quality. Further information is provided in the relevant assessment sections of the EIS (Chapter 11). Where existing mine management plans are proposed to be updated for the Project these are identified in **Chapter 7.0** (Revised Management Measures).

5.15.3 Supported Aspects of the Application

Issue Description

The following aspects of the Tahmoor Application and associated Environmental Assessment documentation is supported by Council staff given their consistency with the previously expressed position and concerns of Council:

- *Detailed groundwater modelling (subject to adequacy review by authorities with related expertise);*
- *The integration of the subsidence impact assessment with other related components of the assessment including aquatic ecology and groundwater assessment;*
- *A detailed analysis of predicted level of subsidence to all built structures within the identified maximum areas of subsidence;*
- *The consideration and assessment of potential impacts associated with the proposal to the hydrology of Thirlmere Lakes located on the eastern edge of the Greater Blue Mountains World Heritage Area;*
- *The listing and quantification of greenhouse gas emissions associated with the proposal including Scope 3 (emissions associated with extracted coal); and*
- *A Social Impact Assessment that is viewed as being largely consistent with the Guidelines prepared for such Assessment.*

Response

Noted. Council's assessment requirements, as provided with the SEARs, were considered in carrying out the relevant environmental and social impact assessments for the Project.

5.15.4 Identified shortcomings in the Project Application

Issue Description

Council is concerned with the number of shortcomings from the EIS including:

- *The independent Peer Review of the Aquatic Ecology Section undertaken by Dr Ian Wright from the Western Sydney University for Council*

- *Absence of reference to research within the Main Volume and Specialist Reports for Subsidence, Groundwater, Surface Water Impact Assessment and Aquatic Ecology that has occurred since 2014 regarding potential environmental impacts associated with subsidence to the structure and ecological condition of water sources.*
- *The absence of reference in the description of impacts from current operations in Tahmoor North to the condition of Redbank Creek to the Research Project by Dr Ian Wright titled "Subsidence Fracturing of Stream Channel from Longwall Coal Mining Causing Upwelling Saline Groundwater and Metal-Enriched Contamination of Surface Waterway".*
- *The absence of any firm commitment to investigate means for the disposal of coal rejects for re—use as a means of reducing the proposed removal of 34.2ha of vegetation of high conservation value that is required for its extension.*

Response

A Project Amendment Report has been developed in conjunction with this Response to Submissions Report, with specialist advice for groundwater modelling, subsidence, aquatic ecology, surface water, heritage, greenhouse gas and social impacts reassessed according to the Amended Project.

Detailed responses have been provided for the above concerns in **5.15.13**, **5.15.15**, **5.15.20**, **5.15.22**, **5.15.23**, **5.15.33**, **5.15.39** and **5.15.41**.

5.15.5 SSD Framework

Issue Description

Council is concerned with the following issues experienced with the SSD framework introduced for the project:

- *The transparency of the State Significant Development Framework and its adequacy in providing a sufficiently comprehensive assessment of the Project Application;*
- *Shortcomings in both the Determination process and adequacy of individual Determinations that deliver outcomes for individual Projects that are suitable to applicable stakeholders including the community; and*
- *Range of amendments to address these concerns and improve the overall transparency and level of public confidence in the SSD framework outlined in its submission were not incorporated into the finalised Guidelines for this Project.*

Response

These issues are outside the scope of the Project development application.

5.15.6 Reforms to the planning framework

Issue Description

Council is concerned with the following issues of specific relevance to SSD Project applications:

- *The achievement of lower environmental outcomes as a result of restrictions placed over specialist advice provided by Government Agencies on State Significant Developments; and*
- *The opportunity for detailed and transparent investigation of complex issues associated with Project Applications has been greatly reduced as a result of the abolishing of Planning Assessment Commissions.*

Response

These issues are outside the scope of the Project development application.

5.15.7 Review and Determination Process for SSD

Issue Description

Council is concerned with the adequacy of the response process to received specialist advice from Government Agencies and research organisations regarding SSD by the DPIE, including in relation to the Russell Vale Colliery Expansion Project. It is considered imperative that this process be fully transparent in terms of detailing the actual review process of this advice as well as the reasons for any received advice not being accepted/supported being made publicly available. Please note, it would be the broad expectation of Council that all specialist advice not be accepted only in particular highly extenuating circumstances.

Response

These issues are outside the scope of the Project development application. The identified matters are the formal responsibility of the DPIE.

5.15.8 Community Consultation: Adequacy of Community Engagement

Issue Description

The proponent is acknowledged to have provided a Briefing to Council on this Application and also held a number of community information drop-in sessions (which have been welcomed). The proponent is also acknowledged to have provided briefings at Community Consultation Committee meetings on aspects of the Project Application. However, the consultation is viewed as not being sufficiently comprehensive to ensure adequate awareness of the Project and potential impacts by both the broader community and potentially affected residents. In summary, while the consultation by SIMEC has been welcomed, it is considered that community participation in this consultation occurred in an opportunistic basis.

In relation to this matter, the Environmental Assessment is a detailed document with a high level of complexity. The EIS is acknowledged to contain a number of features to simplify this complexity such as a Summary of Key Issues. A number of paid advertisements regarding the Project Application are acknowledged to have been placed in local newspapers by SIMEC. However, it is considered, and feedback has been received to this effect, that the document is overwhelming to members of the community in terms of achieving an understanding of the Project. In order to adequately engage the community, Council would expect SIMEC utilise a range of robust methods to promote their community consultation. Such methods would include direct correspondence with key stakeholders, distribution of flyers and utilisation of signage, cross-promotion at other community activities and ensure that their information days were held in highly visible locations that were accessible and held at appropriate times to encourage community participation.

In relation to this matter, the preparation of an EIS Overview and its overall structure and its distribution by SIMEC is welcomed as a means of addressing issues raised above. However, the DPIE is requested to note that Council views the distribution of this Overview to approximately 3,500 residents approximately four weeks into the public exhibition period as being unsatisfactory and a process that Council would not entertain for its projects.

Response

In relation to the complexity of the EIS, it is acknowledged that it is a highly technical document containing a large amount of information. However, the preparation of such a comprehensive assessment was required to provide sufficient information to the DPIE, to make an informed decision about the Project. It is also noted that the SEARs issued for the Project required this level of extensive scientific investigation.

Under the EP&A Act, the Secretary of DPIE is responsible for setting the timing and duration of public exhibition periods for an EIS. For the Project, the Secretary of DPIE determined to extend the public exhibition period from the minimum statutory requirement of 28 days to 42 days. This provided adequate opportunity for stakeholders to consider the proposal and provide informed comments.

In addition to the availability of the EIS on the DPIE Major Projects website, Tahmoor Coal undertook a number of other activities to ensure that sufficient opportunity was provided to community members to obtain information about the project. During the public exhibition period, a community information day was held by Tahmoor Coal, and information stalls were set up at local shopping centres, to provide community members an opportunity to discuss the EIS with technical specialists and to learn about the submission process.

Other activities carried out to support public exhibition of the EIS included a link on the Project web page navigating the public to the EIS on the major projects website, and the provision of a community information EIS Overview booklet which was emailed to Tahmoor Coal's list of contacts and distributed to residents within the Study Area.

Ongoing consultation will be carried out with Wollondilly Shire Council on matters relating to the Project.

5.15.9 Community Consultation: DPIE draft Community Participation Plan

Issue description

It is requested to be noted that the engagement process for the Tahmoor South Application is viewed as being inconsistent with a number of actions in the DPIE draft Community Participation Plan such as "Ensure community engagement accurate/y captures the relevant views of the community".

Response

The consultation undertaken as part of EIS preparation and the preparation of the specialist Social Impact Assessment (SIA) is detailed in Sections 9 and 11.15 and Appendix Q of the EIS. Wide ranging consultation measures were employed to reach a wide variety of stakeholders and capture community views. This includes:

- Community newsletter distribution by letter box drops to approximately 4,000 households and by email to 250 individuals and organisation;
- Project updates at regular Tahmoor Coal Community Consultative Committee;
- Nine community information days since the commencement of the environmental assessment phase;
- Tahmoor Mine community information surveys undertaken in 2012 and 2018;
- Specific meetings with stakeholder groups including: Bargo Primary School, Bargo Dingo Sanctuary, Infrastructure and Emergency Providers, National Parks Association of NSW, Picton Chamber of Commerce, Picton High School, Rivers SOS, Wollondilly Anglican College, Wirrimbirra Flora & Fauna Sanctuary, , and Bargo Progress Association; and
- Consultation with indigenous stakeholders during the preparation of the Aboriginal Cultural Heritage Assessment for the project in accordance with requirements of the *Draft Guidelines for Aboriginal Cultural Heritage Assessment and Community Consultation* (DEC, 2005) and *The Aboriginal Cultural Heritage Consultation Requirements for Proponents* 2010 (DECCW, 2010).

In addition, the consultation undertaken during EIS exhibition is described in **Chapter 3.0**.

The consultation undertaken for the Project is considered to be consistent with the actions of the DPIE Draft Community Participation Plan which recommends consultation to be: open and inclusive; easy to participate in; relevant; timely, and meaningful.

5.15.10 Adequacy Against SEARs

There is concern over the apparent inconsistencies of the EIS with a number of SEARs of relevance to the key issues raised by this submission. It is requested to be noted in this regard that the EIS is considered to have a number of strong inconsistencies with supplementary DPIE SEARs that includes "the EIS should provide an assessment of impacts - substantial and measurable change to the water quality and quantity of the water resource". The provision of a direct response by DPIE to these identified prior inconsistencies as soon as practicable is requested.

Response

SEARs were issued for the project by DPIE on 9 June 2017 and updated on 20 June 2018 (in relation to Social Impact Assessment). DPIE issued supplementary SEARs (in relation to Commonwealth assessment requirements) on 14 February 2018. Tables 1.6 and 1.7 of the Project EIS provide a checklist of how the SEARs and supplementary SEARs for the Project have been addressed. Further, the DPIE accepted the EIS when it was submitted as being adequate to place on public exhibition.

The assessment of impacts undertaken as part of the EIS to address the SEARs was based on best available technical information, industry standards and guidelines, good environmental practice and risk minimisation. Technical studies were prepared to address all issues identified in the SEARs. The EIS adopted a robust and conservative approach to assessment based on the findings of the Southern Coalfields Inquiry (2006), Chief Scientist and Engineer reports on Thirlmere Lakes, PAC reports for other resource projects and extensive collaboration between technical specialists. This assisted with determining risk management zones (RMZs) and informed the extent of longwall mining and proposed mitigation measures for the Amended Project.

Groundwater and surface water impacts (quality and quantity) were subject to detailed assessment including the collection of a minimum of two years of baseline monitoring data in accordance with the recommendations of the Southern Coalfields Inquiry (2006). The assessments are further detailed in Sections 11.3, 11.4 and 11.5 and Appendices I and J of the EIS.

Furthermore, the Groundwater Assessment was subject to peer review and specific assessment against the requirements of the IESC *Information guidelines for Independent expert scientific committee advice on coal seam gas and large coal mining development proposals* (refer Appendix I of the EIS).

Additional specialist assessments carried out to address matters raised in submissions and to assess amendments to the Project are detailed in the Project Amendment Report.

5.15.11 Independent Expert Scientific Committee (IESC) Advice

Issue description

It is the strong preferred view of Council Staff that the EIS be amended to fully incorporate all aspects of the IESC Project advice prior to its forwarding to the Planning Assessment Commission. It is requested that the DPIE make publicly available its response to the Project Advice including reasons for any recommendations not being accepted.

Response

As explained above in **Section 5.15.10**, the EIS has been prepared to address the requirements of s4.15 of the EP&A Act; the requirements of the EP&A Regulation and the SEARs issued for the Project including the supplementary SEARs in relation to Commonwealth requirements (refer Tables 1.6 and 1.7 of the EIS).

In addition, the Groundwater Assessment was subject to peer review and specific assessment against the requirements of the IESC *Information guidelines for Independent expert scientific committee advice on coal seam gas and large coal mining development proposals* (refer Appendix I of the EIS).

Responses to the issues raised by the IESC are provided in **Section 5.1**of this report.

It is noted that additional specialist assessments have been carried out to address matters raised in submissions including the submission by the IESC as well as to assess amendments to the project and this is detailed in the Project Amendment Report and appendices.

5.15.12 Consistency with Current Research

Issue description

A key issue raised in Council's submission on the SEARs was that the "PEA pre-dated and did not refer to the significant scientific research that has occurred or is currently occurring as a result of the 2012 date of this document." The EIS is viewed as only partly responding to this raised issue as it does not refer to a number of key reports particularly in regard to the understanding of surface and groundwater resources and potential impacts of mining operations on these resources. It is therefore considered imperative that the EIS be fully consistent with the most recent research and studies to ensure an adequate scientific basis as well as for transparency purposes. The DPIE is consequently strongly requested to require the revision of the draft EIS to ensure its full consistency with all applicable scientific research prior to referral to the Planning Assessment Commission for its consideration and investigation.

Response

As explained above in **Section 5.15.10**, the EIS has been prepared to address the SEARs issued for the Project and was based on best available technical information, industry standards and guidelines, good environmental practice and risk minimisation. Technical studies were prepared to address all key issues identified in the SEARs to ensure consistency with the findings of the Southern Coalfields Inquiry (2006), Chief Scientist and Engineer reports on Thirlmere Lakes and PAC reports for other resource projects. In addition, the assessment and mine planning for the project was based on extensive collaboration between technical specialists to determine risk management zones (RMZs) and inform the extent of longwall mining and proposed mitigation measures.

Additional specialist assessments carried out to address matters raised in submissions and to assess amendments to the Project are detailed in the Project Amendment Report

5.15.13 REA: Consideration of Alternatives

Issue description

The absence of any firm commitment to investigate means for the disposal of coal waste (name) for re-use as a means of reducing the proposed removal of 34 ha of vegetation of high conservation value for its extension. It is therefore considered that there is insufficient investigation over recent advances in technology and changes as well as economic viability of alternate options for the disposal of rejects. Council Staff are aware that re—use of generated rejects associated with the Dendrobium Colliery has occurred to such a significant extent in response to large incurred expenses for its disposal that only a small amount is now being deposited at the REA for this facility. It is requested that the DPIE in its advice to the Planning Assessment Commission require a commitment in any Project Determination for the proponent to investigate all measures based on available measures that would reduce the volume of waste required to be placed at the REA.

The expansion of the existing REA is acknowledged as being the most appropriate option for a range of operational and economic reasons. However, the expansion of the existing Emplacement Area is noted to involve the removal of 34ha of native vegetation that is considered to be largely of high conservation value. It is consequently considered appropriate and warranted that options for the reuse of the generated rejects be investigated in detail as a means of reducing this environmental impact.

Response

Tahmoor Coal commissioned Palaris Australia to undertake a review of reject management options for the proposal (Appendix A of the Project Amendment Report). This included a review of the 2014 SKM Reject Strategy Report. The following information was reviewed by Palaris Australia:

- Rejects Disposal Options, Study Strategy Report, QN10312-EAM-RP-E4-002, Revision D, Sinclair Knight Merz Pty Ltd, 10 July 2014;
- Rejects Disposal Options Study, Technical Report, QN10312-EAM-RP-E4-0001, Revision F, Sinclair Knight Merz Pty Ltd, 24 July 2014;
- Rejects Disposal Options Study, Project Number: QN10312, Review of 2017 Secretary's Environmental Assessment Requirements, Jacobs, 31 July 2017;

- EPA correspondence dated 12 March 2019;
- Tahmoor South project reject tonnage and schedule;
- Worsley, J.H., Marsh, J.E., Patel, R. and Feldman, S.B, 'optimisation and stabilisation of coal rejects at the Peabody Metropolitan Mine using Acti-Gel 208', in RJ Jewwll and AB Fourie (eds), *Proceedings of the 18th International Seminar of Paste and Thickened Tailings, 2015,* Perth, Western Australia, ISBN 978-0-9924810-1-8, pp.309-319;
- Metropolitan Coal 2018 Annual Review;
- Metropolitan Coal 2017 Annual review;
- Metropolitan Coal CCC meeting minutes (April 2016 – April 2019);
- EMM, 2017, Hume Coal Environmental Impact Statement;
- EMM, 2018, Hume Coal response to Submissions; and
- EMM, 2019, Hume Coal Submissions to the IPC.

This review found that there is unlikely to be any new knowledge obtained since 2014, or gaps in the original work that would have the potential to materially alter the fundamental conclusions and recommendations of that report. The reason that the findings of the 2014 report are not disputed are because:

- There is unlikely to be enough void space to emplace the material in old workings;
- Re-entry to sealed parts of the existing mine would be costly, technically challenging and present a range of operational and safety risks;
- It is not feasible to emplace all reject material underground;
- The environmental benefits of a partial underground solution do not outweigh the additional costs it would incur; and
- The emplacement of rejects underground may also render resources within the Wongawilli Seam partially or completely sterile.

The challenges posed by emplacement of coal rejects into active longwall goaf areas are further supported by the fact that the Hume Coal project independently came to the same conclusions, resulting in the adoption of a non-caving system of mining specifically to facilitate underground reject emplacement. The Amended Project does not have the option of utilising a non-caving minimising method due to mining parameters such as depth of cover and seam gas content as well as the sizeable capital investment already made in the existing longwall equipment.

Notwithstanding the above, changes to the longwall layout and design have allowed the estimated volume of rejects to be generated by the Project to be downgraded from approximately 14.3 Mt to 11.6 Mt. In addition, it is proposed that the height of the REA extension area be increased from RL 305 m to RL 310 m to optimise the REA footprint. Combined, these changes would result in a reduction in the required extension of the REA from 43 ha to 11.06 ha. This leads to a significant reduction in required vegetation clearing and associated terrestrial ecological impacts.

5.15.14 Location of Ventilation Shafts: Air Quality

Issue description

The proposed location of the additional two vent sites is not opposed in recognition of related operational and land tenure constraints for SIMEC Mining. It is requested to be noted however that significant community opposition was expressed over a proposed installation of a similarly located vent shaft associated with the Tahmoor North Colliery Project. The basis of this opposition received from residential properties within the vicinity of this vent potential health issues associated with flaring.

The modelling of likely PM 2.5 emissions and the intended monitoring of these emissions during the operation of the vents is welcomed given their high health risk. However, the experience of Council Staff with mining operations and other types of development involving air emissions is that there is a general level of community ambivalence to modelling undertaken and consistency with guidelines.

It is recommended that the DPIE include in any Determination appropriate conditions that would require specific and targeted consultation prior to the commencement of any work and on-going public display of the monitoring of emissions undertaken.

Response

Odorous discharge can occur from mine ventilation shafts of return air, for example when longwall mining exposes odorous shale oil within mine workings. Detailed odour modelling undertaken as part of the EIS (Refer Section 11.11 and Appendix N of the EIS) predicted that emissions from the proposed new air ventilation shafts would comply with the 99th percentile odour concentration criteria at all surrounding residence and other sensitive receivers (schools). The design of the proposed new ventilation shafts has considered community feedback on the existing T2 ventilation shaft at the Tahmoor Mine.

Due to a history of odour complaints from local residents in relation to the existing T2 ventilation shaft, significant odour modelling work was undertaken in 2012 to better understand the conditions that cause occasional spikes in odour levels. Modelling determined that ground level odour concentrations would meet the required criteria (refer revised Air Quality Impact Assessment).

The ventilation shafts are used for the intake of fresh air and release of spent air. Gas would be vented or flared at the existing Mine Gas Plant (gas vent) or Gas Flare Plant. The key pollutants released from flaring of coal seam methane are oxides of nitrogen NOx (comprised of nitric oxide (NO) and nitrogen dioxide (NO2)), Carbon Monoxide and Volatile Organic Compounds (VOCs). Concern with nitric oxide is related to its transformation to nitrogen dioxide and its role in the formation of photochemical smog. Carbon monoxide and VOCs can be harmful to health. The air quality impact assessment undertaken for the project indicated compliance with relevant Carbon Monoxide, Nitric Oxide and VOC criteria at surrounding receivers.

It is noted that particulate matter emissions from dust generating activities is not expected to occur from the operation of the ventilation shafts, however separate modelling was undertaken as part of the air quality impact assessment on dust generating activities and the assessment indicated compliance with relevant NEPM PM $_{2.5}$ standards at nearby receivers. Real-time adaptive air quality monitoring and management measures are proposed to manage particulate emissions (particularly 24-hour PM_{10} emissions) from mine activities as detailed in Section 11.11.6 of the EIS. The results of air quality monitoring would be published in the annual environmental management report for the mine.

5.15.15 Subsidence: Level of Assessment

Issue description

The highest possible detailed assessment of likely subsidence levels should occur prior to the issuing of the Determination instead of being largely reliant on the Extraction Plan and the Prediction/Monitor/Response approach.

Response

Subsidence was identified as the key issue associated with the project and subject to detailed technical assessment including modelling and sensitivity analysis informed by observed subsidence movements and monitoring results of longwall mining at the existing Tahmoor Mine. The proposed mine plan for the Amended Project was developed following a significant risk assessment based on subsidence predictions, to avoid and minimise impacts to sensitive features including impacts to the Metropolitan Special Area and incised bedrock creeks and rivers. A number of revisions were made to the original mine plan, including shortening of longwalls 105 to 108 from the commencing ends so as not encroach into the Metropolitan Special Area and the removal of mining in the Eastern Domain. Since exhibition of the EIS for the Project additional revisions have been made to the mine plan to further minimise impacts of subsidence as detailed in the Project Amendment Report.

A robust and detailed Subsidence Assessment was undertaken for the project by MSEC which specialises in subsidence predictions and assessment for longwall mines, and particularly in the Southern Coalfields. The findings of the assessment are provided in Appendix F of the EIS and the revised assessment for the Amended Project (Appendix B of the Project Amendment Report) identifies the levels of impact to natural features and built infrastructure are comparable to that experienced in the Southern Coalfields and can be controlled and managed by the preparation and implementation of

Subsidence Management Plans or 'Extraction Plans' as described in the EIS. The assessment identified that the majority of houses within the subsidence study area (70%) would be unaffected or require minor adjustments only as a result of subsidence impacts. Far field horizontal movements are predicted to occur; however, impacts experienced at sensitive features in far field locations are not expected to be significant or measurable (i.e. less than 0.3 mm/m). The overall findings of the assessment are that the levels of impact and damage to identified natural features and built infrastructure are manageable (see Section 11.1.6 of the EIS).

Importantly, the extensive experience gained by Tahmoor Coal in successfully managing subsidence impacts from Tahmoor Mine since mining commenced in 1979 would be applied to the Project and the existing subsidence management framework would be employed for the Amended Project.

Following the issue of development consent, longwall mining operations in NSW are regulated by Extraction Plans (which replace the previously termed Subsidence Management Plans) prepared specifically for each longwall or series of longwalls and provide detailed longwall extraction information which is not available at the EIS stage. The Extraction Plans are submitted to the NSW DPIE for approval prior to the commencement of mining of each longwall or series of longwalls. They include detailed refinements to the mine plan informed by the results of the previous extracted longwalls (including subsidence monitoring results) which may lead to amendments to the Extraction Plans. This forms the framework for regulating longwall mining operations in NSW and it is expected that the same process would be followed in accordance with agency requirements should development consent be granted for the Amended Project.

5.15.16 Subsidence: Trigger Action Response Plans

Issue Description

The need for a form of Trigger Response Plans is recognised as being necessary given the difficulty in identifying likely subsidence levels. However, it is considered that these levels should be identified to the greatest extent possible at the Application Stage and not largely be the responsibility of Extraction Plans subsequent to Determination.

Response

As discussed in Section 11.1.7 of the EIS (Subsidence Management and Mitigation Measures) as part of an overarching Extraction Plan, sub-plans covering specific natural and/ or built features would be prepared to manage the subsidence impacts predicted at that feature. Features for which sub-plans would be prepared include:

- Natural features (such as waterways and cliffs);
- Heritage items;
- Built features, including:
    - Council owned assets and infrastructure;
    - rail assets and infrastructure;
    - potable water assets and infrastructure;
    - sewer assets and infrastructure;
    - gas assets and infrastructure;
    - power assets and infrastructure;
    - communications assets and infrastructure; and
    - public, commercial and residential structures, which can also include specific sub-plans for large structures, such as bridges, retail complexes and industrial facilities.

The management plans for these features would include details such as:

- Proposed mining schedule and mine plan;
- Performance measures and criteria for each feature;

- Predictions and descriptions of impacts for each feature;
- Monitoring requirements for each feature; and
- Risk controls and Trigger Action Response Plan (TARP).

The detail of the sub-plans would be developed in consultation with stakeholders including the owners/ managers of key built features likely to be affected (such as Council, road and rail authorities and utility providers, commercial/business and landowners etc.).This would be done prior to the extraction of a particular longwall or series of longwalls and would be informed by the experience and subsidence monitoring results from the previous extracted longwall and Extraction Plan. Such sub-plans (including associated TARPs) would be developed over the course of mining operations as part of the Extraction Plan approval process as longwall extraction progresses. As such, detailed information on such plans and associated TARPs is not available at this stage.

5.15.17 Subsidence: Impacts to Residential Housing

Issue description

It is recognised that there is a well-established process for monitoring and repairing damage to buildings caused by mine subsidence. Council typically is however the first point of contact when residents and community representatives become concerned about potential impacts to their properties that they may or may not be aware are potentially attributable to mine subsidence. In relation to this matter, the EIS is noted to state "Tahmoor Mine has been successfully managing subsidence impacts to houses and buildings from longwall/ mining at Tahmoor North for many years in accordance with an approved Subsidence Management Plan and would continue to do for Tahmoor South with an Extraction Plan for the Project". The DPIE is requested to note however that Staff are aware of issues over the adequacy of this process raised by members of the community including the standard of repairs to dwellings impacted by subsidence. The DPIE is requested to require the proponent to address these issues in consultation with Subsidence Service NSW and amend the EIS if considered appropriate.

Response

The new coal mine subsidence compensation scheme under the *Coal Mine Subsidence Compensation Act 2017* commenced in 2018 and is applicable to the Project. The new scheme administered by SA NSW enables subsidence damage arising from coal mines to be addressed via a more streamlined process with key changes noted below:

- A compensation claim will be lodged to the SA NSW through an ePortal;
- A case manager will be assigned;
- Claims will be independently assessed by an expert panel;
- Claimants or mine operators can seek a review by the Secretary of the Department if they are not satisfied with the decision, without having to commence litigation;
- Subsidence damage caused by active mining will be compensated directly by the mine operator responsible;
- Subsidence damage from inactive mines will be compensated from the Mine Subsidence Compensation Fund; and
- Mine owners will continue to pay a levy to compensate for impacts arising from inactive mines.

As outlined in Section 11.1.7 of the EIS, prior to mining operations commencing for a new longwall, potentially affected residents would receive a Resident Information Pack which includes:

- Longwall information;
- An explanation of subsidence and the potential effect of subsidence on houses and other structures;
- Anticipated levels of subsidence relating to their property;

- A description of property inspections, surveys and monitoring including how to access free pre-mining property inspections;
- A description of rights and responsibilities relevant to subsidence; and
- Emergency contact details.

The Resident Information Packs includes specific information on the role of Subsidence Advisory NSW (SA NSW) in administrating the *Coal Mine Subsidence Compensation Act 2017*, including contact details; the subsidence claims process where damage by subsidence is suspected; and access to free counselling services in relation to subsidence impacts.

Resident Information Packs are issued as part of the existing operations. This process would continue to be implemented for the Amended Project and while information packs for the Project would generally take the same form and structure of Resident Information Packs for existing operations they will be refined and improved where possible over time. Tahmoor Coal would also continue to engage with the community through its existing Community Consultative Committee Meetings and other processes to address community concerns about subsidence and other matters. Consultation processes that are currently implemented in relation to subsidence management (and would continue to be applied for the Amended Project) are detailed in Section 3.8, 11.1.7 and 11.15 of the EIS.

5.15.18 Subsidence: Impacts to Council Infrastructure

Issue description

The detailed description of public facilities within the Project Application Area and identified likely level of subsidence to be experience by these facilities within the EIS is welcomed. Council's Facilities Section has requested that the accurate extent of likely damage be identified as soon as practically possible to prevent any disruption to the on-going community service purposes of these facilities as well as absence of alternate land for such facilities. The DPIE is consequently requested to recommend in its Assessment Report to the Planning Assessment Commission that there be a condition of consent in any Determination that requires the proponent hold discussions with relevant Council Staff over this matter as soon as practically possible.

Response

Potential subsidence impacts to built infrastructure are manageable and can be controlled by the preparation and implementation of Extraction Plans and associated sub-plans (similar to Subsidence Management Plans), which have already been successfully implemented during mining at Tahmoor Mine.

Since 2004, Tahmoor Mine has mined under the entire township of Tahmoor, safely and competently managing subsidence impacts to approximately 1,890 residential dwellings and commercial premises and on major built infrastructure such as:

- The Main Southern Railway rail line;
- Tahmoor Town Centre shopping centre;
- Wollondilly Shire Council road, bridges;
- Gas, electricity, water, sewer and drainage infrastructure;
- A poultry processing plant;
- Aboriginal cultural heritage sites; and
- Post-European settlement heritage structures.

Tahmoor Coal would continue to use the Extraction Plan process to successfully manage subsidence to built infrastructure as part of the Amended Project. The Extraction Plans and associated sub plans would be developed through consultation with the infrastructure owners (such as Wollondilly Shire Council) and would be subject to approval by DPIE, prior to implementation.

5.15.19 Subsidence: Impacts to Bargo Waste Management Centre

Issue description

The document states that 'the BWMC is expected to experience the full range of predicted subsidence movements...(and)...the landfill areas may experience greater subsidence due to additional settlement of the fill'. This is of grave concern for the future operation of the facility and for the future rehabilitation of the site, as subsidence may damage critical infrastructure such as leachate collection systems, stormwater diversion systems, batters, final capping, environmental monitoring wells, weighbridge and buildings. Damage to leachate collection systems and batters (especially the Eastern batter) is of particular concern as the site is adjacent to Dog Trap Creek, which flows into the Bargo River and ultimately into the Nepean River. Escape of leachate or landfill gas from the site due to damage caused by mine subsidence may have a significant environmental impact on the river network, prompting the NSW Environment Protection Authority to contemplate revocation of the site's Environment Protection Licence, and requiring extremely expensive mitigation infrastructure. The NSW Environment Protection Authority requires installation of a weighbridge at the Bargo Waste Management Centre as a condition of its ongoing operation. Readings from the facility's weighbridge will be used to calculate:

1. *Charges to customers, and*
2. *Council's payment to the EPA in landfill levy.*

To enable Council to lawfully apply charges to customers and to calculate the Centre's landfill levy payments to the NSW Government, the weighbridge must be calibrated regularly in accordance with the National Measurement institute's requirements. Destabilisation of the weighbridge due to mine subsidence is likely to corrupt weighbridge data, in which case Council will not be legally entitled to charge customers based on weighbridge data, nor calculate landfill levy payments to the NSW Government. This may prompt the EPA to revoke Council's Environmental Protection, in effect shutting down the facility.

The DPIE is requested to arrange a meeting as a high priority to discuss the concerns of Council regarding its impacts to the Bargo Waste Management Centre. It is requested that such a meeting be also attended by representatives of Subsidence Service NSW and the Environment Protection Authority.

Response

The concerns regarding the subsidence impacts to the BWMC are noted. Since the exhibition of the EIS, additional revisions have been made to the mine plan to further minimise impacts of subsidence as detailed in the Project Amendment Report. The BWMC is expected to experience subsidence movements as a result of the Amended Project.

Mining directly beneath the BWMC may potentially result in impacts on:

- The slopes of the landfill;
- The surface water treatment. Although, the likelihood of impacts is considered low based on experience of mining beneath farm dams and other wastewater treatment ponds during the mining of Longwalls 22 to 31 at Tahmoor Mine; and
- A new weighbridge currently being designed by Council. Although, the likelihood of impacts is considered low based due to the small footprint of the weighbridge.

Tahmoor Coal would, in consultation with Wollondilly Shire Council, study the potential for impacts to the BWMC and develop management measures to ensure that the BWMC remains safe and serviceable, as well as ensure that impacts on the BWMC do not result in environmental consequences on the adjacent Dog Trap Creek catchment. The management measures may include a combination of:

- Mitigation or strengthening measures prior to mining, particularly to the landfill slopes and surface water treatment ponds;

- Installation of a monitoring systems, which includes, among other things, the monitoring of ground movements, and condition of the landfill slopes, leachate collection system, the storage ponds, storage containers and the weighbridge;
- Conduct regular visual inspections of the BWMC; and
- Implement planned response if triggered by monitoring and inspections.

With appropriate management plans in place, it is considered that the BWMC would remain safe and serviceable at all times during mining within the extent of longwalls boundary for the Project, even if actual subsidence movements were greater than the predictions or substantial non-conventional movements occurred.

5.15.20 Groundwater and Surface Water Assessment approach

Issue description

There is a considered absence of a specific response to the additional Study Requirements provided by applicable NSW Government Agencies as well as the IESC

The Risk Management Zones depicted on maps within the EIS have not been applied to all watercourses and consequently have strong shortcomings in identifying and managing impacts associated with subsidence to both the structure and ecological health of waterways in a catchment context.

The Study Requirement issued by the IESC is noted to state the EIS must provide adequate information to allow the Project to be reviewed (by the IESC) as outlined in the Information Guidelines for Independent Expert Scientific Advice on Coal Seam Gas and Large Coal Mining Development Proposals. However, the reference to this document within the EIS has been identified as being restricted to a general statement "that the assessment has been carried out considering these Guidelines".

The intended approach for monitoring and managing subsidence related impacts is considered heavily dependent on detailed sub-plans prepared after Determination such as Extraction Plans as well as Trigger Action Response Plans. This is viewed as being illustrated by the statement on Page 11-36 that (such Sub-Plans) "would be developed to manage the impacts of Longwall mining on specific features which could potentially be impacted by subsidence".

Response

As explained above in **Section 5.15.10**, the EIS has been prepared to address the SEARs issued for the Project including the supplementary SEARs in relation to Commonwealth requirements (refer Tables 1.6 and 1.7 of the EIS). In addition, the Groundwater Assessment was subject to peer review and specific assessment against the requirements of the *Commonwealth Independent Expert Scientific Committee (IESC) Information guidelines for Independent expert scientific committee advice on coal seam gas and large coal mining development proposals* (refer Appendix I of the EIS). Issues raised by the IESC have been addressed in **Section 5.1** of this report and additional work has been undertaken to address this issue in the Amended Project (refer Project Amendment Report).

The EIS has been prepared with specific consideration to the recommendations and findings of the Southern Coalfields Inquiry (refer Section 5.3.1 and Table 5.1 of the EIS) which were incorporated into the approach to mine planning and technical assessment for the Project. This includes: streams of 3rd order or above within the mine subsidence area being considered as Risk Management Zones.

The proposed mine plan for the Amended Project was developed following an extensive risk assessment process considering subsidence risks to natural features including watercourses. A number of revisions to the original mine plan were made including: shortening the commencing ends of longwalls 105 to 108 such that they do not encroach into the Metropolitan Special Area and Cow Creek; and no longer proposing mining in the Eastern Domain to avoid impacts to Eliza Creek. The current mine plan avoids mining beneath the Bargo River and Hornes Creek and the Amended Project's subsidence study area does not extend to: Carters Creek, Cow Creek, Dry Creek, Eliza Creek or Sugar Loaf Gully. Since exhibition of the EIS additional revisions have been made to the mine plan to further minimise impacts of subsidence as detailed in the Project Amendment Report.

As explained in **Sections 5.15.15** to **5.15.18** Extraction Plans and associated sub plans - developed in consultation with stakeholders and submitted for the approval of DPIE- Division of Resources and Geoscience prior to the commencement of extraction of a longwall or series of longwalls - forms the basis of the management and regulation of longwall mining operations in NSW following grant of development consent. This process has underpinned the successful management of subsidence impacts from existing longwall operations at Tahmoor Mine and would continue to be applied for the Amended Project.

5.15.21 Groundwater: Modelling

Issue Description

The DPIE is consequently strongly requested to seek specialist advice over the suitability of the use of the Tammetta Model by the EIS. It is further requested that this advice be sought prior to the referral of the Project Application to the Planning Commission given that the predicted levels of subsidence informs a number of other environmentally related components of the EIS.

Response

The Tammetta method has been recommended by the IEPMC as the most appropriate method for estimating HoCF for longwall mines (IEPMC, 2018). At Tahmoor Coal, the use of the Tammetta method has been supported by geotechnical investigation and FLAC modelling (SCT 2013, 2014) and further supported by the Independent Peer Reviewer (HydroGeoLogic, 2019). For a detailed discussion on the validity of using the Tammetta method for representing HoCF in the Tahmoor groundwater model please refer to response **Section 5.1.4.**

5.15.22 Groundwater: Height of Fracture Study

Issue Description

Particular concern is a general absence of reference to a range of relevant scientific research and studies since 2014 which viewed as inferring shortcomings in the scientific basis of this component of the EIS. There is in particular, a noted absence of reference to Studies released since 2012 known to Council Staff including the Height of Fracturing Study which is viewed as having strong relevance to the Project Application.

A key noted component of the Height of Fracturing Study is an analysis of the adequacy of models in identifying the groundwater response to mining induced fracturing at various levels including near the surface. The impacts of such fracturing on groundwater is a particular concern of Council and the local community (discussed by this draft submission in regard to groundwater's). The amendment of the EIS to incorporate applicable findings of this Study prior to its forwarding to the Planning Assessment Commission is viewed as being essential by Council Staff to ensure the assessment subsidence related impacts at the application stage is based on current scientific studies.

Require the that the Planning Assessment Commission specifically investigate the adequacy of this component of the EIS given that if informs a number of other components of the Environmental Assessment as well as concerns identified by this draft submission.

Response

The Groundwater Impact Assessment (Section 11.3 and Appendix I of the EIS) included consideration of the following studies in relation to Height of Fracture:

- Galvin, J.R., 2017a. Review of PSM report on height of fracturing - Dendrobium Area 3B, Review commissioned by DPIE;
- PSM, 2017. Height of cracking – Dendrobium Area 3B, Dendrobium Mine (No. PSM3021-002R), Report commissioned by DPIE; and
- SCT, 2014. Longwall 10A Height of Fracture Borehole for Tahmoor South Project – Observations, Measurements, and Interpretation. Report for Tahmoor Mine, doc TAH4125, March 2014.

It is assumed that the ‘Height of Fracturing Study’ that is referred to by Council is the PSM (2017) document.

Additional relevant, recent scientific research considered for the Groundwater Assessment includes:

- Advisian, 2016. Literature Review of Underground Mining Beneath Catchments and Water Bodies. Report for WaterNSW by Advisian, John Ross, PSM, Mactaggart and Grant Sutton & Assoc. December 2016; and
- Crosbie, R. 2015. Groundwater recharge to coal basins in eastern Australia – Bioregional Assessments programme. Presentation to the Australian Groundwater Conference, Canberra, November 2015.

At the time that the Groundwater Assessment for the Project was being prepared, the Independent Expert Panel for Mining in the Catchment (IEPMC) issued their Terms of Reference 1 report (IEPMC, 2019).

As discussed in response in **Section 5.1.4**, the Tammetta method used for estimating HoCF is the approach recommended by the IEPMC (2018) and is considered by the Peer Reviewer to provide a conservative estimate of impacts likely to occur due to mining induced fracturing. The revised modelling will work to improve estimates of impacts to the near surface by incorporating surface cracking into the numerical groundwater model.

5.15.23 Groundwater: Assessment and Information

Issue Description

Applications should contain a description of the properties and behaviour of the groundwater environment in a lateral and vertical direction based on modelling that is informed by extensive groundwater monitoring and consistent with scientific research.

Response

The Groundwater Impact Assessment (Appendix I of the EIS) prepared for the Project was based on detailed groundwater modelling and included the development of a conceptual model and numerical model to represent the historical behaviour of groundwater at Tahmoor Mine, and to predict impacts to groundwater behaviour as a result of the Project in terms of lateral and horizontal groundwater movements.

The modelling included simulation of the 'full recovery' of groundwater levels well in excess of the required minimum simulation of 100 years post-mining and included assessment of the cumulative impacts from the existing Tahmoor Mine and other mines within the Southern Coalfields (including Appin (including Appin North (formerly known as West Cliff) and Appin West (formerly known as Tower)) and Dendrobium coal mines as presented in Sections 6.4.2 and 6.7.2 of the Groundwater Impact Assessment, Appendix I of the EIS).

The groundwater modelling was based on extensive monitoring including various bores being operational since 2008 for multiple years as shown in Figure 3-5 of Appendix I of the EIS, providing at least two years' worth of baseline data consistent with the recommendations of the Southern Coalfields Inquiry. Groundwater monitoring data was sourced from:

- Five bore installations within the Existing Tahmoor Approved Mining Area, each with between six and eight vibrating wire piezometers installed at different locations within the stratigraphic sequence;
- Multiple piezometers installed in bore TBF040c, located above longwall 10A of the existing operations;
- Nine shallow bores within the Hawkesbury Sandstone above the existing operations, labelled as piezometers P1 to P9 on Figure 11.9 of the EIS. Of these P5 and P6 are no longer active;
- Four DI Water monitoring bores at Thirlmere Lakes that monitor the shallow Hawkesbury Sandstone and/or alluvium;
- Thirty monitoring bores installed across the Project Area, 17 with dual piezometer installations and 13 with multi piezometer installations;

- A bore census (survey) of standing water levels and geochemistry from 23 private, DI Water registered bores located across the Project Area and six Tahmoor Coal monitoring bores (GeoTerra, 2013a);
- A deep horizon water sampling bore (TBC035) for EC, oxygen, deuterium and tritium isotope sampling; and
- Two piezometers monitoring groundwater at the REA: TGW5 (up-gradient) and TGW4 (downgradient).

In addition, the Groundwater Assessment has been peer reviewed by Prathapar & Associates (November, 2018), which considered the Groundwater Assessment for the Project to be robust, technically appropriate and consistent with best practice and the following guidelines:

- Australian Groundwater Modelling Guidelines (Barnett et al. 2012);
- The requirements of the NSW Aquifer Interference Policy (NSW Government, 2012); and
- The Information guidelines for Independent Expert Scientific Committee advice of coal seam gas and large mining development proposals (IESC, October 2015).
- Independent Peer Review carried out for DPE noted several items of the Groundwater Assessment that required improvement but considered the overall assessment to be robust and fit-for-purpose. An updated Groundwater Assessment for the Amended Project is provided in the Project Amendment Report (Appendix C).

5.15.24 Groundwater: Detailed Geological Model

Issue Description

Groundwater modelling is not sufficient to accurately identify the interaction of fractures created in geological stratums above coal seams with groundwater in terms of both condition and behaviour. This interaction requires a detailed investigation of the geological stratums in association with collection of extensive baseline data.

A structural geologist involved with the Thirlmere Lakes research project has advised the next stage of this Project will involve the development of a geological model that identifies the interaction between faults and groundwater in a broad context. Council Staff consider that the development of a similar model, (or equivalent) for the Tahmoor South Project Application is warranted based on this received specialist advice.

Response

As identified in **Section 5.15.23** the groundwater impact assessment for the Project was subject to detailed modelling (including the development of a conceptual and numerical groundwater model), based on extensive baseline groundwater monitoring and subject to peer review. The modelling was informed by monitoring results and longwall mining at the existing Tahmoor Mine in relation to fracturing and faults.

As explained in Section 11.3.3 of the EIS, longwall mining typically removes large rectangular panels of coal from a coal seam, often 100-400 m wide and up to 6-8 km long and 2-4.5 m high. In the case of the Project, the amended longwalls are proposed to be approximately 285 m wide, and the mined thickness would be up to 2.6 m. The removal of a panel of coal then results in the overburden caving into the void, resulting in stresses propagating upward, and outward, through the overlying strata. Fracturing and deformation of these strata then results in some changes, from very large to no change, in the permeability and aquifer storage properties of this overburden.

The conceptual model of the impacts of mining on the permeability of caved and deformed overburden has been based on experience of monitoring and groundwater modelling gained at Tahmoor and in other locations, combined with the recent research available for subsidence impacts on aquifer materials.

Tahmoor Coal commissioned SCT to carry out investigative drilling and analysis of a variety of methods (SCT, 2014) of the conditions above Tahmoor Longwall 10A. The analysis identified that mining-induced fractures occur from around 75-80 m above the mined seam in the area. The analysis also showed that at shallow depths fracturing was not connected in a vertical sense, nor permeable enough in a horizontal sense to result in significant changes to the groundwater pressures within the local geology (Hawkesbury sandstone). At greater depths (closer to the seam), the degree of permeability enhancement increased, particularly in the vertical direction, resulting in significant loss of groundwater pressure.

Furthermore, the modelling included consideration of significant geological features within the study area (including faults) and their impact on the behaviour of groundwater flow based on monitoring results at the existing Tahmoor Mine (refer Section 3.8.6 of Appendix I of the EIS).

As detailed in Section 5.2 of Appendix I of the EIS, the numerical modelling for the Project included sensitivity runs with consideration to the effect of various geological feature including the Western and Central faults and T1 and T2 faults.

In addition, the groundwater model was developed by referring to a number of key publications regarding the geology of the Southern Coalfield including:

- Hutton, A.C. 2009. Geological Setting of Australasian Coal Deposits. In R. Kininmonth & E. Baafi (Eds.). Australasian Coal Mining Practice (pp. 40-84). AusIMM, Victoria, Australia;
- Moffit R.S. 1999. Southern Coalfield Regional Geology 1:100 000, 1st edition. Geological Survey of New South Wales, Sydney;
- Rose, G. 1966. Wollongong 1:250 000 Geological Sheet SI/56-09, 2nd edition, Geological Survey of New South Wales, Sydney; and
- Tammetta, P. and Hewitt, P. 2004. Hydrogeological properties of the Hawkesbury Sandstone in the Sydney Region. Australian Geomechanics, 39 (3), pp. 91-107.

As discussed in Section 11.3.5 of the EIS, the existing Tahmoor Mine Groundwater Management Plan (GWMP) will be updated for the Project to define a groundwater monitoring strategy, groundwater level triggers and include a TARP.

The regional groundwater monitoring network will continue to be developed and maintained, including specific monitoring of Thirlmere Lakes and to existing users' water supply. Monitoring sites will be reviewed and sites requiring repair, replacement or augmentation to improve confidence will be addressed in the next revision of the GWMP. This will include monitoring in longwall centre-lines of pre- and post-mining conditions to assist in defining a profile of fracturing and depressurisation above longwalls.

5.15.25 Groundwater: Drawdown Impacts to Aquifers

Issue Description

The accurate calculation of water drawdown as a result of the removal of established longwalls and any potential effect of this activity on nearby aquifers.

Council has been informed a project by the Australian Nuclear Science and Technology Organisation (ANSTO) within the overall Thirlmere Lakes Research Program will undertake a radioisotope analysis comparing under groundwater within the mine to collected water from the lakes. The understood cooperation of SIMEC in this analysis is welcomed. It is considered appropriate however that researchers involved with this project be consulted by the DPIE during the finalisation and implementation of the EIS by the DPIE given its relevance to the Project Application.

Response

Section 7.2 and Appendix C of the Project Amendment Report provide an updated assessment of the impacts of the Amended Project on groundwater drawdown including impacts to bore users (aquifers) and groundwater dependent ecosystems (including Thirlmere Lakes). The Groundwater Impact Assessment identified that the predicted impacts of the proposal would meet the Level 2 minimal impact consideration classification under the *Aquifer Interference Policy.*

The mine inflow rates for the Project are predicted to equate to an average of 1,700 ML of water per annum over the period of mining with peak annual flows predicted to be approximately 2,850 ML in 2029 and 2,600 ML of water in 2032.

The existing groundwater entitlement currently held by Tahmoor Coal under groundwater licence 10WAl18745 is for 1,642 ML/a; meaning a short fall of a maximum of 1,208 ML/a (based on the maximum predicted inflow of 2,850 ML in 2029).

As explained above in **Section 5.15.24**, the existing Tahmoor Mine Groundwater Management Plan (GWMP) will be updated for the Project to define a groundwater monitoring strategy and groundwater level triggers, ensure make good provisions for affected groundwater bore users and to include a TARP to minimise and manage the groundwater impacts of the proposal.

The regional groundwater monitoring network will continue to be developed and maintained, including specific monitoring of Thirlmere Lakes (refer to Section 11.5 of the EIS). Monitoring sites will be reviewed and sites requiring repair, replacement or augmentation to improve confidence would be addressed in the next revision of the GWMP. This will include consideration of additional bores to sample groundwater quality from the mid/lower Hawkesbury Sandstone and Bulgo Sandstone within the project area and ongoing groundwater monitoring at the REA.

Tahmoor Coal would consult with stakeholders as part of the Thirlmere Lakes Research Program. The findings from that program, if relevant, would be incorporated into the groundwater management plan and monitoring strategy for the Amended Project and to also promote information sharing of groundwater monitoring results in relation to impacts to Thirlmere Lakes.

5.15.26 Groundwater: Aquifer Interference Licence

Issue Description

The reference to reductions in water flow as a consequence of mine induced fracturing as an activity requiring a licence under the Aquifer Interference Policy was welcomed by Council. The detailed discussion over the relevance of this Policy to the Project Application and stated intent within the EIS to obtain an aquifer interference licence is consequently welcomed. It would be expected that such a licence would be required to be obtained prior to the commencement of any subsurface works as a condition of consent.

Response

As identified in Sections 11.3.1 and 11.3.4 of the EIS, the groundwater impact assessment for the Project has been undertaken in accordance with the requirements outlined by the NSW Aquifer Interference Policy.

The mine inflow rates for the Project are predicted to equate to an average of 1,700 ML of water per annum over the period of mining with peak annual flows predicted to be approximately 2,850 ML in 2029 and 2,600 ML of water in 2032.

The existing groundwater entitlement currently held by Tahmoor Coal under groundwater licence 10WAl18745 is for 1,642 ML/a; meaning a shortfall of a maximum of 1,208 ML/a (based on the maximum predicted inflow of 2,850 ML in 2029).

Additional groundwater licence(s) would be secured to account for the increased groundwater inflows for the Project in consultation with DI Water and in accordance with the requirements of the *Aquifer Interference Policy* prior to the commencement of the development. Licences are available for purchase to cover the shortfall.

5.15.27 Surface Water: Independent Expert Panel

Issue Description

In relation to this matter, the second Term of Reference for the Expert Independent Panel for Mining in the Catchment requires "A review and update of the findings of the 2008 Southern Coalfields Inquiry, including recommending measures to improve the way mining effects, impacts and consequences are assessed and managed". During a meeting with Council Staff members of the Panel advised on 12th February 2019 that the report on Stage 2 of the investigation (which includes this review) was anticipated to be provided to the NSW Government in approximately May 2019. It is the strong preferred view of Council Staff that the referral of the Tahmoor South Application to the Planning Assessment Commission not occur until after this report is released to allow updating of the EIS. The provision of specific Project Advice from the Panel in accordance with its Terms of Reference would be acceptable if this is not possible.

Response

The EIS was prepared with specific consideration of the recommendations and findings of the Southern Coalfields Inquiry (refer Section 5.3.1 and Table 5.1 of the EIS) which were incorporated into the approach to mine planning and technical assessments for the Project. This includes:

- A minimum of two years of baseline data to form the basis of assessments;
- Assessment of subsidence within 600 m of the edges of secondary extraction; and
- Greater collaboration between subsidence engineers and other technical specialists including ecology, hydrology and geomorphology.

The Independent Expert Panel for Mining in the Catchment has been established to provide informed expert advice to DPIE on the impact of mining activities in the Greater Sydney Water Catchment Special Areas, with a particular focus on risks to the quantity of water in the Catchment. In particular the Terms of Reference (TOR) for the Expert Panel relate to the impacts of the Dendrobium, Metropolitan, Russell Vale and Wongawilli mines on the Greater Sydney Water Catchment Special Areas. This includes the TOR in relation to the Southern Coalfields Inquiry which comprises:

TOR 2(a): *A review and update of the findings of the 2008 Southern Coalfield Inquiry (Impacts of Underground Coal Mining on Natural Features in the Southern Coalfield – Strategic Review) for mining operations at the Dendrobium, Metropolitan, Russell Vale and Wongawilli mines, including recommending measures to improve the way mining effects, impacts and consequences in relation to water quantity are assessed and managed.*

The TOR for the Expert Panel does not reference the existing Tahmoor Mine or the Project. Longwall mining associated with the existing approved Tahmoor Mine does not extend within any Greater Sydney Water Catchment Special Areas and the mine plan for the Amended Project was specifically designed to ensure it does not extend into the Metropolitan Special Area.

The surface water impact assessment undertaken for the project (refer Section 11.4 of the EIS and Appendix J) and revised assessment undertaken for the Amended Project (Appendix D of the Project Amendment Report) included an assessment of Neutral or Beneficial Effects (NorBE) on drinking water catchments in accordance with *State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011* and the 2015 guidelines published by WaterNSW for assessing compliance with NorBE criteria. The assessment identified that the main channel of Cow Creek is located approximately 1 km from the nearest Project longwall. At this distance, the maximum predicted subsidence, upsidence and valley closure are less than 20 mm. Accordingly, the potential for localised impacts on Cow Creek such as fracturing and surface water flow diversion is extremely low. In the unlikely event that fracturing was to occur in Cow Creek, it is not expected to result in a detectable change to water quality. The assessment therefore concluded that the Amended Project would meet the Neutral or Beneficial Effect (NorBE) test for neutral effect on water quality ("no identifiable potential impact") as prescribed in the WaterNSW published guideline.

This is consistent with the WaterNSW submission on the Project which notes that it *considers that groundwater drawdown and baseflow reduction from the Project would pose a low risk to water quantity in the Sydney Drinking Water Catchment (SDWC).*

5.15.28 Surface Water: Assessment and Information

Issue Description

All potentially affected watercourses should be subject to detailed assessment of likely subsidence induced impacts within a catchment context.

Applications should contain scientific rigorous assessments of likely identified impacts to water sources and Trigger Response Plans and any such Plans should be based on strong scientific knowledge and extensive baseline data.

There should be full rehabilitation of any watercourse identified as being impacted by mining operations to its former condition including ecological health.

Response

The EIS (Section 11.4 and Appendix J) included a detailed surface water impact assessment of waterways likely to be impacted by subsidence associated with the Amended Project including drinking water catchments. The EIS was prepared with specific consideration of the recommendations and findings of the Southern Coalfields Inquiry (refer Section 5.3.1 and Table 5.1 of the EIS) which were incorporated into the approach to mine planning and technical assessment for the Project. This includes: streams of 3rd order or above within the mine subsidence area being considered as Risk Management Zones and the use of at least two years' worth of baseline monitoring data in relevant assessments (as followed for the SWIA).

The proposed mine plan for the Amended Project was developed following an extensive risk assessment process considering subsidence risks to natural features including watercourses. A number of revisions to the original mine plan were made during the preparation of the EIS including shortening the commencing ends of longwalls 105 to 108 such that they do not encroach into the Metropolitan Special Area and Cow Creek and no longer proposing mining in the Eastern Domain to avoid impacts to Eliza Creek. The current mine plan proposed as part of the Amended Project avoids mining beneath the Bargo River and Hornes Creek and the project's subsidence study area does not extend to: Carters Creek, Cow Creek, Dry Creek, Eliza Creek or Sugar Loaf Gully. Since exhibition of the EIS additional revisions have been made to the mine plan to further minimise surface subsidence impacts as detailed in the Project Amendment Report.

As explained in **Section 5.15.16** a series of management plans will be prepared for the Project which will form part of the overarching Extraction Plan for the Project. These sub plans will be developed in consultation with relevant stakeholders and agencies to manage the impacts of longwall mining on specific features including waterways/courses as well as other natural features and will include monitoring details and a TARP.

As explained in Section 11.4.6 of the EIS, action response triggers for watercourses will include:

- triggers for water quality exceedances based on recommended approaches in ANZECC (2000) and in particular, schemes which incorporate both baseline and control monitoring data;
- a trigger for unexpected flow loss based on analysis of baseline (i.e. pre-subsidence) streamflow data, post-subsidence streamflow data and contemporaneous data from control sites. Catchment flow modelling would also be used in the analysis; and
- for unexpected loss of pool water holding capacity based on analysis of baseline (i.e. pre-subsidence) pool water level data, post-subsidence pool water level data and contemporaneous data from control pool sites. Pool water balance modelling would also be used in the analysis particularly during unusual climatic/hydrological conditions.

As described in Section 11.4.6 of the EIS, the existing network of streamflow monitoring (gauging stations) and water quality monitoring sites will be maintained to continue to obtain baseline data on watercourses with the inclusion of additional gauges at Dog Trap Creek and Tea Tree Hollow (the two water courses that would be mined beneath by the proposal). A continuous pool water level monitoring network will also be established at Dog Tap Creek and Tea Tree Hollow prior to commencement of longwall mining. Periodic (monthly) inspections, photographic reconnaissance and field-based water quality monitoring of watercourse(s) would be undertaken when longwall mining is within 200 m of any watercourse, at sites upstream and downstream of the potentially affected area and field results would be analysed against action response triggers.

Further aquatic ecology monitoring has commenced in spring 2019 and is scheduled again for autumn 2020 to update the baseline data for future monitoring purposes. This will involve sampling of potential impact sites and non-impacted locations at locations that are representative of the system present in the study area.

If pool / stream remediation measures are required during mining, they will be implemented in consultation with relevant Government agencies. Where there is limited ability for fractures to seal naturally, they will be sealed with an appropriate and approved grout. Tahmoor Mine has recently developed corrective management action plans for Redbank and Myrtle Creeks to remediate subsidence impacts caused by Longwalls 27 to 30. The corrective management action plans form part of the approved 2019/2020 Mining Operations Plan for Tahmoor Coal. The corrective management action plans propose pool remediation and rock bar grout curtain wall works which will be undertaken along Myrtle and Redbank Creeks via a staged approach (refer **Section 5.1.31**). A similar approach will be used for the Amended Project, incorporating learnings from the implementation of remedial measures in Redbank and Myrtle Creeks.

With specific reference to geomorphic impacts, if impacts are identified in creeks, remediation measures may include the following:

- Provide open space within the rock mass at the base of a river channel to absorb valley closure movements or implement an artificial barrier that forces the hydraulic gradient to the surface. A thin, flexible, impermeable barrier installed across a rock bar has the potential to act as an effective barrier to subsurface flow; and
- Actively fill fractures in the subsurface fracture network with introduced material to accelerate the natural remediation process, whereby the mining induced fracture network is filled with sand, silt and clay materials, gradually increasing hydraulic resistance. This strategy involves filling of the subsurface fracture network with fill material such as cementitious grouting, sand or polyurethane resin.

It is recommended in the updated SWIA (Appendix D of the Project Amendment Report) that monitoring of streamflow, pool water levels and water quality continue for two years following cessation of longwall subsidence related movement in a watercourse or following completion of any stream/ pool remediation. Monitoring data should be reviewed at annual intervals over this period. Reviews should involve assessment against long term performance objectives, which should be based on the pre-mine baseline conditions or an approved departure from these.

5.15.29 Surface Water: Redbank Creek Water Quality

Issue Description

Council is concerned with the re-emergence downstream of water drained from watercourses as a result of mined induced fracturing. The Research Study by Dr Ian Wright on Redbank Creek involved the analysis of water considered to be such re-emergence. The high level of pollutant readings at this locality detailed in the research study attached to this submission highlight the potential for significant impacts to waterway health.

Response

Section 5.2.2 of the Surface Water Impact Assessment (Appendix D to the Project Amendment Report) provides an updated assessment of surface water quality in Redbank Creek. Water quality data monitored between February 2005 and August 2019 for water quality sampling sites RC1 (upstream), RC2 (mid) and RC5 (downstream) is presented and assessed. The key outcomes of the assessment are as follows:

- Recorded electrical conductivity (EC - a measure of salinity) increased at the downstream site RC5 following the mining of longwall 26, reaching a peak during the mining of longwall 27 and 28 from 2014 to 2015. Thereafter EC levels at RC5 have fallen to a level observed prior to the commencement of mining;
- Longwall mining in the Redbank Creek catchment has not affected pH levels in the creek to any significant extent;
- Periodic and localised pulses of iron, zinc and sulphate concentrations have been recorded at site RC2; and
- Relatively high manganese concentrations have been recorded at site RC2 and RC5. The elevated manganese concentrations at site RC2 may be, at least in part, unrelated to mining of longwalls 25 to 29 and possibly relate to pre-existing groundwater inflows (ferruginous springs) reported in Redbank Creek. It appears likely that increased manganese concentrations at site RC5 are related to mining, although concentrations have diminished with time.

As stated in Section 9.3 of the Surface Water Impact Assessment (Appendix D to the Project Amendment Report), based on past experience in the Southern Coalfields, including experience at the existing Tahmoor Coal operation, it is likely that subsidence induced fracturing may lead to releases of aluminium, iron, manganese, sulphate and zinc. These releases will occur as transient spikes which would be relatively localised. The impacts to stream fauna similarly are expected to be localised, and fauna are likely be able to recover from transient spikes in concentration. Localised long-term changes to fauna may occur if metal concentration is elevated for extended periods of time (refer Section 6.7.7 of the revised Aquatic Ecology Report in Appendix F to the Project Amendment Report).

5.15.30 Surface Water: Impacts to 3rd Order Streams

Issue Description

A representative of the Scientific Division of OEH expressed a broad view to Council Staff that third order streams should not be directly undermined due to concerns over the potential for draining of pools within such order streams with resulting significant hydrological as well as ecological downstream impacts that are potentially significant. It is consequently considered warranted that the proponent be requested to engage in discussions to adjust the proposed longwall layout to avoid any direct undermining of third order streams in consultation with applicable government agencies and research organisations prior to the forwarding of the Application to the Planning Commission.

Response

The EIS was prepared with specific consideration to the recommendations and findings of the Southern Coalfields Inquiry (refer Section 5.3.1 and Table 5.1 of the EIS) which were incorporated into the approach to mine planning and technical assessment for the project. This includes streams of 3rd order or above within the mine subsidence area being considered as Risk Management Zones. Three third order steams traverse the underground mine footprint; a portion of Dog Trap Creek, Tea Tree Hollow, and a tributary of Tea Tree Hollow.

The proposed mine plan for the Amended Project was developed following an extensive risk assessment process considering subsidence risks to natural features including watercourses. A number of revisions to the original mine plan were made including shortening the commencing ends of longwalls such that they do not encroach into the Metropolitan Special Area and no longer proposing mining in the Eastern Domain to avoid impacts to Eliza Creek. The current mine plan avoids mining beneath the Bargo River and Hornes Creek (a 4th order stream) and the Amended Project's subsidence study area does not extend to: Carters Creek, Cow Creek, Dry Creek, Eliza Creek or Sugar Loaf Gully. Since exhibition additional revisions have been made to the mine plan to further minimise surface subsidence impacts as detailed in the Project Amendment Report. In relation to streams, amendments included the removal of LW109 from the mine plan, which was proposed directly above Dog Trap Creek. Further, changes to the mine design, such as reducing the cutting height and longwall width, have reduced overall subsidence, tilt and curvature predictions across the mining footprint by around 15%.

Tahmoor Coal has recently developed corrective management action plans for Redbank and Myrtle Creeks to remediate subsidence impacts caused by Longwalls 27 to 30. The corrective management action plans form part of the approved 2019/2020 Mining Operations Plan for Tahmoor Coal. The corrective management action plans propose pool remediation and rock bar grout curtain wall works which will be undertaken along Myrtle and Redbank Creeks via a staged approach.

To ensure continual improvement based on the outcomes of creek remediation monitoring, Tahmoor Coal will complete the following reports for the corrective management action plans:

- Quarterly Progress Report each year (31 March, 30 June, 30 September; 31 December);
- Remediation Stage Completion Reports; and
- Final Completion Report.

On completion of each remediation stage, a Stage Completion Report will be prepared. These reports act as a system of continued improvement based on the monitoring and what was identified in the monitoring program in terms of effectiveness.

At the completion of the final remediation works, a Final Completion Report will be prepared by Tahmoor Coal.

This approach has been reviewed and endorsed by DPIE as a component of the MOP for Tahmoor Mine. The plan is currently being implemented along Myrtle Creek and will be updated/ enhanced for Redbank. Tahmoor Coal would build on the experience at Redbank and Myrtle Creeks, as well as at other mines in the Southern Coalfields, to monitor and enhance the success of rehabilitation methods for creeks affected by the Amended Project. Detailed management plans will be developed for the creeks in the subsidence study area as part of the Extraction Plan.

Detailed assessment of residual impacts of the Project on watercourses has been assessed in Section 11.4 and Appendix J of the EIS and Appendix D of the Project Amendment Report including the identification of relevant management, monitoring, TARPs, remediation and contingency measures.

5.15.31 Surface Water: Mitigation and TARPs

Issue Description

It is requested that the DPIE require that the TARPS have a scientific basis to the satisfaction of applicable government agencies and potentially the IESC prior to the forwarding of the Project Application to the Planning Commission. The description of both the existing water quality monitoring and intended monitoring within the EIS is considered broadly adequate. However, current triggers for the implementation of TARPS for the Tahmoor North Colliery Project are viewed as not sufficiently rigorous and have been observed to be commonly exceeded. It is consequently requested that the DPIE in its Assessment Report request that any future Determination for the Project include a condition which requires the monitoring be based on updated Triggers values that have a strong scientific basis.

Response

The Surface Water Impact Assessment has been updated to assess the Amended Project including updated water quality monitoring in accordance with the ANZECC (2000) and ANZG (2018) default guideline trigger values (Appendix D of the Project Amendment Report). The specific targets are as follows:

- pH: 6.5-9;
- Electrical Conductivity: <500 µS/cm;
- Suspended Solids: <30 mg/L;
- Turbidity: <150 NTU;
- Oil and grease: <10 mg/L;
- Iron: <0.7 mg/L;
- Manganese: <1.9 mg/L;
- Nickel: <0.011 mg/L;
- Zinc: <0.008 mg/L;
- Arsenic (V): <13 µg/L; and
- Arsenic (III): <24 µg/L.

The assessment updated the trigger values in conjunction with the data obtained for the EIS and identified that the overflow to Bargo River from dam S11 is estimated to result in a very slight increase in the concentration of sodium and total dissolved solids at Bargo River Downstream, however this would remain below the ANZECC (2000) default trigger values for protection of aquatic ecosystems and recreational use. Therefore, once the upgraded WWTP is operational, the Project is not expected to result in adverse water quality impacts.

The assessment in the EIS and Amended Project considered major streams and creeks within the catchment boundaries surrounding the Project that were considered as potentially being impacted from the Amended Project. Tahmoor North is outside of the Project scope of works and has not been considered as part of this Project. As such, triggers for the implementation of TARPs within Tahmoor North have not been considered in this assessment.

As identified in **Section 5.15.16** and **5.15.28** a series of management plans will be prepared for the Project which will form part of the overarching Extraction Plan. These sub plans will be developed in consultation with relevant stakeholders and agencies to manage the impacts of longwall mining on specific features including waterways/courses as well as other natural features and include monitoring details and TARPs. Management plans for surface water features (including monitoring requirements and TARPS) would be developed by technical specialists based on the assessments undertaken for the proposal, the results of baseline monitoring, in consultation with agencies and informed by lessons learnt and experiences of mining at the existing Tahmoor Mine.

As explained in Section 11.4.6 of the EIS, action response triggers for watercourses will include:

- Water quality exceedances based on recommended approaches in ANZECC (2000) and in particular schemes which incorporate both baseline and control monitoring data;
- Unexpected flow loss based on analysis of baseline (i.e. pre-subsidence) streamflow data, post-subsidence streamflow data and contemporaneous data from control sites. Catchment flow modelling would also be used in the analysis; and
- Unexpected loss of pool water holding capacity based on analysis of baseline (i.e. pre-subsidence) pool water level data, post-subsidence pool water level data and contemporaneous data from control pool sites. Pool water balance modelling would also be used in the analysis particularly during unusual climatic/hydrological conditions.

5.15.32 Surface Water: Watercourse Rehabilitation

Issue Description

It is requested that the DPIE require that the Planning Assessment Commission carry out an investigation into a suitable framework that would achieve full restoration of creek lines impacted by mining to their formal ecological condition.

Response

Management plans for surface water features (including monitoring requirements and TARPS) would be developed by technical specialists based on the assessments undertaken for the proposal, the results of baseline monitoring and in consultation with agencies. These will also be informed by lessons learnt and experiences of mining at the existing Tahmoor Mine.

As identified in **Section 5.15.30** where subsidence induced geomorphic impacts are identified at creeks as part of monitoring under the Extraction Plan process, remediation measures would be implemented in consultation with agencies using strategies such as:

- Provide open space within the rock mass at the base of a river channel to absorb valley closure movements or implement an artificial barrier that forces the hydraulic gradient to the surface. A thin, flexible, impermeable barrier installed across a rock bar has the potential to act as an effective barrier to subsurface flow; and
- Actively fill fractures in the subsurface fracture network with introduced material to accelerate the natural remediation process, whereby the mining induced fracture network is filled with sand, silt and clay materials, gradually increasing hydraulic resistance. This strategy involves filling of the subsurface fracture network with fill material such as cementitious grouting, sand or polyurethane resin.

Monitoring of streamflow, pool water levels and water quality would continue in accordance with the Extraction Plan following cessation of longwall subsidence related movement in a watercourse or following completion of any stream/pool remediation. Monitoring data would be reviewed and assessed against long term performance objectives based on the pre-mine baseline conditions or an approved departure from these.

Tahmoor Coal has recently developed corrective management action plans for Redbank and Myrtle Creeks to remediate subsidence impacts caused by Longwalls 27 to 30 that has been approved by DPIE. The corrective management action plans propose pool remediation and rock bar grout curtain wall works which will be undertaken along Myrtle and Redbank Creeks via a staged approach. Learnings from rehabilitation works in Myrtle and Redbank Creek will be applied to develop an effective and appropriate remediation strategy for Tea Tree Hollow and Dog Trap Creek if the streambed or pools are impacted due to the Project.

5.15.33 Surface Water: Licensed Discharge

Issue Description

The regulation and management of treated mine water discharged into Tea Tree Creek and the Bargo River is a matter for OEH and EPA. However, potential impacts from this discharge on the ecological condition of these waterways is of strong concern to Council and the local community. The DPIE is requested to note that the Bargo River Gorge, whose northern extremity is located close to the confluence of Tea Tree Creek and the Bargo River, is viewed as a highly significant natural, cultural and visual landscape.

Dr Ian Wright was requested to also carry out a peer review of the adequacy of the EIS in assessing and managing impacts resulting from the discharge of treated mine water. Key findings associated with this aspect of the Project Application are detailed in the report received by Council presented in Attachment 1 to this draft submission.

Response

Section 9.1 of the Surface Water Impact Assessment (Appendix D of the Project Amendment Report) discusses the commitment to commission an upgraded WWTP to reduce the concentrations of constituents discharged via LDP1.

The specified target water quality is to meet the 95th percentile ANZECC (ANZG 2018) Guideline values.

Under the current EPL 1389 there is a requirement to enhance treatment of water prior to release in accordance with PRP 22 which involves the development and commissioning of an upgraded WWTP to reduce the concentrations of constituents released via LDP1. The results of predictive modelling of the water management system over the remaining mine life and including Amended Project, undertaken as part of the SWIA (Appendix D of the Project Amendment Report), indicate that release to LDP1 is unlikely to increase above the EPL 1389 volume limits. On the basis of the above, it is expected that the Project would not result in adverse water quality impacts due to releases and overflows from the site water management system compared to the existing situation.

5.15.34 Surface Water: Dr Ian Wright Peer Review

Issue Description

Council engaged the services of Dr Ian Wright to review the Aquatic Ecology as well as related sections of the Surface Water Impact Assessment component of the EIS in recognition of his expertise and involvement with relevant research studies. The received report (presented in Attachment 1) to this draft submission agrees with aspects of the Specialist Report however has also identified a number of shortcomings of relevance to the assessment of potential impacts related to mine subsidence to surface water quality.

The DPIE is requested to provide a response to Council on all findings of this Peer Review prior to the forwarding of the Application to the Planning Assessment Commission as well as make this response publicly available.

Response

Table 5-12 provides a response to the issues raised by Dr Ian Wright in his Peer Review.

Table 5-12 Response to Dr Ian Wright Peer Review

Issue	Response
Given the many years of subsidence and damage to Myrtle and Redbank Creek – there is not data presented to add support to the 'expected recovery'.	It is acknowledged that natural recovery of streams is variable and long term and may take several years. Tahmoor Coal has recently developed corrective management action plans for Redbank and Myrtle Creeks to remediate subsidence impacts caused by Longwalls 27 to 30. The corrective management action plans propose pool remediation and rock bar grout curtain wall works which will be undertaken along Myrtle and Redbank Creeks via a staged approach. This approach was reviewed and endorsed by DPIE as a component of the MOP for Tahmoor Mine. As mentioned above, the plan is currently being implemented along Myrtle Creek and will be updated/ enhanced for Redbank. Tahmoor Coal would build on the experience at Redbank and Myrtle Creeks, as well as at other mines in the Southern Coalfields, to monitor and enhance the success of rehabilitation methods for creeks affected by the Amended Project.
'I could not locate any detailed information in the EIS on what appropriate rehabilitation measures would be applied. I expected to see information on recent subsidence impacts from Tahmoor Operation on Redbank and Myrtle Creek.'	Mitigation measures to minimise impacts to aquatic ecology are summarised in Section 11.7.5 of the EIS based on detailed information provided in Section 7 of the specialist assessment provided in Appendix K of the EIS. These measures include: • An aquatic ecology monitoring program to monitor aquatic health downstream of the discharge from the Project, focusing on precipitates and impacts to

Issue	Response
	benthic macroinvertebrates including *in-situ* quantitative sampling. • Subsidence monitoring of macroinvertebrates for a baseline period of two years prior to longwall extraction. The monitoring program may require adding or relocating monitoring sites according to the final mine plan and using the same sampling methods as used in the aquatic monitoring conducted to date. • A BACI (Before After Control Impact) designed monitoring program to compliment the baseline information collected and to assess monitoring impacts in an adaptive management framework. • Appropriate stream rehabilitation measures applied to areas that undergo significant impacts due to subsidence. • Preparation and implementation of a Creek Remediation Action Plan and TARP for potential impacts to pools and other aquatic habitat features identified in the Aquatic Ecology Assessment (Appendix K of the EIS). A corrective management action plan is currently underway for Myrtle and Redbank Creeks which includes pool remediation and rock bar grout curtain wall works. The plan is currently being implemented along Myrtle Creek and will be updated/ enhanced for Redbank Creek. The outcome of this plan will be used to develop further Creek Remediation Action Plan and a TARP for aquatic environments. Stream triggers would be developed using baseline data and anticipated subsidence effects, with specific triggers continuing to be developed as monitoring continues and is refined in consultation with key stakeholders. Where a trigger is exceeded, the cause and effect would be investigated. If the cause is directly related to mining, a corrective management action plan would be developed. The mitigation or remediation plans would outline methods to reduce ongoing impacts to levels below the impact assessment criteria as quickly as possible. This could include stream grouting and use of other engineering works. In relation to mapped areas of key fish habitat that may be impacted by the Project along Dog Trap Creek and Tea Tree Hollow, if monitoring indicates impacts, DPI Fisheries will be consulted to determine the appropriate habitat rehabilitation measures or if environmental compensation is required. Any recommendations by DPI Fisheries will be incorporated into the monitoring and management of the waterways and key fish habitat. Further, as part of the development of the required Extraction Plan and associated management plans for the Project, a TARP will be prepared, which will incorporate appropriate triggers, monitoring regimes and appropriate actions for key fish habitat in the Project Area.

Issue	Response
	Further details of mitigation measures are provided in Section 9 of Appendix K of the EIS. Additionally, the measures listed are part of a multidisciplinary management strategy of the waterways. Mitigation measures outlined in the aquatic EIS are part of mitigation and monitoring measures outlined in the SWIA (Appendix D of the Project Amendment Report).
There is one very important issue that was missing from the Aquatic Ecology section of the EIS. That is, where was the issue of mosquitos in subsidence damage surface waterways? My study (Wright et al. 2015) found that two sampling sites on Redbank Creek, affected by longwall subsidence, had a domination of aquatic macroinvertebrates by mosquitos. I consider this to be potentially a very serious public health issue. I am not surprised that the EIS did not bring this up, as their sampling presented in the EIS was from 2012-2013.I found the worst mosquito problem in 2013-2014. The mine subsidence modified the stream channel and water quality of Redbank Creek that enabled mosquito larvae and pupae to proliferate. In particular, the fractured promoted not flowing pooled sections, with high salinity, metals and low dissolved oxygen. As air breathing invertebrates, these conditions are perfect for mosquitos. I consider this to be a serious public health risk associated with long-wall subsidence.	Two years of recent monitoring 2017-2019 (Niche, 2019b) of areas previously mined (Redbank Creek) has shown changes to aquatic habitat (total loss of consecutive pools in some cases) and change in macroinvertebrate communities where aquatic habitat exists. These changes resulted in a community dominated by pollution tolerant fly larvae and worms (Niche 2019b). Others have found an increase in Mosquitos (Wright, 2019), and few sensitive species present (Niche, 2019b). Wright found that the community was dominated by mosquitos in 2013-2014, however more recent monitoring (Niche 2019b) conducted 2014-2019 found the community to be dominated by non-biting midge subfamilies Chironominae, Tanypodinae and worms, Oligochaeta. Monitoring was conducted using AUSRIVAS and quantitative suction sampling. It should also be noted that mosquitos (Culicidae) can naturally occur in assemblages in low flow environments when water quality deteriorates. Nevertheless, it is noted that this is potentially an issue exacerbated by subsidence impacts. Aquatic ecological monitoring in Redbank Creek and Myrtle Creek will monitor the densities of mosquitoes and ascertain whether this is an ongoing concern. However, recent monitoring suggests that proliferation of Culicidae as found by Wright was temporary, or isolated to specific pools.
'It was concluded in section 6.4.3 that mine water discharge is unlikely to cause further adverse effects to the environment as there will be no negative change in discharge management. With the implementation of the heavy metals water treatment plant (under PRP 22) future cumulative impacts of mine water discharge is considered neutral. However, mine water discharge currently contributes to poor water quality in Bargo River and there is an interaction with past (water infrastructure developments), that is Picton Weir. This potentially has a cumulative effect to water quality as discharge is less diluted from upstream flow. This cumulative impact however is existing, and is partially *by the potential habitat, and connectivity provided by mine water discharge from Tea Tree Hollow to Bargo River'. In a previous part of this document I highlight that the mine's waste water treatment plant is currently demonstrating its inability to achieve the much lower pollutant concentrations*	It is acknowledged that the WWTP did not reduce contaminants as planned. Since the EIS was submitted, the installation of an upgraded WWTP and other measures are committed to aim to remove contaminants and manage the discharge to meet EPL 1389 requirements under PRP Stage 3 (SIMEC 2019). The specialist reports have been updated and summarised in the Project Amendment Report (Appendix A-Q) to reflect this new water management strategy, which will improve current and future discharge water quality.

Issue	Response
that the EPA currently demands. The EPA instructed the mine to achieve much lower concentration of arsenic, nickel and zinc by the end of 2018. Data from Tahmoor Colliery reports that these pollutant concentrations in the mine waste are much higher than EPA requires. This suggests that the future Tahmoor South operation, as described in the EIS may continue to release ecologically hazardous levels of metals.	
This concluding section of the Aquatic Ecology chapter of the EIS attempts to describe the aquatic ecology impacts (current and future with the project approval) of the discharge of the Tahmoor Colliery waste to the Bargo River via Tea Tree Creek. It fails to fully describe either the existing impact of the waste discharge, or the future predicted impact of the discharge. It makes multiple failures of adequately addressing the SEARs. It is my professional opinion that the Tahmoor Colliery discharge to the Bargo River, via Tea Tree Creek currently is a major point source of water pollution (salt, nickel, and zinc in particular) that causes adverse impacts to aquatic biota. The nature and magnitude of the impact is not fully acknowledged or described in the EIS documents. I do expect that the impact of the future Tahmoor South project, if it continues to discharge waste of a similar standard to the current operation, will continue to have a negative impact on the ecology of Tea Tree Creek and also Bargo River.	The overall impacts from mine water discharge are discussed in Section 6.7 of Appendix F of the Project Amendment Report and show a change in invertebrate assemblages with a loss of pollution sensitive species and an increase in pollution tolerant species downstream. This was based on baseline studies/EIS (Niche 2019), and PRP23 study (Cardno 2016). However, as the contaminant and flow are correlated, it is difficult to accurately determine what is driving this difference. Cardno (2016) could not directly relate this to salinity and found that current EC levels in the Bargo River are also not considered to be excessively high with respect to the reported tolerances of many aquatic biota present in Tea Tree Hollow and the Bargo River. In terms of impact assessment, Tahmoor Coal is committed to the installation of an upgraded WWTP (pursuant to PRP22) so as to improve water quality and aims to have an improved mine water discharge compared to the current regime. Therefore, the water quality is likely to improve with this measure with a significant reduction in EC to 500 µS/cm. The Project Amendment Report reflects this change of water management.

5.15.35 Thirlmere Lakes: Assessment

Issue Description

The DPE is requested to recommended that the Proponent:

Undertake a detailed investigation over potential impacts of the Project to the hydrology of Thirlmere Lakes which considers both the groundwater assessment within the EIS as well as available findings of the Thirlmere Lakes Research Program.

Response

Potential impacts of the project on Thirlmere Lakes have been assessed in Section 11.5 and Appendix I and J of the EIS and Section 7.0 of the revised Surface Water Impact Assessment (Appendix D of the Project Amendment Report). The assessment included specific groundwater modelling of the lakes and development of a water balance model as part of the SWIA based on the results of the groundwater modelling of potential baseflow impacts to the Lakes.

The Thirlmere Lakes are approximately 3.5 km from the Project at its nearest proposed longwalls. Based on available information, including the investigations undertaken as part of the Thirlmere Lakes Inquiry, the Thirlmere Lakes appear to act as a naturally ‘losing’ system under both dry and wet conditions. Therefore, there is limited dependence on groundwater for the water levels and associated ecosystems of the Thirlmere Lakes.

The cumulative impacts to Thirlmere Lakes have been re-considered on the basis of the revised groundwater model and assessment, and revised surface water assessment. These assessments confirmed the findings of the EIS; that the Project would have negligible groundwater and surface water impacts on the Thirlmere Lakes that would be comparable to levels of natural variability (i.e. changes to lake levels of 0.01 m and 0.06 m on average) and would be imperceptible in many circumstances. Potential impacts to terrestrial and aquatic ecology within the Thirlmere Lakes were also therefore determined to be minor to negligible.

5.15.36 Thirlmere Lakes: Monitoring and Research

Issue Description

The DPE is requested to recommended that:

Any Determination includes a condition that requires full compliance with the Study Requirement provided by the Department of Environment and Energy regarding the hydrology of Thirlmere Lakes.

A representative from the Thirlmere Lakes Inter Agency Research Group expressed the view that the on-going management of groundwater impacts by the Project Application should consider and be consistent with the applicable parts of the Thirlmere Lakes Research Program. Any Sub Plans within any Determination be required to consider all relevant available information associated with the Thirlmere Lakes Research Program and that the Thirlmere Lakes interagency Research Group be consulted as part of this consideration process.

Response

Tahmoor Coal would consult with stakeholders as part of the Thirlmere Lakes Research Program. The findings from that program would be incorporated into the groundwater management plan and monitoring strategy for the Project.

5.15.37 Aquatic Ecology: Impacts

Issue Description

Description of potential impacts to the aquatic ecology are viewed as generic and without sufficient scientific basis. For example, the EIS states on Page 60 "where the longwall/s mine directly beneath the streams, it is considered likely that fracturing resulting in surface flow diversion will occur".

Response

The EIS (Section 11.7) provides a summary of the technical assessment prepared for the proposal in relation to Aquatic Ecology. The full technical assessment titled Aquatic Ecology Impact Assessment is provided in Appendix K of the EIS. This was prepared by subject matter experts (Niche Environment and Heritage Pty Ltd) and based on multiple survey and monitoring programs in close collaboration with other technical specialists in relation to inter-related impacts (including subsidence, surface and groundwater). The Aquatic Ecology Impact Assessment was based on the following survey and monitoring effort to obtain at least two years' worth of baseline data for the assessment:

- Tahmoor South Pilot Study (2010-11), which involved a detailed literature review and field survey of the broader lease area. The outcomes of this study informed the detailed baseline monitoring program; and
- Tahmoor South Aquatic Ecology Monitoring Program (2012-13), which involved collecting two years of baseline data on aquatic habitat (including riparian vegetation), macroinvertebrates and fish in order quantify those ecological values which may be sensitive to subsidence impacts. This program has been completed and the data was used to inform the impact assessment for the Amended Project, as well as monitor impacts during and after mining of the Amended Project.

5.15.38 Aquatic Ecology: Mitigation

Issue Description

The recommendations of the Specialist Report for the management of impacts associated with the Project Application to aquatic ecology is noted to be restricted to "that appropriate stream rehabilitation measures be applied to areas that undergo significant impacts due to subsidence". The Specialist Report is consequently considered by Staff to have shortcomings in providing a strong scientific based framework for the management of these impacts.

Response

Mitigation measures to minimise impacts to aquatic ecology are summarised in Section 11.7.5 of the EIS based on detailed information provided in Section 7 of the specialist assessment provided in Appendix K of the EIS. Further mitigation measures have been recommended as part of the Amended Project and are provided in Appendix F of the Project Amendment Report. These measures include:

- An aquatic ecology monitoring program to monitor aquatic heath downstream of the discharge from the Project, focusing on precipitates and impacts to benthic macroinvertebrates including in-situ quantitative sampling;
- Subsidence monitoring of macroinvertebrates for a baseline period of two years prior to longwall extraction. The monitoring program may require adding or relocating monitoring sites according to the final mine plan, and using the same sampling methods as used in the aquatic monitoring conducted to date;
- A BACI (Before After Control Impact) designed monitoring program to compliment the baseline information collected and to assess monitoring impacts in an adaptive management framework;
- Appropriate stream rehabilitation measures applied to areas that undergo significant impacts due to subsidence;
- Preparation and implementation of a Creek Remediation Action Plan and TARP for potential impacts to pools and other aquatic habitat features identified in the Aquatic Ecology Assessment (Appendix K of the EIS). Stream triggers would be developed using baseline data and anticipated subsidence effects, with specific triggers continuing to be developed as monitoring continues and refined in consultation with key stakeholders. Where a trigger is exceeded, the cause and effect would be investigated. In the instance that the cause is directly related to mining, a creek remediation management plan would be developed. The mitigation or remediation plans would outline methods to reduce ongoing impacts to levels below the impact assessment criteria as quickly as possible. This could include stream grouting and use of other engineering works;
- In relation to mapped areas of key fish habitat that may be impacted by the Project along Dog Trap Creek and Tea Tree Hollow, if monitoring indicates impacts, DPI Fisheries will be consulted to determine the appropriate habitat rehabilitation measures or if environmental compensation is required. Any relevant conditions of development consent will be incorporated into the monitoring and management of the waterways and key fish habitat. Further, as part of the development of the required Extraction Plan and associated management plans for the Project, a TARP will be prepared, which will incorporate appropriate triggers, monitoring regimes and appropriate actions for key fish habitat in the Project Area;
- Upgrades would be made to the WWTP under the PRP22 within the current EPL 1389. This involves the development and commissioning of an upgraded WWTP to reduce the concentrations of arsenic, nickel and zinc in mine water being released from LDP1. The upgrades would see enhanced water quality through reduced heavy metals, EC and barium precipitate in Tea Tree Hollow and downstream Bargo River and therefore increase macroinvertebrate habitat and food supply; and
- Implementation of actions to improve mine water discharge including investigation of Tea Tree Hollow downstream of LDP1. In an attempt to determine methods of potential remediation of the creek, aquatic ecology monitoring program aimed at identifying any improvements in aquatic health and monitoring of quantitative benthic suction sampling will be undertaken.

Further details of mitigation measures are provided in Section 7 of Appendix K of the EIS and a consolidated list of measures proposed is provided in Section 7 of Appendix F of the Project Amendment Report.

5.15.39 Aquatic Ecology: Dr Ian Wright Peer Review

Issue Description

Dr Ian Wright from the Western Sydney University was requested to provide a peer review of the Aquatic Ecological Report given his recognised high level of technical expertise in this field. The key findings of this Peer Review of direct relevance to the Aquatic Ecology Specialist Report are detailed in the report received by Council presented in Attachment 1 of this draft submission. The DPIE is requested to provide a response to Council on all findings of this Peer Review prior to the forwarding of the Application to the Planning Assessment Commission as well as make this response publicly available.

Response

As outlined in **Section 5.15.34**, **Table 5-12** provides a response to the issues raised by Dr Ian Wright in his Peer Review.

5.15.40 Biodiversity: Mapping and Surveys

Issue Description

The mapping of vegetation communities on site and surveys carried out by the Specialist Terrestrial Ecology Report is viewed as being consistent with applicable guidelines. These aspects of the Report are also consistent with information available to Council Environmental Staff through mechanisms including surveys as part of received Development and Planning Proposals and from Council on-ground works. It is however requested that the DPIE recommend in its Assessment Report that any Determination include a requirement for targeted fauna surveys given the timeframe between the surveys by the EIS and commencement of vegetation clearance.

Response

Pre-clearance surveys would be undertaken prior to the commencement of vegetation clearing as part of the staged development of the Amended Project, to confirm the clearance footprint and allow for fauna to safely leave the area prior to the commencement of works.

The survey effort completed as part of the Terrestrial Impact Assessment of the Project (including targeted fauna surveys) is identified in Section 11.6.2 and Appendix K of the EIS.

5.15.41 Biodiversity: REA Vegetation Clearance

Issue Description

The proponent is acknowledged to have implement measures to reduce impact associated with the expansion of the REA. However, it is considered there are potential inconsistencies with avoidance and minimising measures contained in the Framework for Biodiversity Assessment. The securing of advice from OEH regarding this matter is considered warranted.

The previous section of this submission regarding the expansion of the REA requested that the DPIE require the proponent to undertake a detailed investigation regarding the reuse of coal rejects as a means of reducing the level of vegetation clearance required.

The above extent of direct impacts predominately for the purposes of storage of generated waste associated with the Project is viewed with strong concern by Council. It is envisaged this would also be viewed with concern by sections of the community that are aware of this purpose.

Response

A number of studies have been undertaken to ensure a carefully considered and appropriate reject disposal strategy is adopted for the Project. A Reject Strategy Report was included as part of the EIS (SKM 2014) which assessed various options for reject disposal, including underground and surface emplacement, in response to submissions, including the submission by Wollondilly Shire Council, Tahmoor Coal commissioned a Rejects Management Options Gap Analysis (Palaris, 2019) (Appendix A of the Project Amendment Report), which involved:

- A review of the reject management options presented in the 2014 SKM Reject Strategy Report and; and

- A gap analysis to identify technological advancements (areas of new industry knowledge gained from recent work at other coal mine sites) or areas where the original 2014 SKM report could be updated.

The Gap Analysis concluded that the only option for reject disposal that could be technically implemented in an active longwall goaf setting (requiring favourable geological dip and sufficient goaf porosity) is the underground emplacement of fines and ultrafines (around 20% of rejects) with the surface emplacement of all coarse fractions (around 80% of rejects). In Tahmoor South the Bulli seam dips regionally in a north east direction (perpendicular to longwall retreat direction) and is very flat (between 1-2 degrees) which is unfavourable in achieving effective emplacement of fines and ultrafines. In addition to the uncertainty around whether this option would be feasible for a material volume of fines and ultrafines, an estimated net cost of greater than A$34.7 M (2019 dollars) makes this a financially unviable option for the Amended Project.

Once surface emplacement was re-confirmed as the most appropriate reject disposal strategy for the Project, Tahmoor Coal undertook a review of the proposed REA design, with the objective of reducing the proposed footprint of the REA as much as possible to avoid impacts to native vegetation. Subsequently, the Project has been amended to reduce the REA extension by 31.94 ha (from 43 ha to 11.06 ha). The reduction in area is made possible by the proposed amendments to the EIS mine plan, which would reduce the total coal production from the Amended Project, by increasing the proposed final landform height of the REA (from RL 305 m as proposed in the EIS to RL 310 m), and by emplacing some rejects over previously completed rehabilitated areas of the REA (which are not EECs) This leads to a significant reduction in required vegetation clearing and associated terrestrial ecological impacts which includes:

- A reduction in the area of SSTF to be cleared from 43.4 hectares to 23.57 and
- A reduction in the number of individuals of *Persoonia bargoensis* to be removed, from 96 individuals to eight (8) (ie. 14% of the population recorded during initial surveys to 1.2%).

Tahmoor Coal has therefore carefully re-considered the REA design to minimise impacts through a reduction in reject production and an increase in height, and removal of some rehabilitated areas to enable this height increase.

5.15.42 Biodiversity: Impact assessment

Issue Description

It is noted with concern that the assessment of impacts associated with the Project to fauna and associated habitat appears to be restricted to impacts that are directly attributable to subsidence and not consider impacts associated with vegetation clearance. Council Staff consider potential impacts from vegetation clearance at both the REA and vent shaft sites as a major impact within the overall context of the Project Application. The DPIE is consequently requested to require the amendment of the EIS to contain a detailed and explicit description of these potential impacts prior to its forwarding to the Planning Assessment Commission.

Response

The Biodiversity Assessment conducted for the EIS (Niche 2018) included an assessment of potential impacts on fauna as a result of vegetation clearance.

An updated Biodiversity Assessment has been prepared for the Amended Project and is located in Appendix E of the Project Amendment Report. This assessment includes consideration of direct impacts to terrestrial ecology as a result of the Amended Project. In summary, direct impacts to vegetation, flora and fauna habitat associated with the Project comprise:

- 23.57 ha of the TEC Shale Sandstone Transition Forest (PCT1395 Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest (HN556)) including 17.26 hectares in good condition, and 6.31 ha in derived native grassland condition;
- The removal of eight *Persoonia bargoensis* plants;
- The removal of 491 *Grevillea parviflora subsp. parviflora* plants;
- The removal of 1 *Pomaderris brunena* plant;

- The removal of 17.26 ha of potential habitat for the Large-footed Myotis; and
- The removal of 17.26 ha of potential Koala habitat.

Quantification and discussion of direct and indirect impacts have been included based on the revised Project footprint (throughout Chapter 7.0 and specifically Section 7.4 of the Project Amendment Report).

5.15.43 Biodiversity: Koalas

Issue Description

Council's submission on the SEARs contained a range of requested issues for the EIS to consider in regard to the potential impacts of the Project Application to koalas given the identification of a koala near the south East corner of the Project Application Area. The extent of surveys and methods specifically for koalas detailed in the Specialist Terrestrial Ecological Report, (including the targeting of spotlighting with areas proposed for disturbance), is viewed as being broadly adequate for the purposes of the EIS. However, it is recommended that the DPIE request in its Assessment Report to the Panel that any Project Determination include a condition that specifically requires an up-to-date analysis of the movement of any koalas as well as presence of any species.

Response

Potential impacts to koala habitat and credit calculations to offset impacts have been identified in Section 11.6 of the EIS and Section 8.5 of Appendix E of the Project Amendment Report. The Amended Project would reduce the removal of Koala habitat as proposed in the EIS by 25.9 ha, from 43.5 ha to 17.26 ha. An offset strategy is proposed to account for this impact to Koala habitat.

The mitigation measures identified Section 11.6.5 of the EIS remain and include the development of a Biodiversity Management Plan which would include an ongoing program to monitor potential flora and fauna impacts. This would include monitoring of impacts to Koalas should they be detected within the Project area. Monitoring measures would include regular inspection, measures for response if impacts are detected, and monitoring of the success of mitigation. The Biodiversity Management Plan described in the EIS remains consistent to the Amended Project.

5.15.44 Biodiversity: Mitigation Measures

Issue Description

Section 9.2.2 of the EIS "Vegetation Clearance" is noted to list a range of matters that are intended to be addressed by a Vegetation Clearance Protocol within a Biodiversity Management Plan. The intended preparation of a Plan to manage impacts associated with vegetation clearance is agreed with in principle. However, Council would request that all impacts be adequately addressed prior to Determination as occurs for applications where it is the consent authority. It is consequently requested that the DPIE require the amendment of the EIS to contain a detailed description of potential impacts to terrestrial biodiversity associated with all components of the Project Application.

Response

As identified in **Section 5.15.42** impacts to terrestrial biodiversity (both direct and indirect) are detailed in Section 7.4 of the Project Amendment Report and Appendix E. Mitigation measures have been identified for the proposal after first considering options for avoiding impacts and conservatively assessing the biodiversity impacts of the proposal.

5.15.45 Biodiversity: Offset Credit Calculations

Issue Description

The level of impact to threatened species and ecological communities listed above is agreed as being likely not to be significant. However, the number of credits required for their removal, (e.g. 32,536 for Grevillia parviflora) is viewed by Council Environmental Staff as greatly in excess in comparisons to applications received by Council where credits less than 500 are viewed as high.

Response

Consistent with the SEARs issued for the Project, biodiversity impacts associated with the proposal have been assessed under the Framework for Biodiversity Assessment (FBA) method and offsets calculated in accordance with the BioBanking Credit Calculator (BBCC) Version 4 and the Major Project module for all development calculations.

A revised Biodiversity Offset Strategy (BOS) has been developed for the Amended Project. The BOS consists of a three-stage offset approach spanning over a 4-year period, as not all the surface infrastructure would be cleared in the first year. Tahmoor Coal proposes to undertake a combination of the following offset mechanisms to offset the Project impacts:

1. Establishment of biodiversity stewardship sites within Tahmoor Coal landholdings, located at:
    - Bargo Colliery land;
    - 185 Charlies Point Road;
    - 220 Charlies Point Road;
    - Pit Top; and
    - Rockford Road;
2. Purchase of the required credits available on the public register; or
3. Payment into the NSW Biodiversity Conservation Trust (BCT) Fund (noting that this is not available for the Commonwealth Shale Sandstone Transition Forest TEC).
4. Establishment of stewardship sites on additional landholdings (purchase or agree with landholders).

Whilst the offset sites would need to be established as Stewardship Sites using the BAM and updated survey requirements, the credit calculation at the proposed offset sites indicate that there would be residual credits for many of the threatened fauna being offset for the Project.

The proposed offset sites would satisfy the credit offset liability for Stage 1 of the staged offset. A short-fall would occur for the overall Project liability in relation to the following:

- Shortfall of approximately 532 x PCT1395 credits using the FBA would occur for the entire Project offset liability.
- Shortfall of approximately 82 x PCT1081 credits using the FBA would occur for the entire Project offset liability.

To approach this shortfall of credits, Tahmoor Coal proposes to purchase the required credits for PCT1395 Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest (HN556) on the BioBanking public register and pay into the BCT Fund for remaining PCT1081 Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin (HN564).

5.15.46 Biodiversity: Adequacy of Offsets

Issue Description

Council has previously raised doubts over the ability of the biobanking framework to deliver suitable sound ecological outcomes in offsetting the removal of existing populations of a particular threatened species given this offsetting occurs for a separate population at an alternate locality. This submission consequently raises questions over the ability of the Project Application to adequately offset the intended removal of 2,234 specimens of the threatened plant Grevillia Parviflora and 100 species of Persoonia bargoensis on ecological grounds. The DPIE is consequently requested to arrange for the provision of demonstration to Council Staff that suitable ecological outcomes will be achieved in regard to the removal of these species.

Response

The Amended Project would reduce clearing of native vegetation from 49.2 ha to 37.77 ha (including 14.2 ha of mine rehabilitation) resulting in a reduction in the overall offset requirements. As a result, a clear pathway has been identified to achieve required offsets.

As identified in Section 7.4 of the Project Amendment Report, as vegetation clearing for the development would be staged, it is proposed that offsets be secured for the proposal in a staged manner. Five sites have been identified to date within Tahmoor Coal landholdings which have the potential to be provided as offset sites to meet the offset requirements for the proposal. Tahmoor Coal would make the final decision on which combination of sites (and the extent of land) to be offered as part of the land-based component of the Offset Strategy. Offset sites would continue to be identified and refined during the approval process.

Tahmoor Coal proposes to undertake a combination of offset mechanisms to offset the Project impacts. The process is outlined in **Section 5.15.45**.

Consistent with the SEARs issued for Tahmoor South, biodiversity impacts associated with the proposal have been assessed under the FBA method and offsets calculated in accordance with the BBCC Version 4 and the Major Project module for all development calculations.

5.15.47 Biodiversity: Offset stewardship

Issue Description

The utilisation of SIMEC owned land as offsetting sites is agreed with in principle subject to demonstration that the intended offsetting is in accordance with the applicable framework and based on strong ecological grounds. The views expressed within the EIS that the offsetting scheme is in accordance with transition arrangements associated with the introduction of the Biodiversity Conservation Act 2016 is agreed with in principle. However, the reference to Biodiversity Stewardship Agreements would indicate that the management of the actual offsetting sites has been prepared in accordance with Part 5 (Division 2) of this Act. It is consequently requested that the DPIE arrange for clarification to be provided to Council over the framework for the assessment and management of offsetting sites utilised by the EIS.

Response

The land based offset package for the proposal would be finalised in consultation with OEH and DOEE. This would include details of ongoing stewardship and management, as required and agreed with the agencies. It is also noted that DPIE should provide further clarification to Wollondilly Shire Council about offsetting as requested.

As noted in **Section 5.15.45**, consistent with the SEARs issued for the Project, biodiversity impacts associated with the proposal have been assessed under the FBA method (including at offset sites) and offsets calculated in accordance with the BBCC Version 4 and the Major Project module for all development calculations.

5.15.48 Land Use: New and Future Development

Issue Description

The EIS should acknowledge and provide specific assessment on two proposals at No. 95 Great Southern Road and No. 1A Kader Street as both of these proposals have been subject to public exhibition. The DPIE is requested to note that Council is in receipt of a sub-division application for 95 Great Southern Road.

Council is in the process of identifying appropriate local growth targets for each town and village in the areas through its current strategic planning work within the overall framework of the Western Sydney District Plan. However, the EIS should include a discussion of the impact and extend to which the project would affect local growth and whether it would affect the villages ability to respond to any particular growth needs going forward.

Response

No. 95 Great Southern Road and No. 1A Kader Street are located in Bargo and within the Subsidence Study Area for the proposal and as such have the potential to be subject to the full extent of predicted subsidence impacts from the Amended Project. Potential subsidence impacts at future residences which may be erected on the subject land would be managed in accordance with the process outlined in Section 11.1.7 of the EIS and as explained in **Section 5.15.17**.

The noise modelling and contour mapping undertaken as part of the Noise Impact Assessment (Section 11.10 and Appendix M of the EIS) indicates that noise exceedances above project specific noise levels would not be experienced at Bargo under the mitigated Project scenario. Similarly, air quality exceedances are not predicted for residences in Bargo in the air quality impact assessment (Section 11.11 and Appendix N of the EIS). As such significant amenity impacts as a result of the Project are not anticipated at these receivers.

Since mining commenced in 1979 Tahmoor Coal mine has co-existed with surrounding land uses and has overall successfully managed longwall related impacts on surrounding land uses including mining beneath the entire township of Tahmoor and in the order of 1,890 residential dwellings and commercial premises and other key infrastructure. Should development consent be granted for the Amended Project any new land use or development that occurs after this would need to give due consideration to the approved project with respect to appropriate buffer distances and other considerations as per the normal practice of development assessment.

Where future development is proposed within a mine subsidence district, the Project (including new houses and other structures) would require SA NSW approval. Similar to building standards relating to other environmental risks (such as flood prone areas and bushfire planning areas), SA NSW sets building and construction requirements to protect buildings and other surface improvements from subsidence damage. These requirements cover the nature and class of improvements, including height, type of building materials used and the construction method and are consistent with the Australian Building Code. It is noted that SA NSW has the power to issue prevention notices to prevent unauthorised construction work in mine subsidence districts, and any improvements erected without SA NSW's approval, or contrary to an approval are not eligible for compensation. SA NSW approved development which occurs within the Project's Subsidence Study Area would be managed with respect to subsidence impacts in accordance with the process outlined accordance with the process outlined in Section 11.1.7 of the EIS.

5.15.49 Traffic: Impacts (Tahmoor Mine's Access)

Issue Description

There is concern over the degradation of the current Level of Service during PM Peak regarding east moving traffic on Avon Dam Rd in 2028. There is also equal concern about west movement traffic on this road as well. The basis of Council's concerns regarding the impact of addition traffic at this intersection as a result of the Project Application is that upgrade work is difficult due to site restrictions as well as the cost involved for such work.

There also needs to be consideration by the Traffic Impact Assessment over potential impacts at this locality from southbound traffic on Remembrance Drive turning right into the Wollondilly Anglican College entrance during school AM peak and PM peak. The DPIE is requested to note incidents of significant queueing associated with this traffic movement has been observed.

There is further concern regarding the intended reduction in the Level of Service for the access road to the existing Colliery in 2020 as part of the implementation of the Project and during the construction phase. The use of concrete medians instead of painted medians (where possible) is recommended to minimise the cost of continuous maintenance of painted medians.

Response

Avon Dam Road

The Traffic Impact Assessment (Section 11.13 and Appendix P of the EIS) modelled traffic impacts associated with the proposal for the year 2020 (the peak year for operational employment, after which employment would reduce) and 2028 (future scenario, 10 years from commencement) assuming a background traffic growth rate of 3.3 percent per year. Traffic modelling included consideration of the Remembrance Driveway/Avon Dam Road intersection:

- The intersection modelling indicates that compared to the 2017 situation, the level of service (LOS) at the intersection would remain satisfactory to good (LOS B) in 2020 with the inclusion of peak traffic from the Project for both the AM and PM peaks; and
- In the future scenario (2028), the level of service (LOS) at the intersection is predicted to remain satisfactory to good (LOS B) in the AM peak with the inclusion of operational traffic from the

Project compared to the base case 2028 scenario. During the PM peak, LOS at the intersection is predicted to decline to "E". However, the decline is related to background growth in traffic with the Project only generating an additional 24 vehicle trips at this intersection in the PM peak hour in 2028. It is noted that the traffic generated by the Project would reduce from its peak in 2020 and by 2023 the increases associated with the Project will be 50% less than in 2020. From 2023 to 2035 employment levels at the mine will be the same as the employment level in 2011. This demonstrates that the Project's contribution to declines in level of service at this intersection would be minor compared to background growth rates (if realised).

Remembrance Driveway at Anglican College and mine access road

- Traffic modelling undertaken of the Remembrance Driveway/Tahmoor Mine Access Road intersection north of the Remembrance Driveway access to the Anglican College indicates that the intersection would retain a satisfactory to good ("B") level of service in 2020 (at peak Tahmoor South employment at) and 2028 (future scenario with background traffic growth) in both the AM and PM peaks;
- The level of traffic during peak periods is predicted to peak in 2020 and 2028 with AM traffic increasing to an additional 31 vehicles per hour (vph) and PM traffic increasing to an additional 37 vph. These impacts of additional traffic on Remembrance Driveway are assessed as being relatively minor in terms of midblock capacity, as the additional volumes would be less than one vehicle every minute;
- This indicates that traffic associated with the Project is unlikely to significantly affect traffic performance on Remembrance Driveway such as to impact on traffic turning into the Anglican College during peak periods;
- Upgrade to the Remembrance Driveway/Mine Access Road intersection would improve the performance and safety of the intersection, particularly with regard to reducing the incidence of rear end collisions between vehicles turning right onto Mine Access Road at the southbound approach, which would also contribute to improving general traffic flow on Remembrance Driveway along this section;
- The Remembrance Driveway/Mine Access Road intersection will be designed and constructed in accordance with relevant Ausroads standards. The use of concrete medians instead of painted medians would be considered (where possible) where consistent with Ausroads standards; and
- Construction activities at the surface facilities area and mine access upgrade would require construction vehicles to access the mine via the Remembrance Driveway/Tahmoor Mine Access Road intersection. However, construction traffic volumes would be less than the peak operational traffic predicted at this intersection (which indicate acceptable level of service in all scenarios and peak periods as noted above). In addition, construction traffic would be generated at different times than operational traffic, primarily outside of the AM and PM peak hours and is therefore unlikely to significantly affect traffic conditions intersection performance on Remembrance Driveway. The commitment to schedule construction traffic movements outside of peak periods wherever possible has been incorporated into the revised Management Measures for the project (refer **Chapter 7.0**).

5.15.50 Traffic: Rail overpass

Issue Description

It is considered that the limited infrastructure capacity at the above junctions warrants special attention due to the short link between Remembrance Driveway and Avon Dam Road. The Australian Rail Track Corporation and John Holland as the owner of the railway over bridge needs to be consulted on the increase of heavy vehicles and types of heavy vehicles due to concerns over impacts to its resulting from collision by trucks. It is requested that the DPIE arrange for a response to be provided to Council regarding the above issues raised by Council's Traffic Engineer during the finalisation of the EIS.

Response

As identified in **Section 5.15.49** the traffic modelling undertaken for the Project indicates that the development's contribution to the decline in predicted level of service at the Remembrance Driveway and Avon Dam Road intersection in 2028 would be minor compared to background traffic growth and its impacts would continue to decline as the operational traffic associated with the project reduces after 2020.

The Australian Rail Track Corporation and John Holland would be notified of the Project prior to commencement and would be consulted as part of subsidence management planning for Avon Dam Road.

5.15.51 Social Impact Assessment: Social Involvement Plan

Issue Description

The introduction of requirements for State Significant Developments to include Social Impact Assessments and Guidelines introduced for such Assessments by the DPIE has been supported. The inclusion of a Social Impact Assessment (SIA) within the EIS based on these Guidelines is consequently strongly welcomed. The Social Impact Assessment has been reviewed by a Council Staff member with relevant experience who has advised that it is thorough, comprehensive and uses established SIA methodology. The Staff Member has further advised that the range of social impacts identified, and the proposed responses and mitigations is considered appropriate. This Officer did however raise the following issue in relation to Section 3.3.3 of the SIA which refers to community partnerships through SIMEC's current Corporate Social Involvement (CSI) program:

There are comments in the documents indicating that an updated CSI program will continue and there is some reference to a VPA being negotiated with Council. But there is no clear information whether the program is to be extended or increased. It would therefore be beneficial for Council to have some input into the updated CSI Program to help ensure that their program focuses on agreed community priorities.

The DPIE is requested to include a recommendation in its Assessment Report that an item be contained in the Determination that requires SIMEC to consult with Council as part of the on-going development and implementation of the Corporate Social Involvement Program.

Response

As identified in Section 5 of Appendix Q (Social Impact Assessment) of the EIS, the existing Tahmoor Coal Social Investment Plan would be updated to allow for the continuation of mining proposed as part of the Project and would provide a framework for ongoing contributions to community partnerships and initiatives through Tahmoor Coal's Corporate Social Involvement (CSI) program. The Tahmoor Coal Social Investment Plan would be updated in consultation with Wollondilly Shire Council.

In addition, Tahmoor Coal is in the process of negotiation with Wollondilly Shire Council regarding a Voluntary Planning Agreement (VPA). Tahmoor Coal commits to negotiating the VPA with Council prior to Project development consent being granted.

5.15.52 Amenity Impacts

Issue Description

The issue of amenity and noise impacts associated with proposed increased truck movements as a result of the Project Application is noted to have been raised at meetings of the Tahmoor Colliery Community Consultation Committee. The SIA is considered to have broadly addressed this issue satisfactorily and consistent with the Guidelines. It is however recommended that the DPIE in its Assessment Report request the inclusion of a condition in any Determination for the Project that requires results of the on-going monitoring of noise impacts to be made publicly available including in any SIMEC publications.

Response

Noise and traffic amenity impacts are detailed in the Noise, Traffic and Social Impact Assessment sections of the EIS respectively (Sections 11.10, 11.13 and 11.15 and Appendices M, P and Q of the EIS). The results of noise monitoring would be made available in Tahmoor Coal's annual environment reporting as well as reported in relevant management and monitoring plans. Operational traffic monitoring was not recommended in the findings of the specialist traffic impact assessment prepared for the project and is not proposed (refer Appendix P of the EIS). Operational traffic management would be managed through the implementation of a Driver's Code of Conduct to reinforce best practice measures and behaviour in terms of light and heavy vehicle movements and to minimise potential impacts to other road users and to maintain road safety. The monitoring and management of noise and traffic would be reported in Tahmoor Coal's annual environment reporting along with other impacts.

6.0 Response to Organisations and Community Submissions

6.1 Organisation – Ironlaw Pty Ltd

6.1.1 Statutory Planning: Wollondilly LEP provisions

Issue description

No assessment of the Project has been carried out as required under section 4.15(1)(a)(i) of the EP&A Act under the Wollondilly Local Environmental Plan 2011 (WLEP). No assessment has been undertaken against the aims and objectives of the other zones which the Project site traverses, in particular against those zones within which mining is prohibited. The assessment of the Project against these objectives, is required under clause 12 of the Mining SEPP as identified in Gloucester Resources. No assessment has been undertaken against the aims of the WLEP 2011, in particular subclauses:

- *(2)(a) "to provide for the management of natural resources and the protection of the natural landscape character";*
- *(2)(b) "to protect, conserve and enhance the built, landscape and Aboriginal; and*
- *(2)(d) "to encourage development that provides for an integrated transport and infrastructure system and adequate facilities and service provision for future growth".*

Response

Permissibility

The Amended Project is located in the Wollondilly LGA; with the existing mining lease extending into the Wingecarribee LGA. The Amended Project is permissible with consent on the subject land under the *State Environmental Planning Policy (Mining, Petroleum and Extractive Industries) 2007* (Mining SEPP). Pursuant to clause 5(3) of the Mining SEPP, in the event there is an inconsistency with any other environmental planning instrument, the Mining SEPP prevails to the extent of the inconsistency.

Clause 7(1)(a) of the Mining SEPP states that development for the purposes of 'underground mining carried out on any land' is permissible with consent. Consequently, the provisions of the Mining SEPP prevail over the Wollondilly LEP 2011 land use table and the Project is permissible with consent on the subject land.

Section 4.15 of the EP&A Act

Section 4.15 of the EP&A Act contains the evaluation criteria that a consent authority is to consider when determining a development application, including:

> *(a) The provisions of –*
>
> *(i) Any environmental planning instrument, and*
>
> *(ii) Any proposed instrument that is or has been the subject of public consultation under this [EP&A] Act and that has been notified to the consent authority (unless the Planning Secretary has notified the consent authority that the making of the proposed instrument has been deferred indefinitely or has not been approved), and*
>
> *(iii) Any development control plan, and*
>
> *(iv) Any planning agreement that has been entered into under section 7.4, or any draft planning agreement that a developer has offered to enter into under section 7.4, and*
>
> *(v) The regulations (to the extent that they prescribe matters for the purposes of this paragraph),*
>
> *That apply to the land to which the development application relates,*

(b) The likely impacts of that development, including environmental impacts on both the natural and built environments, and social and economic impacts in the locality,

(c) the suitability of the site for the development,

(d) any submissions made in accordance with this [EP&A] Act or the regulations,

(e) the public interest.

Section 8 of the EIS for the Project included detailed consideration of a range of State and local environmental planning instruments, which were considered to be of relevance to the development application; including:

- *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007;*
- *State Environmental Planning Policy No. 33 — Hazardous and Offensive Development;*
- *State Environmental Planning Policy No. 44 – Koala Habitat Protection;*
- *State Environmental Planning Policy No. 55 – Remediation of Land;*
- *Sydney Regional Environmental Plan No. 20 - Hawkesbury-Nepean River (No 2- 1997);*
- *State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011*;
- *Wollondilly LEP 2011*; and
- *Wingecarribee LEP 2010*.

Permissibility and relevant planning provisions under the Wollondilly LEP 2011 (including proposed amendments to the LEP, which were under consideration/ public exhibition at the time of EIS preparation) were considered in Section 8 and Tables 8.3 and 8.4 of the EIS. Further assessment of the consistency of the Amended Project with the aims of the LEP is provided below.

It is important to note that the Wollondilly Development Control Plan (DCP) 2016 was not considered as part of the EIS as it does not apply to State Significant Development.

Wollondilly LEP Aims

The Amended Project is considered to be consistent with the aims of the Wollondilly LEP 2011 (Section 1.2(2)), which comprise:

a) To provide for the management of natural resources and the protection of the natural landscape character,

b) To protect, conserve and enhance the built, landscape and Aboriginal cultural heritage,

c) To protect water quality in land that is situated within water supply catchments,

d) To encourage development that provides for an integrated transport and infrastructure system and adequate facilities and service provision for future growth,

e) To recognise, manage and protect rural resource lands for sustainable agriculture and extractive industry practices,

f) To maintain the separation between towns and villages to retain their unique character and rural and natural settings.

Specifically, the Project is deemed applicable to the LEP as no land which has been, or is currently used for agriculture, will be permanently impacted by surface disturbance associated with the Project.

The mine plan for the Project was developed based on an extensive risk assessment process to avoid and minimise impacts to natural features and resources, the natural landscape, water supply catchments and Aboriginal cultural heritage. The revisions to the original mine plan (including shortening of the commencing ends of longwalls 105 to 108) have resulted in longwall mining not encroaching into the Metropolitan Special Area water catchment and Cow Creek; with longwall mining no longer proposed in the Eastern Domain to avoid impacts to Eliza Creek. In addition, the mine plan developed for the Project would avoid mining beneath the Bargo River and Hornes Creek and the Amended Project's subsidence study area does not extend to: Carters Creek, Cow Creek, Dry Creek, Eliza Creek or Sugar Loaf Gully. Furthermore, the Amended Project's subsidence study area does not extend to the Thirlmere Lakes National Park which is part of the Greater Blue Mountains World Heritage area.

As outlined in the EIS, to minimise impacts to Aboriginal cultural heritage, the mine plan was designed to avoid mining directly beneath rock shelter sites along Dog Trap Creek, which contains artwork that is of high cultural and archaeological significance. The mine plan also avoids impacts to archaeological heritage sites and sensitive water features in the south east section of the Project Area south of the Hume Highway. The surface infrastructure has been located to avoid all identified grinding grooves and rock shelters sites. The mine plan would also avoid impacts to key infrastructure such as: the M31 Hume Highway and key Telstra and Optus Sydney to Melbourne optical fibre and National Broadband Network cables, which follow the M31 alignment. A key change to the mine plan as a result of the Amended Project include the removal of longwall 109 to avoid directly mining beneath Dog Trap Creek to avoid impacts to sensitive water features and archaeological significant items.

The EIS for the Project was prepared based on detailed technical assessment and extensive collaboration between specialists to ensure impacts to the environment and to receivers and land use is minimised as far as possible and mitigation measures are developed based on past experience and monitoring results and technical recommendations.

The Tahmoor Mine has operated successfully in the Southern Coalfields since 1979 and constitutes an integral part of the economic and social values of the region. Since 2004, Tahmoor Coal has mined under the entire township of Tahmoor, safely as well as competently managing subsidence impacts to approximately 1,890 residential dwellings, commercial premises, major built infrastructure and associated land use. This demonstrates Tahmoor Coal's ability to undertake its practices with due consideration to the existing and future land uses of the region. On this basis the Amended Project is considered consistent with the aims of the Wollondilly LEP particularly because it is an underground mining operation.

Gloucester Resources Land & Environment Ruling and Clause 12 of Mining SEPP

Refer response to **Section 6.1.2** below.

6.1.2 Land Use: existing, approved and preferred land use

Issue description

The Project is incompatible with existing, approved and likely preferred land uses in the vicinity of the Project. This is because, as outlined below, the Project, if approved in its current form, will have the effect of sterilising any further subdivision or building works on the surface until such time as undermining has ceased.

At paragraph [66] in Gloucester Resources it was agreed between the experts (and ultimately by the Court) that (emphasis added):

indicators of land use trends, giving rise to likely preferred uses, are: the historical, current and approved uses of the land; the planning controls under the applicable land use zonings, including the range of permissible uses in each zone, the objectives of each zone, and the development standards for development in the zone, such as the minimum lot size; uses identified in State,

In circumstances where mining is prohibited within a zone, it should not be considered the preferred use and an assessment against the objectives of that zone and a comparison against the other land uses within that zone that are permitted with consents is required. This has not been undertaken. The assessment that is required to be undertaken in relation to clause 12 of the Mining SEPP, as highlighted by Preston CJ in Gloucester Resources has not been undertaken.

Response

Tahmoor Mine has been operating in the local area for a continuous period of 40 years since 1979 and is considered to be a longstanding approved land use within Wollondilly LGA and provides an integral component of the economic and social values of the region. Since 2004 Tahmoor Coal has mined under the entire township of Tahmoor, safely and competently managing subsidence impacts to approximately 1,890 residential dwellings, commercial premises, major built infrastructure and associated land use. This demonstrates Tahmoor Coal's ability to undertake its activities with due consideration to surrounding land use and the natural landscape.

Clause 12 of the Mining SEPP requires consideration of a mining development's compatibility with *existing, approved* and *likely preferred uses.* In regard to the recent ruling in the Land and Environment Court (*Gloucester Resources Limited v Minister for Planning [2019] NSWLEC 7*), Preston CJ stated that the application is to consider of the compatibility of the Rocky Hill Coal Project with surrounding land use under the requirements of Clause 12 of the Mining SEPP. It should be noted that the proposed Rocky Hill mine was an open cut, greenfield mine as opposed to the Project, which is an extension of an existing approved underground mine, within an existing lease.

The EIS for the Project included detailed consideration of the compatibility of the Project with current and approved surrounding land uses through extensive mine planning to avoid and minimise impacts to sensitive natural features, landscape and associated land use in the first instance and detailed assessment of land use impacts as part of the EIS. This included:

- Section 11.1 of the EIS: assessment of subsidence impacts to existing receivers and infrastructure, as well as future growth areas as documented in the Wollondilly Council's Growth Management Strategy 2011);
- Section 11.15 of the EIS: assessment of the social impacts of the project including impacts to receivers and land use affected by subsidence;
- Section 11.17 of the EIS: assessment of visual impacts with consideration to surrounding landscape character and impacts to surrounding receivers and land use; and
- Section 11.18 and 11.19 of the EIS: assessment of impacts to land capability, agricultural land, and conservation lands.

For completeness, an assessment of the Project against applicable land zonings under the Wollondilly LEP 2011, is provided in the **Table 6-1** below. The assessment demonstrates that the Project is compatible with the current and approved land uses in and surrounding the project area.

Table 6-1 Assessment against Wollondilly LEP zones

Wollondilly LEP Zoning	Objectives	Consideration
Project Component: Surface Facilities Area and REA		
RU2 Rural Landscape	• To encourage sustainable primary industry production by maintaining and enhancing the natural resource base; • To maintain the rural landscape character of the land; • To provide for a range of compatible land uses, including extensive agriculture; and • To provide areas where the density of development is limited in order to maintain a separation between urban areas.	A revised Agriculture Impact Statement has been prepared in response to the submissions received during the exhibition period (contained in Appendix O of the Project Amendment Report). The assessment identifies that disturbance for the surface facilities and REA would result in the permanent loss of some 11.06 hectares of potential agricultural land: 6 hectares of Class 4 (moderate capability) for the surface infrastructure and 11 hectares of Class 6 (low capability) for the proposed REA extensions. Noting that this land is currently not used for agriculture and would be rehabilitated (at mine closure) to its existing state suitable for agricultural use. The Amended Project would maintain existing primary industry and natural resource land use character, consistent with the RU2 land use zone objectives.
Project Component: Longwall mining		
E2 Environmental Conservation	• To protect, manage and restore areas of high ecological, scientific, cultural or aesthetic values; and • To prevent development that could destroy, damage or otherwise have an adverse effect on those values.	The mine plan for the Project was developed based on an extensive risk assessment process to avoid and minimise impacts to environmental conservation areas, natural features and landscape, water supply catchments and Aboriginal cultural heritage. Revisions to the original mine plan have resulted in longwall mining not encroaching into the Metropolitan Special Area water catchment and Cow Creek. As stated in EIS, the mine plan avoids mining beneath the Bargo River and Hornes Creek and the Project's subsidence study area does not extend to: Carters Creek, Cow Creek, Dry Creek, Eliza Creek or Sugar Loaf Gully and avoids mining directly under high value rock shelter art sites along Dog trap Creek. Furthermore, the Project's subsidence study area does not extend to the Thirlmere Lakes National Park and hence the Greater Blue Mountains World Heritage Area. The amended mine plan for the Project would also avoid impacts to key infrastructure such as: the M31 Hume Highway and key Telstra and Optus Sydney to Melbourne optical fibre and National Broadband Network cables, which follow the M31 alignment.
E4 Environmental Living	• To provide for low-impact residential development in areas with special ecological, scientific or aesthetic values; • To ensure that residential development does not have an adverse effect on those values; and • To provide for a limited range of rural land uses that do not have an adverse effect on surrounding land uses.	
RU1 Primary Production	• To encourage sustainable primary industry production by maintaining and enhancing the natural resource base; • To encourage diversity in primary industry enterprises and systems appropriate for the area; • To minimise the fragmentation and alienation of resource lands;	

Wollondilly LEP Zoning	Objectives	Consideration
	• To minimise conflict between land uses within this zone and land uses within adjoining zones; • To provide for a range of land uses (including tourism-related uses) that support the agriculture industry; and • To provide areas within which the density of development is limited in order to maintain a separation between urban areas.	The EIS for the Project has been prepared based on detailed technical assessment and extensive collaboration between specialists to ensure impacts to the environment and to receivers and land use is minimised as far as possible and mitigation measures are developed based on past experience and performance monitoring. Specifically, Tahmoor Coal manages subsidence impacts through the preparation and implementation of Extraction Plans and associated sub-plans, which have already been successfully implemented during existing mining operations at Tahmoor Mine. Since 2004, Tahmoor Mine has mined under the entire township of Tahmoor, safely and competently managing subsidence impacts to approximately 1,890 residential dwellings and commercial premises and on major built infrastructure such as: • The Main Southern Railway rail line; • Tahmoor Town Centre shopping centre; • Wollondilly Council road, bridges and drainage structures; • Gas, electricity, water, sewer and drainage infrastructure; • A poultry processing plant; • Aboriginal cultural heritage sites; and • Post-European settlement heritage structures. This demonstrates Tahmoor Coal can undertake its activities, while managing impacts to surrounding land uses so as not to significantly affect the carrying of existing, approved and preferred land use in the area. This includes residential, rural, environmental and infrastructure land use. The implementation of strict and robust environmental mitigation measures and controls as identified in **Chapter 7.0**, it is considered that the Amended Project can co-exist with current and approved surrounding land uses. This will be achieved by building on the existing strong relationships established with the community and informed by the environmental experience gained over its working history in the Southern Coalfields. As a result, the Amended Project is considered consistent with the objectives of the applicable land use zones under the Wollondilly LEP with regard to the current and approved land uses.
RU2 Rural Landscape	• To encourage sustainable primary industry production by maintaining and enhancing the natural resource base; • To maintain the rural landscape character of the land; • To provide for a range of compatible land uses, including extensive agriculture; and • To provide areas where the density of development is limited in order to maintain a separation between urban areas.	
RU4 Primary Production Small Lots	• To enable sustainable primary industry and other compatible land uses; • To encourage and promote diversity and employment opportunities in relation to primary industry enterprises, particularly those that require smaller lots or that are more intensive in nature; and • To minimise conflict between land uses within this zone and land uses within adjoining zones. • To provide areas within which the density of development is limited in order to maintain a separation between urban areas.	
R2 Low Density Residential	• To provide for the housing needs of the community within a low-density residential environment; and • To enable other land uses that provide facilities or services to meet the day to day needs of residents.	
R3 Medium Density Residential	• To provide for the housing needs of the community within a medium density residential environment; • To provide a variety of housing types within a medium density residential environment;	

Wollondilly LEP Zoning	Objectives	Consideration
	• To enable other land uses that provide facilities or services to meet the day to day needs of residents; and • To encourage the provision of affordable housing.	
R5 Large Lot Residential	• To provide residential housing in a rural setting while preserving, and minimising impacts on, environmentally sensitive locations and scenic quality; • To ensure that large residential lots do not hinder the proper and orderly development of urban areas in the future; • To ensure that development in the area does not unreasonably increase the demand for public services or public facilities; and • To minimise conflict between land uses within this zone and land uses within adjoining zones.	
SP2 Infrastructure Road and Railway	• To provide for infrastructure and related uses. • To prevent development that is not compatible with or that may detract from the provision of infrastructure.	

6.1.3 Statutory Planning: Land Use

Issue description

As discussed in further detail below, the zoning of the land which will be impacted/undermined as a result of the Project includes RU1 Primary Production, RU4 Primary Production Small Lots, R2 Low Density Residential, R5 Large Lot Residential, B2 Local Centre, R3 Medium Density IN2 Recreation. Extractive industries are prohibited in all zones save for RU1 Primary Production.

The uses of the land in the vicinity of the Project include residential (including rural-residential estates), Bargo Sports Ground and Sports Clubs, Bargo Public School, the Bargo Train Station, the Bargo Post Office, Retirement Villages, Rural Agriculture including Ingham's Enterprises, Town Centre Businesses, Bargo Tip and substantial tracks of land earmarked for future residential development.

In addition, Wollondilly Shire Council in its Growth Management Strategy 2011 has indicated that they expect a population increase of 20,000 over the next 25 years, and they plan to deliver 7,500 new houses over the next 25 years. In Bargo itself, they expect a need for 2000 new dwellings.

The EIS makes it clear that there will be impacts on the protection of the natural landscape character as a result of subsidence caused by the proposed mine. There will also be significant impacts on the built landscape with the most severe impacts resulting from subsidence occurring underneath longwalls 107 and 108 (Fig. 11.9 on page 181 of the Subsidence Report). These are within the most built up areas of Bargo, including the Public School, the Great Southern Road, the train station and the Moomba-Sydney Gas Pipeline.

Further, the site will impact items of Aboriginal heritage, local and state listed items of non-aboriginal heritage and it will cover an area of and is adjacent to the Sydney Drinking Water Catchment. In addition, the EIS at 5.3.3 has indicated that 'measuring and predicting the impact of single activities is difficult' due to the lack of a unified data set.

Response

As discussed in **Section 6.1.1 and 6.1.2**, impacts on receivers and land uses have been assessed under the EP&A Act, Wollondilly LEP and Mining SEPP as is identified in detail in Chapter 11 of the EIS. The implementation of strict and robust environmental mitigation measures and controls as per the statutory requirements are identified in **Chapter 7.0**. It is considered that the Amended Project can operate cohesively with the current, approved and future surrounding land uses. This will be achieved by expanding on the existing strong relationships established with the community and informed by the environmental experience gained over its working history in the Southern Coalfields.

Section 5.3.3 of the EIS, documents the findings of the NSW Chief Scientist and Engineer Report on Cumulative Impacts of Activities in Sydney Water Catchment (including of coal seam gas developments and underground coal mining), rather than just the EIS' findings and the related impacts from the Project.

As noted in Section 5.3.3 of the EIS, the Chief Scientist's report concluded that with regards to water quality, impacts resulting from activities can generally be mitigated through treatment. However, with regards to quantity, the report determined that "measuring and predicting the impact of single activities is difficult" due to the lack of a unified data set. Notwithstanding the current limitations associated with cumulative impact assessment, the report concluded that "current activities should proceed while this data is gathered; the current impacts do not seem to affect water quantity in a major way".

As identified in Sections 5.4 and 11.4 of the EIS, the mine plan has been designed to specifically avoid impacts to the Metropolitan Special Area water catchment. The Surface Water Impact Assessment for the Project concluded that the Amended Project would achieve neutral or beneficial effect outcomes in the drinking water catchment.

6.1.4 Subsidence: Impact to future land use

Issue description

The effect of the Project will sterilise all surface ground development until that land has been undermined. This could be until after 2035 and beyond, based on previous indications from Subsidence Advisory NSW (SA NSW).

The Project will cause subsidence beyond that which SA NSW will provide approvals for development under section 22 of the Coal Mine Subsidence Compensation Act 2017 (CMSC Act). In SA NSW's Guideline 4 Surface Development Guideline 4 – Active mining areas – High predicted subsidence impact (Guideline 4), the maximum subsidence-induced ground movements where they will provide approval for development are:

a. *Maximum Horizontal Ground Strain: 5 mm/m tensile or compressive;*

b. *Maximum Tilt: 7 mm/m; and*

c. *Minimum Radius of Curvature: 3 km (hogging and sagging).*

Our client has engaged Garry Mostyn of Pells Sullivan Meynink (CV enclosed) to review the Subsidence Report and Guideline 4. Mr Mostyn agrees that the projected impacts in the Subsidence Report will exceed the maximum permitted levels of subsidence that they will approve development under the CMSC Act. Furthermore, according the SA NSW, studies commissioned by them show that between 30-40% of structures are damaged when longwall mining takes place.

As a result, if the Project is approved, it will mean that no future development will be approved by SA NSW in any areas of the proposed longwall mining which will have a direct impact on the provision of adequate facilities and service provision for future growth.

Of note, while our analysis indicates that our client's land is within an area that is only projected to have 0-7 mm of potential tilt, SA NSW appear to be taking the very conservative position that the risks associated with undermining are too great and all development should be put on hold until the undermining has ceased.

One of the considerations of SA NSW in assessing any application for development on land within a mine subsidence district appears to be the potential compensation costs that Tahmoor mine would have to pay out to affected land owners whose buildings and improvements on the land are damaged as a result of subsidence. Whether this position is correct in their exercise of their statutory obligations is another question altogether. However, it is a clear indication of the incompatibility of this Project in its current form with any further development on the surface as landowners will be unable to obtain relevant approvals under the CMSC Act, thereby sterilising further development, as discussed below. To illustrate, we enclose a letter to Wollondilly Shire Council (Council) dated 21 November 2018 indicating that SA NSW intends to refuse the application TSUB 18-00353 (the SA Application) for the 15 Lot Subdivision at the 95 Great Bargo Road, Bargo pursuant to section 22 of the CMSC Act. This letter indicates that the SA Application has been assessed in accordance with section 22 of the CMSC Act which indicates that the relevant land will be impacted by future mine subsidence as a direct result of the Project. SA NSW later sent a letter to Council on 27 February 2019 indicating that it would not give general terms of approval to the SA Application on the following grounds:

- *The proposed subdivision is located within a consolidated coal lease held by Tahmoor Coal;*
- *Tahmoor Coal have lodged an application (the Project subject of this SSD Application) to extract coal by Longwall mining methods directly under the proposed subdivision and provided plans showing their proposed mining layout to SA NSW. The positioning of the proposed longwall panel makes it likely that the site of the proposed subdivision will be impacted by subsidence;*
- *SA NSW considers the Colliery's statement of its intention to undermine the site to be credible (we note that this is despite no consent having yet been granted for this Project);*
- *Recent studies commissioned by SA NSW on mining in the Tahmoor area indicate that between 30% - 40% of structures are damaged when longwall mining takes place;*
- *The positioning of the proposed longwall panel makes it highly likely that the site of the proposed subdivision will be impacted by subsidence if mining occurs;*
- *Concentrated ground strains are expected to exceed the subsidence impact parameters in the active mining guidelines developed by SA NSW. It is also considered likely that the concentrated ground strains that may occur will not be able to be satisfactorily mitigated against by design and*

- *SA NSW therefore considers that the proposed new road and associated stormwater works proposed with the subdivision and future purchasers of the subdivided land will be adversely impacted if mining takes place.*

Of note, this is despite no decision having yet been made in relation to the Project.

Response

Bargo was proclaimed a Mine Subsidence District in 1975. Mine Subsidence Districts are identified areas where there are potential subsidence risks from underground coal mining that has occurred or may take place in the future. It is also noted that development has occurred incrementally in the area since the mine was initially started with subsidence matters suitably addressed in the past.

SA NSW is the government agency responsible for regulating development within mine subsidence districts to ensure that any development built within a MSD is built to applicable standards which take into account anticipated subsidence within an area. Section 11.1 of the EIS has assessed anticipated subsidence impacts to existing residential properties and infrastructure in the areas as well as to potential future residential growth based on Wollondilly Council's Growth Management Strategy 2011.

While it is acknowledged that development within a mine subsidence district (MSD) would place additional planning controls on a development, it is noted that this would be no different from special planning considerations applying in comparable categories of land such as flood-prone or bush-fire prone areas.

6.1.5 Land Use: Property Rights

Issue description

This is a clear indication that if the Project was approved, the result would be the sterilisation of all other land uses above the Project area. The result of approval of the Project will be catastrophic for any future development of land which is proposed to be undermined. This is contrary to clause 12 of the Mining SEPP, the aims and objectives of the WLEP, and section 4.15(1)(a)(i), (b) and (e) of the EPA Act. This Project should not be allowed to proceed at the expense of the personal and property rights of landowners. To do so is clearly contrary to the aims and objectives of the Mining SEPP and EP&A Act.

Response

Sections 11.1, 11.18 and 11.19 of the EIS describe the existing uses and approved uses of land in the vicinity of the Project and presents the impacts of the Project on the existing/ future uses and outlines the measures proposed to avoid or minimise incompatibility with these other uses. The Tahmoor Mine is an existing operation that has operated in the area since 1979 and the Project would involve extending the life of mining operations with proposed activities primarily confined below ground and largely to existing surface facilities. Subsidence and related impacts to surrounding receivers and land use would be managed through the implementation of well-established protocols and measures developed over the years of successful longwall mining operations at the site. Based on the assessment presented in the EIS, the Project is considered unlikely to significantly impact on surrounding and future land uses in the area.

Refer to responses in **Sections 6.1.1** and **6.1.2** for further consideration of the Project in relation to clause 12 of the Mining SEPP, the aims and objectives of the Wollondilly LEP 2011, and Section 4.15 of the EPA Act.

The potential for subsidence impacts would be made known to owners of properties through the distribution of resident information packs prior to the commencement of mining at each new longwall. The pack would include information on the project and subsidence management including:

- Longwall information;
- An explanation of subsidence and the potential effect of subsidence on houses and other structures;
- Anticipated levels of subsidence for longwalls;
- A description of property inspections, surveys and monitoring including how to access free pre-mining property inspections;

- A description of rights and responsibilities relevant to subsidence;
- Emergency contact details;
- The role of SA NSW in administrating the *Coal Mine Subsidence Compensation Act 2017*, including contact details; and
- The subsidence claims process where damage by subsidence is suspected and access to free counselling services in relation to subsidence impacts.

Tahmoor Coal has extensive success with safety and serviceability experience to-date in managing subsidence related impacts from the Tahmoor Mine so that properties remain safe and serviceable, through the implementation and management of Extraction Plans and associated sub plans in accordance with SA NSW requirements. Similarly, any impacts to private bore users (groundwater quality or quality) would be subject to make good provisions by Tahmoor Coal. As discussed in section 11.15.4 of the EIS, access to private property during construction activities would be subject to landholder access agreements to identify access arrangements and management measures to avoid impacts to private property during project related activities. Environmental impacts of the mine would be managed in accordance with regulatory requirements to ensure acceptable limits are met at the nearest receptors.

Tahmoor Coal would continue to engage with the community through its existing processes including Community Consultative Committee Meetings to address community concerns on subsidence and other matters. Consultation processes that are currently implemented in relation to subsidence management (and would continue to be applied for Tahmoor South) are detailed in Section 3.8 and 11.1 of the EIS. These measures will be implemented to proactively manage personal and property rights of affected residents and property owners.

6.1.6 Land Use: Comparative benefit of mine vs other land use

Issue description

The assessment undertaken in relation to the comparative public benefits of the mine and other land uses is deficient for a number of reasons. In particular:

- *No assessment has been undertaken as to the sterilising of other land uses above the project area; and*
- *No assessment has been undertaken regarding the social impacts that this will have on the community.*

Response

The EIS included assessment of the social and land use impacts and public benefits of the project in Sections 11.1, 11.15, 11.18, 11.19 and 13, respectively. Land use impacts were considered with respect to subsidence impacts to residential property and infrastructure as well as proposed urban growth areas and in relation to impacts to agricultural land, water resources and conservation areas.

The Social Impact Assessment for the Project considered impacts to people with respect to health and wellbeing (including potential increased stress from dealing with subsidence impacts and the claims process), personal and property rights (from subsidence and groundwater bore impacts), decision making systems (including in relation to the subsidence claims process) and fears and aspirations.

As described in the EIS, environmental regulation at the mine would be governed by the development consent for the mine and the associated environmental management framework, which would include complaint handling mechanisms to address issues raised by the community. Subsidence related property claims would be handled in accordance with the SA NSW's requirements and would be overseen by that agency in the case of dispute or advice. Tahmoor Coal would continue to engage with the community and affected stakeholders through its existing mechanisms including the distribution of resident packs and via the mine community consultative committee to ensure those affected are aware of their rights under the development consent and are aware of and have the opportunity to provide feedback on the mine's activities and environmental management.

On balance, the benefits of the Project with identified management, mitigation and offset measures in place, were assessed as outweighing the predicted consequences for the following reasons:

- Economic benefits: to local, Regional and State economies, including continued provision of employment for Tahmoor Mine's existing workforce of approximately 400 employees, as well as providing employment for additional employees (up to around 175 additional staff at peak employment), until 2035. Additional wages, royalties and flow-on effects with a net benefit of a total of $783.8 million will be injected into regional and State economies as a result of the additional 13-year life of mining activities at Tahmoor resulting from the Project; and
- Environmental aspects: the Project utilises the existing Surface Facilities Area of Tahmoor North, therefore alleviating the need to develop additional undisturbed areas. The mine plan has been developed based on an extensive risk assessment process to avoid and minimise impacts to natural features, water catchments and conservation areas, cultural heritage and major infrastructure as far as possible. In addition, because the Tahmoor Mine has been operating in the region since 1979, the geology and environmental conditions are well known and therefore enables informed impact predictions and identification of suitable and proven mitigation and management measures.

Impacts to property are also further discussed in **Sections 6.1.5** and **6.1.7**.

6.1.7 Land Use: Social impacts

Issue description

This will mean that there will be no opportunity for new housing to be built in the area, pushing up the price of housing. Furthermore, it will have a significant impact on both Council and the Department being able to reach its housing targets. There will be no new infrastructure for industry and business built which will have social and economic impacts upon the community which is being undermined.

The EIS has not addressed the possibility of mental health issues arising from increased cost of living and lack of employment opportunities. This Project will not be creating a surplus of jobs, merely extending the life of the existing mine. If a landowner cannot obtain approval under the CMSC Act, they are not entitled to any compensation under that Act. This would directly impact the value of that land which will be undermined, as well as any improvements on that land, it would also cause a great deal of stress and anxiety to those affected landowners. No assessment of these impacts has been undertaken.

Response

As discussed in previous sections, the Tahmoor Mine has been successfully operating in the Southern Coalfields since 1979 and comprises an integral part of the economic, social and visual landscape in the region. In that time, the Tahmoor longwall operations have co-existed with surrounding land use and have not prevented the carrying out of permissible existing, approved and preferred land use within the area.

While it is acknowledged that development within a mine subsidence district (MSD) would place additional planning controls on a development, it is noted that this would be no different from special planning considerations applying in comparable categories of land such as flood-prone or bush-fire prone areas. SA NSW is the government agency responsible for regulating development within mine subsidence districts to ensure that any development built within a MSD is built to applicable standards which take into account anticipated subsidence within an area. Section 11.1 of the EIS has assessed anticipated subsidence impacts to existing residential properties and infrastructure in the areas as well as to potential future residential growth based on Wollondilly Council's Growth Management Strategy 2011).

It is also noted that development has occurred incrementally in the area since the mine was initially started with subsidence matters suitably addressed in the past.

It is acknowledged that subsidence related impacts can have negative social impacts to those affected. Social impacts were assessed in Section 11.15 of the EIS (including employment and economic benefits as well as social impacts from subsidence and other effects from the Project). A Human Health Risk Assessment has been prepared for the Amended Project and is included as part of the Project Amendment Report.

Since 2004, Tahmoor Coal has mined under the entire township of Tahmoor, safely and competently managing subsidence impacts to approximately 1,890 residential dwellings, commercial premises, major built infrastructure and associated land use. Tahmoor Coal has extensive experience to-date in successfully managing subsidence related impacts from the Tahmoor Mine, including in investigating and closing out subsidence claims sensitively and expeditiously in accordance with SA NSW requirements. Tahmoor Coal would apply the same process for the Project in consultation with affected receivers with the aim of minimising stress and anxiety associated with the process as far as possible.

Tahmoor Coal would implement measures to monitor potential social impacts on the community for the duration of the project. Community surveys would be conducted, and Tahmoor Coal would continue to hold community information days, which would allow two-way communications between the community and company. In addition to managing impacts associated with the Project, Tahmoor Coal would continue to provide ongoing community support measures, identified through consultation with the local community. These measures have been incorporated into the revised Environmental Management Measures for the project (**Chapter 7.0**).

6.1.8 Social: Social-economic impacts

Issue description

An assessment of the cost of this loss of development to the area has not been undertaken in the Economic Impact Assessment report at Appendix R to the EIS. Subsidence costs have been generally quantified as $11.8 million in NPV terms, but this appears to be based only upon mitigation measures and does not include the loss of developable land, and the value of this to the community. The methodology in applying the Guidelines for the economic assessment of mining and coal seam gas proposals dated 2015 were strongly criticised in Gloucester Resources. The Applicant should review this report in light of His Honour's decision in that matter and reassess their Project.

The methodology for the estimated net benefits on page 40 of Appendix R, appears to suffer from the same issues and assumptions that were criticised by His Honour in Gloucester Resources. The net cost, having not been quantified and assessed, means that the benefits (as opaque and potentially inflated as they appear to be) and the cost to the community affected by the Project has not been properly undertaken.

Response

A revised Economic Impact Assessment has been conducted as part of the Amended Project (Appendix L of the Project Amendment Report). The economic impact assessment has been prepared to be consistent with the requirements as set out in the Economic Guidelines and the Technical Notes. The net costs of the Project have been estimated consistent with those requirements. The costs associated with subsidence are based on the costs estimated by the proponent to mitigate against these costs, this is an allowable technique under the Technical Notes. The assessment found that as a result of the mining activities currently located on the site of the Project, it is unlikely that further approvals will impact the residual value of land.

6.1.9 Social: Social Impact Assessment

Issue description

The assessment of the social impacts of the mine are inadequate and do not satisfy the key requirements at page 5 of the Social Impact Assessment Guideline (Department of Planning and Environment, 2017) (the Guideline). As raised above in this submission, the social impacts of the subsidence and the sterilisation of the land within the Project area have not been addressed or assessment by the Applicant. For example, personal and property rights at 4.8 of the Social Impact Assessment at Appendix Q of the EIS (SIA) does not even consider the impacts upon the sterilisation of land which is proposed to be undermined by the Project which is a clear violation of property rights. Proposed mitigation measures within this paragraph are vague and uncertain. Further, the Fears and Aspirations section of the SIA does not even address any of the types of issues and social impacts that would arise from the sterilisation of land being undermined by the Project.

The Department does not have sufficient information to be assured that the Project will not have unacceptable social impacts.

The known negative impacts of sterilising land above the proposed longwall undermining within the Project area would outweigh the purported public benefit of the Project.

Response

A social impact assessment was prepared for the Project consistent with the Department's *Social Impact Assessment Guideline for State Significant Mining, Petroleum Production and Extractive Industry Development*. The assessment included consideration of each of the social impact categories identified in Section 1.1 (page 5) of the Department's guideline including: way of life, community identity and cohesion, access and use of infrastructure, services and facilities, culture, health and wellbeing, surroundings (amenity impacts and natural features), personal and property rights, decision making systems, fears and aspirations as well as cumulative impacts. This is reflected in the Department Preliminary Issues Report to the Independent Planning Commission which identifies that "Tahmoor Coal has generally applied the guideline and presented an adequate case for its proposal" (DPIE, 2019).

An addendum to the Social Impact Assessment (SIA Addendum, Appendix R of the Project Amendment Report) has been prepared to update the original SIA prepared for the EIS, following Project amendments. Whilst it is recognised that the Project amendments would reduce the overall impact of the Project, a review of the social consequences of these changes against the original SIA indicates that there would be no subsequent reduction in the level of social impact. This is based on the fact that impacts have not been fully removed or avoided by the amendments and that the community is deemed to remain highly sensitive to social consequences of these issues. As such the overall social significance of the Project has remained unchanged and would remain consistent with those of the already operational mine.

A Health Impact Assessment has been prepared for the Amended Project and is appended to the Project Amendment Report as Appendix N.

The comparative benefit of the project with respect to impacts to land use is further discussed in **Section 6.1.6**.

6.1.10 Greenhouse Gas: Rocky Hill Coal Mine decision

Issue description

In addition, limited assessment has been undertaken by the Applicant in relation to 'upstream' (Scope 2) and 'downstream' (Scope 3) Greenhouse Gas Emissions. The emissions have been summarised as follows (in the table at page "x" of the EIS):

- *Scope 1 – 13.5 million tonnes of CO2-e over the life of the mine;*
- *Scope 2 – 1.5 million tonnes of CO2-e over the life of the mine; and*
- *Scope 3 – 104.5 million tonnes of CO2-e over the life of the mine.*

The total emissions for Scope 1, 2 and 3 would equate to 119.5 million tonnes of CO2-e over the life of the mine, which according the Applicant's calculations in their EIS would equal 1.68% of Australia's portion of Australia's commitment under the Paris Agreement.2 This is a significant contribution for a single project.

Chief Justice:

There is a causal link between the Project's cumulative GHG emissions and climate change and its consequences. The Project's cumulative GHG emissions will contribute to the global total of GHG concentrations in the atmosphere. The global total of GHG concentrations will affect the climate system and cause climate change impacts. The Project's cumulative GHG emissions are therefore likely to contribute to the future changes to the climate system and the impacts of climate change. In this way, the Project is likely to have indirect impacts on the environment, including the climate system, the oceanic and terrestrial environment, and people. Like the proposed coal mine in that case, this Project would have a significant impact on Australia's ability to meet its obligations under the Paris Agreement 2015.

Response

The Greenhouse Gas Assessment for the Amended Project (Appendix K to the Project Amendment Report) includes an assessment of the Amended Project's likely contribution to projected climate change. The assessment found that impacts would be in proportion with its contribution to global GHG emissions. Average annual Scope 1 emissions from the Project (0.75 Mt CO_2-e) would represent approximately 0.175% of Australia's commitment under the Paris Agreement (431 Mt CO_2-e by 2030) and 0.0023% of global GHG emissions (DoEE, 2019; IEA, 2019).

Table 6-2 shows the relative percentage contribution of each different emission scope combination (direct and indirect), to the NSW, Australian and Global GHG emissions. It is noted that combining downstream emissions (Scope 3), adds an element of double counting to the carbon budget if these emissions are captured in the direct (Scope 1) emissions from those downstream operations.

Table 6-2 Project contribution to NSW, Australian and Global GHG emissions

	Annual Project emissions (Mt CO_2-e)	Contribution to total NSW[1] emissions of 128.9 Mt CO_2-e	Contribution to total Australian[2] emissions of 128.9 Mt CO_2-e	Contribution to total Global[3] emissions of 33,100 Mt CO_2-e
Scope 1	0.75	0.586 %	0.175 %	0.0023 %
Scope 1 and 2	0.84	0.649 %	0.194 %	0.0025 %
Scope 1, 2 and 3	6.35	4.93 %	1.47 %	0.0192 %

[1] NSW emissions reported in 2017, taken from the National Greenhouse Gas Inventory (2019) http://ageis.climatechange.gov.au/#

[2] Based on Australia's emission target for 2030 under the Paris Agreement https://climateactiontracker.org/countries/australia/

[3] Latest emissions data available for 2018. https://www.iea.org/geco/emissions/

6.1.11 Greenhouse Gas: Mitigation

Issue description

Management and mitigation measures would be incorporated into the Project to reduce Scope 1, 2 and 3 emissions where feasible and practical.

As a result, the EIS is deficient and has not addressed this critical issue which is required to be addressed by the Mining SEPP.

Response

The revised Greenhouse Gas Assessment for the Amended Project (Appendix K to the Project Amendment Report), considers Scope 1, 2, and 3 emissions within the assessment. Further consideration of mitigation measures has also been included.

As discussed in **Section 6.1.10**, the assessment found the average annual Scope 1 emissions from the Project (0.75 Mt CO_2-e) would represent approximately 0.175% of Australia's commitment under the Paris Agreement (431 Mt CO_2-e by 2030) and 0.0023% of global GHG emissions (DoEE, 2019; IEA, 2019). In addition, the Project would generate approximately 1.3 million tonnes CO2-e of Scope 2 emissions and approximately 88.2 million tonnes CO2-e of Scope 3 emissions over its life. Management and mitigation measures have been updated according to the Amended Project and would be incorporated into the Project to reduce Scope 1, 2 and 3 emissions where feasible and practical.

6.1.12 Statutory Planning: Ecological Sustainable Development

Issue description

The Project is contrary to section 4.15(1)(b) of the EP&A Act due the likely impacts of the development, including environmental impacts on both the natural and built environments, and social and economic impacts in the locality.

Further, the development is not ecologically sustainable development in that it will give rise to additional GHG emissions and will cause impact to the environment which is not sustainable and for which no suitable mitigation measures have been proposed. As a result, the Project is not in the public interest (section 4.15(1)(e) of the EP&A Act).

Response

The net project benefits of the Project were assessed in Section 13 of the EIS with consideration of social and economic factors and environmental, built environment and site suitability considerations as well as assessment against ecologically sustainable development (ESD) principals.

In summary the on-balance benefits of the Project with identified management, mitigation and offset measures in place, were assessed as outweighing the predicted residual consequences for the following reasons:

- Socio-economic benefits: to local, Regional and State economies, including continued provision of employment for Tahmoor Mine's existing workforce of approximately 400 employees, as well as providing employment for additional employees (up to around 175 additional staff at peak employment), until 2035. Additional wages, royalties and flow-on effects with a net benefit of a total of $784 million will be injected into regional and State economies as a result of the additional 13-year life of mining activities at Tahmoor resulting from the Project; and
- Natural and built environmental and site suitability aspects: the Project utilises the existing Surface Facilities Area of Tahmoor North, therefore alleviating the need to develop additional undisturbed areas. The mine plan has been developed based on an extensive risk assessment process to avoid and minimise impacts to natural features, water catchments and conservation areas, cultural heritage and major infrastructure as far as possible. In addition, as the Tahmoor Mine has been operating in the region since 1979, the geology and environmental conditions are well known and therefore allow informed impact predictions and identification of suitable and proven mitigation and management measures based on robust technical assessments. The Project represents the gradual transition of mining activities from Tahmoor North to the Tahmoor South area rather than the development of a greenfield mine adjacent to the current mine and as such impacts would be comparable to existing mining development.

Further details in relation to the GHG emissions associated with the Project are provided in **Sections 6.1.10** and **6.1.11**.

6.1.13 Statutory Planning: Inconsistency with EP&A Act

Issue description

For the reasons outlined above, the Project also fails to satisfy the objects of the EP&A Act, in particular section 1.3:

a. to promote the social and economic welfare of the community and a better environment by the proper management, development and conservation of the State's natural and other resources;

b. to facilitate ecologically sustainable development by integrating relevant economic, environmental and social considerations in decision-making about environmental planning and assessment;

c. to promote the orderly and economic use and development of land;

d. to promote the delivery and maintenance of affordable housing;

e. to promote the sustainable management of built and cultural heritage (including Aboriginal cultural heritage);

f. to promote good design and amenity of the built environment; and

g. to promote the proper construction and maintenance of buildings, including the protection of the health and safety of their occupants.

The development is contrary to section 4.15(1)(a)(i), (b) and (e) of the EP&A Act on the grounds listed above.

Response

The EIS was prepared in accordance with Part 4 of the EP&A Act, the SEARs and Part 3 of Schedule 2 of the EP&A Regulation. As discussed in previous sections the Project is considered to be consistent with the objectives of the EP&A Act as:

- The mine plan for the Project was developed based on an extensive risk assessment process to avoid and minimise impacts to environmental conservation areas, natural features and landscape, water supply catchments, Aboriginal cultural heritage and major infrastructure as far as possible, consistent with the objects to of the Act for: (a) the proper management, development and conservation of the State's natural and other resources, (c) the orderly and economic use and development of land, and (e) the sustainable management of cultural heritage;
- The Project was subject to robust technical assessment informed by: contemporary assessment methodology and peer reviews, detailed collaboration between specialists, at least two years of baseline data, and experience of environmental and geological conditions drawn from over 40 years of longwall mining in the Southern Coalfields. This has allowed informed impact predictions and identification of suitable and proven mitigation and management measures directed by specialist recommendations, consistent with the principles of ESD (b);
- Tahmoor Coal has extensive experience managing subsidence related impacts and carrying out its longwall operations with due consideration to surrounding land use, receivers and property, consistent with objects (d), (f) and (g) of the EP&A Act. Since 2004, Tahmoor Mine has mined under the entire township of Tahmoor, safely and competently managing subsidence impacts to approximately 1,890 residential dwellings and commercial premises and on major built infrastructure. Tahmoor Coal would continue to implement its Extraction Plan process to manage subsidence and related impacts to surrounding land use and infrastructure in accordance with SA NSW requirements; and
- The net benefits of the Project (including employment and royalties and flow-on effects) would promote social and economic welfare consistent with object (a).

Consideration of the Project in relation to Section 4.15 of the EP&A Act is provided in **Sections 6.1.1** and **6.1.5**.

6.1.14 Subsidence: Additional assessment

Issue description

Alternatively, if the Minister or delegate is minded to approve the Project, then:

- *The Applicant should be required to provide an additional assessment of the Project to address the deficiencies of in its Application, including an assessment of subsidence impacts and the resultant sterilisation of surface development for future uses consistent with the character of the area; and*
- *Appropriate conditions should be imposed to mitigate the issues identified.*

The Applicant could reduce impacts by only mining half height seam. Otherwise, if the Applicant is confident of the projected impacts, the Applicant should agree to a condition that it will not cause impacts beyond those in Guideline 4 development so as not to sterilise surface development.

Response

The Project has been amended to reduce the cut height and longwall width to the same as the longwall geometry currently employed in Tahmoor North, which in turn would reduce the subsidence impacts. Reducing the cut height to half height is not economically feasible for this Project.

6.2 Endeavour Energy

6.2.1 Network capacity/ connection

Issue description

Endeavour Energy's Asset Strategy & Planning Branch have advised that in regard to the new electrical load required by the mine, they are currently addressing this via the Endeavour Energy's Network Connections application process. The three following applications relating to the mine are currently being assessed:

- *ARP4022 – asset relocation of section of 11,000 volt / 11 kilovolt (kV) high voltage and 66,000 volt / 66 kV high voltage mains to make way for expansion Rejects Emplacement Area (required July 2021);*
- *DBL2346 – temporary 11 kV high voltage supply for mine shaft drill rig (required July 2021); and*
- *NIL0287 – Permanent 66 kV high voltage supply to the mine for surface ventilation equipment (66 kV /11 kV switchyard start July 2021 completed early 2022).*

For any additional electricity requirements, the applicant will need to submit an application for connection of load via Endeavour Energy's Network Connections Branch to carry out the final load assessment and the method of supply will be determined (also taking into consideration the potential further development / electricity load of the residue allotments). Further details are available by contacting Endeavour Energy's Network Connections Branch. Advice on the electricity infrastructure required to facilitate the Project (including asset relocations) can be obtained by submitting a Technical Review Request to Endeavour Energy's Network Connections Branch. The response to these enquiries is based upon a desktop review of corporate information systems, and as such does not involve the engagement of various internal stakeholders in order to develop a 'Connection Offer'. It does provide details of preliminary connection requirements which can be considered by the applicant prior to lodging a formal application for connection of load. Alternatively, the applicant should engage a Level 3 Accredited Service Provider (ASP) approved to design distribution network assets, including underground or overhead.

Response

Noted. Tahmoor Coal has commenced discussions with Endeavour Energy regarding asset relocation, temporary voltage supply and permanent high voltage supply. Application for connection to the network would be progressed and finalised in accordance with Endeavour Energy requirements including design and electricity infrastructure details. The requirement for consultation and finalisation of connection agreements in accordance with Endeavour Energy requirements has been incorporated into the revised Management Measures (**Chapter 7.0**).

6.2.2 Subsidence Management

Issue description

As this is an extension of the current mine into a new area below the village area of Bargo, the current Subsidence Management Plan should be updated or a new one drafted to include the additional assets that may be impacted by any mine subsidence.

Response

As identified in Section 11.1 of the EIS, prior to the commencement of any new longwall operations an Extraction Plan (which replaces Subsidence Management Plans) would be prepared in consultation with affected infrastructure owners to ensure appropriate monitoring, management and mitigation measures are in place to manage (and if required) remediate subsidence impacts to infrastructure (including electricity services and utilities). All new electricity infrastructure required by the Project would be included in the relevant Plan. The requirement has been incorporated into the revised Management Measures (**Chapter 7.0**).

6.2.3 Earthing

Issue description

The construction of any building or structure (including fencing, signage, flag poles, hoardings etc.) whether temporary or permanent that is connected to or in close proximity to Endeavour Energy's electrical network is required to comply with Australian/New Zealand Standard AS/NZS 3000:2018 'Electrical installations' as updated from time to time. This Standard sets out requirements for the design, construction and verification of electrical installations, including ensuring there is adequate connection to the earth. Inadequate connection to the earth to allow a leaking/fault current to flow into the grounding system and be properly dissipated places persons equipment connected to the network and the electricity network itself at risk from electric shock, fire and physical injury.

Response

Noted. Any construction or building works undertaken in close proximity to Endeavour Energy's electrical network would be undertaken in compliance with Endeavour Energy's requirements and standards. The requirement has been incorporated into the revised Management Measures (**Chapter 7.0**).

6.2.4 Safety Clearances

Issue description

The construction of any building or structure (including fencing, signage, flag poles etc.) whether temporary or permanent must comply with the minimum safe distances / clearances for voltages up to and including 132,000 volts (132 kV) as specified in:

- *Australian/New Zealand Standard AS/NZS 7000 – 2016: 'Overhead line design' as updated from time to time; and*
- *Service and Installation Rules of NSW' which can accessed via the following link to the NSW Planning & Environment website:https://energy.nsw.gov.au/government-and-regulation/legislative-and-regulatory requirements/service-installation-rules.*

As a guide please find attached a copy of Endeavour Energy Drawing 'Overhead Lines Minimum Clearances Near Structures'.

Response

Noted. Any construction or building works undertaken in close proximity to Endeavour Energy's electrical network would be undertaken in compliance with Endeavour Energy's requirements and standards including in relation to safety distances/ clearances. The requirement has been incorporated into the revised Management Measures (**Chapter 7.0**).

6.2.5 Vegetation Management under lines

Issue description

The planting of large trees in the vicinity of electricity infrastructure is not supported by Endeavour Energy. Suitable planting needs to be undertaken in proximity of electricity infrastructure. Only low growing shrubs not exceeding 3.0 metres in height, ground covers and smaller shrubs, with non-invasive root systems are the best plants to use. Larger trees should be planted well away from electricity infrastructure (at least the same distance from overhead power lines as their potential full grown height) and even with underground cables, be installed with a root barrier around the root ball of the plant. Landscaping that interferes with electricity infrastructure may become a potential safety risk, cause of bush fire, restrict access, reduce light levels from streetlights or result in the interruption of supply. Such landscaping may be subject to Endeavour Energy's Vegetation Management program and/or the provisions of the Electricity Supply Act 1995 (NSW) Section 48 'Interference with electricity works by trees' by which under certain circumstances the cost of carrying out such work may be recovered.

Response

Noted. Any landscaping undertaken under an Endeavour Energy transmission asset would comply with Endeavour Energy's requirements and standards to ensure that planted vegetation does not pose a safety or maintenance risk to Endeavour Energy's assets. The requirement has been incorporated into the revised Management Measures (**Chapter 7.0**).

6.2.6 Dial-Before-You-Dig

Issue description

Before commencing any underground activity the applicant is required to obtain advice from the Dial Before You Dig 1100 service in accordance with the requirements of the Electricity Supply Act 1995 (NSW) and associated Regulations. This should be obtained by the applicant not only to identify the location of any underground electrical and other utility infrastructure across the site, but also to identify them as a hazard and to properly assess the risk.

Response

Dial Before You Dig searches and advice would be sought prior to earthworks. The requirement has been incorporated into the revised Management Measures (**Chapter 7.0**).

6.2.7 Excavation

Issue description

The applicant should be advised of the following object of Section 49A 'Excavation work affecting electricity works' of the of Electricity Supply Act 1995 (NSW) covering the carrying out or proposed carrying out of excavation work in, on or near Endeavour Energy's electrical infrastructure. If any excavation work affects Endeavour Energy's electricity infrastructure, prior contact must be made to

Endeavour Energy's Regional Service North via Head Office enquiries on telephone: 133 718 or (02) 9853 6666 from 8am - 5:30pm or alternately email Regional.ServicesCentral@endeavourenergy.com.au.

Response

Noted. Any construction or excavation works undertaken in proximity to Endeavour Energy's electrical network would be undertaken in compliance with Endeavour Energy's requirements and standards and Endeavour Energy would be consulted prior to any such works occurring. The requirement has been incorporated into the revised Management Measures (**Chapter 7.0**).

6.2.8 Public Safety & emergency contact

Issue description

Workers involved in work near electricity infrastructure run the risk of receiving an electric shock and causing substantial damage to plant and equipment. I have attached Endeavour Energy's public safety training resources, which were developed to help general public / workers to understand why you may be at risk and what you can do to work safely. The public safety training resources are also available via Endeavour Energy's website via the following link: http://www.endeavourenergy.com.au/wps/wcm/connect/ee/nsw/nsw+homepage/communitynav/safety/s Safety brochures.

If the applicant has any concerns over the proposed works in proximity of the Endeavour Energy's electricity infrastructure to the road verge / roadway, as part of a public safety initiative Endeavour Energy has set up an email account that is accessible by a range of multiple stakeholders across the company in order to provide more effective lines of communication with the general public who may be undertaking construction activities in proximity of electricity infrastructure such as builders, construction industry workers etc. The email address is Construction.Works@endeavourenergy.com.au.

In case of an emergency relating to Endeavour Energy's electrical network, the applicant should note the Emergencies Telephone is 131 003 which can be contacted 24 hours/7 days.

Response

Noted. Any construction or excavation works undertaken in proximity to Endeavour Energy's electrical network would be undertaken in compliance with Endeavour Energy's requirements and standards. Endeavour Energy's emergency contact details are noted. The requirement has been incorporated into the revised Management Measures (**Chapter 7.0**).

6.3 Undermined Inc.

6.3.1 Thirlmere Lakes: Impacts

Issue description

The Tahmoor South Coal Project should not proceed before the colliery pumps stop extracting water produced from the west where earlier longwall mining approached closest to Thirlmere Lakes. Any delay stopping the pumps extracting water from below the level of Thirlmere Lakes delays restoration of the World Heritage status Thirlmere Lakes National Park.

Response

Mining at Tahmoor Mine has not impacted the World Heritage status of Thirlmere Lakes National Park. The Thirlmere Lakes are approximately 3.5 km from the Project at its nearest proposed longwalls. The Amended Project also involves mining further away from the lakes, compared to the currently approved operations in the north.

The water balance model (see Section 11.5.4 of the EIS and Section 7.3 of the revised Surface Water Impact Assessment, Appendix D to the Project Amendment Report) determined that the most significant outflow component from the Thirlmere Lakes is evaporation/evapotranspiration, comprising approximately two-thirds of outflows. Groundwater recharge by contrast comprises approximately a quarter of outflows. The Project would only affect the groundwater recharge component, albeit to a minor extent.

It has been determined that the Project would have negligible groundwater and surface water impacts on the Thirlmere Lakes that would be comparable to levels of natural variability (i.e. changes to lake levels of 0.01 m and 0.06 m on average) and would be imperceptible in many circumstances. Potential impacts to terrestrial and aquatic ecology within the Thirlmere Lakes were also determined to be minor to negligible.

Nonetheless, the mitigation measures have been revised according to submissions and are discussed in **Section 6.3.2** and **6.3.3**.

6.3.2 Thirlmere Lakes: OEH Research

Issue description

The Office of Environment and Heritage ongoing research into the drying of Thirlmere Lakes is the minimum standard of research required before new areas of coal extraction can proceed. As Undermined Inc. does not want other areas to be damaged as badly as Thirlmere Lakes and Redbank Creek have been, the documentation supporting this Project is inadequate.

Response

The mitigation measures for the Amended Project have been revised to include the requirement for consultation with the Thirlmere Lakes interagency Research Group during the development of groundwater management and monitoring programs for the Amended Project (in relation to potential impacts to Thirlmere Lakes) and consideration of the results of the Thirlmere Lakes Research Program, as they become available.

6.3.3 Groundwater: Dewatering Impacts to watercourses

Issue description

Tahmoor South Coal Project must not proceed until Tahmoor Coal knows whether its longwall mining has affected Thirlmere Lakes, Myrtle Creek, Redbank Creek and dewatered the land it has mined under and can confidently say it will not happen again with this Project.

Response

Research into the hydrological processes that exist at the Thirlmere Lakes is ongoing. As stated in response in **Section 5.15.36**, there is a commitment in place to consult with stakeholders as part of the Thirlmere Lakes Research Program in order to update and maintain the groundwater management plan and monitoring strategy. In addition, groundwater monitoring data will be shared as part of this process in order to assess hydrological changes at the Thirlmere Lakes.

Both the Surface Water and Groundwater Assessments prepared for the EIS undertook specific modelling and analysis of potential impacts to the Thirlmere Lakes system (see responses in **Section 5.15.35** for detailed information regarding this).

Impacts to Redbank Creek have been continuously monitored using both groundwater and surface water assessments. Data from monitoring bore P9 was recently collected and analysed by SCT (2018). This report highlighted increased hydraulic conductivity within the bore P9 in the presence of subsidence-induced surface cracking. The findings from this assessment were used to calibrate the groundwater modelling done to support the Extraction Management Plan for Tahmoor Western Domain Longwalls W1-W2 (HydroSimulations, 2019). This will be utilised in revised modelling for Tahmoor South.

In addition, studies by Geoterra and a recent publication from Morrison *et al*. (2019) studied the changes in surface water quality along a subsidence affected watercourse (Redbank Creek). Morrison *et al*. identified some key analytes to add to the existing monitoring program in order to identify watercourses and water quality effects that may be affected by surface cracking. These findings will also be considered in the development of the revised monitoring strategy in order to ensure any mining induced impacts to surface water can be readily detected.

As stated in response in **Section 5.2.4**, the numerical model employed in the Groundwater Assessment is well calibrated, with lowest residual errors apparent in the shallow aquifers (Hawkesbury Sandstone and alluvium). In addition to the representation of surface cracking effects to be incorporated into the revised groundwater model, predicted impacts from mining at Tahmoor Mine will be able to be reported on with a degree of confidence.

6.3.4 Surface Water: Redbank Creek

Issue description

Redbank Creek has subsided so much from past mining that it is unacceptably dry and polluted. This has happened due to inaccurate forecasting of the effects of long wall mining, the same forecasting used to predict the acceptability (to Tahmoor Coal) of the Project.

Redbank Creek is a clearly visible example of damage caused by longwall mining that cannot be remediated. Tahmoor Coal can only stop mining under creeks if it is to avoid damage that cannot be remediated.

The photo below shows mine subsidence in Redbank Creek. It shows damage done by Longwall 30. It has neither been repaired nor restored and indicates dewatering as well as unacceptable pollution by minerals flowing to the surface from underground.

Despite the drought at the time the photo was taken in 2018, wildlife in Redbank Creek were using the water available in Redbank Creek downstream from the subsided creek bed. Wildlife might still have a chance of surviving longer in an already compromised environment if Tahmoor Coal were to offer not to mine under creeks in the proposed project area.

Response

Section 5.2.2 of the revised Surface Water Impact Assessment (Appendix D to the Project Amendment Report) provides an updated assessment of surface water quality in Redbank Creek. Water quality data monitored between February 2005 and August 2019 for water quality sampling sites RC1 (upstream), RC2 (mid) and RC5 (downstream) is presented and assessed. The key outcomes of the assessment are as follows:

- Recorded electrical conductivity (EC - a measure of salinity) increased at the downstream site RC5 following the mining of longwall 26, reaching a peak during the mining of longwall 27 and 28. Thereafter EC levels at RC5 have fallen;

- Longwall mining in the Redbank Creek catchment has not affected pH levels in the creek to any significant extent;
- Periodic and localised pulses of iron, zinc and sulphate concentrations have been recorded at site RC2; and
- Relatively high manganese concentrations have been recorded at site RC2 and RC5. The elevated manganese concentrations at site RC2 may be, at least in part, unrelated to mining of longwalls 25 to 29 and possibly relate to pre-existing groundwater inflows (ferruginous springs) reported in Redbank Creek. It appears likely that increased manganese concentrations at site RC5 are related to mining, although concentrations have diminished with time.

An Australian Water Balance Model (AWBM) was developed and calibrated to simulate streamflow for Redbank Creek catchment as detailed in the Flood Study. Sites R4 and R11 were used in this assessment of mining impacts on flow in Redbank Creek. Site R4 has a reliable low flow rating and is within the potentially affected reaches of Redbank Creek. Site R11 is the site which is furthest downstream of the potential impacts of longwall mining – located approximately 300 m downstream of LW32.

The model has been reviewed and updated as part of an assessment of the Amended Project (Appendix D to the Project Amendment Report), with additional streamflow monitoring data adopted in the re-calibration of the catchment model. Model parameters affecting surface water runoff were selected to be similar at both locations with parameters affecting baseflow and transmission loss being varied to obtain fits to low flows and low flow recession. The model parameters used in the assessment of flows at R4 and R11 were altered slightly from those given in the SWIA submitted with the EIS in order to improve the model fit during the earlier period of available recorded data (Dec 2009 to the end of 2012 – up to the end of mining of longwall 26).

The examination of the flow record from monitoring site R4 and monitoring site R11 on Redbank Creek was updated to assess impacts from mining of longwalls 27 to 31. The flow record from December 2009 to March 2013, assessed for the EIS, identified that mining of longwalls 25, 26 and 27 within the Redbank Creek catchments, including mining directly beneath Redbank Creek itself, had not affected flows and low flows at site R11 downstream. There was some evidence that flows at site R4 may have been reduced during the period of low flow recorded between October 2012 and January 2013.

The flow record at site R11 examined for the revised assessment suggests a change in the flow regime from the mining of longwall 27, with greater prevalence of baseflow. This is considered likely to be associated with subsidence-induced fracturing causing underflow and delayed drainage of flow reporting to the downstream site R11. A second change in the flow regime is apparent, from the period during the mining of longwall 31, with the prevalence of baseflow diminishing and ephemeral flow prevailing. The recent change to a more ephemeral flow regime may be related to natural ‘healing’ behaviour and/or closure of subsidence cracking due to the mining of additional longwalls. Additional catchment specific research would need to be undertaken to better understand the cause of this behaviour.

6.3.5 Subsidence: Impacts to Watercourses

Issue description

Undermined Inc. does not want to see longwall mining under creeks in the new areas proposed to be mined, to avoid mine subsidence like Redbank Creek (and Myrtle Creek before that) has suffered. We will not accept the destruction of Dog Trap Creek, Tea Tree Hollow and their tributaries.

Response

The proposed mine plan for the Project was developed following an extensive risk assessment process. A number of revisions to the original mine plan were made to minimise impacts to key watercourses and natural features including: shortening the commencing ends of longwalls 105 to 108 so they do not encroach into the Metropolitan Special Area and Cow Creek, and no longer proposing mining in the Eastern Domain to avoid impacts to Eliza Creek. The mine plan avoids undermining the Bargo River and Hornes Creek and the Amended Project's subsidence study area does not extend to: Carters Creek, Cow Creek, Dry Creek, Eliza Creek or Sugar Loaf Gully. Furthermore, the Project's subsidence study area does not extend to the Thirlmere Lakes National Park.

The mine plan has been amended to further reduce subsidence impacts to surface features (refer **Chapter 2.0**) and further refinements may be made to the mine plan during the operational phase based on subsidence monitoring as part of adaptive management during the Extraction Plan process.

6.3.6 Surface Water: Remediation of creeks

Issue description

Undermined Inc. says a sustainable rehabilitation policy should be to restore mined surface landforms and subsurface conditions that are safe and sustainably close to how they were before mining and the replacement of ecological communities removed or damaged by mining in their pre-mined locations. The Tahmoor South Coal Project does not have this objective. Just meeting or almost meeting the existing State Government objectives to protect the environment might have once been acceptable, but now we know the environment is changing and community expectations are increasing, meeting the standards required at the time when this expansion of Tahmoor Coal was planned is no longer good enough.

It is our opinion that any introduction of engineered chemicals, grout or sealants would neither neutralise the pollution nor remediate the chemical damage to Redbank Creek and the creeks proposed to be mined under in the Tahmoor South Coal Project. Based on the assumption subsidence is dynamic and continues over time, our opinion is that repair work will not seal fissures created by subsidence during the lifetimes of people now living. It is also our opinion that engineering repairs carried out to seal water leaking through the bed of Redbank Creek will introduce worse eyesores resulting in Redbank Creek appearing less natural and less acceptable than the Creek's already distressed appearance now.

Response

Where subsidence impacts result in pool or stream bed fracturing, pool / stream remediation measures will be implemented in consultation with key Government agencies. Where there is limited ability for fractures to seal naturally, they will be sealed with an appropriate and approved grout. A corrective management action plan, which forms part of the approved 2019/2020 Mining operations Plan (MOP), has been developed by SIMEC for Myrtle Creek and Redbank Creek with pool remediation and rock bar grout curtain wall works proposed. On completion of the Myrtle Creek corrective management action plan Trial Project, outcomes will be assessed to determine the best approach for a future Stage 2 remediation works in Myrtle and Redbank Creek. This will involve a staged approach, with outcomes from each stage being assessed to provide the best approach for the next stage. The purpose of this approach is to provide a strategy of continuous improvement from the staged outcomes. The findings from the staged approach for Myrtle and Redbank Creek will be applied to develop an effective and appropriate remediation strategy for Tee Tree Hollow and Dog Trap Creek if the streambed or pools are impacted due to the project.

6.3.7 Surface Water: Monitoring data

Issue description

Information on the sustainability and environmental acceptability of the proposed mining process is not offered to the local community affected by the mining. Undermined Inc. has been asking for daily logs of produced water from Tahmoor Coal so the community can do its own autocorrelation and coherence analysis of surface water loss and rainfall. Monthly aggregated data are insufficiently detailed to understand whether improvements need to be made to mining methods to protect the environment.

Response

Noted. Tahmoor Coal has provided data to the Department who are completing the research on Thirlmere Lakes.

6.3.8 Greenhouse Gas: Climate Change

Issue description

Mining companies are responsible for rehabilitation of all impacts of their mining activity including climate change, not just those at the mine site, yet this proposal does not acknowledge that responsibility. Climate change mitigation by Tahmoor Coal is neither proposed nor evaluated in the project documents.

Response

Concern regarding impacts on climate change is noted. The Greenhouse Gas Assessment was revised as part of the Amended Project (Appendix K to the Project Amendment Report), including providing further consideration of mitigation measures. Impacts of Greenhouse Gas emissions are discussed in **Section 6.1.10** and **6.1.11**. Mitigation measures have been further considered as part of the Amended Project and are listed in Table 8.1 of the Greenhouse Gas Assessment (Appendix K to the Project Amendment Report).

6.3.9 Cumulative Impacts: Assessment

Issue description

Environmental assessment and reporting should be on cumulative impacts, and not on individual incremental impacts.

Response

Cumulative impacts associated with the Project are assessed in Section 11.24 of the EIS. Cumulative impacts were accounted for in the assessment of technical issues through the establishment of appropriate baseline data which represents the existing condition from the operation of the existing Tahmoor Mine as well as other mines in the Southern Coalfields.

The method for subsidence prediction for the Project used observed extensive monitoring data from previous mining at Tahmoor Mine, as well as data from the Southern Coalfields of NSW. Subsidence predictions were used to inform assessments of natural and built features and were also compared to observed subsidence and impacts at neighbouring underground coal mining operations. Cumulative local impacts on groundwater, surface water, terrestrial and aquatic ecology have been assessed by utilising two years' worth of baseline data. The cumulative impacts to groundwater were assessed through numerical modelling and included a review of data from several mines in the regional area including Appin, Mt Kembla, Douglas Park (formerly known as Tower) and Dendrobium coal mines as shown in Sections 6.4.2 and 6.7.2 of the Groundwater Impact Assessment, Appendix I of the EIS.

Regional impacts were assessed through analysis of observed data from the existing Tahmoor Mine, other collieries in the Southern Coalfields, and other available data sources relevant to the environmental issue.

6.3.10 Environmental Management Commitments: Risk Framework

Issue description

A robust and independently verified risk assessment framework should be established, based on probability, impact and mitigation options of mining damage.

Response

The environmental management and mitigation measures determined for the Amended Project are based on the findings of robust contemporary specialist assessments, peer review, detailed risk assessment, collaboration between specialists and informed by monitoring data from existing operations at the Tahmoor Mine and other mining operations in the Southern Coalfields.

If approved, the Project would be subject to comprehensive development consent conditions issued by DPIE, and other regulatory agencies, based on their independent assessment of the EIS and project information. The development consent for the Amended Project will form the basis of the management and monitoring framework for the Amended Project consistent with the framework applied to other contemporary resource projects in NSW.

6.3.11 Mine Closure and Rehabilitation: Rehabilitation

Issue description

There should be no mining where damage cannot be rehabilitated.

Response

Mine closure and rehabilitation are assessed in Section 11.23 of the EIS including details of a conceptual mine closure plan identifying draft rehabilitation criteria and preliminary final land use options. It is anticipated that detailed mine closure planning would be undertaken at least five years from closure, building upon the concept outlined in the EIS. The final mine closure plan would require approval by the Resource Regulator and Tahmoor Coal would be responsible for the implementation and funding of the plan in accordance with the approved closure plan and the Project's development consent conditions to the satisfaction of regulatory authorities. This includes any ongoing monitoring or remediation requirements to achieve the agreed rehabilitation outcome/ criteria under the development consent conditions and mine closure plan.

6.3.12 Mine Closure and Rehabilitation: Rehabilitation Funds

Issue description

Rehabilitation funding for mine closure should be put in escrow or similarly secured and not accessible for progressive rehabilitation or diluted in other ways during mine operation.

Response

Refer response to **Section 6.3.11**. Tahmoor Coal is required to provide a security deposit imposed as a condition in its mining leases which ensures that rehabilitation of the mine site will be completed in accordance with the conditions of the relevant mining leases.

6.3.13 Mine Closure and Rehabilitation: Rehabilitation criteria

Issue description

Rehabilitation should target return of the land to pre-mining conditions and use, not just to "safe, non-polluting and sustainable".

Response

Refer response to **Section 6.3.11**.

6.3.14 Responsibility after operations cease

Issue description

There should be a watertight mechanism for this mining company to remain responsible for damage cause or discovered after mining operations cease.

Response

Refer response to **Section 6.3.11**.

6.3.15 Economic: Economic value

Issue description

A monetary value should be assigned not just to economic but also to environmental and social impacts and included in Tahmoor Coal's business plan analysis.

Response

The SEARs for the project require that a social and economic assessment be undertaken providing an assessment of the likely economic impacts of the development, paying particular attention to:

- the significance of the resource;
- the costs and benefits of the development, identifying if it would result in a net benefit to NSW, including consideration of fluctuation in commodity markets and exchange rates; and
- the demand for the provision of local infrastructure and services.

The economic assessment for the Project was prepared in accordance with the framework established in the NSW Government (2015) *Guidelines for the economic assessment of mining and coal seam gas proposals* (the Guidelines). Consistent with the Guidelines, a project's indirect costs are classified as the net public infrastructure costs, the estimated loss of surplus to other industries and the net environmental, social and transport-related costs. The Project's indirect costs include some costs that have been internalised by Tahmoor Coal including the biodiversity and subsidence impacts and costs that have been assessed qualitatively, such as visual amenity. In total indirect costs are estimated to be $45.4 million in Net Present Value (NPV) terms over the life of the Project, which includes $0.11 million of incremental costs relating to greenhouse gas emissions, that are not internalised by the proponent. Indirect environmental costs of the project, as outlined in Section 2.4 of the revised Economic Impact Assessment in Appendix L of the Project Amendment Report is provided in **Table 6-3** below.

Table 6-3 Indirect environmental costs of the Project ($ Million[1])

Indirect cost	NPV[2]
1. Air quality	-
2. Greenhouse gas emissions	0.11
3. Visual amenity	-
4. Transport impact	-
5. Net public infrastructure cost	-
6. Surface water impact	-
8. Residual value of land	-
7. Biodiversity impact[3]	20.3
8. Noise impact	11.5
9. Loss of surplus to other industries	-
10. Water	-
11. Aboriginal cultural and Historical heritage	-
12 Subsidence[3]	13.6
Indirect Costs	**45.4**

[1] Real 2019 Australian dollars
[2] NPV in 2019 Australian dollars based on a 7 per cent real discount rate
[3] Incorporated into operating costs

In accordance with the Guidelines, a Local Effects Analysis (LEA) was undertaken using a similar framework to the CBA but which assesses the net economic impacts of the Amended Project on the local community. The Guidelines refer to the local area as being consistent with the relevant Statistical Area (SA3) as defined by the Australia Bureau of Statistics. In the case of this project the Wollondilly SA3 area is used for the LEA. The LEA found that the Project would generate indirect benefits to local suppliers of $34.5 million through increased demand for the provision of local infrastructure and services, and $122.3 million in NPV terms to local employees over the baseline case.

6.3.16 Terrestrial ecology: Biodiversity

Issue description

Undermined Inc. does not want the 43.4 hectares endangered Shale Sandstone Transition Forest to be removed and destroyed by the Tahmoor South Project proposal to expand the mine waste dump. Even with biodiversity offsetting, there will be a net loss of biodiversity.

Response

The project has been amended to reduce the footprint of the REA extension from 43 ha to 11.06 ha. For the remaining impacted Shale Sandstone Transition Forest, a revised Biodiversity Offset Strategy (BOS) has been developed as part of the Amended Project. The BOS has been developed to ensure that there is no net loss of biodiversity as a result of the project.

6.4 National Trust

6.4.1 Impacts to natural features within the Wirrimbirra Sanctuary

Issue description

The Subsidence report clearly identifies that there will be subsidence impacts to the land within Wirrimbirra Sanctuary. Amongst other impacts, it predicts that a ground cracking and movement may drain the existing natural watercourse through the property. As an intermittent watercourse, it is suggested that any loss of flow (or mineralised ground water contamination, the other 'likely' adverse impact) will not have a substantive impact, as the surrounding flora and fauna is adapted to intermittent water supplies. The Trust suggests that this is naive and wrong-headed, as clearly, the local ecology is more highly dependent upon the intermittent flows and any loss of flow is likely to have an increased impact, not a lesser one.

Response

The potential impacts to the tributary of Tea Tree Hollow and the pools within this tributary are addressed in Section 6 of the Surface Water Impact Assessment (Appendix D to the Project Amendment Report). The Wirrimbirra Sanctuary is a heritage-listed fauna sanctuary, native plant nursery, education centre and flora sanctuary located within the Subsidence Study Area of the Project. A tributary of Tea Tree Hollow and a small portion of Tea Tree Hollow flow through the property. Three pools have been identified on the Tea Tree Hollow tributary – TTH-PO2, TTH-PO3, TTHPO4. Subsidence predictions for the pools on the Tea Tree Hollow Tributary have been provided by MSEC (Appendix B of the Project Amendment Report) and assessed in Section 6 of the Surface Water Impact Assessment. The predicted total closure after all longwalls is 200 mm at TTH-PO2. As such, while there is a chance that the pool may be impacted if subsidence occurs, it is unlikely as less than 10% of pools are expected to be impacted at this level of predicted total closure. The predicted total closure after all longwalls are completed is 300 mm at TTH-PO3 and 325 mm at TTH-PO4. As such, there is a greater chance that pools TTH-PO3 or TTH-PO4 may be impacted, although the likelihood remains low (30% of rock bars or upstream pools are expected to be impacted at this level of predicted total closure).

The revised Groundwater Assessment (Appendix C to the Project Amendment Report) predicted a maximum baseflow reduction rate of 0.016 ML/d for Tea Tree Hollow and the tributary of Tea Tree Hollow at the northern boundary of Wirrimbirra Sanctuary. The streamflow assessment incorporating the maximum baseflow reduction rate indicates that there should be no apparent effect for flows greater than about 0.5 ML/day. The largest effect is seen on flows below approximately 0.01 ML/d. The probability that flow would be greater than 0.01 ML/day would reduce from 80% to 74% of days. This level of change may be detectable during normal periods of low flow and distinguishable from natural variability in catchment conditions. Water level monitoring is proposed to be conducted upstream and downstream of Wirrimbirra Sanctuary and at TTH-PO2 and TTH-PO4. The proposed pool level monitoring will complement stream flow monitoring undertaken on Tea Tree Hollow downstream of the Wirrimbirra Sanctuary. The monitoring network would enable assessment of any changes in pool water level and stream flow in Tea Tree Hollow as a result of the Project. Should impacts be identified, a TARP will be implemented comprising management and remediation measures as detailed in the Project Amendment Report.

6.4.2 Terrestrial ecology: Biodiversity Impacts

Issue description

The Biodiversity Assessment Report clearly identifies that there will be negative impacts upon:

- *An identified Critically Endangered Ecological Community, the Shale Sandstone Transition Forest; and*
- *Threatened Flora Species: the Persoonia bargoensis and Grevillea parviflora.*

Close reading of the report also identifies that there is a lack of information regarding fauna species inhabiting the area and that, in the light of this lack of information, no negative impacts can be identified. This is a very unsatisfactory outcome. For example, no koalas were seen during the fauna survey, consequently, no impacts could be suggested. The National Trust's long involvement with this property suggests that koalas, possums, gliders, wallaroos and wombats are all present in the area and that the further shrinking of available habitat can only be considered to be a negative impact. The Biodiversity Assessment Report is focussed on the assessment of species listed as endangered or threatened – it makes no real attempt to assess the impact upon the general biodiversity of the region.

There is no attempt to assess impacts upon soil biology, upon insect and microfauna, upon eco-systems overall and no consideration of cumulative impacts.

Response

A revised Biodiversity Assessment has been prepared for the Amended Project and is located in Appendix E of the Project Amendment Report. Direct impacts to terrestrial ecology as a result of the Amended Project are also detailed in Appendix E of the Project Amendment Report. In summary, direct impacts to vegetation, flora and fauna habitat associated with the proposal comprise:

- 23.57 ha of the TEC Shale Sandstone Transition Forest (PCT1395 Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest (HN556)) including 17.26 hectares in good condition, and 6.31 ha in derived native grassland condition;
- The removal of eight *Persoonia bargoensis* plants;
- The removal of 491 *Grevillea parviflora subsp. parviflora* plants;
- The removal of one *Pomaderris brunena* plant;
- The removal of 17.26 ha of potential habitat for the Large-footed Myotis; and
- The removal of 17.26 ha of potential Koala habitat.

Specifically, potential impacts to koala habitat and credit calculations to offset impacts have been identified in Section 11.6 of the EIS and Section 8.5 of Appendix E of the Project Amendment Report. The Amended Project would reduce the removal of Koala habitat by 25.9 ha, from 43.5 ha to 17.26 ha.

The mitigation measures identified in Section 11.6.5 of the EIS remain and include the development of a Biodiversity Management Plan which would include an ongoing program to monitor potential flora and fauna impacts. This would include monitoring of impacts to Koalas should they be detected within the Project area. Monitoring measures would include regular inspection, measures for response if impacts are detected, and monitoring of the success of mitigation. The Biodiversity Management Plan described in the EIS remains consistent to the Amended Project.

6.4.3 Terrestrial ecology: Offset strategy

Issue description

The proposed strategy to mitigate the admitted adverse impacts is to establish Biodiversity Stewardship Agreements over five other areas of land in the vicinity (none of which are contiguous) owned by Tahmoor Coal – i.e. the mining company will commit not to destroy other areas of land that it owns. This would be supplemented by purchase of Biodiversity Credits from the Public Register and a one-off payment into the NSW Biodiversity Offsets Fund.

Without commencing a detailed critique of the concept of bio-banking (a separate issue of concern), the Trust notes that several of these parcels of land are associated with airshafts for underground mining or are left-over areas sandwiched between existing mine operation areas and are themselves likely to be affected by subsidence, whilst another is mostly cleared farmland (which will be 'encouraged' to regenerate). It is the Trust's contention that this is grossly inadequate and that monetary contributions to Offset Funds amount to no more than a payment-to-destroy, which the Company can clearly afford from the expected profits from the mining activity.

Response

As part of the Amended Biodiversity Assessment Report Appendix E of the Project Amendment Report, a revised Biodiversity Offset Strategy (BOS) has been developed.

The BOS consists of a three-stage offset approach spanning over a 4-year period, as not all the surface infrastructure would be cleared in the first year. Stage One of the offset strategy will appropriately mitigate the impacts as a result of proposed ventilation shaft TSC 1; Stage Two would mitigate for ventilation shaft TSC 2, the power line and part of the REA; while, Stage Three will offset the remainder of the REA. Tahmoor Coal proposes to undertake a combination of the following offset mechanisms to offset the Project:

1. Establishment of biodiversity stewardship sites within Tahmoor Coal landholdings, located at:
    - Bargo Colliery land;
    - 185 Charlies Point Road;
    - 220 Charlies Point Road;
    - Pit Top; and
    - Rockford Road;
2. Purchase of the required credits available on the public register;
3. Payment into the NSW Biodiversity Offsets Fund (noting that this is not acceptable for the Commonwealth Shale Sandstone Transition Forest TEC); and
4. Establishment of additional landholdings (purchase or agree with landholders).

Whilst the offset sites would need to be established as Stewardship Sites using the BAM and updated survey requirements, the credit calculation at the proposed offset sites indicate that there would be residual credits for many of the threatened fauna being offset for the Project.

The proposed offset sites would satisfy the credit offset liability for Stage 1 of the staged offset.

A short-fall would occur for the overall Project liability in relation to the following:

- Shortfall of approximately 532 x PCT1395 credits using the FBA would occur for the entire Project offset liability; and
- Shortfall of approximately 82 x PCT1081 credits using the FBA would occur for the entire Project offset liability.

To approach this shortfall of credits, Tahmoor Coal proposes to purchase the required credits for PCT1395 Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest (HN556) on the BioBanking public Register, and pay into the BCT Fund for remaining PCT1081 Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin (HN564).

6.4.4 Non-Aboriginal heritage: Wirrimbirra Sanctuary

Issue description

The Trust can state that it was never approached by the consultants for access to Wirrimbirra Sanctuary. A staff member for the consultants did acquire basic information about the property from the Trust's archives in 2013 and we presume that the information presented in the report is based upon this single occasion. The impacts upon the bushland are admitted but dismissed as they will be "remediated". No arrangement for access, much less 'remediation' activity, within the National Trust's property has been negotiated – in fact, no-one has approached the Trust in this regard.

The Trust notes the third point that a detailed "management plan" will be prepared after approval has been given for the project. This is a completely unacceptable approach for a State-significant area, when potentially significant ecological impacts are proposed.

Response

Tahmoor Coal has sought access to the Wirrimbirra Sanctuary to conduct a detailed assessment of the potential impacts of the Project on the built and natural heritage features of the site. The National Trust has agreed to provide access for specialists to assess the impacts for Wirrimbirra Sanctuary in early 2020. Tahmoor Coal is committed to completing a site-specific Statement of Heritage Impact report, in consultation with land owners and the NSW Heritage Council, that would be prepared and submitted to DPIE. Prior to commencement of the Amended Project, Tahmoor Coal would prepare a site-specific Heritage Management Plan for Wirrimbirra Sanctuary.

The impacts of the Amended Project on Wirrimbirra Sanctuary have been assessed in the following revised technical assessments for the Amended Project:

- Subsidence Assessment (Appendix B to the Project Amendment Report). Refer Sections 5.14, Table D.08, Table D.12;
- Surface Water Impact Assessment (Appendix D to the Project Amendment Report). Refer Section 6.6;
- Aquatic Ecology Assessment (Appendix F to the Project Amendment Report, Table 20, impacts to Tea Tree Hollow); and
- Biodiversity Assessment Report (Appendix E to the Project Amendment Report, Section 8.7).

6.5 Greater Blue Mountains World Heritage Area Advisory Committee

6.5.1 Thirlmere Lakes: Impacts

Issue description

Members of the committee attended the recent Thirlmere Lakes Science Day at Picton and advise that considering the overall theme of the results of the research program to date, that is of incomplete characterization of the hydrology of the lakes, a precautionary approach must view the EIS hydrological modelling as questionable. The potential magnitude of any groundwater impact prediction on the GBMWHA will be determined by the accuracy/adequacy of the groundwater model itself and/or by the presence of any faults/lineaments which may increase subsidence and groundwater declines/interactions.

The projected average surface water level decreases cannot be considered insignificant in terms of potential impacts on these ecosystems of the GBMWHA and in the context of the lack of knowledge of the ecology/ ecohydrology of the Lakes.

Response

The accuracy of the groundwater model has been discussed in response to the IESC in **Section 5.1**. It was concluded by the Independent Peer Reviewer that the model was 'fit for purpose' and provided conservative estimates of predicted impacts due to mining (HydroGeoLogic, 2019).

Major faults have been conservatively modelled in the base case groundwater model as being more transmissive than surrounding host strata. Two additional uncertainty/sensitivity scenarios were run where the impact of select faults on predicted mine inflows were further assessed by further increasing the permeability of these features within the groundwater model. The Peer Reviewer stated that these assumptions of fault characteristics allowed for more conservative predictions to be reported (for more information pertaining to this topic please see response **Section 5.1**).

Several other uncertainty analyses which tested key parameter assumptions were conducted in addition to the two uncertainty analysis scenarios testing fault parameter assumptions (see Section 5.2.1 of the Groundwater Assessment prepared for the EIS for a full description of model scenarios). Such assessments allow a range of potential impacts to be outlined. The assessment from the Peer Reviewer concluded that such uncertainty analyses were effective given the nature of the site and available information and provides information suitable for use in "licensing decisions" (HydroGeoLogic, 2019).

As outlined in response in **Section 5.1**, the groundwater model has been prepared using an extensive database of baseline groundwater monitoring data, as well as site hydrogeological and geological data and information published from studies completed at nearby mines. The data considered also includes a range of findings specific to the Thirlmere Lakes (see response **Section 5.1**).

Note also the relative distance from the Project's longwall panels to the Thirlmere Lakes (approximately 3.5 km) compared to those of the historical panels at Tahmoor North that were 600 m away. As a result of this distance, the project alone will not impact on the Thirlmere Lakes. Historical effects of mining Tahmoor North have been shown to be minor, and these are indiscernible from climate related variations, with Lake levels historically fluctuating between dry and full conditions.

6.5.2 Thirlmere Lakes: COA - negligible impacts and monitoring

Issue description

The committee recommends that any condition of consent for the mine include the requirement to ensure a negligible impact on the GBMWHA together with adequate and appropriate monitoring to unambiguously identify that this is achieved. The committee further recommends that any approvals include conditions that address the potential for any subsidence impacts on the GBMWHA and an obligation on the proponent to monitor such likely impacts and amend the mine's planned operations so as to avoid such impacts.

Response

Impacts to Thirlmere Lakes are assessed in Section 11.5 of the EIS. The assessment included development of a numerical groundwater model to estimate potential drawdown impacts in shallow groundwater beneath the Thirlmere Lakes and the development of a water balance model of the Lakes as part of the surface water assessment to simulate impacts on Lake water levels from the estimated drawdown of groundwater. The assessment identified that the Project would result in negligible changes to Lake levels when compared to natural variability and as such negligible impacts are anticipated to the Greater Blue Mountains World Heritage Area (which the Lakes comprise a part of). Regional groundwater monitoring would be undertaken as part of the Groundwater Management and Monitoring Plan for the Project, including specific monitoring at Thirlmere Lakes to monitor Project impacts at the Lakes.

As stated above in the response in **Section 6.3.2**, the mitigation measures for the Project have also been revised to include the requirement for consultation with the Thirlmere Lakes Interagency Research Group during the development of groundwater management and monitoring programs for the Project (in relation to potential impacts to Thirlmere Lakes) and consideration of the results of the Thirlmere Lakes Research Program, as they become available.

6.6 National Parks Association of NSW

6.6.1 Surface Water: Subsidence impacts

Issue description

Catastrophic impacts to Myrtle and Redbank by past and current mining, such as - creek bed fracturing, loss of surface water, contaminated water - remain not remediated even after 14 years of mining.

This current proposal predicts the same impacts to Dog Trap Creek and Tea Hollow. These are not insignificant waterways – Dog trap Creek is a 3rd order stream of which 3.1 kms is to be undermined, with 14 pools considered to be at high risk. Tea Tree Hollow and tributaries are also 3rd order streams of which a total of 4.3 kms is proposed to be undermined. (EIS 11-96)

Response

Please refer to **Section 5.1.31**.

6.6.2 Surface Water: Watercourse remediation

Issue description

These impacts are totally unacceptable to NPA and, we believe, to the wider community. Any remediation which may eventuate, years down the track, may or may not work. Attempts at such remediation, on Waratah Rivulet for instance, have been seen to be intrusive, ugly and questionable in their effectiveness or long-term durability.

Response

Please refer to **Section 5.1.31**.

6.6.3 Surface and Groundwater: Dewatering of landscape

Issue description

The EIS predicts significant mine inflow rates, baseflow reductions in streams and drawdowns of greater than 2 m to bores from the proposed mining. These impacts will persist beyond the lifespan of anyone alive today – The model suggests that in the proposed mining footprint most of the recovery would be complete about 150 years after the cessation of the Project. (EIS11-80)

As we are seeing elsewhere, longwall mining results in a general dewatering of the landscape including both surface and groundwater. This is a matter that is currently being investigated by the Independent Panel for Mining in the Catchments (IEPMC). Its first report suggests that great caution should be taken re mining approvals in our drinking water catchments while there is still so much uncertainty about the totality of mining impacts, on water quantity in particular.

It is NPA's view that this concern should extend to all landscapes. With the impacts of climate change beginning to bite, we cannot see how any proposals which will affect either surface or groundwater, to any degree, can be acceptable.

Response

Significant data has been considered in the construction and calibration of the groundwater model to observed environmental conditions. The assumptions pertaining to mining-related impacts simulated in the groundwater model have been employed conservatively and a range of predicted impacts have been reported using predictions from uncertainty analysis scenarios. In addition, the groundwater model is consistent with recommendations from the IEPMC of the preferred method of estimating height of connected fracturing (HoCF) above longwall panels.

The Groundwater Assessment and Surface Water Impact Assessment (Appendices C and D to the Project Amendment Report) have made predictions and assessed impacts against the Aquifer Interference Policy, the *Water Management Act 2000* and other requirements set out in the SEARs.

Groundwater and surface water licences would be required for the water take of the project.

6.6.4 Thirlmere Lakes: Accuracy of predictions given incomplete research

Issue description

The predictions in the EIS are that the mining of Tahmoor South will have "imperceptible impacts" on Thirlmere Lakes. This is however, based on current knowledge of groundwater-surface water interactions and general hydrology of the lakes.

Meanwhile the scientific studies of the Thirlmere Lakes Research Project are still underway and will not be complete until 2020. Therefore, it seems premature to state that impacts will be imperceptible before these studies and also those being undertaken by the IEPMC have produced their findings.

Too many presumptions/decisions have been made in the past based on incomplete understanding of factors involved. We would not like to see this continue.

Response

Thirlmere Lakes are 600 m from the nearest longwall panels extracted in the 1990s and are approximately 3.5 km from the proposed Amended Project. As a result of this distance, the Project alone will not impact on the Thirlmere Lakes. Historical effects of mining Tahmoor North have been shown to be minor, however these are indescribable from volume of water in the Lakes which varies significantly with climate, with Lake levels historically fluctuating between dry and full conditions.

The mitigation measures for the proposal have been revised to include the requirement for consultation with the Thirlmere Lakes Interagency Research Group during the development of groundwater management and monitoring programs for the Project (in relation to potential impacts to Thirlmere Lakes) and consideration of the results of the Thirlmere Lakes Research Program, as they become available.

6.6.5 Terrestrial Ecology: REA Extension

Issue description

The removal of 43.4ha of Shale-Sandstone Transition Forest (SSTF) and a further 6.2 ha of other bushland vegetation is proposed for the expansion of the REA. SSTF is listed as Critically Endangered, both at State and Federal levels. This does not prevent its destruction, though - it is simply offset. This is not a solution, however, as there is always a net loss with offsetting.

Response

Changes to the longwall extent have allowed the estimated volume of rejects to be generated by the Project to be downgraded from approximately 14.3 Mt to 11.6 Mt. In addition, it is proposed that the height of the REA extension area be increased from RL 305 m to RL 310 m to optimise the REA footprint. Combined, these changes would result in the required extension of the REA significantly reducing from 43 ha to 11.06 ha. This leads to a significant reduction in required vegetation clearing and associated terrestrial ecological impacts.

6.6.6 Project Need and Alternatives: REA

Issue description

The destruction of high value vegetation for the purpose of what is just a coal waste dump, is totally unacceptable to NPA. We see this on-lease dumping of coal waste as a blatant subsidising of the fossil fuel industry by the government (i.e. the taxpayers). Household waste tips run by local councils attract huge fees payable to the EPA yet coal mines can dump their waste product on their lease site for nothing. It's not surprising, then, to read in the EIS - Based on the economic decision criteria used to evaluate the cost-benefit analysis, the expansion of the existing REA was determined to be the preferred option. (EIS 6-7).

We are pleased to note that approval will be sought to allow commercial use to be sourced for this product. If successful, this venture will reduce the amount needing to be dumped, as happened at Westcliff with the Dendrobium rejects. This will not solve the problem entirely, though. This approval, if successful, should require emplacement (backfilling) underground, as with the Metropolitan Mine approval in 2009, which requires that all rejects be emplaced back down the mine by 2021. Currently they are only achieving 20% backfill emplacement but could achieve 100% if noise issues re the operation of milling equipment were overcome.

Where this method is discussed in the EIS, we note it is stated – In the case of Tahmoor, expansion of the REA is still the preferred option for rejects disposal, from both a cost and feasibility perspective. This is because the technology required for underground disposal is not yet sufficiently advanced in Australia. (6-8)

This technology can work. It is used overseas and the trials at Metropolitan should be allowed to proceed. They were given 12 years to make it work and the noise issue should be able to be overcome.

This method of rejects disposal should be mandated by government with any new approvals like Tahmoor South. Without such action it will be too easy for mining companies to just continue pursuing the cheap option of dumping (emplacement) on the surface. As we have seen with Dendrobium, however, when this starts to cost, as occurred in 2011 when off-lease dumping was no longer free, then some alternatives had to be, and were found. Companies need to be forced to find better alternatives than surface emplacement or even current commercial use sources which may not always be available.

Government needs to regulate via consent conditions, the rejects disposal method of backfill emplacement. This precedent was set with Metropolitan and should not be seen as a one-off.

Response

As noted above, changes to the longwall extent have allowed the estimated volume of rejects to be generated by the Project to be reduced from approximately 14.3 Mt to 11.6 Mt. In addition, it is proposed that the height of the REA extension area be increased to RL 310 m to optimise the REA footprint. Combined, these changes would result in the required extension of the REA reducing from 43 ha to 11.06 ha. This leads to a significant reduction in required vegetation clearing and associated terrestrial ecological impacts.

Tahmoor Coal also commissioned Palaris to undertake a review of reject management options (Appendix A to the Project Amendment Report). The review included a review and update of the 2014 SKM Reject Strategy Report. This review included a number of areas identified as different or new assumptions could have been utilised including the base year of economic assessment, size of the REA, cost of externalities, plant assumptions, new knowledge around rheology modifiers and new knowledge around the behaviour of reject in longwall goafs. The review found surface emplacement to be the most technically feasible and appropriate option in line with the conclusion of the work undertaken in 2013 and 2014.

The findings of the 2014 report were upheld because:

- There is unlikely to be enough void space to emplace the material in old workings;
- Re-entry to sealed parts of the existing mine would be costly, technically challenging and present a range of operational and safety risks;
- It is not feasible to emplace all reject material underground;
- The environmental benefits of a partial underground solution do not outweigh the additional costs it would incur; and
- The emplacement of rejects underground may also render resources within the Wongawilli Seam partially or completely sterile.

The challenges posed by emplacement of coal rejects into active longwall goaf areas are further supported by the fact that the Hume Coal project independently came to the same conclusions, resulting in the adoption of a non-caving system of mining specifically to facilitate underground reject emplacement. The Hume Coal project does not have any potential for future mining in underlying coal resources, unlike this Project. The Amended Project does not have the option of utilising a non-caving minimising method due to mining parameters such as depth of cover and seam gas content as well as the sizeable capital investment already made in the existing longwall equipment.

6.6.7 Surface Water: Wastewater Treatment Plant

Issue description

The issue of the quality of the mine wastewater discharge to the Bargo (an average of 4 ML per day) has long been a concern for NPA, particularly as we have a long-standing proposal for a National Park to encompass the river. The issue of the Wastewater Treatment Plant has also been a long-running one.

We had high hopes for a resolution of this problem with the construction of the WWTP in 2015, however constant issues with its performance have persisted. The EIS states

The WWTP was constructed at Tahmoor Underground Mine in June 2015 as part of PRP22 to improve the quality of water discharged from LDP1. Following modifications, detailed commissioning of the WWTP occurred during September to November 2018. PRP22 on EPL 1389 for the WWTP has been extended until November 2018. (3-22)

At the final meeting of the CCC last year in December we were told that yet another 3-6 months would be required before consistent water quality results could be expected from the plant. This is extremely disappointing and quite unacceptable to NPA, especially given the years it took to get the WWTP built in the first place.

Response

Section 9.1 of the revised Surface Water Impact Assessment (Appendix D to the Project Amendment Report) discusses Tahmoor Coal's commitment to commission an upgraded WWTP to reduce the concentrations of constituents discharged via LDP1. The specified wastewater treatment plant has a water quality target to meet the 95th percentile ANZECC (ANZG 2018) Guideline values as stated in EPL1389. Specific targets are:

- pH 6.5-9;
- Electrical Conductivity <500 uS/cm;
- Suspended Solids <30 mg/L;
- Turbidity <150 NTU;
- Oil and grease <10 mg/L;
- Iron <0.7 mg/L;
- Manganese <1.9 mg/L;
- Nickel <0.011 mg/L;
- Zinc <0.008 mg/L;
- Arsenic (V) <13 ug/L; and
- Arsenic (III) <24 ug/L.

6.6.8 EIS Formatting: EIS Numbering

Issue description

The volumes of the EIS have been produced without the usual page numbering. Instead, sections are numbered, then pages within each section. This makes navigating the document needlessly difficult. All such EIS docs should require to be published in a standard format with page numbering in sequence from beginning to end.

Response

The comment regarding numbering is noted. However, the accepted practice is to number the pages with the chapter followed by the number of the page in that chapter as this improves navigation of these large and complex documents.

6.7 RStar Mining

6.7.1 Economic/Social: Project benefits

Issue description

RStar Mining is a family owned mining company that employs over 100 local people at Tahmoor Colliery. Tahmoor Colliery's future is key to RStar Mining's future as we only operate at Tahmoor Colliery.

If the extension of Tahmoor Colliery is not approved we will have to make all employees and staff redundant.

Tahmoor Colliery has long been a very important part of the local community in both job creation and supporting of local charities and events.

The due diligence and care taken at Tahmoor Colliery in the extraction of coal is second to none.

Recently the mine experienced a winder failure that stopped production of coal for over 35 days. Rather then sending personnel home, Tahmoor Colliery sent the personnel into the community to provide skilled labour free of charge. This labour was greatly appreciated by (including but not limited to) Charities, Wollondilly Shire Council, local farmers, local sporting communities and the such.

I can personally attest that the mine has kept both my Father and myself employed since the mine opened in 1978. I believe that if the mine extension is not approved and Tahmoor Colliery eventually shuts, it will have devastating effects on the local community.

Response

The support for the Project is noted. As stated in the Project Amendment Report, the Amended Project would prolong the life of the Tahmoor Mine to provide for the ongoing employment of approximately 400 people in permanent and contract roles and enable existing coal markets to be serviced. The Amended Project would provide ongoing significant local, regional and State economic benefits in the form of additional wages, royalties and flow-on positive economic effects, and would maximise recovery of the existing coal resource within coal lease areas.

6.8 Doctors for the Environment Australia

Issue description

Doctors for the Environment Australia raised concerns regarding the impacts of the Project on climate change, specifically relating to:

- *Increased heatwaves;*
- *Extreme weather events;*
- *Infectious diseases;*
- *Disproportionate impacts on vulnerable groups including children;*
- *The recent NSW Land and Environment Court ruling in Gloucester Resources Limited v Minister for Planning;*
- *The assessment and consideration of scope 3 emissions as part of the NSW Environmental Planning and Approvals process; and*
- *Economic costs of climate change.*

The submission also raised concerns regarding the impacts of increased air pollution.

Response

Tahmoor Coal acknowledges the urgent global need to curb greenhouse gas emissions to prevent further climate impacts. However, there is a high demand for coking coal to produce steel for elements required in healthcare, telecommunications, transport, clean water and agriculture. Coking coal is also important for production of steel materials required for use in renewable energy supply, such as in wind turbines, reinforcing concrete dams for hydroelectricity, and in equipment used for natural gas extraction.

Australia has been recognised as the world's largest exporter of coking coal with global demand for steel likely to increase, as India and other emerging Asian countries develop. Tahmoor Coal has been recognised as a key supplier in Australia's export of coking coal. As noted in the Rocky Hill Determination Report, Tahmoor Coal is a recognised amongst the existing coal mines currently meeting future demand of coking coal, reinforcing the benefits of accessing the coal resource using existing pit top infrastructure, rather than commencing a new mine elsewhere.

Australian coal mines operate to some of the highest environmental standards in the world. Aside from the strong commercial incentive to limit energy use in the operation of the Project, regulations ensure a strict recognition and accounting of emissions. Moreover, Australian coking coal is amongst the highest quality in the world, making it relatively less emissions intensive. Higher energy content and lower impurity coal results in higher quality coke, which in turn requires less coke input and higher productivity per unit of steel produced.

In recognition of the need to reduce global emissions, Tahmoor coal, as a subsidiary to Liberty Steel Group, has recently announced the consolidation of GFG alliance Steel businesses with the ambition to build on existing GREENSTEEL strategy through creating a carbon neutral status by 2030. It will aim to tackle emissions at its sites by exploring technologies such as Direct Reduced Iron, carbon capture and storage and will continue to participate in the development of various forms of renewable energy through its sister company SIMEC Energy.

Project emissions

The Amended Project outlines that the contribution to projected climate change, and the associated impacts of this, would be in proportion with its contribution to global GHG emissions. Average annual Scope 1 emissions from the Project (0.75 Mt CO_2-e) would represent approximately 0.175% of Australia's commitment under the Paris Agreement (431 Mt CO_2-e by 2030) and 0.0023% of global GHG emissions (DoEE, 2019; IEA, 2019). In addition, the Project would generate approximately 1.3 million tonnes CO2-e of Scope 2 emissions and approximately 88.2 million tonnes CO2-e of Scope 3 emissions over its life. Management and mitigation measures would be incorporated into the Project to reduce Scope 1, 2 and 3 emissions where feasible and practical.

The Project will be a small contributor to the global carbon budget. Mitigation measures have been employed by Tahmoor Coal to minimise the generation of direct GHG emissions including fugitive methane abatement such as the use of flares and, if available, recycling through a WCMG Power Plant and Continuous Emissions Monitoring of fugitive emissions.

Current measures are in place for the existing Tahmoor Coal mine. These would be implemented with the extension into the Tahmoor South mining area and will include the development of an Energy Savings Action Plan to minimise energy use and greenhouse gas emissions from the operation of the Project. This would include assisting in general industry research, promoting low emission coal technologies, ongoing monitoring against GHG targets to input to the National Greenhouse and Energy Reporting scheme and to consider the use of alternative fuels where economically and practically feasible.

The majority of Tahmoor Coal's coking coal product is sold to countries that are signatories to the Paris agreement, such as Korea, Japan and China. While Tahmoor Coal cannot mitigate the downstream emissions produced from the mine itself, these countries will have their own laws, frameworks and policies in place to govern any mitigation measures.

Scope 3 Emissions

While the GHG protocol does not require indirect emissions or downstream emissions (Scope 3) to be reported, the Amended Project now includes an assessment of Scope 3 emissions.

Scope 3 emissions are indirect emissions downstream of the Project. That is, they are associated with the Project but occur as direct (Scope 1) emissions at other locations which are controlled by other entities. Scope 3 emissions recognise that the coal produced at Tahmoor will continue to generate GHG emissions as it moves from being the output from that operation to the input for the next entity in the value chain. When Scope 1 emissions are calculated by that next entity, they would be counted twice. Classifying the different emission scopes was deliberate, to avoid double counting.

6.9 Response to Community Submissions

Concerns raised by community submissions have been reviewed and categorised into key issues with consolidated responses provided below. Submission identification numbers are provided in **Appendix A** to allow submitters to locate where issues have been responded to in this document.

6.9.1 Subsidence

6.9.1.1 Subsidence impacts on properties

Issue Description

The following concerns regarding subsidence impacts to properties were raised in community submissions:

- *Subsidence related property damage in the Bargo area, which is currently not subject to longwall mining;*
- *Number of properties predicted to be affected by subsidence in the Bargo area;*
- *Reduction in property value;*
- *Prevent of future growth in the Bargo area; and*
- *Stress and worry for the community over the possibility of damage to their homes and potential reliance on the mine or Subsidence Advisory NSW to repair damage to their property.*

Submission Identification number

2.12, 2.80, 2.83

Response

It is noted that whilst the Bargo area has not been subject to previous subsidence impacts from the Tahmoor Mine, Bargo is within a declared mine subsidence district in recognition of existing longwall operations and potential future operations in the Southern Coalfields. The Bargo area was proclaimed a mine subsidence district in 1975 and lawful development in the Bargo area (as in other mine subsidence districts) is required to consider the potential for future longwall mining, similar to other site-specific planning requirements that may apply to bush-fire prone land or flood-liable land for example.

The Tahmoor Mine has operated in the Southern Coalfields and co-existed with surrounding land uses since 1979, managing its operations so as to not preclude development or growth in surrounding area. The current mine plan has been the subject of significant investigation and revision to minimise subsidence impacts including to the Bargo township, as described in previous sections and the Project Amendment Report. Notably, the revised longwall geometry (longwall width and height of extraction) now proposed as part of the Amended Project is consistent with the longwall mining undertaken at Tahmoor North. The revised Subsidence Assessment, summarised in Section 7.1 of the Project Amendment Report, indicates that the overall distribution of subsidence impacts to houses under the amended mine plan has reduced compared to the assessments previously provided for the EIS mine plan. The main reason for the reduction is that the mining footprint has been amended such that there would be 180 fewer houses that would be directly mined beneath, the majority of which are located above the previously proposed longwalls within the urban areas of Bargo township.

Tahmoor Coal has extensive success in managing subsidence related impacts from the Tahmoor Mine so that properties remain safe and serviceable, through the implementation and management of Extraction Plans and associated sub plans, submitted for the approval of DPIE- Division of Resources and Geoscience. Claims lodged with Subsidence Advisory NSW relating to compensation for mine related damage must adhere to strict timeframes for the assessment of claims in accordance with the *Coal Mine Subsidence Compensation Act 2017* and supporting approved procedures. To provide property owners with ongoing, transparent and timely support in relation to mining impacts to their property, Tahmoor Coal will commit dedicated personnel (e.g. Bargo Community Relations Coordinator) to engage and support each property owner prior to, during, and after the active subsidence period.

As outlined in Section 11.1.7 of the EIS, prior to mining operations commencing for a new longwall, potentially affected residents would receive a Resident Information Pack which includes:

- Longwall information;
- An explanation of subsidence and the potential effect of subsidence on houses and other structures;

- Anticipated levels of subsidence for longwall;
- A description of property inspections, surveys and monitoring including how to access free pre-mining property inspections;
- A description of rights and responsibilities relevant to subsidence; and
- Emergency contact details.

The Resident Information Packs include specific information on the role of Subsidence Advisory NSW (SA NSW) in administrating the *Coal Mine Subsidence Compensation Act 2017*; comprising contact details; the subsidence claims process where damage by subsidence is suspected and details for access to free counselling services in relation to subsidence impacts. SA NSW is also responsible for reducing the risk of mine subsidence damage to properties, through its assessment and control of the types of buildings and improvements which can be erected in Mine Subsidence Districts.

Tahmoor Coal's existing operations have mined beneath approximately 1890 residential homes and commercial premises. The majority of the homes and premises experienced little if any damage from mine subsidence impacts. A small percentage experienced more significant impacts addressed via the *Mine Subsidence Compensation Act 1961* and subsequently the *Coal Mine Subsidence Compensation Act 2017* and approved procedures. All claims lodged with SA NSW are managed by a SA NSW Case Advisor who provide property owners with focussed support and a dedicated point of contact through the process. As noted above, specific amendments have been made to the proposed mine plan to ensure the longwall geometry for the Amended Project is consistent with the longwall mining undertaken at Tahmoor North.

Tahmoor Coal would also continue to engage with the community through its existing Community Consultative Committee Meetings and other processes to address community concerns on subsidence and other matters. Consultation processes that are currently implemented in relation to subsidence management (and would continue to be applied for the Project) are detailed in Section 3.8 and 11.1 of the EIS.

6.9.1.2 Damage to linear infrastructure and utilities

Issue Description

Community submissions raised the following concerns regarding subsidence impacts to infrastructure:

- *Damage to the Southern Highlands Rail Line – safety risk to commuter and freight services;*
- *Damage to the Hume Motorway – safety risk to drivers;*
- *Damage to local roads within Bargo – safety risks and disruption to drivers during repair works;*
- *Delay in repairing subsidence damage to roads and ongoing subsidence impacts after repair; and*
- *Damage to high pressure gas lines – risk of explosion.*

Submission Identification number

2.80

Response

Potential subsidence impacts to built infrastructure and utilities are manageable and can be controlled through the preparation and implementation of Extraction Plans and associated sub-plans (similar to Subsidence Management Plans), which have already been successfully implemented during mining at Tahmoor Mine.

Since 2004, Tahmoor Mine has mined under the entire township of Tahmoor, and has successfully implemented subsidence management and mitigation measures for the impacts of subsidence to a range of commercial premises and on major built infrastructure such as:

- The Main Southern Railway rail line;
- Tahmoor Town Centre shopping centre;
- Wollondilly Shire Council roads and bridges;

- Gas, electricity, water, sewer and drainage infrastructure;
- A poultry processing plant;
- Aboriginal cultural heritage sites; and
- Post-European settlement heritage structures.

As discussed in Section 11.1.6 of the EIS, Tahmoor Mine and the Australian Rail Track Corporation (ARTC) previously developed a detailed risk management plan for managing potential mine subsidence impacts on the Main Southern Railway due to the extraction of Longwalls 25 to 32 at Tahmoor Mine and similar measures would be applied to the Amended Project, to identify and manage impacts in accordance with ARTC requirements.

The M31 Hume Highway would not be mined beneath and is located outside of the predicted limit of subsidence and as such is not expected to be impacted by subsidence. As described in Section 11.1.7 of the EIS, an Extraction Plan would be prepared through consultation with the infrastructure owners and would be approved by the relevant Government agencies.

As described in Section 11.1.6 of the EIS, potential impacts to Remembrance Driveway and local roads include cracking of the pavement, cracking of concrete culverts and drainage structures, and cracking of road cuttings and embankments. Previous experience of mining beneath roads and culverts indicates that the incidence of impacts is low and generally limited to cracking which can be readily remediated. Local road bridges could also experience cracking of the abutments and increased stresses on the decks and the compression heaving of pavements on approach to the bridges. Furthermore, an Extraction Plan would be prepared to assist with the management of Remembrance Driveway and local roads and Tahmoor Coal would work proactively with infrastructure owners and operators to ensure that damage to infrastructure is identified and repaired in a timely manner and to meet design requirements.

Similarly, potential subsidence impacts to high pressure gas infrastructure including the Sydney to Moomba Gas Pipeline and the Gorodok Ethane Pipeline would be managed through the development of Extraction Plans in consultation with the infrastructure owners and as approved by the relevant Government agencies.

6.9.1.3 Damage to water supply

Issue Description

Community submissions raised the following concerns regarding impacts to water/ sewer supply infrastructure:

- *Damage to the 450 mm trunk water main that runs through Bargo along Remembrance Driveway;*
- *Damage to the low-pressure sewer system that services Bargo and Buxton; and*
- *Risk of service disruptions to residents of Bargo and Buxton.*

Submission Identification number

2.80

Response

A revised Subsidence Assessment has been prepared in response to the submissions received during the exhibition period. The overall findings of the revised Subsidence Assessment are that the levels of impact and damage to all identified built infrastructure are manageable and can be controlled by the preparation and implementation of Subsidence Management Plans (or Extraction Plans). The revised Subsidence Assessment is located in Appendix B of the Project Amendment Report.

Watermain

Section 6.6 of the revised Subsidence Assessment (Appendix B of the Project Amendment Report) assessed the impacts of potable water infrastructure including the 450 mm watermain, which follows the alignment of Remembrance Drive. As described in Section 6.6.3 of the revised Subsidence Assessment, it is expected that some minor leakages of the water pipelines could occur at isolated locations, as the result of the extraction of the longwalls; however, the incidence of impacts is expected to be low. Potential impacts are more likely to occur in the locations of non-systematic movements, and at creek crossings, due to valley related movements.

Tahmoor Coal would continue to use the Extraction Plan process to successfully manage subsidence to built infrastructure as part of the Amended Project. The Extraction Plans and associated sub plans would be developed in consultation with the infrastructure owners such as Sydney Water, prior to implementation. If necessary, the Plans would outline the requirement for TARPs and the implementation of mitigating controls and prior to mining. Sections 3.7.1 of the Project Amendment Report and Section 11.1.7 of the EIS provide further details of the Tahmoor Coal subsidence management processes and monitoring requirements. These requirements are reflected in the revised Environmental Management Measures for the Amended Project (refer **Chapter 7.0**).

Sewerage system

Section 6.7 of the revised Subsidence Assessment assesses the impacts to sewerage systems including the low-pressure sewer system that services Bargo and Buxton. As described in Section 6.7.3 of the revised Subsidence Assessment in Appendix B of the Project Amendment Report, it is determined that the pressurised sewerage system at Bargo would be able to accommodate differential subsidence movements. The proposed welded polyethylene (PE) pipes can accommodate substantial deformations without losing their integrity. Only extreme deformations, such as the development of a step in the ground may adversely impact the pipes.

A number of valves and chambers are located above the proposed longwalls. It is expected that the chambers, valves and fittings would act as anchors to the ground during subsidence, allowing the PE pipe to stretch or compress in response to mining-induced differential horizontal movements. While there is potential for impacts to occur at these locations, many similar structures are located within the Tahmoor sewerage system and no impacts have occurred to chambers, valves and other pipe fittings during past mining activity. There is, however, a remote chance that anomalous ground deformation could occur during extraction of the proposed longwalls.

Experience from mining beneath septic tanks has been that while impacts have previously occurred during mining, the rate of impact is low.

Impacts are expected to be of a minor nature which could be easily remediated. Tahmoor Coal would continue to use the Extraction Plan process to successfully manage subsidence to built infrastructure as part of the Project. The Extraction Plans and associated sub plans would be developed through consultation with the infrastructure owners such as Sydney Water, prior to implementation. **Chapter 7.0** and Section 11.1.7 of the EIS provide further details of the Tahmoor Coal subsidence management processes and monitoring requirements. These requirements are reflected in the revised Environmental Management Measures for the Amended Project.

6.9.1.4 Bargo Waste Management Centre

Issue Description

Community submissions raised the following concerns regarding subsidence impacts to the Bargo Waste Management Centre with reference to the Wollondilly Shire Council's submission in relation to this issue:

- *Risk of damage to the Waste Management Centre resulting in pollution not being contained*
- *Subsidence exacerbating the effects of any fill settlement (landslip).*

Submission Identification number

2.80

Response

Impacts to the BWMC have been addressed in detail in **Section 5.15.19** in response to issues raised by Wollondilly Shire Council on this matter.

Mining directly beneath the BWMC may potentially result in impacts on:

- The slopes of the landfill;
- The surface water treatment. Although, the likelihood of impacts is considered low based on experience of mining beneath farm dams and other wastewater treatment ponds during the mining of Longwalls 22 to 31 at Tahmoor Mine; and
- A new weighbridge is currently being designed by Council. Although, the likelihood of impacts is considered to be low due to the small footprint of the weighbridge.

While there may be potential impacts, appropriate management measures would be put in place in consultation with Wollondilly Shire Council to ensure that the BWMC would remain safe and serviceable during mining within the Extent of Longwalls boundary, even if actual subsidence movements were greater than the predictions or substantial non-conventional movements occurred. An Extraction Plan and a series of specific Extraction Plan sub-plans would be prepared and implemented in consultation with Council.

6.9.2 Groundwater

Issue Description

Community submissions raised concerns regarding water losses through subsidence and groundwater inflows to the mine, specifically with respect to groundwater impacts on the Bargo River.

Submission Identification number

2.62

Response

As discussed in Section 11.3.4 of the EIS, over the life of the Project, mine inflows would total around 21 GL. In annual terms, the groundwater take averages around 1,700 ML per year over the period of longwall mining which would remain the same for the Amended Project. Mine inflows would result in a consequent decline in groundwater levels or 'drawdown'. However, this does not imply surface to seam connectivity (i.e. where surface water features could be directly connected to the mine void), and nor does the 1700 ML of mine inflow come from surface water. Most of that comes from groundwater stored within the hundreds of metres of rock above and adjacent to the longwalls.

There is the potential for baseflow losses from waterways affected by subsidence, as a result of subsidence related fracturing of streambeds. The Bargo River would not be directly mined beneath by the Project and would be located 690 m from the nearest longwall (LW102A) of the Amended Project. A 165 m long length of the Bargo River that is immediately upstream from the Picton Weir is located inside the subsidence study area (SSA) of the Amended Project. This length of the river that is within the SSA is a 4th order perennial stream.

A summary of the maximum predicted values of total subsidence, upsidence and closure for the Bargo River within the Subsidence Study Area, resulting from the extraction of the amended longwall panels, is provided in **Table 6-4**.

Table 6-4 Maximum Predicted Total Subsidence, Subsidence and Closure for the lengths of the Bargo River within the Subsidence Study Area due to extraction of the amended longwall panels

Location	Longwalls	Maximum Predicted Subsidence (mm)	Maximum Predicted Upsidence (mm)	Maximum Predicted Closure (mm)
Bargo River (upstream from Picton Weir)	After LW108	< 20	< 20	< 20

At this distance from the amended longwall panels and with these low predicted ground movements, the river is not expected to experience noticeable subsidence movements. This is demonstrated in the baseflow loss predictions for Bargo River in Section 11.4 of the EIS - the probability of flow being greater than 0.1 ML/day reducing from 99% to 97% of days - which is considered imperceptible compared to natural variability and therefore negligible. As such subsidence related flow losses are considered to be a low risk for the Bargo River.

Impacts to the Bargo River are further discussed in **Section 6.9.3**.

6.9.3 Surface water

6.9.3.1 Impacts to Bargo River, Mermaid Pools, Nepean River

Issue Description

Community submissions raised the following concerns regarding impacts to the Bargo River:

- *Water losses through subsidence and ground water inflows to the mine;*
- *Water quality impacts due to subsidence related contaminants;*
- *Water flow in the river during drought;*
- *Impacts to platypus habitat;*
- *Contamination downstream to Bargo River/ Mermaid Pools/ Nepean river; and*
- *Water quality is a health risk to people who swim at Mermaid Pools.*

Submission Identification number

2.72, 2.80, 2.83

Response

Flow impacts

The Project would not directly mine beneath the Bargo River. The nearest longwall (LW102A) of the Amended Project would be located 690 m from the River. A 165 m long length of the Bargo River that is immediately upstream from the Picton Weir is located inside the subsidence study area (SSA) of the Amended Project. This length of the river that is within the SSA is a 4th order perennial stream.

A summary of the maximum predicted values of total subsidence, upsidence and closure for the Bargo River within the Subsidence Study Area, resulting from the extraction of the amended longwall panels, is provided in **Table 6-4** above.

At this distance from the amended longwall panels and with these low predicted ground movements, the river is not expected to experience any noticeable subsidence movements and associated flow losses. Mermaid Pools and the Nepean River are located outside the Subsidence Study Area for Amended Project and are not anticipated to be impacted by subsidence related ground movements.

Impacts to river flow in the Bargo River have been reassessed in the revised Surface Water Impact Assessment (Chapter 6 of Appendix D to the Project Amendment Report). The revised assessment noted that reduced flows into sections of the Tea Tree Hollow and Bargo River catchments were likely due to the reduction in catchment area from the extension of the REA. However, the assessment also found that increased flow is likely to be experienced for Tea Tree Hollow and Bargo River immediately downstream of the REA, as a result of increases in controlled discharge of mine inflow via LDP1 (within the current discharge limits of the licence). This would offset the reductions to the catchment area associated with the REA extension from the Amended Project as, on average, there may be a slight increase in flow to Tea Tree Hollow due to slight increases in mine inflow from groundwater and the expanded REA catchment, that are proposed to be discharged within the current limits of LDP1. The predicted slight increase (0.01 ML per day) represents an inconsequential volume for the Bargo River that would likely be indistinguishable from natural variability in catchment conditions.

Water Quality

With respect to water quality changes that can occur from upsidence induced fracturing in waterways (i.e. releases of aluminium, iron, manganese, sulphate and zinc), the Surface Water Impact Assessment in the EIS (Appendix J) identified that such instances would be localised and transient spikes. This is based on past experience in the Southern Coalfields and at the existing Tahmoor operation. Given the low subsidence related risk at Bargo River and the transient nature of contaminant releases, fracturing related water quality changes are considered be localised and unlikely to be an important controlling factor on the water quality of Bargo River or Mermaid Pools downstream.

In comparison, mine water discharge from LDP1 into Tea Tree Hollow (which flows into Bargo River and downstream into Mermaid Pools) is an important controlling factor on water quality, particularly closer to the point of discharge. An upgraded WWTP is proposed to remove contaminants and manage the discharge to meet Tahmoor Coal's EPL 1389 requirements under PRP Stage 3 (Refer **Chapter 7.0** – Revised Management Measures). It is considered that with the implementation of these measures, water quality from discharges at LDP1 can be managed consistent with existing licence requirements to prevent adverse water quality outcomes downstream.

6.9.3.2 Impacts to Dog Trap Creek and Tea Tree Hollow

Issue Description

Community submissions raised the following concerns regarding surface water impacts:

- *Fracturing of bed rock and draining of pools at Dog Trap Creek and Tea-Tree Hollow;*
- *Impacts to ecosystems from baseflow losses particularly during times of low flow;*
- *Water quality impacts due to subsidence related contaminants;*
- *Impacts would be the same as Myrtle Creek and Redbank Creek and remain unremedied.*

Submission Identification number

2.72, 2.80, 2.83

Response

Baseflow reductions at Tea Tree Hollow and Dog Trap Creek have been reassessed for the Amended Project (Section 6 of the revised Surface Water Impact Assessment, Appendix D to the Project Amendment Report). They have been assessed to be relatively small in terms of mean daily flow (0.4-1.3%) but representing a significant percentage of the average estimated baseflow at Dog Trap Creek (51.9%) and a small percentage at Tea Tree Hollow (0.7%). The reduction in flow in Tea Tree Hollow (downstream) would be offset by on-going licensed discharge from LDP1. The EIS predicted perceptible impacts to flow at Dog Trap Creek and upstream of LDP1 in Tea Tree Hollow with reductions in baseflow most noticeable during periods of low flow (drought) when stream flow would normally be dominated by baseflow.

With respect to water quality changes that can occur from upsidence induced fracturing in waterways (i.e. releases of aluminium, iron, manganese, sulphate and zinc), the SWIA in the EIS (Appendix J) identified that based on past experience in the Southern Coalfields and at the existing Tahmoor operation, such instances would be localised and transient spikes. Similar impacts are expected for the Amended Project.

Since the EIS was exhibited, amendments have been made to the mine plan to reduce subsidence impacts to affected waterways further. The revised Subsidence Assessment summarised in Section 7.1 of the Project Amendment Report indicates the predicted maximum total conventional subsidence, upsidence and closure movements due to the extraction of the amended mine plan are less than the predicted maxima from the EIS mine plan. The reasons are due to a combination of the amended mine plan and the proposed reduction in panel width and extraction height. This is expected to reduce the overall frequency and severity of subsidence related impacts at waterways.

Notwithstanding it is acknowledged that residual impacts to baseflow would remain for Dog Trap Creek and Tea Tree Hollow (upstream) which could impact aquatic biota through pool losses. These impacts are assessed in Section 11.7 of the EIS and Section 7.5 of the Project Amendment Report. The EIS included commitments to remediate streams affected by subsidence and habitat rehabilitation and offset measures in consultation with DPI Fisheries for residual impacts to areas mapped as Key Fish Habitat within Dog Trap Creek and Tea Tree Hollow (refer Section 11.7.5 of the EIS). As part of the Extraction Plan and associated management plans for the Amended Project, a TARP will be prepared, which will incorporate appropriate triggers, monitoring regimes and appropriate actions for key fish habitat in the Project Area.

Impacts to Myrtle Creek and Redbank Creek (with respect to flow losses, water quality and remediation) are addressed in detail in **Sections 5.1.31**. Tahmoor Coal is committed to the rehabilitation of subsidence related impacts at waterways, where observed. Proposed creek rehabilitation is detailed in **Section 5.1.31**.

6.9.3.3 Surface water management

Issue Description

Community submissions raised the following concerns regarding surface water management:

- *Water quality of discharge from LDP1 (heavy metals and salinity);*
- *Soil and water management during earth works.*

Submission Identification number

2.72, 2.80, 2.83

Response

As described in Section 11.7 of the EIS, mine water discharge has the potential to elevate concentration levels of dissolved salts and metals and can pose environmental risks to aquatic biota. A WWTP was constructed at Tahmoor Underground Mine in June 2015 to treat up to 6 ML/d of mine water to reduce the concentrations of Arsenic, Nickel and Zinc in the water discharged from the mine from the LDP1. During commissioning of the WWTP, it was found that the complex water chemistry of the underground mine waters was buffering chemical reactions in the treatment processes preventing the effective removal of metals. As such a range of upgrades to the WWTP was proposed and are currently being implemented. It is expected that with the commissioning of the upgraded WWTP, concentrations of heavy metals from mine water discharge would reduce and result in enhanced water quality in Tea Tree Hollow and the Bargo River downstream, thus improving habitat for primary producers and aquatic fauna.

Within nine months of the WWTP recommissioning, an aquatic health assessment would be undertaken at Tea Tree Hollow and the Bargo River to confirm aquatic health in accordance with the requirements of PRP 26. It is anticipated that the capacity of the WWTP will need to be upgraded at some stage after nine years of the project, with the Project start date in 2022, to meet the water inflows from the Amended Project. The WWTP would be upgraded as required to meet mine water treatment demand post 2031 to ensure that licensed discharge limits at LDP1 are met.

With respect to salinity, as described in Section 11.7 of the EIS, an investigation was undertaken by Cardno (2016) into electrical conductivity (EC)/ salinity levels at the licensed discharge point at Tea Tree Hollow. The PRP 23 investigation found localised effects to aquatic ecology at Tea Tree Hollow and Bargo River, downstream of the licensed discharge point, comprising a reduction in pollution sensitive invertebrates and an increase in pollution tolerant invertebrates. The study found the effects of the discharge to be localised within a few kilometres downstream of the discharge point and not excessive in the context of a system modified by other anthropogenic land uses. Whist EC levels at LDP1 were found to be elevated, the PRP investigation considered the levels to not be excessive and within the reported tolerances of many aquatic biota present in Tea Tree Hollow and the Bargo River. Additionally, EC levels at the Bargo River were found to be more influenced by background levels of EC and flow levels at the Bargo River compared to EC levels from discharge at LDP1. Based on the PRP investigation, changes to the existing licence limit for EC / salinity were not considered beneficial with respect to aquatic health. The Amended Project would be managed to meet existing EC requirements under the conditions of EPL 1389.

Regarding erosion controls, as discussed in Section 11.18.5 of the EIS mitigation measures are currently employed as part of the existing Tahmoor Mine in order to manage potential impacts to soil. The current overarching environmental management system at Tahmoor Mine includes a Soil and Water Management Plan which mitigates potential impacts on soils of the area. This will continue to be used to manage potential impacts to both Tea Tree Hollow and Bargo River.

6.9.3.4 Impacts to Drinking Water & Dams

Issue Description

Community submissions raised the following concerns regarding impacts to the drinking water supply:

- *Potential risks to the Sydney water supply;*
- *Contamination of local waters that lead to the Avon Dam and Nepean Dam; and*
- *Subsidence related damage to dams.*

Submission Identification number

2.80

Response

Flows in the upper reaches of the Nepean River are highly regulated by the Upper Nepean Water Supply Scheme, operated by WaterNSW, which incorporates four major water supply dams on the Cataract, Cordeaux, Avon and Nepean Rivers, part of the Metropolitan Special Area drinking water catchment. Notably, the Amended Project is downstream of these areas, mostly within the Bargo catchment and contributing to the Nepean Catchments downstream of the Metropolitan Special Area. Flows in the Nepean River near and downstream of the Project Area (downstream of the Pheasants Nest Weir) are not part of a WaterNSW Drinking Water Catchment Area. As such it is considered that discharge from LPD1 would not pose a risk to downstream drinking water supplies (including Avon and Nepean Dam). Water treatment measures to improve and control the water quality of discharges from LDP1 to minimise downstream impacts are identified in the previous sections.

The Metropolitan Special Area is located to the east of the Amended Project. Under the *State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011* all development in the Sydney drinking water catchment is required to demonstrate a NorBE on water quality. The Amended Project would involve mining adjacent to but not beneath the Metropolitan Special Area. Longwall panels have been specifically reduced in length for the Project during the EIS so that they do not extend into the Metropolitan Special Area. Cow Creek is located within the Metropolitan Special Area approximately one km from the nearest longwall. At this distance, the maximum predicted subsidence, upsidence and valley closure are less than 20 mm. As such, the potential for localised impacts on Cow Creek such as fracturing, and surface water flow diversion are extremely low. In the unlikely event that fracturing were to occur in Cow Creek, it is not expected to result in a detectable change to water quality.

Section 6.0 of the revised Subsidence Assessment (Appendix B to the Project Amendment Report) provides the descriptions, predictions and impact assessments for the Public Utilities (including Dams) within the Subsidence Study Area. The public utilities located outside the Subsidence Study Area, which may be subjected to far-field movements or valley related movements and may be sensitive to these movements, have also been included as part of the assessment. Due to the distances of both Avon and Nepean Dams from the Amended Project, subsidence related damage to both structures is unlikely. Impacts to both dam structures as a result of far-field movements are also unlikely due to their distances from the revised assessment area.

6.9.4 Thirlmere Lakes

Issue Description

Community submissions raised the concerns that previous mining in Longwall 17 and 18 of Tahmoor mine has already impacted on the United Nations Educational, Scientific and Cultural Organisation (UNESCO) world heritage listed Thirlmere Lakes National Park and that the Project would cause further impacts with the expansion of the mine.

Submission Identification number

2.13

Response

The Thirlmere Lakes are approximately 3.5 km from the Project at the nearest proposed longwalls. The Amended Project also involves mining further away from the lakes, compared to the currently approved operations in Tahmoor North.

Based on available information, including the investigations undertaken as part of the Thirlmere Lakes Inquiry, the Thirlmere Lakes appear to act as a naturally 'losing' system under both dry and wet conditions. Therefore, there is limited dependence on groundwater for the water levels and associated ecosystems of the Thirlmere Lakes.

The water balance model (see Section 11.5.3 of the EIS and Section 7.3 of the revised Surface Water Impact Assessment, Appendix D to the Project Amendment Report) determined that the most significant outflow component from the Thirlmere Lakes is evaporation/evapotranspiration, comprising approximately two-thirds of outflows. Groundwater recharge by contrast comprises approximately a quarter of outflows. The Project would only affect the groundwater recharge component, albeit to a minor extent.

It has been determined that the Project would have negligible groundwater and surface water impacts on the Thirlmere Lakes that would be comparable to levels of natural variability (i.e. changes to lake levels of 0.01 m and 0.06 m on average) and would be imperceptible in many circumstances. Potential impacts to terrestrial and aquatic ecology within the Thirlmere Lakes were also determined to be minor to negligible.

6.9.5 Terrestrial Ecology

Issue Description

Community submissions raised the following concerns regarding impacts to terrestrial ecology:

- *Impacts to Koala habitat; and*
- *Impacts to threatened flora and fauna species and other vegetation.*

Submission Identification number

2.80, 2.83

Response

The Biodiversity Assessment Report included as part of the EIS (Appendix K) included a detailed assessment of potential impacts to threatened flora and fauna species that have either been detected in the area or have the potential to occur; and impacts to native vegetation. Impacts considered the direct removal of vegetation and indirect impacts from subsidence.

Since EIS exhibition, Tahmoor Coal has amended the Project to reduce the REA extension area from 43 ha to 11.06 ha. In addition, amendments to the mine plan, including changes to the longwall geometry and number, is expected to reduce the overall extent of subsidence impacts across the SSA.

The revised Biodiversity Assessment Report for the Project, summarised in Section 7.4 of the Project Amendment Report, identifies that the Amended Project would reduce impacts to all threatened flora species and endangered ecological communities predicted to be impacted by the EIS.

With respect to threatened fauna, the Amended Project would result in the removal of 17.26 ha of koala habitat, a reduction of 25.90 ha when compared to the 43.50 ha of potential habitat proposed in the EIS. Additional impacts were identified for two threatened fauna species as a result of the location of surface facilities and infrastructure: Large-footed Myotis and the Eastern Pygmy Possum. Offsets for these and all other threatened flora and fauna species and EECs predicted to be impacted under the Amended Project have been calculated and is presented in Section 7.4 of the Project Amendment Report.

In addition, mitigation measures were identified in the EIS to further minimise impacts to biodiversity during construction and operation. The mitigation measures identified in Section 11.6.5 of the EIS include the development of a Biodiversity Management Plan which would include an ongoing program to monitor potential flora and fauna impacts. The Biodiversity Management Plan would contain:

- Native vegetation clearing protocol to:
  - Define where clearing of native vegetation is to be undertaken or where native vegetation is to be retained;
  - Specify methods of clearing of native vegetation, including approach for hollow-bearing trees; and detail methods for pre-clearance surveys to identify biodiversity to be protected (including any threatened species) and allow fauna to escape.
- Threatened species management measures including a map, list and description of all threatened species recorded in the vicinity of the surface infrastructure sites;
- Weed management and disease prevention protocols; and
- Other measures such as fire management and progressive rehabilitation of the REA to minimise fragmentation of vegetation.

An on-going monitoring program would be undertaken as part of the Biodiversity Management Plan for the Project. This program would include monitoring of potential flora and fauna impacts and would be implemented for as long as potential impacts could occur. Monitoring measures would include regular inspection, measures for response if impacts are detected, and monitoring of the success of mitigation.

In addition to the Biodiversity Management Plan, Tahmoor Coal will continue to implement a detailed ground disturbance permit procedure. Ground disturbance permits form part of Tahmoor Coal's Environmental Management System (EMS) which is used to manage and reduce environmental impacts of activities covered by Tahmoor Mine's development consents, including impacts to flora and fauna. In accordance with the EMS a ground disturbance permit is required for any surface disturbance work undertaken at Tahmoor Mine including slashing, tree lopping, removal of topsoil, clearing and access to rehabilitation areas. A ground disturbance permit requires approval from Tahmoor Coal's environment and community manager prior to works taking place.

6.9.6 Aboriginal Cultural Heritage

Issue Description

Community submissions raised the following concerns regarding impacts to Aboriginal Heritage:

- *Impacts to significant rock shelter artworks along Dog Trap Creek from subsidence, hydrology changes, vibration and dust.*

Submission Identification number

2.80, 2.83

Response

Dog Trap Creek features a high concentration and diversity of site types, in particular rock shelters with art. Most of the sites recorded are associated with moderately steep slopes along the creek line. Dog Trap Creek is an archaeologically and culturally significant complex due to the distinctive and representative assemblage of anthropomorphic motifs, and art assemblages that are locally notable for the number of stencils and motifs present.

As discussed in section 11.8.4 of the EIS, the mine plan has been designed to avoid direct impacts to the archaeological heritage sites along Dog Trap Creek and avoid direct impacts to archaeological heritage sites in the south east section of the Project Area south of the Hume Highway.

A Heritage Management Plan would be prepared for the Project in consultation with RAPs to include specific background information and mitigation measures proposed by this EIS and the Aboriginal Cultural Heritage Assessment. This would include measures in relation to vibration and dust management as relevant.

The Extraction Plan would also include consideration of sensitive areas or land uses including Aboriginal Heritage sites and include measures to manage potential impacts.

6.9.7 Non-Aboriginal Heritage

Issue Description

Community submissions raised the following concerns regarding impacts to Non-Aboriginal Heritage:

- *Potential damage to up to 21 locations of historic heritage value; and*
- *Additional assessment of historic values is required.*

Submission Identification number

2.80

Response

Since the EIS was publicly exhibited, amendments have been made to the mine plan including changes to the longwall geometry and number which is expected to reduce the overall extent of subsidence movements across the SSA. A revised Subsidence Assessment is summarised in Section 7.1 of the Project Amendment Report and includes an assessment of changed impacts to heritage items as a result of changed subsidence predictions (Section 7.7).

The revised assessment indicates that overall predicted subsidence associated with the amended mine plan has been reduced at all identified heritage sites within the amended subsidence study area, with the exception of Item 10 (Cottage at 91 Hawthorn Road), where a minor increase in subsidence levels is predicted. A small increase in the predicted maximum subsidence is also predicted at a shed located within Wirrimbirra Sanctuary (from a range of 850-1150 mm to 900-1300 mm). Although the predicted maximum tilt, final tilt, total hogging curvature and total sagging curvature within the property are predicted to be less. Notably, overall maximum subsidence across the property is predicted to be less than the predicted levels associated with the EIS mine plan.

As described in Section 11.9.5 of the EIS, the existing Cultural Heritage Management Plan for the Tahmoor Mine would be updated for the Project to include relevant information from the EIS and revised Historic Heritage Assessments. A site-specific Heritage Management Plan would also be prepared for each heritage site of local and/ or State significance identified within the SSA. The Heritage Management Plans would include the following measures to ensure that the heritage values of the sites are appropriately protected and managed as part of the longwall extraction process:

- Assessment of the pre-mining condition of the heritage item;
- Mitigation or strengthening measures prior to mining such as structural reinforcement;
- Monitoring measures such as the monitoring of ground movements and building movements through regular visual inspections; and
- Measures such as remedial or repair works.

6.9.8 Noise and Vibration

Issue Description

Community submissions raised the following concerns regarding noise impacts:

- *concern regarding noise from 24-hour operations including equipment; and*
- *night-time noise impacts causing sleep disturbance.*

Submission Identification number

2.80

Response

In order to reduce sleep disturbance impacts, Tahmoor Coal proposes to amend the Project so that the haulage of rejects at the REA would occur during daytime and evening hours (7am to 10pm). Rejects would continue to be conveyed to the load-out point. A front-end loader would then load the stockpile of reject material into a haul truck for transport around the REA. To manage the stockpiled volume, as well as the daytime conveyed volume of rejects, two haul trucks would be required to operate during the day-time and evening periods.

A revised noise impact assessment is included as part of the Project Amendment Report and is summarised in Section 7.8 of the Project Amendment Report. The key findings of the revised assessment are that:

- The Amended Project is expected to reduce noise emissions at all assessment locations compared to existing levels by at least 2 dB and up to 18 dB at all assessment locations during the night-time period with maximum noise levels not exceeding sleep disturbance screening levels.
- Predicted noise levels from the Amended Project showed a significant reduction in the number of privately-owned dwellings affected by operational noise emissions by more than 5 dB above the relevant project noise trigger level. When compared to existing mine noise, a maximum of 6 residences will be affected by operational noise emissions of more than 5 dB above the relevant project noise trigger level as a result of the operation of the Amended Project whereas there are 33 for the existing Tahmoor Mine operations.
- Operational noise at the nearby Anglican Church and School is predicted to reduce by at least 3 dB when compared to existing mine noise emission levels. Furthermore, mine noise including mitigation measures is predicted to achieve the relevant amenity noise levels at these locations.

The revised assessment indicates that noise impacts from Amended Project (with the inclusion of mitigation measures) would result in a significant improvement to noise levels experienced at receivers from the existing mine including in the night-time period. Residual impacts to receivers where noise levels remain above project specific noise levels, would be managed in accordance with the Voluntary Land Acquisition and Mitigation Policy (VLAMP) as described in Section 7.8 of the Project Amendment Report.

6.9.9 Air Quality

Issue Description

Community submissions raised the following concerns regarding air quality impacts:

- *air pollution from ventilation shafts; and*
- *fumes from vehicles and equipment.*

Submission Identification number

2.80

Response

Odour from ventilation shafts

Odour modelling undertaken as part of the EIS (Appendix N) indicated that odour from the proposed ventilation shafts for the Amended Project would achieve relevant odour criteria.

Given the history of odour complaints for the existing ventilation shaft at the mine (T2), additional modelling was undertaken to model the existing ventilation shaft (T2) as it will continue to operate during the Tahmoor South mining. The number of fans in operation at T2 would reduce from two (currently in use for Tahmoor North), to one fan once the new ventilation shafts and fans are in operation in the Tahmoor South area.

Modelling indicated that odour results from T2 were lower when one fan was in operation compared with two fans. For the purposes of a conservative assessment, ventilation shaft T2 was modelled with two fans operating and a 20 m stack height. The results indicated that the T2 ventilation shaft would achieve the relevant odour criteria.

Operational air quality

The EIS Air Quality Impact Assessment and revised Air Quality Impact Assessment (Appendix J of the Project Amendment Report and summarised in Section 7.9 of the Project Amendment Report) indicates that the operation of the Amended Project is not predicted to result in exceedances of air quality criteria for annual average $PM_{2.5}$, annual average PM_{10}, annual average TSP or annual average deposited dust under the worst case scenario, when considering project only contributions or when including cumulative (background) contributions.

No sensitive receptors are predicted to exceed the maximum 24-hour $PM_{2.5}$ criterion of 25 µg/m3 as a result of the Project (project-only contributions).

One mine owned receptor near the REA (R10) is predicted to experience maximum 24-hour average PM10 concentrations above the criterion of 50 µg/m3, due to the Project's operations alone. This receptor is predicted to exceed the 24-hour average impact assessment criterion on only one day of the year as a result of emissions from the Project. With the incorporation of the TARP and other real-time dust management practices, it is considered that the risk of exceedances would be well managed at the mine so that there will be no adverse air quality outcomes at surrounding receivers.

6.9.10 Greenhouse Gas

Issue Description

Community submissions raised the following concerns regarding greenhouse has impacts:

- *Project contributions to greenhouse emissions from burning of fossil fuels;*
- *Impacts of the project on climate change including seal level rise, human and environmental health and extreme weather events;*
- *Impacts of the project on the ability to meet Australia's obligations under the Paris agreement; and*
- *Implication of Rocky Hill Mine decision.*

Submission Identification number

2.07, 2.21, 2.81

Response

Tahmoor Coal acknowledges the urgent global need to curb greenhouse gas emissions to prevent further climate impacts. However, there is a high demand for coking coal to produce steel for elements required in healthcare, telecommunications, transport, clean water and agriculture. Coking coal is also important for production of steel materials required for in renewable energy supply, such as in wind turbines, reinforcing concrete dams for hydroelectricity, and in equipment used for natural gas extraction.

Australia has been recognised as the world's largest exporter of coking coal with global demand for steel likely to increase, as India and other emerging Asian countries develop. Worldwide, coal production remains steady at around 8 billion short tons (or 160 quadrillion Btu) per year through to 2040. This steady state is forecast to meet most of the world's domestic demands through to 2050. In most regions, coal consumption is projected to remain at current levels with around 0.4 per cent annual growth. Increased coal use in Asian countries drives consumption to more than 9 billion short tons (175 quadrillion Btu) by 2050. Tahmoor Coal has been recognised as a key supplier in Australia's exportation of coking coal.

Australian coal mines operate to some of the highest environmental standards in the world. Aside from the strong commercial incentive to limit energy use in the operation of the Project, regulations ensure a strict recognition and accounting of emissions. Moreover, Australian coking coal is amongst the highest quality in the world, making it relatively less emissions intensive. Higher energy content and lower impurity coal results in higher quality coke, which in turn requires less coke input and higher productivity per unit of steel produced.

In recognition of the need to reduce global emissions, Tahmoor Coal, as a subsidiary to Liberty Steel Group, has recently announced the consolidation of GFG alliance Steel businesses with the ambition to build on existing GREENSTEEL strategy through creating a carbon neutral status by 2030. It will aim to tackle emissions at its sites by exploring technologies such as Direct Reduced Iron, carbon capture and storage and will continue to participate in the development of various forms of renewable energy through its sister company SIMEC Energy.

Project emissions

The Amended Project outlines that the contribution to projected climate change, and the associated impacts of this, would be in proportion with its contribution to global GHG emissions. Average annual Scope 1 emissions from the Project (0.75 Mt CO_2-e) would represent approximately 0.175% of Australia's commitment under the Paris Agreement (431 Mt CO_2-e by 2030) and 0.0023% of global GHG emissions (DoEE, 2019; IEA, 2019). In addition, the Project would generate approximately 1.3 million tonnes CO2-e of Scope 2 emissions and approximately 88.2 million tonnes CO2-e of Scope 3 emissions over its life. Management and mitigation measures would be incorporated into the Project to reduce Scope 1, 2 and 3 emissions where feasible and practical.

The Project would be a small contributor to the global carbon budget. Mitigation measures have been employed by Tahmoor Coal to minimise the generation of direct GHG emissions including fugitive methane abatement such as the use of flares and, if available, recycling through a WCMG Power Plant and Continuous Emissions Monitoring of fugitive emissions.

Current measures are in place for the existing Tahmoor Coal operations. These would be implemented with the extension of mining in Tahmoor South and include the development of an Energy Savings Action Plan to minimise energy use and greenhouse gas emissions from the operation of the Project. This would include assisting in general industry research, promoting low emission coal technologies, ongoing monitoring against GHG targets to input to the National Greenhouse and Energy Reporting scheme and to consider the use of alternative fuels where economically and practically feasible.

The majority of Tahmoor Coal's coking coal product is sold to signatories to the Paris agreement. While Tahmoor Coal cannot mitigate the downstream emissions produced from the mine itself, these countries will have their own laws, frameworks and policies in place to govern any mitigation measures.

Scope 3 Emissions

While the GHG protocol does not require indirect emissions or downstream emissions (Scope 3) emissions to be reported, the Amended Project includes an assessment of Scope 3 emissions.

Scope 3 emissions are indirect emissions created downstream of the Project. That is, they are associated with the Project but occur as direct (Scope 1) emissions at other locations and controlled by other entities. Scope 3 emissions recognise that the coal produced by Tahmoor Coal will continue to generate GHG emissions as it moves from being the output from that operation to the input for the next entity in the value chain. When Scope 1 emissions are calculated by that next entity, they will by definition be counted twice. Classifying the different emission scopes was deliberate, to avoid double counting.

6.9.11 Mine Safety

Issue Description

Community submissions raised the following concerns regarding mining safety:

- *Mining incident which occurred in September 2018 including associated employment conditions; and*

- *Workplace safety.*

Submission Identification number

2.80

Response

Tahmoor Coal takes mine safety extremely seriously and has extensive processes in place to protect employee safety and manage emergency situations in accordance with regulatory requirements including WorkSafe NSW and the Resource Regulator. Tahmoor Coal continues to review its processes, learn from incidents and works with regulators to continually improve its safety processes. It is noted that the Resource Regulator in its submission on the proposed development did not identify any issues of concern in relation to mine safety risk.

With respect to the specific incident noted above, a full investigation was undertaken, and lessons learnt incorporated into safety procedures. At the time of the incident, Tahmoor Coal undertook every effort to provide meaningful work to its employees during the investigation period including community improvement and assistance activities. Employees were also given the option to take leave.

The outcomes of the investigation can be found here: https://www.resourcesregulator.nsw.gov.au/news/2018/resources-regulator-report-reveals-causes-behind-tahmoor-mine-incident

6.9.12 Economic

Issue Description

Community submissions raised the following concerns in relation to economic impacts:

- *That the economic benefits are overstated, and do not take into account financial loss and property impacts form subsidence impacts; and*
- *Taxes and royalties and mine employment vs personal property impacts from subsidence.*

Submission Identification number

2.80, 2.82, 2.83

Response

As outlined in Section 11.15.6 of the EIS, the Project would allow for the continued use of existing infrastructure, providing benefits by way of continuation of employment for the existing, established workforce for a further 13 years. This would provide ongoing employment for the existing 400 employees as well as generate an additional 50 to 175 jobs at peak employment. The Project would generate significant economic benefits, including royalties and net income to the Wollondilly region and State, and would allow for community investment contributions for a further 13 years.

The benefits of the Project would assist the broad aims of A Plan for Growing Sydney (NSW Government, 2014) in providing jobs closer to homes in south-western Sydney. The Project would not conflict with future strategic land use in the Bargo Area, which would be a Metropolitan Rural Area under the plan. Retaining local jobs for local communities of Metropolitan Rural Areas is an important outcome under the plan and the project would be consistent with the outcome.

As outlined in Section 11.15.5 of the EIS, to ensure appropriate planning for eventual mine closure, Tahmoor Coal would implement its Social Involvement Policy, which requires a social impact assessment to be conducted as a component of mine closure planning, no later than five years prior to the end of the mine life. This planning would involve consultation with local and regional stakeholders to explore the employment generating potential of future land uses of the Surface Facilities Area and employment transitioning to help employees find alternate employment.

With the implementation of the Social Involvement Policy including employment transitioning plans to help employees find alternate employment and appropriate mine closure planning, the social impact assessment within the EIS shows that the likelihood and consequence of impacts to the population can be reduced.

Notwithstanding this, during operation of the Project Tahmoor Coal would continue to remediate residential homes affected by the project in accordance with the *Coal Mine Subsidence Compensation Act 2017* administered by SA NSW. Compensation regarding property damage and value would be in accordance with this NSW Government Agency.

The owners of buildings or other surface improvements damaged by mine subsidence can lodge claims for compensation through SA NSW. A SA NSW Case Advisor would be allocated to the claim to support property owners throughout the assessment process and SA NSW would facilitate compensation from mine operators where damage is the result of an active mining operation.

As outlined in Section 11.1.7 of the EIS, the existing Tahmoor Mine has successfully implemented subsidence management and mitigation measures for the impacts of subsidence to a range of commercial premises and on major built infrastructure. A small percentage experienced more significant impacts which have been rectified or continue to be repaired, replaced or otherwise satisfactorily addressed by Tahmoor Mine in close working relationship with SA NSW. Tahmoor Mine has extensive in managing subsidence impacts to houses and buildings from longwall mining at Tahmoor North in accordance with an approved SMP and would continue to do so for Tahmoor South in accordance with the Extraction Plan for the Project. Extraction Plan sub-plans would be developed to manage potential impacts to specific features in consultation with affected stakeholders for approval by relevant Government agencies.

Appendix A of the Economic Impact Assessment (Appendix L of the Project Amendment Report) provides a detailed description of the indirect costs associated with the Project including mitigation and management of environmental impacts. The quantitative and qualitative analysis draws on information provided in the technical assessments undertaken for the Project.

7.0 Revised Management Measures

7.1 Environmental Management

7.1.1 Environmental Management System

Tahmoor Coal currently operates Tahmoor Mine under an existing EMS. Tahmoor Coal also operates under several key EMPs as described in **Table 7-1**. Management plans that form the base of the EMS have been developed to identify, analyse, evaluate and manage all significant potential and actual risks and impacts of activities and operations in the environment and the community. The existing EMS would continue to be adopted for the proposed development but would be updated and augmented where required to incorporate additional environmental management requirements.

Table 7-1 Tahmoor Coal Environmental Management System Document Directory

Tahmoor Coal Existing Environmental Management Plans	
Title	**Purpose**
Cultural Heritage Management Plan	Protect, maintain and mitigate any impacts to items of indigenous and non-indigenous heritage as a result of Tahmoor Mine's operations.
Biodiversity and Land Management Plan	Documents land management practices and control measures to be implemented by Tahmoor Coal to minimise the impact of operations on the surrounding area.
Air Quality and Greenhouse Gas Management Plan	Documents the management practices and control measures which have been implemented at Tahmoor Mine to maintain compliance with all relevant approval conditions related to air quality. Identifies control measures aimed at minimising the release of fugitive greenhouse gas emissions from the operation.
Waste Management Plan	Documents the management measures to be implemented at Tahmoor Mine in accordance with the conditions of development consent, EPL No.1389 and legislative requirements pertaining to waste management.
Noise Management Plan	Provides a framework for site personnel to ensure that compliance is achieved with relevant internal and external regulatory requirements related to noise management at the site.
Conceptual Mine Closure Plan	Provides an overall framework for the mine closure process. The document will form the basis for the development of a detailed mine closure plan within 5 years of the planned completion of mining.
Environmental Monitoring Program	Details the environmental monitoring requirements of Tahmoor Mine and ensures that the environmental monitoring methods are appropriate to assess the environmental performance of the operation, and comply with the relevant regulatory conditions.
Social Involvement Plan	To continually improve and maintain Tahmoor Coal's role as a responsible corporate citizen and to assist with the implementation of appropriate communication strategies to promote positive and long-term relationships with our community.
Pollution Incident Response Management Plan	Addresses the legislative Pollution Incident Response Management Plan requirements. This document also details the procedures for notification of pollution incidents resulting in or having the potential to cause material harm to the environment.
Soil and Water Management Plan	Provides a framework for the management of soil and water on-site at Tahmoor Mine.

Tahmoor Coal Existing Environmental Management Plans	
Title	**Purpose**
Groundwater Management Plan	Provides a framework for the operation of Tahmoor Mine so that surface and subsurface mining operations will be conducted in a manner which minimises the potential impacts on groundwater flow and quality, aquifer integrity, groundwater dependent ecosystems and other off-site groundwater related impacts.

7.1.2 Environmental Monitoring and Reporting

Tahmoor Coal is committed to continuous improvement of its environmental management of the existing Tahmoor Mine and would continue this process for the proposed development. Tahmoor Coal would continue to record all complaints received in a database and would respond to complaints received as quickly as possible. Throughout construction and operation of the proposed development, environmental reporting would include the following:

- annual reporting including a summary of the following over the reporting period:
  - compliance with all relevant approvals and licenses;
  - mining operations;
  - environmental performance;
  - water management;
  - rehabilitation works; and
  - community engagement and complaints.
- compliance reports;
- incident reports;
- remedial actions undertaken should an incident occur;
- checklists to address operational compliance;
- details of stakeholder consultation and meetings;
- outcomes of any auditing that is carried out; and
- the findings of any monitoring that is conducted.

Tahmoor Coal would ensure that all reporting that is undertaken in relation to environment and OHS issues would be in compliance with the relevant licence conditions and regulatory requirements.

7.2 Summary of Management and Mitigation Measures

The Project EIS included a summary of the management measures that would be incorporated into the construction and operation of the Project. Following the receipt and consideration of submissions these management measures were reviewed and additional mitigation measures have been recommended in this Response to Submissions Report. The final summary of Project management measures is provided in **Table 7-2**.

Table 7-2 Summary of Mitigation Measures

Ref#	Potential Impact	Management and Mitigation Measures	Proposed/ existing commitment	Timing
Subsidence				
S-1	Subsidence impacts to natural and built features	Prepare an Extraction Plan for the Amended Project that includes: • Requirements for pre-mining Subsidence Assessment and ongoing monitoring. • Preparation of subsidence management sub-plans for natural and built feature categories that will be impacted by subsidence. Each subsidence sub-plan would detail subsidence performance measures, criteria, predictions and descriptions for each feature, as well as monitoring requirements, risk controls and a TARP. • Consideration of the potential for increased subsidence impacts to occur. The Extraction Plans and associated sub plans would be developed through: • Consultation with the infrastructure owners (such as Council, road and rail authorities and utility providers, commercial/business and landowners); and • Collaboration between specialists such as subsidence engineers, hydrologists and ecologists via a series of workshops and site visits so that the monitoring and management plans that support the Extraction Plan are prepared in a holistic manner and consider the interdependencies between factors such as subsidence, hydrogeology, hydrology, water quality and ecology.	Proposed	Pre-mining
S-2		Ongoing subsidence monitoring throughout extraction will inform updates to the mine plan and refinements as required.	Proposed	Operational

Ref#	Potential Impact	Management and Mitigation Measures	Proposed/ existing commitment	Timing
S-3		Potential impacts to houses would be monitored and managed via: 1. Regular consultation, cooperation and coordination with the community before, during and after mining. This includes letters and door knocking to all residents of structures that will soon be affected by subsidence. The letters would offer a free pre-mining inspection and hazard identification inspection by a structural engineer; 2. Site-specific investigations, where they are necessary and appropriate, into the conditions of buildings and associated structures and their surrounding environment (where access is allowed). The site-specific investigations have been and will continue to be undertaken early so that there is adequate time, if required, to arrange additional inspections and/or surveys and implement any mitigation measures before mining-induced impacts are experienced. 3. Implementation of pre-mining mitigation measures as required following inspections by a geotechnical engineer and/or structural engineer, in consultation and agreement with the landowner. 4. Surveys and inspections during mining within the active subsidence area.	Proposed	Pre, during and post mining
S-4	Subsidence impacts to BWMC	Tahmoor Coal will, in consultation with Wollondilly Shire Council, study the potential for impacts to the BWMC and develop management measures to ensure that the BWMC remains safe and serviceable, as well as ensure that impacts on the BWMC do not result in environmental consequences on the adjacent Dog Trap Creek catchment. The management measures may include a combination of: • Mitigation or strengthening measures prior to mining, particularly to the landfill slopes and surface water treatment ponds; • Installation of monitoring systems, which includes, among other things, the monitoring of ground movements, and condition of the landfill slopes, leachate collection system, the storage ponds, storage containers and the weighbridge; • Conduct regular visual inspections of the BWMC; and • Implement planned response if triggered by monitoring and inspections.	Proposed	Prior to mining beneath the BWMC

Ref#	Potential Impact	Management and Mitigation Measures	Proposed/ existing commitment	Timing
Geomorphology				
GE-1	Impacts to geomorphological features in the Project Area from mining-induced subsidence	Monitoring and management of watercourses would include: • Pre-, during- and post-mining photographic surveys and visual inspections of geomorphological features for each longwall. Results would be documented in the Extraction Plan and Annual Review. • Annual catchment survey at 10 headwater photographic sampling locations to monitor mining-induced subsidence impacts of the Project over time. • A geomorphology survey (baseline and post mining) of waterways overlying each longwall to complement monitoring of subsidence at each longwall. • Installation of subsidence monitoring points before mining of secondary workings for all longwalls. The adaptive management plan for the Project would include re-evaluation of the monitoring techniques for subsidence and biodiversity after mining of each longwall. This would then inform monitoring for subsequent longwall panels. • Monitoring of knickpoint formation during mining of each longwall, and implementation of appropriate controls to prevent knickpoint formation. • Reporting of monitoring results within the Annual Review.	Proposed	Operation
Groundwater				
GW-1	Impacts to groundwater as a result of mining-induced subsidence	Develop and implement a Groundwater Management Plan, including updates for the Project to define a groundwater monitoring strategy, groundwater level triggers and a trigger action response plan, in consultation with relevant Government agencies.	Existing	Pre-mining
GW-2		Relevant Government agencies consulted throughout the Project.	Proposed	Ongoing

Ref#	Potential Impact	Management and Mitigation Measures	Proposed/ existing commitment	Timing
GW-3		Update and maintain regional groundwater monitoring network, with monitoring results reported annually within the Annual Review. This would include replacement of failed bores around Tahmoor North and Tahmoor South, as well as establishing new bores. Monitoring of groundwater levels would include: • A condition assessment of bores and monitoring equipment (VMPs) of new bores around Tahmoor South, with a specific update of the GWMP. • Geophysical logging of boreholes that allow changes in groundwater storage and fracture apertures to be quantified and depth of rock deformation to be identified (i.e. observations of non-deformed ground which could be at least 10- 30 m below surface). • Re-install at least one bore in the footprint of a Tahmoor North longwall (e.g. at TNC029) to monitor post-mining groundwater level and groundwater quality. • Monitoring in longwall centre-lines of pre- and post-mining conditions Tahmoor South. This is would be undertaken for the longwall (101A), and then every two or three after that. Packer testing would also be undertaken, followed by installing VMPs at four elevations in the Hawkesbury Sandstone and then two in the Bulgo Sandstone to assist in defining a profile of fracturing and depressurisation above longwalls. Results from monitoring would be compared to those from groundwater monitoring of reference sites including upstream and outside the predicted subsidence impact zone where relevant.	Proposed	Ongoing
GW-4		Consult with the Thirlmere Lakes Interagency Research Group and relevant stakeholders during the development of groundwater management and monitoring programs for the Amended Project (in relation to potential impacts to Thirlmere Lakes) and consideration of the results of the Thirlmere Lakes Research Program, as they become available.	Proposed	Ongoing

Ref#	Potential Impact	Management and Mitigation Measures	Proposed/ existing commitment	Timing
GW-5		Revision of the groundwater model to: • Take further advantage of unstructured mesh capabilities; • Incorporate conceptual developments from the OEH Thirlmere Lakes Research Program (once complete); and • Incorporate the results of mine inflow monitoring (refer GW-6); • Incorporate monitoring data from groundwater bores in the Western Domain of Tahmoor North.	Proposed	Prior to commencement of mining
GW-6		Improvements would be made to the measurement of the volumetric take (total mine inflow) to better understand inflow to different parts of Tahmoor North/Western Domain and then in the Tahmoor South 'A' and 'B' blocks. The overall water take, accounting for freshwater inputs to the mine and inferred groundwater ingress, would be reported in the Annual Review.	Existing	Operation
GW-7		Pre- and post-mining groundwater monitoring and investigation of mining induced subsidence will be conducted around recent and upcoming longwalls within the Tahmoor North (and 'Western') mine domain and reported in the Annual Review.	Proposed	Pre and post mining
GW-8	Impacts of mining-induced subsidence on groundwater bore users	Survey bores predicted to be impacted by greater than 2 m drawdown, to establish the bores location, use, construction details, as well as periodic groundwater and water quality monitoring, subject to access agreements with the landholder. Implementation of make good measures to affected bores, as relevant.	Proposed	Operation
GW-9	Impacts of mining-induced subsidence on BMWC	An assessment will be undertaken of the potential for leakage of polluted water into the near surface groundwater system when preparing the Extraction Plan for the relevant longwalls undermining the BWMC.	Proposed	Prior to and during mining under the BWMC.

Ref#	Potential Impact	Management and Mitigation Measures	Proposed/ existing commitment	Timing
Surface Water				
SW-1	Impacts to surface water from mining-induced subsidence	Monitoring would be undertaken before mining commences to assess the baseline conditions above each longwall, and would include: • Geomorphological conditions, including creek mapping and high-resolution photography (before, during and after mining beneath each longwall) of rock bars, shallow alluvium (i.e. less than 2 m deep) and permanent or semi-permanent pools within the subsidence impact area. • Water quality • Stream flow Monitoring sites will include: • Ongoing streamflow monitoring at Hornes Creek, Dog Trap Creek, Eliza Creek and Carters Creek in order to expand baseline data of these waterways up to the period of mining within these catchments; • An additional stream flow gauging station would be installed at Tea Tree Hollow, downstream of the edge of the longwall and upstream of Licensed Discharge Point (LDP) 1. • Additional water level monitoring at Hornes Creek, Dog Trap Creek, Tea Tree Hollow and Eliza Creek to establish baseline water level data to enable the assessment of potential impacts to pool water levels; • Streamflow gauging activities would be continued. Enhanced low flow control weirs would be established at the existing gauging station at Dog Trap Creek downstream and the proposed new gauging station at Tea Tree Hollow to support the generation of reliable continuous flow data (including reliable low flow data) at the stations. Routine water level and water quality monitoring at the stations would also be continued. Monitoring results would be reported in the Annual Review.	Existing	Ongoing
SW-2		Monitoring of waterways within 200 m of active longwall mining, including weekly photographic recording and monthly water quality sampling upstream and downstream of potentially affected areas. Results would be analysed against site-specific action response triggers, as detailed in the surface water management plan. Monitoring to be reported in the Annual Review and six-monthly subsidence impact reports.	Proposed	During mining

Ref#	Potential Impact	Management and Mitigation Measures	Proposed/ existing commitment	Timing
SW-3		Develop an adaptive monitoring program and TARP, which includes triggers for water quality exceedances, unexpected flow loss based on analysis of baseline (pre-subsidence) streamflow data and unexpected loss of pool water holding capacity based on analysis of baseline (pre-subsidence) pool water level data. TARP to be documented in the longwall's Extraction Plan outcomes reported within the six-monthly subsidence impact reports. Site specific trigger values, developed in accordance with ANZECC (2000) and ANZG (2018), would be adopted for baseline sites which may potentially be affected by the Project. Analytes would include iron, manganese and barium. A Creek Management Plan will be developed as part of the Mining Operation Plan for Tahmoor Mine and will build on the experience at Redbank and Myrtle Creeks, as well as at other mines in the Southern Coalfields, to monitor and enhance the success of rehabilitation methods for creeks affected by the Tahmoor South Project.	Proposed	Prior to mining.
SW-4		Monitor streamflow, pool water levels and water quality of waterways in the Amended Project area for two years following the cessation of mining. Monitoring to be reported within the Annual Review.	Existing	Post-operation
SW-5		Update the monitoring and management plans and the groundwater/ surface water model in relation to impacts to the Thirlmere Lakes as findings from the OEH research project become available to guide ongoing management of impacts.	Proposed	Prior to mining.

Ref#	Potential Impact	Management and Mitigation Measures	Proposed/ existing commitment	Timing
SW-6	Water quality impacts due to discharge of treated water from LDP1	Monitoring and management of water quality downstream of LDP1 would include: • A new water quality monitoring site would be established on the Bargo River downstream of the confluence with Tea Tree Hollow and upstream of SW14 to increase the spatial representation of water quality sites downstream of LDP1. • Establishment of a TARP for water quality exceedances which incorporate both baseline and control monitoring data. • The pit top water management system performance would be assessed annually against its predicted performance range. • Revision to the water management plan would be undertaken if the performance review indicates the water management system has, or is likely to be, unable to meet its regulatory performance requirements. • The discharge monitoring would include: - A full suite of metals; - Sulfate, total dissolved solids and electrical conductivity, major ions; - Total suspended solids and turbidity; - Any residual settling agent risks (flocculants or coagulants); and • Volume and frequency of controlled discharges and frequency of managed overflows.	Proposed	Prior to mining.
SW-7	Surface water entitlement	Obtain the necessary authorised entitlement to account for the maximum take of water from both surface water and groundwater sources in accordance with the Aquifer Interference Policy.	Proposed	Prior to mining.
Terrestrial Ecology				
TE-1	Impacts to terrestrial ecology	Monitor site disturbance works to, where possible, avoid or minimise impacts to terrestrial ecology.	Existing	Ongoing

Ref#	Potential Impact	Management and Mitigation Measures	Proposed/ existing commitment	Timing
TE-2	from surface impacts of the Project	Revise and update the existing Biodiversity Management Plan (including monitoring and adaptive management requirements). The plan would be prepared in consultation with relevant regulatory agencies. The Biodiversity Management Plan would contain: • Native vegetation clearing protocol to: - Define where clearing of native vegetation is to be undertaken or where native vegetation is to be retained; - Specify methods of clearing of native vegetation, including approach for hollow-bearing trees; and detail methods for pre-clearance surveys to identify biodiversity to be protected (including any threatened species) and allow fauna to escape. • Threatened species management measures including a map, list and description of all threatened species recorded in the vicinity of the surface infrastructure sites; • Weed management and disease prevention protocols; and • Other measures such as fire management and progressive rehabilitation of the REA to minimise fragmentation of vegetation.	Proposed	Construction and operation
TE-3		Tahmoor Coal will continue to implement a detailed ground disturbance permit procedure.	Existing	Ongoing
TE-4		Undertake on-going monitoring of potential flora and fauna impacts, including ongoing amphibian monitoring. Monitoring to be reported annually within the Annual Review.	Existing	Ongoing
TE-5		Prepare and implement the detailed Tahmoor South Project Biodiversity Offset Strategy.	Proposed	Ongoing
Aquatic Ecology				
AE-1	Impacts to aquatic ecology as a result of longwall mining and mining-induced subsidence	Monitor vegetation clearing to avoid or minimise impacts to aquatic ecology. Monitoring to be reported within the Annual Review.	Existing	Ongoing
AE-2		Undertake monitoring of macroinvertebrates for a baseline of two years prior to longwall extraction. The monitoring program may require adding or relocating sites according to the final mine plan and using the same sampling methods as used in the aquatic monitoring conducted to date.	Existing	Prior to commencement of mining

Ref#	Potential Impact	Management and Mitigation Measures	Proposed/ existing commitment	Timing
AE-3		Implement a BACI (Before After Control Impact) designed monitoring program to compliment the baseline information collected and to assess monitoring impacts in an adaptive management framework.	Existing	Ongoing
AE-4	Impact of mine water discharge to aquatic ecology	Investigate Tea Tree Hollow downstream of Licensed Discharge Point 1 (LDP1) to determine potential remediation methods to remove the impacts of the barium precipitate on the aquatic habitat.	Proposed	Prior to commencement of mining
AE-5		Implement an aquatic ecology monitoring program aimed at identifying any future changes in aquatic health due to improvements in the discharge quality from LDP1.	Proposed	Prior to commencement of mining
AE-6	Impact to aquatic ecology from insufficient data samples	Further baseline monitoring will be conducted in Autumn 2020 to update the data for future monitoring purposes. This will involve sampling of potential impact sites and non-impacted locations at locations that are representative of the system present in the study area.	Proposed	Prior to commencement of mining
AE-7		In relation to the Sydney Hawk Dragonfly, monitoring for adult and larval dragonflies will be undertaken in the Bargo River in summer (2019/2020).	Proposed	Summer (2019/2020)
Aboriginal Heritage				
AH-1	Impacts to items and/or places of Aboriginal Cultural Heritage Significance as a result of longwall	Prepare a Heritage Management Plan in consultation with RAPs and DPIE to detail management requirements and responsibilities detailing avoidance, mitigation and management measures.	Proposed	Pre, during and post mining
AH-2		Develop site-specific management strategies in consultation with Aboriginal stakeholders should any monitored rock shelters be impacted by mining-induced subsidence associated with the Project.	Proposed	Prior to commencement of mining

Ref#	Potential Impact	Management and Mitigation Measures	Proposed/ existing commitment	Timing
AH-3	mining and mining-induced subsidence.	Subsidence monitoring and management program would be implemented and would include: • Monitoring of Aboriginal sandstone shelter sites and grinding groove sites located within the 35° angle of draw of the project • A schedule for undertaking the subsidence monitoring at the nominated sites; • Appropriately detailed baseline and archival site recordings, including high resolution digital photographs; • A TARP specific to each of the sites being monitored; • Monitoring prior, during and after longwall mining, with monitoring results reported annually within the Annual Review.	Proposed	Ongoing
AH-4		Involve the Aboriginal community in managing Aboriginal heritage throughout the Project.	Proposed	Ongoing
AH-5		Additional previously unidentified sites requiring assessment would include systematic survey of the relevant area(s) in consultation with the RAPs and would be managed in accordance with the management measures described in the Heritage Management Plan. If impacts to any existing (or newly identified) sites cannot be avoided, additional management, mitigation and archival recording measures would be determined in consultation with the RAPs and statutory agencies. This process will be undertaken in accordance with OEH guidelines.	Proposed	Ongoing
Non-Aboriginal Heritage				
HH-1	Impacts to items of non-Aboriginal	Update the existing Cultural Heritage Management Plan to include relevant information from the Amended Historic Heritage Assessment for the Project.	Proposed	Construction

Ref#	Potential Impact	Management and Mitigation Measures	Proposed/ existing commitment	Timing
HH-2	Cultural Heritage Significance as a result of longwall mining and mining-induced subsidence.	Develop a site-specific Heritage Property Subsidence Management Plan for each heritage site of local and/or State significance identified within the SSA, including Wirrimbirra Sanctuary, Bargo Railway Station and Toilet Block, Bargo Cemetery, Bargo Railway Bridges (South and North) and Tahmoor Mine. Each Heritage Management Plan would form part of the Extraction Plan for the longwalls relevant to each item and would be developed in consultation with property owners/managers and the Wollondilly Shire Council prior to commencement of mining. The Heritage Property Subsidence Management Plans would include the following measures to ensure that the heritage values of the sites are appropriately protected and managed as part of the longwall extraction process: • Assessment of the pre-mining condition of the heritage item; • Mitigation or strengthening measures prior to mining such as structural reinforcement; • Monitoring measures such as the monitoring of ground movements and building movements through regular visual inspections; and • Measures such as remedial or repair works.	Proposed	Construction
HH-3		Develop a site-specific Heritage Property Subsidence Management Plan for Wirrimbirra Sanctuary prior to commencement of mining, including a detailed site inspection. The outcomes of the assessment would be provided in an addition Statement of Heritage Impact in consultation with the National Trust and NSW Heritage Council, or its delegate.	Proposed	Operation
HH-4		Prepare a site-specific Statement of Heritage Impact report, in consultation with land owners and the NSW Heritage Council.	Proposed	Prior to commencement of mining
Noise and Vibration				
NV-1 NV-2	Impacts of construction noise on sensitive receivers	Develop and implement a Construction Noise and Vibration Management Plan.	Proposed	Construction

Ref#	Potential Impact	Management and Mitigation Measures	Proposed/ existing commitment	Timing
NV-3	Impacts of operational noise on sensitive receivers	Implement mitigation measures determined to be reasonable and feasible which were modelled in the Project operational mine scenario.	Proposed	Operation
NV-4		Update the Noise Management Plan, including a noise monitoring program for the Project, including attended and continuous real time noise monitoring. Monitoring to be reported annually within the Annual Review.	Existing	Operation
NV-5		Continue the existing noise monitoring program.	Proposed	Operation
NV-6		Implement following controls: • CHPP improvements: Tahmoor Coal will commence investigations and concept design study for this work in 2020. Feasibility study works, including consideration of various options, is anticipated to continue through the first two years of the Amended Project. It is estimated that the CHPP mitigation measures could be implemented within approximately three years of physical commencement of the Amended Project. • Dozers: the use of only one dozer at night, as well as the restriction to operating area for the stockpile dozer would be implemented upon approval of the Amended Project. The noise suppression kit for the dozer would be procured and installed within the first 12 months after approval of the Amended Project. • Restriction of REA operations: to enable the restriction of REA operations to day and evening only modifications are required to the conveyor, as well as procurement of a front-end loader to assist with loading the second haul truck. It is anticipated that the design, procurement and installation process would be completed within approximately three years of physical commencements of the Amended Project. • Compressors: the upgrade to the compressor enclosure would be installed within approximately two years after approval of the Amended Project. • Barriers: improvements to bund shielding of the rail loop, as well as design/ construction of the barrier adjacent to the product stockpile area are expected to be completed within three years after approval of the Amended Project.	Proposed	Ongoing

Ref#	Potential Impact	Management and Mitigation Measures	Proposed/ existing commitment	Timing
Air Quality				
AQ-1	Impacts of construction of the Project on air quality sensitive receptors	Develop and implement an Air Quality Management Plan for inclusion in the CEMP. The Air Quality Management Plan would include management and mitigation measures to minimise dust generation.	Proposed	Pre-construction/ During construction
AQ-2		Consult nearest residents to the proposed ventilation shaft sites during detailed design.	Proposed	Pre-construction
AQ-3	Impacts of the operation of the Project on air quality sensitive receptors	Update the Air Quality and GHG Management Plan to align with the operation of the Project. Monitoring to be reported annually within the Annual Review.	Proposed	Operation
AQ-4		Continue to implement the reactive and predictive Air Quality Control System to manage dust impacts. Monitoring to be reported annually within the Annual Review.	Existing	Operation
AQ-5		Implement a TARP relating to meteorological triggers for dust generation for receptors in close proximity to the Surface Facilities Area.	Existing	Operation
AQ-6		Installation and monitoring of additional real-time PM_{10} monitors to target the most sensitive receptors likely to be affected by dust.	Proposed	Ongoing
Greenhouse Gas				
GHG-1	Generation of GHG from operation of the Project	Implement fugitive emissions abatement measures.	Proposed	Operation
GHG-2		Continue use of an electric winder as the primary method of materials transport for the mine rather than diesel transport.	Existing	Ongoing
GHG-3		Monitor the upcast ventilation shaft sites to enable accurate measurements of ventilation emissions. Monitoring to be reported within the Annual Review.	Proposed	Operation
GHG-4		Prepare an Energy Savings Action Plan in accordance with the NSW Energy Administration Amendment (Water and Energy Savings) Act, 2005 and the Guidelines for Energy Savings Action Plans (DEUS, 2005). The plan will include standards to minimise energy use and GHG emissions from the Project's operations.	Proposed	Operation
GHG-5		Ensuring maintenance, calibration and record keeping is undertaken on the main ventilation shafts and fans to enable GHG emission calculations. Maintaining records for monthly electricity use and monthly ROM coal production to allow calculation of greenhouse gas emissions. Monitoring to be reported annually within the Annual Review.	Proposed	Operation

Ref#	Potential Impact	Management and Mitigation Measures	Proposed/ existing commitment	Timing
Traffic				
T-1	Impacts of construction traffic on the local road network	Prepare and implement a Construction Traffic Management Plan in consultation with RMS and the Wollondilly Shire Council.	Proposed	Pre-construction
T-2		Prioritise the staging of construction of the proposed ventilation shafts, with one ventilation shaft being drilled at a time. A benefit of this approach is that it will reduce the cumulative impact of heavy and light vehicle movements on the local road network and reduce the overall traffic volume generated by the Project.	Proposed	Construction
T-3	Impacts of the Project on road safety and traffic efficiency along the local road network	Upgrade the Remembrance Driveway/Mine Access Road intersection to improve the performance and safety of the intersection.	Proposed	Construction
T-4		Construct a new carpark at the surface facilities area to accommodate the increased number employees and contractors.	Proposed	Construction
T-5		Consult with infrastructure owners as part of subsidence management planning for Avon Dam Road.	Proposed	Ongoing
T-6	Impacts of operational traffic on the local road network	Update the existing Tahmoor Mine Traffic Management Plan.	Proposed	Operation
T-7		Should any works be required on RMS regulated roads, RMS would be consulted, and works would be carried out in accordance with RMS requirements.	Proposed	Prior to mining
Social Impacts				
SI-1	Impacts of the Project on the social environment of the Project Area	Manage amenity impacts in accordance with the measures outlined in the relevant sections outlined in this table and in Section 11.11, 11.13, 11.15 and 11.17 of the EIS.	Proposed	Construction and Operation
SI-2		Review community engagement activities regularly to ensure the information and mechanisms for providing key community and government stakeholders are appropriate.	Proposed	Ongoing
SI-3		Update the existing Social Involvement Plan. The Plan would provide a framework for ongoing contributions to community partnerships and initiatives through Tahmoor Coal's Corporate Social Involvement (CSI) program.	Proposed	Operation
SI-4		Continuing discussions with the Wollondilly Shire Council regarding a Voluntary Planning Agreement.	Proposed	Prior to determination

Ref#	Potential Impact	Management and Mitigation Measures	Proposed/ existing commitment	Timing
SI-5		Community surveys would be conducted, and Tahmoor Coal would continue to hold community information days, which would allow two-way communications between the community and company.	Proposed	Ongoing
SI-6		Tahmoor Coal would continue to engage with the community through its existing Community Consultative Committee Meetings and other processes to address community concerns about subsidence and other matters. Continued ongoing community support measures would be provided in consultation with the local community.	Proposed	Ongoing
SI-7		Potentially affected residents would receive a Resident Information Pack which includes: • Longwall information; • An explanation of subsidence and the potential effect of subsidence on houses and other structures; • Anticipated levels of subsidence for longwall; • A description of property inspections, surveys and monitoring including how to access free pre-mining property inspections; • A description of rights and responsibilities relevant to subsidence; and • Emergency contact details. The Resident Information Packs include specific information on the role of Subsidence Advisory NSW (SA NSW) in administrating the *Coal Mine Subsidence Compensation Act 2017*; comprising contact details; the subsidence claims process where damage by subsidence is suspected and details for access to free counselling services in relation to subsidence impacts.	Proposed	Ongoing
Visual Impacts				
V-1	Impacts of the surface development of the Project on visual amenity.	New structures would be dark in tone and utilise non-reflective materials where possible.	Proposed	Design
V-2		Design new lighting to consist of low-level night lighting and avoid direct line of sight from surrounding areas where possible.	Proposed	Design
V-3		Design security lighting to minimise light spill where reasonable and feasible.	Proposed	Design
V-4		Retain and protect tree cover to the fullest extent possible where reasonable and feasible.	Proposed	Construction
V-5		Implement landscaping, which is progressive and increases the level of existing screening potential	Proposed	Construction

Ref#	Potential Impact	Management and Mitigation Measures	Proposed/ existing commitment	Timing
V-6		Implement progressive rehabilitation and tree planting on the REA to allow the REA to blend into the landscape; in accordance with the Amended Rehabilitation Plan.	Proposed	Operation
Soils and Land Capability				
SLC-1	Impacts of mining induced subsidence from the Project on soil and land capability.	Update existing Soil and Water Management Plan. Monitoring to be reported within the Annual Review.	Existing	Ongoing
SLC-2		Prepare and implement a TARP as part of the revised Soil and Water Management Plan.	Proposed	Operation
Land Use and Resources				
LUR-1	Impacts of the surface aspects of the Project on land use	Limit land clearing to minimise disturbance to agricultural land.	Proposed	Construction
LUR-2		Develop a Surface, Safety and Serviceability Management Plan for each asset expected to experience impacts from subsidence.	Proposed	Pre-construction
LUR-3		Develop a Land Management Plan to manage land use and agricultural land within the Project Area.	Proposed	Pre-construction
LUR-4		Re-establishing agricultural lands following mine closure in accordance with the Conceptual Mine Closure Plan to ensure successful restoration of agricultural land to target Rural Land Capability Classification.	Proposed	Post-operation
LUR-5		All relevant compensation and /or access would be agreed on under the *Mining Act 1992* in consultation with the Department of Planning Industry and Environment prior to work within Crown Lands/ Roads.	Proposed	Pre-construction
Rejects disposal				
RD1	Impacts associated with improper	Update the existing management, rehabilitation and monitoring plan for the REA. Where REA extension works are undertaken within water front land, rehabilitation activities would be undertaken consistent with the *Guidelines for Working on Waterfront Land.*	Proposed	Operation

Ref#	Potential Impact	Management and Mitigation Measures	Proposed/ existing commitment	Timing
RD2	management of the REA	Update the Water Management Plan to include specific monitoring of Acid and Metalliferous Drainage and contaminants of concern from the REA material and leachate specifying contingency measures if monitoring parameters are exceeded, and how impacts to the environment surrounding the REA will be monitored. It would also include monitoring of groundwater for water quality parameters and contaminant compounds including an ongoing monitoring plan for the site and contingencies if parameters are exceeded.	Proposed	Operation
Waste				
W-1	Inappropriate waste management throughout construction and operation of the Project	Update the existing Waste Management Plan. Monitoring to be reported annually within the Annual Review.	Proposed	Construction and Operation.
Mine Closure and Rehabilitation				
MCR-1	Inappropriate rehabilitation and revegetation of the Project Area	Undertake progressive rehabilitation in accordance with the Rehabilitation and Mine Closure Strategy. Monitoring to be reported within the Annual Review.	Existing	Operation and post-mining
MCR-2	Surface cracking and impacts to waterways and drainage lines from mining-induced subsidence	Preparation of a Creek Remediation Action Plan for creeks within the SSA.	Proposed	Operation.
MCR-3	Process of rehabilitation	A detailed Mine Closure Plan will be prepared at least 5 years before expected mine closure and submitted to the Resource Regulator.	Proposed	Operation

Ref#	Potential Impact	Management and Mitigation Measures	Proposed/ existing commitment	Timing
Hazard and Risk				
HR-1	The generation of contamination from the Project.	Undertake ongoing acid and metalliferous drainage monitoring. Monitoring to be reported within the Annual Review.	Existing	Construction
HR-2	Spontaneous combustion as a result of rejects emplacement	Update the existing Spontaneous Combustion Management Plan.	Proposed	Operation
HR-3		Undertake regular visual inspections of the REA for the presence of spontaneous combustion.	Existing	Ongoing
HR-4	Impacts of bushfire	Smoking would only be permitted at designated smoking areas.	Existing	Ongoing
HR-5		Undertake fuel reduction activities on Tahmoor Coal owned land to limit the speed and spread of potential unscheduled fires.	Existing	Ongoing
HR-6		Maintain fire trail and access roads to from, and within Tahmoor Coal landholdings.	Existing	Ongoing
HR-7		Continued implementation of the Tahmoor Emergency and Management Plan.	Existing	Ongoing
HR-8		Follow the existing Emergency Response Procedures.	Existing	Ongoing
HR-9	Variation in salinity or contaminants of concern in the REA runoff	Conduct surface water and groundwater monitoring during active placement of coal handling and preparation plant rejects.	Proposed	Prior to commencement of mining
HR-10	Construction in proximity to electrical energy network	Application for connection to the network would be progressed and finalised in accordance with Endeavour Energy requirements including design and electricity infrastructure details.	Proposed	Pre-construction
HR-11		Any construction, excavation or building works undertaken in close proximity to Endeavour Energy's electrical network would be undertaken in compliance with Endeavour Energy's requirements and standards, including in relation to safety distances/ clearances. Endeavour Energy would be consulted prior to any such works occurring and emergency contact details on standby when works occur.	Proposed	Pre-construction

Ref#	Potential Impact	Management and Mitigation Measures	Proposed/ existing commitment	Timing
HR-12		Landscaping undertaken under an Endeavour Energy transmission asset would comply with Endeavour Energy's requirements and standards to ensure that planted vegetation does not pose a safety or maintenance risk to Endeavour Energy's assets.	Proposed	Construction
HR-13		Dial Before You Dig searches and advice would be sought prior to earthworks.	Proposed	Pre-construction
Environmental Risk				
EHR-1	Potential impact of diesel emissions on the health of individuals	Undertake monitoring programs and regular maintenance and servicing of diesel vehicles on site to reduce risks to the exposed community.	Existing	Ongoing
Cumulative Impacts				
N/A	Cumulative impacts of the Project	Cumulative impacts would be mitigated and managed by the measures presented in this table for each environmental issue.	Proposed	Ongoing

8.0 Conclusions and Next Steps

During public exhibition of the EIS for the Project, 106 submissions were made, including 13 from Government agencies, 2 from local Councils, 8 from special interest groups or organisations, and 83 from individual community members. Of the 83 community submissions received, 73 were in support of the Project, and 10 raised objections to the Project.

This Response to Submissions Report has provided additional information to address the issues raised in the submissions relating to the key issues associated with the project including: subsidence, groundwater surface water, terrestrial and aquatic ecology, historic and Aboriginal cultural heritage, noise and vibration, air quality, traffic, rehabilitation and mine closure, social and economic impacts, land use, and the reject emplacement area.

The DPIE will now assess the Project in consultation with other relevant agencies, and the assessment process will include review of the EIS and this Response to Submissions Report. The DPIE will then prepare a draft assessment report for consideration by the Minister for Planning or delegate.

9.0 References

Advisian, 2016. *Literature Review of Underground Mining Beneath Catchments and Water Bodies*. Report for WaterNSW by Advisian, John Ross, PSM, Mactaggart and Grant Sutton & Assoc. December 2016.

Barbato, J., Brassington, G., Walsh, R., 2014. *Valley Closure Impact Model for Rock Bar Controlled Streams in the Southern Coalfield*. "Proceedings of the ninth triennial MSTS Mine Subsidence Technological Society Conference", Pokolbin 11 to 13 May 2014. Vol 1, pp. 221-226

Crosbie, R. 2015. *Groundwater recharge to coal basins in eastern Australia – Bioregional Assessments programme*. Presentation to the Australian Groundwater Conference, Canberra, November 2015.

Galvin, J.R., 2017a. *Review of PSM report on height of fracturing - Dendrobium Area 3B*, Review commissioned by DPIE.

Geoterra, 2013. *Tahmoor South - Shallow groundwater baseline monitoring*. Report for Tahmoor Coal, document BAR3 - R1A.

GeoTerra, 2019. *Longwalls West 1 and West 2 Baseline Private Bore Assessment, Tahmoor, NSW.* Report TA36-R1A prepared for Tahmoor Coal Pty. Ltd., May 2019.

Geoterra, in prep. *Tahmoor Bore Census*.

Groundwater Exploration Services [GES], 2019. *TNC40 – Vibrating Wire Piezometer Partial Failure*, 6th February 2019.

Hutton, A.C. 2009. *Geological Setting of Australasian Coal Deposits*. In R. Kininmonth & E. Baafi (Eds.). Australasian Coal Mining Practice (pp. 40-84). AusIMM, Victoria, Australia.

HydroGeoLogic, 2019. *Tahmoor South Coal Project Groundwater Assessment Independent Review (Stage 1)*. Prepared for NSW Department of Planning and Environment, May 2019.

HydroSimulations, 2019. *Tahmoor Coal LW W1-W2 Extraction Plan: Groundwater Technical Report*. Prepared for Tahmoor Coal Pty. Ltd., July 2019.

IEPMC, 2018. *Initial report on specific mining activities at the Metropolitan and Dendrobium coal mines.* 12 November 2018. Available via http://www.chiefscientist.nsw.gov.au/reports/independent-expert-panel-for-mining-in-the-catchment

Moffit R.S. 1999. *Southern Coalfield Regional Geology 1:100 000*, 1st edition. Geological Survey of New South Wales, Sydney.

Morrison, K.G. Reynolds, J.K. Wright, I.A. 2019. *Subsidence Fracturing of Stream Channel from Longwall Coal Mining Causing Upwelling Saline Groundwater and Metal-enriched Contamination of Surface Waterway*. Water, Air, Soil Pollution, 230 (37). https://doi.org/10.1007/s11270-019-4082-4.

MSEC (2019), pers. comm email dated 11/10/2019

PSM, 2017. *Height of cracking – Dendrobium Area 3B, Dendrobium Mine* (No. PSM3021-002R), Report commissioned by DPIE.

Rose, G. 1966. *Wollongong 1:250 000 Geological Sheet SI/56-09*, 2nd edition, Geological Survey of New South Wales, Sydney.

SCT, 2013. *Review of Hydraulic Conductivity and Geotechnical Characteristics of the Overburden at Tahmoor South*. SCT Report for Tahmoor Coal, Report TAH4083 Rev1.

SCT, 2014. *Longwall 10A Height of Fracture Borehole for Tahmoor South Project – Observations, Measurements, and Interpretation*. Report for Tahmoor Mine, doc TAH4125, March 2014.

SCT, 2018. *Redbank Creek Shallow Groundwater Investigation*. Report for SIMEC Mining, doc TAH4909, December 2018.

Tammetta, P. and Hewitt, P. 2004. *Hydrogeological properties of the Hawkesbury Sandstone in the Sydney Region*. Australian Geomechanics, 39 (3), pp. 91-107.

APPENDIX A

Summary of Community Submissions

Appendix A Summary Table for Community Submissions

Community Submission	Submitter identification numbers
Subsidence	
6.9.1.1 Subsidence impacts on properties	2.12, 2.80, 2.83
6.9.1.2 Damage to linear infrastructure and utilities	2.80
6.9.1.3 Damage to water supply	2.80
6.9.1.4 Bargo Waste Management Centre	2.80
Groundwater	
6.9.2 Groundwater concerns	2.62
Surface water	
6.9.3.1 Impacts to Bargo River, Mermaid Pools, Nepean River	2.72, 2.80, 2.83
6.9.3.2 Impacts to Dog Trap Creek and Tea Tree Hollow	2.72, 2.80, 2.83
6.9.3.3 Surface water management	2.72, 2.80, 2.83
6.9.3.4 Impacts to Drinking Water and Dams	2.80
Thirlmere Lakes	
6.9.4 Thirlmere Lakes concerns	2.13
Terrestrial Ecology	
6.9.5 Terrestrial Ecology concerns	2.80, 2.83
Aboriginal Cultural Heritage	
6.9.6 Aboriginal Cultural Heritage concerns	2.80, 2.83
Non-Aboriginal Heritage	
6.9.7 Non-Aboriginal Heritage concerns	2.80
Noise and Vibration	
6.9.8 Noise and Vibration concerns	2.80
Air Quality	
6.9.9 Air quality concerns	2.80
Greenhouse Gas	
6.9.10 Greenhouse Gas concerns	2.07, 2.21, 2.81
Mine safety	
6.10.11 Mine safety concerns	2.80
Economics	
6.9.12 Economic concerns	2.80, 2.82, 2.83

AECOM

Address
Level 21, 420 George Street

Sydney, NSW 2000

Australia

Postal Address
PO Box Q410

QVB PO, Sydney NSW 1230

Australia

Telephone +61 2 8934 0000
Facsimile +61 2 8934 0001
www.aecom.com