Mount Thorley Operations 2014

2

Environmental Impact Statement

Prepared for Mt Thorley Operations Pty Limited | June 2014

VOLUME 2 — Appendices A to F

COAL & ALLIED

Managed by Rio Tinto Coal Australia

EMM

EMGA Mitchell McLennan

VOLUME 1 — MAIN REPORT

VOLUME 2 — Appendices A to F

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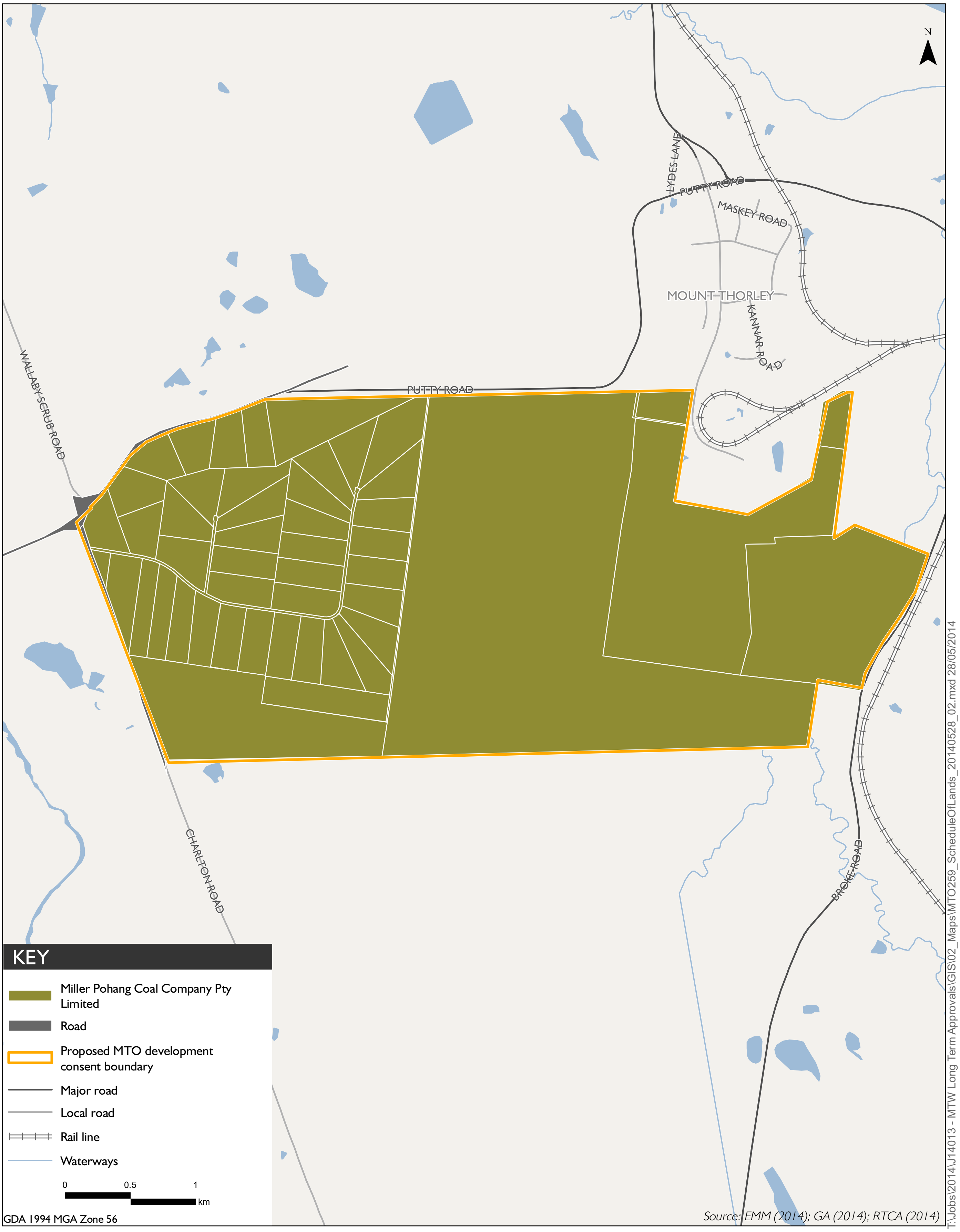
Appendix A

Schedule of land

Appendix A — Schedule of land

A



Schedule of Lands
Mount Thorley Operations 2014
Environmental Impact Statement

Figure A.1

LOT	DP	OWNER
1	45576	Miller Pohang Coal Company Pty Limited
36	755270	Miller Pohang Coal Company Pty Limited
29	248429	Miller Pohang Coal Company Pty Limited
28	248429	Miller Pohang Coal Company Pty Limited
271	600747	Miller Pohang Coal Company Pty Limited
8	251238	Miller Pohang Coal Company Pty Limited
1	42614	Miller Pohang Coal Company Pty Limited
37	248429	Miller Pohang Coal Company Pty Limited
39	248429	Miller Pohang Coal Company Pty Limited
3	247340	Miller Pohang Coal Company Pty Limited
1	247340	Miller Pohang Coal Company Pty Limited
555	609997	Miller Pohang Coal Company Pty Limited
35	248429	Miller Pohang Coal Company Pty Limited
17	658927	Miller Pohang Coal Company Pty Limited
41	248429	Miller Pohang Coal Company Pty Limited
43	248429	Miller Pohang Coal Company Pty Limited
6	247340	Miller Pohang Coal Company Pty Limited
8	247340	Miller Pohang Coal Company Pty Limited
19	247339	Miller Pohang Coal Company Pty Limited
46	248429	Miller Pohang Coal Company Pty Limited
708	749857	Miller Pohang Coal Company Pty Limited
22	263943	Miller Pohang Coal Company Pty Limited
2	42614	Miller Pohang Coal Company Pty Limited
9	247340	Miller Pohang Coal Company Pty Limited
7	247340	Miller Pohang Coal Company Pty Limited
272	600747	Miller Pohang Coal Company Pty Limited
271	260663	Miller Pohang Coal Company Pty Limited
38	248429	Miller Pohang Coal Company Pty Limited
4	247340	Miller Pohang Coal Company Pty Limited
2	247340	Miller Pohang Coal Company Pty Limited
56	755270	Miller Pohang Coal Company Pty Limited
36	248429	Miller Pohang Coal Company Pty Limited
42	248429	Miller Pohang Coal Company Pty Limited
12	247340	Miller Pohang Coal Company Pty Limited
14	247340	Miller Pohang Coal Company Pty Limited
34	248429	Miller Pohang Coal Company Pty Limited
18	247340	Miller Pohang Coal Company Pty Limited
16	247340	Miller Pohang Coal Company Pty Limited
31	248429	Miller Pohang Coal Company Pty Limited
10	247340	Miller Pohang Coal Company Pty Limited
44	248429	Miller Pohang Coal Company Pty Limited

LOT	DP	OWNER
33	248429	Miller Pohang Coal Company Pty Limited
11	247340	Miller Pohang Coal Company Pty Limited
30	248429	Miller Pohang Coal Company Pty Limited
5	247340	Miller Pohang Coal Company Pty Limited
13	247340	Miller Pohang Coal Company Pty Limited
45	248429	Miller Pohang Coal Company Pty Limited
273	260663	Miller Pohang Coal Company Pty Limited
15	247340	Miller Pohang Coal Company Pty Limited
17	247340	Miller Pohang Coal Company Pty Limited
40	248429	Miller Pohang Coal Company Pty Limited
32	248429	Miller Pohang Coal Company Pty Limited
1	43422	Miller Pohang Coal Company Pty Limited

Appendix B

Study team

Appendix B — Study team

B

Table B.1 Study team

Role	Person	Organisation	Qualifications
Lead consultancy			
Project director	Luke Stewart	EMM	BAppSc (Hons)
Project manager	Duncan Peake	EMM	BSc (Hons)
Project coordinator	Andrew Wiltshire	EMM	BSc (Geography), PGDip (EnvMgt)
Contributing authors	Rachael Russell	EMM	BSc, MEnvP
	Kate Cox	EMM	BSc (Marine Science)
	Robert Janssen	EMM	BSc, DipBus
	Rebecca Newell	EMM	BA (Hons Class 1)
Graphics	Antony Edenhofner	EMM	BSc (Applied Economic Geography)
	Robyn Sharpe	Sharper Graphics	DipA(Graphic Design and Advertising)
Administrative support	Jamie Wharemate	EMM	-
Technical specialists			
Aboriginal cultural heritage	David Cameron	Rio Tinto Coal Australia	BA, BA(Hons), PhD (Economic History)
	Luke Goodwin	Central Queensland Cultural Heritage Management	BA(Hons), PhD
	Joel Deacon	Rio Tinto Coal Australia	BA (Hons)
Air quality	Aleks Todoroski	Todoroski Air Sciences	BE(Mech)
	Philip Henschke	Todoroski Air Sciences	BSc
Economics	Brian Fisher	BAEconomics	BScAgr (Hons I)
	Sabine Schnittger	BAEconomics	DipEc, MMatEcon
Groundwater	James Tomlin	AGE Consultants	BSc (Env Studies), MSc (Hydrogeology), CertSc (Geology)
	Doug McAlister	AGE Consultants	MAppSc, Hydrogeology
Noise and vibration	Najah Ishac	EMM	MEngSc, BE (Mech)
	Daniel Weston	EMM	BEngTech (Audio), MDesSc (Acoustics)
	David Sallak	EMM	BE (Mech), Dip (Mech Eng)
Social and consultation	Brett McLennan	EMM	BTP (Hons), BSc (Hons)
	Michael Askew	EMM	Bbus (Management, Environmental & Urban), MEnvSt, PhD (Environmental Studies)
	Louise Askew	EMM	PhD (Geography), BSc (Hons)
Surface water	David Newton	WRM Water and Environment	BE (Hons), MEngSt, PhD (CPEng)
	Tallulah Kaegi	WRM Water and Environment	BE (Hons)
Traffic	Tim Brooker	EMM	PhD, BScEng
Visual	Esther Dickens	IDS	BA Design (Hons) (Landscape Architecture)

Appendix C

Surrounding residences and assessment locations

Appendix C — Surrounding residences and assessment locations

C

Assessment location ID	Property owner
1	Judith Leslie
2	Shayne Aaron Currie
3	Charleroi Pty Limited
4	Graeme O'Brien & Susann Florence O'Brien
5	Daniel Bruce Jones
6	Russell James Doidge, Trinette Louise Reid
7	Darral Keith Margery & Annette Gaye Margery
8	Laurence Fletcher, Margaret Ann Fletcher
9	Donald Bruce Roser
10	Andrew Mark Robey, Kim Luanne Robey
11	Wambo Mining Corporation Pty. Limited
12	Ronald Alexander Corino, Pauline Rayner
13	Ilario Francisco Circosta, Maria Angela Circosta*
14	Karin Margaret Hunt
15	William Lindsay Gordon Slaney, Peta Slaney
16	Leona Ann Williams
17	George David Lianos, Honor Claire Lianos
18	Barry John Anderson, Melissa Gai Anderson
19	Denis Cyril Maizey, Elaine Margaret Maizey
20	Gregory William Banks, Marion Elizabeth Banks
21	Gregory William Banks, Marion Elizabeth Banks
22	Elizabeth Mackenzie
23	Peter Jason Kolatchew, Heidi Kolatchew
24	Ronald Garry Bailey, Fiona Susan Bailey
25	William George Joseph Lambkin, Dawn Lambkin*
26	Barbara Gae Harrison, Trevor Eric Harrison
27	Warkworth Mining Limited
28	Hubert George Upward
29	Ilario Francisco Circosta, Maria Angela Circosta*
30	Damien Michael Hanson, Danielle Louise Hanson
31	Gregory Malcolm Caban
32	Paul Mark Dunn, Susan Joy Urwin
33	Ian Norris Bartholomew, Annette Maria Bartholomew
34	Allan Clyde Lepisto, Nerida Lepisto
35	Lawrence Malcolm Caban, Rhonda Beryl Caban
36	Raymond Carl Powell
37	Gregory Paul Crowe
38	Benjamin John Street, Jami Ann Street
39	Gregory John Mcnaught
40	Margaret Player, John Maclachlan Player
41	Hubert George Upward
42	Mark Anthony Lancaster, Debbie Marie Lancaster
43	Geoffrey Allen Burgess, Betty Joy Burgess
44	Barry Fogwell
45	Adam Charles Cameron
46	Jason Phillip Horn
47	Philip Adamthwaite

Assessment location ID	Property owner
48	Brett James Gallagher, Rebecca Louise Gallagher
49	John Thompson, Delwyn Kay Jackson
50	Bradley Richard Sales, Sharon Ann Bellamy
51	Warkworth Mining Limited
52	Stewart James Mitchell, Marie Clare Mitchell
53	Robert Mclaughlin
54	Christopher Stanley Neville & Elizabeth Ann Neville
55	Robert John Evans
56	Leonard Walter Mclachlan, Noelene Rita Mclachlan
57	Paul William Harris, Tracey Anne Swindail
58	David Andrew Gregory
59	Warkworth Mining Limited
60	Vaughan Thomas Cagney, Candice Rose Albert
61	Darrell Stanley Kaizer
62	Dwi Octaviani
63	Margueriette Ann Henneberry, Paul Andrew Burgess
64	Dusko Dragicevic, Milan Dragicevic
65	Gordon Keith Grainger, Selma Rosalind Grainger
66	Michael Vivian Bendall, Sue-Ellen Bendall
67	Michael Shane Dawson & Suzana Dawson
68	Warkworth Mining Limited
69	Warkworth Mining Limited
70	Peter Francis Ritchie And Fiona Jennifer Ritchie
71	Robert Ian Hedley, Jan Maree Louis
72	Frank Henry Turnbull
73	Phillip Joseph Reid, Carol Reid
74	Ronald Guy Godyn, Anne-Marie Godyn
75	Lindsay Robert Smith, Jillian Maree Smith
76	The State Of New South Wales
77	William Joseph Kelly, Marie Joyce Kelly, Lawrence Kelly
78	Warkworth Mining Limited
79	Wambo Mining Corporation Pty. Limited
80	Dimitrious Vikas & Joy Mary Vikas
81	Agl Energy Limited
82	Stephen Glenn Williamson, Nicole Leanne Highett
83	Xstrata Coal Pty Limited
84	Mary Veronica Thompson
86	The State Of New South Wales
87	Andre Marc Renaud, Noela Mary Renaud*
89	Bryan Dudley Medhurst
90	Coal & Allied Operations Pty Limited
91	Wambo Coal Pty Limited
92	Saxonvale Coal Pty Limited, Nippon Steel Australia Pty Limited
93	Coal & Allied Operations Pty Limited
94	Wambo Coal Pty Limited
95	Miller Pohang Coal Company Pty Limited
96	Wambo Mining Corporation Pty. Limited

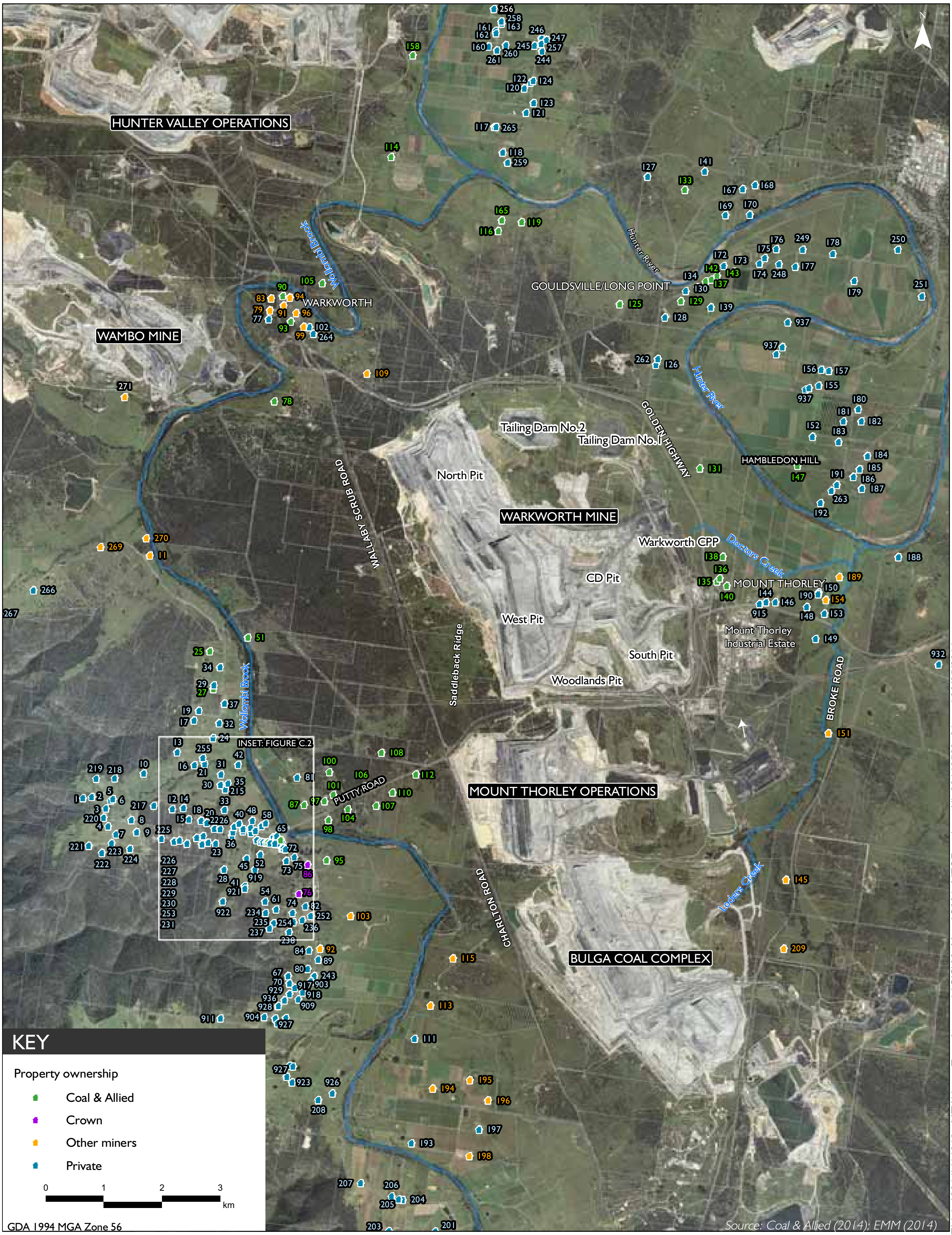
Assessment location ID	Property owner
97	Warkworth Mining Limited
98	Miller Pohang Coal Company Pty Limited
99	Wambo Coal Pty Limited
100	Miller Pohang Coal Company Pty Limited
101	Miller Pohang Coal Company Pty Limited
102	Brian Edward Kennedy, John Griffiths
103	Saxonvale Coal Pty. Limited, Nippon Steel Australia Pty. Limited
104	Miller Pohang Coal Company Pty Limited
105	Coal & Allied Operations Pty Limited
106	Miller Pohang Coal Company Pty Limited
107	Miller Pohang Coal Company Pty Limited
108	Miller Pohang Coal Company Pty Limited
109	Xstrata Coal (Nsw) Pty Limited
110	Miller Pohang Coal Company Pty Limited
111	Ian Wallace Russell
112	Miller Pohang Coal Company Pty Limited
113	Saxonvale Coal Pty Limited, Nippon Steel Australia Pty Limited
114	Coal & Allied Operations Pty Limited
115	Saxonvale Coal Pty. Limited, Nippon Steel Australia Pty. Limited
116	Coal & Allied Operations Pty Limited
117	Phillip John Algie, Colleen Ann Maree Algie
118	Robert John Algie
119	Coal & Allied Operations Pty Limited
120	Russell John Wenham, Janelle Susan Wenham
121	Julie Gai Ernst, Gregory John Ernst
122	Stephen Douglas Edwards, Terri-Anne Howard, Joselyn Vida Clifton
123	Neil Robert Nelson, Glenda Joy Nelson
124	Stephen Douglas Edwards, Terri-Anne Howard, Joselyn Vida Clifton
125	Coal & Allied Operations Pty Limited
126	Peter Glen Stuart
127	Noel Francis Riley, Elaine Roslyn Riley
128	Warren John Welsh, Adam John Young
129	Coal & Allied Operations Pty Limited
130	Francescantonio Ventra, Joanne Ventra
131	Warkworth Mining Limited
133	Coal & Allied Operations Pty Limited
134	Andrew Arthur Barrett, Nicole Maree Kenny
135	Warkworth Mining Limited
136	Warkworth Mining Limited
137	Coal & Allied Operations Pty Limited
138	Warkworth Mining Limited
139	Kevin Denis Hartcher, Linda Anne Hartcher
140	Warkworth Mining Limited
141	Warren Thomas Barry, Lesley Una Barry
142	Coal & Allied Operations Pty Limited
143	Coal & Allied Operations Pty Limited
144	Jason Cyril Rumbel, Rebecca Ruth Rumbel

Assessment location ID	Property owner
145	Saxonvale Coal Pty. Limited, Nippon Steel Australia Pty. Limited
146	Paul Henry Russell
147	Warkworth Mining Limited
148	Dorothy Clare Russell
149	Timothy Peter Hedley
150	Keith David Isaac, Sharon Ann Isaac
151	Bulga Coal Management Pty Limited
152	Graham Edwin Berry, Elizabeth Anne Berry
153	Thomas William Kermode, Kathleen May Kermode
154	Bulga Coal Management Pty Limited
155	Trevor Keith Berry, Graham Edwin Berry
156	Jean Mary O'Hara
157	Jean Mary O'Hara
158	Coal & Allied Operations Pty Limited
160	Elizabeth Stuart Bowman
161	Wyoming Holsteins Pty Limited
162	Wyoming Holsteins Pty Limited
163	Wyoming Holsteins Pty Limited
165	Coal & Allied Operations Pty Limited
167	Nathan James Laing
168	Stuart Francis Nichol Wright, Pamela Lynn Wright
169	Harold Douglas Hobden
170	John Marcheff
172	John Stuart Gough, Lynette Jean Gough
173	Michael John Wellard, Faye Denise Wellard
174	Margaret Anne Neal
175	Bradley John Halter
176	Michael Raymond Mapp, Shirley Maree Mapp
177	Greig Andrew Delaney
178	Craig Ian Flissinger, Catherine Anne Flissinger
179	Tickalara Pty. Limited
180	Bruce Graham Moore
181	David Charles Vassallo, Sheree Ann Vassallo
182	Robert Francis Holstein And Andrea Terry Holstein
183	Paul Anthony Cavanough, Jacinta Jade Dawkins
184	Campbell Stuart Ball And Gail Agnes Ball
185	Leonard Dale Franks
186	Leonard Dale Franks
187	Keith Heuston Pty. Limited
188	Comserve (No.932) Pty Ltd
189	Bulga Coal Management Pty Limited
190	Keith David Isaac, Sharon Ann Isaac
191	Robert John Vidler, Coral May Vidler
192	Jean Mary O'Hara
193	Robert Kennedy
194	Saxonvale Coal Pty Limited, Nippon Steel Australia Pty Limited
195	Saxonvale Coal Pty Limited, Nippon Steel Australia Pty Limited

Assessment location ID	Property owner
196	Saxonvale Coal Pty Limited, Nippon Steel Australia Pty Limited
197	Robert Kennedy
198	Saxonvale Coal Pty Limited, Nippon Steel Australia Pty Limited
199	Adrian Garton, Susan Jean Garton
200	Karren Anne Mccraw, Kenneth Ian Mccraw
201	Richard James Owens
202	Richard James Owens
203	Grapemen Holdings Pty Limited
204	Brenda Joan Tanner
205	Victoria Ann Foster
206	Theo Poulos, Maria Poulos
207	John Stephen Tulloch
208	Cybele Genevieve Orton
209	Saxonvale Coal Pty Limited, Nippon Steel Australia Pty Limited
210	Meria Violet Ford
211	Mike Dean Silk, Antoinette Silk
215	Allan Wayne Louis, Cheryl Anne Louis
217	Packtron Packaging Pty Limited
218	Phillip John Haerse, Elizabeth Rae Haerse
219	Philip Geoffrey Carroll
220	George Jiri Tlaskal
221	Christina Mary Metlikovec
222	John Vincent Putland
223	Andrew Glenn Upward
224	Rex Wayne Davis, Heather Anne Davis
225	Anthony and Trudie Seibel – Barnes
226	Neale Mccallum, Julie Marie Mcnaughton
227	Ian Wyn Jones, Karen Michelle Jones
228	Jason Peter Passlow, Belinda Louise Lee
229	Maurice Francis Chapman, Nellie Vera Chapman
230	Paul Dermot Byrne O'Toole, Melissa Jane O'Toole
231	Mark Mcalpin Roser, Nicole Roser
234	Robert John Bridge, Kylie Terese Bridge
235	Garrett James Walters & Clare Joanne Gowans
236	Scott Francis Ryan
237	Leslie Carol Krey
238	Raymond George Caban, Kathryn Louise Caban
243	John Patrick Cant, Cherie Margaret Cant
244	Todd Anthony Mills, Sharron Ann Mills
245	Chriss Ivan Maskey
246	Paul Raymond Burley, Catherine Maree Burley
247	Tony Zanardi, Sandra Maree Zanardi
248	Keith Joseph Horne
249	Thomas William Watson, Betty Watson
250	John Michael Woods
251	Frederick John & Carole Maria Flinn
252	Jaques Family Investments Pty Limited

Assessment location ID	Property owner
253	Stuart Edward Reakes
254	Peter William Shore & Melanie Louise Shore
255	Ilario Francisco Circosta, Maria Angela Circosta*
256	Bruce Eric Moxey, Thea Anne Moxey
257	Robert John Algie
258	Wyoming Holsteins Pty Limited
259	Robert John Algie
260	Wyoming Holstiens Pty. Limited
261	Wyoming Holstiens Pty. Limited
262	Peter Glen Stuart
263	John Klasen, Ruth Anne Klasen
264	George Robert Miller
265	Phillip John Algie, Colleen Ann Maree Algie
266	Ronald Wayne Fenwick
267	Kenneth Max Brosi
268	Kenneth Max Brosi, Julie Anne Brosi & Pauline June Mcloughlin
269	Wambo Mining Corporation Pty Limited
270	Wambo Mining Corporation Pty Limited
271	Wambo Mining Corporation Pty Limited
903	Adam John Baker
904	Allan Mark Brasington, Judith Anne Brasington
905	Cameron Michael Turner, Melissa Jayne Harris
909	Emanuel Victor Vassallo
911	Gary Dale Harris
915	Jason Cyril Rumbel, Rebecca Ruth Rumbel
917	John Robert Lamb
918	Joseph Vassallo, Doris Vassallo
919	Kenneth Neil Cameron
920	Lindsay Gordon Harris, Jillian May Ferguson
921	Melanie Caban, Keiran Lionel Caban
922	Melanie Evelyn Upward
923	Michelle Maria Brennan
926	Paul William Mackay, Suzanne Elizabeth Mackay
927	Phillip John Gunter, Leona Mary Gunter
928	Sarah Elizabeth Purser, Stirling Owen Keayes
929	Simon James Beavis
932	Stephen Dennis Tipping
936	Thomas Charles Jackson, Susan Gai Jackson
937	Trevor Keith Berry, Graham Edwin Berry

** at date of document publication private residence status still being determined on land transfer and have been treated as mine owned properties in the EIS.*



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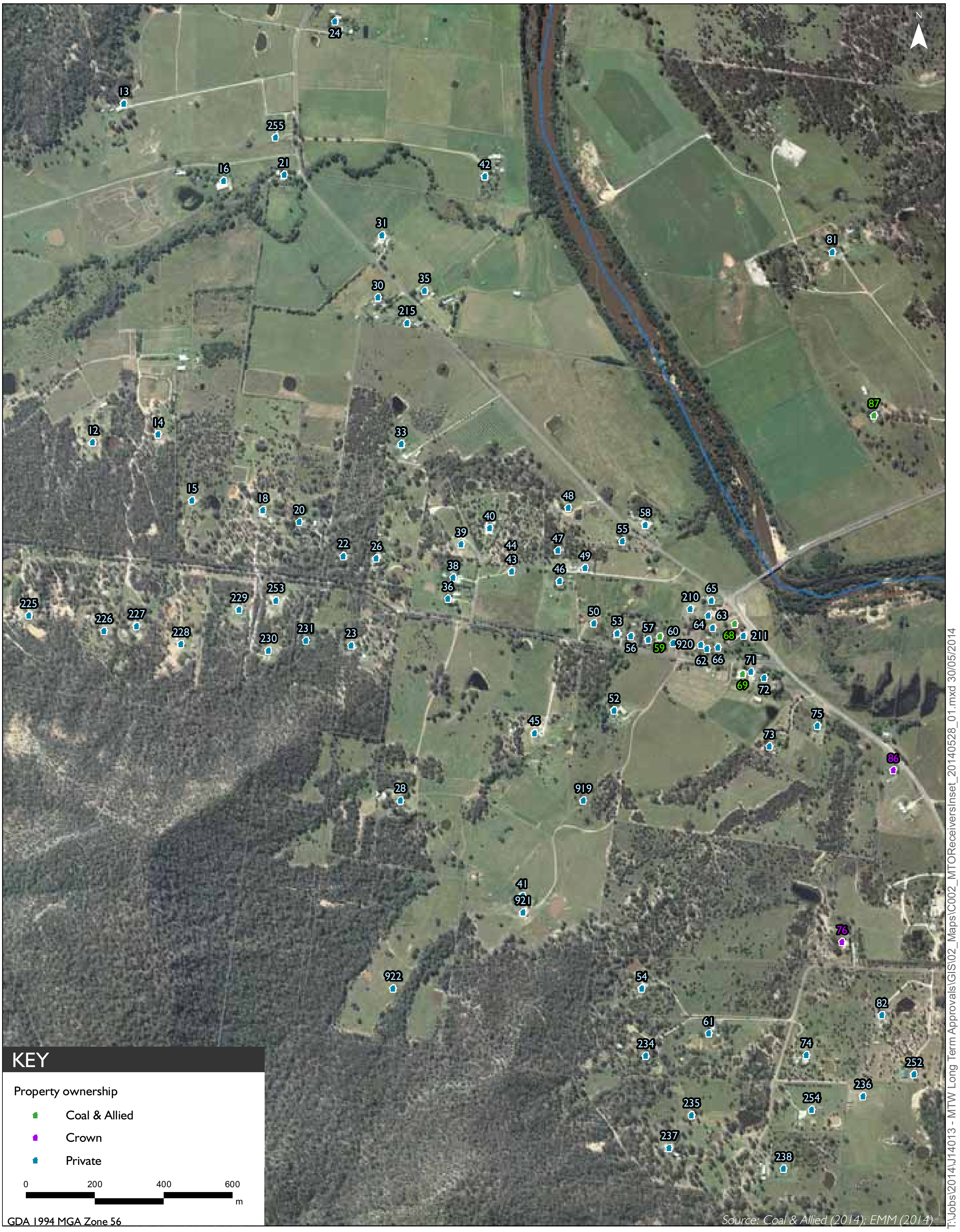
Assessment locations

Mount Thorley Operations 2014
Environmental Impact Statement
Figure C.1



Assessment locations - Bulga area
Mount Thorley Operations 2014
Environmental Impact Statement
Figure C.2

COAL & ALLIED
Managed by Rio Tinto Coal Australia

Appendix D

Secretary's requirements

Appendix D — Secretary's requirements

D

Development Assessment Systems & Approvals
Mining Projects
Contact: Elle Donnelley
Phone: (02) 9228 6340
Fax: (02) 9228 6466
Email: elle.donnelley@planning.nsw.gov.au

Mr Mark Nolan
Principal Advisor Project Approvals NSW
Health, Safety, Environment and Communities
Rio Tinto
PO Box 315
SINGLETON NSW 2330

Dear Mr Nolan

State Significant Development - Secretary's Requirements
Mt Thorley Continuation Project (SSD 6465)

I have attached the Secretary's requirements for the preparation of an Environmental Impact Statement (EIS) for the Mt Thorley Continuation Project.

These requirements are based on the information you have provided to date, and have been prepared in consultation with the relevant government agencies. The agencies' comments are attached for your information (see Attachment 2).

Please note that the Department may alter these requirements at any time, and that you must consult further with the Department if you do not lodge a development application and EIS for the project within the next two years.

Please contact the Department at least two weeks before you plan to submit the development application and EIS for the project. This will enable the Department to:

- confirm the applicable fee (see Division 1AA, Part 15 of the *Environmental Planning and Assessment Regulation 2000*); and
- determine the number of copies (hard-copy and CD-ROM) of the EIS required.

It is important for you to recognise that the Department will review the EIS for the project carefully before putting it on public exhibition, and require you to submit an amended EIS if it fails to adequately address these requirements.

Yours sincerely

DKitto 22/5/14

David Kitto
Director
Mining Projects
As delegate of the Secretary

Secretary's Environmental Assessment Requirements

State Significant Development

Section 78A(8A) of the *Environmental Planning and Assessment Act 1979*

<table>
<tr><td>Application Number</td><td>SSD 6465</td></tr>
<tr><td>Proposal</td><td>The Mt Thorley Continuation Project, which includes:
the continuation of existing and approved development on site;
maintaining maximum coal extraction rates at 10 million tonnes of run of mine coal a year;
receiving coal, tailings and overburden from the Warkworth mine;
receiving overburden from the Bulga mine;
water sharing with other mines;
minor infrastructure upgrades; and
progressively rehabilitating the site.</td></tr>
<tr><td>Location</td><td>Approximately 15 km southwest of Singleton</td></tr>
<tr><td>Applicant</td><td>Mount Thorley Joint Venture</td></tr>
<tr><td>Date of Issue</td><td>22 May 2014</td></tr>
<tr><td>General Requirements</td><td>The Environmental Impact Statement (EIS) for the development must comply with the requirements in Clauses 6 and 7 of Schedule 2 of the Environmental Planning and Assessment Regulation 2000.

In particular, the EIS must include:
a full description of the development, including:
the resource to be extracted, demonstrating efficient resource recovery within environmental constraints;
the mine layout and scheduling;
minerals processing;
a waste (overburden, tailings, etc.) management strategy, dealing with the EPA's requirements (see Attachment 2);
a water management strategy, dealing with the EPA's and NSW Trade and Investment's requirements (see Attachment 2);
a rehabilitation strategy, dealing with NSW Trade and Investment's requirements (see Attachment 2); and
the likely interactions between the development and any other existing, approved or proposed mining development in the vicinity of the site;
a list of any approvals that must be obtained before the development may commence;
an assessment of the likely impacts of the development on the environment, focussing on the specific issues identified below, including:
a description of the existing environment likely to be affected by the development, <u>using sufficient baseline data</u>;
an assessment of the likely impacts of all stages of the development, including any cumulative impacts, taking into consideration any relevant laws, environmental planning instruments, guidelines, policies, plans and industry codes of practice;
a description of the measures that would be implemented to mitigate and/or offset the likely impacts of the development, and an assessment of:
whether these measures are consistent with industry best practice, and represent the full range of reasonable and feasible mitigation measures that could be implemented;
the likely effectiveness of these measures; and
whether contingency plans would be necessary to manage any</td></tr>
</table>

	residual risks; – a description of the measures that would be implemented to monitor and report on the environmental performance of the development if it is approved; • a consolidated summary of all the proposed environmental management and monitoring measures, identifying all the commitments in the EIS; • consideration of the development against all relevant environmental planning instruments (including Part 3 of the *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007);* and • the reasons why the development should be approved having regard to biophysical, economic and social considerations, including the principles of ecologically sustainable development. While not exhaustive, Attachment 1 contains a list of some of the environmental planning instruments, guidelines, policies, and plans that may be relevant to the environmental assessment of this development. In addition to the matters set out in Schedule 1 of the *Environmental Planning and Assessment Regulation 2000*, the development application must be accompanied by a signed report from a suitably qualified expert that includes an accurate estimate of the: • capital investment value (as defined in Clause 3 of the *Environmental Planning and Assessment Regulation 2000*) of the development, including details of all the assumptions and components from which the capital investment value calculation is derived; and • jobs that would be created during each stage of the development.
Specific Issues	The EIS must address the following specific issues: • **Noise & Blasting** – including: - an assessment of the likely operational noise impacts of the development (including construction noise) under the *NSW Industrial Noise Policy*, paying particular attention to establishing accurate background noise levels in the surrounding area and the obligations in chapters 8 and 9 of the policy; - if a claim is made for specific construction noise criteria for certain activities, then this claim must be justified and accompanied by an assessment of the likely construction noise impacts of these activities under the *Interim Construction Noise Guideline*; - an assessment of the likely road noise impacts of the development under the *NSW Road Noise Policy*; and - an assessment of the likely blasting impacts of the development on people, animals, buildings, infrastructure, and significant natural features, having regard to the relevant ANZEC guidelines; • **Air** – including: - an assessment of the likely air quality impacts of the development in accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* and the EPA's additional requirements (see Attachment 2); and - an assessment of the likely greenhouse gas impacts of the development, dealing with the EPA's requirements (see Attachment 2); • **Water** – including: - an assessment of the likely impacts of the development on the quantity and quality of the region's surface and groundwater resources, having regard to the EPA's and NSW Trade and Investment's requirements (see Attachment 2); - an assessment of the likely impacts of the development on aquifers, watercourses, riparian land, water-related infrastructure, and other water users; and - an assessment of the likely flooding impacts of the development; • **Land** – including: - an assessment of the likely impacts of the development on the soils,

	land capability, and landforms (topography) of the site; and - an assessment of the compatibility of the development with other land uses in the vicinity of the development in accordance with the requirements in Clause 12 of *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007*; • **Traffic** – including an assessment of the likely traffic impacts of the development on the capacity, condition, safety and efficiency of the local and State road network; • **Visual** – including an assessment of the likely visual impacts of the development on private landowners in the vicinity of the development and key vantage points in the public domain, the creation of new landforms (overburden dumps, bunds, etc.), and minimising the lighting impacts of the development; • **Biodiversity** – ongoing management of approved impacts on biodiversity; • **Heritage** – ongoing management of approved impacts on Aboriginal and historic heritage (cultural and archaeological); • **Public Safety** – including an assessment of the likely risks to public safety off-site, paying particular attention to bushfire risks and the handling and use of any dangerous goods; • **Social & Economic** – including: - an assessment of the likely social impacts of the development (including perceived impacts), paying particular attention to any impacts on Bulga village; and - an assessment of the likely economic impacts of the development, and paying particular attention to: o the significance of the resource; o economic benefits of the project for the State and region; and o the demand for the provision of local infrastructure and services.
Consultation	During the preparation of the EIS, you must consult with relevant local, State or Commonwealth Government authorities, service providers, community groups and affected landowners. The EIS must describe the consultation that was carried out, identify the issues raised during this consultation, and explain how these issues have been addressed in the EIS.

ATTACHMENT 1

Environmental Planning Instruments, Policies, Guidelines & Plans

Noise & Blasting	
	NSW Industrial Noise Policy (EPA)
	NSW Road Noise Policy (EPA)
	Interim Construction Noise Guideline (EPA)
	Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration (ANZEC)
Air	
	Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (EPA)
	Approved Methods for the Sampling and Analysis of Air Pollutants in NSW (EPA)
	Coal Mine Particulate Matter Control Best Practice – Site Specific Determination Guideline (EPA)
	Generic Guidance and Optimum Model Settings for the CALPUFF Modelling System for Inclusion in the Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (EPA)
	National Greenhouse Accounts Factors (Commonwealth)
Water	
Water Sharing Plans	Hunter Unregulated and Alluvial Water Sources 2009
	Hunter Regulated River Water Source 2003
Groundwater	NSW State Groundwater Policy Framework Document (NOW)
	NSW State Groundwater Quality Protection Policy (NOW)
	NSW State Groundwater Quantity Management Policy (NOW)
	NSW Aquifer Interference Policy 2012 (NOW)
	Australian Groundwater Modelling Guidelines 2012 (Commonwealth)
	National Water Quality Management Strategy Guidelines for Groundwater Protection in Australia (ARMCANZ/ANZECC)
	Guidelines for the Assessment & Management of Groundwater Contamination (EPA)
Surface Water	NSW Government Water Quality and River Flow Objectives (EPA)
	Using the ANZECC Guideline and Water Quality Objectives in NSW (EPA)
	National Water Quality Management Strategy: Australian Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ)
	National Water Quality Management Strategy: Australian Guidelines for Water Quality Monitoring and Reporting (ANZECC/ARMCANZ)
	National Water Quality Management Strategy: Guidelines for Sewerage Systems – Effluent Management (ARMCANZ/ANZECC)
	National Water Quality Management Strategy: Guidelines for Sewerage Systems – Use of Reclaimed Water (ARMCANZ/ANZECC)
	Hunter River Salinity Trading Scheme (EPA)
	Approved Methods for the Sampling and Analysis of Water Pollutants in NSW (EPA)
	Managing Urban Stormwater: Soils & Construction (Landcom) and associated Volume 2E: Mines and Quarries (DECC)
	Managing Urban Stormwater: Treatment Techniques (EPA)
	Managing Urban Stormwater: Source Control (EPA)
	Technical Guidelines: Bunding & Spill Management (EPA)
	Environmental Guidelines: Use of Effluent by Irrigation (EPA)
	A Rehabilitation Manual for Australian Streams (LWRRDC and CRCCH)
	NSW Guidelines for Controlled Activities (NOW)
Flooding	Floodplain Development Manual (OEH)
	Floodplain Risk Management Guideline (OEH)

Land	
	Agfact AC25: Agricultural Land Classification (NSW Agriculture)
	State Environmental Planning Policy No. 55 – Remediation of Land
	Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites (ANZECC)
Traffic	
	Guide to Traffic Generating Development (RTA)
	Road Design Guide (RTA) & relevant Austroads Standards
Public Safety	
	State Environmental Planning Policy No. 33 – Hazardous and Offensive Development
	Hazardous and Offensive Development Application Guidelines – Applying SEPP 33
	Hazardous Industry Planning Advisory Paper No. 6 – Guidelines for Hazard Analysis
Resource	
	Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves 2012 (JORC)
Waste	
	Waste Classification Guidelines (DECC)
Rehabilitation	
	Mine Rehabilitation – Leading Practice Sustainable Development Program for the Mining Industry (Commonwealth)
	Mine Closure and Completion – Leading Practice Sustainable Development Program for the Mining Industry (Commonwealth)
	Strategic Framework for Mine Closure (ANZMEC-MCA)
Environmental Planning Instruments - General	
	State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007
	State Environmental Planning Policy (State and Regional Development) 2011
	State Environmental Planning Policy (Infrastructure) 2007
	Singleton LEP 2013

For *Attachment 2 Agency Correspondence* please refer to the Department of Planning and Environment's website at http://www.planning.nsw.gov.au/

Appendix E

Economic study

Appendix E — Economic study

E

Economic Impact Assessment for Warkworth Continuation 2014 and Mount Thorley Operations 2014

Prepared for Rio Tinto Coal Australia

Client name: RTCA
Date: June 2014

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Abbreviations

ABS	Australian Bureau of Statistics
ASNA	Australian System of National Accounts
BBAM	Biobanking Assessment Methodology
BCAM	Biodiversity certification assessment methodology
BMP	Biodiversity Management Plan
CBA	Cost benefit analysis
CHPP	Coal handling and preparation plant
CMP	Conservation management plan
EEC	Endangered ecological community
EIS	Environmental impact statement
FTE	Full-time equivalent
GDP	Gross domestic product
GOS	Gross operating surplus
GMI	Gross mixed income
GSP	Gross state product
ha	Hectare
HMP	Heritage management plan
HVRF	Hunter Valley Research Foundation
INP	Industrial Noise Policy
IPCC	Intergovernmental Panel on Climate Change
LGA	Local government area
MAGICC	'Model for the Assessment of Greenhouse Gas Induced Climate Change'
MTCL	Mount Thorley Coal Loader
MTO	Mount Thorley Operations
Mtpa	Million tonnes per annum
MTW	Mount Thorley Warkworth
NBA	Northern Biodiversity Area
REIA	Regional economic impact analysis
ROM	Run of mine

RUCs	Road user costs
SBA	Southern Biodiversity Area
SCC	Social cost of carbon
UHSA	Upper Hunter Strategic Assessment
VOCs	Vehicle operating costs
WBACHCA	Wollombi Brook Aboriginal Cultural Heritage Conservation Area
WMS	Water management system
WTA	Willingness-to-accept
WSW	Warkworth Sands Woodland
WTP	Willingness-to-pay
ZOA	Zone of acquisition

Summary

This report describes the direct and flow-on economic benefits of the proposed continuation of operations at Mount Thorley Warkworth (MTW) for the Mid and Upper Hunter region and for NSW.

The proposal is for the continuation of existing operations of an integrated mining complex – consisting of the Warkworth Mine and the Mount Thorley Operations (MTO) – beyond the timeframe permitted under the mines' existing consents until 2035. Two separate applications (proposals) will be lodged to continue operations at MTW; one for Warkworth Mine and one for MTO.

MTW has the necessary infrastructure in place to extend the life of the mine, and currently employs around 1,300 employees and contractors.

The analysis described in this report has been prepared in accordance with relevant NSW Government guidelines, including the 'Guideline for the use of Cost Benefit Analysis in mining and coal seam gas proposals' (NSW Government 2012), the 'Guideline for economic effects and evaluation in EIA' (Planning NSW 2002), and the 'NSW Government Guidelines for Economic Appraisal' (NSW Treasury 2007).

Direct economic benefits

The extent to which a project contributes directly to the economic welfare of a state or region is measured with reference to value added. Value added is the additional value of goods and services that are newly created in an economy, and that are available for domestic consumption or for export. Value added is a central concept in the Australian System of National Accounts (ASNA). Subject to some adjustments, the sum of gross value added across all industries in a State equals gross state product (GSP). Whether the proposed continuation of operations at MTW benefits NSW has therefore been determined by examining its (net) impact on the GSP of NSW.

The economic effects described in this report refer to 'incremental' or 'net' impacts relative to the reference case (the counterfactual) whereby the proposals are not approved. The reference case assumes that mining at MTW continues until the Warkworth Mine development consent expires in May 2021, and the MTO development consent in June 2017. However, mining at Warkworth Mine's West Pit is expected to reach the existing consent limit in 2015, at which point production may no longer be economically viable. The estimated net benefits presented in this report are therefore conservative.

In net present value (NPV) terms, the continuation of operations at MTW would deliver direct net benefits to NSW of almost A$1.5 billion. These net benefits take the form of:

- the additional disposable income received by MTW employees and long-term contractors who live in NSW, around A$612 million in NPV terms;
- the additional coal royalties paid to the NSW government of around A$617 million in

NPV terms; and

- additional payroll taxes, council rates and other payments that accrue to State and local government, and which amount to around A$259 million in NPV terms.

Almost three quarters of MTW employees and long-term contractors live in the Mid and Upper Hunter region. Around A$464 million in NPV terms in additional disposable income would flow to that region.

The assumptions underpinning the derivation of wages and salary benefits described above are conservative. It has been assumed that, in the event that the proposals are not approved and MTW closes by 2021, most MTW employees and contractors would find alternative employment in the Mid and Upper Hunter region. It is noted, however, that unemployment in the Mid and Upper Hunter region has trended upward noticeably in recent years.

State-wide flow-on effects

In addition to the direct effects described above, the continuation of operations at MTW is expected to have positive flow-on effects on the NSW economy. These (indirect) flow-on effects are a reflection of the significant projected expenditures on wages and salaries, and on other mining inputs by MTW. The additional demand for labour, goods and services sets the economy in motion as businesses buy and sell goods and services from one another and households earn and spend additional income. These linkages between businesses and households cause the total effects on the regional and state economy to exceed the initial change in demand by MTW.

The initial flow-on effects of the proposals (taking account only of the *immediate* impacts on other industries who produce the additional inputs required by MTW) are estimated at:

- A$385 million in additional income (in NPV terms) for NSW (A$33 million annually);
- additional annual employment of around 206 full-time equivalent workers in NSW; and
- an increase in the GSP of NSW of around A$450 million in NPV terms (A$39 million annually).

Regional flow-on effects

Significant positive flow-on effects are also expected for the Mid and Upper Hunter region. The initial flow-on effects are estimated at:

- around A$227 million in additional income (in NPV terms) would flow to the Mid and Upper Hunter region; and
- additional annual employment of around 214 full-time equivalent workers.

The employment flow-on effects for the Mid and Upper Hunter region are not directly comparable with those for NSW (and are higher than for NSW). This effect arises because the movement of labour and substitution effects have been accounted for: MTW would continue to offer a significant number of jobs in the Mid and Upper Hunter region if the proposals are approved (continued employment of around 1,300 positions on average over the life of the proposals), but a share of these employees or contractors can be expected to come from outside the region (from other positions in NSW). Therefore the aggregate (net) employment benefits tend to become smaller, as the geographical scope of the analysis expands.

Effects on the Singleton local government area

Thirty five per cent of MTW's employees and long-term contractors live in Singleton. The estimated flow-on effects for the Singleton local government area (LGA) are:

- around A$84 million in additional income (in NPV terms); and
- additional annual employment of around 61 full-time equivalent workers.

Relative contribution of Warkworth Mine to NSW benefits

While Warkworth Mine and MTO would continue to operate as an integrated mining complex if the applications are approved, the relative contributions of the two mines to the benefits that would accrue to NSW have also been examined. The analysis indicates that the direct (net) economic benefit that can be attributed to Warkworth Mine is around $1,339 million in NPV terms, or 90 per cent of the contribution of the MTW Continuation Project to NSW GSP.

Where the economic flow-on effects of the proposals are concerned, the benefits attributable to Warkworth Mine amount to:

- for NSW, around $346 million in additional income (in NPV terms), additional annual employment of 191 full-time equivalent workers, and a contribution to NSW GSP of around $406 million;
- for the Mid and Upper Hunter region, around $204 million in additional income in NPV terms, and additional annual employment of 198 full-time equivalent workers; and
- for the Singleton LGA, around $75 million in additional income in NPV terms, and additional annual employment of 57 full-time equivalent workers.

Relative contribution of MTO to NSW benefits

The analysis indicates that the direct (net) economic benefit that can be attributed to MTO is around $149 million in NPV terms, or 10 per cent of the contribution of the MTW Continuation Project to NSW GSP.

Where the economic flow-on effects of the proposals are concerned, the benefits attributable to MTO amount to:

- for NSW, around $39 million in additional income (in NPV terms), additional annual employment of 15 full-time equivalent workers, and a contribution to NSW GSP of around $45 million;
- for the Mid and Upper Hunter region, around $23 million in additional income in NPV terms, and additional annual employment of 16 full-time equivalent workers; and

- for the Singleton LGA, around $9 million in additional income in NPV terms, and additional annual employment of 4 full-time equivalent workers.

State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007

Section 12AA of the State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007 (Mining SEPP) requires that the consent authority must consider the significance of the resource that is the subject of the application, having regard to benefits, both to the State and the region in which the development is proposed, including (sub-section (2)):

a) employment generation;

b) expenditures, including capital investment; and

c) the payment of royalties to the State.

A summary of the incremental benefits associated with the proposal for these key measures is provided in Table 1-1 below. Approvals of the proposals would result in:

- additional employment generation of 1,307 full-time equivalent (FTE) jobs on average per year for MTW as a whole;
- total additional (operating and capital) capital expenditures of A$6 billion in NPV terms; and
- total additional royalty payments of A$617 million in NPV terms.

Table 1-1. Summary of incremental benefits of the MTW Continuation Project

	Employment generation (annual average FTEs)		Incremental Expenditure (A$ m NPV)	Incremental royalties (A$ m NPV)
	Without approvals (reference case)	With approvals		
MTW	987 over 7 years	1,307 over 21 years	$6,020	$617
Warkworth Mine	835 over 7 years	1,187 over 21 years	$5,723	$567
MTO	152 over 7 years	121 over 21 years	$297	$50

Notes: Totals may not sum due to rounding. NPVs calculated using a discount rate of 7 per cent.

1 Introduction

BAEconomics was commissioned by Rio Tinto Coal Australia to prepare an economic impact assessment of the proposed Warkworth Continuation 2014 and Mount Thorley Operations (MTO) 2014.

The operations at MTO and Warkworth Mine are integrated, and the economic impact assessment has been based on the combined projects (the proposals). This assessment forms part of the environmental impact statement (EIS) for each project. Additionally, a separate economic impact assessment has been prepared for MTO to assess the relative contributions of Warkworth Mine and MTO, respectively, to the direct and flow-on benefits that have been identified.

1.1 Purpose of the economic impact assessment

The proposals would permit MTW operations to continue until 2035 and maintain the current workforce comprising approximately 1,300 people. This economic impact assessment forms part of the EIS that accompanies applications by Coal & Allied for the proposals, in accordance with Part 4, Division 4.1 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). The report is intended to assist Planning and Infrastructure (P&I) in their assessment of the merit of the proposal and inform the Minister for Planning and Infrastructure in determining as to whether or not to grant approval.

The economic assessment has two components, a cost benefit analysis (CBA) and a regional economic impact analysis (REIA). The 'Guideline for the use of Cost Benefit Analysis in mining and coal seam gas proposals' (NSW Government 2012) recommends that applicants for a mining proposal submit a CBA with their development application. The purpose of the CBA is to examine the welfare implications of the application. The 'Guideline for economic effects and evaluation in EIA' (Planning NSW 2002) furthermore recommends that, if a proposal is predicted to have significant economic impacts at a regional or state scale, these regional or state-wide effects should be formally assessed. This report has been prepared in accordance with Director-General's requirements as known at the time of writing.

1.2 Structure of this report

This report is structured as follows:

- Section 2 describes the proposals and regional economic context.
- Section 3 describes the CBA approach and the approach to valuing external effects, the results of the CBA in terms of the welfare implications of the proposals for NSW, and the relative contribution of MTO to these benefits.
- Section 4 describes the predicted regional impacts of the proposals on the Singleton LGA, Mid and Upper Hunter region and on NSW, as well as the relative contribution of MTO.

Supporting documentation is presented in five appendices:

- Appendix A provides additional detail on the methodology and assumptions used to derive the CBA;
- Appendix B describes the external effects identified for the MTW Continuation Project;
- Appendix C describes the external effects attributed separately to MTO;
- Appendix D describes the derivation of the input-output multipliers; and
- Appendix E describes the CBA and the REIA undertaken separately for MTO.

2 The proposals in context

This section describes the current operations of the Warkworth Mine and MTO, the proposals, and sets out the regional context.

2.1 Operational context

Warkworth Mine is an existing open cut coal mine with an approved production rate of 18 million tonnes per annum (Mtpa) of run of mine (ROM) coal, which is equivalent to approximately 12.5 Mtpa of product coal until May 2021. Warkworth Mine is located approximately 15 km southwest of Singleton in the Hunter Valley, and within the Singleton local government area (LGA). Warkworth Mine operates three open cut pits: North, South and West pits. Coal extraction at South Pit is coming to a close with future production at Warkworth Mine to come from West and North pits.

Mining in West Pit at Warkworth Mine is expected to reach consent limits in 2015, which would result in mining at a reduced strike. This would in turn reduce mining below economically viable production rates. The proposal is seeking to extend the spatial limit approved under the current development consent to enable mining in West Pit along the full strike length, and subsequently, to enable the two main pits, North and West Pit, to advance to the west.

MTO is an existing open cut mine that adjoins Warkworth Mine. MTO's current development consent enables the extraction of 10 Mtpa of ROM coal, equivalent to approximately 8 Mtpa of product coal, until June 2017.

Warkworth Mine and MTO were originally developed separately. In 2004, Warkworth Mining Limited (WML) and the owners of MTO entered into an agreement to integrate their respective mining operations. The integrated operation encompassing Warkworth Mine and MTO is known as Mount Thorley Warkworth (MTW). MTW is managed and operated by Coal & Allied, a company owned by Rio Tinto Company, on behalf of the joint venture (JV) partner owners of MTW.

MTW operates under a single management team, and utilises a single workforce and equipment fleet. The agreement also provides for sharing of infrastructure and resources. Hence, MTW operates an integrated mine water management system, and shares management infrastructure, coal handling and preparation plant (CHPP) infrastructure, and other facilities. ROM coal from Warkworth Mine is transported to either the Warkworth CHPP or the Mount Thorley CHPP for processing. Product coal from the Warkworth CHPP is transported via conveyor to either the Mount Thorley Coal Loader (MTCL) or to Redbank Power Station. Coal loaded onto trains at the MTCL is transported to the Port of Newcastle for export.

2.2 Scope of the economic assessment

This economic assessment relates to two applications for MTW; for Warkworth Mine and for MTO, respectively. Approval of the two applications would enable the continued joint operation of the mines while using the existing facilities. The justification for the combined assessment of the proposals is provided in Section 3.1.

2.2.1 Warkworth Mine development application

Warkworth Mine has approval to operate until 19 May 2021 under its development consent. The application seeks a new development consent to enable the ongoing operation of Warkworth Mine for around 21 years from the date of approval, at the existing maximum production rate of 18Mtpa of ROM coal. If approval is granted in late 2014, operations at Warkworth Mine would continue to 2035, a 14-year extension of the current approval. The application seeks the following changes to the existing layout and operation of Warkworth Mine:

- an extension of the mining footprint of 698 hectares (ha) to the west of current operations (referred to in this document as 'the proposed 2014 extension area');
- the closure of Wallaby Scrub Road;
- the ability to transfer overburden to MTO to complete MTO's final landform;
- an option to develop an underpass between Putty Road for the third bridge crossing yet to be constructed (while retaining the current approval for an overpass);
- minor changes to the design of the Northern out-of-pit (NOOP) dam; and
- the continued use of secondary access gates to the mine site and offsets for activities such as drilling, offset management, equipment shutdown, amongst other things.

All other aspects of the operations of Warkworth Mine, including coal production and processing rates, as well as the integrated operations of Warkworth Mine and MTO would remain unchanged.

2.2.2 MTO development application

MTW is furthermore seeking a new development consent to enable the ongoing operation of MTO for 18 years at the current production rate of 10Mtpa of ROM coal. MTO has approval to mine until 22 June 2017 under its development consent. If approval is granted in 2015, operations at MTO are forecast to continue to the end of 2035.

The proposal seeks a continuation of all aspects of MTO as it presently operates and extends or alters them, including:

- mining in Loders Pit and AGN Pit;
- the ability to transfer of overburden between MTO and Warkworth Mine to assist in rehabilitation and development of the final landform;
- the maintenance and upgrade of the integrated MTW water management system (WMS);
- the maintenance and upgrade of the integrated MTW tailings management system;

- the upgrade of the MTO CHPP to facilitate an increase in maximum throughput to 18Mtpa with the ability to receive this coal from Warkworth Mine;
- the continuation of coal transfer between Warkworth Mine and MTO and transportation of coal via the MTCL to the Port of Newcastle.

All activities, including coal extraction will be within disturbance areas approved under the existing development consent.

2.3 Reference case and proposals scenario

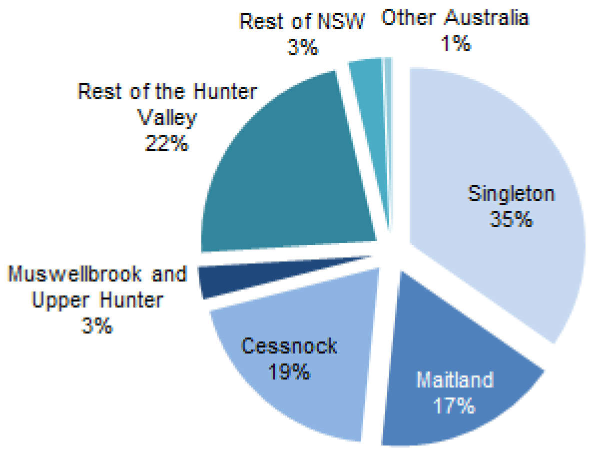
The CBA and REIA described in Sections 3 and 4 of this report, respectively, consider the incremental (net) benefits, and regional and state impacts of the 'proposals' scenario in which the development applications for Warkworth Mine and MTO are approved, relative to a 'reference case' scenario in which the development applications are assumed not to be approved (the counterfactual). The reference case and the proposals scenario differ in terms of their production and employment (and associated costs) profiles:

- In the reference case, coal production at MTW would begin to decline from 2016 onwards and would end in 2021. However, as noted, the reference case is considered 'optimistic', since mining in West Pit at Warkworth Mine is expected to reach the consent limit in 2015, which would result in mining at a reduced strike, and potentially below economically viable production rates. In the proposals scenario, in contrast, production would continue at a level of around 18 Mtpa ROM coal until 2030 and decline toward the end of the open cut life. Production would be completed by the end of 2035.
- In the reference case, employment at MTW would begin to decline from 2016 onwards and all employment at MTW would cease in 2021. In the proposals scenario, the number of full-time employees (FTEs) would be maintained until operations ramp down for expected closure in 2035.

2.4 Local and regional context

The CBA and REIA presented in this report consider the economic impacts of the proposals on NSW. The REIA additionally considers two smaller regions of interest, namely the Singleton LGA and the Mid and Upper Hunter region, which comprises the Singleton, Upper Hunter, Muswellbrook, Cessnock and Maitland LGAs. Around 74 per cent of MTW employees live in the Mid and Upper Hunter region, and 22 per cent live in other LGAs in the Hunter Valley Region (Figure 2-1). Overall, 99 per cent of MTW employees live in NSW.

Figure 2-1. Residences of Mount Thorley Warkworth employees



Notes: Rest of the Hunter Valley refers to Great Lakes, Dungog, Port Stephens, Newcastle, and Lake Macquarie LGAs.

Source: RTCA.

2.4.1 Historical employment and income trends

Table 2-1 provides an overview of the characteristics of the labour force in the Mid and Upper Hunter region based on the Australian Bureau of Statistics (ABS) 2011 Census of Population and Housing:

- In the Mid and Upper Hunter region, Singleton and Muswellbrook stand out as having by far the highest share of persons employed in the mining industry, the lowest rates of unemployment, as well as significantly higher than average incomes.
- The share of persons employed in the mining industry is far higher in the Mid and Upper Hunter region than in the Hunter Valley region overall. Average incomes are correspondingly higher in the Mid and Upper Hunter region.

Table 2-1. Overview of labour force statistics (2011)

	Labour force	Unemployment rate (per cent)	Average wage & salary income [a]	Employed in mining (per cent)
Singleton	11,789	3.4	$62,313	24.6
Maitland	32,829	5.0	$50,647	6.4
Cessnock	22,335	6.5	$48,051	10.2
Upper Hunter	6,771	3.6	$48,075	10.9
Muswellbrook	7,779	4.8	$57,054	21.3
Port Stephens	28,377	6.2	$44,875	1.8
Newcastle	74,540	5.8	$49,187	1.6
Lake Macquarie	88,251	5.3	$47,734	2.6
Great Lakes	12,066	8.3	$38,290	1.5

	Labour force	Unemployment rate (per cent)	Average wage & salary income [a]	Employed in mining (per cent)
Dungog	3,896	4.5	$46,155	3.8
Mid and Upper Hunter region (average)	81,503	5.0	$52,021	14.7
Hunter Valley Region (average)	288,633	5.6	$48,623	8.5

Notes: [a] Wage & salary data are for 2010.
Source: ABS 1379.0.55.001 National Regional Profile, 2007-2011, by LGA.

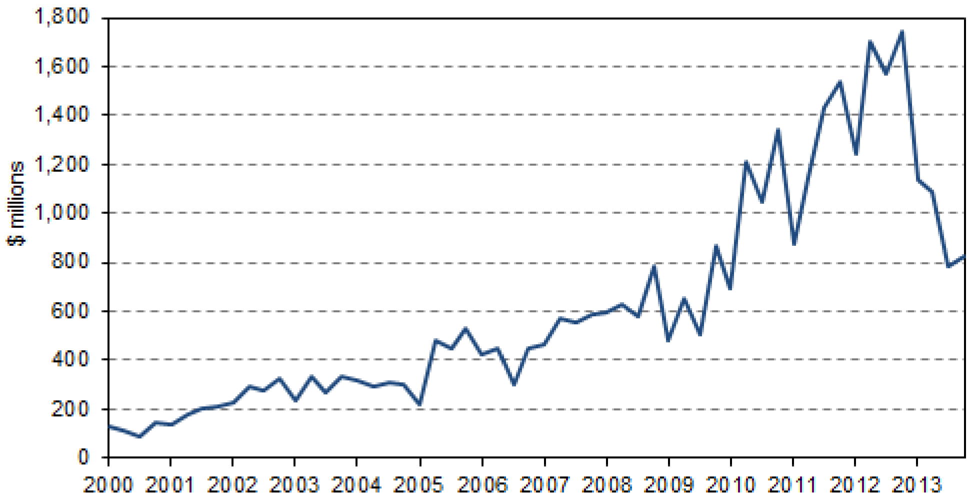
A socio-economic assessment of the Mid and Upper Hunter region undertaken by the Hunter Valley Research Foundation (HVRF 2013) highlights the positive impact of the mining sector on the local economy to date. Across the five LGAs, all income indicators (average wage and salary incomes, median weekly personal, family and household incomes) rose between 2006 and 2011, and at a faster rate than for NSW as a whole. Singleton and Muswellbrook LGAs had the highest levels of average total personal income, and of median personal, family and household income within the Mid and Upper Hunter region. Employment in the mining sector increased by 63 per cent over that timeframe, but other sectors also experienced substantial growth, including construction and other services. In addition, between 2001 and 2011:

- labour force participation increased consistently in all LGAs;
- unemployment fell significantly, and more rapidly than in NSW as a whole;
- the labour force expanded, substantially more so than in NSW as a whole, largely as a result of new migrants and existing residents moving into employment in the mining sector; and
- youth unemployment fell significantly.

2.4.2 Medium-term perspective

A number of indicators suggest that while mining activity was historically very high, significant declines in Australian thermal coal prices, amongst other factors, over the past two years have had a negative impact on activity. Figure 2-2 shows quarterly mining investment in NSW from March 2000 to December 2013. Investment in new tangible assets has fallen by more than half between December 2012 and December 2013. These trends are consistent with the expectation by the HVRF (HVRF 2013a, b) that few additional mining investment proposals will progress in the medium term, excepting moderate expansions of existing mines. Investment intentions on the part of small- and medium sized businesses have similarly declined markedly (HVRF 2014).

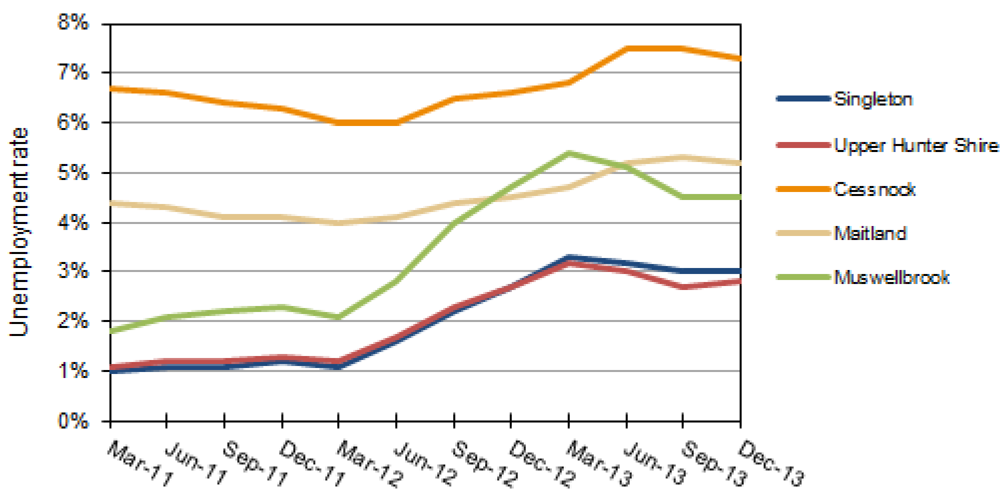
Figure 2-2. New capital expenditure in the NSW mining industry (current prices)



Source: ABS 5625.0 Private New Capital Expenditure and Expected Expenditure, Australia, 27-02-2014.

The effects of the mining slowdown are also being observed in the labour market. In a reversal of past trends, there is now an excess of qualified mining engineers in NSW (Australian Journal of Mining, 2014), as well as a shortage of positions for mining apprentices and trainees in the Hunter Valley (Australian Mining 2013). HVRF (2013a) note that the unemployment rate in the Hunter Valley region has increased notably since 2011. These estimates are consistent with noticeable increases in local unemployment rates (Figure 2-3), and reports of recent job losses in Australia's coal sector (Table 2-2). Recent reports following the closure of the Integra coal operations in the Hunter Valley indicate that around 12,000 jobs have been lost in the Australian coal sector to date, and that a quarter of coal operations in Queensland and NSW are operating at a loss (Saunders 2014).

Figure 2-3. Mid and Upper Hunter region – Local trends in unemployment



Source: Department of Employment, Small Area Labour Markets December Quarter 2013.

Table 2-2. Reported job losses in coal mining (NSW and Queensland)

Mine	Location	Job losses
Ravensworth	Hunter Valley, NSW	46
Stratford and Duralie	Gloucester, NSW	60
Mt Owen	Upper Hunter Valley, NSW	74
Illawarra (BHP)	Illawarra, NSW	36
Illawarra (Gujurat NRE)	Illawarra, NSW	100
Newlands	Bowen Basin, Queensland	300
Gregory	Bowen Basin, Queensland	250
Saraji	Dysart, Queensland	230
Norwich Park	Dysart, Queensland	950
Dawson	Moura, Queensland	200
Oaky Creek	Bowen Basin, Queensland	150
Wilkie Creek	Dalby, Queensland	190
Total		2586

Source: Tasker, S (2014, April 12-13). Coal downturn rocks mining towns. The Australian, p.24,

HVRF's measure of employment intentions suggests that further weakness in the Hunter region labour market can be anticipated. Employment intentions have declined since December 2011; HVRF's most recent measures are lower than during the Global Financial Crisis. Similar trends are also evident in the HVRF's Household Survey, which suggests that consumer confidence and purchasing intentions in the Hunter Valley region remains negative. Overall, HVRF conclude that the economic outlook for the Hunter region reflects the end of the previous expansion phase combined with a drive to achieve efficiencies, the effects of which are now being felt by local suppliers, contractors and operational employees.

2.5 Regional and local effects of the proposals

Against this backdrop, it should be noted that the MTW Continuation Project, if approved, would provide, on average, 1,307 full-time equivalent positions between 2015 and 2035.[1] If current trends continue, almost three quarters of employees (74 per cent) would reside in the Mid and Upper Hunter region, and more than a third (35 per cent) would reside in Singleton.

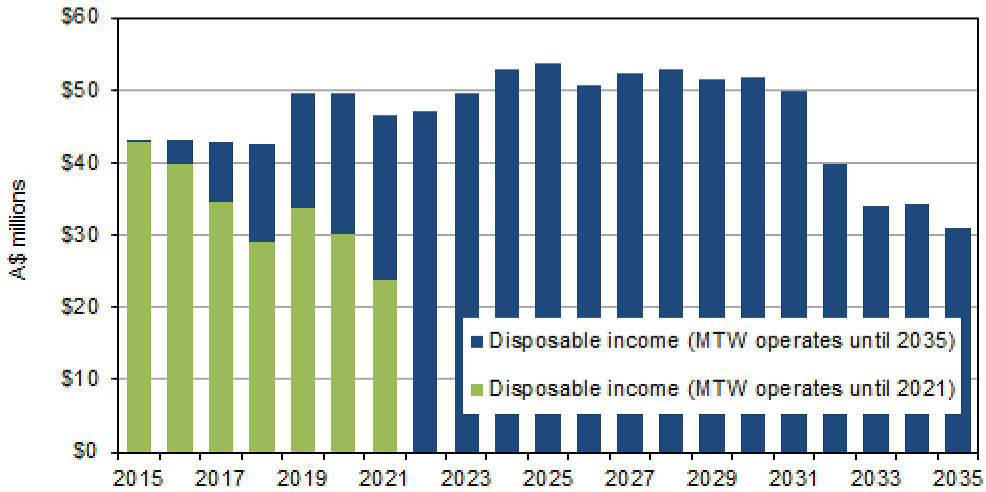
As set out in Section 4 in this report, and using conservative assumptions, the additional regional and local (disposable) income generated is estimated at A$227 million in NPV terms for the Mid and Upper Hunter region and at A$84 million in NPV terms for Singleton LGA. The

[1] Actual levels fluctuate on a year-to-year basis depending on amount of earth that must be removed, market conditions, weather and other factors.

proposals would furthermore generate an additional 214 and 61 FTE indirect jobs in the Mid and Upper Hunter region and in Singleton LGA, respectively.

These figures translate into ongoing and tangible benefits for Singleton. Disposable income paid to Singleton residents (net of taxes, superannuation and Medicare payments) would average almost A$49 million per year from 2015 to 2030 after which production would begin to decline (Figure 2-4). Much of this income would be expected to benefit the local economy.

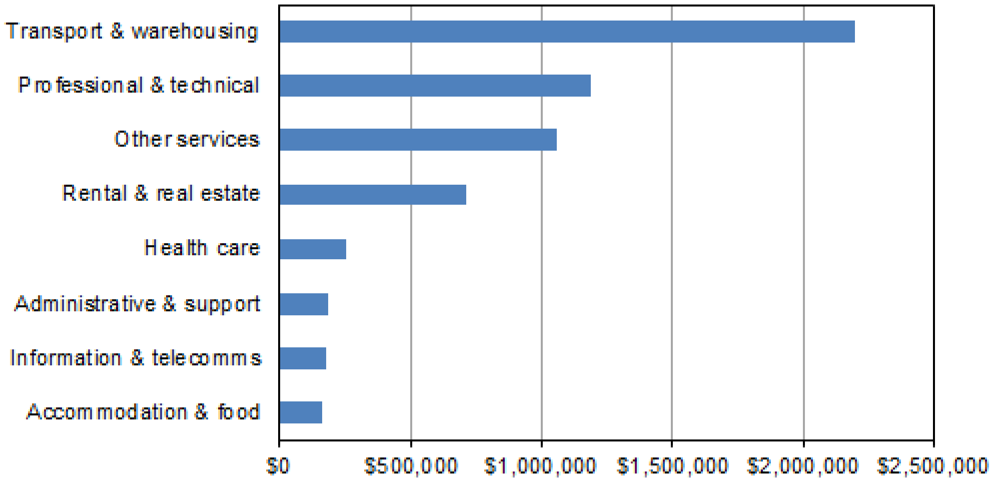
Figure 2-4. Projected disposable income – Singleton residents



Notes: Wages and salaries paid to Singleton employees and contractors, net of income taxes, superannuation contributions and Medicare payments.

Similarly, many of MTW's day-to-day expenditures benefit local suppliers. An analysis of local spend by supplier postcode in 2013, for instance, shows that MTW purchases at Singleton postcodes amount to around A$77.5 million. The majority of these expenditures went to local contractors and labour hire firms (around 30 per cent), and to purchase construction services (17 per cent), mining services and equipment (42 per cent), and steel and electrical equipment (18 per cent). Most of these materials and services are likely to be 'imported' to Singleton, so that businesses based in Singleton would only earn a margin on these sales. However, MTW also purchased almost A$6 million on a variety of services that would likely have been provided by local businesses directly (Figure 2-5). These trends would be expected to continue in the future.

Figure 2-5. MTW spend on services in Singleton (2013)



Source: RTCA.

Finally, if the applications are approved, MTW would continue to pay significant shire rates to Singleton Council, estimated at around A$0.7 million per year until 2035 (around A$8 million in NPV terms). On current trends, these payments would account for around 3.5 per cent of Singleton Council's revenues from rates and annual charges (A$20.2 million in 2012-13, Singleton Council 2013). Some of the additional payments flowing to NSW Government in the form of additional royalty payments and payroll taxes, as well as, indirectly, from additional income tax receipts, can be expected to benefit Singleton in the form of grants and contributions for capital and operating purposes made by the NSW Local Government Grants Commission.

3 Cost benefit analysis of the proposals

This section describes the CBA of the proposals. The main focus in this report is on the costs and benefits of the proposals as they relate to NSW. The methodology and assumptions underpinning the CBA, as well as the results of a CBA of the proposals for Australia, are provided in Appendix A. A separate CBA was undertaken for MTO (described in Appendix E); the results were used to derive the respective contributions of Warkworth Mine and MTO, respectively, to the net benefits of the MTW Continuation Project.

3.1 Economic framework

The CBA considers the direct costs and benefits accruing in NSW from the proposals, for instance, from additional value added in the form of wages and salaries paid to employees and contractors. Flow-on effects of the proposals, such as the effects on regional income, employment or value added, are assessed in the REIA, which is described in Section 4.

3.1.1 Economic impacts of the proposals on NSW

The 'Guideline for the use of Cost Benefit Analysis in mining and coal seam gas proposals' (NSW Government 2012) sets out that the main objective of the CBA is to estimate the impacts of the project on NSW.

From an economic perspective, the extent to which a project contributes to the welfare of a country or state differs from a private benefit calculation, which focuses on profits. The *public* benefit of a project is measured with reference to value added. Value added is the additional value of goods and services that are newly created in an economy, and that are available for domestic consumption or for export.

Value added is a central concept in the Australian System of National Accounts (ASNA), where it is referred to as 'gross value added' to emphasise that this measure is gross of the consumption of fixed capital (that is, depreciation). Gross value added is the difference between output and intermediate inputs (the value created by production), and equals the contribution of labour and capital to the production process (ABS 2013). Subject to adjustments that need to be made to ensure that valuations are internally consistent by accounting for various taxes and subsidies, the sum of gross value added across all industries in a country or state equals gross domestic product (GDP) or gross state product (GSP), respectively. The economic impact of the proposals has therefore been evaluated with reference to its contribution to NSW GSP.

Formally, GSP at market prices derived using the income approach (GSP(I)) measures the sum of income flows accruing to the factors of production, plus taxes less subsidies on production and imports (ABS 2013):

$$GSP(I) = Compensation\ of\ employees$$

$$+\ Gross\ operating\ surplus$$

$$+\ Gross\ mixed\ income$$

$$+(-)Taxes\ (Subsidies)\ on\ production\ and\ imports$$

In the ASNA accounting framework:

- ‘compensation of employees’ refers to the remuneration of labour in the form of wages, salaries, and employers’ social contributions;
- gross operating surplus (GOS) refers to the share of income from production that can be attributed to capital inputs for incorporated businesses;[2]
- gross mixed income (GMI) is a similar concept as GOS, and refers to the share of income from production that can be attributed to unincorporated businesses (for instance, self-employed people) and therefore also includes a labour component; and
- taxes (subsidies) on production include taxes on products, such as GST and import duties, and other taxes (subsidies) on production, such as payroll taxes or subsidies, land taxes, stamp duties and taxes on pollution.

The change in GSP as a result of the proposals being approved therefore captures the incremental benefits accruing to NSW from:

- the additional salaries and wages paid to NSW employees and long-term contractors of MTW;
- the share of MTW’s GOS that can be attributed to NSW, including significant coal royalty payments to NSW; and
- the additional payroll taxes and land taxes/shire rates paid to the NSW State and local Government.

[2] Hence the contribution of capital to value added in NSW depends on the extent to which capital is owned by the residents of NSW.

3.1.2 Combined assessment of the integrated MTW

As set out in Section 2, Warkworth Mine and MTO function as an integrated operation and share the use of a number of resources and infrastructure. These include a joint workforce and management team, water, CHPPs and reject management infrastructure, as well as other facilities. The proposals would also involve some production of coal located within the mining lease of MTO that can only be economically accessed from Warkworth Mine. From an economic perspective, therefore, the value added generated by the two mines is created jointly.

Preparing the CBA separately for Warkworth Mine and MTO does not reflect the current operations of the mines, since ROM coal and waste may be processed either at Warkworth Mine or at MTO, depending on circumstances and what is more efficient, and since product coal produced at Warkworth Mine and destined for export is loaded onto trains at MTO. Preparing a separate CBA for Warkworth Mine and MTO, respectively, therefore requires additional assumptions about how the two mines will operate and interact in future, and assumptions about how shared costs should be allocated to each mining operation.

For the above reasons, the CBA has been prepared for the integrated MTW. However, in order to provide an indication of the respective contributions of the two mines to the economic benefits of the proposals, the direct benefits to NSW and the state, regional and local flow-on effects that can be attributed to MTO and Warkworth Mine have also been separately identified. As described in Appendix E, and for the purposes of attributing the overall benefits of the proposals to Warkworth Mine and MTO, respectively, a (notional) tolling and service arrangement has been introduced whereby MTO is deemed provide coal handling services to and accept overburden services to Warkworth Mine.

3.1.3 Distributional effects

A classical cost-benefit assessment does not consider the distribution of impacts across different segments of society. From this perspective, a CBA is solely concerned with economic efficiency, which implies that all mutually beneficial trades have been made (allocative efficiency), and that all goods and services are produced at least cost (productive efficiency). Allocative and productive efficiency maximise the economic ‘pie’ in the sense that the best use is made of existing resources, and total welfare is maximised.

Irrespective of broader efficiency objectives, information about the distributional impacts of proposed projects – the gains and losses for affected individuals and groups – is of interest to policy makers (Commonwealth 2006). Identifying distributional impacts is sometimes difficult because of data limitations; for instance, increased corporate profits may be distributed to individual shareholders and to superannuation funds (on behalf of other individuals), so that the eventual beneficiaries are a diffuse group of individuals. In other cases, for instance, in the case of local employment effects, beneficiaries can be identified more easily. In the economic impact assessment of the proposals described in this report, we have therefore addressed distributional effects as follows:

- in the context of the CBA, we comment, where possible, on whether the identified impacts may occur at a local or state-wide level; and
- in the context of the REIA, we set out estimated flow-on effects at the State-wide, regional (Mid and Upper Hunter region) and local (Singleton LGA) levels.

3.1.4 Cumulative impacts of the proposals

If the proposals are approved, mining operations would continue at MTW until 2035. The economic impacts of the proposals would therefore not occur on a 'blank slate', but within a broader context where coal mining is already an important aspect of the local economy (as described in Section 2.4). Indeed, the MTW Continuation Project is contingent on the ability of Warkworth Mine and MTO to economically extract existing coal resources because of the considerable capital expended into the operations since 1981, and availability of the required infrastructure, such as rail.

The question then arises whether some of the impacts of the proposals may have broader regional implications that are not adequately captured using a conventional, incremental CBA approach. For instance, this could be an issue in relation to environmental impacts if some critical threshold is exceeded that may lead to wider adverse consequences, or if there are environmental interactions.

It is considered unlikely that cumulative impacts of this type are of concern in the context of the present proposals. Warkworth Mine and MTO have both been in operation since 1981, and have operated jointly as MTW since 2004. The impacts of the mining operations on the environment, in terms of ground and surface water, air quality, noise and vibration, and others (as described in Section 3.2 below) are therefore well understood, and have been assessed taking account of other established mining operations in the area. The expert reports that have been prepared to assess these and other effects reflect this understanding, and have been prepared to identify the incremental and cumulative impacts that may arise from the continued operations of the mines.

3.2 Valuation of external effects

A CBA requires a full accounting calculation whereby the costs and benefits of a project are compared in monetary terms, and therefore requires that costs and benefits should, as far as possible, be valued. As a general matter, CBA relies on the 'opportunity cost' principle to value goods or services (NSW Treasury 2007; Commonwealth 2006). In practice, the opportunity cost concept is made operational with reference to the 'willingness-to-pay' (WTP) criterion. For 'conventional', market-based transactions, such as the sale of coal outputs or the purchase of labour and other inputs, the relevant valuation approach is therefore the market price.

3.2.1 Overview

The NSW Treasury Guidelines (2007) require that 'external effects' (also referred to as 'externalities') are accounted for as part of economic benefits and costs. External effects are spillovers (positive or negative) from the production of a good or service, for example, in the form of air pollution or noise (negative spillovers).

The EIS's prepared for the MTW Continuation Project identify the potential environmental impacts from the proposals across a range of categories, as well as the risks of these impacts occurring, and their potential consequences. The descriptions and valuations of the external effects described in this section and in Appendix B and Appendix C rely on the experts' findings set out in the EIS's.

As set out in Table 3-1, the proposals are predicted to give rise to a range of external effects, although the majority of these impacts is relatively limited. The approach to valuing effects is set out in the following; additional detail is provided in Appendix B.

Table 3-1. External effects associated with MTW

Category	External effect	Overall nature of impact
1. Noise & vibration	Noise exceedance criteria of 5dB exceeded for 4 privately owned receptors; 3 receptors are located at residential properties, 1 receptor is located at a community hall): - 2 residential properties are located within Wambo Mine's ZOA - 1 residential property is within Warkworth Mine's ZOA	Local
2. Air quality	Criteria for 24-hour and annual average particulate (PM10) emissions are exceeded for 2 privately owned receptors located at residential properties: - 2 residential properties are located within Wambo Mine's ZOA	Local
3. Visual amenity	Visual impacts generally moderate to low. Moderate to high visual impacts on residences to the south and west.	Local
4. Aboriginal heritage	Loss of 110 sites	Aboriginal people of the Upper Hunter Valley
5. Ecology *	Clearing of 459 ha of forest and woodland and 151.5 ha of grassland communities, including removal of endangered ecological communities (EECs) and habitats of threatened species	NSW
6. Traffic	Closure of Wallaby Scrub Road Minimal traffic impacts on the local road network	Local
7. Groundwater	Negligible and manageable impacts on groundwater systems	Local
8. Surface water	No significant impacts on surface water quality of adjacent water features	Local

Category	External effect	Overall nature of impact
9. GHG emissions	Net GHG emissions of appr. 15.9Mt CO_2-e	Global
10. Historical heritage	Low potential heritage impacts	Local/NSW

Notes: * The 611 ha estimate excludes the area already approved to be cleared by MTO, but included within Warkworth's disturbance area. Ecological impacts are deemed to refer to NSW, given that Commonwealth approval has been obtained in the course of the 2010 extension application.

Additional detail is provided in Appendix B.

External effects give rise to non-market impacts that are difficult to value. A variety of techniques have been developed to quantify these effects, including surrogate market (revealed preference) valuation techniques and hypothetical market (stated preference) techniques. These techniques aim to elicit estimates of either the WTP for, or the 'willingness-to-accept' (WTA) a particular outcome. They differ in a number of ways, including in terms of the amount and detail of data that are required (which may or may not be available) and how reliable the results are (the extent to which they are subject to biases).

Market-based valuations (direct revealed preference methods) infer an implicit price that is revealed by examining consumer behaviour and/or prices in a similar or related market (Department of Treasury and Finance 2013). Market-based valuation techniques include the use of:

- defensive expenditures: the costs incurred by individuals to mitigate the impact of changes and/or to recreate a situation that existed before a change, for instance by investing in noise insulation;
- replacement costs: the cost of replacing or repairing a damage, for instance, to restore the environment to its previous condition; and
- the productivity method: this method is used where an impact leads to a change in production levels, costs or prices.

Indirect revealed preference methods derive values of environmental goods and services from market prices. They include hedonic pricing whereby WTP for specific environmental or other characteristics is inferred from market prices, and travel cost analysis, where the opportunity cost of time and travel costs is interpreted as a proxy of the value of ecosystem sites, such as parks.

Stated preference methods, finally, rely on specifically constructed questionnaires and interviews that are put to survey participants in order to discover the WTP for a particular outcome, or the WTA a particular outcome. Stated preference techniques include:

- contingent valuation methods: these ask individuals the amount they would be willing to pay to get a particular benefit or to avoid a negative impact, for instance, to maintain an ecosystem, a common good, or a heritage building; and
- choice modelling methods: individuals reveal the value of a non-market impact indirectly by choosing between goods with different characteristics and various monetary contributions.

Stated preference methods suffer from biases that often limit their validity and reliability

(Pearce et al. 2006, Commonwealth 2006).[3] In contrast, and while such approaches cannot be applied in all circumstances and may not precisely capture the effect in question, the strength of revealed preference methods is that they are based on actual decisions made by individuals/households or other decision-makers. This report has therefore relied on market-based and revealed preference techniques for valuing the external effects associated with the proposals. The unifying characteristic of both techniques is that they aim to value non-market impacts by observing actual behaviour, and are therefore considered to be a more reliable indicator of people's preferences.

3.2.2 External effects that can be internalised by MTW

External effects that can be internalised by MTW are non-market costs that can be accounted for through either financial instruments, or the creation of direct offsets.

Financial instruments (market-based valuation)

Financial instruments generally involve the compensation of affected individuals or payments for measures designed to mitigate or remove the impact of the external effect. This is a 'defensive expenditure' valuation method, which relies on the observed behaviour of households or individuals of incurring financial outlays to insulate themselves against a non-market 'bad', for instance, by moving house or by installing double-glazing in noise-affected homes (Pearce et al. 2006).

External effects that have been valued in this manner (that is, on the basis of expenditures that would be incurred by Rio Tinto if the applications are successful) are :

- Noise (1) and air quality (2) impacts: Significant noise and air impacts arise in three residential locations owned by third parties, as well as at Warkworth Community Hall. Two of these residential locations are within the zone of acquisition (ZOA) of a neighbouring mine (Wambo Mine); if the applications are successful, the owner(s) of the third property will have acquisition rights upon request under the development consent. Rio Tinto will additionally invest in noise attenuation equipment for that part of its heavy vehicle fleet, which has not yet had corresponding equipment fitted (drills, dozers, excavators, and trucks).

[3] These limitations include the presence of hypothetical bias, since the situations described to respondents is not a real-world decision (and therefore difficult to assess for respondents); strategic behaviour, whereby the respondent may, for one reason or another, give an exaggerated response; scope problems, whereby responses are insensitive to the size or coverage of the good being valued; anchoring bias, if the valuation given depends on prior options being presented; and information bias, whereby how the question is framed unduly influences the answer. Overcoming these types of difficulties requires a rigorous survey design and testing the survey responses for their robustness, including by testing whether responses can be reproduced and are stable over time. In practice, this is rarely done.

- Visual amenity (3) impacts: While the visual impacts of the MTW Continuation Project are generally expected to be moderate to low, a small number of properties, particularly to the south and west of Warkworth Mine/MTO are predicted to have moderate to high visual impacts.[4] If the applications are approved, Rio Tinto would undertake site specific visual assessments (SSVAs) on request for properties in Bulga village in the primary visual catchment and, where the impact is assessed as high, put in place vegetation screening or other measures agreed with the affected landowners where requied. In addition, MTW is undertaking a variety of onsite mitigation measures, including minimising lighting impacts and the construction of bunds, vegetated and built screens along the site boundary.
- Aboriginal heritage impacts (4): Rio Tinto has reached agreement with the local Aboriginal community and relevant NSW authorities on a suite of management strategies, including:
  - the establishment of the Wollombi Brook Aboriginal Cultural Heritage Conservation Area (WBACHCA) and the Loders Creek Aboriginal Cultural Heritage Conservation Area (LCACHCA) to protect areas of high Aboriginal community and scientific significance;
  - an integrated heritage management plan (HMP) and detailed initiatives to manage the impacts of the proposed 2014 disturbance area; as well as
  - various other commitments to limit the disturbance of Aboriginal places to a minimum and manage other potential issues in consultation with the Aboriginal community.
- Historical heritage impacts (10): While small portions of the Former RAAF Base Bulga Complex and Great North Road Complex would be affected by the proposal, there are no state significant heritage features within the disturbance area. One locally significant feature (the Brick Farm House) would not be directly affected by the proposal, and the overall heritage impacts are likely to be minor. Rio Tinto proposes to undertake various measures to manage any impacts, including Conservation management plans (CMPs) for a portion of the Great North Road Complex, the former RAAF Base Bulga Complex and the Brick Farm House, as well as the establishment of a community trust for the conservation, maintenance, interpretation and/or promotion of important historic heritage values in the surrounding area.

Defensive expenditures may represent an under- or an overestimate of the value of the non-market impact on wellbeing. For instance, households predicted to be significantly affected

[4] It is understood that the number of properties affected is difficult to quantify accurately, given the lack of access to properties. Factors such as existing vegetation, orientation of the house, window locations etc. play a role in the visual impacts of the proposal.

(that is, above government-prescribed criteria) by air and noise outcomes will be offered acquisition of their properties, generally at prices that are above market values. In these cases it could be argued that the valuation of the corresponding external effects on that basis overestimates the impacts, although the affected landowners may have a (subjective) perspective of these impacts that may be lower or higher.

More generally, there will inevitably be instances of more or less arbitrary cut-off points, for instance, because noise or dust criteria are exceeded at one location, but not at a different but nearby location. These types of boundary issues are difficult to address in practice, but are essentially a function of rigid environmental criteria that may deem one level of disturbance to be acceptable, but no longer tolerate a slightly higher level of disturbance. Irrespective of the criteria that may be set down in statutes or regulations, peoples' personal preferences may also vary, so that what may be an acceptable disturbance to some, may be considered distressing by others. While these variations in perceived impacts should be acknowledged, there is no way in which they could be measured or assessed in a reliable manner, and we have not attempted to do so here.

Offsets (market-based valuation)

Direct offsets refer to initiatives that deliver an outcome that is equivalent or preferable to the case in which the proposals do not proceed. The cost of establishing direct offsets and related initiatives is pertinent to the valuation of ecological impacts (5).

The primary impact from the proposals will be the progressive clearing of vegetation, including endangered ecological communities (EECs), within the disturbance boundary. If the proposals are approved, 459 ha of forest and woodland and 151.5 ha of grassland communities would be progressively cleared. In this regard, the clearing of a distinctive type of vegetation – Warkworth Sands Woodland (WSW), an EEC – is of particular concern. In addition, the disturbance area also contains a diverse range of native vegetation other than WSW ('non-WSW' vegetation). WSW and non-WSW vegetation provide habitat for numerous species, as well as threatened fauna and flora.

The impacts of the loss of native vegetation, EECs and habitats resulting from the proposals will be mitigated by establishing a number of offsets that would be approved under the NSW Biodiversity Certification Assessment Methodology (BCAM). The biodiversity certification scheme was established under the Threatened Species Conservation Act 1995. The Minister may confer biodiversity certification on land if the Minister is satisfied that biodiversity certification will improve or maintain biodiversity values (Department of Environment, Climate Change and Water NSW, 2011).

The required offset package for the proposals have correspondingly been estimated using the BCAM and in accordance with the Upper Hunter Strategic Assessment (UHSA):

- Impacts on WSW resulting from the proposals will be offset by the protection of areas of WSW in the Northern Biodiversity Area (NBA) and Southern Biodiversity Area (SBA), as well as the re-establishment of large areas of this community in designated offset areas. Additional offsets for WSW include provisions for the preparation of an Integrated Restoration Implementation Plan and contributions to research.

- Offset requirements for non-WSW vegetation have been determined using BCAM and appropriate offsets will be sought under the UHSA to ensure that a 'maintain and improve' outcome is achieved.

It is understood that commitments made by Rio Tinto will ensure that the offsets for both WSW and non-WSW vegetation will result in a 'maintain or improve' outcome for the respective communities. In the future, the SBA and mined land rehabilitation will combine to create a large area of treed vegetation in the landscape subject to long term conservation and exceeding 1,900 ha in size. The NBA will also be regenerated to form a large patch of woodland and forest of over 340 ha. Such vegetation is intended to provide and maintain substantial habitats for native flora and fauna in the long term. Overall, it is understood that:

- the offsets described above meet the offset requirements of the Office of Environment and Heritage's (OEH's) 'Principles for the Provision of Offsets for Major Projects';
- the credit estimates for the offset requirements identified for the proposals will be verified and certified by OEH for the UHSA; and
- the management and monitoring of the NBA and SBA according to the Warkworth Biodiversity Management Plan (BMP)BMP will ensure that a net positive ecological outcome is achieved.

Given therefore, that the identified ecological impacts (5) will be offset to achieve an outcome that is deemed to be as good or better than the status quo by the relevant NSW authorities and under legislation, the ecological impacts associated with the proposals have been valued at the cost of implementing the offsets and associated initiatives described above.

3.2.3 External costs/benefits that cannot be internalised, but that are measureable

Some external effects cannot be addressed through direct compensation or offsets, but can be given an appropriate public value.

Valuation of traffic impacts

In Australia, the costs and benefits of changed traffic conditions such as those implied by the closure of Wallaby Scrub Road (6) are typically evaluated on the basis of traffic studies overlaid with estimates of road user costs (RUCs, Austroads 2012). RUCs include the opportunity cost of drivers' travel time, which is estimated on the basis of labour costs (revealed preferences) and/or stated preference survey techniques; vehicle operating costs (VOCs), which are typically computed for various representative vehicles; and accident costs, which refer to costs associated with pain and suffering, other economic costs, and various measures of property damage. This approach that has been adopted here to value the impacts of closing Wallaby

Scrub Road.[5]

Publicly determined values

Revealed preference studies consider the public expenditure or taxes that are used to achieve, for example, an environmental outcome. From this perspective, the consequences or outcomes of government decisions reflect implicit choices and value judgements. The price of water licenses, as determined by government allocations and revealed through trades gives an indication of the value attached to the use of scarce water resources. The incremental effects on groundwater (7) and surface water (8) can therefore be valued using the cost of licences that MTW would need to acquire in order to compensate for any external effects:

- Where future groundwater requirements are concerned, it is understood that if the applications are approved, no additional Permian licenses would need to be acquired in future. No additional licensing costs have therefore been incorporated.
- Where future surface water requirements are concerned, it is understood that additional water access licences may potentially be required in future, but that such an outcome would be highly uncertain and dependent on future rainfall patterns. Given these climate-related uncertainties no additional licensing costs have been included in the CBA. We note that average prices for water access licence trades for the Hunter between 2008–09 and 2012–13 were around $2,600/ML (National Water Commission 2014), so that the potential costs of acquiring additional licenses would range from $2.3 million (average) to $8.9 million (maximum) in years in which MTW's existing entitlements were exceeded. These expenditures are unlikely to be material in changing the outcome of the CBA.

Damages associated with greenhouse gas emissions

If the applications are approved, the mining and associated processes will give rise to an increase in greenhouse gas (GHG) emissions (9). GHG emissions are projected to increase global mean temperatures, which are in turn expected to give rise to a range of negative effects, including on specific sectors like agriculture, but also on water availability, on the health of populations, and others.

The additional GHG emissions associated with the MTW Continuation Project have been valued using a 'social cost of carbon' (SCC), as determined by the US Interagency Working Group on Social Cost of Carbon (2013). The SCC is an estimate of the monetised damages associated with an incremental increase in carbon emissions in a given year. It includes changes in net agricultural productivity, human health, property damages from increased flood risk, and the value of ecosystem services due to climate change. The NSW share of damages

[5] Additional greenhouse gas emissions associated with the closure of Wallaby Scrub Road have been valued jointly with incremental emissions associated with the proposals.

associated with additional GHG emissions has been estimated with reference to the NSW GSP as a percentage of world GDP.

3.2.4 Threshold values

Threshold values are costs and benefits that cannot be addressed through direct compensation or mitigation and that cannot be given an appropriate public value. Threshold values provide an indication of the value that the non-market benefits of protecting a resource or asset would need to reach, in order to be in the community's best interest to forego the benefits. No external effects that may be considered to fall under this heading have been identified for the proposals.

3.3 Results of the CBA

This section summarises the results of the CBA. As set out above, the proposals have been evaluated with reference to its impact on NSW GSP.

3.3.1 Gross operating surplus accruing to MTW

As set out in Section 3.1 above, one of the components of NSW GSP is the share of MTW's GOS that can be attributed to NSW. Deriving the incremental benefits to NSW if the proposals are approved therefore requires that the net GOS associated with the proposals is identified (Table 3-2). In the national accounts GOS is the portion of the income derived from production that is earned by the capital factor. GOS is therefore calculated as output valued at producer prices, net of intermediate consumption (operating expenditure), net of employee compensation, and net of taxes on production (ABS 2013).

Calculating the GOS requires that certain ASNA conventions are followed (see Appendix A). Expenditures on assets that are not 'used up' in the course of the production process and which yield benefits beyond the period in which they are purchased (i.e. capital expenditure) are not included in the calculation to derive GOS. GOS is also measured *prior to* deducting any explicit or implicit interest charges, rent or other property incomes payable on the financial assets, land or other natural resources required to carry on production (ABS 2013). The GOS calculation in Table 3-2 therefore excludes the opportunity cost of the land used by MTW to undertake mining activities. Coal royalty payments, which represent payments made by mining companies to the government in return for the right to extract minerals, are treated as property income, and are also not included as intermediate consumption. In summary, GOS resembles (but is not the same as) a corporation's earnings before interest payments, taxes and depreciation, and hence includes a number of components that are not explicitly listed in Table 3-2. These components include royalty payments, corporate income taxes, depreciation, interest payments and certain other expenses.

Table 3-2 indicates that the incremental GOS of the proposals is around A$2.156 billion in net present value (NPV) terms. The relevance of this calculation is that a number of items that are 'costs' to MTW represent 'benefits' to NSW, as described in the subsection below.

Table 3-2. Gross operating surplus of the proposals

Costs	NPV (A$ m real 2014)	Benefits	NPV (A$ m real 2014)
Operating expenditure	$3,812	Value of mining output	$7,527
Wages & salaries	$1,494		
Other taxes less subsidies on production	$65		
Total	$5,372		$7,527
Gross operating surplus	**$2,156**		

Notes: NPVs have been derived using a discount rate of 7 per cent.
Totals may not sum precisely due to rounding.
GOS includes royalty payments of $617m and company tax payments of $355m.

3.3.2 Net impacts of the proposals on NSW GSP

The net economic benefit of the proposals for NSW is estimated at A$1.488 billion in NPV terms (Table 3-3).

The key components of the benefits described in Table 3-3 are the additional wages and salaries paid by MTW to NSW employees (A$612 million), royalties (A$617 million), as well as various taxes paid by MTW (which directly or indirectly benefit NSW). Given that 74 per cent of MTW employees currently live in the Mid and Upper Hunter region (Figure 2-1), around A$464 million in NPV terms of the additional disposable income generated by the proposals would benefit the regional economy, as would the additional land taxes/shire rates paid by MTW (around A$10 million in NPV terms). For completeness, we have also derived the net economic benefits of the proposals for the Australian economy (see Appendix A, A.3).

Table 3-3. Incremental (economic) benefits of the proposals for NSW

Costs	NPV (A$ m real 2014)	Benefits	NPV (A$ m real 2014)
Production related		**Production related**	
		Compensation of employees/ contractors (disposable income)	$612
		NSW share of personal income taxes	$78
		NSW share of Medicare payments	$2
		Share of MTW GOS accruing to NSW:	
		Royalties	$617
		Shareholder income	$12
		Company taxes	$116
		Taxes on production and imports:	
		Payroll taxes	$61
		Land taxes/shire rates	$5
Total production related	**$0**	**Total production related**	**$1,501**
Externalities (costs)		**Externalities (offsets)**	
Noise & vibration	$15	Zone of mitigation work, noise attenuation	$15
Visual amenity	$2	Visual amenity upgrades	$2
Noise & air general	$3	Acquisition of properties	$3
Aboriginal heritage	$1	Cultural Heritage Facility	$1
Ecology	$10	Acquisition of offsets	$10
Traffic impacts	$13	Traffic impacts	$0
Groundwater	$0	N/a	$0
Surface water	$0	N/a	$0
European heritage	$0.5	Heritage trust, Great North Road	$0.5
GHG emissions	$0.5	GHG emissions	$0
Total externalities	**$45**	**Total externalities**	**$31**
Grand total	**$45**		**$1,533**
Net economic benefits	**$1,488**		

Notes: NPVs have been derived using a discount rate of 7 per cent.

The damages cost of GHG emissions to NSW have been estimated by multiplying the global cost derived using the SCC (A$131 m) by the share of NSW GSP to world GDP.

Totals may not sum precisely due to rounding.

Detailed calculations to derive production-related benefits that can be attributed to NSW are set out in Appendix A.

Description and rationale for the valuation of external effects are set out in Appendix B.

In interpreting Table 3-3, it is important to bear in mind that the extent to which a project contributes to the welfare of a country or state differs from a private net benefit calculation, which focuses on profits. The extent to which a project contributes to an economy such as NSW is measured with reference to value added: the value that is added to the intermediate inputs that are used, which is also the difference between output and intermediate inputs.[6] The intermediate inputs that MTW uses in the course of the production process (such as short-term labour, materials, fuel etc.) in turn represent the value added of MTW suppliers. Intermediate inputs are therefore not counted in this calculation to avoid double-counting; GDP/GSP is then the sum of the value added of each firm, government institution and producing household in a given country or state. In Table 3-3, therefore, no 'production costs' to NSW are reported in the left hand column, these costs are intermediate inputs to MTW and have been subtracted to derive value added.

With the exception of those arising from traffic impacts, which have been valued separately, external effects have generally been valued on the basis of the financial payments made by Rio Tinto or on the basis of offsets, as set out in Appendix B.

A number of adjustments have been made to ensure that production-related benefits are appropriately attributed to NSW.

Only some of the incremental wage and salary benefits resulting from the proposals can be attributed to NSW, namely:

- the incremental *disposable* incomes (gross wages and salaries net of taxes, superannuation, and Medicare contributions) paid to MTW employees and long-term contractors who reside in NSW; and
- of the total imposts paid by these employers and contractors, the share of income taxes and Medicare contributions that would accrue to NSW.

Incremental wage and salary benefits accruing to NSW have been reduced to avoid overestimating the employment benefits to NSW. Incremental wage and salary benefits are calculated by subtracting total disposable income in the reference case from total disposable income in the proposals scenario. In order to ensure that the resulting estimates err on the side of being conservative, it has been assumed that:

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[6] GDP or GSP is not a direct measure of economic and social 'welfare', but a measure of the production of goods and services (Lequiller and Derek 2007). However, production is an important dimension of welfare because it enables greater consumption, and because strong GDP growth goes hand in hand with declining unemployment. Dimensions of welfare that are not reflected in GDP include social inequality, security of goods and persons, and the quality of the environment.

- A proportion of MTW employees and contractors who would be made redundant if the applications are refused (the reference case) would find alternative employment in NSW (rather than leave the NSW workforce altogether). For the purpose of deriving the central net benefit estimates reported in Table 3-3, we have assumed that 30 per cent of persons made redundant would be re-employed in the same year, and that 40 per cent of persons made redundant would be re-employed in the subsequent year. The remaining 30 per cent are assumed to either leave the workforce altogether or to move interstate.
- A proportion of any additional employees and contractors employed by MTW over the life of the mines would be attracted from other sectors/employers in NSW (rather than be drawn from the unemployment pool or from interstate). For the purpose of deriving the central net benefit estimates reported in Table 3-3, we have assumed that 70 per cent of any additional employees/contractors would be redeployed from other jobs in NSW.

In both cases, it has been assumed that people are either re-employed at the weighted-average Mid and Upper Hunter region salary, or were paid that salary before moving to MTW. The above assumptions are based on a review of the (limited) information that is available about relevant labour market outcomes (see Appendix A). The materiality of these assumptions has been tested using sensitivity analysis (see Section 3.4 below).

Adjustments have also been made to estimate the share of MTW's GOS that would take the form of income to NSW shareholders of Rio Tinto, and to estimate the NSW share of corporate and personal income taxes, and to estimate the NSW share of Medicare contributions.

3.4 Sensitivity analysis

A number of assumptions have a material effect on the results of the CBA. Their impact on the results has been tested by conducting a number of sensitivities.

3.4.1 Variations in the discount rate

A discount rate of 7 per cent per annum has been assumed for the analysis. As required in the Guideline for the use of Cost Benefit Analysis in mining and coal seam gas proposals (NSW Government 2012) we have tested the sensitivity of the results of the CBA by applying a discount rate of 4 per cent and 10 per cent per annum, respectively. Table 3-4 shows that material net benefits would accrue to NSW irrespective of which discount rate is used.

Table 3-4. Discount rate sensitivity

Discount rate assumption	Incremental benefits of the proposals for NSW (NPV A$ m 2014)
7 per cent	$1,488
4 per cent	$2,064
10 per cent	$1,099

Notes: The discount rate used to derive the SCC has not been varied; given the very small share of damages attributable to NSW, changes in the discount rate would not materially affect the results.

3.4.2 Variations in coal prices and exchange rates

Most of MTW's coal production is exported overseas, and is priced in US dollars. The results of the CBA rely on a price for thermal export coal of US$85/t and a US$/A$ exchange rate of 0.85. Different combinations of coal prices and US$/A$ exchange rates will therefore affect MTW's GOS, including corporate income tax payments and royalty payments to NSW. Table 3-5 and Table 3-6 show the incremental royalty and tax benefits accruing to NSW, and the incremental total production benefits accruing to NSW, respectively.

Table 3-5. Sensitivity to variations in coal prices and US$/A$ exchange rates – Incremental royalty payments, payroll taxes and land taxes/shire rate benefits of the proposals to NSW (NPV A$ m 2014)

Coal price assumptions / Exchange rates (US$/A$)	Thermal coal export price (US$ per tonne)		
	US$ 75	US$ 85	US$ 95
0.75	$682	$767	$852
0.85	$608	$682	$757
0.95	$549	$616	$682

Notes: NPVs have been derived using a discount rate of 7 per cent.

Royalty and tax benefits refer to royalties, NSW share of company income taxes, payroll taxes and land taxes/shire rates.

Table 3-6. Sensitivity to variations in coal prices and US$/A$ exchange rates – Incremental production-related benefits of the proposals to NSW (NPV A$ m 2014)

Coal price assumptions / Exchange rates (US$/A$)	Thermal coal export price (US$ per tonne)		
	US$ 75	US$ 85	US$ 95
0.75	$1,485	$1,662	$1,839
0.85	$1,345	$1,501	$1,658
0.95	$1,235	$1,375	$1,515

Notes: NPVs have been derived using a discount rate of 7 per cent.

Production-related benefits refer to royalty and tax benefits, as well as net compensation of employees/contractors, the NSW share of personal income taxes and Medicare payments, and income accruing to NSW shareholders of MTW.

3.4.3 Variations in re-employment assumptions (NSW)

As noted above, only a subset of employee compensation benefits can be considered to be additional for the purposes of the net benefit calculation. For the purpose of calculating the net benefits of the proposals we have assumed that:

- 30 per cent of employees and long-term contractors who would be made redundant by the closure of MTW would find employment elsewhere within NSW in the same year, and 40 per cent of these employees and contractors would find employment in NSW in the year after being made redundant. We have assumed that all persons would be re-employed at the weighted-average wage and salary income reported for the Mid and Upper Hunter region by the ABS for the corresponding LGAs.[7]

- 70 per cent of any additional employees and long-term contractors employed by MTW may move to MTW from other industries/employers in NSW. Only the incremental income that these employees/contractors would earn when employed by MTW is therefore counted as a net benefit.

The implications of variations in these assumptions are explored in Table 3-7 and Table 3-8 below. Table 3-7 explores variations in the re-employment assumptions. For instance, for the 30/40 split described above, net employment benefits (in terms of disposable income) would amount to A$612 million and net production-related benefits to NSW would amount to A$1,507 million. If it is alternatively assumed that all employees made redundant by the closure of MTW would find alternative employment in the same year, net employment benefits would fall to A$504 million and the net benefits to NSW would be A$1,368 million.

Table 3-7. Sensitivity of production-related benefits to variations in re-employment assumptions

Re-employment assumptions	Incremental benefits of the proposals to NSW (NPV A$ m 2014)	
	70 per cent of additional hires originate from NSW	
	Net employment benefits (disposable income) (NPV A$2014 m)	Net production-related benefits to NSW (NPV A$2014 m)
0%	$825	$1,777
30% Year 1, 40% Year 2	$612	$1,501
50% Year 1, none thereafter	$665	$1,570
70% Year 1, none thereafter	$601	$1,487
100% Year 1	$504	$1,363

Notes: Average alternative wage and salary income is assumed to be $58,853 (A$2014).
NPVs have been derived using a discount rate of 7 per cent.
Production-related benefits refer to royalty and tax benefits, as well as net compensation of employees/contractors, the NSW share of personal income taxes and Medicare payments, and income accruing to NSW shareholders of MTW.

Table 3-8 considers variations in the assumptions about the share of additional employees recruited from NSW assuming the above 30/40 split in re-employment outcomes. If only 50 per cent of any additional employees and contractors are drawn from other sectors in NSW,

[7] The ABS (2013) publishes regional profiles (1379.0.55.001) for Cessnock, Maitland, Upper Hunter, Singleton, and Muswellbrook LGAs. Average wages have been adjusted to A$2014 figures using the ABS wage price index (6345.0).

net employment benefits would amount to A$622 million, and net benefits to NSW would be A$1,507 million.

Table 3-8. Sensitivity of production-related benefits to variations in redeployment assumptions

Redeployment assumptions	Incremental benefits of the proposals to NSW (NPV A$m 2014)	
	30% re-employed in Year 1, 40% re-employed in Year 2	
Percentage of additional hires originating from NSW	Net employment benefits (disposable income) (NPV A$2014 m)	Net production-related benefits to NSW (NPV A$2014 m)
50 per cent	$622	$1,515
70 per cent	$612	$1,501
100 per cent	$596	$1,481

Notes: Average alternative salary is assumed to be $58,853 (A$2014).

NPVs have been derived using a discount rate of 7 per cent.

Production-related benefits refer to royalty and tax benefits, as well as net compensation of employees/contractors, the NSW share of personal income taxes and Medicare payments, and income accruing to NSW shareholders of MTW.

Overall, Table 3-7 and Table 3-8 show that significant employment and other benefits would accrue to NSW irrespective of the precise assumptions that are made about re-employment and redeployment outcomes. This reflects both the substantial employment that would be generated if the proposals are accepted, and high wage and salary outcomes at MTW, relative to average wages and salaries in the Mid and Upper Hunter region.

3.5 Relative contribution of Warkworth Mine to aggregate NSW benefits

The share of aggregate net benefits that can be attributed to Warkworth Mine has been estimated by determining the net benefits attributable to MTO, and subtracting these from the aggregate net benefits derived for the MTW Continuation Project.[8] The calculation to determine the net benefits of MTO is described in Appendix E.

The external effects identified in Table 3-1 can overwhelmingly be attributed to Warkworth

[8] The sum of individual project benefits and costs may not equal the corresponding benefits and costs of the total project when there are benefits from 'joint' production. The benefits of the total project will be greater than the parts if, for example, there are returns to scale and therefore falling average costs of transport. How these benefits are shared between the projects is not a material concern, save for the distribution of profits to investors. Conversely, the costs for the total project may escalate as the level of say, dust, noise or traffic congestion increases. However, so long as these external costs can be offset, how the costs of the offsets are shared between the projects is not a material concern save for the distribution of profit to different investors.

Mine, and have been valued the same manner as for MTW.[9]

Table 3-9 below shows the incremental benefits of Warkworth Mine for NSW. As described in Appendix E, MTO is assumed to operate at arms' length from and offer tolling services to Warkworth Mine. In the event that the applications are accepted, coal would be mined at MTO until 2018; after this time, MTO would provide coal processing and handling services to Warkworth Mine and would accept overburden from Warkworth Mine. These services would be provided in return for a fee for service. The estimated net benefit to NSW that can be attributed to Warkworth Mine is A$1,339 million, around 90 per cent of the total net benefit that would accrue to NSW if both applications are approved (A$1,488).

Table 3-9. Incremental (economic) benefits of Warkworth Mine for NSW

Costs	NPV (A$ m real 2014)	Benefits	NPV (A$ m real 2014)
Production related		**Production related**	
		Compensation of employees/ contractors (disposable income)	$549
		NSW share of personal income taxes	$70
		NSW share of Medicare payments	$2
		Share of Warkworth Mine GOS accruing to NSW:	
		Royalties	$567
		Shareholder income	$11
		Company taxes	$96
		Taxes on production and imports:	
		Payroll taxes	$54
		Land taxes/shire rates	$3
Total production related	**$0**	**Total production related**	**$1,352**
Externalities (costs)		**Externalities (offsets)**	
Noise & vibration	$13	Zone of mitigation work, noise attenuation	$13
Visual amenity	$2	Visual amenity upgrades	$2
Noise & air general	$3	Acquisition of properties	$3
Aboriginal heritage	$1	Cultural Heritage Facility	$1
Ecology	$10	Acquisition of offsets	$10

[9] Mitigation expenditures in the form of upgrades to each mine's equipment have been allocated to Warkworth Mine and MTO, respectively.

Costs	NPV (A$ m real 2014)	Benefits	NPV (A$ m real 2014)
Traffic impacts	$13	Traffic impacts	$0
Groundwater	$0	N/a	$0
Surface water	$0	N/a	$0
European heritage	$0.5	Heritage trust, Great North Road	$0.5
GHG emissions	$0.5	GHG emissions	$0
Total externalities	$42	Total externalities	$29
Grand total	**$42**		**$1,381**
Net economic benefits	**$1,339**		

Notes: NPVs have been derived using a discount rate of 7 per cent.

The damages cost of GHG emissions to NSW have been estimated by multiplying the global cost derived using the SCC (A$ $129.6 m) by the share of NSW GSP to world GDP.

Totals may not sum due to rounding.

Detailed calculations to derive production-related benefits that can be attributed to NSW are set out in Appendix A.

Warkworth Mine's GOS and the basis for the allocation of revenues and costs is set out in Appendix E.

3.6 Relative contribution of MTO to aggregate NSW benefits

The derivation of the share of direct flow-on effects that MTO would contribute to the overall benefits from the MTW Continuation Project is described in Appendix E.

If the applications are accepted, MTO may also give rise to external effects, although these are predicted to be far more limited than for the integrated operation of MTW (Table 3-10, Appendix C). As noted above, external effects relating to noise (1) have been valued with reference to the costs of upgrading dedicated MTO equipment.

Table 3-10. External effects associated with MTO

Category	External effect	Overall nature of impact
1. Noise & vibration	No additional residential properties affected	Local
2. Air quality	No additional residential properties affected	Local
3. Visual amenity	N/a (rehabilitation of MTO is progressing)	N/a
4. Aboriginal heritage	N/a	N/a
5. Ecology	N/a	NSW/Australia
6. Traffic	Minimal traffic impacts on the local road network	Local
7. Groundwater	N/a	Local
8. Surface water	No significant impacts on surface water quality of adjacent water features	Local
9. GHG emissions	Incremental GHG emissions in	Global

Category	External effect	Overall nature of impact
	2019 only	

Notes: Additional detail is provided in Appendix C.

Table 3-11 below shows the incremental benefits of MTO for NSW. The estimated net benefit to NSW that can be attributed to MTO is A$151 million, around 10 per cent of the total net benefit that would accrue to NSW if both applications are approved (A$1,494).

Table 3-11. Incremental (economic) benefits of MTO for NSW

Costs	NPV (A$ m real 2014)	Benefits	NPV (A$ m real 2014)
Production-related		**Production-related**	
		Compensation of employees/ contractors (disposable income)	$63
		NSW share of personal income taxes	$8
		NSW share of Medicare payments	$0.2
		Share of MTO GOS accruing to NSW:	
		Royalties	$50
		Shareholder income	$0.4
		Company taxes	$20
		Taxes on production and imports:	
		Payroll taxes	$6
		Land taxes/shire rates	$1
Total production related	**$0.0**	**Total production related**	**$149**
Externalities (costs)		**Externalities (offsets)**	
Noise & vibration	$3	Zone of mitigation work, noise attenuation	$3
GHG emissions	$0	GHG emissions	$0
Total externalities	**$3**	**Total externalities**	**$3**
Grand total	**$3**		**$152**
Net economic benefits	**$149**		

Notes: MTO is projected to account for 232,704 t $C0_2$ in 2019. The damages cost of GHG emissions to NSW have been estimated by multiplying the global cost derived (A$1.5 m) by the share of NSW GSP to world GDP.

NPVs have been derived using a discount rate of 7 per cent.

Totals may not sum due to rounding.

Detailed calculations to derive production-related benefits that can be attributed to NSW are set out in Appendix A. MTO's GOS and the basis for the allocation of revenues and costs is set out in Appendix E.

4 Regional and local impact analysis of the proposals

This section sets out the REIA for the proposals. The detailed methodology used for deriving the input-output multipliers is described in Appendix D.

4.1 Economic framework

The REIA described in the following identifies the likely incremental flow-on effects of the proposals on the NSW economy, the Mid and Upper Hunter region and the Singleton LGA. These effects refer to the adjustments in the regional and state economies that follow from initial changes in the level of demand for goods, services and wages that result from an extension of mine production if the projects are approved.[10]

4.1.1 Choice of input-output analysis

There are a number of methods that can be used for calculating flow-on effects from mine extensions. They all face a singular issue in that the relative importance of a project increases when moving from a national to a state, and then to a regional perspective. At the same time, the degree of difficulty in estimating flow-on effects increases when moving from the national to the state and regional level. For the most part, this reflects a general lack of information about the specific composition and source of intermediate inputs used by an industry, as well as about trade at a state and regional level. In addition, there may also be local rigidities in employment, capital assets and other fixed resources that are not consistent with the assumptions that underpin methodologies for measuring flow-on effects.

The methodology used here relies on input-output analysis to derive various multipliers. The primary reasons for selecting this methodology are the simplicity and clarity with which the underlying assumptions can be set out and appropriate caveats made. Further, when compared to more complex methods such a general equilibrium (GE) analysis:

- The gross value of the proposals is small in relation to the Australian and NSW economies. Unlike an input-output analysis, a GE analysis takes into account the price impacts of a project on inputs and outputs. However, given the relatively small size of the proposals under consideration here, material price impacts would not be expected and the difference between the results of a GE and an input-output analysis should also be small.

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[10] As set out in Section 2, in the case of the proposals, the change in mine production being analysed relates to the ongoing production until 2035 that would occur if the application is approved, versus the shut-down of the mine by 2021 for Warkworth Mine and 2017 in the case of MTO if the applications are not approved.

- Given the lack of information about industry structure and trade at a regional and state level, there is no reason to think that one method would be materially more accurate than another. Both GE and input-output analysis depend critically on accurately modelling flows of production and expenditure.

4.1.2 Adjusting regional/state industry composition and trade

Regional impact analysis depends, in large part, on adjusting the flows of production and expenditure, as represented by national input-output tables, to represent a state or regional economy.[11] However, industries at a regional or state level have differing compositions of inputs and outputs than is the case for the national average; the same difficulty arises for specific projects within a region. Hence, a consistent set of ancillary information that is specific to national, state and regional economies is required to apportion national aggregates. The most commonly used information for this purpose (which is also recommended by the ABS) is industry employment.

As of 2011, the ABS has conducted a census of employment by industry and at the LGA level. This employment information can be used to calculate location quotients (LQs) to adjust national industry structure and trade flow data to derive the corresponding state and regional aggregates. Employment based LQs are ratios that indicate the percentage of people employed in a particular industry at a state/regional level, relative to the percentage of people employed in that industry in the economy as a whole. In the case of the Mid and Upper Hunter region, for instance, the employment based LQ indicates that the share of employment in the mining sector is significantly larger than it is for the Australian economy as a whole. Employment based LQs are then used to proportionally adjust the contribution of an industry to the use of intermediate inputs in a state or region. The consequent shortfall in intermediate inputs is made up by increasing 'imports' from outside the state or region across all industries.

The use of employment LQs has a critical limitation. Input-output tables do not explicitly account for fixed capital, human or physical, although the returns to these assets are implicitly reflected in wages and operating surpluses (profits). As the impact analysis becomes more granular, the geographic location of these fixed assets can become increasingly important. A region may simply not have the fixed assets needed to cost-effectively produce the input required by a local industry and as a consequence they will be 'imported' from other regions, states, or from overseas.

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[11] Input-output tables capture the flows of intermediate inputs between producers and form the basis for deriving multipliers. These tables are generally prepared at a national level; national input-output multipliers are essentially derived from a weighted average of enterprises at the national level. Thus the Australian input-output tables reflect a snapshot in time of the entire Australian economy and the inter-relationships between producers, households, governments, and the outside world. However, while the ABS publishes national input-output tables, similar information about the relationships between economic agents within a region and flows into and out of the region ('imports' and 'exports') is not available.

4.2 Interpretation of input-output multipliers

A change in demand sets the economy in motion as the productive sectors buy and sell goods and services from one another and households earn additional incomes, which gives rise to further flow-on effects (Coughlin et al. 1991). These relationships cause the total effects on the regional and state economy to exceed the initial change in demand.

Regional economic impacts can be measured in terms of income, value added and employment, which in turn gives rise to income, value added and employment multipliers.[12] In the case of the proposals:

- the income multiplier refers to the percentage change in total income arising per dollar change in the wages and salaries paid by MTW;
- the employment multiplier corresponds to the change in total employment (in numbers of FTEs) arising per additional person employed by MTW; and
- the value added multiplier refers to the percentage change in total value added arising per dollar change in the value added created by MTW.

Multipliers are classified into 'types'. Type I multipliers refer only to flow-on effects in the production sectors, while Type II multipliers incorporate subsequent impacts on households. In the case of the proposals:

- Type IA multipliers refer to the 'initial' and 'first round' effects arising from an increase in demand from MTW. The initial effect refers to the additional output from the proposals. The first round effect captures the immediate subsequent impacts on income, employment or value added from all industries whose output is required to produce the additional output from MTW.
- Type IB multipliers refer to the initial and 'production induced' effects, which encompass first round effects and additionally 'industrial support' effects. Industrial support effects capture subsequently induced effects that occur after the first round effects (since the initial output effect from MTW will induce additional output in other industries, which will in turn lead to further rounds of effects and so on).
- Type IIA multipliers incorporate the effects of the initial increase in output of MTW on households, and refer to the sum of production induced and consumption induced effects. Consumption induced effects capture the fact that, as a result of the additional

[12] It is also possible to calculate output multipliers, as representing the amount of additional output induced by the need for other industries to produce the output to meet the demand for an extra dollar of output from a project. However, the value of total business activity implied by output multipliers is larger than the market value of the goods and services that are produced, because some of the re-spending is used for the purchase of intermediate goods and services. Because of the implied double-counting, some commentators consider output multipliers to be misleading, and we do not report them here.

output from MTW and subsequent production induced effects in other industries, wage and salary earners will earn extra income which they spend on goods and services produced by all industries in the state or region.

4.3 Limitations of input-output analysis

The principal advantage of the impact multiplier method is the simplicity with which levels of mining investment, employment and output can be translated into measures of changes in regional income and employment. However, the accounting conventions that form the basis of input-output models and hence how multipliers are derived impose a number of restrictive assumptions. Some of these assumptions pertain to input analysis generally while others relate to the use and interpretation of input-output analysis at a regional/state, as opposed to a national level. The key assumptions are set out below.

4.3.1 Key assumptions

Fixed capital stocks

The National Accounts, on which input-output analysis is based, do not explicitly account for fixed capital stocks. This is an issue with input-output analysis generally as fixed capital has a significant impact on how an industry adjusts over time. A corollary to this is that input-output analysis is static in the sense that it takes no account of the time required for the composition of inputs and outputs of production to shift to a changed level in output. Industries that require large amounts of fixed capital and labour adjust slowly, particularly when they are near full employment or when the supply of skilled labour is tight. These dynamics are hard to predict, but the implication over the short- to medium-term is that input-output effects will be overstated to varying degrees across industries.

The fixed nature of the capital stock is a critical issue in regional impact assessments. In moving from the national to a state or regional level, the location of fixed assets becomes increasing important in establishing the goods and services that are supplied locally and those which are imported. Moreover, there is no information as to whether fixed assets are owned locally or whether the owners are located outside the region or state. As a consequence it becomes increasingly difficult to determine the valued added by local industry.

Supply constraints

Relatedly, when the initial impact considered is an increase in production, the assumption of fixed production patterns requires that there is a sufficient endowment of resources that is either available in (or able to migrate to) a region to meet the increase in demand for inputs whose supply is fixed. These inputs include resources such as land and water, as well as labour with adequate skills. If there is a reduction in production, as is the case here in the reference case, some or all of the fixed resources may be deployed elsewhere within or outside the region of interest. The return to these fixed resources is likely to be lower; however, if these next best opportunities are not taken into account the costs of foregoing the proposals will be overstated.

Homogenous and fixed production patterns

The input coefficients that measure inter-industry flows between sectors are 'fixed' in input-output models; at any level of output, an industry's relative pattern of purchases from other sectors is unchanged. These assumptions are likely to be inconsistent with production patterns in the local economy, since the local economy may not have on offer the range of inputs required for a given industry. Therefore, the impact of the change in output on the local economy will differ from that implied by a national multiplier.

Fixed prices

Input-output analysis assumes that prices in the economy in question are held constant, so that the additional material and labour inputs are available at existing prices and wage rates. In reality, prices of inputs may change with substantive changes in their demand. To the extent that there is an impact on prices, imputed output effects will be overstated. However, this is only a problem in input-output analysis for projects of a sufficient scale to materially shift the demand for inputs into production and the total supply of industry output.

4.3.2 Implications for the regional impact assessment

Many of the above assumptions can lead to an overstatement of the impacts of a project; the resulting regional impact estimates should therefore be interpreted as an upper bound of the likely effects (Bess and Ambargis 2011, Coughlin et al. 1991).

Furthermore, and while, from a theoretical perspective, the total (Type IIA) multiplier is the appropriate choice for calculating flow-on effects (since this measure takes into account the full adjustment of the economy to a change in economic activity), total multipliers are calculated in a manner that compounds any measurement errors and breaches in the assumptions that underpin the analysis. For example, total multipliers are calculated as a progression of first, second and successive round effects, with each embodying any errors in earlier effects. From this perspective, a more conservative approach is to rely only on multipliers that capture first round effects (Type IA multipliers).

As noted above, there are additionally specific issues that arise in deriving value added multipliers. Value added includes profits that are distributed on the basis of ownership of capital assets, which becomes increasingly uncertain as the analysis becomes more granular.[13] The calculation of value added at a regional level is therefore not meaningful.

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[13] For instance, there is no way of knowing from generally available public information whether a productive asset (say, a factory) that is located in the Upper Hunter Region is owned by persons living in the Upper Hunter Region, or in NSW, or elsewhere. It then becomes very difficult to attribute the value added generated by the factory on a regional and even state basis.

4.4 Results of the regional and local impact analysis

4.4.1 Income, employment and value added multipliers

Table 4-1 shows the estimated income, employment and value added multipliers for NSW, the Mid and Upper Hunter region, and Singleton LGA for the proposals. Based on this analysis, the approval of the proposals would lead to the following effects on the economy of NSW (Type IA multipliers):[14]

- each additional dollar in wages and salaries paid by MTW induces an additional A$0.63 in total income;
- each additional person employed by MTW induces employment of an additional 0.9 FTEs; and
- each additional dollar of value added created by the proposals induces an additional A$0.3 in value added.

Table 4-1. Income, employment and value added multipliers for NSW, the Mid and Upper Hunter region and for Singleton LGA

Multiplier	Type IA	Type IB	Type IIA
		New South Wales	
Income	1.63	2.23	3.54
Employment	1.91	3.81	6.05
Value added	1.30	1.55	2.05
		Mid and Upper Hunter region	
Income	1.49	2.09	2.63
Employment	1.76	3.62	4.79
Value added	1.25	1.45	1.71
		Singleton LGA	
Income	1.67	3.07	4.33
Employment	1.46	1.68	2.37
Value added	1.25	1.39	1.62

Source: BAEconomics analysis.

[14] To calculate the first-round flow-on effects of the MTW Continuation Project, it is necessary to deduct the initial effects from the multipliers (i.e., the additional expenditure from the project itself) by subtracting one.

4.4.2 Net impacts of the proposals (MTW)

The direct impacts of the proposals relative to the wind-down of MTW in the reference case are summarised in Table 4-2. Annualised values have been used to calculate the flow-on effects on an annual basis.

Table 4-2. Summary of net direct annual impacts of the proposals (MTW)

Item	Proposals scenario (NPV, 2014 A$ m)	Reference case (NPV, 2014 A$ m)	Net change (NPV, 2014 A$ m)	Amortised net change (annual A$ m)
Value of output	$13,972	$6,445	$7,527	$664
Input costs	$7,253	$3,441	$3,812	$336
Gross wages & salaries	$2,694	$1,200	$1,494	$132
Gross operating surplus	$3,896	$1,746	$2,150	$190
Taxes on production	$129	$58	$71	$6
Value added + 'imports'	$6,719	$3,004	$3,715	$328

Notes: Expenditures incurred by MTW to mitigate external effects have been excluded from this analysis as they are assumed to equal the costs of the externalities they are intended to mitigate.

Input costs are total operating expenses, excluding wages & salaries. Gross operating surplus is the value of output less intermediate inputs (excluding capital costs). The sum of wages & salaries for employees and long-term contractors, gross operating surplus, taxes on production, and royalties equals value added prior to the deduction of 'imports'. Employment is the average level of FTE employment (employees and long-term contractors) from 2014 to 2035.

Table 4-3 shows the net income (or compensation) benefits and the average annual increase in employment if the proposals are approved, at the state, regional and local level. These estimates are used as the basis for calculating the state, regional and local flow-on effects on income and employment. The apportionment of the change in income and employment associated with the MTW Continuation Project at the state, regional and local levels is based on the labour market assumptions detailed in Appendix A. Adjustments have accordingly been made to account for:

- the size of the MTW labour force residing in NSW, the Mid and Upper Hunter region, and in the Singleton LGA, respectively;
- the expectation that some share of workers who would be made redundant in the event that the proposals are not approved would be re-employed within NSW, the Mid and Upper Hunter region, or Singleton LGA, respectively; and, similarly,
- the expectation that a share of any additional workers employed by MTW would be redeployed from within NSW, from within the region, or from within Singleton LGA.

A large share of the MTW workforce lives within the Mid and Upper Hunter region (74 per cent) and locally in Singleton (35 per cent); the positive income effects associated with the proposals are therefore concentrated regionally and locally. We have assumed that a relatively larger share of any MTW workers made redundant would be re-employed within NSW than within either the Mid and Upper Hunter region or the Singleton region. As a consequence, the regional impacts on employment at the regional level are larger than at the State level.[15] Table 4-3 also includes the proportion of intermediate mine inputs that are estimated to be 'imported' from outside NSW. This figure is used as a basis for calculating the value added or GSP flow-on effect for NSW (as set out in Appendix D).

Table 4-3. Net income benefits, average annual net change in employment and derived 'imports' (MTW)

Area	Net income (NPV, 2014 A$ m)	Net employment (annual average)	Imports (per cent)
NSW	$612	227	4.9
Mid and Upper Hunter region	$464	282	-
Singleton LGA	$126	133	-

Notes: Net income is compensation of MTW employees/contractors, adjusted by (net of) compensation of redeployed persons in the reference case, adjusted by (net of) the compensation differential of additionally employed persons in the proposals scenario.

Net employment (annual average) is the average annual difference in the number of FTEs, adjusted (as above) for redeployed and additionally employed persons in the reference case and proposals scenario, respectively.

Imports is the share of intermediate mine inputs (operating expenses, excluding wages & salaries) estimated to be 'imported' from outside NSW.

Flow-on effects for NSW

To calculate the initial flow-on effects of the proposals for NSW, it is necessary to deduct the direct effects from the multipliers by subtracting one from the first round effect in Table 4-1:

- the initial income multiplier effects are calculated by applying the multiplier to the total value of wages adjusted by the proportion of wages paid to employees living in NSW;
- the initial employment multiplier effects are calculated by applying the multiplier to the total net change in average employment adjusted by the proportion of wages paid to employees living in NSW; and
- initial value added effects for NSW are calculated by first calculating the value added accruing to NSW, and by subsequently deducting imports into mining and then applying the NSW multiplier.

Further, as noted above, it is necessary to consider the issue of the transfer of labour between

[15] To illustrate this effect, assume that there is a business with 10 employees who all live in the Mid and Upper Hunter region. If the business is closed, the Mid and Upper Hunter region initially loses 10 jobs, although some of the employees (say 3) may find a new job in the Mid and Upper Hunter region, so that the net job loss is 7. In addition, however, another 5 employees may find a new job elsewhere in NSW, so that the net job loss for NSW overall is only 2.

industries. The total flow-on income and employment effects have been adjusted to account for the expectation that a share of the FTEs that would be made redundant in the reference case will be re-employed. Total value added (the sum of salaries and wages and GOS) has been adjusted for the corresponding change in incomes. The assumptions made for NSW are consistent with those made in CBA.[16]

Table 4-4 shows the estimated flow-on effects from the proposals for NSW. The estimated net flow-on benefits of the proposals amount to an overall increase in GSP of A$452 million in NPV terms (A$39 million per annum), equivalent to about 12 per cent of the net value added of the project (A$3,715 million). The great majority of the flow-on benefits is attributable to the increased compensation of employees and long-term contractors. It is estimated that the proposals would generate additional income of A$385 million in NPV terms, and a net addition of 206 FTE jobs.

Table 4-4. Initial flow-on effects (Type IA) for NSW (MTW)

	Income (2014 NPV A$ m)		Employment (FTEs)	Value added (GSP) (2014 NPV A$ m)	
	Total	Annual	Annual	Total	Annual
Flow-on effects	$385	$33	206	$450	$39

Flow-on effects for Mid and Upper Hunter region

Table 4-5 shows the estimated flow-on effects from the proposals for the Mid and Upper Hunter region. The net benefits to the Mid and Upper Hunter region are estimated to be:

- around A$227 million in additional income generated (A$20 million per annum); and
- additional annual employment of around 214 full-time equivalent workers.

These effects have similarly been calculated by adjusting the various factors for the percentage of MTW employees living in the Mid and Upper Hunter region. Given the various uncertainties set out above, value added effects have not been calculated on a regional basis.

Table 4-5. Initial flow-on effects (Type IA) for the Mid and Upper Hunter region (MTW)

	Income (2014 NPV A$ m)		Employment (FTEs)
	Total	Annual	Annual
Flow-on effects	$227	$20	214

[16] That is, it is assumed that 30 per cent of employees and contractors that are made redundant are re-employed within one year, an additional 40 per cent of employees/contractors is re-employed in the second year, and 30 per cent of any displaced workers leave the NSW workforce.

Flow-on effects for the Singleton LGA (MTW)

Table 4-6 shows the estimated flow-on effects from the proposals for the Singleton LGA. The net benefits for the Singleton LGA are estimated to be:

- around A$84 million in additional income generated (A$7 million per annum); and
- additional annual employment of around 61 full-time equivalent workers.

These effects have similarly been calculated by adjusting the various factors for the percentage of MTW employees living in the Singleton LGA (35 per cent).

Table 4-6. Initial flow-on effects (Type IA) for the Singleton LGA

	Income (2014 NPV A$ m)		Employment (FTEs)
	Total	Annual	Annual
Flow-on effects	$84	$7	61

4.4.3 Net impacts of Warkworth Mine

This section summarises the results of the regional and local impact analysis for Warkworth Mine. The income, employment and value added multipliers summarised in Table 4-1 were used to derive these flow-on effects by first applying these to MTO, and then deriving the flow-on benefits attributable to Warkworth Mine by differencing. The share of Warkworth Mine workers and contractors living in Singleton, the Mid and Upper Hunter region, and NSW was assumed to be the same as for MTW overall.

Flow-on effects for NSW

Table 4-7 shows the estimated flow-on effects from the proposals for NSW. The estimated net flow-on benefits of the proposal amounts to an overall increase in GSP of A$407 million in NPV terms (A$35 million per annum). It is estimated that the proposal would generate additional income of A$346 in NPV terms, and a net addition of 191 FTE jobs.

Table 4-7. Initial flow-on effects (Type IA) for NSW (Warkworth Mine)

	Income (2014 NPV A$ m)		Employment (FTEs)	Value added (GSP) (2014 NPV A$ m)	
	Total	Annual	Annual	Total	Annual
Flow-on effects	$346	$30	191	$406	$35

Flow-on effects for the Mid and Upper Hunter region

Table 4-8 shows the estimated flow-on effects from the proposals for the Mid and Upper Hunter region. The net benefits to the Mid and Upper Hunter region are estimated to be:

- around A$204 million in additional income generated (A$18 million per annum); and
- additional annual employment of around 198 FTE jobs.

Table 4-8. Initial flow-on effects (Type IA) for the Mid and Upper Hunter region (Warkworth Mine)

	Income (2014 NPV A$ m)		Employment (FTEs)
	Total	Annual	Annual
Flow-on effects	$204	$18	198

Flow-on effects for the Singleton LGA

Table 4-9 shows the estimated flow-on effects from the proposals for the Singleton LGA. The net benefits for the Singleton LGA are estimated to be:

- around A$75 million in additional income generated (A$6 million per annum); and
- additional annual employment of around 57 full-time equivalent workers.

Table 4-9. Initial flow-on effects (Type IA) for the Singleton LGA (Warkworth Mine)

	Income (2014 NPV A$ m)		Employment (FTEs)
	Total	Annual	Annual
Flow-on effects	$75	$6	57

4.4.4 Net impacts of MTO

This section summarises the results of the regional and local impact analysis for MTO. The income, employment and value added multipliers summarised in Table 4-1 were used to derive these flow-on effects. The respective share of MTO employees and contractors living in Singleton, the Mid and Upper Hunter region, and NSW was assumed to be the same as for MTW overall.

Flow-on effects for NSW

Table 4-10 shows the estimated flow-on effects from the proposals for NSW. The estimated net flow-on benefits of the proposal amounts to an overall increase in GSP of A$45 million in NPV terms (A$4 million per annum). It is estimated that the proposal would generate additional income of A$39 in NPV terms, and a net addition of 15 FTE jobs.

Table 4-10. Initial flow-on effects (Type IA) for NSW (MTO)

	Income (2014 NPV A$ m)		Employment (FTEs)	Value added (GSP) (2014 NPV A$ m)	
	Total	Annual	Annual	Total	Annual
Flow-on effects	$39	$3	15	$45	$4

Flow-on effects for the Mid and Upper Hunter region

Table 4-11 shows the estimated flow-on effects from the proposals for the Mid and Upper Hunter region. The net benefits to the Mid and Upper Hunter region are estimated to be:

- around A$23 million in additional income generated (A$2 million per annum); and
- additional annual employment of around 16 FTE jobs.

Table 4-11. Initial flow-on effects (Type IA) for the Mid and Upper Hunter region (MTO)

	Income (2014 NPV A$ m)		Employment (FTEs)
	Total	**Annual**	**Annual**
Flow-on effects	$23	$2	16

Flow-on effects for the Singleton LGA

Table 4-12 shows the estimated flow-on effects from the proposals for the Singleton LGA. The net benefits for the Singleton LGA are estimated to be:

- around A$9 million in additional income generated (A$1 million per annum); and
- additional annual employment of around 4 FTE jobs.

Table 4-12. Initial flow-on effects (Type IA) for the Singleton LGA (MTO)

	Income (2014 NPV A$ m)		Employment (FTEs)
	Total	**Annual**	**Annual**
Flow-on effects	$9	$1	4

Appendix A Cost-benefit analysis - MTW

A.1 CBA accounting framework

The accounting and definitional conventions set out in the following reflect the framework used in the ASNA, as set out in ABS (2013). These conventions have been applied for deriving the incremental GOS associated with the proposals, as well as the net benefits accruing to the State of NSW.

A.1.1 MTW Incremental gross operating surplus

GOS is a measure of the surplus accruing to incorporated enterprises owners from processes of production before the deduction of various items. GOS is the excess of gross output over the sum of intermediate consumption (gross value added), net of compensation of employees, and taxes less subsidies on production and imports. GOS is calculated before deduction of consumption of fixed capital, dividends, interest, royalties and land rent, and direct taxes payable (ABS 2013):

$$Output - Intermediate\ consumption$$

$$= Gross\ value\ added$$

$$- Compensation\ of\ employees$$

$$-(+)\ Other\ taxes\ (subsidies)\ on\ production$$

$$= Gross\ operating\ surplus$$

The components of GOS are defined as follows:

- *Output*: Output consists of the value of goods and services produced, valued at producer prices.
- *Intermediate consumption*: Intermediate consumption (or ‘intermediate use’) consists of the value of the goods and services consumed (‘used up’) as inputs to the production process, including those used directly as inputs, as well as ancillary activities. Intermediate consumption does not include the consumption of fixed capital (depreciation) and royalties.
- *Compensation of employees*: Compensation of employees comprises wages and salaries and employers’ social (e.g. superannuation) contributions. Compensation of employees excludes payroll tax, but it includes severance, termination and redundancy payments by employers. Employees are defined as all persons engaged in the activities of incorporated business units. Long-term contractors operating on rostered shifts and under MTW direction have been included in this category.

- *Other taxes (less subsidies) on production*: Other taxes on production include payroll taxes, recurrent taxes on land or buildings, stamp duties and taxes on pollution.

A.1.2 Incremental contribution to NSW GSP

GSP (I) is defined as (ABS 2013):

$$GSP(I) = Compensation\ of\ employees$$

$$+\ Gross\ operating\ surplus$$

$$+\ Gross\ mixed\ income$$

$$+\ (-)\ Taxes\ (Subsidies)\ on\ production\ and\ imports$$

Each of these items has been adjusted to determine the share accruing to NSW, as follows.

Compensation of NSW employees

Compensation of employees is as defined above. The share of MTW employees residing in NSW has been determined on the basis of postcode data provided by MTW.

In order to correctly apportion wage and salary benefits to NSW, gross wages and salaries have been decomposed into disposable income, income taxes, superannuation contributions, and Medicare levies. Only incremental disposable income is assumed to constitute a full benefit to NSW.

Some share of income taxes and Medicare levies paid by MTW employees and long-term contractors to the Commonwealth Government can be deemed to benefit the residents of NSW. However, there is no clear relationship between taxes/levied paid to the Commonwealth and the resulting benefits accruing to residents of NSW. There is no specific 'formula' for determining payments to the states/territories, and to the extent that some of the services provided by the Commonwealth are 'public' goods, all residents of Australia benefit from them, regardless of where they live. Allocations to the states/territories instead take the form of general purpose payments (mainly GST), specific purpose payments, national partnership payments, and other general revenue assistance in some circumstances (NSW Government 2013, Council of Australian Governments n.d.). Given the lack of a clear funding formula, the share of income taxes and Medicare levies paid by MTW employees and contractors that accrues to NSW has been determined on the basis of population share. The most recent ABS statistics indicate that the NSW share of the Australia population is around 32 per cent (ABS 2013).

MTW GOS accruing to NSW

Only a portion of the incremental GOS associated with the proposals accrues to NSW, namely:

- the coal royalties paid by MTW to NSW;
- the share of profits resulting from the proposals accruing to shareholders of Rio Tinto who live in NSW; and

- the share of company taxes paid by MTW to the Commonwealth Government that accrues to NSW.

Some share of MTW's GOS (profits) accrues to NSW shareholders of Rio Tinto, although this calculation is necessarily inexact. The share of surplus has been calculated as follows:

- Warkworth Mine and MTO have different ownership structures, with a minority share of each being foreign-owned. To determine Rio Tinto's share of GOS, the profit split for each mine, as prescribed in the JV agreement, has been applied to Rio Tinto's ownership share of each mine to determine Rio Tinto's overall share of the surplus from MTW.
- The GOS calculated as described above refers to revenues from coal sales, net of intermediate consumption, wages & salaries, and certain taxes, but it includes depreciation/amortisation and inventory adjustments, among other items, which are unknown and are not included in a CBA. Only a share of GOS is therefore available for distribution to Rio Tinto shareholders. Rio Tinto's accounts do not enable any clear conclusions to be drawn between GOS or a similar measure, on the one hand, and dividend payments, on the other, and indeed numerous year-on-year variations would be expected to arise and obscure such a relationship. For the purposes of approximating the relationship between Rio Tinto's share of MTW profits and any payout to Rio Tinto shareholders, the average relationship between consolidated sales revenue and equity dividends paid to shareholders of Rio Tinto as reported in Rio Tinto's annual reports and accounts (2007 to 2013) has been estimated. That ratio is around 4.3 per cent.[17]
- Only a portion of the dividends available for distribution will be paid to Australian shareholders. It is not known what percentage of Australian Rio Tinto shareholders reside in NSW. For the purpose of this calculation, we have therefore approximated the share of NSW shareholders on the basis of the share of the Australian population living in NSW (around 32 per cent), multiplied with the proportion of Rio Tinto shareholders estimated to be Australian residents.

In addition, MTW pays company taxes to the Commonwealth Government, some share of which can be deemed to benefit the residents of NSW. However, as for personal income taxes, there is no direct relationship between any company tax paid by MTW to the Commonwealth and the resulting benefits accruing to residents of NSW. The share of company taxes paid by MTW that accrues to NSW has therefore also been determined on the basis of share of population.

Additional taxes accruing directly to NSW

MTW makes the following payments that accrue directly to different levels of government in NSW:

[17] We note that this calculation does not take into account any share value appreciation or depreciation.

- payroll taxes; and
- land taxes/shire rates.

A.2 Labour market assumptions

This annex describes the available empirical information about labour market outcomes that has informed the assumptions made about re-employment and redeployment of MTW workers.

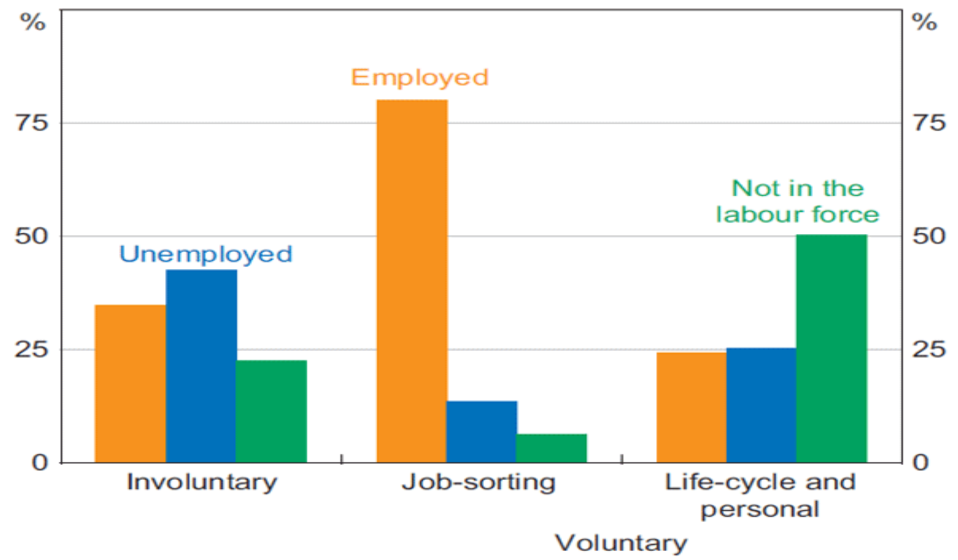
A.2.1 Outcomes following involuntary redundancy

There is only limited information about the eventual labour market outcomes relating to workers who are made redundant at some stage during their working lives.

A recent RBA (2012) analysis indicates that re-employment outcomes differ depending on whether workers separate from their jobs involuntarily (for instance, as a result of being made redundant) or voluntarily (for instance, to look for better employment opportunities). More than 75 per cent of people who leave their jobs voluntarily tend to find new employment in the same year. In contrast, of those employees experiencing an involuntary separation during the year to February 2012 (Figure A-1):

- 35 per cent were re-employed within the year;
- 43 per cent remained unemployed at the end of the year; and
- 23 per cent left the labour force altogether.

Figure A-1. Outcomes following job separations, shares of separations by type, year to February 2012



Source: RBA 2012.

The most recent comparable study of labour market outcomes following a retrenchment was published by the ABS in 2002 (ABS 2002). Of around 600,000 people who had been made redundant in the three years prior to July 2001, and as of July 2001:

- 67 per cent were employed;
- 17 per cent were still unemployed; and
- 16 per cent had left the labour force.

A similar ABS study conducted in July 1997 found that 55 per cent were employed after three years, 29 per cent were unemployed, and 16 per cent had left the labour force.

The Household, Income and Labour Dynamics in Australia (HILDA) survey conducted by the Melbourne Institute of Applied Economic and Social Research additionally provides information on labour market outcomes over time (Melbourne Institute 2013). The HILDA survey suggests:

- The likelihood of remaining unemployed from one year to the next increased to around 35 per cent between 2009 and 2010 for persons aged 25 to 54 years, compared to 34 per cent between 2008 and 2009, and 22 per cent from 2007 to 2008. ABS (2014) statistics additionally indicate that the average period of unemployment is around 38 weeks.
- Also for persons aged 25 to 54 years, the likelihood of moving from 'unemployed' status to 'out of the labour force' status was 21 per cent between 2009 and 2010, 34 per cent between 2008 and 2009, and 30 per cent between 2007 and 2008.

A.2.2 Duration of unemployment

ABS (2014) research suggests that the average duration of unemployment is about 38 weeks.

A.2.3 Labour mobility

Geographical labour mobility of employees is by far the highest for mining sector employees (PC 2013). At the time of the 2011 census, almost 10 per cent of mining sector employees had moved house in the previous year, compared to an average of around 3 per cent for all employed people.

ABS and other sources also suggest that unemployed persons move house relatively more often. A representative sample compiled from the Survey of Income and Housing (SIH) found that in the five years up to 2007-08, 61 per cent of unemployed people moved at least once, compared to 48 per cent of employed people and 33 per cent people not in the labour force who reported a move.

Net outward migration has been a feature of the NSW labour market for some time. The RBA (2012) estimates that the last decade to March 2012, employment growth in New South Wales was negative, of which almost (-)3 per cent was accounted for by interstate migration and (-)1 per cent by overseas migration.[18]

A.2.4 Labour market assumptions

NSW

Re-employment assumptions

In the event that the proposals are not approved, MTW would cease operating in 2021. In that case, MTW employees and long-term contractors would be made redundant and:

- a share of MTW employees and contractors would find alternative employment, either within the Upper Hunter Region or in New South Wales; and
- the remainder of MTW employees and contractors would leave NSW to seek alternative employment or leave the workforce altogether. In either of these cases, the benefit to NSW of additional wage and salary income would be lost.

For the purpose of the CBA and the REIA, the following central modelling assumptions have been applied and tested using a range of sensitivities:

- 30 per cent of employees/contractors who are made redundant in the event that the proposals are not approved are re-employed in NSW in the same year;
- 40 per cent of employees/contractors are re-employed in NSW in the following year; and
- 30 per cent leave the NSW labour force in the same year, either by moving interstate or by leaving the labour force altogether.

Redeployment assumptions

In the event that the proposals are approved, some proportion of any additional employees/contractors can be assumed to move into these positions from existing jobs within NSW, rather than arriving from interstate or being drawn from the unemployment pool. For the purpose of the CBA and the REIA, we have assumed that 70 per cent of any additional MTW employees/contractors would be redeployed from existing jobs in NSW. For these employees/contractors, only the expected additional income from employment at MTW is counted as a net benefit.

Re-employment and redeployment incomes

We have assumed that workers from MTW who are made redundant if the proposals are not approved, and who are re-employed in New South Wales would earn the average wage in the Mid and Upper Hunter region. Adjusted to 2014 prices, average wages & salaries in the region

[18] ABS data indicates net interstate migration from New South Wales of around 11,400 persons between the age of 20 and 64 in 2012.

are around A$58,853, slightly higher than for New South Wales as a whole. The same figure has been applied to estimate the incremental employment benefits for redeployed persons.

Mid and Upper Hunter region and Singleton LGA

Re-employment assumptions

For the purpose of the REIA, the following central modelling assumptions have been applied for the Mid and Upper Hunter region/Singleton LGA:

- 20 per cent of employees/contractors who are made redundant in the event that the proposals are not approved are re-employed in the Mid and Upper Hunter region/in Singleton LGA, respectively, in the same year;
- 30 per cent of employees/contractors are re-employed in the Mid and Upper Hunter region/in Singleton LGA, respectively, in the following year; and
- 50 per cent leave the Mid and Upper Hunter region/the Singleton LGA labour force, respectively, in the same year, either by moving outside the region/Singleton LGA or by leaving the labour force altogether.

Redeployment assumptions

For the purpose of the REIA, we have assumed that 50 per cent of any additional MTW employees/contractors would be redeployed from existing jobs in the Mid and Upper Hunter region/Singleton LGA, respectively. For these employees/contractors, only the expected additional income from employment at MTW is counted as a net benefit.

Re-employment and redeployment incomes

We have assumed that workers from MTW who are made redundant if the proposals are not approved, and who are re-employed in the Mid and Upper Hunter region/Singleton LGA, respectively, would earn the average wage in the Mid and Upper Hunter region. Adjusted to 2014 prices, average wages & salaries in the region are around A$58,853, slightly higher than for New South Wales as a whole. The same figure has been applied to estimate the incremental employment benefits for redeployed persons.

A.3 Net benefits of the MTW Continuation Project for Australia

The CBA described has focused on the benefits of the proposals for NSW. For completeness, we have extended this analysis to the benefits of the proposals for Australia as a whole as shown below.

Table A-1. Incremental (economic) benefits of the proposals for Australia

Costs	NPV (A$ m real 2014)	Benefits	NPV (A$ m real 2014)
Production-related		**Production-related**	
		Compensation of employees/ contractors, net of reemployment benefits	$546
		Personal income taxes	$369
		Medicare payments	$16
		Share of MTW GOS accruing to NSW:	
		Royalties	$617
		Shareholder income	$36
		Company taxes	$362
		Taxes on production and imports:	
		Payroll taxes	$61
		Land taxes/shire rates	$5
Total production related	**$0**	**Total production related**	**$2,012**
Externalities (costs)		**Externalities (offsets)**	
Noise & vibration	$15	Zone of mitigation work, noise attenuation	$15
Visual amenity	$2	Visual amenity upgrades	$2
Noise & air general	$3	Acquisition of properties	$3
Aboriginal heritage	$1	Cultural Heritage Facility	$1
Ecology	$10	Acquisition of offsets	$10
Traffic impacts	$13	Traffic impacts	$0
Groundwater	$0	N/a	$0
Surface water	$0	N/a	$0
European heritage	$0.5	Heritage trust, Great North Road	$0.5
GHG emissions	$1.6	GHG emissions	$0
Total externalities	**$46**	**Total externalities**	**$31**
Grand total	**$46**		**$2,043**
Net economic benefits	**$1,997**		

Notes: NPVs have been derived using a discount rate of 7 per cent.

The damages cost of GHG emissions to Australia have been estimated by multiplying the global cost derived using the SCC (A$131 m) by the share of Australian GDP to world GDP.

Totals may not sum due to rounding.

Appendix B External effects – MTW

The following summarises the key potential environmental impacts identified by EMM and other specialised experts for the MTW Continuation Project.

B.1 Noise & vibration

The operational noise studies considered the potential noise impacts on 220 privately-owned residential locations surrounding the mine over the life of the proposals. The assessment predicted noise emissions based on an equipment fleet with best practice sound suppression on all major plant. MTW is additionally implementing industry-leading innovation for pre-emptive real time noise modelling and is using best practice real time noise monitoring and management techniques.

B.1.1 Impacts

The operational noise at residences study concluded that operational noise will comply with relevant criteria for all the 221 assessment locations during calm weather conditions for each of the day, evening and night periods.

Predictions during prevailing meteorological conditions indicated that operational noise levels from the proposal would result in significant noise level exceedances at three assessment locations. Of these:

- two assessment locations are within the ZOA of a neighbouring mine; and
- one assessment location will be offered acquisition rights by MTW.

It should be noted a further non-residential assessment location, Warkworth Community Hall, is predicted to exceed noise criteria.

Further, the proposals are likely to result in lower noise levels for eastern receivers than current and approved operations due to implementation of plant attenuation.

The assessment predicted that noise impacts are within appropriate criteria for operational blasting (blast vibration and overpressure impacts) and increased traffic volumes on public roads due to traffic detours resulting from the closure of Wallaby Scrub Road.

Predicted noise levels under prevailing weather conditions are below the conservative sleep disturbance criterion at each of the 12 representative assessment locations.

Where low frequency noise is concerned, the review of monitoring data from the 2013 calendar year indicates:

- Of the 11 monitoring locations where noise from Warkworth Mine was observed, measurements exceed the Broner criteria at three non-residential locations to the south-east of Warkworth Mine; however, road traffic noise contributions are likely to contribute to elevated noise level.

- The NSW Industrial Noise Policy's (INP's) assessment criteria was exceeded in three measurement samples. However, in each case, the overall dB(C) value is below the 'Broner' criteria.

Where cumulative noise impacts are concerned:

- The INP's acceptable night time criterion is satisfied at all but two representative assessment locations, predominantly because of operations by Wambo Mine operations. These locations are in the ZOA of neighbouring mines.
- No additional exceedances to the amenity criterion are predicted.

The proposal would not result in any net increase in rail traffic over and above currently approved rail activities servicing the integrated MTW operation.

Appropriate management of blasts would ensure blast noise overpressure and ground vibration limits are satisfied.

The results of noise modelling of two road traffic scenarios predict that day and night criteria would be met for both scenarios. The relative change in noise level is marginal.

B.1.2 Proposed mitigation

MTW noise management plan

The MTW noise management plan details a range of existing acoustic management and monitoring procedures:

- *Real-time noise monitoring*: Directional real-time noise monitoring is used to proactively manage noise emissions from MTW on a continuous basis during night time operations.
- *Supplementary attended noise monitoring*: A programme of targeted supplementary attended noise monitoring is operated at MTW to support the real-time directional monitoring network and ensure the highest level of noise management is maintained.
- *Administrative controls*: Administrative controls implemented at MTW include the Trigger Action Response Process (TARP); heavy mine equipment sound power level screening; shift handover report; and validation surveys of the real-time monitoring network.
- *Substitution controls*: Substitution controls are implemented in response to one or more triggers, and are utilised both proactively and reactively. Substitution measures involve the repositioning or replacement of equipment or reassignment of tasks when conditions require.
- *Engineering measures*: MTW have progressed with the attenuation of its fleet of haul trucks and other mining equipment. All new trucks purchased for use on the site will be commissioned as noise suppressed (or attenuated) units. MTW have also completed works to replace all in-pit reverse alarms with 'quacker' style reverse alarms on its mining fleet. During 2012, engineering works were undertaken to address noise associated with shovel operations. Where additional reasonable and feasible

opportunities for engineering controls are identified in the future, these will continue to be investigated and trialled as appropriate.

- *Elimination controls*: Elimination controls, equipment or task shutdown are implemented in response to one or more triggers.
- *Continuous improvement*: MTW is committed to continuous improvement of the noise management plan and driving industry best practice noise management.
- *Predictive modelling interface*: MTW is developing a predictive modelling interface which allows for proactive planning of mining operations and weather conditions as a leading measure for managing noise emissions.
- *Development and installation of alternate real-time noise monitoring technologies*: Warkworth Mine is investigating alternate noise monitoring technologies to assist with operational control.

Acquisition of properties

One residential location with predicted significant noise level exceedances during prevailing meteorological conditions will be offered acquisition rights by MTW.

B.2 Air quality

The assessment of air impacts considered existing mining areas and the proposed extension area, and incorporated all existing and approved MTW operations. The assessment results represent the potential impacts resulting from the entirety of MTW, including the changes resulting from the proposals. The modelling assessment also includes dust from all nearby existing and proposed mining projects including MTO, Wambo Mine, Hunter Valley Operations, Rix's Creek and Bulga Coal Complex.

B.2.1 Impacts

Table B-1 below describes the projected air quality impacts of the proposals. Air quality monitoring focused on:

- particulate matter, consisting of dust particles of varying size and composition (deposited dust), total suspended particulate matter (TSP), and TSP particles which have a diameter of 10 micrometres (µm) or less (PM_{10}) or 2.5µm or less ($PM_{2.5}$);
- carbon monoxide (CO); and
- nitrogen dioxide (NO_2).

Table B-1. Air quality impacts of the proposals

Predicted impacts	Summary of outcomes (third parties)
Dispersion modelling	Three privately-owned assessment locations may experience concentrations above the relevant criterion for 24-average and annual average PM_{10}. Of these, two are within the ZOA of Wambo Mine, one is not a residential location.

Predicted impacts	Summary of outcomes (third parties)
Maximum 24-hour average PM_{10} contemporaneous assessment (including MTO)	It is unlikely that cumulative impacts would arise at the assessment locations near the Bulga and Wallaby Scrub Road monitoring locations. There is potential for cumulative impacts to arise near the Warkworth, Knodlers Lane and MTIE monitoring stations: - The potential risk of cumulative impacts at the Knodlers Lane and MTIE monitors is deemed relatively low with only two and three additional days, respectively, of predicted impact above the relevant criterion in Year 9 and only one day for Knodlers Lane in Year 14. - The potential risk of cumulative impacts near the Warkworth monitor is greater with one, six and four additional days predicted to exceed the relevant criterion in Years 3, 9 and 14, respectively.
Cumulative $PM_{2.5}$	Background levels of PM2.5 at the Site would be significantly lower than the levels in Singleton, given the concentration of wood heaters, people and cars is considerably less in the near vicinity of the proposal. No assessment location would experience cumulative $PM_{2.5}$ level above the NEPM advisory reporting standards.
Diesel emissions	All assessment locations are predicted to experience maximum 1-hour average and annual average NO_2 concentrations below relevant criteria. Predictions of CO would be well below the air quality goals.
Blast fume emissions	During the middle daytime hours no impacts due to blasting fume emissions are predicted to occur. In the early evening, there is potential for impacts to arise offsite. However, application of blasting restrictions would avert such potential impacts for most assessment locations. MTW are implementing a predictive management system to aid with management of blasting operations. It is anticipated that with implementation of the protocols potential blast impacts would be averted.

The air quality study also considered the health effects associated with exposure to particulates. Finer particles (smaller than 10µm) tend to be of concern in this context. However, and given that the majority of particulate emissions from mining are dust, which originates from the soil, mining techniques used at coal mines generally cannot break down rock, coal or soil material into very fine fractions. As a result emissions from mines are predominantly in the coarse size fraction which would not penetrate as deeply into the lung, or carry additional toxic combustion substances. On average it has been measured that approximately 5 per cent of TSP from mining is in the $PM_{2.5}$ size fraction, and approximately 12 per cent of PM_{10} from mining is in the $PM_{2.5}$ fraction. This contrasts with studies:

- of urban areas, where approximately 50 per cent of the PM_{10} is comprised of particles in the $PM_{2.5}$ size range, and most of these are from combustion; and

- of rural areas, where domestic wood smoke is a key issue of health impact. Recent studies by the CSIRO into the composition of particulate matter in the Hunter Valley found that a key source of fine particulate is wood smoke.

Overall, the assessment results show that:

- Three privately-owned assessment locations, may experience concentrations above the relevant criteria for 24-hour average and annual average PM_{10}. Two of these locations are within a neighbouring mine's ZOA, and one is a non-residential location (Warkworth Hall).
- No impacts are predicted from emissions resulting from the use of diesel powered equipment.
- Impacts from blast fume emissions are expected to be manageable with the operation implementation of MTW's blast management plan.

B.2.2 Proposed mitigation

MTW Air Quality and Greenhouse Gas Management Plan

The management of air quality is integrated across Warkworth Mine and MTO and is undertaken in accordance with the MTW Air Quality and Greenhouse Gas Management Plan (AQMP).

The proposal would apply site-specific best practice measures to manage dust emissions, and would continue to do so over the life of the proposal. A range of improvements have been made at the site in recent years, including:

- mine infrastructure to improve the watering of haul roads, such as six new fill points and four new water carts to replace smaller carts;
- aerial seeding programs to better stabilise mine areas prior to full rehabilitation;
- installation of dust hoods on hoppers into which the trucks unload coal; and
- community response officers on each night shift to assist with operational control.

Acquisition of properties/air quality mitigation measures

Two residential locations which are predicted to experience higher than acceptable concentrations of particulate matter will be offered acquisition rights by MTW.

B.3 Visual amenity

B.3.1 Impacts

The operations of MTW, comprising Warkworth Mine and MTO, form part of the existing landscape.

The visual impact of the proposal would generally be low/moderate for a majority of the primary visual catchment, with more prominent views and greater impacts on residences in elevated locations in and around Bulga village (Table B-2).

Table B-2: Visual amenity impacts

Direction of view	Impacts
North	Limited views from Warkworth village, the Golden Highway, or near- to medium field locations in the rural foothills to Warkworth Mine. Eastern overburden emplacement areas may be visible during the initial period of the proposal. Views would be distant and have a low visual impact in a wider context
North-east	Change in visual effect would be low, given the exposure to existing overburden emplacement areas.
East	Visual effects vary from high at closer assessment locations, such as the Golden Highway and Putty Road, to low for more distant locations. Residences to the east along Putty Road, Golden Highway, and nearby rural roads would have views to the eastern face of the active Warkworth Mine overburden emplacement areas. The sensitivity of these residences is potentially moderate to high.
South	Topography, vegetation and other mining operations generally conceal the current operation and the proposal from the south. Parts of the overburden emplacement areas may be seen where they are raised above existing levels, corresponding to moderate visual effects despite the distance at which they are seen (3 to 5km). The views in this area would generate a high to moderate visual impact for floodplains visual catchment units.
West	The removal of Saddleback Ridge and progression of mining westward would generally be concealed to most viewers to a varying extent by the intervening vegetation and topography. Views from some south-westerly view points along Putty Road, as well as from some parts of Bulga village, would exist; however, the visual effects would be low. The proposed overburden emplacement is largely screened from Wambo Road. Road users from Putty Road to the south of Bulga village and along Inlet Road would have moderate to low sensitivity and visual impacts due to the exposure of overburden emplacements once Saddleback Ridge is removed. Most residential properties to the west would have a high level of sensitivity, with some properties in elevated locations in Bulga potentially experiencing high visual impacts depending on the orientation of the property and intervening vegetation screening.

In summary, potential visual impacts of the proposal would generally be moderate to low, as the impact on visual amenity will be limited and localised. The existing topography and vegetation would continue to provide screening to the mine to varying extents depending on view location and elevation. Some residences west of the Site, such as elevated residences around Bulga village, may potentially experience high visual impacts.

B.3.2 Proposed mitigation

MTW Visual Impact Management Plan

As part of the Warkworth Extension 2010, a MTW Visual Impact Management Plan (VIMP) was developed. The draft VIMP would be revised and adapted to the proposals.

Current onsite mitigation measures include:

- structure design to minimise visual impacts, consistent with engineering principles and practice, and any site constraints;
- direction of lighting away from offsite areas to the greatest degree possible, and the use of sensor lighting where permanent lighting unnecessary; and
- construction of bunds, vegetated and built screens at appropriate locations along the site boundary.

Visual impact mitigation measures would be put in place to mitigate the potential impacts on the overall surrounding landscape including vegetation and bund screening to the boundaries of the Site. Elements of the draft VIMP that apply to the proposal include:

- examination, in detail, of any high sensitivity viewing points and determination of the opportunities for relevant screening treatments including onsite boundary treatments or mitigation measures to individual residences;
- minimisation of the amount of pre-rehabilitation areas exposed to view by establishing grass cover to remove colour contrast; and
- establishment of planting patterns of trees and grasses in rehabilitation areas to create a high level of visual integration with the surrounding landscape.

Site-specific visual assessments

In order to determine mitigation for any viewpoint with high sensitivity, site specific visual assessments (SSVAs) would be undertaken. The VIMP would outline a process to undertake these assessments:

- A landowner in Bulga village affected by visual impacts from the proposal may request a SSVA, which may result in the application of appropriate screening treatments at the affected property or between the property and the source for impacts assessed as high.
- For the small number of individual residences within the primary visual catchment, which may have high visual impacts at some stage of the proposal, suitable mitigation measures would be implemented, subject to agreement with the landowner. This is likely to constitute vegetation screening; however, all mitigation measures would be guided by an SSVA and associated consultation with the affected property owners.

B.4 Aboriginal cultural heritage

B.4.1 Impacts

If the proposals are approved, 110 places containing Aboriginal cultural heritage objects would potentially be impacted. The great majority of these places contain isolated stone artefacts; in addition one site contains grinding grooves and three contain scarred tree. These places are of cultural significance for the Aboriginal people of the Upper Hunter Valley.

The places are concentrated along drainage lines with a particular focus around permanent sources of water. These areas have generally been subjected to a long history of disturbance through a range of land uses.

In general, the majority of the Aboriginal cultural heritage places identified and recorded to date are unlikely to yield significant additional information with regard to patterns of land and resource use either locally or regionally. It is also difficult to date the majority of these cultural heritage places, which limits their scientific value. Therefore, further archaeological research into the scientific values of a majority of the identified Aboriginal cultural heritage places is not considered warranted.

B.4.2 Proposed mitigation measures

Extensive consultation has been undertaken with the Aboriginal community in respect of the proposals.[19] MTW's Aboriginal cultural heritage management consists of a suite of policies, protocols and processes in the areas of community engagement, heritage management and relationships with Aboriginal communities, including:

- implementation of the Cultural Heritage Management System (CHMS);
- ongoing consultation through the Coal & Allied Upper Hunter Valley Aboriginal Cultural Heritage Working Group (CHWG);
- the development of an Archaeology and Cultural Heritage Management Plan (ACHMP) for Warkworth Mine and MTO; and
- preparation and implementation of management plans required under relevant development consents.

[19] These include: extensive consultation processes undertaken as part of the Aboriginal Cultural Heritage Assessment for the Warkworth Extension 2010 (Central Queensland Cultural Heritage Management 2010); consultation undertaken as part of the fulfilment of the conditions of the now disapproved Warkworth Extension 2010; and consultation undertaken recently as part of Modification 6, and subsequent approval of an Aboriginal heritage impact permit for this area by OEH in February 2014. Since 2008 there have been 30 Aboriginal community consultation meetings conducted under the auspices of the CHWG with regard to the Warkworth Extension 2010 and/or the HMP.

A number of management measures are proposed for the places that will be disturbed under the proposal:

- Areas of high scientific and Aboriginal community significance within the MTW mining leases are to be protected in the long term through the establishment of the Wollombi Brook Aboriginal Cultural Heritage Conservation Area (WBACHCA) and the Loders Creek Aboriginal Cultural Heritage Conservation Area (LCACHCA), as agreed with both the Aboriginal community and relevant government agencies (the NSW Office of Environment and Heritage, and NSW Planning and Infrastructure). The WBACHCA will include the Bulga Bora Ground, to the west of the Warkworth Mine fronting Wollombi Brook. The LCACHCA lies within the remaining undeveloped south-eastern portion of MTO. Both these conservation areas will be managed under its own stand-alone and formalised Aboriginal cultural heritage management plan, and will be established for the long-term conservation and management of Aboriginal cultural heritage places and values.
- A suite of management and monitoring strategies developed in consultation with the Aboriginal community will be implemented to protect Aboriginal cultural heritage at MTW. They include an integrated heritage management plan (HMP), developed in consultation with CHWG, extensive and detailed initiatives to manage the impacts on the proposed 2014 disturbance area, and the preparation of a research programme (the Hunter Valley Sand Bodies Research Study).
- In addition, Coal & Allied commits to:
    - only implementing the agreed impact management measures for those places for which development impacts are unavoidable;
    - staging the agreed impact management measures over time;
    - continuing to manage all Aboriginal cultural heritage within the area in accordance with the provisions of the CHMS and ACHMP ;
    - managing areas containing stone artefacts in accordance with the specific provisions for such objects within the ACHMP, and investigating and managing the three areas noted as having the potential to contain archaeological deposits in accordance with the specific provisions for such features within the ACHMP;
    - continuing investigations into the feasibility of moving the grinding grooves;
    - managing other currently unidentified Aboriginal cultural heritage places which may come to light;
    - involving the Aboriginal community in the implementation of all impact management measures; and
    - curating and storing all Aboriginal cultural heritage objects collected in accordance with the Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW.

B.5 Ecology

B.5.1 Impacts

If the proposals are approved, an additional 459 ha of forest and woodland and 151.5 ha of grassland communities would be progressively cleared over the 21 year project life (Table B-3). The Site also includes some areas that were designated as offsets for the 2003 consent.

Two broad types of vegetation occur at the affected site:

- a distinctive type of vegetation reminiscent of coastal vegetation that is referred to as Warkworth Sands Woodland (WSW), an EEC; and
- native vegetation other than WSW ('non-WSW' vegetation).

Table B-3. Vegetation commodities within the MTW disturbance boundary

Vegetation Community	Area (ha)
Forest and Woodland	
Warkworth Sands Woodland (WSW)	72.0
Central Hunter Grey Box - Ironbark Woodland	365.5
Regenerating Central Hunter Grey Box - Ironbark Woodland	6.5
Central Hunter Ironbark - Spotted Gum - Grey Box Forest	15.0
Subtotal Forest and Woodland	459.0
Grassland	
Warkworth Sands Grassland (WSG)	1.0
Central Hunter Grey Box - Ironbark Derived Grassland	151.0
Subtotal Grassland	152.0
Total	**611.0**

Both WSW and non-WSW vegetation provide habitat for threatened fauna and flora, particularly birds and bats. While few old growth trees remain within the site due to extensive clearing in the past, the regenerating vegetation provides habitats for numerous species. In addition to the direct removal of vegetation, there are also potential indirect impacts resulting from the proposals.

B.5.2 Proposed mitigation/offsets

In accordance with the requirements of contemporary government policy, including utilising the Upper Hunter Strategic Assessment (an agreement between the NSW and Commonwealth governments to prepare a Biodiversity Management Plan for the Upper Hunter), Rio Tinto proposes to mitigate the impacts of the loss of native vegetation, EECs and habitats with a biodiversity offset strategy. The strategy would include establishing a number of offsets to satisfy the credit requirements established under the NSW Biodiversity Certification

Assessment Methodology (BCAM). The suitability of the credits supplied within the offsets would be determined using another government-supplied tool called Biobanking Assessment Methodology (BBAM).

Biodiversity certification

Under the biodiversity certification scheme the Minister may confer biodiversity certification on land if the Minister is satisfied that certification will improve or maintain biodiversity values (Department of Environment, Climate Change and Water NSW, 2011). Biodiversity certification may be obtained for land and for native vegetation, and is contingent on the processes prescribed under the BCAM being followed. The BCAM assesses the loss of biodiversity values on land proposed for biodiversity certification and the impact, or likely impact, of proposed conservation measures on land proposed for biodiversity conservation, including conservation measures proposed to be implemented in the future.

Under the BCAM biodiversity offsets are measures that benefit biodiversity by compensating for the adverse impacts elsewhere of actions such as land clearing. These offsets work by protecting and managing biodiversity values in one area in exchange for impacts on biodiversity values in another. The gain in biodiversity achieved by improving a similar area of woodland balances the loss to biodiversity due to the clearing.

The required offset package for the proposals has been estimated using the BCAM and in accordance with the Upper Hunter Strategic Assessment (UHSA), which is preparing a strategic biodiversity offsetting strategy for Upper Hunter mines. BCAM quantifies the projected ecological impacts in terms of 'credits', a measure of habitat quality. Credits may include those for species (species credits) or those for plant communities (ecosystem credits). It is understood that the credit estimates for the offset requirements identified for the proposals will be verified and certified by the Office of Environment and Heritage (OEH) for the UHSA.

Biodiversity offsets

The approach used to determining offsets for the proposals have been designed to consider the two broad types of vegetation that occur at the affected site: WSW and non-WSW vegetation and are assessed in three separate components:

- Component 1: WSW/WSG vegetation impacted by the proposal;
- Component 2: Non-WSW/WSG vegetation impacted by the proposal; and
- Component 3: Non-WSW/WSG vegetation impacted by the 2003 extension.

Component 1: Areas of WSW impacted by the proposal will be offset by conserving the remaining WSW within the Northern and Southern biodiversity areas (NBA and SBA), as well as a suite of supplementary measures. It is understood that Rio Tinto has made a commitment to acquire the required credits, thereby ensuring that the offsets for the remaining vegetation communities will result in a 'maintain or improve' outcome for WSW communities. Most of the credit requirements will be provided through the conservation of WSW in the SBA and NBA, resulting in an increase in the total area of WSW under long term conservation. A range of supplementary measures will be implemented to compensate for the remaining credit requirements, including the re-establishment of WSW from its derived native grassland (Warkworth Sands Grassland) in the SBA and NBA, preparation of an Integrated Restoration Implementation Plan, protection and conservation of Warkworth Sands Grassland to be re-established as part of the current development consent and the development of completion criteria for rehabilitation.

Component 2: To offset the impacts of the proposals on non-WSW vegetation, Rio Tinto has made a commitment to providing acquisition of credits under the UHSA, thereby ensuring that the offsets for the remaining vegetation communities will result in a 'maintain or improve' outcome for these communities.

Component 3: Impacts to non-WSW EECs will be offset in two components: for the 2003 Extension and those for the proposal. Offsets for non-WSW from the 2003 Extension are proposed to be reallocated to the non-WSW portions of the SBA and include mine rehabilitation of woodland communities. In addition to these land-based offsets, approximately 872.5ha of mined land will be rehabilitated. Any residual credits required to offset the impact for the 2003 Extension will be purchased and retired by Rio Tinto.

B.6 Traffic

Two types of traffic impacts have been considered:

- the impacts of additional traffic resulting from the proposals on public roads; and
- the impact of the closure of Wallaby Scrub Road.

B.6.1 Traffic impacts on public roads

The road and intersection traffic surveys for the study were undertaken shortly before the Hunter Expressway opened on 22 March 2014. The expressway may reduce the future regional through traffic usage of routes such as Wallaby Scrub Road and Charlton Road, by providing a faster and safer route for the longer distance traffic travelling between Sydney and some Upper Hunter locations.

Impacts

The following traffic impacts that would result from the proposals were identified (Table B-4).

Table B-4. Public roads traffic impacts

Traffic aspect	Impacts
Proposals-related traffic and transport	There would be no material change to employee traffic and truck traffic over the life of the proposal.
External traffic movements	On most major roads, current MTW daily traffic movements represent 11 to 22 per cent of the total daily traffic movements. On Broke Road and the Golden Highway north of Mount Thorley, MTW represents 3 to 4 per cent of the total daily traffic movements.

Traffic aspect	Impacts
	The effects of heavy vehicle traffic movements represent between 4 and 5 per cent of the total MTW generated daily traffic.
Traffic at intersections	At the Warkworth Mine access/Putty Road and MTO CPP access/ Broke Road intersections there would be no change to the level of service with the future intersection operations. At the Golden Highway/Mitchell Line of Road intersection, level of service and intersection traffic delays would not generally be affected. The degree of saturation for the left turn movements from Mitchell Line of Road would increase from 0.7 to a maximum of 0.781. At the Golden Highway/Broke Road intersection, level of service and intersection traffic delays would not generally be affected.
Impacts of the Wallaby Scrub Road traffic detour	Future traffic proportions travelling from Charlton Road would continue to decline with increasing use of the Hunter Expressway route. Daily traffic increases which would occur on the alternative traffic detour routes following the closure of Wallaby Scrub Road would be small in comparison to the actual capacity of the affected roads. There would be minimal intersection traffic impacts on the alternative traffic detour routes for Wallaby Scrub Road.
Car parking and alternate site access	There are no proposed changes to the MTW car parking areas.
Cumulative impacts	There would be minimal cumulative intersection traffic impacts when the proposal, including the effects of the Wallaby Scrub Road closure, is considered in combination with the Bulga Optimisation Project.
Rail impacts	The daily train movements for coal transport from MTW would be consistent with those loaded previously at MTCL and are not anticipated to increase above historic levels.

In summary, the proposal would result in only minimal traffic impacts on the wider local road network with the primary traffic impacts related to the closure of Wallaby Scrub Road. There would generally be minimal traffic impacts on the traffic detour routes for the Wallaby Scrub Road closure as these roads (and the relevant intersections) have sufficient spare capacity to accommodate this traffic with minimal intersection capacity impacts or delays. Emergency vehicle access to areas west of Wallaby Scrub Road would be maintained by the construction of an appropriate emergency access road/fire trail between Putty Road and the Golden Highway. However, the fire trail route would be slower and less direct than the existing Wallaby Scrub Road route, which would increase emergency response times. The proposal is not expected to cause any rail transport impacts.

Proposed mitigation measures

Measures to manage and monitor potential traffic and transport impacts from the proposals include:

- preparation of a road closure implementation plan for Wallaby Scrub Road, in consultation with emergency services, RMS and Singleton Council, which would include strategies to minimise the potential traffic and road safety impacts of the closure;
- construction of an appropriate emergency access road between Putty Road and the Golden Highway prior to the closure of Wallaby Scrub Road to an appropriate standard, and in consultation with emergency services; and
- review the existing speed advisory and curve warning signs for all the curves on the roads which are likely to be used by detoured traffic (i.e. Putty Road, Broke Road, and Golden Highway) prior to the closure of Wallaby Scrub Road.

B.6.2 Closure of Wallaby Scrub Road

If the proposals are approved, Wallaby Scrub Road would close in 2016. Wallaby Scrub Road is a rural public road managed and maintained by Singleton Council. The road currently serves as a short-cut for people travelling north from Charlton Road/Putty Road or south from the Golden Highway.

Table B-5 shows the origin and destination of vehicles travelling on Wallaby Scrub Road, as well as estimated incremental impacts on travel time and distance as a result of the closure of the road, as estimated by EMM.

Table B-5. Use characteristics of Wallaby Scrub Road and closure impacts on road users

		Closure implications for road users	
Traffic origin/destination	Portion of traffic (through-traffic)*	Increased travel time (minutes per trip)	Distance to travel (km per trip)
To/from east on Putty Road	5%	6	8.8
To/from Bulga/south of Bulga	25%	6	8.8
To/from Charlton Road	71%	4	6.2

Notes: Numbers may not add to 100% due to rounding.
Source: EMM (2014).

Approach to valuing traffic impacts

The impacts of closing Wallaby Scrub Road have been valued using a CBA approach. The approach used here follows that recommended by Austroads (2001, 2012a).[20] Austroads classify the costs and benefits of changed traffic conditions according to three categories:

[20] Austroads is the association of Australian and New Zealand road transport and traffic authorities, including the six Australian state and two territory road transport and traffic authorities.

- *Operator costs*, which refer to road construction and maintenance costs. Closure of Wallaby Scrub Road would eliminate maintenance costs (if any) currently incurred by Singleton Council. We have not attempted to value these avoided costs.
- *Road user costs (RUCs),* which consist of incremental vehicle operating costs (VOCs), the opportunity cost of travel time, the costs of likely accidents, and freight performance impacts. With the exception of freight impacts (which appear to be immaterial), these costs have been considered for the purposes of estimating the closure impacts.
- *Non-user costs*, which refer to incremental noise, air pollution, nature and landscape, climate change and cultural heritage impacts. With the exception of GHG emissions, these non-user costs are subsumed within the broader external effects attributable to the proposals, and have been considered as part of the broader CBA for the proposals.

Valuation assumptions

General assumptions

87 per cent of traffic on Wallaby Scrub Road consists of passenger cars, assumed to be travelling for private purposes. The remainder consists of motorcycle and pedestrian cycles (2 per cent), light goods vehicles (7 per cent), other goods vehicles (1 per cent), and public service goods vehicles (3 per cent). For the purpose of valuing the costs and benefits associated with the closure of Wallaby Scrub Road we have assumed that all traffic consists of passenger cars of a 'large' class (under A$60,000).

The annual average rate of traffic growth is estimated by EMM at approximately 2 per cent.

Incremental vehicle operating costs

VOCs vary by vehicle type and fuel used and are typically computed for specific vehicle 'stereotypes' to represent an appropriate traffic composition (Austroads 2001, 2012a). Incremental VOCs comprising the cost of fuel, tyres, and maintenance for a large car were derived from the most recent NRMA (2013) survey. In 2014 prices, VOCs are estimated at A$0.27/km.

Opportunity cost of incremental travel time

Travel time costs are calculated with respect to vehicle occupants and amalgamated up to a per vehicle level (Austroads 2001, 2012a). For the purpose of this analysis, we have assumed that the travel in question is for private purposes. Table B-6 shows the estimated values of travel time used for the analysis.

Table B-6. Valuation of the opportunity cost of incremental travel time (A$2014)

Type of vehicle	Occupancy rate, non-urban (persons per vehicle)	Time value per occupant ($ per person-hour)	Total time value per vehicle ($ per vehicle hour)
Private car	1.7	$14.66	$24.92

Source: Austroads 2012b, updated to A$2014 values using CPI.

Accident costs

The potential impacts of the Wallaby Scrub Road closure on road safety were assessed by EMM. While detoured traffic will be subject to increased travel distances, generally there will be safer travelling conditions for detoured traffic (and lower accident rates per kilometre travelled) when travelling via the Golden Highway, due to the improved intersection sight distances and higher road construction standards. These improved traffic safety conditions should generally compensate for the greater travel distances travelled by the detoured traffic.

As noted in Section B.6.1, a road closure implementation plan for Wallaby Scrub Road, will be prepared in conjunction with relevant stakeholders in the local community, emergency services, RMS and Singleton Council, which will include strategies to minimise the potential traffic and road safety impacts of the closure. This will include a review of the requirement for speed advisory and additional curve warning signs at all curves on the roads which are likely to be used by detoured traffic (Putty Road, Broke Road and Golden Highway) prior to the detour being implemented.

GHG emissions

For the purposes of valuing GHG emissions arising as a result of longer vehicle travelling distances, the incremental carbon dioxide emissions were estimated. These estimates have been included in the projected emissions arising from the proposals, and valued jointly with these using the SCC (Section B.9).

Estimated net impacts of the closure of Wallaby Scrub Road

Table B-7 summarises the estimated net costs (benefits) of closing Wallaby Scrub Road from 2016 onwards. In NPV terms:

- the opportunity cost associated with the increase in travel times is estimated at A$6.4 million; and
- incremental VOCs are estimated at A$6.3 million.

Table B-7. Net impacts of the closure of Wallaby Scrub Road

Costs/benefits	NPV A$ m (2014)
Incremental travel time cost	$6.4
Incremental VOCs	$6.3
Total	**$12.7**

Notes: Figures may not add up due to rounding. Incremental GHG emissions have been valued jointly with aggregate emissions arising from the proposals (Section B.9).

B.7 Groundwater

B.7.1 Impacts

In summary, the technical study concluded that:

- groundwater within the Wollombi Brook alluvium appears to be relatively unaffected by current mining; and
- the results of the numerical groundwater model indicate risks to groundwater systems are considered to be negligible and manageable subject to the obtainment of the necessary water entitlements.

B.7.2 Mitigation

MTW water management plan

Groundwater at MTW is managed in accordance with the MTW water management plan. Proposed management and monitoring measures that would be implemented under the proposals include:

- monitoring of in-pit mine water seepage to identify seepage rates and water quality;
- trigger level monitoring and reporting, with site-specific investigation into trigger level exceedances; and
- data management and reporting, including the establishment of trigger levels, annual reporting, and storage of all groundwater with suitable QA/QC controls.

Water offsets

MTW operates subject to an existing requirement to acquire groundwater licences under its current development consent. The proposals do not add to the additional groundwater licensing requirements, hence there is no net change from MTW's current obligations with respect to licensing.

Further, it is the responsibility of MTW to ensure that the necessary licences are held with sufficient share component and water allocation to account for all water taken from a groundwater or surface water source as a result of an aquifer interference activity, both for the life of the activity and after the activity has ceased.

As required by the AIP, sufficient water licences will be held by MTW to account for any water take during mining. Additional modelling may be undertaken to improve the model in areas where clarification may be required. Should the modelling results alter the predicted take then the licensing requirements will also be adjusted.

B.8 Surface water

B.8.1 Impacts

A significant proportion of mine site water requirements would be sourced from water collected onsite, including rainfall runoff and groundwater inflows to the open cut pits. Possible sources of additional water for the proposal, which would be negotiated on an as-needed basis including water sharing with Hunter Valley Operations, with Bulga Coal Complex, and with Wambo Mine. If required, additional water licences would be sought and purchased by Coal & Allied over the life of the proposals. As all offsite water supplies for the proposal would be obtained from licensed sources, there would be no adverse impact on other licensed users who would still have access to their entitlement.

During active mining operations, MTW would capture runoff from areas that would have previously flowed to Wollombi Brook or the Hunter River. The combined impact of the proposals is a maximum reduction of 0.44 per cent of the Wollombi Brook catchment to the confluence of the Hunter River.

The results of the water balance modelling indicate that no uncontrolled release of saline water would occur over the life of the proposal. Excess saline water is released in accordance with the existing rules of the Hunter River Salinity Trading Scheme (HRSTS). There would be no downstream impacts on surface water quality.

There is a low risk of the proposed MTW water management systems (WMS) accumulating water over the 21 year life of the proposal.

Controlled releases of saline water under the HRSTS are predicted to have the following impacts:

- The impacts of HRSTS discharges on the Hunter River flow characteristics are negligible during both wet periods and dry periods.
- It is not expected that discharges under the proposal would have an additional impact on the stream condition of Doctors Creek, or that controlled discharges would result in adverse hydraulic impacts on the Hunter River, such as increased bed and bank erosion.
- Discharge dam water quality (median) is poorer than the lowest recommended ANZECC trigger value and the Hunter River water quality for chloride, sodium and sulphate. However, it is likely that complete mixing of the discharge water with the river flow would occur within a few hundred metres of the outlet.

The potential interactions between the proposed operations and a 100 year flood event for the Hunter River to the east and Wollombi Brook to the west have been investigated:

- the proposal would not result in any additional flood risk to infrastructure adjacent to the Hunter River; and
- the proposal would not impact on flooding behaviour in Wollombi Brook and would not have any measurable effect on the geomorphology of Wollombi Brook.

In summary, the results of the surface water study indicate that the impacts of the proposal on surface water resources are unlikely to be significantly different to the existing approved operations and would not have a significant impact on surface water quality of the adjacent water features.

B.8.2 Mitigation measures

MTW water management system

The proposed MTW water management system (WMS) has been developed in conjunction with the mine planning and operational teams to develop a surface water management system that has minimal impacts on surface water resources. It consists of:

- a number of new or modified water storages, including saline water storage, and a sediment dam located at Warkworth Mine to capture runoff from future spoil and rehabilitation areas;
- changes in the layout of approved mining operations; and
- the management of groundwater inflows, catchments, and water quality.

The proposed MTW WMS has been designed to minimise the capture of clean runoff wherever possible.

Surface water at MTW is currently managed in accordance with the MTW water management plan. The proposal required the remodelling of the existing operations and the proposal to identify water demand requirements from surface water resources, which would be mitigated through the implementation of the following measures:

- control the flow and storage of water of different qualities across the Site through the proposed MTW WMS;
- a sediment control plan to reduce sediment loads from disturbed area runoff;
- drainage of the final landform; and
- a surface water monitoring programme to continually assess environmental impacts and ensure that the MTW WMS is meeting its objectives of managing impacts on receiving waters.

Water Offsets

It is the responsibility of MTW to ensure that the necessary licences are held with sufficient share component and water allocation to account for all water taken from a groundwater or surface water source as a result of an aquifer interference activity, both for the life of the activity and after the activity has ceased.

As required by the AIP, sufficient water licences will be held by MTW to account for any water take during mining. Additional modelling may be undertaken to improve the model in areas where clarification may be required. Should the modelling results alter the predicted take then the licensing requirements will also be adjusted.

B.9 GHG emissions

B.9.1 Impacts

The incremental (Scope 1, 2, fugitive and traffic) emissions over the life of the proposals have been estimated at around 15.9 Mt CO_2-e. This estimate includes estimated increases in greenhouse gas emissions as a result of additional travel time due to the closure of Wallaby Scrub Road. For the purpose of the analysis in this report, various options for valuing the GHG emissions arising from the MTW Continuation Project have been explored. The option used in this report relies on the SCC.

B.9.2 Estimates of global damages

One approach for quantifying the impacts of GHG emissions is to rely on global damage functions, which assess the impact on GDP for a specified rise in global mean temperature (e.g. IPCC 2007, Tol 2009). Global damage estimates of GHG emissions rely on either the 'enumerative' method, whereby the range of physical effects of climate change are modelled, valued, and summed over countries or regions; or the 'statistical' method, whereby the welfare impacts of climate change are directly estimated (on the basis of observed variations), and extrapolated to other countries/regions.

Global damage functions

Part II of the IPCC's Fourth Assessment Report (Climate Change 2007, AR4) presents a range of damage functions (Table B-8). The IPCC's Fifth Assessment Report (AR5, WGII Chapter 25) did not present new estimates of the damage of global warming.

Table B-8. Indicative world impacts of temperature changes, by region (per cent of current GDP)

	IPCC SAR	Mendelsohn et al. (2000)		Nordhaus and Boyer (2000)	Tol (1999)[a]
	2.5°C Warming	1.5°C Warming	2.5°C Warming	2.5°C Warming	1°C Warming
North America					3.4 (1.2)
United States			0.3	-0.5	
OECD Europe					3.7 (2.2)
European Union				-2.8	
OECD Asia Pacific					1.0 (1.1)
Japan			-0.1	-0.5	
Eastern Europe					2.0 (3.8)
Eastern Europe				-0.7	
Russia			11.1	0.7	
Middle East				-2.0[b]	1.1 (2.2)
Latin America					-0.1 (0.6)
Brazil			-1.4		
Asia					-1.7 (1.1)
India			-2.0	-4.9	
China			1.8	-0.2	2.1 (5.0)[c]
Africa				-3.9	-4.1 (2.2)
Developed cntrs.	-1.0 to -1.5	0.12	0.03		
Developing cntrs.	-2.0 to -9.0	0.05	-0.17		
World					
Output weighted	-1.5 to -2.0	0.09	0.1	-1.5	2.3 (1.0)

	IPCC SAR	Mendelsohn et al. (2000)		Nordhaus and Boyer (2000)	Tol (1999)[a]
	2.5°C Warming	1.5°C Warming	2.5°C Warming	2.5°C Warming	1°C Warming
Pop. weighted				-1.9	
World av. prices					-2.7 (0.8)
Equity weighted					0.2 (1.3)

Notes: [a] Figures in parentheses denote standard deviations. [b] High-income countries in Organization of Petroleum Exporting Countries. [c] China, Laos, North Korea, Vietnam. Estimates are incomplete and confidence in individual numbers is very low. There is a considerable range of uncertainty around estimates. Figures are expressed as impacts on a society with today's economic structure, population, laws, etc. Positive numbers denote benefits; negative numbers denote costs. Tol's (1999a) estimated standard deviations are lower bounds to real uncertainty. Mendelsohn et al. (2000) estimates denote impact on a future economy.

Source: Table 19-4. McCarthy, 2001.

The damage estimates shown above are essentially unchanged from those reported in the IPCC's Third Assessment Report (Climate Change 2001, TAR); they suggest that:

- The impacts of future climate change will be mixed across world regions. For increases in global mean temperature of less than 1-3°C above 1990 levels, some impacts are projected to produce benefits in some places and some sectors, and produce costs in other places and other sectors.
- It is very likely that all regions will experience either declines in net benefits or increases in net costs for increases in temperature greater than about 2-3°C. While developing countries are expected to experience larger percentage losses, global mean losses could be 1-5% of GDP for 4°C of warming.

The IPCC's 'Special Report on Regional Impacts of Climate Change estimate' (IPCC 1997) contained cross-sectoral estimates of climate change impact costs. Estimates of the annual impact for Australia and New Zealand combined fell in the range of -1.2 per cent to -3.8 per cent of GDP for an equivalent doubling of CO_2. The report noted that the real uncertainty in these estimates is much greater than the range given, and that important costs may be underestimated, including changes in weeds, pests, and diseases; storm surges; and urban flooding. Damages may also increase nonlinearly with increased global warming. On the other hand, adaptations to climate change are not included in the calculations.

AR5 (WGII Chapter 25) also notes that there are relatively few damage estimates for Australia. AR5 cites economy-wide net costs for Australia of a loss in gross national product (GNP) of 7.6 per cent by 2100 under an unmitigated climate change scenario, and of a loss in GNP of 2 per cent for stabilisation scenarios at 450 or 550 ppm CO_2-e. It is noted that these estimates are highly uncertain and depend strongly on valuation of non-market impacts, the treatment of potentially catastrophic outcomes, and assumptions about adaptation, global changes and flow-on effects for Australia.

GHG impact valuation on the basis of global damages

Calculating the global damages associated with the incremental GHG emissions arising from the proposals requires an assessment of the corresponding increase in global temperatures.

The expected increase in global average temperature associated with the project has been calculated using MAGICC 6 (Meinshausen, Raper and Wigley 2011; www.magicc.org). MAGICC 6 is a software package that takes emissions scenarios for greenhouse gases, reactive gases, and sulfur dioxide as input and gives global-mean temperature, sea level rise, and regional climate as output. MAGICC is a coupled atmospheric-ocean carbon cycle model. It has been used in all IPCC reports to produce projections of future global-mean temperature and sea level change.

The climate scenario selected for this evaluation exercise is RCP6.0. It is one of the four Representative Concentration Pathways (RCPs) adopted by the Intergovernmental Panel for Climate Change (IPCC) for its fifth Assessment Report (AR5). Information about the RCPs and the scenario development process for the IPCC AR5 can be found in the IPCC Expert Meeting Report on New Scenarios.

Table B-9 shows the results from the MAGICC analysis. The modelling results from MAGICC show that the changes in global temperature and radiative forcing between the two scenarios are negligible. The temperature rises by 2035 in both scenarios are 1.4434 degrees, relative to pre-industrial levels. By 2035, the total radiative forcing under the reference scenario is 3.55562 Wm^{-2} while the total radiative forcing under the proposals scenario is 3.55566 Wm^{-2}. The overall implication is that the proposals will have no discernible impact on global mean temperature increase over the period of the project. There are therefore no measurable adverse additional impacts on Australia or on NSW, and the costs associated with an increase in GHG emissions are not significantly different from zero during the life of the proposal if this project is considered in isolation.

Table B-9. Temperature rises and radiative forcing

Relative to pre-industrial levels	Temperature rises ($^{\circ}$ C)		Radiative forcings (Wm^{-2})	
	2025	2035	2025	2035
Reference case	1.22132	1.44338	3.27549	3.55562
Proposals case	1.22132	1.44340	3.27550	3.55566

Source: BAEconomics analysis.

GHG impact valuation on the basis of carbon offsets

The current Australian Government has announced its intention to repeal the Carbon Pricing Mechanism (CPM). Entities operating in Australia who wish to offset their emissions can then purchase carbon credits issued under Australian Government programs, internationally recognized Kyoto Protocol units, or 'voluntary' offsets. The following offset options are expected to be available:

- Australian Carbon Credit Units (ACCUs) issued under the Carbon Farming Initiative (CFI);
- international offsets recognised under the Kyoto Protocol, mainly Certified Emissions Reductions (CERs) from Clean Development Mechanism (CDM) projects; or
- voluntary offsets.

Prices of emissions offsets

Around 1.75 million ACCUs were issued in 2012-13, the first compliance year of the CPM. The great majority of these related to landfills and were emissions avoidance projects. These ACCUs typically traded in the range of A$ 22.50 to $22.75/t CO_2-e, just below the fixed carbon price established for the CPM of A$23/t CO_2-e. Little or no new investment in CFI projects occurred in the 18 months prior to December 2013 (Reuters Point Carbon 2013a). It is generally considered that investment in new CFI land-based forestry projects will not be viable without a significant carbon price (CSIRO 2011, Reuters Point Carbon 2013a).

CERs traded at around A$17/t CO_2-e in 2010, but average prices have since fallen considerably to around A$12/t CO_2-e in 2011 and A$3/t CO_2-e in 2012 (Parliament of Australia 2013). CER futures for delivery in June 2014 are trading at around A$0.22/t CO_2-e (Intercontinental Exchange 2014).

Offsets in voluntary market traded at a weighted average price of around A$5.9/t CO_2-e in 2012 and at A$6.2/t CO_2-e in 2011 (Forest Trends' Ecosystem Marketplace & Bloomberg New Energy Finance 2013). Table B-10 shows average prices and volumes transacted for the range of international voluntary offsets traded since the inception of various schemes and in 2012. The Australian Government currently only recognises offsets issued under two voluntary standards – the Gold Standard and the Verified Carbon Standard (VCS), which accounted for the majority of transactions. As of June 2013, prices for Gold Standard offsets ranged from around A$12 to A$15/t CO_2-e, while prices for VCS offsets ranged from A$1 to A$8/t CO_2-e (Bloomberg 2013).

Table B-10. Average prices and volumes for voluntary offsets

Standards/registries	Time period	Average price (A$)	Transactions (Mt CO_2-e)
American Carbon Registry	All years	4.4	12.3
	2012	7.4	0.5
CarbonFix Standards	All years	13.9	0.5
	2012	17.5	0.04
Chicago Climate Exchange	All years	1	21
	2012	0.12	8
The Gold Standard	All years	11.4	36
	2012	9.3	9
Verified Carbon Standard (VCS)	All years	5	155
	2012	5.2	34
VER+	All years	5.7	3.5
	2012	18.1	0.02

Notes: The timeframe covered by 'all years' differs by type of standard. For instance, the American Carbon Registry was created in 1995, whereas the Gold Standard exists since 2003.

Source: Forest Trends' Ecosystem Marketplace & Bloomberg New Energy Finance 2013.

Application to MTW emissions

There is only a limited range of credible options for acquiring offsets to mitigate the additional emissions expected from the MTW Continuation Project:

- The Department of Climate Change and Energy Efficiency (DCCEE) estimates that for a carbon price starting at A$20/t CO_2-e in 2013 and increasing to A$30 t CO_2-e in 2020, the scope for additional offsets under the CFI is low. In 2011, DCCEE estimated that abatement from Kyoto compliant activities could range from less than 5 Mt CO_2-e to less than 15 Mt CO_2-e in 2020, while abatement from non-compliant activities would range from less than 2 Mt CO_2-e to less than 7 Mt CO_2-e in 2020 (DCCEE 2011). DCCEE note that these estimates are highly uncertain
- CERs issued under the CDM have come under criticism for the quality of many of the corresponding projects, including because of concerns about the 'additionality' of claimed emissions abatement (Reuters Point Carbon 2013b). A combination of excess supply and limited demand has led to a collapse in CER prices that may not be reversed in the near future.
- Companies who are not required to do so by law are instead turning to voluntary offset markets, where prices are higher than those for CERs, but which are backed by a credible certifying organisation, such as the Gold Standard or VCS (Bloomberg 2013).

In our judgement, the most credible and reliable option at this point in time relates to the price of voluntary offsets issued either under the VCS or the Gold Standard, which are recognised by the Australian Government. The most recent published prices for these offsets ranged from A$1 to A$15/ t CO_2-e. Taking the mid-point of A$7.5/t CO_2-e as a central estimate yields an overall estimate for the value of the additional GHG emissions attributable to the proposals of $46.4million, of which the share attributable to NSW would be A$0.1 million.

B.9.3 GHG impact valuation on the basis of the social cost of carbon

A final option for valuing the GHG emissions associated with the proposals, which forms the basis for the estimate presented in this report, is on the basis of the 'social cost of carbon' (SCC). We have relied on estimates of the SCC as determined by the US Interagency Working Group on Social Cost of Carbon (2013). The SCC is an estimate of the monetised damages associated with an incremental increase in carbon emissions in a given year. It includes changes in net agricultural productivity, human health, property damages from increased flood risk, and the value of ecosystem services due to climate change. These estimates were derived for the purposes of incorporating the social benefits and costs of CO_2 emissions into cost-benefit analyses. Table B-11 below summarises these estimates.

Table B-11. Social cost of CO2, 2010 to 2050 (US$ 2007 per metric tonne of CO_2)

Year \ Discount rate	5 per cent	3 per cent	2.5 per cent
2010	11	33	52
2015	12	38	58

Year \ Discount rate	5 per cent	3 per cent	2.5 per cent
2020	12	43	65
2025	14	48	70
2030	16	52	76
2035	19	57	81
2040	21	62	87
2045	24	66	92
2050	27	71	98

Source: Interagency Working Group on Social Cost of Carbon (2013)

The SCC estimates in Table B-11 are expressed in constant 2007 US dollars, and are estimated for emissions at different points in time; at five year intervals starting in 2010 and ending in 2050. The flow of future social costs was discounted back to each point in time at three discount rates, namely 2.5, 3.0 and 5.0 per cent. Costs in the intervening years were calculated by linear interpolation. The discount rate for social cost benefit analysis specified by the NSW government is 7 per cent. To achieve consistency between the GHG valuation and the NSW CBA, it is necessary to impute these costs at a 7 per cent discount rate. This can only be achieved through approximation, as the technical paper does not provide the flows of future damages. In order to impute the SCC at a 7 per cent discount rate, the approximating function was calibrated from the average costs across each time period at each discount rate. The functional form was chosen to fit the general pattern of the relationship between discount rates and costs:

$$Cost_i = \alpha_o + \alpha_1 \frac{1}{r_i} + \alpha_2 \frac{1}{r_i^2} \quad \#$$

Where $Cost_i$ is the average cost and r_i is the discount rate. The calibration is an exact solution to three linear equations.

The equation was used to calculate a base cost at a 7 per cent discount rate. This was in turn expressed as a proportion of the average cost at a 5 per cent discount rate. This proportion was applied to costs at 5 per cent discount rate in each of the base years to obtain the imputed SCC. Costs in the intervening years were calculated by interpolation. Costs were converted from US$ 2007 to US$ 2014 using the US GDP deflator. Table B-12 summarises the results. Using the estimates below and converting these into A$ yields a total GHG emissions damage estimate of A$131 million. This global damage estimate has been multiplied with the ratio of NSW GSP to world GDP, estimated at 0.36 per cent by, first, deriving the share of Australian to world GDP at purchasing power parity (PPP) converted prices of 1.2 per cent (Heston et al. 2012), and second, adjusting for the share of NSW GSP to Australian GDP (around 30 per cent, ABS 5206.0. This calculation gives an estimate of the damages that are attributable to NSW of around A$0.5 million.

Table B-12. Imputation of 3 per cent discount rate SCC estimates to 7 per cent discount rate SCC estimates

	Imputed 7 % Discount Rate	
Year	**US$ 2007**	**US$ 2014**
2010	4.69	4.89
2011	4.70	4.91
2012	4.72	4.93
2013	4.76	4.97
2014	4.79	5.01
2015	4.84	5.05
2016	4.89	5.11
2017	4.96	5.18
2018	5.03	5.25
2019	5.11	5.34
2020	5.20	5.43
2021	5.31	5.55
2022	5.43	5.67
2023	5.57	5.82
2024	5.72	5.98
2025	5.89	6.15
2026	6.06	6.33
2027	6.24	6.52
2028	6.43	6.71
2029	6.62	6.92
2030	6.82	7.12
2031	7.02	7.33
2032	7.22	7.54
2033	7.42	7.75
2034	7.63	7.97
2035	7.84	8.18

B.9.4 MTW mitigation measures

Current GHG management practices to minimise the overall generation of CO2-e emissions would continue under the proposal. The MTW, through the operator's larger climate change program has objectives in four key areas delivered through ongoing integration into existing business processes:

- supporting research and promotion of technologies that reduce carbon dioxide emission from the use of coal;
- improved use of energy at operations, projects and supply chain;

- designing future projects with energy efficiency and climate change risks considered; and
- raising awareness amongst stakeholders.

Specific management measures that would continue to be employed at MTW include:

- monitoring and monthly reporting of bulk consumption of diesel with the onsite fuel management system monitoring the quantity of fuel dispensed from tanks and service trucks through metering;
- vehicles and plant equipment fitted with identification tags to assist in tracking diesel consumption;
- regular maintenance of diesel equipment operational efficiency;
- monitoring and monthly reporting of total electricity consumption with significant infrastructure and equipment such as the CPPs, draglines and electric rope shovels fitted with various meters to monitor electricity consumption;
- development and implementation of energy efficiency performance metrics for fuel and electricity consumption which are tracked monthly against internal targets; and
- waste management for energy efficiency through measures such as planning when purchasing items to avoid or minimise waste with preference given to products that are recyclable and reusable over ones that are not; consideration of minimum of packaging or packaging which is reusable or recyclable; and segregating waste to facilitate maximum reuse or recycling.

Research program funding is also provided by Rio Tinto Australia for the COAL21 Fund, the Australian Coal Association Research Programme, and the Cooperative Research Centre for Greenhouse Gas Technologies to support and develop the research of low emissions coal technologies.

B.10 Historical heritage

B.10.1 Impacts

An assessment of the heritage impacts of the proposals found:

- no registered heritage item or places within the proposed 2014 disturbance area;
- two non-registered state significant features (former RAAF base Bulga Complex and Great North Rd) and two non-registered local significant features (P1 Huts #1 and #2);
- one registered heritage item or place on the boundary of the study area - the Brick Farm House (listed as a local item under Singleton LEP 2013); and
- seven registered heritage items and places within a 7.5km radius from the centre of the proposed 2014 disturbance area.

In summary, while small portions of the Former RAAF Base Bulga Complex and Great North Road Complex would be impacted by the proposal, heritage impacts are likely to be minor. The study found that impacts on the P1 Huts are likely to be moderate. Within the study area, but outside of the proposed 2014 disturbance area, there are no state significant heritage features and one local significant feature; the Brick Farm House that would not be directly impacted by the proposal. The study found that subject to the implementation of the mitigation measures, potential heritage impacts within the study area are likely to be low.

B.10.2 Offsets and management

CMPs have been prepared for a portion of the Great North Road Complex, former RAAF Base Bulga Complex and the Brick Farm House.

Recommendations within these plans would be implemented to ensure the heritage values of these places are maintained and conserved. Coal & Allied would also prepare a CMP for Springwood Homestead.

The following additional management measures would be undertaken:

- a Chance Finds Procedure would be implemented to assist in the process for identifying and reporting unexpected finds;
- the establishment of the Mount Thorley Warkworth Historic Heritage Conservation Fund, in order to provide resources for local historical research and heritage conservation projects proposed by the local community; and
- the establishment of the Great North Road Conservation Fund, in order to provide resources for heritage conservation works on significant surviving elements of the convict built Great North Road located within Singleton LGA (and potentially other areas including the Great North Road World Heritage Area).

Appendix C External effects – MTO

C.1 Noise & vibration

C.1.1 Impacts

The results for operational noise studies indicate that:

- For all Bulga locations, predicted noise levels would satisfy or be within 1-2 dB(A) of PSNLs during prevailing meteorology.
- At all other locations, operational noise levels would result in a marginal or moderate exceedance of the PSNLs at a number of locations during prevailing conditions. One location has been predicted to have a significant noise level exceedance. However, this residential location is already within the ZOA for MTO.

Predicted noise levels under prevailing weather conditions are below the conservative sleep disturbance criterion at each of the 11 representative assessment locations.

Where low frequency noise is concerned, measured noise levels at eight locations indicate that there were no instances when relevant assessment criteria were exceeded.

The proposal would not result in any net increase in rail traffic over and above currently approved rail activities servicing the integrated MTW operation.

In summary, overall, operational noise at eastern assessment locations is expected to remain relatively unchanged from existing and approved activities. No significant exceedances are predicted for assessment locations in Bulga. Further, the proposal is likely to result in lower noise levels for eastern receivers than current and approved operations due to implementation of plant attenuation.

C.1.2 Proposed mitigation

Noise impacts would be managed under MTW's noise management plan, which incorporates a range of acoustic management and monitoring procedures, as described in Section B.1.2.

C.2 Air quality

C.2.1 Impacts

The assessment results represent the potential impacts resulting from MTO, including the changes resulting from the proposal. The modelling assessment also includes dust from all nearby existing and proposed mining projects including Warkworth Mine, Wambo Mine, Hunter Valley Operations, Rix's Creek and Bulga Coal Complex.

In summary, the study undertaken for the proposal predicted dust emissions at a number of assessment locations in the vicinity of MTO using air dispersion modelling:

- Fifteen mine-owned assessment locations may experience concentrations above the criterion for annual average PM_{10}. A subset of these assessment locations may also experience concentrations above the relevant criteria for 24-hour average PM_{10}, annual average TSP, and annual average dust deposition.
- Three privately-owned assessment locations may experience cumulative concentrations above the criterion for annual average PM_{10}. Two are currently within Wambo Mine's ZOA, and one is not a residential location (Warkworth Hall). MTO is a minor contributor to dust for these three assessment locations with contributions predicted to be approximately 1 µg/m3. No residential locations are predicted to exceed criteria due to MTO in isolation.
- No impacts are predicted from emissions resulting from the use of diesel powered equipment.
- Impacts from blast fume emissions are expected to be manageable with the operation of MTW's blast management plan.

C.2.2 Proposed mitigation

MTW Air Quality and Greenhouse Gas Management Plan

The management of air quality is integrated across Warkworth Mine and MTO and would be undertaken in accordance with the MTW Air Quality and Greenhouse Gas Management Plan (AQMP), as described in Section B.2.2.

Acquisition of properties/air quality mitigation measures

One residential location that would be significantly affected will be offered acquisition rights by MTW.

C.3 Visual amenity

No properties are predicted to be significantly affected by MTO.

C.4 Aboriginal cultural heritage

C.4.1 Impacts

The proposal would not result in any disturbance beyond currently approved limits. Therefore, the proposal would not explicitly impact on Aboriginal cultural heritage. Irrespective of this, additional studies and extensive consultation has been undertaken with the Aboriginal community in respect of the proposals.[21]

103 places containing Aboriginal cultural heritage objects have been identified and recorded to the west of the MTO operations. Of these, 55 have previously been destroyed under consents granted under the NP&W Act. The 48 extant places primarily consist of stone artefacts.

The area within the proposed MTO development consent boundary has been extensively mined and, in places, substantially rehabilitated. With the exception of one partially destroyed potential archaeological deposit, the remaining extant Aboriginal cultural heritage places are predominantly across the south-eastern corner of the Site. The extant Aboriginal cultural heritage places identified within the Site would not be disturbed if the proposal is accepted.

C.4.2 Mitigation measures

While the proposal would not result in any disturbance beyond currently approved limits and would not explicitly impact on Aboriginal cultural heritage, Aboriginal cultural heritage impact management measures have been developed for the collective management of Aboriginal cultural heritage for MTO. These include:

- the finalisation of the MTW integrated heritage management plan (HMP);
- management of Aboriginal cultural heritage within the site;
- management of Aboriginal cultural heritage within the Loders Creek cultural heritage conservation area (ACHCA); and
- management of Aboriginal cultural heritage at other Coal & Allied owned lands, including extant places within the development consent area.

Coal & Allied will complete the systematic and comprehensive reassessment of the south eastern corner of the Site, which commenced in mid-2013. All extant Aboriginal cultural heritage would continue to be managed consistent with the provisions of the current ACHMP.

In addition, the Loders Creek Aboriginal cultural heritage conservation area (ACHCA) is proposed to be conserved irrespective of the absence of any predicted impacts of the proposal. The Loders Creek ACHCA would be protected permanently from future mining, exploration drilling and associated disturbances. It would be managed in accordance with a

[21] These include: extensive consultation processes undertaken as part of the Aboriginal Cultural Heritage Assessment for the Warkworth Extension 2010 (Central Queensland Cultural Heritage Management 2010); consultation undertaken as part of the fulfilment of the conditions of the now disapproved Warkworth Extension 2010; consultation undertaken recently as part of Modification 6, and subsequent approval of an Aboriginal heritage impact permit for this area by OEH in February 2014; consultation specific to the proposal undertaken at CHWG meetings held on 3 April and 7 May 2014. Since 2008 there have been 30 Aboriginal community consultation meetings conducted under the auspices of the CHWG with regard to the Warkworth Extension 2010 and/or the HMP.

specific management plan developed in consultation with the CWHG and other stakeholders.

C.5 Ecology

C.5.1 Impacts

The vegetation and habitats of the Site have been cleared progressively in accordance with the development consent and Coal & Allied's vegetation clearing protocols. The proposal would not result in additional vegetation clearance and is expected to have negligible impact on the ecology of the Site and the local area (Table C-1). The proposal is expected to improve the biodiversity values of the regional area, as rehabilitation is further developed and implemented across the Site.

Table C-1. Potential ecological impacts and mitigation

Project component	Potential direct impact	Potential indirect impact	Mitigation/ management measures to be implemented	Residual impact potential
Mining	Inadvertent harm to mobile fauna that could move into the Site on occasion e.g. kangaroos	Dust from mining/ truck movements affecting vegetation /fauna in surrounding areas	Coal & Allied protocols – dust suppression, noise and air quality monitoring, fauna management	Very low
Overburden placement	Runoff from overburden entering vegetation in remnant areas to the north, west and south of MTO	Changes in vegetation community composition/ habitats	Monitoring of overburden and a buffer area for remnant vegetation and implementation of MTW WMS	Very low
Bulga Coal Complex interactions	No additional impacts expected	No additional impacts expected	N/a	None
Tailings management	No additional impacts expected	No additional impacts expected	Ground- and surface water monitoring and management	None
Upgrades to water management (Loders Creek)	Potential erosion/ sedimentation increase in receiving waters	Changes to habitat quality for aquatic species	Ground- and surface water monitoring and management	None
MTO CPP upgrade	No additional impacts expected	No additional impacts expected	Coal & Allied protocols for environmental management for new construction	None

C.5.2 Proposed mitigation

To minimise impacts on the local environment, rehabilitation would be undertaken progressively across the mined area:

- 483ha of mined land would be rehabilitated to locally occurring ecological communities, including some areas of EEC; and
- 97ha would be rehabilitated to trees over grass, providing additional stepping stone habitat for mobile species.

Specific performance indicators would be developed and measured to track the progress of rehabilitation with performance monitoring reported annually. The final landform would be developed with recognition of pre-mining landform and incorporating existing rehabilitation areas consistent with adjacent vegetation communities. The proposals include:

- the use of locally occurring species for rehabilitation;
- implementation of a seed collection programme to ensure species abundance and diversity;
- provision of a regional habitat corridor, providing for the movement of flora and fauna species over a large area at the conclusion of mining;
- fauna habitat enhancement;
- The development of performance indicators and ongoing monitoring.

C.6 Traffic

C.6.1 Impacts

Impacts relating to proposal related traffic and transport, traffic impacts on road networks, traffic impact at intersections, cumulative impacts, car parking and alternate site access, and rail impacts are assessed as the same as the impacts identified for MTW (Section B.6.1). Employee traffic generated by Warkworth Mine and MTO on external public roads would not change under the proposal. Truck traffic generated would generally remain at similar levels under the proposal. Further, the proposal would not result in an increase in annual train movements.

C.6.2 Mitigation

Measures to manage and monitor potential traffic and transport impacts are the same as those identified for MTW (Section B.6.1).

C.7 Groundwater

C.7.1 Impacts

The following impacts were identified:

- *Alluvium*: The maximum water take under the proposal from the Wollombi Brook alluvium is estimated at 194 ML/year. Maximum take from the Hunter River alluvium is undetectable.
- *Groundwater users*: The modelling predicted no drawdown in any privately-owned water supply bores within alluvium or the porous and fractured rock aquifers in the Permian aquifer.
- *Groundwater dependent ecosystems*: The Hunter Valley Oak Forest community would not be affected by the proposal. No significant change is expected in the water table for the Wollombi Brook alluvium or Hunter River alluvium.
- *Pit inflows*: Modelling results indicate inflows from the Permian are initially 389 ML/year in 2015. After the Loders Pit is backfilled and mining ceases, the seepage from the Permian gradually reduces until the voids in the spoil fill with water.
- *Post mining recovery*: The mounded groundwater or ponded open water in the backfilled depression in Loders Pit was calculated to have a median salinity of 3,000µS/cm. The outflow of this water to the Wollombi Brook alluvium is not considered a salinity risk.
- *Water quality post mining*: The predicted reduction in base flow of more saline groundwater to Wollombi Brook means there is limited potential for surface water salinity to increase in the Wollombi Brook during the life of the proposal. The landform that would remain post mining would not degrade the beneficial use of the alluvial groundwater post mining. The impact of mining on the salinity of the base flow in the Wollombi Brook would be practically undetectable.

In summary, the modelling of groundwater impacts indicates that the groundwater system appears relatively unaffected by current mining, and contains brackish to saline groundwater. The proposed backfilling of the Loders Pit reduces the long term take of groundwater from the alluvium, and offers a net environmental benefit reducing water take from the groundwater systems post mining (relative to the current development consent).

C.7.2 Mitigation

MTW water management plan

As described in Section B.7.2, groundwater at MTW is managed in accordance with the MTW water management plan. The same management and monitoring measures would be implemented for MTO as described for MTW.

Water offsets

MTO operates subject to an existing requirement to acquire groundwater licences under its current development consent. As there is no change to the current 1995 approved mining footprint, the existing water take remains as approved.

C.8 Surface water

C.8.1 Impacts

Identified surface water impacts are the same for MTO as for MTW (Section B.8.1). The proposed MTW WMS has been developed in conjunction with the mine planning and operational teams to minimise impacts on surface water resources. The proposed MTW WMS is a continuation of the current MTW WMS, and the results of the surface water study indicate that the impacts of the proposal on surface water resources are unlikely to be significantly different to the existing approved operations and would not have a significant impact on surface water quality of the adjacent water features. The capture of runoff from undisturbed natural catchment draining to any of MTW's water management dams and mining areas may require a water access licence.

C.8.2 Mitigation measures

The proposed MTW water management system (WMS) has been developed in conjunction with the mine planning and operational teams to develop a surface water management system that has minimal impacts on surface water resources, as described in Section B.8.1.

C.9 GHG emissions

The incremental (Scope 1, 2, fugitive and traffic) emissions over the life of MTO's operations have been estimated at 232,704 Mt CO_2-e in 2019. MTO is projected to account for 232,704 t C02 in 2019. The damages cost of GHG emissions to NSW have been estimated by multiplying the global cost (A$1.5 m) by the share of NSW GSP to world GDP.

Appendix D Regional impact analysis

D.1 Derivation of multipliers

This annex describes the methods used to calculate the flow- on effects of changes in the level of mining investment and production in NSW and the Mid and Upper Hunter region.

A number of practical difficulties arise in estimating regional or state-wide input-output multipliers for the purpose of conducting a regional impact analysis. Regardless of the approach that is adopted, regional impact analysis depends on national account statistics that, in Australia, are derived for the economy as a whole. The difficulty that then arises in assessing regional economic impacts is the inability to accurately account for the flow of goods and resources within and between regions.

In the past, apportioning national input-output multipliers to a regional or state level required assumptions that could not be verified. However, the collection of regional employment statistics in the 2011 census now provides a consistent and transparent method of deriving regional economic impacts at a reasonably granular level. The approach we have adopted here therefore makes use of 2011 census figures at an LGA level and the most recent national accounts figures compiled by the ABS for 2009-10, as set out below.

D.1.1 Concordance of the national accounts with census employment data

The Australian National Accounts input-output tables set out the flows of industry inputs (columns) and outputs (rows) for 114 industry classifications. The ABS census records employment an aggregated level with 19 industry classifications. The concordance between the census and the accounts is set out in Table D-1.

Table D-1. Industry concordance between the industries in the National Accounts and industry level employment data in the 2011 census

2011 ABS census	ABS National Accounts industry codes	
Aggregate Industry	Starting From	Ending With
Agriculture, forestry and fishing	101	501
Mining	601	1001
Manufacturing	1101	2502
Electricity, gas, water and waste services	2601	2901
Construction	3001	3201
Wholesale trade	3301	3301
Retail trade	3901	3901
Accommodation and food services	4401	4501
Transport, postal and warehousing	4601	5201
Information media and telecommunications	5401	6001
Financial and insurance services	6201	6401

Rental, hiring and real estate services	6601	6702
Professional, scientific and technical Services	6901	7001
Administrative and support services	7210	7310
Public administration and safety	7501	7701
Education and training	8010	8210
Health care and social assistance	8401	8601
Arts and recreation services	8901	9201
Other services	9401	9502

Source: 5209.0.55.001 - Australian National Accounts: Input-Output Tables, 2009-10. 2011 ABS census.

To construct the flows of industry inputs and outputs at the same level of the census, the rows and columns are summed. For example, there are seven industries classified as being part of the broader agriculture classification. Summing the seven rows aggregates the outputs of agriculture as a whole into each of the 114 industries. Summing the resulting new rows across the seven individual agricultural industries give the total input requirements for agriculture as a whole from each the 114 regions. The final result is a balanced flow table with 19 industry classifications.

The balancing items include rows and columns that are important for the regional impact analysis:

- there are rows for wages and salaries, imports and value added, respectively; and
- there are columns for household consumption, as well as for other final demands.

D.1.2 Requirements matrix and first round (Type IA) output multipliers

The initial requirement for an extra dollar's worth of output of a given industry is called the initial output effect. It equals one in total for all industries, since an additional dollar's worth of output from any industry will require the initial one dollar's worth of output from that industry plus any induced extra output. The first round effect is the amount of output required from all industries of the economy to produce the initial output effect.

First round effects can be measured by deriving the 'direct requirements matrix'. In this matrix, the coefficients in a given industry's column show the amount of extra output required from each industry to produce an extra dollar's worth of output from that industry. The requirements matrix has been constructed from the Australian input-output (flows) table by standardising the inputs into each industry to produce one unit of output in each industry. This is achieved by dividing each row of the table by the total output on an industry-by-industry basis.

The first round impact multiplier is then the sum of the standardised inputs for a given industry. For example, each element of the column for agriculture is divided by total agricultural output and then summed to obtain the total input requirement for one addition unit of output. The initial multiplier can be interpreted as the direct costs of an additional unit of production at current prices. Given these inputs are supplied domestically, the costs are other industry outputs and therefore contribute to total economic output. The sum of the initial output effect (which equals one) and the first round effect is the Type IA output multiplier. This is simply the total first round contribution of a project to the economy. For a project that is small when compared to the size of the industry, the first round and Type IA impact multipliers are valid given the requirements are representative of those used in the project.

D.1.3 Simple output or Type IB multiplier

The simple Type IB multiplier takes into account the inputs required for the increased agricultural output (for example) that must also be produced, which requires the expansion of these industries and those that support them. These may be seen as series of flow-on effects that continue until the overall industry flows are again balanced.

Calculation of the simple multipliers requires solving a matrix equation. Let A be the 19 by 19 matrix of industry requirements (as discussed above), x a vector of inputs used in each of the industries and y a vector of net outputs from the economy. Net output can be standardised to 1 for each industry, giving rise to the simple linear input-output equation:

$$Ax - x = 1$$

Solving for the overall input requirement to one additional unit of output from each industry:

$$x = (I - A)^{-1}$$

where I is an identity matrix with ones along the main diagonal and zeros elsewhere, and the superscript -1 denotes the matrix inverse. Summing the columns of $(1 - A)^{-1}$ gives the simple multipliers. For example summing the agricultural column gives the total inputs from all industries needed to sustain the production of one additional unit of net agricultural output at the national level.

The simple multiplier represents a shift in the composition of industry output, as well as the total level of industry output assuming constant prices. This may be reasonably valid for a small increase in, for example agricultural, output. However, for large change like what has occurred in the Australian mining industry, output prices for most industries will adjust in an offsetting manner. That is, the relative prices for the outputs that are used more extensively in mining will rise, while prices for those that are less extensively use will fall. The implication is that the simple multiplier will, for a given increase in mining output, overstate the flow-on effects in industries where relative prices rise and understate flow-on effects where relative prices fall.

For a project that is small relative to the size of industry the price effects will be small and the bias in the simple multiplier may be ignored. However, the composition of flow effects will vary if the input requirements for the project differ from those of the industry. A comparison can lead to useful caveats regarding the simply multiplier effects on other industries.

D.1.4 The total or Type IIA output multiplier

The total multiplier takes into account the relationship between wages and household demand, that is, the increase (decline) in household demand that results from a rise (fall) in household income. This is derived by adding the wages row and the household expenditure column to the A matrix from the requirements table. Let the expanded matrix be denoted B. The total multipliers are analogous to the simple multiplier and given by the column sums of the matrix $(I-B)^{-1}$.

The key issue with the total multiplier is that wage rates and output price changes will tend to offset the effect. In a limiting case, an increase in wage rates will result in an increase in output prices and leave total output and real household expenditure unchanged. However, if the project is small relative to the size of the economy the effects on household income and wages can be ignored.

D.1.5 Employment, income and value added multipliers

First round, simple and total employment, income and value add multipliers can be calculated in much the same way as the output multipliers. The caveat noted for wage rates and employment in the previous section applies.

Employment multipliers

To calculate employment multipliers requires information about employment by industry that is provided in the ABS National Accounts (Table 20). For each industry, the FTE level of employment is divided by total industry output. This creates a vector of employment requirements per unit of output (denoted h) that can be used to convert the physical input requirements per additional unit of industry output into requirements for labour. The sum of these labour requirements constitute the employment multipliers, written in matrix notation as:

- Type IA: hA;
- Type IB: $h(I-A)^{-1}$; and
- Type IIA: $h(I-B)^{-1}$.

These multipliers give the FTEs of employment needed to support an additional unit of output. These multipliers can be adjusted to Type IA, Type IIA multipliers by expressing the multiplier as the total employment needed per person directly employed on the project. This is done by dividing each of the multipliers above by the number of workers required per unit of output. They are not the number of jobs created as this will be impacted by the number of part-time work that are converted to full-time workers or vice versa.

Income multipliers

The calculation of the income multiplier is done in the same way. The wage and salary requirement per unit are given in the requirements table. Designating these as a vector w the income multipliers written in matrix notation are:

- Type IA: wA;

- Type IB: $w(I-A)^{-1}$; and
- Type IIA: $w(I-B)^{-1}$.

These multipliers can be adjusted to Type IA, Type IIA multipliers by expressing the multiplier as the total income per dollar of salaries and wages expended directly on the project. This done by dividing each of the multipliers above by the salaries and wages required per unit of output.

Value added multipliers

Value added is the value of industry output less the costs of inputs, whether produced domestically or imported (the contribution to regional GDP). This can again be calculated, as a vector, v, from the requirements table as value added per unit of industry output. The multipliers are then calculated in an identical way to employment and income:

- Type IA: vA;
- Type IB: $v(I-A)^{-1}$; and
- Type IIA: $v(I-B)^{-1}$.

These multipliers can be adjusted to Type1A, Type 2a multipliers by expressing the multiplier as the total income per dollar of value added by the project. This done by dividing each of the multipliers above by the valued added per unit of output.

D.1.6 Regional impacts

It is not possible to maintain the level of consistency that exists in national input output tables at a regional level. Comprehensive data on industry composition, household consumption and the flow of goods and services to and from regions is not available.

A standard approach that can be reproduced across different regional definitions in a consistent manner is to use employment by industry data to form what are known as location quotients (LQs). LQs are used to translate economy-wide input-output relationships into regional relationships. For instance, while coal mining only accounts for a small share of employment at a national level, employment in coal mining in the Mid and Upper Hunter region is very significant. Hence national input-output tables need to be adjusted to better reflect the characteristics of the local economy.

Locational Quotients

A raw LQ is simply the percentage of FTE employment in a given industry and region, divided by the percentage of FTE employment in a given industry at the national level. This may be written for the i^{th} industry and the j^{th} region as:

$$LQ_{i,j} = \frac{\dfrac{\text{employment}_{i,j}}{\sum_i \text{employment}_{i,j}}}{\dfrac{\sum_j \text{employment}_{i,j}}{\sum_i \sum_j \text{employment}_{i,j}}}$$

The LQ has a natural interpretation for an industry within a region:

- if the LQ is less than one, the goods and services from that industry will tend to be imported into the region to meet demand; while
- if the LQ is greater than one, the goods and services from that industry will tend to be exported into the region to meet demand elsewhere.

Given that goods and services and labour requirements are the same in all regions, the relationship will tend to be proportional so long as the actual size of the labour force does not represent a constraint. These are standard assumptions in an input output analysis. However, at the regional level, the violation of these assumptions can often be more apparent. For example, specialised good or services demanded for a project may simply not be produced domestically and may have to imported, with a consequent reduction in regional flow-on effects. However, this can be addressed within the context of the requirements table if project information on where purchases are made is available.

Total employment may not be a constraint for a large region, such as a state. However, while a large proportion of people may be employed in an industry in a small region, the overall workforce in that industry may not be sufficient to meet labour requirements. While this may in part be offset by migration, it can simply be more efficient to import goods and services into the region.

It is recommended practice (Bess and Ambargis 2011) to adjust the raw LQs in small regions by the following formula:

$$LQ_{i,j} = \begin{cases} LQ_{i,j} & \text{if} \quad LQ_{i,j} < 1 \\ 1 & \text{if} \quad LQ_{i,j} >= 1 \end{cases}$$

LQs consist of the ratio of an industry's share of regional earnings to the industry's share of national earnings. This adjustment has the effect of holding constant or reducing regional flow-on effects. The basic idea is that industries in the region are not likely to produce all of the intermediate inputs required to produce the change in final demand. In these cases, local industries must purchase intermediate goods and services from producers outside the region, thereby creating leakages from the local economy.

Regional Multipliers

Give LQ is a vector of location quotients, the regionally adjusted Type IA and Type IB input multipliers are calculated by multiplying the industry requirements by the quotients. The output multipliers are the column sums of:

- Type IA: $LQ \times A$;
- Type IB: $(I - LQ \times A)^{-1}$; and
- Type IIA: $(I - LQ \times B)^{-1}$.

Where $\times$ denotes element-by-element multiplication of each column of A by LQ.

The income, employment and value add multipliers are calculated in the same manner as the national multipliers.

D.1.7 Adjusted Mining Industry Expenditures

The LQ adjusts for locally sourced intermediate inputs. Therefore the expenditure column of the input-output matrix, which includes wages, gross operating surplus, taxes and imports needs to be rebalanced to sum to total industry output. The balancing item is imports. The Australian and the adjusted State and regional mine expenditure are shown in Table D-2.

Table D-2. Australian, NSW, Mid and Upper Hunter region, and Singleton LQ adjusted mine expenditures

Expenditure	Australia	NSW	Mid and Upper Hunter region	Singleton LGA
Agriculture, forestry and fishing	0.1%	0.1%	0.1%	0.1%
Mining	11.7%	11.7%	11.7%	11.7%
Manufacturing	4.5%	3.9%	4.5%	3.2%
Electricity, gas, water and waste services	1.6%	1.3%	1.6%	1.6%
Construction	4.7%	3.5%	3.7%	3.0%
Wholesale trade	1.2%	1.3%	0.9%	0.9%
Retail trade	0.3%	0.4%	0.3%	0.3%
Accommodation and food services	0.2%	0.3%	0.2%	0.2%
Transport, postal and warehousing	2.7%	2.5%	2.0%	1.6%
Information media and telecommunications	0.2%	0.2%	0.1%	0.0%
Financial and insurance services	2.8%	3.8%	1.2%	0.9%
Rental, hiring and real estate services	1.5%	1.5%	1.4%	1.5%
Professional, scientific and technical Services	4.0%	4.2%	2.2%	1.9%
Administrative and support services	0.5%	0.5%	0.5%	0.5%
Public administration and safety	0.3%	0.3%	0.2%	0.2%
Education and training	0.1%	0.1%	0.1%	0.0%
Health care and social assistance	0.0%	0.0%	0.0%	0.0%
Arts and recreation services	0.0%	0.0%	0.0%	0.0%
Other services	1.0%	1.0%	1.0%	1.0%
Total Domestic Inputs	37.4%	36.5%	31.6%	28.7%

Expenditure	Australia	NSW	Mid and Upper Hunter region	Singleton LGA
Total Inputs	41.4%	41.4%	41.4%	41.4%
Wages and Salaries	11.6%	9.8%	9.8%	11.6%
Gross Operating Surplus	46.4%	46.4%	46.4%	46.4%
Taxes	0.6%	0.6%	0.6%	0.6%
Imports	4.0%	4.9%	9.8%	12.7%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**

D.2 Estimates of multipliers

The multipliers reported in the following were derived from national level multipliers in accord with guidelines provided by the ABS (n.d.). State and regional multipliers were derived using employment LQs to translate economy-wide input-output relationships into regional relationships. Table D-3 shows national multipliers derived from the 2010 National Accounts tables for:

- gross output (production);
- income;
- employment (FTE equivalent); and
- value added (contribution to GDP).

Table D-3. National input-output multipliers

Multiplier	Type IA: Direct + Type IA effects	Type IB: Direct + Type IA + industry support effects	Type IIA: Direct + Type IA + industry support + consumption induced effects
Output	1.36	1.69	2.62
Income	1.63	2.23	4.37
Employment	1,93	3.90	6.11
Value Added	1.30	1.54	2.05

Source: ABS 5209.0.55.001 - Australian National Accounts: Input-Output Tables, 2009-10, Table 9.

Table D-4 shows these multipliers for NSW.

Table D-4. NSW input-output multipliers

Multiplier	NSW		
	Type IA	Type IB	Type IIA
Output	1.31	1.56	2.46
Income	1.63	2.23	3.54
Employment	1.91	3.81	6.05
Value Add	1.30	1.55	2.05

Source: ABS 5209.0.55.001 - Australian National Accounts: Input-Output Tables, 2009-10, Table 9; 2011 ABS Census.

Table D-5 shows these multipliers for the Mid and Upper Hunter region.

Table D-5. Mid and Upper Hunter region input-output multipliers

Multiplier	Mid and Upper Hunter region		
	Type IA	Type IB	Type IIA
Output	1.32	1.51	1.92
Income	1.49	2.09	2.63
Employment	1.67	3.07	4.33
Value Add	1.23	1.34	1.62

Source: ABS 5209.0.55.001 - Australian National Accounts: Input-Output Tables, 2009-10, Table 9; 2011 ABS Census.

Table D-6 shows these multipliers for Singleton LGA.

Table D-6. Singleton LGA input-output multipliers

Multiplier	Singleton LGA		
	Type IA	Type IB	Type IIA
Output	1.28	1.42	2.02
Income	1.67	3.07	4.33
Employment	1.46	1.68	2.37
Value Add	1.28	1.42	2.02

Source: ABS 5209.0.55.001 - Australian National Accounts: Input-Output Tables, 2009-10, Table 9; 2011 ABS Census.

Appendix E CBA and REIA – MTO

The following describes the approach and the results of the CBA and REIA, respectively, for MTO. While MTO would continue to operate as part of an integrated mining complex consisting of the Warkworth Mine and MTO, the analysis described in the following identifies the net benefits and flow-on effects that can be attributed to MTO.

E.1 Attribution of costs and revenues

If the applications are successful, mining would continue at MTO until 2018. After this time, and until the projected closure of the combined operation, mining would only take place at Warkworth Mine. From 2018 onwards, MTO would receive overburden from Warkworth Mine to assist in rehabilitation and development of the final landform. In addition, the following activities would take place at MTO:

- the operation of the integrated MTW water management system (WMS);
- the operation of the integrated MTW tailings management system;
- the operation of the MTO CHPP facility; and
- the ongoing coal transfer from Warkworth Mine for transport to the Port of Newcastle.

Given the closely integrated nature of the Warkworth Mine and MTO operations, and in order to estimate the revenues and costs that would accrue to MTO separately, a conceptual 'tolling' arrangement has been introduced. Under this tolling arrangements, MTO is deemed to charge Warkworth Mine a toll for processing coal originating from Warkworth Mine, as well as for accepting mine waste from Warkworth Mine. These (notional) processing payments are treated as revenues accruing to MTO, and as costs falling on Warkworth Mine. MTO is also assumed to retain a small labour force to operate its processing plant after mining at MTO has been completed. Tax and other payments to the NSW and Commonwealth governments have been adjusted accordingly. However, the bulk of taxation payments, in particular royalty payments, remain with Warkworth Mine, given that, from 2019 onwards, all coal will originate from Warkworth Mine.

Additionally, the cost of mitigating external effects that can be attributed to the continued operation of MTO have been incorporated in the costing. These costs relate to noise impacts, as well as the costs of obtaining additional water licences (Appendix C). All other assumptions are identical to those used in the CBA and REIA for the combined (Warkworth Mine and MTO) operations.

Table E-1 below summarises the approach that has been taken for the purpose of attributing these costs.

Table E-1. Approach to MTO revenue and cost attribution

Item		Modelling approach
Revenues from coal mining		Allocated to MTO on the basis of ROM coal
Tolling revenues		
	Coal processing tolling revenues	Coal processing tolling charge derived as: - CHPP Complex processing labour costs, - plus CHPP non-labour costs (services, consumables, raw materials, energy costs, other opex) based on detailed CHPP cost modelling, and - assuming that MTO earns a 30 per cent margin on processing operating costs
	Coal dumping tolling revenues	Coal dumping tolling charge estimated as: - estimated Warkworth Mine waste transferred to MTO (as per mine plan), - charged at a variable dumping charge of \$0.2/bcm (real \$2014).
Operating costs	Administration/overhead, wages & salaries, payments to contractors, services, consumables, raw materials, energy costs, other operating costs	Allocated to MTO on the basis of ROM coal produced by Warkworth Mine/MTO after adjusting for coal processed by MTO
Council taxes/shire rates		Allocated on the basis of JV ownership shares
External effects (MTO)		
	Air/noise	Acquisition of one residential property
	Noise and vibration	Noise attenuation specific to MTO equipment

E.2 Results of the CBA (Warkworth Mine)

This section summarises the results of the CBA for Warkworth Mine. The ongoing operation of Warkworth Mine has been evaluated with reference to its impact on NSW GSP. The results shown in the following have been obtained by differencing the net benefits obtained for MTO from those of MTW.

E.2.1 Gross operating surplus accruing to Warkworth Mine

One of the components of NSW GSP is the share of MTO's GOS that can be attributed to NSW. As set out in Section 3, GOS is calculated as output valued at producer prices, net of intermediate consumption (operating expenditure), net of employee compensation, and net of taxes on production (ABS 2013). Table E-2 summarises the GOS attributed to Warkworth Mine.

Table E-2. Gross operating surplus attributed to Warkworth Mine

Costs	NPV (A$ m real 2014)	Benefits	NPV (A$ m real 2014)
Operating expenditure	$3,667	Value of mining output	$6,892
Wages & salaries	$1,346		
Other taxes less subsidies on production	$58		
Total	**$5,071**		**$6,892**
Gross operating surplus	**$1,821**		

Notes: NPVs have been derived using a discount rate of 7 per cent.
Totals may not sum precisely due to rounding.

E.2.2 Net impacts of MTO on NSW GSP

The net economic benefit from the ongoing operation of MTO for NSW is estimated at A$1,343 million in NPV terms (Table 3-9). The key components of these benefits are the additional wages and salaries paid by MTO to NSW employees, as well as royalty payments (for the limited number of years when MTO is projected to produce coal).

The valuation approach applied here is the same as that used for the combined operation of Warkworth Mine/MTO:

- external effects have generally been valued on the basis of the financial payments made by Rio Tinto or on the basis of offsets;
- only incremental disposable income accruing to MTO employees and long-term contractors who reside in NSW represents a net benefit to NSW, as well as the share of income taxes and Medicare contributions that would accrue to NSW; and
- additionally, incremental wage and salary benefits accruing to NSW have been reduced to avoid overestimating the employment benefits to NSW.

E.3 Results of the CBA (MTO)

This section summarises the results of the CBA for MTO. The ongoing operation of MTO has been evaluated with reference to its impact on NSW GSP.

E.3.1 Gross operating surplus accruing to MTO

One of the components of NSW GSP is the share of MTO's GOS that can be attributed to NSW. As set out in Section 3, GOS is calculated as output valued at producer prices, net of intermediate consumption (operating expenditure), net of employee compensation, and net of taxes on production (ABS 2013). Table E-3 summarises the GOS attributed to MTO. Table E-3 indicates that the incremental GOS attributable to MTO is around A$332 million in NPV terms.

Table E-3. Gross operating surplus attributed to MTO

Costs	NPV (A$ m real 2014)	Benefits	NPV (A$ m real 2014)
Operating expenditure	$393	Value of mining output	$635
Wages & salaries	$148	Revenues from tolling, coal processing	$248
Other taxes less subsidies on production	$8		
Total	**$549**		**$883**
Gross operating surplus	**$334**		

Notes: NPVs have been derived using a discount rate of 7 per cent.
Totals may not sum precisely due to rounding.

E.3.2 Net impacts of MTO on NSW GSP

The net economic benefit from the ongoing operation of MTO for NSW is estimated at A$151 million in NPV terms (Table 3-11). The key components of these benefits are the additional wages and salaries paid by MTO to NSW employees, as well as royalty payments (for the limited number of years when MTO is projected to produce coal). The valuation approach applied here is the same as that used for the combined operation of Warkworth Mine/MTO.

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Appendix F

Noise and vibration study

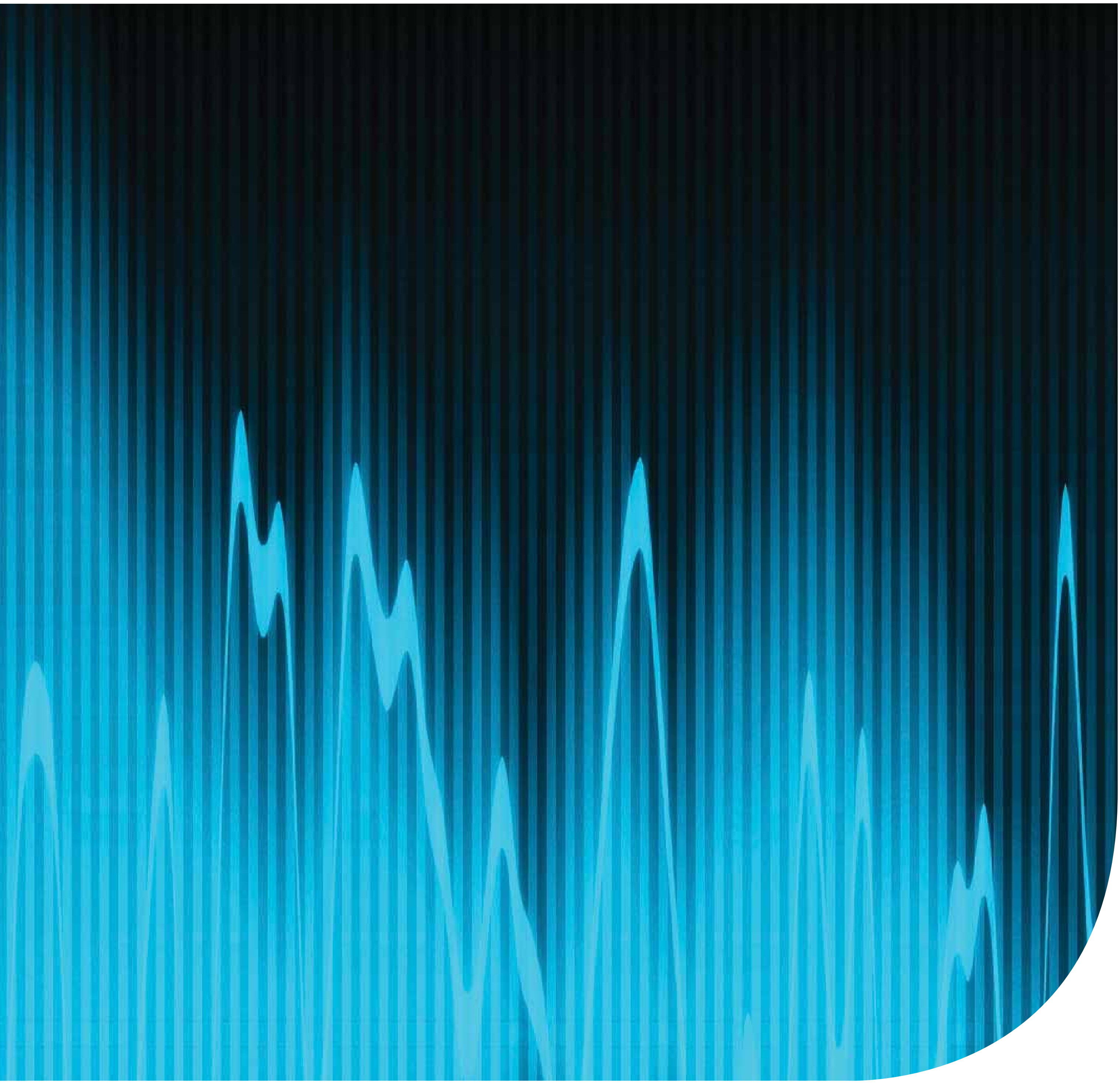
Appendix F — Noise and vibration study

F

Mount Thorley Operations 2014

Noise and vibration study

Prepared for Mt Thorley Operations Pty Limited | 2 June 2014



Planning + Environment + Acoustics

Mountt Thorley Operations 2014

Noise and vibration study

Prepared for Mt Thorley Operations Pty Limited | 2 June 2014

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Mountt Thorley Operations 2014

Final

Report J14013RP2 | Prepared for Mt Thorley Operations Pty Limited | 2 June 2014

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Position	Senior Acoustic Consultant	Managing Director	Position	Managing Director
Signature			Signature	
Date	2 June 2014	2 June 2014	Date	2 June 2014

This report has been prepared in accordance with the brief provided by the client and has relied upon the information collected at or under the times and conditions specified in the report. All findings, conclusions or recommendations contained in the report are based on the aforementioned circumstances. The report is for the use of the client and no responsibility will be taken for its use by other parties. The client may, at its discretion, use the report to inform regulators and the public.

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1 Introduction

1.1 Background

Mount Thorley Operations (MTO) is an open cut coal mine approximately 10.5 kilometres (km) south-west of Singleton in the Hunter Valley, NSW. The mine is operated by Coal & Allied on behalf of Mount Thorley Co-venture. MTO currently operates under Development Consent No. DA 34/95 (the development consent) issued by the then Minister for Planning on 22 June 1996 under Part 4 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act).

Immediately to the north is Warkworth Mine. Since 2004, the two mines have integrated at an operational level and are known as Mount Thorley Warkworth (MTW), with a single management team responsible for all the operations. Equipment, personnel, water, rejects and coal preparation are all shared between the mines. The MTW operations involve an existing operation of approximately 1,300 persons, which includes full-time personnel and a small number of short-term contractors. Ownership of the two mines remains separate.

Mining activities approved under DA 34/95 have mostly been completed with the exception of Loders Pit and Abbey Green North Pit (AGN) with rehabilitation well-progressed on the east of the Site. Run-of-mine (ROM) coal from MTO is transported to either the MTO or Warkworth Mine coal preparation plant (CPP) for processing. Extraction of coal from other pits has been completed; overburden emplacement is ongoing. Product coal from the CPPs is transported via conveyor to the Mount Thorley Coal Loader (MTCL). Coal loaded onto trains at the MTCL is transported to the Port of Newcastle for export.

The Mount Thorley Operations 2014 (the proposal) seeks an approval under Part 4, Division 4.1 of the EP&A Act to complete mining and rehabilitation activities within the current limits of approval.

This assessment forms part of the Environmental Impact Statement (EIS) prepared by EMGA Mitchell McLennan Pty Ltd (EMM) for the proposal.

This noise and vibration assessment has been prepared with reference to the NSW Department of Planning and Environment's (DP&E) State Significant Development - Secretary’s requirements Mt Thorley Continuation Project (SSD 6465) and in accordance with the NSW EPA's *Industrial Noise Policy* (*INP*), published in January 2000.

As part of the development of the mine plan for the proposal an order of magnitude style noise impact work package was undertaken by MTO with a comprehensive series of noise modelling scenarios developed and assessed by EMM. The purpose of this work was to inform the mine planning process with regards to potential noise impacts including noise management techniques to minimise impacts, a key risk as noted in the proposal risk assessment.

1.2 Project description

The proposal comprises:

- the completion of mining in Loders pit and AGN pit;
- the ability to accept overburden from Warkworth Mine to complete the final landform;

- the maintenance of operational level integrated components of MTW, including upgrades to the water management system;

  - an upgrade to the approved discharge point and increase the discharge rate of 200 megalitres (ML) per day;

  - the ability to transfer and accept mine water from neighbouring mines (eg Bulga Coal Complex, Wambo Mine, Hunter Valley Operations);

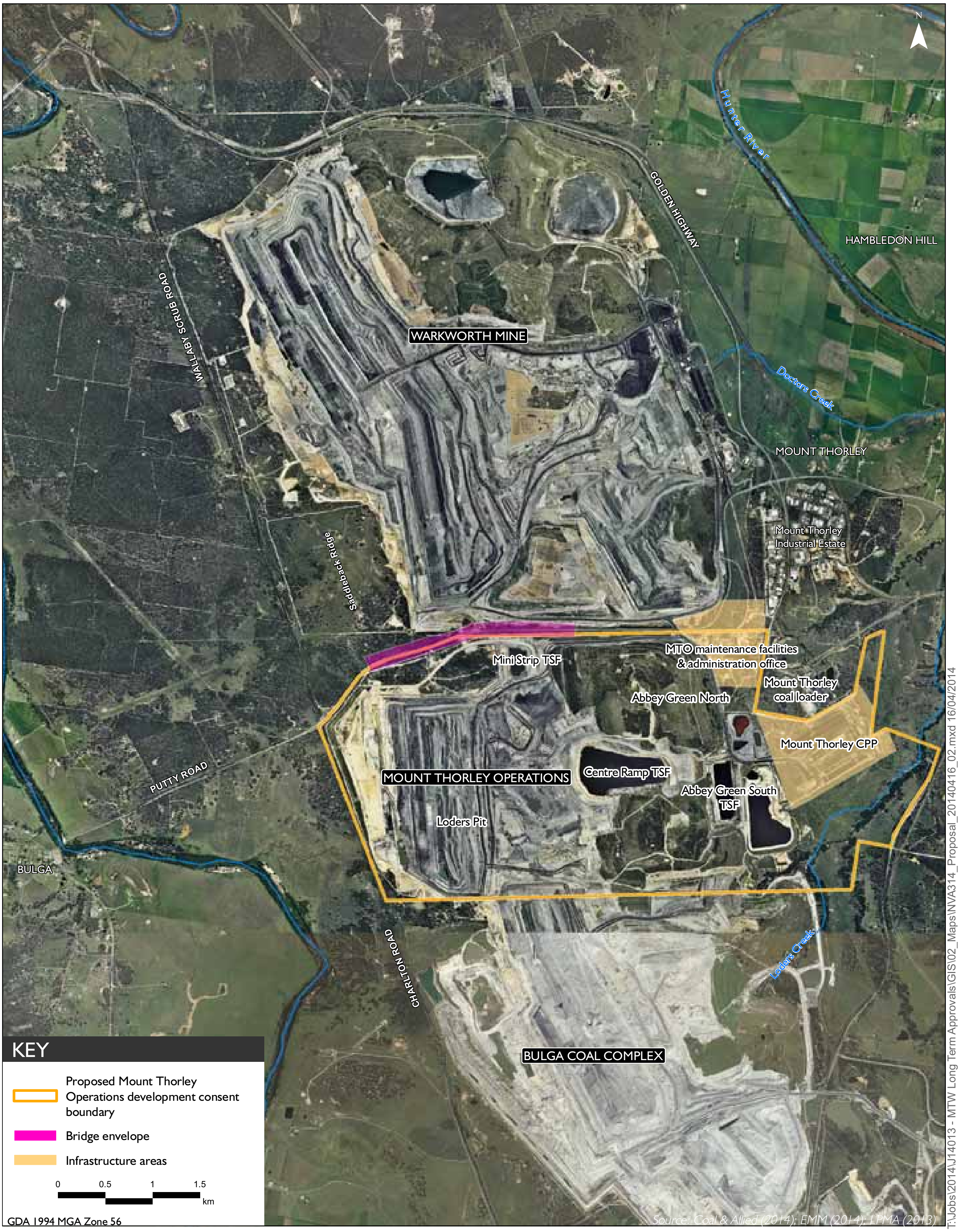
  - an increase in dam 9S (Southern out-of-pit - SOOP) storage capacity to 2.2 gigalitres (GL) within the same disturbance footprint; and

- the acknowledgement of all approved interactions with Bulga Coal Complex;

- an upgrade to the CPP to facilitate an increase in maximum annual throughput of 18 Mt; and

- the maintenance of approval of all aspects of the existing operations for Warkworth Mine approved under DA 34/95, including, coal processing rates and integrations with WML amongst other aspects.

The proposal seeks development consent for a period of 21 years to undertake the activities described above and in the EIS. The proposal is shown in Figure 1.1.



EMM COAL & ALLIED Managed by Rio Tinto Coal Australia

Overview of the proposal

Mount Thorley Operations

Noise and vibration assessment

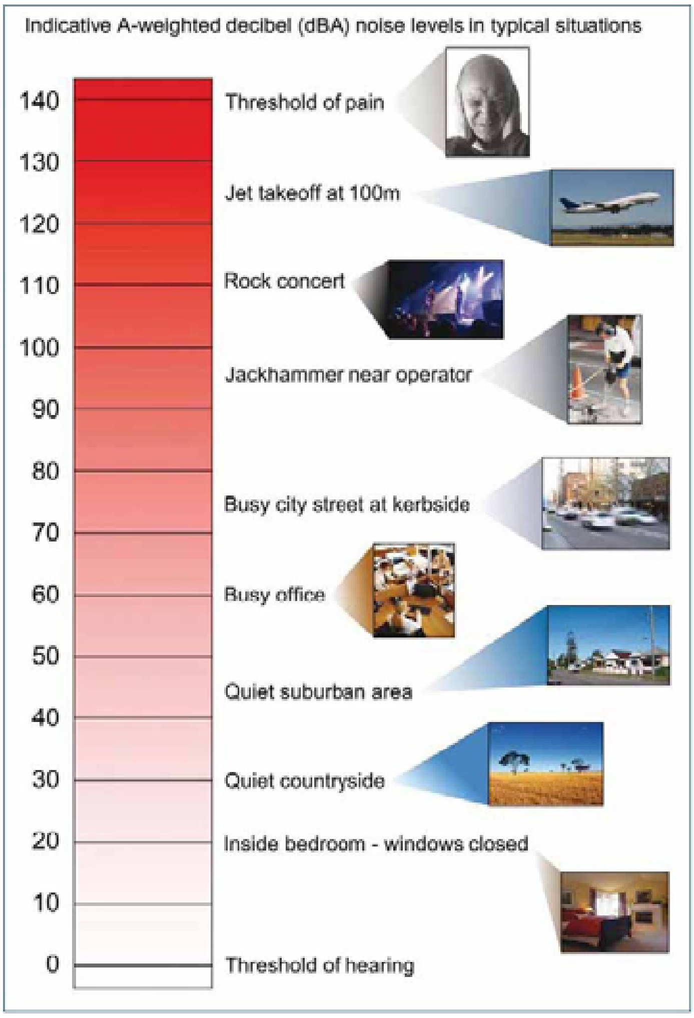
Figure 1.1

1.3 Common noise levels

Table 1.1 gives an indication as to what an average person perceives about changes in noise levels Examples of common noise levels encountered on a daily basis are provided in Figure 1.2.

Table 1.1 Perceived change in noise

Change in sound level (dB)	Perceived change in noise
1 to 2	typically indiscernible
3	just perceptible
5	noticeable difference
10	twice (or half) as loud
15	large change
20	four times as loud (or quarter) as loud



Source: Road Noise Policy (DECCW 2011)

Figure 1.2 Common sources of noise with levels

2 Glossary

A number of technical terms are required for the discussion of noise and vibration. These are explained in Table 2.1.

Table 2.1 Glossary of acoustic terms

Abbreviation or term	Description
ABL	The assessment background level (ABL) is defined in the INP as a single figure background level for each assessment period (day, evening and night). It is the tenth percentile of the measured L90 statistical noise levels.
Amenity criteria	The amenity criteria relate to all industrial noise. Where industrial noise approaches base amenity criteria, then noise levels from new industries need to demonstrate that they will not be an additional contributor to existing industrial noise.
ANZECC	Australian and New Zealand Environment Conservation Council
CNMP	Construction noise management plan
Coal & Allied	Coal & Allied Operations Limited
Day period[1]	Monday to Saturday: 7.00 am to 6.00 pm, on Sundays and public holidays: 8.00 am to 6.00 pm.
dB(A)	Noise is measured in units called decibels (dB). There are several scales for describing noise, the most common being the 'A-weighted' scale. This attempts to closely approximate the frequency response of the human ear.
DGRs	Director-General's environmental assessment requirements
DP&E	Department of Planning and Environment (NSW government)
EA	Environmental assessment
EMM	EMGA Mitchell McLennan Pty Limited
EPA	NSW Environment Protection Authority
EP&A Act	Environmental and Planning Assessment Act 1979 (NSW)
Evening period[1]	Monday to Saturday: 6.00 pm to 10.00 pm, on Sundays and public holidays: 6.00 pm to 10.00 pm.
ICNG	Interim Construction Noise Guideline
INP	Industrial Noise Policy (NSW EPA 2000)
Intrusive criteria	The intrusive criteria refers to noise that intrudes above the background level by more than 5 dB. The intrusiveness criterion is described in detail in this report.
L_1	The noise level exceeded for 1% of the time.
L_{10}	The noise level which is exceeded 10% of the time. It is roughly equivalent to the average of maximum noise level.
L_{90}	The noise level that is exceeded 90% of the time. Commonly referred to as the background noise level.
L_{eq}	The energy average noise from a source. This is the equivalent continuous sound pressure level over a given period. The $L_{eq(15min)}$ descriptor refers to an L_{eq} noise level measured over a 15-minute period.
Linear peak	The peak level of an event is normally measured using a microphone in the same manner as linear noise (ie unweighted), at frequencies both in and below the audible range.
L_{max}	The maximum sound pressure level received during a measuring interval.
Night period[1]	Monday to Saturday: 10.00 pm to 7.00 am, on Sundays and public holidays: 10.00 pm to 8.00 am.
NMP	Noise management plan
PSNL	The project-specific noise levels (PSNL) are criteria for a particular industrial noise source or industry. The PSNL is the lower of either the intrusive criteria or amenity criteria.

Table 2.1 Glossary of acoustic terms

Abbreviation or term	Description
RBL	The rating background level (RBL) is an overall single value background level representing each assessment period over the whole monitoring period. The RBL is used to determine the intrusiveness criteria for noise assessment purposes and is the median of the average background levels.
RNP	Road Noise Policy
RING	Rail Infrastructure Noise Guideline
Sound power level (Lw)	A measure of the total power radiated by a source. The sound power of a source is a fundamental property of the source and is independent of the surrounding environment.
Temperature inversion	A meteorological condition where the atmospheric temperature increases with altitude.
The proposal	Warkworth Continuation 2014
The Site	Area covered by application
Vibration	A motion that can be measured in terms of its displacement, velocity or acceleration. The common unit for velocity is millimetres per second (mm/s).

Note: 1. excludes road traffic noise where Day: 07.00 am to 10.00 pm; Night: 10.00 pm to 07.00 am.

3 Existing acoustic management

3.1 Overview of noise management system

The MTW Noise Management Plan (NMP) details a range of existing acoustic management and monitoring procedures which are managing the existing operations to comply with the conditions of the development consent. The management measures include those which are implemented on a continuous (standard) basis, as well as both proactive and reactive measures, categorised in accordance with the hierarchy of control. The hierarchy of control is as follows:

- administrative controls;
- substitution controls;
- engineering; and
- elimination controls.

Together, this suite of management measures and processes comprise the MTW Noise Management System.

The effectiveness of the MTW Noise Management System has been tested on a number of occasions in recent years, including formal compliance audits, requests for Independent Review, ad-hoc supplementary monitoring programs, and departmental requests for information. MTW continues to demonstrate a position of predominant compliance with noise criteria, and a high level of adherence to the measures outlined in the NMP.

MTW continues to work with the Department to improve the NMP, demonstrating commitment to continuous improvement and driving mining industry best practice noise management. It is expected that the continued implementation and refinement of measures outlined in the NMP (as updated from time to time) will enable MTW to effectively manage any noise impacts associated with this proposal, and to ensure a high level of compliance is maintained throughout the life of the Project.

3.2 Administrative controls

The following administrative controls are implemented at MTW, including:

- TRIGGER Action Response Process (TARP);
- Heavy Mining Equipment (HME) Sound Power Level (Lw) screening;
- handover report; and
- validation surveys of the real-time monitoring network.

Each of these measures is described below.

3.2.1 Trigger Action Response Process (TARP)

The TARP is the key reactive noise control implemented at MTW, and involves the effective and timely response to elevated noise (trigger), irrespective of meteorological conditions.

Triggers are enacted in a number of ways, prompting commencement of reactive processes to validate, quantify and appropriately respond to noise conditions, including:

- receipt of a noise alarm from the real-time, directional noise monitoring network;
- identification of elevated noise through routine supplementary surveillance noise monitoring, undertaken by MTW personnel each night;
- notification of elevated noise through the routine (monthly) attended compliance monitoring regime undertaken by experienced and independent experts; and
- receipt of community complaint in relation to noise.

When a trigger is confirmed (noise levels which are approaching or exceeding the noise criteria in the vicinity of nearby private residences), an appropriate response is implemented to ensure the noise event is resolved within 75 minutes of identification. The response may include substitution or elimination measures, commensurate with the nature and severity of the noise event.

3.2.2 HME Sound Power Level (Lw) screening

Understanding of the sound profile of the mining fleet is critical to effective introduction of both proactive and reactive noise controls. To ensure this information is kept up-to-date and relevant, sound power level testing (sound screening) is undertaken on 33% of the attenuated HME fleet annually. In this way, 100% of attenuated equipment will be screened on a rolling three-year cycle. The results of sound screening will be used for the following:

- to inform MTW of equipment which is experiencing degradation in suppression equipment and requiring repair;
- to inform MTW of fleet types and units which can be preferentially deployed into or removed from noise risk areas; and
- to periodically update the predictive modelling interface (PMI) to increase model accuracy and usefulness (refer to Section 5.1).

When one piece of equipment measures >3 dB(L) against operational specifications, MTW maintenance staff will inspect and assign the piece of equipment to the appropriate maintenance schedule.

3.2.3 Nightshift environmental management report

The MTW operational personnel prepare and circulate a report following each night shift which describes the noise management activities undertaken including routine controls, minor changes and equipment shutdowns, if any, during the shift. Where noise enhancing weather conditions are predicted for the shift ahead these are described in the report. Along with the description of the conditions, potential management strategies are also detailed.

3.2.4 Validation surveys of the real-time monitoring network

To ensure that the real-time monitoring network adequately assesses and represents all receivers, validation surveys are undertaken on an as-needs basis, involving supplementary noise monitoring in the vicinity of the private residence concerned, and comparison with measured levels from the nearest real time monitor. Where a survey indicates a change may be required this is reviewed and actioned as appropriate to ensure monitoring systems and reactive triggers remain representative.

3.2.5 Substitution controls

Substitution controls are implemented in response to one or more triggers (described in 'administrative controls' above), and are utilised both proactively and reactively. Substitution measures involve the repositioning or replacement of equipment or reassignment of tasks when conditions require. For example, assignment of sound attenuated trucks to higher (noise) risk hauls during noise enhancing conditions ahead of shift, or reactively following a trigger.

3.3 Engineering measures

In conjunction with its suppliers, MTW has progressed with the attenuation of its fleet of haul trucks and other mining equipment. All new trucks purchased for use on the Site will be commissioned as noise suppressed (or attenuated) units. MTW currently operates a mixture of sound attenuated and non-sound attenuated machines and the existing fleet of trucks are being progressively fitted with suitable noise attenuation packages. Baseline testing has been completed and acoustic engineering is being applied to understand what sound power levels are achievable across the fleet. The attenuation program is being undertaken in a targeted manner, addressing the noisier pieces of equipment as a priority for the operations given the remaining development consent life.

Identification and rectification of defects to sound attenuation equipment is undertaken as required through the normal maintenance process where reasonable and feasible. MTW has also completed works to replace all in-pit reverse alarms with 'quacker' style reverse alarms on its mining fleet.

During 2012, engineering works were undertaken to address noise associated with shovel operations. Engineering controls were introduced including hydraulic snubber brakes, and fitting of self-greasing permalubes to the dipper door pins. Where additional reasonable and feasible opportunities for engineering controls are identified in the future, these will continue to be investigated and trialled as appropriate.

3.4 Elimination controls

Elimination controls are implemented in response to one or more triggers (described in 'administrative controls' above). Elimination controls, equipment or task shutdown, are implemented as a last resort where other controls have been inadequate.

4 MTW noise management system in action

4.1 Night shift Environmental Management Report

MTW operational personnel prepare and circulate a shift report for planning activities and to handover to the next shift.

The report describes the noise management activities undertaken including routine controls, minor changes and equipment shutdowns, if any, during the shift. Where noise enhancing conditions are predicted for the next shift these are described in the report. Along with the description of the conditions, potential management strategies are also detailed. An example of information contained within the handover report is shown in Figure 4.1.

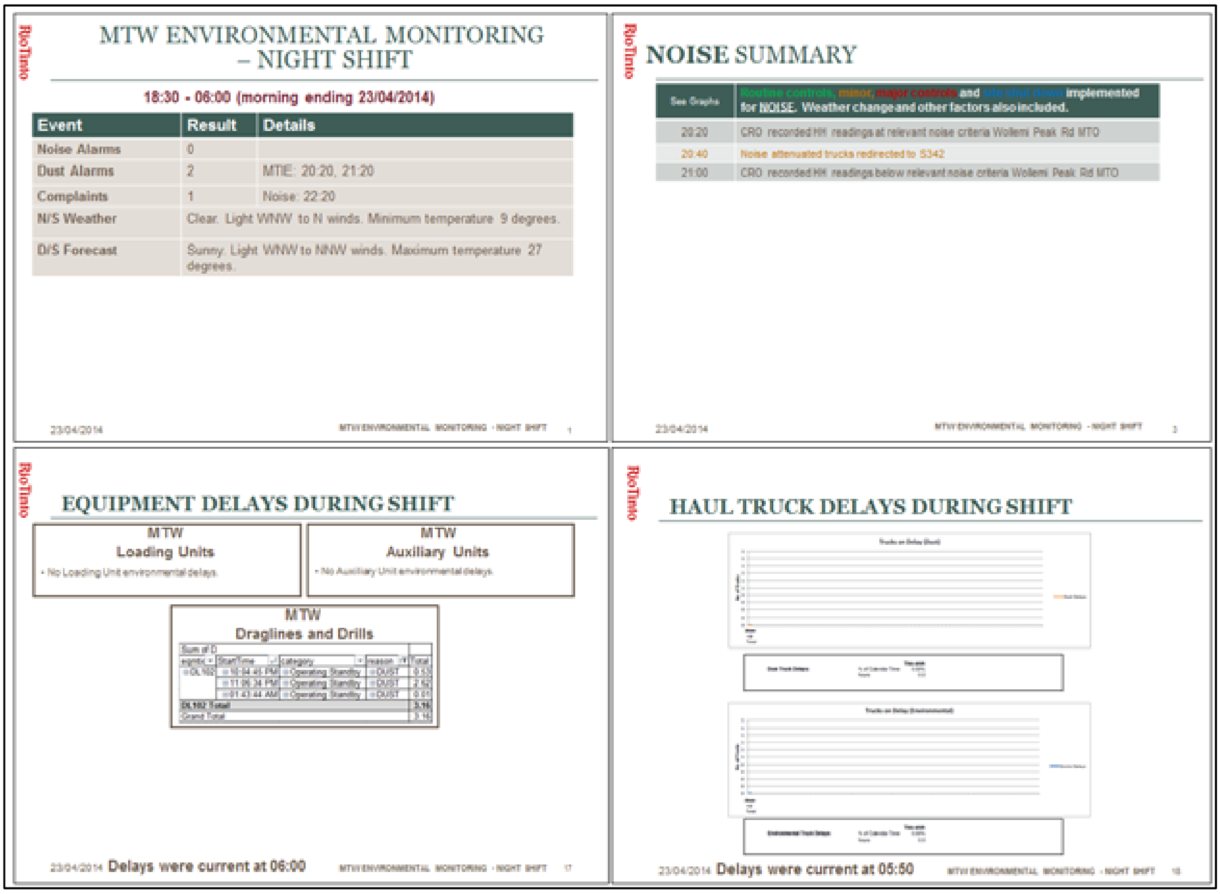


Figure 4.1 Example information from the night shift environmental management report (night shift 22 April 2014)

4.2 Real-time noise monitoring

Directional real-time noise monitoring is utilised to actively manage noise emissions from MTW on a continuous basis during night time operations. The real-time monitoring network comprises a number of monitors which have been strategically placed to adequately represent a wide range of private residences. Operational personnel have access to real-time data via the environmental intranet (also available on hand-held devices such as smart phones) and use a suite of tools to allow for swift resolution of any emerging issues during any shift including live audio streaming, dedicated pages for each monitoring location (an example is provided as Figure 4.2), and 'Noise roses' (a spatial representation of the directional assessment of measured noise, see Figure 4.3).

A real-time noise alarm system was introduced to MTW during 2011 which uses a set of rules to alert operational personnel to emerging noise issues in real-time. Numerous noise alarms have been acknowledged and responded to during night shift operations in 2014. Since the introduction of real-time noise alarms at MTW in 2011, the monitoring network has expanded in the Bulga village area, now comprising four directional real-time monitors to ensure adequate representation of private residences in the area (see Figure 4.4).

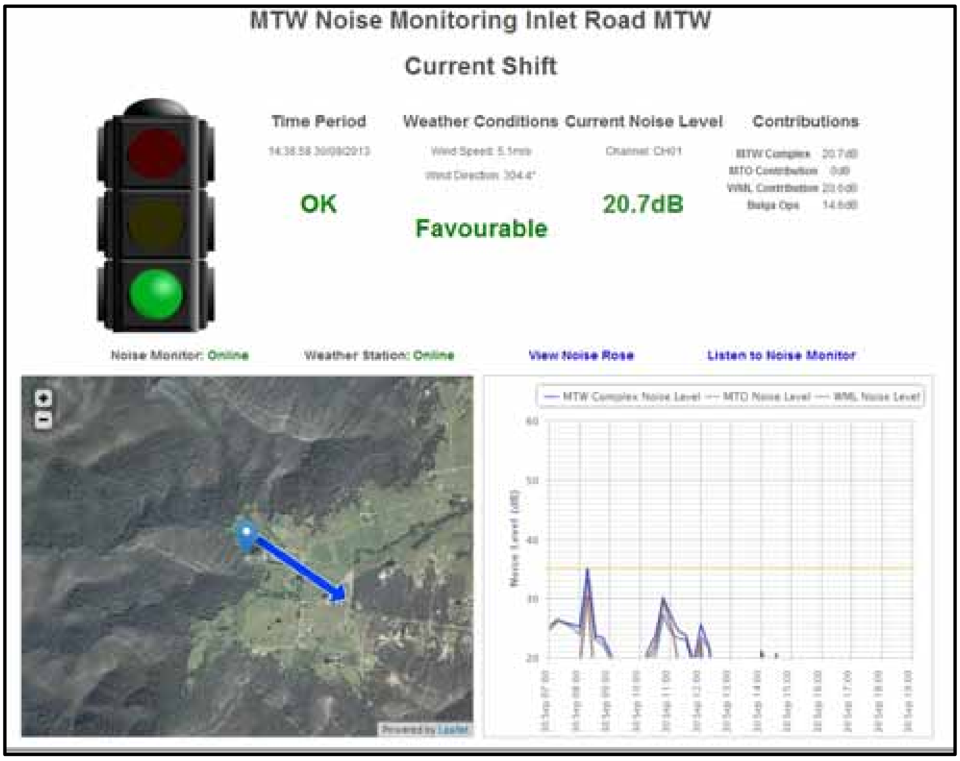


Figure 4.2 Noise management resource – trending noise levels at 'Inlet Road West' monitoring location

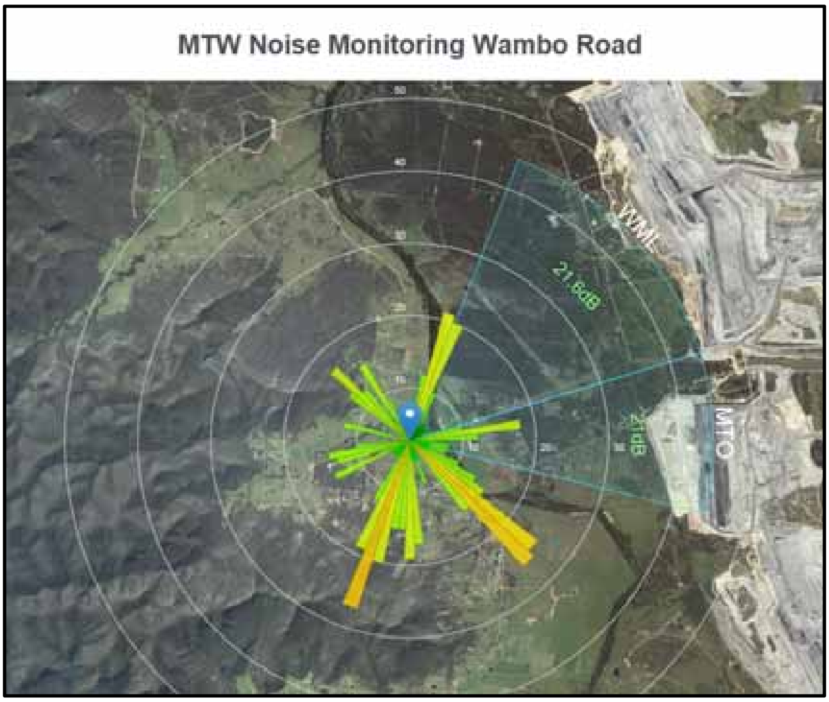


Figure 4.3 Noise rose – a spatial representation of directional noise assessment in real-time

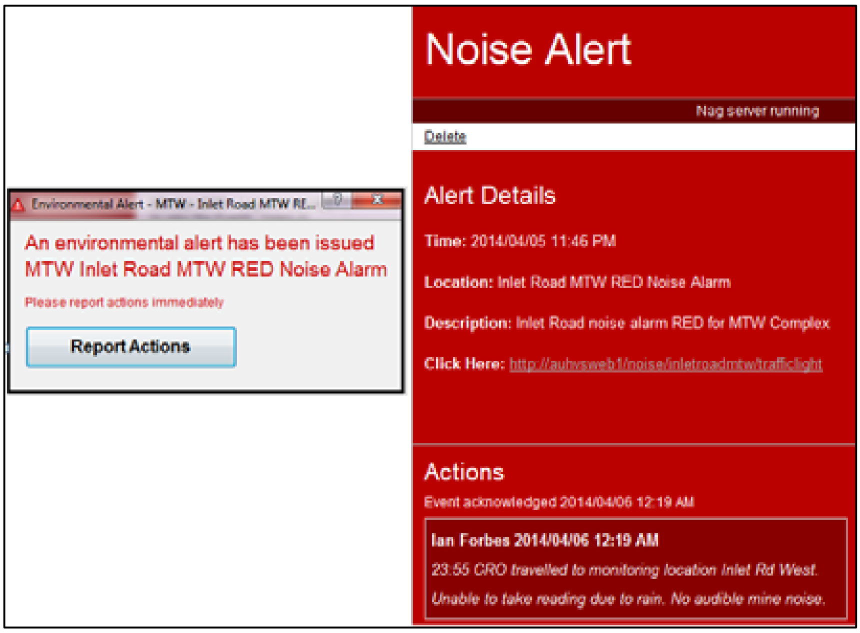
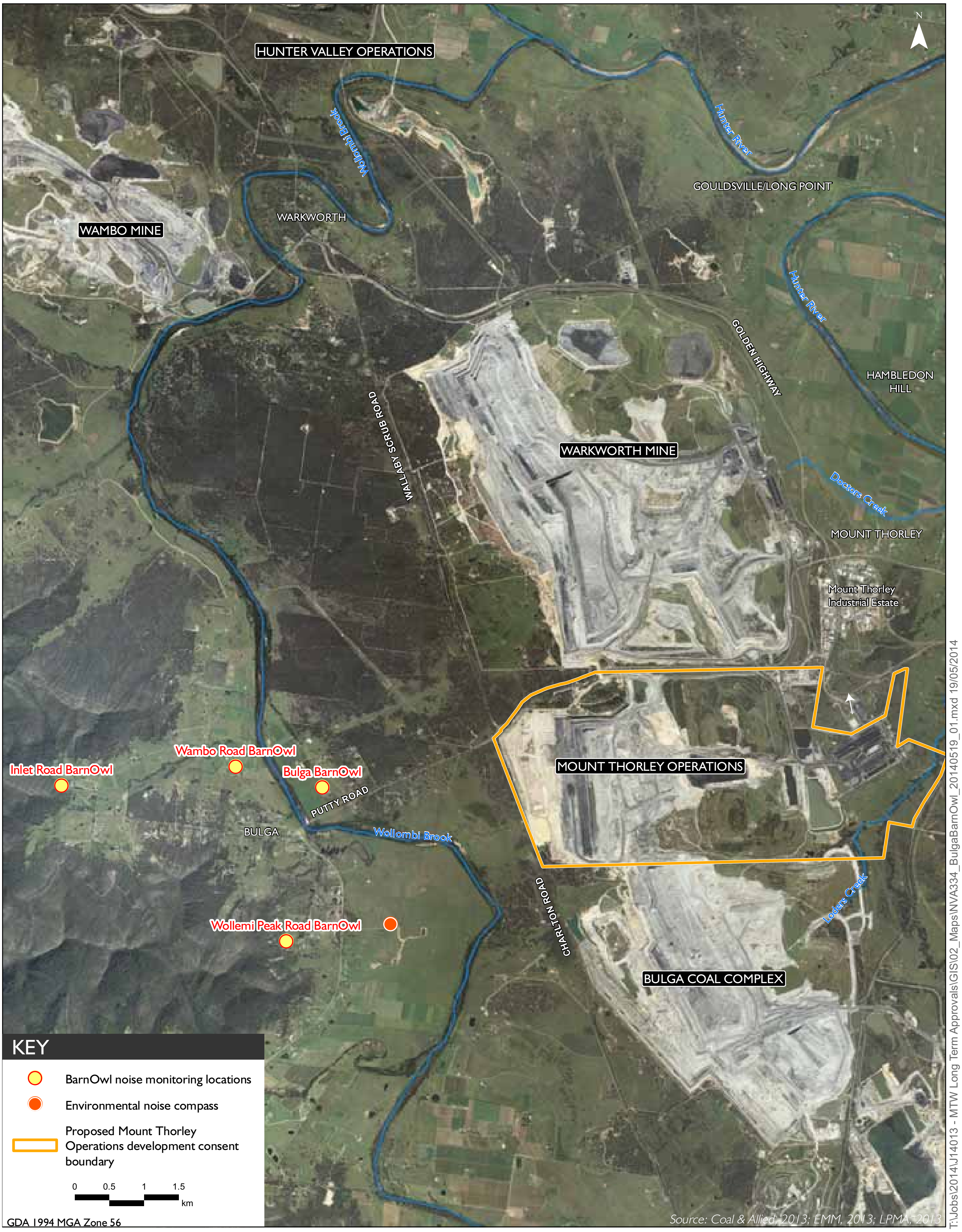


Figure 4.4 'Real-time' noise alarms in action at MTW



Directional real-time noise monitoring locations in the Bulga village community

Mount Thorley Operations

Noise and vibration assessment

Figure 4.5

4.3 Supplementary attended noise monitoring

A programme of targeted supplementary attended noise monitoring is operated at MTW to support the real-time directional monitoring network and ensure the highest level of noise management is maintained. The examples provided in this section generally apply to WML however are directly applicable to MTO given noise management across MTW is integrated. The supplementary programme is undertaken by MTW personnel and involves:

- undertaking routine inspections from both inside and outside the mine boundary;
- routine and as-required handheld noise assessments (undertaken in response to noise alarm and/or community complaint), comparing noise levels against consent noise limits; and
- validation monitoring following operational modifications to assess the adequacy of the modifications.

When a trigger is confirmed (noise levels which are approaching or exceeding the noise criteria in the vicinity of nearby private residences), an appropriate response is implemented to ensure the noise event is resolved within 75 minutes of identification. The response may include substitution of elimination measures, commensurate with the nature and severity of the noise event.

Supplementary noise monitoring undertaken in 2014 has, to-date, resulted in operational modifications (including equipment stoppage and, in some cases complete site shutdown) on numerous nights, resulting in over 8,000 hours of equipment stoppage.

A complete site shutdown (with the exception of dragline operations and some ancillary equipment activity) has been called on several occasions in 2014, in response to elevated noise measurements in the Bulga area. This significant level of operational disruption demonstrates MTW's clear commitment to minimising impacts and maintaining compliant operations.

Table 4.1 details MTW equipment stoppages due to noise year to date, by equipment type.

Table 4.1 MTW equipment stoppages

Equipment type	Equipment delay due to noise management (hours) January – April 2014
Drills	225
Dozers	764
Bladed equipment	41
Loaders	124
Shovels	748
Trucks	6,184

The following case studies are provided to demonstrate the effective implementation of the MTW Noise Management System in recent months.

4.3.1 Night shift 24 February 2014

Fifty-six pieces of equipment were stood down for a total of 181.7 equipment operating hours on the night of 24 February 2014 after elevated noise was detected through supplementary handheld monitoring at the 'Wambo Road' monitoring location. Real-time monitoring data supported the observations of the operator conducting the supplementary assessments. Operational modifications were immediately introduced, with follow-up monitoring undertaken to validate and verify the effectiveness of the modifications. Noise levels were verified as below the trigger limit 65 minutes following detection, compliant with the commitments made in the MTW NMP.

Meteorological conditions on the night assisted noise propagation toward Wambo Road (easterly and south easterly winds), however were such that the consent noise criteria did not apply (average wind speed of 3.8m/sec). Despite this, significant operational modifications were made to ensure noise remained below criteria so as to minimise impacts on surrounding residents. It should be noted that MTW did not receive any community complaints from Wambo Road residents on the night of 24 February 2014. A summary of noise management activities undertaken on the night is shown in Table 4.2.

Table 4.2 Summary of actions implemented on 24 February 2014

Time	Trigger / response / verification	Details
19:40	N/A	Supplementary monitoring undertaken at Wambo Road – noise levels significantly under WML trigger.
21:20	Trigger	Supplementary monitoring undertaken at Wambo Road detects elevated noise from WML.
21:25	Response	Drill 223 and Drill 230 shut down.
21:30	Response	Excavator 393 and supporting equipment shut down.
21:35	Response	Drill 227 shut down.
21:40	Verification	Supplementary monitoring undertaken – noise remains elevated.
21:50	Response	Excavator 313 and supporting equipment shut down.
21:55	Verification	Supplementary monitoring undertaken – noise remains elevated.
22:00	Trigger	Real time noise monitoring data supports supplementary monitoring observations.
22:00	Response	Shovel 344 and supporting equipment shut down.
22:10	Verification	Supplementary monitoring undertaken – noise remains elevated.
22:15	Response	Excavator 310 and supporting equipment, Shovel 345 and supporting equipment shut down.
22:20	Response	Dozer 516 shut down.
22:25	Verification	Supplementary monitoring undertaken confirms controls introduced are effective. Staged restart of some activity commences.
23:10	Verification	Supplementary monitoring undertaken – confirms controls remain effective – additional equipment is returned to service.
23:30	Verification	Supplementary monitoring undertaken – confirms controls remain effective - no further action required.
01:10	Verification	Supplementary monitoring undertaken – confirms controls remain effective - no further action required.
02:00	Verification	Supplementary monitoring undertaken – confirms controls remain effective - no further action required.
03:25	Verification	Supplementary monitoring undertaken – confirms controls remain effective - no further action required.

Figure 4.6 provides a graphic of the noise roses from the Wambo Road monitor for the night of 24 February 2014. Haul truck delays for the same night are displayed in Figure 4.7.

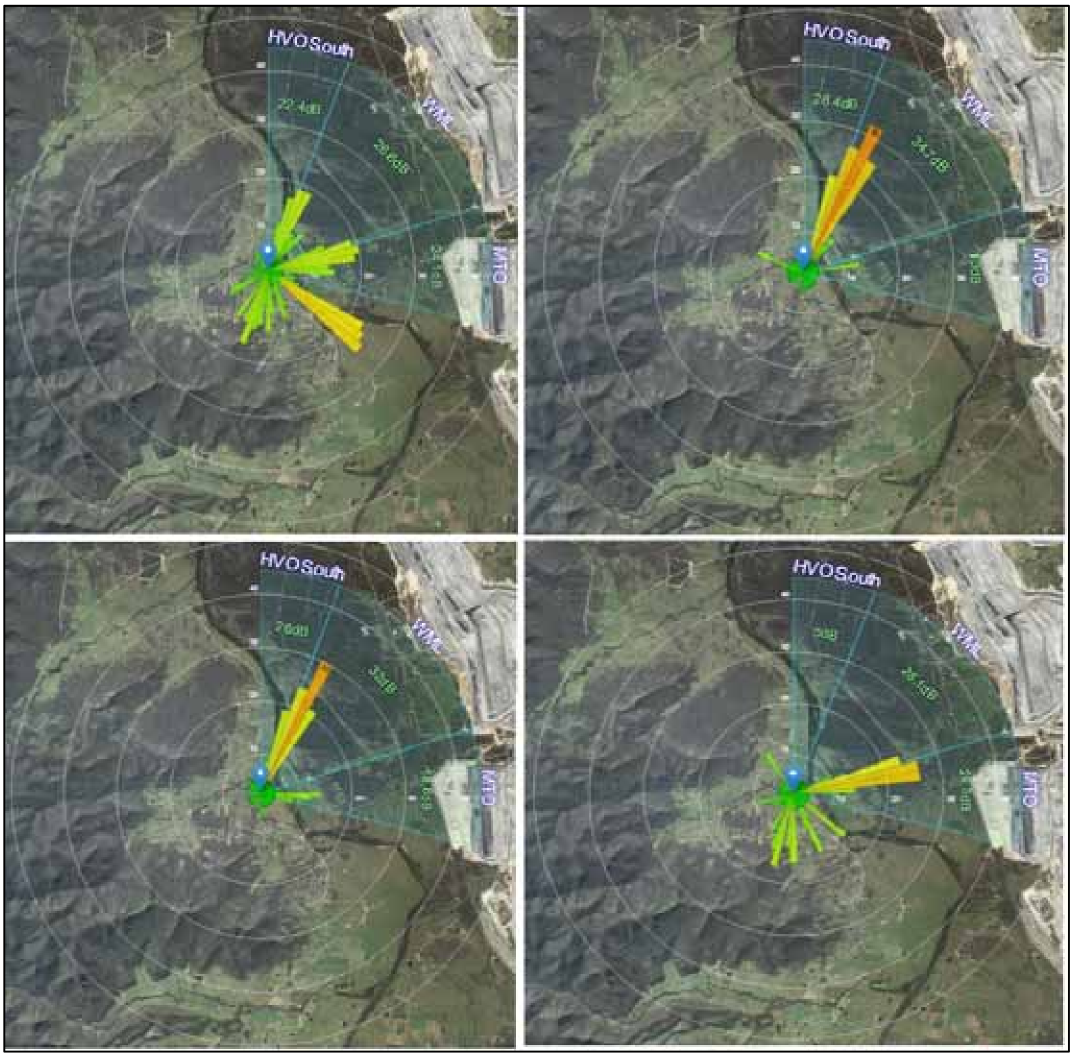


Figure 4.6 **'Noise Rose' graphics from the Wambo Road real-time noise monitor on the night of 24 February 2014. Clockwise from left: 19:40, 21:30, 22:15, 22:50**

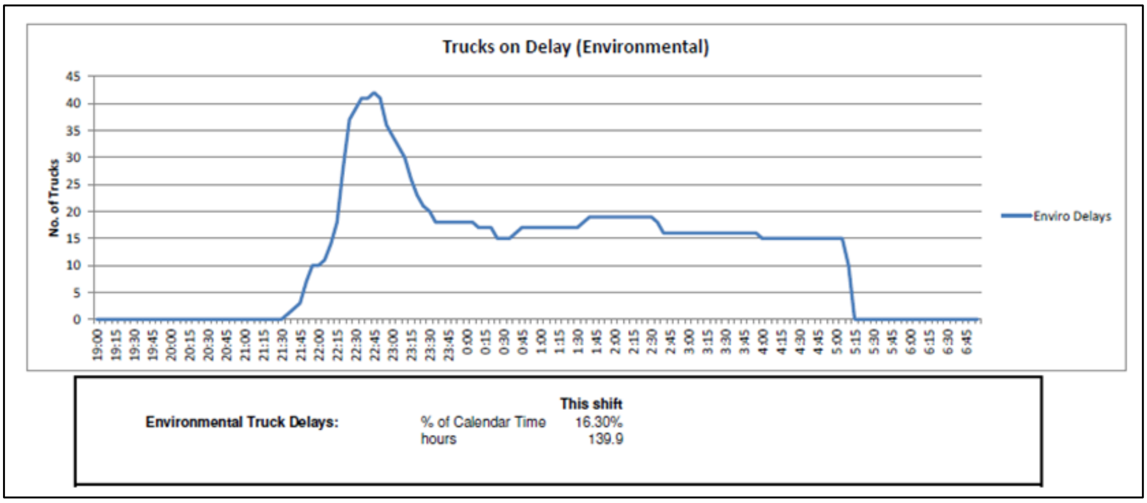


Figure 4.7 Haul truck delays (standby) due to noise on the night of 24 February 2014

4.3.2 Night shift 4 March 2014

Ninety-five pieces of equipment were stood down for a total of 209.6 equipment operating hours on the night of 4 March 2014 after elevated noise was detected through supplementary handheld monitoring at the 'Wollemi Peak Road' monitoring location. Real-time monitoring data supported the observations of the operator conducting the supplementary assessments. Operational modifications were immediately introduced, with follow-up monitoring undertaken to validate and verify the effectiveness of the modifications. Noise levels were verified as below the trigger limit 40 minutes following detection, compliant with the commitments made in the MTW NMP.

Similar to those witnessed on 24 February 2014, meteorological conditions on 4 March were noise enhancing toward Wollemi Peak Road during the period of elevated noise at Wollemi Peak Road (easterly and south-easterly winds). However, again, meteorological conditions were such that the consent noise criteria did not apply (winds >3m/sec for the majority of the period between 8:00pm and 10:00pm). Despite this, significant operational modifications were made to ensure noise remained below criteria so as to minimise impacts on surrounding residents as detailed in Table 4.3.

Table 4.3 Summary of actions implemented on 4 March 2014

Time	Trigger / response / verification	Details
19:40	N/A	Supplementary monitoring undertaken at Wollemi Peak Road – WML noted as inaudible.
20:30	N/A	Supplementary monitoring undertaken at Wollemi Peak Road – WML noted as inaudible.
20:43	Trigger	Complaint received from the Wollemi Peak Road area.
20:55	Trigger	Complaint received from the Wollemi Peak Road area.
21:15	Trigger	Supplementary monitoring undertaken at Wollemi Peak Road detects elevated noise from WML.
21:27	Trigger	Complaint received from the Wollemi Peak Road area.
21:40	Response	Shovel 344 and supporting equipment shut down.
		Excavator 313 and supporting equipment shut down.
21:45	Verification	Supplementary monitoring undertaken at Wollemi Peak Road – noise remains elevated.

Table 4.3 Summary of actions implemented on 4 March 2014

Time	Trigger / response / verification	Details
22:05	Response	Site shutdown (with the exception of Draglines, Drills, and equipment handling reject material on the eastern side of the operation).
22:10	Verification	Supplementary monitoring undertaken at Wollemi Peak Road - confirms controls introduced are effective.
22:30 – 01:20	Verification	Six supplementary monitoring events undertaken at Wollemi Peak Road - confirms controls remain effective.

Figure 4.8 and Figure 4.9 provide noise roses and haul truck delays details respectively.

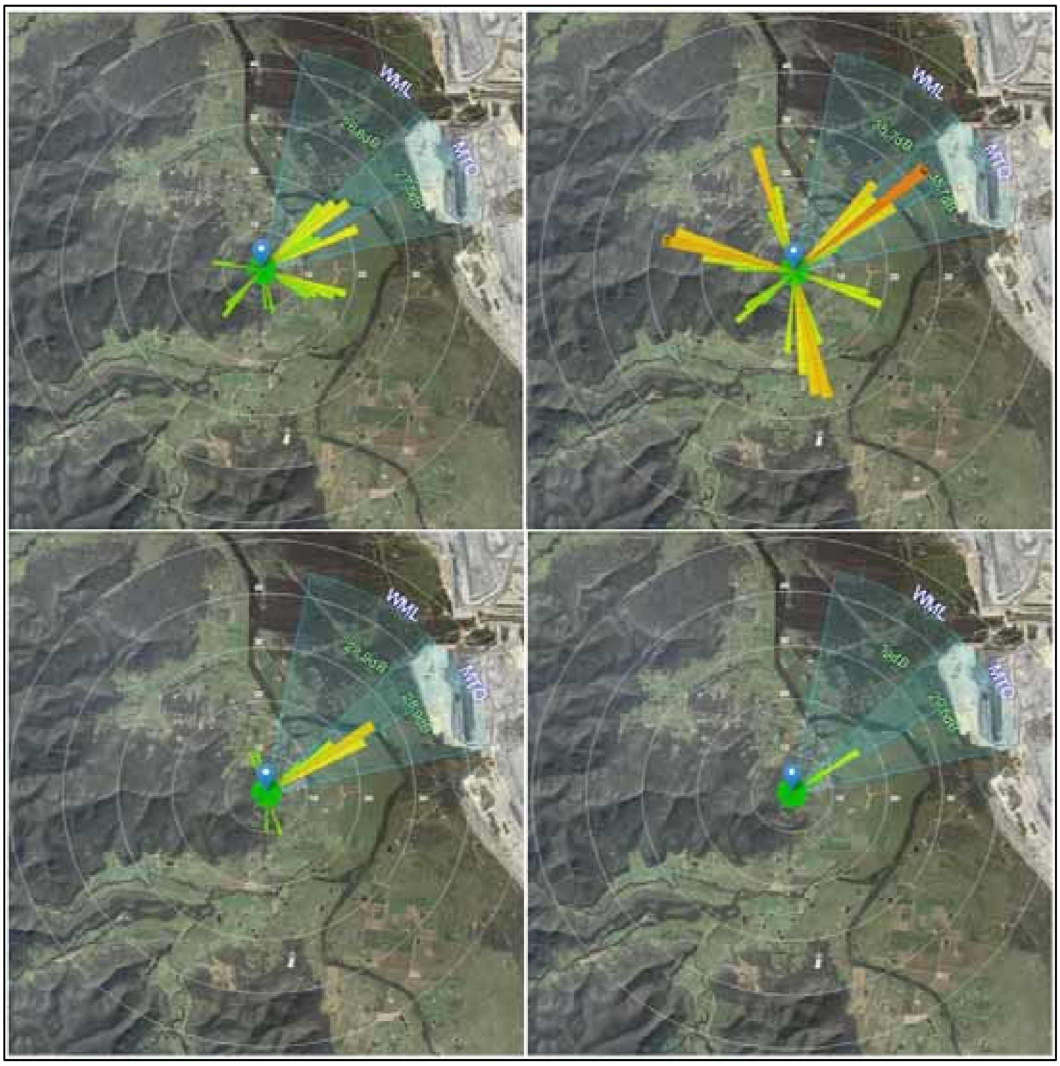


Figure 4.8 'Noise Rose' graphics from the Wollemi Peak Road real-time noise monitor on the night of 4 March 2014. Clockwise from left: 20:00, 21:15, 22:55, 00:50 (5th March)

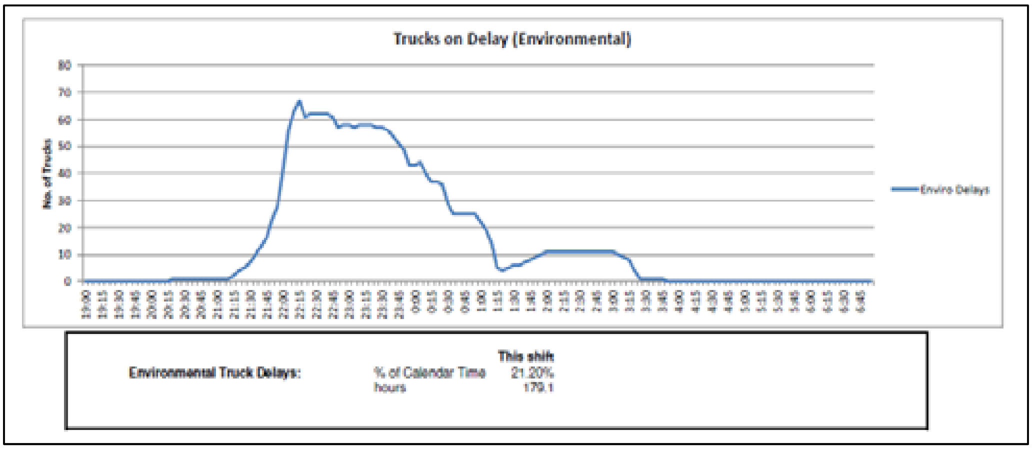


Figure 4.9 Haul truck delays (standby) due to noise on the night of 4 March 2014

4.3.3 Night shift 17 March 2014

Sixty-eight pieces of equipment were stood down for a total of 153.9 equipment operating hours on the night of 17 March 2014 after elevated noise was detected through supplementary handheld monitoring at the 'Wambo Road' monitoring location. Operational modifications were immediately introduced, with follow-up monitoring undertaken to validate and verify the effectiveness of the modifications. Noise levels were verified as below the trigger limit 45 minutes following detection, compliant with the commitments made in the MTW NMP. Real-time noise monitoring data was not available at the time due to a network malfunction.

Meteorological conditions on the night assisted noise propagation toward the Bulga village area (light winds, blowing from the south).

A summary of noise management activities undertaken is presented in Table 4.4.

Table 4.4 Summary of actions implemented on 17 March 2014

Time	Trigger / response / verification	Details
20:30	N/A	Supplementary monitoring undertaken at Wambo Road – WML noted as audible but well below trigger limit.
21:30	N/A	Supplementary monitoring undertaken at Wambo Road – WML noted as audible but well below trigger limit.
22:50	N/A	Supplementary monitoring undertaken at Wambo Road – WML noted as audible but well below trigger limit.
00:10	Trigger	Supplementary monitoring undertaken at Wambo Road detects elevated noise from WML.
00:15	Response	Excavator 312 and supporting equipment shut down.
		Excavator 313 and supporting equipment shut down.
00:25	Verification	Supplementary monitoring undertaken at Wambo Road – noise remains elevated.
00:30	Response	Shovel 344 and supporting equipment shut down.
		Excavator 393 and supporting equipment shut down.
		Front End Loader 649 and supporting equipment shut down.
00:40	Verification	Supplementary monitoring undertaken at Wambo Road – noise remains elevated.

Table 4.4 Summary of actions implemented on 17 March 2014

Time	Trigger / response / verification	Details
00:40	Response	Shovel 345 and supporting equipment shut down.
		Dozer 579 shut down.
00:55	Response	Dozer 518 shut down.
00:55	Verification	Supplementary monitoring undertaken at Wambo Road - confirms controls introduced are effective.
		Dozer 519 shut down.
02:05 – 04:50	Verification	Nine supplementary monitoring events undertaken at Wambo Road – confirms controls remain effective.

Figure 4.10 describes the haul truck delays for the night.

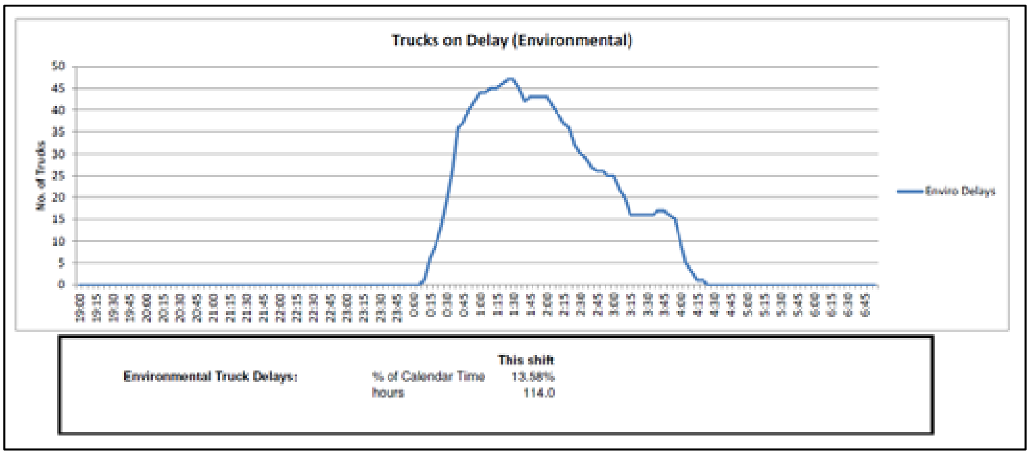


Figure 4.10 Haul truck delays (standby) due to noise on the night of 17 March 2014

5 Continuous improvement - acoustic management

MTW is committed to reasonable and feasible continuous improvement and is currently working towards implementing a predictive modelling interface (PMI) and alternative real-time noise monitoring technology as described below.

5.1 Predictive Modelling Interface

MTW is in the process of developing a PMI which allows for proactive planning of mining operations and weather conditions as a leading measure for managing noise emissions. The PMI utilises predictive meteorological forecast data coupled with detailed mine plans and equipment sound power level information to predict noise levels at residences. The PMI is currently being refined and is expected to be fully integrated into day-to-day operations.

5.2 Development and installation of alternate real-time noise monitoring technologies

MTW is also in the process of investigating alternate noise monitoring technologies to assist with operational control. During 2012 MTW committed capital funding to build and install a first of class directional noise monitor, known as 'environmental noise compass' (ENC) in the Bulga village area. The ENC was installed late December 2013 and is currently collecting data. The ENC aims to accurately pinpoint and identify noise emissions from multiple sources in real-time, to a greater level of accuracy than existing directional noise monitoring technology. This technology is expected to provide additional noise management value to MTW and is considered a first in noise management in NSW. A picture of a typical unit is provided in Figure 5.1.

Figure 5.1 Typical image of the Environmental Noise Compass (ENC)

6 Compliance history

Compliance assessment monitoring for MTO has been undertaken in a number of forms during the period 2004 to 2014 including:

- routine compliance assessment (Global Acoustics) – 2004 to present and in more recent years, monitoring has included low frequency noise assessment;
- Long Point supplementary monitoring program (EMM) – June to October 2011; and
- independent review of noise impacts – Bulga (Sinclair Knight Merz) – December 2011 and January 2012.

An assessment of monitoring data (publically available via the Rio Tinto Coal Australia website www.riotintocoalaustralia.com.au) demonstrates predominant compliance with noise criteria has been achieved throughout the life of the mine.

7 Properties surrounding the mine

A total of 221 privately owned residential locations were identified within proximity of the mine that will be potentially exposed to noise from the proposal. These assessment locations are listed in Appendix A and illustrated in Figures 7.1 and 7.2. The locations are numbered in accordance with the numbering system adopted in the EIS which is consistent with all supporting technical studies of the proposal. It should be noted that mine owned properties are not included in this list. The INP (page 58) defines a receiver as:

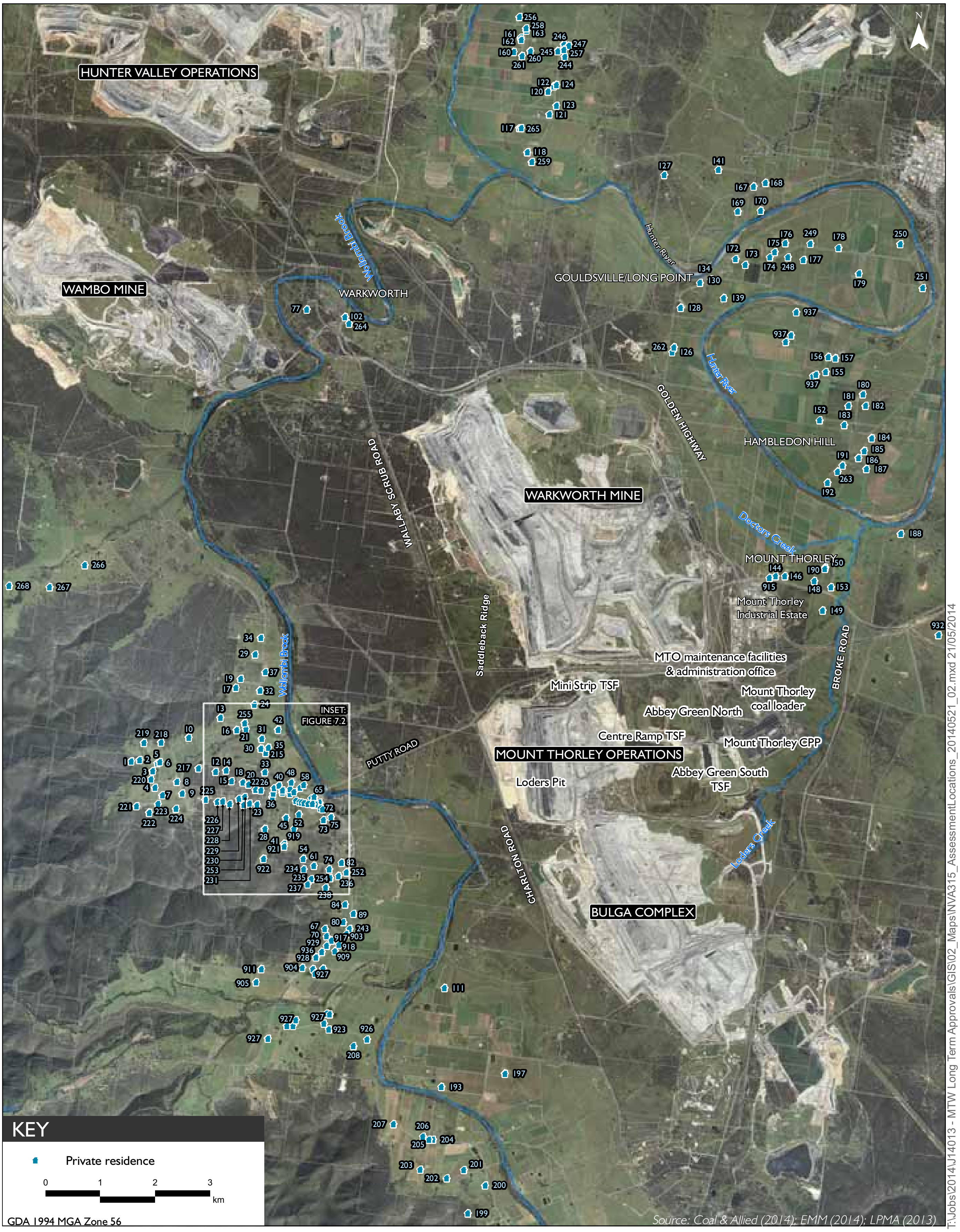
> *"The noise sensitive land use at which noise from a development can be heard."*

Such mine owned properties can be vacant or tenanted with mine staff or persons that have agreements with the mines relating to noise amenity or other emissions. Mine owned residential properties therefore are not considered 'noise sensitive' as defined in the INP. Further, the INP states:

> *"It will be used as a guide by Environment Protection Authority (EPA) officers for setting statutory limits in licences...."*

Such statutory limits have not in the past been set on non-private dwellings/properties by EPA or by NSW DP&E.

The locations of residences were identified by the applicant using land ownership registrations, aerial photographical images and, where possible, verification in the field limited to publicly accessible locations. It may be possible due to limitations of the mapping process that some properties have been missed or others incorrectly identified as a residence when they are in fact a non-residing building on a privately owned lot (eg shed). Notwithstanding the assessment locations identified are considered representative of all residential locations and catchments surrounding the Site.



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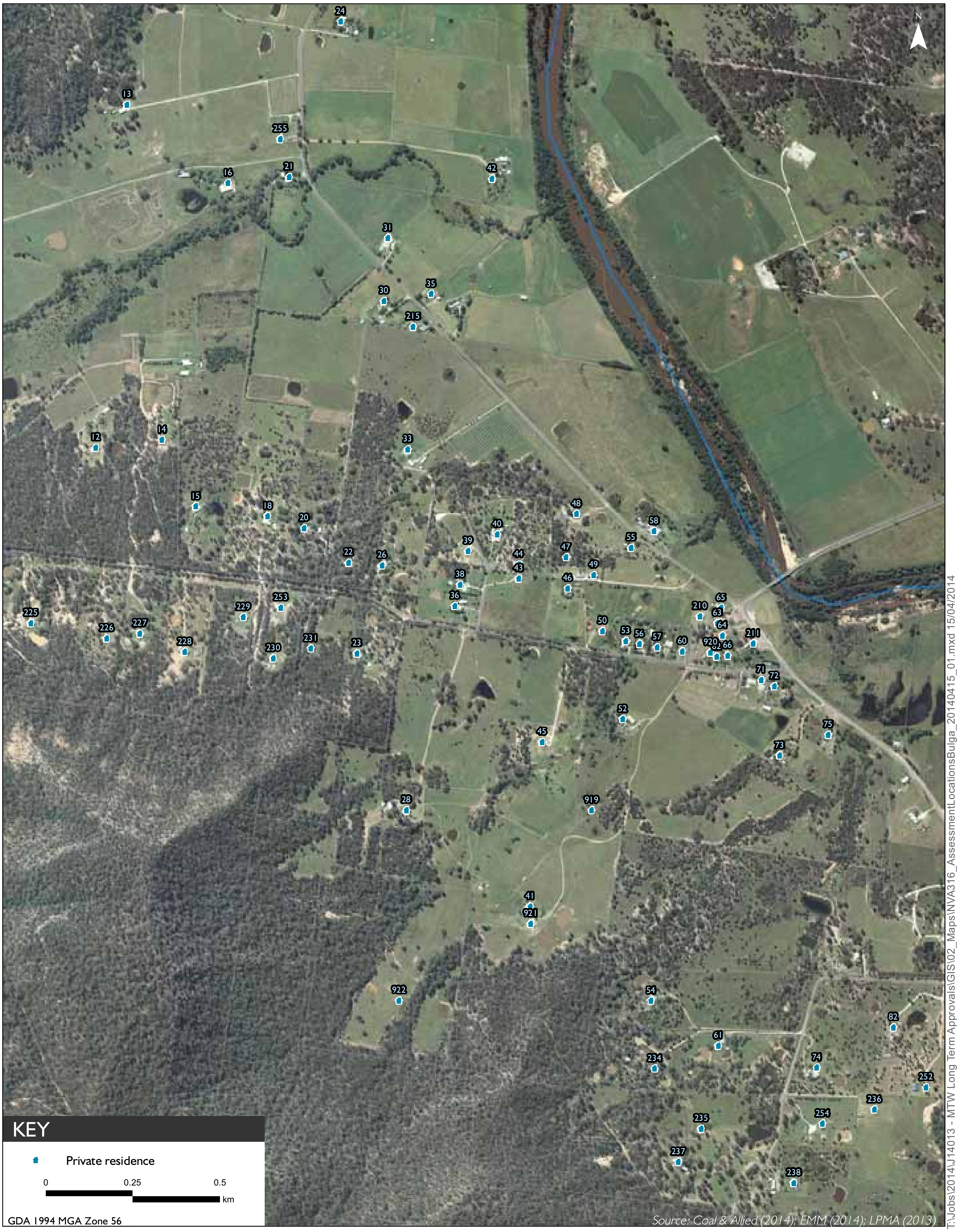
Assessment locations

Mount Thorley Operations

Noise and vibration assessment

Figure 7.1



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Assessment locations - Bulga

Mount Thorley Operations

Noise and vibration assessment

Figure 7.2

8 Existing acoustic environment

8.1 Bulga background noise review

An extensive data gathering and analysis process was completed using six real time noise monitors in Bulga. The purpose of the monitoring was to quantify the background noise level for which the INP intrusiveness criteria should be set. For an impact assessment, the INP requires the assessment of noise levels that exclude influence on derived representative background noise levels from the Site's existing operations. However, noise from other existing mines in the area are included in the background analysis as per the INP.

This was made possible by the use of noise loggers with directional filtering functionality, and for all locations the BarnOwl logger from SoundScience was used. The BarnOwl's directional L_{eq} data was used to filter influences on the total L_{90} (or background noise metric). That is, L_{eq} noise (of 34 dB(A) or greater) from the direction of MTO that could inflate total L_{90} to levels above 30 dB(A) (the INP's minimum threshold value) were removed from analysis.

The results of the long term background noise monitoring are summarised as rating background levels (RBLs in accordance with the INP) in Table 8.1 for all six locations A to F (refer to Figure 8.1). The data used in the exercise was collected between November 2012 and August 2013. RBLs are shown for day, evening and night assessment period as required by the INP. The assessment background levels (ABLs) determined in accordance with the INP that were used to derive the RBL data is provided in Appendix E. The quantity of data collected for the background noise survey is substantially greater than the INP's required minimum of seven days and, therefore, provides a much more comprehensive representation of the repeatable RBL value at each location.

Table 8.1 Representative background noise levels for Bulga (RBL as per INP)

Location	Period (Duration)	RBL, dB(A)		
		Day	Evening	Night
A. Wollemi Peak Rd	20/06/13 - 14/08/13 (3 months)	33	33	34
B. 367 Wambo Rd	01/12/11 - 29/11/12 (11 months)	30	33	34
C. 128 Wambo Rd	29/11/12 - 31/07/13 (8 months)	33	37	33
D. 193 Inlet Rd	01/12/11 - 28/05/12 (6 months)	30	32	31
E. 339 Inlet Rd	18/03/13 - 30/06/13 (3.5 months)	30	30	30
F. Scout Hall (Putty Rd)	01/12/11 - 04/09/12 (10 months)	33	37	36

Notes: 1. Location E data show RBLs at or below the INP minimum of 30 dB(A)) for some assessment periods, and hence 30 dB(A) was adopted as per the INP across all three assessment periods.

2. The RBL is as defined in the INP, ie the median value of all ABLs. The ABL is also as per the INP, ie the lower 10^{th} percentile of L_{90} values.

Table 8.1 demonstrates relatively higher background noise at locations A, C and F. These locations are in relatively more exposed locations to the mines, Putty Road or the centre of Bulga than the other three locations (refer to Figure 8.1).

An analysis of the RBLs was completed for unfiltered data (ie whereby MTO source direction was included) and it was found that RBL values are 1 dB to 3 dB higher at most locations for certain periods. For example, at the three locations exhibiting RBLs higher than the INP minimum of 30 dB(A), the unfiltered data shows the following RBLs:

- A. Wollemi Peak Rd - 34 dB(A) day and 35 dB(A) evening and night. That is, 1 dB, 2 dB and 1 dB higher for the day, evening and night respectively;

- C. 128 Wambo Rd - 33 dB(A) day, 37 dB(A) evening and 36 dB(A) night. That is, 3 dB higher at night; and

- F. Scout Hall (Putty Rd) - 33 dB(A) day, 37 dB(A) evening and 35 dB(A) night. That is, 1 dB lower during the night.

The RBL data shows background noise levels are marginally higher during the evening or night at some locations as compared to their corresponding daytime values. This is likely a result of enhancement of neighbouring mine noise from influences of weather conditions. This is shown at five of the six locations monitored and therefore strongly supports a proposition that weather enhanced mine noise is likely during times when temperature inversion conditions exist for example. This should be taken into consideration when reviewing the impact assessment of the proposal.

Notwithstanding higher background noise levels during the evening and night as compared to the daytime, the INP's application notes have been conservatively adopted to determine the final RBL for the six locations as follows:

- A. Wollemi Peak Rd 33 dB(A) day, evening and night;
- B. 367 Wambo Rd 30 dB(A) day, evening and night;
- C. 128 Wambo Rd 33 dB(A) day, evening and night;
- D. 193 Inlet Rd 30 dB(A) day, evening and night;
- E. 339 Inlet Rd 30 dB(A) day, evening and night; and
- F. Scout Hall (Putty Rd) 33 dB(A) day, evening and night.

As shown above, three of the locations (B, D and E) have the INP's minimum threshold background value of 30 dB(A). These locations are relatively more removed from industrial sources (the mines), local road traffic and are further away from the central part of Bulga village, as compared to the other three locations.

The three locations where an RBL of 33 dB(A) is found, is consistent with the data in the Environmental Impact Statement for the Extension of Warkworth Coal Mine (August 2002) (Warkworth EIS 2002) for location N6 in that document, being the central area of Bulga village. Location F herein aligns approximately with location N6 in the 2002 study. Similarly, location N5 in the 2002 study aligns approximately with location B herein and represent the northern parts of Bulga on Wambo Road. These two sites demonstrate a consistent background noise level of 30 dB(A) in both studies.

As shown in Figure 8.1, the six locations are well dispersed across the Bulga area and therefore provide representative data for all residences in the area. Hence, this data was adopted for all Bulga residences based on a specific property's proximity to influencing noise sources in the environment (eg the mines to the east, Putty Road and the central part of Bulga village) as compared with one of the six monitoring locations' proximity to these sources.

The background noise levels assigned to each assessment location are illustrated in Figures 8.2 and 8.3. Where assessment locations are not in proximity to a noise logger and no data exists, the INP minimum of 30 dB(A) is conservatively assumed.

Also, given the differences in calculated RBL at locations D and F at Bulga, a transition of the RBL was developed along this orientation east to west. On the basis that mine noise was one of the main influences on background noise in the area, the transition was developed from demonstrated changes in predicted noise levels for MTO and Bulga mines (as published in their most recent assessments).

This interpolation of the RBL results in a relatively smoother transition in RBL values across this area and more fairly assigns corresponding criteria to adjoining neighbours. This approach minimises the situation often found where one property has a marked step increase in RBL and therefore criteria than their immediate neighbour, or in other words the problematic 'line-in-the-sand' delineation of criteria which often results in different zones of impact (eg one property is assigned treatment while their neighbour is not).

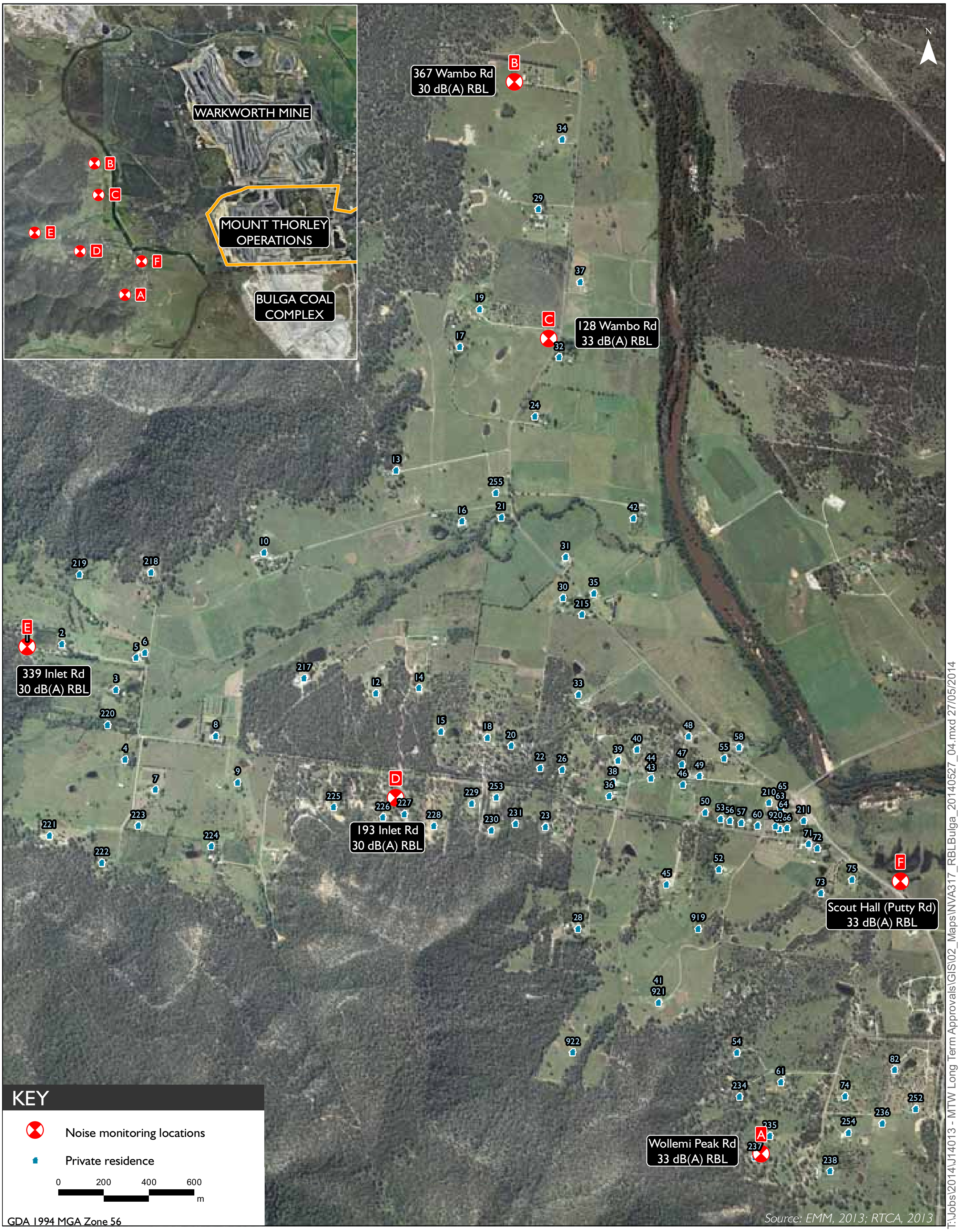
8.2 Background noise levels at other localities

The historic data contained in the Warkworth EIS, 2002 includes RBL data as per the INP for Hambledon Hill, Gouldsville, Long Point Road and Warkworth village. The corresponding RBL values for these locations are as follows:

- Hambledon Hill (east of WML) 30 dB(A) day, evening and night;
- Gouldsville Road (north east of WML) 33 dB(A) day, evening and night;
- Long Point Road (further north east of WML) 30 dB(A) day, evening and night; and
- Warkworth village (north west of WML) 33 dB(A) day, evening and night.

For residences of Maison Dieu to the north of MTO and Warkworth Mine, in the absence of suitable long term monitoring data, background noise levels consistent with the INP's minimum threshold value of 30 dB(A) has been conservatively adopted. It is probable that background noise levels are higher due to Hunter Valley Operations South mine and other industry to the north of these residences.

The other group of residences considered are those located in relative proximity to the Mount Thorley Industrial area to the south east of Warkworth Mine. Background or RBL data at these locations is not documented in any literature in the public domain. It is expected that these properties would be influenced by industrial noise from the nearby industrial estate, including the Mount Thorley coal loader and associated rail operations, as well as MTO. Further, some properties in this vicinity do not have operational noise limits in either Warkworth Mine or MTO's development consent. They do, however, have existing acquisition rights due to impacts from the mines. These are locations 144, 146 and 915 (915 is on the same lot as 144 and hence the same acquisition limit is adopted). Furthermore, existing acquisition consent noise limits for these properties differ for Warkworth Mine and MTO. For example, the Warkworth Mine development consent includes an acquisition limit of 44dB(A) for assessment location 144 while the MTO development consent modified in 2012 places location 144 in an 'acquisition on request' list. Hence, RBL values were not assigned to these locations and an assessment is completed against acquisition limits. Those properties in this area that do not have acquisition rights will be assessed conservatively as having the INP's minimum threshold RBL of 30 dB(A) for day, evening and night.



Long-term background noise monitoring locations in Bulga

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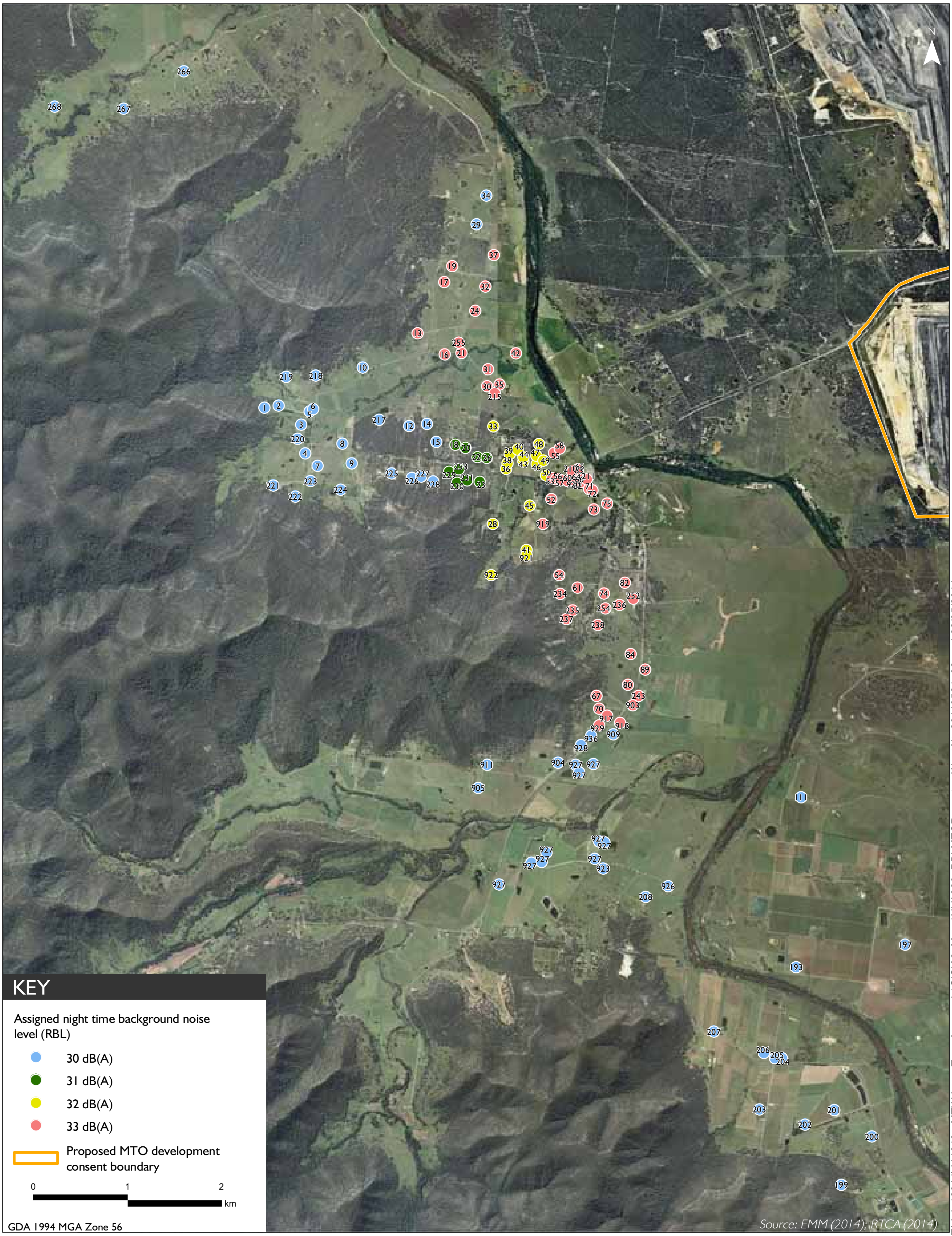
Noise and vibration assessment

Figure 8.1

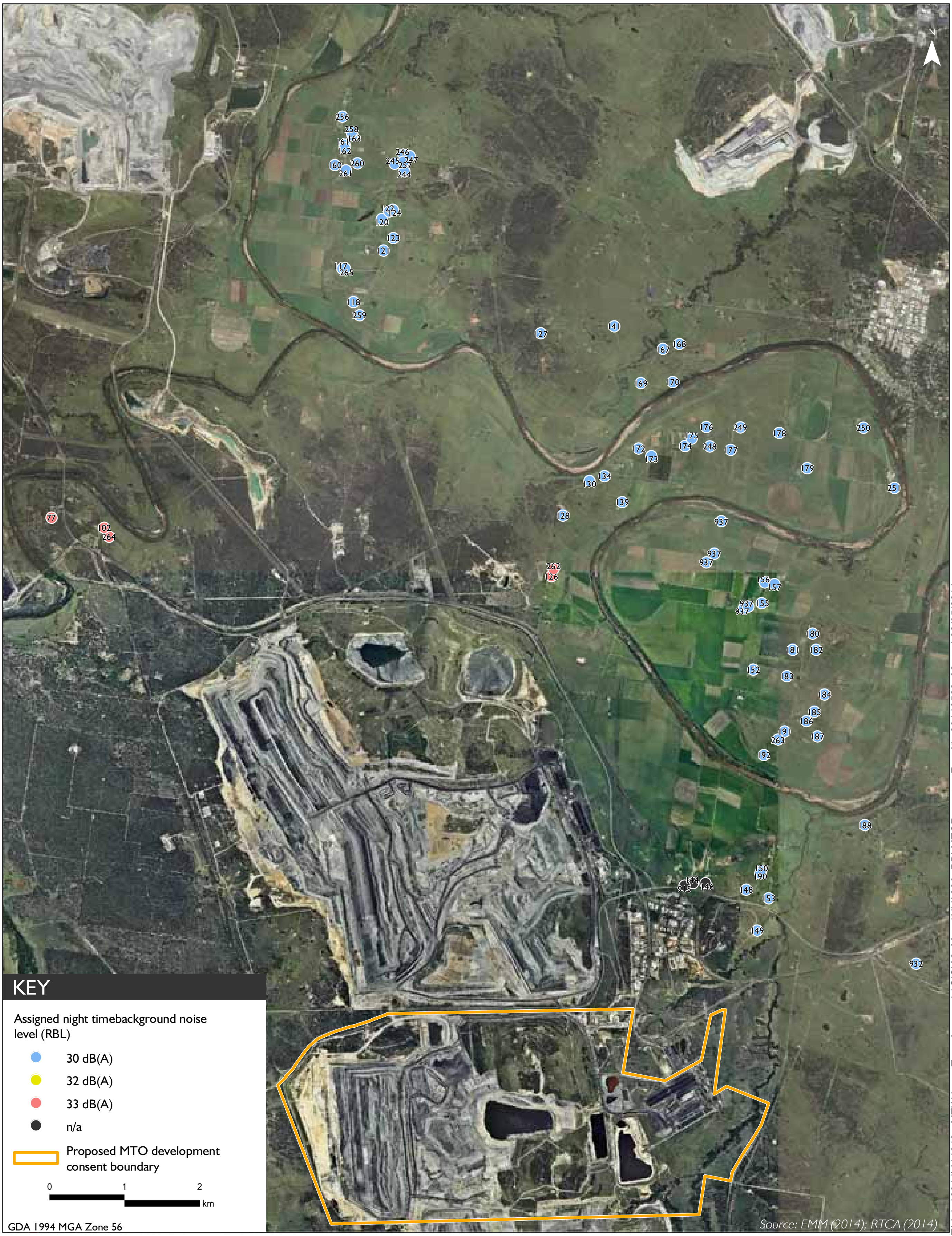


Assigned night time background noise levels - Western and southern assessment locations

Mount Thorley Operations

Noise and vibration assessment

Figure 8.2



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Assigned night time background noise levels - Eastern and northern assessment locations

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Noise and vibration assessment

Figure 8.3

8.3 Local weather patterns

A review was completed of meteorological data from the applicant's Automatic Weather Station (AWS) located at Charlton Ridge. The data was used in determining the above RBL values in accordance with the INP. The data was also statistically analysed to determine seasonal prevailing winds and any correlations with seasonal RBL values. These are noted in Table 8.2 and when reviewed alongside RBL data for example (as provided in Appendix E), the following trends are observed:

- Location A - The monitoring data available at the time was collected during the three winter months in 2013. During winter the winds are predominantly westerly, and therefore the data is considered to be less affected by mine noise than other times in the year. The winter period is also less likely to be affected by wildlife noise (eg insects).

- Location B - There are 11 months of data for this location and hence the long term analysis provides an assessment across all seasons. It is apparent that summer months are influenced by insect noise as evident from the relative flatness and converging L_{90} and L_{eq} levels. The convergence of these noise metrics continues into autumn (eg March 2012), particularly during the night period. The data exhibited a noticeable increase in RBLs for the evening and night periods compared to daytime periods for the warmer months in the year.

- Location C - There is eight months of data analysed for this location, including summer, autumn and most of winter. The RBL values for January, February and March are relatively elevated as compared to other months. The data exhibited a noticeable increase in RBLs for the evening periods for the warmer months in the year. This was likely to be caused by insects and the like based on the relative flatness in the data during the summer months.

- Location D - As for other locations, it is probable that summer months present relatively elevated RBLs as compared to other seasons.

- Location E - Data was recorded during autumn and winter months where prevailing winds were predominantly westerly and hence likely to have kept mine noise at lower levels, resulting in the presented RBLs of 30 dB(A).

- Location F - The data exhibited a noticeable increase in RBLs for the evening and night periods for the warmer months in the year. The influences of seasonal weather and insects provide for a strong justification to assign representative RBLs for each site and period. However this was not the adopted approach and a conservative RBL adopted across all periods.

Table 8.2 Seasonal wind analysis

Season	Month	Comment on predominant winds
Summer	December	Predominantly easterly winds for D, E, N
	January	Predominantly easterly winds for D, E, N
	February	Predominantly easterly winds for D, E, N
Autumn	March	Predominantly easterly winds for D, E, N
	April	Drop in % of easterly winds; 55 % instead of >70%
	May	Westerly winds almost 50% of the time
Winter	June	Westerly winds >50% of the time
	July	Westerly winds >50% of the time
	August	Westerly winds nearly 80% of the time

Table 8.2 Seasonal wind analysis

Season	Month	Comment on predominant winds
Spring	September	Westerly winds almost 50% the time
	October	Increase in % of easterly winds ; nearly 50% on average; 70% in evening
	November	Increase in % of easterly winds ; nearly 50% on average; 88% in evening and 75% at night

Notes: D = Day, E = Evening, N = Night

9 Noise and vibration criteria

9.1 NSW Industrial Noise Policy

The overall aim of the NSW INP is to allow the need for industrial activity to be balanced with the desire for quiet in the community. One of its specific objectives is to establish noise criteria to protect the community from excessive intrusive noise and preserve amenity for specific land uses.

The INP discusses that within the community, there is a very large range of human reaction to noise, including those who are very sensitive to noise. This noise-sensitive sector of the population will react to intruding noises that are barely audible within the overall noise environment, or will have an expectation of very low environmental noise levels. On the other hand, there are those within the community who find living in noisy environments, such as near major industry, on main roads or under aircraft flight paths, an acceptable situation. The bulk of the population lies within these two spectrums, being unaffected by low levels of noise and being prepared to accept levels of noise commensurate with their surroundings.

The criteria in the INP have been selected to protect at least 90% of the population living in the vicinity of industrial noise sources from the adverse effects of noise for at least 90% of the time (refer Section 1.4.1 of the INP "Principles underpinning the noise criteria"). Provided the criteria in the INP are achieved, then it is unlikely that most people would consider the resultant noise levels excessive.

The INP sets two separate noise criteria to meet environmental noise objectives: one to account for intrusive noise and the other to protect the amenity of particular land uses. The intrusiveness of an industrial noise source may generally be considered acceptable if the equivalent continuous (energy-average) A-weighted level of noise from the source (represented by the L_{Aeq} descriptor), measured over a 15-minute period, does not exceed the background noise level measured in the absence of the source by more than 5 dB. The INP requires intrusive noise criterion to be measured over a 15 minute period.

The 15-minute period used for the intrusive noise criterion has been selected as a reasonable estimate of the period over which annoyance may occur. This time period has been used by the EPA for at least the past 14 years when the INP has been in force, and experience has shown that it is a reasonable approach to assessing intrusive noise impacts. Whereas the amenity criterion is measured over a longer time period (ie an entire 11-hour daytime, 4-hour evening or 9-hour night period) and aims to limit cumulative continuing increases in the ambient noise level within an area from industrial noise sources. In assessing the noise impact of industrial sources, both components must be taken into account for residential assessment locations, but, in most cases, only one will become the limiting criterion and form the project-specific noise levels (PSNL) for the industrial source.

9.1.1 Intrusiveness criterion

The intrusiveness criteria are derived in accordance with the INP (ie background plus 5 dB) and are listed in Table 9.3. As will be described later, these become the limiting or PSNL for the proposal.

9.1.2 Amenity criteria

The INP uses the amenity criteria to limit continuing increases in noise levels. It states "Meeting the acceptable noise levels in Table 2.1 will protect against noise impacts such as speech interference, community annoyance and, to some extent, sleep disturbance. These levels represent current best practice for assessing industrial noise sources, based on research and a review of assessment practices used overseas and within Australia."

Most residences in surrounding areas potentially affected by this proposal would be categorised as rural or suburban according to the INP. However, two areas are considered as Urban/Industrial interface. The residential categories as defined in the INP are as follows:

Rural area

> "an acoustical environment that is dominated by natural sounds, having little or no road traffic..*";*

Suburban area

> "an area that has local traffic with characteristically intermittent traffic flows or with some limited commerce or industry";

Urban area

- dominated by 'urban hum' or industrial source noise;
- has through traffic with characteristically heavy and continuous traffic flows during peak periods;
- is near commercial districts or industrial districts;
- has any combination of the above, where 'urban hum' means the aggregate sound of many unidentifiable, mostly traffic-related sound sources; and

Urban/Industrial

> "an area defined as for 'urban' above that is in close proximity to industrial premises and that extends out to a point where the existing industrial noise from the source has fallen by 5 dB. Beyond this region the amenity criteria for the 'urban' category applies. This category may be used only for existing situations".

In the above context, the centre of Bulga is a 'suburban' area while most other assessment locations considered in this assessment reside in 'rural' areas. For this study, categorising residences as rural or suburban is inconsequential since the limiting night time amenity criterion is identical for both categories. Outside of the INP, it is acknowledged that feedback from Bulga residences describe their area as rural rather than suburban.

A relatively small number of residences adjoin the Mount Thorley industrial area and hence their amenity category is better described as urban/industrial interface according to the INP's definition. Similarly, the remaining two residences in Warkworth village are exposed to relatively high industrial noise from Wambo Mine as will be demonstrated in the cumulative assessment later in this report. These two residential areas are therefore assessed as Urban/Industrial interface.

The amenity criterion for each of these categories is given in Table 9.1 (as per Table 2.1 of the INP).

One fundamental difference between the intrusiveness and amenity criteria is that the former is applicable over 15 minutes in any period, while the latter is assessed over the entire duration of the day (7 am – 6 pm), evening (6 pm – 10 pm) or night (10 pm – 7 am) periods.

Table 9.1 EPA residential amenity criteria

Indicative noise amenity area(Residence)	Time of day	Recommended L_{Aeq} noise level, dB(A)	
		Acceptable	Maximum
Rural	Day	50	55
	Evening	45	50
	Night	40	45
Suburban	Day	55	60
	Evening	45	50
	Night	40	45
Urban	Day	60	65
	Evening	50	55
Urban/Industrial interface	Night	45	50
	Day	65	70
	Evening	55	60
	Night	50	55

The INP approach to derivation of amenity noise levels is directly applicable for proposed developments, new to an area with an existing level of industrial noise. Section 2.2.4 of the INP (Assessment in developing areas) clarifies that the acceptable amenity noise levels represent the ideal total level of noise from industry that should be met by a proposed development and any future developments. This section advocates where several developments are proposed, these are to be assessed as a group. It states:

> *"This holistic approach allows project-specific noise levels to be set for a proposed industrial development, so that the total impact from all proposed and potential industrial developments does not cause amenity to deteriorate. In addition, this approach provides an equitable distribution in the burden of meeting the noise criteria."*

As the proposal relates to an existing site that has been present as long or longer than other mines in the area, it is not equitable to assume MTO does not exist (ie and therefore a proposed project) while at the same time assuming other mines do exist. The appropriate method is to adopt a holistic approach as advocated by the INP, particularly given it is highly unlikely that any further developments will contribute to cumulative noise given geographic physical limitations.

The objective of the INP's holistic approach to amenity noise is to satisfy the recommended acceptable noise levels. The strictest of these is the night time acceptable amenity criterion of 40 dB(A), which has been adopted in this assessment for most residences and from all industrial noise sources as per the INP. This is a practical approach in the current situation given the reasons above but also because the neighbouring industrial sites (Warkworth Mine and Bulga Coal Complex) are changing their noise contribution in the area as described in respective environmental assessments. The other instrument that supports this holistic approach is the non-discretionary Mining SEPP described in Section 9.2.

In deriving the amenity target for MTO, the INP does not support and it is not appropriate to ignore MTO's current contribution to the total existing industrial noise levels of the area.

Nonetheless to illustrate the holistic method's appropriateness, we considered several example assessment locations in Bulga to demonstrate whether the intrusive or amenity criteria is the more limiting when ignoring the presence of the existing MTO operations. Table 9.2 demonstrates that all example assessment locations adopt the intrusiveness criteria as the limiting criteria. In one case (location 58) the two criteria have the same target level, but the intrusive value is the more limiting metric.

Table 9.2 EPA residential amenity versus intrusiveness criteria test cases

Assessment location (Area)	Existing Industrial noise[1]	Amenity Criteria			Intrusiveness criteria
	$L_{eq,9hr}$, dB(A)	ANL $L_{eq,9hr}$, dB(A)	Difference, dB(A)	Adjusted criteria $L_{eq,9hr}$, dB(A)	$L_{eq,9hr}$, dB(A)
15 (Bulga)	35	40	5	38	35
26 (Bulga)	36	40	4	38	36
44 (Bulga)	36	40	4	38	37
58 (Bulga)	36	40	4	38	38
77 (Warkworth village)	57	50	-7	40	35
128 (Gouldsville)	37	40	3	40	35
146 (Mount Thorley)	38	50	12	50	N/A
150 (Mount Thorley)	34	40	6	39	35

Notes: 1. In deriving 'existing' noise levels from WML and Bulga mine, the latest noise assessment were adopted. This provides a more realistic quantification of the cumulative impacts when the proposal coincides with neighbouring contributions, which are changing on those of current levels. Existing Wambo mine noise adopted from 2003 EIS. Where locations do not match those listed, the closest neighbouring location was used. HVOS results obtained from the 2003 EIS. An industry accepted approximation between $L_{eq,15min}$ and $L_{eq,9hr}$ of 3dB was adopted.

Assessment location 58

- existing industrial noise level is 36 dB(A) (ignoring the whole of WML and made up of adverse weather results for Bulga mine and MTO as modelled in early years in recent publications as described in the cumulative noise assessment section later in this report);
- the night amenity criteria is derived from Table 2.2 of the INP as 38dB(A)$L_{eq,9hour}$ (or acceptable level 40 dB(A) minus 2 dB);
- the night time intrusiveness criterion for this location is 38 dB(A)$L_{eq,15minute}$; and
- As an $L_{eq,9hour}$ metric, the 38 dB(A) amenity criterion is less stringent than a 38 dB(A) $L_{eq,15minute}$ intrusiveness metric and this would apply across assessment locations of Bulga generally. Since intrusiveness criteria for Bulga residences are 38 dB(A) $L_{eq,15minute}$ or lower, the intrusiveness criteria will be more limiting than amenity criteria.

9.1.3 Summary of criteria approach

Irrespective of the RBL values assigned to specific assessment locations, the amenity criteria sets a noise 'ceiling' for all industrial sites to stop 'noise creep'. This is illustrated in Figure 9.1 using the night time amenity criterion of 40 dB(A)$L_{eq,9hour}$. This is an example only, but shows as each mine comes into existence (Mine 1 to Mine 3 in that order) it is possible that RBL values step up each time as does the corresponding intrusive criteria for each mine. However, this creep effect is at some point stopped by the amenity criteria ceiling as shown because the INP requires that both the intrusiveness and amenity criteria are met.

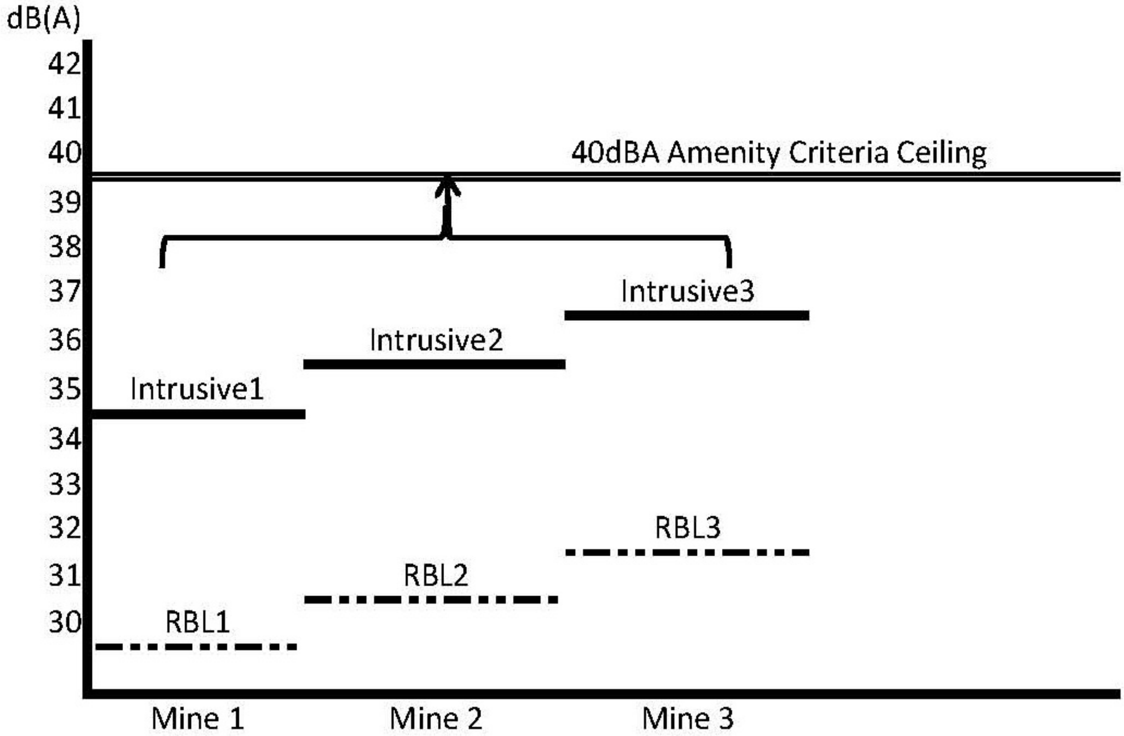


Figure 9.1 Amenity criteria to stop 'noise creep'

9.2 State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007

The State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007 (Mining SEPP) includes clause 12AB Non-discretionary development standards for mining. The clauses relevant to this project are listed below.

Clause 12AB(1):

> The object of this clause is to identify development standards on particular matters relating to mining that, if complied with, prevents the consent authority from requiring more onerous standards for those matters (but that does not prevent the consent authority granting consent even though any such standard is not complied with).

Clause 12AB(3) Cumulative noise level:

> The development does not result in a cumulative amenity noise level greater than the acceptable noise levels, as determined in accordance with Table 2.1 of the Industrial Noise Policy, for residences that are private dwellings.

Other clauses of interest for this project are listed below.

Clause 12AB(5) Airblast overpressure:

> Airblast overpressure caused by the development does not exceed:
>
> (a) 120 dB (Lin Peak) at any time, and

(b) 115 dB (Lin Peak) for more than 5% of the total number of blasts over any period of 12 months, measured at any private dwelling or sensitive receiver.

Clause 12AB(6) Ground vibration:

Ground vibration caused by the development does not exceed:

(a) 10 mm/sec (peak particle velocity) at any time, and

(b) 5 mm/sec (peak particle velocity) for more than 5% of the total number of blasts over any period of 12 months, measured at any private dwelling or sensitive receiver.

The cumulative noise clause described in the Mining SEPP is fundamental to this study and is clear in its objective that the holistic approach to amenity is advocated as described earlier.

9.3 Operational noise assessment criteria

Operational noise assessment criteria for the proposal have been set considering the methods described in the NSW INP and the Bulga background noise monitoring review (prepared in accordance with the NSW INP as described in Section 8.1).

Table 9.3 provides the proposed assessment criteria or PSNL for the proposal.

Table 9.3 Noise assessment criteria, dB(A)

Locality	Assessment location	Rating Background Level (RBL)[1]	Intrusiveness criteria, PSNL (RBL+5dB), $L_{eq,15min}$[2]	Derivation of RBL
Bulga	13, 16, 17, 19, 21, 24, 30-32, 35, 37, 42, 52-58, 60-67, 70-75, 80, 82, 84, 89, 210, 211, 215, 234-238, 243, 252, 254, 255, 903, 917-920, 929	33	38	Proximity similar to logger at A,C and F
	28, 33, 36, 38-41, 43-50, 921, 922	32	37	Background set using degradation of noise levels from MTO and Bulga Mine in this region (discussed in Section 8.1)
	18, 20, 22, 26, 23, 229, 230, 231, 253	31	36	Background set using degradation of noise levels from MTO and Bulga Mine in this region (discussed in Section 8.1)
	1-10, 12, 14, 15, 29, 34, 217, 218-223, 224-228	30	35	Proximity similar to logger at B, D or E
	266-268, 904, 905, 909, 911, 927, 928, 936	30	35	RBL not available - assumed minimum
Gouldsville/	126, 262	33	38	RBL From 2002 EIS location N2
Long Point	128, 130, 134, 139, 172-179, 248, 249	30	35	RBL assumed from 2002 EIS location N3
	127, 141, 167-170, 250, 251	30	35	RBL not available - assumed minimum
Hambledon	152, 155-157, 180-187, 191,	30	35	RBL from 2002 EIS location N6

Table 9.3 Noise assessment criteria, dB(A)

Locality	Assessment location	Rating Background Level (RBL)[1]	Intrusiveness criteria, PSNL (RBL+5dB), $L_{eq,15min}$[2]	Derivation of RBL
Hill/Wylies Flat	192, 263, 937			
Maison Dieu	117, 118, 120-124, 160-163, 244-247, 256-261, 265	30	35	From HVOS Coal Project EA 2008
Milbrodale	111, 193, 197, 199-208, 923, 926	30	35	RBL not available - assumed minimum
Mount Thorley	144, 146, 915	n/a[3]	n/a[3]	RBL not available.
	148-150, 153, 188, 190, 932	30	35	RBL not available - assumed minimum
Warkworth	77, 102, 264	33	38	RBL assumed from 2002 EIS location N4

Notes: 1. Rating background level, or RBL, derived in accordance with the INP as described in Section 8.

2. Intrusiveness criteria is equal to the measured RBL + 5 dB.

3. RBLs without influence from the Site are not available and existing consent do not specify operational limits (only acquisition limits are provided in the existing consent). These locations have been previously identified as impacted by the Site.

9.4 Zones of impact

Section 1.4.8 of the INP describes zones of impact from industrial noise. It states "The various assessed levels of impact around an industrial noise source could be described as a zone of affectation, characterised by annoyance. Within this zone could lie a much smaller zone closer in to the source where impacts were greater and justified acquisition of residences. The border between the annoyance and acquisition zones would be represented by a noise level well above both background level and the EPA's criteria."

The commonly applied approach to zones of impact accepted by the NSW DP&E is provided below.

9.4.1 Noise management zone

The noise management zone is where modelled noise levels are above the PSNL but below the acquisition criteria (described later in Section 9.4.2). Within the management zone, receptors may experience noise levels up to 5 dB(A) above the PSNL. Depending on the degree of potential impact above the PSNL (1 to 5 dB), noise impacts in the noise management zone could range from minor (1 to 2 dB) to moderate (3 to 5 dB). For contemporary planning approvals for mining projects in the NSW, DP&E has prescribed the following actions in the conditions of approval:

- prompt response where issues of concern are raised by community;
- noise monitoring onsite and within the community at representative locations;
- consideration of on-site noise mitigation measures and plant maintenance procedures by the mine and where appropriate sound suppression components and preventative maintenance;
- investigation of, and where practical and cost-effective, acoustical treatment/mitigation at receptors where levels are 3 to 5 dB above PSNL (typically referred to as the 'mitigation zone').

The INP at Section 8.2 'Negotiation between proponent and regulator' states

> Where proposed mitigation measures will not reduce noise levels to the project-specific noise levels, the proponent should seek to negotiate with the regulatory/consent authority to demonstrate that all feasible and reasonable mitigation measures have been applied. The regulatory/consent authority can choose to accept the level of impact proposed, or negotiate for a better level of control where this is considered achievable.
>
> Where, in the final analysis, the level of impact would still exceed the project-specific noise levels, the economic and social benefits flowing from the proposed development to the community should be evaluated against the undesirable noise impacts.
>
> Where it can be demonstrated by the proponent that the development offers net benefits, a regulatory consent authority may consider these as grounds for applying the achievable noise levels, rather than the project-specific noise levels, as the statutory compliance limit.

9.4.2 Noise affectation zone

The noise affectation zone applied by DP&E is where noise levels are more than 5 dB over the PSNL. Implementation of the following measures may be required:

- discussions with relevant property owners to assess concerns and provide solutions;
- implementation of acoustical mitigation at receptors; and
- negotiated agreements with property owners, or acquisition of the property by the applicant upon request by the property owner.

9.5 Cumulative noise

In addition to considering the individual impact of the proposal on residences, the INP also requires an assessment of the proposal's contribution to the total, or cumulative noise received by any particular residence from all industrial operations.

The cumulative noise impacts resulting from the proposal are most appropriately assessed in the context of the amenity criteria listed in Table 9.1. The assessment of cumulative impacts is presented in Section 11. This approach is consistent with the INP's approach to the assessment of cumulative noise.

9.6 Sleep disturbance

The operational criteria described in Sections 9.1, which consider the average noise emission of a source over 15 minutes, are appropriate for assessing noise from steady-state sources, such as engine noise from mobile plant and other equipment. However, noise from sources such as reversing alarms or track plates is intermittent (rather than continuous) and, as such, needs to be assessed using the L_1 or L_{max} noise metrics. Such criteria is provided in the INP application notes which can be found on the EPA website (http://www.epa.nsw.gov.au/noise/applicnotesindustnoise.htm).

The most important potential impact of intermittent noise to be considered is sleep disturbance of nearby residents. While the INP does not specify a criterion for assessing sleep disturbance, various studies including the EPA's *Road Noise Policy* (RNP) (DECCW 2011) indicate that levels below 50 to 55 dB(A) inside homes are unlikely to wake sleeping occupants. If bedroom windows are open, this corresponds to an external maximum noise level of approximately 60 to 65 dB(A) L_{max}. Similarly, the World Health Organisation (WHO 1999) suggest that levels below 45 dB(A) inside homes are unlikely to wake sleeping occupants. It is noted that the WHO criterion applies under the assumption that windows are closed.

However, the EPA's current position on sleep disturbance, is that maximum (L_{max}) noise from industrial sources should not exceed background (or RBL) plus 15 dB. Based on a night time RBL of between 30 dB(A) and 33 dB(A (refer to Section 8), this assessment has adopted an external sleep disturbance criterion of 45 dB(A) to 48 dB(A) L_{max} for residences as applicable.

Where the sleep disturbance criterion is satisfied, sleep disturbance is unlikely. But where it is not met, a more detailed analysis is required. The detailed analysis should quantify the extent of impacts, including levels of exceedance above the criterion and the duration and the number of events that may occur.

9.7 Low frequency noise

Low frequency noise (LFN) has been raised as an issue by surrounding residences of MTO in previous consultation undertaken as part of normal noise management activities and also as a part of the social impact assessment consultation being undertaken for this EIS. MTO has listened to this feedback and to consider this issue EMM have completed three different methods of assessment for LFN as detailed below. These include the INP, 'Broner' and the Department of Environment Food and Rural Affairs (DEFRA) (UK) methods.

9.7.1 Industrial Noise Policy

Section 4 of the INP provides guidelines for applying 'modifying factor' adjustments to account for low frequency noise emissions. The INP states that where there is a difference of 15 decibels or more between the measured 'C' weighted (dBC) and measured 'A' weighted (dBA) levels, then a correction factor of 5 dB is applicable to the measured noise at the assessment location.

The INP's LFN criteria are being reviewed in light of challenges in practice at large distances from sources. For example, sounds that do not pose low frequency dominated spectra at close range, would by virtue of enough distance loss factors, inappropriately attract the INP penalty for low frequency as higher frequencies in their spectra are considerably more abated than the lower frequencies. The INP LFN criteria were originally intended for testing sources at relatively close range.

A letter prepared by the NSW Ombudsman (dated 22 January 2014) to DP&E relating to the subject site and the INP's approach to LFN, is attached in part as Appendix F. This document notes that: the DP&E (formerly DPI) and EPA (formerly OEH) agrees on the technical merits on the difficulty in applying the LFN modifying factor in rural areas; EPA have commissioned a comprehensive study on LFN as part of the revision of the INP; that EPA would not include conditions about LFN in an Environmental Protection Licence (EPL); and a review of the INP will be conducted with LFN being a priority issue.

The letter shows that the Environment Defenders Office (EDO) forwarded a complaint on behalf of the Bulga Milbrodale Progress Association Inc. (BMPA), about the DP&E's decision to refuse to apply LFN data in accordance with the Industrial Noise Policy (INP) and condition of consent for Mount Thorley and Warkworth coal mines, to the NSW Ombudsman.

The results of this complaint, were contained in the letter to DP&E. A copy of this was obtained under the Government Information (Public Access) Act 2009. An extract from this letter follows:

> *"As you are aware, Bryce Purches of this office had made inquiries with the DP&E and the NSW Office of Environment and Heritage (OEH). Mr Purches has recently left, and the file has been reallocated to me for assessment of the information received by those agencies.*
>
> *The Ombudsman is primarily concerned to ensure government agencies are fair and reasonable in their dealings. It is clear that opinions, even by experts, may differ. We are unwilling in such situations to question expert opinion, except in those rare cases where the opinion appears so unsupportable that it suggests something improper may have occurred. It is seldom appropriate for us to decide between differing technical views, nor do we have the resources to routinely obtain our own independent expert opinion.*
>
> *To this end, we sought information from DPI and OEH about the review of the INP, and the application of LFN data to the operations of Mount Thorley Warkworth open cut mine in accordance with the conditions of consent DA 300-9-2002-1.*
>
> *DPI has provided information and evidence to demonstrate that the (then) DECCW (OEH) had from 2010 made a commitment to revise the INP in relation to low frequency noise, and to review the INP as a whole. While progress on this has been slower than expected, our verbal interactions with OEH has confirmed that they anticipate a review will be completed later this year.*
>
> *Assessment of LFN appears to be quite contentious, especially in rural settings. I do not propose to develop a view as to which position is most likely accurate, as I have explained above, we do not have that expertise, or the resources to seek that expertise.*
>
> *It would appear to me, however, that the following points have been agreed by DP and OEH:*
>
> - *There may be technical merit as to the difficulty in applying the low frequency modifying factor in rural areas, subject to further study. OEH has commissioned a comprehensive study of LFN as a part of the INP review, titled Low Frequency Noise & Infrasound, still underway;*
> - *That OEH would not include conditions about LFN in Environment Protection Licences; and*
> - *A review of the INP would be conducted, and LFN would be a priority issue.*
>
> *When we receive complaints about compliance and enforcement, failure to take action alone is generally not sufficient grounds to justify an investigation by this office. We look closely at the facts of each case, including the agency's reasons for its decisions.*
>
> *In this case, there appears to be appropriate consideration of professional advice from qualified staff and experts about LFN that casts doubt as to the practicality of strict enforcement of the condition of consent. Notwithstanding this, OEH has also acknowledged that any review of LFN in the INP will include consultation with NSW Health given the health issues said to be associated with LFN.*
>
> *Noise monitoring continues to be a high priority issue, and a Noise Management Plan and Noise Monitoring Programme for the whole mining complex are in place. Further, DPI due to a Land and Environment Court decision.*

> *For the reasons outlined above, it appears to me the information and evidence provided by the agencies is sufficient to satisfy me that the DPI has provided adequate reasons for its decision and has properly considered all relevant issues, and there is no other evidence of wrong conduct that requires intervention by this office.*

I appreciate why you forwarded this matter to this office, and I acknowledge the importance of noise monitoring and the impacts of noise on the local community. BMPA should continue to engage with the agencies and the mine operators as is appropriate and participate in community consultation and engagement as opportunities arise."

The above confirms that the applicant currently undertakes regular LFN monitoring as part of the noise management regime for the MTO.

9.7.2 'Broner' method

A paper by Dr Norm Broner, "*A Simple Outdoor Criterion for Assessment of Low Frequency Noise Emission*" published in Acoustics Australia Vol.39 April 2011, provides absolute level criteria for frequency noise. The paper presents the following targets external to a residence:

- For the daytime or when source operates intermittently (1-2 hours):
  - desirable 65 dBC L_{eq}
  - maximum 70 dBC L_{eq}
- For the night time or when the source operates continuously:
  - desirable 60 dBC L_{eq}
  - maximum 65 dBC L_{eq}

This assessment will also review LFN against the Broner (2011) approach.

9.7.3 Department of Environment, Food and Rural Affairs (United Kingdom)

The Department of Environment Food and Rural Affairs (DEFRA) (UK) commissioned the University of Salford to prepare a detailed study on LFN in the community with the intent of formulating a practical LFN criterion to be used in the field by environmental health officers. The study, *Proposed criteria for the assessment of LFN disturbance* (Dr Moorhouse et al 2005), draws on several European LFN assessment methods to develop a frequency based reference criterion.

The process involves measuring the L_{eq}, L_{10} and L_{90} in third octave bands between 10 Hz and 160 Hz within an unoccupied room where the alleged LFN source has been observed. If the measured L_{eq} exceeds the levels in Table 9.4 in any third octave band, then this indicates the presence of a LFN source. This character of the noise should also be checked using an audio recording, where possible.

Table 9.4 DEFRA – proposed low frequency reference curve

Hz	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160
dB, Leq	92	87	83	74	64	56	49	43	42	40	38	36	64

Notes: 1.The levels can be relaxed by 5 dB if: the source is present during the day only; or if the source is steady as demonstrated by: L10-L90 < 5 dB or the rate of change of sound pressure level (Fast time weighting) is less than 10 dB per second, where these parameters are evaluated in the third octave band which exceeds the reference curve values by the greatest margin.

The criterion applies to internal measured noise levels and therefore has fundamental limitations at the proposal stage, where external noise levels in single octave bands down to 31.5 Hz can be typically modelled and assessed. The application at the proposal stage would also rely on broad assumptions relating to the facade reduction provide by a given dwelling, which would vary greatly depending on the building materials dwelling to dwelling (eg light-weight versus brick veneer construction). Furthermore, room acoustic affects such as reverberation and room modal characteristics would present challenges at the assessment stage.

A test of internal LFN was completed at an unused dwelling to demonstrate the DEFRA approach and the results are described later in this report.

10 Operational noise impact assessment

This section presents the results of modelled noise levels from the proposal inclusive of the effect of prevailing meteorological conditions recorded at the Site.

The INP requires the assessment of predicted noise levels against the PSNL's and where these are exceeded, identify all reasonable and feasible noise mitigation. The INP Section 7 "Mitigating noise from industrial sources" states there are three main strategies for noise control. These are controlling noise at the source, the transmission path and at the receiver.

Initial modelling for unmitigated operations showed that mitigation measures were warranted. The applicant has currently attenuated approximately 50% of the haul truck fleet, with the aim of attenuating all trucks by the end of 2016. Attenuation packages to all dozers, excavators and drills is progressing and will also be completed by the end of 2016 calendar year. The cost of the attenuation program is in excess of $50M across MTW. This mitigation strategy has been included in the noise modelling.

Noise mitigation along the transmission path was also considered and was found to be ineffective for the residences of Bulga given the relatively flat open terrain between the Site and residences.

Finally, controlling noise at the receiver has been considered and properties have been identified where treatment to existing dwellings would be made available.

10.1 Noise modelling approach

To assess the potential for noise impacts on residences, a total of three indicative mine scenarios have been assessed. These three indicative mine plans reflect the worst-case operating scenarios in respect of the potential for impacts to surrounding residences. These indicative mine plans are referred to as Year 3, Year 9 and Year 14, each indicating the approximate time after the anticipated commencement date.

Mining of the existing approved open cut resources at MTO is anticipated to be complete by approximately 2022. Following this, rehabilitation would be undertaken. The proposal would continue existing operational practices including use of draglines, shovels, excavators, loaders, dozers and truck fleets. This combination has proved appropriate for the geological conditions encountered at the mine and the required production rates. These activities would continue within the existing MTO tenement (CL 219).

Indicative mine plan snapshots showing the proposal's operations in 2017 (nominally Year 3), 2023 (Year 9) and 2028 (Year 14) can be seen in EIS Figures 1.5, 1.6 and 1.7, respectively.

The indicative Year 3, 9 and 14 mine plans were chosen as representative mining snapshots which allow for technical assessments for activities occurring at MTO.

- In indicative Year 3 mine plan (nominally 2017), mining has ceased in all pits with the exception of Loders Pit. Rehabilitation activities have been completed in sections of the Site near the CRTSF and also areas in the south-east. Indicative Year 3 is also generally representative of current operations.

- Indicative Year 9 (nominally 2023) is approximately the half way point of the proposal timeframe and represents when coal and overburden are being transported from Warkworth Mine to MTO for processing and emplacement, respectively. It is expected that AGN will commence mining in 2018 or 2019 and be completed within approximately two years before becoming a Tailings Storage Facility (TSF) as approved. For modelling purposes, and to ensure a worst case scenario is captured, the noise study has conservatively assumed that mining in AGN is still taking place in 2023; however, in practice it is likely to be completed and being used as a TSF before 2023. Rehabilitation activities have been completed across more than half of the Site with the exception of Loders Pit which is receiving overburden from Warkworth Mine to develop final landform and the base of the TSF to RL 50m which will start receiving tailings once AGN is full in approximately 2026.

- Indicative Year 14 (nominally 2028) represents a similar scenario to Year 9 (2023) with coal and overburden transfer occurring. No mining is anticipated to occur. Rehabilitation activities have been completed across the majority of the Site with the exception of the Loders Pit which is receiving tailings from Warkworth Mine.

During operations, alternative mine plans may be used to the indicative plans above, provided that the environmental impacts remain within the envelope as assessed in the EIS. The mining operations can therefore retain some flexibility within the constraints of the identified and assessed environmental envelope.

Noise modelling was based on three-dimensional digitised ground contours for the surrounding land, mine pits and overburden emplacement areas for three stages. The indicative mine plans represent worst case snapshots and equipment was placed at various locations and heights, representing realistic operating conditions in each of these indicative stages of the mine.

The noise model was configured to predict the total L_{eq} noise levels from mining operations based on the sound power levels presented in Table 10.2. These sound power levels are short term L_{eq} values of generally pass-by events and are therefore conservative representations of the INP's assessment metric, the $L_{eq,15minute}$. It should be noted that the model includes the entire spectral emissions for each individual plant item and therefore uses these spectra to predict received levels. This accounts for the linear characteristics of each source and not just the overall dB(A) level. The results presented assume all plant and equipment to be operating simultaneously and at full power. In practice, such an operating scenario would occur very infrequently. The noise predictions presented are therefore conservative.

The noise modelling reflected in this chapter is based on mine planning that has been optimised over many iterations of noise modelling. In arriving at this mine plan, alternative noise minimisation techniques such as reducing the height of night-time overburden emplacement activities were considered but found to be impractical or to provide minimal acoustic benefit.

Importantly, the modelling includes best practice noise attenuation to all dominant noise plant including haul trucks, drills, dozers and excavators. The applicant is committed to attenuation of its entire fleet by the end of 2016. The attenuation status as of April 2014 is 50% of all haul trucks.

10.2 Noise modelling parameters

The prediction of noise from The proposal's operations was undertaken using the Predictor software by Bruel & Kjaer. The software predicts total noise levels at residences from the concurrent operation of multiple noise sources. The model included consideration of factors such as the lateral and vertical location of plant, source-to-receiver distances, ground effects, atmospheric absorption, topography of the mine and surrounding area and meteorological conditions. This section outlines the base parameters used in the noise modelling.

In EMM's experience on many similar projects, the EPA, has encouraged site specific validation of noise predictions wherever possible to better represent potential impacts from industrial operations. The results of an extensive field validation exercise part of and as documented in the 2002 and 2010 Warkworth noise assessments were adopted in the current prediction of noise levels for prevailing winds. Similar studies have been conducted and results of which published in technical journals (eg *Experimental Outdoor Sound Propagation' 13th International Congress on Sound & Vibration*, 2006 and *Experimental Outdoor Sound Propagation vs ENM* Australian and New Zealand Acoustic Society Conference, 2007). These studies concluded that the prediction of L_{eq} noise is consistently overestimated during weather enhanced conditions, a finding also consistent with a NSW Australian Acoustic Society presentation by Dr Robert Bullen in 2009 about such modelling software algorithms, particularly the Environmental Noise Model (ENM) algorithm.

10.2.1 Equipment noise levels

Table 10.1 describes the main noise sources associated with the proposal.

Table 10.1 Main noise sources of the proposal

Mining activity	Typical plant
Mine	Drills, shovels, front-end loaders, trucks, excavators, dozers, graders, draglines, cable reelers and generators for lighting sets.
Overburden emplacements, rejects emplacement and haul roads	Trucks, dozers, graders and generators for lighting sets.
Coal transportation	Trucks and graders on haul roads, CPP and conveyor.

Sound power levels for equipment used for in-pit earth-moving and overburden emplacement are listed in Table 10.2. These sound power levels are based on measurements at Site, and supplier in-service commitments for newly purchased or retro-fitted attenuated equipment. As described earlier, these are short term pass-by values and therefore a conservative representation of $L_{eq,15minute}$.

Table 10.2 Equipment sound power levels used in noise modelling - including attenuated equipment

Typical item	Representative $L_{eq,15minute}$ sound power level, dB(A)
#Haul truck	115
Water cart	116
#Drill	114
Shovel	117
#Dozer	115
Rubber tyre dozer	117

Table 10.2 Equipment sound power levels used in noise modelling - including attenuated equipment

Typical item	Representative $L_{eq,15minute}$ sound power level, dB(A)
Dragline	119
Grader	108
Loader	116
#Excavator (3600)	119
#Excavator (5500)	117
Lighting plant (night only)	104
Infrastructure area:	
CPP	113
Reclaimer	111
Crusher/feed bin	105
#Conveyor (covered)	75 per linear metre
Conveyor (uncovered)	82 per linear metre

Notes: 1. # Indicates attenuated plant.

2. The Proponent commits to all new trucks, dozers, drills and excavators purchased for use on the site are commissioned as noise suppressed (or attenuated) units and the existing fleet of trucks, dozers, drills and excavators on site are progressively fitted with suitable noise attenuation packages to ensure that 100% of the fleet being used on site is attenuated by the end of 2016.

The applicant adopts a strict specification to suppliers when purchasing new plant or fitting attenuation packages to existing plant. This specification includes a dB(L) or linear target in addition to a dB(A) target as shown in Table 10.3.

It should be noted that in previous assessments for MTW and other mines in the Hunter Valley, an attenuated haul truck sound power level of 113dB(A) is referenced. MTW has been engaging with their suppliers for many years now to confirm a technical pathway to achieve that sound power level. At the time of publishing this study, MTW, in conjunction with its suppliers, have been successful in testing and operating sound suppressed haul trucks to a sound power level of 115dB(A) in-service. MTW has conservatively opted to model the haul trucks with a sound power level of 115dB(A) for this EIS to represent a more accurate reflection of the noise emitted from the Site.

A supplier of the Site's haul trucks (Komatsu) has confirmed a technical path to reliably reach a 113 dB(A) sound power level in the future. This technology is not currently available and at present, this next phase package of attenuation is likely to be tested in the next 12 months. If this materialises, the predicted noise levels herein will reduce if it is determined that the package is reasonable and feasible to adopt.

Table 10.3 In-service target sound power levels

Plant	Lw, dB(L)	Lw, dB(A)
	(Primary target)	(Reference only)
Haul Truck	123	115
Water Truck	125	116
Dragline	126	119
Shovel (electric)	124	117
Excavator	126	119
Loader	123	116

Table 10.3 In-service target sound power levels

Plant	Lw, dB(L) (Primary target)	Lw, dB(A) (Reference only)
Grader	117	108
Track dozer (1st gear)	123	115
Rubber Tyred Dozer	121	117
Drill	121	114

10.2.2 Mining equipment schedule for MTO

The typical equipment schedules for the three modelled indicative mining scenarios are presented in Table 10.4. The modelled location of mining equipment is detailed in Appendix C.

Table 10.4 Modelled typical mining equipment schedule (MTO only)

Equipment	Year 3	Year 9	Year 14
Haul truck	25	20	6
Water cart	1	2	1
Drill	1	1	0
Shovel	1	0	0
Dozer	5	6	0
Rubber tyre dozer	1	0	0
Dragline	1	0	0
Grader	2	2	1
Loader	0	1	0
Excavator (3600)	2	2	0
Lighting plantplant[1]	5	5	0
Infrastructure area:			
plant CPP	1	1	1
Reclaimer	4	4	4
Crusher/Feed bin	1	1	1

Notes: 1. Lighting plant operates only during evening and night periods.

2. The listed plant are those proposed to operate within the MTO site boundary and exclude plant within WMLs site boundary.

10.3 Predicted noise during calm weather

Operational noise levels to residences were determined for periods with no wind or temperature gradients, which are termed SI (Still Isothermal) or 'calm' conditions. Values for air temperature and relative humidity used in the noise modelling were 20°C and 70 per cent for day, and 10°C and 90 per cent for evening and night periods.

The $L_{eq,15min}$ noise levels at assessment locations resulting from mining operations during calm conditions for day, evening and night periods are presented in Appendix D (columns 4, 5, 7, 8, 10, 11). Comparison of predicted noise levels for day, evening and night periods for any particular year of mining indicates little difference This is not unexpected as the equipment fleet is identical for both day and night scenarios with the exception that the latter includes lighting plant.

Notably, operational noise levels were predicted to comply with the INP's PSNL's for all assessment locations during calm meteorological conditions for day, evening and night periods.

10.4 Predicted noise during 'prevailing' meteorological conditions

The INP provides guidance on how noise due to varying meteorological conditions is to be assessed. The procedure is based on identifying and combining worst case meteorological conditions at the site (referred to as the 'prevailing meteorology') and assessing the noise levels against the relevant limits.

During wind and temperature gradient conditions, noise levels at residences may increase or decrease compared with noise during calm conditions. This is due to refraction caused by the varying speed of sound with increasing height above ground. The level of noise received increases when the wind blows from source to assessment locations or under temperature inversion conditions, and conversely, decreases when the wind blows from receivers to source or under temperature lapse conditions.

Despite the increase in noise at properties caused by adverse winds, ambient noise also increases during such weather conditions (due to wind induced vegetation noise) and mine noise can be masked.

10.4.1 Assessment of potential for temperature inversions

The Pasquil stability class represents the degree of mixing in the atmosphere, and can be used to gauge the presence and magnitude range of temperature inversions. Stability classes are categorised from Class A to Class G. Stability Class A applies under sunny conditions with light winds when dispersion is most rapid. Stability Class D applies under windy and/or overcast conditions when dispersion is moderately rapid and Stability Class F and G occur at night when winds are light and the sky is clear. Stability Classes B, C and E represent the presence of intermediate conditions. Temperature inversions may occur during Classes E, F and G. In particular, Class F generally represents a range of temperature gradients from 1.5ºC/100 m up to less than 4ºC/100 m.

Records of wind speed, wind direction and sigma-theta (α - used to approximate Pasquil stability classes) were acquired from the Coal & Allied Charlton Ridge AWS for the period 2007 to 2013, inclusive. The proposal's air quality specialist confirmed this data as representative for the site and surrounds through a comparison of data from other neighbouring weather stations.

The Stability Class frequency for the area, as determined from the hourly weather data, is indicated in Table 10.5. The last column indicates that atmospheric stability class F/G occurs for only 8 per cent of the winter nights in the area. This is well below the EPA's INP's 30% per cent threshold where stability class F are considered to be a 'feature' of an area and therefore does not need to be included in noise impact assessment. Nonetheless, the prediction of noise impacts in this assessment includes consideration of the effects of a 3.9ºC/100 m temperature inversion consistent with the recommendations of the INP. This approach is appropriate given the well documented presence of temperature inversions in the broader Hunter Valley region.

Table 10.5 Atmospheric stability class frequency for Warkworth Mine

Stability Class	Percentage of occurrence (winter night)
A	8
B	5
C	18
D	49
E	12
F/G	8
Total	**100**

Notes: 1. This information is based on winter night analysis for years 2007 to 2013 inclusive as provided by Coal & Allied from the Charlton Ridge AWS.

10.4.2 Assessment of prevailing winds for the area

A detailed review of the vector components of the aforementioned hourly wind data (direction and speed) was undertaken in accordance with the INP. The results are summarised in Appendix C. The wind directions determined to be a feature of the area in accordance with the INP are summarised in Table 10.6. The cumulative total values indicate wind speed occurrence above the INP 30 per cent threshold, which triggers the requirement for assessment (Section 5.3 of the INP). This is determined by a cumulative arithmetic addition of percentage occurrence values (refer Appendix C). EMM's wind calculator adopted for the proposal provides results consistent with the EPA's wind calculator (as found on the EPA's website) for defining feature wind directions.

It is demonstrated that the assessable winds occur during the evening and night time, and these specific winds are considered a 'feature' of the area according to the INP.

For indicative Years 3 and 9 of proposed operations, when mining plant will operate on Saddleback Ridge, a drainage wind of 2m/s and a 3ºC/100m temperature inversion was included in the modelling. Previous noise impact assessments for the Site have also considered the likelihood of drainage winds from various local escarpments and from various opposing directions. One commonality is the flow or drainage of Wollombi Brook to the north-northwest. This was therefore the chosen direction of the modelled drainage wind. The resultant effect was the enhancement of mine noise propagation to assessment locations west of the mine due to a modelled combined wind and temperature inversion. Importantly, drainage is also likely a likely feature of the escarpment west of Bulga and therefore would result in favourable (westerly) wind conditions at times for the properties of Bulga.

Table 10.6 Assessed INP meteorological conditions

Scenario	Wind direction	Wind speed (m/s)[1]
Day periods		
1	Calm	0
Evening period		
1	Calm	0
2	E	2.3
3	ESE	2.7
4	SE	2.6
5	SSE	2.5
6	S	2.5
7	SSW	2.3
8	SW	1.9
9	WSW	1.9
Night periods		
1	Calm	0
2	E	2.1
3	ESE	2.5
4	SE	2.7
5	SSE	2.7
6	S	2.6
7	SSW	2.3
8	SW	1.8
9	WSW	1.6
10[2]	SSE + 3 Deg Temp Inv	2.0

Notes: 1. Wind condition applies only to noise modelling for Year 3 and 9.

10.5 Predicted noise levels

The wind conditions in Table 10.6 were used in the modelled predictions of mining noise levels. The predictions of mining noise during periods of 'prevailing meteorology' are presented in Appendix D. The results presented in Appendix D are derived from considering the effect of only INP-assessable meteorological conditions (Table 10.6) and not all possible wind conditions that may be experienced at site.

These results are also presented in the form of coloured markers for indicative years 3, 9 and 14 (Figure 10.1, 10.2 and 10.3 respectively) which categorically represent predicted noise levels at assessment locations with respect to PSNL's. Assessment locations which meet PSNL are indicated with a black marker for the respective indicative mining year. Assessment locations with a green, blue or orange marker represent predicted minor (1 to 2 dB(A)), moderate (3 to 5dB(A)) or significant noise level exceedances (respectively) of the PSNL for the respective mining year. These data incorporate all 'prevailing' INP weather conditions (ie calm, INP winds and temperature inversions) for day, evening and night operations, as appropriate.

Figures 10.4 and 10.5 present coloured markers based on the worst case noise level predicted at each assessment location across the three indicative mining years (ie outer envelope or worst case for all years). For clarity, the markers are presented separately for assessment locations west and east of the site.

Noise during 'prevailing meteorological conditions' is below or at the EPA's PSNLs at 160 residences out of 221 assessed. Conversely, noise during 'prevailing meteorological conditions' are predicted to exceed the PSNL at 61 assessment locations, and in a single case, also exceed the site's applicable acquisition limit.

A summary of these noise level exceedances are provided in Table 10.7 for Bulga assessment locations and surrounding areas. Table 10.7 shows that predicted noise levels for all Bulga assessment locations will satisfy or be within 1-2 dB of PSNLs.

Table 10.7 Summary of operational PSNL exceedances – Bulga and surrounds

Extent of noise exceedance	Number of affected properties			
	Indicative Year 3	Indicative Year 9	Indicative Year 14	All years
Marginal (1-2dB(A))	53	0	0	53
Moderate (3-5 dB(A))	0	0	0	0
Significant (greater than 5 dB(A))	0	0	0	0

Table 10.8 summarises the exceedances for all other locations generally to the east of the mine, but includes Warkworth village and Maison Dieu locations to the north west and north. Table 10.8 indicates that operational noise levels will exceed the PSNLs by varying amounts at eight assessment locations as shown during prevailing meteorology. Seven of these locations have been afforded mitigation to dwellings by the applicant. One assessment location (149) has been predicted with a significant noise level exceedance during Year 9 operations.

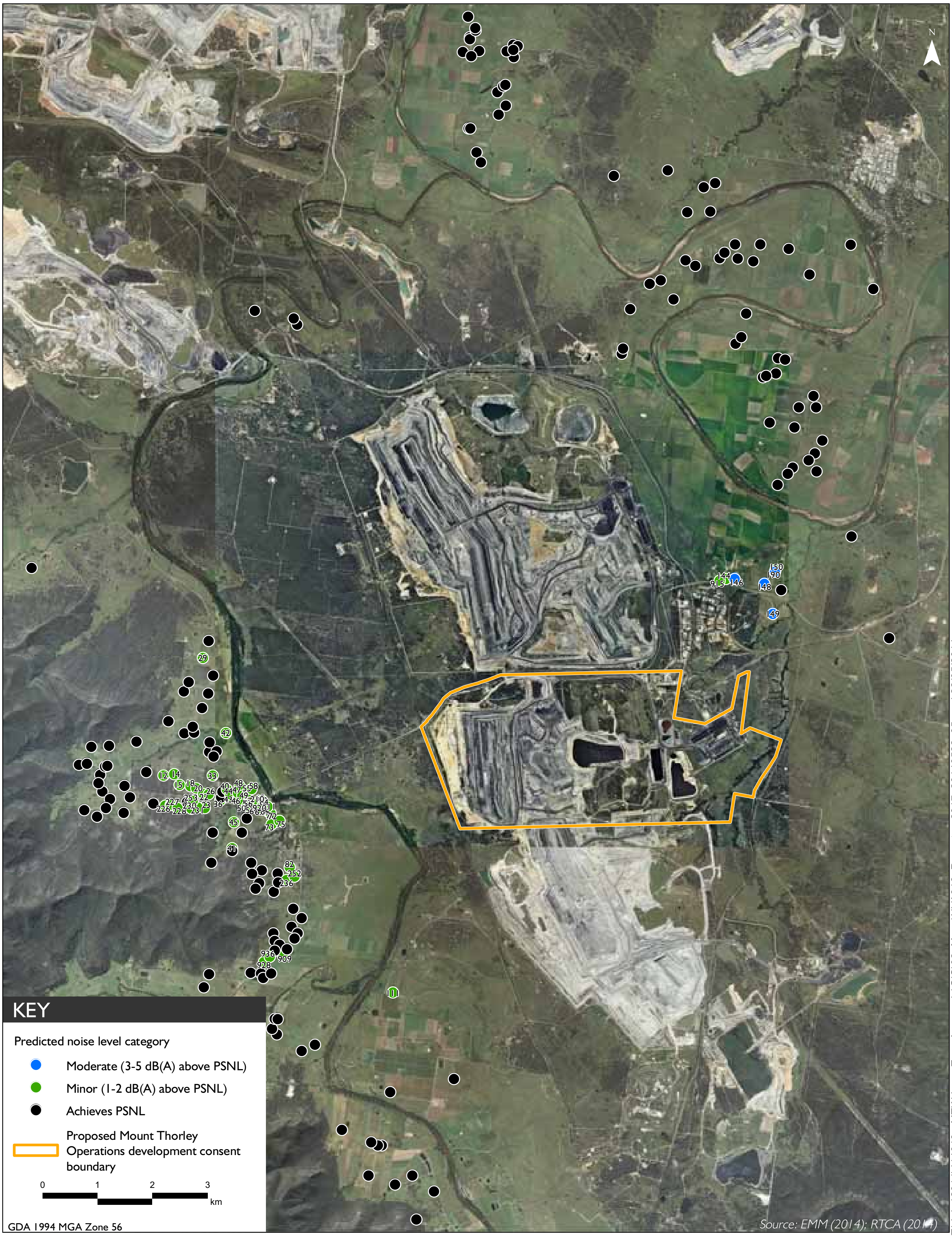
Table 10.8 Summary of operational PSNL exceedances – other assessment locations

Extent of noise exceedance	Number of affected properties			
	Year 3	Year 9	Year 14	All years[1]
Marginal (1-2dB(A))	3	5	5	4[2]
Moderate (3-5 dB(A))	4	2	1	3[2]
Significant (greater than 5 dB(A))	0	1	0	1

Notes: 1.The 'All years' column lists the assessment location by worst of marginal, moderate and significant and therefore does not double count or double assign a location in these three categories.

2. These locations have had mitigation installed on dwellings.

It is also important to note that operational noise levels from the proposal are not expected to be materially different from current noise levels for locations east of the mine given relatively no changes to current activities in the eastern parts of the mine site.



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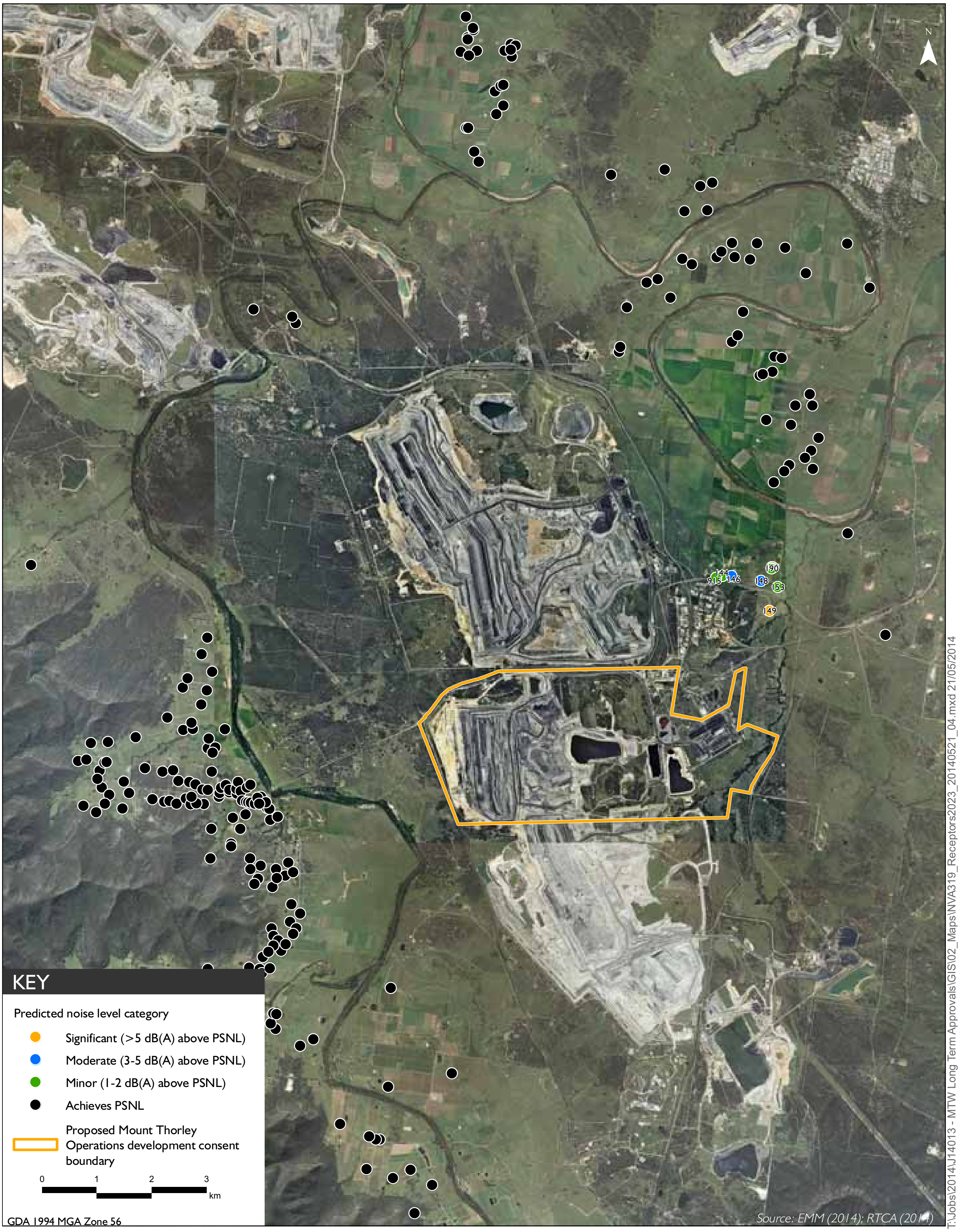
Year 3 worst case day, evening and night operational noise levels, INP weather (Leq,15min dB(A))

Mount Thorley Operations

Noise and vibration assessment

Figure 10.1

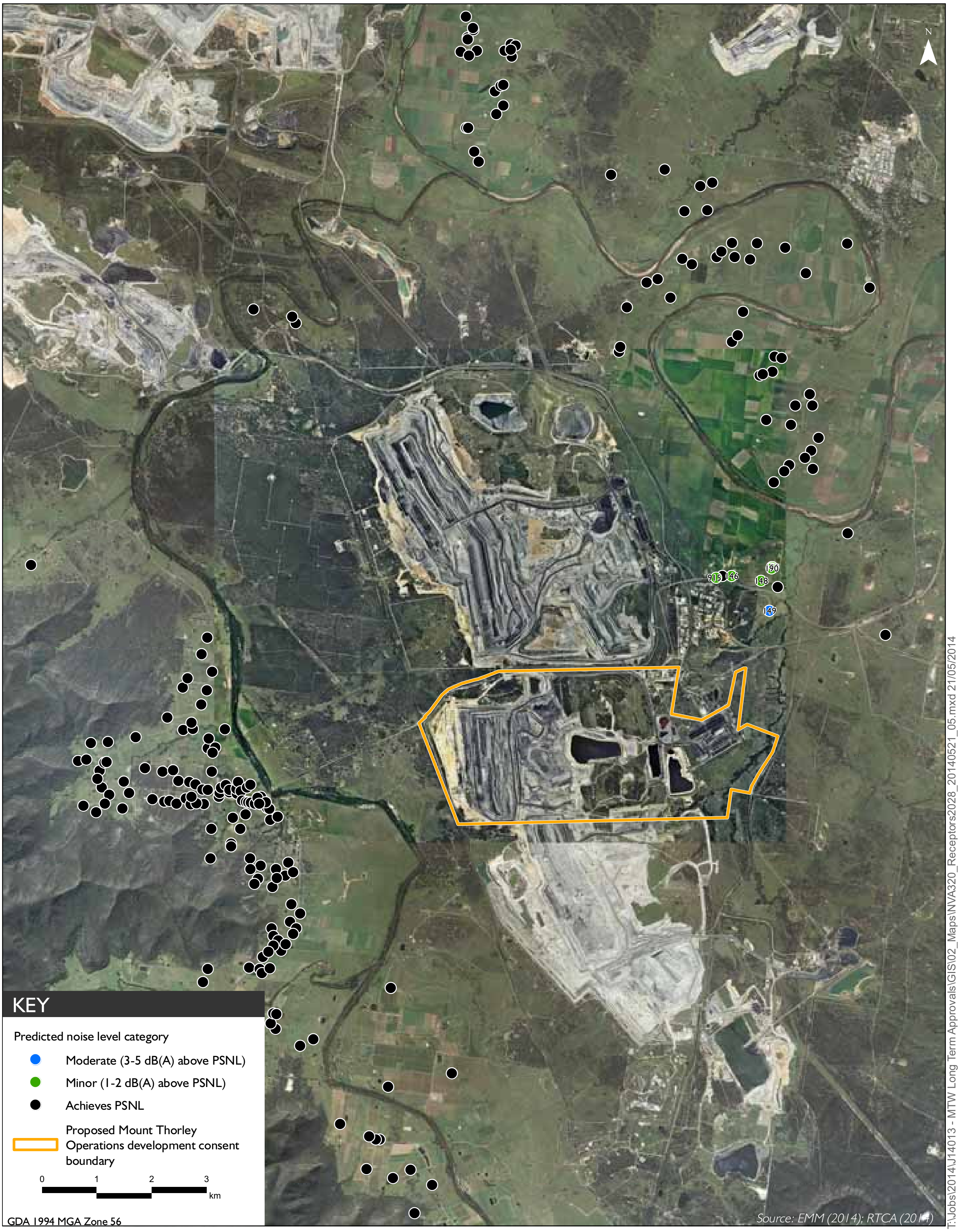


Year 9 worst case day, evening and night operational noise levels, INP weather (Leq,15min dB(A))

Mount Thorley Operations

Noise and vibration assessment

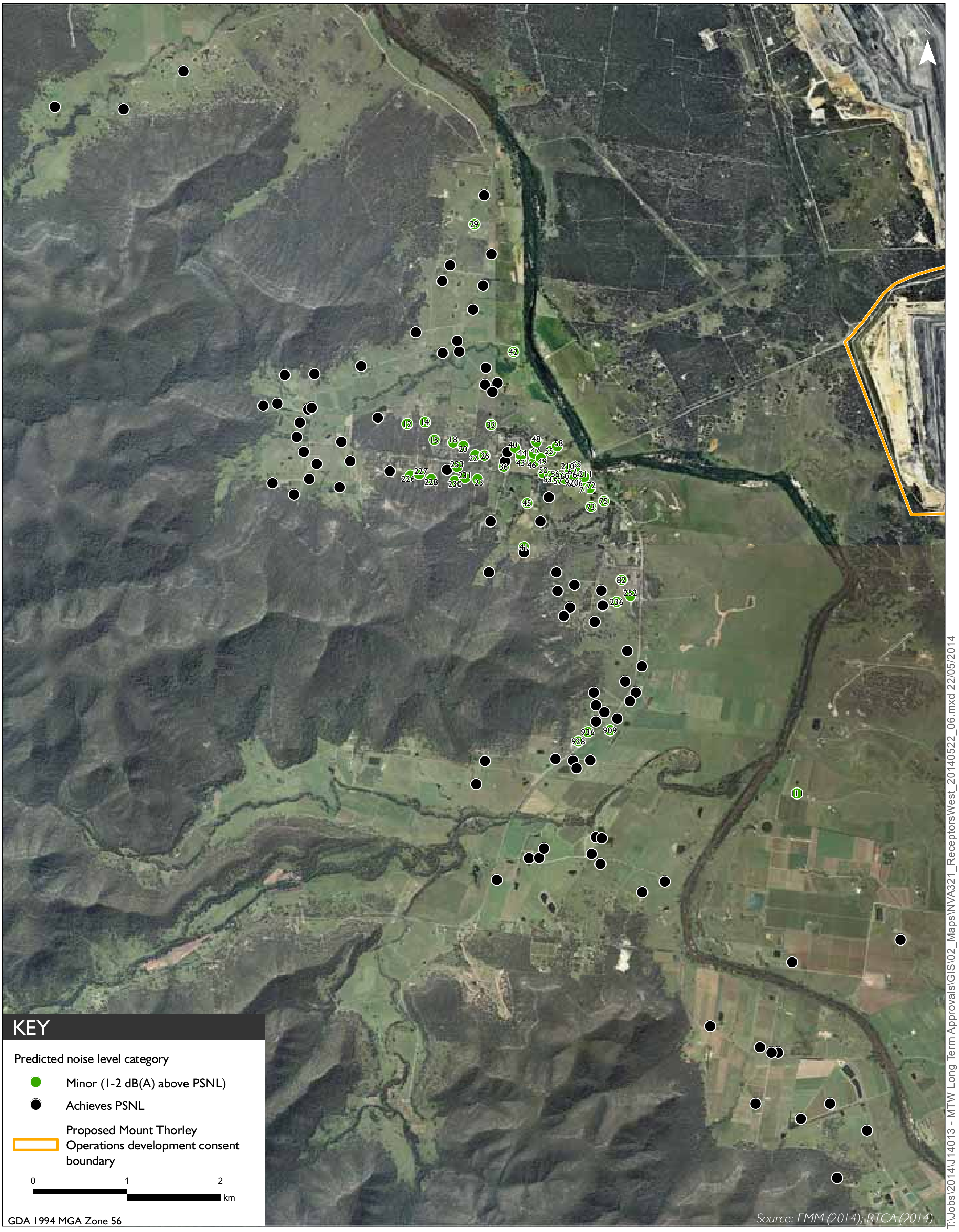
Figure 10.2



Year 14 worst case day, evening and night operational noise levels, INP weather (Leq,15min dB(A))

Mount Thorley Operations
Noise and vibration assessment

Figure 10.3



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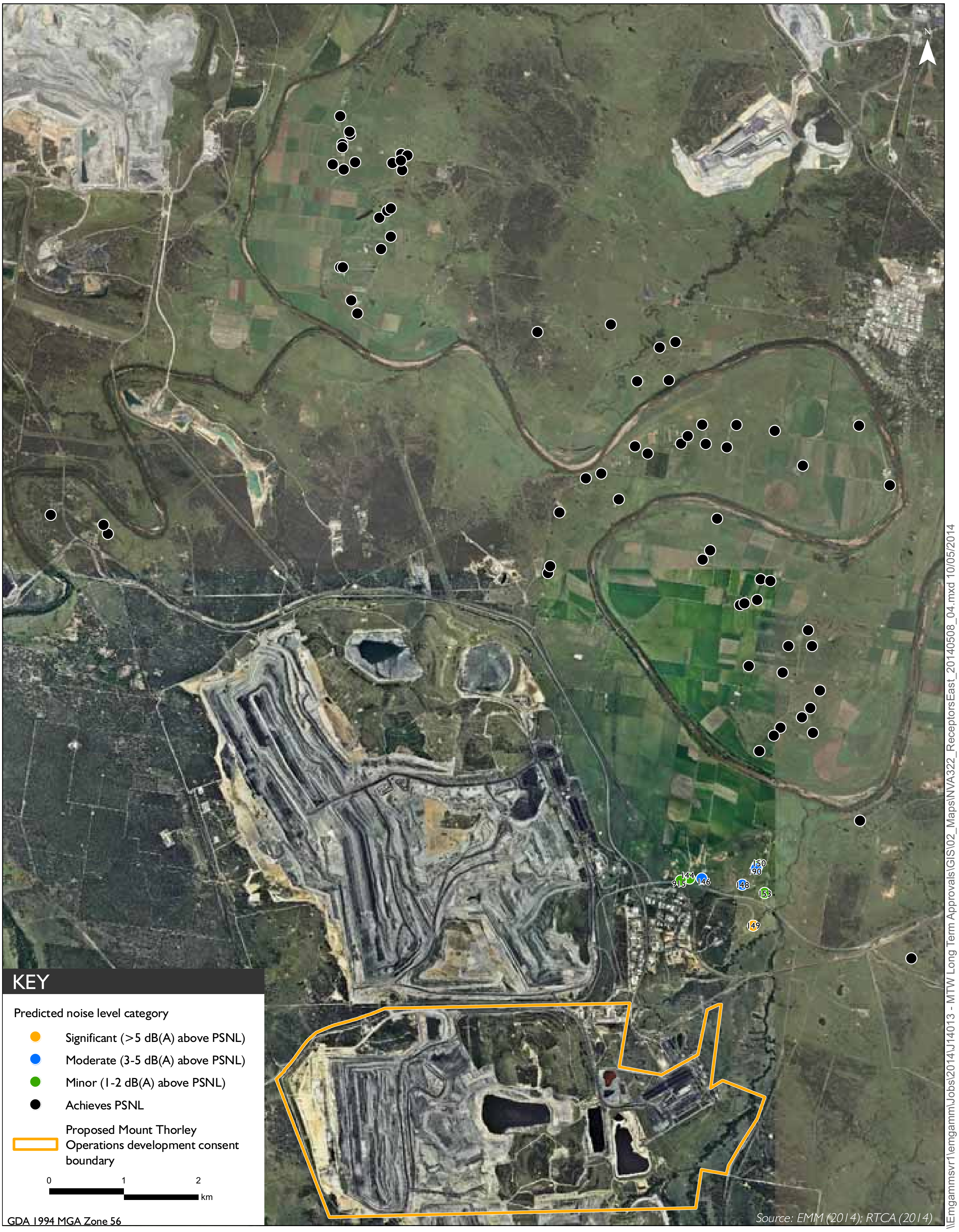
All years worst case day, evening and night operational noise levels, INP weather (Leq,15min dB(A)) – Western assessment locations

Mount Thorley Operations
Noise and vibration assessment

Figure 10.4



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All years worst case day, evening and night operational noise levels, INP weather (Leq,15min dB(A)) – Eastern assessment locations

Mount Thorley Operations

Noise and vibration assessment

Figure 10.5

10.6 Residual level of impact (INP Section 8.2.1)

Section 8.2.1 of the INP lists issues to be considered if predicted noise levels exceed the PSNL's after reasonable and feasible mitigation has been applied. Table 10.9 provides an assessment of residual noise impacts (presented in Table 10.7 and 10.8) from the proposal.

Table 10.9 Residual level of impact

INP factors for consideration	Justification of the proposal
1. Characteristics of the area and receivers likely to be affected	The majority of the local area surrounding the proposal is characterised by mining and associated infrastructure and agricultural land, mainly pasture, with moderate sized stands of native woodland retained along the steeper hillsides and ridgelines and in patches along creek lines. The applicant owns a substantial area of land surrounding the Site. MTO has been in operation since 1981 and the originally approved mine has been modified several times. Immediately to the north of MTO is Warkworth Mine, which also commenced operations in 1981. The integrated operation of MTW has been ongoing since 2004. The Bulga Coal Complex, which is adjacent to the south, has been operating since the 1980s. Wambo Mine and Hunter Valley Operation South, to the north of Warkworth Mine, commenced operations in 1969 and 1971, respectively. The noise and vibration study predicted noise levels at 221 assessment locations surrounding the mine. The predicted noise levels are during worst case INP prevailing meteorological conditions and for the majority of the time actual noise levels are likely to be less than those predicted. Of the 221, three are predicted with moderate noise level exceedances (3-5 dB(A) above PSNL) and one is predicted with significant noise level exceedances (greater than 5 dB(A) above PSNL). Assessment locations with predicted moderate and significant noise level exceedances account for less than 2% of the total assessment locations considered. A total of 139 assessment locations within Bulga were considered. Of these, 53 are predicted with minor noise level exceedance during Year 3 operations only. A sleep disturbance assessment showed predicted noise levels to satisfy strict EPA criteria. Due to proposed attenuation of plant, noise from current and approved operations is expected to decrease. A cumulative noise assessment in accordance with the INP and Mining SEPP demonstrates criteria would be satisfied. There is a very large range of human reaction to noise, including those who are very sensitive to noise. This noise-sensitive sector of the population would react to intruding noises that are barely audible within the overall noise environment, or would have an expectation of very low environmental noise levels. On the other hand, there are those within the community who find living in noisy environments, such as near major industry, on main roads or under aircraft flight paths, an acceptable situation. The bulk of the population lies within these two spectrums, being unaffected by low levels of noise and being prepared to accept levels of noise commensurate with their surroundings.
2. Characteristics of the proposal and its noise or vibrations	The MTO is an existing and well established mine in the Hunter Valley. The proposal seeks a continuation of all aspects of the mine as it presently operates. MTO currently invests significantly in noise management and would continue to do so under the proposal. For example, attenuation of all major plant across the MTW would exceed $50M and will be completed by the end of 2016. The applicant has committed to managing noise levels to meet or be within 1-2 dB of PSNL at the majority of properties. Managing noise to this level is reasonable and feasible for the Site. Managing noise to PSNLs at all locations was tested and found not to be reasonable or feasible for the Site as it would result in the mine not being economically viable. The assessment has identified that noise levels predicted above PSNLs would only occur

Table 10.9 Residual level of impact

INP factors for consideration	Justification of the proposal
	during worst case prevailing metrological conditions. It has been demonstrated that with continued management of the mine, such as by implementing equipment fleet with best practice noise suppression, that INP PSNLs can be met for the majority of assessment locations. Further, with the proposed attenuation of mobile plant at the Site, it is expected that noise levels would improve for all assessment locations to the east of the Site. The noise modelling adopts area specific validation and, therefore, provides added confidence in the accuracy of predictions. Extensive monitoring to measure compliance would be continued under the proposal. The economic study for the proposal has identified that the direct economic benefit that can be attributed to MTO is around $151million in NPV terms. The economic flow-on effects from MTO amount to: • for NSW, around $39million in additional income (in NPV terms), additional annual employment of 15 full-time equivalent workers, and a contribution to NSW GSP of around $45million; • for the Mid and Upper Hunter region, around $23million in additional income in NPV terms, and additional annual employment of 16 full-time equivalent workers; and for the Singleton LGA, around $9million in additional income in NPV terms, and additional annual employment of 4 full-time equivalent workers.
3. The feasibility of additional mitigation or management measures: —Alternative sites or routes for the development —The technical and economic feasibility of alternative noise controls or management procedures	The MTO is an existing and well established mine in the Hunter Valley and relocation is not reasonable or feasible. The applicant has considered a range of noise management and mitigation measures for the proposal. Those that are considered reasonable and feasible have been included in this assessment. These include: a significant investment in providing best practice noise suppression on equipment fleet. These measures in combination with the established real-time noise monitoring and management system would assist in keeping noise levels to within or below 1-2 dB of PSNL for the majority of assessment locations - this is a reasonable and feasible outcome for the viability of the proposal.
4. Equity issues in relation to: —The costs borne by a few for the benefit of others —The long-term cumulative increase in noise levels —The opportunity to compensate effectively those affected	The applicant would be investing significantly in noise management and mitigation over the life of the proposal which would be of significant benefit to the surrounding communities. The cumulative noise assessment demonstrates that with reasonable and feasible mitigation and management in place that the INP recommended acceptable amenity noise limits can be achieved for the life of the mine. The applicant would appropriately address all assessment locations identified with noise level exceedance as negotiated with DP&E.

10.7 Assessment of potential sleep disturbance

As described in Chapter 9, sleep within residences may be disturbed by intermittent noises such as shovel gates banging, bulldozer track plates and heavy vehicle reversing alarms. Typical noise levels from the loudest of these events are presented in Table 10.10.

Table 10.10 Maximum noise from intermittent sources

Noise source	Measured L_{max} noise level, dB(A)
Haul truck	125
Shovel gate banging	120
Bulldozer with reversing alarm	115

Table 10.10 indicates that the highest maximum noise levels expected at residences would likely result from haul trucks. The maximum sound power level of unmitigated haul trucks has previously been measured to be typically 125 dB(A) L_{max}. Maximum noise levels at each residence were calculated under assessable worst case weather for the three indicative years of operations.

Table 10.11 provides the maximum predicted L_{max} noise levels from the proposal under adverse meteorology at select representative assessment locations based on the typical equipment locations used for mining operations. Predictions were based on a single event, rather than the simultaneous operation of a number of plant items because of the low probability of more than one peak noise event occurring concurrently. The criteria used to assess sleep disturbance are based on the EPA's requirement for the maximum L_{max} level of 'background noise level plus 15 dB'. This results in sleep disturbance criteria of 45 to 48 dB(A) L_{max} depending on the individual assessment location's background noise levels.

Table 10.11 indicates that predicted noise levels under prevailing weather conditions are within the EPA's sleep disturbance criterion at all representative assessment locations shown.

Table 10.11 Predicted maximum noise levels from site under prevailing meteorology

Property no.	External L_{max} noise level from on-site plant, dB(A)			L_{max} criterion, dB(A)
	Year 3	Year 9	Year 14	
1	33[1]	<30	<30	45
34	35[1]	32	<30	45
42	39[1]	36[1]	<30	48
58	39[1]	36	<30	48
72	39[1]	38	30	48
75	40[1]	38	30	48
118	<30	<30	<30	45
126	33	32[1]	<30	45
144	41	42	42	45
148	41	40	40	45
237	38[1]	34[1]	<30	45

Notes: 1. The L_{eq} operational noise level prediction from Appendix D has been adopted where it is higher than the predicted L_{max} noise level. This is because it is theoretically impossible to measure an L_{eq} greater than the L_{max}. However, the prediction method adopts the maximum noise level from a single source which can result in an L_{max} prediction less than the overall L_{eq} result, which includes all noise sources.

10.8 Low frequency noise

10.8.1 Review of external noise monitoring data

The applicant currently undertakes regular LFN monitoring as part of the noise management regime for MTO as outlined in Section 3 and 4. Monitoring data from the 2013 calendar year was reviewed in detail (total of 46 measurements) to provide a current representation of potential LFN impacts from the mine. This method is preferred and considered more comprehensive than an alternate theoretical noise modelling approach, as it provides a 'real-world' representation of noise levels received in the surrounding communities.

The data was reviewed and assessed using the INP and Broner assessment methods as outlined in Section 9.7. The review has been limited to data samples where a mining noise contribution was observed from MTO only.

Table 10.12 Review of LFN monitoring data - 2013

Monitoring location	Measured noise levels with MTO site noise contribution, dB		INP assessment, dB[2]	'Broner' criteria, dBC	Comment on audible noise sources
	L_{Aeq}	L_{Ceq}	L_{Ceq}- L_{Aeq}		
Bulga Village	41	52	11	60	MTO
Inlet Road West (Bulga)	32	51	**19**	60	MTO
South Bulga	33	56	**23**	60	MTO and wind
South Bulga	34	55	**21**	60	MTO
Wambo Road	35	50	**16**	60	MTO
Wollemi Peak Road	42	51	10	60	MTO
Wollemi Peak Road	35	51	**16**	60	MTO & Dogs
Wollemi Peak Road	43	54	12	60	MTO
		INP criteria	**15**		

Notes: *1. Values are shown in bold if they exceed the INP or 'Broner' low frequency assessment criteria.*

2. As per Sections 9.7.1, the INP low frequency assessment method is exceeded if the difference is greater than or equal to 15 dB.

3. Source is Global Acoustics reports (various) - EMM has not verified the raw data.

Table 10.10 indicates that there are no instances where the INP and 'Broner' assessment criteria are exceeded in the same measurement sample.

The dB(C) minus dB(A) difference of 20 dB as used in DIN45680 is achieved for all measurements with the exception of two measurements at South Bulga. One of these measurements is influenced by wind noise which is likely to influence a higher dB(C) value. The remaining measurement accounts for less than 5% of the total measurements taken in the Bulga locality (23).

10.8.2 Review of representative internal noise levels – DEFRA curve assessment

External and internal noise monitoring was undertaken at a mine owned residence on Putty Road during the night-time on 17 April 2014 to quantify representative internal mine levels and to apply the DEFRA reference curve to highlight any potential for internal LFN impacts.

The dwelling selected is located at 1916 Putty Road (E 315215, N 6386292) approximately 3 km west of MTO. The dwelling construction was relatively lightweight with external timber cladding and internal villaboard/plasterboard lining. The house is raised on brick footings with a timber floor and joist construction. Standard glazing (4 to 6 mm) in aluminium frames was observed. Overall, the building construction is typical of a light-weight rural dwelling, providing relatively low impedance to LFN, and therefore provides a conservative test case for this exercise.

Measurements were taken in two rooms, one representative of a living and dining room and the other representative of a bedroom. Three measurement positions were selected in the living and dining room and two in the bedroom. The schematic in Figure 10.6 shows the approximate measurement positions.

Figure 10.6 Dwelling schematic and internal noise measurement positions

The sound level meters used were set to record third octave band spectral noise level data continuously in one minute intervals over a period of approximately two hours. Calibration was checked before and after and the meters were found to be within an acceptable tolerance (+/- 0.5 dB(A)). A mine noise contribution was clearly audible externally throughout the measurement period.

i External noise levels

The level of mining noise externally was approximated from measured levels between the third octave frequency range of 10 Hz to 800Hz inclusive (ie low pass). The external low pass noise level was found to be in the range of 59 dB(L) to 64 dB(L), 54 dB(C) to 58 dB(C) and 40 dB(A) to 44 dB(A). The average of the external noise levels is presented in Figure 10.8. It was also found that corresponding dB(C) minus dB(A) readings did not exceed 14 dB throughout the two hours of monitoring. Other noise sources included occasional traffic on Putty Road and natural noise sources such as insects and crickets.

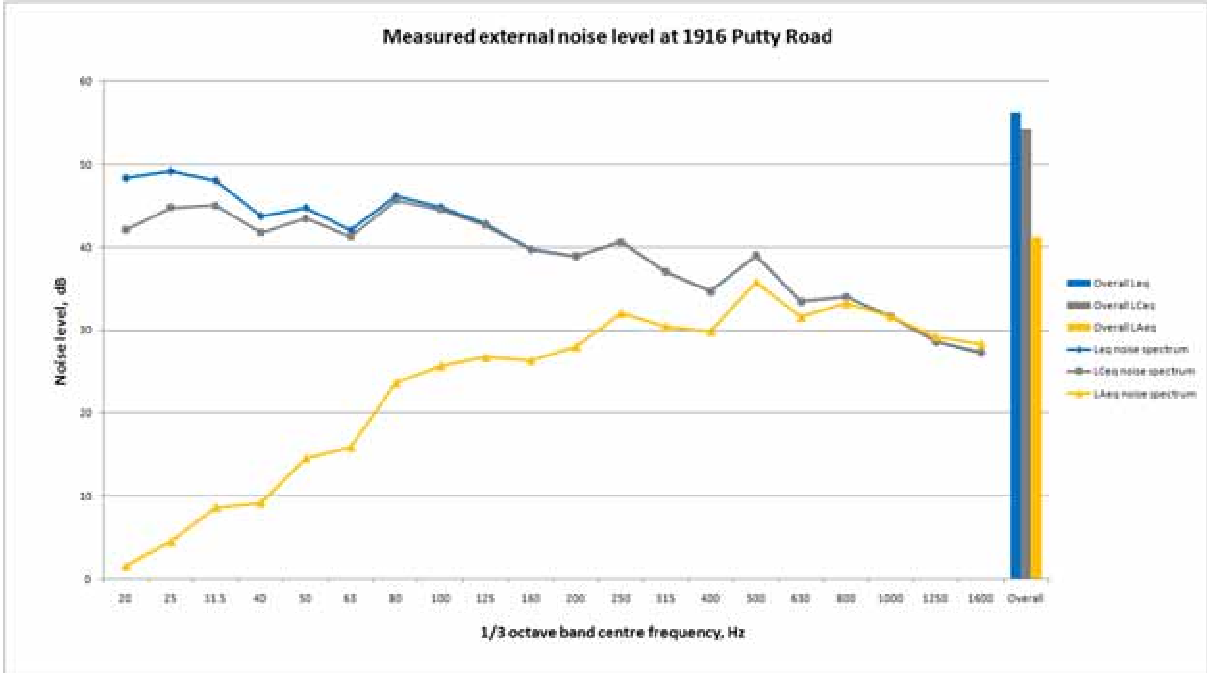


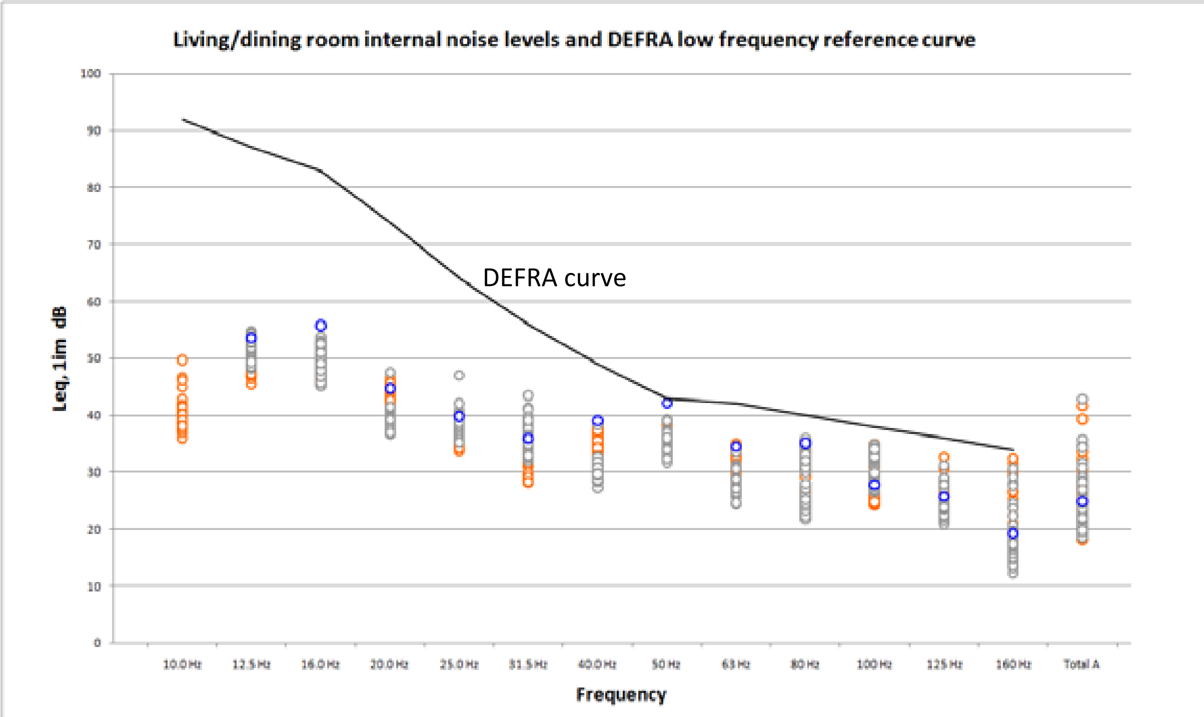
Figure 10.7 External noise levels at 1916 Putty Road

ii Internal noise levels

Whilst mining noise was audible, measurable and consistent outside this dwelling, internally mining noise was not audible in any areas or rooms. The dwelling where measurements were completed (1916 Putty Road) is relatively closer to MTO than Bulga village. To simulate noise levels at the closest private assessment locations in Bulga, the recorded internal noise levels were corrected by subtracting 3 dB to represent the loss in noise energy. This correction was calculated using MTO indicative Year 3 noise model, as the noise contribution from MTO operations was observed to be dominant externally during the measurement period.

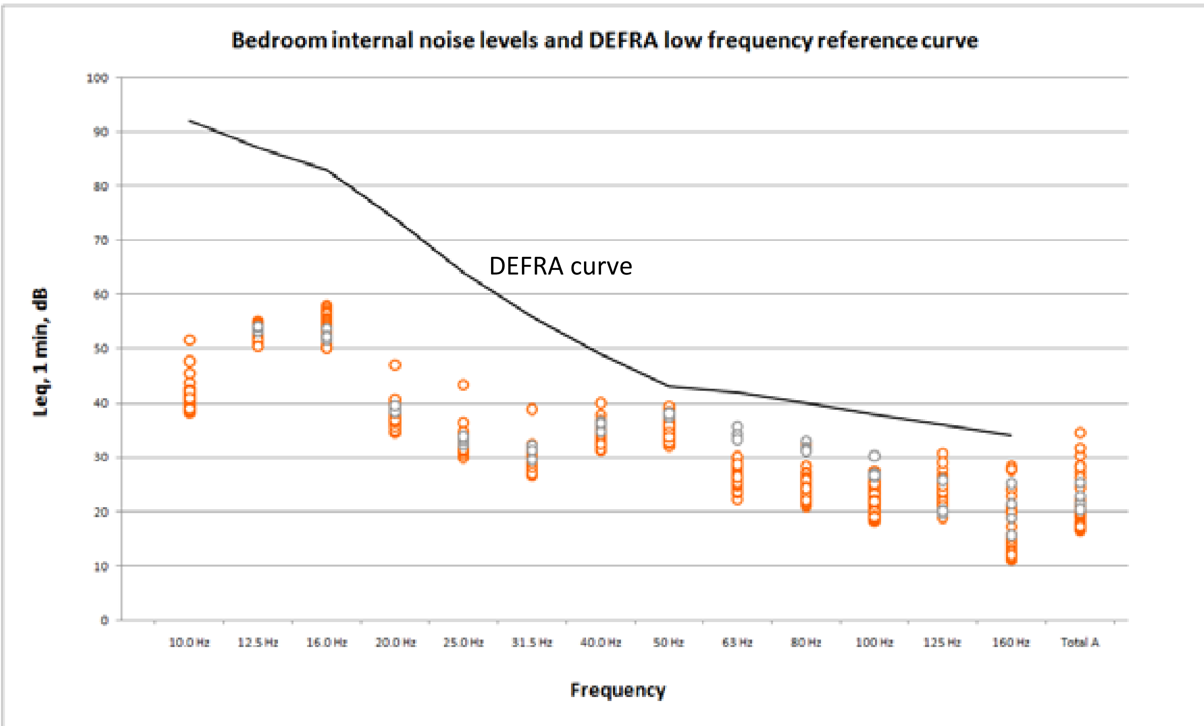
The results from the noise monitoring plotted against the DEFRA LFN reference curve are provided in Figure 10.8 and Figure 10.9 for the living/dining and bedroom, respectively. The charts exclude samples where extraneous noise was observed. A total of 88 one minute samples in the living/ dining room and 51 in the bedroom were captured.

It is clear from the charts that noise levels recorded in the living/dining and bedroom are below the DEFRA LFN reference curve for all measurements.



Note: orange marker represents position 1, grey marker represents position 2 and blue marker represents position 3.

Figure 10.8 Internal LFN monitoring results (living/dining room)



Note: orange marker represents position 1 and grey marker represents position 2.

Figure 10.9 Internal LFN monitoring results (bedroom)

10.9 Other activities

10.9.1 Construction

The proposal is for continuation of mining operations with no additional construction proposed. A construction noise impact assessment has therefore not been prepared in this report.

10.9.2 Road and rail traffic

The proposal will not result in any net increase in road and rail traffic volumes of that currently approved and therefore such impacts for the proposal have not been assessed.

10.9.3 Blasting

The proposal is for continuation of mining operations which will remain within the current approved boundaries. Blasting impacts will therefore remain as previously assessed in past noise and vibration impact assessments for the proposal.

11 Cumulative noise

This section provides an assessment of cumulative noise from all industrial sites to assess an area's amenity against the Mining SEPP's non-discretionary standards which adopt the INP's ANLs. The amenity criteria provide the over-arching goal that if achieved will mean a residence's amenity is not compromised.

The ambient noise at assessment locations in the vicinity of the proposal is also influenced by adjoining industrial premises, for example Wambo Mine, Hunter Valley Operations South Mine, MTO, Bulga Coal Complex, and to some extent Redbank Power Station.

The level of noise at residences from each of these surrounding industries was referenced from the following documents:

- an EIS for the expansion of Wambo Mine (Resource Strategies 2003);
- an Environmental Assessment Report for Hunter Valley Operations South Coal Project (ERM 2008);
- the EIS prepared for Mount Thorley Operations 2014 being exhibited concurrently with this proposal and corresponding noise assessment (EMM 2014); and
- the EIS for the Bulga Coal Complex optimisation project (Umwelt 2013).

Most of these assessments predict noise levels at residences under both calm and adverse weather conditions. To assess cumulative impacts, the L_{eq} noise levels predicted by this assessment were combined with the L_{eq} noise levels from relevant mining stages of each of the aforementioned assessments. For Redbank power station, EMM's attended noise measurements completed during a study in 2010 were adopted and are limited to assessment locations in Gouldsville and Long Point Road.

The cumulative impacts can be predicted for any given mining year, using the conservative approach of combining worst case adverse weather condition noise predictions from each of the mines. In some cases, this is a highly conservative strategy for at least the plausible scenario that for some assessment locations, meteorological conditions required to produce worst case noise levels from one mine will generally be different and are, in some cases, in opposition. For example, while westerly winds will serve to increase noise to residences in Warkworth village from Wambo Mine, they will also serve to decrease noise from the proposal.

In light of this, the assessment of cumulative noise impacts was undertaken on the basis of considering the following:

1. For assessment locations west of the proposal:
    a) adverse weather predictions from Wambo Mine and Redbank power station were combined with calm predictions from all other mines. This simulates north_westerly wind situations; and
    b) calm predictions from Wambo Mine where combined with adverse weather predictions from all other sites. This simulates easterly or south-easterly winds and therefore worst case for these assessment locations.

2. For assessment locations east and north of the proposal:

   a) adverse weather predictions from Bulga Optimisation Project (BOP) and the proposal where combined with calm predictions from all other sites. This simulates a southerly wind situation; and

   b) adverse predictions from all mines where combined with calm predictions from Hunter Valley South Operations. This simulates a conservative worst case situation for these assessment locations.

Table 11.1 summarises the cumulative noise levels at residences surrounding the proposal. As for the sleep disturbance assessment, a subset of representative assessment locations has been used to assess cumulative noise impacts. The results are presented as a range of noise levels in accordance with the approach described above.

The first number in the range relates to scenario (a) above, while the second number of the range relates to scenario (b). Also presented (in parentheses) within Table 11.1 is the respective percentage contribution to the total cumulative noise level from the Site. To estimate $L_{eq,period}$ noise levels from each site, the published $L_{eq,15minute}$ predictions were adjusted by subtracting 3dB to account for changes in operations and weather conditions between a “prevailing” worst case 15 minute and an average nine hour night period. This adjustment is conservative based on our experience in the field for this and other sites.

The results show that the INP's (and Mining SEPP) acceptable night time criteria are satisfied at most locations. The exception is location 77 in Warkworth village north-west of the Site (dominated by Wambo Mine operations worst case predictions). This assessment location is already entitled to acquisition rights upon request from a neighbouring mine. Given the magnitude of exceedance at location 77, and being representative of Warkworth village, through extrapolation the amenity criterion is likely to be exceeded at neighbouring locations 102 (the hall) and 264, due to Wambo Mine.

It is demonstrated that the non-discretionary Mining SEPP is satisfied for Bulga residences and, therefore, the area's amenity is not compromised as it meets the INP's ANL. Further, the amenity, which relates to cumulative noise from all industry, cannot worsen for this area because no new large scale industry will be able to physically exist in a position that could push amenity levels any higher for Bulga residences.

Refer to Figure 7.1 for assessment locations and to Figure 11.1 for predicted amenity noise criteria exceedances.

Table 11.1 Cumulative noise at properties, dB(A) $L_{eq,period}$

Property no.	MTO mine operating years			INP Amenity criteria
	Year 3	Year 9	Year 14	
1	26 (53%) - 33 (54%)	25 (21%) - 32 (23%)	23 (1%) - 32 (4%)	40
19	34 (9%) - 39 (27%)	34 (4%) - 38 (12%)	34 (0%) - 37 (3%)	40
32	32 (11%) - 38 (34%)	33 (3%) - 37 (20%)	33 (1%) - 36 (4%)	40
34	34 (6%) - 38 (14%)	34 (2%) - 40 (5%)	35 (0%) - 38 (1%)	40
37	34 (7%) - 38 (22%)	34 (2%) - 38 (17%)	34 (0%) - 37 (3%)	40
41	29 (58%) - 37 (39%)	29 (30%) - 37 (24%)	27 (0%) - 36 (3%)	40
42	32 (20%) - 38 (47%)	32 (14%) - 37 (34%)	31 (0%) - 36 (5%)	40
44	32 (29%) - 38 (42%)	33 (14%) - 38 (22%)	32 (0%) - 36 (4%)	40
58	32 (24%) - 38 (38%)	33 (14%) - 38 (21%)	32 (0%) - 36 (5%)	40
77	**53 (0%) - 57 (0%)**	**53 (0%) - 57 (0%)**	**53 (0%) - 57 (0%)**	**50**
84	29 (67%) - 37 (39%)	28 (27%) - 37 (20%)	25 (1%) - 33 (6%)	40
118	29 (2%) - 35 (10%)	28 (2%) - 35 (5%)	28 (1%) - 34 (1%)	40
128	34 (3%) - 39 (9%)	34 (3%) - 37 (12%)	33 (2%) - 37 (3%)	40
146	33 (35%) - 41 (33%)	32 (47%) - 40 (42%)	31 (43%) - 40 (25%)	50
149	34 (19%) - 39 (72%)	35 (28%) - 39 (70%)	31 (37%) - 38 (85%)	40
150	34 (8%) - 37 (50%)	34 (10%) - 36 (45%)	30 (14%) - 35 (66%)	40
155	32 (5%) - 36 (19%)	32 (4%) - 35 (15%)	31 (3%) - 35 (7%)	40
157	32 (4%) - 36 (17%)	32 (4%) - 35 (19%)	31 (2%) - 35 (6%)	40
237	29 (71%) - 38 (50%)	29 (33%) - 37 (18%)	27 (1%) - 36 (3%)	40

Notes: 1. Numbers in bold indicates levels above EPA's night Amenity Criterion.

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Cumulative noise assessment

Mount Thorley Operations

Noise and vibration assessment

Figure 11.1

12 INP Checklist

The INP provides nine steps for noise management at Section 1.4 'Applying the policy'. For reference, these steps are provided in Table 12.1 along with references within this report as to where these steps have been addressed.

Table 12.1 INP Checklist

INP Step	Reference section in this document
1 Determining the project specific noise levels for intrusiveness and amenity that are relevant to the site or the area (*Section 2*).	Section 9.1
2. Measuring and determining existing background and ambient noise levels, using the method relevant to the expected level of impact (as outlined in *Section 3)*.	Section 8
3. Where the proposed development is expected to produce annoying noise characteristics, adjustments are to be applied to the noise levels produced by the development in question (as outlined in *Section 4)*.	Section 9.7 and 10.8
4. Predicting or measuring the noise levels produced by the development in question, having regard to meteorological effects (such as wind, temperature inversions) (see *Section5*).	Section 10
5. Comparing the predicted or measured noise level with the project-specific noise levels and assessing impacts (*Section 6*).	Section 10.5, 10.6 and Appendix D
6. Considering feasible and reasonable noise mitigation strategies where the project specific noise levels are exceeded (*Section 7*).	Sections 3 to 6, 10.2.1 and 10.6
7. Negotiation between the regulatory/consent authority and the proponent and between the community and the proponent to evaluate the economic, social and environmental costs and benefits from the proposed development against the noise impacts (*Section 8*).	Refer EIS Chapter 7 'Stakeholder engagement', and Chapter 24 'Justification and conclusion'. Several meetings have been held between the applicant and the regulator in relation to noise, social and economic implications of the proposal.
8. The regulatory/consent authority sets statutory compliance levels that reflect the achievable and agreed noise limits for the development (*Section 9*).	To be completed by consent authority at the completion of the approval process.
9. Monitoring of environmental noise levels from the development to determine compliance with the consent/licence conditions (*Section 11*).	To be completed post approval for the proposal. Monitoring data for the current operations is provided in Section 6.

13 Conclusion

This study considers the potential for noise impacts to residences from the proposal, including:

- background noise level analysis in accordance with the INP;
- establishing PSNLs in accordance with the INP;
- detailed three-dimensional noise modelling and predictions;
- assessment against PSNLs;
- assessment of potential sleep disturbance;
- assessment of LFN (external and internal);
- best practice sound suppression on all major plant at an estimated capital cost exceeding $50M across MTW; and
- description of comprehensive management procedures adopted by the Site.

The assessment of the potential for noise impacts on 221 residences over the life of the proposal includes predictions of emissions based on an equipment fleet with best practice sound suppression on all major plant. Further, the Site has developed a first in the NSW industry for pre-emptive real time noise modelling interface (a first in the NSW mining industry) and is using best practice real time noise monitoring and management techniques. This constitutes all reasonable and feasible mitigation has and would be adopted as part of the proposal.

One of the study's aims was to demonstrate the effectiveness of managing off site noise to within the INP's requirements and as described below this has largely been achieved.

Operational noise at residences was predicted under varying meteorological conditions prevalent at the Site including calm, winds and temperature gradient conditions. Modelling has been validated in the past against monitoring results with strong correlations found.

The study developed a fairer approach to background noise level assignment for Bulga residences using long-term monitoring locations and transition of RBLs between these locations.

The assessment concludes that operational noise will comply with the INP's operational criteria for all assessment locations during calm weather conditions for day, evening and night periods.

Predictions during adverse weather indicate that operational noise levels from the proposal would likely present significant noise level exceedances at one assessment location (149) located to the east. To that end, operational noise to eastern assessment locations is expected to remain relatively unchanged from existing and approved activities. No significant exceedances are predicted for assessment locations in Bulga. Further, the proposal is likely to result in lower noise levels for eastern receivers than current and approved operations due to implementation of plant attenuation.

References

Bill Jordan & Associates (2009), Edinglassie Homestead & Rous Lench – Blast Vibration Vulnerability

British Standard 7385-2 and US Bureau of Mines Standard RI 8507 (2006)

Bulga Optimisation (Umwelt 2013); Project Environmental Impact Statement

International Organisation for Standardisation (1999); DIN 4150 Part 3 – Structural Vibration: Effects of Vibration Structures

Deutsche Norm (1999); DIN 4150 Structural Vibration Part 3: Effects of Vibration on Structures

Blastronics Pty Limited (1994); Drill & Blast Study, Mount Pleasant, prepared for Coal & Allied

Dr Norm Broner (2011); A Simple Outdoor Criterion for Assessment of Low Frequency Noise Emission Acoustics Australia Vol.39

Dr Moorhouse (2005); Proposed criteria for the assessment of low frequency noise disturbanceBill Jordan & Associates (2009); Edinglassie Homestead & Rous Lench – Blast Vibration Vulnerability

EMM (2010); Mount Thorley Warkworth Operations Modification - Proposed Warkworth Extension Acoustic Assessment report

Experimental Outdoor Sound Propagation' 13th International Congress on Sound & Vibration, (2006) and Experimental Outdoor Sound Propagation vs ENM Australian and New Zealand Acoustic Society Conference (2006)

Environment Protection Authority (2011); Road Noise Policy

Environment Protection Authority (2000); NSW Industrial Noise Policy

Australian and New Zealand Environment and Conservation Council (ANZECC) (1990); Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration

The Australian Standard, AS2187.2 (2006); Explosives - Storage and Use Part 2 Use of Explosives (Appendix J)

The State Environmental Planning Policy (2007); Mining, Petroleum Production and Extractive Industries (Mining SEPP)

Resource Strategies (2002); Wambo Development Project, Environmental Impact Statement

Appendix A

Assessment locations

Table A.1 Properties included in the noise assessment

Locality	Assessment location ID	MGA Coordinates	
		Easting	Northing
Bulga	1	310903	6386238
Bulga	2	311055	6386261
Bulga	3	311295	6386059
Bulga	4	311336	6385751
Bulga	5	311384	6386200
Bulga	6	311422	6386223
Bulga	7	311470	6385618
Bulga	8	311735	6385855
Bulga	9	311832	6385649
Bulga	10	311950	6386665
Bulga	12	312442	6386044
Bulga	13	312532	6387028
Bulga	14	312632	6386066
Bulga	15	312729	6385875
Bulga	16	312822	6386804
Bulga	17	312814	6387573
Bulga	18	312935	6385847
Bulga	19	312900	6387741
Bulga	20	313041	6385812
Bulga	21	312998	6386821
Bulga	22	313169	6385713
Bulga	23	313193	6385453
Bulga	24	313145	6387267
Bulga	26	313266	6385706
Bulga	28	313335	6385003
Bulga	29	313160	6388183
Bulga	30	313270	6386465
Bulga	31	313281	6386646
Bulga	32	313252	6387528
Bulga	33	313338	6386039
Bulga	34	313265	6388491
Bulga	35	313406	6386485
Bulga	36	313473	6385589
Bulga	37	313345	6387861
Bulga	38	313489	6385650
Bulga	39	313511	6385747
Bulga	40	313595	6385794
Bulga	41	313690	6384726
Bulga	42	313580	6386816
Bulga	43	313658	6385668
Bulga	44	313658	6385708
Bulga	45	313725	6385198

Table A.1 Properties included in the noise assessment

Locality	Assessment location ID	MGA Coordinates	
		Easting	Northing
Bulga	46	313798	6385640
Bulga	47	313793	6385729
Bulga	48	313823	6385853
Bulga	49	313872	6385678
Bulga	50	313898	6385517
Bulga	52	313956	6385265
Bulga	53	313965	6385488
Bulga	54	314037	6384456
Bulga	55	313981	6385757
Bulga	56	314005	6385480
Bulga	57	314055	6385470
Bulga	58	314046	6385804
Bulga	60	314128	6385459
Bulga	61	314231	6384325
Bulga	62	314225	6385443
Bulga	63	314229	6385540
Bulga	64	314242	6385504
Bulga	65	314239	6385584
Bulga	66	314258	6385447
Bulga	67	314434	6383176
Bulga	70	314462	6383042
Bulga	71	314354	6385377
Bulga	72	314392	6385359
Bulga	73	314407	6385160
Bulga	74	314514	6384263
Bulga	75	314546	6385220
Bulga	80	314769	6383296
Bulga	82	314734	6384379
Bulga	84	314796	6383618
Bulga	89	314951	6383454
Bulga	210	314178	6385559
Bulga	211	314331	6385481
Bulga	215	313354	6386390
Bulga	217	312125	6386110
Bulga	218	311450	6386578
Bulga	219	311134	6386568
Bulga	220	311258	6385905
Bulga	221	311001	6385414
Bulga	222	311233	6385294
Bulga	223	311393	6385458
Bulga	224	311716	6385367
Bulga	225	312256	6385540

Table A.1 Properties included in the noise assessment

Locality	Assessment location ID	MGA Coordinates	
		Easting	Northing
Bulga	226	312474	6385495
Bulga	227	312569	6385509
Bulga	228	312698	6385457
Bulga	229	312866	6385557
Bulga	230	312952	6385439
Bulga	231	313060	6385467
Bulga	234	314048	6384261
Bulga	235	314181	6384088
Bulga	236	314679	6384143
Bulga	237	314116	6383992
Bulga	238	314448	6383932
Bulga	243	314883	6383176
Bulga	252	314827	6384207
Bulga	253	312973	6385584
Bulga	254	314529	6384103
Bulga	255	312973	6386930
Bulga	266	310048	6389815
Bulga	267	309407	6389413
Bulga	268	308672	6389436
Bulga	903	314821	6383080
Bulga	904	314024	6382465
Bulga	905	313176	6382198
Bulga	909	314611	6382770
Bulga	911	313271	6382442
Bulga	917	314549	6382967
Bulga	918	314686	6382893
Bulga	919	313866	6385003
Bulga	920	314208	6385455
Bulga	921	313692	6384676
Bulga	922	313313	6384456
Bulga	927	314213	6382445
Bulga	927	314251	6382364
Bulga	927	314400	6382451
Bulga	927	314414	6381446
Bulga	927	314462	6381631
Bulga	927	314521	6381618
Bulga	927	313398	6381173
Bulga	927	313742	6381405
Bulga	927	313851	6381411
Bulga	927	313902	6381509
Bulga	928	314270	6382655
Bulga	929	314462	6382864

Table A.1 Properties included in the noise assessment

Locality	Assessment location ID	MGA Coordinates	
		Easting	Northing
Bulga	936	314376	6382753
Gouldsville/Long Point	126	320764	6393699
Gouldsville/Long Point	127	320624	6396932
Gouldsville/Long Point	128	320916	6394511
Gouldsville/Long Point	130	321271	6394970
Gouldsville/Long Point	134	321472	6395034
Gouldsville/Long Point	139	321707	6394686
Gouldsville/Long Point	141	321604	6397030
Gouldsville/Long Point	167	322254	6396725
Gouldsville/Long Point	168	322468	6396793
Gouldsville/Long Point	169	321959	6396271
Gouldsville/Long Point	170	322379	6396285
Gouldsville/Long Point	172	321925	6395400
Gouldsville/Long Point	173	322099	6395301
Gouldsville/Long Point	174	322545	6395438
Gouldsville/Long Point	175	322633	6395534
Gouldsville/Long Point	176	322830	6395688
Gouldsville/Long Point	177	323156	6395384
Gouldsville/Long Point	178	323801	6395607
Gouldsville/Long Point	179	324177	6395141
Gouldsville/Long Point	248	322876	6395431
Gouldsville/Long Point	249	323284	6395685
Gouldsville/Long Point	250	324927	6395679
Gouldsville/Long Point	251	325339	6394874
Gouldsville/Long Point	262	320794	6393794
Hambledon Hill/Wylies Flat	152	323454	6392457
Hambledon Hill/Wylies Flat	155	323565	6393343
Hambledon Hill/Wylies Flat	156	323610	6393617
Hambledon Hill/Wylies Flat	157	323739	6393594
Hambledon Hill/Wylies Flat	180	324246	6392934
Hambledon Hill/Wylies Flat	181	323983	6392725
Hambledon Hill/Wylies Flat	182	324296	6392725
Hambledon Hill/Wylies Flat	183	323903	6392368
Hambledon Hill/Wylies Flat	184	324407	6392127
Hambledon Hill/Wylies Flat	185	324272	6391894
Hambledon Hill/Wylies Flat	186	324164	6391772
Hambledon Hill/Wylies Flat	187	324308	6391565
Hambledon Hill/Wylies Flat	191	323873	6391630
Hambledon Hill/Wylies Flat	192	323595	6391320
Hambledon Hill/Wylies Flat	263	323786	6391522
Hambledon Hill/Wylies Flat	937	322832	6393883
Hambledon Hill/Wylies Flat	937	322935	6394004

Table A.1 Properties included in the noise assessment

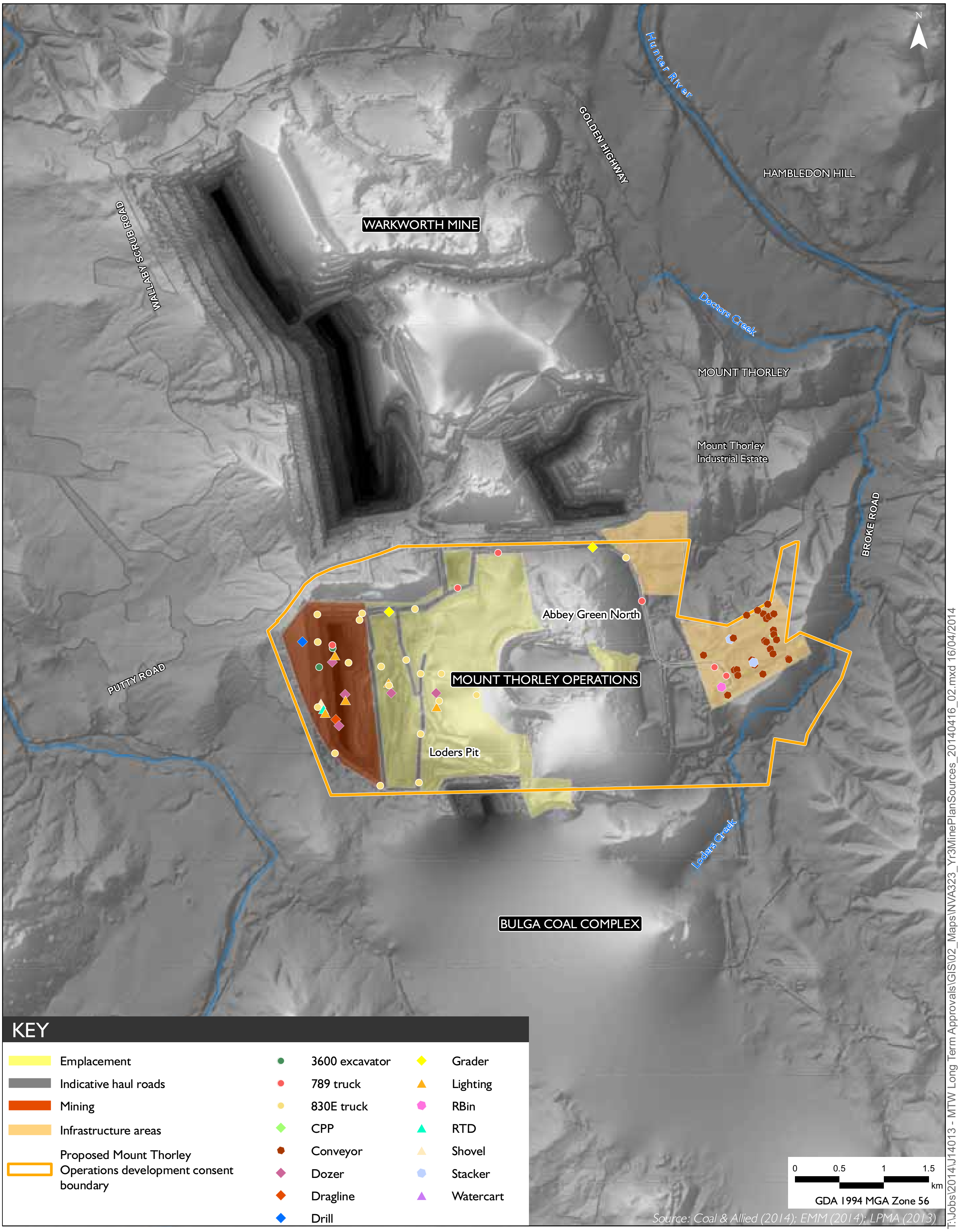
Locality	Assessment location ID	MGA Coordinates	
		Easting	Northing
Hambledon Hill/Wylies Flat	937	323028	6394431
Hambledon Hill/Wylies Flat	937	323333	6393272
Hambledon Hill/Wylies Flat	937	323391	6393295
Maison Dieu	117	317982	6397794
Maison Dieu	118	318128	6397356
Maison Dieu	120	318504	6398457
Maison Dieu	121	318530	6398039
Maison Dieu	122	318608	6398554
Maison Dieu	123	318658	6398205
Maison Dieu	124	318655	6398582
Maison Dieu	160	317883	6399178
Maison Dieu	161	318010	6399448
Maison Dieu	162	318011	6399407
Maison Dieu	163	318114	6399572
Maison Dieu	244	318808	6399092
Maison Dieu	245	318679	6399194
Maison Dieu	246	318795	6399314
Maison Dieu	247	318879	6399292
Maison Dieu	256	317979	6399821
Maison Dieu	257	318793	6399221
Maison Dieu	258	318104	6399611
Maison Dieu	259	318211	6397178
Maison Dieu	260	318180	6399198
Maison Dieu	261	318030	6399106
Maison Dieu	265	318014	6397793
Milbrodale	111	316609	6382098
Milbrodale	193	316558	6380293
Milbrodale	197	317716	6380532
Milbrodale	199	317036	6377983
Milbrodale	200	317360	6378494
Milbrodale	201	316963	6378778
Milbrodale	202	316649	6378621
Milbrodale	203	316167	6378781
Milbrodale	204	316407	6379326
Milbrodale	205	316333	6379327
Milbrodale	206	316214	6379385
Milbrodale	207	315682	6379608
Milbrodale	208	314955	6381041
Milbrodale	923	314505	6381343
Milbrodale	926	315197	6381155
Mount Thorley	144	322654	6389614
Mount Thorley	146	322820	6389611

Table A.1 Properties included in the noise assessment

Locality	Assessment location ID	MGA Coordinates	
		Easting	Northing
Mount Thorley	148	323360	6389527
Mount Thorley	149	323510	6388982
Mount Thorley	150	323560	6389775
Mount Thorley	153	323662	6389415
Mount Thorley	188	324940	6390387
Mount Thorley	190	323552	6389746
Mount Thorley	915	322542	6389581
Mount Thorley	932	325626	6388538
Warkworth	77	314103	6394482
Warkworth	102	314808	6394346
Warkworth	264	314870	6394227

Appendix B

Mine plans and modelled equipment locations

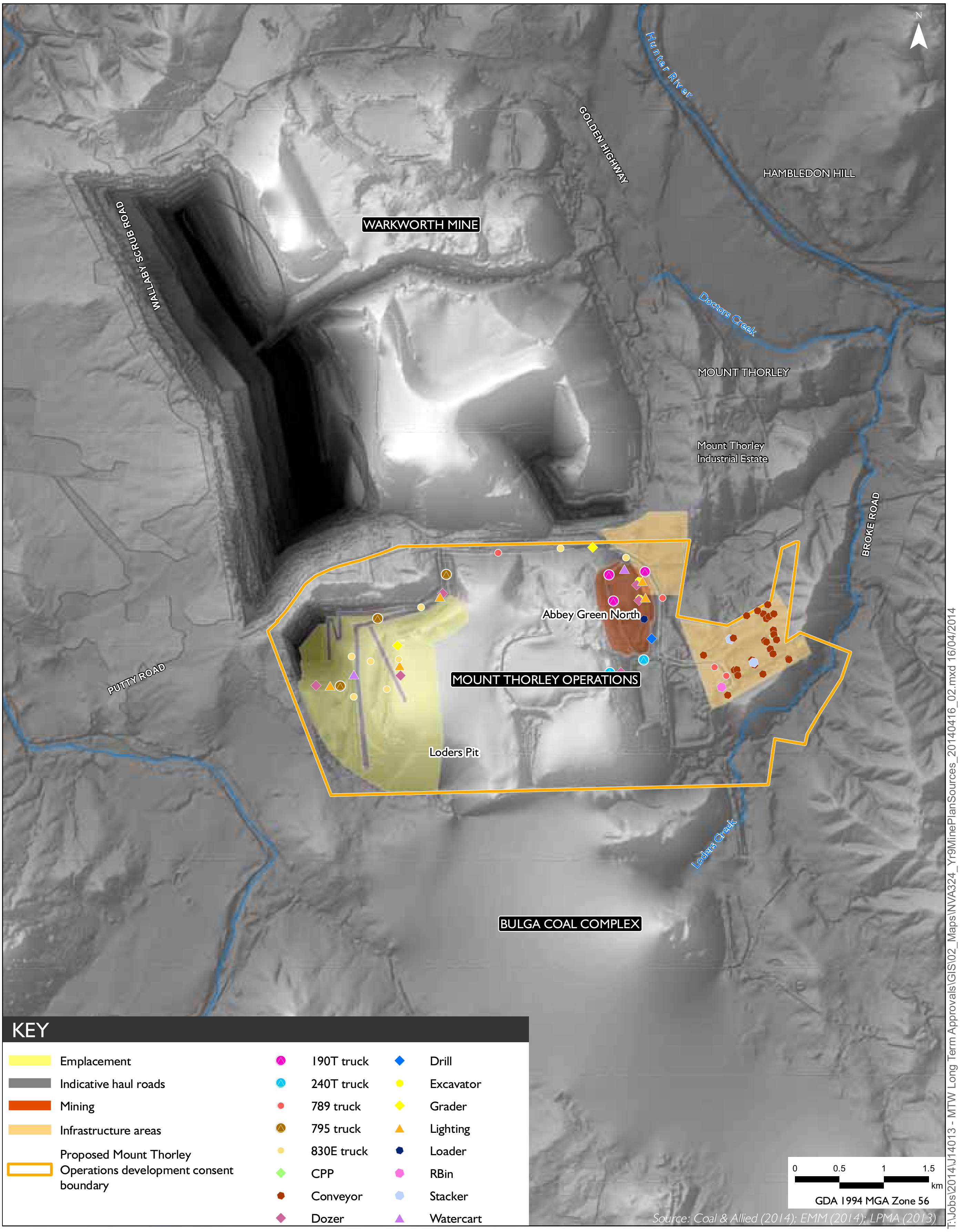


Year 3 mine plan and equipment locations

Mount Thorley Operations

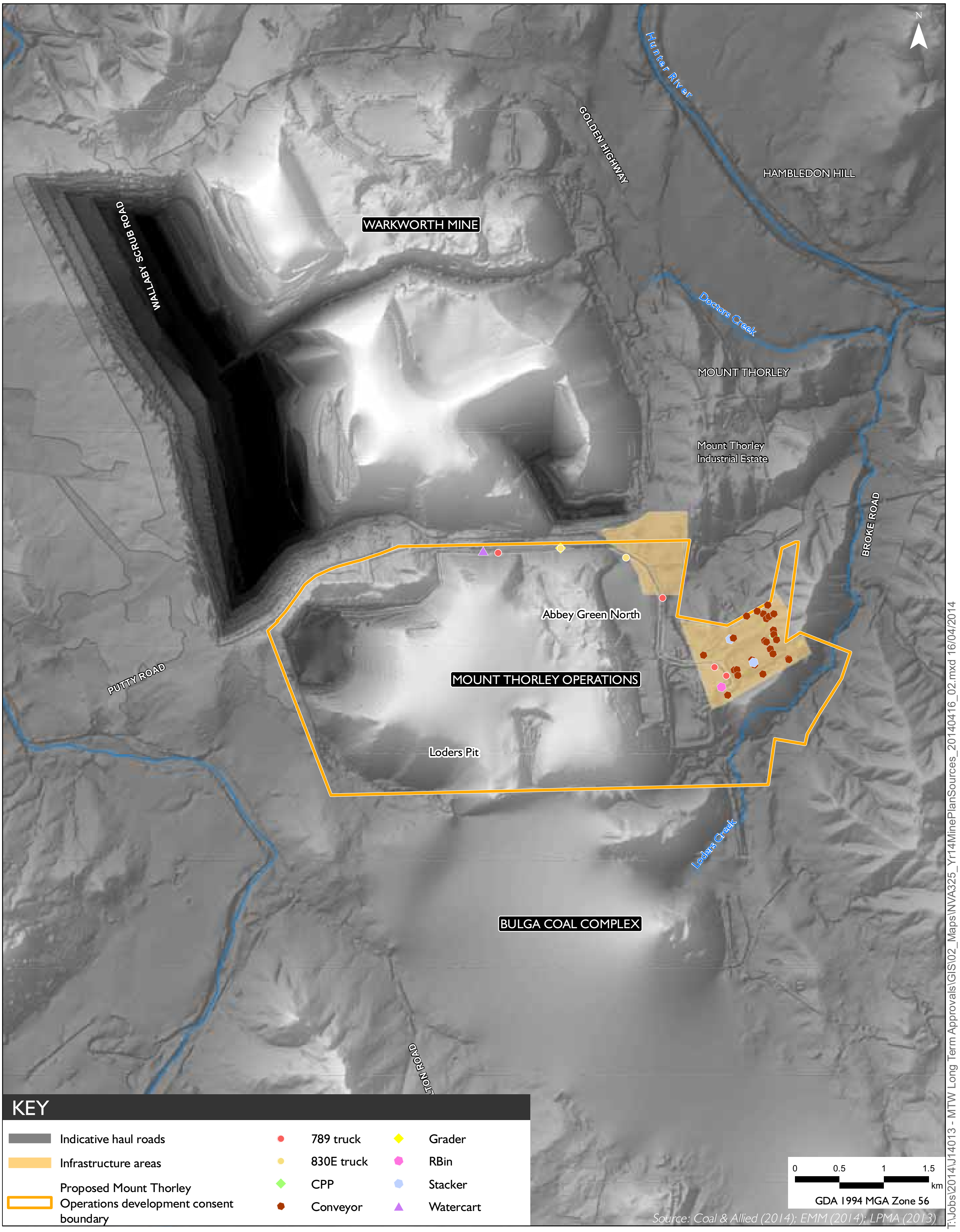
Noise and vibration assessment

Figure B1



EMM
COAL & ALLIED

Year 9 mine plan and equipment locations
Mount Thorley Operations
Noise and vibration assessment
Figure B2



EMM
COAL & ALLIED

Year 14 mine plan and equipment locations

Mount Thorley Operations

Noise and vibration assessment

Figure B3

Appendix C

INP wind analysis

Table C.1 Day percentage of wind speed (vector at 22.5o intervals)

Direction	Winter	Autumn	Spring	Summer
22.5°	17.4	23.6	21.9	21
45 °	20.8	23.3	17.6	22.2
67.5 °	23	21.6	12.9	22
90 °	25.7	24.6	12.9	21.1
112 .5 °	27.8	28.9	15.3	22.1
135 °	27.2	29.3	16	21.7
157.5 °	24.9	28	16	19.7
180 °	21.5	24.9	15.5	16.3
202.5 °	16.8	21	14.6	13
225 °	12.4	17.5	13.4	10.1
247.5 °	6.4	12.5	13.3	7.3
270 °	5.6	14	16.9	8.3
292.5 °	9.3	19.1	22.5	13.1
315 °	11.3	20	23.3	15.2
337.5 °	12.7	20.8	23.6	16.6
360 °	14.6	22	23.3	18.6

Notes: 1. Bold highlight denotes occurrence of 30 % and greater.

Table C.2 Evening percentage of wind speed (vector at 22.5o intervals)

Direction	Winter	Autumn	Spring	Summer
22.5°	8.6	8.2	9	13
45 °	13	13.3	7.7	17.4
67.5 °	18.1	20.3	8.1	24.3
90 °	22	**30.6**	16.4	28.7
112 .5 °	22.8	**44.8**	**33.6**	**31.7**
135 °	22.7	**48.7**	**41.1**	**31.8**
157.5 °	21.8	**48.3**	**42.9**	**30.5**
180 °	18.9	**46.4**	**43.9**	28.1
202.5 °	13.6	**40.3**	**43.1**	21.8
225 °	8.2	**32.2**	**41.4**	13.9
247.5 °	5.1	20.8	**32.1**	10.7
270 °	4.3	9.4	18.1	9.6
292.5 °	4.3	7.4	15.3	9.9
315 °	4.4	7.1	14.4	9.8
337.5 °	5.3	7.1	13	10
360 °	6.4	6.9	11.2	10.8

Notes: 1. Bold highlight denotes occurrence of 30 % and greater.

Table C.3 Night percentage of wind speed (vector at 22.5o intervals)

Direction	Winter	Autumn	Spring	Summer
22.5°	7.2	9.8	17.4	13.6
45 °	9.4	7.1	10	10.9
67.5 °	18	7.6	4.2	12.3
90 °	**32**	23.1	9.7	25.4
112 .5 °	**44**	**43.1**	21.2	**39.3**
135 °	**46.8**	**47**	25.8	**43.6**
157.5 °	**47.1**	**48.5**	27.8	**45**
180 °	**46.2**	**49**	29.3	**45.1**
202.5 °	**41.9**	**48.6**	**31.3**	**43.6**
225 °	**30.8**	**44.4**	**33.1**	**38.1**
247.5 °	16	27.9	**30.6**	25.8
270 °	7.3	16	27.3	19.4
292.5 °	7	16.1	28	19.6
315 °	7.1	15.3	27.3	19
337.5 °	7.2	14.4	25.7	18
360 °	7.2	12.8	22.7	16.2

Notes: 1. Bold highlight denotes occurrence of 30 % and greater.

Appendix D

Predicted noise levels during calm and INP prevailing meteorological conditions

Table D.1 Predicted operational noise levels during calm and prevailing meteorological conditions, dB(A)

Locality	Assessment location	RBL	Indicative Year 3, $L_{eq,15min}$			Indicative Year 9, $L_{eq,15min}$			Indicative Year 14, $L_{eq,15min}$			INP PSNL, $L_{eq,15min}$	Potential acquisition criteria, $L_{eq,15min}$
			Calm		Prevailing	Calm		Prevailing	Calm		Prevailing		
			Day	Eve/Night	Eve/Night	Day	Eve/Night	Eve/Night	Day	Eve/Night	Eve/Night		
Bulga	1	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	2	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	3	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	4	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	5	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	6	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	7	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	8	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	9	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	10	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	12	30	≤35	≤35	36	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	13	33	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	38	43
	14	30	≤35	≤35	36	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	15	30	≤35	≤35	36	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	16	33	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	38	43
	17	33	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	38	43
	18	31	≤36	≤36	37	≤36	≤36	≤36	≤36	≤36	≤36	36	41
	19	33	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	38	43
	20	31	≤36	≤36	37	≤36	≤36	≤36	≤36	≤36	≤36	36	41
	21	33	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	38	43
	22	31	≤36	≤36	37	≤36	≤36	≤36	≤36	≤36	≤36	36	41
	23	31	≤36	≤36	37	≤36	≤36	≤36	≤36	≤36	≤36	36	41
	24	33	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	38	43
	26	31	≤36	≤36	37	≤36	≤36	≤36	≤36	≤36	≤36	36	41
	28	32	≤37	≤37	≤37	≤37	≤37	≤37	≤37	≤37	≤37	37	42
	29	30	≤35	≤35	37	≤35	≤35	≤35	≤35	≤35	≤35	35	40

Table D.1 Predicted operational noise levels during calm and prevailing meteorological conditions, dB(A)

Locality	Assessment location	RBL	Indicative Year 3, $L_{eq,15min}$			Indicative Year 9, $L_{eq,15min}$			Indicative Year 14, $L_{eq,15min}$			INP PSNL, $L_{eq,15min}$	Potential acquisition criteria, $L_{eq,15min}$
			Calm		Prevailing	Calm		Prevailing	Calm		Prevailing		
			Day	Eve/Night	Eve/Night	Day	Eve/Night	Eve/Night	Day	Eve/Night	Eve/Night		
	30	33	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	38	43
	31	33	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	38	43
	32	33	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	38	43
	33	32	≤37	≤37	38	≤37	≤37	≤37	≤37	≤37	≤37	37	42
	35	33	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	38	43
	36	32	≤37	≤37	38	≤37	≤37	≤37	≤37	≤37	≤37	37	42
	37	33	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	38	43
	38	32	≤37	≤37	≤37	≤37	≤37	≤37	≤37	≤37	≤37	37	42
	39	32	≤37	≤37	≤37	≤37	≤37	≤37	≤37	≤37	≤37	37	42
	40	32	≤37	≤37	38	≤37	≤37	≤37	≤37	≤37	≤37	37	42
	41	32	≤37	≤37	38	≤37	≤37	≤37	≤37	≤37	≤37	37	42
	42	33	≤38	≤38	39	≤38	≤38	≤38	≤38	≤38	≤38	38	43
	43	32	≤37	≤37	38	≤37	≤37	≤37	≤37	≤37	≤37	37	42
	44	32	≤37	≤37	38	≤37	≤37	≤37	≤37	≤37	≤37	37	42
	45	32	≤37	≤37	38	≤37	≤37	≤37	≤37	≤37	≤37	37	42
	46	32	≤37	≤37	38	≤37	≤37	≤37	≤37	≤37	≤37	37	42
	47	32	≤37	≤37	38	≤37	≤37	≤37	≤37	≤37	≤37	37	42
	48	32	≤37	≤37	38	≤37	≤37	≤37	≤37	≤37	≤37	37	42
	49	32	≤37	≤37	38	≤37	≤37	≤37	≤37	≤37	≤37	37	42
	50	32	≤37	≤37	38	≤37	≤37	≤37	≤37	≤37	≤37	37	42
	52	33	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	38	43
	53	33	≤38	≤38	39	≤38	≤38	≤38	≤38	≤38	≤38	38	43
	54	33	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	38	43
	55	33	≤38	≤38	39	≤38	≤38	≤38	≤38	≤38	≤38	38	43
	56	33	≤38	≤38	39	≤38	≤38	≤38	≤38	≤38	≤38	38	43
	57	33	≤38	≤38	39	≤38	≤38	≤38	≤38	≤38	≤38	38	43

Table D.1 Predicted operational noise levels during calm and prevailing meteorological conditions, dB(A)

Locality	Assessment location	RBL	Indicative Year 3, $L_{eq,15min}$			Indicative Year 9, $L_{eq,15min}$			Indicative Year 14, $L_{eq,15min}$			INP PSNL, $L_{eq,15min}$	Potential acquisition criteria, $L_{eq,15min}$
			Calm		Prevailing	Calm		Prevailing	Calm		Prevailing		
			Day	Eve/Night	Eve/Night	Day	Eve/Night	Eve/Night	Day	Eve/Night	Eve/Night		
	58	33	≤38	≤38	39	≤38	≤38	≤38	≤38	≤38	≤38	38	43
	60	33	≤38	≤38	39	≤38	≤38	≤38	≤38	≤38	≤38	38	43
	61	33	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	38	43
	62	33	≤38	≤38	39	≤38	≤38	≤38	≤38	≤38	≤38	38	43
	63	33	≤38	≤38	39	≤38	≤38	≤38	≤38	≤38	≤38	38	43
	64	33	≤38	≤38	39	≤38	≤38	≤38	≤38	≤38	≤38	38	43
	65	33	≤38	≤38	39	≤38	≤38	≤38	≤38	≤38	≤38	38	43
	66	33	≤38	≤38	39	≤38	≤38	≤38	≤38	≤38	≤38	38	43
	67	33	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	38	43
	70	33	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	38	43
	71	33	≤38	≤38	39	≤38	≤38	≤38	≤38	≤38	≤38	38	43
	72	33	≤38	≤38	39	≤38	≤38	≤38	≤38	≤38	≤38	38	43
	73	33	≤38	≤38	39	≤38	≤38	≤38	≤38	≤38	≤38	38	43
	74	33	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	38	43
	75	33	≤38	≤38	40	≤38	≤38	≤38	≤38	≤38	≤38	38	43
	80	33	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	38	43
	82	33	≤38	≤38	39	≤38	≤38	≤38	≤38	≤38	≤38	38	43
	84	33	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	38	43
	89	33	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	38	43
	210	33	≤38	≤38	39	≤38	≤38	≤38	≤38	≤38	≤38	38	43
	211	33	≤38	≤38	39	≤38	≤38	≤38	≤38	≤38	≤38	38	43
	215	33	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	38	43
	217	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	218	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	219	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	220	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40

Table D.1 Predicted operational noise levels during calm and prevailing meteorological conditions, dB(A)

Locality	Assessment location	RBL	Indicative Year 3, $L_{eq,15min}$			Indicative Year 9, $L_{eq,15min}$			Indicative Year 14, $L_{eq,15min}$			INP PSNL, $L_{eq,15min}$	Potential acquisition criteria, $L_{eq,15min}$
			Calm		Prevailing	Calm		Prevailing	Calm		Prevailing		
			Day	Eve/Night	Eve/Night	Day	Eve/Night	Eve/Night	Day	Eve/Night	Eve/Night		
	221	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	222	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	223	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	224	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	225	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	226	30	≤35	≤35	36	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	227	30	≤35	≤35	36	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	228	30	≤35	≤35	36	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	229	31	≤36	≤36	≤36	≤36	≤36	≤36	≤36	≤36	≤36	36	41
	230	31	≤36	≤36	37	≤36	≤36	≤36	≤36	≤36	≤36	36	41
	231	31	≤36	≤36	37	≤36	≤36	≤36	≤36	≤36	≤36	36	41
	234	33	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	38	43
	235	33	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	38	43
	236	33	≤38	≤38	39	≤38	≤38	≤38	≤38	≤38	≤38	38	43
	237	33	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	38	43
	238	33	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	38	43
	243	33	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	38	43
	252	33	≤38	≤38	39	≤38	≤38	≤38	≤38	≤38	≤38	38	43
	253	31	≤36	≤36	37	≤36	≤36	≤36	≤36	≤36	≤36	36	41
	254	33	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	38	43
	255	33	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	38	43
	266	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	267	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	268	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	903	33	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	38	43
	904	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40

Table D.1 Predicted operational noise levels during calm and prevailing meteorological conditions, dB(A)

Locality	Assessment location	RBL	Indicative Year 3, $L_{eq,15min}$			Indicative Year 9, $L_{eq,15min}$			Indicative Year 14, $L_{eq,15min}$			INP PSNL, $L_{eq,15min}$	Potential acquisition criteria, $L_{eq,15min}$
			Calm		Prevailing	Calm		Prevailing	Calm		Prevailing		
			Day	Eve/Night	Eve/Night	Day	Eve/Night	Eve/Night	Day	Eve/Night	Eve/Night		
	905	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	909	30	≤35	≤35	36	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	911	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	917	33	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	38	43
	918	33	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	38	43
	919	33	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	38	43
	920	33	≤38	≤38	39	≤38	≤38	≤38	≤38	≤38	≤38	38	43
	921	32	≤37	≤37	≤37	≤37	≤37	≤37	≤37	≤37	≤37	37	42
	922	32	≤37	≤37	≤37	≤37	≤37	≤37	≤37	≤37	≤37	37	42
	927	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	927	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	927	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	927	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	927	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	927	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	927	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	927	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	927	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	927	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	928	30	≤35	≤35	36	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	929	33	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	38	43
	936	30	≤35	≤35	36	≤35	≤35	≤35	≤35	≤35	≤35	35	40
Gouldsville/ Long Point	126	33	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	38	43
	127	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	128	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	130	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40

Table D.1 Predicted operational noise levels during calm and prevailing meteorological conditions, dB(A)

Locality	Assessment location	RBL	Indicative Year 3, $L_{eq,15min}$			Indicative Year 9, $L_{eq,15min}$			Indicative Year 14, $L_{eq,15min}$			INP PSNL, $L_{eq,15min}$	Potential acquisition criteria, $L_{eq,15min}$
			Calm		Prevailing	Calm		Prevailing	Calm		Prevailing		
			Day	Eve/Night	Eve/Night	Day	Eve/Night	Eve/Night	Day	Eve/Night	Eve/Night		
	134	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	139	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	141	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	167	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	168	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	169	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	170	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	172	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	173	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	174	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	175	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	176	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	177	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	178	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	179	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	248	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	249	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	250	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	251	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	262	33	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	38	43
Hambledon Hill/Wylies Flat	152	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	155	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	156	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	157	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	180	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	181	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40

Table D.1 Predicted operational noise levels during calm and prevailing meteorological conditions, dB(A)

Locality	Assessment location	RBL	Indicative Year 3, $L_{eq,15min}$			Indicative Year 9, $L_{eq,15min}$			Indicative Year 14, $L_{eq,15min}$			INP PSNL, $L_{eq,15min}$	Potential acquisition criteria, $L_{eq,15min}$
			Calm		Prevailing	Calm		Prevailing	Calm		Prevailing		
			Day	Eve/Night	Eve/Night	Day	Eve/Night	Eve/Night	Day	Eve/Night	Eve/Night		
	182	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	183	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	184	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	185	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	186	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	187	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	191	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	192	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	263	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	937	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	937	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	937	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	937	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	937	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
Maison Dieu	117	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	118	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	120	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	121	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	122	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	123	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	124	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	160	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	161	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	162	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	163	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	244	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40

Table D.1 Predicted operational noise levels during calm and prevailing meteorological conditions, dB(A)

Locality	Assessment location	RBL	Indicative Year 3, $L_{eq,15min}$			Indicative Year 9, $L_{eq,15min}$			Indicative Year 14, $L_{eq,15min}$			INP PSNL, $L_{eq,15min}$	Potential acquisition criteria, $L_{eq,15min}$
			Calm		Prevailing	Calm		Prevailing	Calm		Prevailing		
			Day	Eve/Night	Eve/Night	Day	Eve/Night	Eve/Night	Day	Eve/Night	Eve/Night		
	245	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	246	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	247	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	256	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	257	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	258	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	259	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	260	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	261	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	265	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
Milbrodale	111	30	≤35	≤35	37	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	193	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	197	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	199	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	200	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	201	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	202	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	203	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	204	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	205	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	206	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	207	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	208	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	923	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	926	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
Mount Thorley	144[2]	n/a	≤39	≤39	40	≤39	≤39	41	≤39	≤39	≤39	n/a	44[1]

Table D.1 Predicted operational noise levels during calm and prevailing meteorological conditions, dB(A)

Locality	Assessment location	RBL	Indicative Year 3, $L_{eq,15min}$			Indicative Year 9, $L_{eq,15min}$			Indicative Year 14, $L_{eq,15min}$			INP PSNL, $L_{eq,15min}$	Potential acquisition criteria, $L_{eq,15min}$
			Calm		Prevailing	Calm		Prevailing	Calm		Prevailing		
			Day	Eve/Night	Eve/Night	Day	Eve/Night	Eve/Night	Day	Eve/Night	Eve/Night		
	146[2]	n/a	≤37	≤37	40	≤37	≤37	40	≤37	≤37	39	n/a	42[1]
	148	30	≤35	≤35	39	≤35	≤35	39	≤35	≤35	37	35	40
	149	30	≤35	≤35	40	≤35	≤35	41	≤35	≤35	40	35	40
	150	30	≤35	≤35	37	≤35	≤35	37	≤35	≤35	36	35	40
	153	30	≤35	≤35	≤35	≤35	≤35	37	≤35	≤35	≤35	35	40
	188	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
	190	30	≤35	≤35	38	≤35	≤35	37	≤35	≤35	36	35	40
	915[2]	n/a	≤39	≤39	40	≤39	≤39	41	≤39	≤39	40	n/a	44[1]
	932	30	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	≤35	35	40
Warkworth	77	33	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	38	43
	102	33	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	38	43
	264	33	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	≤38	38	43

Notes: *1. Current acquisition limit in development consent*

2. The colouring (green, blue, orange) has been assigned relative to the development consent current acquisition limit rather than the RBL which was undetermined at these locations.

Appendix E

ABLs used to derive RBLs

Table E.1 Location A - Wollemi Peak Road - MTO filtered out ABLs and RBLs

Date	ABL Day	ABL Evening	ABL Night
Thursday, 20-06-13	0	29.7	32.4
Friday, 21-06-13	30.6	36.4	34.3
Saturday, 22-06-13	30.4	28.9	31.8
Sunday, 23-06-13	0	35.8	27.8
Monday, 24-06-13	29.1	19.7	19.9
Tuesday, 25-06-13	27.7	31	31.4
Wednesday, 26-06-13	39.2	38.2	39.3
Thursday, 27-06-13	0	43.7	42.8
Friday, 28-06-13	37.1	0	0
Monday, 01-07-13	37.7	45.5	43.2
Tuesday, 02-07-13	36.7	43	40.1
Wednesday, 03-07-13	40.1	0	40.1
Thursday, 04-07-13	37.5	38	35
Friday, 12-07-13	33.3	38.3	37.2
Saturday, 13-07-13	30.9	0	0
Monday, 15-07-13	33.3	0	38.9
Tuesday, 16-07-13	34	0	39.9
Wednesday, 17-07-13	35	0	40
Thursday, 18-07-13	36.3	0	0
Friday, 19-07-13	0	36.3	0
Saturday, 20-07-13	37.1	34.5	29.7
Sunday, 21-07-13	33.2	32.8	33.7
Monday, 22-07-13	33.6	29.6	31.4
Tuesday, 23-07-13	31	28.9	26.8
Wednesday, 24-07-13	31.5	30	0
Thursday, 25-07-13	0	0	37.7
Friday, 26-07-13	34.9	33.2	34.6
Saturday, 27-07-13	34	34.8	37.6
Sunday, 28-07-13	34.1	36	39.2
Monday, 29-07-13	30.7	35.5	37.7
Tuesday, 30-07-13	31.2	0	34.8
Wednesday, 31-07-13	32.5	31.9	0
Thursday, 01-08-13	31.6	35.8	38
Friday, 02-08-13	32.5	28.9	27.5
Saturday, 03-08-13	33.6	30.6	0
Sunday, 04-08-13	0	25.4	0
Monday, 05-08-13	33.8	29.5	32.3
Tuesday, 06-08-13	35.5	31.3	32.3
Wednesday, 07-08-13	31.8	0	34

Table E.1 Location A - Wollemi Peak Road - MTO filtered out ABLs and RBLs

Date	ABL Day	ABL Evening	ABL Night
Thursday, 08-08-13	33	32.7	31.2
Friday, 09-08-13	33.6	32	30.1
Saturday, 10-08-13	32.4	32.3	0
Monday, 12-08-13	0	30.7	30.8
Tuesday, 13-08-13	32.2	0	32.3
Rating Background Level (RBL)	**33.3**	**32.7**	**34.3**

Notes: 1. '0' Values indicate excluded data due to weather or inadequate sampling as per the INP. When calculating the median value, these '0' samples are ignored as per the INP.

Table E.2 Location B - 367 Wambo Road - MTO filtered out ABLs and RBLs

Date	ABL Day	ABL Evening	ABL Night
Wednesday, 07-12-11	0	28	28.1
Thursday, 08-12-11	32.5	36.3	35.2
Friday, 09-12-11	29	36.4	37
Saturday, 10-12-11	28	32	34.8
Sunday, 11-12-11	28	36.4	35.9
Monday, 12-12-11	34.2	34.3	36.1
Tuesday, 13-12-11	28.3	36.4	36.3
Wednesday, 14-12-11	30.4	36.5	34.7
Thursday, 15-12-11	28.5	33.6	35.9
Friday, 16-12-11	0	0	0
Saturday, 17-12-11	0	34.6	34.3
Sunday, 18-12-11	27	31.7	37.3
Monday, 19-12-11	33.6	32.6	34.3
Tuesday, 20-12-11	31.4	35.7	0
Wednesday, 21-12-11	0	0	0
Thursday, 22-12-11	0	0	31.8
Friday, 23-12-11	0	0	0
Saturday, 24-12-11	0	36	0
Sunday, 25-12-11	0	0	0
Monday, 26-12-11	0	31.9	0
Wednesday, 28-12-11	0	35.8	33.4
Thursday, 29-12-11	34.3	35.7	34.2
Friday, 30-12-11	31.4	34.7	0
Saturday, 31-12-11	29.8	32.9	0
Sunday, 01-01-12	27.7	31.5	30.9
Monday, 02-01-12	28.9	32.9	34.5
Tuesday, 03-01-12	32.7	32.7	37.5
Wednesday, 04-01-12	28.9	29.6	34.1
Thursday, 05-01-12	30.3	29.3	0
Friday, 06-01-12	31	30.3	28.2
Saturday, 07-01-12	32.8	33.3	36
Sunday, 08-01-12	32	0	0
Monday, 09-01-12	35.1	34.6	34.3
Tuesday, 10-01-12	28	28	0
Tuesday, 17-01-12	0	34.9	35.8
Wednesday, 18-01-12	32.2	0	35.3
Thursday, 19-01-12	0	34	33.3
Friday, 20-01-12	32.2	31.4	34.3
Saturday, 21-01-12	32.3	0	35

Table E.2 Location B - 367 Wambo Road - MTO filtered out ABLs and RBLs

Date	ABL Day	ABL Evening	ABL Night
Sunday, 22-01-12	37	35.3	33.5
Monday, 23-01-12	0	33.7	35
Tuesday, 24-01-12	32.3	0	0
Thursday, 26-01-12	0	0	39.8
Friday, 27-01-12	37.9	37.3	38.2
Saturday, 28-01-12	32.5	30.5	37.9
Sunday, 29-01-12	32.6	31.4	0
Monday, 30-01-12	34.7	0	38
Friday, 03-02-12	0	44.6	45.7
Saturday, 04-02-12	31.8	39	44.5
Sunday, 05-02-12	31.8	35.7	43.3
Monday, 06-02-12	34	36.6	37.5
Tuesday, 07-02-12	34.1	35.8	0
Wednesday, 08-02-12	36.8	37.5	39.4
Thursday, 09-02-12	33.8	37.7	40.1
Friday, 10-02-12	0	38.3	0
Saturday, 11-02-12	31.1	0	38.4
Sunday, 12-02-12	29.3	33	40.6
Monday, 13-02-12	32.6	0	40.7
Tuesday, 14-02-12	35.6	40.2	40.9
Wednesday, 15-02-12	32.4	40.1	37.9
Thursday, 16-02-12	27.4	36.1	38.1
Friday, 17-02-12	27.5	36.6	41.1
Saturday, 18-02-12	29.7	0	44
Sunday, 19-02-12	27.4	33.1	0
Monday, 20-02-12	34.9	0	0
Tuesday, 21-02-12	38.8	43.8	48.4
Wednesday, 22-02-12	37	44.1	46
Thursday, 23-02-12	28.8	39.9	46.4
Friday, 24-02-12	31.2	40.3	42.2
Saturday, 25-02-12	32.5	38.3	40.1
Sunday, 26-02-12	34.2	37.5	41.3
Monday, 27-02-12	30.1	35.5	41.6
Tuesday, 28-02-12	28.3	35.1	42.3
Thursday, 01-03-12	36.9	0	0
Saturday, 03-03-12	0	46.6	48.3
Sunday, 04-03-12	34.1	46.1	47.3
Monday, 05-03-12	0	43.4	47.5
Tuesday, 06-03-12	32.2	44.3	44.4

Table E.2 Location B - 367 Wambo Road - MTO filtered out ABLs and RBLs

Date	ABL Day	ABL Evening	ABL Night
Wednesday, 07-03-12	33.4	0	0
Saturday, 10-03-12	28.2	41.3	0
Sunday, 11-03-12	0	40.6	0
Saturday, 17-03-12	0	40.6	0
Wednesday, 21-03-12	0	38	41.2
Thursday, 22-03-12	29.4	39.6	38
Friday, 23-03-12	36.5	40.9	34.1
Saturday, 24-03-12	27.8	42.7	36.5
Sunday, 25-03-12	31.6	40.7	39.4
Monday, 26-03-12	28.9	39.8	36.3
Tuesday, 27-03-12	31.7	38.9	41.2
Thursday, 29-03-12	0	42	34.4
Wednesday, 18-04-12	0	34.7	29.4
Thursday, 19-04-12	28.2	31.9	31.8
Friday, 20-04-12	31.7	36.1	23.5
Saturday, 21-04-12	26	33.5	27.5
Sunday, 22-04-12	26.1	0	31.3
Monday, 23-04-12	0	29.8	26.1
Tuesday, 24-04-12	0	26.5	22.8
Wednesday, 25-04-12	26.2	22.8	0
Thursday, 26-04-12	31.2	35.1	0
Tuesday, 01-05-12	25.2	32.2	34.1
Saturday, 05-05-12	0	28	0
Sunday, 06-05-12	24.5	0	24.5
Tuesday, 08-05-12	0	0	29.6
Saturday, 12-05-12	0	0	21.4
Sunday, 13-05-12	26.7	0	0
Tuesday, 15-05-12	0	0	29.6
Friday, 18-05-12	22.9	0	31.3
Tuesday, 22-05-12	26.4	22.3	25.7
Wednesday, 23-05-12	28.2	29.2	32.3
Friday, 25-05-12	27.8	34.9	31.7
Saturday, 26-05-12	31.2	30.4	24.3
Sunday, 27-05-12	22.9	29.2	27.5
Monday, 28-05-12	24.7	27	29
Tuesday, 29-05-12	26.3	28.1	24.3
Wednesday, 30-05-12	26.7	30.4	31.3
Thursday, 31-05-12	26.9	35	0
Friday, 01-06-12	31.6	34.3	36

Table E.2 Location B - 367 Wambo Road - MTO filtered out ABLs and RBLs

Date	ABL Day	ABL Evening	ABL Night
Monday, 04-06-12	31.1	28.4	29.3
Tuesday, 05-06-12	29	0	35
Wednesday, 06-06-12	34	31.4	34.6
Sunday, 10-06-12	0	0	27.4
Tuesday, 12-06-12	0	34.5	0
Wednesday, 13-06-12	0	33.5	0
Saturday, 16-06-12	0	28.5	0
Sunday, 17-06-12	0	0	28.8
Tuesday, 19-06-12	0	0	31
Wednesday, 20-06-12	0	29.4	31.3
Thursday, 21-06-12	35.6	33.7	36
Friday, 22-06-12	0	25	26.4
Saturday, 23-06-12	28.6	26.4	30.5
Sunday, 24-06-12	0	31.6	33.3
Monday, 25-06-12	33.5	32.5	31.3
Tuesday, 26-06-12	0	29.8	32.9
Wednesday, 27-06-12	29.8	0	36.5
Thursday, 28-06-12	27.4	34.5	28.9
Friday, 29-06-12	29.4	32.2	27.7
Saturday, 30-06-12	25.3	32.3	0
Sunday, 01-07-12	0	32.2	26.4
Monday, 02-07-12	29.2	22.4	25
Tuesday, 03-07-12	30.4	22.8	25.3
Wednesday, 04-07-12	0	25.6	0
Thursday, 05-07-12	0	28.3	0
Saturday, 07-07-12	0	35.4	0
Monday, 09-07-12	29	0	0
Tuesday, 10-07-12	36.5	0	0
Saturday, 14-07-12	28.4	0	0
Sunday, 15-07-12	30	0	28.5
Wednesday, 18-07-12	0	32.2	0
Thursday, 19-07-12	0	35	0
Friday, 20-07-12	25.8	31.7	33.1
Saturday, 21-07-12	31.4	31.8	34.9
Sunday, 22-07-12	27.8	31.6	33
Monday, 23-07-12	31.1	33.5	34.1
Tuesday, 24-07-12	24.7	33	32.5
Wednesday, 25-07-12	26.8	36.4	35
Thursday, 26-07-12	33.7	33	27

Table E.2 Location B - 367 Wambo Road - MTO filtered out ABLs and RBLs

Date	ABL Day	ABL Evening	ABL Night
Friday, 27-07-12	27.6	25.2	22.8
Saturday, 28-07-12	23.5	22.4	25.7
Sunday, 29-07-12	23.8	24.9	23.1
Monday, 30-07-12	29.1	27.6	28.9
Tuesday, 31-07-12	32.1	33	0
Friday, 03-08-12	25	0	0
Monday, 13-08-12	0	31.7	0
Tuesday, 14-08-12	25.2	29.9	0
Wednesday, 15-08-12	0	0	23.1
Thursday, 16-08-12	0	26.3	0
Sunday, 19-08-12	0	24.1	0
Thursday, 30-08-12	0	32.1	21.8
Friday, 31-08-12	27.6	21.3	0
Saturday, 01-09-12	0	22.7	24.6
Sunday, 02-09-12	25.6	26	27.8
Monday, 03-09-12	23.3	28.9	32
Tuesday, 04-09-12	23.7	25	34.4
Wednesday, 05-09-12	36	38	28.7
Thursday, 06-09-12	29.9	21.8	25.9
Friday, 07-09-12	29.8	22.9	22.5
Saturday, 08-09-12	30.9	19.8	21.2
Sunday, 09-09-12	23.8	29.8	31.4
Monday, 10-09-12	23.1	25.1	28.7
Tuesday, 11-09-12	32	33.8	28.9
Wednesday, 12-09-12	26.2	29.4	32.4
Thursday, 13-09-12	33.7	19.6	19.6
Friday, 14-09-12	0	22	0
Saturday, 15-09-12	0	25	0
Sunday, 23-09-12	0	33.5	0
Monday, 24-09-12	25.5	0	0
Tuesday, 25-09-12	0	35	0
Friday, 28-09-12	0	32.6	0
Saturday, 29-09-12	0	0	20.3
Sunday, 30-09-12	24.6	19.6	0
Monday, 01-10-12	26.1	0	0
Friday, 05-10-12	0	36.9	29.7
Tuesday, 09-10-12	26.3	0	0
Wednesday, 10-10-12	25.9	0	0
Thursday, 11-10-12	0	29.6	0

Table E.2 Location B - 367 Wambo Road - MTO filtered out ABLs and RBLs

Date	ABL Day	ABL Evening	ABL Night
Tuesday, 16-10-12	0	34.1	0
Thursday, 18-10-12	29.9	37.2	0
Friday, 19-10-12	25.6	0	0
Saturday, 20-10-12	0	38.2	0
Monday, 22-10-12	26.7	36.3	0
Tuesday, 23-10-12	34.7	34	0
Friday, 26-10-12	0	30.7	0
Wednesday, 31-10-12	0	28	0
Friday, 02-11-12	0	32.9	0
Saturday, 03-11-12	29.6	0	0
Monday, 05-11-12	0	30.4	33.5
Friday, 09-11-12	0	29.2	0
Saturday, 10-11-12	0	32.9	0
Monday, 12-11-12	0	0	28
Tuesday, 13-11-12	0	32.2	0
Wednesday, 14-11-12	0	34.9	0
Tuesday, 20-11-12	34.2	0	0
Wednesday, 21-11-12	22.9	23	0
Friday, 23-11-12	29.5	0	0
Saturday, 24-11-12	0	0	30.4
Rating Background Level (RBL)	**29.6**	**33.0**	**33.5**

Notes: *1. '0' Values indicate excluded data due to weather or inadequate sampling as per the INP. When calculating the median value, these '0' samples are ignored as per the INP.*

Table E.3 Location C - 128 Wambo Road – MTO filtered out ABLs and RBLs

Date	ABL Day	ABL Evening	ABL Night
Tuesday, 01-01-13	35	33.8	36.9
Wednesday, 02-01-13	37.5	0	0
Thursday, 03-01-13	0	37.4	0
Friday, 04-01-13	35.4	37.5	0
Saturday, 05-01-13	36.3	35.6	0
Sunday, 06-01-13	38.4	40.2	0
Monday, 07-01-13	39.9	37.9	0
Tuesday, 08-01-13	37.7	37.1	39
Wednesday, 09-01-13	39.6	38.6	0
Thursday, 10-01-13	38	39.9	0
Friday, 11-01-13	38.3	37.3	37.8
Saturday, 12-01-13	37.4	38.7	38.9
Sunday, 13-01-13	36.5	0	0
Monday, 14-01-13	35.9	37	35.7
Tuesday, 15-01-13	36	38.3	36.8
Wednesday, 16-01-13	35.8	38.5	0
Thursday, 17-01-13	0	36.8	0
Friday, 18-01-13	37.4	37.1	37.6
Saturday, 19-01-13	36.5	35.6	0
Sunday, 20-01-13	0	0	38.8
Monday, 21-01-13	35.9	37.6	39.6
Tuesday, 22-01-13	0	0	0
Wednesday, 23-01-13	0	36.2	39.3
Thursday, 24-01-13	35.6	36.8	40.9
Friday, 25-01-13	36.7	36.7	40.1
Saturday, 26-01-13	38.1	39.3	0
Tuesday, 29-01-13	36.2	39.9	0
Wednesday, 30-01-13	0	38.7	0
Thursday, 31-01-13	37.9	38	0
Saturday, 02-02-13	37.1	41.4	0
Sunday, 03-02-13	36.3	0	0
Monday, 04-02-13	0	39.9	0
Tuesday, 05-02-13	36.3	0	0
Wednesday, 06-02-13	35.3	38.2	41.4
Thursday, 07-02-13	35.9	36.3	41
Friday, 08-02-13	0	0	40.4
Saturday, 09-02-13	34.6	36.9	38.2
Sunday, 10-02-13	35.9	0	0
Monday, 11-02-13	0	39.9	0

Table E.3 Location C - 128 Wambo Road – MTO filtered out ABLs and RBLs

Date	ABL Day	ABL Evening	ABL Night
Tuesday, 12-02-13	35.7	39.1	0
Wednesday, 13-02-13	0	40.2	0
Thursday, 14-02-13	36.4	40.3	40.7
Friday, 15-02-13	35.6	39	0
Saturday, 16-02-13	35.7	40.8	40.1
Sunday, 17-02-13	36	38.9	0
Monday, 18-02-13	37	39.2	0
Tuesday, 19-02-13	35.9	37.6	0
Wednesday, 20-02-13	37.8	38.5	0
Thursday, 21-02-13	38.7	37.9	36.8
Saturday, 23-02-13	0	0	44.2
Sunday, 24-02-13	39.8	41.6	0
Monday, 25-02-13	38	37	45.1
Tuesday, 26-02-13	38.3	39.5	0
Wednesday, 27-02-13	38.3	38.6	0
Thursday, 28-02-13	39	40	0
Sunday, 03-03-13	40.4	43.6	0
Monday, 04-03-13	0	44.3	0
Tuesday, 05-03-13	38.8	42.9	0
Wednesday, 06-03-13	37.8	43.1	0
Thursday, 07-03-13	39.2	42.1	0
Friday, 08-03-13	36.3	42.4	0
Saturday, 09-03-13	38.2	41.7	0
Sunday, 10-03-13	38.5	40.6	0
Monday, 11-03-13	38.1	40.4	0
Tuesday, 12-03-13	37.5	41.5	0
Wednesday, 13-03-13	39	41.5	0
Thursday, 14-03-13	37.1	40.3	39.8
Friday, 15-03-13	36.8	38.8	39.2
Saturday, 16-03-13	0	38.6	37.8
Sunday, 17-03-13	37.7	40.9	0
Monday, 18-03-13	36.7	39.3	37.9
Tuesday, 19-03-13	36.4	40.3	0
Wednesday, 20-03-13	36.7	41.2	0
Thursday, 21-03-13	38.3	39.2	0
Friday, 22-03-13	39.5	37.2	36.3
Saturday, 23-03-13	37.3	0	39.9
Sunday, 24-03-13	35.8	39.1	0
Monday, 25-03-13	37.8	38.9	38.6

Table E.3 Location C - 128 Wambo Road – MTO filtered out ABLs and RBLs

Date	ABL Day	ABL Evening	ABL Night
Tuesday, 26-03-13	34.5	37.4	37.8
Wednesday, 27-03-13	32.9	37.2	38.2
Thursday, 28-03-13	33.4	0	0
Friday, 29-03-13	34.9	38	34.9
Saturday, 30-03-13	32.8	35.9	33.8
Sunday, 31-03-13	31.1	34.7	0
Monday, 01-04-13	32	39.6	31.4
Tuesday, 02-04-13	32	0	31.9
Wednesday, 03-04-13	35	33.8	32.8
Thursday, 04-04-13	32.5	0	37.1
Friday, 05-04-13	34	0	36.6
Saturday, 06-04-13	31.3	0	31.6
Sunday, 07-04-13	30.6	39.1	30.8
Monday, 08-04-13	31.9	37	31.1
Tuesday, 09-04-13	31.2	37.4	35
Wednesday, 10-04-13	31.4	38.5	29.9
Thursday, 11-04-13	30.9	37.3	37
Friday, 12-04-13	33.1	37.4	36.2
Saturday, 13-04-13	30.9	37.5	30.7
Sunday, 14-04-13	30.9	36.5	30.9
Monday, 15-04-13	30.6	0	0
Wednesday, 17-04-13	31	34.1	28.6
Thursday, 18-04-13	30.8	33.2	28.2
Friday, 19-04-13	34.1	30.6	27.7
Saturday, 20-04-13	0	34.8	30
Sunday, 21-04-13	0	36.1	31.6
Monday, 22-04-13	31.6	30.8	29.3
Tuesday, 23-04-13	31.1	30.4	29.1
Wednesday, 24-04-13	31.9	34.3	29.2
Thursday, 25-04-13	30.8	30.3	29.9
Friday, 26-04-13	31.5	33.3	31.5
Saturday, 27-04-13	30.9	0	30.6
Sunday, 28-04-13	31.1	32.3	30
Monday, 29-04-13	29.4	37.1	31.7
Tuesday, 30-04-13	30.4	37.5	0
Tuesday, 01-05-12	30.8	32.3	29.5
Wednesday, 02-05-12	32.6	30.9	0
Thursday, 03-05-12	0	34.5	29.7
Friday, 04-05-12	29.9	31.4	28.4

Table E.3 Location C - 128 Wambo Road – MTO filtered out ABLs and RBLs

Date	ABL Day	ABL Evening	ABL Night
Saturday, 05-05-12	30	32.1	31.5
Sunday, 06-05-12	31.2	30	31.1
Monday, 07-05-12	31	0	33.3
Tuesday, 08-05-12	30.9	34.1	34.2
Wednesday, 09-05-12	30.1	35.5	31.8
Thursday, 10-05-12	30	33.7	31.8
Friday, 11-05-12	29.5	36.2	35.4
Saturday, 12-05-12	29.9	36.5	33.3
Sunday, 13-05-12	31.6	31.8	28.6
Monday, 14-05-12	29.2	30	29
Tuesday, 15-05-12	30.8	28.2	28
Wednesday, 16-05-12	30.3	27.8	28.4
Thursday, 17-05-12	30.3	28.3	29
Friday, 18-05-12	30.1	27	26.9
Saturday, 19-05-12	29.3	27.7	27.3
Sunday, 20-05-12	30.6	28.6	28.8
Monday, 21-05-12	31.8	29.3	30.8
Tuesday, 22-05-12	0	39.9	0
Wednesday, 23-05-12	41.3	41.3	42
Friday, 25-05-12	27.1	0	32.7
Saturday, 26-05-12	27.4	35	33.1
Sunday, 27-05-12	30.8	30.8	32.2
Monday, 28-05-12	30.3	37.6	29.3
Tuesday, 29-05-12	28.9	36.5	0
Wednesday, 30-05-12	28.5	37.3	34.9
Thursday, 31-05-12	27.7	36.8	0
Saturday, 01-06-13	32.8	34.6	0
Sunday, 02-06-13	0	30.3	28.2
Monday, 03-06-13	26.4	31.7	31.2
Tuesday, 04-06-13	26.8	34.1	36.8
Wednesday, 05-06-13	28.8	33	31.1
Thursday, 06-06-13	31.8	0	30.7
Friday, 07-06-13	31.3	33.3	32.6
Saturday, 08-06-13	27.7	0	37.1
Sunday, 09-06-13	27.5	36.9	34
Monday, 10-06-13	30.5	29.7	30.6
Tuesday, 11-06-13	28	33.9	36.4
Wednesday, 12-06-13	0	29.3	28.5
Thursday, 13-06-13	29.7	28.1	27.6

Table E.3 Location C - 128 Wambo Road – MTO filtered out ABLs and RBLs

Date	ABL Day	ABL Evening	ABL Night
Friday, 14-06-13	0	29.1	26.5
Saturday, 15-06-13	27.5	30.1	30.7
Sunday, 16-06-13	25.6	29.6	29
Monday, 17-06-13	25.5	26.7	25
Tuesday, 18-06-13	26.4	0	25.3
Wednesday, 19-06-13	29.1	0	33.7
Thursday, 20-06-13	26	31.1	29
Friday, 21-06-13	27.2	33.8	30.8
Saturday, 22-06-13	27.2	27.2	26.5
Sunday, 23-06-13	0	0	28.7
Monday, 24-06-13	27	31.1	30.3
Tuesday, 25-06-13	0	28.8	30
Wednesday, 26-06-13	0	34.7	33.9
Friday, 28-06-13	30.9	0	0
Sunday, 30-06-13	31.1	35.2	0
Tuesday, 02-07-13	0	37.9	0
Wednesday, 03-07-13	28.8	38	33.6
Thursday, 04-07-13	0	34.2	0
Friday, 05-07-13	0	30	27.8
Saturday, 06-07-13	30.6	35.6	0
Sunday, 07-07-13	34.4	36.2	35.4
Monday, 08-07-13	0	38.1	0
Tuesday, 09-07-13	0	34.7	37.3
Wednesday, 10-07-13	0	34.8	34.7
Thursday, 11-07-13	31.4	40.4	0
Friday, 12-07-13	0	38.1	35.6
Saturday, 13-07-13	0	40.3	37.7
Sunday, 14-07-13	33.3	39.2	0
Monday, 15-07-13	33.1	38.3	37.8
Tuesday, 16-07-13	33	42.1	39
Wednesday, 17-07-13	33.1	42.1	38.3
Thursday, 18-07-13	33.8	41.3	38
Friday, 19-07-13	0	37.5	0
Saturday, 20-07-13	35.3	37.2	34.1
Sunday, 21-07-13	35.4	33.8	34.8
Monday, 22-07-13	36.4	32.8	32.9
Tuesday, 23-07-13	0	34.5	0
Wednesday, 24-07-13	33.4	0	0
Thursday, 25-07-13	33.4	36.7	36.4

Table E.3 Location C - 128 Wambo Road – MTO filtered out ABLs and RBLs

Date	ABL Day	ABL Evening	ABL Night
Friday, 26-07-13	34.4	0	34.5
Saturday, 27-07-13	34	0	0
Sunday, 28-07-13	33.6	36.2	36.8
Monday, 29-07-13	32.7	35.9	36.4
Tuesday, 30-07-13	33.1	0	0
Wednesday, 31-07-13	0	36.4	0
Rating Background Level (RBL)	**33.1**	**37.1**	**33.3**

Notes: 1. '0' Values indicate excluded data due to weather or inadequate sampling as per the INP. When calculating the median value, these '0' samples are ignored as per the INP.

Table E.4 Location D - 193 Inlet Road – MTO filtered out ABLs and RBLs

Date	ABL Day	ABL Evening	ABL Night
Friday, 09-12-11	0	32.6	0
Saturday, 10-12-11	29.7	29.8	0
Sunday, 11-12-11	0	33.4	37
Monday, 12-12-11	29.8	33.7	34.8
Tuesday, 13-12-11	28.3	32.7	0
Wednesday, 14-12-11	29.8	35.2	35.9
Thursday, 15-12-11	0	32.5	36.1
Saturday, 17-12-11	0	33.7	0
Sunday, 18-12-11	29.8	32.4	39.1
Monday, 19-12-11	30.9	32	37.9
Tuesday, 20-12-11	32.4	33.6	35
Wednesday, 21-12-11	31.3	0	0
Thursday, 22-12-11	28.8	0	36.5
Saturday, 24-12-11	0	34.4	0
Monday, 26-12-11	0	30.2	39.2
Tuesday, 27-12-11	32.2	33.3	35
Wednesday, 28-12-11	32.2	31	37.1
Thursday, 29-12-11	32.8	32.1	38.1
Friday, 30-12-11	33.6	32	0
Saturday, 31-12-11	32.7	32.4	0
Sunday, 01-01-12	33.6	33.9	32.9
Monday, 02-01-12	34.7	33.4	35.6
Tuesday, 03-01-12	34.8	33.4	36.4
Wednesday, 04-01-12	37.8	35.3	35
Thursday, 05-01-12	30.9	31	0
Friday, 06-01-12	0	30.4	32.9
Saturday, 07-01-12	37.8	34.9	39.1
Sunday, 08-01-12	37.8	0	0
Monday, 09-01-12	39.4	36	37.5
Tuesday, 10-01-12	35.8	31.5	34.4
Wednesday, 11-01-12	35.6	34.5	21.5
Thursday, 12-01-12	28.7	32.6	29.7
Friday, 13-01-12	35.8	34.5	33.5
Saturday, 14-01-12	32.1	33.5	35.1
Sunday, 15-01-12	31.7	35.8	38.3
Monday, 16-01-12	39.4	38.5	40.2
Tuesday, 17-01-12	37.9	37	39.6
Wednesday, 18-01-12	39.7	36.7	38.1
Thursday, 19-01-12	39.9	37	39.4

Table E.4 Location D - 193 Inlet Road – MTO filtered out ABLs and RBLs

Date	ABL Day	ABL Evening	ABL Night
Friday, 20-01-12	36.2	34.5	33.5
Saturday, 21-01-12	31.3	31.5	33.8
Sunday, 22-01-12	35.7	35.1	36
Monday, 23-01-12	0	37.2	37.6
Tuesday, 24-01-12	32.9	33.3	39.7
Thursday, 26-01-12	0	39.3	42.1
Friday, 27-01-12	37.9	37.6	0
Saturday, 28-01-12	36.7	33.7	39.1
Sunday, 29-01-12	36.2	33.1	0
Monday, 30-01-12	36	34.1	39.7
Friday, 03-02-12	0	43.4	44
Saturday, 04-02-12	33.4	38.6	0
Sunday, 05-02-12	33.9	33	0
Monday, 06-02-12	32.5	32.3	38.1
Tuesday, 07-02-12	29.1	35.7	38.4
Wednesday, 08-02-12	31.2	37.3	40
Thursday, 09-02-12	35.1	38.3	40.2
Friday, 10-02-12	0	37.8	39.4
Saturday, 11-02-12	33.5	36.2	35
Sunday, 12-02-12	32.1	35.4	39
Monday, 13-02-12	0	0	38.1
Tuesday, 14-02-12	32.9	33.6	36.5
Wednesday, 15-02-12	30.4	38.1	36.1
Thursday, 16-02-12	30.1	34.9	34.9
Friday, 17-02-12	30.7	36.4	36
Saturday, 18-02-12	30.5	0	36
Sunday, 19-02-12	30.4	29.2	0
Monday, 20-02-12	27.6	0	0
Tuesday, 21-02-12	0	30.6	42.7
Wednesday, 22-02-12	30.2	31.2	33.8
Thursday, 23-02-12	30.3	31.2	33.8
Friday, 24-02-12	0	33.4	0
Saturday, 25-02-12	31.5	31.4	0
Sunday, 26-02-12	28.6	28.4	32.6
Monday, 27-02-12	28.8	27.4	33.8
Tuesday, 28-02-12	29.5	26.7	0
Wednesday, 29-02-12	30.9	0	0
Thursday, 01-03-12	33.6	0	0
Saturday, 03-03-12	0	35.1	37.3

Table E.4 Location D - 193 Inlet Road – MTO filtered out ABLs and RBLs

Date	ABL Day	ABL Evening	ABL Night
Sunday, 04-03-12	32.3	31.7	33.2
Monday, 05-03-12	30	34.2	30.3
Tuesday, 06-03-12	31.5	29.2	28
Wednesday, 07-03-12	30.4	29.6	0
Thursday, 08-03-12	30.1	31.5	23.5
Friday, 09-03-12	30.1	28.7	28.2
Saturday, 10-03-12	0	33.5	24.9
Sunday, 11-03-12	30.2	29	30.4
Monday, 12-03-12	31.3	32.6	32.8
Tuesday, 13-03-12	29.9	31.8	23.6
Wednesday, 14-03-12	27.5	29.1	28.1
Thursday, 15-03-12	29.7	28.5	30
Friday, 16-03-12	29.9	34.1	0
Saturday, 17-03-12	0	29.3	26.2
Sunday, 18-03-12	31.8	0	0
Monday, 19-03-12	34.7	0	32.3
Tuesday, 20-03-12	30.2	31.4	30.8
Wednesday, 21-03-12	30.5	28	27.8
Thursday, 22-03-12	27.2	30.2	28
Friday, 23-03-12	30.5	25.6	18.7
Saturday, 24-03-12	28.1	25.6	26.1
Sunday, 25-03-12	32.5	34.3	30.6
Monday, 26-03-12	27.9	34	27.7
Tuesday, 27-03-12	29.5	34.4	33
Wednesday, 28-03-12	27.4	33	25.7
Thursday, 29-03-12	0	29.8	24
Friday, 30-03-12	27.4	32.8	24
Saturday, 31-03-12	27.5	31.4	0
Sunday, 01-04-12	28	27.2	0
Monday, 02-04-12	27.3	31.3	30.7
Tuesday, 03-04-12	27.5	29.9	30.5
Wednesday, 04-04-12	0	31.8	31.4
Thursday, 05-04-12	31.3	33.9	30.8
Friday, 06-04-12	27.8	31.8	30.4
Saturday, 07-04-12	0	24.9	28.1
Sunday, 08-04-12	0	0	25
Monday, 09-04-12	26.5	23.3	22.3
Tuesday, 10-04-12	30.2	23.9	28.7
Wednesday, 11-04-12	0	25.1	25.8

Table E.4 Location D - 193 Inlet Road – MTO filtered out ABLs and RBLs

Date	ABL Day	ABL Evening	ABL Night
Thursday, 12-04-12	27.7	24.9	27.7
Friday, 13-04-12	0	33	30.1
Saturday, 14-04-12	27.1	32.4	21.9
Sunday, 15-04-12	27.3	28.8	25.8
Monday, 16-04-12	28.6	27.9	28.6
Tuesday, 17-04-12	0	0	28.5
Wednesday, 18-04-12	0	29.8	28.7
Thursday, 19-04-12	28.7	29.9	22.7
Friday, 20-04-12	29.6	32.6	20.1
Saturday, 21-04-12	28.3	31.1	27.9
Sunday, 22-04-12	28.1	31.5	29
Monday, 23-04-12	0	27.6	22.6
Tuesday, 24-04-12	0	25.4	19.2
Wednesday, 25-04-12	27.2	22.3	20
Thursday, 26-04-12	25.3	30	29.6
Friday, 27-04-12	28.5	31.6	28.6
Saturday, 28-04-12	28.6	29.2	24.1
Sunday, 29-04-12	27.7	26.5	31.1
Monday, 30-04-12	28.3	31.3	0
Tuesday, 01-05-12	29.3	29.6	30.5
Wednesday, 02-05-12	28.2	27	20.4
Thursday, 03-05-12	0	32.8	25.3
Friday, 04-05-12	27.1	29.7	25.5
Saturday, 05-05-12	26.2	26.8	26
Sunday, 06-05-12	25.9	24	20.9
Monday, 07-05-12	23.6	28.9	26.7
Tuesday, 08-05-12	0	27.5	25
Wednesday, 09-05-12	26.6	28.6	26.4
Thursday, 10-05-12	27.6	31.3	27
Friday, 11-05-12	28.8	26.6	23.3
Saturday, 12-05-12	26.7	23.4	19.2
Sunday, 13-05-12	24	21.6	18.8
Monday, 14-05-12	23.9	23.8	24.6
Tuesday, 15-05-12	25.6	24.1	24.2
Wednesday, 16-05-12	25.7	29.5	30.5
Thursday, 17-05-12	25.3	29.9	30.8
Friday, 18-05-12	25.7	27.8	27.1
Saturday, 19-05-12	25.8	28.4	26

Table E.4 Location D - 193 Inlet Road – MTO filtered out ABLs and RBLs

Date	ABL Day	ABL Evening	ABL Night
Monday, 21-05-12	24.4	28.1	27.3
Tuesday, 22-05-12	25.8	21.5	24.8
Wednesday, 23-05-12	25	26.6	31.3
Friday, 25-05-12	29.4	33.4	25.4
Saturday, 26-05-12	29.9	25.2	23.9
Sunday, 27-05-12	26.9	26.7	27
Rating Background Level (RBL)	**30.0**	**31.6**	**30.5**

Notes: 1. '0' Values indicate excluded data due to weather or inadequate sampling as per the INP. When calculating the median value, these '0' samples are ignored as per the INP.

Table E.5 Location E - 339 Inlet Road - MTO filtered out ABLs and RBLs

Date	ABL Day	ABL Evening	ABL Night
Monday, 18-03-13	0	31	31.8
Tuesday, 19-03-13	31.7	0	29.1
Thursday, 21-03-13	30.4	30.5	30.5
Friday, 22-03-13	31.6	29.9	0
Saturday, 23-03-13	0	32.4	0
Sunday, 24-03-13	0	0	28.4
Monday, 25-03-13	30.2	31.1	31
Wednesday, 27-03-13	29.9	0	0
Thursday, 28-03-13	30.7	0	0
Friday, 29-03-13	0	30	31.9
Saturday, 30-03-13	31	0	0
Sunday, 31-03-13	29.1	0	0
Monday, 01-04-13	0	30.6	0
Tuesday, 02-04-13	29.4	27.2	0
Wednesday, 03-04-13	30.5	32.8	32.4
Thursday, 04-04-13	0	30.9	0
Friday, 05-04-13	31.9	0	0
Saturday, 06-04-13	34.1	32.2	0
Sunday, 07-04-13	0	29.6	0
Monday, 08-04-13	0	30	29.5
Tuesday, 09-04-13	0	29	0
Wednesday, 10-04-13	0	29.3	0
Thursday, 11-04-13	28.9	0	0
Friday, 12-04-13	0	29	28.5
Saturday, 13-04-13	27.3	0	0
Sunday, 14-04-13	27.4	26.9	25.1
Monday, 15-04-13	28.1	0	0
Tuesday, 16-04-13	0	27.8	0
Wednesday, 17-04-13	29	28.9	0
Thursday, 18-04-13	29.6	0	21
Friday, 19-04-13	0	24.5	0
Saturday, 20-04-13	0	30.1	27.6
Sunday, 21-04-13	0	0	26.8
Monday, 22-04-13	26.6	23.2	21.2
Tuesday, 23-04-13	0	26.6	0
Wednesday, 24-04-13	25.8	22.7	22.6
Thursday, 25-04-13	26	0	0
Friday, 26-04-13	0	21.8	23.4
Saturday, 27-04-13	0	27.8	0

Table E.5 Location E - 339 Inlet Road - MTO filtered out ABLs and RBLs

Date	ABL Day	ABL Evening	ABL Night
Sunday, 28-04-13	0	22.4	0
Monday, 29-04-13	27.9	0	0
Tuesday, 30-04-13	0	28.3	0
Wednesday, 01-05-13	27.1	0	20.7
Thursday, 02-05-13	0	0	31
Friday, 03-05-13	0	26.3	0
Saturday, 04-05-13	0	29.8	18
Sunday, 05-05-13	26	25.4	26.7
Monday, 06-05-13	28.8	23.5	0
Wednesday, 08-05-13	27.4	29.5	31.1
Thursday, 09-05-13	27.1	0	27
Friday, 10-05-13	0	0	29.4
Saturday, 11-05-13	27.8	28	28.3
Sunday, 12-05-13	27.4	28.1	0
Monday, 13-05-13	0	0	17
Tuesday, 14-05-13	0	0	18.8
Wednesday, 15-05-13	24.8	18.8	18.6
Thursday, 16-05-13	25.5	18.7	18.3
Friday, 17-05-13	0	17.9	0
Saturday, 18-05-13	0	18.7	0
Sunday, 19-05-13	23.5	17.7	0
Monday, 20-05-13	0	19	20.8
Tuesday, 21-05-13	25.6	17.3	20.4
Wednesday, 22-05-13	31.1	28.7	34
Thursday, 23-05-13	0	33.6	0
Friday, 24-05-13	0	34.5	0
Saturday, 25-05-13	0	28	0
Sunday, 26-05-13	0	30	29.2
Monday, 27-05-13	30.2	0	0
Tuesday, 28-05-13	0	28.7	25.8
Wednesday, 29-05-13	0	29.6	0
Thursday, 30-05-13	29	27.9	28.4
Friday, 31-05-13	0	26.7	0
Saturday, 01-06-13	28.6	30.5	0
Sunday, 02-06-13	0	29.4	27.2
Monday, 03-06-13	0	24.1	25.7
Tuesday, 04-06-13	0	28.1	0
Wednesday, 05-06-13	28.2	23.1	21.6
Thursday, 06-06-13	0	24.3	20.8

Table E.5 Location E - 339 Inlet Road - MTO filtered out ABLs and RBLs

Date	ABL Day	ABL Evening	ABL Night
Friday, 07-06-13	0	22.8	21.6
Saturday, 08-06-13	29.5	29.4	0
Sunday, 09-06-13	0	28.6	27.1
Monday, 10-06-13	28.1	21.7	21.3
Wednesday, 12-06-13	0	0	20.3
Thursday, 13-06-13	0	0	21
Friday, 14-06-13	26.5	0	20.4
Saturday, 15-06-13	25.5	0	20.7
Sunday, 16-06-13	26.6	0	19.8
Tuesday, 18-06-13	25.9	0	0
Wednesday, 19-06-13	0	21.8	0
Thursday, 20-06-13	28.1	21.8	23.5
Friday, 21-06-13	28.4	0	26
Saturday, 22-06-13	25	23.4	0
Monday, 24-06-13	0	20.6	0
Tuesday, 25-06-13	0	0	20.8
Wednesday, 26-06-13	0	31.5	0
Friday, 28-06-13	31.2	0	0
Sunday, 30-06-13	29.3	0	0
Rating Background Level (RBL)	**28.2**	**28.1**	**25.7**

Notes: 1. '0' Values indicate excluded data due to weather or inadequate sampling as per the INP. When calculating the median value, these '0' samples are ignored as per the INP.

Table E.6 Location F – Scout Hall - MTO filtered out ABLs and RBLs

Date	ABL Day	ABL Evening	ABL Night
Wednesday, 07-12-11	0	32.8	38.7
Thursday, 08-12-11	37.3	36.5	42
Friday, 09-12-11	34.4	38.2	39.6
Saturday, 10-12-11	31.7	35	36.3
Sunday, 11-12-11	0	38.3	42.5
Monday, 12-12-11	34.9	37.5	40.8
Tuesday, 13-12-11	0	38	39.3
Wednesday, 14-12-11	31.1	41.3	39.2
Thursday, 15-12-11	32.8	39.2	40.8
Saturday, 17-12-11	0	40.8	44
Sunday, 18-12-11	32.7	37.7	42.2
Monday, 19-12-11	36.2	36.3	39.7
Tuesday, 20-12-11	0	38.6	40.3
Wednesday, 21-12-11	33.2	0	0
Thursday, 22-12-11	34.7	0	42.7
Saturday, 24-12-11	0	39.7	0
Monday, 26-12-11	0	0	44.5
Tuesday, 27-12-11	0	38.9	43.3
Wednesday, 28-12-11	33.4	0	41.4
Thursday, 29-12-11	35.6	0	41.4
Saturday, 31-12-11	33.5	37.4	0
Sunday, 01-01-12	0	0	39.1
Monday, 02-01-12	0	0	38.9
Friday, 06-01-12	0	33.2	38.3
Saturday, 07-01-12	0	0	39.9
Tuesday, 10-01-12	0	0	38.3
Thursday, 12-01-12	0	37	35
Wednesday, 18-01-12	0	0	38.6
Friday, 20-01-12	0	0	35.3
Saturday, 21-01-12	0	31.1	37.6
Sunday, 22-01-12	0	0	37.8
Monday, 23-01-12	0	35.7	40
Tuesday, 24-01-12	34.4	33.3	42.7
Thursday, 26-01-12	0	0	45.2
Friday, 27-01-12	0	0	42.8
Friday, 03-02-12	0	41.8	44.9
Saturday, 04-02-12	0	0	42.1
Monday, 06-02-12	0	35.3	41
Tuesday, 07-02-12	31.1	32.9	39.8

Table E.6 Location F – Scout Hall - MTO filtered out ABLs and RBLs

Date	ABL Day	ABL Evening	ABL Night
Wednesday, 08-02-12	0	35.6	40.4
Thursday, 09-02-12	35.2	38.6	39.7
Saturday, 11-02-12	0	35	37.2
Sunday, 12-02-12	0	0	38.3
Monday, 13-02-12	0	0	38.3
Tuesday, 14-02-12	32.7	38	38.6
Wednesday, 15-02-12	33	36.8	40.2
Thursday, 16-02-12	0	0	37.3
Saturday, 18-02-12	0	0	38.4
Tuesday, 21-02-12	31.9	35.3	39.9
Wednesday, 22-02-12	30.3	36.4	39.1
Saturday, 25-02-12	35.7	36.4	38
Sunday, 26-02-12	33.5	33.6	38.8
Monday, 27-02-12	34.3	0	0
Saturday, 03-03-12	0	42.4	44.4
Sunday, 04-03-12	37	40.5	44.9
Monday, 05-03-12	36.6	41.8	41.1
Tuesday, 06-03-12	34.5	39.6	0
Thursday, 08-03-12	0	39.7	35
Friday, 09-03-12	34.4	37.3	37.8
Saturday, 10-03-12	31.3	0	37.2
Sunday, 11-03-12	32.8	40.4	39.2
Monday, 12-03-12	34.6	41.3	40.5
Tuesday, 13-03-12	33.3	0	37.7
Wednesday, 14-03-12	33.4	0	38.2
Thursday, 15-03-12	33.8	41.2	39.4
Friday, 16-03-12	36.2	0	0
Saturday, 17-03-12	0	39.1	38.3
Sunday, 18-03-12	37.6	0	38.5
Monday, 19-03-12	0	0	39.9
Tuesday, 20-03-12	33.7	0	0
Wednesday, 21-03-12	33.6	0	38.2
Thursday, 22-03-12	33.4	0	37
Friday, 23-03-12	0	39.2	29.5
Saturday, 24-03-12	33.2	38.7	33
Sunday, 25-03-12	33.2	0	38.3
Monday, 26-03-12	32.5	41.1	35.9
Tuesday, 27-03-12	31.2	0	40.1
Wednesday, 28-03-12	33.9	42.1	37

Table E.6 Location F – Scout Hall - MTO filtered out ABLs and RBLs

Date	ABL Day	ABL Evening	ABL Night
Thursday, 29-03-12	0	39.2	35.6
Friday, 30-03-12	31.7	39.6	34.1
Saturday, 31-03-12	31	40.8	0
Sunday, 01-04-12	31.3	39.8	0
Monday, 02-04-12	31.3	41.2	36.8
Tuesday, 03-04-12	30.4	40.9	37
Wednesday, 04-04-12	33.4	44.8	39.5
Thursday, 05-04-12	34.5	44.1	39.4
Friday, 06-04-12	33.3	39.8	36.2
Saturday, 07-04-12	0	39.9	35.1
Sunday, 08-04-12	32.1	0	33.3
Monday, 09-04-12	33.5	37.8	30.1
Tuesday, 10-04-12	0	34.1	0
Wednesday, 11-04-12	33.1	33.7	34.1
Thursday, 12-04-12	30.7	38.1	34.8
Friday, 13-04-12	31.2	41	35.6
Saturday, 14-04-12	31	39.7	33.2
Sunday, 15-04-12	31.1	43	35.8
Monday, 16-04-12	32.2	39.5	0
Tuesday, 17-04-12	0	0	35.2
Wednesday, 18-04-12	0	41.5	37.1
Thursday, 19-04-12	32	42.6	33.9
Friday, 20-04-12	31.4	42.5	31.8
Saturday, 21-04-12	29.5	40.9	33.5
Sunday, 22-04-12	31.8	42.1	36.3
Monday, 23-04-12	0	41.3	36.6
Tuesday, 24-04-12	0	37.1	0
Wednesday, 25-04-12	0	30.1	0
Thursday, 26-04-12	29.2	36.8	34.8
Friday, 27-04-12	30.8	40.3	33.4
Saturday, 28-04-12	31.2	37.2	33.7
Sunday, 29-04-12	0	37.9	33.1
Monday, 30-04-12	30.8	41.2	0
Tuesday, 01-05-12	30.8	36.5	35.5
Wednesday, 02-05-12	30.3	32.5	32
Thursday, 03-05-12	0	41.2	33.7
Friday, 04-05-12	29.6	37	31.3
Saturday, 05-05-12	29.6	35.5	32.6
Sunday, 06-05-12	31.9	31.7	29.9

Table E.6 Location F – Scout Hall - MTO filtered out ABLs and RBLs

Date	ABL Day	ABL Evening	ABL Night
Monday, 07-05-12	30.3	35.2	34.1
Tuesday, 08-05-12	31.3	34.8	33.7
Wednesday, 09-05-12	0	34.3	33.7
Thursday, 10-05-12	30.2	36.6	33.2
Friday, 11-05-12	33.1	34.5	32.6
Saturday, 12-05-12	32.2	0	0
Monday, 14-05-12	0	32.1	31.2
Tuesday, 15-05-12	28.6	34.4	31.5
Wednesday, 16-05-12	28.1	37.3	33.4
Thursday, 17-05-12	28.9	38.3	34.2
Friday, 18-05-12	31	37.2	34.1
Saturday, 19-05-12	33.1	37.5	34.2
Sunday, 20-05-12	30.2	35.1	30.4
Monday, 21-05-12	31.2	37.3	34.8
Tuesday, 22-05-12	32.6	26.2	31.3
Wednesday, 23-05-12	33	34.7	37.2
Saturday, 26-05-12	0	29	31.2
Sunday, 27-05-12	28.8	33.8	30.5
Monday, 28-05-12	30.3	32.3	31.8
Tuesday, 29-05-12	29.3	32.2	28.9
Wednesday, 30-05-12	30.3	34.6	33.9
Thursday, 31-05-12	30.1	36.1	0
Friday, 01-06-12	31.9	34.4	37.5
Wednesday, 06-06-12	0	0	36.7
Thursday, 07-06-12	31.5	38.8	0
Friday, 08-06-12	33.5	40.6	36.1
Saturday, 09-06-12	30.6	40.4	35.4
Tuesday, 12-06-12	0	39.4	35.5
Wednesday, 13-06-12	32.2	37.9	35.6
Thursday, 14-06-12	30.5	40.8	37.6
Friday, 15-06-12	35.9	38	36.4
Saturday, 16-06-12	36.9	0	0
Monday, 18-06-12	0	33.1	32.3
Tuesday, 19-06-12	0	33	34.1
Wednesday, 20-06-12	35.1	32.7	32.3
Saturday, 23-06-12	34.6	31.9	32.2
Sunday, 24-06-12	34.3	34.5	34
Tuesday, 26-06-12	0	33.7	0
Wednesday, 27-06-12	0	38.2	0

Table E.6 Location F – Scout Hall - MTO filtered out ABLs and RBLs

Date	ABL Day	ABL Evening	ABL Night
Thursday, 28-06-12	33.1	0	0
Friday, 29-06-12	34.8	40.6	36.2
Saturday, 30-06-12	33.4	38.5	0
Sunday, 01-07-12	0	31.6	0
Monday, 02-07-12	0	28	28.1
Tuesday, 03-07-12	32.9	28.7	30.6
Wednesday, 04-07-12	31.7	31.5	29.9
Thursday, 05-07-12	0	32	33.5
Friday, 06-07-12	0	34.7	33.9
Saturday, 07-07-12	30.5	38	33.7
Sunday, 08-07-12	30.8	41.7	36.6
Monday, 09-07-12	30.6	41.3	39.5
Tuesday, 10-07-12	36.2	38.5	0
Wednesday, 11-07-12	0	43	40.3
Thursday, 12-07-12	0	39.4	0
Friday, 13-07-12	0	0	38.1
Saturday, 14-07-12	0	39.2	0
Monday, 16-07-12	32.4	41.8	38.3
Tuesday, 17-07-12	37.2	40.6	37.4
Wednesday, 18-07-12	34.6	37.3	34.7
Thursday, 19-07-12	34	36.5	32.2
Friday, 20-07-12	31.9	37.3	0
Sunday, 22-07-12	0	37.9	37.4
Monday, 23-07-12	34.2	39.4	38.6
Tuesday, 24-07-12	28.9	41.9	38.1
Wednesday, 25-07-12	34.3	43.8	39.6
Thursday, 26-07-12	34.3	39.6	34.7
Friday, 27-07-12	33.9	31.4	29.5
Saturday, 28-07-12	30.9	29.2	28.2
Sunday, 29-07-12	33.1	28.7	28.6
Monday, 30-07-12	0	33.1	31.2
Tuesday, 31-07-12	31	33.8	0
Wednesday, 01-08-12	31.8	31.7	31.5
Thursday, 02-08-12	31.7	36.9	33.6
Friday, 03-08-12	34.2	31.4	33.2
Saturday, 04-08-12	0	29.6	33.9
Sunday, 05-08-12	0	29.5	0
Monday, 06-08-12	0	24.2	27.2
Tuesday, 07-08-12	33.1	33.6	32.5

Table E.6 Location F – Scout Hall - MTO filtered out ABLs and RBLs

Date	ABL Day	ABL Evening	ABL Night
Monday, 13-08-12	0	37.8	34.6
Tuesday, 14-08-12	0	36.2	33.5
Wednesday, 15-08-12	0	32.7	27.5
Thursday, 16-08-12	0	29.7	0
Friday, 17-08-12	0	29.2	0
Sunday, 19-08-12	36.1	29.4	0
Monday, 20-08-12	31.4	0	0
Wednesday, 22-08-12	0	34.8	34.7
Friday, 24-08-12	0	0	32.1
Saturday, 25-08-12	0	0	33.9
Sunday, 26-08-12	0	32.1	33.3
Monday, 27-08-12	32.3	0	0
Tuesday, 28-08-12	32.6	37.1	0
Wednesday, 29-08-12	0	33.4	32.6
Thursday, 30-08-12	0	24	23.6
Friday, 31-08-12	0	0	24.4
Saturday, 01-09-12	27.1	25.9	25.6
Sunday, 02-09-12	0	29.7	31.1
Monday, 03-09-12	25.8	34.7	0
Tuesday, 04-09-12	0	28.4	0
RBL	**32.6**	**37.3**	**36.2**

Notes: *1. '0' Values indicate excluded data due to weather or inadequate sampling as per the INP. When calculating the median value, these '0' samples are ignored as per the INP.*

Appendix F

Ombudsman letter regarding low frequency noise

Ombudsman
New South Wales

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Level 24, 580 George Street, Sydney NSW 2000
T 02 9286 1000 | F 02 9283 2911
Tollfree 1800 451 524 | TTY 02 9264 8050
www.ombo.nsw.gov.au

22 January 2014

Our reference: C/2013/6408
Your reference: 13/17860
Contact: Veronica Brogden
Telephone: (02) 9286 0933

Mr Sam Haddad
Director-General
Department of Planning and Infrastructure
GPO Box 39
SYDNEY NSW 2001

RECEIVED
28 JAN 2014
Director-General

Dear Mr Haddad

Complaint by EDO NSW on behalf of Bulga Milbrodale Progress Association (BMPA)

We wrote to your office on 23 October 2013 seeking response to a number of questions about a complaint by BMPA. A/Director General, Mr Richard Pearson responded on 27 November 2013.

I have now completed my assessment of that matter, and have written to the NSW EDO advising that I do not propose to take any further action. My letter, with reasons for my decision is attached for your records.

Please pass on my thanks to all staff involved in responding to our inquiries.

Yours sincerely

Veronica Brogden
Senior Investigation Officer, Local Government

Ombudsman
New South Wales

ABN 76 325 886 267
Level 24, 580 George Street, Sydney NSW 2000
T 02 9286 1000 | F 02 9283 2911
Tollfree 1800 451 524 | TTY 02 9264 8050
www.ombo.nsw.gov.au

22 January 2014

Our reference: C/2013/6408
Contact: Veronica Brogden
Telephone: (02) 9286 0933

Sue Higginson
Principal Solicitor
Environmental Defenders Office, NSW
Level 5, 263 Clarence Street
SYDNEY NSW 2000

COPY

Dear Ms Higginson

Complaint by Bulga Milbrodale Progress Association Inc (BMPA) about NSW Department of Planning and Infrastructure (DPI)

I refer to your letter dated 22 August 2013 in which you forward a complaint on behalf of the BMPA, about the DPI's decision to refuse to apply Low Frequency Noise (LFN) data in accordance with the Industrial Noise Policy (INP) and condition of consent for Mount Thorley and Warkworth coal mines.

As you are aware, Bryce Purches of this office had made inquiries with the DPI and the NSW Office of Environment and Heritage (OEH). Mr Purches has recently left, and the file has been reallocated to me for assessment of the information received by those agencies.

The Ombudsman is primarily concerned to ensure government agencies are fair and reasonable in their dealings. It is clear that opinions, even by experts, may differ. We are unwilling in such situations to question expert opinion, except in those rare cases where the opinion appears so unsupportable that it suggests something improper may have occurred. It is seldom appropriate for us to decide between differing technical views, nor do we have the resources to routinely obtain our own independent expert opinion.

To this end, we sought information from DPI and OEH about the review of the INP, and the application of LFN data to the operations of Mount Thorley Warkworth open cut mine in accordance with the conditions of consent DA 300-9-2002-I.

DPI has provided information and evidence to demonstrate that the (then) DECCW (OEH) had from 2010 made a commitment to revise the INP in relation to low frequency noise, and to review the INP as a whole. While progress on this has been slower than expected, our verbal interactions with OEH has confirmed that they anticipate a review will be completed later this year.

Assessment of LFN appears to be quite contentious, especially in rural settings. I do not propose to develop a view as to which position is most likely accurate, as I have explained above, we do not have that expertise, or the resources to seek that expertise.

It would appear to me, however, that the following points have been agreed by DPI and OEH:

- There may be technical merit as to the difficulty in applying the low frequency modifying factor in rural areas, subject to further study. OEH has commissioned a comprehensive study of LFN as a part of the INP review, titled *Low Frequency Noise & Infrasound*, still underway;
- That OEH would not include conditions about LFN in Environment Protection Licences; and
- A review of the INP would be conducted, and LFN would be a priority issue.

When we receive complaints about compliance and enforcement, failure to take action alone is generally not sufficient grounds to justify an investigation by this office. We look closely at the facts of each case, including the agency's reasons for its decisions.

In this case, there appears to be appropriate consideration of professional advice from qualified staff and experts about LFN that casts doubt as to the practicality of strict enforcement of the condition of consent. Notwithstanding this, OEH has also acknowledged that any review of LFN in the INP will include consultation with NSW Health given the health issues said to be associated with LFN.

Noise monitoring continues to be a high priority issue, and a Noise Management Plan and Noise Monitoring Programme for the whole mining complex are in place. Further, DPI has advised that there will be a requirement to provide separate noise management and monitoring documents for the Mount Thorley and Warkworth mines, in consultation with OEH and DPI due to a Land and Environment Court decision.

For the reasons outlined above, it appears to me the information and evidence provided by the agencies is sufficient to satisfy me that the DPI has provided adequate reasons for its decision and has properly considered all relevant issues, and there is no other evidence of wrong conduct that requires intervention by this office.

I appreciate why you forwarded this matter to this office, and I acknowledge the importance of noise monitoring and the impacts of noise on the local community. BMPA should continue to engage with the agencies and the mine operators as is appropriate and participate in community consultation and engagement as opportunities arise.

I will now close this file and take no further action.

Yours sincerely COPY

Veronica Brogden
Senior Investigation Officer, Local Government

NSW GOVERNMENT | Planning & Infrastructure

Office of the Director General

Mr Bruce Barbour
NSW Ombudsman
Lvl 24, 580 George St
Sydney NSW 2000

13/17860

Attention: Mr Bryce Purches

Dear Mr Barbour

I refer to your letter requesting information about the regulation of low frequency noise at the Mt Thorley and Warkworth Coal Mines (MTW) following a complaint from the NSW Environmental Defender's Office on behalf of the Bulga Milbrodale Progress Association.

I understand that the request from the NSW Ombudsman is part of a preliminary investigation in accordance with s13AA of the *Ombudsman Act 1974,* to determine whether this matter should be formally investigated.

I have responded to each of the questions you have raised in the attachment to this letter.

Should you have any further enquiries about this matter, I have arranged for Mike Young, Manager Mining and Industry Projects, to assist you. Mr Young can be contacted on 02 9228 2091.

Yours sincerely

27/11/13

Richard Pearson
A/Director General

Enclosed:
- Attachment addressing information request from NSW Ombudsman
- Mount Thorley Warkworth *Noise Management Plan*
- Mount Thorley Warkworth *Interim Noise Monitoring Programme*
- Mount Thorley Warkworth Annual Environmental Management Report (extract)
- Mount Thorley Warkworth *Independent Noise Monitoring Report*
- Letter from Director General of DECCW, dated 20 December 2010

Response to Questions Raised by NSW Ombudsman

1) *Please provide a copy of the current Noise Management Plan and Noise Monitoring Programme which apply to the consent.*

As requested, copies of the Noise Management Plan and the Noise Monitoring Programme for MTW are enclosed. However, these documents apply to the MTW complex as a whole, and Coal & Allied will be required to prepare and implement separate documents for the Mount Thorley and Warkworth mines in the near future as a result of the NSW Land & Environment Court decision to disallow the application of complex-wide noise criteria. The revised plans will need to be developed in consultation with the NSW Environmental Protection Authority (EPA), and will require approval from the Department.

2) *Is live monitoring of low frequency noise currently undertaken by either the operators of the mine or the Department in relation to cl.28 of the consent? If not, please explain why?*

The real time monitoring is undertaken using an automated system installed in various locations around the mine by Coal & Allied. However, the real time monitoring is limited to the assessment of A-weighted noise levels only, and hence it is not possible to apply the low frequency modifying factors which require C-weighted noise levels to be measured. Furthermore, the real time monitoring is only used for proactive management of noise on the site, and is not used to determine compliance with the noise criteria in condition 28 of the Warkworth consent.

Instead, attended monitoring undertaken by the operators of the mine is used to determine compliance with the noise criteria in the consent. Attended monitoring can measure both A-weighted and C-weighted noise levels and is therefore used to determine if the modifying factor should be applied to the monitoring data.

3) *Are the modification factors for low frequency noise in Section 4 of the INP currently applied to all the reported/measured noise levels relating to the monitoring of the consent?*

The low frequency modifying factor is only applied to the monitoring data where a low frequency impact is identified during the attended monitoring. Under Section 4 of the INP, this modifying factor should be applied if the difference between the C weighted and A weighted noise level is greater than 15 dB.

In the case of Warkworth, Coal & Allied has been applying the low frequency modifying factor since 2010. The most recent *Annual Environmental Management Report* (AEMR), shows that the low frequency penalty was applied on 7 occasions out of a total of 130 attended noise measurements undertaken during 2012 (see extract from the 2012 AEMR attached).

4) *If the modification factors for low frequency noise in Section 4 of the INP have been applied, please provide a document, by way of example which shows how these modification factors have been applied and reported.*

The 2012 AEMR provides an example of how the low frequency modifying factor has been applied and reported. The AEMR is submitted to the Department, and made available on the company's website.

A further example is the *Independent Noise Monitoring Report* prepared by SKM in April 2012 for the Mount Thorley and Warkworth mines. The Independent Noise Monitoring Report provides a comprehensive discussion about low frequency noise and the difficulties of measuring low frequency noise generated by mines, particularly at distances greater than 3 km (see page 12 of the attached report). I understand that presentations were given to the community about the outcomes of the independent monitoring undertaken by SKM.

5) *If the modification factors have not been applied please explain why*

The low frequency modification factor for the Warkworth mine is applied and reported as described above.

6) *Are the modification factors for low frequency noise in Section 4 of the INP currently applied to the data contained in the Annual Environmental Management Reports submitted to the Department by the operators of the mine?*

The low frequency modifying factor is applied to the data at the time of the attended monitoring, and then reported in the AEMR that is submitted to the Department.

7) *Please explain on what basis the Department formed the view that the OEH or EPA has been conducting a review of the relevant sections of the INP in 2011 and 2012.*

There has been ongoing collaboration between the Department and the EPA regarding the assessment of low frequency noise and the need to review the applicable sections of the INP since 2009.

For example, enclosed is a letter from the Director General of the Department of Environment, Climate Change and Water (formerly OEH and EPA) dated December 2010. This letter highlights:

- the difficulties in applying the low frequency modification factor in rural settings;
- that the EPA did not intend to include conditions regarding low frequency noise in Environment Protections Licences; and
- a commitment to review the policy in regard to low frequency noise as a priority ahead of a full review of the INP.

Furthermore, the *Upper Hunter Strategic Regional Land Use Plan* (SRLUP) issued by the NSW Government in September 2012, indicates that a review of the INP as it relates to mining projects was already underway at that time (see page 62 of the SRLUP which is available on the Department's website).

Finally, the EPA has commissioned SKM to prepare a comprehensive study of low frequency noise as part of the review of the INP. The report is titled *Low Frequency Noise & Infrasound*, and is expected to be finalised in the near future.

8) *Please provide copies of any correspondence between the OEH or EPA which confirms that a review of Section 4 of the INP has been ongoing since at least the 15 December 2011.*

A copy of the letter from the Director General of DECCW, dated 20 December 2010, is enclosed.

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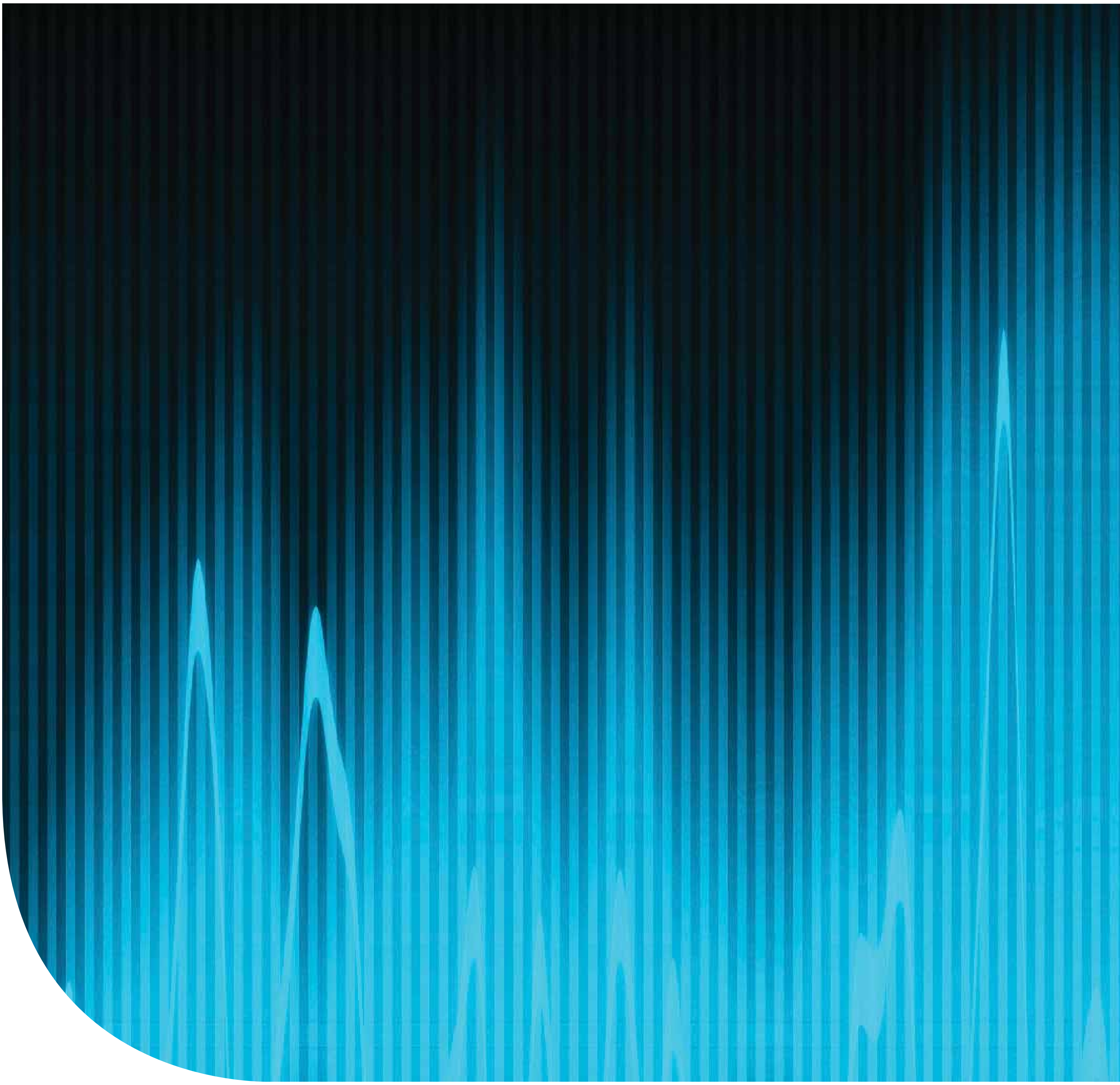

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