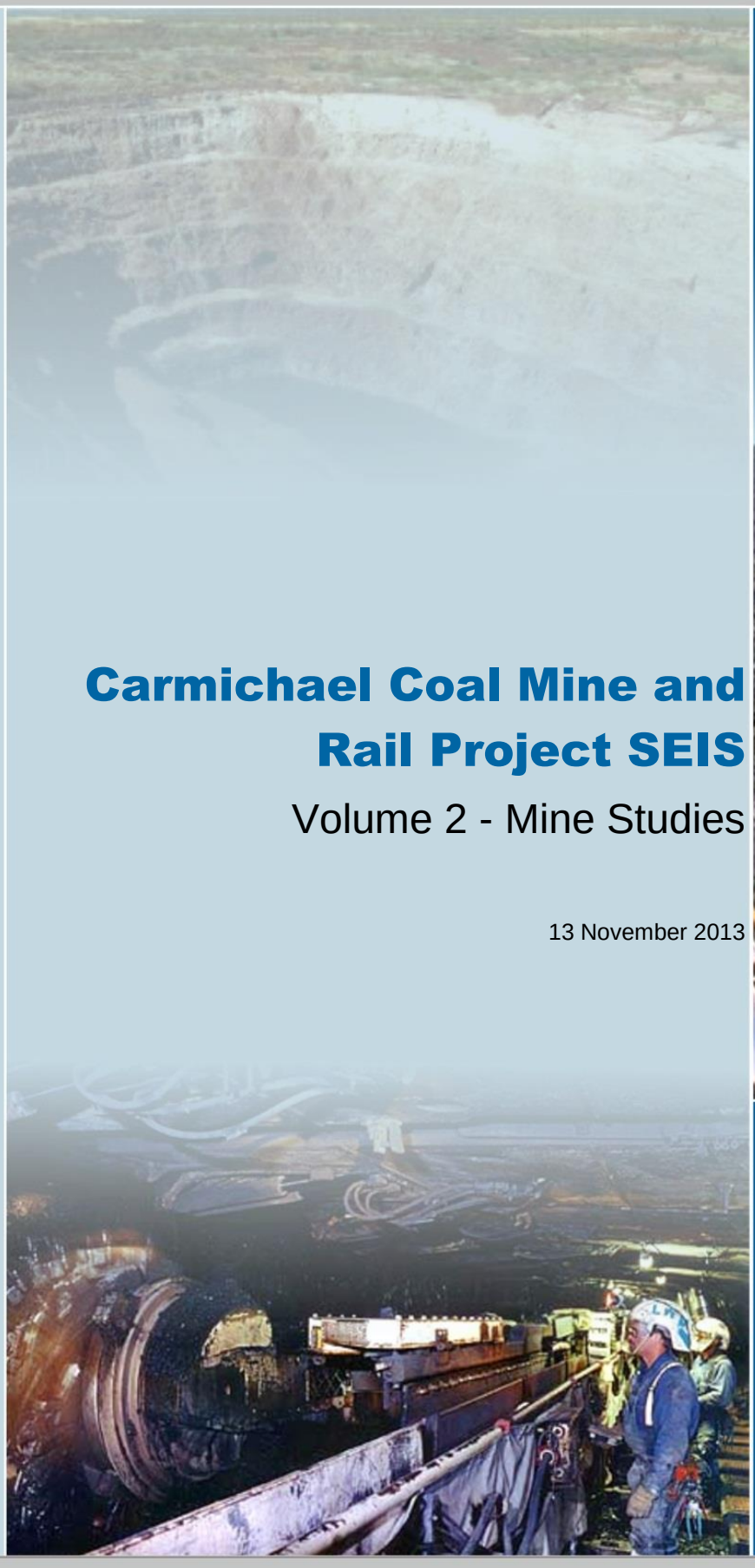
Adani Mining Pty Ltd



Carmichael Coal Mine and Rail Project SEIS

Volume 2 - Mine Studies

13 November 2013

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- *reliance on the Report by a third party, or use of this Report other than for the Purpose.*

Table of contents

Figure index

Table index

1. Introduction

Volume 2 of the Supplementary Environment Impact Statement (SEIS) applies to the Project (Mine). The purpose of the document is to provide readers with an overview of Project (Mine) amendments, summary of comments received during the EIS submission period and how these comments have been addressed as part of the SEIS.

For each area of investigation the section is structured as follows:

- Introduction – this provides an overview of the elements of the amendments to project description relevant to the area of investigations and how they may impact the EIS findings. A description of updated or new studies relevant to the area of investigation is also provided.
- Summary of comments – this provides a brief description of the comments received in regard to the area of investigation grouped across common themes.
- Response to comments – this provides a summary of how each comment under the common themes and where necessary directs the reader to more detailed information within the volume 4 appendices.
- Summary of commitments – this provides details of new commitments applicable to the Project based on the outcomes of the SEIS work or response to comments.

2. Project description

2.1 Introduction

This chapter describes changes to the Project (Mine) subsequent to the EIS. These changes are described in detail in SEIS Volume 4 Appendix B Updated Mine Project Description, and summarised in Section 2.2. Changes to the Project (Mine) Offsite infrastructure are summarised in Section 2.3.

The fundamental components of the Project (Mine) are as follows:

- Open cut mine
- Underground mine
- Mine infrastructure areas (MIAs)
- Coal handling and processing plant
- Out-of-pit dumps
- Raw water and waste water management infrastructure
- Offsite infrastructure, including
  - Workers accommodation village
  - Airport
  - Industrial development area
  - Water supply infrastructure

2.2 Updated mine plan

Table 1 summarises changes to the Project (Mine) subsequent to the EIS, reflected in an updated mine plan (refer Figure 1). The Project (Mine) for the SEIS is described in more detail in Volume 4 Appendix B Updated Mine Project Description. The main changes to the Project (Mine) are as follows:

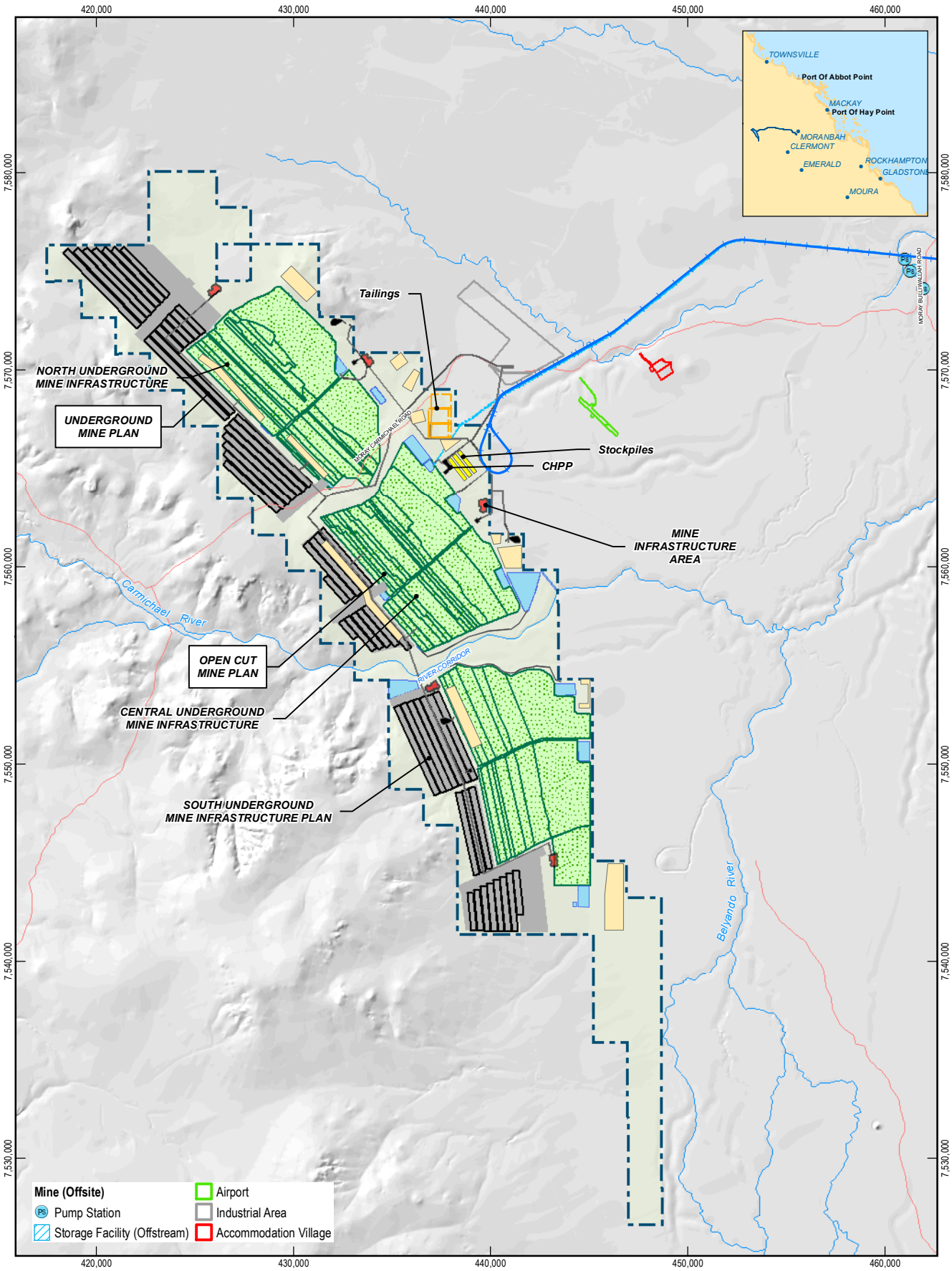
- Revision of mine stage planning (refer to Volume 4 Appendix B Updated Mine Project Description)
- Consolidation of open cut pits from 16 pits (Pit A through Pit P) to 6 pits (Pit B through Pit G)
- Revision of underground mining to increase to five underground areas
- Separation and distribution of central MIA into five multiple, smaller MIAs
- Rearrangement of Project (Mine) offsite infrastructure (refer to Section 2.3)

The EIS mine stage plan reflecting commencement of construction in 2013, produce first coal in 2014 and begin rehabilitation in 2102. The SEIS mine stage plan was amended to commence in 2014, produce first coal in 2016 and begin rehabilitation in 2071. The overall effect is a decrease mine life from 90 years in the EIS to 60 years in the SEIS.

Pit A through Pit K, north of Carmichael River, were consolidated into Pit B through Pit E. Pit L through Pit O, south of the Carmichael River, were consolidated into Pit F and G. Underground mining comprises the balance of operational areas, effectively replacing open cut pits A and P.

The MIAs will support the overburden and coal vehicle fleets for the life of the Project (Mine). Each will include a permanent heavy vehicle workshop, warehouse, 3.5 ML diesel storage and additional lubricant storage. The coal handling and processing plant coal stockpiles remain in the original location of the central MIA.

Changes to the Project (Mine) Offsite infrastructure is described in Section 2.3.



LEGEND

- Local Road
- River / Watercourse
- Overland Conveyors
- Rail (West)
- Mine (Onsite)
- Open Cut Blocks
- Out of Pit Waste Dumps
- Water Management Dams
- Mine Infrastructure Area
- Mine Infrastructure
- Stockpiles
- Tailings Cell
- Top Soil Storage

1:275,000 (at A4)

0 2 4 6 8 10

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project SEIS

Job Number 41-26422
Revision B
Date 18-10-2013

Project Mine Layout

Figure 1

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Data Source: GA: Road, River / Watercourse (2007); DME:EPC1690 (2010), EPC1080 (2011); Adani: Alignment, Offsite(2013), Mine Layout / Infrastructure (2013); Created by: MS

Table 1 Summary of Project (Mine) changes

Component	EIS	SEIS
Footprint	22,063 ha	20,188 ha
Underground mine area	7,768 ha	7,564 ha
Output	60 Mtpa[1]	60 Mtpa
Operating life	90 years	60 years
Overburden	22.9 billion bcm[2]	13.1 billion bcm
Average water demand	9.3 GL/year	12 GL/year
Peak workforce (construction)	3,000	1,075
Peak workforce (operation)	3,000	3,800
Capital investment	$21.5 billion[3]	$16.5 billion

1 Million tonnes per annum

2 Bank cubic metres

3 Excludes power and water

2.3 Offsite infrastructure

The main changes to the Project (Mine) offsite infrastructure are as follows:

- Adjustment of accommodation camp aspect, approximately 413 m movement of south-west corner
- Relocation of the airport south of Moray Carmichael Road, approximately 5.6 km
- Realignment of consolidated water supply pipeline to Project (Rail) corridor
- Removal of in-stream storage of North and Obungeena creeks
- Removal of offsite bore fields and associated pipelines.

The Carmichael Coal Mine and Rail EIS proposed the development of an offsite bore field for water extraction. That bore field is no longer a component of the proposed project. Should external bore water be required, separate approvals and assessments would be required for this post the EIS and SEIS process. In that event, any bore would be constructed in accordance with the Minimum Construction Requirements for Water Bores in Australia (National Uniform Drillers Licensing Committee 2011) – the standard for constructing, maintaining, rehabilitating and decommissioning water bores in Australia.

2.4 Updated studies

The following studies were updated to address changes to the Project (Mine) subsequent to the EIS.

- Volume 4 Appendix C1 Project Approvals Report
- Volume 4 Appendix C2 Mine Applications
- Volume 4 Appendix C4 Offsite Applications
- Volume 4 Appendix C6 Draft Conditions Report
- Volume 4 Appendix E Economic Assessment
- Volume 4 Appendix F Offsets Strategy

- Volume 4 Appendix H Revised MNES Report
- Volume 4 Appendix I1 Revised Subsidence Assessment Report
- Volume 4 Appendix I2 Draft Subsidence Management Plan
- Volume 4 Appendix J1 Revised Mine Ecology Report
- Volume 4 Appendix J2 Black-throated Finch Monitoring Survey
- Volume 4 Appendix J3 Doongmabulla and Mellaluka Springs Report
- Volume 4 Appendix J4 Population Survey of Waxy Cabbage Palm
- Volume 4 Appendix J5 Offsite Infrastructure Ecological Assessment
- Volume 4 Appendix J8 Great Barrier Reef Wetlands Protection Areas
- Volume 4 Appendix K1 Mine Hydrogeology Report
- Volume 4 Appendix K2 Water Balance Report
- Volume 4 Appendix K3 Mine Water Quality Report
- Volume 4 Appendix K4 Flood Mitigation and Creek Diversion Design
- Volume 4 Appendix K5 Mine Hydrology Report
- Volume 4 Appendix K6 Addendum to Revised Mine Hydrogeology Report
- Volume 4 Appendix L Revised Mine Air Quality Assessment Report
- Volume 4 Appendix M Mine Greenhouse Gas Emissions Report
- Volume 4 Appendix N Updated Mine Noise and Vibration Assessment
- Volume 4 Appendix O1 Mine Waste Characterisation Report
- Volume 4 Appendix O2 Mine Waste Management Strategy
- Volume 4 Appendix O3 Landform Design Study Report
- Volume 4 Appendix P Traffic Impact Assessment
- Volume 4 Appendix Q1 Environmental Management Plan Mine
- Volume 4 Appendix Q2 Environmental Management Plan Offsite
- Volume 4 Appendix R1 Closure and Rehabilitation Strategy Mine
- Volume 4 Appendix R2 Closure and Rehabilitation Strategy Offsite

2.5 Summary of comments

Key submissions on the EIS relevant to the description of the description of the Project (Mine) are summarised below.

- An overview map depicting access locations and State-controlled roads is not provided
- Mine layout is conceptual, and not reflective an actual mine plan
- Mine layout does not show mining in eastern, residual areas of EPC 1690
- Mine layout inconsistent with described location of flood levees on Carmichael River

- Investigations that should be prerequisites for mine developed, such as hydrology and coal quality, are described as progressing in parallel with mine development
- Draft subsidence management plan and rehabilitation management plan are absent
- Macro-Conceptual Mine Study and Xenith report referenced in the EIS are absent, while the EIS does not provide a level of detail on the specific of coal extraction, surface subsidence and technical issues associated with the mining operation
- Description of coal washery process does not refer to input materials and quantities
- Potential for final voids to act as regional sinks for groundwater (through inflow and evaporation)
- Description of subsidence impacts on water resources is not sufficiently detailed
- Water management in sediment ponds after Project (Mine) operation is not detailed
- Description of offset distance of mining activities near Carmichael River floodplain is inconsistent
- Description of use of water licence for construction, where water permit is the appropriate approval
- Editorial errors in EIS Volume 2 Chapter 2 Description of the Project, including
  - Ambiguous description of sizing of sediment basin
  - Missing data for Dam 3 in Table 2-23

A copy of the Submissions Register for the EIS is located in the SEIS Volume 4 Appendix A. The submissions register contains a full record of all submissions made on the EIS, including those summarised above.

2.6 Response to comments

2.6.1 An overview map depicting access locations and State-controlled roads is not provided

An updated traffic impact assessment, including identification of key intersections and overview of the State-controlled road network, is included as Volume 4 Appendix P Traffic Impact Assessment. The impact assessment includes figures depicting the overall plan of roads within the region that the Project (Mine) is expected to impact, including all State-controlled roads and local roads. Appendix B of the impact assessment describes transport routes and usage for key Project logistics.

2.6.2 Mine layout is conceptual, and not reflective an actual mine plan

A revised mine plan is provided in Volume 4 Appendix B Updated Mine Project Description. An ongoing programme of geological and geotechnical investigations is being, and will continue to be, carried out to further define the coal resources and refine the mine plan as the Project (Mine) progresses.

2.6.3 Mine layout does not show mining in eastern, residual areas of EPC 1690

A revised mine plan is provided in Volume 4 Appendix B Updated Mine Project Description. The mine plan is reflective of planned mining activities, inclusive of both EPC 1690 and EPC 1080, and has been developed on the outcomes of detailed coal exploration over these EPCs.

2.6.4 Mine layout inconsistent with described location of flood levees on Carmichael River

A revised hydrology assessment is provided in Volume 4 Appendix K5 Mine Hydrology Report. The report provides mapping of a Cabbage Tree Creek levee and confirms that the location of the Northern Carmichael River levee is largely identical to that modelled for the EIS, excluding some minor adjustments to sections that angle away from the river. Volume 4 Appendix K4 Flood Mitigation and Creek Diversion Design depicts proposed levees and other flood mitigation infrastructure within the revised mine plan to ensure consistency with commitments made.

2.6.5 Investigations that should be prerequisites for mine developed, such as hydrology and coal quality, are described as progressing in parallel with mine development

A revised mine plan is provided in Volume 4 Appendix B Updated Mine Project Description. Volume 4 Appendix K5 Mine Hydrology Report and Volume 4 Appendix I1 Revised Subsidence Assessment Report reflect the revised mine plan. An ongoing programme of geological and geotechnical investigations is being, and will continue to be, carried out to further define the coal resources and refine the mine plan as the Project (Mine) progresses. This process includes coal quality drilling, to improve knowledge of raw quality and washability characteristics. It should be noted that the SEIS mine plan has been prepared from the basis of extensive exploration data gathered since the submission of the EIS.

2.6.6 Draft subsidence management plan and rehabilitation management plan are absent

The following studies have been included in the SEIS

- Volume 4 Appendix R1 Closure and Rehabilitation Strategy Mine
- Volume 4 Appendix R2 Closure and Rehabilitation Strategy Offsite
- Volume 4 Appendix I1 Revised Subsidence Assessment Report
- Volume 4 Appendix I2 Draft Subsidence Management Plan

2.6.7 Mine plan level of detail

A revised mine plan is provided in Volume 4 Appendix B Updated Mine Project Description, which provides details on mining methods. An ongoing programme of geological and geotechnical investigations is being, and will continue to be, carried out to further define the coal resources and refine the mine plan as the Project (Mine) progresses. Volume 4 Appendix I1 Revised Subsidence Assessment Report describes surface subsidence while Appendix I2 Draft Subsidence Management Plan provides a management and monitoring framework for areas potentially impacted by subsidence.

2.6.8 Description of coal washery process does not refer to input materials and quantities

A revised mine plan is provided in Volume 4 Appendix B Updated Mine Project Description, which provides details on mining methods including coal washing requirements. Volume 4 Appendix O2 Mine Waste Management Strategy describes the volume and treatment of tailings over the life of the Mine. Tailings volumes were calculated based on the revised mine plan, as the difference between run of mine (ROM) coal and product coal.

2.6.9 Potential for final voids to act as regional sinks for groundwater (through inflow and evaporation)

An assessment of the impact of final voids in regard to groundwater is provided in SEIS Volume 4 Appendix K1 and Appendix K6. The extent and design of final voids has been revised since the publication of the EIS. However, the final landform indicates that final ground surface in part of each of the final pits will be below pre-development ground surface and current groundwater level elevations. Whilst there is the potential for these final voids to gradually fill with water once dewatering operations have ceased, potential evaporation losses from the voids significantly exceed predicted groundwater inflow and hence the voids are expected to remain dry, except following prolonged heavy rainfall events. In this case, ongoing evaporation from these voids will essentially act as long-term groundwater extractions from within the Project (Mine) area, with the potential to permanently reduce groundwater levels to the base of proposed final voids. As a result, the various impacts related to dewatering of the mine during the operational period will persist post-closure. In some cases predictions indicate that potential long-term post closure impacts may exceed those calculated for the operational period, since evaporation is likely to continue to control groundwater levels within the final un-remediated voids in perpetuity, whereas dewatering of the proposed mine workings during the operational phase is only required for the life of the mine.

Volume 4 Appendix R1 Closure and Rehabilitation Strategy Mine includes measures for ongoing groundwater monitoring, modelling, mitigation and treatment.

2.6.10 Description of subsidence impacts on water resources is not sufficiently detailed

Volume 4 Appendix I1 Revised Subsidence Assessment Report includes an assessment of potential effects on hydraulic connectivity. Volume 4 Appendix I2 Draft Subsidence Management Plan provides a management and monitoring framework for areas potentially impacted by subsidence and water resources. Volume 4 Appendix K5 Mine Hydrology Report describes the potential impacts of subsidence of surface water, and proposed mitigation measures. In general, the proposed flood mitigation and creek diversion design diverts water from areas of predicted subsidence. Where surface water cannot be effectively redirected from subsidence, low flow connecting channels will provide for flows between subsidence ponds to the downslope side of the subsidence area. These low flow channels will serve to mitigate potential impacts of overtopping of upslope ponding in the event of high rainfall. Volume 4 Appendix R1 Closure and Rehabilitation Strategy Mine includes measures for prevention of ponding in the subsidence zone.

2.6.11 Water management in sediment ponds after Project (Mine) operation is not detailed

Volume 4 Appendix R1 Closure and Rehabilitation Strategy Mine includes post-closure management of overland flow and the rehabilitation of water management structures.

The rehabilitation approach for all water storages will consist of:

- Testing of water quality in all storages that may have received mine affected or contaminated water
- Treatment to water quality requirements and discharge to final void or Carmichael River
- Assessment of whether storage may be of beneficial use for rehabilitation or, in consultation with landholders, water storages for ongoing grazing

A staged management procedure for storages that are to be removed is provided in Volume 4 Appendix R1 Closure and Rehabilitation Strategy Mine. Additionally and where practical, Adani will re-profile the subsidence zone to prevent ponding.

2.6.12 Description of offset distance of mining activities near Carmichael River floodplain is inconsistent

A revised mine plan is provided in Volume 4 Appendix B Updated Mine Project Description, which consistently refers to a minimum 500 m corridor either side of the centreline of the Carmichael River.

2.6.13 Description of use of water licence for construction, where water permit is the appropriate approval

Volume 4 Appendix C1 Project Approvals Report (and Volume 4 Appendix C2 Mine Applications) has been updated to correctly refer to water permits and water licences, as applicable.

2.6.14 Editorial errors in EIS Volume 2 Chapter 2 Description of the Project

A revised mine plan is provided in Volume 4 Appendix B Updated Mine Project Description. Section 8.6.5 of the revised mine plan corrects the following editorial errors.

- Ambiguous description of sizing of sediment basin
- Missing data for Dam 3 in Table 2-23

2.7 Amendments to commitments

In the event that the significant impacts to regional groundwater is observed due to final voids Adani is committed to taking any further steps necessary to reduce post closure impacts on groundwater levels and/or flows to acceptable levels. Potential mitigation measures which may reduce and/or mitigate impacts during the post closure phase include:

- Reviewing and revising the extent, location and/or timing of the proposed mine workings
- Reviewing the backfilling level of final voids in order to minimise or prevent ongoing losses due to evaporation
- Offsetting any residual impacts which cannot be otherwise mitigated.


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3. Climate, natural hazards and climate change

3.1 Introduction

3.1.1 Amendments to project description

The changes to the Project (Mine) that will have an effect on the climate, natural hazards and climate change chapter in the Environmental Impact Statement (EIS) include a change in the overall mining duration from 90 to 60 years and changes to the Mine layout and final land form.

3.1.2 Update to studies

As a result of the Project (Mine) changes the following studies relevant to climate, natural hazards and climate change have been updated:

- Flood Mitigation and Creek Diversion Design (refer to SEIS Volume 4, Appendix K4)
- Revised Mine Hydrology Impact Assessment (refer to SEIS Volume 4, Appendix K5)
- Bushfire Management Plan (refer to SEIS Volume 4, Appendix S2)

3.2 Summary of comments

One submission was received with comment regarding climate, natural hazards and climate change in relation to the Project (Mine). The comment identified the potential changes in flooding regimes resulting from changes in landform associated with the Mine.

A table that provides responses or cross references to the responses to individual comments is provided in SEIS Volume 4, Appendix A.

3.3 Response to comments

Comments regarding flood impacts from landscape changes have been noted. Flood modelling has been reviewed against the detailed Mine plan and detailed in the Revised Mine Hydrology Impact Assessment Report (refer to SEIS Volume 4, Appendix K5).

In regard to flooding associated with changes in the landform associated with the Mine, the Preliminary Flood Mitigation and Creek Diversion Design (SEIS Volume 4, Appendix K4) modelled a range of flood protection and mitigation infrastructure proposals with the most significant being:

- 1 in 1,000 year ARI-immune flood protection levees for the Carmichael River corridor
- 1 in 100 year ARI-capacity local waterway diversion drains with the ability to provide 1 in 1,000 year ARI flood immunity to the pits through the mine site, through the use of supplementary adjacent levees; maintaining natural flow paths and hydrology to the maximum extent practicable
- 1 in 50 year ARI-immune haul road and conveyor crossing of the Carmichael River

Subsequent modelling of the Carmichael River corridor with this proposed infrastructure in place and modelling of all the diversion drains indicated the ability of this infrastructure to protect the mine site from large flood events.

Table 2 presents the afflux values for the ARI events considered as part of the Project (Mine) modelling.

Table 2 Projected afflux from proposed development at selected locations

Location	Description	Afflux (m) For ARI			
		10 year	50 year	100 year	1,000 year
1	Carmichael River Model Inflow Boundary	0.01	0.00	0.00	0.00
2	2 km Downstream of Carmichael River Model Inflow	0.02	0.00	0.00	0.01
3	Western Project (Mine) area Boundary	0.02	0.01	0.01	0.06
4	Upstream of Haul Road Crossing	0.11	0.19	0.23	0.98
5	Downstream of Haul Road Crossing	0.03	-0.04	-0.08	0.31
6	Upstream Cabbage Tree Creek	0.04	0.16	0.23	0.70
7	Midway through Project (Mine) area	0.02	0.14	0.21	0.59
8	Eastern Project (Mine) area Boundary	0.01	0.00	0.01	0.07
9	Downstream Cabbage Tree Creek	0.01	0.07	0.09	0.17

Afflux was found to be significant within the mine area due to the combined effect of minor increased inflows from some of the diverted waterways, reduced runoff coming from the developed mine internal areas and hydraulic constriction by the flood protection levees, haul road and conveyor crossing. Upstream of the haul road crossing afflux was modelled to peak at 0.98 m for the 1 in 1,000 year ARI event, but at the downstream eastern boundary this had already reduced to peak at 0.09 m adjacent to the Carmichael River and 0.27 m downstream of Cabbage Tree Creek. These values are reduced in smaller events, with afflux at the mine area boundaries generally being relatively insignificant (0 – 0.09 m, with the higher values being confined to the eastern boundary downstream of Cabbage Tree Creek). It is believed that the significant reduction in afflux values predicted over this short distance indicates that neighbouring properties are likely to experience minimal increase in flood extents both downstream and, especially, upstream of the mine area. The most significant afflux is confined within the mine area.

3.4 Amendments to commitments

No further commitments have been made regarding climate, natural hazards and climate change.

4. Land

4.1 Introduction

4.1.1 Amendments to project description

The changes to the Project (Mine) relevant to the land chapter include changes to the Mine plan and layout. Table 3 details the changes to areas of impact based on the revised Mine Plan.

Table 3 EPC Areas

EPC	Total area (ha)	EIS area of impact (ha)	SEIS area of impact (ha)
1690	26,016	19,528	19,857
1080	18,714	10,093	8,035

The results of the Environmental Impact Statement (EIS) in relation to land will not change significantly as the land use and tenure of the proposed mine changes are the same as those identified in the EIS. The changes to the mine and infrastructure layout are within the same order of magnitude as described within the EIS and impacts on the scenic amenity of residences will remain the same as those predicted in the EIS.

Changes to impacts relating to topography, geology and soils will not vary significantly from those identified in the EIS.

4.1.2 Update to studies

The following additional studies have been undertaken in response to changes to the mine plan and submissions on the EIS:

- Revised Subsidence Assessment Report (refer to SEIS Volume 4 Appendix I1)
- Draft Subsidence Management Plan (refer to SEIS Volume 4 Appendix I2)
- Revised Mine Hydrogeology Report (refer to SEIS Volume 4 Appendix K1), incorporating an update to the Mine geological model, and an Addendum to the Mine Hydrogeology Report providing supporting information on groundwater flows, directions, interactions (refer SEIS Volume 4 Appendix K6)
- Closure and Rehabilitation Strategies (refer to SEIS Volume 4 Appendix R1 and Appendix R2)
- Revised Mine and Offsite Environmental Management Plans (refer to SEIS Volumes Q1 and Q2 respectively).

4.2 Summary of comments

Issues raised in these submissions included:

- Soil and land suitability assessment required for additional mine lease surface area
- Loss of good quality agricultural land, strategic cropping land and long term impacts on agricultural viability
- Subsidence, final voids and rehabilitation including final land use
- Offsite infrastructure arrangements

- Loss of and management of stock route network

A table that provides responses or cross references to the responses to individual comments is provided in Volume 4 Appendix A.

4.3 Response to comments

4.3.1 Soils

Mapping

It was requested that the location of boreholes be shown on the soil mapping. The relevant figure has been updated and is provided as Figure 2.

Geological

Since completion of the EIS, an ongoing drilling program has progressively gathered additional information in regard to the geology of the Mine Area. The borelogs from this drilling program have been added to the existing geological model to provide a greater level of detail in regard to the local geology.

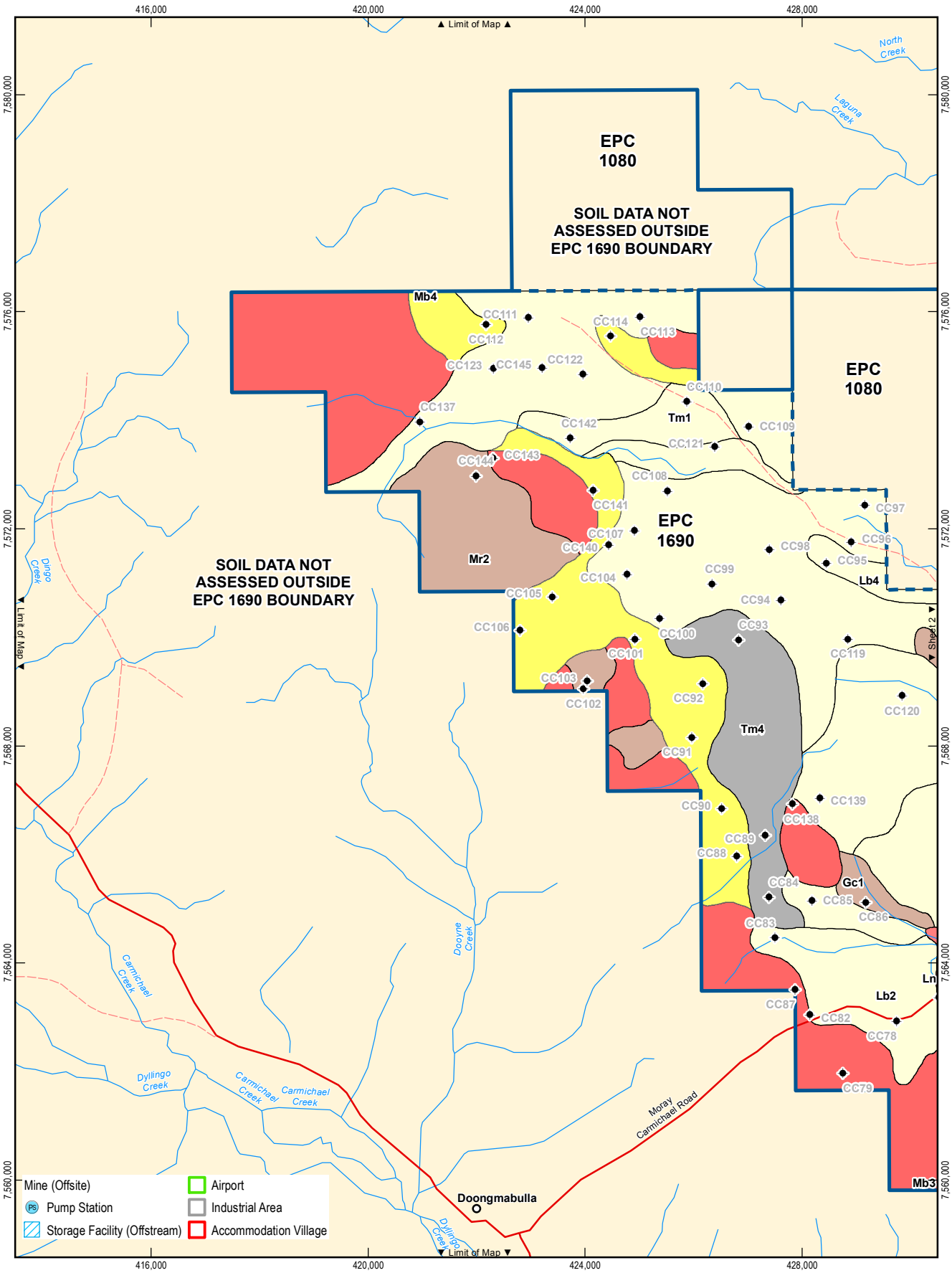
A sketch cross section illustrating the stratigraphy within the Mine Area is shown in Figure 3.

The Project (Mine) lies within the Galilee Basin, an intracratonic sedimentary basin deposited in the Permian and Triassic Periods. Tertiary-age strata (including sandstones, mudstones and conglomerates) are mapped at outcrop over much of the Mine Area and based on geological information available from the initial exploration program were typically thought to range in thickness from 45 – 100 m thick in the west. However, an extensive drilling program has continued throughout the EIS and SEIS period which culminated in a detailed review of all the available geological information by Xenith Consulting and Geotechnical Consulting Services (GCS). The results of this review suggest that the Tertiary cover is not as laterally extensive or as thick as previously thought. Based on the detailed geological information now available for the site it appears likely that the published mapping under-estimates the extent of the underlying Dunda Beds towards the western margin of the lease. This is broadly consistent with the results of soils mapping undertaken for the EIS.

Further details in regard to sampling effort and Mine Area geology are provided in (SEIS Volume 4 Appendix K1 and Appendix O1).

Land suitability assessment

It was requested that a soil survey and a soil and land suitability assessment of areas contained within EPC 1080 and the MIA be undertaken. A soil survey and soil and land suitability assessment will be undertaken prior to construction of the Project. This assessment will include the areas contained within EPC 1080 and the Offsite infrastructure area. A commitment to undertake this assessment has been included within the SEIS Project Commitments (refer to SEIS Volume 4 Appendix G Project Commitments).

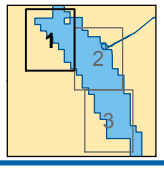


LEGEND

- Homestead
- Local Road
- Track
- Watercourse
- Rail (West)
- Boreholes
- Mine (Onsite)

GHD Soil Survey

- Gc1, Gc2, Mr2
- Lb1, Ln
- Mb3
- Lb2, Lb4, Tm1, Tm2
- Mb2, Mb4
- Cr1, Cr3, Cr4
- Eb2
- E
- Tm4
- Eb1, Eb3



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0 1 2 3 4

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

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Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project SEIS

Soil Survey Results for EPC1690

Job Number	41-26422
Revision	B
Date	14-10-2013

Figure 2
Sheet 1 of 3

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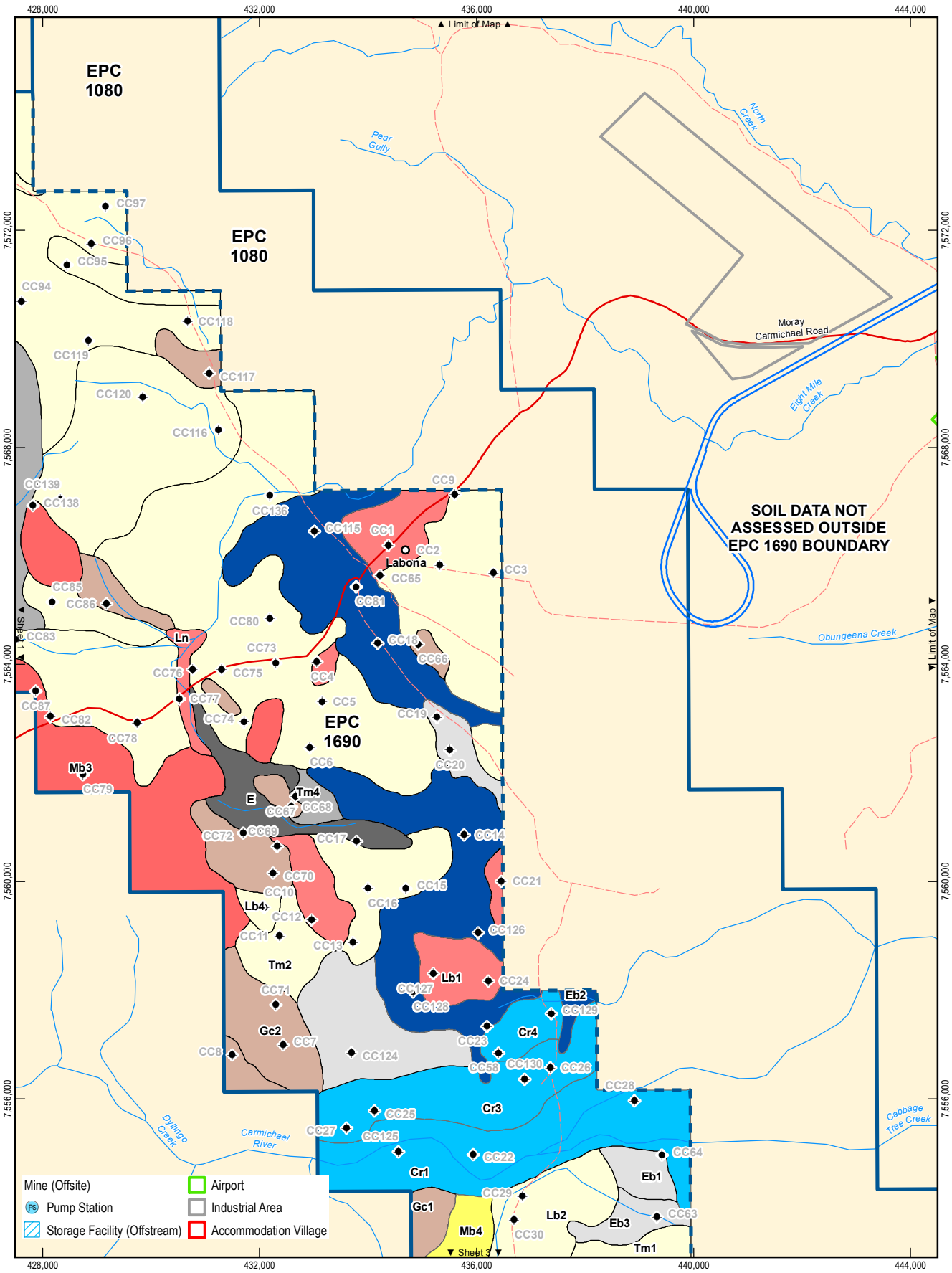
Level 9, 145 Ann St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data Source: © Copyright Commonwealth of Australia - Geoscience Australia: Road, Homestead, Watercourse (2007); DME: EPC 1690 (2010)/EPC 1080 (2011); GHD: Carmichael Soil Survey (2011); Adani: Alignment (2013), Mine (Offsite) (2012); GHD: Soil Survey Results (2011). Created by: BW,MS.

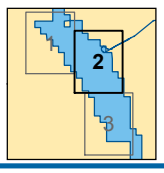


LEGEND

- Homestead
- Local Road
- Track
- Watercourse
- Rail (West)
- Boreholes
- Mine (Onsite)

GHD Soil Survey

- Gc1, Gc2, Mr2
- Lb1, Ln
- Mb3
- Lb2, Lb4, Tm1, Tm2
- Mb2, Mb4
- Cr1, Cr3, Cr4
- Eb2
- E
- Tm4
- Eb1, Eb3



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Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

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Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project SEIS

Soil Survey Results for EPC1690

Job Number	41-26422
Revision	B
Date	14-10-2013

Figure 2
Sheet 2 of 3

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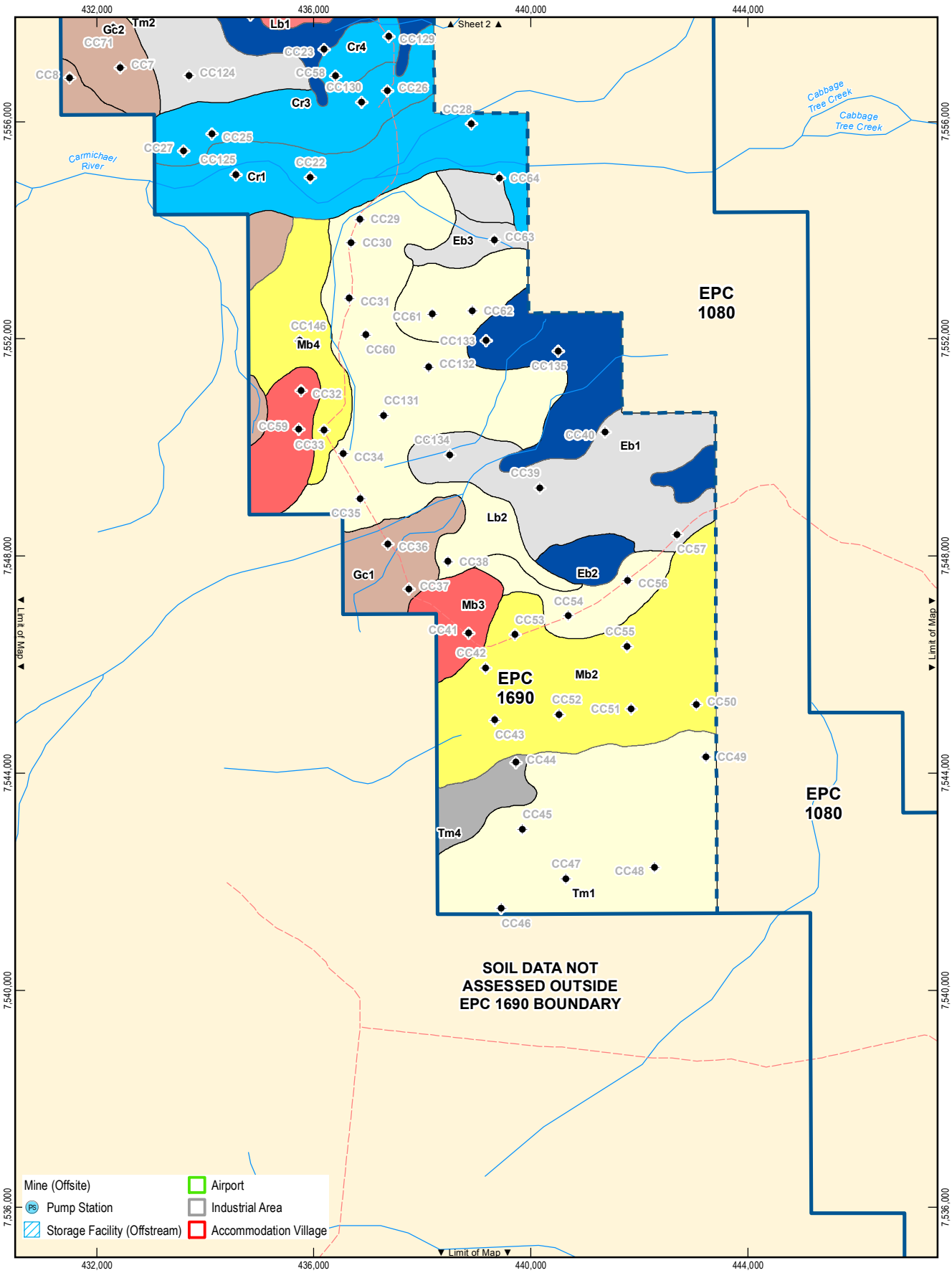
Level 9, 145 Ann St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data Source: © Copyright Commonwealth of Australia - Geoscience Australia: Road, Homestead, Watercourse (2007); DME: EPC 1690 (2010)/EPC 1080 (2011); GHD: Carmichael Soil Survey (2011); Adani: Alignment (2013), Mine (Offsite) (2012); GHD: Soil Survey Results (2011). Created by: BW,MS.

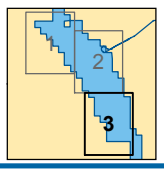


LEGEND

- Homestead
- Local Road
- Track
- Watercourse
- Rail (West)
- Boreholes
- Mine (Onsite)

GHD Soil Survey

- Gc1, Gc2, Mr2
- Lb1, Ln
- Mb3
- Lb2, Lb4, Tm1, Tm2
- Mb2, Mb4
- Cr1, Cr3, Cr4
- Eb2
- E
- Tm4
- Eb1, Eb3



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Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
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Carmichael Coal Mine and Rail Project SEIS

Soil Survey Results for EPC1690

Job Number 41-26422
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Figure 2
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Level 9, 145 Ann St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

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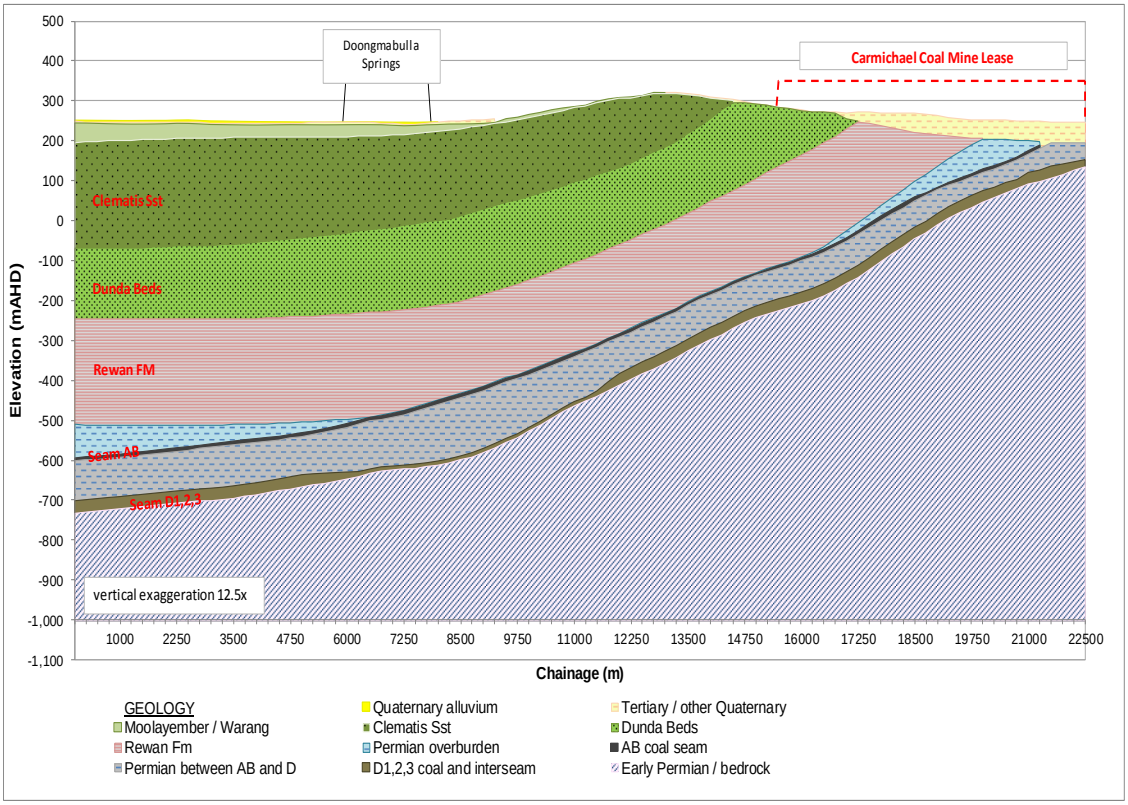
Figure 3 Sketch geological cross-section through the Project (Mine) lease



Stripping depths

Comments regarding stripping depths have been noted. DNRM are correct in assuming that in some specific locations the depth of 'useable soil' will be greater than 40 cm. However, the depth to underlying rock will vary considerably and maybe (probably) over short distances. The actual distribution or variability of this depth could not be determined accurately at the mapping scale used in the EIS. The 40 cm depth used in the EIS was used as a conservative indicative depth only, and if the actual variability needs identifying and mapping for specific areas then more detailed work will be undertaken. This can be undertaken for each development stage as the mine progresses.

4.3.2 Good quality agricultural land and strategic cropping land

Comments regarding the impact of the mine on GQAL have been noted. The Mine plan has been developed to minimise the impact of the Project (Mine) on GQAL. However, these are unavoidable impacts associated with a declared significant project.

4.3.3 Subsidence, final voids and rehabilitation

Subsidence

It has been requested that the EIS should sufficiently describe the impacts of subsidence on water resources and provide suitable mitigation measures. Further information regarding the management of ponding and low water flows resulting from subsidence was also requested.

The impacts of subsidence on water resources have been included within the updated sections of the SEIS Revised Subsidence Assessment Report (refer to SEIS Volume 4 Appendix I1) and Draft Subsidence Management Plan (refer to SEIS Volume 4 Appendix I2), the Revised Mine Hydrogeology Report (refer to SEIS Volume 4 Appendix K1) and the Revised Mine Flooding Report (refer to SEIS Volume 4 Appendix K4).

The subsidence report concluded that:

- The predicted subsidence and tilts are likely to be of sufficient magnitude to result in changes in the surface water flows along the drainage lines.
- Increased ponding is predicted to develop in the drainage lines directly above the proposed longwalls.
- It is expected, at the magnitudes of predicted curvatures and strains, that significant fracturing and buckling would occur in the uppermost bedrock beneath the natural surface soils along the drainage lines. Surface cracking in the beds of the drainage lines would be visible at the surface where the depths of the surface soils are relatively shallow.

Rehabilitation measures for areas of subsidence are provided in the Closure and Rehabilitation Strategy for the Mine (refer to SEIS Volume 4 Appendix R1).

Final voids

Several comments regarding final voids and particular mitigation measures were received.

Open-cut voids will be progressively backfilled from the low-wall with overburden and mine waste. Backfilling will include selective handling and management of potentially acid forming, saline or sodic materials including encapsulation if necessary.

Pre-strip materials from development of adjacent open-cuts will also be placed in finished open-cuts where possible to reduce the volume and slopes of any final void.

The final landform for each open-cut and void will be achieved through:

- initial geotechnical appraisal of high-wall stability and suitable final slope angle
- blasting and dozing of the high-wall to achieve a stable slope with safe edges
- assessing the potential for spontaneous combustion to occur from exposed coal seams and ameliorative works as required to reduce risk
- re-profiling the low-wall to final angle of 12° to 14°. Potential overland flow from incident rainfall which could cause scouring and erosion will be managed by the construction of water retention or diversion structures on slopes and in the catchment above open-cut voids as required
- accident prevention by effective bunding and/or fencing of the perimeter and the erection of danger signs
- minimising the amount of inflow of overland flow caused by rainfall and eroded soil into the void were feasible

Water quality in final voids is not expected to cause degradation of adjacent or downstream surface or ground water resources. Testing will be carried out prior to, during and after rehabilitation to establish whether water quality meets relevant guideline levels. If water quality is degraded, a more detailed assessment of risk to water resources will be undertaken, including groundwater monitoring and modelling and mitigation or treatment.

As discussed in the Revised Mine Hydrogeology Report (refer to SEIS Volume 4 Appendix K1) the final ground surface within these voids will be substantially below the pre-development ground surface and also below current groundwater level elevations. Therefore once dewatering operations have ceased in each pit, there is the potential for groundwater levels to gradually rebound and permanent lakes could develop in all pits.

Adani is committed to taking the steps necessary to reduce post closure impacts on groundwater levels and/or flows to acceptable levels. Potential mitigation measures which may reduce and/or mitigate impacts during the post closure phase include:

- Reviewing and revising the extent, location and/or timing of the proposed mine workings
- Reviewing the backfilling level of final voids in order to minimise or prevent ongoing losses due to evaporation
- Offsetting any residual impacts which cannot be otherwise mitigated

Details regarding final voids have been included within the Revised Mine Hydrogeology Report (refer to SEIS Volume 4 Appendix K1), Addendum to Revised Mine Hydrogeology Report (refer to SEIS Volume 4 Appendix K6) and the Closure and Rehabilitation Strategy for the Mine (refer to SEIS Volume 4 Appendix R1).

Rehabilitation

Adani has prepared a Closure and Rehabilitation Strategy for the Mine (refer to SEIS Volume 4 Appendix R1).

The nominated post mine land use includes grazing on a mosaic of native pasture and woodland habitat. The overarching objectives for rehabilitation include:

- Returning the site to a stable and safe landform
- Establishing a landform with similar land use capabilities or suitability to that of pre-development
- Mine wastes and disturbed lands rehabilitated to a non-polluting and self-sustaining condition
- Maintaining water quality
- Management of potential acid mine drainage, if required
- Establishing vegetation cover to minimise erosion and sediment loss

Mining is a temporary use of land. Adani is committed to a sustainable post-mining land use of the proposed areas of disturbance from the Project (Mine). Where possible the proposed post-mining land use strategy seeks to return the final landform as closely as possible to its original condition, i.e. having a similar suitability and range of land use options as existed prior to mining.

There will be areas of the project, such as the final void, in which rehabilitation to a similar condition as pre-mining is impractical, and other areas where land has existed in a degraded condition or was subject to poor land management. In such cases, other beneficial post-mining land use options have been identified.

4.3.4 Offsite infrastructure

Since completion of the EIS, development applications for the Offsite infrastructure have been prepared. These applications include details for the workers accommodation village, airport and industrial area (refer SEIS Volume 4 Appendix C4 Offsite Applications).

The offsite applications include:

- Application for preliminary approval (planning)
- Mine Worker Accommodation approval applications
- Industrial precinct approval applications
- Airport precinct approval applications
- Application to take water from the Belyando River

The proposed Preliminary Approval seeks to establish a site and operation specific planning framework that will effectively guide future development over the site in the most efficient and practical manner offered by the *Sustainable Planning Act 2009* (SP Act 2009). The proposed framework effectively allows for the approvals process to occur in a more logical manner that responds to the wider development context on site and the extensive amount of analysis that has already been conducted on site.

This approach responds to the comments raised in relation to how the offsite infrastructure area would be developed.

Ongoing consultation will be undertaken with Isaac Regional Council (IRC) during the development of the Offsite infrastructure area. Project approvals triggered under the IRC Planning Scheme will be submitted to IRC in accordance with SP Act 2009.

4.3.5 Loss of stock route network

Several comments were received regarding impacts to the stock route network. Realignment of the stock route is to be addressed during development of the stock route alignment agreement with DNRM, DTMR, IRC and landholders.

4.4 Amendments to commitments

The following additional commitments are relevant to impacts associated with land:

- Adani will undertake a soil survey and soil and land suitability assessment within EPC 1080 and the Offsite infrastructure area.
- Adani will maintain ongoing liaison with IRC regarding the development of offsite infrastructure.
- Adani will consult with DNRM, DTMR, IRC and landholders as part of the development of the stock route realignment plan.
- Adani will return the Mine Area to a post-mining sustainable land use.

Refer to SEIS Volume 4 Appendix G Project Commitments.

5. Nature conservation

5.1 Introduction

5.1.1 Amendments to Project (Mine) description

The changes to the Project (Mine) relevant to the nature conservation chapter include:

- changes to the Mine plan and layout
- changes to the layout of the Offsite infrastructure area

5.1.2 Update to studies

The following additional studies have been undertaken in response to these amendments and to comments received during the EIS submission period.

These reports include:

- Revised Offset Strategy Report (refer SEIS Volume 4 Appendix F)
- Draft Subsidence Management Plan (refer SEIS Volume 4 Appendix I2)
- Revised Mine Ecology Report (refer SEIS Volume 4 Appendix J1)
- Black-throated Finch Monitoring Report (refer SEIS Volume 4 Appendix J2)
- Doongmabulla and Mellaluka Springs Report (refer SEIS Volume 4 Appendix J3)
- Population Survey of Waxy Cabbage Palm Report (refer SEIS Volume 4 Appendix J4)
- Offsite Infrastructure Ecological Assessment Report (refer SEIS Volume 4 Appendix J5)
- Offsite Infrastructure BioCondition Report (refer SEIS Volume 4 Appendix J6)
- Offsite PMAV Report (refer SEIS Volume 4 Appendix J7a)
- Offsite PVMP Report (refer SEIS Volume 4 Appendix J7b)
- GBR Wetland Protection Areas Report (refer SEIS Volume 4 Appendix J8)

Mine Ecology Report

A revised assessment of terrestrial and aquatic ecology was undertaken based on the changes to the Mine Plan and Offsite infrastructure area layout. This assessment drew upon the findings of additional surveys also completed since the publishing of the project EIS.

This report is included as SEIS Volume 4 Appendix J1.

Black-throated Finch (southern) Additional Surveys

Following the confirmed presence of the species on site during investigations for the EIS, additional monitoring work was undertaken in May 2013. Consultation meetings were held with the Black-throated Finch Recovery Team (3 May 2013) and DSEWPaC (7 June 2013) and a draft monitoring program was developed. A key component of this was intensive local monitoring (observation) on the Mine Area. This monitoring assisted in responding to comments in submissions about the EIS.

The additional surveys established 80 monitoring sites: 52 x 2 ha woodland sites, 8 x water body count sites and 20 camera trap sites. Detailed vegetation and habitat data was collected at the 2 ha sites. Surveys were conducted over 8 days, by a four-person field team (i.e. 32 person field days). A total 208 records of black-throated finch were recorded from 2 ha counts in 12 locations (some may have been recounts of previously-seen birds), including 3 records of nesting. The camera traps recorded a further 6 locations and mainly utilising troughs and ephemeral water, with flocks between 1 and 41 birds. The highest numbers of finches consistently recorded in association with areas of intact remnant vegetation (particularly where in good condition) in the north-west, west and south-west of the Project (Mine) Area. The cumulative survey effort also indicates that black-throated finch is more likely to utilise small and ephemeral water sources than large, exposed water bodies. Nesting was confirmed within the Project (Mine) Area for the first time during this monitoring exercise, with one finch carrying nest material and two nests found, although nests may have been used for roosting rather than breeding at this time.

The full results of this monitoring are reported in SEIS Volume 4 Appendix J2.

Doongmabulla and Mellaluka Springs Surveys

Following the identification of potential indirect impacts to Doongmabulla Springs as a result of the Project (Mine) and the identification of a further potential spring group at Mellaluka, a further survey was carried out in March/April 2013. This survey assisted in responding to comments received in submissions about the EIS.

The additional work carried out revealed that, in general, the habitats present within the Doongmabulla Springs complex are intact and in good ecological condition exhibiting only minor disturbance and that the greatest habitat values of the complex are the permanency of water and the connectivity of the wetland to the nearby waterways and the surrounding region. It also revealed a lesser complexity of habitat within the Mellaluka Springs complex than at Doongmabulla and that the value of this habitat may be more limited for some species.

The full results of this survey are reported in SEIS Volume 4 Appendix J3.

Population Survey of Waxy Cabbage Palm in Carmichael River

During surveys of the Carmichael Coal Mine and Rail Project EIS, the waxy cabbage palm was identified to occur within the confines of the Project Area. This species is listed as vulnerable under both Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the *Nature Conservation Act 1992* (NC Act). As part of the SEIS process, further ecological studies were undertaken in March/April 2013 to locate and map the distribution of this species and better understand the population size present within the Project Area.

Photographic records, individual counts and location (GPS) records were used to estimate the population size and location of the waxy cabbage palm along the banks of the Carmichael River. The length of the Carmichael River within EPCs 1690 and 1080 was traversed to ensure an accurate estimate of population was obtained for this area.

The additional work resulted in a total of 831 palms being located, with the majority of individuals situated within the Carmichael River within two areas of particular population density (of 479 palms and 155 palms, respectively). Adult palms accounted for only approximately 11

percent of this population. During the survey, four threatening processes were noted: weed infestation (particularly from rubber vine), feral pigs, cattle and bush fire.

The full results of this survey are reported in SEIS Volume 4 Appendix J4.

Offsite Infrastructure Ecological Surveys

Following the finalisation of the Mine Plan in relation to the proposed location of offsite infrastructure, further surveys were carried out within the Mine (Offsite) Area in April/May 2013. These surveys assisted in responding to comments received in submissions about the EIS. The work included bio-condition assessments (for use within the Project Offsets Strategy), and the production of a Property Map of Assessable Vegetation (PMAV) and Property Vegetation Management Plan (PVMP), as well as targeted flora and fauna assessments.

The additional work carried out revealed that the survey area is a predominantly cleared agricultural landscape and that remnant vegetation only occurred over approximately 4.5 percent of that area, primarily in association with two creek lines and their adjacent floodplain areas. The remnant vegetation present included approximately 10 ha of (constituent endangered REs of) Brigalow threatened ecological community (TEC). While no threatened flora or aquatic species were recorded during the survey, three EPBC Act listed fauna species were confirmed present: black-throated finch, squatter pigeon and ornamental snake, as well as the *Nature Conservation Act 1992* (NC Act) listed black-necked stork and cotton pygmy-goose.

The full results of these surveys are reported in SEIS Volume 4 Appendix J4, J5, J6, J7a and J7b.

Great Barrier Reef Wetland Protection Areas (GBR WPA)

Following the identification of three potential (mapped) GBR WPAs within the Mine Area that were dry at the time of earlier survey work, additional surveys were carried out in May 2013 to seek confirmation of their status and condition. This survey assisted in responding to comments received from DEHP.

The additional work carried out revealed that although the areas were once again dry at the time of the survey, the soil characteristics (colour and alluvium nature) and flora species present were indicative of the areas being wetlands, as was the presence of snail and crab shells and burrows that may be utilised by freshwater fauna species. The three WPAs are considered to fit the Queensland wetland classification of a ‘semi-arid grass, sedge and herb swamp’.

The full results of this survey are reported in SEIS Volume 4 Appendix J8.

5.2 Summary of comments

Submissions relating to nature conservation for the Project (Mine) were raised by advisory agencies, organisations, private submitters, and landholders.

Comments raised in these submissions included:

- Adequacy of surveys and level of survey effort, particularly in relation to rare and threatened species and offsite infrastructure areas
- Impacts on black-throated finch (southern), particularly through clearing of known habitat for the subspecies

- Impacts to the threatened fauna species, koala and squatter pigeon, through clearing of potential habitat for the species including clearing within Bygana West Nature Refuge
- Consideration of brigalow scaly-foot as a likely to occur species
- The detailed mitigation and management of introduced weed and pest species
- Assessment of wetlands within the Project area, particularly the potential presence of GBR WPAs
- Impacts on groundwater dependant ecosystems and species, such as impacts on riparian vegetation surrounding the Carmichael River, including waxy cabbage palm and *Eryngium fontanum*
- Impacts on the Great Artesian Basin, including Mellaluka Springs and Doongmabulla Springs
- Long-term planning for closure and rehabilitation of the Mine

A table that provides responses or cross references to the responses to individual comments is provided in SEIS Volume 4 Appendix A.

5.3 Response to comments

5.3.1 Adequacy of survey effort

Several submissions on the EIS, commented on an insufficient level of survey effort for the offsite infrastructure areas.

Additional survey work has since been carried out within the offsite infrastructure areas and the results of these surveys have been reported in the Offsite Infrastructure Ecology Assessment Report (SEIS Volume 4, Appendix J5). A revised Mine Ecology Report (SEIS Volume 4, Appendix J1) provides an overall assessment of the mine and offsite infrastructure impacts, bringing together the consideration of these areas, as opposed to the separate reporting of these areas that featured within the EIS. Construction impacts associated with development of the offsite infrastructure have been recalculated based on the revised Project Description (SEIS Volume 4, Appendix B).

Whilst the survey work carried out on EPC 1080 was acknowledged as relatively lower than that carried out for 1690, it was considered to be sufficient to determine the principal vegetation communities present within the area and the condition of these communities. Given the extensive survey effort on the neighbouring 1690 area, as well as the comprehensive offsite surveys of adjacent areas since that time, it has been possible to extrapolate these findings and apply them to the 1080 area, in order to gain a broad understanding of the flora known and likely to be present, sufficient for the purposes of the EIS.

5.3.2 Black-throated finch

A prominent issue raised in the submissions on the EIS for the Project focused on the level of survey effort for and the magnitude of predicted impact on the black-throated finch (southern), which is listed as endangered under the EPBC Act and the NC Act. In particular, this was a major focus of the submissions received from SEWPaC, the Black-throated Finch Recovery Team and a number of private submitters.

Since the time of the EIS submission, consultation meetings have been held with the Black-throated Finch Recovery Team (3 May 2013) and DSEWPaC (7 June 2013) and a four part monitoring program has been developed, comprising of:

- Regional distribution (species distribution modelling)
- Regional distribution (surveys)
- Local monitoring (observational) on the Mine Area
- Local monitoring (detailed) on the Mine Area

Further information and detail of these tasks is presented in a draft Black-throated Finch Adaptive Monitoring Plan.

A detailed plan was prepared for the Local monitoring (observation) on the Mine Area task, with the aim of collecting comprehensive information on habitat use, distribution across the Mine Area, nest sites, variation in sites where black-throated finch were present and absent, types of water sources preferred for use, habitat condition, weed, fire and grazing effects and landscape use.

The first survey was conducted in May 2013 (the second survey will occur in August 2013). It established 80 monitoring sites: 52 x 2 ha woodland sites, 8 x water body count sites and 20 x camera trap sites. Detailed vegetation and habitat data was collected at the 2 ha sites. Survey methods follow those in the EPBC Significant Impact Guidelines.

Surveys were conducted over 8 days. A further 208 records of black-throated finch were recorded mainly from 2 ha counts in 12 locations, including 3 records of nesting. The camera traps recorded a further 6 locations and mainly utilising troughs and ephemeral water sources.

In terms of the evidence of nesting, at one site, an adult bird was observed transporting *Panicum sp*. stalks suggesting nesting activity nearby; however, the nests were not found. At another site, at least two active nests being used by black-throated finch were found in *Acacia coriacea*. At a third site, an active nest being used by black-throated finch was found in *Eucalyptus melanophloia*. No breeding activity was observed (this nest may have just have been used for roosting). The on-going monitoring will continue to survey nesting activity in these sites, and search for additional nest locations.

The cameras were set for between 22 and 42 days, recording data continuously, thus representing over 500 days of continuous monitoring. This level of effort is substantially greater than that recommended by the Significant Impact Guidelines and the new data is providing important information on water sources regularly used, and daily water use budgets. Further monitoring will identify if these water sources are regularly used, or if water sources use shifts seasonally. Furthermore, different water sources will be monitored over time, as others dry out.

The full results are presented in SEIS Volume 4, Appendix J2 Black-throated Finch Monitoring Survey Report.

The surveys will continue over time to provide data on temporal and spatial variation of habitat use of the Mine Area. Camera traps in particular will also provide significant secondary information on other key species, such as feral animals (pigs *Sus scrofa* and cats *Felis catus*), which may be used in feral pest management on the Mine Area, and the presence of other EPBC Act listed species such as the squatter pigeon (southern). This data will contribute significant information for incorporation into the Black-throated Finch Species Management Plan

for the Mine Area, and will assist in species recovery and mitigation of impacts on the Mine Area, following the principles of adaptive monitoring and management.

The phased construction schedule will allow important population, movement and habitat information to be collected, particularly with respect to seasonal use, key areas, nest sites, important feeding areas, etc. The most up-to-date information will be used to formulate the optimal strategies to manipulate the distribution of black-throated finch on the Mine Area (e.g. via use of water sources, fire, grazing removal), or the requirement for trapping or translocations. In the case of subsidence, which will occur gradually and in a complex and partly unpredictable manner, the data being collected will be used adaptively to focus on mitigating adverse effects should these occur and manage key resources for black-throated finch on the Mine Area.

5.3.3 Potential habitat for koala and squatter pigeon

A small number of submissions were received with respect to the surveys carried out and predicted losses of potential habitat for certain threatened species, primarily koala and squatter pigeon (southern), and the consequent potential impacts to these species.

While no targeted koala surveys were carried out for the EIS, a substantial amount of active searching have been undertaken for threatened fauna species within habitat types that may be occupied by them. Both koala and squatter pigeon were located and the EIS had taken a conservative approach to the definition of potential habitat for these species and had assessed against this. Where impacts have been deemed to be unavoidable, potential habitat has been recommended for offsets (as reported within the Project Offset Strategy), following the appropriate policies and guidelines.

In assessing the potential value of habitats, the definition of 'habitat critical to the survival of' koalas was taken from the Commonwealth's 'Interim Koala Referral Advice for Proponents' (June 2012) and its application to the EIS and SEIS is considered to be appropriate, pending the publication of further finalised guidance. Furthermore, the extent of potential habitat for these species that has been assessed against is very likely to be a considerable over-estimation of the actual occurrence of these species on the ground. For example, koalas are known to occur in low-density, scattered populations across suitable habitats throughout central Queensland, with a particular affiliation to tree-lined creek systems (for movement and dispersal through the landscape). Therefore, the predicted impact of clearance of potential habitat is very likely to be an over-estimation of the actual impact to localised koala populations, where present.

The revised MNES chapter and report (SEIS Volume 1, Section 12 and Volume 4, Appendix H) include further detail on the description of potential impacts upon these species and mitigation proposals with respect to fauna crossings and corridors, in order to counter isolation effects.

5.3.4 Brigalow scaly-foot

Two submissions were received that requested that the brigalow scaly-foot be included as a species that is ‘likely to occur’ within the Project (Mine) area, where the previous assessment was ‘may occur’. According to the submissions, the species is known from several records upstream of the site of the Project (Mine) and in habitat types located within the Project (Mine) area.

The likelihood of occurrence assessment for this species was previously based upon the published modelled distribution mapping that indicated that the species' range did not extend to the EPC 1080 and 1690 areas. DSEWPaC subsequently provided an additional record to the west of the project area that the EIS authors were unaware of at the time of writing of the EIS and the opinion that the recent records may represent extensions to the previously considered range. Given this additional information, the species could be considered as 'likely to occur'. This will be discussed within the revised Mine Ecology Report (SEIS Volume 4, Appendix J1). Note that the Brigalow scaly-foot has been delisted from the Commonwealth EPBC Act since the time of EIS publication and is now only listed at State level.

5.3.5 Management of weed and pest species

A number of submissions were received on the EIS with respect to the proposed management and mitigation measures provided within the EIS to address the potential introduction and/or spread of invasive weed and pest species as a result of the construction and operation of the Project (Mine).

As a result, a number of updates have been made to the Project's Environmental Management Plans (SEIS Volume 4, Sections Q1 (Mine), Q2 (Offsite)). Specifically, these have included:

- management measures to prevent the introduction of species not currently present in the project area and to prevent weed incursion and spread to surrounding properties and environments
- the active control of weed presence on site
- best practice compliance with the requirements of the Plant Protection Act and the alignment of Project plans with the priority weed species targeted by local government action
- the management and mitigation of the invasion of buffel grass and other exotic pasture grass species, as a potential threat to key fauna species, notably the black-throated finch
- the potential presence and need for the control of locust species
- the prevention of the attraction of pest species to construction sites and the waste minimisation and control processes to be implemented
- biosecurity management
- the potential introduction of aquatic weed species and how these will be managed and controlled

5.3.6 Great Barrier Reef Wetland Protection Areas

Several submissions on the EIS were received requesting additional surveys of the three GBR WPAs within EPCs 1690 and 1080. Specifically, these submissions requested that the GBR WPAs be assessed against the Queensland Wetland Definition and Delineation Guideline Part A and B. Additionally, there was a request for the GBR WPAs to be assessed for ecological values when they contain water, as during surveys for the EIS, the wetlands were assessed when they were dry.

Following those submissions, the GBR WPAs were surveyed in May 2013 using the Queensland Wetland Definition and Delineation Guidelines. Despite still being dry at the time at the time of the second survey, the three mapped WPAs were confirmed as fitting the

Queensland WPA classification of 'semi-arid grass, sedge and herb swamp', due to the soil, flora and fauna characteristics observed, though none of these sites were considered to be of particularly high aquatic ecological value. Nevertheless, the potential loss of, or other impacts to, the three WPAs have been considered in full within the SEIS assessment and appropriate mitigation and/or offsetting measures proposed. Full results are presented in the GBR WPA report (SEIS Volume 4 Appendix J8 GBR Wetland Protection Areas Report).

5.3.7 Riparian zone impacts to the Carmichael River and waxy cabbage palm

Potential impacts on the waxy cabbage palm (*Livistona lanuginosa*) were a key issue raised in the comments on the EIS.

A population survey of the waxy cabbage palm has since been conducted at Doongmabulla Springs and in the sections of the Carmichael River that adjoin and pass through the mine site (Population Survey of Waxy Cabbage Palm, SEIS Volume 4 Appendix J4). The revised Mine Ecology Report (SEIS Volume 4 Appendix J1) also discusses this species. Revised groundwater modelling (SEIS Volume 4 Appendix K1), together with the population survey, have contributed to a revised impact assessment on this species.

The groundwater dependency of the species has been acknowledged and reported on within these new documents. In addition, this species experiences periodic flooding within the Carmichael River channel and is specifically adapted to use flooding events to spread seed and therefore colonise new areas and, in fact, is reliant upon these events (as reported in the EIS). Therefore, flooding itself is not considered to be an adverse impact of the Project (Mine), but actually a requirement for successful recruitment.

In addition, further studies on the Project's impact on hydrology have been undertaken to reflect the amended mine plan. Additional studies have included:

- Mine Water Balance (SEIS Volume 4 Appendix K2)
- Flood Mitigation and Creek Diversion Design (SEIS Volume 4 Appendix K4)
- Updated Hydrology Assessment Report (SEIS Volume 4 Appendix K5)

The results of these studies have informed how hydrological impacts to the Carmichael River will impact ecological values within the buffer zone, as well downstream of the Project area, can be undertaken.

5.3.8 Doongmabulla and Mellaluka Springs

During the EIS submission period, several comments regarding inadequate survey effort at Mellaluka Springs were received. The Mellaluka spring complex is a wetland of local significance that was not surveyed in the preparation of the EIS. Although Mellaluka Springs does not appear on the list of Great Artesian Basin (GAB) discharge spring wetlands (Rod Fensham, pers. comm.), which are listed as an 'endangered' TEC under the EPBC Ac), the springs complex occurs in close proximity to the GAB boundary and may comprise/support similar ecological communities and/or be hydrologically linked to these areas.

Further survey work has since been carried out at Mellaluka Springs, as reported in the Doongmabulla and Mellaluka Springs Report (SEIS Volume 4, Appendix J3). This report includes an assessment of threatened species and/or communities that may be present within

the Springs and considers any hydrological linkages between Mellaluka and other springs areas. The Springs are not thought to be GAB-fed and no threatened or endemic species were recorded there during this survey; the area was of lesser complexity and ecological value overall when compared to the Doongmabulla Springs area. There may be localised impacts to Mellaluka Springs during the operation of the Project (Mine). Without mitigation, the predicted post-closure reduction in pressure is likely to result in a loss of ecological function for all springs in the Mellaluka Springs group at that time (2060). This has since been considered within the assessment of impacts for the Project (Mine) and a number of monitoring and management options put forward.

Several comments on the EIS were received in regards to the potential impacts the Project may have on the ecological values of Doongmabulla Springs, a GAB discharge springs wetland, which is listed as an endangered TEC under the EPBC Act. Submissions on the EIS also raised the issue of potential impacts on migratory bird species that utilised the springs as habitat. Many species of migratory birds are protected under international conventions and listed as migratory under the EPBC Act.

The revised MNES Chapter includes information on GAB wetlands from two surveys at Doongmabulla springs (reported on separately in the Doongmabulla and Mellaluka Springs Report (SEIS Volume 4 Appendix J3), the revised Mine Ecology Report (SEIS Volume 4 Appendix J1) and the revised groundwater modelling (Volume 4 Appendices K1 and K6 of the SEIS). Impacts on Doongmabulla Springs and the flora and fauna that live there, including *Eryngium fontanum*, were specifically addressed in the EIS in Volume 2 Chapter 5. No significant assemblages of migratory birds were identified at the Springs sites during any of the surveys carried out; whilst these resources may be of local value to a number of migratory species, it is not thought to support greater regional populations of these species. This report also discusses the importance of Doongmabulla Springs wetlands for the endemic species that it contains.

5.3.9 Mine closure and rehabilitation

A small number of submissions on the EIS were received with respect to the commitment to longer-term planning for the closure and rehabilitation of the Mine and concerns over a reference to an exotic pasture grass, *Urochloa mosambicensis*.

A draft Closure and Rehabilitation Strategy (SEIS Volume 4 Appendix R1) has since been produced separate to the Environmental Management Plan (SEIS Volume 4 Appendix Q1) within the SEIS. This commits to a number of actions for the phased and progressive rehabilitation of worked areas of the Project (Mine) and to final rehabilitation measures at the time of Project (Mine) decommissioning. Measures to be implemented will include the:

- Rehabilitation and ongoing management of terrestrial systems disturbed at any stage of Mine operations, with the objective of revegetating cleared areas as soon as possible after disturbance, and replicating as closely as possible the resources available prior to the commencement of mining. A key aspect of this rehabilitation will be restoring and maintaining connectivity across the local landscape, particularly between intact habitats within and near the Project (Mine) Area.
- Remediation and development of the final landform to consider drainage, erosion resistance and potential resultant change to vegetation communities and surface water

flows, in order to minimise changes to the aquatic habitats of the Carmichael River and downstream.

- Rehabilitation requirements for any watercourse crossings
- Rehabilitation or re-establishment of riparian zones for watercourses
- Monitoring requirements for aquatic communities and water quality

In terms of exotic pasture grasses, although *Urochloa mosambicensis* is listed a species that black-throated finch has been observed feeding on (as with a few other introduced species), it will not be recommended for rehabilitation. In fact, the Black-throated Finch Monitoring Survey Report clearly indicates that the best areas for the species on the Mine Area are weed and exotic pasture free and should be maintained in their current condition, with minimal or grazing exclusion (refer to SEIS Volume 4, Appendix J2 Black-throated Finch Monitoring Report).

5.4 Additional commitments

The following additional commitments are relevant to broader ecological impacts and specific impacts to matters of NES:

- Impacts to the waxy cabbage palm will be managed and mitigated through:
  - The supplementary introduction of surface water to the channel near the upstream Mine Area boundary through controlled discharges
  - Monitoring of riparian condition, base flows and groundwater levels
  - Removal of weeds and pest animals
  - Possible translocation of individual plants (if deemed viable), seed collection and planting programs
  - Research and monitoring to understand distributional range, water dependency requirements and threatening process triggers
  - Development of Groundwater Dependent Ecosystem Management Plan
- Flow and groundwater level monitoring, mapping and measurements of the perimeter of the main wetland areas and selected isolated mound springs to monitor changes to the springs
- Ecological studies of aquatic invertebrates, blue devil, salt pipewort and stygofauna will be conducted in the springs with associated reporting of results
- Pumping groundwater to the surface may act to offset the loss of some sections of the Mellaluka Spring wetland, and the proponent will install electric submersible pumps when drawdown commences for this purpose
- A wetland remediation and management plan will be prepared at this time in consultation with the Mellaluka owner. A pump may also be required to ensure the continuation of water to the Mellaluka homestead
- Detailed design of the Central MAW Dam North will take into account the location of GBR WPA 1. Any loss of the GBR WPAs will require an offset
- Management actions will seek to maintain and where possible enhance black-throated finch habitats and populations (e.g. pest control, water source, grazing and fire management) in unmined parts of the Mine Area, as well as in offset areas

- Black-throated finch surveys will continue so as to provide data on temporal and spatial variation of habitat use in the Mine Area and will contribute significant local data for incorporation into the Black-throated Finch Species Management Plan for the Mine Area, which will assist in refinement of species recovery actions and mitigation of impacts on the Mine Area

Refer to SEIS Volume 4 Appendix G Project Commitments for full details.

6. Water resources

6.1 Introduction

6.1.1 Amendments to project description

The changes to the Project (Mine) relevant to the water resources chapter include:

- changes to the Mine plan and layout
- changes to the coal handling and processing
- changes to the layout of the Offsite infrastructure area

6.1.2 Update to studies

The following additional studies have been undertaken in response to these changes:

- Revised Mine Hydrogeology Report (refer to SEIS Volume 4 Appendix K1). The revised report includes a new geological model, groundwater model, hydraulic test data and inputs from the revised mine plan presented in the project description (SEIS Volume Appendix B Project Description).
- Water Balance Report (refer to SEIS Volume 4 Appendix K2). While the water balance model for the EIS was developed with Microsoft Excel the SEIS water balance makes use of GoldSim modelling software, allowing for a better understanding of water movements on site. In addition a salt balance was developed within the GoldSim environment. The water balance was developed in accordance with the revised mine plan presented in the project description (SEIS Volume Appendix B Project Description) and revised offsite water supply which includes the removal of the offsite borefield.
- Mine Water Quality Report (refer to SEIS Volume 4 Appendix K3). The report includes additional monitoring results collected from surface and groundwater, proposed water quality objectives for operations and revised impact assessment with regard to the revised mine plan presented in the project description and in particular more detailed water management information (SEIS Volume Appendix B Project Description).
- Flood Mitigation and Creek Diversion Design (refer to SEIS Volume 4 Appendix K4). The study done as part of the EIS was updated to better represent the mine plan presented in the revised project description (SEIS Volume 4 Appendix B Project Description). In addition the proposed creek diversions have been presented in detail, ponding assessments for subsidence have been provided and flood modelling has been redone.
- Revised Mine Hydrology Report (refer to SEIS Volume 4 Appendix K5). The update includes assessment based on the revised mine plan presented in the project description, in particular more detail on water management infrastructure (SEIS Volume Appendix B Project Description). The report includes a geomorphology assessment in response to comments on the EIS and an assessment of subsidence effects on hydrology.
- Addendum to Revised Mine Hydrogeology Report (refer to SEIS Volume 4 Appendix K6). The addendum includes supporting information to the hydraulic properties of the Rewan and potential connectivity to the adjacent GAB, groundwater flow direction, conceptual model and model validation and sensitivity analysis.

6.2 Summary of comments

Issues raised in submissions on the EIS included:

- requirement for determination in regard to watercourses
- impact on local and regional water
- insufficient groundwater level data provided
- additional information of impacts on groundwater
- use of groundwater for potable use
- loss of underground water supply to bores
- potential groundwater drawdown impacts, particularly in relation to Great Artesian Basin (GAB) springs, highlands declared sub artesian area, riparian vegetation, Doongmabulla Springs, listed important wetlands and various registered bores
- analysis of drawdown of groundwater table in vicinity of Carmichael River
- information required on the water source and how it will be managed for sustainability
- alterations to Carmichael flow regime
- insufficient information provided on mine water management and discharges (including during flood events)
- insufficient information on quality of mine affected water
- need for identification of environmental values and potential change in water quality and quantity at these locations
- inadequate consideration of hydrology and flooding impacts

Issues raised by DNRM, DEHP and the Department of Environment on review of the Revised Mine Hydrogeology Report included requirements to:

- provide a comprehensive sensitivity analysis of the numerical groundwater model
- substantiate groundwater flow directions presented in the conceptual groundwater model
- provide further evidence regarding the connectivity between the GAB aquifers and the Permian-age strata of the proposed mine
- confirm the conceptual model and hence source aquifer of Mellaluka Springs
- commission a peer review of the numerical groundwater model and predicted impacts
- provide additional predicted groundwater level drawdown maps

6.3 Response to comments

6.3.1 Watercourse determination

Two watercourse determination requests were provided to the DNRM via email on 11 April 2013 in relation to a watercourse determination. Correspondence from DNRM dated 17 May 2013 confirmed the following features have been previously determined watercourses.

- Carmichael River

- Belyando River
- Logan Creek

The same correspondence also determined that the following features, exhibit the characteristics of a watercourse as defined in the Water Act.

- Dyllingo Creek
- Surprise Creek
- Mistake Creek

However, the following features do not exhibit the characteristics of a watercourse and are therefore considered to be drainage features that facilitate overland flow:

- Eight Mile Creek
- Laguna Creek
- Pear Gully
- Obungeena/Ogenbeena Creeks
- Unnamed feature located to the south of MLA70441
- Unnamed feature located to the north of MLA70441

6.3.2 Groundwater

A number of submissions were received in regard to groundwater, particularly relating to the level of information available for the Mine Area and modelling undertaken for the EIS. The following provides specific responses and details of available further information.

Insufficient groundwater level data provided

Since completion of the EIS ongoing groundwater monitoring has occurred at the monitoring network established in 2011 and 2012. Additional monitoring bores have also been installed during 2013. The additional data has been utilised to inform interpretation of potential impacts and to also assist in calibration of the groundwater model.

Calibration of the groundwater flow model was undertaken in steady state through comparison of observed and modelled groundwater levels at 88 borehole locations.

Differences between modelling and actual changes in groundwater levels

Some differences between predicted and actual impacts are inevitable. As far as possible the groundwater modelling work undertaken for the project has been undertaken using a range of conservative assumptions such that the model is expected to over-estimate predicted impacts in most cases. Furthermore a detailed sensitivity analysis has been undertaken which includes an assessment of the sensitivity of a range of model predictions to possible variation in key hydraulic from those calibrated using the groundwater model. The groundwater modelling work has also been peer reviewed. Nevertheless despite these checks and balances it is possible that actual impacts will vary from those predicted. This serves to highlight the need for the proposed ongoing investment in management, monitoring and mitigation presented in the EIS and SEIS.

Inadequate assessment of drawdown impacts

The revised hydrogeology assessment includes presentation of drawdown impacts based on the outcomes of the revised groundwater modelling presented in the SEIS Volume 4, Appendix K1, Revised Mine Hydrogeology Report and its Addendum, Appendix K6. This information has also informed review of assessment of ecological impacts associated with drawdown to groundwater levels and to groundwater pressure expressed through springs or bores (refer SEIS Volume 4 Appendix J1 Updated Mine Ecology Report).

Adani has made a commitment to undertake further baseline assessments at any bores which could be significantly impacted by the development and 'make good' any residual impacts on local groundwater users as detailed in Section 7.6.2 SEIS Volume 4 Appendix K1 Mine Hydrogeology Report.

Additional analysis of management and protection for aquifers in the area required

SEIS Volume 4, Appendix K1, Revised Mine Hydrogeology Report now includes a revised and improved calculation of interaction between surface water resources in the Carmichael River and underlying groundwater resources (Section 5.6.7 and 5.7.5). Adani has also made a commitment to mitigate any observed impacts using measures such as the diversion of minor creeks and/or discharge of suitably treated mine inflows to the river (Section 7.6.6). Refer to Appendix K6 for further information on impact to Carmichael River.

Additional information of impacts on groundwater post closure

The post-closure assessment has been undertaken based on the revised groundwater model and Mine plan. Adani is committed to ongoing review of the extent of final voids to minimise or prevent ongoing impacts associated with the final voids.

Further details are provided in Section 8.4 SEIS Volume 4, Appendix K1 and Addendum K6.

Use of groundwater for water supply

As stated in Section 7.1 of the SEIS Volume 4 Appendix K1, Revised Hydrogeology Report water demand for the operational mine will be met from a combination of dewatering, stored surface water and water imported from offsite. Further information is provided in SEIS Appendix K2 Water Balance Report.

Loss of underground water supply to bores

Refer to the SEIS Volume 4, Appendix K1, Revised Mine Hydrogeology Report (refer Section 7.6.2). Pre-operational monitoring and monitoring of groundwater levels outside of the Mine Area will be carried out as part of the Environmental Monitoring Plan to be developed for the Project (Mine). Should significant effects on registered bores used for water supply be identified, Adani will make good any loss in water availability in conjunction with the landholder.

Detailed review of groundwater modelling required

An independent review of the EIS hydrogeology studies was undertaken by Briese Groundwater Consulting Pty Ltd, and through recommendations informed additional work undertaken for the SEIS. The Updated Hydrogeology Report has also been reviewed by Briese Groundwater Consulting Pty Ltd (refer Appendix A). The review concluded that the work undertaken had produced a robust conceptual groundwater model, and numerical flow model in which a high

degree of confidence can be placed on the predicted impacts and mitigation/containment strategies.

Potential groundwater drawdown impacts in relation to Great Artesian Basin

Additional reporting on the potential impacts of the project on GAB water resources has now been included in Sections 5.6.7 and 5.7.5 of SEIS Volume 4, Appendix K1 Updated Mine Hydrogeology Report.

The Mine Area is mapped as encompassing part of the Eastern Recharge Area of the GAB. Hence, any impacts on groundwater levels in relatively permeable sandstone units such as the Dunda Beds and Clematis Sandstone has the potential to reduce the volume of recharge to the overall GAB. However, it should be noted that the topography, groundwater modelling results and available groundwater level data all suggest that current groundwater flow in Triassic-age units to the west of the site is towards the east i.e. away from the main body of the GAB rather than towards it. Where this eastward groundwater flow direction is confirmed by further monitoring then no impacts on the wider GAB groundwater resources would occur as a result of dewatering.

No direct impacts on groundwater resources in the GAB are anticipated. However, groundwater modelling results suggest that some indirect impact on the GAB is possible via inducing:

- Drawdown in the near-surface Tertiary and Quaternary-age units which are present throughout the majority of the modelled area and hence also extend into the GAB area to the west; and/or
- Additional leakage from the overlying GAB units through the Rewan Group.

Reduction in base flow to local surface watercourses

Potential base flow impacts have been reviewed based on updated modelling. The groundwater modelling work undertaken for the project has been undertaken using a range of conservative assumptions such that the model is expected to over-estimate impacts in most cases. Actual impacts will inevitably vary from those predicted and there is an expectation that in general, actual impacts will be less than those predicted. The language used in the SEIS is consistent with this uncertainty and therefore talks about likely impacts. Refer to Appendix K6 for further information on impact to Carmichael River.

Groundwater inflows

Predicted groundwater inflows to the operational pits and underground mine workings and to post closure voids are quantified in SEIS Volume 4, Appendix K1, Updated Mine Hydrogeology Report. Annual evaporation depths in open pits are documented in Section 5.7.1 of the hydrogeology report. Refer to Appendix K6 for further information on impact to groundwater inflows.

Commitment to groundwater management and monitoring activities

Once the final mine design and layout have been developed, a review of the adequacy of the current groundwater monitoring network and the additional monitoring proposals will be undertaken. The findings of this review will form a key component of a groundwater management plan, which would be developed prior to commencement of construction of the Project (Mine).

Refer to SEIS Volume 4, Appendix K1 Hydrogeology Report for mitigation and monitoring measures Section 7.6.

Review of the Revised Mine Hydrogeology Report

The following additional study was undertaken in response to a review of the Revised Mine Hydrogeology Report by DNRM, DEHP and the Department of the Environment:

- Mine Hydrogeology Report Addendum (refer to SEIS Volume 4 Appendix K6). The addendum presents additional details on the hydraulic properties of the Rewan Group, potential connectivity to the GAB, groundwater flow directions, key hydrological processes and groundwater model validation. The addendum also contains additional modelled predictive drawdown mapping. The addendum is intended to be read in conjunction with the Revised Mine Hydrogeology Report (refer to SEIS Volume 4 Appendix K1).

Prior to preparing the addendum, URS was appointed by Adani to undertake an independent review of the numerical groundwater model. Advice received from URS was considered in the preparation of the addendum.

6.3.3 Drawdown and springs

Comments were received in regard to the information available for Mellaluka Springs. Further assessment of this spring complex has been undertaken and is included in SEIS Volume 4 Appendix J3 and K3. Assessments undertaken indicate that the Mellaluka spring is not a GAB spring.

Additional ecological and hydrogeological work has now been undertaken at both the Mellaluka and Doongmabulla spring complex sites as detailed in the SEIS Volume 4 Appendix J3 Springs Ecological Assessment Report, Appendix K1, Updated Mine Hydrogeology Report and its Addendum, Appendix K6. Further assessment of the significance, or otherwise of the predicted aquifer pressure reductions at the various spring sites has also now been included in SEIS Volume 4 Appendix J3 Doongmabulla and Mellaluka Springs Report and Appendix K1 Mine Hydrogeology Report.

Comments also identified the need for additional monitoring information for the springs. Section 2.3.2 of SEIS, Volume 4 Appendix K1, Updated Mine Hydrogeology Report, details standpipe piezometers recently installed between the Mine area and the Doongmabulla springs, and the Mine Area and the Mellaluka springs for baseline groundwater levels and quality monitoring. These locations will also be suitable for monitoring against trigger levels (yet to be determined) during operational activities.

Comments relating to the drawdown impacts to springs and understanding of potential impacts to the springs have been addressed through additional baseline investigations and revised modelling. Adani is committed to undertaking ongoing monitoring at the spring sites, and at a number of other locations in between these springs and the Mine Area, in order to confirm baseline conditions and hence identify suitable trigger levels. Once suitable trigger levels have been identified and agreed with relevant agencies then these triggers will be used to manage impacts to within acceptable levels.

The revised SEIS Nature Conservation and MNES Chapters include information on springs from the surveys at Doongmabulla and Mellaluka springs (Refer to SEIS Volume 4 Appendix J3

Springs Ecological Assessment Report) and the revised groundwater and surface water modelling (Refer to SEIS Volume 4 Appendix K5 Revised Mine Hydrology Report, and SEIS Volume 4 Appendix K1 Updated Mine Hydrogeology Report.

The SEIS Volume 4, Appendix K1 Updated Mine Hydrogeology Report now includes further consideration and description of the relative sensitivity of springs to the predicted drawdowns (see Sections 5.6.6 and 5.7.4). The ecological impacts of the predicted drawdowns on local springs and Waxy Cabbage Palms are assessed in the SEIS Volume 4 Appendices J3 and J4.

The revised SEIS Nature Conservation and MNES Chapters includes information on springs from the surveys at Doongmabulla and Mellaluka springs (Refer to SEIS Volume 4 Appendix J3 Springs Ecological Assessment Report) and the revised groundwater and surface water modelling (refer to SEIS Volume 4 Appendix K5 Revised Mine Hydrology Report, and SEIS Volume 4 Appendix K1 Updated Mine Hydrogeology Report and its Addendum, Appendix K6).

6.3.4 Impacts to Carmichael River

Comments were received regarding the potential for drawdown to impact the Carmichael River through reduction in groundwater inflows. The updated groundwater modelling results suggest that groundwater discharges to the Carmichael River upstream of the mine site. Total impacts, through a combination of reduced base flow upstream and increased losses across the site are estimated to be 33 percent of the long term average pre-development base flow at the end of the mine life.

No significant impacts on flows in the various ephemeral minor creeks which drain the Project (Mine) area are anticipated since these water courses are not thought to currently receive any substantial discharges from groundwater.

Further details are provided in SEIS Volume 4 Appendix K1 and its Addendum, Appendix K6.

6.3.5 Mine water management, treatment and discharges

Comments were received in regard to the approach to management of water on the Mine Area. The following general water management principles are proposed for the Project (Mine):

- Raw water will be delivered and temporarily stored in a raw water dam
- Mine Affected Water (MAW) is to be retained on site and stored in the MAW storages that will be designed and managed in accordance with the *Manual for Assessing Hazard Categories and Hydraulic Performance of Dams* (DERM, 2012)
- MAW will, when necessary, be discharged into receiving waterways from the centrally located MAW collection storages (central MAW storages) one for north and the other for south of the Carmichael River. Discharges will be in accordance with relevant licence conditions under the Environmental Authority. The aim is not to discharge into the river system except during extreme climatic circumstances in which the AEP of the storm event exceeds the design parameters adopted
- Runoff from disturbed catchments (Sediment Affected Water - SAW) has to be treated to achieve minimum reductions in key pollutant levels before being reused, released into the natural environment or it is considered MAW
- Clean water runoff from undisturbed catchments is diverted around any mine workings or disturbed areas and released downstream into the same waterway where possible

- Mine workings are protected from local stormwater runoff and regional flooding
- Any controlled discharges are in accordance with Environmental Authorities licence conditions
- Acid Mine Drainage (AMD) water needs to be treated through neutralisation processes in the sediment basins of the MAW storages. The nature of treatment will depend upon the water quality
- Each pit area and associated overburden area and disturbed areas are protected from overland floods by a levee with a design height equivalent to a 1 in 1,000 year ARI flood level. Within those protected areas the pit will be specifically protected by a bund directly upstream of the highwall (refer to Figure A0 in Appendix A for the levee locations)
- Upstream (clean water) runoff is directed around the protected areas and will be diverted around the mine site to minimise the site water inventory and maintain pre-development discharges into Carmichael River
- Each overburden area has a dedicated sedimentation basin that treats runoff to clean water. This is for the overburden areas for pit B, C, F and G
- In the overburden areas of pit D and E, dry tailings will be placed. The sediment basins for these overburden areas are sized as a MAW storage due to potential water quality issues
- Potentially disturbed areas upstream of the pits (on the advancing site of the highwall) are confined and protected by a levee in order to minimise any sediment affected water entering the natural waterways. Sediment affected water (runoff) in these areas will be collected in sumps from which water will be transferred to the central process water storages
- On both sides of the Carmichael River water from disturbed areas is collected in a central process water dam from which water will be extracted for dust suppression or coal washing
- Each pit has a dedicated MAW storage at the far end of the highwall. Inflows (both rainwater and groundwater) to the pit areas will be pumped to these dedicated MAW storages from which the MAW will be pumped to two central MAW storages
- MAW water from the underground workings is also pumped to the pit MAW storages, from which this MAW is also directed to the central MAW storages
- On the north and south side of the Carmichael River is a central MAW storage in which all MAW water on site is stored. These two storages also function as the dedicated discharges points for MAW, if required
- Raw water is stored in two storages of 1 GL each, one (1) north and one (1) south of the Carmichael River.

The water balance study identifies all inflows and outflows on site and includes the proposed mine water management principles. As part of the study the required major water management infrastructure, i.e. the water storages, have been identified, located and preliminary sized. The designed water management strategy focusses strongly on reusing water on site as much as possible and on minimising volumes of mine affected water (MAW) on site. MAW is collected in two (2) central MAW dams, one (1) on each site of the Carmichael River. These dams are

identified as the two (2) potential discharge points for MAW. Besides these dams only the sediment dams for the overburden areas are expected to overflow. The water balance predicts total discharges to the Carmichael River of MAW to be in the order of magnitude of 3,000 to 4,000 ML per year for the first 40 years of the mine life, and approximately 5,500 ML per year for the last 20 years of the mine life.

6.3.6 Water quality

A number of comments were received in regard to management of water quality downstream of the Mine.

Since completion of the EIS ongoing monitoring of water quality has been undertaken (refer SEIS Volume 4 Appendix K3 Water Quality Report. Project specific water quality values will be developed and applied as a condition of approval based on this monitoring.

The mine water management strategy (refer to SEIS Volume 4 Appendix K2 Water Balance Report) is aimed at minimising any contaminants leaving the mine. A salt balance has been developed to get a better understanding of salinity levels of water in storages on site and of water potentially released into the environment. In the SEIS Appendix K5 Revised Mine Hydrology Report, Water Quality Objectives have been determined that have to be met for any controlled releases. It is believed that any controlled releases will be relatively minimal (considering the size of the mine) and are manageable from an environmental perspective.

6.3.7 Flooding

Several comments were received in regard to impacts associated with flooding due to the Project (Mine). Flood risk related impacts are addressed in SEIS Volume 4 Appendix K4, Flood Mitigation and Creek Diversion Design and in Appendix K5, Revised Mine Hydrology Report.

Flood modelling of the proposed Project (Mine) was undertaken for the Carmichael River corridor and for minor waterways intersecting the mine through the north and the south. The Carmichael River was found to flood within a relatively narrow extent upstream of the mine area, growing in width towards the downstream boundary of the mine area where the flattening terrain allows effluent flows into the head of Cabbage Tree Creek under flood conditions. Multiple minor waterways were found to intersect the mine area from the western boundary both to the north and to the south of the Carmichael River, flooding across the proposed mine site to discharge into waterways to the east.

Based on the existing conditions and analysis of the predicted change in hydrological conditions post-development, a conceptual staged drainage scheme was proposed for the mine site. Recommended infrastructure is presented at a preliminary design stage within this report, including the following format:

- 1 in 1,000 year ARI-immune flood protection levees for the Carmichael River corridor
- 1 in 100 year ARI-capacity local waterway diversion drains with the ability to provide 1 in 1,000 year ARI flood immunity to the pits through the mine site (through the use of supplementary adjacent levees); maintaining natural flow paths and hydrology to the maximum extent practicable
- 1 in 50 year ARI-immune haul road and conveyor crossing of the Carmichael River, comprising a bridge to pass the 1 in 50 year ARI flood level plus 500 mm freeboard while the road is at a height of at least above the 1 in 50 year ARI flood level plus 600 mm

freeboard. The bridge height was sufficient to avoid direct overtopping in the 1 in 100 year ARI event, but water does bypass the haul road constriction via one of the proposed diversion drains, which needs adjustment during future design stages. Scour protection must be considered due to potentially large head loss from overtopping by the 1 in 1,000 year ARI event.

Subsequent modelling of the Carmichael River corridor with this proposed infrastructure in place and modelling of all the diversion drains indicated the ability of this infrastructure to protect the mine site from large flood events.

Afflux was found to be significant within the mine area due to the combined effect of minor increased inflows from some of the diverted waterways, reduced runoff coming from the developed mine internal areas and hydraulic constriction by the flood protection levees, haul road and conveyor crossing. Upstream of the haul road crossing afflux was modelled to peak at 0.98 m for the 1 in 1,000 year ARI event, but at the downstream eastern boundary this had already reduced to peak at 0.09 m adjacent to the Carmichael River and 0.27 m downstream of Cabbage Tree Creek. These values are reduced in smaller events, with afflux at the mine area boundaries generally being relatively insignificant (0 – 0.09 m, with the higher values being confined to the eastern boundary downstream of Cabbage Tree Creek). It is believed that the significant reduction in afflux values over this short distance indicates that neighbouring properties are likely to experience minimal increase in flood extents both downstream and, especially, upstream of the MLA. The most significant afflux is confined within the mine lease.

6.3.8 Water harvesting

Adani has undertaken additional groundwater investigations and modelling to inform the potential impacts associated with on lease groundwater harvesting from the project. Adani has also commenced its groundwater monitoring program to better understand the hydrogeology in the area. Please refer to SEIS Volume 4, Appendix K1 Revised Mine Hydrogeology Report and its Addendum, Appendix K6, for further information.

A revised water licence application has been provided in Volume 4 Appendix C4 for the harvesting of flood waters from the Belyando River. The proposed activity has been assessed in accordance with the Regional Water Plan for the Belyando and the application seeks an allocation form the annual Strategic Reserve. The EIS had nominated in stream harvesting from dams on the North and Obungeena Creeks and an offsite bore field. These have now been removed from the SEIS assessment.

6.4 Amendments to commitments

Adani is committed to undertaking ongoing monitoring through the established groundwater monitoring network and also through additional monitoring bores to be installed prior to commencement of construction.

7. Air quality

7.1 Introduction

7.1.1 Amendments to Project (Mine) description

The changes to the Project (Mine) relevant to the air quality chapter include:

- changes to the Mine plan and layout
- changes to mine duration of 90 years to 60 years
- changes to the layout of the Offsite infrastructure area

7.1.2 Update to studies

The air quality assessment has been revised based on the amendment to the Project (Mine) (refer SEIS Volume 4 Appendix L).

The impact assessment demonstrated the dust impacts are consistent with the goals of the EPP Air. This is with respect to human health effects at 'remote' off-site receptor locations. Dust impacts beyond the site boundary may require management at the peak production phases of the mine life.

7.2 Summary of comments

Submissions relating to Air Quality for the Project (Mine) were raised by advisory agencies, organisations and private submitters.

Comments raised in these submissions include:

- Use of dust criterion and standards
- Dust monitoring
- Impacts of coal dust accumulation within aquatic habitats

A table that provides responses or cross references to the responses to individual comments is provided in Volume 4 Appendix A.

7.3 Response to comments

7.3.1 Dust criterion and standards

A number of submissions relate to the long-term health impacts of changes in air quality associated with the Project (Mine). The air quality modelling and assessment for the EIS and SEIS has been undertaken in accordance with all relevant standards (*Environmental Protection (Air) Policy 2008 (Air EPP))* and the requirements of the Project ToR. Suspended particle levels were assessed for the peak operations. It was found that all of the identified off-site sensitive receptors, including those of the mine worker accommodation village and airport terminal were compliant with the Air EPP. Deposited dust levels were found to decrease rapidly beyond their source so that at all offsite sensitive receptor locations levels were significantly below the assessment criteria.

Mitigation measures for nuisance impacts are included to minimise impacts even when levels are within guideline values. Measures have been included for dust and noise impacts in the Project Environmental Management Plans (SEIS Volume 4 Appendices Q1 and Q2).

7.3.2 Dust monitoring

Even though the modelling predicts compliance at all identified sensitive receptors, dust monitoring will be undertaken to determine whether predicted emissions levels occur. In order to monitor background dust levels, a system of dust monitors will be installed upwind and downwind of the Project (Mine).

Dust deposition gauges have already been established at several nearby homesteads to establish background levels of potential impacted receptors. This pre-mining network will be augmented by monitoring at sensitive receptors, predicted to receive dust levels close to or reaching the EPP Air objectives, at the workers accommodation village for example. Dust monitoring of PM_{10} may also be performed at any post-mining Offsite sensitive receptors identified as being 'at risk'.

By monitoring dust upwind of the Project (Mine), downwind of the Project (Mine) and at sensitive receptor locations, dust impacts can be quantified. The Carmichael automated weather station (AWS) will record local wind conditions at the Project (Mine) that can be used to assess high-dust events. Management measures will be applied to mitigate emissions impacts wherever a criterion is shown to be exceeded.

7.3.3 Dust accumulation in aquatic habitats

One submission raises concerns regarding the potential for accumulation of coal dust within the aquatic habitats surrounding the Mine area. The submission referenced a study that had examined potential for coal dust particles sourced from coastal locations (e.g. stockpiles, ship loading) to be deposited within the marine waters of the Great Barrier Reef. Although the submission did not provide the reference it is presumed to be work completed by Dr Andutta of James Cook University. The author's recent publications (e.g. Andutta et al., 2012) examined the flushing of waters within the Great Barrier Reef and advection processes suggested to carry inshore coal dust particles to the outer reefs. A separate study completed by Burns and Brinkman (2011) noted that very fine coal particles were present from samples collected from coral reefs offshore of Mackay. The report did not consider biological accumulation of contaminants associated with the deposition of coal dust, nor did the report consider non-coastal sources of dust particles.

The Great Barrier Reef World Heritage Area (GBRWHA) is located over 300 km downstream of the Study Area and although connected hydrologically via watercourses, substantial hydrological barriers and other catchment land uses exist between the ocean and the Study Area, including the Burdekin River dam. The Mine Area contributes a small percent area (0.44 percent) to the Burdekin Falls dam catchment and significant controls will be established to manage onsite and offsite water and sediment quality impacts at the Mine Area. These measures will mitigate potential for impacts to aquatic values that could affect the downstream reefal environment. The distance from the GBR and the barriers would impede site conditions from having an influence on the values for which the reef is protected. No impacts associated with the Project will result in a substantial and measurable change in the hydrological regime of the GBRWHA waters and, therefore, no effects on the GBRMP are predicted either.

Monitoring of water quality will be conducted in accordance with the Project (Mine) EMP (refer SEIS Volume 4 Appendix Q1).

7.4 Amendments to project commitments

No further commitments have been made regarding air quality.

8. Greenhouse gas emissions

8.1 Introduction

8.1.1 Amendments to project description

The change to the Project (Mine) that will affect the greenhouse gas impacts for the mine in the Environmental Impact Statement (EIS) is the revised mine plan. The principal differences influencing the greenhouse gas assessment is the change in overall mining duration from 90 to 60 years and a reduction in the amount of material extracted over the life of the mine.

8.1.2 Update to studies

As a result of the Project changes listed above an updated Mine Greenhouse Gas Emissions Report (refer to SEIS Volume 4, Appendix M) has been undertaken for the Project (Mine):

The results of the revised greenhouse gas report has shown the following reduction in greenhouse gasses from those calculated in the EIS:

- The average annual Scope 1 and Scope 2 greenhouse gas emissions reduced to 1,440 kilotonnes CO_2-e per annum from 2,286 kilotonnes CO_2-e per annum. This is a direct result of the reduction of materially being extracted annually from the mine.
- The total Scope 1 and Scope 2 emissions over the 60 year life of the Project (Mine) as 86 million tonnes CO_2-e instead of the previously proposed 90 year life of the Project (Mine) producing 206 million tonnes CO_2-e.

8.2 Summary of comments

The majority of the issues raised for the mine greenhouse gas chapter were in regards to scope 3 emissions and stated that the EIS had not adequately addressed scope 3 greenhouse gas emissions.

A table that provides responses or cross references to the responses to individual comments is provided in SEIS Volume 4, Appendix A.

No additional studies have been undertaken in response to these comments.

8.3 Response to comments

As identified above the majority of issues raised for the mine greenhouse gas chapter were related to scope 3 emissions and that the EIS had not adequately addressed scope 3 greenhouse gas emissions.

Comments regarding scope 3 emissions have been noted. As specified in the Project ToR, an assessment and inclusion of scope 3 GHG emissions were not a requirement of the project , as such they are not included as part of the EIS or SEIS.

8.4 Amendments to commitments

An Environmental Management Plan (EMP) (refer to SEIS Volume 4 Appendix Q1 and Q2) has been developed and will be implemented during construction and operation of the project (Mine). This EMP includes commitments aimed to avoid and reduce greenhouse gas emissions,

energy costs and energy consumption to assist Adani to improve its operational efficiency and business productivity. These commitments are further outlined in the updated Mine Greenhouse Gas Emissions Report (refer to SEIS Volume 4, Appendix M).

9. Noise and vibration

9.1 Introduction

9.1.1 Amendments to project description

The changes to the Project (Mine) relevant to the noise and vibration chapter assessment include.

- changes to the Mine plan and layout
- changes to Mine duration from 90 years to 60 years
- changes to the layout of the Offsite infrastructure area, including
  - relocation of the airport

9.1.2 Update to studies

The noise and vibration assessment has been revised based on the amendment to the Project (Mine) (refer SEIS Volume 4 Appendix N Updated Mine Noise and Vibration Assessment). The revised noise and vibration assessment also includes an assessment of aircraft noise generated by the airport.

The impact assessment indicated that construction noise relating to the mine would not cause adverse impacts at noise sensitive receptors. Operational noise was predicted to be compliant with the most stringent night-time noise criteria at all assessed surrounding sensitive receptors. Aircraft noise was not expected to cause adverse impacts at noise sensitive receptors, and were significantly lower than the standards in *AS2021 Acoustics Aircraft noise intrusion-Building siting and construction*.

Updated noise and vibration report

Operational noise modelling results indicate the predicted noise levels for all assessed mine operational years are expected to be compliant with the most stringent night-time noise criteria at all assessed surrounding sensitive receptors under neutral and adverse weather conditions. The highest predicted mine operational noise level at a sensitive receptor is 20 dB(A) during peak mine year 2049, which is expected to occur at sensitive receptors 3 and 4. This noise level is compliant with the most stringent night-time criteria of 28dB(A).

The contribution of noise generated by the power generation area (diesel generators) located adjacent to the workers accommodation village is expected to exceed the night-time noise criteria at the workers accommodation village by up to 4 dB. With future opportunity to connect into a distributed power system built by others, there will be no requirement for these onsite generators. Nevertheless, general mitigation measures are provided in Volume 4 Appendix Q2 (MEP – Offsite) to assist with minimising noise impacts on residents located in the workers accommodation village.

Noise from the proposed offsite infrastructure has been conservatively assessed and included in the operational noise models. Noise impacts associated with the proposed industrial precinct, rail siding and water pumping stations are not expected to cause adverse noise impacts at sensitive receptors.

Although Project (Mine) operations are generally not expected to cause adverse noise impacts, mitigation measures have been identified in the event that exceedance of the noise criteria occurs, or a complaint is received and validated.

Airport noise assessment

An assessment of noise impacts associated with the airport has been included in the updated noise and vibration report. Table 4 shows the predicted noise levels at identified sensitive receptors.

Table 4 Aircraft noise levels

Receiver	Boeing 737 Take-off (dBA)	Boeing 737 Landing (dBA)	Light Aircraft Take-off (dBA)	Light Aircraft Landing (dBA)
R1 Workers accommodation village	<51	<49	<47	<44
R2 Albinia homestead	<50	<48	<46	<44
R3 Doongmabulla homestead	<51	<49	<44	<45

Aircraft noise levels at sensitive receiver R1 range from <44 dBA to <51 dBA. These values are significantly lower than those stipulated by the standard (<80 dBA to <85 dBA for 20 or less flights per day) and hence is deemed to be 'acceptable'. Once the construction of the accommodation village is complete, the site will become a residential receiver and the indoor noise criteria will apply. As aircraft noise levels range from <44 dBA to <51 dBA, the receiver is expected to comply with the indoor design sound levels for all residential activities.

Similarly, for receiver R2 indoor noise levels will range from <44 dBA to <50 dBA and for receiver R3, <44 dBA to <52 dBA. These fall below the indoor design sound levels (50 dBA to 60 dBA) for existing buildings. Hence, no further noise protection is specifically required against aircraft noise at these and other nearby receivers.

9.2 Summary of comments

The majority of submissions relating to Noise and Vibration for the Project (Mine) were raised by advisory agencies. Comments in these submissions included:

- Lack of use of WHO (2009) noise criteria
- Noise impacts on health
- Noise monitoring effort
- Noise impacts on sensitive fauna species and sensitive receptors
- Frequency of noise measurements insufficient

A table that provides responses or cross references to the responses to individual comments is provided in Volume 4 Appendix A.

9.3 Response to comments

9.3.1 Noise criterion and standards

The WHO Night Noise Guidelines For Europe (2009) provide detailed discussion of night time noise levels and the effects on sleep and health for residential noise receivers and is based on noise studies undertaken since the implementation of the WHO 1999 Guideline, which is considered relevant and complementary to the WHO 2009 Guideline.

The target levels recommended by the WHO 2009 Guideline are based on the concept of lowest observed adverse effect level (LOAEL) for night noise with consideration to biological effects, sleep quality, well-being, and night noise related medical conditions. These targets were derived with consideration to typical European building construction and proportion of time that dwelling windows are open and closed, resulting in a 21 dB attenuation outside to inside. The targets have therefore been adjusted for Australian typical construction with windows open to reflect Queensland conditions, a 10 dB attenuation.

The WHO 2009 Guideline recommended night noise targets are presented in Table 5 including adjusted targets for Australian conditions. The NNG level is recommended except where achievement is not feasible in the short term, in this case the IT level would be applicable. With regards to the guideline and the Project, the NNG for Australian conditions is the applicable night noise target, however as the PNC Project (Mine) Specific Noise criteria for night time are more stringent at 28 dB(A) $L_{eq,1hr}$, the PNC levels become the controlling criteria for assessment of operational night noise impacts from the Project.

Table 5 Summary of WHO night noise guidelines for Europe, 2009

Descriptor	Outdoor Guideline Value for Europe	Outdoor Guideline Value for Australian Conditions[1]
Night Noise Guideline (NNG)	40 dB(A) Lnight, outside[2]	29 dB(A) Lnight, outside
Interim Target (IT)	55 dB(A) Lnight, outside	-

1 Based on an assumed standard façade attenuation of 10 dB for typical Australian building construction.

2 Lnight, outside is the night time noise indicator defined by EU Directive 2002/49/EC and is the long-term averaged night noise level determined over a year, where night is the eight hour night period (23:00 – 07:00).

Volume 4 Appendix N Mine Noise and Vibration Assessment has been updated to include assessment against the WHO 2009 sleep disturbance criteria.

9.3.2 Noise impacts on health

Volume 4 Appendix N Updated Mine Noise and Vibration Assessment includes an updated reference to the 2009 World Health Organisation (WHO) noise recommendations. The Planning for Noise Control (PNC) guidelines were adopted over the WHO 1999 and 2009 criteria, as the most stringent external night-time criteria for the purposes of the noise assessment.

9.3.3 Noise monitoring effort

Both attended and unattended noise monitoring was undertaken for the EIS. Unattended monitoring continued between the 26 August and 6 – 7 September 2011, during which time noise data was continuously sampled, including night-time data. Attended measurements were taken at unattended monitoring locations during the daytime to supplement logger data.

The most stringent night-time criteria possible under the PNC guidelines were used in the assessment, which are based on the minimum night-time background noise level. Therefore, any additional attended monitoring during night-time would not have affected the assessment outcomes.

9.3.4 Noise impacts on sensitive fauna species and sensitive receptors

Mitigation measures for nuisance impacts are included to minimise impacts even when levels are within guideline values. Potential noise impacts on native fauna are assessed in Volume 4 Appendix J1.

9.4 Amendments to project commitments

No further commitments have been made regarding noise and vibration.

10. Waste

10.1 Introduction

10.1.1 Amendments to Project (Mine) description

The changes to the Project (Mine) relevant to waste include:

- changes to the Mine plan and layout
- changes to Mine scheduling
- changes to coal handling and processing

10.1.2 Update to studies

The following additional studies have been undertaken in response to these amendments and to comments received during the EIS submission period:

- Waste Characterisation Report (refer SEIS Volume 4 Appendix O1)
- Mine Waste Management Strategy (refer SEIS Volume 4 Appendix O2)
- Landform Design Study Report (refer to SEIS Volume 4 Appendix O3)

Waste characterisation report

The waste characterisation report provides an update to reporting included in the EIS (Volume 4 Appendix V Acid Mine Drainage Report). The revised report has been prepared on a total of 470 samples whereas the EIS report was based on 100 samples.

Based on the available results the majority of the overburden and interburden materials (not immediately adjacent to the coal seams) and roof and floor wastes are not likely to be a source of acid immediately after mining. Nor would most of these materials be expected to be an immediate source of salinity; however, some portion could be a source of salinity. The clay materials of the overburden and interburden could have a markedly higher potential to release salts and metals to contact water even though the pH may remain alkaline. Typically however, the concentrations of metals in water contacting the waste would be expected to be low while waters remain circum-neutral.

The majority of the overburden and interburden waste from all lithological groups is likely to be non-acid forming in the longer term. Some carbonaceous mudstone, carbonaceous sandstone, carbonaceous siltstone, clay, claystone, mudstone, sandstone, sandy clay, siltstone and tuff may be acid forming in the long term and there may be a requirement to manage these materials to prevent or limit the longer-term development of AMD.

Test results indicate that the clays, weathered rocks (including mudstone, claystone, carbonaceous mudstone and siltstone) may have dispersive behaviour. Slightly weathered siltstone may show very slight potential for dispersivity. The weathered sandstone did not show any indication of dispersive behaviour. Soil samples showed completely non-dispersive results due to the presence of calcite.

The fresh rocks were generally non-dispersive, although some claystones and siltstones may have a very low potential for dispersion. There was variability in dispersion results within each group.

Weathered rock, siltstone and sandstone showed potential for deterioration and breakdown after exposure to water. The siltstone showed moderate rate deterioration, and sandstone slow deterioration. This may indicate that although the fresh rock units are not dispersive, they are not durable, and with time may degrade to sand, silt or clay. The degraded material may be more prone to physical erosion than the original fresh rock.

Concentrations of sulfate, fluoride, boron and molybdenum in surface runoff from the overburden dump could exceed the cattle drinking water quality guidelines. Similarly, estimated concentrations of the above solutes and zinc in percolate from the overburden dumps are predicted to exceed the cattle drinking water quality guidelines. However, based on the proposed water management strategy for the project, under normal operating conditions the runoff will be captured in the dams and will be recycled or used in the process.

The estimated concentrations are intended to indicate concentrations that might be expected as a result of the first flushing of the overburden. They would not be expected to be sustained in the longer term as readily available solutes would be transported from the overburden. Water quality in the longer term would be expected to be dependent on the presence and distribution of PAF materials within the dumps including the tailings. However, results from longer term kinetic testing would be required to complete these estimates.

Mine Waste Management Strategy

The purpose of the conceptual level Mine Waste Management Strategy (refer SEIS Volume 4 Appendix O2) was to provide high level assurance of the proposed tailings management strategy for the Project.

The estimated volume of tailings over the life of mine based on the proposed mine plan, schedule and run of mine beneficiation, was confirmed. Mineral waste volumes, including the coarse rejects and tailings as generated from the on-site CHPP are provided in Table 6.

Table 6 Method 1 total reject and waste volume

Description	Value
Total fine rejects (tailings) (Mm ^{3})	59.16
Total Coarse + Fine Rejects (tailings) (Mbcm ^{1})	369.99
Total Reject to be Dumped (Mlcm ^{2})	462.49
Total Overburden Waste to be Dumped (Mlcm)	16,428.85
Total Waste Dumped (Total Reject + OB Waste) (Mm ^{3})	16,891.34

1: Million bank cubic metres

2: Million loose cubic metres. Includes net bulking factor (bulking factor – compaction factor)

3: Cubic metres is the same volume as Mlcm

A conceptual level tailings management strategy that includes the proposed long term on site tailings storage solution has been developed considering operational constraints including the mine schedule and therefore, CHPP throughout; the tailings dewatering process, and the available footprint in which to dry the wet tailings prior to their ultimate encapsulation in engineered cells within out of pit overburden storage emplacements D and E.

A consideration of potential impacts to environmental and water values based on the proposed tailings management strategy included considering the surface and groundwater, in addition to the tailings geochemistry.

In summary, based on the information available at the time of writing, the proposed tailings management strategy appears to be viable, with any potential impacts manageable.

Landform Design Study

Adani commissioned a Landform Design Study (refer to SEIS Volume 4 Appendix O3) to carry out erosion modelling to provide assessment of the potential stability of proposed waste landforms.

Simulations indicate that the light clay Sample 1 topsoil is unsuitable for placement on the outer batter slopes, and should only be placed on the top of the dump, where it may be highly productive in terms of vegetation growth. Achieving sufficient vegetation contact cover will be critical for rehabilitation success, and for the long-term stability of the batter slopes to be formed.

For the sandy Sample 2 topsoil, the simulations (Figure 9) indicate that, provided the surface material acts similarly to the topsoil tested, erosion rates would increase with slope length to a maximum rate that would be acceptable at gradients of 6.3 - 10 degrees, provided:

a) vegetation cover in excess of 60% was achieved sustainably and reliably.

b) there is no discharge of runoff from the top of the landform onto the outer batter slopes; and

c) appropriate progressive rehabilitation practices are applied.

However, for rehabilitated inner batter slopes, for which gradients of 12-14 degrees have been proposed, other landform stabilisation measures such as mixing competent rock into the batter surface would be need to be implemented to achieve suitable stability, even when using the sandy Sample 2 topsoil and achieving 60% vegetative cover.

10.2 Summary of comments

The following provides details of submission relating to mine waste management:

- Insufficient information is provided regarding mine waste characterisation
- Approach to management of mine waste stockpiles for weathering and acid

A table that provides responses or cross references to the responses to individual comments is provided in SEIS Volume 4 Appendix A.

10.3 Response to comments

As detailed in Section 10.1.2, additional sampling and analysis has been undertaken to refine the waste characterisation of the Mine. The results of this analysis indicate that the majority of the overburden and interburden waste from all lithological groups is likely to be non-acid forming in the longer term. Some carbonaceous mudstone, carbonaceous sandstone, carbonaceous siltstone, clay, claystone, mudstone, sandstone, sandy clay, siltstone and tuff may be acid forming in the long term and there may be a requirement to manage these materials to prevent or limit the longer-term development of AMD.

The fresh rocks were generally non-dispersive, although some claystones and siltstones may have a very low potential for dispersion. There was variability in dispersion results within each

group. Weathered rock, siltstone and sandstone showed potential for deterioration and breakdown after exposure to water. The siltstone showed moderate rate deterioration, and sandstone slow deterioration. This may indicate that although the fresh rock units are not dispersive, they are not durable, and with time may degrade to sand, silt or clay. The degraded material may be more prone to physical erosion than the original fresh rock.

Further details in regard to management of overburden areas is provided in the Mine EMP SEIS Volume 4 Appendix Q1, Mine Waste Management Strategy Appendix O2 and Landform Design Study Appendix O3.

11. Transport

11.1 Introduction

11.1.1 Amendments to Project (Mine) description

The changes to the Project (Mine) that will impact the transport chapter in the Environmental Impact Statement (EIS) are the changes in the overall mining duration from 90 to 60 years. Construction impacts are not likely to change from those presented in the EIS, however impacts related to operation will be altered due to the reduced life of the project (Mine) by 30 years.

11.1.2 Update to studies

As a result of the changes listed above, and in response to submissions received on the EIS, a revised Transport Impact Assessment Report (TIA) (refer to SEIS Volume 4 Appendix P TIA) has been prepared for the Project (Mine).

11.2 Summary of comments

Issues raised in the EIS submissions included:

- Access locations for mine construction works and camps
- The EIS does not adequately address the requirements of section 1.9 and 3.9 of the Terms of Reference (ToR)
- Requirement for a preliminary risk assessment and risk management plan for aspects of the Project (Mine) associated with transport activities and infrastructure
- Need for suitable evacuation strategies from mine and camps
- Location of flood warning stations in relation to roads
- Road operational safety is inadequately addressed
- Summary information of crashes
- Details of specific management measures regarding fatigue management
- Provision for ‘park up’ rest areas
- Strategy for goods/freight delivery to site including disaster management of fuel and dangerous goods
- Impacts of heavy vehicle traffic on local and state controlled roads (SCR)
- Transport assessment is not in accordance with the Department of Transport and Main Road’s (DTMR) Guidelines for Assessment of Road Impacts of Development (GARID) and other relevant DTMR polies and guidelines
- Traffic volumes and population data are out of date.
- General corrections to road impact assessment
- Inadequate traffic assessment methodology
- Impacts on SCR network

- Cumulative impacts on surrounding road infrastructure.
- Damage to existing infrastructure and management and maintenance of local road infrastructure
- Road hierarchy and plan for building roads to Council standard
- Data on peak hour traffic
- Need for report to be relied upon by a third party
- Underestimated number of light vehicle trips associated with the mine construction and operation activities
- Road transport impacts from construction through life of mine
- Impacts on school bus routes.
- Need for a sensitivity analysis to justify the assignment of traffic volumes
- Road operational efficiency matters
- Need or cumulative impacts of fuel transport & storage to be adequately managed on a regional basis
- Transportation of workers to sites

A table that provides responses or cross references to the responses to individual comments is provided in SEIS Volume 4, Appendix A.

11.3 Response to comments

11.3.1 Access locations

A comment was received regarding the access locations for mine construction works and camps. Access points including roads were provided in the EIS through the Material Change of Use application material under EIS Volume 4 Appendix D.

The comment has been noted and the requested information has been included within the revised TIA undertaken for the Project (Mine) (refer to SEIS Volume 4 Appendix P). As identified in the TIA workforce access to each site will be via bus / coach for all locations – the primary route for the majority of local movements will be the Moray - Carmichael Road. Access locations to temporary rail construction camps are provided with Material Change of Use application material under SEIS Volume 4 Appendix C3. Access locations for the workers accommodation village is provided with Material Change of Use application material under EIS Volume 4 Appendix C4.

11.3.2 Inadequacies of traffic assessment

Overview of comments received

Several comments were received regarding the adequacy of the EIS traffic assessment to address the requirements of the ToR and DTMRs guidelines and policies. These comments specifically related to sections 1.9, 3.9 and 6.1 of the ToR.

Whilst the EIS traffic assessment was generally undertaken in accordance with the ToR requirements, a revised transport impact assessment has been undertaken in response to these

comments and presented in a format which is more familiar to DTMR and meets the assessment requirements for EIS impact assessment considering that further detailed assessment will be required to gain final DTMR approvals beyond the EIS (refer to SEIS Volume 4 Appendix P).

Consultation

Comments regarding consultation with relevant transport authorities as identified in the ToR have been noted. As detailed in the TIA undertaken for the Project (Mine) (refer to SEIS Volume 4 Appendix P TIA) the Traffic Management Plans for the Project (Mine) will be developed in consultation with the DTMR, QPS and local authorities. Further to this, there has been ongoing consultation with agencies and authorities throughout the SEIS development. Adani notes that submissions were received from multiple DTMR office's and acknowledges that to date, consultation has been centralised with the Brisbane DTMR office for the purposes of the EIS. Adani met with DTMR and the Office of the Coordinator General on 8 April 2013 to review the DTMR submission and discuss information requirements for the SEIS and post SEIS. Adani has committed to ongoing consultation with all relevant DTMR office's.

DTMR guidelines and policies

Comments regarding the ToR requirement for the transport assessment to be in accordance with the DTMR's GARID are noted. A revised TIA has been undertaken for the Project (Mine) (refer to SEIS Volume 4 Appendix P) and is consistent with the requirements of DTMR's GARID.

Traffic management

As identified in the TIA traffic management issues will be addressed through the preparation and implementation of construction and operation Traffic Management Plans. These will be developed during the detailed design phase of the Project (Mine) in consultation with the DTMR, QPS and local authorities.

11.3.3 Emergency/risk/safety management

Overview of comments received

Several comments were received regarding road operational safety, specifically, response times of emergency vehicles, mine camp evacuation strategies, location of flood warning stations, information on crash data, fatigue management, provision of 'park up' rest areas, and strategies for disaster management regarding the delivery of fuel and dangerous goods.

Comments were also received regarding the need for a preliminary risk assessment and risk management plan.

A number of these items were presented in the EIS document, and where appropriate, revised assessments and statements have been made in the SEIS, particularly in the revised transport impact assessment (refer to SEIS Volume 4 Appendix P). Additionally, updated Environmental Management Plans have been provided in the SEIS which include Emergency Management requirements (Volume 4 Appendices Q1, Q2 and W) and a specific Rail emergency management plan is provided in Volume 4 Appendix V of the SEIS.

Emergency response

Comments regarding emergency response times have been noted. Management and mitigation procedures outlining emergency response times for emergency vehicles will be included within the revised traffic management plan for the Project (Mine).

Risk assessment and management plans

Comments regarding hazard and risk associated with the Project (Mine) transport activities and infrastructure has been noted. The revised TIA has been undertaken for the Project (Mine) (refer to SEIS Volume 4 Appendix P). The TIA assesses the potential hazards and risks arising from roads and traffic related to the projects construction and operational phases. Hazards and risks are further assessed for the Project (Mine) in the EIS, Volume 2, Chapter 12 – Hazard and Risk and Volume 3, Chapter 12 – Hazard and Risk.

Flooding

Comments regarding the need for evacuation strategies from mine is noted. The Hazard and Risk Assessments undertaken in the EIS consider the requirements for evacuations. In addition, the design criteria for roads and rail are consistent with the required engineering standards to ensure access during flooding events up to and including design criteria for roads and rail. Events over and above these agreed design criteria (approved by agencies including DTMR) will create regional access challenges. Evacuation procedures and plans will be implemented that accommodate a range of scenarios.

Comments regarding flood warning stations have been noted. Adani has made a commitment to install meteorological monitoring stations, and flow gauging stations on the key watercourses that would affect flooding in proximity to the Mine and Offsite Infrastructure. Further details are included in the SEIS Volume 4 Appendix K4 Flood Mitigation and Creek Diversion Design.

Road operational safety

The requested information regarding road operational safety and crash data has been included within the revised TIA undertaken for the Project (Mine) (refer to SEIS Volume 4 Appendix P TIA)

Rest areas and fatigue management

Comments regarding 'park up' rest areas and road signage are noted. Adani will consult with DTMR and QPS regarding the need for and location of additional 'park up' rest areas and road signage. Relevant management and mitigation measures regarding fatigue management will be identified from consultation and will be incorporated into the revised traffic management plan for the Project (Mine).

Haulage of dangerous goods

Haulage of dangerous goods was described in the EIS and has been included in the revised TIA calculations prepared for the SEIS and included within the Hazard and Risk Assessment conducted for the EIS which considered road transport impacts and incident management. Information on dangerous goods storage can be found in the application material located in the SEIS Volume 4 Appendices C2 through C5.

11.3.4 Oversized vehicles

Comments regarding details of likely heavy and oversized vehicles and impacts on local and SCR networks are noted.

Requested information has been included within the revised TIA undertaken for the Project (Mine) (refer to SEIS Volume 4 Appendix P TIA).

11.3.5 Impacts on the State Controlled Road Network

Several comments were received regarding the impact analysis on the SCR network. An assessment of impacts on the SCR network within the limits of the ToR and Impact Assessment Boundary was undertaken for the EIS. Specifically, impacts to the Gregory Developmental Road were provided. Further information regarding impacts on the SCR network is included within the revised TIA undertaken for the Project (Mine) (refer to SEIS Volume 4 Appendix P TIA).

Adani will continue consultation with and undertaken agreements with IRC, QPS and DTMR in regards to impacts to road infrastructure on the local and SCR network.

11.3.6 Local Road Infrastructure Impacts

Several comments were received regarding the Project (Mine) impacts on local road infrastructure. In response to these comments an assessment of the traffic impacts to the local roads as a result of the Project (Mine) has been undertaken and included in SEIS Volume 4, Appendix P TIA. Adani will continue consultation with and undertaken agreements with IRC, QPS and DTMR in regards to impacts to road infrastructure on the local and SCR network.

Details regarding local road upgrades and maintenance have been outlined in the TIA undertaken for the Project (Mine) (refer to SEIS Volume 4 Appendix P TIA). Adani is currently in discussions with IRC to draft an agreement regarding the long term maintenance of impacted local roads.

11.3.7 General Comments

Data on peak hour traffic

Comments regarding peak hour traffic volume data has been noted. Requested information has been included within the revised TIA undertaken for the Project (Mine) (refer to SEIS Volume 4 Appendix P TIA)

Third party advice

Comment regarding the need for the TIA to be relied upon by a third party is noted. Certification of the transport reports was not a requirement under the ToR. An updated TIA is provided in the SEIS (Volume 4 Appendix P TIA) and was prepared by a specialist transport consultant in accordance with DTMR requirements.

Light vehicle trips

The comment regarding light vehicle trips associated with the mine construction and operation activities being underestimated is noted. The requested information has been included within the revised TIA undertaken for the Project (Mine) (refer to SEIS Volume 4 Appendix P TIA).

Road transport impacts

The requested information regarding road transport impacts from construction through life of mine have been included within the revised TIA undertaken for the Project (Mine) (refer to SEIS Volume 4 P TIA).

School bus routes

Information regarding the impacts on school bus routes was included in the EIS transport assessment has been included within the revised TIA undertaken for the Project (Mine) (refer to SEIS Volume 4 Appendix P TIA.

Traffic volumes

Information regarding the justification of traffic volumes has been included within the revised TIA undertaken for the Project (Mine) (refer to SEIS Volume 4 Appendix P TIA).

Road operational efficiency

The requested information regarding road operational efficiency has been included within the revised TIA undertaken for the Project (Mine) (refer to SEIS Volume 4 P TIA).

Transport of workers

As noted in the revised TIA undertaken for the Project (Mine) (refer to SEIS Volume 4 Appendix P TIA) workforce access to each site will be generally via bus / coach for all locations. The primary route for the majority of local movements will be the Moray-Carmichael Road.

A bus fleet will be required to support both the construction and operational phases of the project. The buses will primarily transport the workforce to / from the Airport(s) (FIFO) and each work site.

11.4 Amendments to commitments

The following commitment has been made regarding transport:

- General
  - Adani has made a commitment to install meteorological monitoring stations, and flow gauging stations on the key watercourses that would affect flooding in proximity to the Mine and Offsite Infrastructure
  - Adani will consult with DTMR and QPS regarding the need for additional 'park up' rest areas and road signage. Relevant management and mitigation measures regarding fatigue management will be identified from consultation and will be incorporated into the revised traffic management plan for the Project (Mine).
  - Adani will continue consultation with and undertaken agreements with IRC, QPS and DTMR in regards to impacts to road infrastructure on the local and SCR network.
  - Adani is currently in discussions with IRC to draft an agreement regarding the long term maintenance and development of impacted local roads.

- TIA report
  - Upgrade the existing Carmichael – Elgin Road to become a sealed, single lane carriageway so as to provide a trafficable road under most rain event conditions and minimise the risk of closure.
  - Upgrade the existing Carmichael – Elgin Road / Gregory Developmental Road intersection – as part of the upgrade works for the Carmichael – Elgin Road it is recommended that the existing intersection be upgraded to include protected right turn and left movements at this intersection.
  - Signage at the Gregory Developmental Road / Kilcummin Downs Road – it is recommended that during the course of the construction period (2014 and 2015), including the life of the Rail Camp 1, “Trucks Turning” signage be installed at the intersection so as to advise road users of the potential for heavy vehicles to be negotiating this intersection.
  - Upgrade Kilcummin Downs Road / Rail Camp 1 Site access – it is recommended that the proposed site access location be upgraded to allow for a protected right turn into the site access.
  - Signage located at the intersection of the Peak Downs Highway with the Gregory Developmental Road and also north of the proposed Disney Quarry along the Gregory Developmental Road to advise motorists of the construction activities along this road section.
  - The Gregory Developmental Road and Peak Downs Highway are not approved for HML vehicles. Should these routes be required to be used by HML a separate application will be required for these routes. This will go through to DTMR for their review and is subject to their approval.
  - A bus fleet will be required to support both the construction and operational phases of the Project. The buses will primarily transport the workforce to / from the Airport(s) (FIFO) and each work site.

12. Hazard and risk

12.1 Introduction

This section of the SEIS provides an overview of the amendments to the Project (Mine) and additional work undertaken in relation to hazard and risk since the EIS was made available for public comment in December 2012. A summary of key submissions is provided with response to these key matters. Response to individual submissions is provided in Volume 4 – Appendix A.

12.2 Amendments to the Project

Amendments to the Project (Mine and Offsite), as described in Project Description Volume 2 – Chapter 2, do not present new impact values in regards to hazard and risk assessment, as such, the impact assessment undertaken for the EIS remains relevant and unchanged. However, there have been amendments to project details supported by a number of studies which are relevant to the hazard and risk impact assessment. These are listed in the following section.

12.3 Updates to studies

A number of studies have been undertaken since the release of the EIS, relevant to hazard and risk. The list of studies undertaken as part of the SEIS includes:

- Revised Mine Plan (SEIS, Volume 4, Appendix B)
- Mine Approval Application Documents (SEIS, Volume 4 Appendix C2)
- Draft Proposed Approvals Report (SEIS, Volume 4, Appendix C5)
- Revised mine flood modelling (SEIS, Volume 4, Appendix K5)
- Revised water balance (SEIS, Volume 4, Appendix K2)
- Revised mine hydrogeological report (SEIS, Volume 4, Appendix K1)
- Addendum to mine hydrogeology report (SEIS, Volume 4, Appendix K6)
- Mine waste characterisation study (SEIS, Volume 4, Appendix O1)
- Mine waste management strategy (SEIS, Volume 4, Appendix O2)
- Landform design study (SEIS, Volume 4, Appendix O3)
- Closure and rehabilitation strategy (SEIS, Volume 4, Appendix R1 and R2)
- Revised traffic impact assessment (SEIS, Volume 4, Appendix P)

12.4 Summary of comments

Summary of key comments raised on the EIS relevant to hazard and risk (Mine and Offsite) included:

- Emergency response planning and facilities
- Access for emergency vehicles and establishment of emergency services at the mine
- Potential impact of sewage and hazardous substances during flood events

- Lack of detail to assess regulated structures assessment as per the manual for Hazard Category
- Increased risk of road trauma
- Increased risk of transmission of communicable disease

12.5 Response to comments

12.5.1 Emergency management

Adani will develop an Emergency Management Plan and an Emergency Response Plan prior to the start of construction works, in consultation with relevant emergency service providers such as QAS, DCS and QPS. Adani will engage with these emergency service providers throughout the construction and operation phase of the Project (Mine and Offsite).

These plans will detail the principles of prevention, preparation, response and recovery that will be applied to emergency management. They will identify the mechanisms for risk identification and management, training, integration with emergency services and communication plans. Adani has committed to the preparation of these plans for approval prior to the commencement of works.

12.5.2 Management of hazardous materials in flood events

The potential impact of flooding on the management of hazardous materials for the Project (Mine) is addressed in Volume 2, Section 12.2.4 of the EIS. Flooding at the mine poses a potential risk to the integrity of MAW storages, sediment basins and tailings dams and consequently, these structures are required to be assessed in accordance with the DERM Manual for Assessing Hazard Categories and Hydraulic Performance of Dams (Refer to Volume 2, Sections 12.2.2.3 and Section 12.2.2.4 of the EIS for assessments). Potential impacts and mitigation measures for flooding at the Project (Mine) are outlined in Volume 2, Section 3.3.2 of the EIS. Potential impacts of flooding on MAW and mitigation measures are addressed in Volume 2, Section 3.3.1.

Since the preparation of the hazard and risk assessment for the EIS, further detailed mine planning has occurred in regards to flood protection criteria for mine infrastructure, active mining areas, levees, dams and storages, roads, workshops and fuel/ANFO storage and office areas. This further detail provides support to the efficacy of risk mitigation measures and hence residual risk rankings. The detail has not affected the ranking and assessment of hazards and risk prior to controls.

Management and mitigation measures to minimise the risk of release of hazardous material in flood events are included in the revised EMPs for the Project (Mine, Rail and Offsite Infrastructure area).

Design criteria for flood impact assessment are specified which includes mine infrastructure areas (hazardous good storage). Please refer to Volume 4 Appendix K4.

12.5.3 Regulated structures

A preliminary hazard assessment in accordance with the Manual for Assessing Hazard Categories and Hydraulic Performance of Dams (DERM, 2012) has been performed for the following dams as part of the revised Mine Hydrology Report (SEIS Volume 4 Appendix K5):

- The central MAW dams where all MAW from the site will be collected
- The overburden dams of pits D and E that capture MAW runoff

The preliminary hazard assessment for the central MAW dams assumes that each dam will maintain a Hazard Category of high and thus need to be designed to withhold a 1 in 100 year AEP event.

Both overburden MAW dams have been assumed to have a significant hazard category. This assumption is solely based on the understanding tailings and rejects materials will be placed in the overburden areas for these two pits. While this material is placed it will be exposed to rainfall events meaning that runoff potentially contains contaminants associated with the mining activities. The dam itself will be built as a sump (below natural ground level), hence the risk of a dam break failure is considered minimal. The Manual specifies for a significant hazard category a 1:20 AEP event (5 percent AEP). Model (operational) rules allow for the MAW in the overburden MAW dams to be pumped, when available, directly into the north central MAW dam, henceforth ensuring that the allocated DSA volume is available within in each dam on 1 November each year.

A hazard assessment for all dams on site will be required during future design stages. Note that for dams without an actual catchment, like the MAW transfer dams, allowing for the DSA will be a matter of increasing the storage depth. Therefore the MAW storages are not expected to overflow or break during the life of the mine and release contaminants into the environment.

12.5.4 Risk of road trauma

Revised Traffic Impact Assessment (SEIS Volume 4 Appendix P) has shown a considerable reduction in the generation of traffic volumes as opposed to the conservative values provided in the EIS. A reduction in traffic volumes would result in a reduction in road incidents. However, risks of traffic crashes still exist even though the assessment of volumes indicates they are within the capacity of the roads.

The peak traffic generation during the construction phase of the Project is likely to be associated with the transporting of plant, equipment and material deliveries. The main traffic generated through the operation phase will be from plant, equipment and material deliveries. Traffic management issues will be addressed through the preparation and implementation of construction and operation Traffic Management Plans. These will be developed during the detailed design phase. The Traffic Management Plans will be developed in consultation with the Department of Transport and Main Roads, police and local authorities.

The Project will comply with the requirements under the Department of Transport and Main Roads (DTMR), namely the *Road Planning and Design Manual*, DTMR *Manual of Uniform Traffic Control Devices* and *Austroads Guide to Traffic Management*.

12.5.5 Risk of communicable disease

Medical Facilities will be established at the mine site and Mine Workers Accommodation Village in accordance with relevant legislative framework. Adani will proactively explore health programs that further improve worker's health. This will include a thorough worker health education program. Adani will ensure that appropriate Emergency Response Plans are implemented and aligned with the Adani Corporate Crisis Management Plan which will outline the appropriate response needed for such events.

12.6 Summary of commitments

Additional commitments to be considered as part of the SEIS include:

- Development of a Disaster Management Plan
- Development of a Mosquito/Biting Management Plan

13. Environmental management plan

13.1 Introduction

This section of the SEIS provides an overview of the amendments to the Project (Mine) and additional work undertaken in relation to the Environmental Management Plans - EMP (Mine and Offsite) since the EIS was made available for public comment in December 2012. A summary of key submissions is provided with response to individual submissions provided in Volume 4 – Appendix A.

13.2 Amendments to the Project

Amendments to the Project Description (Mine) subsequent to the EIS are located in the Project Description (Mine) (SEIS Volume 2, Section 2). In summary, Project (Mine and Offsite) changes include:

- Mine (onlease):
  - Updated Mine plan (including mine and water infrastructure)
  - Reduced Project (Mine) life from 90 years to 60 years
  - The stock route that crosses the northern part of the Project (Mine) site proposed to be moved, rather than closed.
- Mine (offlease):
  - Increased workforce accommodation requirements
  - The location of the airport moved from the north of the rail line, to the south of the rail line
  - Removal of offsite borefield Removal of in-stream storage of North and Obungeena creeks
  - Removal of offsite bore fields and associated pipelines.

13.3 Updates to studies

A number of studies have been undertaken since the release of the EIS, which have been used for informing the mitigation measures and controls identified in the EMPs (Mine and Offsite). These include:

- Revised subsidence assessment (SEIS, Volume 4, Appendix I1)
- Draft Subsidence Management Plan (SEIS, Volume 4, Appendix I2)
- Doongmabulla and Mellaluka Springs assessment (SEIS, Volume 4, Appendix J3)
- Population Survey of Waxy cabbage palm (SEIS, Volume 4, Appendix J4)
- Revised mine hydrogeological modelling (SEIS, Volume 4, Appendix K1)
- Revised water balance (SEIS, Volume 4, Appendix K2)
- Revised water quality (SEIS, Volume 4, Appendix K3)
- Revised flood study (SEIS, Volume 4, Appendix K4)
- Addendum to revised mine hydrogeology report (SEIS, Volume 4, Appendix K6)

- Revised air quality modelling (SEIS, Volume 4, Appendix L)
- Revised noise and vibration modelling (SEIS, Volume 4, Appendix N)
- Mine waste characterisation report (SEIS, Volume 4, Appendix O1)
- Mine waste management plan (SEIS, Volume 4, Appendix O2)
- Closure and Rehabilitation Strategy for Mine and Offsite (SEIS, Volume 4, Appendix R1 and R2)

13.4 Summary of comments

Key comments raised in the EIS submissions included:

- Use of locally indigenous plants during rehabilitation
- Rehabilitation of at least two wildlife corridors across the open cut mining impact area
- EMP does not identify nearby nature refuges as 'sensitive areas'
- Stygofauna sampling and mitigation measures require inclusion in the EMP
- Biosecurity and weed and pest management
- Insufficient information on:
  - proposed mine wastewater discharge method and method proposed for monitoring mine waste discharge represents a high risk to local environmental values
  - ERAs under schedule 2 and 6 of the Environmental Protection Regulation 2008 and Notifiable activities under schedule 3 of the Environmental Protection Act 1994
  - design details for regulated structures on site
  - trigger level for groundwater monitoring
  - soil management and soil erosion potential
  - subsidence modelling to assess risks associated with the predicted nine metre subsidence
  - rehabilitation

A number of submissions received requested further assessment, avoidance and mitigation measures for the potential impact of Mine and offsite infrastructure construction and operation. These have incorrectly been identified as being required to be addressed in the EMP (Mine and Offsite). These submissions include:

- Groundwater dependant ecosystems and potential impacts of drawdown
- Management system for mine affected water
- Infiltration of surface water to the groundwater via subsidence cracks
- Compliance with appropriate flood design criteria for emergency services and emergency services
- Identification of acid mine drainage and waste characterisation
- Recommended additional mitigation measures to ensure adequate access for emergency services and evacuation during construction and maintenance
- Background of air quality monitoring data or air quality modelling

The EMP presented in the EIS is a proposed project implementation document providing a framework for the management, monitoring and mitigation of key project impacts arising from the EIS. The EMP is not the primary impact assessment document. Where there has been an amendment to impact assessment studies and findings, these have been reflected in the relevant section of the SEIS. Further details on how these submissions have been addressed are available in the Submissions Register (Volume 4, Appendix A).

13.5 Response to comments

The EMPs (Mine and Offsite) (SEIS, Volume 4, Appendices Q1 and Q2, respectively) have been revised to respond to comments raised in the EIS on the EMPs, specifically:

- Section 3 – Environmental Management Framework: Table 3-5: Environmentally Relevant Activities was updated with further detail and quantities against each ERA.
- Section 9 – Surface Water: Water quality objectives table was updated in accordance with the revised Water Quality Report (SEIS, Volume 4 Appendix K3).
- Section 15 – Biosecurity Management was incorporated to address biosecurity (weed and pest) matters in relation to the Mine and Offsite area, including mitigation measures and identifies appropriate controls for weed and pest management. The EMP also identifies that Adani will prepare a site specific weed and pest management plan prior to construction commencing which will require the mapping of existing weeds along the alignment, identification of appropriate site specific controls and identification of locations for temporary / permanent wheel wash facilities
- Draft Environmental Authority Conditions have been taken out of the EMP and added to the Proposed Draft Approvals Report (SEIS, Volume 4, Appendix C6), which sets out the proposed approval conditions for consideration by the Coordinator-General.
- Rehabilitation and Closure section now forms a standalone Closure and Rehabilitation Strategy for each of the Mine and Offsite Area (SEIS, Volume 4, Appendices R1 and R2) providing management controls and methods outlined in the EIS EMP. The Closure and Rehabilitation Strategy also builds on the EIS EMP and provides further detail on conceptual management and mitigation measures, indicators and rehabilitation completion criteria, progressive and interim rehabilitation procedures and a monitoring program for rehabilitation assessment.

14. References

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Appendices


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Appendix A – Review of hydrogeological model

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EHB:eb (G-001.Carmichael)
30 July 2013

General Manager Environment and Sustainability
Adani Mining Pty Ltd
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10 Eagle St.
BRISBANE QLD 4000

Attention: Mr Hamish Manzi

Dear Hamish

RE: CARMICHAEL COAL MINE and RAIL PROJECT
PEER REVIEW OF GROUNDWATER IMPACT ASSESSMENT

1.0 INTRODUCTION

I wish to confirm that I have been engaged by Adani Mining Pty Ltd (Adani) to undertake a peer review of the hydrogeological studies being undertaken by Adani and their groundwater consultant GHD Pty Ltd (GHD), for the Carmichael Coal Mine and Rail Project (the Project), located in the Galilee Basin of Queensland. A peer review is considered an essential component of the Environmental Impact Statement (EIS) and Supplementary EIS (SEIS) process due to the sensitivity of the Project, particularly with respect to its potential to impact on the Great Artesian Basin (GAB) and Doongmabulla Spring complex. The on-going peer review process commenced in April 2012 following submission of a preliminary report by GHD dated 26 March 2012[1].

2.0 PEER REVIEW

It was recognized subsequent to submission of the EIS that data gaps in the conceptualization of the hydrogeological regime remained, particularly in the area south of the Carmichael River, leading to some uncertainty in development of the groundwater model and predictions of impact. The prime groundwater issues identified in the EIS that required further assessment for an SEIS are:

[1] GHD (March 2012) *"Report for Carmichael Coal Mine and Rail Project: Mine Technical Report - Hydrogeology Report 23244-D-RP-0026"* Rev B

- The impact of mining on Doongmabulla Springs and groundwater dependent ecosystems (GDE's);
- The impact of mining on the Mellaluka Springs where up to 5m of drawdown is predicted post mining; and
- The impact on the water table in the area of the Carmichael River where up to 45m of drawdown is predicted.

Consequently I recommended that further hydrogeological investigations be undertaken south of the river with the objectives of:

- Confirming or otherwise the general south-east hydraulic gradient in the Dunda Beds and Rewan Formation towards Mellaluka springs;
- Provide stratigraphic data to assist in re-interpretation of the extent and thickness of the Tertiary and underlying Triassic sediments, particularly the thickness and extent of the Rewan Formation and Dunda Beds;
- Assessing if there are significant water bearing sand beds in the Tertiary and the hydraulic relationship between all aquifers;
- Obtaining additional data on the permeability of the Tertiary and Triassic strata and of the underlying coal seams; and
- Establishing the source of artesian pressures identified in previous investigations.

Following these recommendations Adani and GHD undertook further field investigations involving:

- Construction of monitoring bores and permeability testing of various hydrogeological units (falling head, packer and pumping tests);
- Drilling and testing three bores in the Mellaluka springs area;
- Establishment of monitoring bores to the west of the lease;
- Additional groundwater level monitoring and water quality sampling, and
- Development of a more robust groundwater model based on:
    - the data obtained from the additional field work;
    - the re-interpretation of the geology, particularly of the distribution and thickness of the Tertiary; and
    - improved simulation of surface water / groundwater interactions along the Carmichael River.

3.0 CUMULATIVE IMPACT ASSESSMENT

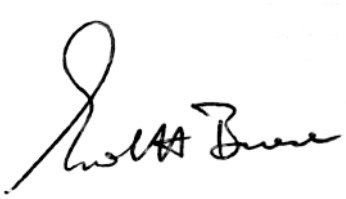
A cumulative impact assessment is required where there is more than one mine in an area and where the impact of the mines on the groundwater regime may overlap. A cumulative impact assessment of the Project and the China Stone Project to the immediate north was considered, however no information is currently available for the China Stone Project which is currently in the process of undertaking hydrogeological studies for preparation of an EIS. Without this information,

particularly of the extent and rate of development of the pits and underground mine, it is not possible to undertake a cumulative impact assessment that will provide meaningful data.

4.0 CONCLUSION

I consider that the extensive groundwater studies undertaken for the EIS and SEIS have resulted in the development of both a robust conceptual groundwater model, and of a numerical flow model in which a high degree of confidence can be placed on the predicted impacts and mitigation/containment strategies.

Yours faithfully



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