2. Description of the Project (Mine)

2.1 Project Overview

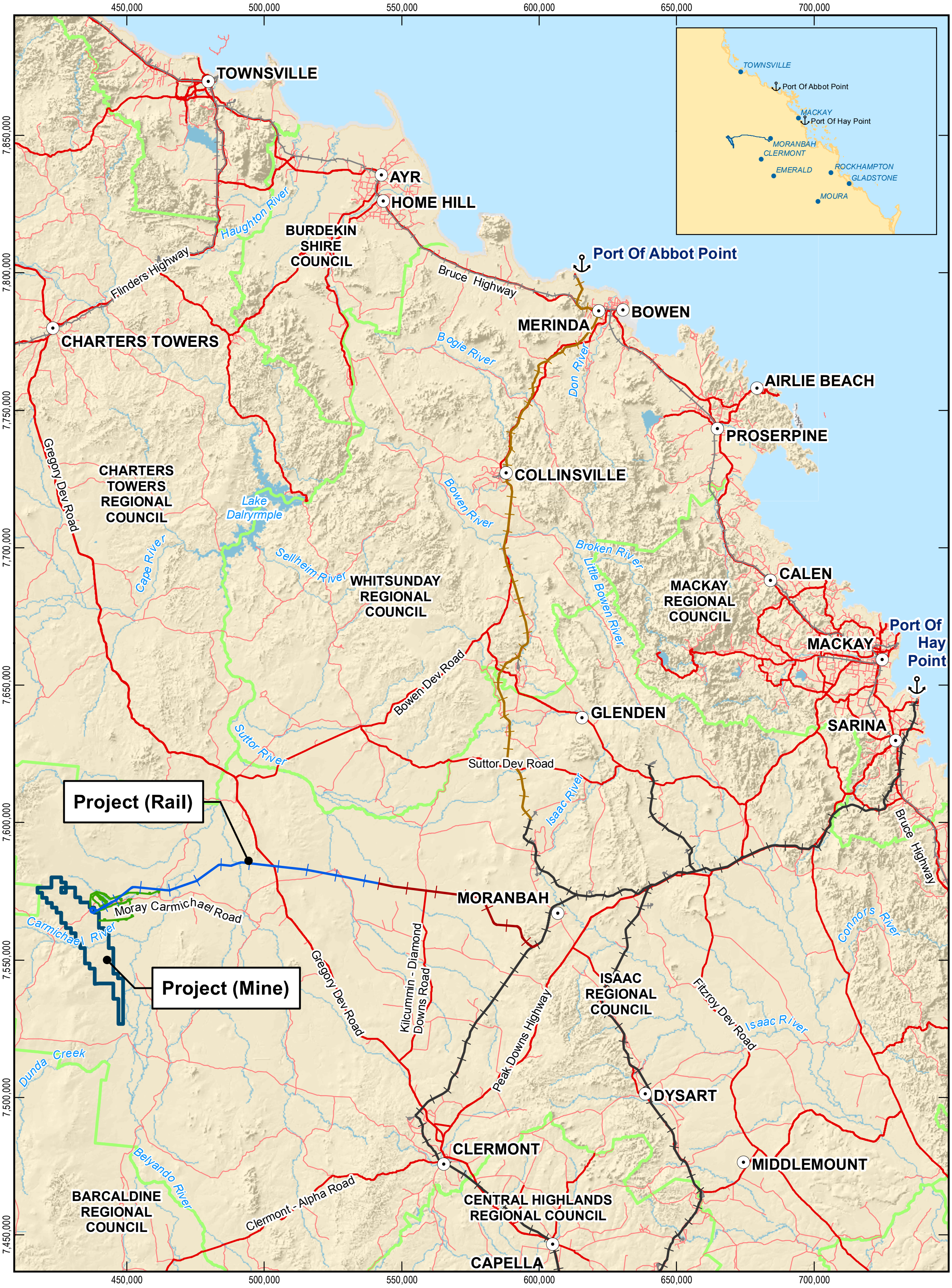
Adani Mining Pty Ltd (Adani) is proposing to develop a 60 million tonne (product) per annum (Mtpa) thermal coal mine in the north Galilee Basin approximately 160 kilometres (km) north-west of the town of Clermont, Central Queensland. All coal will be railed via a privately owned rail line connecting to the existing QR National rail infrastructure, and shipped through coal terminal facilities at the Port of Abbot Point and the Port of Hay Point (Dudgeon Point expansion). The Carmichael Coal Mine and Rail Project (the Project) will have an operating life of approximately 90 years. The Project comprises of two major components:

- The Project (Mine): a greenfield coal mine over EPC1690 and the eastern portion of EPC1080, which includes both open cut and underground mining, on mine infrastructure and associated coal processing facilities (the Mine) and the Mine (offsite) infrastructure including:
  - A workers accommodation village and associated facilities (including: industrial area and rail siding)
  - A permanent airport site
  - Water supply infrastructure
- The Project (Rail): greenfield rail lines connecting the Mine to the existing Goonyella and Newlands rail systems; including:
  - Rail (west): a 120 km dual gauge portion from the Mine site running west to east to a junction with proposed lines running south-east to the Goonyella rail system and north-east to the Newlands rail system
  - Rail (east): a 69 km narrow gauge portion connecting to the Goonyella rail system south of Moranbah to provide for export of coal via the Port of Hay Point (Dudgeon Point expansion)

The Project has been declared a ‘significant project’ under the *State Development and Public Works Organisation Act 1971* (SDPWO Act) and as such, an Environmental Impact Statement (EIS) is required for the Project. The Project is also a ‘controlled action’ and requires assessment and approval under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Adani is seeking environmental approval and conditions for the rail project under the *State Development and Public Works Organisation Act 1971* (SDPWO Act) and EPBC Act. At the completion of the assessment of the project, the Coordinator-General will issue a report containing imposed and recommended conditions for the Project. It is proposed these conditions cover as many environmental approvals under other Queensland Government legislation as possible using the SDPWO Act part 4, divisions 4, 5, 6 and 8. The proponent seeks to use these provisions to streamline the process as much as possible and seeks conditioning and approvals activities. Volume 4, Appendix D (Project Approvals and Planning) outlines the environmental approvals sought through this EIS and supporting application information.

The Project EIS has been developed with the objective of avoiding or mitigating all potential adverse impacts to environmental, social and economic values and enhancing positive impacts. Detailed descriptions of the Project are provided in Volume 2 Section 2 Project Description (Mine) and Volume 3 Section 2 Project Description (Rail). Figure 2-1 illustrates the location of the Project.



LEGEND

- Town
- Major Port
- Other Rail Network
- Goonyella System
- Newlands System
- State Road
- Local Road
- Watercourse
- Local Government Area
- Project (Rail)
  - Rail (West)
  - Rail (East)
- Project (Mine)
- Mine (Offsite)

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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

Project Location

Job Number	41-25215
Revision	L
Date	05-09-2012

Figure: 2-1

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Level 4, 201 Charlotte St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data Source: © Commonwealth of Australia (Geoscience Australia): Town, Railways, Watercourses (2007); DERM: LGA, (2011), Hillshade (2009); DMR: State Roads (2008); Gassman/Hyder: Mine (Offsite) (2012); DME: EPC1690 (2010), EPC1080 (2011); Adani: Alignment Opt9 Rev3 (2012). Created by: BW, JVC

2.2 Mine Site Details

2.2.1 Location

The Project (Mine) is located in the northern part of the Galilee Basin, Central Queensland. The Mine will be developed over EPC1690 (incorporating Mining Lease Application (MLA) 70441) and the eastern and northern portion of EPC1080. The Project is located approximately 160 km north-west of the town of Clermont. The nearest regional centre is Emerald, approximately 350 km south (refer Figure 1-1). The Project (Mine) is predominantly within the Local Government Area (LGA) of Isaac Regional Council, with the exception of 167 ha within the north-western corner of the EPC1690, which is located within the LGA of Charters Towers Regional Council (CTRC). The IRC is located within the Isaac, Mackay and Whitsunday Region while the CTRC is located within the Northern Region of Queensland.

The Mine infrastructure includes all infrastructure located within the boundary of EPC1690 and part of EPC1080. Adani currently holds EPC1690 and has lodged a mining lease application (MLA) over this land (MLA70441 previously MDLA372). EPC1690 runs north-west to southeast, covering approximately 45 km in length and approximately 7 km in width. Adani has obtained consent from Waratah Coal Pty Ltd to lodge a mining lease application over the eastern and northern portion of EPC1080. The eastern and northern portion of EPC1080 is approximately 50 km in length and between 3 and 6 km wide. The offsite infrastructure is located outside EPC1690 and EPC1080, and is not within the proposed mining lease.

2.2.2 Project Area Tenure and Land Use

2.2.2.1 Mine and Onsite Infrastructure

The Project (Mine) and associated onsite infrastructure lies cross six cattle stations, namely the Moray Downs, Carmichael, Albinia, Lignum, Doongmabulla and Mellaluka cattle stations (refer to Table 2-1). Adani has purchased the Moray Downs cattle station and is in the process of negotiating access to remaining affected properties under the provisions of the *Mineral Resources Act 1989*. Lot details, encumbrances and interests currently held within properties covered by the Project (Mine) are listed in Table 2-1 and Table 2-2 respectively and shown in Figure 2-2.

The tenure of the subject parcels of land is leasehold. As identified in Table 2-1, the majority of the subject parcels are on a Grazing Homestead and Perpetual Lease (GHPL) and Pastoral Holding (PL) lease. A GHPL is an ongoing tenure issued for the purposes of grazing and/or agricultural purposes in accordance with the *Land Act 1994*, while a PL is a term lease issued for pastoral purposes. The surrounding land use is typically farmland, predominantly livestock with some cropping. There are some improvements existing within the Project (Mine) as part of these cattle properties, including paddocks, watering bores and access tracks. Further detail on location and boundaries of land use and tenure is outlined in Volume 4 Appendix M, Section 2.3.

Table 2-1 Project Area Land Use and Tenure

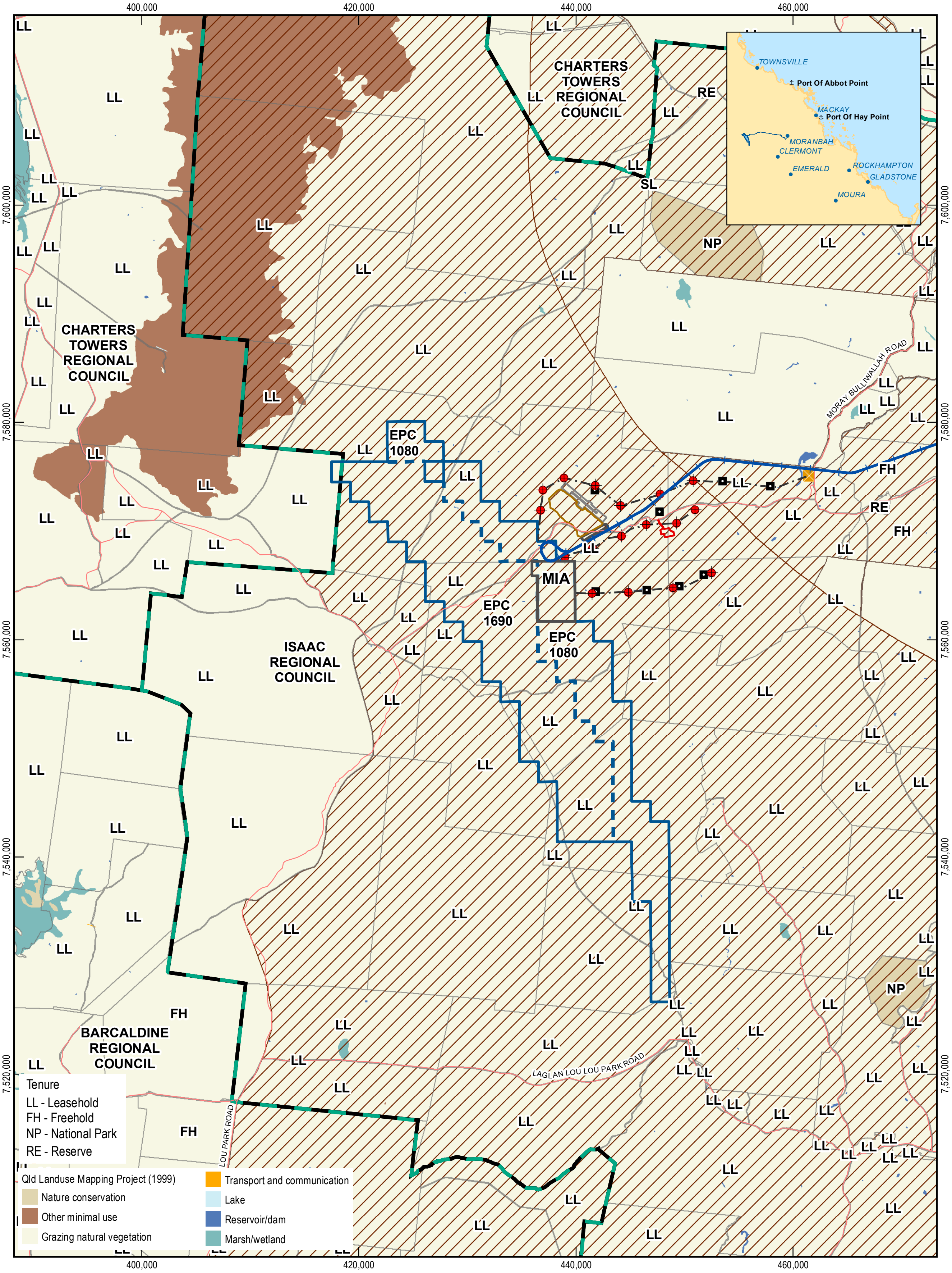
Project Component	Property Details	Affected area (ha) within the Property	Current Land Use	Current Tenure/Category of Tenure
Mine Area	Lot 1 on AY35 (Carmichael)	167	Cattle grazing	Leasehold (Grazing Homestead Perpetual Lease)
	Lot 1 on SP164918 (Lignum)	4,242	Cattle grazing	Leasehold (Grazing Homestead Perpetual Lease)
	Lot 662 on PH1491 (Moray Downs)	20,857	Cattle grazing	Leasehold (Pastoral Holding)
	Lot 633 on SP228220 (Doongmabulla)	64	Cattle grazing	Leasehold (Pastoral Holding)
	Total of EPC1690 excluding road easements: 25,330 ha			
Road Easements traversing Mine	Several properties	686	Road	Road easement
	Total of EPC1690 including road easements: 26,016 ha			
Out-of-pit Spoil Area	Lot 662 on PH1491 (Moray Downs)	12,065	Cattle grazing	Leasehold (Pastoral Holding)
	Lot 1 on SP164918 (Lignum)	4,059	Cattle grazing	Leasehold (Grazing Homestead Perpetual Lease)
	Lot 3 on DR17 (Albinia)	119	Cattle grazing	Leasehold (TL)
	Lot 5091 on PH1882 (Mellaluka)	2,339	Cattle grazing	Leasehold (PPH)
	Lot 2093 on PH1883 (Madison)	47	Cattle grazing	Leasehold (TL)
	Total area for part of EPC1080 including road easements: 18,714 ha			
Road Easements traversing Out-of-pit Spoil Area	Several properties	85	Road	Road easement
	Total area for part of EPC1080 excluding road easements: 18,629 ha			
Total land area of Mine (Onsite Infrastructure) (including easements): 44,760 ha				

Table 2-2 Encumbrances and Interests

Project Component	Subject Property	Easement
Mine Area	Lot 1 on AY35	Rights and interests reserved to the Crown Lease No.17655213 Nature Refuge No.704134903
	Lot 1 on SP164918	Rights and interests reserved to the Crown Lease No. 40040496 Nature Refuge Noting No. 708488668
	Lot 662 on PH1491	Rights and interests reserved to the Crown Lease No.17665183
	Lot 633 on SP228220	Rights and interests reserved to the Crown Lease No.17665175
Out-of-pit Spoil Area	Lot 662 on PH1491	Rights and interests reserved to the Crown Lease No.17665183
	Lot 1 on SP164918	Rights and interests reserved to the Crown Lease No.40040496 Nature Refuge No.708488668
	Lot 3 on DR17	Rights and interests reserved to the Crown Lease No.40061637
	Lot 5091 on PH1882	Rights and interests reserved to the Crown Lease No.17669158
	Lot 2093 on PH1883	Rights and interests reserved to the Crown Lease No.40058661

Table 2-3 Homesteads Immediately within the Project Area

Homestead Name	Land Use	Tenure	Location/Distance to Project (Mine)
Immediately within Project Area			
Lot 662 on PH1491 Labona (within Moray Downs)	Rural	Leasehold	Within central eastern portion of Project (Mine), specifically EPC1690
Lot 5091 on PH1882 Mellaluka	Rural	Leasehold	On the southern boundary of Project (Mine), specifically EPC1080



LEGEND

- Town
- State Road
- Local Road
- Local Government Area
- Native Title Register
- Rail (West)
- Mine (Onsite)
- Mine Infrastructure Area

Mine (Offsite)

- Borehole
- Storage Site (Instream)
- Storage Facility (Offstream)
- Pipeline Network
- Airport Location
- Rail Siding
- Industrial Area
- Workers Accommodation Village

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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

Job Number 41-25215
Revision D
Date 16-11-2012

Mine Land Use and Tenure

Figure 2-2

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Level 4, 201 Charlotte St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data Source: GA: Roads (2007); DME: EPC 1690 (2010)/EPC 1080 (2011); DERM: Cadastre, LGA (2010), Landuse (1999), Adani: Alignment Opt9 Rev3 (2012); Gassman/Hyder: Mine (Offsite) (2012) . Created by: BW,MS

2.2.2.2 Offsite Infrastructure Area

The land on which the offsite infrastructure will be developed is within Lot 662 on PH1491 (see Table 2-4) known as Moray Downs and is held by Adani Mining Pty Ltd as a Pastoral Lease under the *Land Act 1994* (see Table 2-5).

Table 2-4 Offsite Infrastructure Land Use and Tenure

Project Component	Property Details	Area (ha) within the Property	Current Land Use	Current Tenure/Category of Tenure
Mine offsite infrastructure: Workers accommodation village	Lot 662 on PH1491	74	Cattle grazing	Leasehold (Pastoral Holding)
Mine offsite infrastructure: Permanent airport	Lot 662 on PH1491	317	Cattle grazing	Leasehold (Pastoral Holding)
Mine offsite infrastructure: Rail siding area	Lot 662 on PH1491	95	Cattle grazing	Leasehold (Pastoral Holding)
Mine offsite infrastructure: Heavy industrial area	Lot 662 on PH1491	948	Cattle grazing	Leasehold (Pastoral Holding)
Mine offsite infrastructure: Offsite water supply infrastructure	Lot 662 on PH1491	413	Cattle grazing	Leasehold (Pastoral Holding)
Total area for Lot 662 on PH1491: 1,847 ha				

Table 2-5 Encumbrances and Interests

Project Component	Subject Property	Easement
Mine offsite infrastructure	Lot 662 on PH1491	Rights and interests reserved to the Crown Lease No.17665183

2.2.3 Surrounding Tenure and Land Use

The land use and tenure of properties within and surrounding the Project (Mine) is rural (low intensity cattle grazing) and under leasehold ownership (refer to Table 2-1 and Table 2-2 and Figure 2-2). As with the above detailed parcels of land, these properties are generally on a GHPL or PL type of lease.

A total of nine homesteads are located immediately within/surrounding the Project Area. Seven homesteads are more than 1 km away from the Project Area, while two, namely the Labona and Mellaluka homesteads, are located immediately within the Project Area (refer to Table 2-6).

The Labona homestead will be demolished as part of the Project (Mine) construction activities. The Mellaluka homestead will remain as this portion of the Project Area will not be utilised for mining activities. Should Adani wish to utilise this portion of EPC1080, the impact upon the Mellaluka homestead will be reassessed as part of an assessment of the impacts of expanding the mining activity.. Refer to Volume 4 Appendix M for further information.

Table 2-6 Homesteads Immediately Surrounding Project Area

Homestead Name	Land Use	Tenure	Location/Distance to Project (Mine)
Lot 663 on SP228220 Doongmabulla	Rural	Leasehold	5.77 km west of Project (Mine), specifically EPC1690
Lot 1 on AY 35 Carmichael	Rural	Leasehold	11 km west of Project (Mine), specifically EPC1690
Lot 1 on SP228220 Bimbah East	Rural	Leasehold	18 km to the south-west of Project (Mine), specifically EPC1690
Lot 1 on SP164918 Lignum	Rural	Leasehold	1.4 km to the south east of Project (Mine), specifically EPC1080
Lot 2 on SP177201 Bygana	Rural	Leasehold	4.9 km to the south-east of Project (Mine), specifically EPC 1080
Lot 5158 on PH991 Moonoomoo	Rural	Leasehold	17 km north of Project (Mine), specifically EPC1690
Lot 3 on DR17 Albinia	Rural	Leasehold	7.5 km south east of Project (Mine), specifically EPC1080

2.3 Ongoing Evaluation and Exploration Activities

An ongoing programme of geological and geotechnical investigations will be carried out to further define the coal resources and refine the Mine Plan as mining progresses. This will include lease-wide coverage as well as more intense drilling of the sub-crop in the area of early production, covering both the open cut mine areas and underground mine. This drilling program will increase knowledge of the deposit for resource estimation, washability testing, hydrogeological and geotechnical evaluation. These investigations will also provide further detail on ground conditions and enable detailed design of all infrastructure and structures associated with the Project (Mine).

Exploration activities will progress in stages aligned to the development of the Project:

- Resource drilling to improve the level of certainty of the deposit characteristics and elevate the resource category
- Geotechnical drilling to acquire knowledge of the appropriate underground working sections and geotechnical environment
- 3D seismic surveys over the underground mines to clearly define the structural geology
- Hydrology studies to develop models of the subsurface hydrology regime for geotechnical studies, and evaluation of mine drainage and aquifer impacts of both open cut and underground mining

- Coal quality drilling to improve knowledge of the coal raw quality and the coal washability characteristics to allow detailed CHPP design in later stages of planning

2.4 Rationale for Mine Design and Operational Features

2.4.1 Overview

The objectives of the Project (Mine) are to:

- Produce 100 per cent thermal coal product
- Achieve a maximum production of 60 Mtpa of product coal, on an as received basis, sourced from open cut and underground mining
- Produce coal with a target ash of 25 per cent ash requiring minimal washing

Adani commissioned Runge Pty Ltd to undertake a Macro-conceptual Mining Study (Runge Limited 2011) (the Mine concept plan) for the development of the 60 Mtpa product coal Mine. The purpose of the Study was to:

- Develop preliminary mine designs and associated mine plans
- Outline basic infrastructure, equipment and plant requirements
- Develop concept level cost estimates and production schedules
- Identify the mining, infrastructure and environmental constraints
- Identify major risks or opportunities associated with the Project

Mine planning and design is in the conceptual stage, with the mine plan developed on the basis of:

- Assessment of the general physical characteristics of the deposit based on a geological model built from existing exploration data
- Determination of the target coal resource and mine limits based on resource quality and economic considerations
- Selecting the most appropriate mining method, and particularly, which parts of the resource to target through open cut and underground methods
- Mine waste characteristics and management requirements
- Identifying supporting infrastructure needs including both on-site and of-site infrastructure
- Identifying optimal locations for infrastructure including minimisation of sterilisation of resource, location of workers accommodation away from noise and dust sources and overall efficiency of operation

This work has led to the conceptual mine plan presented in this EIS, which is based on the outcomes of the Macro-conceptual Study (Runge Limited 2011). While the overall mine concept and mining and infrastructure components are unlikely to change, further geological exploration and geotechnical investigations are likely to lead to a number of refinements throughout the life of the mine.

2.4.2 Coal Seam Physical Characteristics

The technical feasibility of the Mine is dependent on the environmental, geological and geo-technical characteristics of the Project Area. Geological characteristics include the geology and location of varying qualities, quantities and depths of coal deposits, the surface water and groundwater features of the site and the location of the coal sub-crop. The location and structure of the resource dictates the Mine layout, however, as the resource is further defined through continued exploration, the Mine layout will also be reviewed and adjusted. The geological data used to support the Mine plan is based on the Galilee Project – In situ Coal Resources Estimate (Xenith Consulting 2009). This model has been developed in Mincom's Minescape software, and is underpinned by 47 exploration boreholes at drill hole spacing of approximately 4 km centres. Adani has an ongoing exploration programme from which the geological model will be progressively updated.

The coal deposit underlies almost 100 per cent of EPC1690. The coal seams strike approximately north-south through the Mine, with a regional dip of two to six degrees to the west. The seams are contained within the Permian coal measures, which are overlain across the total area by a poorly consolidated to unconsolidated cover of Tertiary materials, averaging 74 m in thickness but ranging to over 150 m in some areas. Figure 2-3 shows a generalised Mine stratigraphic column. Coal seams are observed in three main groups, the AB seam, C and D seams and E and F seams. These seams have been further divided into intervals based on identifiable parting bands. The C seam and B splits have been excluded from the resource calculation because of high ash and inconsistent thicknesses. Further detail on the geotechnical attributes of the Mine is outlined in Volume 2 Section 4.2 Land.

The distribution between the main seam groups and comparison with the tonnage targeted for mining are shown in Table 2-7. The table also outlines the quality and thickness of the resource. A total JORC indicated and Inferred Resource Estimate of 7.8 billion tonnes (Bt) is reported to a depth of 500 m.

Table 2-7 Coal Resource and Recovery by Seam, Thickness and Quality

Seam Group	Estimated Resource Bt	Mined ROM Coal Bt	Raw Ash (%)	Thickness (m)
AB Seams	3.4	2.0		
AB1			23.4	6.8
AB2			38.4	2.1
AB3			31.8	4.5
D Seams	3.8	2.4		
D1			22.2	4.9
D2			22.9	3.5
D3			21.5	3.2
E Seam	0.4	0.2	25.4	2.2
F Seam	0.2	0.2	28.6	2.2
Total	7.8	4.8		

Figure 2-3 Carmichael Mine Stratigraphic Column

Age		Lithology	Stratigraphy	Thickness
Tertiary		Clay / Mudstones		40 – 100 m
Triassic		Mudstone / Siltstone	Rewan Formation	
Late Permian		Sandstone	Bandanna Formation	
		COAL – AB Seam		12 – 18 m Resource Seam
		Sandstone / Siltstone		10 m
		COAL – B Splits		1 – 2 m
		Siltstone / Mudstone		60 – 70 m
		COAL – C Seam (carbonaceous)		3 – 4 m
		Siltstone / Sandstone	Colinlea Sandstone	2 – 20 m
		COAL – D1 Seam		4 – 6 m Resource Seam
		Sandstone		5 – 30 m
		COAL D2/D3 Seam		8 – 10 m Resource Seam
		Siltstone / Mudstone		10 – 20 m
		COAL – E Seam		1 – 3 m Resource Seam
		Sandstone / Siltstone		5 – 10 m
		COAL – F Seam		1 – 5 m Resource Seam
Early Permian		Sandstone		

2.4.3 Deposit Economics

The optimum open cut pit shell and underground mine limits were defined through a cost ranking analysis. Cost ranking is a process that analyses the comparative mining costs of each potential mining block in the deposit to identify economic trends and the potential magnitude of the reserves tonnage that lie within a pre-determined cost cut off. The method defines the likely economic limits of the open cut mine layout and assists in the development of the most cost-effective scheduling sequence.

Cost ranking undertaken as part of the Macro-conceptual Study was a key determinant in the size and shape of the current Mine layout and provided a basic analysis of the possible sequencing of mining in advance of the preparation of the detailed Mine Plan. The extraction of the target quantity of product to meet demand was considered. A target ash of 25 per cent, achieved through minimal washing, and the ability to allow high-ash run of mine (ROM) coals to be recovered was adopted for the Study.

2.4.4 Mining Methods Rationale

A combination of both open cut and underground mining methods are proposed to extract the coal. The direct influences in the selection of an open cut mining method and the associated open cut Mine Plan has been the:

- Targeted scale of production
- Cost ranking to define the economic limits of the open cut mine
- Strike of the coal seams
- Geometry of the deposit
- Stability of the overburden materials in the deployment of draglines and other mobile equipment
- Application of draglines as a more flexible system, particularly to deal with changing geotechnical conditions and large operating cost advantages
- Ability to use draglines with truck-shovel pre-strip for the removal of primary overburden for a robust and well proven application
- Ability to provide flexible scheduling and access
- Ability to develop long, consistent strips for the efficient use of large scale open cut equipment as quickly as possible
- Haulage distances for waste once steady-state operations are reached

The direct influences in the selection of a longwall underground mining method and the associated underground Mine Plan has been:

- A cost ranking exercise to determine an economic transition boundary between open cut and underground mining areas
- The need for a production output of approximately 20 Mtpa ROM to augment open cut operation to meet target production
- The safety, production rates and recovery rates of the single pass longwall mining method

- The depth ranges of 300 to 500 m of the resource, and productivity levels required to ensure economic extraction
- Presence of lower ash AB1 seam and D1 seams which can be blended with higher ash product from open cut pits to achieve an overall ash target of 25 per cent
- An assumed initial longwall productivity of approximately 5 Mtpa ROM from each longwall face installed
- Benchmarking production levels based on comparative productive Australian longwall operations

The management of the Carmichael River, which bisects the Mine east west, has been a consideration in the Mine design. The Carmichael River is an ephemeral tributary of the Belyando River that flows west to east across the lease and bisects the deposit. A corridor, at a minimum of 500 m will be retained either side of the centre line of the Carmichael River to protect it and the riparian zone from mining operations. Mine production is scheduled to commence on the southern side of the Carmichael River around 2033, when the river will be spanned via bridge or similar method to allow access to the south of the River.

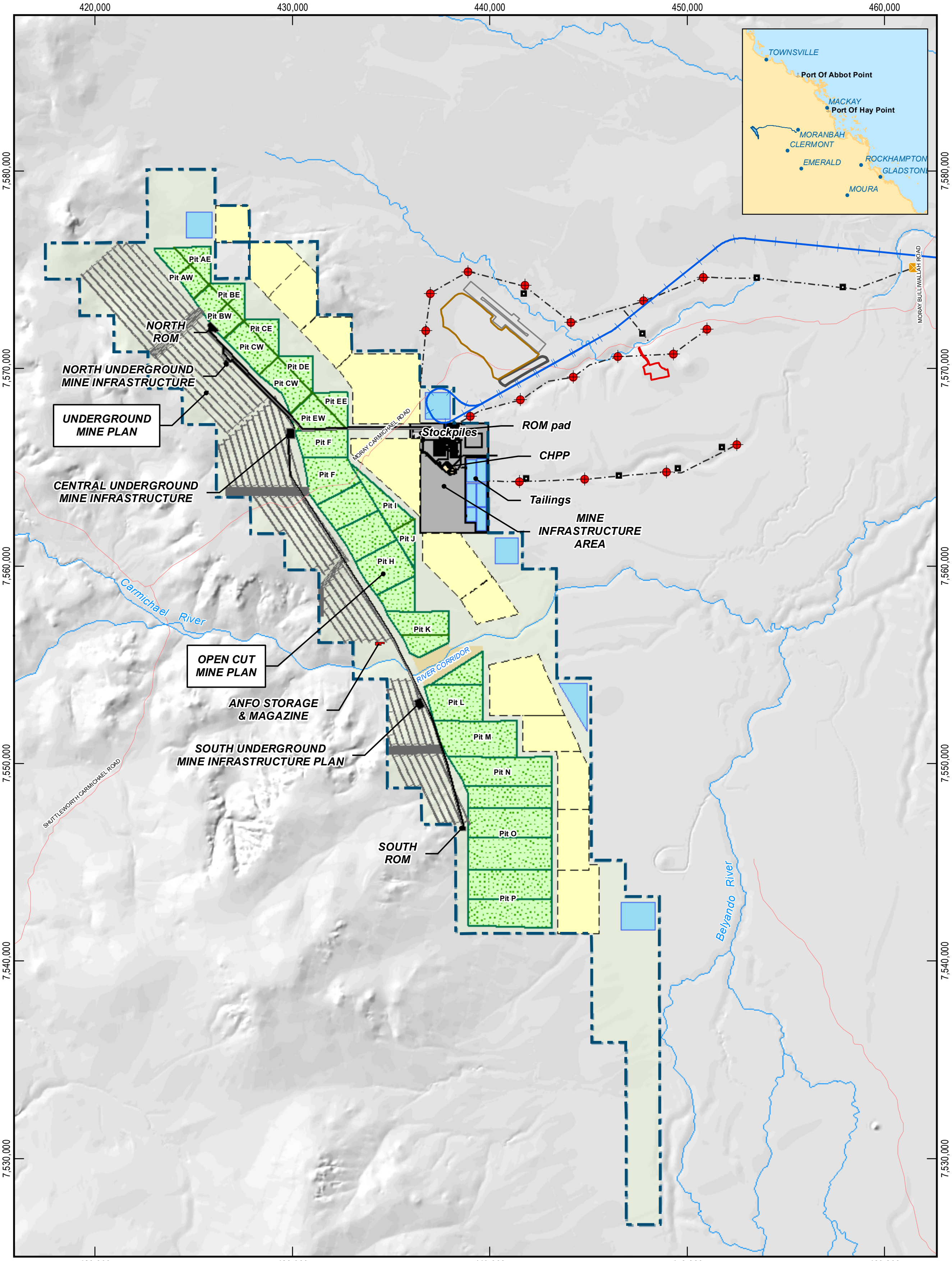
Further detail on the environmental values and potential impacts to the Carmichael River is included in Volume 2 Section 6 Water Resources.

2.4.5 Placement of On-site Infrastructure and Out-of-pit Dumps

The geological characteristics of the Mine define the location of open cut and underground mining operations. This in turn drives the optimal location of mine infrastructure and interdependencies such as site access, services and infrastructure connecting the Mine with offsite infrastructure and third party service providers. If infrastructure is developed over economic coal deposits, those deposits will be difficult or unfeasible to extract. The layout of the infrastructure is therefore designed to avoid this. In particular, the main infrastructure area is located outside the sub-crop line of the identified economic seams.

Location of out-of pit dumps is driven by minimising handling of material and also avoiding sterilisation of coal resources. The out-of-pit dumps were initially located over the underground mining areas within EPC1690, however subsequent to the development of the 2011 Mine Plan, Adani was able to secure the eastern portion of EPC1080, adjacent to the eastern boundary of EPC1690 which allows for more efficient placement of spoil adjacent to the low wall of each open cut. EPC1080 will now be used for the out-of-pit dumps.

Further detail on the key operational activities associated with the mine infrastructure area is in Section 2.11. Figure 2-4 illustrates the general Mine layout, and location of the on Mine and offsite infrastructure.



LEGEND

Local Road	Rail (West)	Open Cut Blocks	Mine (Offsite)	Industrial Area
River / Watercourse	Mine (Onsite)	Out of Pit Waste Dumps	Borehole	Rail Siding
Overland Conveyors		Water Management Dams	Storage Site (Instream)	Airport Location
		Mine Infrastructure Area	Storage Facility (Offstream)	Workers Accommodation Village
			Pipeline Network	

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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

Project (Mine) On Mine
and Offsite Infrastructure

Job Number	41-25215
Revision	D
Date	07-09-2012

Figure 2-4

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Data Source: GA: Road, River / Watercourse (2007); DME:EPC1690 (2010), EPC1080 (2011); Adani: Alignment Opt9 Rev3 (2012), Mine Layout / Infrastructure (2012); Gassman/Hyder: Mine (Offsite) (2012). Created by: JVC/MS

2.4.6 Equipment and Plant Selection

The planned scale of production requires large-scale mining equipment, which will vary in fleet numbers depending on the stage of Mine operations. Equipment selection will depend on required production rates, reliability of equipment and suitability to the operating conditions, particularly high summer temperatures.

For the open cut component, truck-and-shovel equipment will be used for the pre-strip of overburden and then draglines will be used for removal of the bulk of overburden. Bucket wheel excavators or other continuous mining equipment will be used for final overburden removal and coal extraction.

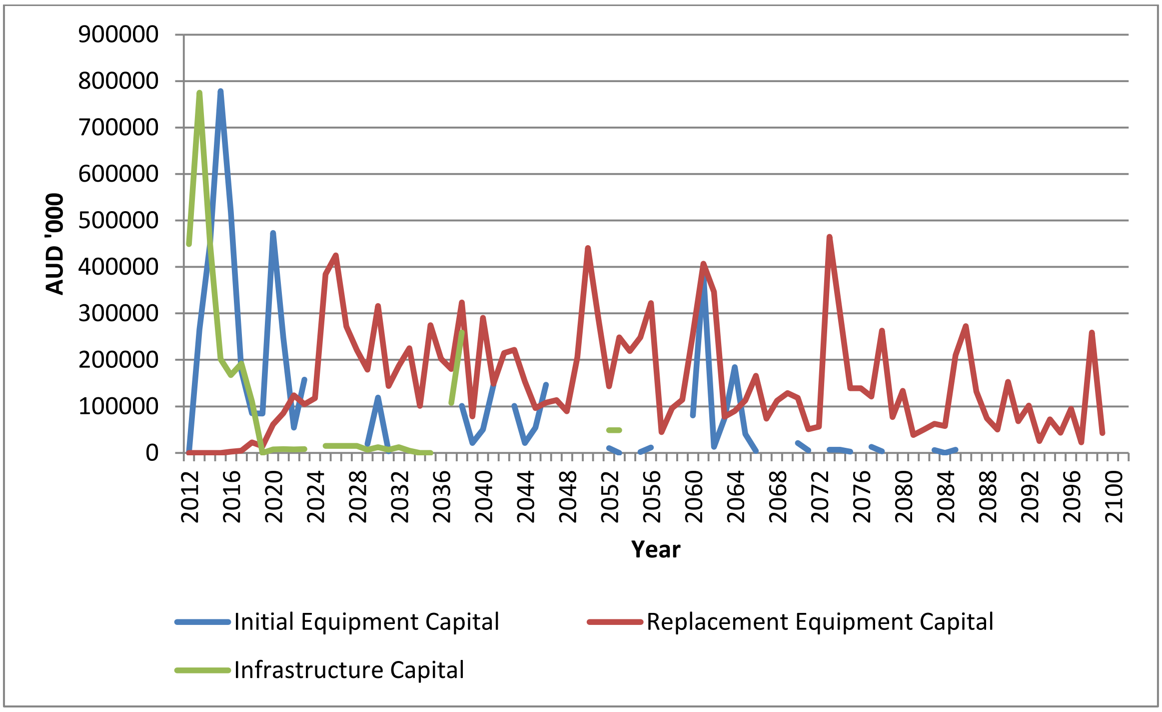
The underground mining method will be longwall mining. Longwall mining requires sets of equipment consisting of hydraulic shields to provide roof support during extraction, shearers to cut the coal from the seam and conveyors to transfer the coal to the surface. Underground mining equipment has not yet been selected.

A combination of haul trucks and conveyors will be used to move coal from the extraction location to ROM stockpiles, with the balance yet to be determined. Conveyors generally provide for more efficient transport of coal, but are less flexible and cannot be readily re-routed and hence, an optimal combination of trucks and conveyors is being sought. Further detail on the selection and capacity of the equipment and plant is outlined in Section 2.11.

2.5 Capital Investment

Capital investment for the life of the Mine is expected to total $21.5 billion. Estimates undertaken have indicated that $5.818 billion will be spent in the years preceding 2022, with the remaining $15.6 billion spent over the years of operation for replacement equipment (Runge Limited 2011). This estimate excludes the capital cost of power and water. The capital investment program over the life of the Mine is outlined in Figure 2-5. Further detail on capital investment is provided in Volume 4 Appendix H Economic Assessment.

Figure 2-5 Total Capital Investment over the Life of the Project (Mine)



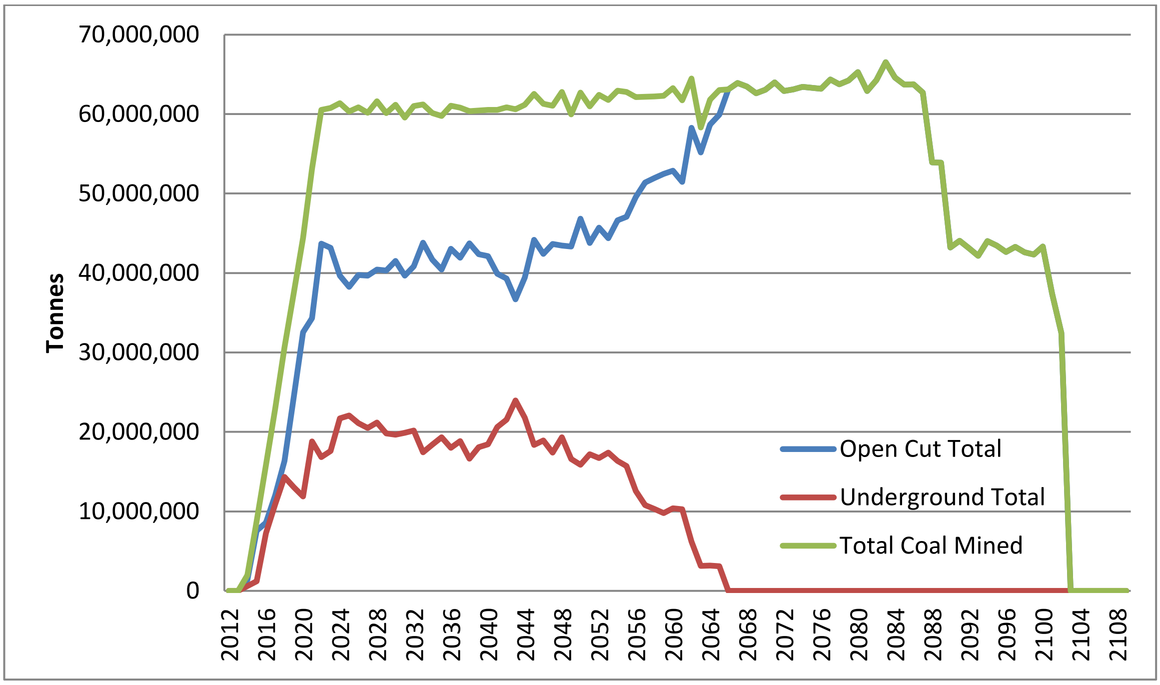
Source: Runge Limited 2011

2.6 Production Schedule

The Mine plan is based on achieving the production objective of 60 Mtpa (product) as quickly as possible and then maintaining a relatively steady rate of production over the life of the mine. Balance has also been sought between higher and lower ash coals such that coal can be blended to produce an overall ash content of no greater than 25 per cent while minimising washing requirements.

Figure 2-6 outlines the coal production schedule of open cut ROM, underground ROM and total product tonnes for the operational life of 90 years, 2014 to 2103. The operational life will be followed by a period of approximately seven years for decommissioning and rehabilitation, finishing in 2110. The production schedule is detailed in Table 2-9 and in Section 2.11.

Figure 2-6 Coal Production (product coal) by Source Mine



Source: Runge Limited 2011
Note that 2013 aligns with Year 1 of coal production

Table 2-8 Combined Mine product Coal Schedule

Period (years)	ROM Coal Mt (16 % Total Moisture)			Product Coal Mt (18 % Total Moisture)
	Open Cut	Underground	Total	Total
2014	1.4	0.6	2.0	1.9
2015	7.6	1.2	8.8	8.7
2016	8.6	7.2	15.8	15.9
2017	12.0	10.9	23.0	23.2
2018-2027	351.8	177.8	529.7	523.8
2028-2037	413.7	192.7	606.4	598.5
2038-2047	413.8	195.7	609.4	600.2
2048-2057	462.2	158.5	620.7	598.7
2058-2067	567.8	56.4	624.2	594.7
2068-2077	633.5	-	633.5	600.3
2078-2087	641.7	-	641.7	600.2

Period (years)	ROM Coal Mt (16 % Total Moisture)			Product Coal Mt (18 % Total Moisture)
	Open Cut	Underground	Total	Total
2088-2110*	651.9	-	651.9	606.0
Total Life of Mine	4,165.9	801.0	4,967.0	4,772.1

Source: Runge Limited 2011

Note: * Production ceases in 2103 a further period of decommissioning to 2110

Table 2-9 and Table 2-10 outline the quantities of coal and waste that will be moved over the life of the Project (Mine), from the open cut and underground mining respectively. In order to maintain the target throughout the life of the Project (Mine), the annual production levels from the open cut will increase from approximately 40 (product) to 60 Mt (product) when the underground mines are depleted in 2066. Waste quantities are measured as bank cubic metres (bcm) which is the volume of waste in-situ, that is, prior to excavation.

Table 2-9 Open Cut Scheduled Quantities

	Dragline Prime	Pre-strip	Inter-burden	Total Prime Waste	Coal Mining
Period (Years)	**Mbcm**	**Mbcm**	**Mbcm**	**Mbcm**	**MROMt (ROM)**
2013	-	21	-	21	-
2014	-	56	1	57	1
2015	-	84	5	89	8
2016	10	112	8	130	9
2017	19	126	12	157	12
2018	19	126	17	161	16
2019	19	126	33	178	24
2020	20	140	41	201	33
2021	31	153	36	220	34
2022	40	153	38	232	44
2023	40	153	40	234	43
2024	40	153	38	232	40
2025	40	153	35	229	38
2026	40	153	38	232	40
2027	51	153	40	244	40
2028-2037	452	1,591	309	2,351	372
2038-2047	548	1,744	312	2,604	456

	Dragline Prime	Pre-strip	Inter-burden	Total Prime Waste	Coal Mining
Period (Years)	**Mbcm**	**Mbcm**	**Mbcm**	**Mbcm**	**MROMt (ROM)**
2048-2057	477	1,535	244	2,256	462
2058-2067	538	2,093	315	2,945	568
2068-2077	717	2,358	328	3,404	633
2078-2087	702	2,254	260	3,217	642
2088-2097	529	1,674	176	2,379	454
2098-2110	254	837	68	1,158	198
Total	4,589	15,949	2,394	22,932	4,166

Source: Runge Limited 2011

Table 2-10 Underground Mining Schedule (Mt ROM)

	Northern UG		Central UG		Southern UG		Total UG		
Years	**AB1 Seam**	**D1 Seam**	**AB1 Seam**	**D1 Seam**	**AB1 Seam**	**D1 Seam**	**AB1 Seam**	**D1 Seam**	**Total**
2013	-	-	-	-	-	-	-	-	-
2014	0.6	-	-	-	-	-	0.6	-	0.6
2015	0.8		0.4	-	-	-	1.2	-	1.2
2016	6.2	0.4	0.7	-	-	-	6.9	0.4	7.2
2017	6.8	0.4	3.7	-	-	-	10.5	0.4	10.9
2018	7.5	0.4	6.5	-	-	-	13.9	0.4	14.3
2019	6.4	0.4	5.9	0.4	-	-	12.3	0.8	13.1
2020	5.9	0.4	5.3	0.4	-	-	11.1	0.8	11.9
2021	6.3	5.7	6.4	0.4	-	-	12.6	6.2	18.8
2022	5.6	5.0	5.8	0.4	-	-	11.4	5.4	16.8
2023	5.7	6.4	5.1	0.4	-	-	10.8	6.8	17.6
2024	6.5	5.1	5.2	4.8	-	-	11.7	10.0	21.7
2025	5.3	5.8	5.8	5.1	-	-	11.1	10.9	22.1
2026	6.1	4.6	5.7	4.6	-	-	11.9	9.2	21.1
2027	5.7	5.3	5.1	4.3	-	-	10.8	9.6	20.5
2028-2037	51.8	47.3	47.8	45.8	-	-	99.6	93.1	192.7
2038-2047	30.6	43.7	46.4	38.7	34.4	1.8	111.4	84.3	195.7

	Northern UG		Central UG		Southern UG		Total UG		
Years	**AB1 Seam**	**D1 Seam**	**AB1 Seam**	**D1 Seam**	**AB1 Seam**	**D1 Seam**	**AB1 Seam**	**D1 Seam**	**Total**
2048-2057	-	35.7	1.6	38.6	38.0	44.6	39.6	118.9	158.5
2058-2067	-	16.2	-	14.3	-	25.9	-	56.4	56.4
Total	157.8	182.8	157.4	158.3	72.4	72.3	387.6	413.4	801.0

Source: Runge Limited 2011

The Project (Mine) life cycle consists of preconstruction, construction, operation and closure and decommissioning. Rehabilitation is progressive throughout the mining activity. The construction and early operation stages overlap so that production can commence as soon as possible.

Table 2-11 provides an overview of the Project (Mine) Stage Plan. Figure 2-8 to Figure 2-17 show selected stages of the construction and operation stages.

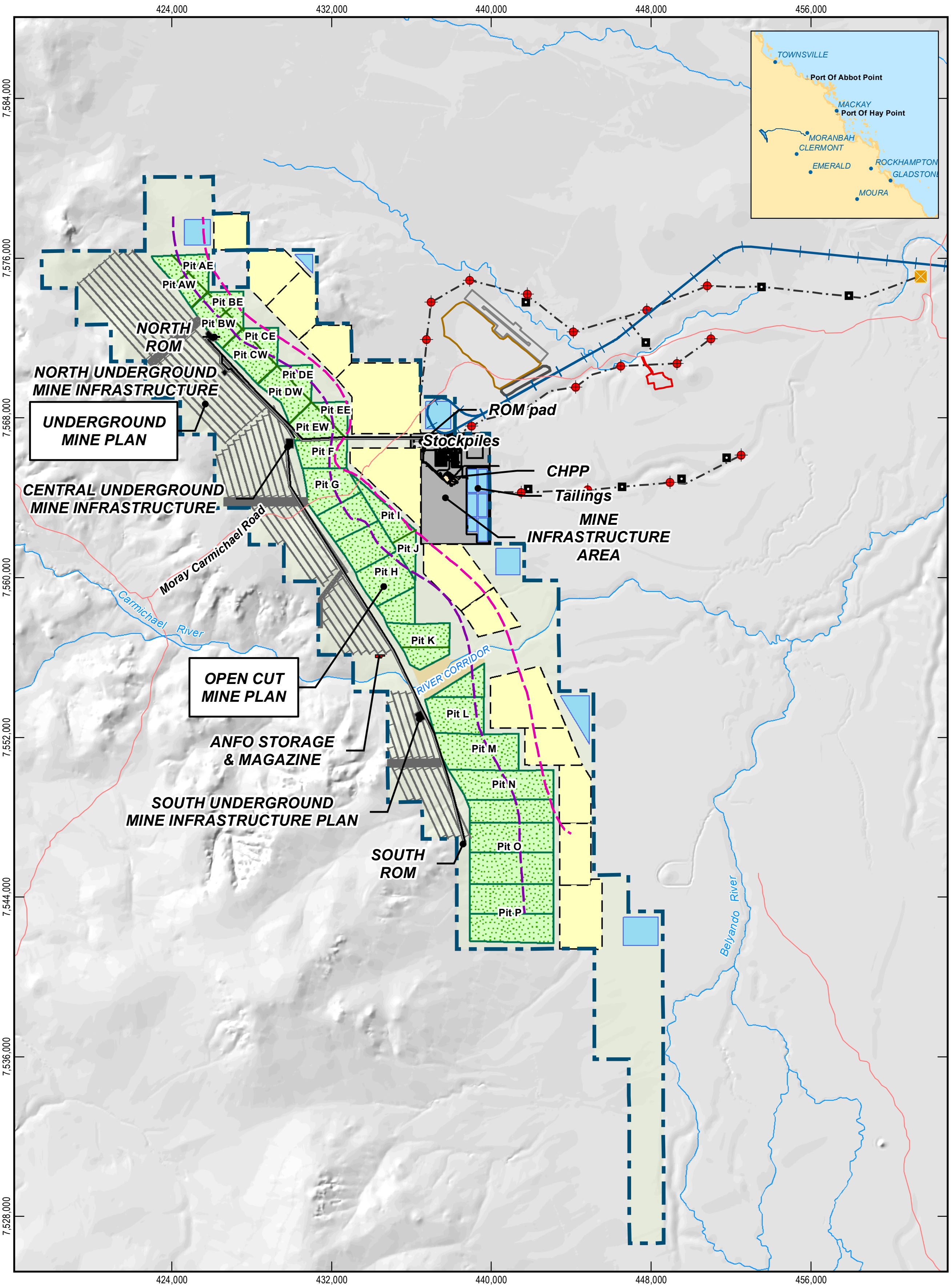
Table 2-11 Project (Mine) Stage Plan Overview

Year(s)	Activities
2013	Prepare works for Mine onsite and offsite infrastructure Undertake redevelopment of Moray Carmichael Road from Gregory Development Road to Mine site Commence construction of workers accommodation village and access road from Moray Carmichael Road Commence construction of open cut, northern underground and central underground mines including overland conveyors and central ROM facilities Commence construction of permanent airport Commence construction of power, water supply and other external services Commence excavation of G Pit and J Pit box-cut (pits nomenclature is illustrative and may change) Refer Figure 2-7
2014	Continue construction of workers accommodation village Continue on mine infrastructure and associated infrastructure Produce first coal from northern underground and open cut Complete G Pit box-cut Refer Figure 2-9
2015	Complete on mine infrastructure and associated infrastructure Produce first coal from central underground Commence E Pit (west) and E Pit highwall diversion drain Refer Figure 2-10

Year(s)	Activities
2016	Complete G Pit Commence C Pit (west) Commence Dragline 1 in G Pit Refer Figure 2-11
2017	Construct Northern ROM and overland conveyor Commence A Pit (west) and A Pit dump diversion drain Complete tailings dam of approximately 130 Mm^3 Refer Figure 2-12
2018 – 2027	2018 – Complete wash plant and commence coal washing: utilise tailings cells until J Pit inventory is mined out 2020 – Mine out I Pit and commence rehabilitation 2021 – Dragline 2 commences in both C and E Pits 2027 – Commence H Pit and construct G Pit and H Pit highwall diversion drains 2027 – Dragline 3 commences in A Pit 2027 – Rehabilitation planning commences Refer Figure 2-13
2028 – 2037	2029 – Commence B Pit (west) 2033 – Commence D Pit (west) 2033 – Construct low low-level crossing of Carmichael River 2034 – Commence M Pit 2035 – Commence A Pit (east) 2035 – Rehabilitate A Pit (west) and profile spoil dump and west void 2036 – Rehabilitate C Pit (west) and spoil dump 2037 – Commence N Pit 2037 – Commence Southern Underground construction 2037 – Construct permanent G Pit and H Pit highwall diversion drains Refer Figure 2-14

Year(s)	Activities
2038 – 2047	2038 – Construct Carmichael River southern flood protection levee 2038 – Construct southern ROM 2039 – Commence production southern underground mine 2040 – Commence G Pit rehabilitation 2041 – Commence A Pit (west) rehabilitation 2041 – Commence C Pit (east) production 2044 – Dragline introduced into M Pit 2045 – Commence L Pit 2047 – Complete N Pit box-cut Refer Figure 2-15
2048 – 2057	No new pits commenced
2058 – 2067	2058 – Duplicate southern ROM capacity 2060 – Commence P Pit 2061 – J Pit rejects dam full. Move to G Pit and rehabilitate J Pit 2062 – Completion of northern and central underground mines 2062 – Rehabilitate northern and central underground Infrastructure and overland conveyor routes 2065 – Completion of southern underground mine 2065 – Rehabilitate southern underground infrastructure and overland conveyor route 2066 – Construct Carmichael River northern flood protection levee 2067 – Commence K Pit and O Pit Refer Figure 2-16
2068 – 2077	2070 – Commence B Pit (east) 2076 – Decommission Northern ROM
2077 – 2087	2084 – Complete north pit area (A Pit to E Pit) and commence final rehabilitation on mine site. 2086 – Complete mining north of Carmichael River and commence final rehabilitation of active pits (mine infrastructure and haul road remain).
2088 – 2110	2102 – Complete mining in M Pit, N Pit and O Pits, to toes of out-of-pit spoil dumps. 2102 to 2110 – Rehabilitate mine site Refer Figure 2-17

Source: Runge Limited 2011



LEGEND

Local Road	Rail (West)	Mine (Offsite)	Airport Location
River / Watercourse	Mine (Onsite)	Borehole	Rail Siding
AB1 Cropline	Open Cut Blocks	Storage Site (Instream)	Industrial Area
D1 Cropline	Out of Pit Waste Dumps	Storage Facility (Offstream)	Workers Accommodation Village
Overland Conveyors	Water Management Dams	Pipeline Network	

1:275,000 (at A4)

0 2 4 6 8

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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Carmichael Coal Mine and Rail Project

Job Number 41-25215
Revision C
Date 16-11-2012

General Mine Layout

Figure 2-7

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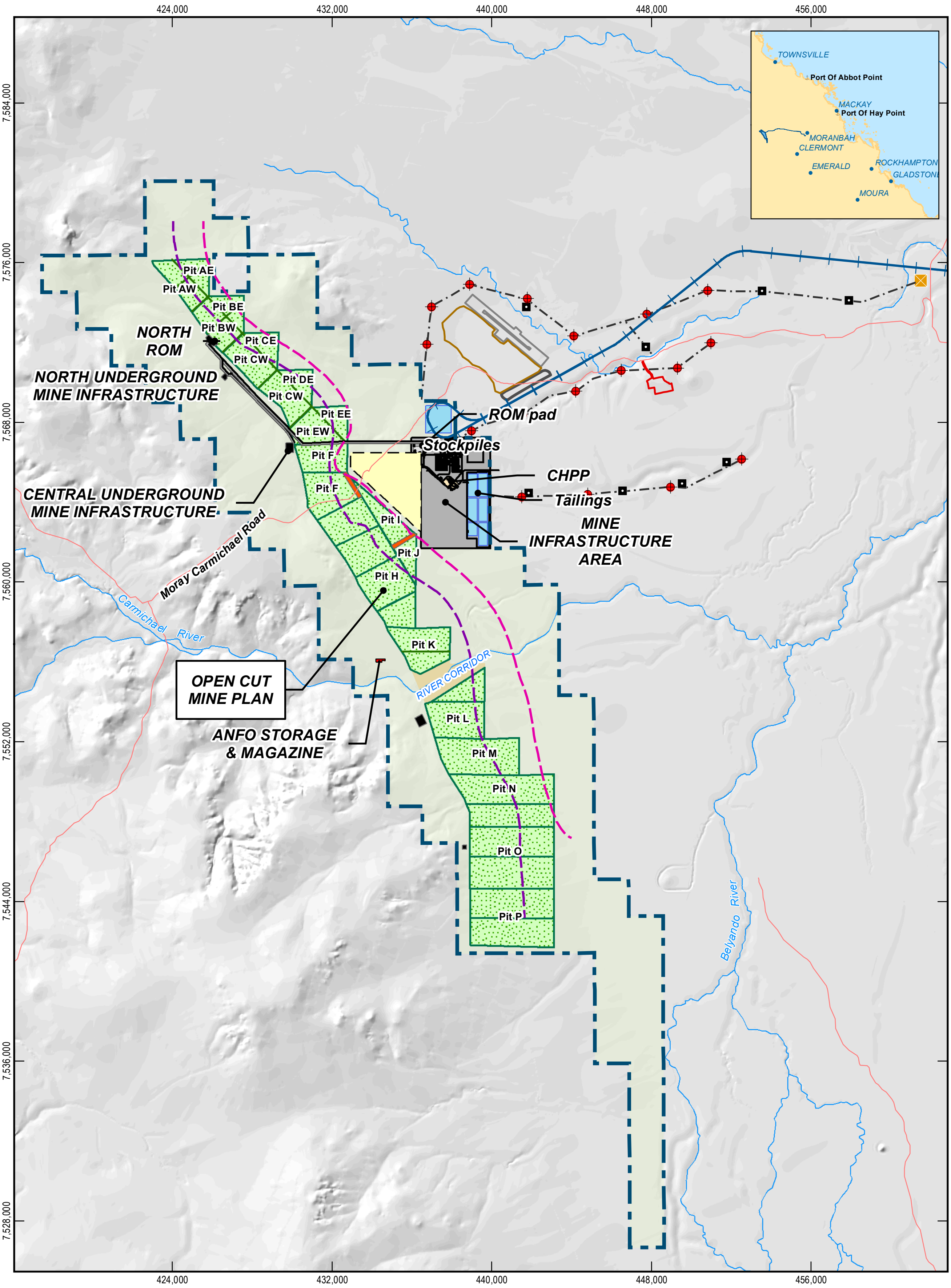

LEGEND

Local Road	Rail (West)	Open Cut Blocks	Mine (Offsite)	Airport Location
River / Watercourse	Mine (Onsite)	Out of Pit Waste Dumps	Borehole	Rail Siding
AB1 Cropline		Water Management Dams	Storage Site (Instream)	Industrial Area
D1 Cropline		Active Mining Area	Storage Facility (Offstream)	Workers Accommodation Village
Overland Conveyors			Pipeline Network	

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Mine Layout Progress Plot - Year 2013

Figure 2-8

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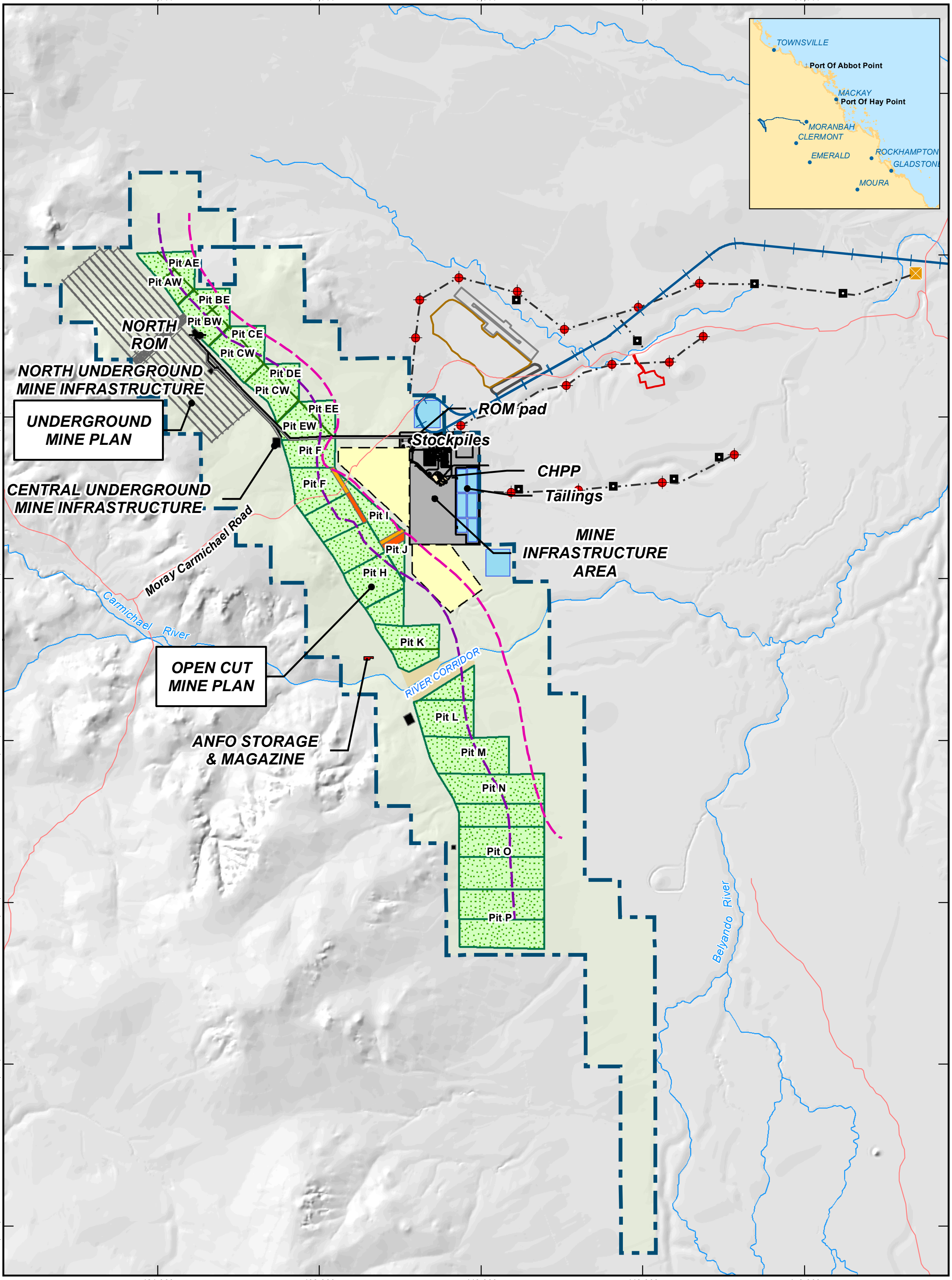

LEGEND

Local Road	Rail (West)	Open Cut Blocks	Mine (Offsite)	Airport Location
River / Watercourse	Mine (Onsite)	Out of Pit Waste Dumps	Borehole	Rail Siding
AB1 Cropline		Water Management Dams	Storage Site (Instream)	Industrial Area
D1 Cropline		Active Mining Area	Storage Facility (Offstream)	Workers Accommodation Village
Overland Conveyors		Disturbed Mining Area	Pipeline Network	

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Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
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Mine Layout Progress Plot - Year 2014

Figure 2-9

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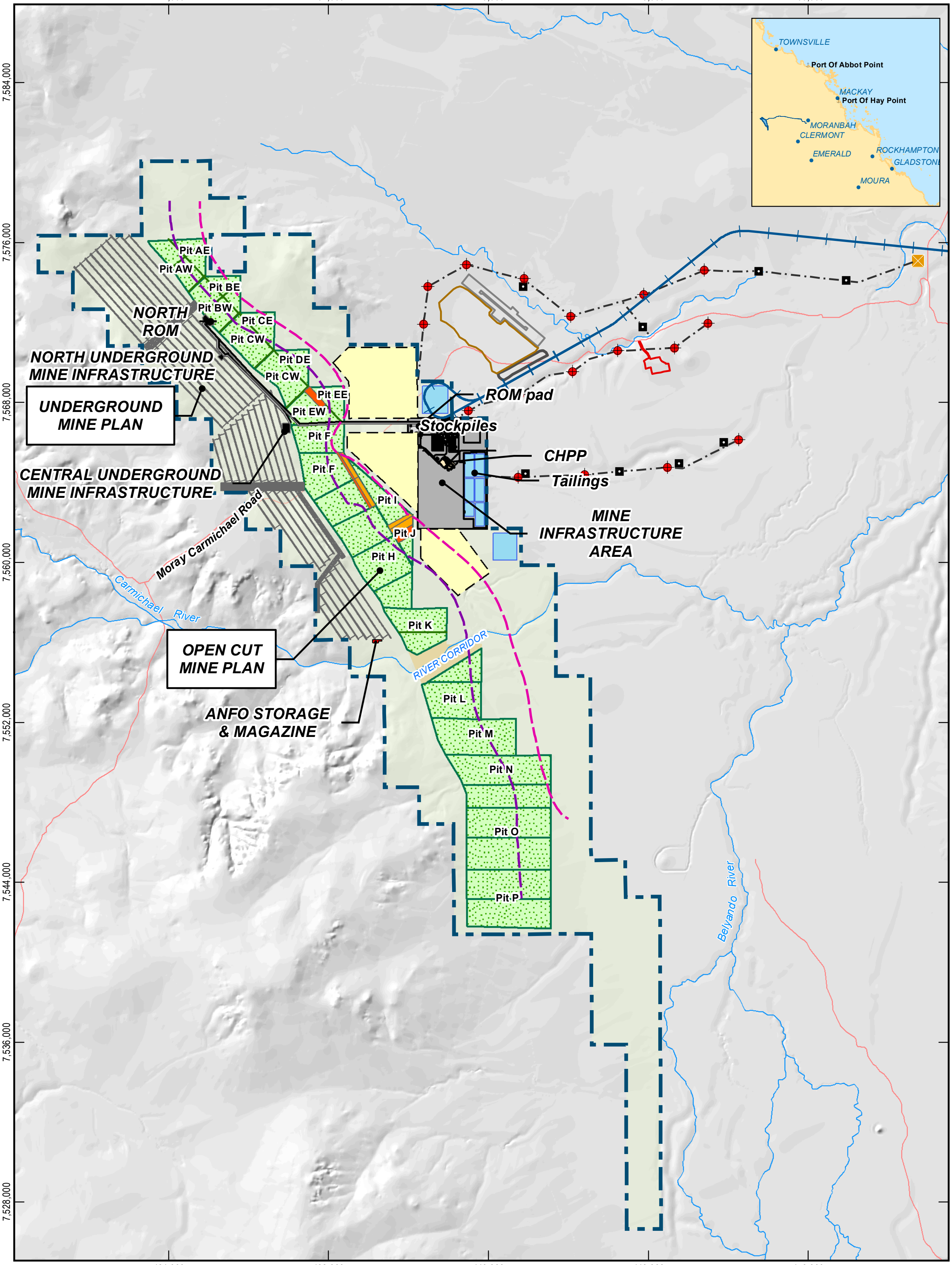

LEGEND

Local Road	Rail (West)	Open Cut Blocks	Mine (Offsite)	Airport Location
River / Watercourse	Mine (Onsite)	Out of Pit Waste Dumps	Borehole	Rail Siding
AB1 Cropline		Water Management Dams	Storage Site (Instream)	Industrial Area
D1 Cropline		Active Mining Area	Storage Facility (Offstream)	Workers Accommodation Village
Overland Conveyors		Disturbed Mining Area	Pipeline Network	

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Mine Layout Progress Plot - Year 2015

Figure 2-10

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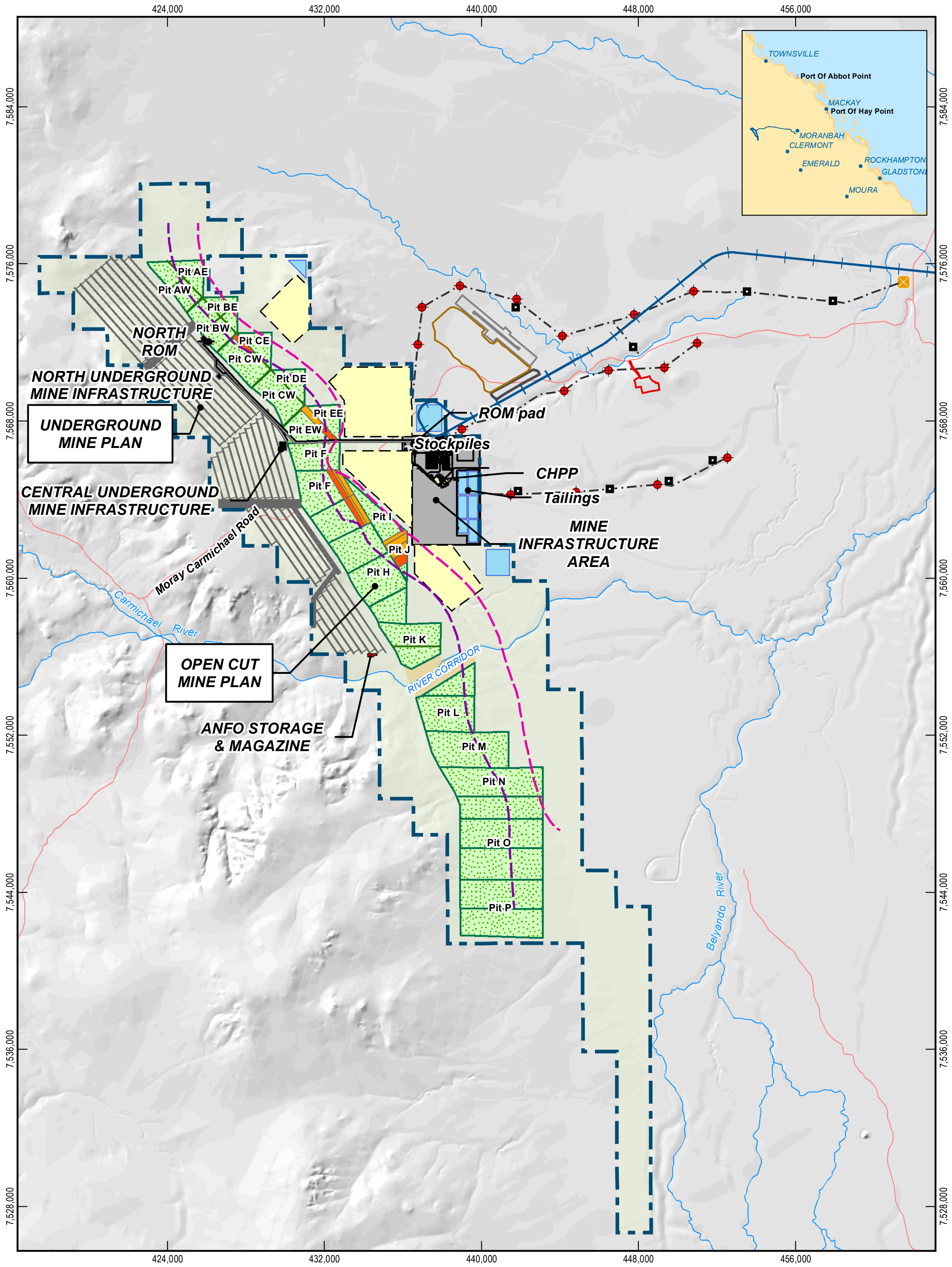

LEGEND

- Local Road
- River / Watercourse
- AB1 Cropline
- D1 Cropline
- Overland Conveyors
- Rail (West)
- Mine (Onsite)
- Open Cut Blocks
- Out of Pit Waste Dumps
- Water Management Dams
- Active Mining Area
- Disturbed Mining Area
- Mine (Offsite)
- Borehole
- Storage Site (Instream)
- Storage Facility (Offstream)
- Pipeline Network
- Airport Location
- Rail Siding
- Industrial Area
- Workers Accommodation Village

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Mine Layout Progress Plot - Year 2016

Figure 2-11

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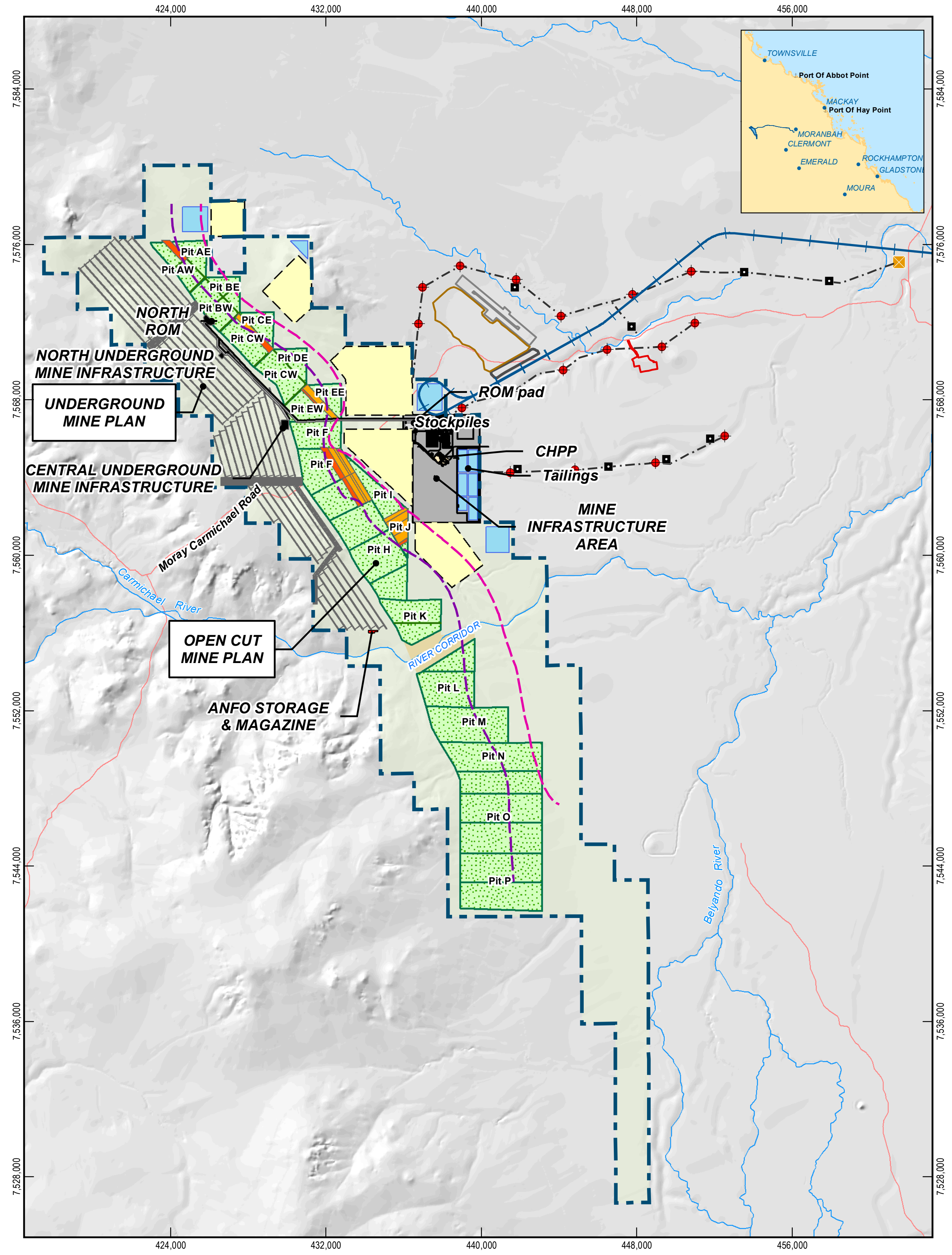

LEGEND

- Local Road
- River / Watercourse
- AB1 Cropline
- D1 Cropline
- Overland Conveyors
- Rail (West)
- Mine (Onsite)
- Open Cut Blocks
- Out of Pit Waste Dumps
- Water Management Dams
- Active Mining Area
- Disturbed Mining Area
- Mine (Offsite)
- Borehole
- Storage Site (Instream)
- Storage Facility (Offstream)
- Pipeline Network
- Airport Location
- Rail Siding
- Industrial Area
- Workers Accommodation Village

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Kilometres

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Mine Layout Progress Plot - Year 2017

Figure 2-12

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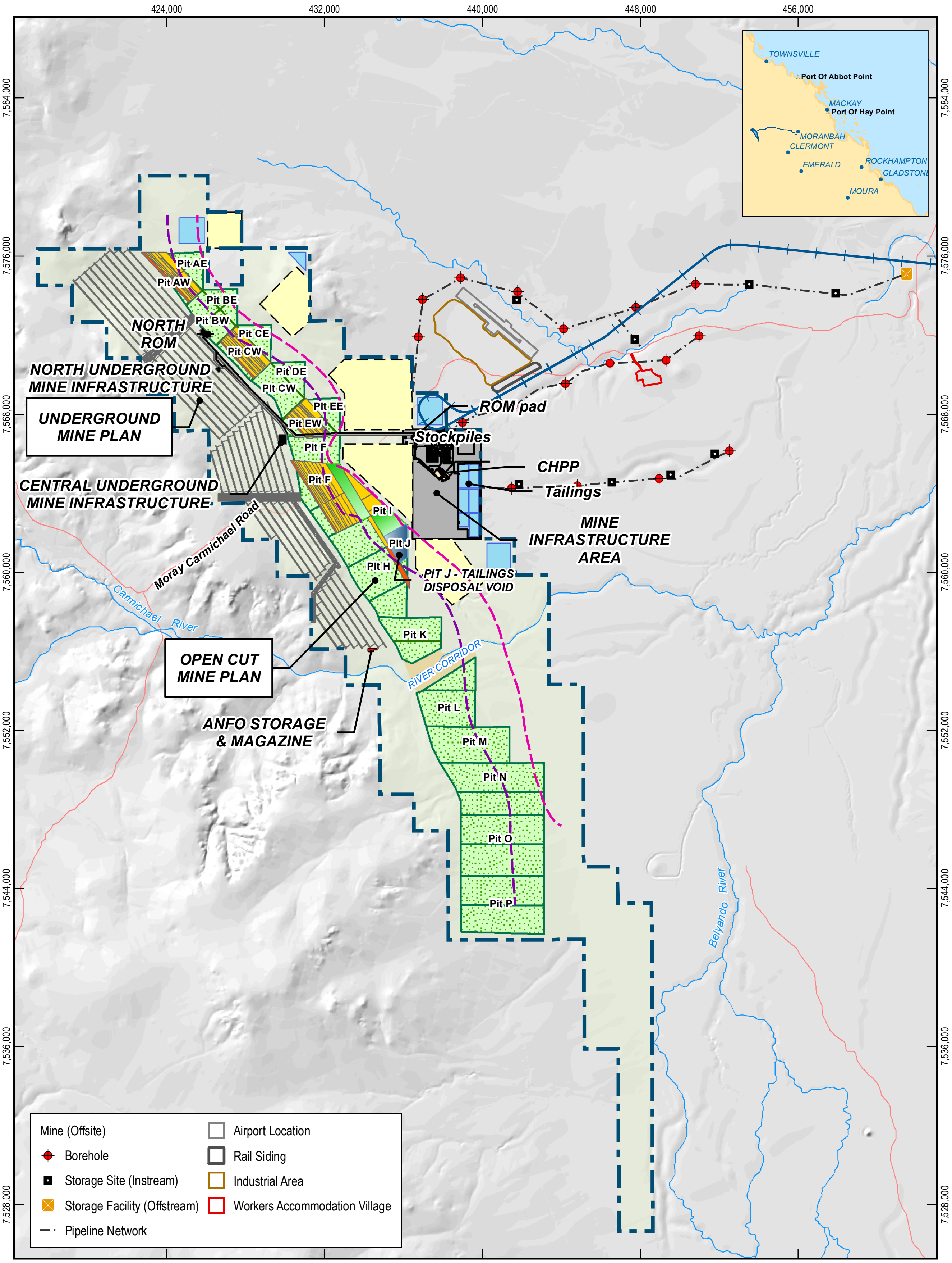

LEGEND

Local Road	Rail (West)	Open Cut Blocks	Area Under Rehabilitation
River / Watercourse	Mine (Onsite)	Out of Pit Waste Dumps	Active Mining Area
AB1 Cropline		Water Management Dams	Disturbed Mining Area
D1 Cropline			
Overland Conveyors			

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0 2 4 6 8

Kilometres

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Mine Layout Progress Plot - Year 2027

Figure 2-13

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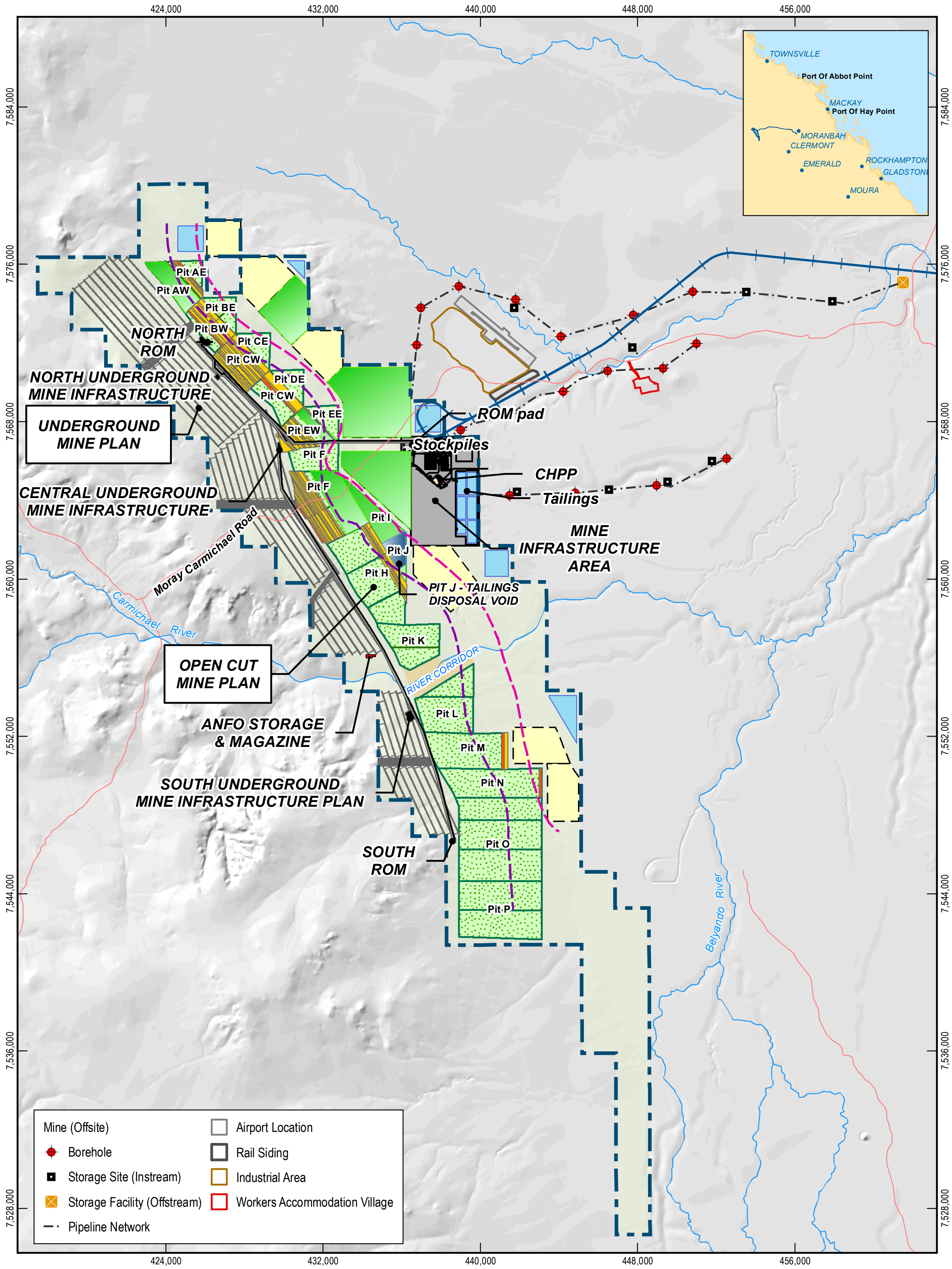

LEGEND

- Local Road
- River / Watercourse
- AB1 Cropline
- D1 Cropline
- Overland Conveyors
- Rail (West)
- Mine (Onsite)
- Open Cut Blocks
- Out of Pit Waste Dumps
- Water Management Dams
- Area Under Rehabilitation
- Active Mining Area
- Disturbed Mining Area

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1:275,000 (at A4)

0 2 4 6 8

Kilometres

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Carmichael Coal Mine and Rail Project

Job Number	41-25215
Revision	C
Date	16-11-2012

Mine Layout Progress Plot - Year 2037

Figure 2-14

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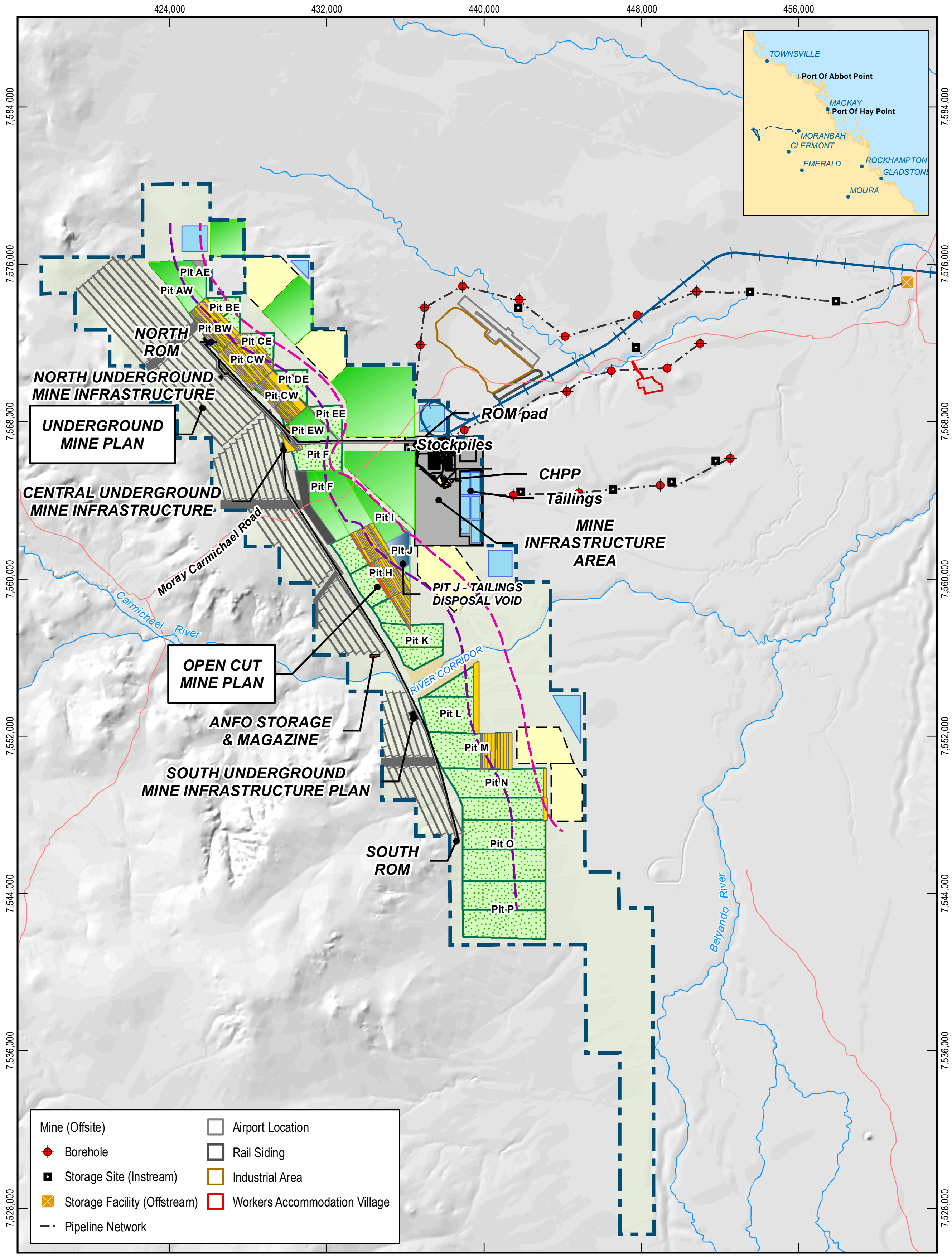
Data Source: GA: Road, River / Watercourse (2007); DME: EPC1690 (2010), EPC1080 (2011); Adani: Mine Layout / Infrastructure (2012), Alignment Opt9 Rev3 (2012); Gassman/Hyder: Mine (Offsite) (2012). Created by: JVC



LEGEND

River / Watercourse	Rail (West)	Open Cut Blocks	Active Mining Area
Local Road	Mine (Onsite)	Out of Pit Waste Dumps	Disturbed Mining Area
AB1 Cropline		Water Management Dams	Void
D1 Cropline		Area Under Rehabilitation	Remediated Void
Overland Conveyors			

1:275,000 (at A4)

0 2 4 6 8

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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GHD adani

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project

Job Number 41-25215
Revision C
Date 16-11-2012

Mine Layout Progress Plot - Year 2047

Figure 2-15

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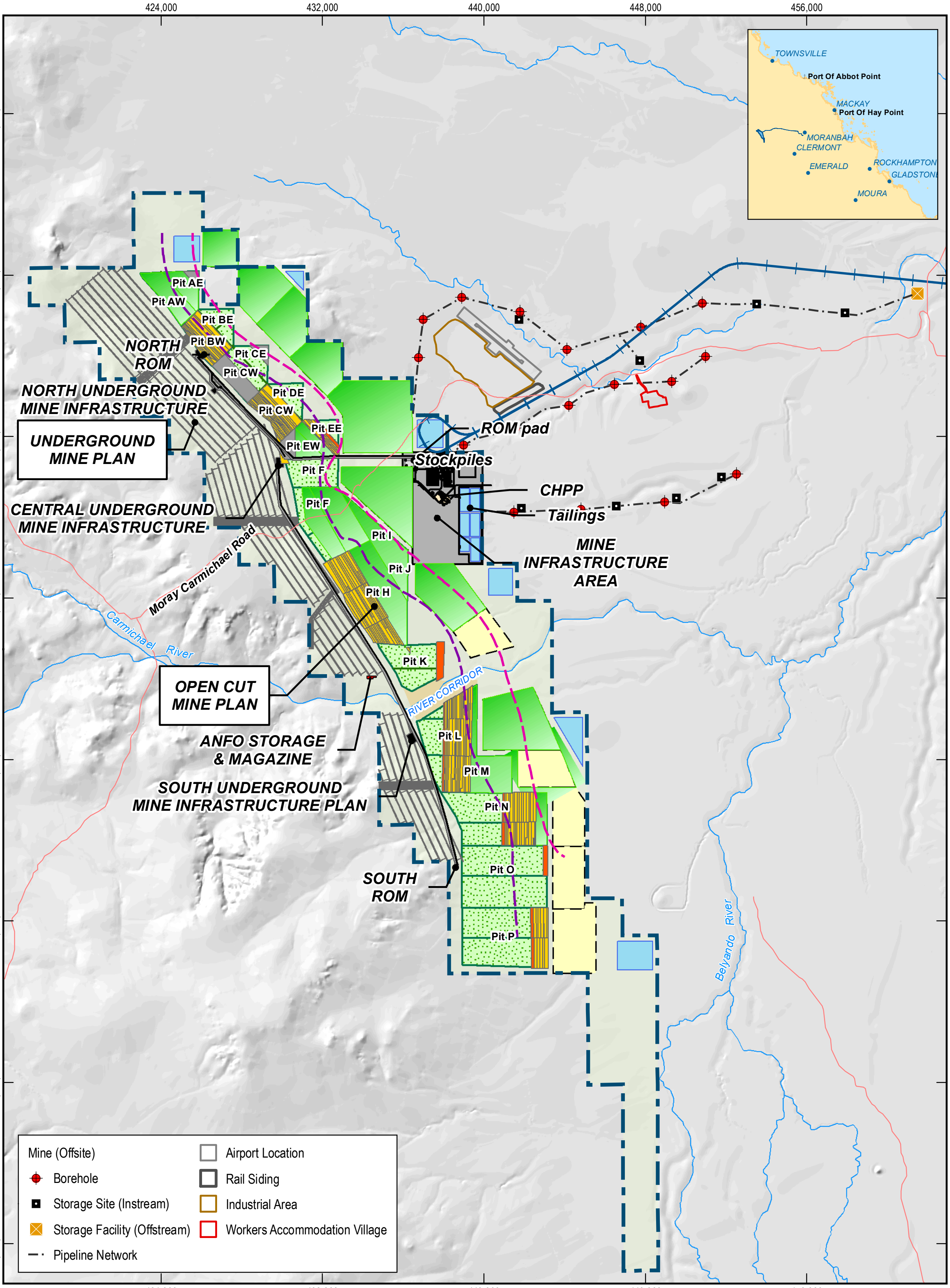
Data Source: GA: Road, River / Watercourse (2007); DME: EPC1690 (2010), EPC1080 (2011); Adani: Mine Layout / Infrastructure (2012), Alignment Opt9 Rev3 (2012); Gassman/Hyder: Mine (Offsite) (2012). Created by: JVC



LEGEND

Local Road	Rail (West)	Open Cut Blocks	Active Mining Area
River / Watercourse	Mine (Onsite)	Out of Pit Waste Dumps	Disturbed Mining Area
AB1 Cropline		Water Management Dams	Void
D1 Cropline		Area Under Rehabilitation	Remediated Void
Overland Conveyors			

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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

Job Number 41-25215
Revision C
Date 16-11-2012

Mine Layout Progress Plot - Year 2067

Figure 2-16

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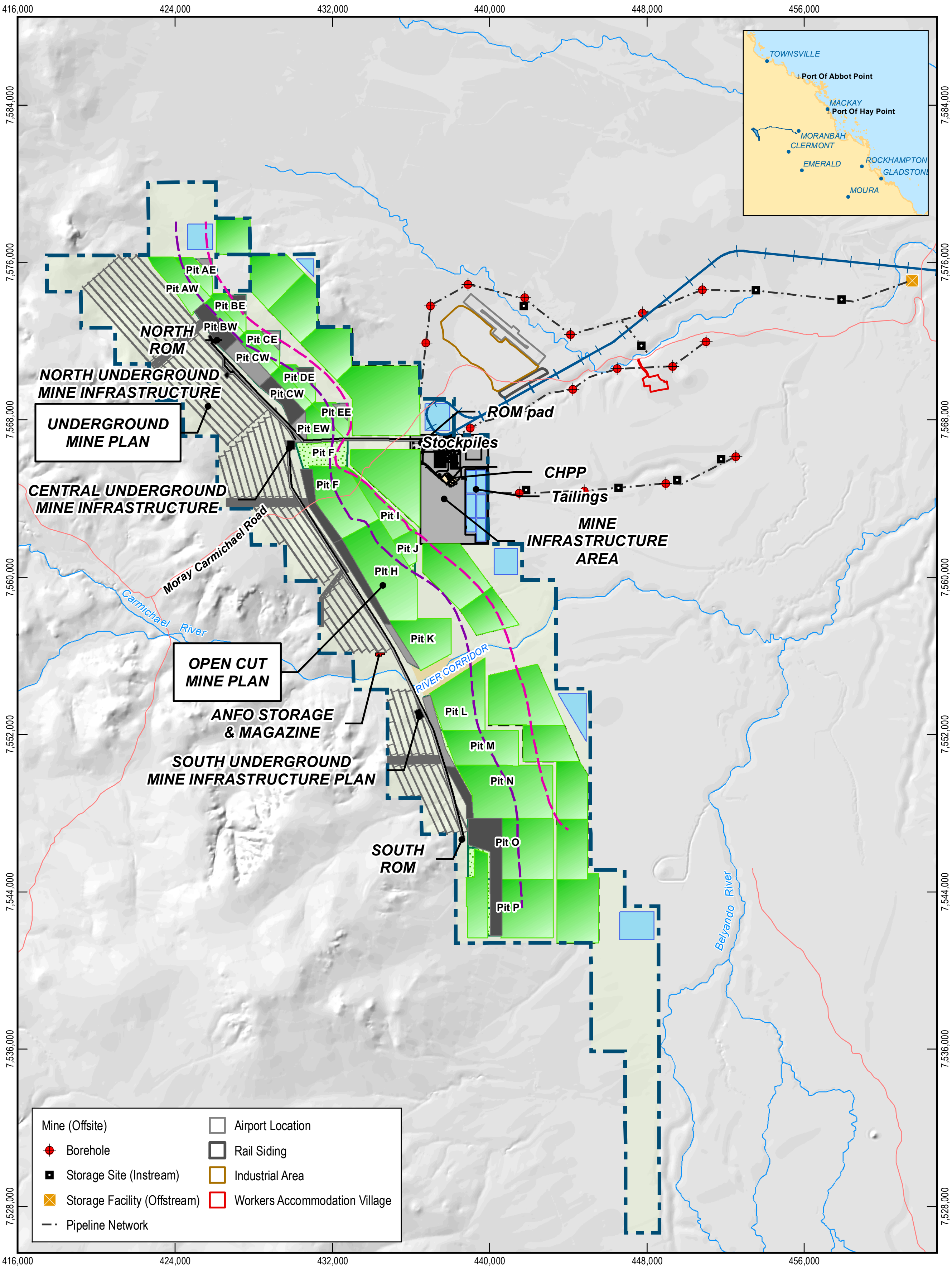
Data Source: GA: Road, River / Watercourse (2007); DME: EPC1690 (2010), EPC1080 (2011); Adani: Mine Layout / Infrastructure (2012), Alignment Opt9 Rev3 (2012); Gassman/Hyder: Mine (Offsite) (2012). Created by: JVC



LEGEND

Local Road	Rail (West)	Open Cut Blocks	Active Mining Area
River / Watercourse	Mine (Onsite)	Out of Pit Waste Dumps	Disturbed Mining Area
AB1 Cropline		Water Management Dams	Void
D1 Cropline		Area Under Rehabilitation	Remediated Void
Overland Conveyors			

1:275,000 (at A4)

0 2 4 6 8

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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GHD adani

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project

Job Number 41-25215
Revision C
Date 16-11-2012

Mine Layout Progress Plot - Year 2103 Figure 2-17

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Data Source: GA: Road, River / Watercourse (2007); DME: EPC1690 (2010), EPC1080 (2011); Adani: Mine Layout / Infrastructure (2012), Alignment Opt9 Rev3 (2012); Gassman/Hyder: Mine (Offsite) (2012). Created by: JVC

2.7 Mine Infrastructure

2.7.1 Main Mine Infrastructure Area

A central mine infrastructure area (MIA) will be established as shown on Figure 2-18 as the main service area for the proposed Mine. This MIA will include:

- Raw and product coal stockpiles (see Section 2.8.3).
- Coal handling and processing plant (see Section 2.8.4)
- Rail load out facilities and rail loop. Two by 40 Mtpa capacity load out facilities will be installed.
- Raw water storage dam. Capacity of this dam is expected to be 20 GL, with additional dedicated capacity for fire water to be determined during the detailed hazard and risk assessment.
- Mine vehicle and light vehicle maintenance facilities, including a workshop, parking area, wash down stations and tyre replacement bays. All maintenance facilities will be contained such that any oil leaks or spills are captured. The vehicle wash facilities will allow for capture and recirculation of water or return of water to the mine water system.
- Warehousing and storage facilities
- A dedicated waste storage area. This area will allow for segregation of waste types to promote reuse and recycling where possible and will also allow for the safe storage of any environmentally hazardous wastes such as oily wastes and waste oils.
- Diesel fuel storages for up to 5 ML of diesel and refuelling stations. Diesel storage, refuelling and related facilities will comply with AS 1940:2004 (storage and handling of flammable and combustible liquids)
- Oil storage. Oils will be stored in a secure, roofed and bunded area such that any spills or leaks are contained.
- Administration offices, training rooms and related facilities
- A bath-house, kitchen, mess and other worker amenities
- A potable water treatment plant to treat approximately 5 ML per day of potable water
- A sewage treatment plant to treat approximately 5 ML per day of sewage. The sewage treatment plant will not be required to treat any trade waste.
- Emergency muster area
- Emergency response equipment including a fire station and ambulance as well as mine rescue equipment
- First aid facilities
- Electrical switch yards and related equipment and reticulation to mine facilities
- A stormwater collection system. It is proposed that mine affected water, being water from coal stockpiles, the CHPP area and any other potentially dirty water areas will be collected and transferred to the nearest mine affected water dam. Clean water will be diverted around the MIA, and water from uncontaminated areas will be captured and drained to a sediment pond.

2.7.2 Underground Mine Infrastructure Areas

Three smaller MIAs will be established for each of the three proposed underground mining operations, adjacent to the mine access (see Figure 2-21). These will include:

- Small diesel storage facilities
- Offices and amenities, including bathhouse and kitchen/mess facilities
- Power and water services
- Ventilation systems
- Mine rescue facility
- Small potable water and sewage treatment plants treating approximately 2 ML per day each
- Clean and dirty stormwater management facilities, directing clean stormwater to sediment ponds and dirty stormwater to the nearest mine affected water dam
- Equipment storage and laydown
- Workshops. Only minor maintenance and repair of equipment will take place at these underground mine MIAs, with equipment transferred to the main MIA any major maintenance or repairs.

2.7.3 Other Infrastructure

Other surface infrastructure that will be required includes:

- Sediment dams and mine affected water dams. These are discussed further in Section 2.1.1.
- 66 kV and 11 kV electrical reticulation
- Raw water reticulation to mine facilities
- Overland coal conveyors
- Mine truck haul roads
- Light vehicle access roads including roads along the overland coal conveyors
- A bridge across the Carmichael River. This will provide for light and heavy vehicle access to the mine areas south of the Carmichael River, and also carry power, water and conveyors.
- Explosives magazine and preparation facility with security fencing and bunding. The current location is about 500 m to the north of the Carmichael River, on the western side of the mining lease, but this will be reviewed in detailed design as part of a detailed hazard and risk assessment.
- Levees and other water management structures at the Carmichael River (described in Section 2.12).

The underground mine surface access roads, ROM coal overland conveyors and mine surface facilities will be located above the barrier pillar between the open cut and underground mining areas. The precise location of this is subject to more detailed planning scheduling. The underground mine operations are connected to the MIA via an infrastructure corridor approximately 1 km wide located over F Pit.

2.8 Coal Handling and Processing

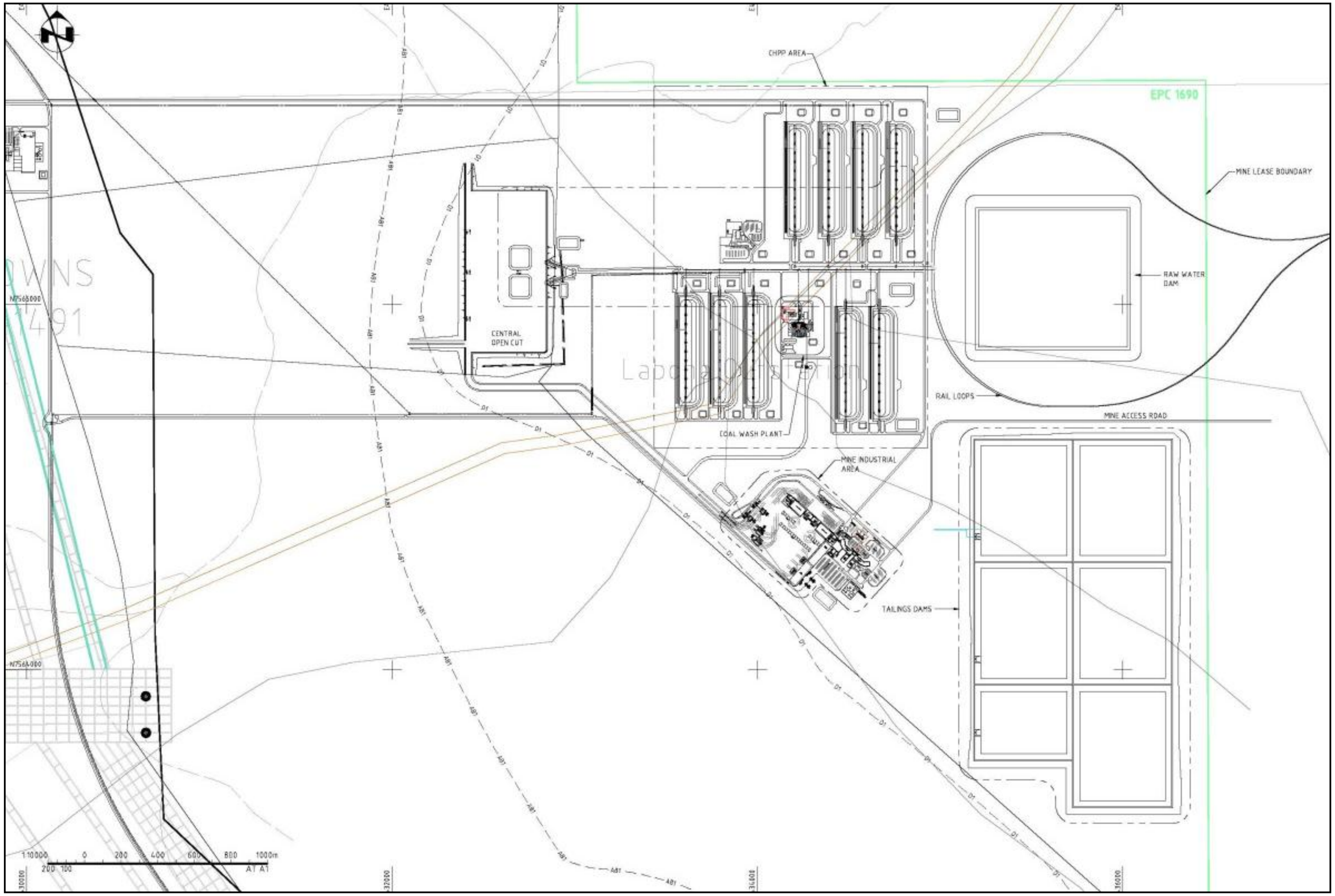
2.8.1 Overview

The following key components form part of the coal handling and processing system:

- 20 Mtpa capacity central open-cut ROM hopper, sizing station, and raw coal handling
- Separate ROM facilities for open cut and underground mining operations having a total capacity of 80 Mtpa (to deliver 60 Mtpa product coal an 80 Mtpa ROM facility is required):
  - 60 Mtpa ROM capacity CHP facility and product coal stockpiles for the open cut coal operation
  - 20 Mtpa CHP facility and product coal stockpiles for the underground coal mine operation
- 20 Mtpa capacity central open-cut ROM hopper, sizing station, and raw coal handling
- Tailings co-disposal system including tailings impoundments for 10 to 12 years operations (after this time fine material will be placed in a below surface open cut void)
- Washed product coal stockpiles and reclaim systems
- CHPP industrial area, offices, and amenities for CHPP maintenance and operations
- Clean and dirty water management structures
- Environmental dam and other raw water storages
- 66 kV electrical reticulation to mine facilities
- Raw water reticulation to mine facilities
- Light vehicle access roads around the CHPP and MIA
- Heavy vehicle ramps and ROM dump pads at the dump stations

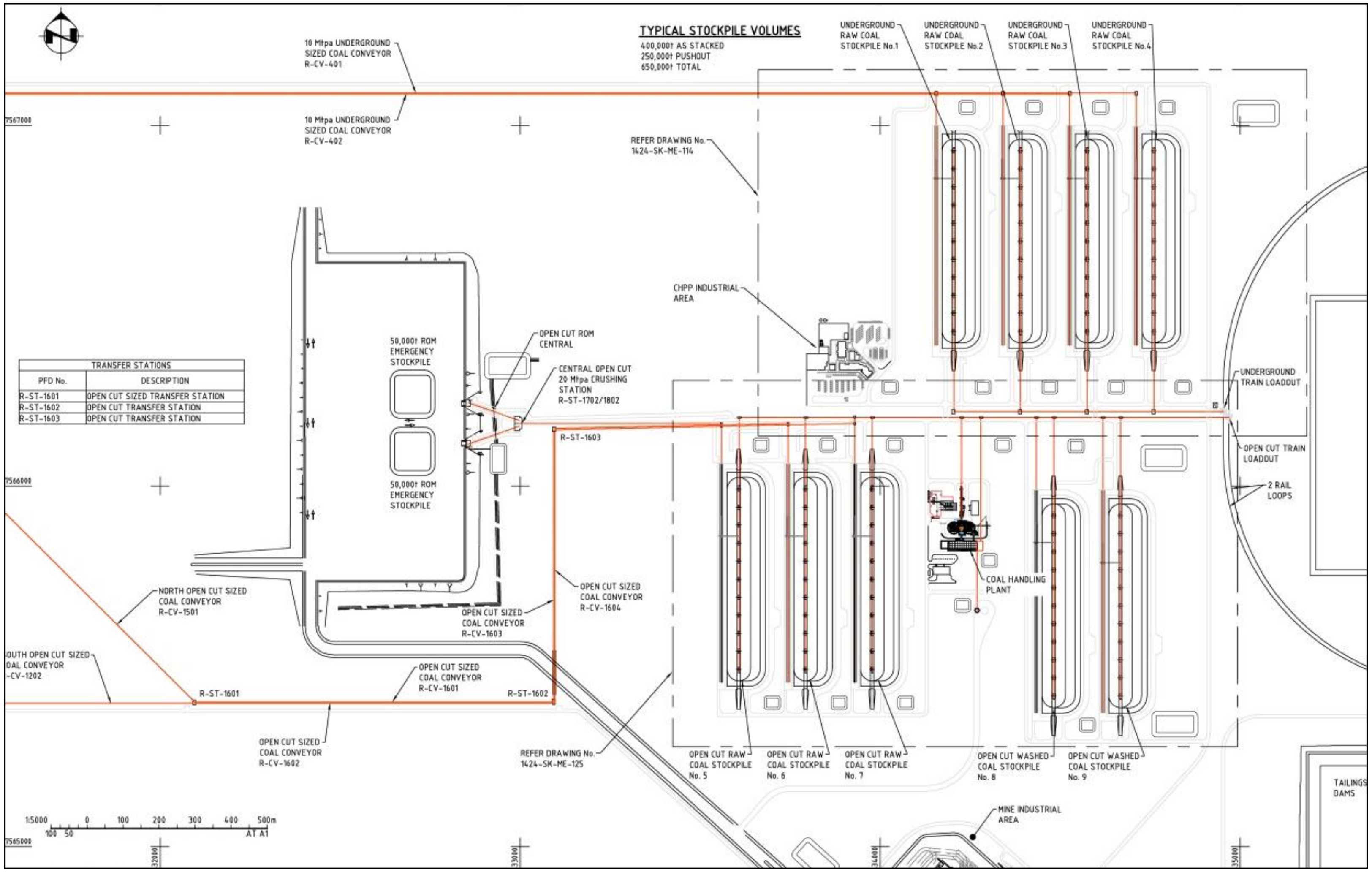
Figure 2-20 outlines the general arrangement of the open cut facility.

Figure 2-18 Mine Infrastructure Area Indicative Layout



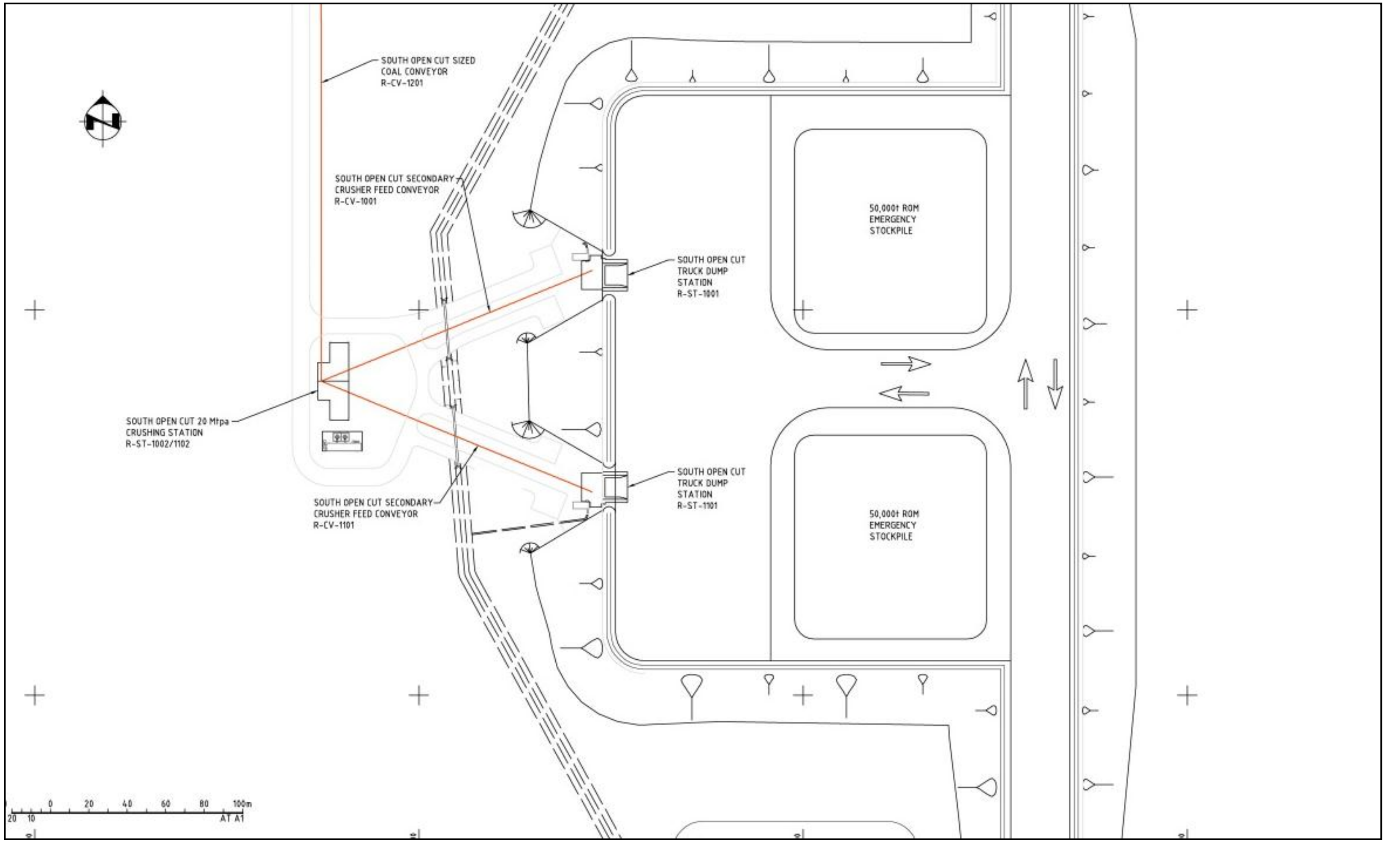
Source: Runge Limited (2011)

Figure 2-19 Main Infrastructure Area Indicative Layout of Stockpiles



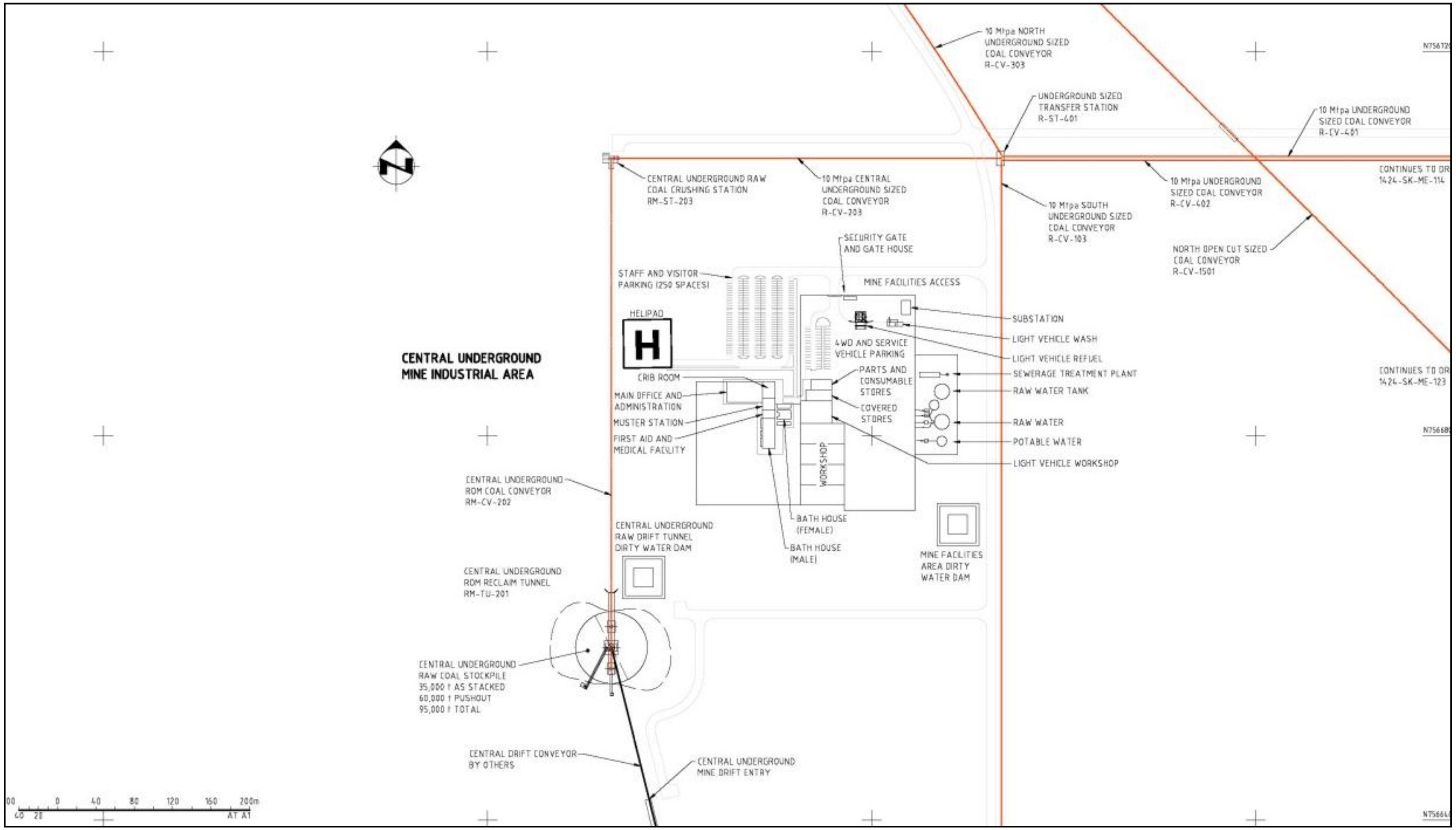
Source: Runge Limited (2011)

Figure 2-20 Open Cut Receival General Arrangement



Source: Runge Limited (2011)

Figure 2-21 Underground Mine Pit Top Infrastructure General Arrangement



Source: Runge Limited (2011)

2.8.1 Coal Receival and Initial Screening

Run of mine (ROM) coal receival areas will be provided for each of the three underground mines and for the northern, central and southern open cut areas, with the central open cut receival areas located at the main MIA. The underground receival areas will have a capacity of 10 Mtpa each and the open cut receival areas will have a capacity of 20 Mtpa each, although not all of the open cut receival areas will be in operation at the same time. ROM coal will be dumped directly into the hoppers or, if required a small ROM stockpile will be established.

From the hoppers, coal will pass through a series of crushers that will progressively reduce coal lumps to a nominal size of 50 mm or less. Oversize coal material will be rejected and returned to the crushers for resizing. Any material that is rejected from crushing will be disposed of by placement in overburden disposal areas.

After sizing, coal samples will be taken for testing. This is to ensure that coal quality is known and coal can be directed to the correct stockpile. Coal will then be transported from each of the receival areas to the main MIA via an overland conveyor.

2.8.2 Conveyors

A series of overland conveyors will convey raw coal from the various open cut and underground mine operations to the raw and product coal stockpiles located at the main MIA. All overland conveyors will consist of prefabricated modular ground mounted conveyor gantries which can be elevated as required to cross other infrastructure. As conveyors work most efficiently with minimal vertical and horizontal direction changes, grades to less than 2 per cent vertically and less than 0.5 per cent horizontally.

Subject to detailed design investigations into dust levels, conveyors are expected to be partially enclosed and will be roofed. Belt cleaning facilities and enclosure of any towers (where conveyors change direction) will also minimise dust and coal spillage from conveyors. Conveyors will also be fitted with heat and smoke detectors and fire suppression systems.

2.8.3 Stockpiles

Coal entering the main MIA will be directed to raw or product coal stockpiles, depending on the requirements for further processing. It is anticipated that coal from the underground mine will not require further processing and will be placed directly in product coal stockpiles while a proportion of coal from the open cut will also be placed directly in product coal stockpiles, and a portion directed to raw coal stockpiles for further processing.

Coal stacker/reclaimer systems will be used to form stockpiles and to remove coal for loadout.

Stockpiles will have a nominal 400,000 tonne capacity and dimensions of 700 m high, 60 m wide and 20 m high as formed by coal placed using the coal stacking system. It will be possible to use bulldozers to expand the capacity of each stockpile to 600,000 tonnes if required. Layout of stockpiles at the main MIA is shown in Figure 2-19.

Raw and product coal has the potential for spontaneous combustion, with the likelihood of spontaneous combustion increasing with the length of time that coal remains in a stockpile. Further testing will be undertaken prior to and throughout mining to understand the optimal stockpiling times for raw and product coal. A stockpile management system will then track the time in and time out of coal in each stockpile and ensure that coal does not remain in stockpiles long enough to present a risk of spontaneous combustion.

Stockpiles will also be visually monitored for signs of spontaneous combustion. If spontaneous combustion occurs, the affected coal will be spread out using earthmoving equipment and sprayed with water to cool it down. The coal will then be replaced in the stockpile and compacted to prevent oxygen ingress.

Stockpiles will also be fitted with pole mounted water sprays to control dust. These will rotate to ensure coverage of the entire stockpile. The product coal stackers will also be fitted with luffing booms which adjust to minimise the drop height of coal from the stacker to the stockpile limit dust generation and also formation of coal fines from break up of lumps of coal landing on the stockpile

2.8.4 Coal Handling and Processing Plant

A proportion of coal from the open cut mine is expected to be further processed in a coal handling and preparation plant (CHPP) to remove ash and fine particles. The CHPP will be located in the main MIA as shown in Figure 2-18.

The CHPP facility has been sized for nominal 20 Mtpa (raw coal) capacity on the assumption that about 50 per cent of coal from the open cut mines will require processing. This is based on preliminary data on ash content and further work is underway to better understand the ash content of coal.

There will be three processing streams within the CHPP:

- A coarse circuit for coal sizes greater than 2 mm
- A fines circuit for coal sizes between 0.25 mm and 2 mm
- An ultra-fines circuit for coal sizes smaller than 0.25 mm. If this material is high ash, it will be rejected as tailings as the particle size creates significant issues in relation to coal handling.

For the coarse and fines circuits, a range of processing approaches are available, however fundamentally, each process involves physical agitation and washing with water to remove ash and ultrafine particles and then a recovery process where water and ultrafine material is separated from the coarse and fine materials.

Water will be recovered from some parts of the CHPP, while some water will also be lost with the ultrafine material. Ultrafine material will be partially thickened to reduce water content. For the first 10-12 years of mining tailings will be placed in an above ground tailings storage facility east of the MIA. Once sufficient space is available in-pit, tailings will then be placed in dedicated areas in pits J and K. While detailed analysis of coal quality has not been undertaken, it is anticipated that 3-5 Mtpa (dry) of tailings will be produced.

The above ground tailings storage facility will be an engineered structure with hydraulic capacity as required by the *Manual for Assessing Hazard Categories and Hydraulic Performance of Dams* (Queensland DERM 2012). A preliminary assessment of this facility indicates that it is likely to fall into the significant hazard category and hence is required to:

- Provide for a design storage allowance equivalent to a 1:20 year annual exceedence probability (AEP) event

- Have a mandatory reporting level set at the 1:10 year AEP (72 hour duration) storm level
- Provide spillway capacity for 1:100 to 1:1000 AEP event
- Have embankment crests set at the 1:100 AEP level plus 500 mm freeboard.

The above ground tailing storage facility will also be lined with a very low permeability liner.

Water will evaporate and decant from tailings placed in the tailings storage facility. Decanted water will be collected, treated to remove suspended solids and adjust pH if necessary and returned to the mine water management system.

2.8.5 Product Coal Handling and Train Load Out

Each stockpile will have a reclaim system for transfer of coal via conveyor to the train load out. Automatic weighing equipment on the conveyors will maintain a steady rate of transfer of coal to the train loading stations. It will be possible to vary the rate of reclaim from each stockpile if necessary to blend coal from different stockpiles.

Two train load out systems will be provided. Anticipated train loading rates will be up to 10,000 tph. The train loading system is fitted with a wagon derailment detector and spillage pit, with a sump and pump for removal of any rainwater or dust suppression water, which will be returned to the mine water management system.

2.8.6 Mine Waste

Approximately 22.9 billion bank cubic metres (bcm) of over and interburden will be generated from the open cut section of the Carmichael mine during the mine life. Of this material, for the first 5 years of operation, some 2.7 billion bcm of the total 22.9 billion bcm will initially be stored in out of pit waste rock structures on EPC1080 and on the eastern side of the coal sub-crop on EPC 1690. Following this, the balance of the material will be placed into mined out voids as these become available.

The geochemical test work reported in this chapter suggests that some proportion of the Carbonaceous Group, which included carbonaceous claystones, carbonaceous mudstones, shales and carbonaceous siltstone, in addition to the uneconomic C coal seam may be potentially acid forming. The approximate maximum volume of Carbonaceous Group material within fresh interburden required for removal as determined within the limitations of this study was calculated as 1 billion bcm, or approximately 5.5 per cent of total waste. The approximate maximum volume of the C seam in pits and therefore required to be removed is 0.8 billion bcm, which represents approximately 3.5 per cent of the total mine waste. Therefore, based on the limitations of the mine waste geochemistry assessment, a total of 1.8 billion bcm, or around 8 to 9 per cent of the total volume of mine waste may require the application of dedicated AMD management strategies.

The geochemical static testing conducted to date, being 100 samples, indicated that the Carbonaceous Group, along with the coal, is the most likely to be potentially acid forming (PAF). In addition some materials have been classed as uncertain (UC) in regard to their potential to be net acid forming. These UC samples were from a range of lithological units including mudstone, clay, claystone and sandstone.

Generally, the results indicate that the majority of units within the over and interburden are likely to be non-acid forming (NAF); however, additional testing in the form of another 370 static geochemical tests and 12 kinetic leach columns is planned to increase statistical confidence in the dataset. Following assessment and reporting of these additional samples, more definitive management strategies can be determined.

Coal CHPP rejects and tailings will be disposed of in below ground voids, which can subsequently be capped with spoil at the end of the mine life. Coarse rejects are likely to comprise roof and floor material from the underground mine, identified in the chapter above as being potentially one of the higher risk geological units at Carmichael. The geoechemical assessment indicated that salinities generally ranged between 100 and 1,000 µS/cm for roof and floor material, posing a risk for slightly saline drainage. Additionally, the carbonaceous mudstone, claystone and a sandstone sample indicated that these geological units may be potentially acid forming.

Further details of waste management are provided in Volume 2 Section 10 Waste and Volume 4 Appendix V Acid Mine Drainage Report.

2.9 Pre-construction

This section describes the activities to be undertaken on the mine site prior to commencement of production. During the pre-construction phase Adani will undertake minor realignment and upgrade works of the Moray Carmichael Road, in accordance with the standard agreed between Adani and IRC and contained within the road maintenance and upgrade agreements. The road will facilitate both the construction and operation of the Mine and construction of the offsite infrastructure. The workers accommodation village and permanent airport will be developed during this phase, to provide accommodation for the construction workforce and associated air transport.

The site clearing includes removal of vegetation and general debris, any structures and diversion of any existing infrastructure or services. Due to the history of land use within the site, the level of vegetation clearing is minimal, and existing structures and infrastructure and services will be minimal. The site clearing must occur before the earthworks commence. While the terrain in these areas is relatively level, some earthworks will be required to:

- Level, grade and compact the building footprint for any on mine or off site structures or platforms
- Level and grade the access road to the Mine and the offsite infrastructure
- Level and grade the airstrip at the permanent airport to engineering requirements
- Provide stormwater management

A number of pre-construction activities will be undertaken under existing approvals within the scope of the Level 1 Environmental Authority held by Adani. All additional approvals required for the construction of the Project (Mine) are described in Volume 4 Appendix D Project Approvals. These approvals include details of the EMPs, and Safety Management Plans as approved by the relevant Federal, State and local authorities. Appendix D Project Approvals also outlines all relevant licences that have been applied for or attained for the purpose of the Project (Mine). The execution of the mining lease over EPC1690 and EPC1080 is also required before commencement of construction.

During the pre-construction phase Adani will undertake minor realignment and upgrade works of the Moray Carmichael Road, in accordance with the standard agreed between Adani and IRC and contained within the road maintenance and upgrade agreements. The road will facilitate both the construction and operation of the Mine and construction of the offsite infrastructure.

A number of pre-construction activities will be undertaken under existing environmental approvals (exploration) held by Adani. More detailed description of approvals required for the construction of the Project (Mine) are described in Volume 4, Appendix D (Project Approvals and Planning Assessment).

2.10 Mine Construction

2.10.1 Overview

Construction will commence as soon as approval requirements are in place and, for activities within the Mining Lease, once the Mining Lease has been granted. Approval requirements for various on-lease and off-site components of the Project (Mine) are given in Volume 4 Appendix D Project Approvals and Planning Assessment.

Construction scheduling will focus on allowing production to commence as soon as possible and, as discussed in Section 2.6, there is an overlap between construction and operation phases. The majority of construction works will take place over a 36-48 month period, however, the initial construction phase will continue until the mine reaches full production about eight years after commencement of construction.

As the mine progresses south, additional construction works will be required to construct the bridge and infrastructure crossing of the Isaac River and mine support facilities south of the river.

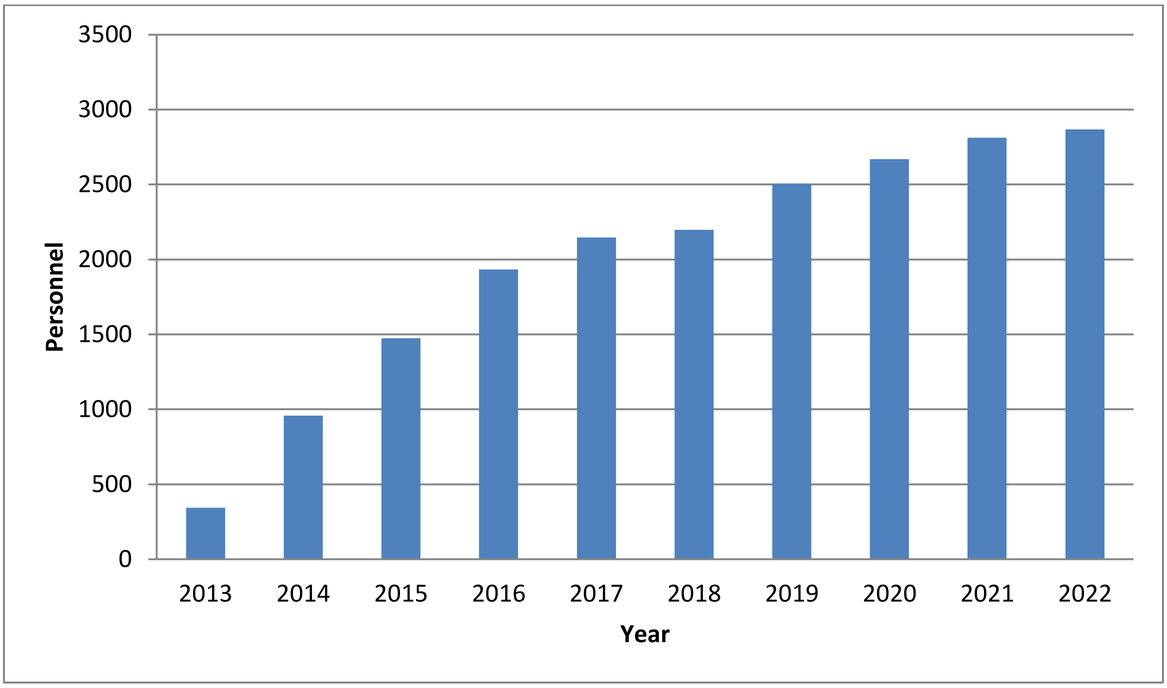
- Construction activities will generally occur seven days per week and 24 hours per day.
- Construction activities will be carried out by one or more contractors.

2.10.2 Construction Workforce

An initial workforce of approximately 400 persons will be onsite for the pre-construction phase and then construction phase of the Project. Numbers will increase up to 3,000 people over the subsequent eight years, until full production.

Figure 2-22 shows the workforce numbers (full time equivalent) for the construction period. As there is an overlap between construction and initial operation of the Mine, total workforce for the period of 2013 through to full production at 2022 is shown. The totals shown below represent the total number of people, due to roster variations, not the full time equivalent positions. The residential population will be lower. Details of workforce numbers and assessment of social impacts is provided in Volume 1 Section 3 and 4.

Figure 2-22 Mine Workforce (fte) by Year to Full Production (2022)



Source: Runge Limited (2011)

2.10.3 Main Construction Phase

2.10.3.1 Off-site Infrastructure

The following off-site items are required to be constructed in the main construction period:

- An upgrade of the Moray-Carmichael Road. This will include some minor realignment, including realignment to remove two crossings of North Creek, and reforming of the road to allow heavy vehicle traffic.
- Construction of access roads from Moray-Carmichael Road to the workers accommodation village, airstrip and industrial area. These will be bitumen sealed provided year round access.
- Construction of the workers accommodation village. The village will be constructed in three stages. An initial stage of 250 beds will provide accommodation for workers undertaking early construction activities. Two subsequent stages of 1,000 and 750 beds will be constructed as the construction workforce grows and mobilisation of the operation workforce commences.
- Installation of sewage treatment systems at the workers accommodation village and also the industrial area and airport. The type of sewage treatment facilities and whether treated wastewater will be reused or disposed of by irrigation is to be determined in the detailed design stage.
- Construction of the airstrip and terminal facilities.
- Construction of the industrial area including fuel storage and refuelling areas, maintenance facilities, vehicle wash areas and office and administration facilities.
- Construction of off-site water supply components. This will include:

- Upgrades of eight existing dams on North Creek and Obungeena Creek.
- Installation of a borefield as shown on Figure 2-43.
- Construction of an off-stream storage near the Belyando River. This will be 5 GL capacity “turkey nest” style dam, and requirements for lining will be determined during detailed design.
- Installation of pipelines connecting the water supply sources to the off-site infrastructure area and demand points within the proposed mine.

- Establishment of a landfill.

Power supply infrastructure requirements have not yet been determined but it is expected that offsite components of transmission lines will be constructed by the relevant electricity authority.

2.10.3.2 Mining Infrastructure

Infrastructure components to be constructed within the proposed mining lease in the initial construction period will include:

- Access roads to the MIA and initial mining areas
- Initial stream and overland flow diversion around the MIA and first open cut area (see also Figure 2-31
- Conveyor networks for early years of mining operations in the central mining area
- The main MIA, including facilities described in Section 2.7.1
- Sewage treatment system. The type of sewage treatment facilities and whether treated wastewater will be reused or disposed of by irrigation is to be determined in the detailed design stage.
- Fuel storage
- Waste storage areas
- Internal electrical reticulation
- Explosive storage

2.10.4 Moray Carmichael Road

As the Moray Carmichael Road passes through the proposed mine footprint, it will need to be realigned. It is proposed to temporarily realign the road while mining takes place in the central part of the proposed mine, and then, once rehabilitation in this area is complete, establish a permanent road alignment as close as possible to the existing alignment.

The temporary and final roads will meet the relevant rural road design standards that are in place at the time from Isaac Regional Council and Department of Transport and Main Roads.

2.10.5 Ongoing Construction Works

As mining progresses, a range of additional construction works will be required including:

- Underground mining ROM stockpile and infrastructure areas for each of the underground mines. These will have worker amenities, sewage treatment systems, raw and mine water storages, stormwater containment systems, minor vehicle maintenance facilities and fuel storage.

- Extension of conveyor and haul road networks to the north and then to the south as mining progresses
- Construction of a bridge and infrastructure crossing of the Carmichael River. Bridge design has not been completed but will include a span of the main river channel.
- Construction of levee banks along the north and south of the Carmichael River/Cabbage Tree Creek. Levees will be built a minimum of 500 m away from the river channel and will need to be in place before open cut mining extends into the Carmichael River floodplain. Design and construction will comply with Manual for Assessing Hazard Categories and Hydraulic Performance of Dams (DERM 2012)
- Diversions of streams away from open cut areas (see also Figure 2-32 to Figure 2-40). Stream diversions will comply with guidelines in place at the time, with current relevant guidelines DERM 2011 *Watercourse Diversions – Central Queensland Mining Industry version 5.0*
- Construction of additional mine water storage dams. Dam design criteria are set put in Section 2.12.6

2.10.6 Construction Methods

2.10.6.1 Vegetation Clearing

Vegetation clearing will be staged to minimise areas of disturbance prior to construction. Timber will be harvested, with scrub and stumps being grubbed utilising a bulldozer. While there are minimal areas of high ecological value within the construction footprint, pre-clearing surveys will be conducted in areas where conservation significant flora and fauna may be present, including along vegetated creeks and drainage lines.

Depending on the type of vegetation and level of weed infestation, cleared timber will be mulched utilising a tub grinder, or similar, for use as soil conditioner or alternately cleared vegetation will be piled into windrows and left to decompose naturally.

2.10.6.2 Erosion and Sediment Controls

During the wet season, erosion and sediment controls will be installed immediately after vegetation clearing and prior to any other surface disturbance. Further information on erosion and sediment control is provided in Volume 2 Section 13 EMP.

2.10.6.3 Bulk Earthworks

While areas within the construction footprint are relatively flat, civil earthworks will be required for installation of structural foundations, lay down areas and hardstands. Topsoil will be stripped ahead of earthworks and stockpiled for reuse in rehabilitation of areas no longer required for construction, or in rehabilitation trials (see also Section 2.15).

The requirement for piling will be determined during the detailed design phase, where required piling rigs will bought to site. It is not anticipated to generate excess spoil during this phase. If excess spoil is generated, this will be stockpiled for later disposal with mine waste.

2.10.6.4 Buried Infrastructure

Water supply pipelines will be buried and the requirement for other linear infrastructure to be buried will be determined during detailed design. Final alignments have not yet been determined but will seek to minimise clearing of remnant native vegetation.

For buried infrastructure, the construction method will consist of:

- Clearing vegetation along the proposed alignment, with clearing widths held to the minimal width required for safe construction. Larger trees will be felled and root systems grubbed, but where possible, root structures of smaller plants and grasses will be left intact in topsoil.
- Installation of erosion and sediment controls
- Removal of topsoil which will be set aside in windrows parallel to the proposed alignment for reuse in rehabilitation of the alignment
- Excavation of a trench, with spoil material placed in windrows along the alignment
- Installation of the pipeline or other buried infrastructure component, with quality control to ensure that there are no leaks or other faults.
- Backfilling of the trench with spoil material. Excess spoil will be removed for use as fill in other construction areas or stockpiled for later disposal in mine waste stockpiles
- Replacement of topsoil and stabilisation. Rehabilitation trials will be required to determine whether to utilise native or introduced grass species to attain the best ground cover.

Construction scheduling will focus on minimising the time between initial vegetation clearing and reinstatement to minimise risk of erosion and soil loss. Erosion and sediment control measures will remain in place until the disturbed surfaces are stabilised.

Water supply pipelines will be required to cross several ephemeral streams and drainage lines. Stream crossings will be performed in dry conditions wherever possible, with forward planning to minimise the length of time that there are disturbed areas within the bed and banks of streams and thus, the likelihood of flow conditions occurring during construction. The construction method will be similar to that outlined above for underground infrastructure, however in addition the following measures will be undertaken:

- Clearing of vegetation and particularly tall trees in the riparian zone and bed and banks of watercourses will be minimised as far as possible without compromising safety
- The bed level of the stream or drainage line will be restored so that there is no disruption to flows
- The bed and banks of the stream will be stabilised such that native vegetation can be re-established and scouring does not occur.

Codes and guidelines that will be incorporated into design, construction and rehabilitation of watercourse crossings are listed in Section 2.10.6.5. Laydown areas will be required for pipes and bedding material and will be located in areas already cleared of native vegetation.

2.10.6.5 General Requirements for Works in Watercourses

Works in watercourses will need to be undertaken both on and off the proposed mining lease, including for access road crossings, water supply infrastructure and underground infrastructure. The regulatory requirements in relation to works in watercourses are different depending whether the works are on or off the proposed mining lease and hence, self-assessable codes and guidelines are not necessarily applicable in all instances. However, these codes and guidelines still provide guidance in terms of standards and practices for design, construction and rehabilitation of works in watercourses and will be referenced as such for all works in watercourses. The following will therefore be considered in relation to works in watercourses:

- Department of Natural Resources and Mines, September 2012, *Riverine management—a best practice approach when carrying out activities in a watercourse, lake or spring*
- Department of Natural Resources and Mines, 2012, *Guideline - activities in a watercourse, lake or spring associated with a resource activity or mining operations - WAM/2008/3435*
- Department of Environment and Resource Management, 2012, *Guideline - Activities in a watercourse, lake or spring carried out by a landowner* - WAP/2011/4765
- Department of Employment, Economic Development and Innovation, October 2011, *Code for self-assessable development Minor waterway barrier works – Part 1 – Minor dams and weirs*; Code number: WWBW01
- Department of Employment, Economic Development and Innovation, October 2011, *Code for self-assessable development, Minor waterway barrier works – Part 3: Culverts*; Code number: WWBW01
- Department of Employment, Economic Development and Innovation, October 2011, *Code for self-assessable development Minor waterway barrier works – Part 4 Bed-Level Crossings*; Code number: WWBW01
- Department of Employment, Economic Development and Innovation, September 2010, *Code for self-assessable development, Temporary waterway barrier works*; Code number: WWBW02.

2.10.6.6 In-stream Water Storages

The existing in-stream water storages on North Creek and Obungeena Creek will be enlarged to a maximum capacity of 250 ML each by a combination of:

- Excavation to increase the depth
- Raising of embankment heights.

For each of the dams, any water within the dams will need to be drained to allow the enlargement to go ahead. This water will preferentially be used for construction water supply, particularly dust suppression. If water in the existing dams exceeds construction demand, then it will be disposed of by spray irrigation on adjacent grazing land. Water quality analysis undertaken for this EIS indicates that water in the dams will be suitable for this disposal method.

As North Creek and Obungeena Creek become un-channelised downstream of the dam locations, water will only be discharged into the watercourses if the volume is low enough not to cause inundation of downstream areas and the quality is suitable to avoid impacts on aquatic ecosystem values.

Geotechnical investigations will be required to evaluate the detailed methods for enlarging each dam and to identify suitable materials for raising the embankments. A failure impact assessment will be conducted and design requirements established in the Water Supply (Safety and Reliability) Act 2008 will be followed, however there is no population at risk downstream.

Construction will take place under minimal flow conditions wherever possible. Even if flows occur, it is not required to provide a diversion around the dams during construction as flows in the creeks are relatively minor and there are no downstream populations at risk. If enlargement of the dams furthest downstream on each of North and Obungeena Creeks takes place during the wet season, a sediment check dam will be installed downstream to assist in removing sediment from any water that comes into contact with exposed surfaces. This is not required for the dams further upstream and dams downstream will effectively trap sediment laden waters. Following completion of construction, the external walls of embankments will be stabilised with vegetation, geotextile fabric or similar such that erosion of the embankments does not occur.

The construction area for the North Creek and Obungeena Creek dams will be approximately 125,000 m^2. This includes the surface area of the dam, pump station and all laydown, spoil storage and stockpile areas. Approximately 80,000 m2 will be required for stockpiles and laydown areas..

The pump station slabs will be reinforced concrete, and will be cast in situ. The concrete will likely be obtained from a batching plant on site, with the reinforcement imported.

2.10.6.7 Mine Raw Water Storage

While detailed design has not been commenced for the mine raw water storage, it is anticipated that in-situ materials will be used for construction of the embankments for this storage. Design and construction standards are listed in 2.12.6.2.

2.10.6.8 Belyando River Pump Station and Storage Dam

The Belyando River storage dam is an off-steam storage and will be located on the footprint of an old quarry. While detailed design has not yet been undertaken, it is anticipated that the dam will be constructed by a combination of excavation into the ground and construction of embankment walls from in-situ material. Any excess spoil will be transported to the mine site for later disposal with mine waste. A liner will be installed using either compacted clay material which will be imported or a high density poly-ethylene (HDPE) liner.

A channel will be installed into the bank of the Belyando River leading to a pump station. The construction area for the pump station will be approximately 2,500 m^2. This includes the pump station and channel area, and all laydown, spoil and stockpile areas.

The pump station structure will be cast in situ during non-flood periods. The excavation of the channel and pump station invert river level will be done in phases, with connection to the river made late in the construction period as the river level is higher in this area due to the retarding effect of the downstream causeway. The concrete structure will support a steel or concrete platform above to house the electrical infrastructure. Concrete will be likely obtained from a batching plant on site. Reinforcement, other steelwork, electrical and mechanical equipment will be delivered to site.

2.10.6.9 Boreholes

Water supply bores will be drilled on site using a drilling rig. The borehole will be cased, and the borehole pump installed. HDPE pipelines will connect the boreholes to the main user storage. A small amount of concrete will be required. This will likely be provided from an on-site batching plant. The mechanical equipment will be imported.

2.10.6.10 Access Roads and Tracks

Both temporary and permanent access roads will be required for the off-site infrastructure and within the mining lease. Access road alignments have not yet been determined but will take into consideration utilisation of existing tracks where possible to minimise vegetation clearing. Permanent, long-term and/or high volume access roads will be constructed from bitumen or gravel and will have drainage provided to prevent concentration of flows across or along road alignments. Minor or temporary access tracks will generally be single lane dirt tracks with minimal earthworks.

Access roads and tracks will be required to cross ephemeral watercourses. Wherever possible, crossing locations will be selected to minimise the need to clear riparian or in-stream vegetation. For permanent, long-term and/or high volume access roads, culverts will be used with flood immunity design criteria specified in Section 2.12.6.1. Codes and guidelines listed in Section 2.10.6.5 will be followed as closely as possible, particularly in relation to minimising damage to the bed and banks of watercourses and maintaining flows and fish passage. If construction occurs in the wet season, a sediment check dam or similar device will be installed downstream of the construction area to capture sediment released during construction.

For minor access roads, crossings will either be at bed level, or with a low flow pipe installed under a slightly elevated crossing. Again, locations will be selected to minimise clearing of riparian vegetation or in-stream vegetation and codes and guidelines listed in Section 2.10.6.5 will be followed as far as practicable. Crossing locations will be stabilised such that erosion and scouring does not occur.

2.10.6.11 Carmichael River Bridge

A bridge will be required across the Carmichael River in 2033 to access the southern part of the proposed mine. Detailed design for the bridge has not yet been undertaken, but the bridge will be designed to minimise afflux impacts and to meet flood immunity criteria set out in Section 2.12.6.1. The bridge will span the main channel of the Carmichael River, with no pylons or supports within the low flow channel.

During construction, it will be necessary to install a low level crossing across the Carmichael River to allow construction vehicles, equipment and materials to be transported to the south side of the River. This will consist of a compacted dirt roadway, with low flow pipes laid underneath. On completion of construction, this will be removed and the bed and banks rehabilitated.

2.10.6.12 Flood Levees

Flood levees will be constructed to protect the open cut pits and underground mine portals from flooding from the Carmichael River and possibly Eight Mile Creek. While geotechnical investigations have not yet been undertaken, it is expected that levees will be able to be constructed from locally available materials. Flood levees will meet hydraulic design criteria set out in 2.12.6.1 and structural and hydraulic requirements set out in 2.12.6.2.

2.10.7 Construction Traffic and Transport

The Project Area encompasses several transport corridors of national, state, regional, district and local significance. These types of roads are either under the management and control of either the State road authority, Department of Transport and Main Roads (DTMR), or in the local road authority, the IRC. Table 2-12 provides the classification of each road within the study area and identifies the road authority that manages each road. The traffic volumes generated by the construction of the

Mine will vary and will depend on the construction timetable. The main traffic generated through the construction phase will be from plant, equipment and material deliveries, as listed in the Table 2-13.

Table 2-12 Roads within the Vicinity of the Project (Mine)

Road Name	Road Authority	Classification
Flinders Highway (Charters Towers to Townsville)	DTMR	State Strategic Road
Gregory Developmental Road (Charters Towers to Clermont)	DTMR	State Strategic Road
Bowen Developmental Road (Bowen-Collinsville)	DTMR	District
Bowen Developmental Road (Collinsville – Belyando Crossing)	DTMR	District
Suttor Developmental Road (Nebo-Mount Coolon)	DTMR	Regional Road
Peak Downs Highway (Clermont – Nebo)	DTMR	State Strategic Road
Peak Downs Highway (Nebo – Mackay)	DTMR	State Strategic Road
Moray Carmichael Boundary Road	Isaac Regional council	Local Road
Moray Bulliwallah Road	Isaac Regional council	Local Road
Elgin Moray Road	Isaac Regional council	Local Road

Table 2-13 Construction Plant and Material

Construction Activity	Plant and material required
Coal Handling Preparation Plant (CHPP)	CHPP facility including structural steelwork and, equipment. Buildings in the vicinity including administration, workshop, bathhouse, mess building, kitchen building. Concrete allowance for car park area (delivery from batch plant to site). Sewerage treatment facility and water treatment facility.
Major Underground Face and Mobile Equipment	Longwall Units, Continuous Miners and Diesel Equipment.
Electrical Infrastructure	Substation equipment and HV cables.
North Underground Mine Facility	Various buildings and associated areas including administration, bathhouse, helipads and workshops. Reclaim tunnel. Coal valves for stockpiles (pre-assembled). Concrete allowance for car park areas (delivered from batch plant to site).

Construction Activity	Plant and material required
	Sewerage treatment plant, raw water tanks and HDPE lining for dirty water dams. Structural steelwork for overland conveyors, stacker conveyor system, crushing stations, chutes, primary and secondary crushers.
Central Underground Mine Facility	Various buildings and associated areas including administration, bathhouse, helipads and workshops. Reclaim tunnel. Coal valves for stockpiles (pre-assembled). Concrete allowance for car park areas (delivered from batch plant to site). Sewerage treatment plant, raw water tanks and HDPE lining for dirty water dams. Structural steelwork for overland conveyors, stacker conveyor system, crushing stations, chutes, primary and secondary crushers.
Underground Coal Stockpile Areas	Structural steelwork for conveyors, including stacking, reclaim, and train load-out conveyors. Pre-assembled coal-valves.
Reclaim Stations	Steel structure, service monorails and chutes for various reclaim stations.
Open Cut Stockpile Areas	Structural steelwork for conveyors. Coal valves. Reclaim tunnels. Thickeners stations and rejects bin
North Open Cut Mine Facilities	Steelwork for crushing stations (crushers, chutes, roller screen, and service monorails) Steelwork for truck dump station
Central Open Cut Mine Facilities	Steelwork for crushing stations (crushers, chutes, roller screen, and service monorails) Steelwork for truck dump station
Overland Conveyors	Steelwork for overland conveyors
Airfield	Airstrip, access road, apron and terminal buildings
Workers accommodation village	Sleeping pods, laundry, footpaths, first aid, toilet block, mobile refrigerator, ice room, gymnasium, IT room and internet, dry mess, wet mess, kitchen, and workshops.
Concrete and Concrete Materials	Concrete for buildings (delivered from batch plant to site) and delivery of concrete materials from quarries to batch plants.

Table 2-14 summarises the estimated total vehicle movements during peak under a worst-case scenario**.**

Table 2-14 Estimated Total Vehicle Movements (Worst-case Scenario)

Heavy Vehicle Movements	Daily (vehicles per day)	Peak Hour (vehicles per hour)
Flinders Highway	68	7
Gregory Development Road	68	7
Peaks Down Highway	0	0
Kilcummin Diamond Downs Rd	0	0

2.10.8 Temporary Construction Utilities

It is anticipated that diesel generators will be provided for electricity during construction of offsite infrastructure. Water will also be required, and will be provided either from the Labona Bore or will be imported.

2.10.9 Construction Water Requirements

Water requirements for the construction of the Project will include:

- Concrete making
- Dust suppression
- Vehicle wash down
- Potable water

The majority of the construction is scheduled between 2014 and 2016, though there will be some on-going construction activities until the mine reaches full production. Table 2-15 shows water demand for the construction of the mine. Water will be supplied from the mine site or from the Moray Downs property. The water demand for the remainder of the railway construction will be temporary and is considered in Volume 3 Project (Rail).

Table 2-15 Onsite Construction Water Demands

Year	On-Site Water Demand (GL/year)
Year 1	0.5
Year 2	1
Year 3	1
Year 4	2
Year 5	2

2.10.10 Rehabilitation of Temporary Construction Sites

For mine infrastructure temporary construction and laydown areas have been located in areas that will be required for mine operations to minimise the overall disturbance footprint. Hence, rehabilitation of these areas will not be required. Areas that are not to be used immediately will be stabilised by placement of gravel or seeding with grass if necessary to minimise erosion risk.

For the off-site infrastructure, temporary construction and laydown areas have been located in areas already cleared of native vegetation. If any areas are not required once construction is completed these will be ripped, topsoil replaced, and grass sown to provide ground cover. Erosion and sediment controls will be left in place until 70 per cent ground cover is achieved.

2.10.11 Construction Equipment

The types of heavy vehicles and equipment required for the construction include:

- 3, 5 and 7 axle trucks, flatbed semitrailers, extendable trailers, B double tankers, road trains to transport plant and material to the site
- Low loaders for construction equipment
- Tipper trucks, to transport bedding sand on-site and excavated burden off-site
- Excavation machinery
- Dozers, backhoes, scrapers, graders, rollers and water carts
- Buses for workers

2.11 Mine Commissioning and Operation

2.11.1 Commissioning

2.11.1.1 CHPP and Coal Handling Systems

Commissioning of the CHPP and coal handling systems involves operating the systems under close supervision and monitoring quality of outputs until a satisfactory level of performance is achieved. Only normal coal fines and rejects waste will be produced during commissioning and there is no potential for hazardous wastes to be generated.

2.11.1.2 Plant and Equipment

There are no specific commissioning requirements for plant and equipment.

2.11.1.3 Dams, Pipes and Pump Stations

While there are no specific commissioning requirements for dams without mechanical gates, there are a number of surveillance requirements during design and construction, both under the DERM Manual for Assessing Hazard Categories and Hydraulic Performance of Dams (February 2012) (dams within the mining lease) and Queensland Dam Safety Management Guidelines (NRM, 2002). Prior to allowing any dams to fill, a review will be undertaken to check that all design and construction requirements have been met.

Pipes and pump stations must be tested for hydraulic performance as part of commissioning. This is to check that all components are fully sealed and that the required capacity has been achieved.

Pipelines also need to be cleaned of any debris that may be within the pipeline after construction. This is done by pressure testing pipes and pumps with water. Pipes are filled with water and pressurised and then monitored for drops in pressure that may indicate leaks. Pumps are also tested by monitoring pressure and checking for leaks.

Water from hydro-testing will either be discharged to land (irrigation) or surface waterways or transferred to water storage dams for reuse. It is not currently anticipated that any additives will be required, but water is likely to have collected debris from within the pipes and pumps and will need to be screened to remove this debris if it is to be discharged to surface waterways. Any discharge to surface waterways or land irrigation will be done in a manner that does not cause scouring or erosion.

2.11.2 Operations

The Mine includes the:

- Open cut mine (located within EPC1690 and part of EPC 1080)
- Underground mine (located within EPC1690)
- Mine infrastructure area and CHPP (located within EPC1080)
- Out-of-pit dumps (located within EPC1080 and on east side of sub-crop in EPC 1690)
- Associated raw water and waste water management infrastructure

The open cut mine has a capacity of 40 Mtpa (product) and will be located along the eastern portion of EPC1690. The open cut mine will be predominantly truck/shovel/excavator operation, supplemented by draglines and dozers for primary waste removal. The standard dragline method is one used in many Central Queensland coal mines. The method involves an extended key and bench operation that can be easily optimised (see Figure 2-24). Sixteen open cut pits will be mined over the life of the proposed mine, designated pits A to P. Pits A to K are located north of the Carmichael River and Pits L to P are south of the river.

During the early stage of development of each pit, overburden will be transported to out-of-pit dumps on EPC 1080 and on east side of sub-crop in EPC 1690, which will be profiled and rehabilitated as operations progress. Thereafter, backfilling of the pit will be maximised during operations and eventually a proportion of the waste used to re-profile the high-wall of the final voids.

Three underground longwall coal mines will be developed, designated as the North, central and south underground mines. The north and central underground mines are located to the north of the Carmichael River, with the south underground mine to the south of the river. The underground mines will produce 20 Mtpa (product) of lower ash coal over the first 45 years of the overall mine life. The lower ash coal will be blended with higher ash coal from the open cut mines, to minimise the overall need for coal processing and washing to meet the target ash content of 25 per cent.

A north-south surface corridor will separate the underground from the open cut mines. This is used to locate the underground drift access and surface coal haulage access and provide a barrier pillar for safe concurrent working of the underground and open cut operations. Coal from both the underground and open cut mines will be conveyed by truck and overland conveyor to the centralised CHPP within the mine infrastructure area, where the high-ash portion will be processed and then blended with lower ash coal, which will bypass the CHPP.

2.11.3 Operational Workforce

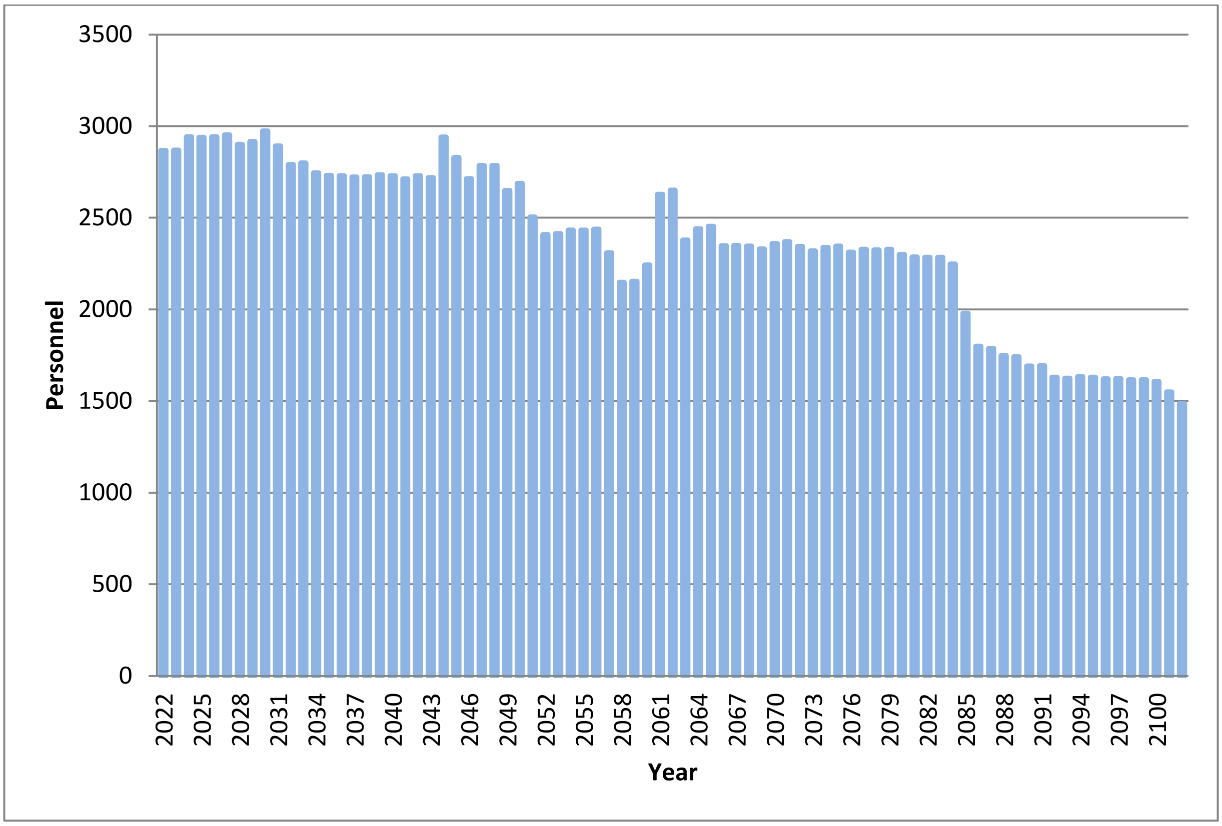
The Project (Mine) total operational workforce, including underground and open cut operations, is expected to average 2,366 full time equivalent employment (peak just under 3,000) for the period from full production in 2022 to completion of all on Mine works in 2102. The number will remain above 2,000 when underground mining ceases production by 2067, but will decrease as production winds done and the Mine ceases production in 2102.

Figure 2-23 illustrates the Project (Mine) total operational workforce. Operation of the Project (Mine) will require workers in the following categories:

- Open cut and underground mine operators including operation of excavators, dozers, drag lines and longwall mining equipment
- CHPP operators
- Tradespeople including diesel fitters and electrical tradespeople and mechanical fitters
- Technical services and support including: geological, engineering, health safety and environment services and laboratory and quality control.
- Machinery operation and maintenance workers
- Managers and production supervisors
- Administrative and support areas such as office staff, catering, cleaning and transportation.

Further detail on the construction and operations workforce is located within Volume 1 Section 6 Social Impact Assessment and Appendix F.

Figure 2-23 Project (Mine) Total Workforce (fte) from Peak Production to Completion (2022-2102)



Source: Runge Limited 2011

2.11.4 Transport and Traffic

Operation will commence from 2014, with the target of 60 Mtpa (product) reached in 2022. Mining will be sustained at 60 Mtpa (product) until production rates are constrained by lack of pit room for pre-strip, expected to be around 2087. Traffic volumes generated by the Mine will remain at a consistent level each year from 2022 to 2087. Table 2-16 summarises the estimated total vehicle movements for the peak worst-case scenario.

Table 2-16 Estimated Total Vehicle Movements (Worst-case Scenario)

Vehicle Movements	Daily (vehicles per day)	Peak Hour (vehicles per hour)
Light vehicle movements by service personnel	18	9
Heavy vehicle movements on:		
Flinders Highway	125	12
Gregory Development Road	125	12

2.11.5 Open Cut Mine Operations

2.11.5.1 Mining Method

The following outlines the nature and description of all key operations associated with the open cut mine. The open cut mining method includes:

- Overburden removal
- Overburden disposal
- Drilling and blasting
- Coal mining
- Co-disposal of rejects and tailings

Figure 2-24, Figure 2-25 and Figure 2-26 provide schematics of open cut mine operations.

Topsoil will be stripped prior to mining or dumping in each area by a combination of scrapers and excavators. Topsoil stripping depth will be determined prior to stripping as will the need for single or two phase stripping. The topsoil will be stockpiled until it is required for rehabilitation, or hauled directly for respreading on the completed and re-profiled mining areas. Depending on requirements to be specified in the Rehabilitation Management Plan, some amelioration of topsoil may take place prior to or at the time of stripping and replacement. A topsoil register will be retained to track the origin, interim storage and final destination of topsoil.

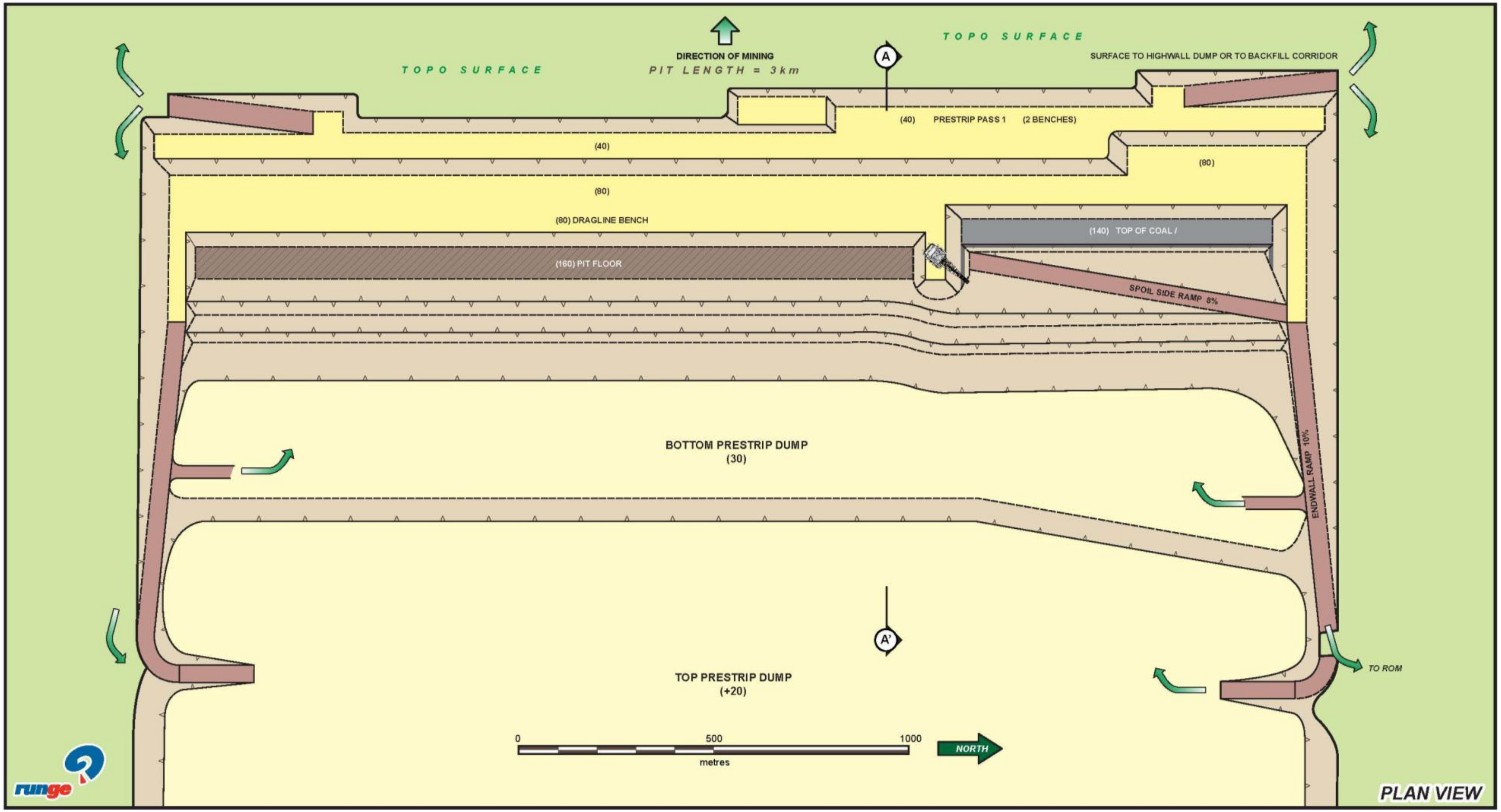
Vegetation clearing will be undertaken using bulldozers or similar equipment. In areas of high ecological value, pre-clearing surveys will be undertaken to identify conservation significant flora and fauna and determine appropriate methods to avoid or minimise harm. The clearing method and whether vegetation is stockpiled, mulched or otherwise treated will depend on the type of vegetation in a particular area, and the level of weed infestation.

An initial box cut will be constructed on the east side of each open cut to provide access for removal of overburden. The Tertiary layer overburden, consisting of an average 80 m thick layer will be removed using excavators loading material into rear dump trucks, as will the uppermost layers of the Permian formation. This will expose the AB seam, which will be mined.

Draglines will then be introduced to uncover the D seam, removing 70-80 m of Permian material. A combination of draglines and excavator/dump truck will be used to continue mining to the E and F seams.

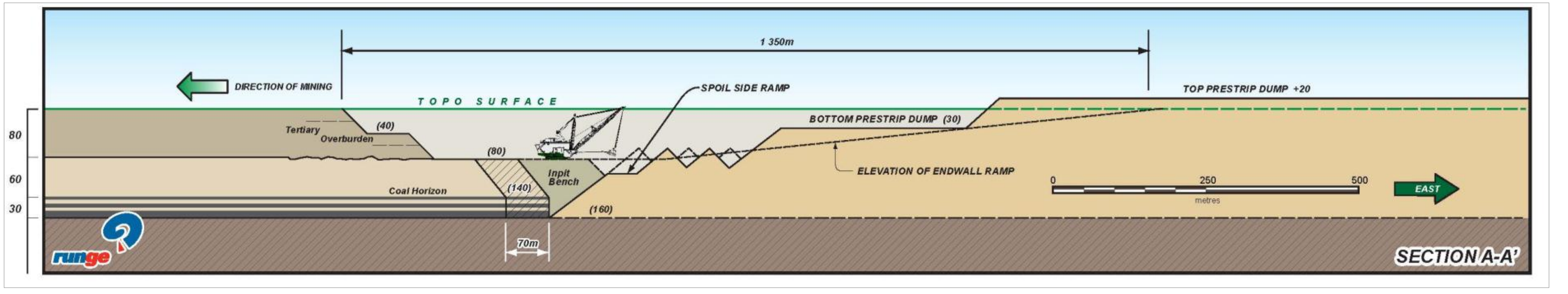
Mining will occur in an east to west direction, leaving a low wall of mined out material to the east with coal being removed from a high wall which will progress westwards. Because of the geometry of the Mine and limited access on the low wall side of the mine, backfilling of each pit cannot commence until the box-cut and several overburden strips have been completed. The waste associated with this phase of mining will be hauled to out-of-pit dumps located east of the pits, within EPC1080. After that time, all pre-strip will be hauled to backfill dumps, using a series of endwall ramps.

Figure 2-24 Open Cut Mine Concept – Plan View



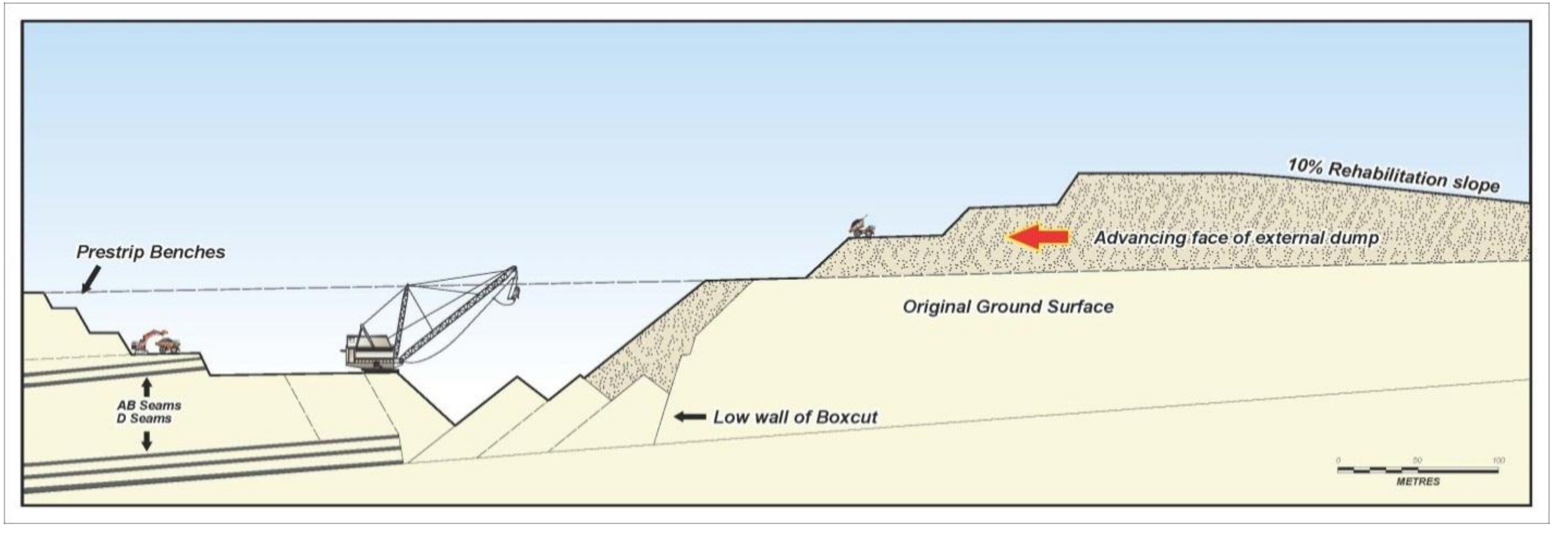
Source: Runge Limited 2011

Figure 2-25 Open Cut Mine Concept – Section A-A



Source: Runge Limited 2011

Figure 2-26 Diagrammatic Layout of Out-of-pit Disposal



Source: Runge Limited 2011

Much of the Tertiary and weathered Permian overburden is likely to be able to be dug with shovels and drag lines but some light blasting will be used to speed up excavation. Thin inter-burden and coal will be ripped with bulldozers as and pushed into windrows for loading onto trucks by front-end loaders. All blasting will be undertaken using ammonium nitrate/fuel oil (ANFO) and emulsion explosives. The maximum tonnage of explosives required per year is approximately 85,000 t. All ANFO and emulsion explosives will be stored in a dedicated secure bulk explosives facility with an associated high explosives magazine, located approximately 10 km to the south of the central mine infrastructure.

Trucks and equipment will access the open cut by ramps which will progress with depth and westward movement of mining, with a maximum length of approximately 2.5 km.

During the life of the Mine, there will be approximately 3 billion m³ of out-of-pit waste. The maximum height above the natural surface of the out-of-pit dumps is estimated to be 100 m. The outer face of the dumps will be profiled to a final rehabilitation gradient of 10 per cent / (6.3 degrees). The inner face will be dumped to angle of repose, and later re-profiled between 10 and 20 per cent to assist in rehabilitation of the final landform and mining voids. Approximately 88 per cent of the open cut waste will be placed into backfill in the open cut pits. This will include all of the dragline and inter-burden material. The profile of the mined area will rise gently to the east as the mine becomes deeper, with the maximum height expected to reach approximately 50 m above the natural surface.

Figure 2-8 to Figure 2-17 provides an outline of the mine progress over the life of mine.

2.11.5.2 Equipment Associated with Open Cut Mining Method

The open cut Mine will initially consist of a conventional dragline and truck-shovel pre-strip operation, with coal haulage by rear-dump haul truck to one of three ROM dump stations. In steady-state operations, draglines will expose the coal in a single seam 2-pass operation on the D seam. Once the upper D1 seam is exposed and mined, the underlying D2 and D3 seams will be exposed by the interburden in pit fleet or dozed in-pit and mined separately. Where the E and F seams are included in the block, these will also be exposed by the interburden fleet.

In the pre-strip horizon, the overburden will be excavated ahead of the dragline by backhoe excavators (up to 800 t) and / or Electric Rope Shovels, and hauled to out-of-pit dumps beyond the high-wall with RDT (up to ultra-class or 400 t). Much of the Tertiary and weathered Permian overburden is likely to be free-dig material, but it is planned that light blasting may be used to maintain productivity of digging.

The upper AB seams will be exposed by pre-strip as it descends to the fresh Permian horizon. There is sufficient thickness of fresh overburden in most areas of the Mine to support an efficient dragline operation. Once the box-cuts have been completed and sufficient room has been created to commence backfill dumping, the waste trucks will haul the waste into backfill via a series of end-wall ramps or via the highwall ramp and an out-of-pit haul road located in the adjacent pit area. In-pit bridges placed at dragline working level will not be used because the pits are too deep to allow this to remain productive.

Due to the depth of the box-cuts, backfill dumping of the pits cannot commence until pre-stripping is around five strips in advance of the box-cut. Over the life of the project, a total of four draglines will be required. These will be staged from 2016 on an individual basis as required, with three prior to 2027 and the fourth by 2074. The draglines will be constructed on a dragline construction area located adjacent to the scheduled point of first deployment. The first dragline pad will be located within the footprint of G Pit, and will be utilised until 2027.

The draglines will be used for primary stripping wherever possible to minimise the pit size and mining costs, but will be confined to the stronger Permian waste materials for geotechnical reasons. Large excavators and rear dump trucks will be used in the pre-strip to allow flexibility of mine sequencing and gain access to the deep box-cut. There may be opportunities in the future to optimise equipment sizes or incorporate continuous handling systems such as conveyors for waste haulage, and thereby minimise equipment numbers, labour and diesel consumption. In general, the complexity and depth of the operation restrict the application of large continuous systems over most areas of the mine.

The CAT 8750 dragline or equivalent with other manufacturers has been selected because it is the largest capacity dragline in common use in the Australian coal industry. The objective has been not only to minimise the size of the excavation required but to also limit the volume of truck-shovel pre-strip and minimise the number of draglines consistent with the planned rate of coal exposure.

Mid-size rear dump trucks have been selected for mining the coal and inter-burden so that they can negotiate the deep ramps and match the scale of the coal and inter-burden benches. The fleet size has been limited by providing overland conveyor haulage for the long flat hauls back to the CHPP.

In some areas, the mix of equipment sizes is not optimised because of competing needs. This is particularly the case with the coal fleet, where medium sized rear dump trucks have been selected, loaded by either mid-size backhoe excavators or large front-end-loaders, depending on face height. These have been selected in order to match the excavator size on the smaller coal benches (79 per cent of the coal is less than 3 m bench height) and to negotiate the spoil-side ramps. Bottom dump trucks have not been selected because of poor grade-ability and the possible poor pit conditions.

2.11.5.3 Major Equipment – Open Cut

Table 2-17 outlines an overview of the major equipment list, the unit type, make/model, capacity and application as selected during the conceptual design phase. The make and model is given to illustrate size of the machine. Final equipment types and capacities will be determined as mine planning and design progresses, however the equipment types listed in Table 2-17 are unlikely to change.

Table 2-17 Indicative Major Equipment List

Unit Type	Typical Make / Model	Capacity	Application
Main Waste			
Overburden drill	Sandvik DR460	270 mm diam.	Main waste drilling
Dragline	Marion M8750B	111 m^3	Main waste removal
Excavator	Liebherr R9800	800 t/42 m^3	Main waste loading
Excavator	CAT 6060	550t/34 m^3	Main waste loading
Rear-dump truck	Caterpillar 797F	370 t	Main waste haulage
Rear-dump truck	Caterpillar 793F	230 t	Main water haulage

Unit Type	Typical Make / Model	Capacity	Application
Secondary waste and coal			
Overburden drill	Sandvik D45KS	150-210 mm diam	Secondary waste drilling
Excavator	Liebherr 9350BH	300 t/ 17 m^3	Secondary waste loading
Front end loader	Caterpillar 994D	19 m^3	Backup and thin waste loading
Rear-dump truck	Caterpillar 789C	140 t	Secondary waste haulage
Coal Mining			
Coal drill	Sandvik D45KS	150 diam.	Coal drilling (if required)
Front end loader	Caterpillar 994D	31 m^3	Coal handling – thin seams
Excavator	Liebherr 9350BH	300 t/20 m^3	Coal loading – thick seams
Rear-dump truck	Caterpillar 789C	140 t	Coal haulage
Reject Haulage			
Rear-dump truck	Caterpillar 789C	140 t	Reject haulage, coal and inter-burden back up
Major ancillaries			
Bulldozer	Caterpillar D11T	634 kW	Waste face clean-up, dragline dozer, spoil dump maintenance, misc. construction, thin waste ripping
Bulldozer	Caterpillar D10T	433 kW	Coal face clean-up, road maintenance, misc. construction, thin coal and waste ripping
Rubber tyred dozer	Caterpillar 854G	597 kW	Coal and waste face clean-up, road maintenance, misc. construction
Grader	Caterpillar 24M	373 kW	Coal and waste face clean-up, road maintenance, misc. construction
Water truck	Caterpillar 789C	170 kl	Road maintenance, misc. construction

Note:
Model name is illustrative only to indicate size and type

2.11.6 Underground Mine Operations

Underground mining will augment production from the open cut operations. Three multi-seam underground mines will be developed progressively in the deeper areas of the deposit to the west of the open cut highwall. The underground mines will target the lower ash AB1 and D1 seams. Although the D2 and D3 seams present attractive underground working sections, their close proximity to the D1 seam may present technical problems. There may be opportunities to mine these seams as well as the thinner underlying E and F seams at a later time.

As outlined in Section 2.4.4, the objective of these mines is to increase resource recovery beyond the economic open cut mining limit and produce a low ash coal to improve the blend from the open cut without washing, or reduce the amount of washing required.

The underground mine consists of:

- Northern underground mine: installed with two longwall units
- Central underground mine: installed with three longwall units
- Southern underground mine

The longwall mining method will be used because of its ability to deliver a safe, high production rate and high resource recovery. Longwalls will be approximately 4.0 m to 4.5 m high. Thick seam mining is not proposed as the coal properties do not appear to be suitable.

Figure 2-27 provides a schematic of underground longwall mine operations. Longwall mining involves the use of a longwall shearer, which is a coal cutting machine with a rotating drums. The shearer moves back and forth across a wide part of the coal seam called the longwall face. The cut coal falls and is loaded onto the chain conveyor by the shearer. The chain conveyor then transports the coal to the conveyor belt for removal from the work area. Longwall systems have in-built hydraulic roof supports, which advance as mining progresses. The supports make possible high levels of production and ensure the safety of the operators. As the longwall mining equipment moves forward, overlying rock that is no longer supported by coal/hydraulic roof supports is allowed to fall behind the operation in a controlled manner. This is known as goaf.

The underground mines will be developed as separate operations, operating independently of the open cut. The proposed conceptual layout is based around longwall panels extending out on both sides of a centrally located set of main headings.

Access to all three underground mines will be located beyond the final highwall for the open cut, and each will have separate drift entry to both seams, and separate surface facilities (see Section 2.7. All coal from the underground mines will be transported from the pithead to the central coal handling plant (CHPP) by overland conveyor (OLC). Seam access for each mine will be via two inclined drifts, one providing drive in-drive out diesel vehicle access for personnel and materials and the other housing the conveyor coal clearance system.

Figure 2-27 Underground Longwall Mine Operations – Plan View

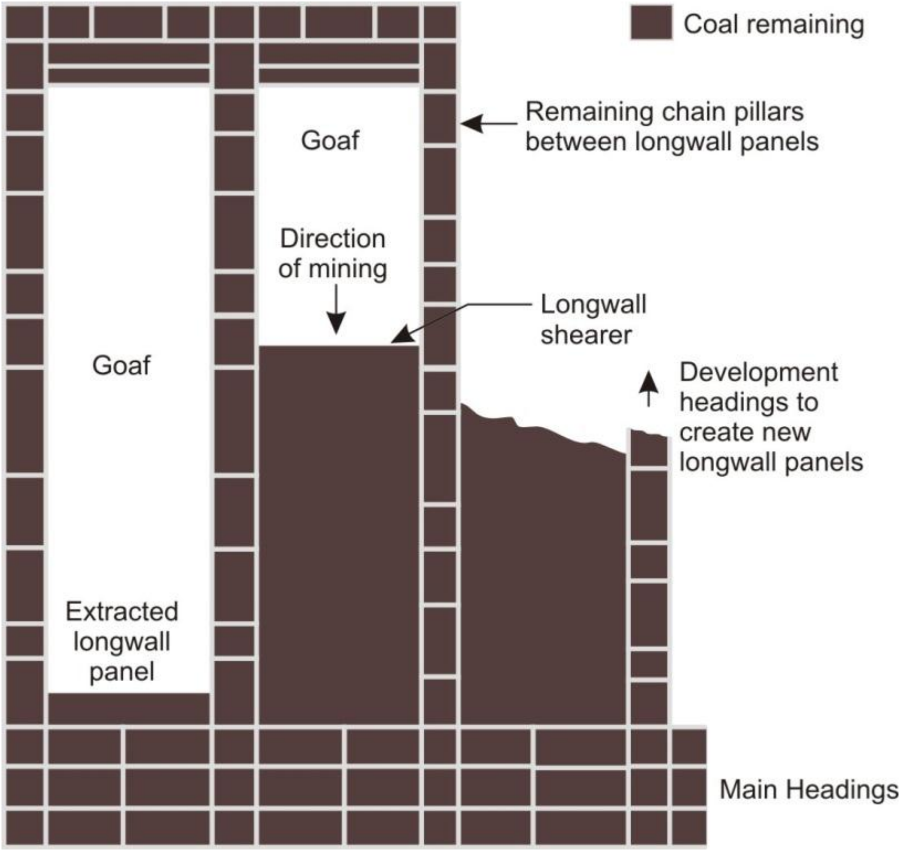
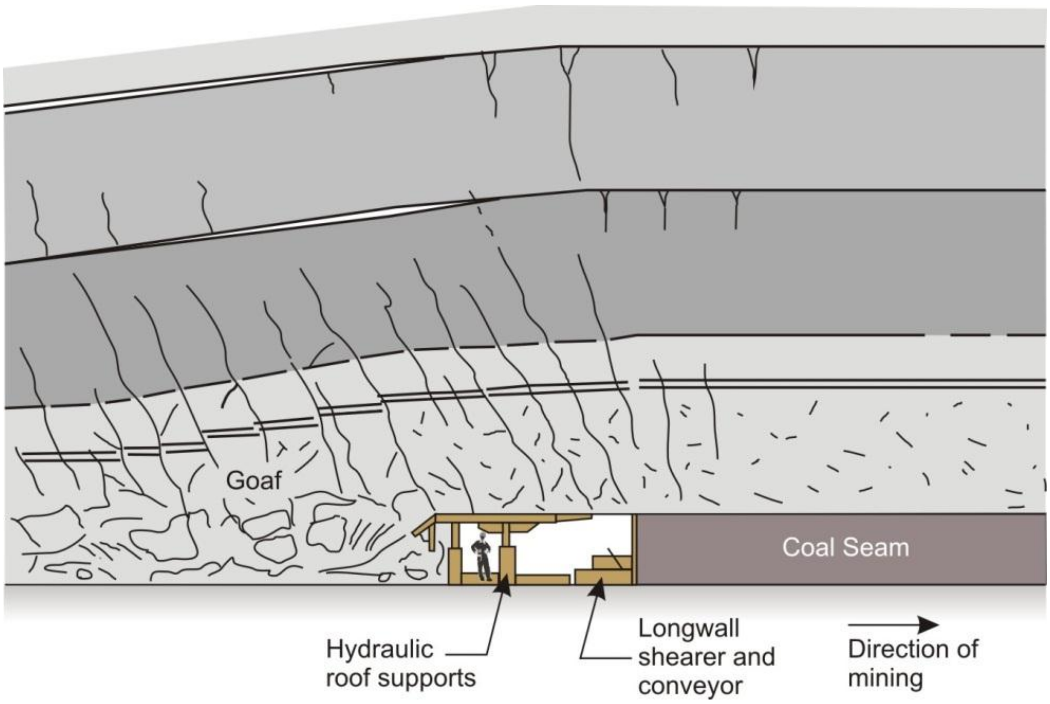


Figure 2-28 Underground Longwall Mine Operation – Section View



Initial development of the mine involves construction of a tunnel, known as a drift from the surface to intersect the target seams. Once the target depth has been reached, the main entrance to the mine, known as pit bottom, will be established and transportation and ventilation systems installed. Conveyors will be installed in the drift to bring coal to the surface, and roadways and other infrastructure requirements will also be established.

The main heading will then be driven in a north-east to south-west direction, following the seam and thus becoming deeper as it progresses.

The longwall panels are then developed progressively by driving parallel headings perpendicular to the main heading. These headings allow mining equipment to be introduced and the ventilation and conveyor systems to be installed. Mining of the longwall panels then progresses from the furthest extremity, back towards the main heading.

As two seams are targeted by underground mining, the upper AB1 seam will be targeted first and then a second layer of headings and longwall panels will be developed about two to three years after the upper layer has been mined to target the D1 seam. This will allow for subsidence from mining of the AB1 seam to have occurred and settled adequately.

The North underground mine will be developed first, with development of the central mine to follow immediately.

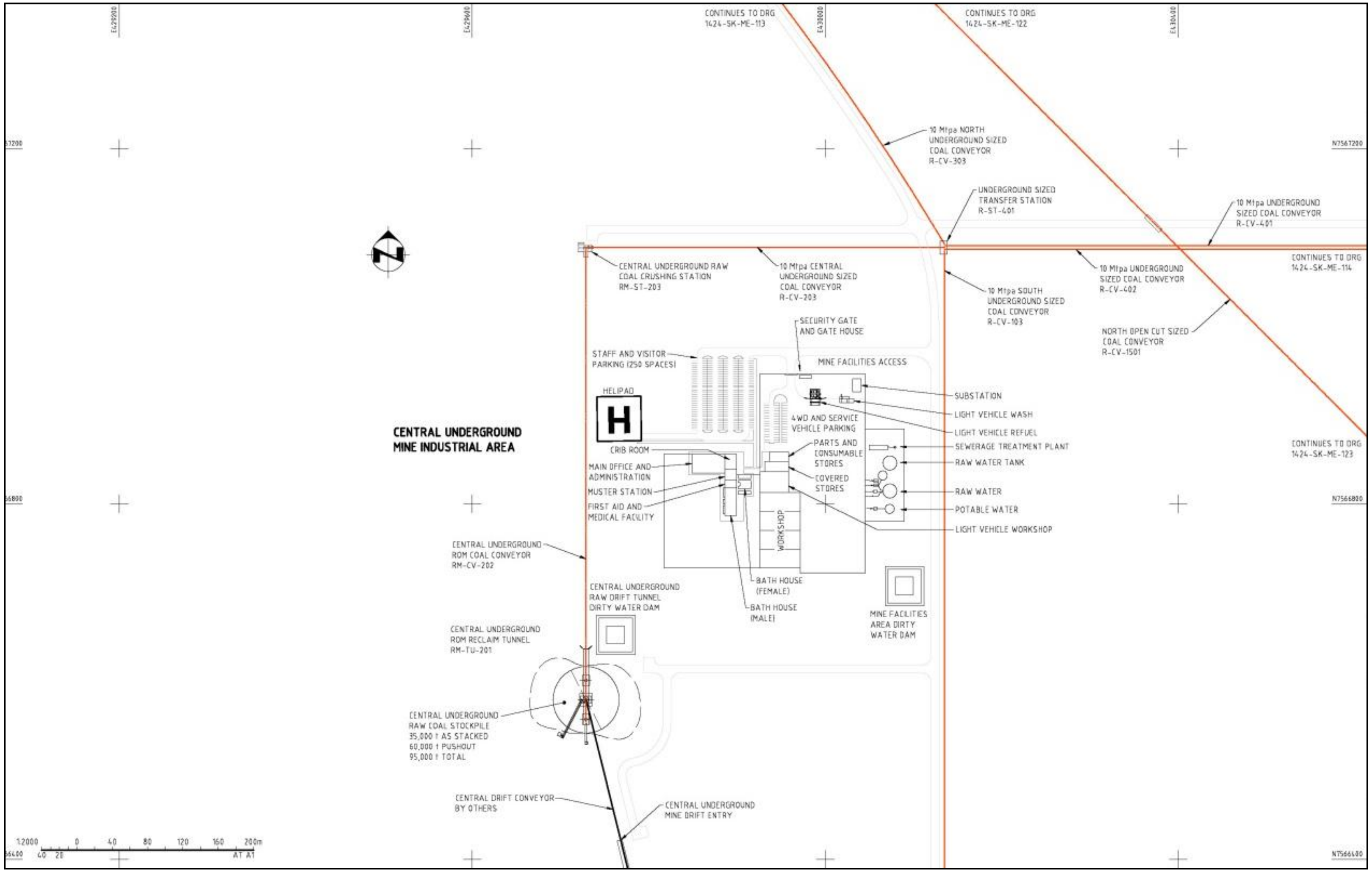
The underground mines will each have a separate pit-head ROM stockpile, where the coal will be reclaimed, sized and conveyed on an overland conveyor to an independent product coal handling stockpile adjacent to the central CHPP facility. Figure 2-29 shows a typical layout for the above ground infrastructure.

The initial underground mine design parameters include:

- Longwall face length of 300 m
- Planned longwall panel block length of 5,000 m
- Development face width of 5.2 to 5.8 m
- Two headings per gateroad panel
- Gateroad pillar dimensions (centre to centre) of 100 x 35 m
- 9 Headings mains panel
- Mains pillar dimension (centre to centre) of 70 x 50 m

Figure 2-7 to Figure 2-17 provides an outline of the mine progress over the life of Mine.

Figure 2-29 Typical Layout for Above Ground Infrastructure (Underground Mine)



Source: Runge Limited 2011

2.12 Mine Water Management

2.12.1 Mine Water Management

2.12.1.1 Approach

The mine water management system is based on segregation of water streams into clean, dirty and mine affected streams as follows:

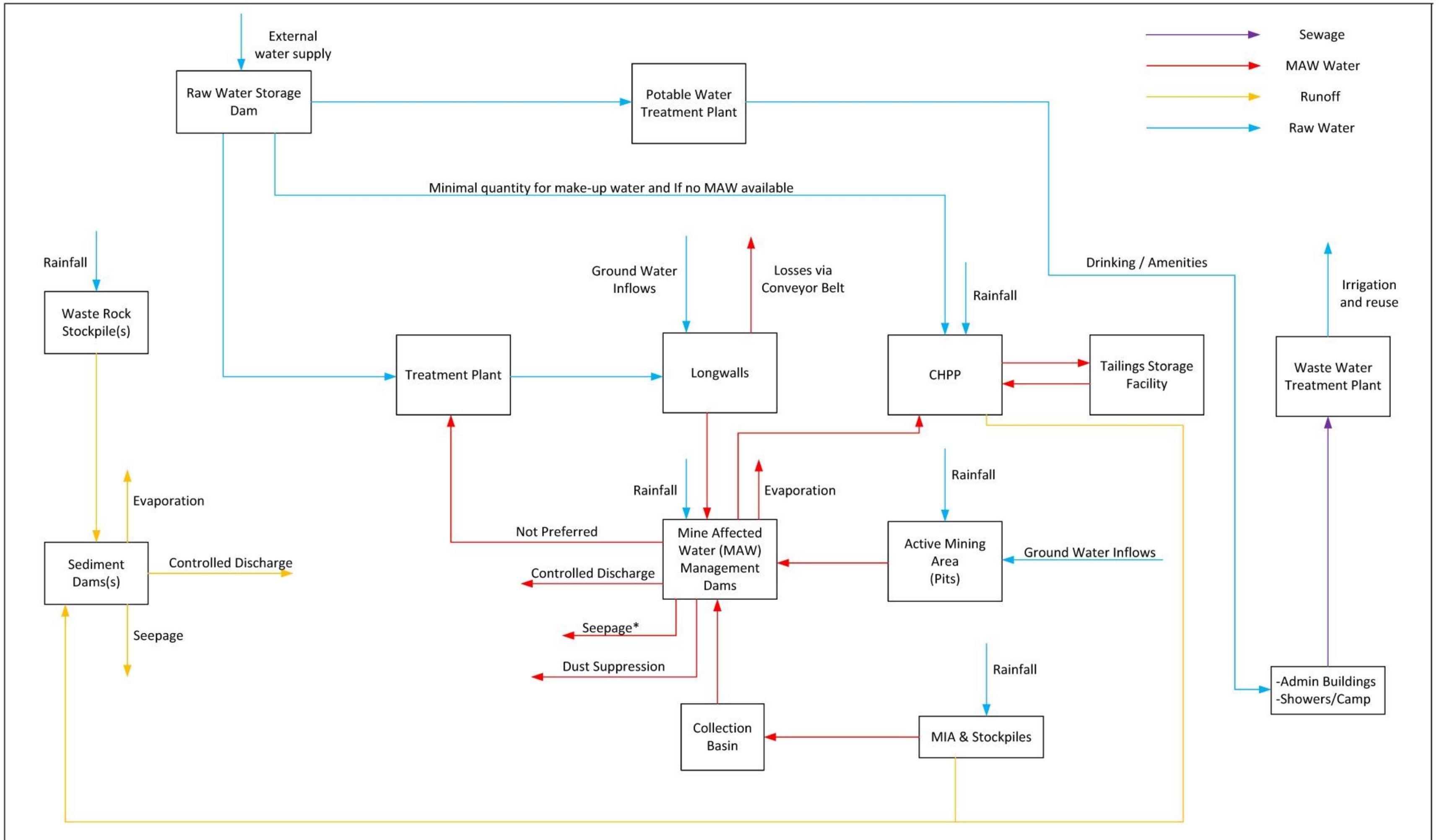
- Clean water streams will be waters that are unaffected by the mining or associated activities, and will include:
  - Water captured from undisturbed areas of the site, or
  - Water from catchments upstream of the proposed mine
  - Runoff from rehabilitated areas once rehabilitation criteria have been achieved with respect to vegetation cover and runoff water quality.
  - Groundwater from any advanced dewatering ahead of open cut or underground mining.
- Dirty water streams will be those that have come into contact with disturbed areas but not into contact with mining activities. This may include:
  - Stormwater runoff from waste dump areas where this contains sediment only
  - Stormwater from the MIA area that has not been in contact with coal, vehicle and equipment maintenance workshops, waste storage areas and fuel or chemical storage areas
- Mine affected water streams will consist of
  - Any water from direct dewatering of open cut pits or underground mines
  - Water that has been in contact with coal, including decant water from tailings storage facility, water from the coal processing plant and stormwater from coal stockpiles
  - Treated wastewater from sewage treatment plants
  - Runoff from vehicle and equipment maintenance areas, waste storage areas and fuel or chemical storage areas

Clean water will be managed by diverting around disturbed areas or disturbed areas, or conveying through the proposed mine in watercourse diversions. Where groundwater is produced from advanced dewatering, this may not be suitable for direct release to surface watercourses and will be stored in a dam for reuse or discharge under controlled conditions.

Dirty water will potentially be contaminated with sediment and will be directed to sediment dams where settlement will occur. Most sediment will be designed to capture flows up to the 1:20 AEP rain event. Water from any car parking areas or hardstand areas will also be directed through an oil/water separation system. Water from sediment dams may be used for dust suppression and other uses as required. Mine affected water will be directed to one of up to five mine affected water dams to be constructed in stages as the mine progresses (see Figure 2-31 to Figure 2-40). Mine affected water from the MIA areas will be passed through a sediment pond to allow coarse sediment to settle out.

Mine water management is presented schematically in Figure 2-30.

Figure 2-30 Mine Water Balance Schematic



*5% seepage has been included in the PWB model. Should further assessments predict that MAW water quality will pose environmental harm then dams will be lined to minimise this volume.

2.12.1.2 Mine Affected Water Management Infrastructure

The mine affected water dams (as shown in Figure 2-4) will receive mine affected water as defined in 2.12.1.1. These dams will become active as the mine progresses, as shown in Table 2-18. Design criteria are provided in Section 2.12.6.2.

Table 2-18 Water management dams versus mine stages

	2013	2014	2015	2016	2017	2027	2037	2047	2067	2103
Dam 1				Active	Active	Active	Active	Active	Active	Active
Dam 2	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active
Dam 3	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active
Dam 4							Active	Active	Active	Active
Dam 5								Active	Active	Active

The volumes of MAW dams have not yet been determined but will be based on a detailed water balance which will indicate the maximum storage required such that uncontrolled releases do not occur from the proposed mine in rain events below the 1,000 year AEP. Dam footprints will be in the order of 200-300 ha and wall height above ground level of 5 m. Additional volume will be achieved by excavating and Table 2-19 shows the net volumes possible in the five MAW storages at various design depths, indicating that a large volume of storage is available.

Table 2-19 Net Volumes Available for MAW Storage (ML)

Storage	Volume at 10 m storage depth (ML)	Volume at 15 m storage depth (ML)	Volume at 20 m storage depth (ML)	Volume at 25 m storage depth (ML)
1	16,696	24,756	32,626	40,310
2	17,300	25,656	33,819	41,792
3	15,962	23,662	31,176	38,507
4	17,193	25,575	33,816	41,915
5	24,820	36,878	48,704	60,301
Total volume (ML)	91,972	136,527	180,141	222,825

Note that the above volumes assume a 5 m high dam wall. (i.e. 15 m storage depth assume 5 m above ground and 10 m below ground storage)

Water from these storages will be reused in the coal handling process when possible. Water balance modelling has been undertaken to provide a means to investigate the adequacy of proposed mine affected water storage dam capacities to minimise the frequency of discharges from the mine site and to maximise reuse of mine affected water. The strategy for releases of mine affected water is discussed in Section 2.12.5.

There will be no catchment draining into the MAW dams and hence, the dams will not receive direct any surface runoff. It is not intended to allow the MAW dams to overflow, however if required to comply with the *Manual for Assessing Hazard Categories and Hydraulic Performance of Dams* (Queensland DERM 2012), spillways may be required. The MAW dams will be operated to maintain water levels below the mandatory reporting level as specified in this manual.

Preliminary hazard assessments have been undertaken against the DERM 2012 Manual, and are presented in Volume 4 Appendix P2 Preliminary Water Balance. The hazard rating is Significant for the "failure to contain" scenario and High for the "dam break" scenario. Therefore, in accordance with DERM 2012 manual, the initial MAW dams require provision for a design storage allowance in addition to the needs of normal operation storage requirements to allow for incident rainfall.

The MAW dams will also be subject to ongoing surveillance and maintenance under the DERM 2012 manual. Water quality will also be regularly monitored, including testing for acidity and metals. MAW dams will be decommissioned at closure of the mine (see also Section 2.15).

2.12.1.3 Dirty Water Management Infrastructure

Sediment basins will be constructed prior to the commencement of operations within the corresponding spoil areas to treat stormwater runoff from these areas. Diversion drains will be installed to prevent any water from undisturbed areas from entering into sediment basins.

Sediment basins will also be provided for that part of the MIA that is not in contact with coal. Oil water separators will also be provided where water has flowed over areas such as car parks and equipment park up areas where it may have come into contact with hydrocarbons.

Sediment basins will remain in place until the entire subcatchment draining to each basin has achieved the nominated rehabilitation criteria and then the need for the sediment basin will be evaluated against closure requirements. Where there is an environmental benefit in leaving a sediment dam in place, or where it may provide useful water supply for future grazing activities, the basin may be left in place.

Sediment basins will be designed to overflow in events up to the 20 year AEP rain event. Overflow will be to either an adjacent diversion drain or a creek and energy dissipation and scour protection will be provided so that erosion is minimised. Outflows will be controlled by a weir, with bunds and embankments established to provide 0.5 m freeboard above the spillway design flow rate water surface level.

Each basin will have a nominal pool depth of 2 m, allowing up to 1 m depth for the accumulation of captured sediment. Modelling has been undertaken to test the effectiveness of sediment basins in capturing sediment in runoff from spoil areas and to determine the size requirements to achieve adequate retention of sediment and water. Indicative sediment basin sizes to achieve water quality objectives in downstream environments are shown in Table 2-20.

A preliminary assessment of hazards associated with the proposed sediment dams has been undertaken against the *Manual for Assessing Hazard Categories and Hydraulic Performance of Dams* (Queensland DERM 2012). The hazard rating is "low" for the "failure to contain" scenario and "low" for the "dam break" scenario for each of the thirteen sediment basins. Neither do the basins meet the 8 m embankment height trigger that would require the application of a Minimum Hazard Category. Regardless, sediment dams will require routine surveillance and maintenance, including maintenance to remove accumulated sediment. Accumulated sediment will be placed in spoil disposal areas.

Water quality in the sediment dams will also be routinely monitored.

Table 2-20 Sediment Basin Parameters

Basin	Surface Area x 1000 m2	Extended Detention Depth (m)	Permanent Pool Volume x 1000 m3	Basin Width (m)	Basin Length (m)
N1	251	0.5	251	289	868
N2	217	0.5	217	269	807
N3	385	0.5	385	358	1,075
N4	158	0.5	158	229	688
N5	95	0.5	95	178	534
N6	137	0.5	137	214	641
N7	154	0.5	154	227	680
N8	119	0.5	119	199	597
S1	274	0.5	274	302	907
S2	139	0.5	139	215	646
S3	135	0.5	135	212	636
S4	146	0.5	146	221	662
S5	208	0.5	208	263	790

2.12.1.4 Clean Water Management Infrastructure

While existing water courses will be retained wherever possible, watercourse diversions will be required to divert clean water around the open cut and spoil dump areas both to provide flood immunity to the site and to minimise the volume of mine-affected water requiring treatment before discharge. For the purposes of conceptual design, diversion drains are categorised as follows:

- External diversion drains - These are located outside of the mine affected area (but within the MLA) and are constructed in phases depending upon mining activity and to last for the life of the mining activity in that area. They will also be maintained and integrated into the rehabilitation plan for the mine site. A case study design for one of these external diversion drains is described here in order to demonstrate indicative sizing. Sizing of the remainder of the proposed external diversion drains will be required in further stages of design; and
- Internal diversion drains and bunds - These are located within the MLA and are constructed as required to provide required flood mitigation. These will require relocation or replacement as the mine plan advances to allow for the progression of the open cut mining footprint and to ultimately ensure alignment and compliance with final landform and drainage requirements. The diversion drains are expected to remain after the mine operations have ceased. Due to the open cut pits and waste rock stockpiles the natural waterways cannot be restored. It is also expected that the diversion drains will develop their own environmental values during the many years they will be required that would be destroyed by reinstating the previous natural waterway.

Summary figures are provided showing the progression of the drainage scheme across the mine life for the selected mine staged mine plans (references Figure 2-31 to Figure 2-40). Design criteria have been established for diversion drains required to redirect surface water away from mine affected areas and are presented in Section 2.12.6.3.

Drain discharge points have been designed to closely mimic existing drainage paths and maintain inflows to waterways to the east of the mine. The preliminary conceptual design of a single diversion drain has been undertaken and is presented in Volume 4 Appendix P Mine Hydrology Report to demonstrate diversion drain design and function.

The other key aspect of clean water management relates to flooding of the pits, particularly from the Carmichael River and Eight Mile Creek. Levees are proposed to protect pits from flooding with a design criteria of the 1,000 year AEP rain event adopted. A preliminary flood study was undertaken and is discussed in Volume 2 Section 6 Water Resources. Indicative levee locations are shown in Figure 2-31 to Figure 2-40.

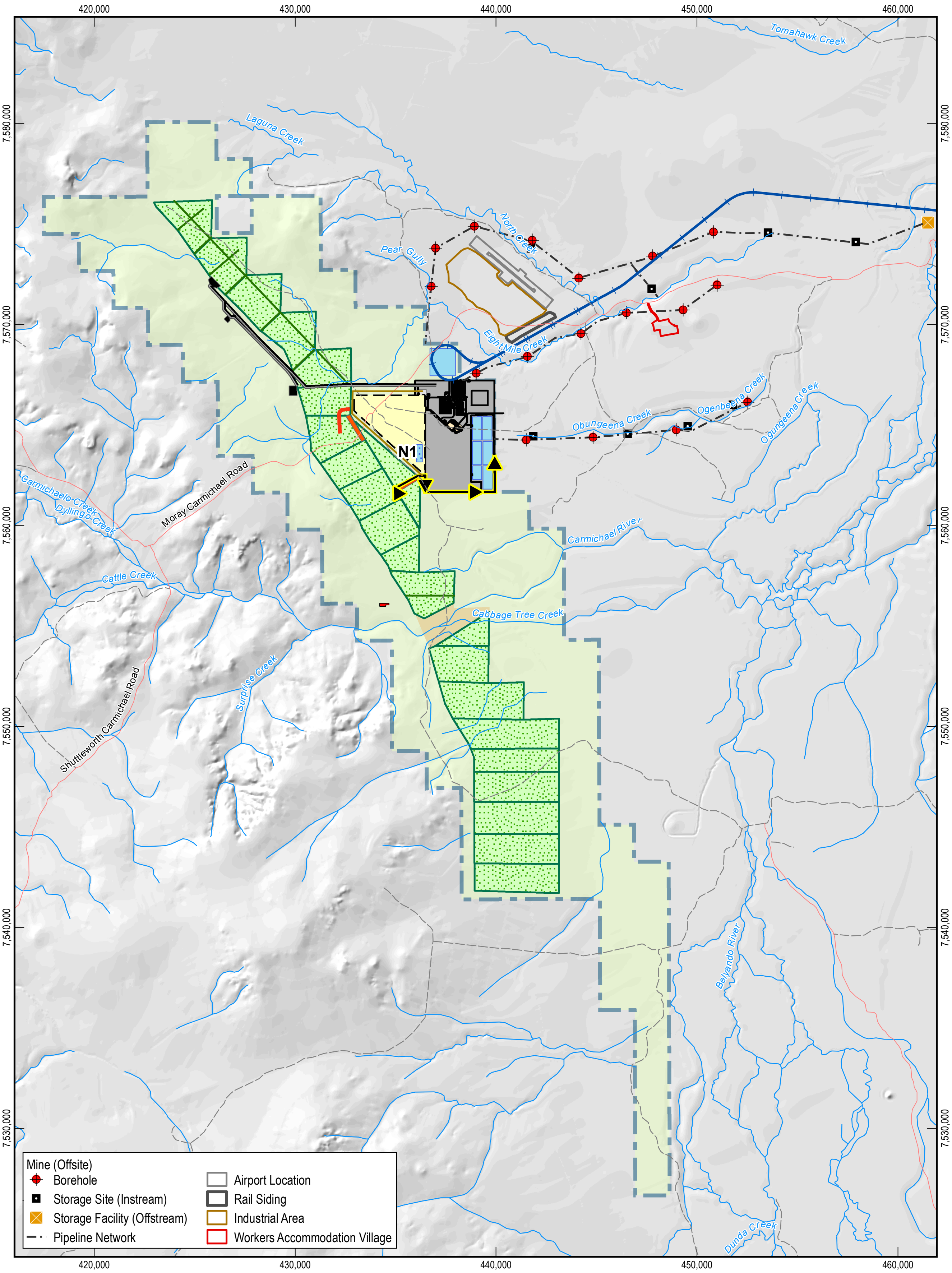
Major levees either side of the Carmichael River corridor are included from year 2047 (southern levee) and 2067 (northern levee). These are wrapped around active open cut pits and out-of-pit waste dump areas to protect the mine from river flooding, while allowing flows to enter the head of the Cabbage Tree Creek effluent flow path. The design criteria requires the levee to provide 1,000 year ARI flood immunity to the open cut pits, and 100 year ARI immunity to the waste dump areas. No immunity was required for the underground mining areas. For this reason the alignment was chosen to curve around the open cut pits and waste dump areas to provide protection from local overland flow as well as flooding from the Carmichael River. The alignment was also designed to allow for the effluent flow path from the Carmichael River into Cabbage Tree Creek.

The hydraulic model of the Carmichael River under developed conditions was used to determine the design levee height. The model was run for the 1,000 year ARI design event with infinitely high levees in place. The levee height was then calculated as the 1,000 year ARI water level plus freeboard. For the northern Carmichael River levee the height of the levee above natural ground level averages approximately 2 m with a maximum height of 6.08 m. For the southern Carmichael River levee the height of the levee above natural ground level averages at approximately 2 m with a maximum height of 3.4 m

Flood modelling also indicates that minor levees may be needed to protect open cuts areas from flooding of minor waterways at various stages of mine progress as follows:

- Inflows to Eight Mile Creek in the earlier stages of the mine life (see Progress Plot – Year 2014 to Year 2017).
- Either side of Eight Mile Creek inflow at the eastern edge of the active mine areas so as to safely pass the existing waterway between out of pit waste dump areas (see Year 2015 onwards).
- Local waterways crossing the northwest corner of the active mine areas (see Year 2027).
- Bottom south east corner of active mine areas (see Year 2067).
- Other minor levees as necessary to protect open cut pits and other infrastructure from local runoff (all years).

Flood immunity standards are provided in Section 2.12.6.1. Design requirements for levees are provided in Section 2.12.6.2. Further details in regard to management of surface water flows is provided in Volume 4 Appendix P Mine Hydrology Report.



LEGEND

- Local Road
- Track
- Watercourse
- Overland Conveyors
- Levee
- Rail (West)
- Proposed Diversion
- Active Mining Area
- Out of Pit Waste Dumps
- Water Management Dams
- Sediment Basins
- Open Cut Blocks
- Mine (Onsite)

1:270,000 (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

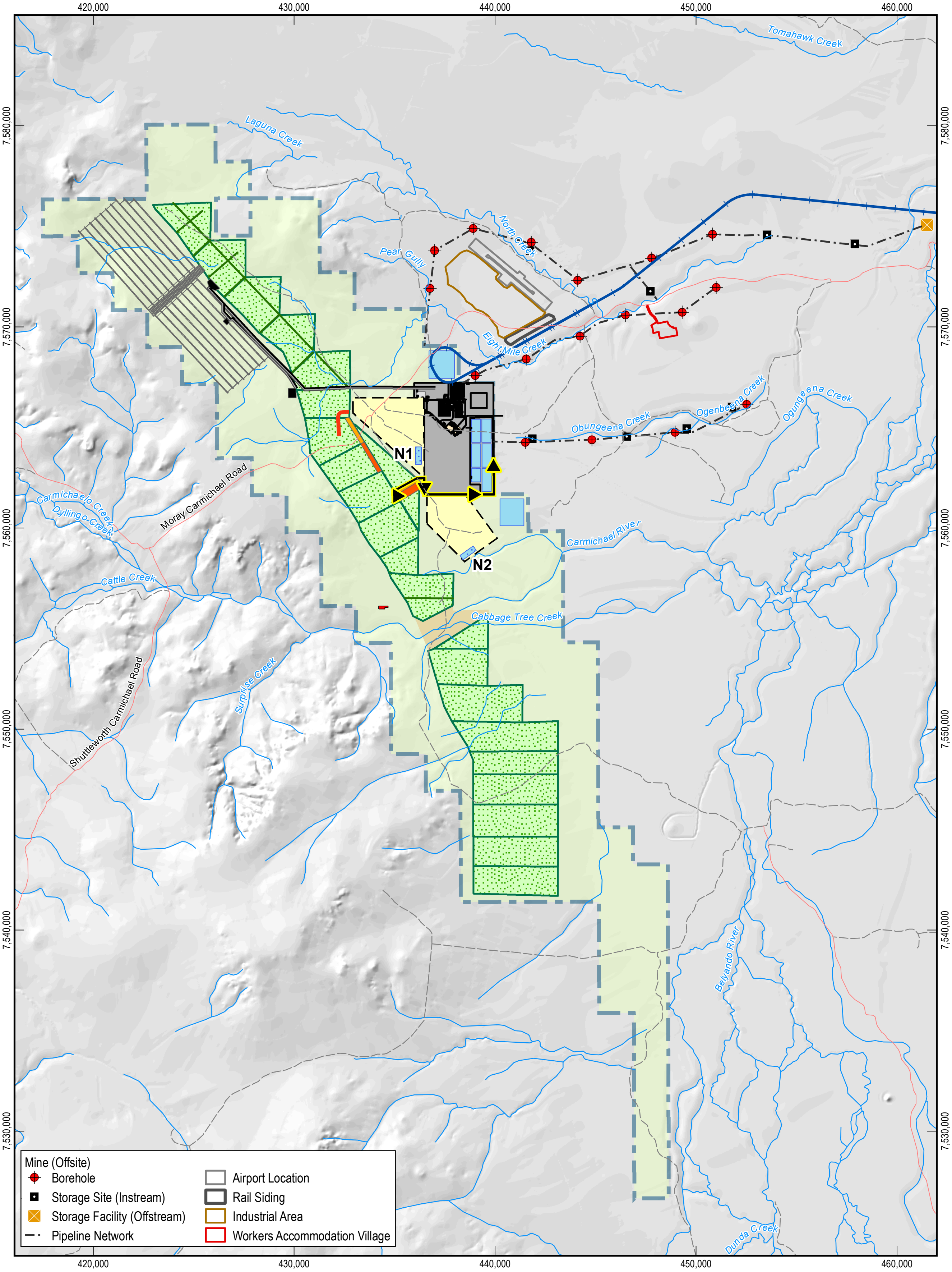
Job Number 41-25215
Revision A
Date 16-11-2012

Diversion Drain Layout Progress Plot - Year 2013

Figure 2-31

Level 4, 201 Charlotte 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: Roads, Watercourse (2007); GHD: Creek Crossings, Levees, Sediment Basins, Diversions (2012);
Adani: Alignment Opt9 Rev3 (2012), Mine Layout/Infrastructure (2012); Gassman/Hyder: Mine (Offsite) (2012); DME: EPC1690 (2010), EPC1080 (2011). Created by: TH, CA



LEGEND

- Local Road
- Track
- Watercourse
- Overland Conveyors
- Levee
- Proposed Diversion
- Rail (West)
- Active Mining Area
- Disturbed Mining Area
- Out of Pit Waste Dumps
- Open Cut Blocks
- Water Management Dams
- Sediment Basins
- Mine (Onsite)

1:270,000 (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

Job Number 41-25215
Revision A
Date 16-11-2012

Diversion Drain Layout Progress
Plot - Year 2014

Figure 2-32

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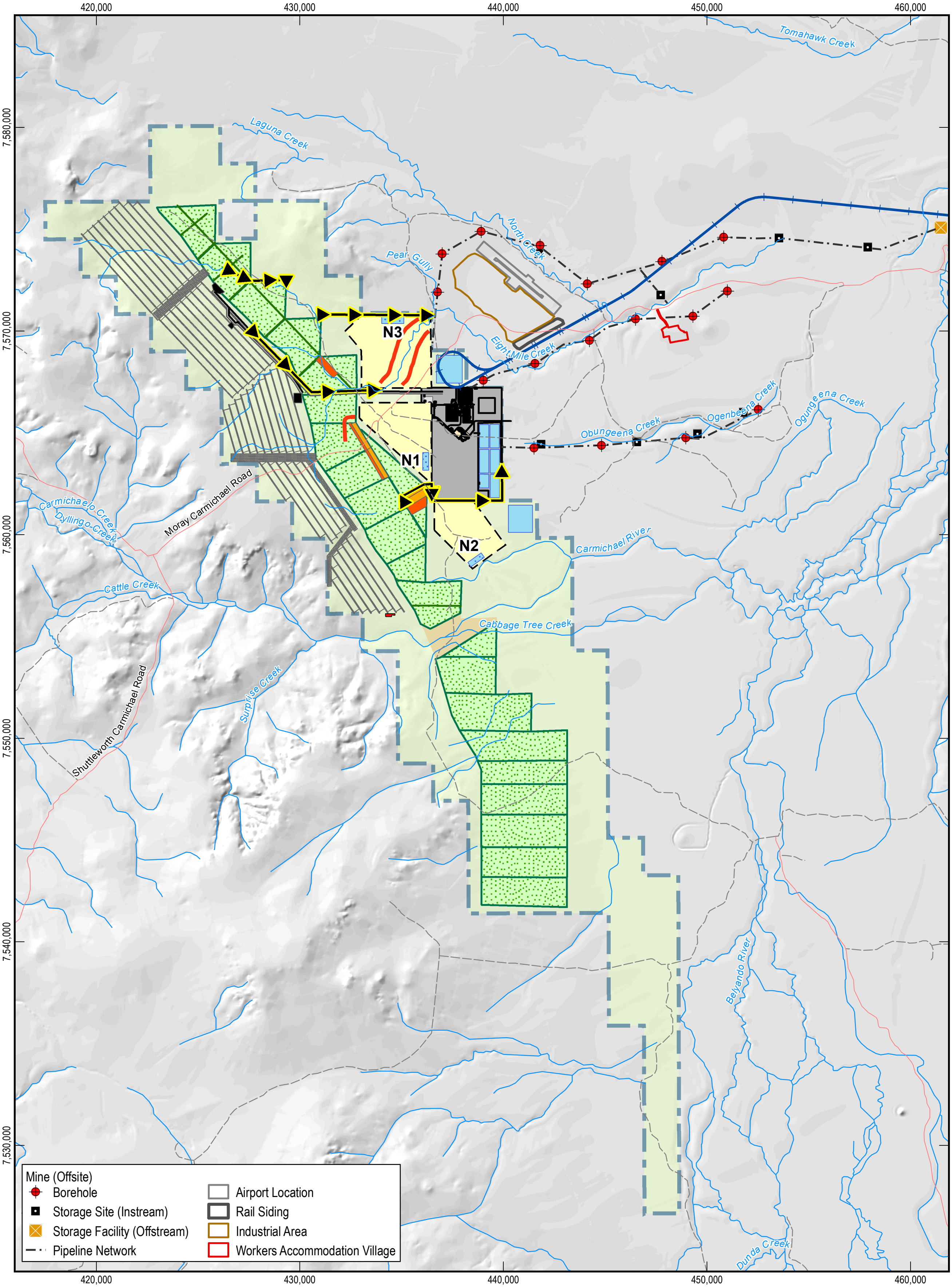

LEGEND

- Local Road
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- Levee
- Proposed Diversion
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- Active Mining Area
- Disturbed Mining Area
- Out of Pit Waste Dumps
- Open Cut Blocks
- Water Management Dams
- Sediment Basins
- Mine (Onsite)

1:270,000 (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

Job Number 41-25215
Revision A
Date 16-11-2012

Diversion Drain Layout Progress
Plot - Year 2015

Figure 2-33

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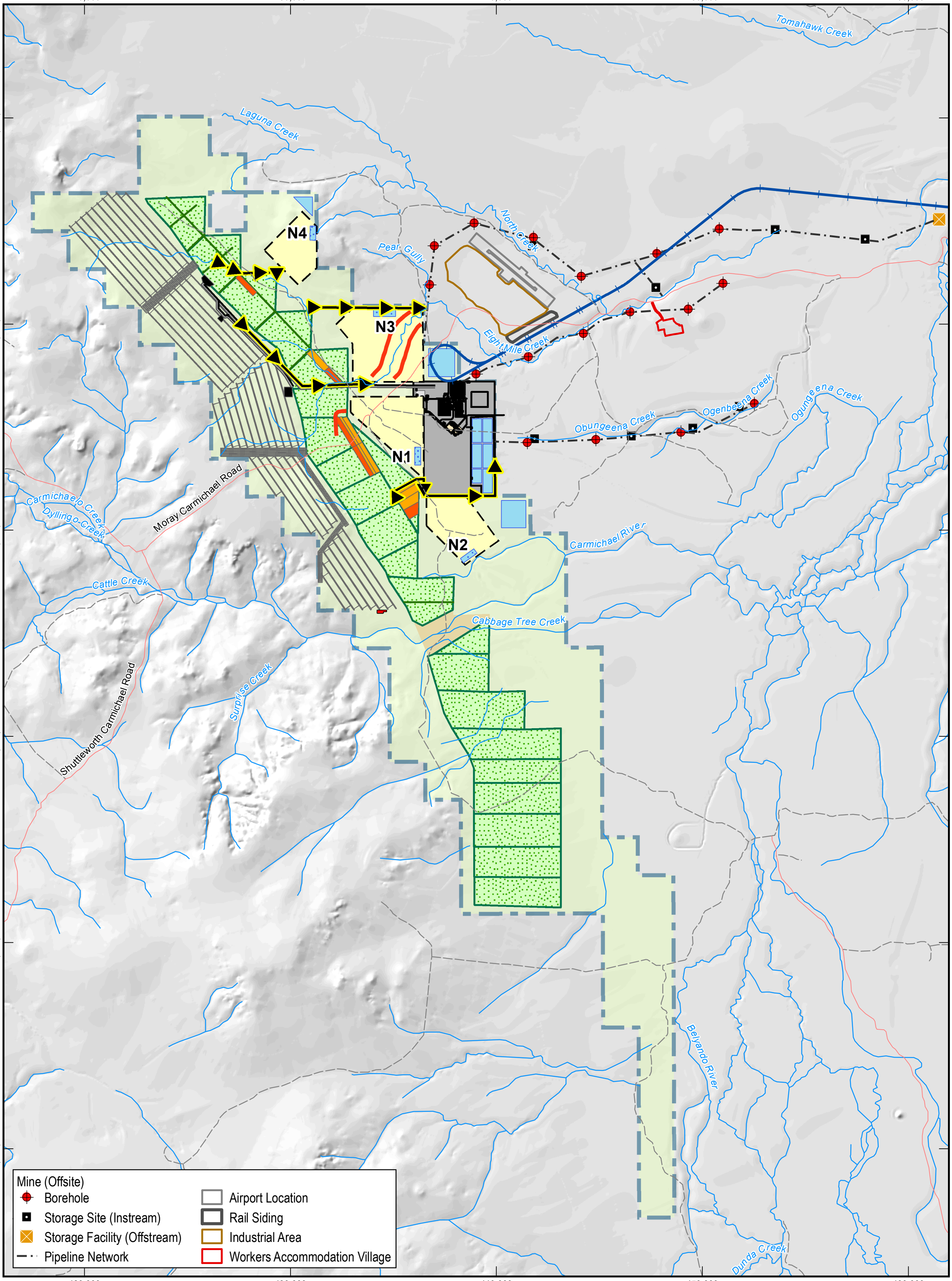

LEGEND

- Local Road
- Track
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- Active Mining Area
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- Out of Pit Waste Dumps
- Open Cut Blocks
- Water Management Dams
- Sediment Basins
- Mine (Onsite)

1:270,000 (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

Diversion Drain Layout Progress
Plot - Year 2016

Job Number 41-25215
Revision A
Date 16-11-2012

Figure 2-34

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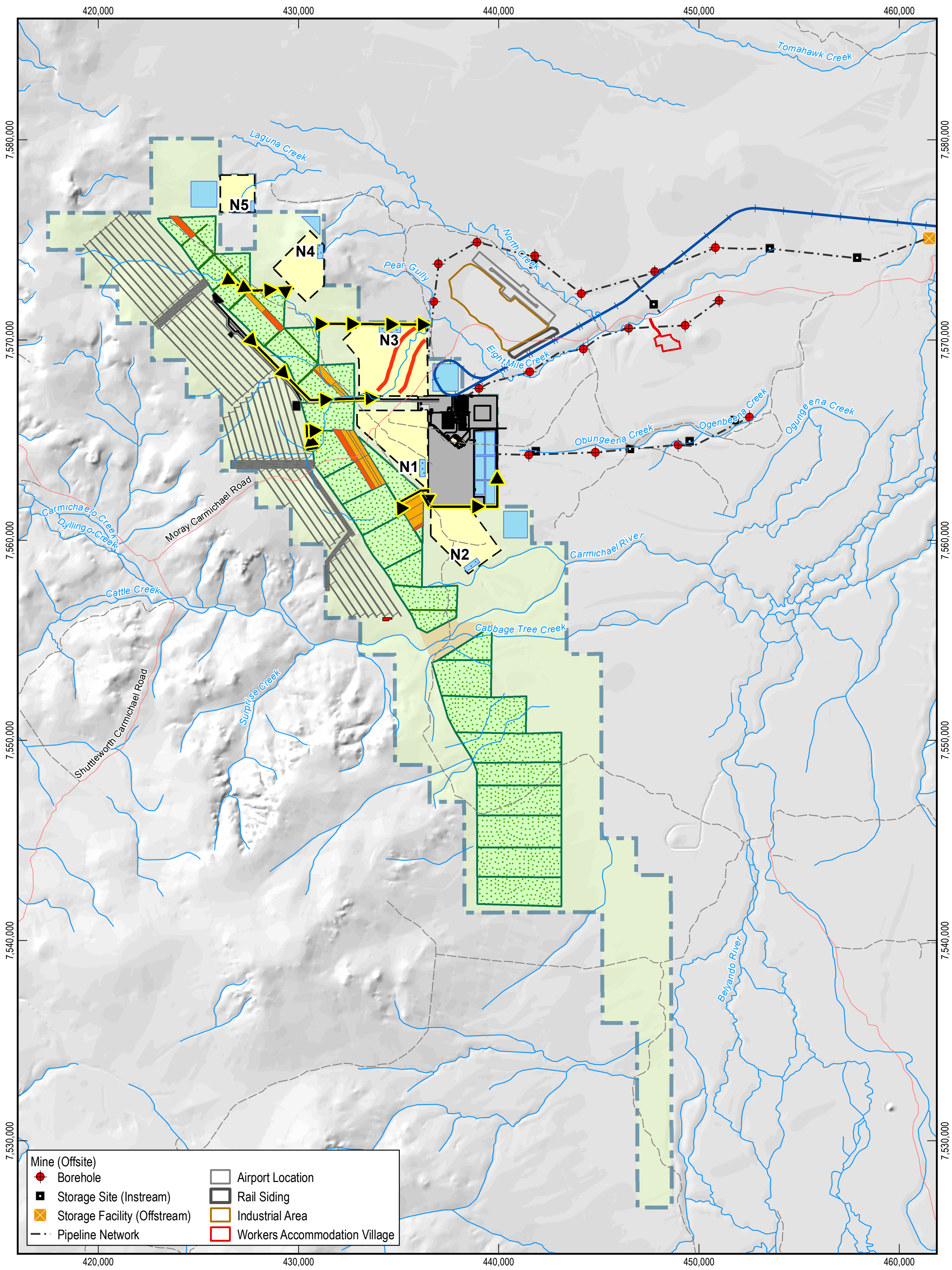

LEGEND

- Local Road
- Track
- Watercourse
- Overland Conveyors
- Levee
- Proposed Diversion
- Rail (West)
- Active Mining Area
- Disturbed Mining Area
- Out of Pit Waste Dumps
- Open Cut Blocks
- Water Management Dams
- Sediment Basins
- Mine (Onsite)

1:270,000 (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

GHD adani

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project

Job Number 41-25215
Revision A
Date 16-11-2012

Diversion Drain Layout Progress
Plot - Year 2017

Figure 2-35

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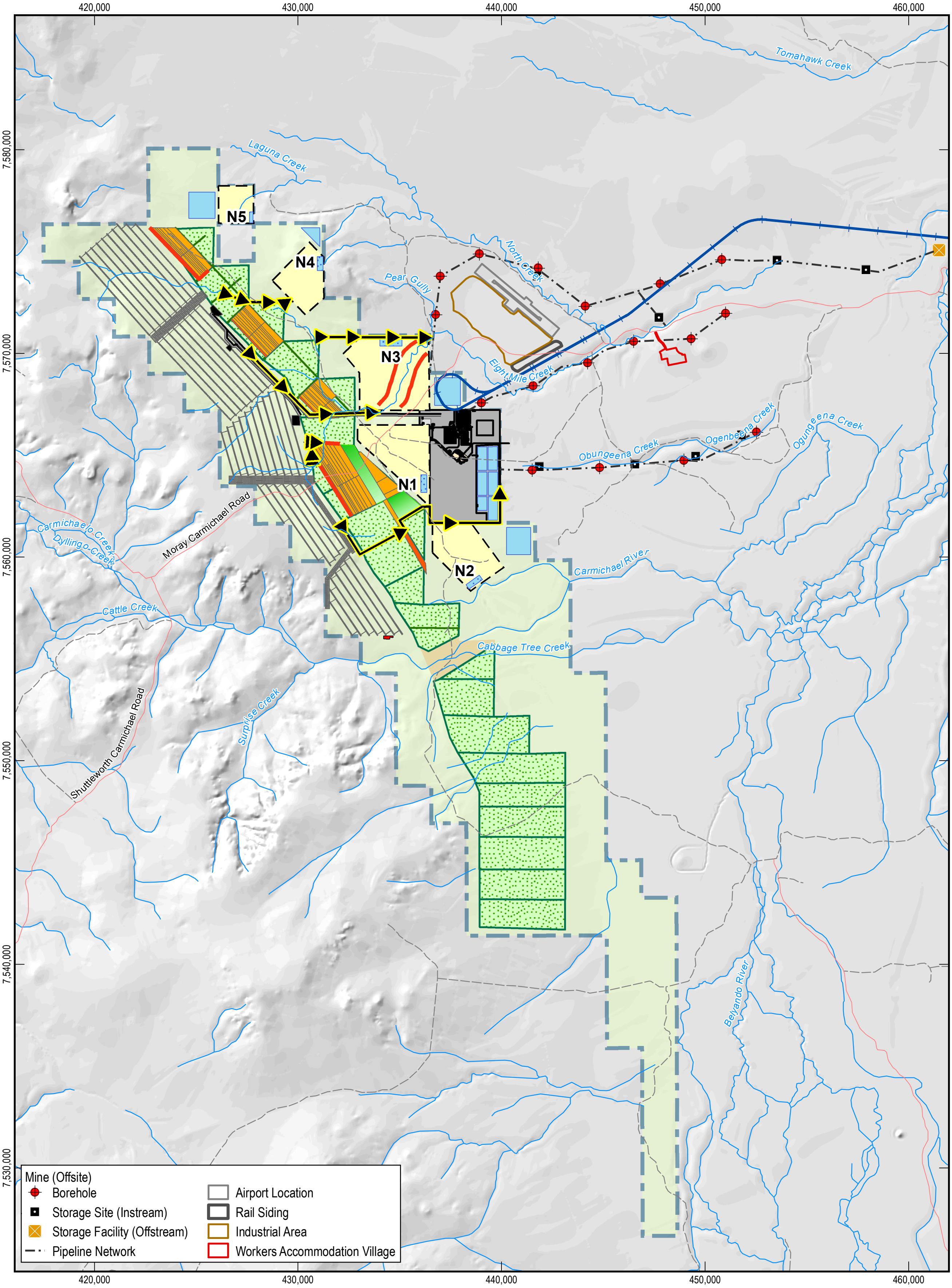

LEGEND

Local Road	Levee	Active Mining Area	Open Cut Blocks
Track	Proposed Diversion	Disturbed Mining Area	Water Management Dams
Watercourse	Rail (West)	Area Under Rehabilitation	Sediment Basins
Overland Conveyors		Out of Pit Waste Dumps	Mine (Onsite)

1:270,000 (at A4)

0 2 4 6 8 10

Kilometres

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

Diversion Drain Layout Progress
Plot - Year 2027

Job Number 41-25215
Revision A
Date 16-11-2012

Figure 2-36

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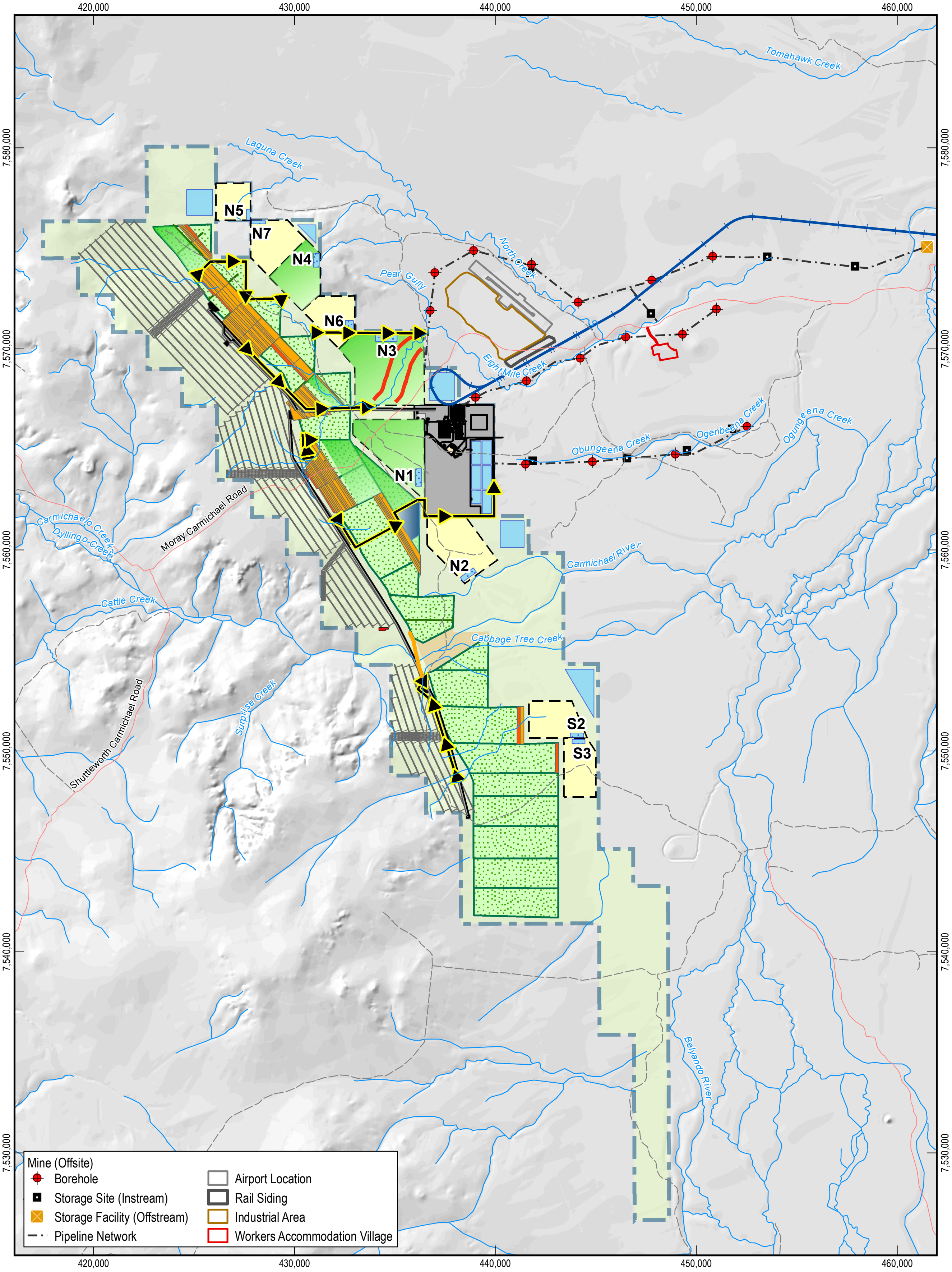

LEGEND

Local Road	Haul Rd & Conveyor Crossing	Active Mining Area	Open Cut Blocks
Track	Levee	Disturbed Mining Area	Water Management Dams
Watercourse	Proposed Diversion	Area Under Rehabilitation	Sediment Basins
Overland Conveyors	Rail (West)	Out of Pit Waste Dumps	Mine (Onsite)

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0 2 4 6 8 10

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
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GHD adani

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project

Job Number 41-25215
Revision A
Date 16-11-2012

Diversion Drain Layout Progress
Plot - Year 2037

Figure 2-37

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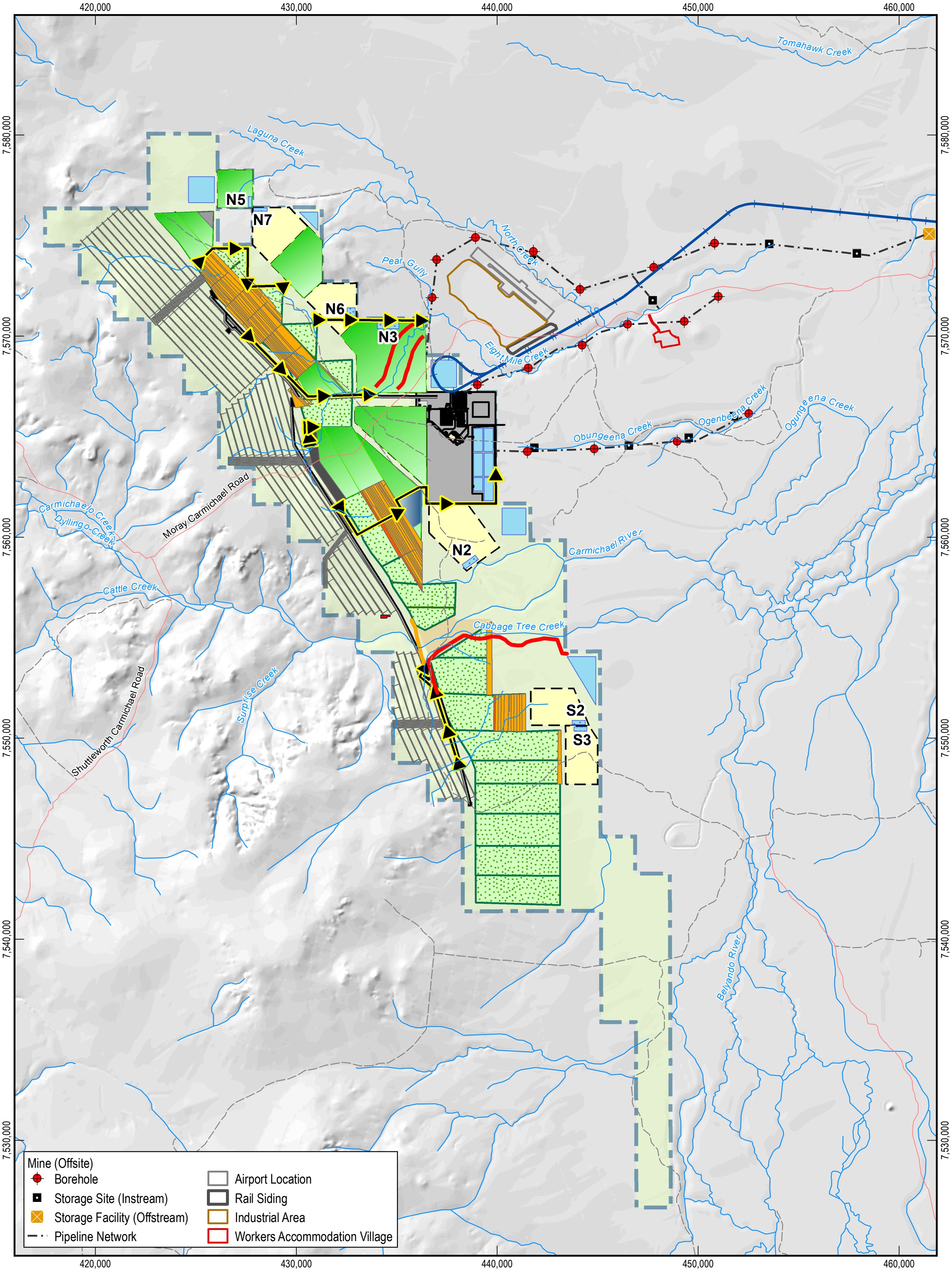

LEGEND

Local Road	Haul Rd & Conveyor Crossing	Active Mining Area	Open Cut Blocks	Remediated Void
Track	Levee	Disturbed Mining Area	Water Management Dams	Void
Watercourse	Proposed Diversion	Area Under Rehabilitation	Sediment Basins	
Overland Conveyors	Rail (West)	Out of Pit Waste Dumps	Mine (Onsite)	

1:270,000 (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

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Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project

Job Number | 41-25215
Revision | A
Date | 16-11-2012

Diversion Drain Layout Progress Plot - Year 2047

Figure 2-38

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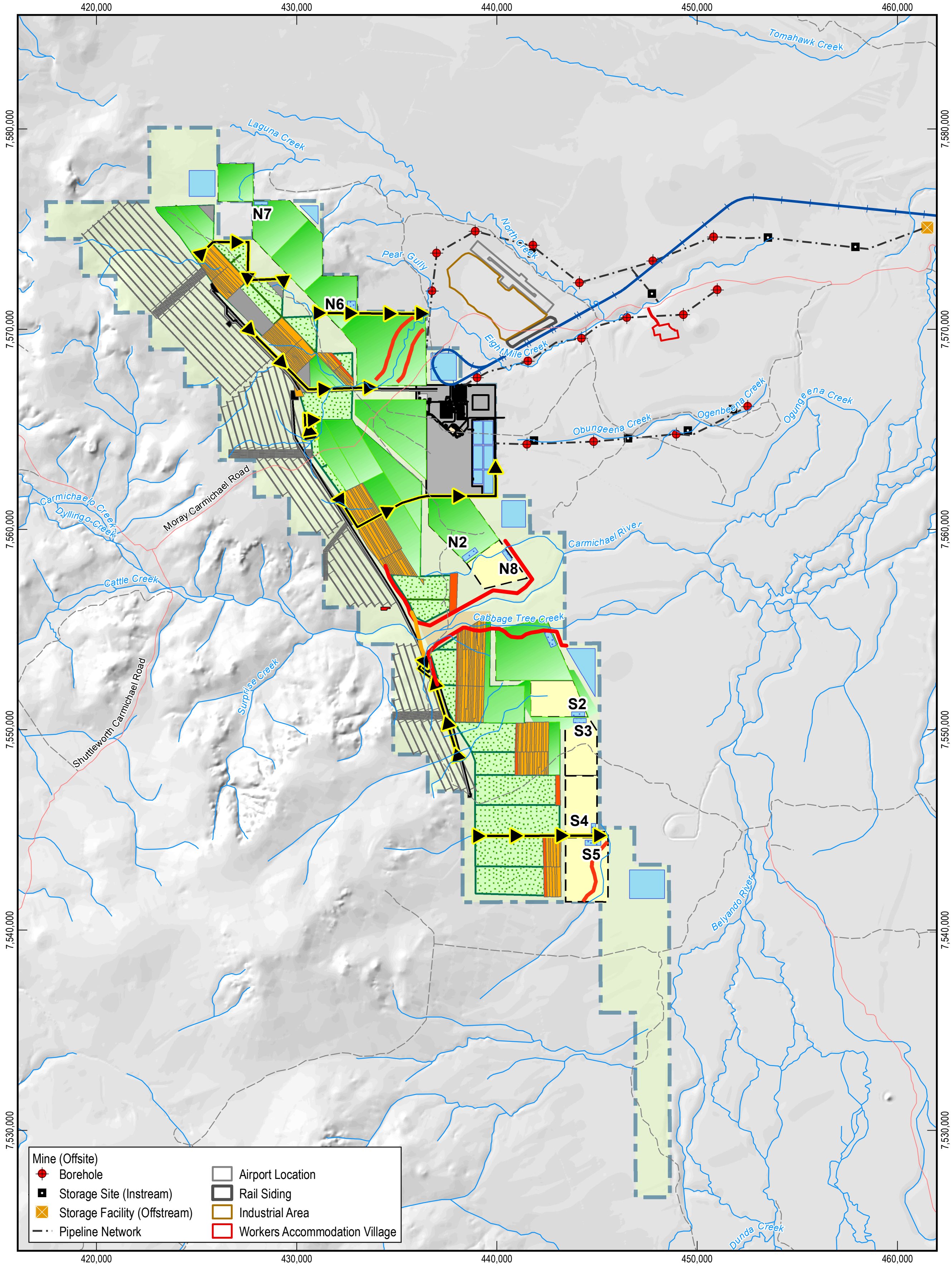

LEGEND

Local Road	Haul Rd & Conveyor Crossing	Active Mining Area	Open Cut Blocks	Remediated Void
Track	Levee	Disturbed Mining Area	Water Management Dams	
Watercourse	Proposed Diversion	Area Under Rehabilitation	Sediment Basins	
Overland Conveyors	Rail (West)	Out of Pit Waste Dumps	Mine (Onsite)	

1:270,000 (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

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GHD adani

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project

Diversion Drain Layout Progress Plot - Year 2067

Job Number 41-25215
Revision A
Date 16-11-2012

Figure 2-39

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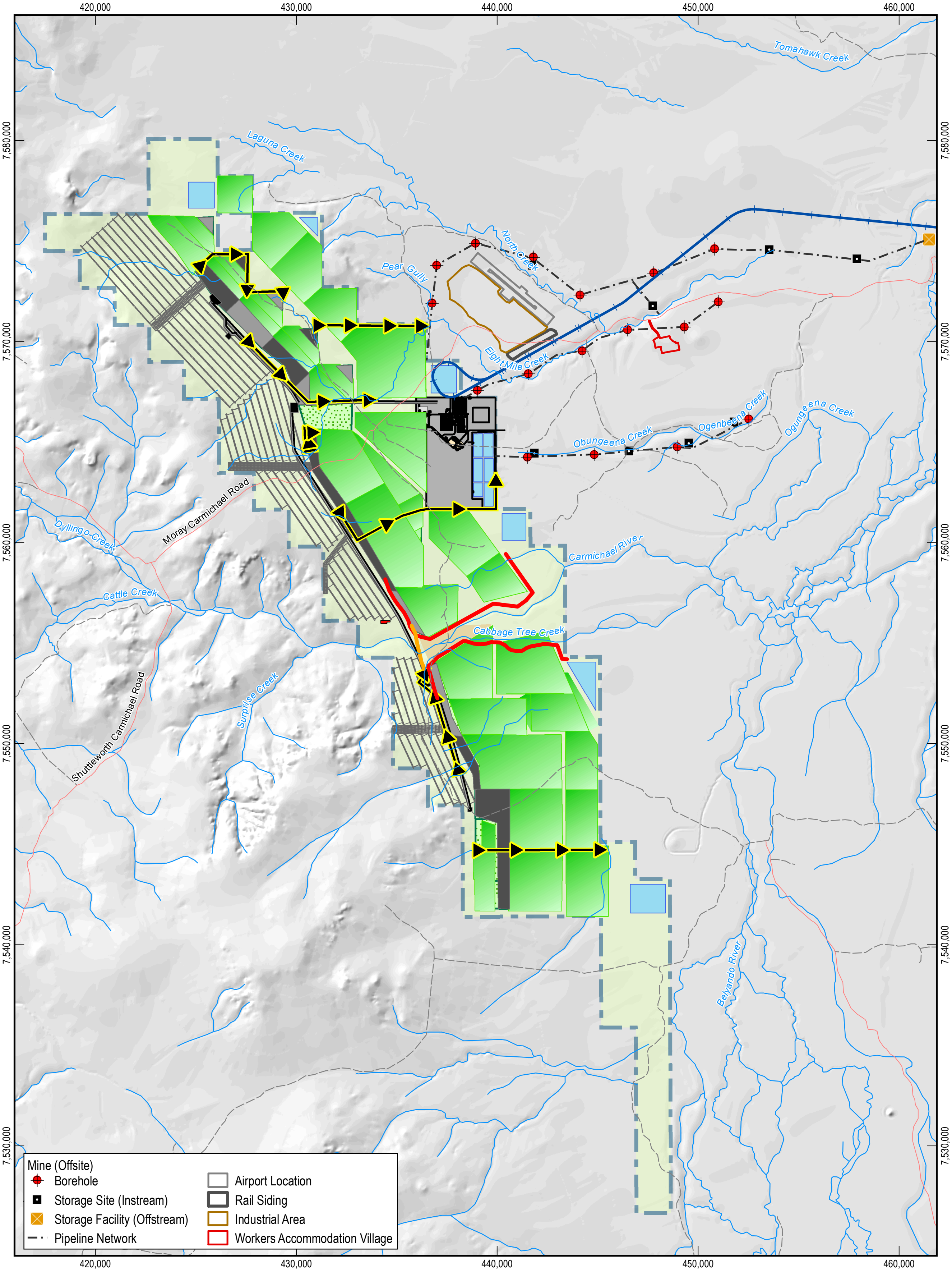

LEGEND

Local Road	Haul Rd & Conveyor Crossing	Void	Open Cut Blocks
Track	Levee	Remediated Void	Mine (Onsite)
Watercourse	Proposed Diversion	Area Under Rehabilitation	
Overland Conveyors	Rail (West)	Water Management Dams	

1:270,000 (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

GHD adani

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project

Job Number 41-25215
Revision A
Date 16-11-2012

Diversion Drain Layout Progress
Plot - Year 2103

Figure 2-40

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2.12.2 Water Demand Requirements

To support the mine, a constant and secure water supply is needed throughout the life of the project. The required water supply and demand was developed during the project feasibility. A further review of this assessment based on other coal mine operations, industry standard practices, and new information regarding coal washing and dust suppression, has been completed and a summary is included in this section.

Water is required for:

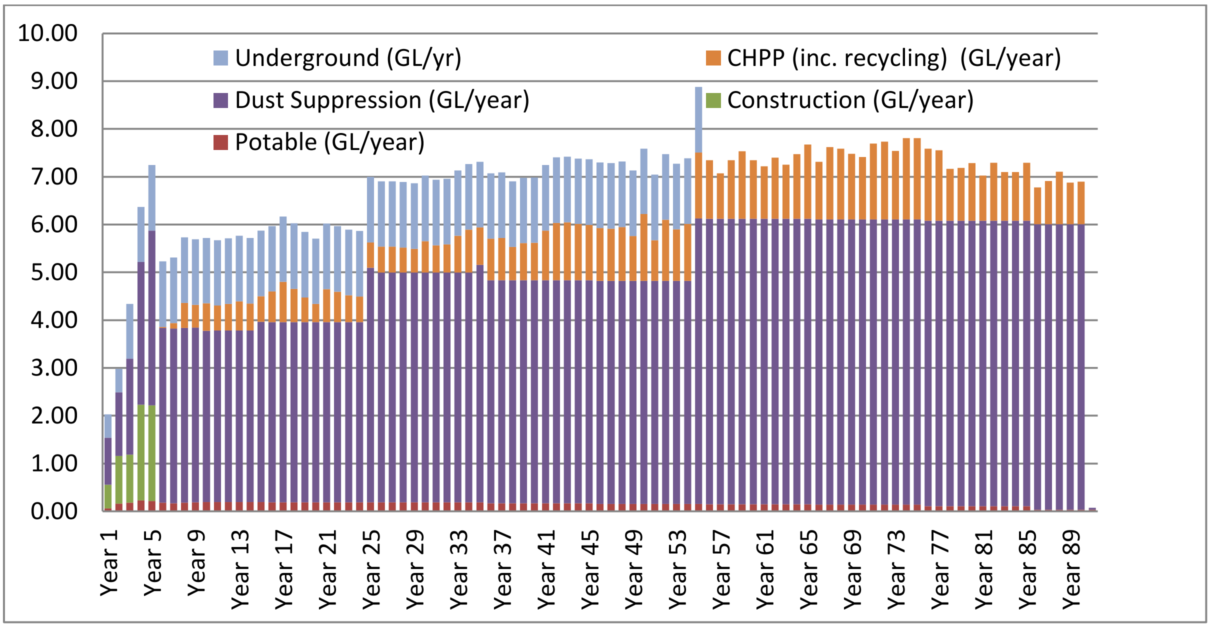
- Potable water at the worker accommodation village and MIA areas within the mining lease. This water will come from the off-site raw water supply and may possibly be supplemented by rainwater capture from rooftops. potable water usage for the worker accommodation village was estimated at 350L per person per day, with 40 L/person/day required at the central MIA and 100 L/person/day for underground mine workers. Usage is higher than for average households in Australia however demand for showering and laundry is expected to be higher due to the nature of the work being undertaken and the hot climate.
- Dust suppression and vehicle wash down. This includes dust suppression on haul roads, active open cut mining areas, any areas under construction and coal, topsoil and mine waste stockpiles. Dust suppression is by far the largest water demand stream for the proposed Project and groundwater from open cut and underground mine dewatering will be utilised for dust suppression except for topsoil stockpiles where raw water or water salvaged from sediment dams will be used. Dust suppression requirements vary from year to year, depending on the area of haul roads and exposed soils.
- Underground mine operations. This includes requirements for machinery, spray systems on conveyors and roof bolting. The development phase is for the initial long wall will take about 2 years, and underground mining will commence in the second year, ramping up to full production by year 5. Underground mining will continue for about 45 years. It is not proposed to reuse or recycle water used underground. Underground mine water requirements must all be sourced from raw water and groundwater inflows cannot be used in the underground mine.
- Water demand for coal handling, washing, preparation and processing will vary depending on the quality of raw coal, which varies across the proposed mine. Typically, about 125 L of water is required per tonne of ROM coal and the proportion of coal produced that requires washing will vary from around 20 to 40 per cent, with an average of 29 per cent over the life of the mine. Both raw water and groundwater inflows can be used for the CHPP, and raw water calculations assume that a minimum of 10 per cent of the CHPP water demand must be supplied from raw water and that the remainder can be supplied from mine affected water when available. Water demand requirements assume recycling of 30 per cent of the water use in the CHPP.

Table 2-21 shows the estimates of water demand for the mine site from 2013 to 2110. The water demand for the mine site and all associated operations is expected to experience a peak range of 9 – 10 GL/yr from year 2021. This will occur during the majority of the mine’s life with lower demands during the start-up and close down phases. Figure 2-41 shows graphical representation of water demand.

Table 2-21 Estimated Water Demand

Year (Stage)	MROMt / an Coal Washing	Potable Supply (GL/yr)	Construction (GL/yr)	Dust S'pression (GL/yr)	CHPP (GL/yr)	Total (GL/yr)	Total with Recycling (GL/yr)
2013	0	0.04	1	1.00	0.00	2.04	2.04
2014	0	0.09	2	1.50	0.00	3.59	3.59
2015	0	0.14	1.5	2.50	0.00	4.14	4.14
2016	20	0.17	2	2.63	2.80	7.60	6.76
2017	20	0.19	2	2.88	2.80	7.87	7.03
2018	25	0.20	0	2.63	3.50	6.33	5.28
2019	30	0.23	0	4.33	4.20	8.75	7.49
2020	35	0.25	0	5.83	4.90	10.98	9.51
2021	40	0.27	0	5.83	5.60	11.71	10.03
2022-2027	40	0.27	0	5.83	5.60	11.71	10.03
2028-2037	40	0.27	0	5.83	5.60	11.71	10.03
2038-2047	40	0.27	0	5.83	5.60	11.71	10.03
2048-2057	40	0.27	0	5.83	5.60	11.71	10.03
2058-2067	40	0.27	0	5.83	5.60	11.71	10.03
2068-2077	40	0.27	0	5.83	5.60	11.71	10.03
2078-2087	40	0.27	0	5.83	5.60	11.71	10.03
2088-2097	40	0.14	0	5.83	5.60	11.57	9.89
2097-2110	40	0.14	0	5.83	5.60	11.57	9.89

Figure 2-41 Estimated Water Demand



Using the preliminary water balance established for the Project (Volume 4 Appendix P2), raw water requirements have been estimated and are shown in Table 2-22. These estimates are on the assumption that:

- All potable demand is met from raw water supply
- At least 10 per cent of the demand for the CHPP is from raw water
- All water required for underground use is from raw water
- Raw water is used to top up the mine water inventory in dry years when there is insufficient water available from runoff within the mine area or in years where there is less groundwater inflow.

On this basis, the maximum raw water demand is expected to be less than 4 GL per annum.

Table 2-22 Raw Water Requirements (ML/annum)

Stages	2013	2014	2015	2016	2017	2027	2037	2047	2067	2103
Potable Water Demand	56	154	179	232	216	197	188	190	155	34
10% of CHPP process water is raw water	0	0	0	0	0	77	76	113	197	0
Water Required for underground mining operations	485	485	1,146	1,146	1,373	1,373	1,373	1,373	1,373	0

Stages	2013	2014	2015	2016	2017	2027	2037	2047	2067	2103
PWB Deficit from 120 years analysis	244	226	103	0	292	590	601	454	1,906	0
Total Raw Water Demand	785	864	1,428	1,378	1,881	2,236	2,238	2,129	3,630	34

2.12.3 Water Supply

2.12.3.1 Overview

An initial water supply assessment was undertaken to determine potential sources of water to meet estimated demands. This assessment identified that adequate water could be sources from the following sources:

- Flood harvesting from the Belyando River
- In-steam storages on North Creek and Obungeena Creek
- Groundwater bores in the vicinity of the off-site infrastructure area.

Some overland flow harvesting may also be used through capture in stormwater systems.

All extraction from watercourses, groundwater and overland flow systems is governed by the *Water Act 2000* and the supporting Water Resource Plan (WRP). The mine and associated local surface water sources are located in the Burdekin Basin and usage of water resources is governed by the *Water Resource (Burdekin Basin) Plan 2007.* The sources are located within sub-catchment E of the WRP, which has 150 GL (20 Strategic, 130 State) of reserve available for use by new projects, including 20 GL in the strategic reserve and 130 GL in the State reserve. On this basis, there are no legislative impediments to obtaining local surface water supply for the Project.

Preliminary water balance results indicate that raw water supply requirements may be as low as 4 GL/annum however, further design and modelling is required to confirm this and water supply requirements may be as high as 10 GL/annum. Initial modelling undertaken on the Belyando system indicates that this quantity of water can be extracted without affecting downsteam environmental flow objectives. Raw water will be stored in a 20 GL storage to be located at the central MIA with smaller storages and a system of pumps and pipes required to transfer water from the various sources to the raw water dam.

2.12.3.2 MIA Raw Water Storage

A 20 GL raw water storage will be located at the central MIA. As this storage is located on a mining lease, the *Manual for Assessing Hazard Categories and Hydraulic Performance of Dams* will be followed in relation to design, construction and operation/maintenance. Dam walls are expected to be about 6 m above ground surface. The storage will be lined to prevent seepage.

2.12.3.3 Belyando River Flood Harvesting

Using the Resource Operational Plan (ROP) (supports the WRP) legislated hydrological water balance model, Integrated Quantity Quality Model (IQQM), a water harvester on the upper reaches of the Belyando River was evaluated to reflect the proposed operation of a large scale flood harvesting extraction.

A 5 GL balancing storage dam will be established on the footprint of a disused quarry as shown in Figure 2-43. A pump and pump inlet will then be constructed on the bank of the Belyando River and will pump water to the balancing storage on flood flows. Modelling has indicated that the pump can be set to commence pumping when flows exceed 430 ML/day and then cease pumping when flows fall back below 430 ML/day. The pump will have a maximum capacity of 250 ML/day, although this may be revised downwards once a detailed water balance has been undertaken. This approach allows the existing environmental flow objectives to be complied with, and does not adversely impact on downstream users.

Design details are not available for the balancing storage but it will be designed to meet the Queensland dam safety guidelines (see also Section 2.12.6.2). This includes a requirement to conduct a failure impact assessment, as well as design criteria, construction supervision requirements and ongoing surveillance and maintenance. The balancing storage will generally be kept empty as water will be transferred to the main raw water storage dam within the central MIA. However, the balancing storage then allows smaller pumps and pipes to transfer water to the central MIA, reducing capital and operating costs.

The proposed Belyando River pump station will be located on the Moray Anabranch on the western riverbank. The pump station will consist of four centrifugal, submersible pumps operating in Duty / Assist / Assist / Standby configuration within a channel excavated to river invert depth, providing a combined flow rate of approximately 200 ML/day. The pumps will be located within a three sided concrete structure, with the control valves located on an adjacent, integral slab. All electrical equipment will be situated at high level, above the 1:100 ARI flood level. The proposed pump station structure footprint is 12 m x 10 m, with the incoming flow channel approximately 10 m wide x 15 m long.

When the water level associated with the required minimum flow in the river is reached the pumps will operate and discharge to the proposed 5 GL storage located near the existing quarry site. The pumps will operate primarily via level control to ensure that the pumps do not take flow before the required river flow is reached. The pump impeller will be situated below the 1:1 ARI flood level. Bar screens will be located upstream to protect them from large debris during flood events. Power will be from a diesel generator or the electrical transmission system.

2.12.3.4 In-Stream Storage Extractions

There are eight existing farm dams on watercourses in the vicinity of the off-site infrastructure area, four on North Creek and four on Obungeena Creek. These will be enlarged to a capacity of about 250 ML each and used to capture flow from these watercourses. Captured flow will be transferred to the raw water storage dam at the central MIA.

2.12.3.5 Groundwater Extraction

Surface water supply will be supplemented with groundwater supplies in the highland sub-artesian declared area through a series of boreholes. Utilising groundwater as part of the water supply strategy provides security in dryer years. Initial studies indicate that adequate water is available for extraction of around 1.5 to 2.5 GL per annum, however further hydrogeological assessment is required to confirm this.

2.12.4 Water Balance

A Preliminary Water Balance (PWB) assessment has been undertaken for the mine plan associated with Exploration Permit for Coal (EPC) 1690 and 1080 (Volume 4 Appendix P2). The PWB provides information on anticipated water volumes on the mine site in order to estimate water supply shortages or surpluses and required storages to prevent uncontrolled releases. The PWB considers direct rainfall- runoff from active and disturbed mining areas within the site, groundwater inflow to open cut pits and underground mine operations, and various operational water demands & losses. This PWB does not consider runoff from catchments outside of the lease areas that transit the site via existing or proposed constructed overland flow paths or waterways. The PWB includes 10 development stages of the mine plan over the 90 year mine life.

The mine stages, general layout, extent of active mining areas, undisturbed and disturbed areas, voids, remediated voids and rehabilitated areas, and spoil areas in open cut pits were extracted from the mine plan generally described by Runge (2011). The PWB analysis uses monthly time increments based on long-term historical climatic data (1890-2010). The PWB analysis shows that despite the Project being a large mine development total volumes of water are quite manageable with monthly excess or deficit volumes in general levelling out to a significant degree due to reuse. Table 2-23 shows the calculated average and maximum volumes of MAW that would require storage each year for each of the modelled stages of the proposed mine.

Despite the large reuse component there is a potential for large volumes of MAW to build-up in the mine water management dams. On an annual basis the average build-up of MAW is not huge, but as the mine will be operational for a long period MAW volumes would build-up significantly without controlled discharges to the environment. Cumulative maximum volumes of MAW that may occur are shown in Table 2-24.

Table 2-23 Average and Maximum MAW Volumes in the Water Management Dams

Mine Stages	Level	Dam 1	Dam 2	Dam 3	Dam 4	Dam 5	Total
2013	Average		274	58			863
	Maximum		404	2,35			2,756
2014	Average		336	59			931
	Maximum		429	2,39			2,821
2015	Average		405	97			1,383
	Maximum		442	2,90			3,342
2016	Average	256	399	1,06			1,719
	Maximum	389	437	3,19			4,019
2017	Average	282	426	85			1,560
	Maximum	394	477	2,93			3,806
2027	Average	288	416	1,02			1,730
	Maximum	414	473	2,94			3,831
2037	Average	308	391	84	289		1,832
	Maximum	423	439	2,78	409		4,060

Mine Stages	Level	Dam 1	Dam 2	Dam 3	Dam 4	Dam 5	Total
2047	Average	309	322	1,21	329	358	2,535
	Maximum	431	429	3,57	434	575	5,439
2067	Average	277	278	91	330	449	2,247
	Maximum	414	408	3,31	442	615	5,193
2103	Average	240	248	30	246	355	1,390
	Maximum	386	400	43	403	574	2,193

Table 2-24 Cumulative Maximum Volumes of MAW in the Water Management Dams

Mine Stages	Dam 1	Dam 2	Dam 3	Dam 4	Dam 5	Total
2013		404	2,352			2,756
2014		429	2,392			2,821
2015		442	2,900			3,342
2016	389	437	3,193			4,019
2017	394	477	2,935			3,806
2027	4,559	5,242	32,381			42,182
2037	4,655	5,173	32,227	409		42,464
2047	4,744	4,816	39,269	4,771	575	54,175
2067	9,039	8,986	74,713	9,291	12,917	114,946
2103	14,884	14,675	116,428	15,888	22,103	183,978

2.12.5 Surface Water Discharges

While Table 2-23 shows that it is theoretically possible to build large enough MAW dams to contain MAW within the proposed mine, the cumulative volumes shown in Table 2-24 indicate that it is desirable to have the ability to discharge MAW to the environment under controlled conditions so that MAW inventory does not build up over time. This strategy will also reduce risks associated with failure of MAW dams and very extreme weather events. Both of these hazards have a very low likelihood of occurring but significant consequence if the hazard does occur, and hence any methods to reduce risk should be considered.

As MAW has, higher electrical conductivity then the receiving environment, the proposed strategy for controlled discharges is to release MAW on high flow events in the receiving environment such that a high level of dilution can be provided instantaneously. This strategy is utilised in the Bowen Basin (DEHP 2012 Model Water Conditions for Coal Mines in the Fitzroy Basin) and has also been applied in conditions for the Alpha Coal Mine (Alpha 2012).

Maximum allowable controlled releases of MAW to the environment are basically depended on water quality aspects (chiefly electrical conductivity) of both of the MAW and of the receiving water and on the volume of water in the receiving waterways. Only limited information is available on the electrical conductivity of MAW for the Project; however an analysis of flow volumes in the Carmichael River and Belyando River indicates that both rivers have sufficient high flow events to provide a level of dilution equivalent to that required in conditions for the Alpha Coal Project (Alpha 2012). This analysis is available in Volume 2 Appendix P2.

The controlled releases volume analysis allows for a conservative estimate based on:

- Catchment analysis based on the Quantile Regression Technique
- Alpha Coal Mine discharge conditions, with no discharges when the in-channel flow of the receiving waterway is less than 5 m^3/s (Alpha 2012)

In summary there is the potential to release an estimated average of 12,000 ML annually into the Carmichael River and 96,000 ML annually to the Belyando River under these conditions. Potential average discharges are naturally highest during the wet season. In order to prevent build-up of MAW in MAW dams, a conservative assumption is that in each of the modelling years, water that builds up over the year would need to be released, that is, a strategy of maintaining the MAW dams at close to empty is adopted. In reality, this is an overly conservative assumption as some water inventory will in fact be maintained on the site to buffer against dry years.

However, adopting this worst case scenario in relation to the need to discharge MAW, Table 2-24 shows the MAW build up in each of the modelled years. The maximum produced volume of MAW relates to Dam 3 for stage 2047 and concerns 3,570 ML annually (refer to Table 2-24). This volume relates to approximately 30 per cent of the, conservatively estimated, available discharge capacity (maximum discharge allowance) into the Carmichael River and approximately 4 per cent for the Belyando River, based on the strategy of only discharging on high flows when sufficient dilution is available.

In reality, controlled discharges would be lower as a base mine water inventory would always be retained on site to ensure that sufficient water was available in dry years. Further detailed modelling is required to determine what this base inventory would be, but the modelling undertaken to date is sufficient to indicate that discharges can be managed in the worst case situation.

Considering all the above provided information it is concluded that MAW volumes on the mine site are manageable as no excessive build-up of MAW volumes are expected and estimate required discharges are well below estimated maximum discharges that can be attenuated within the Carmichael/Belyando system. Estimated average annually required discharges show that controlled discharges are expected to be well within discharge limitations (based on flow volumes of the receiving environment).

The proposed controlled discharge will be achieved by providing a high volume outlet from a water storage into either the Carmichael or Belyando River, whereby MAW can be released quickly by gravity flow when flow conditions in the receiving environment permit. As a further control, electrical conductivity in the receiving environment will be monitored, both upstream and downstream of the discharge point to confirm that water quality objectives in relation to electrical conductivity are not exceeded. Further infrastructure studies will be undertaken to determine the optimum configuration and location of infrastructure required for the controlled discharge.

2.12.6 Design Parameters – Water Management Infrastructure

2.12.6.1 Flood Immunity

Criteria have been determined for flood immunity for mine facilities and infrastructure and are presented in Table 2-25. The required flood immunity is presented in terms of the average recurrence interval (ARI) which represents the average or expected period between flood events. As such, a 100 year ARI flood event is, on average, expected to occur only once every 100 years. However, significant rainfall and flood events are in fact random events and hence, there may be several such events within a short period of time, or conversely, several centuries may elapse between events.

Climate change scenarios and potential impacts on runoff rates and flood levels will be reviewed in detailed design.

The design flood immunity has been selected based on consideration of:

- Potential environmental harm that might arise due to flooding of a particular area
- Safety considerations, particularly the ability to evacuate workers in a flood event
- Operational considerations, including a balance between the cost of constructing facilities and infrastructure to a higher level of flood immunity and the lost production and repair costs that would arise in the event of a major flood.

Table 2-25 Flood Design Criteria

Component	Required Flood Immunity	Comments
Open cut pits and underground mine access portals	1,000 year ARI	
Stream diversions and levees (embankment crest level)	1000 year ARI + 500 mm freeboard	Minor stream diversions may be designed to a lower design criteria where this does not compromise operations.
Diesel storages and other hazardous chemical storages	1000 year ARI	
Above ground tailings storage facilities (embankment crest level)	1000 year ARI	Based on preliminary hazard assessment using DERM 2012.
Conveyors	100 year ARI	An additional 500 mm of freeboard to be provided to the lower belt
MIA, CHPP and all stockpiles	100 year ARI.	
Internal drainage within MIAs	50-100 year ARI	
Mine affected water storages (embankment crest level)	100 year ARI + 500 mm freeboard	Based on preliminary hazard assessment using DERM 2012.
Sediment dams	100 year ARI + 500 mm freeboard	

Component	Required Flood Immunity	Comments
Roads used for evacuation	50 year ARI	
Haul roads	50 year ARI	
Minor access roads throughout mine site	5 year ARI	
Carmichael-Moray Road realignment and other public roads	IRC design requirements	Local public roads currently flood in most wet seasons.

2.12.6.2 Dams

Off-site raw water storage dams will be designed to meet requirements under the *Water Supply (Safety and Reliability) Act 2008*. Dam design criteria are based on the results of a failure impact assessment. Design, construction, operation and management of any storages that require failure impact assessment will be in accordance with the *Queensland Dam Safety Management Guidelines* (Queensland NRM, February 2002).

Review of failure impacts for the smaller in-stream storages on North Creek and Obungeena Creek indicates that these are not referable dams. Regardless, the dams will be designed to the relevant requirements of the *Queensland Dam Safety Management Guidelines*.

Dams located on the mining lease are regulated under the EP Act. A preliminary assessment of dams against the *Manual for Assessing Hazard Categories and Hydraulic Performance of Dams* (Queensland DERM 2012) has been undertaken and is presented in Section 12 (Hazard and risk).

As such, these dams will be designed in accordance with the requirements of the *Manual for Assessing Hazard Categories and Hydraulic Performance of Dams* and will meet the hydraulic performance and containment criteria specified in these guidelines. As it is intended to operate an integrated water management system on the proposed mine site, allowance will also be made in design of mine water transfer systems to be able to transfer water around the site to maintain design storage allowances and mandatory reporting levels.

Draft environmental authority conditions have also been proposed for dams within the mining lease.

2.12.6.3 Engineered Diversion Drains

The external diversion drains are to be designed in accordance with the following drainage design criteria:

- DERM 2011 Watercourse Diversions – Central Queensland Mining Industry version 5.0. The design must accommodate the 100 year ARI flow with an additional 600 mm freeboard; no allowance for climate change (higher rainfall intensities) as derived using the hydrologic models described in Section 6.
- The design should consider expected subsidence up to seven metres (SCT, 2011).
- The maximum flow velocity in the diversion drains to be no greater than 2.5 m/s velocity for the 50 year ARI event (DERM, 2011).

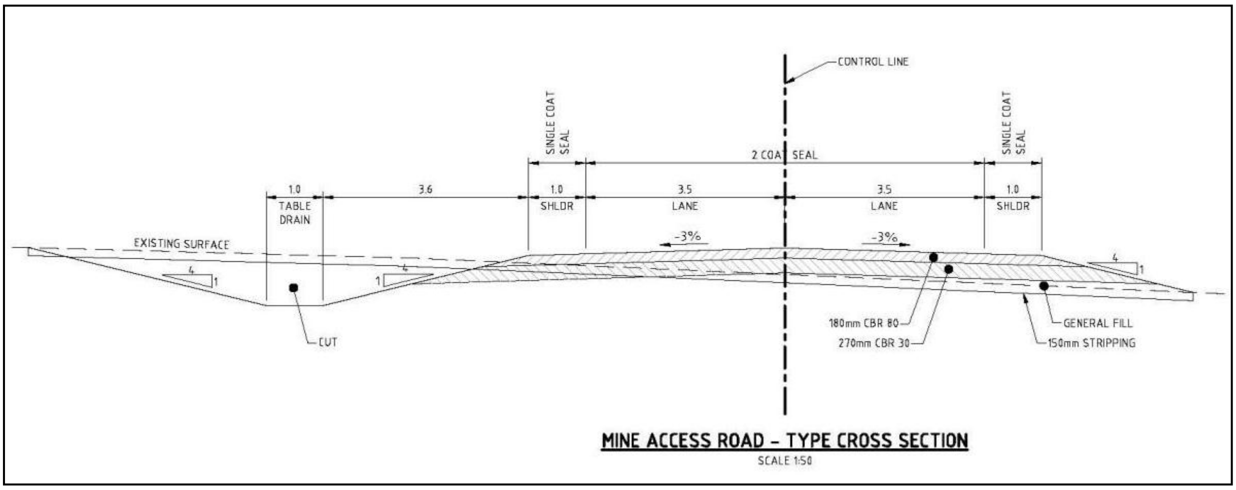
- No greater than 80 N/m^2 shear stress for the 50 year ARI event (DERM, 2011).
- No greater than 220 watt/ m^2 stream power for the 50 year ARI event (DERM, 2011).
- Drain banks to have 1:5 slope.
- Where the mine pits are potentially at risk of inundation from the diversion drains, diversion bunds will be constructed along the eastern side of the drain to provide for 1,000 year ARI flood immunity for the pit from flood waters originating from the diversions drains. These are sized according to the 1,000 year ARI peak flood level, plus 600 mm freeboard.

2.13 Offsite Infrastructure

2.13.1 Site Access

Current access to the Project (Mine) is via Moray Carmichael Road, which runs off the Gregory Developmental Road, located approximately 70 km to the east of the Project (Mine). Moray Carmichael Road will be realigned and upgraded for heavy traffic access to the Mine and the offsite infrastructure, and will be realigned to eliminate two crossings of North Creek and avoid the Project (Rail) alignment. Access roads from two points on the realigned Moray Carmichael Road will be developed to provide access to the workers accommodation village and the airport and industrial development areas. Figure 2-4 illustrates the location of the current and proposed site access. Figure 2-42 provides a typical cross section of the Moray Carmichael Road upgrade.

Figure 2-42 Typical Cross section of Moray Carmichael Road



Source: Runge Limited 2011

2.13.2 Workers Accommodation Village

The workers accommodation village will be purpose built to accommodate the workforce for the construction and operation of the Project (Mine). Facilities at the workers accommodation village will include medical facilities; recreational areas such as outdoor barbecues and shelters; recreational facilities including gymnasium, sport fields; covered walkways and hard and soft landscape treatments; laundry facilities; bus pick up and set down area and parking areas (refer to Figure 2-43).

Further detail on the approvals required for the workers accommodation village is outlined in Volume 4, Appendix D Project Planning and Approvals.

The design outcome for the workers accommodation village has been developed in a staged manner where the workers accommodation can grow in accordance with demand, whilst ensuring that each stage is appropriately serviced in terms of facilities and infrastructure. Three conceptual stages of development are as outlined below:

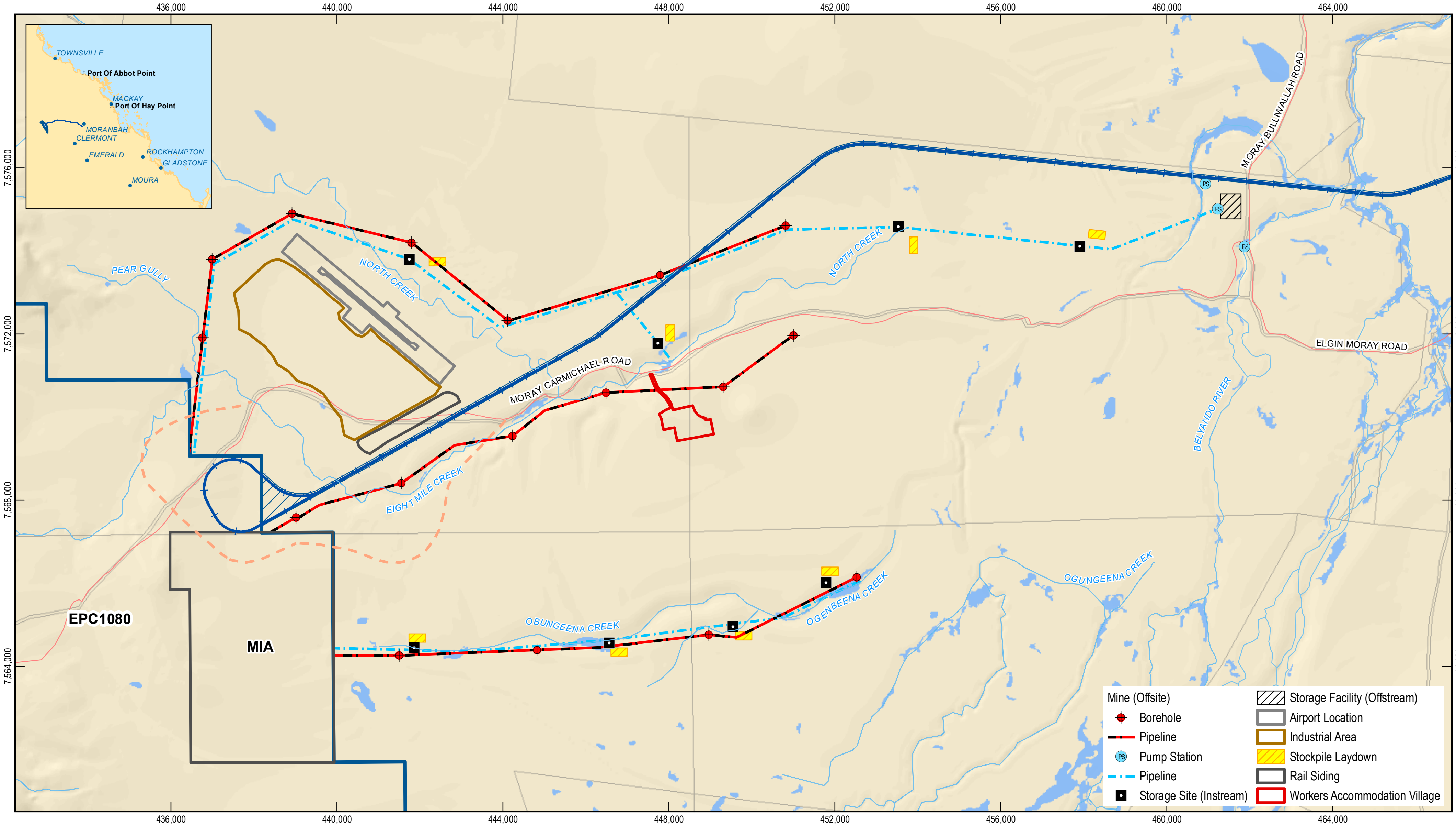
- Stage 1A consists of the initial 250 one bed units with ensuite bathrooms located around and linked by covered walkways to the temporary Community buildings. These buildings include administration offices; dining area; kitchen; loading area; maintenance/storage building; and a first aid room. Located around the accommodation units will be three laundry facilities buildings and two barbeques and shelters. Communal landscaped recreation areas will be provided in and around the units. A temporary bus collection and parking areas are to be provided adjacent to the entry to the site in proximity of the administration area. This first stage will be provided with interim infrastructure services.
- Stage 1B there will be an additional 1,000 one bed room units with ensuite bathrooms linked with covered walkways to the community facilities and services. There will be 11 communal laundries and barbeque areas will be provided in suitable locations throughout the settlement amongst the communal landscaped recreation areas around the units. Stage 1A dining area will be remodelled as a gym and recreation area. A new larger dining area with north-eastern aspect and associated kitchen will be built closer to the community centre. Loading, maintenance and storage areas will also be in a ‘back of house’ area to the southeast of stage 1B. An administration area, shopping and banking facilities will be near the main entry adjacent to the dining area. Health, security and training rooms will also be in this area. An on-site bus pick up and set down area including parking areas will be provided as well as an extension of the main service infrastructure and road system. An internal village green area and separate expansive landscape recreation areas adjacent to the rooming units will be provided.
- Stage 1C will consist of a further 750 one bed room units with en suites bathrooms , eight communal laundry buildings and barbeque facilities linked with covered walkways to the facilities provided in stage 1B. Additional outdoor recreation areas and running tracks along the extension and completion of the internal road systems and additional car parking will be completed in this stage. Figure 2-44 illustrates the design outcome proposed for the workers accommodation village.

Adani's exploration and construction workforce accommodation needs are, and will be, met by the following:

- up to 200 beds conditioned under EPC 1690 and accompanying environmental authority (exploration)
- an amendment for expansion up to 400 beds on the current exploration tenure (exploration) currently under consideration by DEHP on EPC 1690
- an application for an additional temporary workforce accommodation camps sought in early 2013.

Applications under the SP Act for the temporary camps are located in Volume 4, Appendix D (Project Approvals and Planning Assessment). The applications address supporting activities such as water required for laundry and washing, waste water treatment, sewage treatment works, electricity generation and solid waste management.

An application for the permanent workers accommodation village to support ongoing mining production will be made for up to 2,000 beds. If an State Development Area is declared over the area, the application will address these legislative requirements. Otherwise, it is anticipated an application will be made under the SP Act, Section 242.



1:125,000 (at A4)

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

N

LEGEND

- Town
- State Road
- Local Road
- Other Railway
- Cadastral Parcel
- Watercourse
- Waterbody
- Rail (West)
- Rail (West)
- Mine (Onsite)
- Mine Infrastructure Area
- Moray Carmichael Road (Realignment)

GHD adani

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project

Job Number 41-25215
Revision C
Date 16-11-2012

Offsite Infrastructure Location

Figure 2-43

G:\41\25215\GIS\Maps\MXD\000_Overview_Location\41_25215_003_rev_a.mxd Level 4, 201 Charlotte St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data source: DERM: DEM (2008), DCDB (2010); DME: EPC1690 (2010) / EPC1080 (2011); Adani: Alignment Opt9 Rev3 (SP1&2) (SP3) (2012); © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads (2007); Gassman/Hyder: Mine (Offsite) Moray Carmichael Road Realignment (Opt 2) (2012). Created by: BW,MS

Figure 2-44 Workers Accommodation Village

Source: Gassman, 2012

2.13.3 Permanent Airport

Initially an airport will function for the Carmichael Coal Mine and Rail Project to service fly-in-fly-out operation and general access to other regional and national centres. The siting of the airport considers its function of servicing the mine and rail workers and accommodation. The airport will be accessed from the realigned Moray Carmichael Road and will be positioned approximately 5 km west of the workers accommodation village as shown on Figure 2-43.

The permanent airport will occupy approximately 365 ha and consist of an airstrip with a maximum length of 3,000 m and a width of 300 m, and a landside terminal of approximately 3,000 m^2. These parameters are based on providing service to Code E aircraft, e.g.: B777 or similar, as described in the international standard for the design of airports (ICAO Annex 14) and the Australian standard (Manual of Standards Part 139) including:

- 45 m wide paved runway with 7.5 m wide sealed shoulders for jet blast protection and capable of supporting a wide-bodied aircraft.
- Runway direction orientated 130 degrees/310 degrees (NW-SE) for prevailing winds, mining operations and topography.
- 300 m wide runway strip within which the earth is graded for drainage and excursions and obstacles are limited.
- 240 m long by 90 m wide runway end safety area on both ends of the runway.
- Land provision for a future 900 m long high intensity approach lighting (HIAL) on both ends of the runway. In addition, the Queensland planning policy heavily constraints and restricts the use of this same space (1,000 m long by average 300 m wide) to activities with very low population densities (such as passive recreation parks). As such, this land is better quarantined for airport uses.
- Instrument Landing System System (ILS) comprising a Glidepath and Localiser to aid landing movements, particularly in poor visibility conditions.
- A single intersecting taxiway off and near the centre of the runway. The proposed frequency of traffic does not require a parallel taxiway or any other intersecting taxiways. However, the lateral spacing of the apron off the runway strip allows space for a parallel taxiway to be constructed between the runway and the apron without affecting operations on either.
- Apron placed with sufficient lateral separate from the runway for B777 and other Code E aircraft tails to sit below the obstacle limitation surface (OLS). As noted above, this separation will allow a parallel taxiway to be constructed in the future.
- Apron built to provide two free-moving (no push-backs) aircraft positions for a B777 and Code C aircraft (A321, A320, B737) without impacting on the other aircraft. A compliant landing pad for helicopter operations has also been provided off the apron.

2.13.4 Industrial Development Area

An industrial area will be established as part of the off-site infrastructure to provide for servicing and maintenance of vehicles and equipment for the mine. Facilities will include:

- Vehicle and equipment fabrication and maintenance workshops
- Bulk fuel storage
- Vehicle wash areas
- Warehouse and storage
- Office and administration buildings

The industrial area will be located on a land parcel approximately 4 km to the east of the EPC 1080 lease directly to the north of the proposed rail alignment. The industrial area is located in this position to allow access to a rail siding for use in supply logistics to the mine development.

2.13.5 Rail Siding

The proposed rail siding area is situated at the western end of the Project (Rail) alignment (refer Figure 2-4). As the Project (Rail) alignment is a single lines with a rail siding area for multiple trains. The intent of the rail siding is to improve the functioning and operation of the new rail line proposed to service the planned mine. The rail line will be used for a number of ancillary purposes such as fuel delivery. The rail line is envisaged as a single line with rail sidings as an effective mechanism to enable a number of trains to utilise the line without impacting on each other at the western end of the line.

Given the large length of the coal trains that could be ultimately utilising this proposed rail line, a siding of minimum dimension 2.5-3 km was highlighted as being required. Further, it was also advised that the best location for any such siding (apart from being adjacent to the proposed rail line) would be interlocked with the above-mentioned industrial area such that the full potential of the proposed rail line could be achieved and managed in a coordinated manner.

2.13.5.1 Communications / Controls

All pump stations will include check and control (sluice) valves on each pump discharge pipeline. Pumps will operate primarily on level control within the river or storages. However, all pumps will be linked to allow for remote control from the Carmichael Coal mine site. All pipelines will include flow meters to monitor the flow rates. This is especially important for the river extraction pumping mains as the flow will have to be monitored to ensure that the allowed flow extraction volumes are not exceeded.

The borehole pumps will operate independently of each other, as the pipelines have been sized to allow them to run concurrently.

2.13.5.2 Access

Access roads are to be provided to allow for vehicular access to:

- All pumping station and storage locations
- Air valves, scour valves an isolation valves on all pipelines (locations to be confirmed during detailed design)

- All boreholes
- All electrical infrastructure

Parking and loading areas, suitably sized for appropriate vehicles, will be provided to allow for maintenance and removal of mechanical and electrical equipment.

Access requirements within individual structures will be confirmed during detailed design.

2.13.5.3 Access

The following road infrastructure is required to provide access to Project (Mine) offsite infrastructure.

- Realignment of the Moray Carmichael Road to eliminate two crossings of North Creek and eliminate the need for a grade separated crossing of the Project (Rail) alignment and provide access to the permanent airport
- Access roads from two points on Moray Carmichael Road to allow vehicular access to the workers accommodation village
- Access roads to allow vehicular movement within the workers accommodation village

The following road infrastructure is required to service the offsite water supply infrastructure.

- 10 m wide corridors to allow vehicular access for maintenance work along water supply pipelines from North Creek (25 km) and Obungeena Creek (20 km)
- Access roads to allow vehicular access to all pumping stations and storage locations; air valves, scour valves and isolation valves on all pipelines; all boreholes; and all electrical infrastructure.

2.13.6 Power Services

The power supply for the Mine, workers accommodation village, permanent airport, industrial area and offsite water supply infrastructure will be via one or more of the following potential options:

- A dual circuit 275 kV electricity transmission line, including substations
- A dual circuit 132 kV electricity transmission line, including substations
- A base-load diesel generator supply at site predominantly for construction and early mine operation, utilised until the 132 kV or 275 kV electricity transmission line/s become available
- A base-load combined cycle gas fired power station for all or part-site-supply, including gas supply pipeline from the yet to be identified source from coal seam gas fields currently being developed or existing gas fields. Remaining and contingency power would be supplied via the 132 kV or 275 kV electricity transmission line/s eventually installed

Adani is currently investigating power supply options via a number of alternative sources including

- Powerlink via the new Surbiton 275 kV Substation fed from Lilyvale in the south
- Powerlink via the Moorevale 132 kV Substation (yet to be developed near Moranbah) fed from the existing Nebo 275 kV Substation to the north
- Powerlink via the Strathmore 275 kV Substation (near Collinsville)
- Copper String Project via the Pentland 330 kV Substation (Project is yet to be committed and developed)

As the preferred option has yet to be identified, no impact assessments have been undertaken. Impact assessment of will be undertaken when the preferred option has been determined.

2.14 Hazardous Materials

The Mine and offsite infrastructure will use a number of environmentally hazardous substances during both construction and operations. Table 2-26 provides an indicative list of substances that may be used, the purpose or use and the likely quantities that will be stored within the mining lease and at the off-site infrastructure area.

Table 2-26 Indicative List of Environmentally Hazardous Substances to be stored On-site

Substance	Construction On-lease	Construction Off-lease	Operation On-lease	Operation Off-lease	Use
Diesel	500 kL	100 kL	5 ML	10 ML 100 kL	Fuel for heavy vehicles Fuel for light vehicles
Lubrication/ Hydraulic Oils	5 kL		2,500 kL		Lubricate plant and equipment and replenish hydraulic systems
Solvents and degreasers			100 kL		Vehicle and equipment maintenance
Ammonium nitrate	Nil		600 t		Blasting at mine site
Emulsion	Nil		45 t		Blasting at mine site
Methyl isobutyl carbinol	Nil		400 kL		CHPP Flotation agent
Nitrogen gas	144 m^3		144 m^3		Pneumatic equipment
Acetylene	200 m^3		100 m^3		Welding / Oxy-acetylene cutting
Oxygen	200 m^3		100 m^3		Welding / Oxy-acetylene cutting
Aluminium sulphate	Nil		1 kL	3 kL	Water treatment
Sodium hypochlorite	Nil		3 kL	7 kL	Water treatment
Herbicides and pesticides	< 200 kL		< 200 kL	<200 kL	Pest and weed control
Vehicle batteries (Sulphuric Acid)	0.25 t		0.5 t		Spent batteries from vehicles
Used vehicle tyres	550 pa		550 pa		Spent tyres from mine vehicles
Waste oil	1.0 kL		7 kL		From vehicles / equipment

The most significant quantity of environmentally hazardous materials to be stored and used in the Project will be diesel. A 500 kL diesel inventory will be required for construction and will be stored in above ground storage tanks at key construction laydown areas within the mining lease and at the proposed accommodation village. Diesel for use during construction will be brought to the site by road tanker. Once construction is complete, minor diesel storages within the mining lease will be removed, however the diesel storage at the workers accommodation village will be retained for use during operations to refuel light vehicles and diesel generators.

For mining operations, diesel will initially be brought to the proposed mine by truck and be stored in two by 2.5 ML storage tanks located within the proposed mining lease. Once the proposed rail siding is complete, a major diesel storage of up to 10 ML will be constructed at the rail siding, and diesel will be brought to the site by train. Diesel will then be transferred from this major storage to smaller 2.5 ML storages within the mining lease for day to day use.

Dedicated refuelling facilities will be provided at storage tanks with rollover bunds and concrete bases, draining to a collection sump. Refuelling of larger, less mobile equipment will also be carried out using mobile tankers and refuelling procedures will be developed for this activity.

It is not intended to refuel trains at the mine site or off-site infrastructure. It is also not intended to store aviation fuel at the proposed airport, but rather, aircraft will refuel at the point of origin. All diesel storages and associated equipment and procedures will be in accordance with Australian Standard AS1940:2004 – *Storage and Handling of Flammable and Combustible Liquids*, or updated versions of this standard that may occur over time.

All other chemicals will also be stored in accordance with relevant Australian Standards and requirements specified in material safety data sheets (MSDS). Transport will be in accordance with the Australian Code for Transport of Dangerous Goods by Road and Rail (ADG Code) or updated versions that may occur over time.

Storages will be regularly inspected for potential damage or spills and leaks and procedures will be developed in relation to handling and use of all environmentally hazardous materials. Spill containment and clean up equipment will be available at locations where there is a risk of spill.

2.15 Mine Decommissioning and Rehabilitation

2.15.1 Overview

The operational life of the Project (Mine) is over 90 years, therefore a general overview of decommissioning and rehabilitation is provided based on current legislative requirements, noting that such requirements may be different at the time of decommission and rehabilitation.

The four general rehabilitation goals require rehabilitation of areas disturbed by mining to result in sites that are:

- safe to humans and wildlife
- non-polluting
- stable
- able to sustain an agreed post-mining land use

2.15.2 Rehabilitation Approach

2.15.2.1 Open Cut Pits

Topsoil will be stripped from all open cut and spoil dump areas prior to commencement of each stage of mining. Topsoil management is discussed in Section 4.3.

In initial years of mining, all spoil will be placed outside of pits in the spoil dump area. As mining progresses and void space becomes available, the priority will be to place spoil in adjacent pit areas, however some out-of-pit placement will continue where transport costs to adjacent pit areas are prohibitive. As far as practicable, spoil will be placed in the final landform profile, with indicative slopes of up to 10 per cent.

Once mining is completed in each pit, the partially backfilled voids will be remediated by:

- Blasting and dozing the highwall to a geotechnically safe angle, indicatively 17 per cent .
- Re-profiling and rehabilitating the low wall to a safe and sustainable profile that blends with the adjacent spoil stockpiles. Indicative slopes for this area are 10 per cent .
- Establishing (or retaining) permanent drains to divert clean runoff water from entering the void.

Sediment ponds capturing drainage from spoil areas will remain in place until vegetation cover criteria have been achieved.

Once final landforms are achieved, topsoil will be spread and the area seeded with grass species or planed with native vegetation, depending on the selected post mining land use. Trials will be undertaken early in the mining program to identify the best methods to manage and ameliorate topsoil so that it can be successfully placed on sloping areas and to achieve revegetation requirements.

At the cessation of mining from each open cut pit, a final void will remain (see Figure 2-17). The estimated surface area of total final void including the internal slopes is approximately 3,000 ha at depths of up to 400 m. All voids are expected to be dry on the basis that current groundwater modelling indicates that voids that are not backfilled to levels above the main groundwater inflows will remain dry due to evaporation of groundwater inflows.

It is noted that mine scheduling over the 90 year mine life is likely to vary from current projections due to demand, and coal quality considerations and there may also be opportunities to further optimise the mine plan in relation to backfilling of voids. As such the approach to the final void will also vary.

2.15.2.2 Subsided areas and underground mining

Subsided areas will be actively managed as subsidence occurs to retain native vegetation and ground cover as far as possible. Key aspects of subsidence management will include:

- Determining baseline conditions and establishing monitoring points to track effects on topography, stream behaviour, soils and vegetation health and composition.
- Filling in of any cracks that present a safety risk or are capturing water
- Replacement of native vegetation that is lost due to subsidence
- Control of weeds in areas where subsidence causes native vegetation die-back
- Stabilisation of any erosion that occurs due to changes in overland flow characteristics

- Proactive or reactive stabilisation of watercourses to avoid destabilisation of bed and banks and avulsion (formation of preferential flow paths).

As ponding is expected to occur in subsidence troughs, an assessment will also be undertaken to determine whether ponds need to be drained or can be retained as habitat features.

As each of the proposed underground mines is completed:

- Materials that might potentially cause groundwater contamination will be removed
- access portals will be sealed such that access is not possible.
- Ventilation shafts will be sealed.

2.15.2.3 Mining Infrastructure Areas

At any stage during the proposed mining operation that surface facilities and infrastructure are no longer required, an assessment will be undertaken of the appropriate decommissioning approach. This assessment will consider:

- Potential future uses of the feature, for example, whether access tracks can be retained for post-mining access. This will be done in consultation with the landholder.
- Environmental risks associated with the surface facility or infrastructure, for example whether there are contaminants present that may cause environmental harm if released
- Safety risks.

Where surface facilities and infrastructure are to be retained, the following steps will be undertaken:

- Any potential contaminants will be removed and recycled or disposed of in accordance with practices in place at the time
- A safety inspection will be undertaken to ensure that the features is safe and stable and a report prepared for the landholder
- If there are any ongoing maintenance requirements, a maintenance plan will be prepared and provided to the landholder and the plan will be reviewed with the landholder to make sure that all requirements are understood.

Where surface facilities and infrastructure are to be removed, the following steps will be undertaken:

- Any potential contaminants, including contaminated soils will be removed and recycled or disposed of in accordance with practices in place at the time
- All structures and infrastructure will be removed to ground level. Where plant components or materials can be reused or recycled, this will be done, otherwise materials will be disposed of in accordance with waste disposal practices in place at the time.
- Concrete footings and pads will be removed to a depth of 1.5m.
- Buried pipes and other below ground elements will generally be left in situ as removal may cause further surface disturbance. These will be drained, capped and made safe. A plan of the location of all below ground infrastructure will be made and provided to the landholder.

Once surface components have been removed and buried components made safe, the area will be spread with topsoil and revegetated as per the closure criteria for the relevant domain (Table XX).

2.15.2.4 Tailings Storage Facility

The above ground tailing storage facility is expected to operate for the first 10-12 years of the proposed mine. During this time, decant water draining from tailings will be removed such that a stable tailings mass is created.

Closure will involve:

- Capping with a very low permeability layer
- Profiling such that drainage is directed away from the capping surface and ponding does not occur
- Placement of topsoil and revegetation as per nominated closure criteria.

2.15.2.5 Water Management Infrastructure

Water management infrastructure may be left in place where this will be of benefit to the future land use. In particular, sediment ponds may provide useful water resources for cattle grazing and native fauna. Where sediment dams are to be left in place:

- A dam safety inspection will be undertaken and if safety concerns are identified the dam will be decommissioned
- Sediments at the base of the dam will be tested for contamination and removed if contaminant levels exceed guidelines in place at the time
- Where there are ongoing maintenance requirements, a maintenance plan will be prepared and handed over to the landholder with an explanation of the requirements and obligations.

Where sediment dams are to be removed, the dams will be breached such that water containment can no longer occur, and drainage paths created and stabilised such that erosion and scouring does not occur. If sediment contamination has occurred, sediments will be removed for disposal.

As MAW dams and the raw water dam will be designed not to have any catchment inflows, it is unlikely that these will be left in place. Embankment walls will therefore be breached such that the dams can no longer hold water, and where necessary, battered back to provide safe slope angles. Sediments will be tested for contamination and removed if contaminant levels exceed guidelines in place at the time.

Pipes and pumps will be treated as described in Section 2.15.2.3.

2.15.2.6 Stream Diversions

As permanent landform changes will have occurred across the mine footprint, it is not intended to restore diverted watercourses to original alignments. Stream diversions will therefore have been designed and constructed with the view of providing stable watercourses that mimic natural watercourse characteristics as closely as practical.

On closure, all diversions will be inspected and any further stabilisation works undertaken as necessary. Opportunities to restore native vegetation in riparian corridors will also be explored.

2.15.2.7 Carmichael River Corridor

It is intended to restore and manage the Carmichael River corridor as a wildlife corridor, with selective grazing consistent with this use. Further investigations are required regarding management of groundwater drawdown effects on the Carmichael River corridor, and this will inform detailed rehabilitation planning for this domain.

Levees will be left in place where required to protect final voids from flooding, otherwise removed. Levees to be left in place will be inspected and further stabilised as necessary to allow these to become permanent structures.

An assessment will be undertaken as to whether the bridge is to remain in place or be removed.

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