Section 2.0

Project Description

2.0 Project Description

The Project includes the ongoing operation of existing and approved mining operations and the construction and operation of additional mining and infrastructure components at NPM until the end of 2032 (extension of mining activities by an additional seven years).

As required by the DGR's this section provides a detailed description of the project including:

- The need for the project (refer to **Section 2.1**).
- The likely inter-relationship between the proposed operations and the existing or approved mining operations at Northparkes Mines (refer to **Section 2.2** and **2.3**).
- Detailed resource assessment (refer to **Section 2.3.1**).
- The likely staging of the Project including construction, operational stage/s and rehabilitation (refer to **Section 2.3**).
- A discussion of the alternatives to the project including justification for the proposed mine plan (refer to **Section 2.4**).

2.1 Need for the Project

The continuing expectation of a long term deficit in meeting projected copper demand is a key driver for the Project, as future demand is likely to result in healthy copper prices and ensure the economic feasibility of continued operations over the extended duration of the Project. From a corporate perspective, Rio Tinto has publicly stated (Rio Tinto 2012) that it is confident in the fundamentals of the industry and the long-term future of the copper market.

In 2011, NPM was one of the top six copper producing mines in Australia. NPM has been a strong contributor to the Rio Tinto Group with annual production averaging approximately 48 kilo tonnes (kt) copper and 69 kilo ounce (koz) gold in concentrate for the three years to the end of 2012. Production figures for Australian copper mines in calendar year 2011 are shown in **Figure 2.1**.

Forecasts for global refined copper consumption indicate an increase of 3.4 per cent between 2010 and 2025, equivalent to a rise in demand from 17.3 Mt (2009) to 29.6 Mt (2025) (Brook Hunt 2010; CRU 2010).

Conversely, overall global base case mine production is forecast to decline by 2 per cent per annum between 2010 and 2025, with global output falling from a peak of 18.2 Mt in 2012 to 11.5 Mt in 2025 (Brook Hunt 2010). The implied shortfall in global mine output is estimated at 3.4 Mtpa in 2015, 8.1 Mtpa in 2020 and 14.4 Mtpa by 2025.

Approximately 60 per cent of copper is used as an electrical conductor, and with the electrification and urbanisation of emerging markets, primarily China, followed by India and South East Asia, continued growth in copper demand growth is expected through the next several decades (Rio Tinto 2012).

NPM copper concentrate has historically been highly sought after due to its low impurity levels and high copper grades. The majority of production is currently sold through contracts to customers in China, Japan and India. The bulk of copper concentrates have been sold under long term sales agreements.

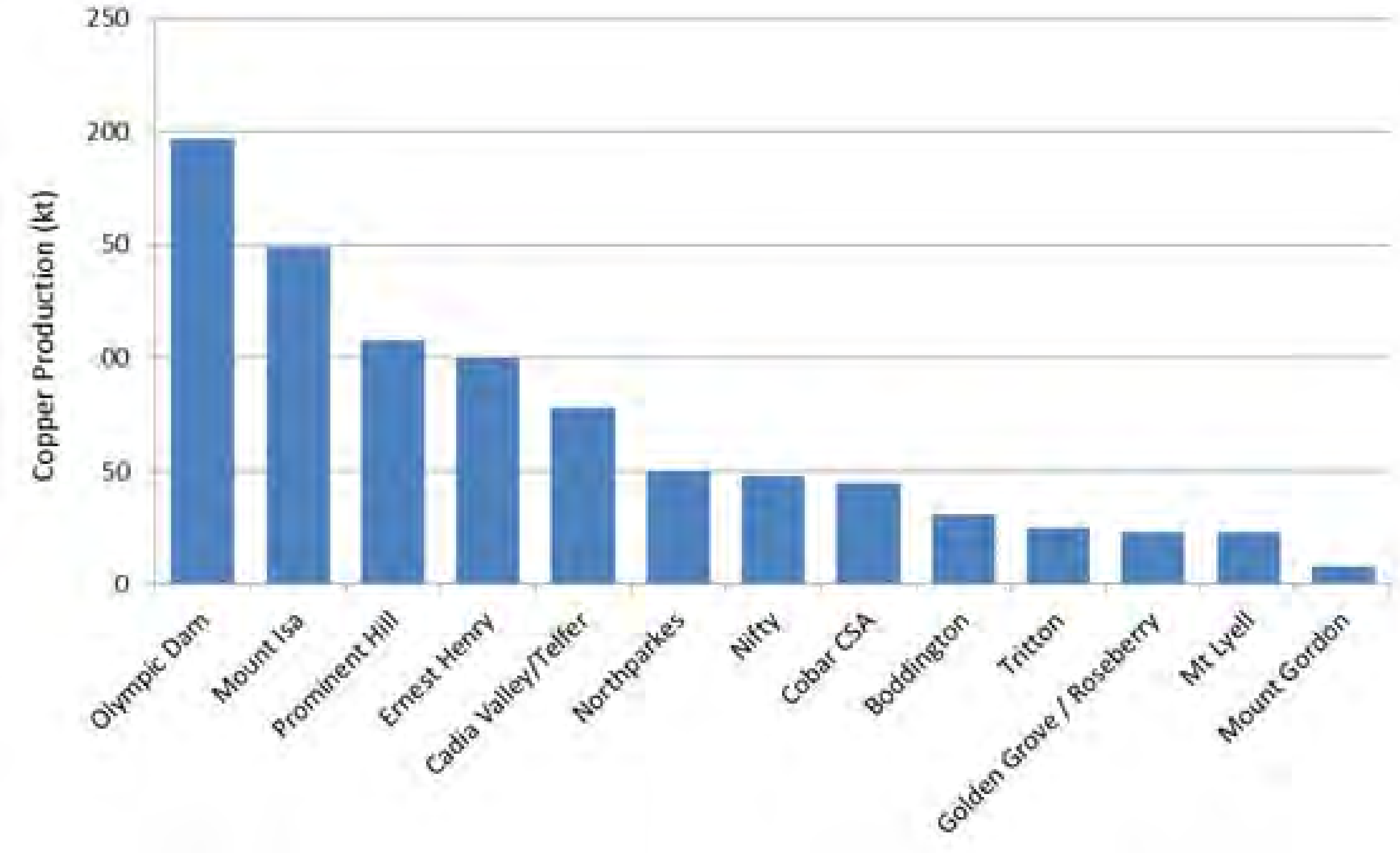

FIGURE 2.1

2011 Australian Copper Mine Production Table

Over the life of its operations, NPM have sought expressions of interest and market responses from potential customers for the purchase of mine concentrates, which has consistently resulted in a positive response and oversubscription of some production estimates. For instance, in 2006, expressions of interest from eight parties for between 310 to 590 kt per annum (ktpa) were received for NPM concentrate. This demonstrates that demand for copper concentrate far exceeds forecast production levels of 140 to 160 ktpa and illustrates the considerable demand for NPM concentrate going forward.

The range of operational and capital efficiencies associated with the Project as described in the assessment of potential project alternatives provided in **Section 2.4** positions the continued life of NPM operations as a continued important contributor to the copper market.

2.2 Description of Existing and Approved Operations

The Project includes the proposed consolidation and replacement of the existing project approval held by NPM, issued by the DP&I pursuant to Part 3A of the EP&A Act (PA06_0026, as modified) and an existing development consent from PSC under Part 4 of the EP&A Act (DA 11092). **Figure 1.3** shows existing and approved surface infrastructure at the NPM site which includes:

- undertaking mining operations until 2025;
- two open cut mines, E22 and E27, associated ore stockpiles, waste rock dumps and an acoustic bund. Open Cut mining ceased at NPM in October 2010;
- E26 underground block cave mine, including associated underground mining infrastructure and surface subsidence affectation area;
- E48 underground block cave mine and associated underground mining infrastructure and surface subsidence affectation area;
- ore processing plant including surface crusher, crushed ore stockpiles, grinding mills, froth flotation area and concentrate storage processing up to 8.5 Mtpa;
- three existing operational TSFs (TSF 1, 2 and Estcourt (includes E27 Open Cut void infill));
- surface infrastructure including the underground access portal, workshops, mining offices, hoisting shaft, ventilation fans and overland conveyors. Ore stockpiles, waste are located around the surface affected area outside the predicted final subsidence limits. Underground mining contractor laydown areas are established on the surface around the mining offices;
- site access via the mine owned Northparkes Lane to Bogan Road (refer to **Figure 1.3**);
- site infrastructure including administration building and change rooms, core shed, laboratory, emergency response shed, warehouse, workshop, chemical and explosive storage areas, internal mine site road and associated parking facilities;
- service infrastructure including sewerage systems, electricity and telecommunication;
- road haulage of concentrate to the Goonumbla rail siding;
- concentrate loading at Goonumbla rail siding for transport to Port Kembla; and

- block cave knowledge centre, which provides training to staff from Northparkes Mine and from other Rio Tinto mines across Australia and internationally. The facility includes offices, class rooms, training workshops and additional car parking facilities.

As shown on **Figure 1.3**, a number of substantial project components, for which NPM has approval under PA06_0026 to construct and operate, have not yet commenced. The components include the following:

- TSF 3 'Rosedale' Cell's A and B, associated return water dam and Rosedale Borrow Pit;
- Rosedale Borrow Pit (for provision of material for the construction of TSF 3);
- Tailings infill between TSF 1 and TSF 2; and
- Development of an additional Waste Rock Stockpile to the east of the E26 Subsidence Zone.

These approved, but not yet constructed, facilities will be retained under this Project as shown in **Figure 1.3,** with the exception of the approved TSF 3 (Rosedale TSF) and associated return water dam and Rosedale borrow pit which will be incorporated into the development of the proposed TSF 3 infrastructure and small scale open cuts (E31/31N) (refer to **Section 2.3**).

2.2.1 Underground Operations

Current underground operations are undertaken by using block caving methods within a number of ore bodies (E26 and E48) to target specific ore grades (refer to **Figure 2.2**). **Figure 2.3** provides a typical example of the block cave mining method, which includes the establishment of various levels, primarily the extraction level, which consists of extraction drives and associated draw points from which caved ore is drawn, a crushing/haulage level and ventilation infrastructure.

NPM's typical mine layout comprises a number elements, including energy-efficient electric loaders, high-volume jaw-gyratory crushers and conveyors, most of which are automated. The NPM layout is also based on a single production horizon, eliminating the additional trucking/rail haulage levels, effectively requiring two levels to be developed for block cave mining. A typical arrangement of the block cave mining method at NPM is shown on **Figure 2.3**.

Access to the underground operations is by a 1 in 7 grade, approximately 5 metres wide by 5.5 metres high decline from the surface portal located above E26 for person and material access. The access to the E48 ore body is via an approximately 200 metre extension from the E26 access decline (refer to **Figure 2.2**).

The pipe-like E26 ore body is divided into two lifts. Lift 1 (which was completed in October 2003) extends from the surface to approximately 480 metres below the surface. Underground block cave mining in E26 also consists of Lift 2 and Lift 2N. The extraction level of Lift 2 extends to approximately 830 metres below the surface (refer to **Figure 2.2**). To create E26 Lift 2 and 2N, approximately 24 kilometres of tunnels were developed and some 161 drawpoints were excavated through which the broken rock is drawn.

The E48 ore body is located approximately 2 kilometres north of E26, and midway between the E26 hoisting shaft and the processing plant (refer to **Figure 1.3**). Operations in E48 commenced in 2010 using similar block cave methods described above. The E48 development comprises approximately 12 kilometres of underground infrastructure with the extraction level located approximately 580 metres below the surface (refer to **Figure 2.2**).

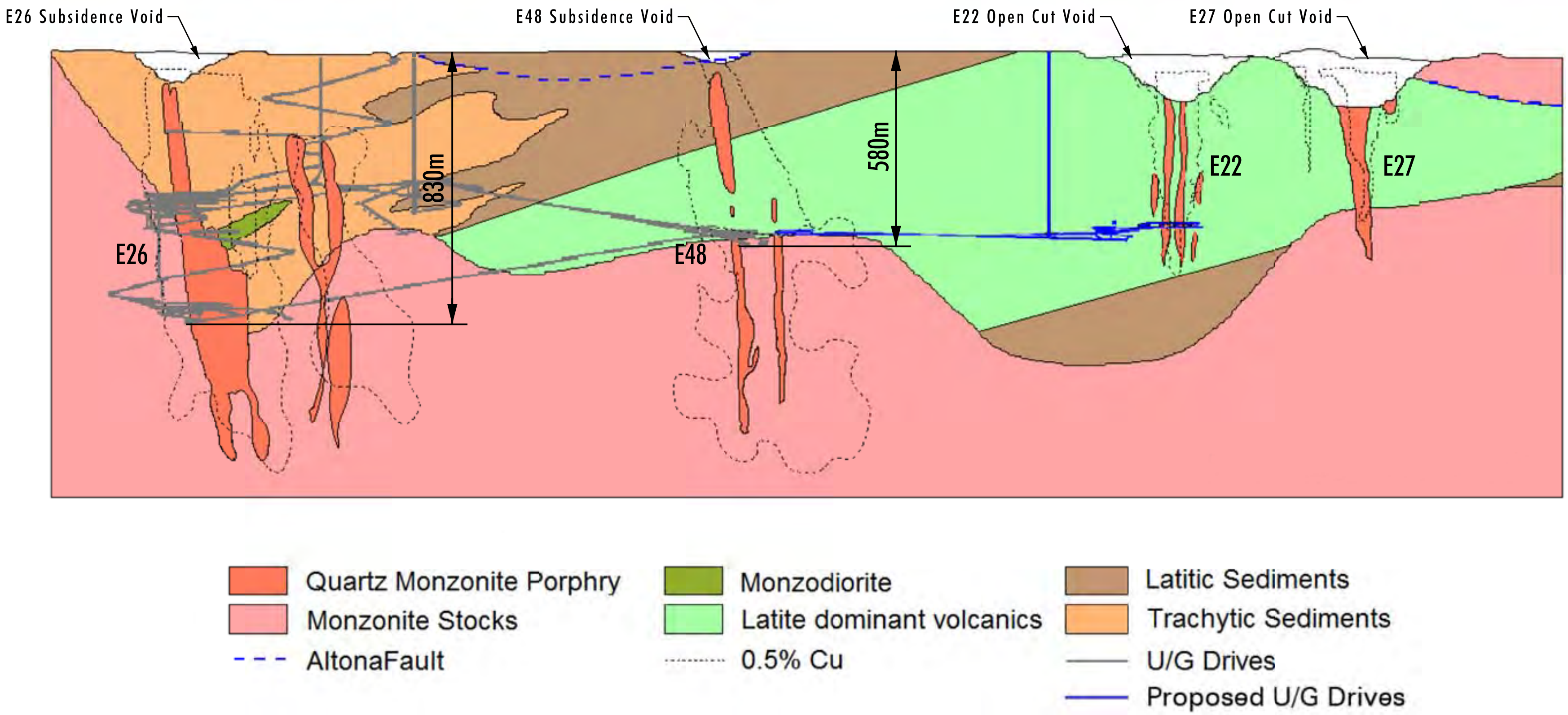

FIGURE 2.2

Representative Cross Section of NPM Geology showing Main Reserves and Mining Areas

Source: NPM (2013)

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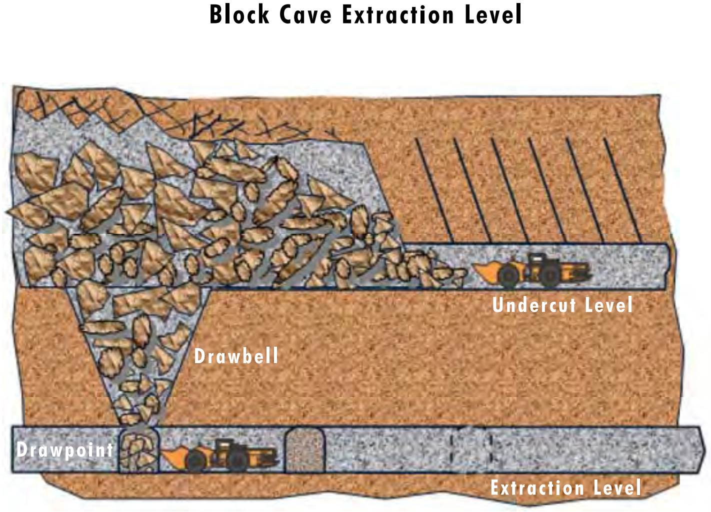
20130513 16.45



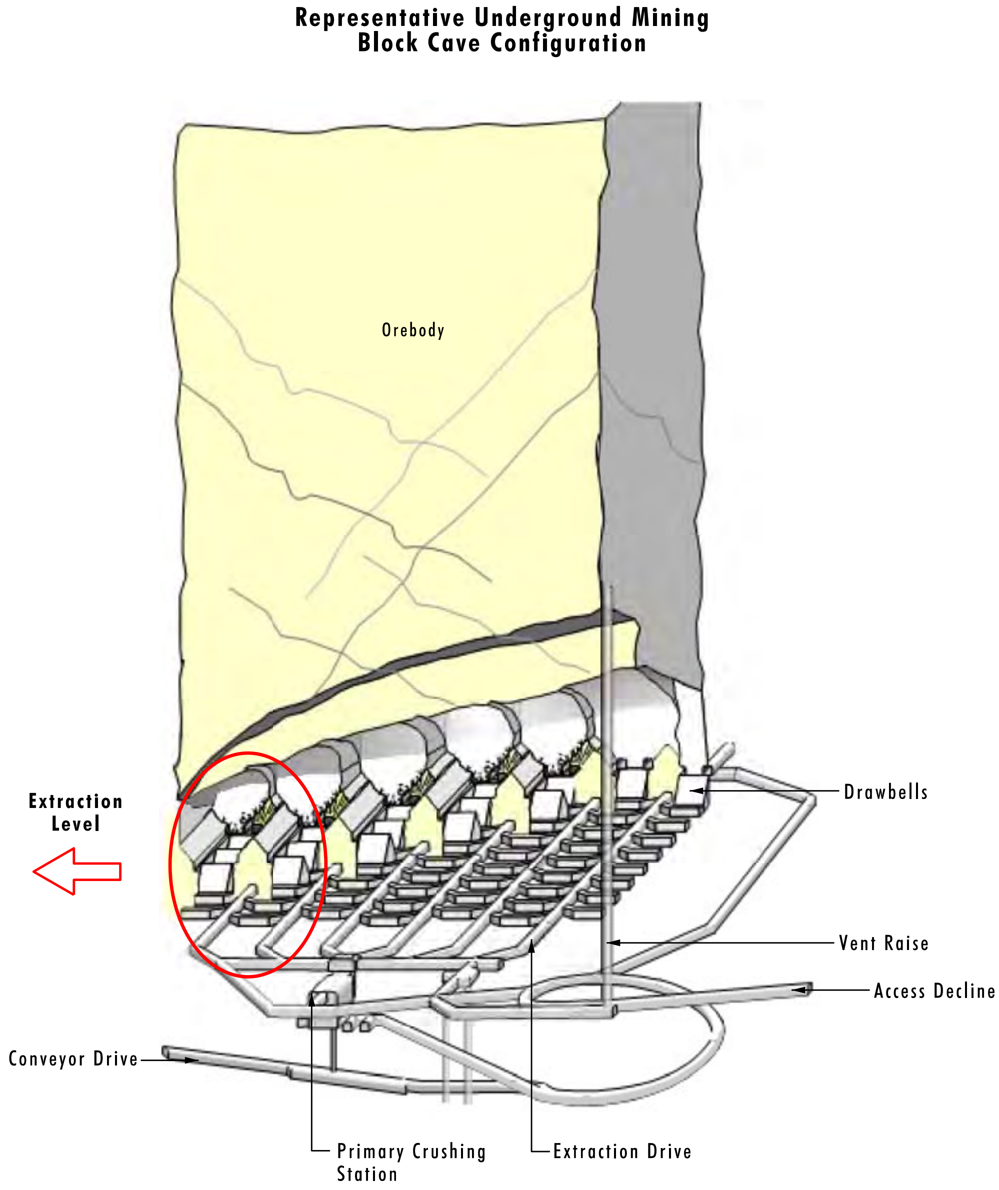


FIGURE 2.3

Typical NPM Block Cave Mining

Source: NPM (2013)

File Name (A4): R10/2949_307.dgn
20130507 12.48

The E48 underground mine development also included the development construction of an additional crusher, underground workshops and facilities and a new section of underground conveyor.

The design of the NPM underground block cave allows for the sharing of ancillary infrastructure between the two underground lifts, which creates significant operational efficiencies (refer to **Figure 2.3**). Feeding from the extraction level drawpoints are automated electric loaders transporting the ore to jaw-gyratory crushers placed at the margins of each extraction level. The rock is crushed and then transported to the surface via a dedicated hoisting shaft (approximately 520 metres deep) which is located adjacent to access decline at E26 (refer to **Figure 2.2**). Ore hoisted from underground is then conveyed to the north by an onsite conveyor for secondary crushing and stockpiling adjacent to the ore processing plant (refer to **Figure 1.3**).

The nature of the underground mining operations results in defined subsidence impacts on the surface above the ore body (refer to **Figure 1.3**). The nature of the block cave underground mining method results in subsidence which directly impacts the land surface resulting in relatively predictable disturbance footprints above underground mining operations (refer to **Figure 1.3**). NPM undertake ongoing monitoring of existing subsidence areas across its operations as outlined further in **Section 5.14**.

2.2.2 Open Cut Operations

Campaign open cut mining at NPM has previously been conducted in the E22 and E27 ore bodies (refer to **Figure 1.3**) to provide contingency to underground ore sources. Historically ore produced from the open cut operations has been blended with ore from the E26 and E48 underground mine to maintain a consistent float of material to keep the processing plant ‘fed’ with ore.

Open cut mining ceased in the E27 open cut mine in September 2005, with campaign open cut mining continuing in E22 until October 2010. Open cut mining at NPM has used conventional mining methods, including excavators, haul trucks, and drill and blast methodologies. Waste material from open cut mining has been stockpiled in dumps adjacent to both the E22 and E27 pits (refer to **Figure 2.4**). The E27 open cut void has been incorporated into the Estcourt TSF (refer to **Figure 1.3**).

Blasting previously undertaken as part of open cut mining activities has occurred for production, trim and pre split blasting. Blasting has been typically undertaken six times per week during campaign open cut mining. Blast size has ranged over each of the typical blast types with general Maximum Instantaneous Charge (MIC) ranging from 30 kilograms to 50 kilograms. Blasting practices are designed and controlled to account for engineering and environmental constraints with all blasts monitored to ensure compliance with relevant limits.

2.2.3 Ore Stockpiling and Processing

Ore processing is a term used to describe the process of taking ore (mineralised rock from the earth) and turning it into a concentrate. In the case of NPM the ore is processed into a copper concentrate (containing traces of gold and silver) at an approved ore processing rate of up to 8.5 Mtpa. The following section provides an overview of ore stockpiling and processing at NPM, which is carried out at the centrally located processing facility, situated to the south-east of the E27 open cut void (refer to **Figure 1.3**).

Umwelt
Environmental Consultants

Source: NPM (2013), Google Earth (2010)

0 0.5 1 2km
1:40 000

Legend

- Project Area
- Existing Tailings Storage Facility
- Existing and Approved Material Stockpiles
- Existing ROM Stock Pile
- Existing Sound Bund

FIGURE 2.4

Existing and Approved Material Stockpiles

File Name (A4): R10/2949_219.dgn
20130513 12.11

Extracted ore is placed in Run-Of-Mine (ROM) stockpiles adjacent to the processing plant (refer to **Figure 2.4**). The ROM stockpiles have a capacity of up to 300,000 tonnes. To facilitate processing, ore is reclaimed from the ROM stockpiles by reclaim feeders which deliver the ore via conveyors to the processing plant.

In addition to the main ROM stockpiles, there are a number of additional material stockpiles located on site. As shown on **Figure 2.4**, these existing stockpiles are generally located adjacent to the existing ore processing plant and historical open cut mining areas (E22 and E27), and in the vicinity of E26. These stockpiles contain varying quantities of ore which is available to supplement primary ore supply to the processing plant, as required. Material stockpiled which is not suitable for processing is used as construction material and/or remains in the stockpile and rehabilitated upon cessation of use.

A general schematic of ore processing at NPM is shown on **Figure 2.5**. As shown on **Figure 2.5**, ore processing includes a number of defined stages including grinding, flotation and thickening to produce the copper concentrate product and tailings.

The grinding circuit is comprised of two separate modules, each incorporating a Semi Autogenous Grinding (SAG) mill, oversize crushing technology, two stages of ball milling and froth flotation. NPM's existing flotation circuit operates as two parallel modules, each linked to its own grinding circuit. The flotation process aims to float a sulphide concentrate to recover the major copper and gold bearing minerals. Sulphide copper-gold ore is floated using a standard process where the copper and gold-bearing sulphide minerals are recovered using xanthate as the primary collector and methyl isobutyl carbinol (MIBC) as the frother. The circuits consist of pre-float, rougher, scavenger, cleaner, cleaner-scavenger and re-cleaner treatment, which seek to maximise resource recovery through the utilisation of a closed circuit flotation process (refer to **Figure 2.5**). Final tailings (waste or unrecovered material) from each module are pumped to a tails thickener for dewatering.

The final concentrate produced for each module assays at approximately 30 per cent copper and is pumped to a concentrate thickener. Final concentrate from the flotation circuits is pumped to thickeners where it is thickened to an average underflow density of approximately 55 to 60 per cent solids. Thickened concentrate is then pumped to concentrate storage tanks prior to treatment through the filtration circuit which utilises ceramic disc filters. The filtered concentrate cake is discharged onto slow moving conveyor belts, each equipped with a weightometer to determine final production of concentrate. The concentrate is conveyed into a storage shed, for stockpiling and drying before loading and transporting to customers.

The high-grade copper concentrate is removed from the storage bays using a front-end loader, which loads the concentrate into sealed shipping containers. The sealed containers are trucked to the Goonumbla rail siding approximately 12 kilometres from the NPM site (refer to **Figure 1.3**). Containers are temporarily stored adjacent to the rail siding prior to being loaded via front end loader onto trains (carrying capacity of each train up to 60 containers) and transported to Port Kembla, south of Wollongong, where the concentrate is then shipped to international customers.

Based on current approved processing levels of 8.5 Mtpa, up to approximately five trains per week on average are utilised to transport copper concentrate to Port Kembla. Trains access the Goonumbla facility via a rail siding. The Goonumbla rail siding is located on the line connecting Cootamundra (also located on the Main South line which connects Sydney to Melbourne), Parkes and Dubbo. Parkes is also located on the Broken Hill line which is the major east-west rail line. Existing rail infrastructure allows NPM to utilise existing rail networks for transport of concentrate to Port Kembla.

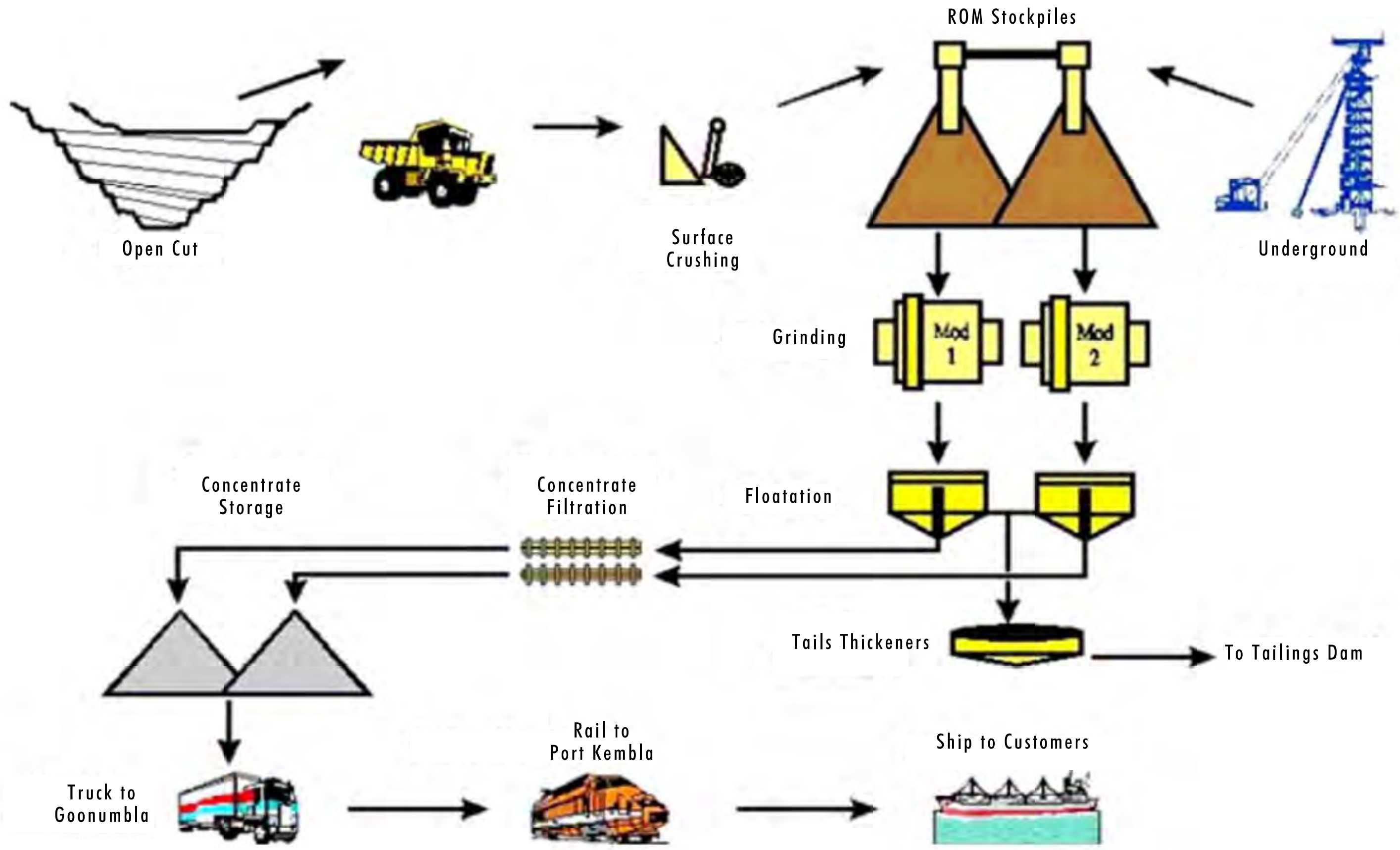


FIGURE 2.5

Typical Ore Processing Schematic

Source: GHD (2009)

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20130502 15.38

2.2.4 Tailings Management

Tailings refers to the waste generated during the processing of ore. The typical NPM tailings composition is summarised in **Table 2.1**.

Table 2.1 – Typical Tailings Composition

Chemical	Concentration (%)
Orthoclase $KAlSi_2O_8$	69
Silica, Crystalline – Quartz SiO_2	<18.1
Additives	6.4
Illite	3
Mica	2.3
Aluminium Silicate $Al_2O_3SiO_2$	0.9
Water	<1
Copper Sulphides	0.2

Comprehensive tailings strategies are in place at NPM to manage operational and environmental aspects of tailings disposal. Three sets of slurry pumps, in parallel, pump the thickened underflow tailings (55 to 60 per cent solids by weight) to the onsite tailings dams TSF 1, 2 or Estcourt TSF (refer to **Figure 1.3**).

Tailings are pumped to the TSFs until the capacity of the existing perimeter wall is reached. Deposition is then transferred to the adjacent storage facility to allow tailings to dry prior to capacity being increased through perimeter wall lifts. The TSF walls are constructed from clay and rock material recovered from nearby borrow pits and from the E22 and E27 open cut pits.

TSF 1 and 2 have an approved height of 28 metres above the natural ground with an existing height of between 22 and 25 metres as at mid-2012. The Estcourt TSF which has recently commenced operation has an approved height of 25 metres above the natural ground, with a current wall height ranging from 10 to 20 metres, whilst the approved but not yet constructed Rosedale TSF has an approved height of 20 metres above natural ground.

Maximising water recovery and increasing in-situ dry density are the main aims of the tailings management approach. TSF 1 and 2 share a common Return Water Dam which is located between the two embankment walls. The tailings are gradually sub-aerially deposited into the active TSF from a number of spigots around the tailings dams, until an approximately uniform 100 millimetres thick layer of tailings forms across the surface of the storage facility. Tailings run off is directed to the internal central decant tower. The central decant system is gravity fed with a buried rubber ring jointed pressure pipe joining the centre decant and the Return Water Dam. The decant tower height is increased by the placement of successive collars as the deposited tailings level rises.

NPM have developed a specific site wide Management Plan for Environmental Dust. The plan identifies the potential impacts, documents likely sources, sets performance criteria, and establishes control measures and monitoring requirements. With respect to minimising dust generated from the existing tailings facilities this has included a commitment to progressive rehabilitation, capping the dams as soon as practicable and continuing to investigate other techniques such as dust suppressants, including a 2012 trial of applying a Polymer based dust suppressant to reduce dust generated from the drying TSFs, with the results reported to relevant agencies including Office of Environment and Heritage (OEH).

2.2.5 Waste Rock Management

Waste rock and clays generated as waste from open cut activities or stripped from areas as part of preparing for onsite surface disturbance is stored across the NPM operation in stockpiles. The locations of onsite stockpiles are illustrated in **Figure 2.3**. Material contained within the stockpiles will either by reclaimed and processed to obtain the lower grades of ore, utilised for the construction of onsite infrastructure (i.e. TSFs) and/or remain stockpiled and rehabilitated upon cessation of use.

2.2.6 Water Management, Use and Transport

Water is required at NPM for the processing plant, mining activities, dust suppression and general potable water usage. NPM obtains the majority of its existing water supply from Water Access Licences and a Joint Water Supply Licence held with PSC. The main source of water for PSC, and the most reliable water source for NPM, is a bore field in the Lachlan Valley near Forbes. In addition to this bore water, PSC obtains additional water from the Lachlan River and two surface dams near Parkes. The supply of NPM operational water occurs via the PSC water pipeline to Parkes which has then been augmented to the mine site by NPM (refer to **Figure 2.6**).

NPM supplements the water it receives from PSC with the water recycled from the process plant thickeners and TSFs and rainfall recovered from the TSFs and other water storages within the existing mine site. Any groundwater make recovered from the mine workings is also included and recycled for re-use as a part of mining operations.

Table 2.2 summarises the water sources for NPM operations during the 2008 to 2012 period.

Table 2.2 – Northparkes Mine Fresh Water Sources 2008 to 2012

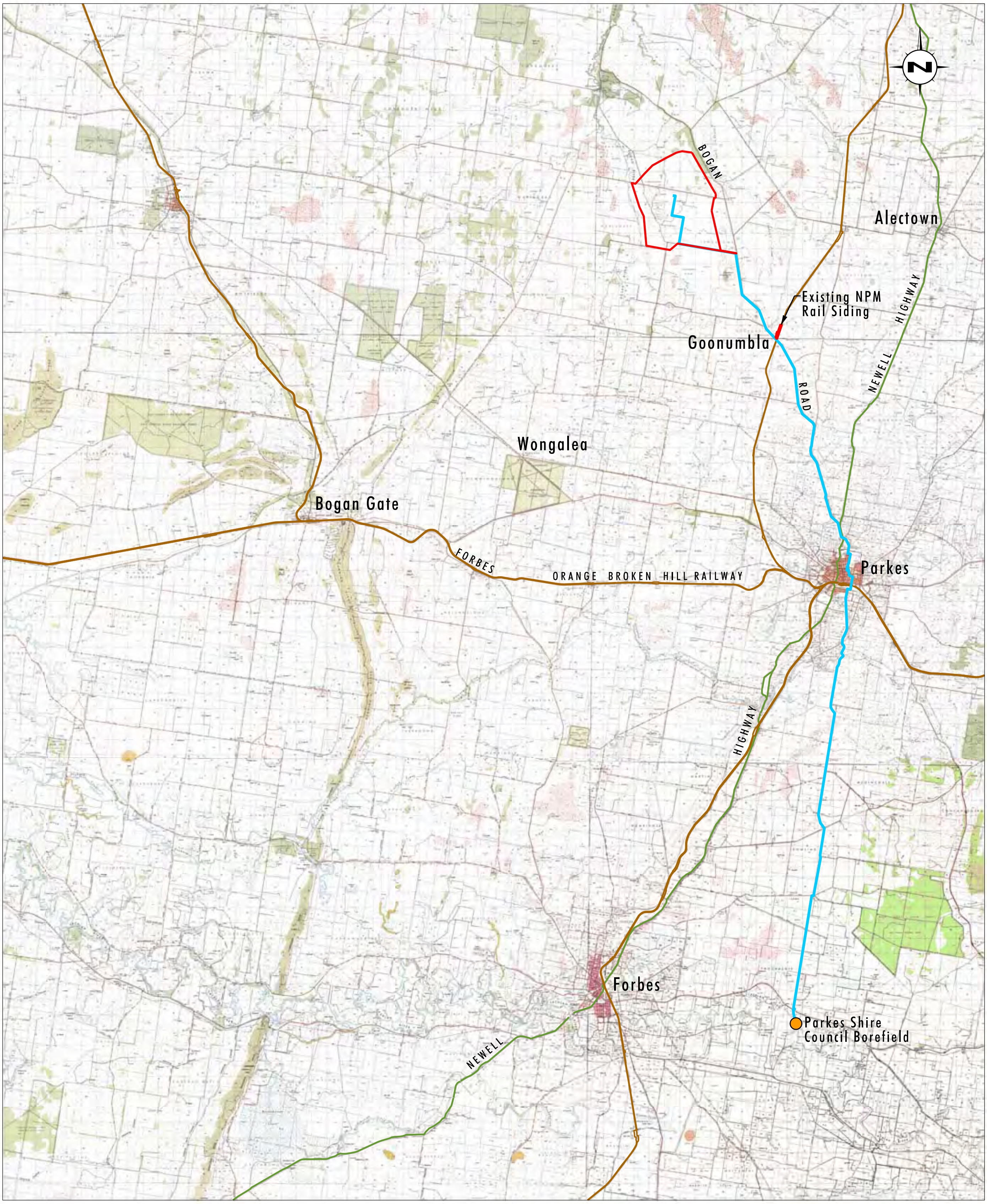
Source	Quantity Used (ML)				
	2012	2011	2010	2009	2008
Fresh water piped from the Lachlan Valley bore field (A)	3,019	2,379	3,141	3,499	3,471
Collected from site surface water catchments (B)	1,762	1,054	1,627	430	304
Total Water Used (A + B)	4,781	3,433	4,768	3,929	3,775
Recycled water	2,188	1,898	1,375	1,797	1,288

NPM manage all types of water in its mining operations through the site wide Water Management Plan. The Plan has the objectives of:

- ensuring a long term reliable water supply to site;
- maximising water efficiency to reduce reliance on fresh water usage; and
- protecting clean water systems.

NPM is a nil water discharge site, with the existing NPM water management system operated and managed to comply with section 120 of the *Protection of the Environment Operations Act 1997* (PoEO Act), as required under NPM's Environment Protection Licence (EPL) 4784.

Clean water diversion channels are constructed around the existing processing plant, site offices, TSFs and other operational areas, to ensure clean water is appropriately separated from operational water.



Source: NPM (2012)

0 5 10 15km
1:350 000

Legend

- Project Area
- Highway
- Railway
- Existing Water Supply Pipeline

FIGURE 2.6

Existing Water Supply Pipeline

2.2.7 Site Infrastructure

NPM provides a range of support infrastructure developed to facilitate onsite mining activities. These facilities include mining offices, workshops and parking facilities and are located at two on-site locations at NPM (refer to **Figure 1.3**).

The majority of supporting site infrastructure is located in the main office and workshop complex located adjacent to the processing plant and rill tower (refer to **Figure 1.3**). In the southern extent of the site, the underground offices, where specific support services, including crew offices, and remote operating centres are located to support underground mining activities. Primary existing car parking facilities onsite are located adjacent to these mine infrastructure areas.

2.2.8 Ancillary Underground Infrastructure/Activities

Specific ancillary support infrastructure and activities are provided to support underground operations at NPM including the following:

- Underground ventilation; fresh air enters the underground mining area via the, decline, hoisting shaft and services raise, and two exhaust fan installations.
- Underground dewatering systems, which pump any water which accumulates underground to surface where it is incorporated into the site process water system and is recycled onsite.
- Underground electricity is conveyed to underground workings by a reticulated 11 kilovolt (kV) circuit.
- Maintenance workshops, underground refuelling station, underground offices, crib rooms and amenity facilities (located underground).

2.2.9 Site Access

Site access is via the mine owned Northparkes Lane to Bogan Road (refer to **Figure 1.3**). Northparkes Lane and Bogan Road provide site access to both staff vehicles and copper concentrate haulage trucks. Bogan Road provides the main road access to NPM from Parkes and surrounding areas. The concentrate haulage trucks which transport ore from the processing plant to the Goonumbla rail siding, located approximately 12 kilometres to the south-east of NPM processing plant, use Bogan Road. Access to the site can also be obtained from Peak Hill via Coradgery, Robertson and Taweni Road, which require connection to both Bogan Road and Northparkes Lane to facilitate site access.

Within the active mining areas, there are a number of internal roads, with sealed roads provided between the major infrastructure and administrative centres onsite as described in **Section 2.2.7** including between the administration offices, processing plant and underground service facilities/offices. Other infrequently used roads are gravelled. An access control point is provided between the internal mine site roads and Northparkes Lane at the main car park and entry to the site.

2.2.10 Service Infrastructure

Northparkes is fully serviced by a range of ancillary services including power supply waste water and telecommunications. **Figure 2.7** shows the location of existing key ancillary services currently servicing NPM, with further description outlined in the following sections.

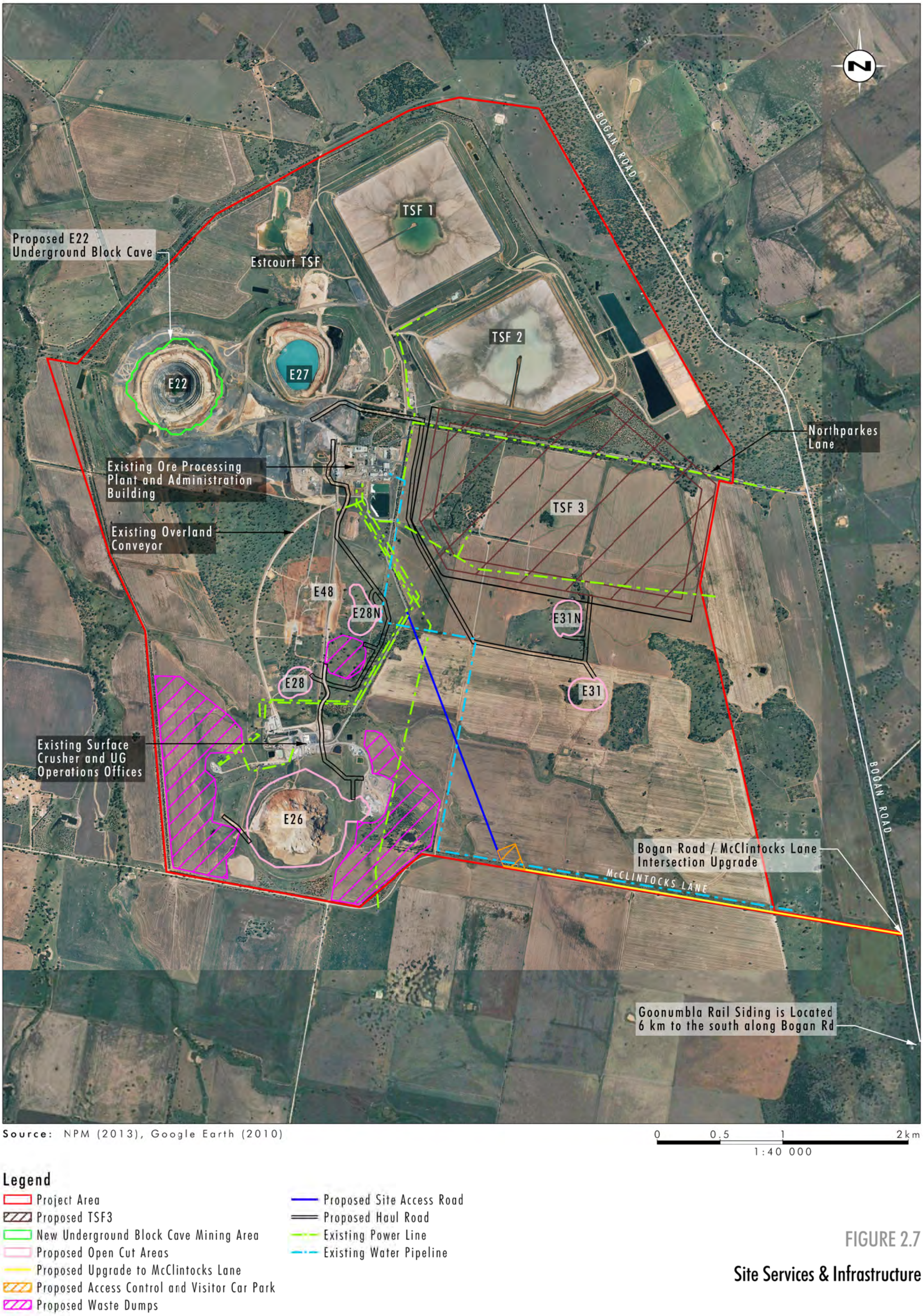


FIGURE 2.7

Site Services & Infrastructure

2.2.10.1 Electricity Supply

Electricity is supplied by Essential Energy through a 132 kV line to the NPM site from the Forbes-Wellington 132 kV line at its intersection with the Parkes - Condobolin Road. NPM operate onsite 132 kV and 11 kV substations as well as 11 kV feeder lines to provide electricity supply across the site. The location of existing power lines on-site is shown on **Figure 2.7**.

2.2.10.2 Waste Water

Domestic sewage from the operation is processed by four treatment plants. Three are located near offices located adjacent to the existing processing plant, and one is situated at the underground operations offices (refer to **Figure 1.3**). Residual water resulting from this process is treated and recycled back into the system to be incorporated into the water used by the processing plant.

2.2.10.3 Telecommunications

External telecommunications are provided by Telstra using the digital mobile and landline network, which are generally co-located with power line infrastructure servicing NPM. Internal communications on site are via portable VHF radios and telephones.

2.2.11 Block Cave Knowledge Centre

The Block Cave Knowledge Centre is developed as an international knowledge centre for block cave mining. The centre includes training rooms, an open plan office, a computer room, crib room, 360 cinema, multi-media studio and equipment, simulation room (including heavy vehicle training/workshop centre), storage rooms and amenities (refer to **Figure 1.3**).

The knowledge centre seeks to provide specific and simulated mine training to Rio Tinto staff in a controlled environment, before applying newly acquired skills to active mining areas, as a process to maximise on-site safety and to confirm Rio Tinto's commitment to its vision of achieving Zero Harm.

2.2.12 Existing Conservation Area

The development of the Estcourt TSF in accordance with PA06_0026 (Mod 1) required the establishment of a Biodiversity Offset Area. The Biodiversity Offset Area is 65 hectares and is located to the north-east of the existing NPM site (refer to **Figure 1.3**). The Biodiversity Offset Area is managed in accordance with PA06_0026 (as modified) and detailed in the approved Vegetation Management Plan.

2.3 The Project

2.3.1 Geological Setting and Resources Assessment

The NPM deposits occur within the Ordovician Goonumbla Volcanics of the Goonumbla Volcanic Complex (Simpson *et al.* 2000). The Goonumbla Volcanics form part of the Junee-Narromine Volcanic Belt of the Lachlan Orogen (Glen *et al.* 1998). At NPM, the Goonumbla Volcanics are a folded sequence of trachyandesitic to trachytic volcanic and volcaniclastic sediments that are interpreted to have been deposited in a submarine environment.

In the NPM region the Goonumbla Volcanics have been intruded by equigranular monzonite stocks. Quartz monzonite porphyry pipes and dykes, some of which are associated with mineralisation, have intruded both Goonumbla Volcanics and the equigranular monzonite stocks.

The NPM deposits are typical porphyry copper systems in that the mineralisation and alteration are zoned around quartz monzonite porphyries. The porphyries form narrow (typically less than 50 metres in diameter) but vertically extensive (greater than 1000 metres) pipes. Mineralisation extends from the porphyries into their host lithology. The E26 and E48 deposits range from 60 to 500 metres in diameter and extend vertically for more than 1300 metres. Whereas the E22 and E27 mineralised systems are deeply eroded and it is apparent that only the deepest parts of the system are substantially preserved. **Figure 2.2** shows a cross section of NPM's underground resource and mining areas.

Table 2.4 provides an overview of the current resources assessment for NPM which includes each of the proposed mining areas to the target copper concentration level. This includes the continued underground mining operations in E26 and E48, as well as the proposed underground mining operations in E22, and proposed open cut mining operations in E31, E31N, E28, E28N and E26.

Ore Reserves and indicative resource grades, as at 31 December 2012, as formally reported in Rio Tinto's annual report are summarised in **Table 2.3**. **Table 2.4** summarises the 31 December 2012 Mineral Resources.

Table 2.3 – NPM Ore Reserves

	Proved Ore Reserves as at 31 December 2012			Probable Ore Reserves as at 31 December 2012			Total Ore Reserves as at 31 December 2012			Recovery %		Rio Tinto Share of Production	
	Tonnage (Mt)	% Cu	Au g/t	Tonnage (Mt)	% Cu	Au g/t	Tonnage (Mt)	% Cu	Au g/t	Cu	Au	Cu (Mt)	Au (Moz)
Stockpiles													
Oxide Stockpiles	0	0	0	0	0	0	0	0	0	0	0	0	0
Sulphide Stockpiles	8.24	0.4	0.24	0	0	0	8.24	0.4	0.24	0.86	0.67	0.023	0.041
Total Stockpiles	**8.24**	**0.4**	**0.24**	**0**	**0**	**0**	**8.24**	**0.4**	**0.24**	**0.86**	**0.67**	**0.023**	**0.041**
Underground													
E26	0	0	0	10.04	0.69	0.19	10.04	0.69	0.19	0.88	0.65	0.047	0.034
E48	0	0	0	55.98	0.82	0.3	55.98	0.82	0.3	0.89	0.69	0.332	0.324
Total Underground	**0**	**0**	**0**	**66.02**	**0.80**	**0.28**	**66.02**	**0.85**	**0.3**	**0.89**	**0.73**	**0.379**	**0.358**
NPM Total	**8.24**	**0.4**	**0.24**	**66.02**	**0.80**	**0.28**	**74.26**	**0.76**	**0.28**	**0.89**	**0.68**	**0.402**	**0.399**

Source: NPM Ore Reserve statement for the year ended 31 December 2012. Figures stated may differ slightly from those in Rio Tinto's Annual Report due to rounding.

Table 2.4 – NPM Mineral Resources

	Measured Resources 31 December 2011			Indicated Resources 31 December 2011			Inferred Resources 31 December 2011			Total Resources 31 December 2011			Rio Tinto Share of Contained Metal	
	Tonnage (Mt)	% Cu	Au g/t	Tonnage (Mt)	% Cu	Au g/t	Tonnage (Mt)	% Cu	Au g/t	Tonnage (Mt)	% Cu	Au g/t	Cu (Mt)	Au (Moz)
Underground														
E22	0	0	0	0	0	0	33.4	0.6	0.47	33.4	0.6	0.47	0.16	0.404
E26	13.62	0.91	0.3	3.71	0.71	0.13	57.4	0.66	0.18	74.73	0.71	0.2	0.423	0.383
E48	**0**	**0**	**0**	**0**	**0**	**0**	**179.7**	**0.51**	**0.24**	**179.7**	**0.51**	**0.24**	**0.733**	**1.109**
NPM Total	**13.62**	**0.91**	**0.3**	**3.71**	**0.71**	**0.13**	**270.5**	**0.55**	**0.25**	**287.83**	**0.57**	**0.26**	**1.32**	**1.896**

Note: Mineral Resources are exclusive of Ore Reserves. Sum of respective components may not equal totals due to rounding.

Source: NPM Mineral Resource statement for the year ended 31 December 2012. Figures stated may differ slightly from those in Rio Tinto's Annual Report due to rounding.