

Section 1

Introduction

PREAMBLE

This section introduces the proposal of Australian Zirconia Ltd to develop and operate the Dubbo Zirconia Project (the "Proposal") and includes:

- *an outline of the scope and format of the document;*
- *details about the Applicant, Australian Zirconia Ltd;*
- *relevant background to the Proposal and an overview of its resources and reserves;*
- *information on the approvals process; and*
- *identification of the personnel involved in the design, document preparation and specialist consultant investigations.*

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1.1 SCOPE

This *Environmental Impact Statement* (EIS) has been prepared by RW Corkery & Co Pty Limited to support an application for development consent by Australian Zirconia Ltd (“the Applicant”) to construct and operate the Dubbo Zirconia Project (“the Proposal” or “DZP”). The Proposal would comprise a small scale open cut mine supplying ore containing rare metals (zirconium, niobium, hafnium and tantalum) and rare earth elements (REEs) to a processing plant near the village of Toongi, approximately 25km south of Dubbo (see **Figure 1.1**). The location of the proposed open cut, processing plant and associated facilities for the management of waste generated by these activities is collectively referred to as the “DZP Site”.

The processing operations on the DZP Site would require the delivery of large volumes of chemical reagents and processing materials, natural gas and water. The infrastructure required to enable the delivery of these also form components of the Proposal for which development consent is sought. A copy of the development application is included as **Appendix 1**.

The chemical reagents and processing materials would be transported to the DZP Site either via the public road network, rail network, or a combination of both. The use of the public rail network would require the reconstruction and re-opening of the Dubbo to Toongi section (“the Toongi-Dubbo Rail Line”) of the Dubbo-Molong Rail Line (a branch line of the Main Western Rail Line). The use of the public road network, regardless of whether the rail network forms part of the proposed transport operations, requires upgrades to Obley and Toongi Roads.

Natural gas would be delivered to the DZP Site via a pipeline to be constructed as a spur line from the Central West Pipeline maintained by the APA Group within the rail corridor of the Merrygoen (Newcastle) and Toongi-Dubbo Rail Lines.

Water would be obtained under licence from the Macquarie River and delivered to the DZP Site via a pipeline to be constructed within an easement negotiated with the relevant landowners.

It is noted that the Proposal also requires the construction and operation of a new 132kV electricity transmission line (ETL) from an existing sub-station to the south of Geurie to Toongi. However, as the ETL would be owned and operated by Essential Energy, a separate application will be made for this ‘activity’ under Part 5 of the EP&A Act by the Applicant. While the exact alignment of this ETL remains to be defined, **Figure 1.1** provides the route options currently being considered. Notably, the alignment of the ETL on the DZP Site has been defined based on an established entry point to the DZP Site and High Voltage (HV) Switch Yard location adjacent to the main power load of the processing operations¹. Reference to the ETL is retained in the documentation where this information provides relevant information or context to the description or assessment of the Proposal.

The Proposal is classified as State Significant Development (SSD) under the *State Environmental Planning Policy (State and Regional Development) 2011* for which approval is required in accordance with Division 4.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The approval authority is the Minister for Planning and Infrastructure or as delegated by the Minister to the Planning Assessment Commission, the Director-General or to another public authority and an *Environmental Impact Statement* is required to be submitted to support the application. This document has been prepared in satisfaction of that requirement and in accordance with the requirements of Section 79C of the EP&A Act.

¹ The choice of preferred route will be subject to assessment and approval by Essential Energy with there remaining potential for minor alignment changes to either route as a result of environmental or other factors which may be identified during the ETL assessment process.

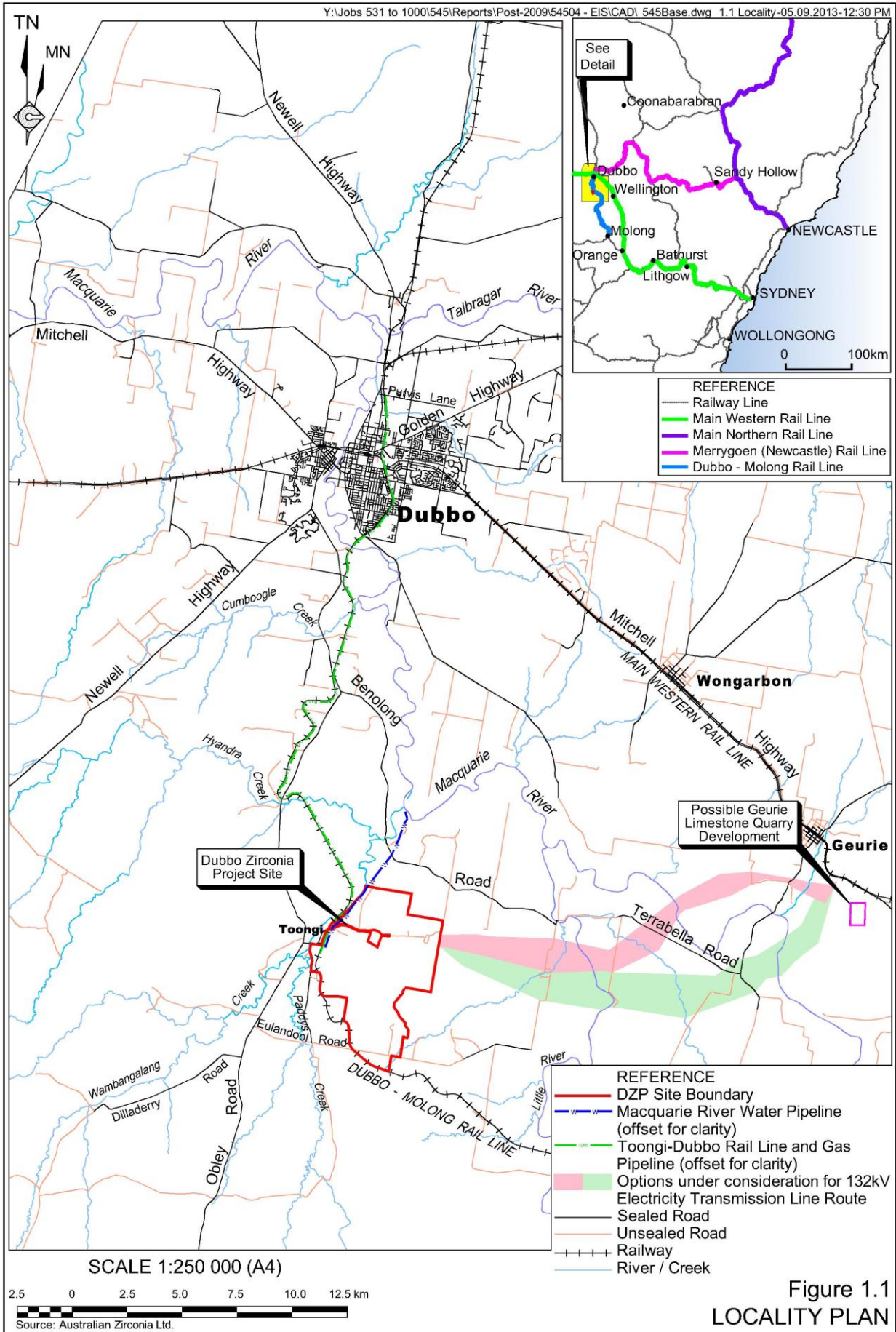


Figure 1.1
LOCALITY PLAN

The information presented in this document covers all aspects of the planning, development, operation, rehabilitation and environmental management and monitoring of the Proposal. These aspects are addressed to a level of detail consistent with industry standards, the scale of the proposed operations and the potential for environmental impact. These aspects are also presented in a manner that addresses the specific requirements of the Director-General of the Department of Planning and Infrastructure (DP&I) and other Commonwealth, State and local government agencies and/or authorities, together with those issues raised during the community consultation process. A copy of the Director-General's Requirements (DGRs) is provided in **Appendix 2**, whilst a table recording where the DGRs and other requirements raised by government agencies and where they are addressed in this document is presented in **Appendix 3**.

1.2 FORMAT OF THE ENVIRONMENTAL IMPACT STATEMENT

The EIS has been structured to address the general requirements and key issues nominated by the DGRs and other relevant State and local government agencies. The EIS has been compiled in two volumes, i.e. the Main Volume comprising six sections of text, a glossary and reference section, and a second supporting volume including a set of appendices to the EIS.

The format of the EIS has been structured as follows.

- Section 1:** introduces the Proposal, the Applicant (Australia Zirconia Ltd) and provides relevant background information including the geological setting and estimated resources within the DZP Site. Information on the management of investigations is also provided for the EIS.
- Section 2:** describes the Applicant's objectives and proposed mining, processing, product despatch, hours of operation, infrastructure and services, water and waste management and rehabilitation activities. This section also describes the feasible alternatives considered by the Applicant during the design of the Proposal.
- Section 3:** provides a description of the process used to identify and prioritise the key issues for assessment with reference to the DGRs for the Proposal, stakeholder consultation completed throughout the Proposal planning stages and a general environmental risk analysis undertaken to establish the specific environmental risk(s) posed by the identified issues.
- Section 4:** presents the environmental setting of the DZP Site, including information on topography, meteorology, land ownership and land use. The section also describes the existing environment, proposed management, assessment of potential impact and maintenance/monitoring requirements for the key issues identified in Section 3.
- Section 5:** provides a draft statement of commitments compiled by the Applicant in relation to environmental management and monitoring for the entire Proposal.
- Section 6:** evaluates the Proposal in terms of biophysical, economic and social considerations, and the goals and guidelines of Ecologically Sustainable Development. A conclusion relating to the acceptability of the Proposal based on the above is presented to conclude the EIS.

References: lists the various source documents referred to for information and data used during the preparation of the EIS.

Glossary: explains the technical terms, acronyms, symbols and units used throughout the EIS.

Appendices: present the following additional information.

1. A copy of the Applicant's application for development consent.
2. A copy of the DGRs for the Proposal. This includes the Supplementary DGRs issued following determination of the Proposal as a controlled action by the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) on the basis of potential impacts on Matters of Environmental Significance (as defined by the *Environment Protection and Biodiversity Conservation Act 1999*).
3. An itemised and tabulated summary of the DGRs, including the requirements provided by the various government agencies consulted. This appendix also includes reference to the section(s) within the EIS or *Specialist Consultant Studies Compendium* where each is addressed.
4. A risk screening and Preliminary Hazard Analysis completed by Sherpa Consulting Pty Ltd in accordance with the requirements of *State Environmental Planning Policy (SEPP) 33*.
5. A concept design plan for the Macquarie River Water Pipeline (Pressurised Supply Pipeline and River Pump Station) prepared by Darling Irrigation.
6. A concept design report prepared by D.E. Cooper & Associates Pty Ltd nominating the critical design requirements and features of the proposed solid and liquid residue management for the Proposal.
7. A short report prepared by Hennessy Water reviewing the availability of water from surface and groundwater sources to supply the Proposal.
8. A letter report prepared by Environmental Earth Sciences Pty Ltd providing a desktop review of groundwater resource availability within the bedrock and alluvial aquifers below the DZP Site.
9. An *Agricultural Impact Statement* prepared by Diana Gibbs & Partners and RW Corkery & Co. Pty Limited in accordance with the requirements of the NSW Strategic Agricultural Land Use Policy (DP&I, 2012).
10. A Preliminary Contamination Assessment completed for Lot 1, DP818802 (former GrainCorp owned land for grain storage and rail loading which adjoins the DZP Site at Toongi) completed by Ground Doctor Pty Ltd.
11. Material Safety Data Sheets for the various products of the DZP.

This EIS is supported by a three volume *Specialist Consultant Studies Compendium*, incorporating 12 stand-alone reports prepared by eleven specialist environmental consultancies engaged to assess specific environmental issues relevant to the Proposal. The contents of these reports are summarised into the appropriate section(s) of the EIS.

1.3 THE APPLICANT AND THE APPLICATION AREA

1.3.1 The Applicant

The Applicant, Australian Zirconia Ltd was formed in July 2000 to hold all the assets of the DZP and to facilitate the ultimate development of the Proposal. Australian Zirconia Ltd is a wholly-owned subsidiary of Alkane Resources Ltd (“Alkane”), a publicly listed Australian mining and exploration company which has been in existence since 1969 and has approximately 6 100 shareholders.

Alkane has a long term involvement and ongoing commitment to the Central West of New South Wales and has substantial investment in the people and resources of the region. Alkane is currently operating the Tomingley Gold Mine approximately 50km southwest of Dubbo and previously operated the Peak Hill Gold Mine on the outskirts of Peak Hill from 1996 to 2005.

Australian Zirconia Ltd is operated by a board and management team with numerous years of experience in open cut and underground mining projects. The key Australian Zirconia Ltd personnel are as follows.

- Mr David Ian Chalmers (*MSc*) – Managing Director.
- Mr Terry Ransted (*BAppSc*) – Chief Geologist.
- Mr Mike Sutherland (*BSc, GComRel*) – General Manager (Alkane) NSW.
- Mr Tony Wright – Commercial Manager.
- Ms Natalie Chapman (*BSc (Hons), MComm, MBA*) – Corporate Communications Manager.

1.3.2 The Application Area

The DZP Site, Toongi-Dubbo Rail and Gas Pipeline Corridor and Macquarie River Water Pipeline are collectively referred to as “the Application Area”. **Table 1.1** lists the associated land titles for each of the component areas.

Table 1.1
Application Area Land Titles

DZP Site [#]		Macquarie River Water Pipeline	Toongi–Dubbo Rail and Gas Pipeline Corridor
Part Lot 311 DP595631	Lot 271 DP593668	Lot 311 DP595631	Toongi – Dubbo Rail Reserve
Part Lot 35 DP753220	Part Lot 1 DP133581	Lot 27 DP753220*	Purvis Lane Reserve
Part Lot 18 DP753252	Lot A & B DP439352	Lot 62-63 DP753220*	Public Road Network
Lot 19 DP 753252	Part Lot A DP391069	Lot 30 DP753220*	Toongi Road Reserve
Lot 55 DP 753252	Lot B DP 391069	Lot 1-4 DP753226*	Obley Road Reserve
Lot X DP 405495	Lot 211 DP595631	Various public / crown road reserves	
Lot 1 DP818802	Lot 50 DP 753252		
Lot 7300 DP1149010 (Licensed for grazing)			
Unformed ‘Paper’ Road (Crown Land) separating Lot 311 DP55631 and Lots A & B DP439352			
Unformed ‘Paper’ Road (Dubbo City Council) separating Lot 1 DP818802 and Lot 7300 DP 1149010			

* By negotiation with landowner

[#] See **Figure 1.2**



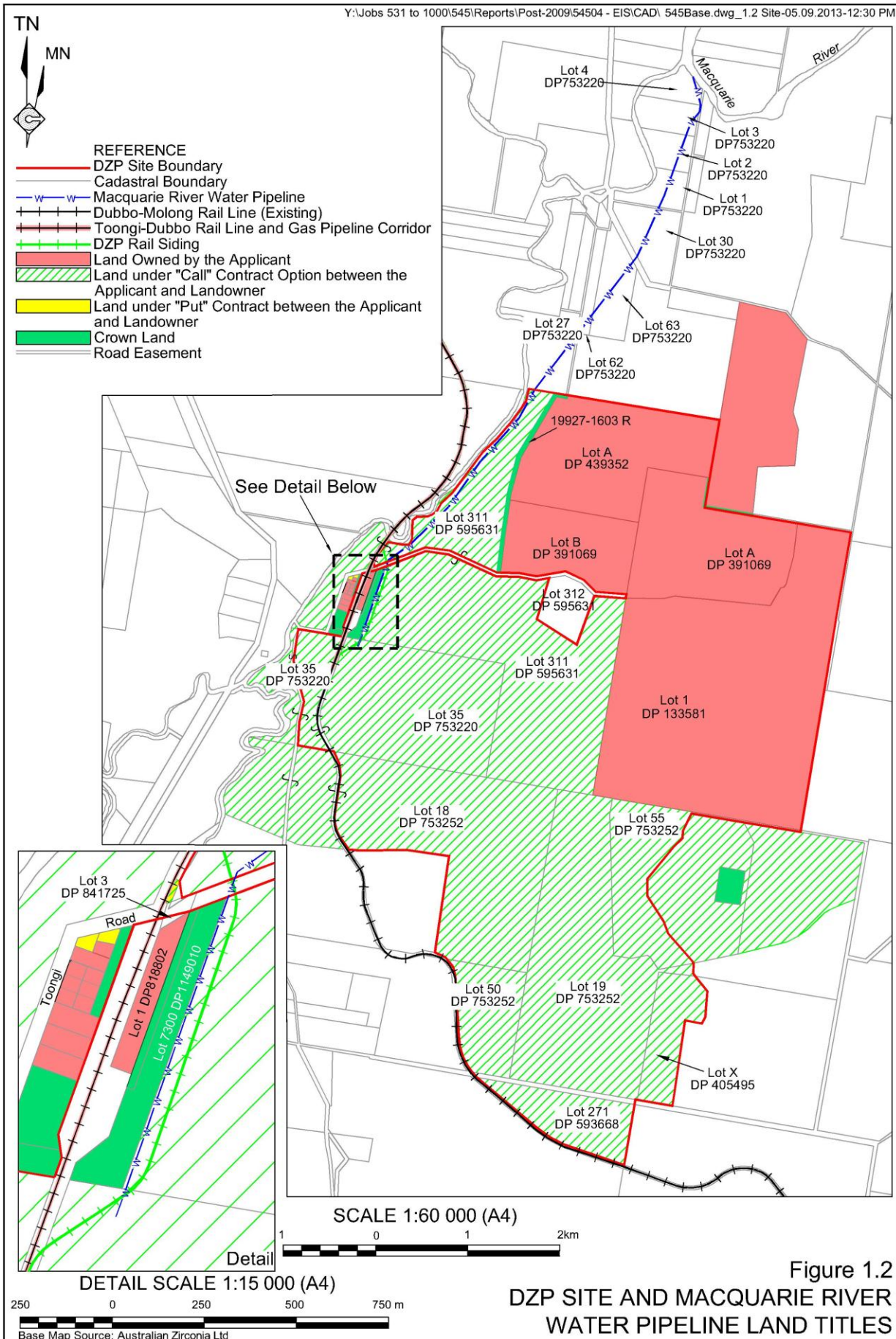


Figure 1.2
**DZP SITE AND MACQUARIE RIVER
 WATER PIPELINE LAND TITLES**

The proposed operations would be focused on the development and operation of an open cut mine, processing plant and various structures designed to manage the waste rock and residues generated by the mining and processing operations. The land on which these components would be located is referred to as the “DZP Site”. The development and operation of the Proposal would also rely on the development of various additional components to provide access to water, processing reagents and other critical raw materials. The features of the DZP Site and these additional components are identified in **Figure 1.1** and described as follows.

- The DZP Site: incorporates all areas of disturbance associated with mining, processing, waste management and related activities. Cadastral boundaries of land which the Applicant either owns or has negotiated purchase (subject to the approval of the Proposal), and on which DZP-related disturbance is proposed, have been used to define the DZP Site boundary² (see **Figure 1.2**). On and surrounding the DZP Site are large areas of land which would be owned by the Applicant but remain undisturbed and either be incorporated into a *Biodiversity Offset Strategy* (see Section 2.17.8) or allocated to ongoing agricultural activities.
- Macquarie River Water Pipeline: comprising a water pipeline within an easement approximately 7.6km long and 20m wide to supply water sourced from the Macquarie River (under licence) to the DZP Site (see **Figure 1.2**).
- Toongi-Dubbo Rail and Gas Pipeline Corridor: comprising an upgrade to the Toongi-Dubbo section of the currently disused Dubbo-Molong Rail Line, and the construction of a pipeline to deliver natural gas to the DZP Site which would be developed as a spur line from the Central West Pipeline (operated by APA Group) from Purvis Lane, Dubbo. The gas pipeline would be located within an approximately 30km long, 5m wide corridor within the rail easement. Access to the rail easement would be negotiated with the authority responsible for the management of this section of the NSW rail network, John Holland Rail.
- Public Road Network: comprising upgrades to Toongi Road and Obley Road to accommodate the type and volume of heavy vehicles that would travel between the Newell Highway and the DZP Site. Upgrades would include widening, improvement to pavement depth or condition, the construction of new or upgraded intersections, curve realignments and upgrades to creek crossings. These proposed upgrades are discussed in Section 2.12.4.

1.3.3 Existing Mineral Authorities

Table 1.2 and **Figure 1.3** present the Mineral Authorities held by the Applicant.

An expression of interest for an exploration licence for Group 11 minerals (uranium and thorium) covering an identical area as EL 5548 was lodged with the Department of Trade & Investment on 28 September 2012. An application for an exploration licence for Group 1 minerals, adjoining EL 5548 to the south (ELA 4827), was lodged with the Department of Trade & Investment on 31 May 2013.

² The DZP Site also includes one crown land road easement which the Applicant has approached the Department of Primary Industries – Catchments & Lands about acquiring.

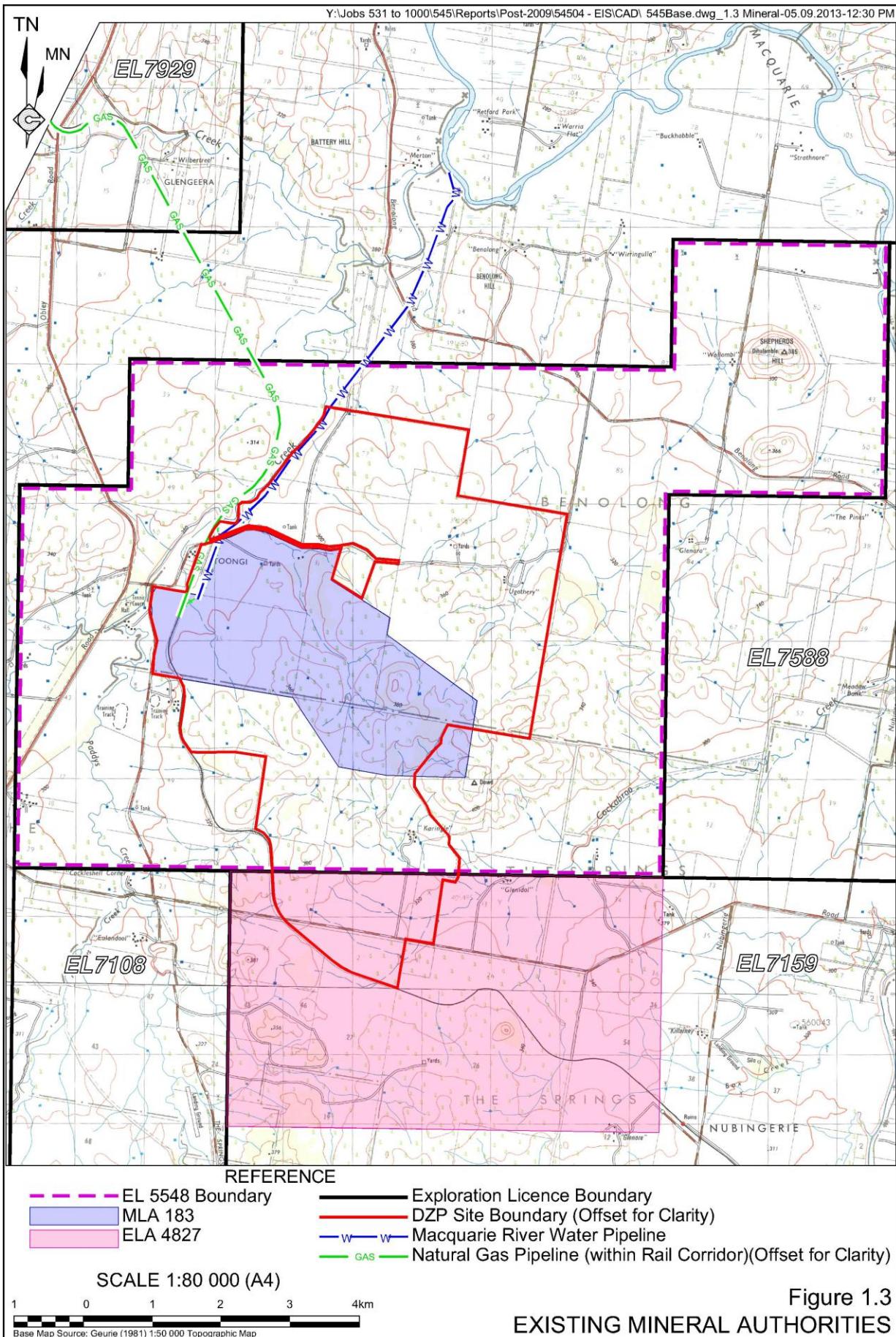


Figure 1.3
EXISTING MINERAL AUTHORITIES

**Table 1.2
Mineral Authorities**

Authority	Application Date	Date Granted	Expiry Date	Minerals Group ¹
MLA 183	14 Aug 2001	NA	NA	Columbium (niobium, Nb); rare earth minerals, tantalum (Ta), zirconia (Zr)
EL 5548	NA	21 Jan 1999	21 Jan 2013 ²	Group 1
ELA 4827	31 May 2013	NA	NA	Group 1
Note 1: Mineral groups as defined under the <i>Mining Act 1992</i>				
Note 2: Renewal Sought				
NA: Not Applicable				
Source: MinView Search (10/05/2013)				

A mining lease application (MLA183) covering 916.95ha within the nominated DZP Site was lodged with the then Department of Mineral Resources on 14 August 2001. As a result of modifications to the DZP Site impact footprint since 2001, the Applicant is finalising the submission of a revised MLA over an area coincident with the DZP Site boundary.

1.4 BACKGROUND TO THE PROPOSAL

The DZP is centred on a trachyte formation which forms one of several alkaline volcanic and intrusive bodies of Jurassic age in the region (approximately 205 to 140 million years ago) (refer to Section 1.5 for further detail on the geological setting). Previous geological mapping, sampling and drilling (preceding EL 5548) indicated a substantial body of altered trachyte containing highly elevated levels of the metals zirconium, hafnium, niobium and tantalum, and REEs (including yttrium).

The Applicant subsequently undertook additional drilling (in 2000 and 2001) of the trachyte on a staggered 100m x 50m grid to an average vertical depth of 55m. The drilling demonstrated the remarkably uniform grade of the trachyte with dimensions of 900m by 500m to the drilled depth.

Following identification of the resource, the Applicant undertook metallurgical scoping studies and assessment of potential markets and identified that it would be possible to produce high purity products for sale into expanding markets. At the same time, the Applicant commissioned a number of specialist environmental studies over the DZP Site and commenced consultation with the relevant government agencies as part of a planned development application in 2001.

A feasibility study completed by SNC Lavalin in 2001 established that while the Proposal based on processing 200 000tpa provided a positive cash flow it did not generate a sufficiently attractive return on capital. Key recommendations were to further refine the process flowchart through the construction of a demonstration pilot plant and provide product samples for market evaluation.

Work on a Demonstration Pilot Plant (DPP) was commenced with an AusIndustry Commercial Ready Grant from the Australian Federal Government in 2006. The DPP was designed and built by ANSTO Minerals at the Australian Nuclear Science and Technology Organisation (ANSTO) facility at Lucas Heights in Sydney under the supervision of TZ Minerals International Pty Ltd (TZMI). The DPP has been operating since 2008, confirming the process flowsheet and

providing market samples of sufficient quantity to reassure customers that the different style of products would be suitable for their various end-use applications. In particular, the following advances have underpinned the feasibility of the Proposal.

- Several tonnes of a range of zirconia products have been prepared to customer-specific requirements.
- A niobium product (niobium pentoxide) has been developed.
- The recovery of a light REE product and heavy REE concentrates have been demonstrated.

On the basis of the progress made with the DPP, a Definitive Feasibility Study was completed in April 2013 by TZMI illustrating the feasibility of the DZP. Section 1.6 considers the need for the Proposal and provides a summary of the various products and uses of the rare metals and REEs to be produced by the Proposal. Many of these products are associated with 'green technology' with marketing studies confirming that open and growing market opportunities exist for the sale of these products.

1.5 GEOLOGICAL SETTING

1.5.1 Regional Setting

The DZP Site is located at the northern end of the Palaeozoic Lachlan Fold Belt where the volcanic-sedimentary-intrusive sequences are covered by onlapping Mesozoic sediments of the Gunnedah Basin. The oldest rocks present in the locality are the Silurian age Cudal Group (430 to 410 million years ago) comprising a sequence of fine and medium grained sedimentary and rare volcanic rocks.

The DZP Site is centred on an alkaline suite of intrusive and extrusive rocks that intrude and partly onlap relatively flat lying sediments. This sequence occupies the southern edge of the Great Australian Basin forming a broad embayment of 10km in diameter and overlays a tightly folded Siluro-Devonian volcano-sedimentary terrain.

The alkaline igneous rocks are of Jurassic age (140 to 205 million years) and are considered part of a relatively extensive alkaline igneous complex in the region south of Dubbo (in turn part of the major eastern Australian volcanic event). Geological mapping has identified a number of trachytes in the region, with geochemical sampling by the Applicant and others, having identified anomalous levels of niobium, yttrium and zirconium of potential economic significance within two of these. One is the Toongi deposit, a relatively small, laccolith-like body of hydrothermally altered trachyte. The second (referred to as the "Railway deposit") is a similar trachyte deposit to the north-northwest of the DZP Site which may be developed in the future, but does not form any part of the current application.

Table 1.3 provides the stratigraphy of the regional geology of the DZP Site.

1.5.2 DZP Site Geology

The Toongi ore body is a Jurassic aged trachyte flow or sill overlying a flat-lying sequence of interbedded Triassic sandstone and siltstone. The trachyte is one of a number of alkaline igneous bodies which form part of a relatively extensive alkaline igneous complex in the Dubbo region, which in turn forms part of the major Eastern Australian alkaline volcanic event.

Table 1.3
Regional Stratigraphy

System	Group	Formation	Reference (1:250 000 mapsheet)	Description
Quaternary			Qa	Alluvium
Tertiary			Tb	Olivine basalt as flows, dykes and plugs
Jurassic			Jt	Trachyte, quartz trachyte, minor phonolite, rhyolite as flows, tuffs, plugs, sills and necks
			Jb	Olivine basalt as flows and possible dykes
Triassic		Napperby	Rp	Siltstone, lithic quartz-sandstone, minor conglomerate
Devonian			Dmd	Dolerite dykes, diorite, gabbro sills and stocks
	Gregra	Cuga Burga Volcanics	Dg	Latitic crystal-lithic sandstone, breccia, siltstone, tuff, minor andesite, basalt, limestone
Siluro-Devonian	Toongi		So	Sandstone, shale, siltstone, latitic sandstone, volcanoclastic sandstone
Silurian	Cudal	Hanover	Sc	Micaceous shale, siltstone, fine-grained sandstone, rhyolite-tuff, tuff-sandstone, latitic sandstone, breccia

Source: Dubbo 1:250 000 Geology Map (AGSO/DMR 1999) – Table 7

The Toongi Trachyte is roughly elliptical in shape with outcrop dimension of 600m x 400m. Exploration completed by the Applicant has identified the trachyte body as extending below a thin veneer of soil and recent sediments to be approximately 900m (east-west) x 500m (north south) (surface area of approximately 36ha) (see **Figure 1.4**). The Toongi Trachyte has been defined through drilling to a depth of approximately 115m.

Mineralogical studies indicate that the ore minerals contained within the deposit are extremely fine grained being less than 10µm in size (and generally less than 100µm) and of rare composition. The Toongi Trachyte exhibits uniformly elevated grades for zirconium (Zr), hafnium (Hf), niobium (Nb), tantalum (Ta), yttrium (Y) and rare earth elements (REEs). The ore body also contains uranium and thorium and is classified as a weakly radioactive ore. Notably, however, neither uranium nor thorium products are to be produced by the Proposal nor would these be concentrated in the waste generated by the proposed processing operations and disposed of on the DZP Site (refer to Section 2.6.3).

1.5.3 Resources

Exploration over the Toongi ore body has included 120 reverse circulation and three diamond drill holes completed on a staggered 100m x 50m grid (see **Figure 1.5**) and **Figure 1.6** provides a cross-sectional interpretation of the Toongi deposit. Interpretation and modelling of the drill hole data have resulted in a Measured Resource to approximately 55m vertical depth of 35.7Mt with the following rare metal and REE grades: 1.94% ZrO₂ (zirconium), 0.46% Nb₂O₅ (niobium), 0.03% Ta₂O₃ (tantalum), 0.04% HfO₂ (hafnium), 0.14% Y₂O₃ (yttrium) and 0.75% REO (rare earth oxides). Several deeper drill holes confirm the continuity of ore grades to approximately 115m depth providing an additional Inferred Resource of 37.5Mt at similar grades.

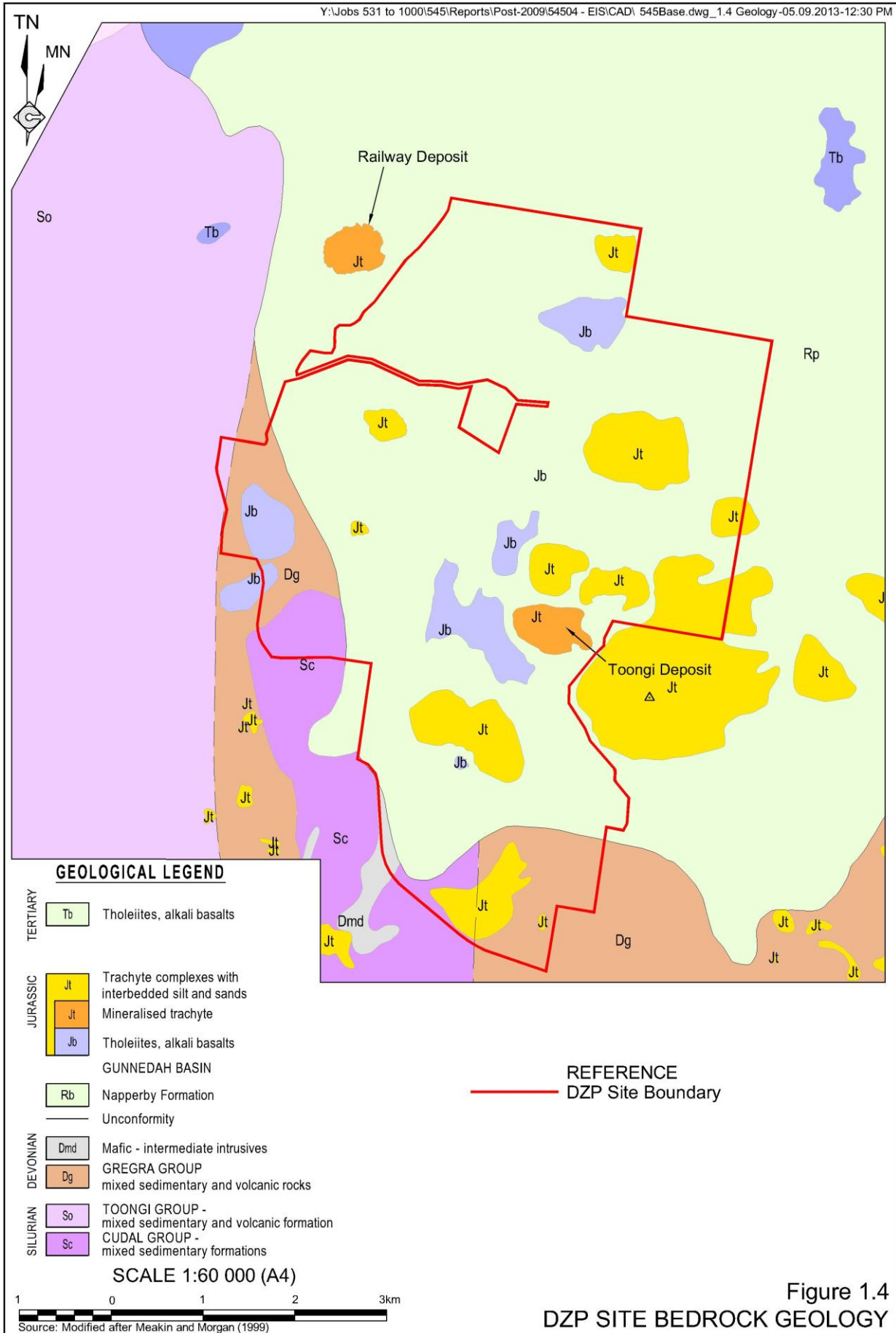


Figure 1.4
DZP SITE BEDROCK GEOLOGY

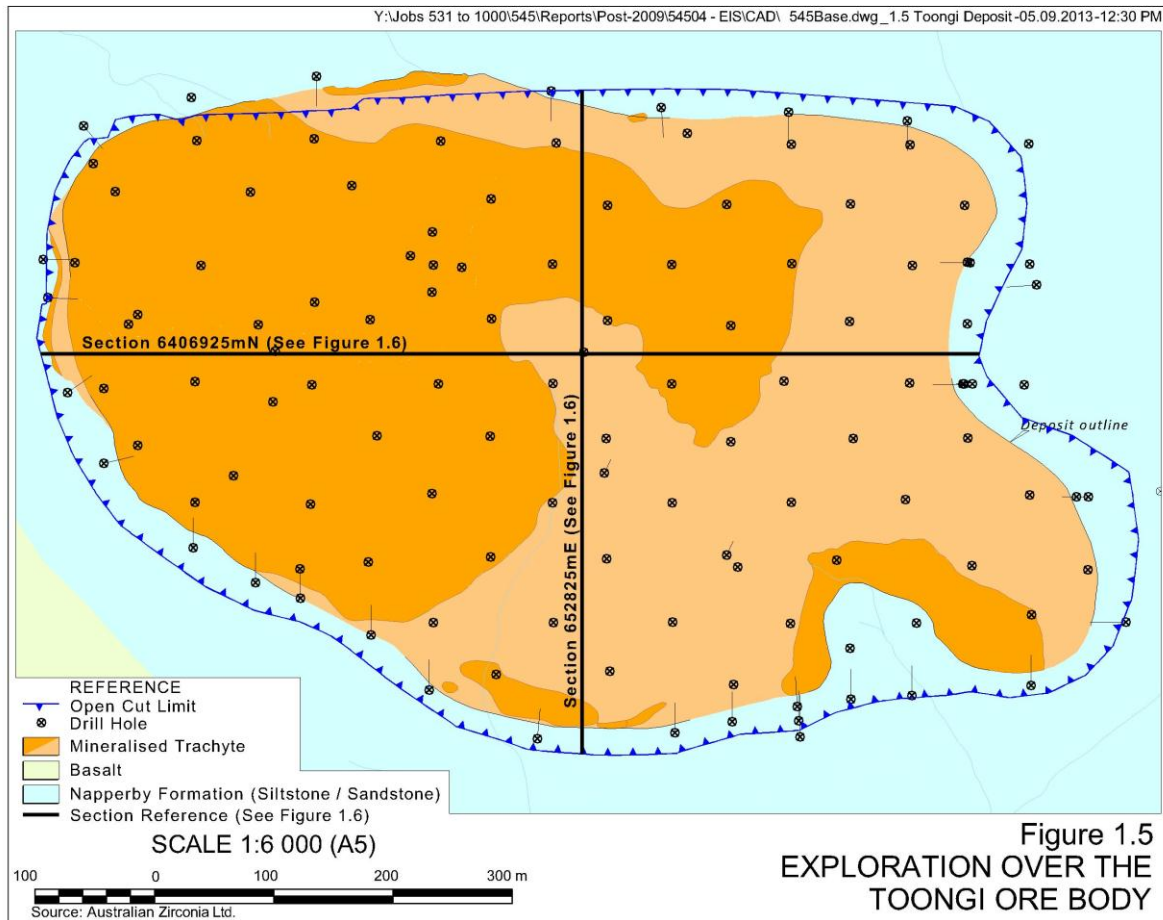


Figure 1.5
EXPLORATION OVER THE
TOONGI ORE BODY

Based on the estimated costs and revenues from the feasibility study completed in September 2011, a Proven Ore Reserve of 8.07Mt at 1.92% ZrO₂ (zirconium), 0.04% HfO₂ (hafnium), 0.46% Nb₂O₅ (niobium), 0.03% Ta₂O₅ (tantalum), 0.14% Y₂O₃ (yttrium) and 0.75% REO (rare earth oxides) has been estimated to approximately 25m. Using the same costs and revenues, an additional 27.86Mt at 1.93% ZrO₂ (zirconium), 0.04% HfO₂ (hafnium), 0.46% Nb₂O₅ (niobium), 0.03% Ta₂O₅ (tantalum), 0.14% Y₂O₃ (yttrium) and 0.74% REO (rare earth oxides) has been estimated as a Probable Ore Reserve below the Proven Ore Reserve.

Table 1.4 summarises the measured and inferred resources of the DZP.

Table 1.4
DZP Resources

Resource Status	Measured		Inferred
	Proven	Probable	
Total (Mt)	8.07	27.86	37.5

Source: AZL

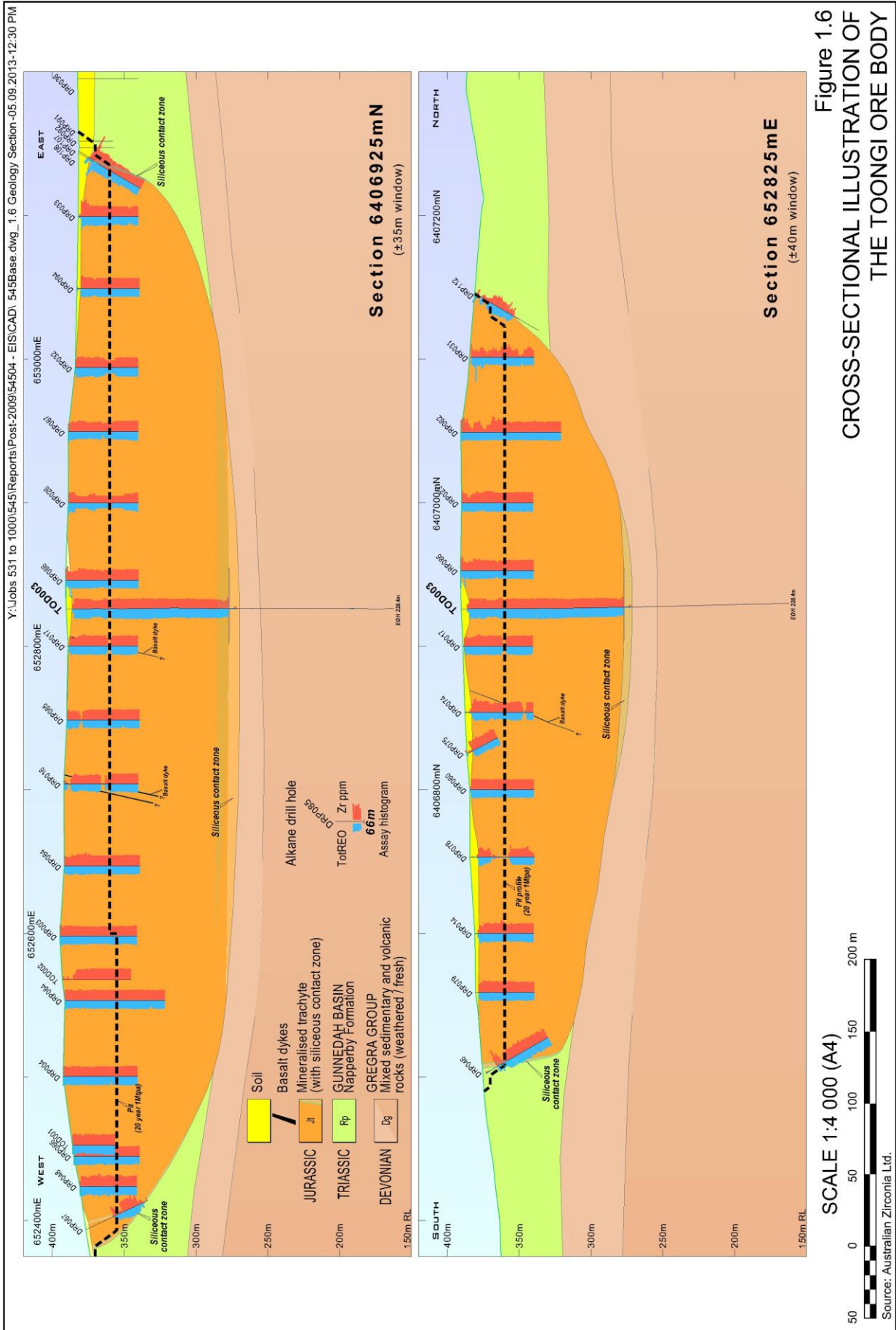


Figure 1.6
 CROSS-SECTIONAL ILLUSTRATION OF
 THE TOONGI ORE BODY



1.6 PRODUCTS AND THE NEED FOR THE PROPOSAL

The Definitive Feasibility Study completed in April 2013 illustrated existing markets for the products of the Proposal that were developed using the DPP in conjunction with ANSTO Minerals. These final products include a range of zirconia products, several niobium products and other heavy and light rare earth metals. There is considerable international market demand for rare metal chemicals, e.g. from zirconium, niobium, hafnium and tantalum, that can be used in the ceramic, catalyst, electronics, engineering ceramic, and specialty glasses and alloys industries. Rare earth metals are also in demand because of their use in clean technologies, computing, automotive, entertainment, medical and military industries. In many cases, there is no alternative to rare earths in manufacturing some products. More specifically the rare earth metals may be considered amongst a range of ‘new age metals’ that are becoming increasingly valuable for their applications in new technological developments.

Some of the possible uses for these products have environmental benefits. Several of the metalliferous products of the DZP would be used as substitutes for more traditionally used, but more harmful, products, while some products would be used as components of modern technologies that deliver specific environmental benefits. **Table 1.5** provides an overview of the products of the Proposal and their potential environmental benefits.

Table 1.5
DZP Products and Uses

Page 1 of 2

Product	Use	Replaces	Environmental Benefit
Compounds of Zirconium	Drying agent in paints	Lead, traditionally used as the drying agent.	Zirconium-based paints remove the need to use lead-based paints in houses, schools, and buildings. Lead is toxic to humans and to the environment.
	Oxygen sensors and catalytic converters in cars		Zirconium has long been a key element in thimble-shaped oxygen sensors, which measure the fuel-to-air ratio of car exhausts. These sensors provide signals to the car's emissions management system, which then regulates the ratio in order to maximise the performance of the vehicle and minimise needless greenhouse gas emissions.
	Catalytic converters in cars		Zirconia has been used to increase the efficiency of catalytic converters in cars. ³ Catalytic converters change harmful compounds in car exhausts into harmless materials.
Niobium	Lightweight vehicle chassis	Heavier metals, like steel, that increase the chassis weight	Niobium is a lightweight metal used mainly in alloys and super alloys. Niobium alloys in vehicle chassis lighten the weight of the chassis, and therefore the overall weight of the car, by up to 10%, leading to a reduction in the amount of petrol required to power the car.
Hafnium	Control rods in nuclear reactors		Hafnium enables the production of control rods used in nuclear reactors. According to the US Nuclear Energy Institute, the use of nuclear power around the world reduced CO2 emissions by more than 2 billion metric tons in 2005 by replacing the use of fossil fuels used to generate electricity. ⁴

³ <http://media.rsc.org/Zinc%20and%20zirconia/Zirconia.pdf>

⁴ <http://www.nei.org/keyissues/protectingtheenvironment/quantifyingnuclearenergyenvironmentalbenefits>

Table 1.5 (Cont'd)
DZP Products and Uses

Product	Use	Replaces	Environmental Benefit
Tantalum	Capacitors for electronic goods	Non-tantalum capacitors	Tantalum capacitors, though relatively expensive, are highly sought after in a range of electronic goods such as mobile phones. Solid-bodied tantalum capacitors can run for decades; their long life is an incentive for the continued use of relevant electronic devices rather than replacing the devices due to capacitor failure.
Rare earths – Yttrium	Corrosion-resistant coatings for cars	Lead-based coatings	Yttrium has been used in the development of cationic electro-deposition coatings to prevent corrosion of cars. Yttrium is much less toxic to humans and to the environment than lead-based products, and is a more effective anti-corrosion tool, with only half the yttrium by weight required to protect car bodies from corrosion when compared to lead. ⁵
Rare earths – europium	LED lights	Traditional incandescent lights	Europium can be used in white light emitting diodes (LEDs) ⁶ , the next big thing in sustainable lighting technologies. LEDs are much more energy efficient than traditional lighting systems and a trend towards energy efficient lighting is already visible in retail, hospitality and public spaces.
Rare earths	Wind turbine magnets		Rare earths enable the production of wind turbines, a clean energy source. Australia has a renewable energy target of 20% by 2020, making the production of clean energy sources essential to achieving this goal. ⁷
Rare earths - lathanum	Hybrid car components	Traditional car components	Rare earths are used in a variety of hybrid car components ⁸ . Their light weight helps to reduce the overall weight of the car parts, thereby contributing to reduced use of petrol.
Rare earths	Hybrid car batteries	Traditional lead-acid car batteries	The development of hybrid cars is helping shift the world's reliance away from the use of finite resources such as crude oil. Hybrid car batteries made from rare earths are up to twice as power efficient as traditional lead-acid batteries. ⁹
Rare earths	Compact fluorescent light globes	Traditional incandescent bulbs	Compact fluorescent bulbs can produce the same amount of light as traditional incandescent bulbs but greatly reduce electricity consumption ¹⁰ .

Considering the information provided in **Table 1.5**, it is clear that the proposed products of the Proposal would provide environmental benefits as substitutes for harmful substances and are also likely to encourage the growth of alternative energy technologies. As alternative energy sources are increasingly sought to replace traditional fossil fuel burning processes, the global demand for rare earth metals such as those proposed to be produced by the Proposal will increase.

⁵ <http://www.epa.gov/greenchemistry/pubs/pgcc/winners/dgca01.html>

⁶ <http://www.popularmechanics.com/technology/engineering/news/important-rare-earth-elements#slide-2>

⁷ <http://www.environment.nsw.gov.au/resources/climatechange/10923windfacts.pdf>

⁸ <http://www.popularmechanics.com/technology/engineering/news/important-rare-earth-elements#slide-1>

⁹ <http://www.popularmechanics.com/technology/engineering/news/important-rare-earth-elements#slide-1>

¹⁰ http://energy.gov/sites/prod/files/piprod/documents/US-EU_WORKSHOP_on_RARE_EARTHS_Program.pdf

If approved, the Proposal would potentially become one of the largest suppliers of these metals outside China. As a consequence of the rarity of supply outside China, and the strategic demand for these metals, the price for these products has a robust outlook. The Proposal would also be insulated from product price fluctuations due to the number of products being produced. The defined resource could support the ongoing operation of the DZP for 80 plus years and provide extended economic benefits to the local communities of Toongi and Dubbo, the state of New South Wales and Australia.

1.7 MANAGEMENT OF INVESTIGATIONS

This document has been prepared by Mr Alex Irwin, *B.Sc (Hons)*, and Ms Christy Hill, *B.Env.Man.(SusDev)*, both Senior Environmental Consultants of R.W. Corkery & Co Pty. Limited (RWC). Internal peer review was undertaken by Mr Rob Corkery, *M.Appl.Sc, B.Appl.Sc*, Principal of RWC with input from Mr Mitchell Bland (*B.Sc (Hons), MEcon Geol, LLB (Hons)*), Principal Environmental Consultant of RWC.

Details of the DZP have been provided by Messrs Mike Sutherland, Terry Ranstead and Ian Chalmers of the Applicant. Input into the proposed processing operations of the DZP has been provided by Messrs Gavin Diener, Alex Ryan and Dereck Becker of TZMI and Mr Jeff Hughes of Engineering and Project-Management Services (EPMS). The development of the water supply strategy (refer to Section 2.8.2) was prepared with the assistance of Mr Peter Hennessy (*B.Appl.Sc. [Systems Agriculture]*) of Hennessy Water. Mr Hennessy has been successfully brokering sales of permanent and temporary water allocation assignments on the Macquarie and Cudgegong Rivers for the past 20 years

A strong emphasis has also been placed on a multi-disciplinary team approach to the design of the Proposal, the assessment of potential environmental impacts, and the identification of operational safeguards and measures. The following specialist consultants were commissioned by the Applicant to prepare the nominated specialist assessments.

- Mr Phillip Cameron (*BSc, AssocDip AppSci*) and Ms Heidi Kolkert (*BA, BSc (Hons)*) of OzArk Environmental Heritage & Management Pty Limited (OzArk): Biodiversity Impact Assessment.

OzArk's assessment builds upon earlier surveys and assessment completed by Geoff Cunningham of Geoff Cunningham Natural Resource Consultants Pty Ltd (GCNRC) (flora) and Dr David Goldney (fauna) in 2001 and 2002. OzArk also rely upon specialist studies and advice provide by Dr Arthur White of Biosphere Environmental Consultants Pty Ltd in relation to herpetological issues and Dr Gilbert Whyte of Ecobiological in relation to entomological associations between threatened species and ants.

- Dr Alison Hunt (*BSc (Hons), PhD*) of Alison Hunt & Associates: Aquatic Ecology Assessment.

Dr Hunt's brief also included the consideration of potential impacts on local stygofauna.

- Dr Jodie Benton (*PhD, BA (Hons)*) and Mr Nicholas Harrop (*BA (Hons) Archaeology*) of OzArk: Cultural Heritage Assessment.

OzArk's assessment builds upon earlier surveys and assessment completed by Lloyd Nolan of Guarra Aboriginal Site Surveys in 2000 and 2002.

- Mr Damon Roddis (*B.Env.Sc.(Hons), CEnvP*), Ms Justine Firth (*BSc (Atmospheric Science) (Hons), Grad.Dip. (Env Law)*), and Mr Ronan Kellaghan (*B.Sc.(Hons), H.Dip (Comp.Sc.), M.Env.Man.*) of Pacific Environment Limited (PEL): Air Quality Impact Assessment.

PEL's assessment includes consideration of particulate matter, gaseous stack, radiation, odour and greenhouse gas emissions. The modelling completed by PEL draws upon and forms a component of a Specialist Radiation Assessment.

- Mr Jim Hondros (*BAppSci, GDipOHM, MAppSci*), of JRHC Enterprises Pty Ltd: Radiation Impact Assessment.

Using the radiation emission modelling of the Air Quality Impact Assessment, the Radiation Impact Assessment considers the potential health impacts of such emissions against Australian and International standards. Input provided by Mr Adrian Manis of ANSTO was central to this assessment.

- Mr Oliver Muller (*B.Sc Resource Env. Man. & Human Geography*) and Mr Teanuanua Villierme (*BAppSc, M.EngMan*) of EMGA Mitchell McLennan (EMM): Noise and Vibration Impact Assessment.

The Noise and Vibration Impact Assessment of EMM builds upon noise monitoring completed by Richard Heggie Associates Pty Ltd in December 2001.

Both the Noise and Vibration Assessment and Air Quality Impact Assessment incorporate meteorological data collected at the Toongi Meteorological Station (operated by Alkane Resources Ltd) and collated by Mr Pavel Zib (of Zib & Associates Pty Ltd).

- Mr Mark Passfield (*BSc (App. Physical Geography)(Hons)*) of Strategic Environmental and Engineering Consultants (SEEC) Pty Ltd: Surface Water Impact Assessment.

SEEC's assessment builds upon surveys and assessment completed by Golder Associates Pty Ltd in 2002. The Surface Water Assessment considers the various hydrological impacts of the Proposal including: water balance of the Liquid Residue Facility; effects of and on local flood conditions; changes to local catchments; and erosion and sediment control.

- Mr Mark Stuckey (*B.Sc.Agr.(Soil Science), M.Sc.(GwHyd)*), Mr Alan Wade and Mr Stuart Brisbane (*B.Sc.(Soil Science), M.Phil.*) of Environmental Earth Sciences (EES): Groundwater Assessment.

The hydrogeological investigations and assessment completed by EES builds upon detailed groundwater testing, modelling and assessment completed by Golder Associates Pty Ltd in 2002. EES has also provided a desktop review of groundwater resource availability below the DZP Site and surrounds.

- Dr Pat Hulme (*B.Sci.Ag.(Hons), PhD, CPSS3*) and Mr David Duncan (*B. ApplSc – Ag*) of Sustainable Soils Management (SSM): Soils and Land Capability Assessment.

SSM's assessment builds upon earlier survey and assessment completed by GCNRC in 2001 and 2002.

- Mr Ben Rossiter (*BEng (Env.) Hons. Cl II*) of Constructive Solutions Pty Ltd: Traffic Impact Assessment.

The brief of Constructive Solutions also included provision of conceptual engineering plans for new and upgraded road intersections and assessment of the proposed level crossings to be reinstated as a result of the Toongi – Dubbo Rail Line.

- Mrs Diana Gibbs (*B.Sc. (Hons), M. Env.Stud (Ecological Economics)*) of Diana Gibbs and Partners: Socio-Economic Assessment.

Mrs Gibbs has also undertaken an economic assessment of the various transport options of the Proposal and prepared an *Agricultural Impact Statement* in accordance with the *NSW Strategic Regional Land Use Policy*.

- Mr Giles Peach (*B Eng, C Eng, MIMechE*) and Ms Melissa Chin (*BEng (Chem), M.Com (Business Strategy)*) of Sherpa Consulting: SEPP33 Risk Screening and Preliminary Hazard Analysis.

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