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Oceanic Coal Australia Pty Limited

ENVIRONMENTAL ASSESSMENT

Proposed Longwalls 51 & 52

West Wallsend Colliery

January 2014

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Prepared by
Umwelt (Australia) Pty Limited

on behalf of
Oceanic Coal Australia Limited

Project Director:	**John Merrell**
Project Manager:	**Luke Bettridge**
Report No.	**3149/R01/FINAL**
Date:	**January 2014**

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Executive Summary

West Wallsend Colliery (WWC) is an underground coal mine that has been operating since 1969 and is located in Western Lake Macquarie, New South Wales (NSW). The current mining operations at WWC are based on modern longwall mining techniques with mining currently progressing beneath areas of native woodland/forest vegetation, including mining beneath the Sugarloaf State Conservation Area (SSCA). Mining is approved to continue at WWC until 2021.

As a result of the ongoing review of mining operations at WWC, Oceanic Coal Australia Pty Limited (OCAL), the operator of WWC, is seeking to modify the current Project Approval for WWC granted in 2012 (DA 09_0203) (Project Approval) to include two additional longwall panels known as Longwall 51 and Longwall 52 (the Project). The proposed additional mining area is adjacent to areas currently approved to be mined by WWC. The Project will consist of the development and mining of the two longwall panels with no changes proposed to the surface infrastructure which supports the mining operations at WWC. The proposed modification to the Project Approval is being sought under Section 75W of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

The Project is an outcome of a detailed review undertaken of the WWC operations by OCAL, including review of the remaining coal resources within the WWC Mining Leases. As part of this review OCAL has identified that it will not mine some of the currently approved coal resources at WWC to provide improved protection for environmental features above the approved mining area and to ensure compliance with subsidence performance criteria in Within the currently approved mining areas, the combination of coal previously excluded from mining and those now no longer planned to be mined, equates to approximately 3 Million tonnes of run-of-mine (ROM) coal. This review process also identified that with the recent termination of a sub-lease to the adjacent Newstan Colliery, two additional longwall blocks (the Project) could be mined within the existing WWC mining lease area to compensate for this lost production.

As significant areas of the approved mine plan at WWC will no longer be mined, the inclusion of the proposed LW 51 and LW 52 which will recover approximately 2.55 Million tonnes of ROM coal will not result in any changes to the approved mine life. Annual production will remain at the existing approved limit of 5.5 million tonnes per annum (Mtpa) ROM coal.

The conceptual mining layout for the Project was developed by OCAL following consideration of a range of features and the findings of environmental studies. Key environmental and infrastructure constraints considered for the conceptual mine plan included:

- avoidance of impacts to significant Aboriginal cultural heritage and archaeological sites located to the east of the proposed mining area;
- minimising potential impacts to identified areas of alluvium to the south of the Project Area along Palmers Creek;
- minimising potential impacts to Wakefield Road and the M1 Motorway to the north of the proposed mining area; and
- avoiding an area of low depth of cover to the west of the proposed mining area.

This Environmental Assessment (EA) provides a detailed assessment of the potential environmental and social impacts associated with the Project and has identified appropriate mitigation and monitoring measures that will be implemented to minimise impacts. The key issues identified for the Project included subsidence, ecology, Aboriginal cultural heritage

and water resources. A brief overview of the key findings of the assessment process for these key issues is provided in **Table 1**.

Table 1 – Overview of the Environmental Assessment Findings for Identified Key Issues

Key Project Environmental Issues	Overview of Key Assessment Findings
Subsidence	• Detailed subsidence assessment completed. • There are no cliffs, cliff terraces, minor cliffs or rock features (as defined by the Project Approval) above Longwall 51 and Longwall 52 (DGS 2013). • The Project has been designed to avoid adverse subsidence impacts on key features such as the Ryhope Creek groundwater resource, Aboriginal grinding grooves and infrastructure such as the M1 Motorway. • Longwall mining has been limited to a minimum of 80 metres depth of cover and mining height will be reduced in some areas to limit the potential for connective cracking. • A range of subsidence impacts have been predicted as a result of the Project and the proposed subsidence monitoring and management measures to identify and address these impacts have been identified. • Following greater than predicted subsidence events which occurred during mining of LW 41 at WWC, OCAL has undertaken detailed investigations and the geological conditions and surface topography that contributed to these events have not been identified within the Project Area for this Project. Therefore, similar subsidence events are not predicted.
Ecology	• Two threatened flora species were recorded in the Project Area, being black-eyed Susan (*Tetratheca juncea*) and small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*). Both of these species are listed as vulnerable under both State and Commonwealth legislation. • No threatened ecological communities were recorded in the Project Area. • A total of seven State listed threatened fauna species were recorded in the Project Area during the surveys conducted for the Project; six species of mammal (including five species of micro-bat and one species of mega-bat) and one bird species. Two of these species are also Commonwealth listed threatened species. • No vegetation community in the Project Area is considered likely to be dependent on groundwater resources (Aurecon 2013). • The ecological assessment found that although the Project will impact on ecological values, the majority of vegetation and fauna habitat in the Project Area will remain largely undisturbed. • The assessment also found that the predicted impacts are not expected to result in a significant loss of floristic diversity or community composition, or fauna habitat within the Project Area, the SSCA or the region. • The Project is not predicted to result in a significant impact on threatened species, populations or communities known or with potential to occur in or around the Project Area. • OCAL has committed to a range of measures to minimise the ecological impacts of the Project.

Table 1 – Overview of the Environmental Assessment Findings for Identified Key Issues (cont.)

Key Project Environmental Issues	Overview of Key Assessment Findings
Aboriginal Cultural Heritage	• A comprehensive Aboriginal Cultural Heritage Assessment process was completed for the Project in consultation with the registered Aboriginal parties for the Project. • Two Aboriginal sites (a scarred tree and an isolated find) were identified above the proposed mining area, with two grinding groove sites located to the east of the mining area. • The mine plan has been designed to avoid impact on the two grinding groove sites. • The subsidence assessment identified a very low risk of impact to the scarred tree, however, monitoring and management measures have been identified to manage the residual risk. • The isolated find is located on an access track that may require subsidence remediation works and is proposed to be temporarily collected to avoid damage during these works, then returned to as close as practical to the original location. • The existing WWC Aboriginal Cultural Heritage Management Plan will be updated for the Project in consultation with the registered Aboriginal parties to include the management and monitoring measures proposed as part of the Project.
Water Resources	• The Project has been designed to minimise the potential for impact on alluvial aquifers and surface water systems. • The upper reaches of two first order tributaries will be undermined by the Project, however, the impact of subsidence on these tributaries is not predicted to be significant. Impacts to water quality are expected to be negligible. • The risk to alluvial groundwater and coal seam aquifers is assessed as low. • The Project is not predicted to impact significantly on any groundwater bores.

Further details of the predicted environmental and social impacts of the Project including assessment of all other potentially relevant environmental issues is provided in this EA.

The Project will provide for continued operations at WWC and will provide the following benefits.

- ongoing employment of approximately 390 people during the mining of Longwall 51 and Longwall 52, with many more indirect jobs created through flow-on effects. The mining of Longwall 51 and Longwall 52 will take approximately 12 months;

- recovery of approximately 2.55 Mt of ROM coal;

- payment of significant royalties to the State of NSW due to the extraction of this coal. The existing WWC operations paid approximately $18 million in royalties in 2012 and 2013 financial reporting periods, with the estimated royalties for the predicted coal sales for LW 51 and LW 52 being approximately $6.6M;

- efficient and economic recovery of a valuable coal resource that is unlikely to be economically extracted by any other mining operation. The existing mine workings and mining infrastructure at WWC provide the opportunity to economically extract this resource;

- continued export earnings for Australia; and

- significant economic benefits to the local community through ongoing local employment, purchase of goods and services, and local expenditure both directly and through employee wages during the mining of Longwall 51 and Longwall 52.

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APPENDICES

1.0 Introduction

West Wallsend Colliery (WWC) is an underground coal mine that has been operating at West Wallsend since 1969 and is located in Western Lake Macquarie (refer to **Figure 1.1**), within the Newcastle Coalfield of New South Wales (NSW). The main surface facilities at WWC are located approximately 1 kilometre east of Killingworth and approximately 1.25 kilometres south-west of Barnsley (refer to **Figure 1.2**). Mining is approved to continue at WWC until 2021.

Underground mining at WWC has previously been undertaken using both bord and pillar and longwall mining methods. Current operations at WWC are based on modern longwall mining methods with mining currently progressing beneath areas of native woodland/forest vegetation to the north and south of the M1 Motorway, as shown in **Figure 1.2**. The currently approved mine plan shown as the Continued Underground Mining Area on **Figure 1.2** includes longwall mining beneath the Sugarloaf State Conservation Area (SSCA).

As a result of the ongoing review of mining operations at WWC, Oceanic Coal Australia Pty Limited (OCAL), the operator of WWC, is seeking to modify the current Project Approval for WWC granted in 2012 (DA 09_0203) (Project Approval) to include two additional longwall panels known as Longwall 51 (LW 51) and Longwall 52 (LW 52) (refer to **Figure 1.3**) (the Project) pursuant to Section 75W of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The proposed longwall mining area is located within WWC's southern mining area known as the Southern Domain and adjacent to areas which are currently approved to be mined by WWC. The Project will consist of the development and mining of the two longwall panels with no changes proposed to the approved surface infrastructure which supports the mining operations.

The Project is an outcome of a detailed review of the WWC operations undertaken by OCAL, including review of the remaining coal resources within the WWC Mining Leases. This review included consideration of updated predicted subsidence risks using information gained from the investigations relating to the greater than predicted subsidence events experience above LW 41 (refer to **Section 2.1.1**). In accordance with its Project Approval requirements relating to adaptive management, WWC has significantly reduced the area that will be mined in LW 42 and LW 43 to ensure compliance with the subsidence performance criteria in the Project Approval. The approved areas of coal no longer planned to be mined in these two longwall panels contain approximately 2.2 Million tonnes of run-of-mine (ROM) coal. Other reductions to the approved mine plan have also been made due to operational factors which equates to approximately 3 Million tonnes of ROM coal in total. Further details of the reductions to the approved mine plan are provided in **Section 3.1**. The review of remaining resources also identified that with the recent termination of a sub-lease to the adjacent Newstan Colliery, two additional longwall blocks could be mined within the existing WWC mining lease area. The proposed extraction of the coal resources in this area is assessed in this Environmental Assessment (EA).

As significant areas of the approved mine plan at WWC will no longer be mined, the inclusion of the proposed LW 51 and LW 52 which will recover approximately 2.55 Million tonnes of ROM coal will not result in any changes to the approved mine life. Annual production will remain at the existing approved limit of 5.5 million tonnes per annum (Mtpa) ROM coal.

This EA has been prepared by Umwelt (Australia) Pty Limited (Umwelt) on behalf of WWC to accompany the application to modify the Project Approval. It includes a description of the proposed modification, a discussion of the planning context applying to the proposal, a detailed environmental impact assessment as well as identification of the required environmental management and mitigation measures to be implemented as part of the proposed modification.

FIGURE 1.1

Locality Plan

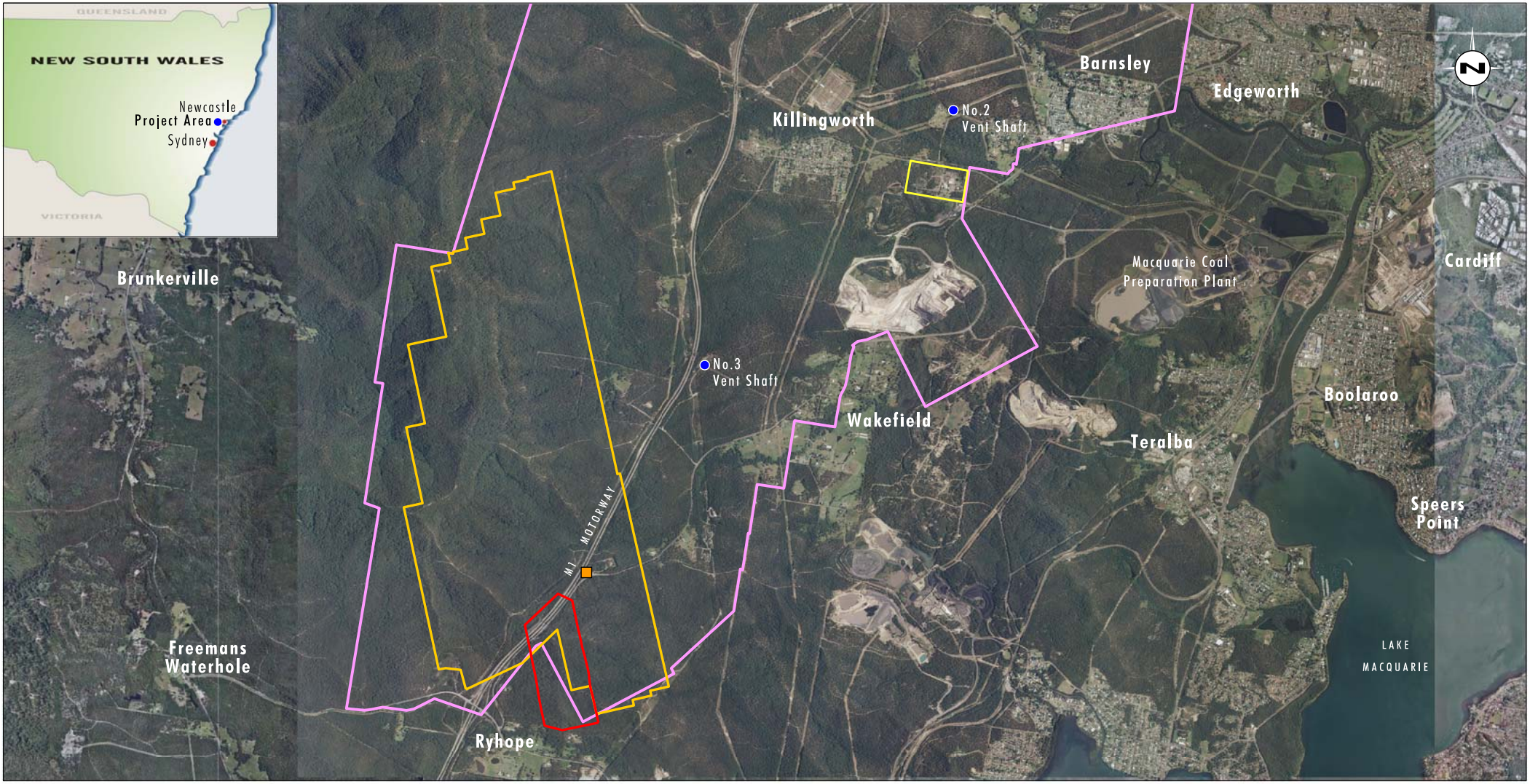

Image Source: OCAL (2008), Google Earth (2009)
Data Source: OCAL (2013)

0 1.0 2.0 3km
1:60 000

Legend

- Project Area
- Approved Continued Underground Mining Area
- West Wallsend Colliery Holding
- Existing West Wallsend Colliery Pit Top Facility
- Approved Mining Services Facility

FIGURE 1.2

Local Setting and WWC Mining Area

File Name (A4): R01/3149_048.dgn
20131205 13.03

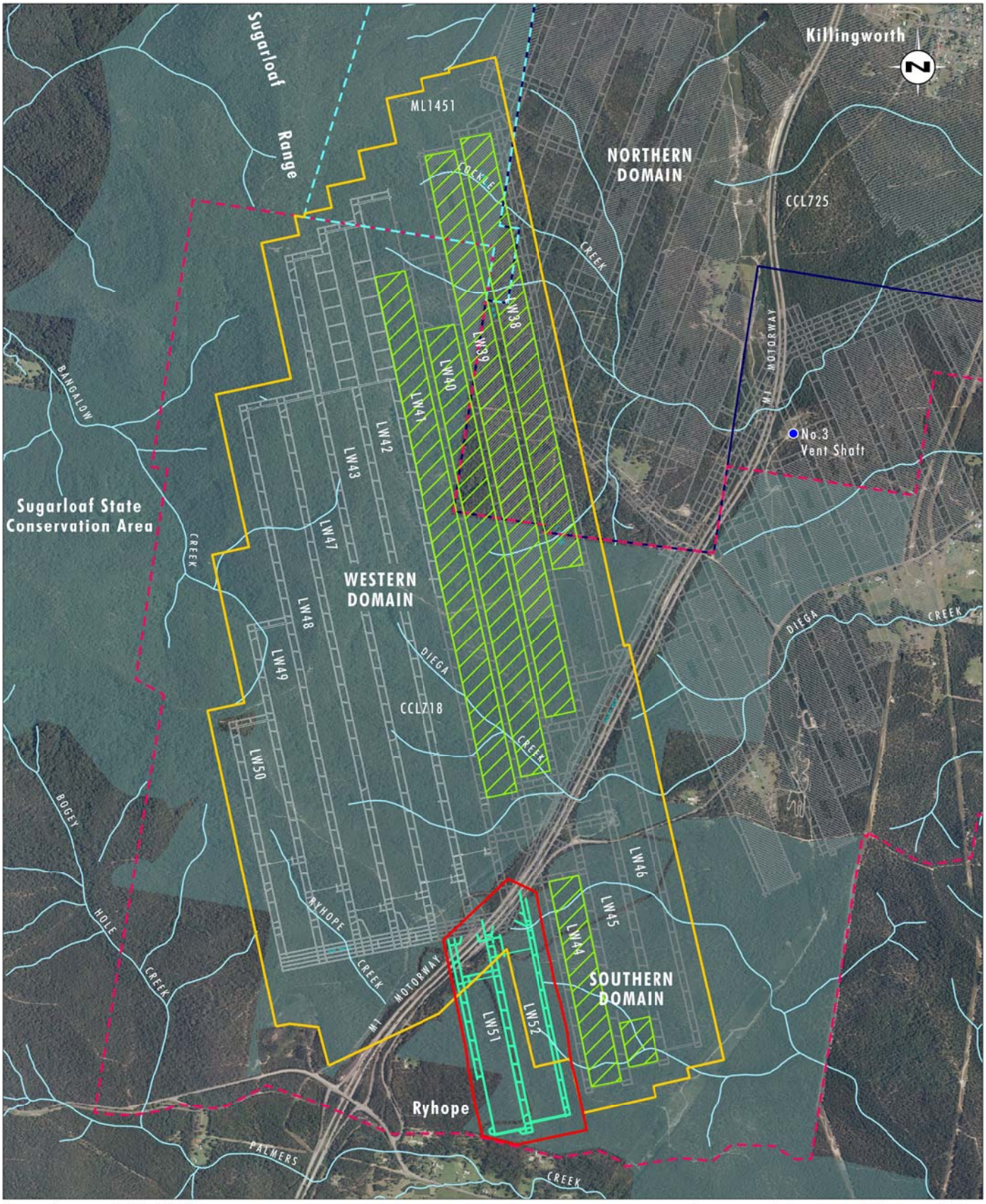

Image Source: OCAL (2008)
Data Source: OCAL (2013), LPI (2003)

0 0.5 1.0 1.5km
1:30 000

Legend

- Project Area
- Approved Continued Underground Mining Area
- Approved Underground Workings in the West Borehole Seam
- Proposed Longwall Panels 51 and 52
- Longwall Progression as of October 2013
- Former Underground Workings
- Sugarloaf State Conservation Area
- CCL725
- CCL718
- ML1451

FIGURE 1.3

Conceptual Layout for Proposed Longwall Panels 51 and 52

File Name (A4): R01/3149_032.dgn
20131218 10.55

1.1 The Applicant

WWC is operated by OCAL on behalf of the Macquarie Coal Joint Venture (MCJV). OCAL is the major joint venture participant of MCJV with 70 per cent ownership. Other participants include Marubeni Coal Pty Ltd (17%), OCAL Macquarie Pty Ltd (10%) and JFE Minerals (Australia) Pty Ltd (3%). OCAL, which also owns OCAL Macquarie Pty Ltd, is ultimately owned by Glencore Xstrata Plc (Glencore).

As well as WWC, OCAL also owns a former open-cut coal mine (Westside Mine) and a currently operating coal preparation plant (Macquarie Coal Preparation Plant (MCPP)). Westside Mine is located adjacent to the southern boundary of the WWC pit top and rehabilitation of the open cut is well advanced. The MCPP is located approximately 3 kilometres to the east of the pit top. All coal from WWC is transferred to the MCPP via an existing private haul road. The locations of the WWC Colliery Holding and other facilities operated by the MCJV in the Lake Macquarie Local Government Area (LGA) are shown on **Figure 1.2**.

1.2 Overview of the Project

Mining at WWC is currently undertaken within two main areas, being the Western and Southern Domains (refer to **Figure 1.3**). Part of the Southern Domain was previously sub-leased to another mining company, however, this sub-lease has recently been terminated. With the availability of this area, WWC has identified the opportunity to mine an additional two longwall panels within the Southern Domain, being the proposed LW 51 and LW 52 which are located adjacent to the approved LW 44 (refer to **Figure 1.3**). The mine workings within the Southern Domain are undertaken within Consolidated Coal Lease 718 (CCL 718). As with much of the existing and approved future longwall mining at WWC, all of LW 52 and the majority of LW 51 will be located beneath the SSCA (refer to **Figure 1.3**).

The conceptual mining layout for LW 51 and LW 52 has been developed following consideration of a range of features and the findings of environmental studies. Key constraints that were considered in determining the extent of proposed mining extraction resulting in the conceptual layout for LW 51 and LW 52 include:

- avoiding impacts to significant Aboriginal cultural heritage and archaeological sites located to the east of the proposed mining area;
- minimisation of potential impacts to identified areas of alluvium to the south of the Project Area along Palmers Creek;
- reducing impacts on Wakefield Road and the M1 Motorway to the north of the proposed mining area;
- avoiding an area of low depth of cover to the west of the proposed mining area;
- providing sufficient barriers to any existing and approved underground mining both at WWC and surrounding mining operations; and
- operating within the extent of WWC's mining titles, including the former sub lease area.

The above physical and environmental features, combined with the need to provide for the safe, economic and efficient recovery of the available coal resources have been the key determining factors which influenced the proposed conceptual design of the proposed mine plan for LW 51 and LW 52. The final design of the mine will be contained within the proposed

extent of mining extraction, and will be subject to further geological, geotechnical and operational constraints, and will be detailed in the required Extraction Plan and Subsidence Management Plan (SMP).

The proposed modification to the Project Approval is to provide for the mining of LW 51 and LW 52 and there are no other changes to WWC proposed as part of the Project. Key features of WWC as detailed within the WWC Continued Operations Project Environmental Assessment (EA) (Umwelt 2011) and an overview of whether they are to be amended as part of the Project are detailed in **Table 1.1**.

Table 1.1 – Key Features of WWC and the Proposed Modification

Major Project Components/Aspects	Proposed Operations	Changes As a Result of This Modification
Limits on Extraction	Up to 5.5 million tonnes per annum (Mtpa) Run of Mine (ROM) coal	No
Estimated Mine Life	Approximately 12 to 15 years of mining	No
Operating Hours	24 hours per day, 7 days per week	No
Number of Employees	Approximately 390 full time equivalents	No
Mining Methods	Underground Mining – longwall method	No
Mining Lease Areas	All existing and proposed mining within CCL 718, 725 and ML 1451	No
Mining Area	Longwall mining in the Northern, Southern and Western domains at WWC	Extraction of two new longwalls in the Southern Domain, LW 51 and LW 52.
Infrastructure	Existing West Wallsend Pit Top infrastructure Existing No. 2, No. 3 Vent Shafts and existing ballast borehole Existing Longwall 11 borehole facility Proposed future ventilation infrastructure and minor surface infrastructure Proposed Mining Services Facility	No

It is not proposed that there will any changes to the production limits at WWC, with the peak production rate to remain at 5.5 Mtpa ROM coal. There will also be no changes to the estimated mine life as a result of the Project (refer to **Section 3.1**). The Project will not result in any changes to the existing WWC pit top facilities.

1.3 Overview of Existing Environment

1.3.1 Project Area

The Project Area is located within the Newcastle Coalfields on the Western side of Lake Macquarie, as shown in **Figure 1.2**, in the Lake Macquarie LGA.

The Project Area is located in the Southern Domain at WWC which is located between the villages of Ryhope and Wakefield (refer to **Figure 1.2**). The east side of the Project Area overlaps with part of the approved WWC underground mining area known as the Continued Underground Mining Area (refer to **Figure 1.2**). The land within the portion of the approved WWC underground mining area located to the east and south of the M1 Motorway consists of native forested areas in undulating terrain with several ridges and upper catchment drainage lines. This forested area, formerly Awaba and Heaton State Forests, is now part of the SSCA. There are no houses or other developed areas within the Project Area.

The Project Area includes the proposed limit of longwall mining area for LW 51 and LW 52 and extends beyond the predicted subsidence affectation zone for the Project, which is the predicted vertical limit of measurable subsidence and is defined by the 20 millimetre subsidence contour (refer to **Section 6.2**).

1.3.2 Land Ownership

The ownership of land within the Project Area is provided in **Figure 1.4** and is detailed in the Schedule of Land in **Appendix 1**. The majority of land within the Project Area forms part of the SSCA. Other areas of land are owned by Lake Macquarie City Council (LMCC) and the Roads and Maritime Services (RMS). There are also several Crown Road reserves within the Project Area.

1.3.3 Land Use

The land surrounding the Project Area, as shown in **Figure 1.5**, is predominantly part of the SSCA. Other surrounding land uses include the M1 Motorway and associated services easement, local roads and rural residential holdings to the south of the Project Area along the Palmers Creek alluvial zone. In the south western portion of the Project Area there is an area of land owned primarily by LMCC. This land is a former paper subdivision that was originally intended for residential development, however, there has not been any development of this subdivided area, no facilities such as roads or power exist and residential development of this area is no longer planned. The area is currently forested and is zoned for environmental protection (refer to **Section 4.0**). LMCC has indicated that it is investigating using part of this land as a biodiversity offset for another development in the Lake Macquarie LGA.

The SSCA is managed by the Office of Environment and Heritage (OEH) and was formed as part of the implementation of the Lower Hunter Regional Strategy (Regional Strategy) and Lower Hunter Regional Conservation Plan (Conservation Plan) in 2007. The SSCA is accessed by various stakeholders mainly for recreational purposes, such as bushwalking, mountain bike riding and recreational vehicle use. WWC has a long history of consultation with OEH regarding its mining operations beneath the SSCA, as well as surface works including subsidence monitoring and remediation work, environmental monitoring, exploration and other WWC activities. Consultation undertaken with the OEH specifically in regards to the Project is detailed within **Section 5.1**.

1.3.4 Overview of Environmental Features

The geology of the Project Area includes the Narrabeen Group quartz and lithic sandstones, conglomerates, siltstones and reddish shales over the Boolaroo and Lambton subgroups of the Newcastle Coal Measures, comprising coal seams, tuff, sandstone, conglomerate and shale (Matthei 1995).

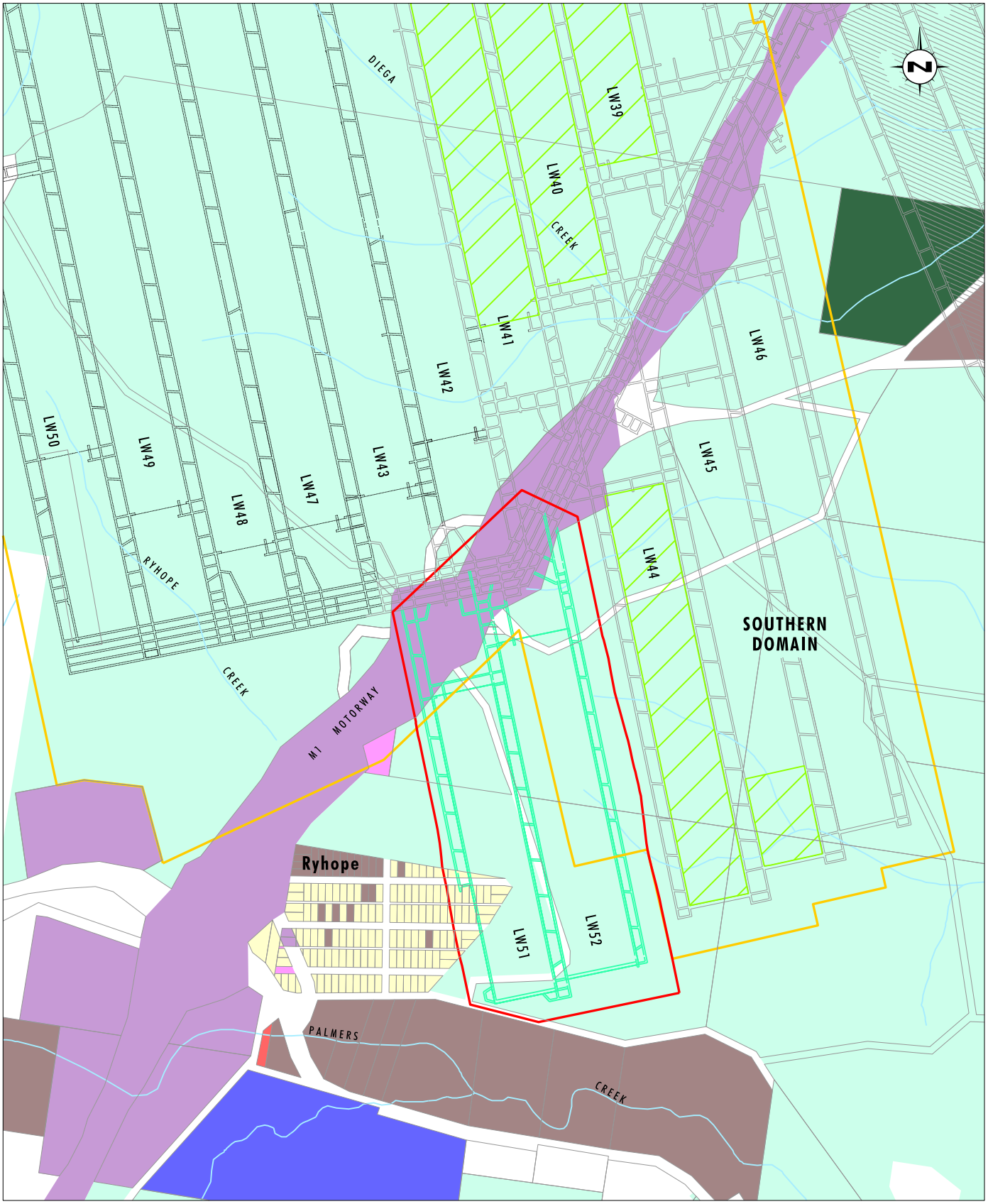

Image Source: OCAL (2008)
Data Source: OCAL (2013), LPI (2003), OEH (2013)

0 250 500 750m
1:15 000

Legend

- Project Area
- Continued Underground Mining Area
- Approved Underground Workings in the West Borehole Seam
- Proposed Longwall Panels 51 and 52 (Conceptual Layout)
- Longwall Progression as of October 2013
- Former Underground Workings
- LMCC
- Macquarie Memorial Park Pty Ltd
- Private
- RMS
- State Conservation Area
- State of NSW
- Unknown

FIGURE 1.4

Land Ownership

File Name (A4): R01/3149_033.dgn
20131218 11.16

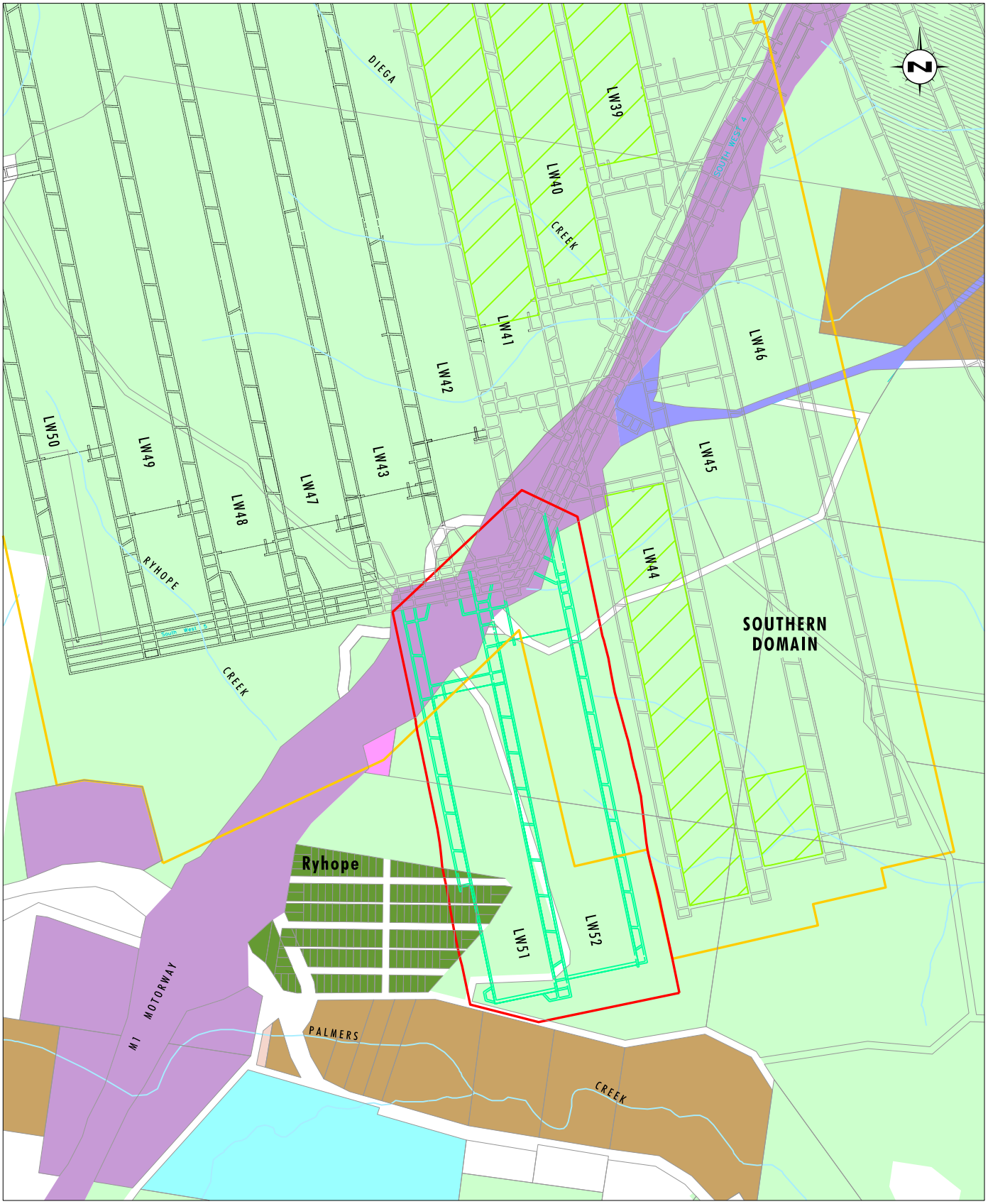

Image Source: OCAL (2008)
Data Source: OCAL (2013), LPI (2003), OEH (2013)

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1:15 000

Legend

- Project Area
- Approved Continued Underground Mining Area
- Approved Underground Workings in the West Borehole Seam
- Proposed Longwall Panels 51 and 52
- Longwall Progression as of October 2013
- Former Underground Workings
- Crown Land
- LMCC - road reserve and easement
- Rural Residential
- State Conservation Area
- RMS
- Crematorium
- Unknown
- Undeveloped Bushland

FIGURE 1.5

Land Use within and Surrounding the Project Area

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20131218 11.05

The landscape of the Project Area is characterised by a north-south oriented spur which extends from a northwest – southeast major spurline from the main Sugarloaf Ridge (refer to **Figure 1.6**). The southern extent of the Sugarloaf Range is characterised by rolling hills with slopes of varying gradients below long broad crests (Matthei 1995: 61, 132).

The maximum elevation of the spur within the Project Area is approximately 100 metres AHD, with the minimum elevation being approximately 40 metres AHD near the southern end of the two proposed longwall panels. The depth of cover above the proposed longwall extraction area ranges from approximately 80 metres to 140 metres.

The Project Area lies within the catchment of Palmers Creek, with the alluvial zone associated with this creek located to the south of the Project Area. A section of one first order tributary of Palmers Creek occurs above LW 52.

The majority of the Project Area is heavily forested, with limited clearing associated with access tracks. The M1 Motorway, Wakefield Road and service corridors bisect the northern portion of the Project Area.

1.4 Environmental Assessment Team

Umwelt prepared this EA on behalf of OCAL. Studies contributing to and included in this EA were undertaken by a number of technical specialists, including:

- Subsidence – Ditton Geotechnical Services;
- Ecological Assessment – Umwelt;
- Aboriginal Archaeology and Cultural Heritage Assessment – Umwelt;
- Groundwater – Aurecon; and
- Surface Water Assessment – Umwelt.

1.5 Environmental Assessment Structure

This EA has been prepared in accordance with the EP&A Act and the *Environmental Planning and Assessment Regulation 2000* (Regulation) (refer to EA Statement of Authorship in **Appendix 1**). Consultation was undertaken with the Department of Planning and Infrastructure (DP&I) regarding the environmental assessment approach for the Project, however, no Director-General's Requirements were issued for this EA. An overview of the layout of this EA is provided below:

- The Executive Summary provides a brief overview of the Project, the major outcomes of the environmental assessment, and an outline of the key Project commitments to mitigate potential impacts.
- **Section 1.0** provides the background and context for the Project, an overview of the existing environment and the EA project team.
- **Section 2.0** provides a description of the existing and approved operations at WWC.
- **Section 3.0** provides a detailed description of the Project.

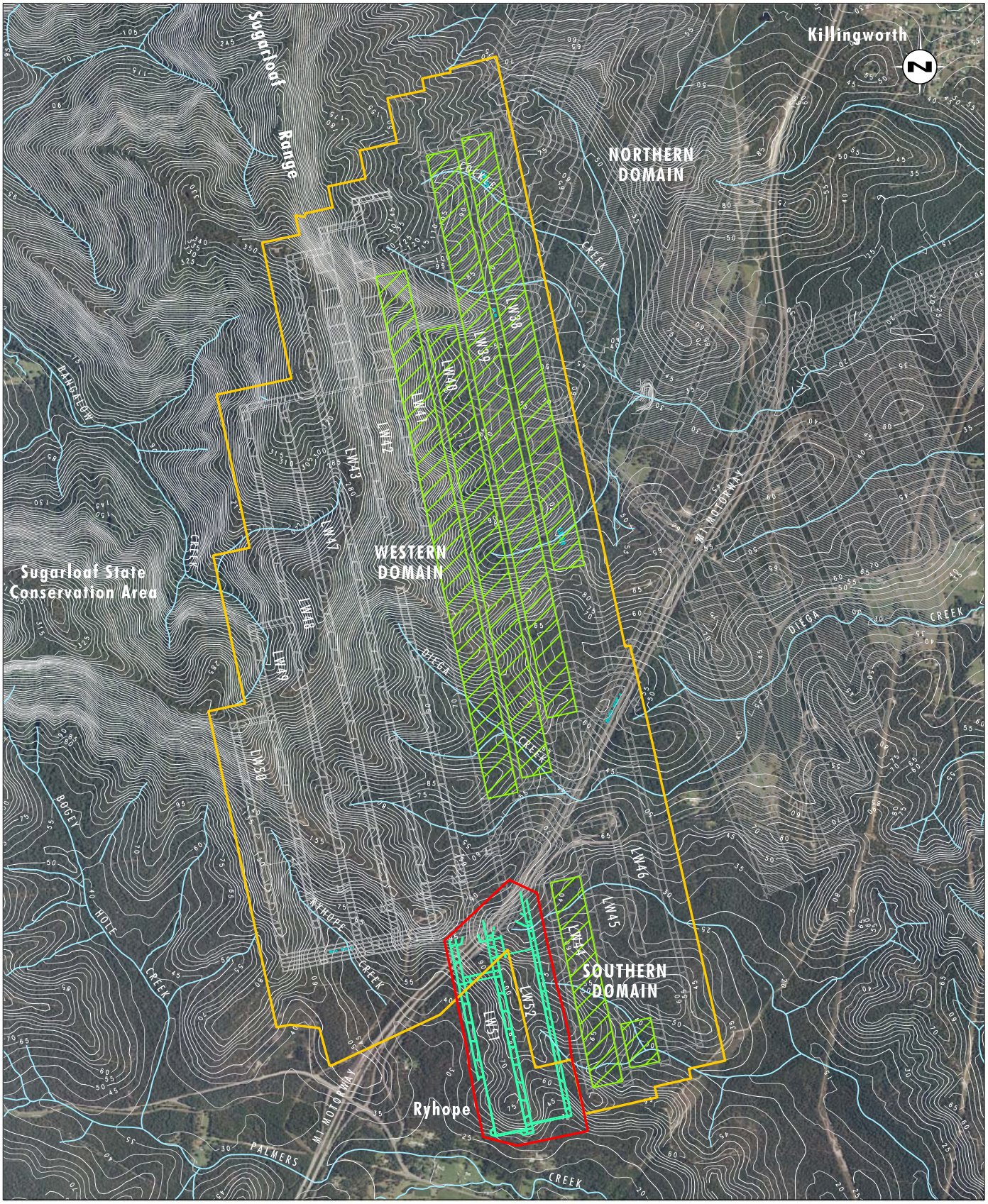

Image Source: OCAL (2008)
Data Source: OCAL (2013)
Note: Contour Interval 5m

0 0.5 1.0 1.5km
1:30 000

Legend

- Project Area
- Approved Continued Underground Mining Area
- Approved Underground Workings in the West Borehole Seam
- Longwall Progression as of October 2013
- Former Underground Workings
- Proposed Longwall Panels 51 and 52
- Drainage Lines

FIGURE 1.6

Topography and Drainage of the Project Area and Surrounds

File Name (A4): R01/3149_019.dgn
20131205 13.19

- **Section 4.0** describes the planning context for the Project, including the applicability of Commonwealth and State legislation.
- **Section 5.0** describes the consultation process undertaken as part of the environmental assessment process and the environmental and community issues identified as part of this process for detailed assessment in this EA.
- **Section 6.0** contains a comprehensive analysis and assessment of the environmental impacts of the Project, including the Project specific and cumulative impacts.
- **Section 7.0** contains a summary of the environmental and social management and monitoring measures that will be implemented as part of the Project.
- **Section 8.0** contains a conclusion and justification for the Project.
- **Section 9.0** provides a list of references referred to in the EA.

2.0 Description of Existing Operations

As discussed in **Section 1.0**, WWC has been operating continuously since 1969. The Project Approval for the current mining operations was granted by the Deputy Director General of DP&I on 25 January 2012 under Part 3A of the EP&A Act. The existing Project Approval permits*:*

- longwall mining of the continued underground mining area (refer to **Figure 1.3**) which is largely beneath the SSCA;
- the continued use of the existing WWC infrastructure including the existing pit-top facilities, No. 2 Vent shaft, No. 3 Vent shaft and ballast borehole; and
- construction and use of new surface facilities and ancillary activities to support the abovementioned operations.

The approved mine plan provides for the underground mining of the West Borehole Seam with mining approved until December 2021. WWC currently mines the West Borehole coal seam using longwall mining techniques, up to a height of approximately 4.2 to 4.5 metres. The approved production limit is 5.5 Mtpa of ROM coal.

The WWC pit top facilities are located at The Broadway, east of Killingworth, and are comprised of infrastructure required to support the operation of the mine. This infrastructure includes the main car park, administration buildings, stores, workshops, the main drift and shaft which provide access for personnel and materials into the mine, the Bradford breaker for coal crushing, surface conveyors, emergency coal stockpiles, pipelines, water management infrastructure, utilities, a 2000 tonne coal storage bin and the coal haul road loop, as shown in **Figure 2.1**.

ROM coal mined from underground mining areas is transferred to the WWC pit top via a series of underground conveyors and existing underground roadways. The ROM coal is then transferred to the WWC surface facilities via the personnel and materials drift and from there is conveyed to the Bradford breaker where the coal is initially sized and waste rock removed. From the Bradford breaker, coal is conveyed via a surface conveyor to the 2000 tonne storage bin. From the 2000 tonne storage bin coal the coal is loaded into coal haul trucks which transfer the coal to the nearby MCPP, via a private haul road.

The majority of coal from WWC is washed and loaded onto trains at the MCPP to be transported to the Port of Newcastle for export. A small percentage of coal mined from West Wallsend has also been periodically transported from MCPP to Eraring Power Station via coal haul trucks on a private coal haul road, in accordance with existing approvals. In addition, some coal has also been transported by rail to Wollongong for use in steel making. The transport of coal is covered by existing development consents held by OCAL (refer to **Section 2.2.2**), that are not the subject of the proposed modification application.

WWC has ventilation facilities (shafts and fans) that provide for ventilation of the underground mine and borehole facilities that provide for the delivery underground of materials for use in the mine. The No. 2 and No. 3 ventilation fan shafts and the existing ballast borehole facility for supplying ballast and other materials will continue to be used for future operations at WWC. The locations of the existing WWC pit top, as well as existing infrastructure including the No. 2 and No. 3 ventilation fans and ballast borehole are shown on **Figure 1.2**.

Image Source: OCAL - Aerial Photograph (2011)
Data Source: OCAL (2011)

0 50 100 200m
1:5 000

Legend

- Existing West Wallsend Colliery Pit Top Facility
- Sediment Dams

FIGURE 2.1

West Wallsend Colliery Surface Facilities

The Project Approval provides for additional surface facilities, being a mining services facility located north of Wakefield Road and a demountable training building, which are approved to be constructed to support WWC operations. The Project Approval also provides for the continued use of existing ancillary services where possible to minimise the surface disturbance associated with the construction of new infrastructure.

The Project Approval also provides for a range of other minor ancillary mining infrastructure that are required above the continued underground mining area including access tracks, service boreholes, gas drainage and flaring facilities. The exact location and number of these minor facilities is determined as part of the detailed mine planning process for each set of longwall panels and is included in the Mining Operations Plan (MOP) and SMP which are approved by the Department of Trade and Investment, Regional Infrastructure and Services – Division of Resource and Energy (DRE) prior to their construction. As outlined in the WWC Continued Operations Project EA (Umwelt 2010), prior to construction of this ancillary infrastructure, a detailed environmental due diligence assessment process is undertaken to assist in confirming the location and identify the environmental management measures that need to be implemented.

2.1 Existing Environmental Management and Monitoring

WWC has an established Environmental Management System (EMS) and a range of comprehensive management plans that have been developed in accordance with the Project Approval. Environmental Management Plans developed for WWC's operations include:

- Environmental Management Strategy;
- Extraction Plan/Subsidence Management Plan; including:
  - Built Features Management Plan;
  - Water Management Plan;
  - Biodiversity Management Plan;
  - Land Management Plan;
  - Heritage Management Plan;
  - Public Safety Management Plan; and
  - Subsidence Monitoring Program;
- Noise Management Plan;
- Air Quality and Greenhouse Gas Management Plan;
- Water Management Plan;
- Surface Water Management Plan;
- Aboriginal and Cultural Heritage Management Plan (ACHMP); and
- Rehabilitation Management Plan.

The EMS has been developed to comply with Glencore requirements and has been developed generally in accordance with ISO 14001, the international standard for EMSs. The EMS provides a risk based platform on which relevant environment and community controls, procedures and management plans have been established and are regularly

reviewed. Operational procedures are also developed to appropriately manage environmental aspects and impacts, with relevant site personnel trained in relation to these procedures.

As part of its EMS, WWC conducts regular environmental monitoring and auditing to gauge performance, compliance with regulatory requirements, and to minimise impacts on the surrounding community and the environment. Environmental monitoring currently undertaken includes the following:

- water quality monitoring;
- groundwater monitoring;
- noise monitoring;
- dust monitoring;
- archaeological and cultural heritage monitoring undertaken in accordance with the requirements of the WWC Aboriginal Cultural Heritage Management Plan (ACHMP);
- extensive subsidence monitoring of previous and current underground mining areas; and
- biodiversity monitoring.

In accordance with the requirements of the Project Approval, WWC has also established a website to provide ongoing to access to information related to WWC and its operations. All approved environmental management plans developed in accordance with the requirements of the Project Approval are available on this website, as well as the environmental monitoring results related to the ongoing operations.

2.1.1 Existing Subsidence Monitoring and Management

OCAL has implemented a range of subsidence monitoring and management activities as part of the SMP/Extraction Plans that have been developed and approved for its current mining operations at WWC. These measures have been refined over WWC's long history of operation as a result of consultation with relevant stakeholders and also the outcomes of monitoring programs.

As part of its ongoing monitoring of subsidence effects from longwall mining, during mining of LW 41 OCAL identified that some of the subsidence effects recorded above LW 41 were greater than predicted. This greater than predicted subsidence occurred in early October 2012 and was identified by OCAL during the completion of a weekly geotechnical inspection of the surface affected subsidence zones associated with LW 41. These weekly inspections are carried out as part of the approved subsidence monitoring program at WWC. The greater than predicted subsidence was reported immediately to the relevant regulatory authorities. These subsidence effects included a vertical block movement (VBM) which impacted an area approximately 120 metres long and 17 metres wide. A VBM has been defined by DGS as the interaction of subsidence with persistent structure zones (that were mapped at seam level) that appears to have allowed VBM to develop on or near spur crests behind some steep slopes. This subsidence event occurred as a result of anomalous subsurface fracturing due to unknown geological conditions, with these features resulting in unpredicted movement as mining progressed through the area. The subsidence effects and ongoing remediation associated with mining of LW41 have been subject to detailed investigations, reporting and consultation with government agencies, with this process currently ongoing. OCAL has prepared facts sheets to provide the community with information relating to these subsidence events. This information is included as **Appendix 2**.

As part of the continued mining operations at WWC, OCAL undertakes a detailed subsidence assessment process to determine the predicted subsidence impacts associated with the completion of each area of longwall mining. This includes modelling and prediction of mine subsidence by technical specialists who utilise subsidence monitoring results from previous mining undertaken at WWC to assist in refining the models that predict the subsidence which is expected to occur. These models are regularly updated based on monitoring data and the subsidence modelling for this Project considered the subsidence monitoring results from LW41, including consideration of the greater than predicted subsidence events.

As detailed in the subsidence assessment, refer to **Section 6.2** and **Appendix 3**, underground and surface geological mapping work has not detected any significant geological structure of concern in the Project Area and therefore the geological conditions that led to the unpredicted subsidence events above LW41 are not predicted to occur in the Project Area. The subsidence assessment for the Project has identified that if present, differential subsidence due to the Project is unlikely to generate VBM's greater than 1 metre deep based on the features observed on similar terrain to the north.

Further discussion of the subsidence impacts associated with the Project is included in **Section 6.2** and **Appendix 3**.

3.0 Description of Project

During the completion of the WWC Continued Operations Project EA (Umwelt 2010) it was noted that coal reserves were located within the WWC Southern Domain adjacent to Longwall 44, where the proposed LW 51 and LW 52 are located (refer to **Figure 1.3**). The reserves within the Southern Domain were partly contained within WWC's CCL 718, however, a portion of the coal reserves were also located within an area subject to a sub-lease to an adjacent mining operation. The recent termination of this sub-lease area has provided the opportunity for this area to be further investigated for underground mining.

OCAL subsequently undertook further investigations in this area related to geological and environmental factors, leading to the development of the proposal to extract two additional longwall panels (LW 51 and LW 52) (refer to **Section 3.1**). The mining of LW 51 and LW 52 will result in approximately 2.55 million tonnes of ROM coal being recovered.

Following the receipt of the Project Approval for continued underground mining in 2012, OCAL has also continued to refine its mine plan in response to ongoing geological and mining assessments of the reserves within its approved underground mining area. An outcome of these reviews is that the start positions for several panels within the Western Domain have been amended to manage strata control risk, reducing the total amount of coal to be extracted from this area. The LW 41 start position has been amended to manage issues relating to coal seam thickness and stability. These changes to the mine layout have resulted in approximately 775,000 tonnes of ROM coal being removed from the mine plan.

As discussed in **Section 1.0**, OCAL has also reviewed future mining areas in light of the greater than predicted subsidence events experienced above LW 41. As an outcome of this review and to provide for compliance with WWC's Project Approval subsidence performance criteria, WWC has significantly reduced the area that will be mined in LW 42 and LW 43. **Figure 3.1A** shows the proposed LW 42 and LW 43 layout, as included within the WWC Extraction Plan for LW 42 and LW 43. The WWC Extraction Plan for LW 42 and LW 43 has been submitted to DP&I. At current coal prices, the value of the approved coal resource that will no longer be mined due to the mine plan changes is approximately $113M. This change also means that significant roadway development designed to access the full extent of LW 42 and LW 43 will no longer be used to facilitate longwall extraction and further costs will be incurred to develop revised roadways to facilitate the proposed shorter blocks.

These reductions in the approved mine plan reduce the amount of coal which will be extracted from the approved mining area. OCAL has advised that the total reductions to the approved mining layout will be greater than the coal tonnage to be mined in LW 51 and LW 52, meaning that coal recovery associated with the Project will not extend the previously predicted life of WWC nor increase the total coal recovery beyond that previously planned for WWC.

3.1 Concept Mine Plan

The Project involves the extraction of two additional longwall panels, LW 51 and LW 52, and associated first working (i.e. underground mine access ways). There are no other changes to the approved mine plan.

The conceptual mining layout for LW 51 and LW 52 has been developed considering a range of environmental, geological and mining factors (refer to **Figure 3.1**). The conceptual mine plan which forms the basis of the assessment in this EA has been designed following consideration of current mining techniques and technologies and is based on the current understanding of the local geology. Mining operations are, however, dynamic and the

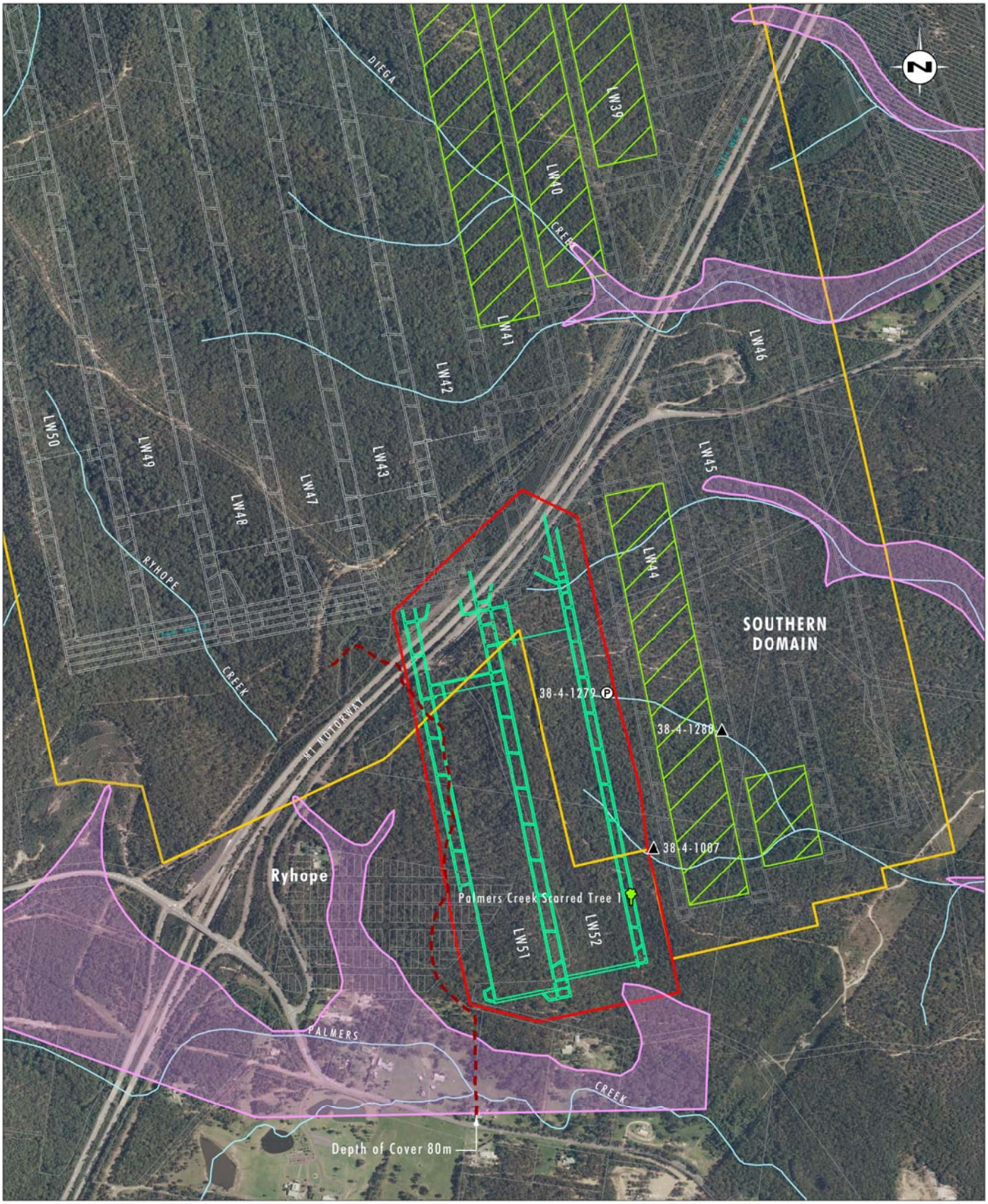

Image Source: OCAL (2008)
Data Source: OCAL (2013), LPI (2003), OEH (2013)

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1:15 000

Legend

- Project Area
- Approved Continued Underground Mining Area
- Approved Underground Workings in the West Borehole Seam
- Proposed Longwall Panels 51 and 52
- Longwall Progression as of October 2013
- Former Underground Workings
- Depth of Cover 80m
- Extent of Alluvium within the Continued Underground Mining Area
- ▲ Axe Grinding Groove
- Ⓟ Grinding groove with PAD
- Scarred Tree

FIGURE 3.1

West Wallsend Colliery
Mine Plan Constraints

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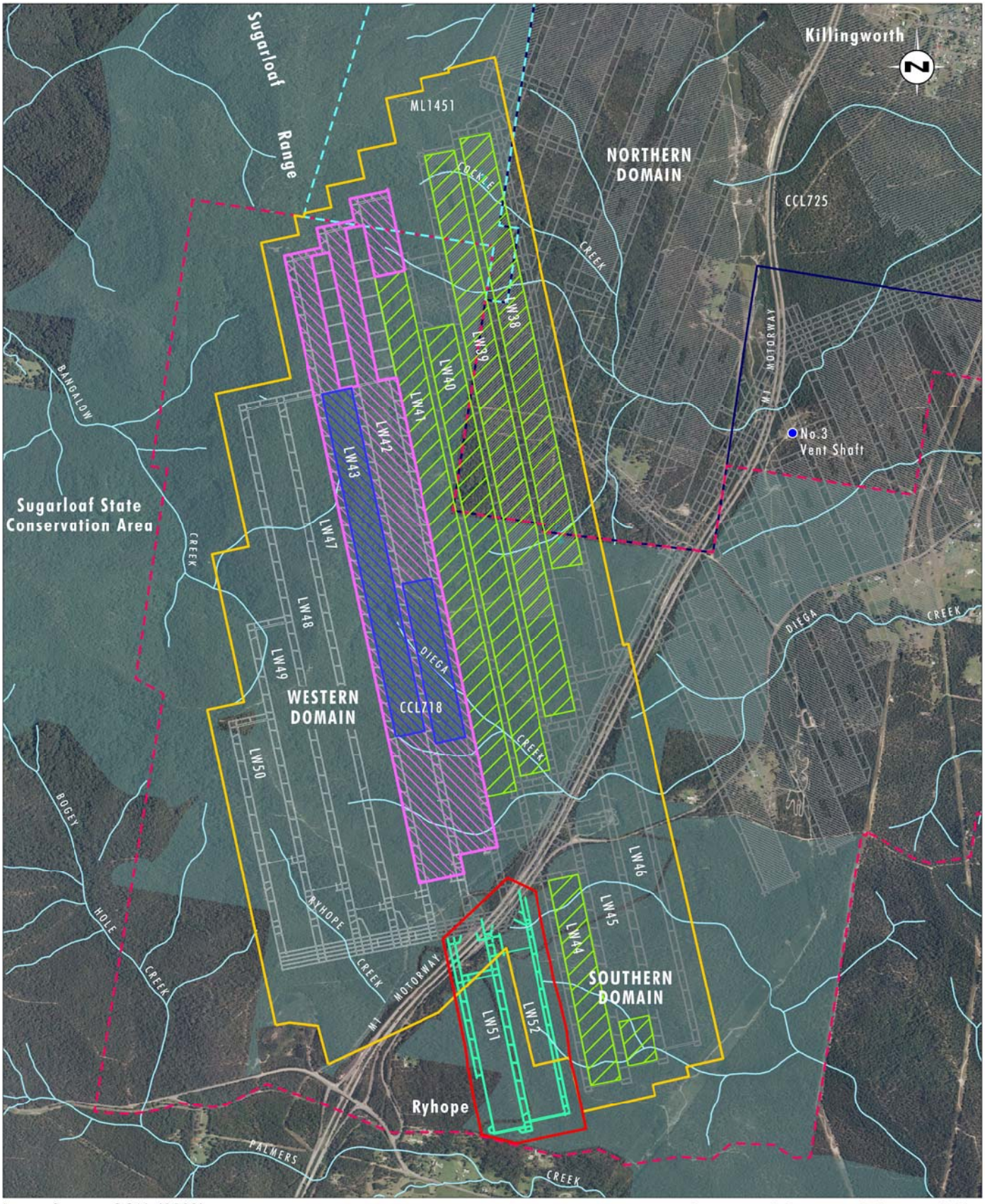

Image Source: OCAL (2008)
Data Source: OCAL (2013), LPI (2003)

0 0.5 1.0 1.5km
1:30 000

Legend

- Project Area
- Approved Continued Underground Mining Area
- Approved Underground Workings in the West Borehole Seam
- Proposed Longwall Panels 51 and 52
- Former Underground Workings
- Current Planned Area for Longwall 42 and 43 Extraction Plan
- Longwall Progression as of October 2013
- Area of LW41, LW42 and LW43 not mined due to Mine Plan changes
- Sugarloaf State Conservation Area
- CCL725
- CCL718
- ML1451

FIGURE 3.1A

West Wallsend Colliery
Mine Plan Modifications
LW 41 - LW 43

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20140123 14.56

conceptual mine plan layout and mining sequence may be subject to changes. Approval is therefore sought for the mining extraction area and extent of associated activities discussed in this section, with any changes to the concept mine plan to be addressed as part of the Extraction Plan/SMP processes.

The proposed mining extraction area has been based on a conceptual mine plan designed following consideration of the:

- location of the M1 Motorway and adjacent easement to the north of the proposed LW 51 and LW 52. The easement contains three optic fibre cables and two pipelines containing gas and oil products;
- alignment of previously mined longwall blocks and mains development. The orientation of the LW 51 and LW 52 panels is influenced by the location of the existing mine workings, which will be used to access the proposed LW 51 and LW 52;
- proximity of Aboriginal archaeological site Palmers Creek Grinding Groove 2, and another grinding groove site further to the east. These sites were identified during the WWC Continued Operations EA as being of significant importance to the Aboriginal Stakeholders;
- extent of underground mine workings associated with Newstan Colliery to the south of the proposed longwall panels. Extensive underground mining has been undertaken to the south of the Project Area, with the mine plan designed to result in the extraction of the maximum volume of coal without interacting with previous mine workings;
- alluvium to the south of the Project Area along Palmers Creek; and
- depth of cover within the Project Area. The WWC Continued Operations EA committed to mining not being undertaken in areas with a depth of cover of less than 80 metres within the Diega Creek catchment due to the potential for connective cracking to occur in areas of a low depth of cover. The western extent of longwall extraction in LW 51 has been bounded by the 80 metre depth of cover contour.

The conceptual mine plan widths, orientations and panel locations have all been developed in consideration of the above factors, with the economic limit of mining also taken into consideration (refer to **Figure 3.1**). A number of mine plan configurations were considered in the development of the proposed mine plan, with these Project alternatives discussed further in **Section 3.5**.

Consistent with the existing WWC operations, the Project will involve the continued use of the longwall retreat system of mining. This method has been used for the extraction of the previous longwall panels at WWC since 1987 and is currently being used for the existing mining operations. The longwall equipment allows extraction heights of up to 4.8 metres.

The conceptual layout for LW 52 is approximately 207 metres wide, including development roadways. The proposed LW 51 is approximately 180 metres wide. The maximum mining height will typically range from approximately 4.2 metres to 4.5 metres however the extraction height is proposed to be reduced in selected areas as required to minimise potential for connective cracking (e.g. based on the concept mine plan, extractions heights are likely to be reduced to heights between 3.6 metres and 3.8 metres in sections of LW 51 in areas with a depth of cover of less than 90 metres). The proposed longwall widths and cutting heights of the concept mine plan are broadly consistent with those of the approved operations.

3.1.1.1 Resource Description

The target coal resource is part of the Newcastle Coal Measures with mining to target the West Borehole Seam. The seam ranges from 4.1 metres to 4.4 metres in LW 51, and from 4.3 metres to 4.6 metres in LW 52. The seam is formed by the coalescence of seams that occur in the eastern part of the WWC mining leases.

Stratigraphic sections through the Southern Domain to show the location of the West Borehole Seam in relation to the surface and other coal seams are included within **Appendix 3**.

The stratigraphy of this area, as in many other parts in the Newcastle coalfields, is marked by rapid lateral variations in inter-seam sediment thicknesses/intervals, resulting from the deposition of sandstone and conglomerate channels. **Figure 3.2** provides a representative stratigraphic column for the Southern Domain. The target coal resource includes a range of coal types from export coking to export thermal and domestic thermal.

There has been no indication or evidence of spontaneous combustion from either pillar extraction or longwall extraction in the West Borehole Seam, during the long history of operations at WWC. Similarly, there has been no occurrence of acid mine drainage issues related to mining within the West Borehole Seam. The characteristics of the proposed new mining area are consistent with the previously mined areas and therefore no issues relating to spontaneous combustion or acid mine drainage are expected as a result of the Project.

The surface terrain above the target coal resource is formed by the Moon Island Beach Sub-Group of the Newcastle Coal Measures. Sandstone and conglomerate of the Teralba Conglomerate Formation dominate the ridges within the Project Area. Tuffaceous claystone (Awaba Tuff), siltstone and coal seams (Fassifern Seam) generally underlie the near surface conglomerate units.

The mining of LW 51 and LW 52 will result in approximately 2.55 million tonnes of ROM coal being recovered. The product coal from LW51 and LW52 will be a combination of coking and thermal coal.

3.1.1.2 Geological Structures

Geological structures, such as faults and dykes, have the potential to impact on and limit the feasibility of mining. Such structures impact upon the ability to safely or economically mine coal resources. Proven and inferred (from geological investigations) structural features are detailed in **Appendix 3**. Extensive exploration work has been completed by OCAL to define the geological structures within the WWC mining area. Substantial information has also been gathered from previous surrounding mining operations.

Other relevant sources of information are geophysical surveys, in-seam drilling and surface boreholes. Regional geological structure in the Project Area consists of minor to major normal faulting and igneous dyke intrusions (refer to **Appendix 3**). Most dykes are emplaced in a north-north west/south-south-east direction.

3.1.1.3 Depth of Cover

Depth of cover is the vertical distance from the top of the coal seam being targeted for extraction to the surface of the land above. The depth of cover within the Project Area ranges from 80 to 150 metres, with the mine plan developed to avoid longwall extraction in areas of low depth of cover (i.e. <80 metres) to minimise the potential for connective cracking (that is a series of interconnected cracks of the rock that connect the surface to the location

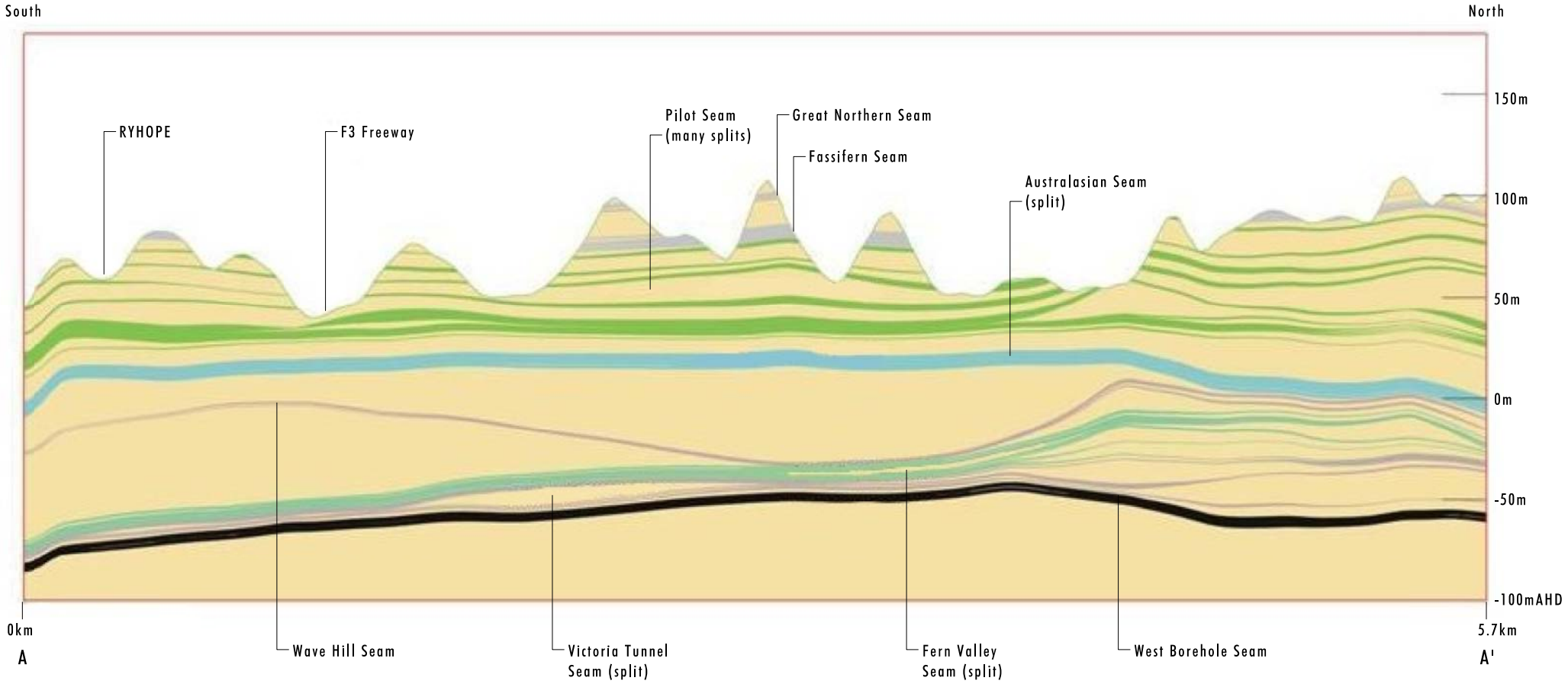


FIGURE 3.2

Typical Strategraphic Cross Section
West Borehole Seam

Image Source: West Wallsend Colliery SMP (2007)
Note: Refer to Figure 3.2 for Section Line location

of the extracted coal seam). A detailed subsidence assessment has been undertaken for the Project to consider the range of subsidence impacts that may occur as a result of the proposed mining, including assessment of the potential for connective cracking to occur and depth of cover issues (refer to **Section 6.2.1**).

3.2 Ancillary Mine Infrastructure

There will be no changes to the existing and approved mine surface infrastructure as a result of the Project. There is a range of ancillary infrastructure that is approved above the current underground mining area which is usually constructed as mining progresses. This ancillary infrastructure includes access tracks, service boreholes, gas drainage and flaring facilities. Consistent with the approach for currently approved operations, the exact location and number of these minor facilities will be determined as the Project progresses, depending on operational needs, coal seam gas make, geological conditions, safety considerations and other mining and environmental variables. The final locations will be determined as part of the detailed mine planning process for each panel and will be included in the MOP and SMP provided to the DRE prior to their construction. The final locations will avoid known archaeological sites, and be designed to minimise impacts on threatened species, with all works to be undertaken in accordance with the existing WWC environmental management plans and procedures.

3.2.1 Resource and Geotechnical Drilling

WWC is also seeking approval to undertake further resource and geotechnical drilling in the vicinity of LW 51 and LW 52 to provide further information to facilitate mining. Drilling will be undertaken in consultation with OEH for works in the SSCA and also in consultation with the WWC Aboriginal Cultural Heritage working group. Prior to drilling activities occurring, a review of the potential environmental impacts from the planned activities will be completed so that the activities are located and designed, as far as practical, to have minimal environmental impact. Following the environmental assessment of the proposed disturbance footprint, these areas will be prepared using small earthmoving equipment to allow for the work to be undertaken safely and in a manner that minimises environmental impacts.

Following the completion of drilling activities, boreholes will be decommissioned in accordance with DRE requirements. All disturbed areas including access tracks and drill pads will be rehabilitated in consultation with relevant stakeholders, including OEH for any works in the SSCA.

3.2.2 Subsidence Management Activities

Subsidence management encompasses those activities involved in the identification of features to be impacted, subsidence prediction, monitoring, assessment and remediation of subsidence impacts. Ongoing review of the monitoring results and the need for any change to the management activities or the mine layout is also undertaken. Subsidence management activities, including, surveying, inspections and surface crack remediation, have been undertaken at WWC for a period of 20 years. Through this extensive experience WWC has developed mechanisms to monitor and remediate potential subsidence impacts. All remediation activities within the SSCA are undertaken in consultation with OEH and also subject to OEH consent.

In accordance with Statement of Commitments 6.2.8 and 6.2.9 from the WWC EA and Project Approval, OCAL is currently in consultation with the relevant government agencies to form an Independent Review Committee to review the monitoring results from the mining of LW 40. The review will inform the mine plan with respect to future mining of LW 42, LW 43

and LW 47 in areas with a depth of cover of less than 100 metres in the Diega Creek catchment.

An overview of subsidence management activities implemented at WWC is provided below and further details on the potential subsidence impacts and management strategies are discussed in **Section 6.2**.

3.2.2.1 Surveying

Survey lines will be required to assess and monitor the potential impacts of subsidence on both natural and constructed features. Prior to installation of survey marks, detailed descriptions of the survey marks and their location will be forwarded to the relevant stakeholders, including OEH and DRE.

The survey lines typically involve the clearing of an area of approximately 1-1.5 metres in width, primarily of the shrub layer with groundcover remaining largely intact. Establishment of the survey lines will not involve any excavation of the ground surface. The survey lines range in length depending on the feature or area being monitored, with the survey marks being spaced at approximately 10 metres. Where possible the line will be moved to avoid larger trees, reducing the extent of vegetation clearing required.

3.2.2.2 Subsidence Inspections

Subsidence monitoring inspections will be undertaken in accordance with the existing Public Safety Subsidence Management Plan (PSSMP). The process includes pre-mining inspections and recording of features (e.g. cliff lines), and post mining inspections to record all surface subsidence impacts and identify the appropriate subsidence management measures to be implemented. WWC will implement this process for LW 51 and LW 52 and will monitor and remediate subsidence impacts within the Project Area.

3.2.2.3 Surface Crack Remediation

Surface cracking is predicted to occur as a result of mine subsidence from the extraction of the longwall panels. Further details of the predicted nature of surface cracking due to the Project are provided in **Section 6.2**.

Remediation of surface cracks will be required in the Project Area. The surface cracks, which will be identified during the subsidence inspections, will be remediated in accordance with the existing WWC Subsidence Crack Remediation Procedure. Typically the remediation involves the grouting of the subsidence crack and if required backfilling and compaction of the area with inert fill. All remediation works within the SSCA are undertaken in consultation with OEH and also in accordance with a consent issued by OEH for such remediation works. Any remediation works on other land are undertaken in consultation with the land owner.

3.2.2.4 Due Diligence Assessments for Subsidence Management Activities

Where subsidence remediation activities have the potential to impact upon sensitive environmental or cultural heritage features, due diligence assessments will be undertaken to assess the best approach to implementing the required subsidence management activities. This will include a review of the management approaches required to minimise potential impacts related to cultural and historical heritage, ecology and general environmental issues such as erosion and sediment control. Where environmental or cultural due diligence assessments are required, they will be undertaken in consultation with the relevant stakeholders, prior to commencement of the works.

3.3 Benefits of the Project

The Project will provide for continued operations at WWC which provides the following benefits:

- ongoing employment of approximately 390 people during the mining of LW 51 and LW 52, with many more indirect jobs created through flow-on effects. The mining of LW 51 and LW 52 will take approximately 12 months;
- recovery of approximately 2.55 Mt of ROM coal;
- payment of significant royalties to the State of NSW due to the extraction of this coal. The existing WWC operations paid approximately $18 million in royalties in 2012 and 2013 financial reporting periods, with the estimated royalties for the predicted coal sales for LW 51 and LW 52 being approximately $6.6M;
- efficient and economic recovery of a valuable coal resource that is extremely unlikely to be economically extracted by any other mining operation. The existing mine workings and mining infrastructure at WWC provide the opportunity to economically extract this resource;
- continued export earnings for Australia; and
- significant economic benefits to the local community through ongoing local employment, purchase of goods and services, and local expenditure both directly and through employee wages during the mining of LW 51 and LW 52.

3.4 Project Alternatives

The main alternatives considered in relation to the Project relate to the conceptual mine plan, as presented in **Section 3.1**. The original proposed mining layout was altered based on the outcomes of the investigation and assessment of the environmental features and mining constraints in the Project Area. This resulted in several changes to the mine plan to optimise the resource recovery whilst minimising environmental impacts. A key early consideration was the separation distance required to the south to prevent impact on the Palmers Creek alluvial aquifer. Early groundwater studies investigated the required separation distance and resulted in the mine plan's southern limit moving further north to provide a suitable horizontal buffer of around 150 metres.

The separation distance required for the two grinding groove sites to the east of the longwall panels was also subject to detailed subsidence modelling to provide for maximum coal recovery whilst designing the mine layout to avoid impacts on these sites. There are mineable coal resources to the east of the mine layout however the limit of mining was designed to deliver on OCAL's commitment to not impact these sites.

Another alternative was the widening of LW 52 following a review of an initial conceptual mine plan, from approximately 168 metres to 196 metres to maximise the volume of coal extracted from the proposed longwalls on the basis of preliminary subsidence predictions relating to environmental features.

The alternative of not proceeding was also considered by OCAL, however this option was not considered appropriate by OCAL as it is expected that the environmental and social impacts of the Project can be effectively managed (refer to **Section 5.0**) and not proceeding would reduce the mine life, resulting in social and economic impacts including the loss of the benefits of the Project as discussed in **Section 3.3**. Not proceeding would result in the closure of WWC 12 months earlier with the associated loss of employment for approximately 390 people associated with that closure, as well as loss of flow on employment.

4.0 Planning Context

This section provides details of the relevant Commonwealth and State legislation and planning provisions and a discussion of their application to the Project.

4.1 Commonwealth Legislation

4.1.1 *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)

Under the EPBC Act, approval from the Commonwealth Minister for Environment is required for any action that may have a significant impact on matters of national environmental significance.

These matters are:

- World Heritage Properties;
- National Heritage Places;
- Wetlands of International Importance;
- Threatened Species and Ecological Communities;
- Migratory Species;
- Nuclear Actions;
- Commonwealth Marine Areas;
- Great Barrier Reef Marine Park; and
- Water Resources impacts associated with coal seam gas and large coal mining projects.

If an 'activity' is likely to have a significant impact on a matter of national environmental significance then it may be a 'controlled action' and should be referred to the Commonwealth Minister for consideration. Water resources is a new matter which has been added to the list of matters of national environmental significance which relates specifically to protection of water resources from impacts of coal seam gas and large coal mining projects.

The provisions of the EPBC Act which are relevant to the Project are those which relate to potential impacts on migratory species, threatened species, or ecological communities listed under the EPBC Act as well as impacts on water resources.

A detailed ecological assessment has been conducted Project (refer to **Section 6.2**) and has concluded that the Project is not likely to result in a significant impact on ecological matters of national environmental significance.

In regard to the potential impact of the Project on water resources, a detailed groundwater assessment for the Project has been undertaken (refer to **Section 6.7**) which has identified that the Project was unlikely to result in a significant impact on groundwater. Therefore the Project does not need to be referred to the Commonwealth Minister in regard to potential impacts on groundwater resources.

In regard to the potential impact of the Project on surface water resources, a detailed assessment has been undertaken (refer to **Section 6.6**) which has identified that based on the subsidence predictions (refer to **Section 6.2**), the Project is not predicted to result in significant impacts on surface waters.

As outlined in this EA, the Project is not expected to significantly impact on the matters of national environmental significance and OCAL does not consider that the Project requires the approval of the Commonwealth Minister.

4.1.2 *Native Title Act 1993*

The *Native Title Act 1993* is not directly relevant to the approval process for the Project however it does have implications for the grant of mining leases under the *Mining Act 1993* where there is potentially claimable land within the lease application area. It is noted that WWC already holds the necessary mining leases for the Project, however, future renewals of the mining leases will be required.

A recent Native Title search (24 June 2013) identified that an additional Native Title claim was registered (13 June 2013) on behalf of the 'Awabakal and Guringai People' (NC2013/002). The Native Title claim included an area stretching from Broken Bay in the south to Newcastle and Maitland in the north and incorporates the proposed Project Area.

The implications of the *Native Title Act* on the renewal of any mining lease necessary for the Project will be dealt with as part of the mining lease renewal process. The above Native Title claimant and other potentially relevant Native Title parties have been consulted in regard to the Aboriginal cultural heritage assessment for the Project (refer to **Section 6.5**).

4.2 New South Wales Legislation

4.2.1 *Environmental Planning and Assessment Act 1979* (EP&A Act)

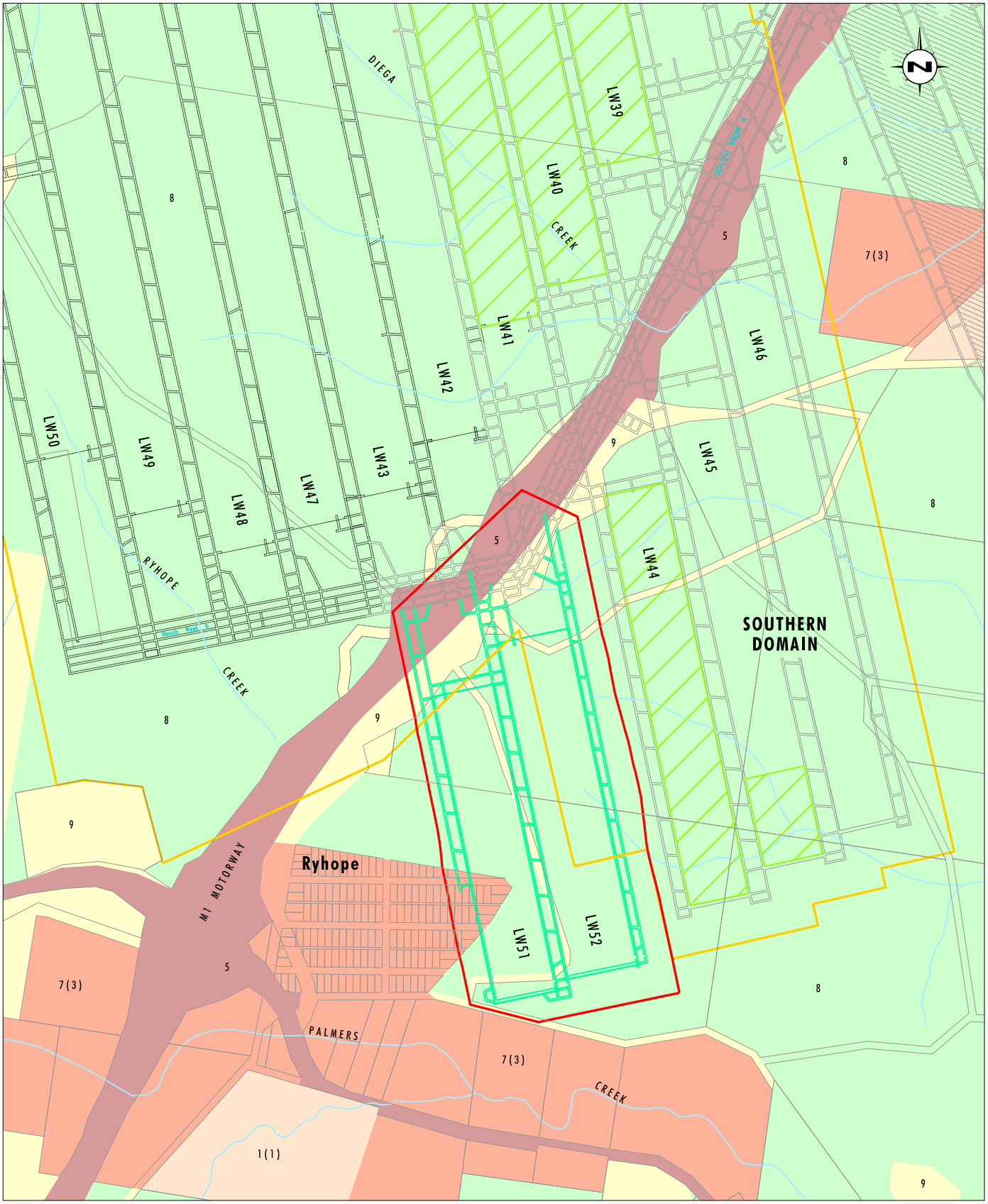
As outlined in **Section 1.0,** a modification to the WWC Project Approval is sought under Section 75W of the EP&A Act. The Project Approval was granted under Part 3A of the EP&A Act and although Part 3A has been repealed, Schedule 6A of the EP&A Act provides for the continued reliance on Section 75W to modify Project Approvals granted under Part 3A.

Section 75W is therefore the appropriate approval pathway for the proposed modification.

Permissibility

Environmental planning instruments, other than State Environmental Planning Policy (SEPPs), do not apply to projects assessed under Section 75W of the Act, except as regards to permissibility.

The Project is located within the Lake Macquarie Local Government Area (LGA). Hence the Lake Macquarie Local Environment Plan (LEP) 2004 is relevant to the permissibility of this Project. Under the LEP the Project Area is zoned 5 Infrastructure, 7(3) Environmental (General), 8 National Park and 9 Natural Resources. The majority of the Project Area is zoned 8 National Park under the Lake Macquarie LEP (refer to **Figure 4.1**). Under the LEP, mining is not permissible within land zoned 8 National Parks or 5 Infrastructure or 7(3) Environmental (General). Mining is permissible with development consent under 9 Natural Resources zoning.



Data Source: LMCC LEP (2004), Cessnock LEP (2009)

0 250 500 750m
1:15 000

Legend

- Project Area
- Approved Continued Underground Mining Area
- Approved Underground Workings in the West Borehole Seam
- Proposed Longwall Panels 51 and 52
- Longwall Progression as of October 2013
- Former Underground Workings
- 1(1) - Rural (Production)
- 5 - Infrastructure
- 7(3) - Environmental (General)
- 8 - National Park
- 9 - Natural Resources

FIGURE 4.1

Zoning within and Surrounding the Project Area

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The permissibility provisions of SEPP (Mining, Petroleum Production and Extractive Industries) 2007 (Mining SEPP) are relevant to this Project. Section 7(1)(a) of the Mining SEPP specifies that 'underground mining carried out on any land' is permissible with development consent. The Mining SEPP also specifies that mining may be carried out with development consent on land that is reserved as a State Conservation Area under the *National Parks and Wildlife Act 1974*. Consequently, the Project is permissible with development consent under the Mining SEPP, and the Minister (or delegate) may approve the Project regardless of permissibility under the relevant LEP.

Other Approvals

If a project is granted Project Approval under Part 3A, the following approvals, which may otherwise have been relevant, will not be required to carry out the project (refer to **Table 4.1**).

Table 4.1 – Approvals Legislation Which Does Not Apply

Act	Approval
Fisheries Management Act 1994 (FM Act)	Permit for works or structures within a waterway
Heritage Act 1977 (Heritage Act)	Disturbance to an item listed on State Heritage Register or Interim Heritage Order; Excavation permit
National Parks & Wildlife Act 1974 (NP&W Act)	S87 preliminary research permit; s90 consent to destroy relics
Native Vegetation Act 2003	Consent for the clearing of native vegetation
Water Management Act 2000 (WM Act)	Water use approval, water management work approval or activity approval

Approvals Legislation to be Applied Consistently

If a project is granted approval under Part 3A of the EP&A Act, the following approvals, which will be required for the Project, must be issued in a manner that is substantially consistent with the terms of the Project Approval (refer to **Table 4.2**).

Table 4.2 – Approvals/Legislation to be Applied Consistently

Act	Approval	Authority
Protection of the Environment Operations Act 1997 (PoEO Act)	Environment Protection Licence	NSW Environment Protection Authority (EPA))
Roads Act 1993 (Roads Act)	Permit to impact on a public road	RMS, LMCC or Department of Lands depending on the type of road
Mine Subsidence Compensation Act 1961	Development within Mine Subsidence District	Mine Subsidence Board
Mining Act 1992	Mining Lease	Department of Trade and Investment
Pipelines Act 1967	Licence	Department of Trade and Investment

4.2.2 Other State Legislation and Environmental Planning Instruments

A summary of the other State environmental and planning legislation potentially relevant to the Project is provided in **Table 4.3**.

Table 4.3 – Summary of State Legislation and Relevance to the Project

Act	Comment	Further Approval Required for Proposed Modification
Mining Act 1992	Under this Act a ML is required before any mining or specified mining purpose can be carried out on the land. OCAL currently holds CCL 718 over the Project Area. A portion of the CCL 718 lease area has previously been sub-leased to Centennial Coal Pty Ltd, for workings related to the Newstan Colliery. This sub-lease has since been transferred back to WWC. A renewal for CCL718 was lodged in 2010. All mining operations must be subject to a MOP and Extraction Plan.	No approvals required, however, WWC will require a revised MOP and Extraction Plan.
Coal Mine Health and Safety Act 2002	The principal aim of the *Coal Mine Health and Safety Act 2002* is to secure the objectives of the *Work Health and Safety Act 2011* in relation to coal operations. It does this by imposing certain specific safety requirements on coal mines. This includes the requirement to comply with minimum barriers for underground mining workings and the requirement to obtain consent from the Minister for Mineral Resources for the establishment of emplacement areas. No new emplacement areas will be required as a result of the Project. Clause 88 of the Coal Mine Health and Safety Regulation 2006 imposes a requirement to obtain approval for secondary workings (including extraction by longwall methods) as that which existed previously in Section 138 of the *Coal Mines Regulation Act 1982*. Approval will be required under clause 88 prior to secondary extraction within the Project Area.	Yes
Protection of the Environment Operations Act 1997 (PoEO Act)	The PoEO Act is administered by the Environment Protection Authority (EPA) and requires licences for environmental protection including waste, air, water and noise pollution control. OCAL currently holds Environment Protection Licence (EPL) 1360. OCAL will obtain a variation to EPL1360 to provide for relevant changes resulting from the Project.	Yes

Table 4.3 – Summary of State Legislation and Relevance to the Project (cont.)

Act	Comment	Further Approval Required for Proposed Modification
Water Management Act 2000	This Act regulates the taking, interception, storage and use of surface water and groundwater within areas subject to water sharing plans. The Hunter Unregulated and Alluvial Water Sources Water Sharing Plan (Hunter Unregulated and Alluvial WSP) commenced on 1 August 2009 and applies to the 'Water Sources', as defined in the Hunter Unregulated and Alluvial WSP within the Project Area. Therefore, the surface waters and any alluvial waters within the Project Area are governed by the WM Act, whilst the groundwater associated with the hard rock aquifers (i.e. coal seams) remain governed by the *Water Act 1912* (Water Act). As discussed in **Table 4.1**, the following approvals are not required under the WM Act for this Project: water use approval; water management work approval; or activity approval. The Project is not predicted to result in take of water from any water sources covered by a Water Sharing Plan and therefore no water licences will be required. An assessment of the Project has been undertaken in accordance with the NSW Aquifer Interference Policy with the findings outlined in **Section 6.6**.	No
Water Act 1912	This Act has been repealed by the *Water Management Act 2000*; however, some of the licensing provisions remain in force where the water source is not covered by a water sharing plan under the WM Act. OCAL currently holds Part 5 licences under this Act for the interception and extraction of groundwater as part of its mining operations. These licences are predicted to be sufficient for both the existing and proposed WWC operations. The Project will not require any further Part 5 licences.	Yes, however, current allocations are expected to be adequate
Environmentally Hazardous Chemicals Act 1985	The OEH is granted power under the *Environmentally Hazardous Chemicals Act 1985* to assess and control chemicals and declare substances to be chemical wastes. A licence is required for any storage, transport or use of prescribed chemicals. The Project will not result in any changes to the storage, transport or use of prescribed chemicals. No approvals will be required.	No

Table 4.3 – Summary of State Legislation and Relevance to the Project (cont.)

Act	Comment	Further Approval Required for Proposed Modification
Roads Act 1993	The *Roads Act 1993* is administered by Roads and Maritime Services (RMS), local council or the Department of Lands depending on the classification of the road; the RMS has jurisdiction over major roads, the local council over minor roads, and the Department of Lands over Crown roads and Crown road reserves. The Act requires that applications for the closure of Crown roads be made to the Minister. Consent under Section 138 of the *Roads Act 1993* is required in order to undertake works within a road reserve. The Project does not propose any works within road reserves or the closure of any roads. It is noted that some road reserves occur in the predicted subsidence affectation zone for the Project (refer to **Section 6.3**), however, the need to undertake any future subsidence remediation works within these Crown road reserves is unknown at this time. Therefore, no further approvals will be required under this Act at this time. If any works are required, any required approvals would be obtained prior to such works being undertaken.	No
Crown Lands Act 1989	The Act provides for the administration and management of Crown land in the eastern and central divisions of the State. Crown land may not be occupied, used, sold, leased, dedicated, reserved or otherwise dealt with unless authorised by this Act or the *Crown Lands (Continued Tenures) Act* 1989. Some Crown road reserves are located within the Project Area. The need to any future subsidence remediation works within these road reserves is unknown at this time. Any required approvals would be obtained prior to such works being undertaken.	No
Mine Subsidence Compensation Act 1961	Under this Act, the approval of the MSB is required for the erection or alteration of improvements within a mine subsidence district. The Project Area is located within the Killingworth/Wallsend Mine Subsidence District and approval under s15 of the Act will be required for the construction of any new surface infrastructure required to support mining operations of LW 51 and LW 52. There are no significant surface facilities proposed to be developed as part of the Project, however, some minor facilities such as borehole facilities may be required to support the mining operations. Should such facilities be required, any required approvals will be obtained at that time. MSB has consulted with the MSB regarding the Project.	No
Dams Safety Act 1978	The *Dams Safety Act 1978* requires that large dams that may constitute a hazard to human life and property must be periodically reviewed by the NSW Dams Safety Committee. These dams are known as prescribed dams and are listed in Schedule 1 of the Act. The Project will not require the construction of any new dams. No approvals will be required under this Act.	No

Table 4.3 – Summary of State Legislation and Relevance to the Project (cont.)

Act	Comment	Further Approval Required for Proposed Modification
National Parks and Wildlife Act 1974	Section 47(J) defines 'mining interests' as any ML under the *Mining Act 1992* and specifies that a mining interest shall not be granted in respect of lands within a SCA without the concurrence in writing of the Minister. A renewal of, or extension of the term of, a mining interest in respect of lands within a SCA (other than an existing interest) shall not be granted under the *Mining Act 1992* without the concurrence in writing of the Minister. These provisions require that should WWC wish to apply for a new ML or renew an ML, the concurrence of the Minister for Environment and Heritage will be required. WWC currently hold the MLs required for continued mining operations within the SCA.	No

Table 4.4 outlines the relevant State Environmental Planning Policies (SEPPs) required to be considered in relation to the Project.

Table 4.4 – Relevant SEPPs for Consideration in Relation to the Project

NSW Legislation – Environmental Planning Instruments		
Planning Provision	**Comment**	**Relevance**
State Environmental Planning Policy (State & Regional Development) 2011	The project approved under DA 09_0203 is of a classification listed in the SEPP and would have been classified as State significant development if a new development not a modification.	Project is classed as State Significant Development.
State Environmental Planning Policy (Mining, Petroleum Production & Extractive Industries) 2007	Regulates the permissibility of mining and related development and specifies matters that must be considered in assessing mining developments requiring consent under Part 3A (repealed) and Part 4 of the EP&A Act.	The proposed Project is not considered exempt or complying development and therefore requires consent.
State Environmental Planning Policy 33 (Hazardous & Offensive Development) 1992	SEPP No. 33 requires the consent authority to consider whether an industrial proposal is a potentially hazardous industry or a potentially offensive industry. A hazard assessment is completed for potentially hazardous development to assist the consent authority to determine acceptability.	The existing WWC operations are not considered as hazardous or offensive. The Project will not result in any changes to the existing WWC operations which would alter this classification. No further consideration of SEPP No. 33 is required.
State Environmental Planning Policy 44 (Koala Habitat Protection)	SEPP No. 44 restricts a Council from granting development consent for proposals on land identified as core koala habitat without preparation of a plan of management.	A koala habitat assessment was completed as part of the ecological assessment for this Project and core koala habitat is not present within the Project Area.

Table 4.4 – Relevant SEPPs for Consideration in Relation to the Project (cont.)

NSW Legislation – Environmental Planning Instruments		
Planning Provision	**Comment**	**Relevance**
State Environmental Planning Policy 55 (Remediation of Land)	SEPP 55 restricts a consent authority from granting consent for the carrying out of development on land unless the consent authority has considered any potential contamination issues.	No potential contamination issues have been identified within the Project Area.

5.0 Stakeholder Consultation and Issues

As discussed in **Section 1.0**, WWC has been operating at the site since 1969 and over this time has established a sound relationship with key stakeholders including with the local community including the local Aboriginal community, LMCC, the SSCA and relevant government agencies.

WWC distributes a Community Newsletter on a periodic basis that provides information on the mines operational, safety, environmental and community performance to the local community. The newsletter is distributed to the community surrounding WWC including West Wallsend, Barnsley, Ryhope and Wakefield. The most recent newsletter was distributed in November 2013 and included details of the Project and contact details for any interested community members that wanted to further discuss the Project. A copy of this newsletter is included in **Appendix 4**.

The stakeholder consultation program undertaken specifically for this Project is outlined in the following section and built on the existing program for WWC.

5.1 Authority Consultation

The authority consultation process for the Project included the following:

- an introductory phone conference with representatives from DP&I in May 2013 to introduce the Project and discuss the approval path and approach to the environmental assessment for the Project;

- a meeting with DRE in May 2013 to discuss the Project, including the status of mining leases within the Project Area, proposed mine plan, predicted subsidence impacts, resource recovery and approach to the environmental assessment;

- a meeting with LMCC in May 2013 to discuss the proposed Project, approach to the environmental assessment and the land ownership within the Project Area (LMCC is a landowner);

- a meeting with the Office of Environment and Heritage regarding the assessment and management of underground mining in the SSCA (May 2013), the approach to the environmental assessment and to discuss the land owner consent requirements for the Project; and

- a meeting with the NSW Office of Water (NOW)) in May 2013 regarding the surface and groundwater assessment approach.

None of the above meetings identified additional environmental assessment requirements beyond those already being undertaken for the Project.

OCAL sent a letter to DP&I on 11 November 2013 requesting DP&I to confirm the approval path for the Project and identifying the key issues being subject to detailed studies as part of this EA. A letter was received on 15 November 2013 from DP&I confirming that the Project will be assessed under Section 75W of the EP&A Act and confirming that the key issues for the Project are subsidence, surface water and groundwater, biodiversity and Aboriginal cultural heritage. The letter also specified which government agencies OCAL should consult with regarding the Project, in addition to consulting with the relevant Aboriginal stakeholders. OCAL has satisfied these consultation requirements.

Following the completion of specialist studies and during finalisation of this EA, there was further agency consultation to discuss the assessment findings and the proposed management and mitigation measures. This consultation included meetings and correspondence with the following agencies:

- MSB – meeting undertaken on 19 November 2013;
- RMS – meeting undertaken on 12 November 2013; and
- LMCC – further correspondence dated 12 December 2013 relating to the conceptual mining layout in relation to Council land.

Further consultation with relevant government agencies will occur as part of the assessment of the Project including planned further meetings with OEH regarding interactions with the SSCA and discussions with the EPA. OCAL contacted the EPA regarding the Project in December 2013, with further consultation planned for January 2014.

There will be ongoing consultation with the relevant service organisations, including Telstra, Optus, NextGen, Gencom and Jemena, during the continued operations of WWC regarding management of subsidence impacts on infrastructure. WWC has a long history of effective consultation with these service providers. It is also noted that subsidence predictions for the mining LW 51 and LW 52 indicate no measurable subsidence impacts the services easement and Telstra Communications tower to the west of the M1 Motorway.

5.2 Community Consultation

A newsletter relating to OCALs operations, including the Project was distributed to the community surrounding WWC including West Wallsend, Barnsley, Ryhope and Wakefield in November 2013. The newsletter included an overview of the Project and provided contact details for any members of the community that wanted more information or to discuss the Project. A copy of this newsletter is included in **Appendix 4**.

Face to face meetings and phone consultation has been undertaken with private landholders adjacent to the Project Area in Rhyhope. Meetings were offered to landholders with meetings held with three nearby landholders to discuss the Project. Key points of discussion included the subsidence impacts of the existing WWC operations, recent media and a recent grouting incident. The layout of the proposed Project and the design considerations to avoid a significant impact on the alluvial zone were also discussed. OCAL also provided details of its proposed ongoing groundwater monitoring program to confirm impact assessment predictions.

The Project has been discussed with the West Wallsend Colliery Community Consultative Committee during the May 2013 and November 2013 meetings.

5.3 Aboriginal Community Consultation

WWC has a well established relationship with the registered Aboriginal parties for WWC due to the ongoing Aboriginal cultural heritage management program in place for the mine. This includes regular meetings and fieldwork associated with WWC's existing operations. The registered Aboriginal parties, including relevant Native Title groups, were integrally involved in the Aboriginal cultural heritage assessment process for the Project with further details of the engagement process undertaken as part of the assessment process included in **Section 6.4**.

6.0 Environmental Assessment

6.1 Preliminary Environmental Risk Analysis

A preliminary environmental risk analysis was undertaken for the Project to identify the key issues that required detailed assessment as part of the EA process. As detailed within **Section 3.0**, the majority of the operations at WWC will be not be changed as a result of the Project, with the key issues requiring assessment therefore related to the assessment of the potential impacts associated with mining of the proposed LW 51 and LW 52. The identification of the key environmental issues that required assessment was based on consideration of:

- the scale and potential impact of the Project;
- outcomes of the previous and current stakeholder consultation;
- the planning and environmental context of the Project; and
- the findings of the 2010 WWC EA and ongoing environmental monitoring of the existing WWC operations.

The outcomes of the preliminary environmental risk analysis are provided in **Table 6.1**.

Table 6.1 – Potential Environmental Impacts Associated with the Project

Aspect	Environmental Assessment
Aboriginal Archaeology and Cultural Heritage	The placement of the proposed longwall panels was undertaken to avoid impact to the two grinding groove sites located to the east of the proposed mining area. A detailed assessment of Aboriginal Cultural Heritage has been undertaken and is included in **Section 6.4**.
Subsidence	Subsidence impacts will occur as a result of the Project. A detailed subsidence impact assessment has been undertaken for the Project and has been included within **Section 6.2**. The subsidence assessment provides the predicted subsidence as a result of the mining of LW 51 and LW 52 and details the management measures proposed to be implemented to manage subsidence from the Project.
Water Resources	The nature of the Project means it has the potential to result in surface water and groundwater impacts. A Groundwater Assessment has been completed for the Project and is detailed in **Section 6.6**. A surface water assessment has also been undertaken for the Project and is included within **Section 6.5**.
Ecology	Subsidence associated with the Project has the potential to result in ecological impacts. A detailed ecological assessment has been undertaken for the Project with the results of the ecological assessment included in **Section 6.3**.

Table 6.1 – Potential Environmental Impacts Associated with the Project (cont.)

Aspect	Environmental Assessment
Noise	The Project will not result in any changes to the existing WWC surface facilities and therefore it will not result in any changes to noise impacts from these facilities. Subsidence remediation works will be undertaken within the Project Area. The subsidence remediation works will require the completion of grouting of selected subsidence cracks and may involve the utilisation of small tracked earthmoving equipment during daylight hours to remediate selected subsidence cracks. The nearest privately owned residence is approximately 400 metres from the longwall extraction area. Due to the limited scale of minor surface works associated with the Project, it is considered the potential for noise emissions from the Project will not result in any impacts to residential receivers. Noise management controls to be implemented for the Project will be consistent with those utilised for existing remediation activities at WWC which include the completion of a risk assessment prior to remediation works, as well as the completion of remediation works in accordance with WWC's existing subsidence remediation processes outlined in the Extraction Plan/SMP.
Air Quality	The Project does not involve any changes to WWC surface facilities and will therefore not change air quality impacts associated with these facilities (e.g. coal handling and transportation, ventilation shafts etc.). As discussed above for noise, there will be some small scale earthmoving equipment used for subsidence remediation works, however, minimal dust generation will be associated with these activities and standard construction dust controls will be applied where necessary (e.g. keeping working areas damp). No further assessment of air quality impacts is required.
Traffic	Traffic volumes and access arrangements are consistent with the approved WWC. The Project does not result in any changes to the traffic arrangements or volumes of the approved WWC and as such no further assessment of traffic impacts is required.
Greenhouse Gas	Greenhouse gas emissions and energy use will be consistent with the approved WWC operations as the overall life of the Project would not change and the seam to be mined is the same seam as mined by the current operations. No further assessment of greenhouse gas and energy impacts is required.
Visual Amenity	The nature of the Project (i.e. underground longwall mining) and the nature of the existing environment (topography and vegetative cover) means there is limited potential for visual impacts to occur, except for viewing locations in close proximity to the mining area. An assessment of the potential visual impacts of the Project has been undertaken and is provided in **Section 6.7.2**.
Public Amenity	Management of subsidence will require access restrictions to some portions of the SSCA during mining activities. Therefore the Project has the potential to result in public amenity impacts. This potential impact is assessed in **Section 6.7.3**.
Historic Heritage	No historic heritage sites have been identified in the Project Area and there will be no impact on historic heritage values (refer to **Section 6.7.4**).
Land Resources and Agriculture	The location of the proposed mining primarily under the heavily vegetated SSCA, means the Project is unlikely to impact on high quality agricultural lands or soils. None of the land in the Project Area is currently used for agriculture. An assessment of the potential impact of the Project on land resources and agriculture has been undertaken and is provided in **Section 6.7.1**.

Table 6.1 – Potential Environmental Impacts Associated with the Project (cont.)

Aspect	Environmental Assessment
Socio-Economic	Due to the nature of the Project and as there will be no changes to employment and no changes to WWC existing surface facilities, the Project is unlikely to result in significant socio-economic impacts. A discussion of the likely socio-economic impacts of the Project is included in **Section 6.7.5**.
Waste	WWC currently operates under a Waste Management Plan. This plan will be applied to the Project. There are no changes to waste streams or waste management practices resulting from the Project. No further assessment is warranted.

6.2 Subsidence

A detailed Subsidence Assessment has been completed for the Project by Ditton Geotechnical Services Pty Ltd (DGS). A summary of the key findings of the assessment is provided below, with the full assessment report included in **Appendix 3**.

Subsidence monitoring at WWC has been undertaken for over 20 years. This long history of monitoring has provided detailed information on which the current subsidence predictions have been developed. The monitoring data from WWC's mining operations provides an insight into potential subsidence impacts in the Project Area and on the effectiveness of subsidence remediation strategies.

WWC also has a long history of working with infrastructure owners relevant to subsidence impacts and has established existing subsidence management plans with the respective surface feature stakeholders above its mining area. As the Project progresses, these management plans and the WWC SMP/Extraction Plan will be revised in consultation with the existing stakeholders to reflect the surface features within the Project Area.

WWC as part of its existing SMP and associated management plans, has developed and implemented subsidence remediation strategies for the mining undertaken by WWC. These existing remediation strategies will be updated in consultation with relevant stakeholders to address potential subsidence impacts of mining within the Project Area.

As detailed within **Section 6.2.2**, it is noted within the Subsidence Assessment (refer to **Appendix 3**) that there were subsidence impacts above LW 41 located within the Western Domain which were observed to be greater than the predicted subsidence impacts. The subsidence model utilised for the LW 51 and LW 52 subsidence assessment has been updated based on the subsidence impacts which occurred within LW 41.

6.2.1 Subsidence Processes

Longwall mining is a form of underground coal mining where coal is removed from a selected mining horizon within the coal seam. The proposed LW 51 panel is approximately 876 metres in length and 180 metres wide, with LW 52 being approximately 964 metres in length and 207 metres wide. Longwall panels are mined sequentially with adjacent panels separated by a barrier of coal, referred to as chain pillars.

The underground roadways along one side of the longwall are referred to as the maingate; the underground roadways on the adjacent side are called the tailgate. These underground roadways are developed by continuous miner units. The end of the longwall block that includes the longwall equipment is referred to as the longwall face. The collapsing void behind the longwall is called the goaf.

The longwall shearer is a machine that passes back and forth along the longwall face removing nominally 1 metre thick slices of coal during each pass. As the shearer removes the coal, the hydraulic roof supports advance forward into the newly created cavity. As mining progresses the area behind the face, i.e. the goaf, collapses causing the overlying rock to fracture and settle, this results in subsidence. This settlement progresses up through the overlying strata resulting in subsidence of the ground surface immediately above and surrounding the longwall panels. A diagrammatic representation of a typical subsidence profile is shown in **Figure 6.1**. It is important to note that direct connection between the surface and the underground workings has the highest potential to occur in areas of low depth of cover (i.e. <80 metres) to the seam. This connection, where it occurs is through a mosaic of fractures in the rock resulting from the subsidence. Mining of LW 51 and LW 52 will not occur <80 metres depth of cover.

The term 'subsidence' generally refers to the range of ground movements which result from mining operations. These movements are described by the following parameters:

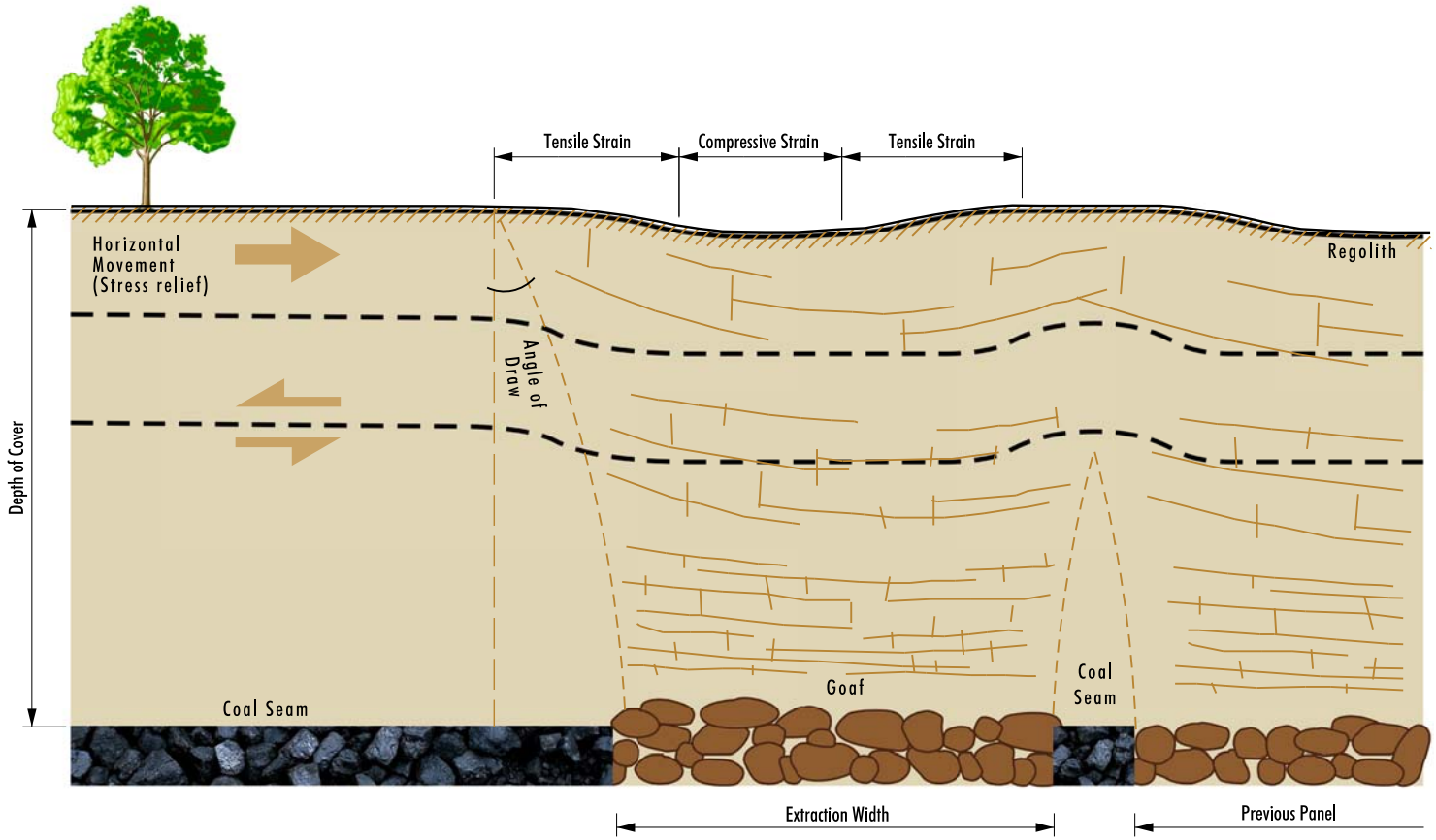
- **subsidence** refers to the vertical and horizontal displacement of the ground;
- **tilt** is the change in the slope of the ground as a result of differential subsidence;
- **curvature** is the rate of change in tilt; and
- **strain** is the change in horizontal distance between two points on the ground. Tensile strains occur when the distance between two points increases and compressive strains occur when the distance between two points decreases.

The area predicted to be affected by subsidence due to the Project is shown on **Figure 6.2**. The subsidence affectation zone for the Project has been defined by the following parameters:

- the conceptual mine plan;
- the area bounded by the 26.5 degree angle of draw (i.e. the angle of the line connecting the edge of the goaf and the limit of subsidence at the surface) (refer to **Figure 6.2**); and
- the predicted vertical limit of measurable subsidence, taken as the 20 millimetre subsidence contour.

The extent of subsidence depends on a number of factors including the width and height of the coal seam removed in a given longwall panel, the characteristics of the overlying rock strata and the depth of cover above mining operations. The vertical extent of subsidence is generally less than the thickness of coal removed due to the bulking effect of the collapsed strata.

Overburden depths for the Project are shown in **Table 6.2**.



Cross-section of Subsidence Profile

FIGURE 6.1

Typical Subsidence Profile

Note: Not to Scale
Source: SCT Operation PTY Limited, 2009

Image Source: OCAL (2008)
Data Source: OCAL (2013), LPI (2009)

0 100 200 400m
1:7 500

Legend

- Project Area
- Approved Underground Workings
- Proposed Longwall Panels 51 and 52
- 20mm Subsidence Affectation Zone (LW51 & LW52)

FIGURE 6.2

Subsidence Affectation Zone

Table 6.2 – Overburden Depths (metres) within the Project Area

Longwall	Minimum	Maximum
LW 51	80	140
LW 52	110	150

Figure 6.3 shows the range of depth of cover within the Project Area. The mine plan has been designed to avoid longwall extraction in areas of low depth of cover (i.e. <80 metres).

The subsidence predictions and impact assessment have been undertaken based on empirical modelling and comparison from previously recorded monitoring data in the context of the conceptual mine plan for the Project. The subsidence predictions have also incorporated the results of subsidence monitoring undertaken for the recently mined LW 39, LW 40 and LW 41 at WWC. As mining progresses, there will be ongoing refinement of the predictive model as a result of subsidence monitoring and comparison with predictions. The mine layout will also continue to be refined as the Project progresses potentially resulting in changes to subsidence predictions. Any changes to the mine layout and subsidence predictions will be assessed as part of the SMP/Extraction Plan or other relevant process at that time.

The WWC Project Approval identifies performance measures for subsidence related impacts. These performance measures relate to impacts on natural and heritage features (e.g. land surface such as cliffs and rock face features, water resources, biodiversity and heritage), built features such as roads, powerlines and pipelines, and public safety. OCAL continually reviews the performance of WWC against these subsidence performance measures and makes changes to future mining operations as required to satisfy these measures.

As noted within **Section 2.1.1**, during mining of LW 41 OCAL observed subsidence impacts which were greater than predicted. These subsidence impacts were observed during routine subsidence monitoring which was being conducted in accordance with the requirements of the SMP/Extraction Plan that had been developed for LW 41.

The greater than predicted subsidence impacts which were recorded in LW 41 occurred as a result of anomalous subsurface fracturing due to unknown geological conditions, with these features resulting in unpredicted movement as mining progressed through the area. As detailed within the subsidence assessment (refer to **Appendix 3**), underground and surface mapping work has not detected any significant structure of concern in the LW 51 and LW 52 Project Area. The subsidence assessment has identified that if present, differential subsidence is unlikely to generate VBM greater than 1 metre based on the features observed on similar terrain to the north.

6.2.2 Subsidence Prediction Methodology

Two empirically based prediction models (ACARP, 2003 and SPDS®) have been used by DGS to generate subsidence predictions for the Project Area.

The assessment of impact on surface and subsurface features has also considered the predicted subsidence parameters and previous experience gained from the detailed subsidence monitoring program undertaken in the previous longwalls at WWC.

Specific details of the subsidence prediction models used in this assessment are included in **Appendix 3**.

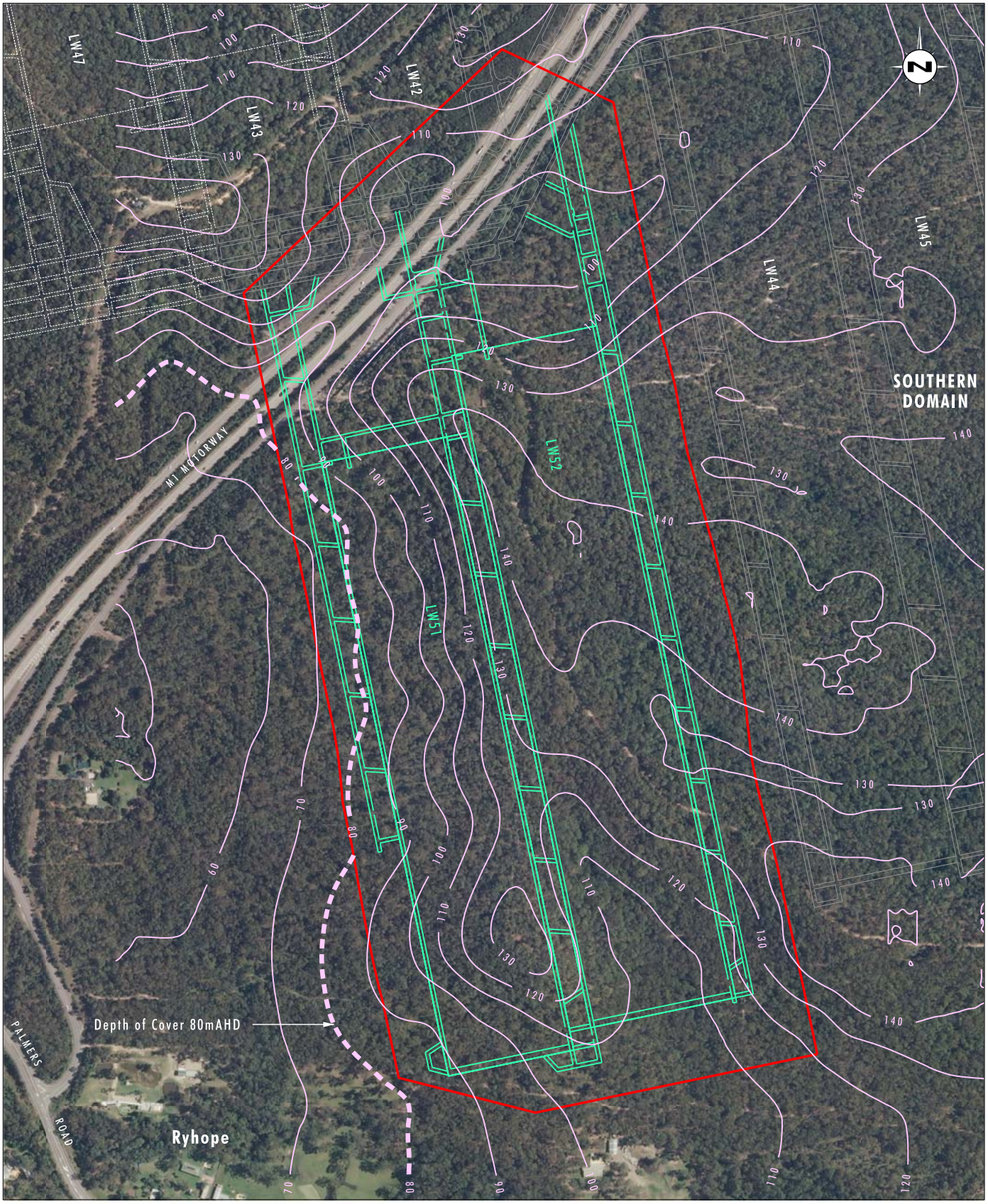


Image Source: OCAL (2008)
Data Source: OCAL (2013), LPI (2009)

0 100 200 400m
1:7 500

Legend

- Project Area
- Approved Underground Workings
- Proposed Longwall Panels 51 and 52
- Depth of Cover Contours

FIGURE 6.3

Depth of Cover of Project Area

6.2.3 Overview of Subsidence Impact Assessment

An overview of the subsidence predictions is discussed in the following section, and a detailed review of the predictions is included in the DGS report in **Appendix 3**.

The lithology above the strata above the proposed longwall extraction area consists of shallow soil profiles overlying near surface sandstone, conglomerate, siltstone and mudstones of the Permian Narrabeen Group and Upper Newcastle Coal Measures. Intermittent low-height conglomerate rock outcrops <1.5 metres in height exist along the mid to upper slopes of the ridges. There are approximately 5.4 hectares and 2.9 hectares of steep slopes with gradients that range from 18° to 35° above LW 51 and LW 52 respectively. There are no cliffs, cliff terraces, minor cliffs or rock features (as defined by the Project Approval) above LW 51 and LW 52 (DGS 2013).

The subsidence predictions for the Project have been developed based on the previous subsidence monitoring for WWC, in particular the Northern and Western Domain longwall panels.

The key subsidence effect predictions/results for the Project are:

- final mean (to upper 95% confidence limit) predicted panel subsidence after extracting LW 51 and LW 52 will range from 2.41 to 2.61 metres (57% to 58% of mining height). Predicted subsidence contours for the Project are shown on **Figure 6.4**;
- chain pillar subsidence after mining (i.e. the area at the edge of the LW blocks) after mining 4.2 to 4.5 metre high longwall panel faces will range from 0.12 metres to 0.15 metres above pillars;
- mean (to upper 95% confidence limit) tilts are estimated to range from 48 mm/m to 97 mm/m;
- the maximum tensile strains are predicted to range from 11 mm/m to 50 mm/m; and
- the maximum compressive strains are predicted to range from 13 mm/m to 61 mm/m.

Specific subsidence parameters including tilt and strain have been prepared for all surface features, both natural and built within the Project Area, with the findings detailed in the following sections.

6.2.4 Subsidence Impacts, Management Strategies and Monitoring

Subsidence impact assessment involves using subsidence predictions to forecast the level of impact on natural and man-made surface features within the subsidence affectation area. A review of all natural features, archaeological sites and items of surface infrastructure potentially impacted by subsidence has been completed with detailed subsidence predictions and impact assessment provided for each aspect (refer to **Appendix 3**).

The following sections provide a description of the predicted subsidence impacts as expressed on the surface of the ground and the physical impact of such on the natural features, archaeological sites and surface infrastructure.

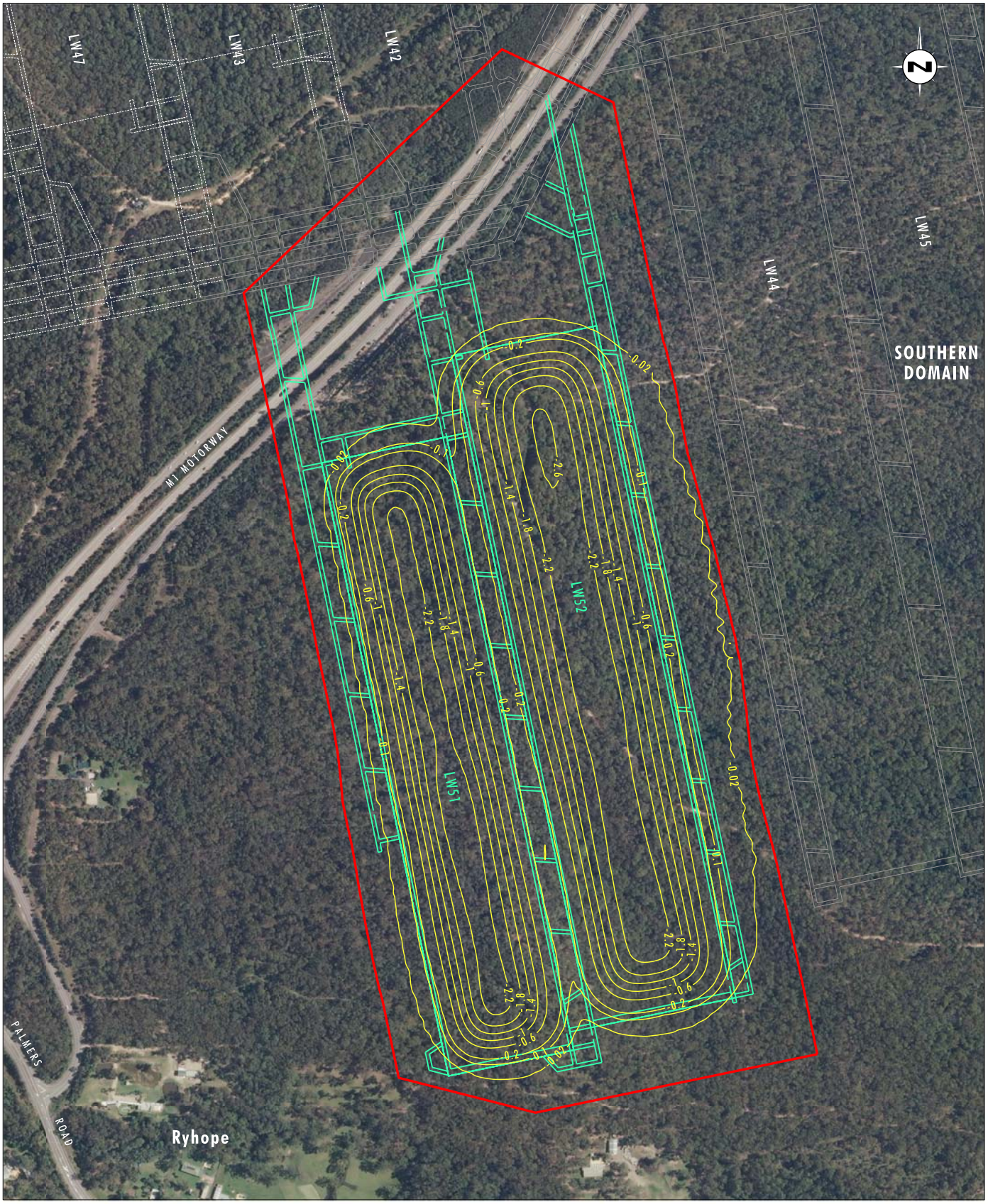


Image Source: OCAL (2008)
Data Source: OCAL (2013), LPI (2009)

0 100 200 400m
1:7 500

Legend

- Project Area
- Approved Underground Workings
- Proposed Longwall Panels 51 and 52
- Subsidence Affectation Zone (LW51 & LW52)

FIGURE 6.4

Predicted Subsidence within the Project Area

6.2.4.1 Surface Cracking

Potential Impacts

The development of surface cracking above a longwall panel is caused by the bending of the overburden strata as it sags down into the newly created void in the coal seam. The sagging strata is supported by collapsed roof material (goaf) that slowly compresses to final maximum subsidence. The characteristics of the overburden, and vertical stress acting on the goaf, will influence the final maximum subsidence magnitude.

Based on the predicted range of maximum transverse tensile strains from 11 to 50 mm/m, maximum surface cracking widths of between 110 millimetres and 250 millimetres may potentially occur within the limits of mining and in areas with moderately undulating terrain (i.e. slopes < 18°). Cracks of up to approximately 830 millimetres may occur on ride crests due to rigid body rotations of steep slopes. Similar size 'scarps' or VBM's could also develop as a result of subsiding a steep slope by the same order of magnitude.

Tensile cracks up to 20 or 30 metres behind the advancing longwall face may also potentially occur. The majority of these cracks will generally close in the central compressive strain areas of the longwall panel after the subsidence trough has fully developed.

Surface cracking has the potential to impact upon a range of surface features, both natural and built. The main infrastructure items which are expected to be impacted by surface cracking are surface access tracks and fire trails. Surface cracking on these tracks and trails will generally close after the subsidence trough has fully developed. During mining, daily inspections of all surface access tracks and fire trails will be undertaken to identify potential surface cracking that may pose a public safety risk (refer to **Section 6.2.4**). The proposed subsidence remediation strategies to address potential surface cracking impacts are discussed further in **Section 6.2.4**.

The potential for direct hydraulic connection to the surface, due to sub-surface fracturing, is considered possible between 80 metres and 100 metres depth of cover. However direct connection to the surface is unlikely to occur where cover depths are greater than 100 metres. As shown on **Figure 6.3**, the low depth of cover areas (80-100 metres) are located on the western edge of LW 51. It is assessed from the predicted heights of continuous fracturing above the longwalls extracted as part of the Project, that this fracturing is 'unlikely' to develop to the surface cracking zone and result in surface to seam connectivity. To manage the potential for connectivity, it is proposed that the mining height will be reduced in the LW 51 80 metre to 90 metre depth of cover zone.

6.2.4.2 Sub-Surface Cracking

The caving and subsidence development processes above a longwall panel typically result in sub-surface fracturing and shearing of sedimentary strata in the overburden (refer to **Figure 6.1**). The extent of fracturing and shearing is dependent on mining geometry and overburden geology.

The prediction model utilised to estimate heights of continuous fracturing above the proposed longwalls has been recently developed by DGS after a comprehensive review of published height of fracturing data in the NSW and Queensland Coalfields. The DGS model has been used in this study to predict the heights of sub-surface fracturing within the Project Area.

A detailed review of sub-surface fracturing heights is included in **Appendix 3** DGS Report and generally indicates that sub-surface fracturing could develop to within 10 metres from the surface, and is the depth where interaction with surface cracking may start to occur. As discussed in **Section 6.2.4.1**, extraction heights will be managed to reduce the potential for connective cracking.

6.2.4.3 Steep Slopes

The Project Area includes approximately 8.3 hectares of steep slopes, with gradients ranging from 18° to 35° and with shallow residual soil. The height of the slopes ranges from approximately 30 metres to 40 metres above the valleys.

The steep slopes above LW 51 and LW 52 are predicted to be tilted and cracked by subsidence of approximately 2.4 metres to 2.6 metres respectively. The slopes above LW 51 are predicted to be increased towards the west by an average of 70 millimetres/metre, a change of approximately 4°. The slopes above LW 52 are predicted to be tilted towards the east by 70 millimetres/metre, a change of approximately 4°. En-masse slip of hills or ridges on weakened bedded partings in thinly bedded siltstones/shale due to the predicted tilts is considered unlikely provided cracking on steep slopes are repaired with crushed rock or environmentally approved cementatious grout. Local instability and erosion could occur on the steep slopes due to mine subsidence deformation.

It is noted that there have been several VBM events on the steep slopes above LW 40 and LW 41 due to geological structure interactions. The VBM's have ranged in size from 0.5 metres to four metres (DGS 2012). The subsidence assessment outlines that it is considered that this type of impact requires the presence of persistent, sub-parallel geological structure with opposing hades beneath an unconfined ridge crest or spur. The zone between the structure will also probably be highly weathered and disturbed and therefore weaker than the surrounding rock mass. Underground and surface mapping work undertaken to date has not detected any significant structure of concern in the Project Area, however if present, differential subsidence is unlikely to generate VBM's greater 1 metre deep based on the features observed on similar terrain to the north.

There is also a very low likelihood that rock fall rollout will occur from steep slope rock outcrops less than 1.5 metres high. It is considered that rock roll out is most likely to occur from steep slopes above the starting end of LW 51 and could impact the access tracks below. Management measures to be implemented to manage risk related to rock roll out are detailed in **Section 6.2.5**.

6.2.4.4 Valley Closure and Uplift

Closure and uplift movements can potentially occur where longwalls are mined beneath valley crests and also along broader drainage gullies and human-made cuttings. There are three valleys and one human-made cutting associated with the M1 Motorway that may be affected by closure and uplift movements due to subsidence from the Project. There are also valleys are located adjacent to LW 52, with Aboriginal archaeological features located within the valleys.

Previous monitoring of closure and uplift, within the previously mined areas at WWC have demonstrated that closure and uplift impacts have not been significant. Measured movements have been similar to those related to survey accuracy and natural ground movement (i.e. +/- 20mm). The predicted closure and compressive results indicate that cracking is unlikely in valleys associated minor drainage lines near the M1 Motorway, however, may occur in a minor drainage line valley to the east of the extraction area. It is considered 'very unlikely' that the M1 Motorway or its infrastructure will be impacted by valley closure or upsidence.

The subsidence assessment also indicates that the development of upsidence cracking has the potential to also cause localised deviation of surface flows in rocky, ephemeral creek beds. Should this occur, surface flows would be expected to re-surface downstream of the impacted area. This cracking, due to the highly mobile nature of bedload sediments within the drainage lines would be expected to seal from the natural inflow and movement of sediment. It is noted that drainage lines above the Project Area are limited to ephemeral drainage lines.

6.2.4.5 Ponding

Ponding refers to the potential for depressions to develop or for the increase in depth of existing depressions, at the surface above longwall panels. These depressions lead to ponding of surface water and can affect drainage patterns and subsequently ecological values.

As discussed in **Section 6.5.1.3**, the soil characteristics indicate that the creek lines within the Project Area are potentially susceptible to erosion with the potential for erosion being increased where vegetation cover is absent. However, the predicted subsidence associated with the Project is not expected to result in significant changes to remnant ponding, flow volumes or flow characteristics within Palmers Creek. The potential risk of watercourse scouring within the two affected watercourses as a result of the predicted subsidence is considered to be minimal, meaning that increases in the sediment load within Palmers Creek are unlikely. As a result, impacts to the existing water quality within the Palmers Creek catchment are expected to be negligible. Further discussion of surface water impacts is provided in **Section 6.5**.

6.2.4.6 Aboriginal Archaeological Sites

Impact Potential Criteria

Subsidence predictions have been developed for the Aboriginal archaeological sites identified within the Project Area. These predictions are provided in **Appendix 3**. Each site has been ranked in accordance with its potential for both cracking and potential erosion damage, from very low to high potential for impact.

A brief overview of the potential impacts is discussed below. For a full review of the Aboriginal archaeological sites, their significance, the potential subsidence impacts and the potential management strategies, refer to **Section 6.4**.

The mine plan has been designed in consultation with Aboriginal stakeholders, with the aim of minimising the potential for impact to Aboriginal archaeological sites, in particular the two grinding groove sites located to the east of LW 51 and LW 52.

Potential Subsidence Impacts to Grinding Groove Sites

There are two axe grinding groove sites located within the Project Area (refer to **Section 6.4**). As the mine plan has been designed to minimise the potential for impacts to the grinding groove sites, the cracking impact potential for the grinding groove sites is considered very low. The potential for erosion damage to the grinding grooves is also considered very low.

Potential Impacts to Isolated Finds and Scarred Trees

One isolated find was identified during the Aboriginal archaeological survey. One scarred tree was also identified as part of the survey. Details of the significance of these sites are provided in **Section 6.4**.

Based on the predictions it is concluded that the probability of cracking impacts to artefact scatters and isolated find is 'very low'. The probability of cracking impacts to the scarred tree is 'very low' to 'low'. The main potential for impact to these sites is related to conducting subsidence remediation works. The management of these sites is further discussed in **Section 6.4**.

6.2.4.7 Wakefield Road

Wakefield Road is a sealed road, owned and maintained by LMCC that is located to the north of the proposed mining area. Wakefield Road is located outside of the subsidence affection (i.e. outside of the 20 millimetre subsidence contour) and is therefore unlikely to be adversely impacted by vertical subsidence. A far-field subsidence impact assessment has been completed, findings that cracking is unlikely to occur.

As with previously undermined sections of Wakefield Road, it is proposed to develop a management plan with the relevant stakeholders which provides for a safe, serviceable and repairable public asset. This process has been implemented successfully for previous underground mining beneath Wakefield Road and for this Project, as cracking is unlikely to occur, the management requirements are more straightforward than these previous undermining events. The proposed management of subsidence impacts on Wakefield Road is further discussed in **Section 6.2.5**.

6.2.4.8 Ephemeral Creeks, Tributaries and Alluvium

The drainage system within the Project Area is located within the Palmers Creek catchment and is ephemeral in nature, flowing only during rainfall events. Further information regarding the drainage system is detailed within **Section 6.5**.

As discussed in **Section 6.2.1.1**, the soil characteristics indicate that the creek lines within the Project Area are potentially subject to erosion with the potential for erosion being increased where vegetation cover is absent. However, the predicted subsidence associated with the Project is not expected to result in significant changes to remnant ponding, flow volumes or flow characteristics within these tributaries. The potential risk of watercourse scouring within the two affected watercourses as a result of the predicted subsidence is considered to be minimal, meaning that increases in the sediment load within Palmers Creek are unlikely. As a result, impacts to the existing water quality within the Palmers Creek catchment are expected to be negligible.

The proposed management of subsidence impacts on the drainage systems will be developed based on the existing management strategies which have been successfully employed by WWC for managing similar impacts in previously mined areas. The proposed management strategies for the creek systems within the continued underground mining areas are discussed in **Section 5.2.4**.

6.2.4.9 Far-Field Horizontal Displacements

Horizontal movements due to longwall mining have been recorded at distances well outside of the angle of draw in the Newcastle, Southern and Western Coalfields (Reid, 1998, Seedsman and Watson 2001). Horizontal movements recorded beyond the angle of draw are referred to as far-field horizontal displacements (FFDs). FFDs generally only have the potential to damage long, linear features such as pipelines, bridges and dam walls.

The shortest distances from the M1 Motorway pavements (north and south bound lanes) to the proposed longwall panel finishing ends range from 44° to 87°, which indicates that the motorway is 'likely' to be located outside the angle of draw limits to measurable vertical subsidence. The worst-case impact to the motorway pavements after mining is assessed to be 'negligible'.

Predictions of far-field effects have been completed for two buildings to the south of LW51, the Telstra communications tower and services easement to the north-west of LW51. It is assessed that the predicted far-field effects are unlikely to cause impact to the structures assessed.

6.2.4.10 M1 Motorway

The M1 Motorway along with the associated services easement, is a significant built surface feature adjacent to the proposed mining area. The Project has been designed to minimise impacts to the M1 Motorway. A significant barrier of coal has also been retained between the M1 Motorway and the Project.

The potential for far field movements has been considered in the subsidence assessment and is expected to be 'negligible'. Due to the sensitivity of the M1 Motorway a proposed specific subsidence monitoring program is discussed in **Section 5.2.4**.

6.2.5 Subsidence Management Strategies and Proposed Subsidence Monitoring Program

6.2.5.1 Proposed Subsidence Management Strategies

WWC has a well established subsidence management program in place for the mining operations which has been refined over the many years of operation at the site. As part of OCAL's response to recent events at WWC OCAL has worked with relevant government agencies and other stakeholders to further improve its approach to subsidence management. This includes updating the Public Safety Management Plan and provision of an updated subsidence remediation procedure. OCAL is also currently preparing a revised grouting procedure that will provide for improved management of how grout is used in subsidence remediation works. These improvements in subsidence management will be applied to the Project.

Table 6.3 provides an outline of the subsidence management strategies relating to the natural and built features within the Project Area that will be implemented as part of the Project.

In the majority of cases the proposed subsidence management strategies are based on the existing subsidence management strategies that are currently employed by WWC (including the recent upgrades discussed above) in consultation with the relevant stakeholders.

Table 6.3 – Summary of Proposed Subsidence Management Measures

Surface Feature	Proposed Subsidence Management
Surface Cracking	• Surface crack remediation works will primarily be undertaken in accessible areas where required, mainly where surface cracking occurs across access roads and tracks, associated with steep slopes, and potentially in ephemeral watercourses. Surface cracks will be identified during subsidence monitoring inspections, with appropriate remediation strategies developed for each situation; • All surface crack remediation will be undertaken in consultation with the relevant stakeholders and may involve either the ripping/tilling of small to moderate sized cracks or pouring crushed rock, gravel, concrete or grout into larger sized cracks. Remediation strategies will be implemented in accordance with the existing WWC Surface Crack Remediation Procedure and in the SCA in accordance with approvals granted by OEH; and • Management strategies to address subsidence crack impacts in creeks and watercourses include undertaking pre-mining and post-mining inspections. This includes daily inspections of surface access tracks when mining is being undertaken. The results of these inspections are then communicated to the respective stakeholders. Should a significant crack be identified during these inspections, an appropriate remediation strategy is developed. Specific monitoring requirements are outlined in **Section 6.2.5.2**.
Sub-surface cracking	The practical options available for controlling sub-surface fracturing are limited to the following (in order of increasing impact to proposed mining layouts): • address large surface cracks as soon as possible if they occur along the creeks, assess the potential for grouting or other remediation technique; and • decrease the longwall mining height to reduce the potential for continuous sub-surface fracture heights.
Creeks and Watercourses	WWC will continue to implement the existing strategies which are used to address subsidence crack impacts in creeks and watercourses, including: • undertaking pre-mining and post-mining inspections to assess potential subsidence impacts; • communicating inspection results to the respective stakeholders; • any impacts identified during inspections will result in the development of a remediation strategy, in consultation with the relevant stakeholders; and • remediation strategies may include remediating large surface cracks, as soon as possible, if they occur along the creeks and assessing the potential for grouting. Within the Project Area, due to the nature of the drainage lines, any remediation works would be managed in-stream.
Slope Stability	To reduce the potential for adverse impacts from slope instability and increased erosion due to cracking, the proposed subsidence management strategy will include: • surface slope monitoring (combined with general subsidence monitoring along cross lines and centre lines); • infilling of surface cracking, where possible, to prevent ingress of run-off into the slopes; and • on-going review and appraisal of any significant changes to surface slopes such as cracking along ridges, increased erosion down slopes, foot slope seepages and drainage path adjustments observed after each longwall is extracted.

Table 6.3 – Summary of Proposed Subsidence Management Measures (cont.)

Surface Feature	Proposed Subsidence Management
Valley Closure – 'uplift'	• Install and monitor survey lines along ephemeral drainage gullies and along gully crests during and after longwall undermining; • Review predictions of upsidence and valley crest movements after each longwall; and • Assess whether repairs to cracking, as a result of upsidence or gully slope stabilisation works are required to minimise the likelihood of long-term degradation to the environment or risk to personnel.
Ponding	• A Surface and Groundwater Response Plan has been developed for WWC. The plan is a component of the WWC Water Management Plan which has been developed based on consultation with OEH and NOW. The plan has been developed to assess potential ponding impacts on existing vegetation for the approved WWC mining operations (refer to **Section 5.3**). This plan will be implemented for the Project; and • The on-going review and appraisal of changes to surface drainage paths and surface vegetation in areas of ponding development (if they occur), after each longwall is extracted.
Aboriginal Cultural Heritage sites	• Monitoring of Aboriginal Cultural Heritage sites is undertaken at WWC in accordance with the WWC ACHMP. The monitoring program includes the completion of baseline recording to record Aboriginal sites prior to mining being undertaken, with subsequent inspections undertaken post mining, at nominated intervals, to confirm whether impacts to the sites have been observed. The ACHMP has been developed in consultation with Aboriginal stakeholders, OEH and DP&I. The plan includes protocols for the management of Aboriginal sites; and • Development of appropriate monitoring and remediation strategies in accordance with the recommendations outlined in **Section 6.4**.
Gencom Communication Towers and proposed power-line	• The development of a suitable monitoring and response plan based on consultation with Gencom, to ensure that any impacts on the towers and powerlines do not result in unsafe conditions or loss of serviceability during and after mining.
Wakefield Road	• The development of a suitable monitoring and response plan, based on the previous subsidence management plan developed in consultation with LMCC, to ensure the management of any impacts on the road does not result in unsafe conditions during and after the effects of mining; and • The stability of the embankment will also be monitored along the crests and toes, with any cracks repaired as soon as possible to prevent excessive moisture ingress into the embankment.
M1 Motorway, Services Easement	• The development of suitable specific monitoring and response plans with the respective stakeholders; • Conduct periodic subsidence monitoring of the M1 Motorway and the services easement, including the following: ▪ Pre-mining surveys and condition assessments of the M1 Motorway pavement edges, drainage structures, cuttings; and ▪ Post mining surveys and condition assessments of the M1 Motorway pavement edges, drainage structures, cuttings; • Conduct a review of monitoring data after the completion of each longwall panel; and • Conduct a pre and post mining risk assessment on the M1 Motorway fill embankments.
Fences	• The development of a suitable monitoring and response plan, based on consultation with owners and regulatory authorities.

6.2.5.2 Proposed Subsidence Survey Monitoring Program

To monitor and assess the potential subsidence impacts on the identified surface, natural and built features, the existing WWC Subsidence Monitoring Program will be updated and implemented for the Project. The details of the monitoring program are included in the SMP/Extraction Plans prepared by OCAL and approved by relevant government agencies prior to mining in each area. The monitoring program will involve the following:

- the installation of subsidence survey points to monitor potential subsidence impacts on the identified surface features;
- conducting visual inspections within the Project Area to assess potential subsidence impacts and to identify any potential remediation that may be required;
- installation of monitoring for potential sub-surface impacts on groundwater; and
- post mining aerial photography interpretation.

The results of the monitoring program will be communicated to the respective stakeholders in accordance with the SMP/Extraction Plan and used to refine the ongoing management of subsidence as the Project progresses.

6.2.5.3 Subsidence Management Plan

WWC currently has an approved SMP/Extraction Plan for the mining of Longwalls 44 and 45. A comprehensive SMP/Extraction Plan will be developed for the Project to provide detailed guidance for subsidence management, as required by Project Approval conditions. This plan will be developed based on the existing SMP/Extraction Plan and will refine subsidence management strategies including mitigation, monitoring and remediation techniques utilised by WWC.

The SMP/Extraction Plan will also include revised stakeholder Subsidence Management Plans that have been established with each of the identified stakeholders within the Project Area. These plans specify subsidence predictions and specific management measures for natural and built surface features.

6.3 Ecology

A comprehensive ecological survey and assessment was undertaken for the Project by Umwelt, generally in accordance with relevant OEH survey and assessment guidelines (DEC 2004). The Ecological Assessment was prepared to assess the potential impact of the Project on native flora and fauna species, threatened and migratory species, Endangered Populations (EPs), Threatened Ecological Communities (TECs) and their habitats occurring in the Project Area and on adjoining lands. The objectives of the Ecological Assessment were to:

- identify the existing knowledge of the flora and fauna species and vegetation communities recorded within the Project Area from previous studies in the Project Area, local studies and/or ecological databases;
- undertake targeted surveys to further identify any threatened flora or fauna species, migratory fauna species, EPs, TECs, or their habitats within the Project Area, particularly those listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act), NSW *Fisheries Management Act 1994*, and the Commonwealth EPBC Act;

- assess the potential impact of the Project on any threatened flora and fauna species, migratory fauna species, EPs, TECs, or their habitats recorded (or with potential to occur) in the Project Area;
- assess the potential impact of the Project on any threatened flora and fauna species, migratory fauna species, EPs, TECs, or their habitats recorded (or with potential to occur) on lands adjoining the Project Area or with potential to be affected by the Project; and
- develop appropriate impact mitigation and management options to minimise ecological impacts associated with the Project.

The Ecological Assessment is included in **Appendix 5**, with a summary of the key findings outlined below.

6.3.1 Survey Methodology

Prior to commencement of field surveys a review of all relevant and available literature was undertaken in order to gain an understanding of the ecological values of the Project Area.
A search of the OEH Atlas of NSW Wildlife database and the Commonwealth Department of the Environment Protected Matters database was undertaken to identify threatened species, EPs and TECs whose range falls within the Project Area, and/or have been previously recorded within a 10 kilometre radius. The data obtained from these two database searches was used to compile a list of threatened species, EPs and TECs with potential to occur within the Project Area and informed the development of the survey methodology.

Previous ecological survey work has been undertaken that included part of the Project Area, including previous vegetation community mapping of the SSCA. Detailed ecological surveys were also undertaken within the WWCCOP study area which included a portion of the current Project Area (Umwelt 2010). This existing information provided a good understanding of the ecological values of the Project Area which was supplemented with further targeted ecological survey in the Project Area.

Table 6.4 provides a summary of the total 2013 ecological sampling effort across the Project Area as described in the survey methodology section of the Ecological Assessment provided in **Appendix 5**.

Table 6.4 – Summary of the Total 2013 Survey Effort in the Project Area

Vegetation Survey	**Survey Method and Effort**
Vegetation Quadrats	6 vegetation quadrats
Vegetation Transects	2 flora transects and 750 metres of targeted threatened flora species transects.
Fauna Survey	
Hair funnels	840 hair funnel nights
Bird surveys	9 surveys, each one person hour in duration 9 person hours in total
Diurnal reptile and amphibian surveys	9 Surveys, each 0.5 person hours in duration 4.5 person hours in total
Walking spotlight surveys	4 walking spotlight surveys, each one person hour in duration 4 person hours in total
Driving spotlight surveys	5 km of driving spotlighting with two observers
Nocturnal call playback	4 nocturnal call playback sessions
Habitat assessments (including SEPP 44)	9 habitat assessment surveys undertaken across the Project Area
Anabat echolocation recording	8 nights of continuous recording at 4 different locations

6.3.2 Survey Results

6.3.2.1 Flora Species

During the 2013 flora survey for the Project, a total of 112 species were recorded within the Project Area from 50 families. Myrtaceae (myrtaceous plants) was the most speciose plant family (14 species), followed by Fabaceae (Faboideae) (pea plants) (11 species recorded), and Poaceae (grasses) with nine species recorded. Of the 112 species recorded, 107 (96%) were native and five (4%) were introduced. A full list of the flora species recorded during the survey effort is presented in the Ecological Assessment (refer to **Appendix 5**).

6.3.2.2 Vegetation Communities

Five vegetation communities have been identified within the Project Area. The vegetation communities are:

- Freemans Peppermint – Apple – Bloodwood Forest;
- Sugarloaf Uplands Smooth-barked Apple Forest;
- Riparian Paperbark – Peppermint Forest;
- Coastal Wet Gully Forest; and
- Cleared Land.

The distribution of vegetation communities within the Project Area is shown on **Figure 6.5**. Detailed descriptions of these vegetation communities are provided in **Appendix 5**.

6.3.2.3 Threatened Flora Species and Endangered Populations

Two threatened flora species were recorded in the Project Area, being black-eyed Susan (*Tetratheca juncea*) and small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*). Both of these species are listed as vulnerable under the TSC Act and the EPBC Act. The locations of records of these species are shown in **Figure 6.6**. Black-eyed Susan is a common understorey species in the Project Area and the locations shown on **Figure 6.6** provide an indication of the general distribution of this species. Small-flower grevillea was recorded in five locations.

No threatened flora populations were recorded within the Project Area and none are expected to occur.

6.3.2.4 Threatened Ecological Communities

No TECs listed under the TSC Act or EPBC Act were recorded in the Project Area.

6.3.2.5 Fauna Species

A total of 59 vertebrate fauna species were recorded within the Project Area, comprising 34 bird species, 18 mammal species, four reptile species and three amphibian species. A full list of the fauna species recorded is provided in the Ecological Assessment (refer to **Appendix 5**).

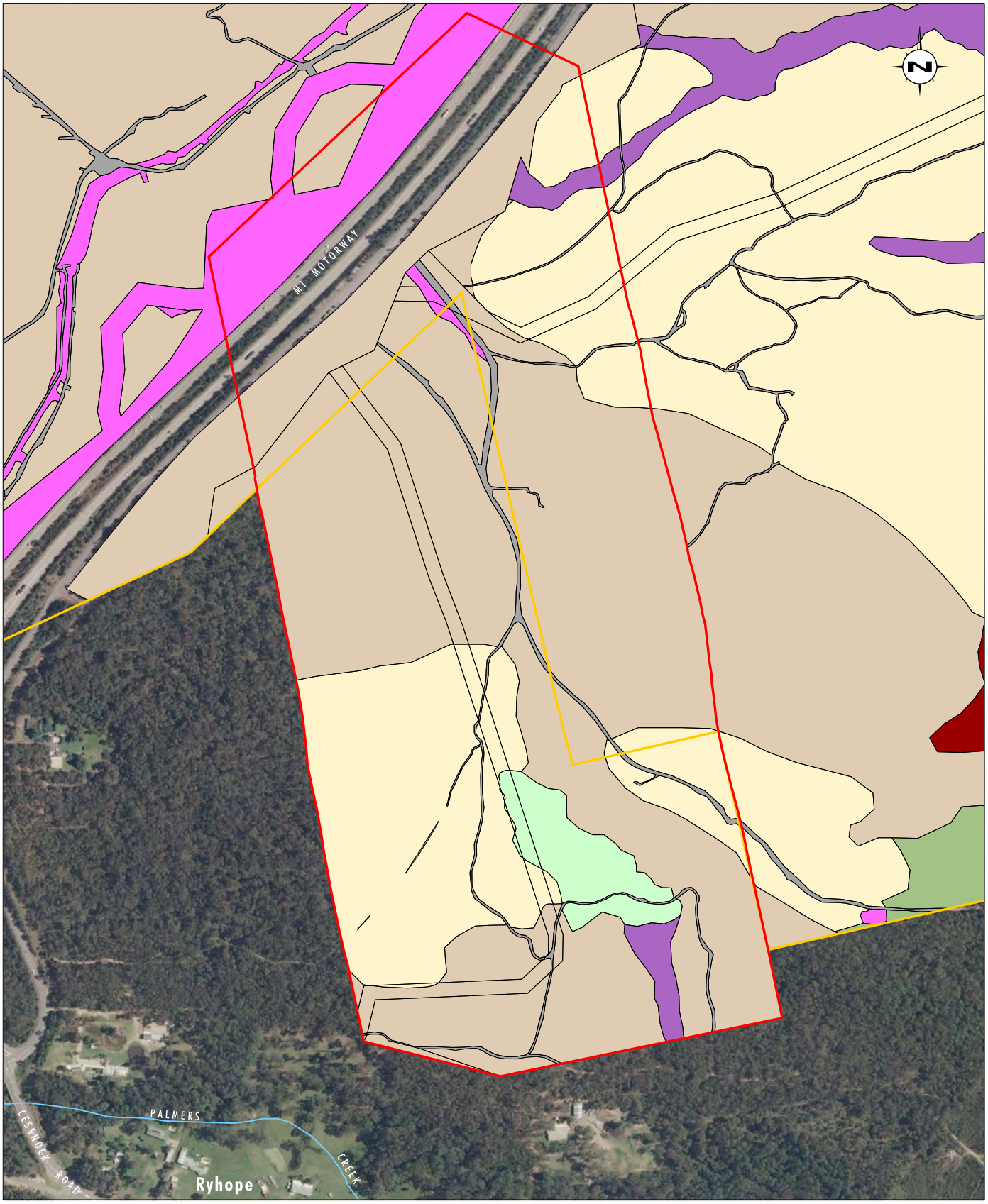


Image Source: OCAL (2008)
Data Source: OCAL (2013), Bell & Driscoll (2009), Umwelt (2013)

0 100 200 400m
1:7 500

Legend

- Project Area
- Approved Continued Underground Mining Area
- Cleared Land
- Disturbed - Regrowth
- Coastal Wet Gully Forest
- Coastal Foothills Spotted Gum-Ironbark Forest
- Freemans Peppermint-Apple-Bloodwood Forest
- Riparian Paperbark-Peppermint Forest
- Sugarloaf Uplands Smooth-barked Apple Forest
- Sugarloaf Uplands Dry Spotted Gum-Ironbark Forest

FIGURE 6.5

Vegetation Communities

File Name (A4): R01/3149_043.dgn
20130916 15.34

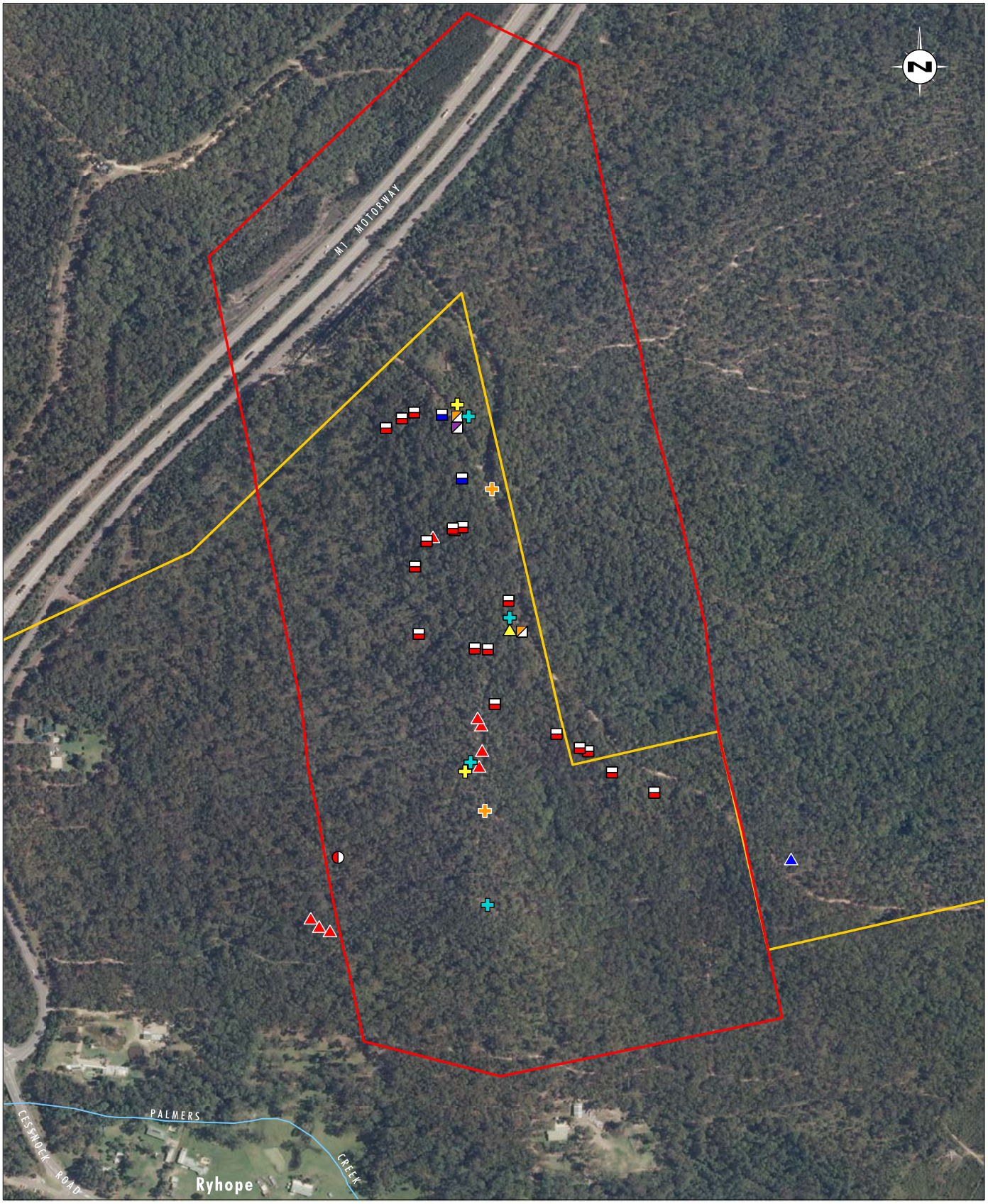


Image Source: OCAL (2008)
Data Source: OCAL (2013), Atlas (2013), Umwelt (2013)

0 100 200 400m
1:7 500

Legend

- Project Area
- Approved Continued Underground Mining Area

Atlas Site Data:

- *Grevillea parviflora* subsp. *parviflora*
- *Tetratheca juncea*

Umwelt Site Data:

- Little Lorikeet
- Eastern Bentwing-bat
- Eastern Freetail-bat
- Greater Broad-nosed Bat
- Grey-headed Flying-fox
- Large-eared Pied Bat
- Little Bentwing-bat
- *Grevillea parviflora* subsp. *parviflora*
- *Tetratheca juncea*

FIGURE 6.6

Threatened Species Locations

File Name (A4): R01/3149_044.dgn
20130916 15.29

6.3.2.6 Threatened Fauna Species and Endangered Populations

A total of seven threatened fauna species were recorded in the Project Area during the surveys conducted for the Project. The recorded threatened species included six species of mammal (including five species of micro-bat and one species of mega-bat) and one bird species. No threatened reptile or amphibian species were identified during surveys. The threatened fauna species listed under the TSC Act that were identified within the Project Area include:

- little lorikeet (*Glossopsitta pusilla*);
- grey-headed flying-fox (*Pteropus poliocephalus*);
- eastern freetail bat (*Mormopterus norfolkensis*);
- little bentwing-bat (*Miniopterus australis*);
- eastern bentwing-bat (*Miniopterus schreibersii oceanensis*);
- large-eared pied bat (*Chalinolobus dwyeri*); and
- greater broad-nosed bat (*Scoteanax rueppellii*).

Two of the TSC Act listed mammal species recorded during surveys are also listed under the EPBC Act; with the grey-headed flying-fox (*Pteropus poliocephalus*) and the large-eared pied bat (*Chalinolobus dwyeri*) both listed as vulnerable.

No endangered fauna populations were recorded within the Project Area, and none are expected to occur.

6.3.2.7 Groundwater Dependent Ecosystems

No vegetation community in the Project Area is considered likely to be dependent on groundwater resources (Aurecon 2013).

6.3.3 Ecological Impact Assessment

The proposed underground mining operations will result in subsidence above the extracted longwall panels. Subsidence of the ground surface itself does not typically adversely impact ecological values, however, it can lead to surface impacts such as cracking, impacts to rock outcrops and tree falls that may impact ecological values. The subsidence impacts associated with this Project are predicted to include potential tree falls on steep slopes in high tilt areas adjacent to the outer extent of the longwall panels, with the most likely impacts predicted to occur on the western edge of Longwall 51.

Surface cracking is likely to occur where tensile stresses develop, on the edges of longwall panels and along tops of topographic high points. Cracking may also occur at regular intervals along the centre of the panels and be interspersed with compression humps. Based on the subsidence predictions maximum surface cracking typical widths of between 110 millimetres and 250 millimetres are likely to occur within the limits of mining and in areas with moderately undulating terrain (i.e. slopes < 18°). Cracks of up to approximately 830 millimetres may occur near ridge crests due to rigid body rotations of steep slopes. 'Scarps' or VBM's could also develop as a result of subsiding steep slopes by the same order of magnitude.

This subsidence cracking will impact on ecological values at the immediate location of the crack due to its disturbance of the ground, however, the adjoining vegetation is typically not significantly affected except where significant cracking of tree roots occurs, affecting tree health and stability. This means that the area of vegetation directly affected by subsidence cracking above a longwall panel is generally small. For example, a detailed assessment of subsidence cracking above LW 41 where greater than predicted subsidence cracking was observed, using conservative cracking impact area estimates, calculated the total area impacted by cracking as approximately 0.84 hectares or 0.9 per cent of the land surface above LW 41.

The Project also has the potential to result in the creation of unstable landscapes on steep slopes (>35 degrees) within the Project Area due to water ingress/erosion. Additionally, fire trails, steep slope areas and potentially other sections of the land surface above the longwall extraction area are also likely to be impacted by cracking and some areas of cracking will require remedial works. As a result, subsidence remediation works with tracked equipment is likely to be required in some areas, primarily along tracks and in steep slope areas, including up-slope runoff deviation and grout repairs. This may involve filling subsidence cracks with grout and potentially using small tracked equipment to compact subsidence cracks.

Based on the subsidence predictions OCAL has advised it does not envisage that large scale remediation works will be required to be undertaken within the Project Area, with the subsidence remediation works to be managed by OCAL to minimise impacts on existing vegetation where possible. Where impacts are required to undertake remediation work, ecological due diligence inspections will be undertaken to inform the required management measures to be implemented to minimise ecological impacts. Subsidence impacts to vegetation are expected to be limited to the direct cracking impacts, some potential tree fall in steep slope areas and circumstances where machinery is required to repair subsidence cracking, with grouting the preferred method for subsidence crack remediation.

Based on the results of the subsidence assessment, subsidence cracking is expected to result in a relatively low level of impact on vegetation communities and fauna habitats as it is envisaged that large scale remediation works will not be required. Subsidence remediation works are likely to be localised within the Project Area and result in relatively small areas of vegetation impact. Tree falls are predicted on steep slope areas and potentially associated with larger cracks, however, not all trees in these areas will be affected with most trees unaffected.

No surface water ponding is anticipated to occur within the Project Area as a result of subsidence and therefore no impact on vegetation and fauna habitats is expected to occur as a result of surface water ponding impacts. The surface water assessment (refer to **Section 6.5**) has found that the risk of significant watercourse scouring or instability as a result of subsidence is low and therefore the risk of impact to ecological values as a result of subsidence watercourse impacts is low.

The Ecological Assessment (refer to **Appendix 5**) concluded that some impacts to ecological values will occur, however, the majority of vegetation and fauna habitat in the Project Area will remain largely undisturbed. The assessment also found that the predicted impacts are not expected to result in a significant loss of floristic diversity or community composition, or fauna habitat within the Project Area, the SSCA or the region.

6.3.3.1 Impact of the Project on Threatened Species, EPs and TECs

An assessment of the significance of the impact of the Project on threatened species was undertaken using an initial screening process to identify threatened species that have been recorded in the Project Area or may be potentially impacted by the Project. An assessment of significance was then conducted for these potentially impacted species under both state and Commonwealth legislation (refer to **Appendix 5**).

The assessments found that the Project is unlikely to result in a significant impact on threatened flora and fauna habitat as a result of the predicted subsidence. Some impact will occur due to cracking and tree fall and surface remediation works are expected to be required to repair potential subsidence impacts and will also result in impacts to ecological values. The Assessments of Significance under the EP&A Act and the EPBC Act conclude that the Project will not have a significant impact on threatened species, EPs or TECs known or with potential to occur in or around the Project Area (refer to **Appendix 5**).

An assessment under SEPP 44 concluded that the Project Area does not contain potential or core koala habitat as defined by the SEPP 44 Assessment methodology and further assessment under SEPP 44 was not required.

6.3.3.2 Impact of the Project on Ecological Values of the SSCA

Based on the ecological impact assessment findings discussed above, the Project is not expected to have a significant impact on the ecological values of the SSCA. Some impacts to ecological values are predicted due to subsidence and associated remediation works, however, the Project is not predicted to result in a substantial loss of vegetation communities or significant impact on the floristic composition of vegetation communities; fauna species or habitat; or threatened species, EPs and TECs or their habitat.

While subsidence of between 2.44 and 2.61 metres is predicted to occur across the SSCA within the Project Area, subsidence impacts are not expected to compromise the ecological values and integrity of the SSCA. The results of ecological monitoring in previously mined areas at WWC indicate that whilst some impacts have occurred, overall, mining has not resulted in significant impacts to ecological values. The ecological impact mitigation strategy and monitoring proposed for the Project will provide for the potential impacts of the Project on the SSCA to be monitored and managed as mining progresses.

6.3.3.3 Ecological Impact Mitigation and Management Strategies

Consistent with the strategy in place for the existing WWC operations, one of the key goals of the ecological impact mitigation strategy is to maintain or improve ecological features and functions within the Project Area, in order to mitigate the impacts associated with underground mining in the Project Area.

Prior to the commencement of mining subsidence monitoring lines are installed to allow OCAL to quantitatively assess the level of subsidence. The installation of these monitoring lines requires the trimming of shrub and ground cover vegetation within one metre of the line to a height of approximately 100 millimetres. The ecological impact of these subsidence monitoring lines is expected to be low, however, OCAL will ensure that an ecological due diligence inspection of any proposed subsidence monitoring lines is undertaken by a suitably qualified ecologist prior to the installation of the lines. This ecological due diligence inspection will allow specific ecological values that will be affected by the subsidence monitoring line to be identified and appropriate strategies to minimise ecological impacts to be developed and implemented.

Where subsidence occurs and requires remediation, OCAL will ensure that an ecological due diligence inspection of any proposed subsidence remediation areas is undertaken by a suitably qualified ecologist prior to the commencement of any remediation works that may impact on ecological values. The purpose of these inspections is to confirm that the subsidence has not caused any further impact to that predicted in the Ecological Assessment, and identify if the remediation works have the potential to significantly impact any threatened species, EP's or TEC's. Where potential impacts on threatened species, EP's or TEC's are identified, strategies to minimise impacts will be determined and implemented.

Due diligence inspections will also be undertaken at the location of any proposed boreholes so that the boreholes can be located and constructed in a manner that will not result in an adverse impact on threatened flora and fauna species or their habitat.

To reduce the potential for ecological impact resulting from the subsidence remediation works, it is recommended that remediation works be undertaken either using manual techniques or using the smallest practical machinery.

6.3.3.4 Biodiversity Monitoring Requirements

WWC has an existing program of annual biodiversity monitoring. The current program aims to establish two permanent monitoring plots above each longwall panel at least two years prior to mining. The location of the monitoring plots are selected based on the highest potential for ecological impact as a result of longwall mining; being their proximity to riparian areas, steep slopes and proximity to the end of a longwall panel. Each monitoring plot is then monitored on an annual basis during the time of mining of the corresponding longwall panel and for two years following mining (usually five years in total).

This existing monitoring program will be applied to LW 51 and LW 52, with two permanent monitoring plots to be established above the longwall extraction area and monitored annually before, during and after mining.

6.4 Aboriginal Archaeology and Cultural Heritage

An Aboriginal Cultural Heritage and Archaeological Assessment was undertaken for the Project by Umwelt in consultation with the registered Aboriginal parties. The detailed assessment report is included as **Appendix 6**, with a summary included in this section.

Consultation with the Aboriginal community is an integral part of identifying and assessing the significance of Aboriginal objects (sites) and/or places and determining and carrying out appropriate strategies to mitigate impact upon Aboriginal heritage. Registered Aboriginal party consultation for the currently approved WWC mine plan has been ongoing since 2008. Since then, WWC has worked closely with the registered Aboriginal parties to understand and manage the Aboriginal cultural values of the sites in the approved underground mining area. WWC recognises the cultural attachments that the Awabakal people and other registered Aboriginal parties have to the Aboriginal heritage sites, landscape features and the overall landscape of the WWC area and the Sugarloaf Range in general. WWC works with the registered Aboriginal parties to ensure appropriate management of cultural values is implemented through compliance with an ACHMP (Umwelt 2102a).

Initial consultation for the WWCCOP Environmental Assessment was undertaken in compliance with the DECC's[1] *Interim Community Consultation Requirements for Applicants* (ICCRs 2004). The notification process required under the ICCRs resulted in the registration of five Aboriginal parties: Awabakal Descendents Traditional Owners Aboriginal Corporation (ADTOAC), Awabakal Local Aboriginal Land Council (ALALC), Awabakal Traditional Owners Aboriginal Corporation (ATOAC), Cacatua Culture Consultants (CCC) and Koompahtoo Local Aboriginal Land Council (KLALC – please note that KLALC closed in 2010).

A recent Native Title search (24 June 2013) identified that a Native Title claim was registered (13 June 2013) on behalf of the 'Awabakal and Guringai People' (NC2013/002). The Native Title claim included an area stretching from Broken Bay in the south to Newcastle and Maitland in the north and incorporates the proposed Project Area. On 5 July 2013 consultation was undertaken with Kerrie Brauer (ATOAC), who is registered on the above-mentioned Native Title claim. The aim of the discussion was to determine if the consultation process should be extended to incorporate other persons listed on claim NC2013/002. Kerrie Brauer confirmed that consultation with herself and Shane Frost (ADTOAC - also an applicant on NC2013/002) was sufficient to ensure that the consultation process had included all relevant Native Title registrants.

Consultation for the proposed modification was undertaken as a continuation of the ongoing consultation for the WWC, with the consultation also in compliance with the ACHMP (Umwelt 2012a).

The Project was first brought to the attention of the registered Aboriginal parties in November 2012, during a regular six monthly meeting held between WWC and the registered Aboriginal parties. Site inspections were undertaken on 20 February 2013 and 17 April 2013 with registered Aboriginal parties.

The draft report was provided to each of the registered Aboriginal parties on 5 August 2013 and a workshop to discuss and incorporate Aboriginal cultural values into the assessment report was held with the registered Aboriginal parties on 15 August 2013. Each of the registered Aboriginal stakeholders provided comments on the draft Aboriginal heritage assessment and these comments are included in **Appendix 6**.

6.4.1 Survey Methodology

The draft survey strategy was prepared taking into consideration the DECCW (now OEH) *Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW* (DECCW 2010b), as well as the size of the area proposed for potential impact by subsidence. As the area in the north-eastern section of the Project Area had previously been surveyed for the WWCCOP EA, it was not required to be resurveyed and was not included in the survey (refer to **Figure 6.7**). As the impact area not previously surveyed was deemed to be small, it was decided that total survey of this area (hereafter the survey area) was feasible and would be undertaken.

The survey methodology approved by the registered Aboriginal parties included:

- dividing the survey area into four smaller areas for recording purposes;
- total pedestrian survey of previously unsurveyed landforms;
- based on the topography of the Project Area, intensive investigation of unmapped drainage depressions;

[1] Department of Environment and Climate Change (DECC) now OEH

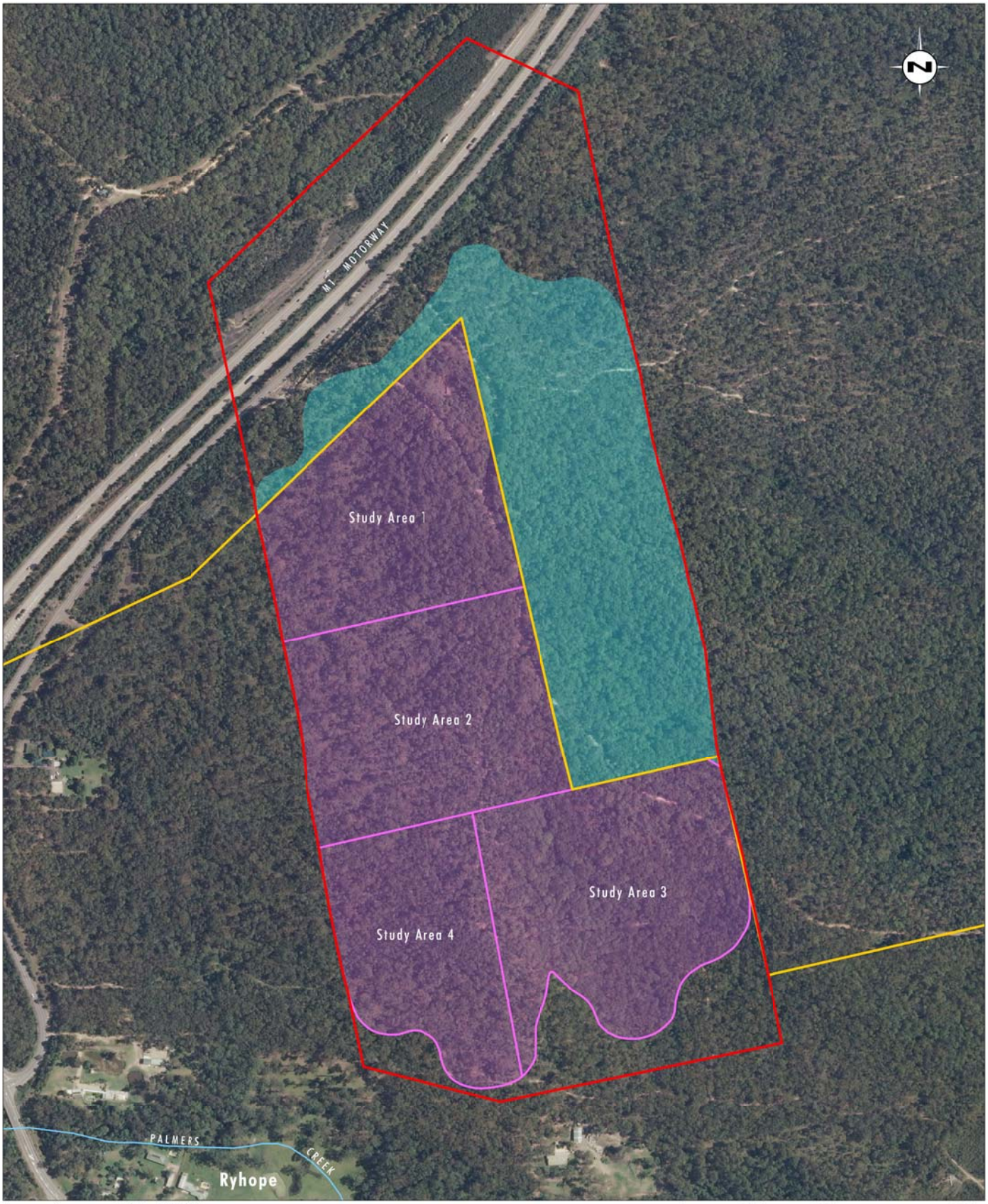


Image Source: OCAL (2008)
Data Source: OCAL (2013), LPI (2003)

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Legend

- Project Area
- Approved Continued Underground Mining Area
- Study Area
- Previously Surveyed (2009)

FIGURE 6.7

Aboriginal Cultural Heritage Study Areas

- targeting of areas of exposure; and
- consideration of the likelihood that there may be A1 and A2 soils containing artefactual material that have moved down slope from the spur crest above as the result of erosion.

6.4.2 Previous Survey and Assessment

A number of Aboriginal cultural heritage and archaeological assessments have been conducted within the WWC operational area and immediate surrounds, including assessments pertaining to previous phases of continued operations at WWC.

A search of the OEH AHIMS register was undertaken on 16 January 2013. The results of the search indicated that there are three previously registered Aboriginal archaeological sites within the Project Area, where it overlaps with the approved WWC underground mining area (**Figure 6.8**). The three sites include two sets of grinding grooves and an isolated artefact site.

The two grinding groove sites (38-4-1007 and 38-4-1279) were assessed as part of the WWCCOP and in view of their Aboriginal cultural heritage and archaeological significance the previously proposed mine plan was modified to avoid subsidence impact (Umwelt 2010b). Therefore, the existing approved WWC mine plan avoids impacting these two sites. The isolated artefact (38-4-1580) was identified and collected in 2013 under the protocols of the ACHMP (Umwelt 2012a) during inspection of an access track to check for artefacts that might be impacted by vehicles moving along the track to access areas within the Southern Domain.

An additional 40 sites are registered within two kilometres of the Project Area (refer to **Figure 6.8**), with a further 88 sites in a wider area incorporating the WWC underground mining area.

The previously identified sites within the two kilometre search area include grinding groove sites (7); grinding grooves with PAD (1), artefact scatters (13), isolated artefacts (16), scarred trees (2) and a stone arrangement. Most of the sites in the two kilometre search area are located 750 metres or greater to the north of the Project Area, within the WWC underground mining area. Ten of the sites are within the Southern Domain of the WWC underground mining area, to the east of the Project Area.

6.4.3 Survey Results

Two additional sites were recorded during the field inspections undertaken in February 2013 and April 2013. A scarred tree was identified within the Project Area and an isolated artefact was identified on the main access track within the Project Area where it overlaps with the continued underground mining area (refer to **Figure 6.8**). Site Cards for the newly identified sites are included in **Appendix 6**.

Palmers Creek ST1

Palmers Creek ST1 is a living white mahogany (*Eucalyptus acmenoides*) with an oval scar on its east side. The tree is in fair condition, with possible evidence of white ants. The tree is approximately 2.2 metres in circumference and has survived bushfire, as evidenced by burnt bark and outer layers of heartwood. The visible scar begins 40 centimetres from the ground, and is approximately 2.1 metres in height. The regrowth over the heartwood is 20 centimetres thick, leaving a maximum width of scar of 60 centimetres. The scar is in fair condition. The heartwood has been burnt, with some of the charred wood flaked off. The wood underneath seems to be solid and unaffected by insects or decay.

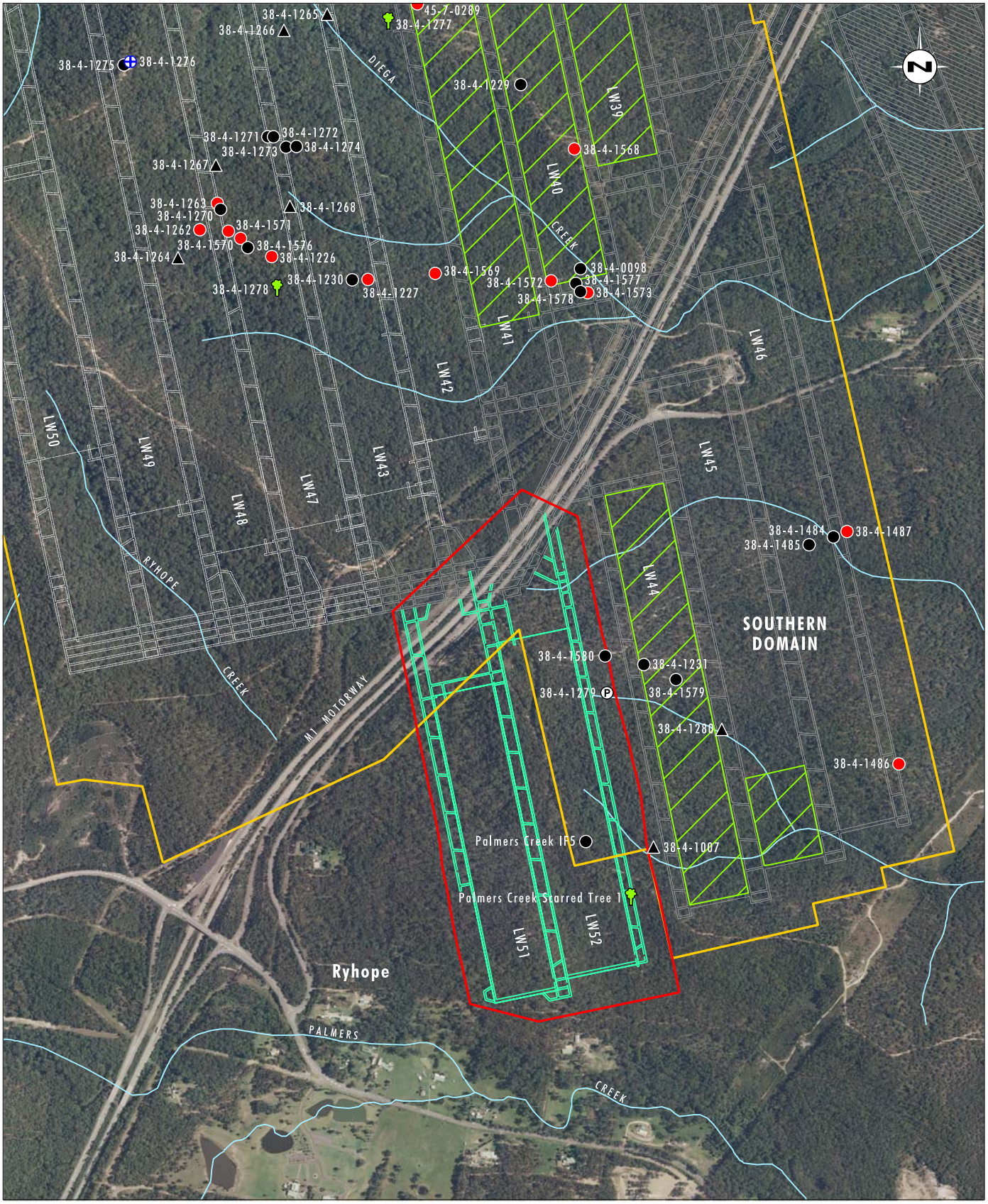

Image Source: OCAL (2008)
Data Source: OCAL (2013), LPI (2003)

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Legend

- Project Area
- Approved Continued Underground Mining Area
- Approved Underground Workings in the West Borehole Seam
- Proposed Longwall Panels 51 and 52
- Longwall Progression as of October 2013
- Former Underground Workings
- Artefact Scatter (Open Camp Site)
- Axe Grinding Groove
- Grinding groove with PAD
- Isolated Find
- Scarred Tree or Carved Tree
- Stone Arrangement
- Drainage Lines

FIGURE 6.8

Newly identified and previously registered Aboriginal Archaeological Sites

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The tree is situated on an upper slope 50 metres south of the spur crest, with the scar on the east face of the tree, towards the spur crest. The scar is not visible from the track on the spur crest, which passes through a saddle between two high points in this area.

Palmers Creek IF5

Palmers Creek IF5 consists of a silcrete broken flake on a mid slope of a spur crest in the centre of a four wheel drive track. The track is used by WWC, Ausgrid, NPWS and motor bikes. Recreation four wheel drive access is limited as there is a locked gate at the access point from Wakefield Road.

The access track has been impacted by vegetation clearance, erosion and vehicle movements.

6.4.4 Significance Assessment

The assessment of significance of Aboriginal sites has two components: Aboriginal cultural significance, which is determined by the Aboriginal stakeholders, and archaeological significance, which is determined by an archaeologist based on the ability of the site to contribute to the scientific understanding of Aboriginal use of the landscape. These two components are not always interrelated, with sites potentially having different cultural and archaeological values.

6.4.4.1 Aboriginal Cultural Significance

Throughout the consultation process for the WWCCOP, the ACHMP (Umwelt 2012) and during ongoing consultation with ADTOAC, ALALC, ATOAC and CCC in relation to the current Project Area it has been made clear by the registered Aboriginal parties that the entire Sugarloaf Range (including the Project Area) is of traditional, historic and contemporary cultural significance to the Awabakal and the Aboriginal people that live within Awabakal Lands. This significance is not limited to the archaeological sites identified.

All of the registered Aboriginal parties agree that all of the sites identified are significant, and are interconnected. They stated that two sites on their own cannot be separated from the other sites in the surrounding landscape and that the cultural landscape as a whole is what makes them significant. Both Palmers Creek ST1 and Palmers Creek IF5 have been assessed as having extremely high Aboriginal cultural value. The registered Aboriginal parties have advised that:

- the two new sites have been given ‘Extremely High’ Aboriginal cultural significance due to their connection with the other sites in the landscape; and

- the mapping of recorded sites shows that there is continuous use of the landscape from Lake Macquarie all the way up to and including the Sugarloaf Range.

6.4.4.2 Archaeological Significance

The archaeological significance of Aboriginal archaeological sites is assessed according to their research potential. Six criteria were taken into account when assessing archaeological significance: rarity, representativeness, integrity, connectedness, complexity and potential for archaeological deposit. These criteria were assessed within a local and regional context.

Palmers Creek IF5 (artefact scatter) was assessed as having low archaeological significance. Palmers Creek ST1 (scarred tree) was assessed as having moderate archaeological significance. Both Palmers Creek Grinding Groove 1 and Palmers Creek

Grinding Groove 2 have previously been identified as having high archaeological significance.

6.4.5 Impact Assessment

The following discussion relates to the two newly recorded sites, Palmers Creek IF5 and Palmers Creek ST1 as well as the previously recorded grinding groove sites (38-4-1007 and 38-4-1279). The two grinding groove sites were assessed as part of the WWCCOP and in view of their Aboriginal cultural heritage and archaeological significance the mine plan was modified to avoid subsidence impact at that time.

The Aboriginal archaeological sites assessed for their Aboriginal cultural and archaeological significance were assessed for potential to be impacted directly or indirectly by subsidence or directly by subsidence remediation works. No impacts to Aboriginal sites are proposed due to surface infrastructure.

The potential impacts arising from subsidence and subsidence remediation works to Aboriginal archaeological sites was assessed in the subsidence assessment (refer to **Appendix 6**). DGS assessed the potential for damage to the Aboriginal archaeological site features based on predictions for 'final subsidence, tilt, strain and surface gradient change contours'.

No direct impact is predicted for the two grinding groove sites (Palmers Creek Grinding Grooves 1 #38-4-1007 and Palmers Creek Grinding Grooves 2 #38-7-1279). These are sites of extremely high Aboriginal cultural significance and of low to moderate and moderate to high archaeological significance, as well as low to moderate and moderate to high research potential respectively. However, there is the potential for indirect impact from any increased sediment load in the creeklines due to subsidence. Any such additional sediment could act to abrade and/or bury the grinding grooves. This risk can be effectively mitigated through the implementation of an appropriate subsidence remediation strategy for any cracking that may result in erosion entering the creekline in which the grinding grooves occur.

Potential damage due to cracking of the soil profile and subsequent remediation is predicted for Palmers Creek IF5 (artefact scatter). This site is of extremely high Aboriginal cultural significance, low archaeological significance and low research potential.

Potential impact to Palmers Creek ST1 (scarred tree) may result due to tree fall and/or cracking of the soil profile/sandstone bedrock and subsequent remediation. The subsidence assessment identified that the subsidence impact potential for this site was very low, and it is therefore unlikely, but possible, that this site will be adversely impacted by the Project. This site is of extremely high cultural significance and moderate archaeological significance and low research potential.

6.4.6 Management Strategy

A number of methods/strategies are available to mitigate the potential direct and/or indirect impacts of the Project on Aboriginal sites. Available mitigation options need to be assessed for their appropriateness from an Aboriginal cultural and archaeological perspective.

The broad management outcomes proposed for Aboriginal archaeological sites are:

- design of the mine plan to avoid impact to Palmers Creek 1 and 2 Grinding Groove sites. This has already been done as part of this Project with the mine plan designed to avoid undermining these sites. The subsidence assessment found that the risk of direct impact due to subsidence on these sites is very low (DGS 2013);

- intervention to prevent damage (e.g. collection of artefacts prior to subsidence remediation works and their replacement when works completed);
- appropriate salvage of sites, where appropriate;
- using clean imported fill, sourced from the closest available location, to repair soil cracking near Aboriginal sites, rather than ripping/dozing;
- implementation of the subsidence monitoring program to review the potential for erosion and sedimentation from subsidence cracking, and the potential for sediment to enter the creeks upstream of the grinding groove sites. Appropriate erosion and sediment controls will be implemented where the potential for impact exists; and
- ongoing monitoring by the registered Aboriginal parties and a qualified archaeologist following the cessation of all subsidence impacts to record actual impacts to sites, if any, due to subsidence and identify any required management measures.

Specific management measures for each site are discussed below.

Palmers Creek Grinding Grooves 1 and 2

It is noted that the currently approved WWC mine plan was modified from its originally proposed layout to exclude undermining of Palmers Creek Grinding Grooves 1 (#38-4-1007) and Palmers Creek Grinding Grooves 2 (#38-4-1279) due to their extremely high Aboriginal cultural value (Umwelt 2010). Similarly in 2005, undermining of the Palmers Creek Grinding Grooves 1 (#38-4-1007) was removed from the mine plan for the Southern Domain to protect its cultural values. Thus these sites have already been recognised for their conservation value and there are existing commitments for their ongoing protection from mining impacts (Umwelt 2010, 2012a). Consistent with this approach, the mine plan for longwalls 51 and 52 has been designed to avoid impact on under Palmers Creek Grinding Grooves 1 (#38-4-1007) or Palmers Creek Grinding Grooves 2 (#38-4-1279).

Palmers Creek Grinding Grooves 1 (#38-4-1007) and Palmers Creek Grinding Grooves 2 (#38-4-1279) are not within the longwall layout for the Project and are at the extremity of the area of the predicted subsidence contours. Thus direct impact by subsidence is assessed as highly unlikely (DGS 2013). However, without appropriate management and where subsidence cracking and associated remediation works disturb the ground surface, there is the potential for additional sediment load in the creeklines due to erosion of areas affected by subsidence cracking. As part of the Project, WWC will implement subsidence monitoring programs to identify the potential for any indirect impacts to Aboriginal sites (e.g. erosion and sedimentation). Where the potential for impacts are identified, appropriate management strategies will be implemented (e.g. cracking remediation, sediment controls).

Palmers Creek IF5 (isolated find)

Palmers Creek IF5 is located on an access track which may require remediation following subsidence. The WWC ACHMP (Umwelt 2012a) provides for temporary surface collection of artefacts identified on access tracks where vehicle use/track maintenance/subsidence remediation is assessed by the registered Aboriginal parties and a suitable qualified archaeologist as likely to result in harm to the artefacts. It is assessed that the most appropriate management option for Palmers Creek IF5 is to collect the surface artefact in compliance with a revised version of the ACHMP that includes the management of Aboriginal archaeological sites in the Project Area. The artefact will be returned to the Palmers Creek IF5 site area following cessation of subsidence remediation works. The artefact will be returned as close as possible to its collection location. A new site card will be provided to OEH identifying the new location.

Palmers Creek ST1 (scarred tree)

It is considered that the most appropriate management option is to monitor the scarred tree following subsidence to assess the level of impact (if any) and to employ the most appropriate subsidence mitigation for the ongoing care of the tree. Mitigation options following cessation of subsidence include:

a. if there are no obvious subsidence impacts to the tree or the soil profile in its surrounds post subsidence re-inspect the tree approximately one month and three months after undermining and if still in good health no further management is required; OR

b. if there are no obvious subsidence impacts to the tree but the soil profile in its surrounds has cracked, infill the cracks as soon as practicable with imported fill avoiding any damage to the tree. Re-inspect the tree approximately one month and three months after undermining and if still in good health no further management required; OR

c. if the tree has fallen and/or the tree is dying, with the assistance of a suitably qualified aboriculturalist remove the section of the tree with the scar. Treat the section of the tree removed for its preservation and in consultation with the registered Aboriginal parties determine an appropriate location for its ongoing storage.

Revision of the WWC ACHMP

WWC will revise the WWC ACHMP to include the Aboriginal cultural and archaeological management commitments made in this report. The revised ACHMP will provide detailed management strategies for all identified Aboriginal archaeological sites within the WWC mining area including the Project Area.

6.5 Surface Water Assessment

The Project Area lies within the Palmers Creek catchment. Within the subsidence affectation area drainage lines are limited to the uppermost reaches of two first order tributaries of Palmers Creek (refer to **Figure 6.9**). Both of these tributaries are ephemeral. The following assessment considers the potential impact of the Project on these tributaries of Palmers Creek and on surface water resources more generally, including on water quality.

6.5.1 Catchment Description

Palmers Creek has a total catchment area of approximately 2,630 hectares, of which approximately 27 hectares (1%) is within the identified subsidence affectation zone for the Project (refer to **Figure 6.9**). The uppermost reaches of two first order tributaries of Palmers Creek are located within the subsidence affectation zone (refer to **Figure 6.9**). Within the subsidence affectation zone, the tributaries of Palmers Creek are defined by small gullies approximately one metre to two metres wide, with sandy bed and banks that are typically in good condition with limited erosion. Extensive riparian vegetation is present, and is continuous with the surrounding forested areas.

The portion of the Palmers Creek catchment that is included within the subsidence affectation zone includes the Killingworth (ki) soil landscape unit, typically found locally on rolling hills. Killingworth soils are typically shallow to moderately deep (60 centimetres to 150 centimetres deep), with well to imperfectly drained soils on crests and hillslopes, including yellow podzolic soils, yellow soloths, gleyed podzolic soils, gleyed soloths, structured loams, bleached loams and lithosols (Matthei 1995). Killingworth soils have a

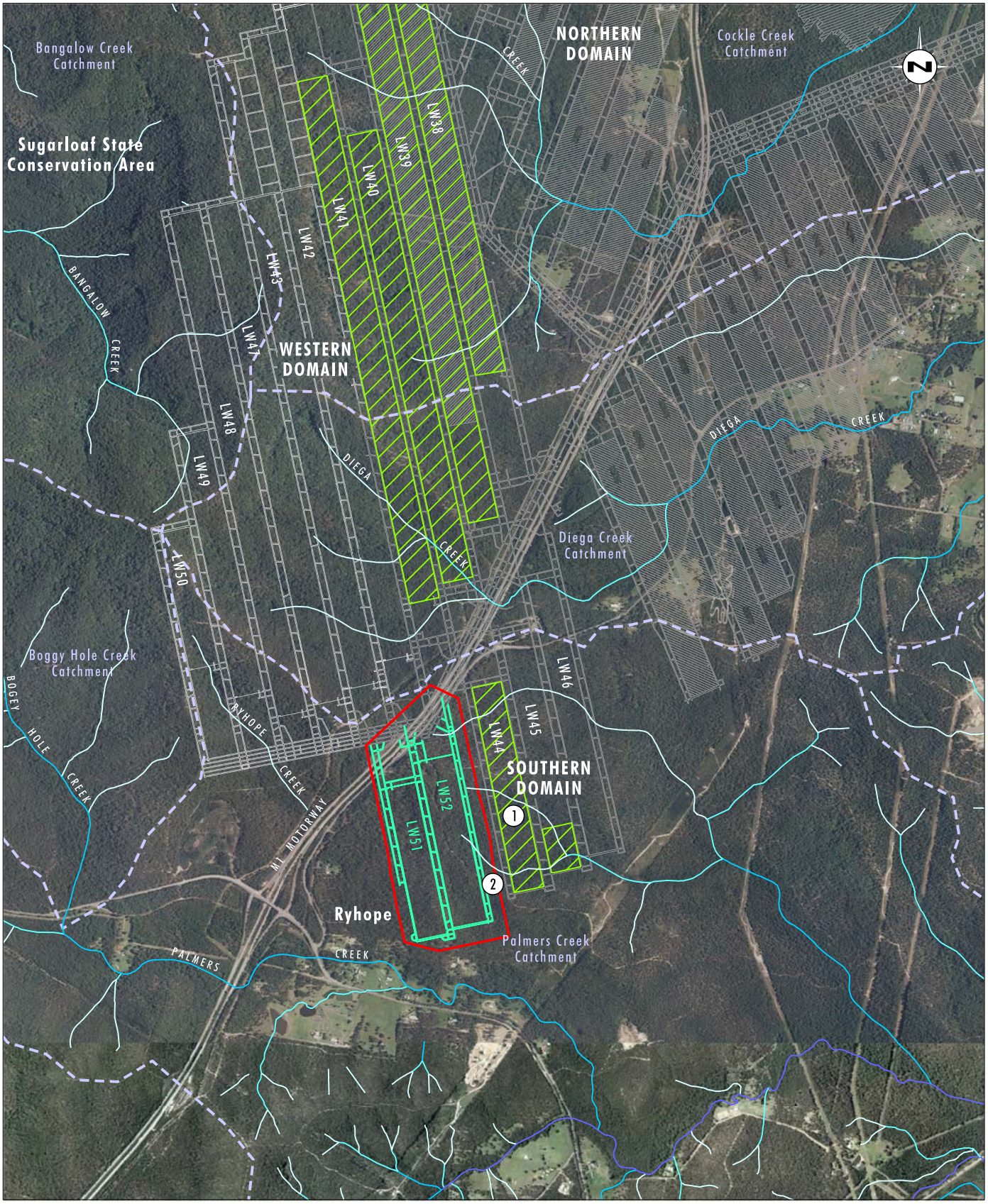

Image Source: OCAL (2008), Google Earth (December 2009)
Data Source: OCAL (2013), LPI (2009)

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1:30 000

Legend

- Project Area
- Approved Underground Workings
- Longwall Progression as of October 2013
- Former Underground Workings
- Proposed Longwall Panels 51 and 52
- Catchment Boundary
- ① Modelled Watercourse 1
- ② Modelled Watercourse 2
- 1st Stream Order
- 2nd Stream Order
- 3rd Stream Order

FIGURE 6.9

Catchments Context

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potentially high erosion hazard, have very strong acidity and low to very low fertility (Matthei 1995). Such soils are typically fine in areas where clayey and silty soils occur and are therefore considered to be potentially dispersive (Landcom 2004).

6.5.2 Water Quantity

Catchment Boundaries

The catchment boundary of Palmers Creek within the region of the proposed LW 51 and LW 52 is shown on **Figure 6.9**. As the predicted subsidence affectation zone is contained completely within the Palmers Creek catchment area, catchment boundaries will not be altered from those that currently exist as shown on **Figure 6.9** as a result of subsidence.

Farm Dams, Roads and Culverts

The subsidence affectation zone is located primarily within the SSCA and includes open forest with several fire and access trails.

No farm dams have been identified within the subsidence affectation area.

The Sydney to Newcastle M1 Motorway and Wakefield Road and their associated drainage systems are located outside the subsidence affectation zone. The mine plan has been designed so as to not impact on the Sydney to Newcastle M1 Motorway or Wakefield Road.

6.5.3 Drainage Lines

As discussed above, the subsidence affectation zone includes the uppermost reaches of two first order tributaries of Palmers Creek (refer to **Figure 6.9**). These tributaries are ephemeral and only flow for short periods following rainfall, however, some areas of potential in-channel ponding are present in reaches downstream of the subsidence affectation zone.

Watercourse Ponding and Alignment

A ponding analysis was completed for the Project which indicated that within the subsidence affectation area, areas of remnant ponding are limited to small sections (typically less than 100 m^2) within Watercourse 2 (refer to **Figure 6.10**). The ponding analysis indicates that the predicted impacts to the existing remnant ponding areas within the subsidence affectation area due to the Project is negligible (refer to **Figure 6.10**).

Hydraulic Modelling

A one dimensional (1D) hydrodynamic model XP-Storm was used to model the flows within Palmers Creek and its tributaries. The XP-Storm package models a watercourse as a series of nodes along a channel that are connected by drainage links. Model nodes provide locations for sub-catchment information to be included into a model, including sub-catchment area, slope and percentage impervious area. Drainage links describe the dimensions of each reach of the modelled watercourse, by way of channel length, slope, cross section, top of bank, upstream and downstream channel inverts and surface roughness ('Mannings n').

An XP-Storm model was developed of Palmers Creek as part of the Surface Water Assessment for the WWCCOP EA (Umwelt 2010). The XP-Storm model included the first and second order watercourses shown on **Figure 6.10**. XP-Storm model nodes were placed along the watercourses at points of interest, including watercourse confluences, and the locations where streams crossed the proposed locations of the middle of each longwall and the centre of each chain pillar. The elevations of the nodes and links and the watercourse

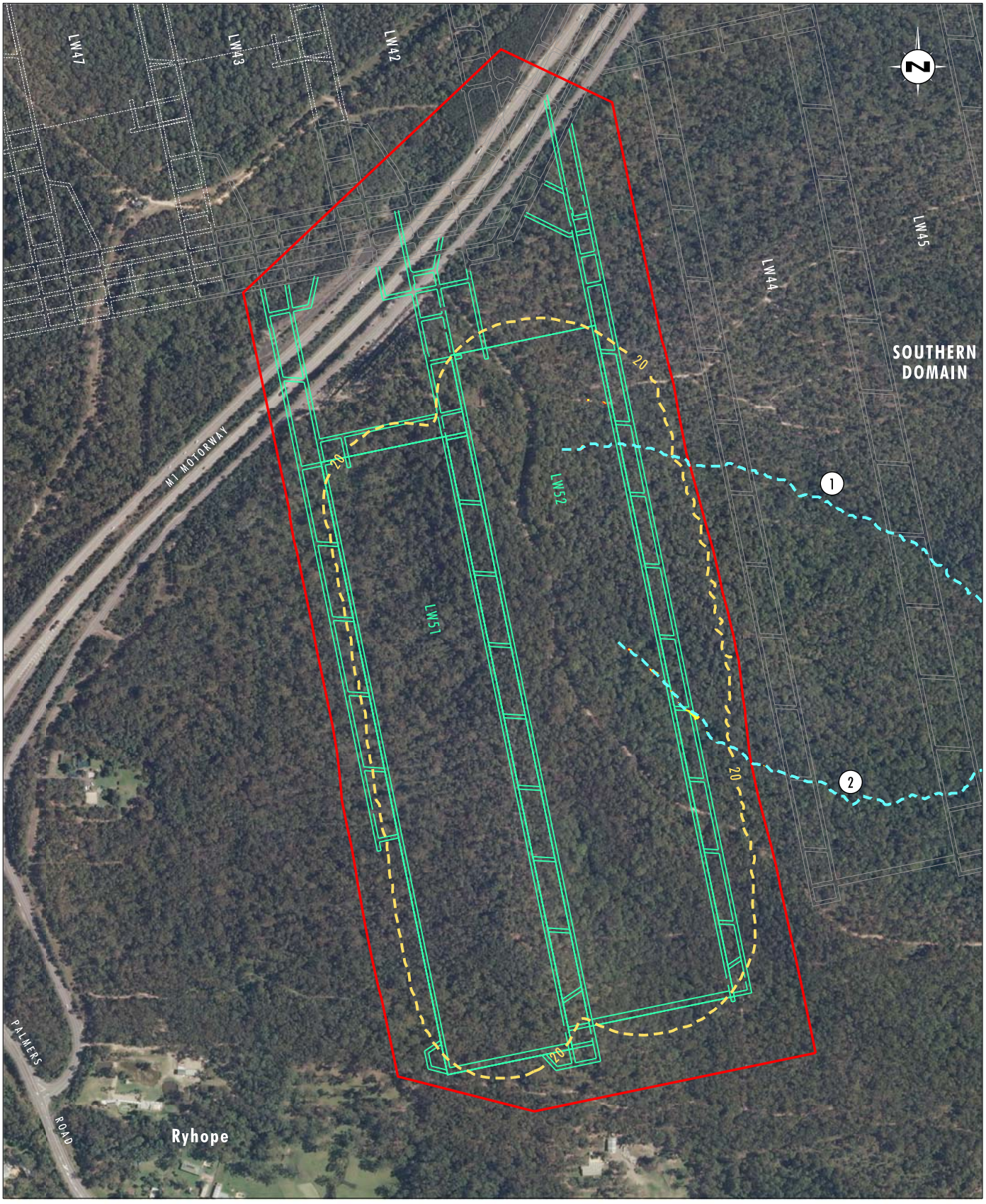

Image Source: OCAL (2008)
Data Source: OCAL (2013), LPI (2009)

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Legend

- Project Area
- Approved Underground Workings
- Exsiting Ponding
- Post-mining Ponding
- Proposed Longwall Panels 51 and 52
- 20mm Subsidence Affectation Zone (LW51 & LW52)
- Modelled Watercourse
- ① Modelled Watercourse 1
- ② Modelled Watercourse 2

FIGURE 6.10

Remnant Ponding and Predicted Subsidence

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cross sections for the existing (i.e. pre-mining) and predicted post-subsidence landform were generated directly from digital terrain models.

The XP-Storm model was used to estimate the potential changes to flows within Palmers Creek in response to the predicted subsidence associated with the Project. The model included the predicted subsidence associated with approved LW 44 and LW 45 within the reaches of the modelled tributaries downstream of the subsidence affectation zone for the Project (refer to **Figure 6.10**). The XP-Storm model was used to estimate the response of Palmers Creek and its tributaries to four design storm events, specifically the 2 year Average Recurrence Interval (ARI), 10 year ARI, 20 year ARI and 100 year ARI, critical duration design storm events.

Hydraulic modelling enables several flow metrics that describe the hydraulic behaviour of watercourses modelled to be determined. The flow metrics include maximum modelled flow depths, velocities and tractive stresses. Maximum flow depths provide information on the capacity of each watercourse, where as velocities and tractive stresses provide information on the stability limits of the watercourse.

Potential Changes to Maximum Flow Depths due to the Project

The maximum modelled depths within the two tributaries of Palmers Creek within and downstream of the subsidence affectation zone are shown in **Charts 6.1** and **6.2**.

The modelling indicates that within the subsidence affectation zone, little change to the maximum modelled flood depths for the four modelled design rainfall events is expected (refer to **Charts 6.1** and **6.2**). The modelling indicates that the maximum estimated increase in maximum modelled flood depth is approximately 12 millimetres within Watercourse 2 for the 100 year ARI design storm event (refer to **Chart 6.2**).

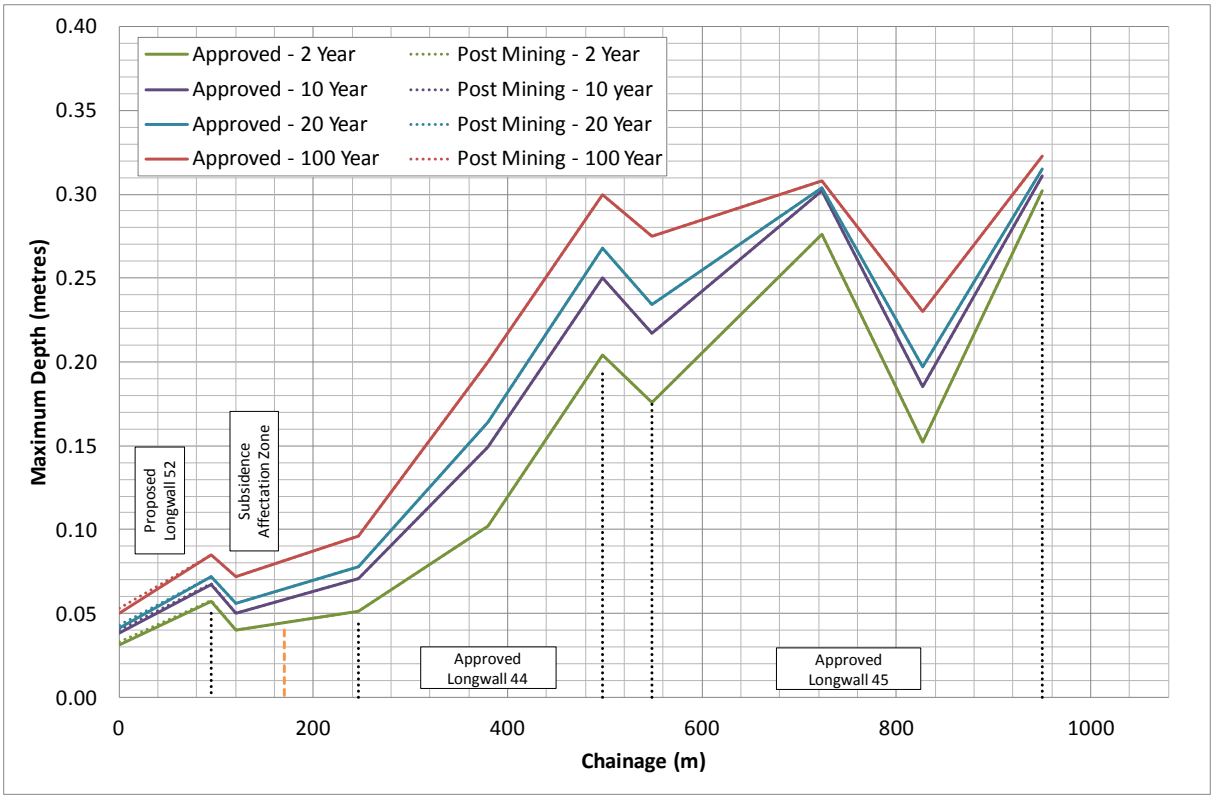

Chart 6.1 – Modelled Maximum Depths for Watercourse 1

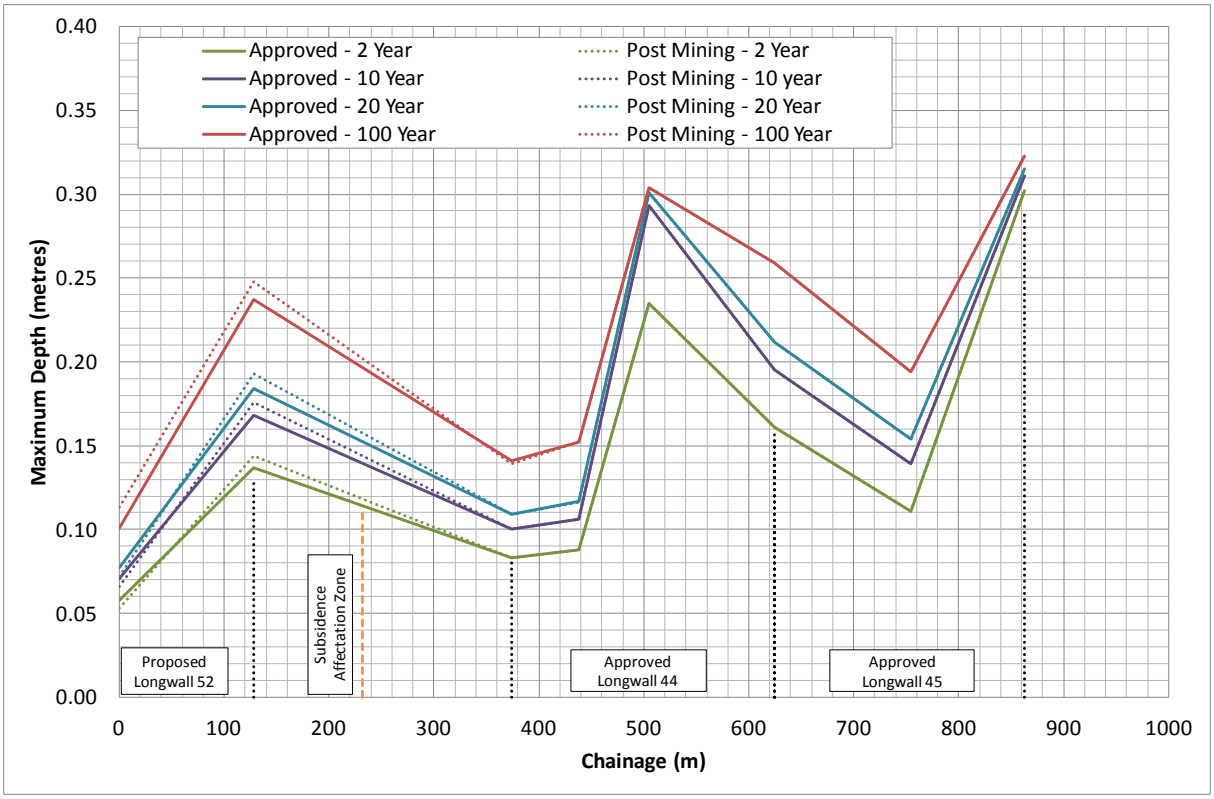

Chart 6.2 – Modelled Maximum Depths for Watercourse 2

Potential Changes to Velocity due to the Project

The maximum modelled velocities within the two tributaries of Palmers Creek within and downstream of the subsidence affectation zone are shown in **Charts 6.3** and **6.4**.

The modelling indicates that within the subsidence affectation zone, the maximum modelled velocities within the two tributaries of Palmers Creek reduce by up to 0.15 m/s (for the 100 year ARI design storm event within Watercourse 2 (refer to **Chart 6.4**). Downstream of the subsidence affectation zone, the modelling indicates no change to the maximum modelled velocities (refer to **Charts 6.3** and **6.4**).

The modelled changes to the maximum modelled velocities within the two tributaries of Palmers Creek do not result in changes to the estimated flow velocity stability category, either within the subsidence affectation zone or within the reaches downstream (refer to **Charts 6.3** and **6.4**). As a result, the predicted subsidence is not expected to impact on the stability of the watercourses that will be subject to subsidence as a result of the Project.

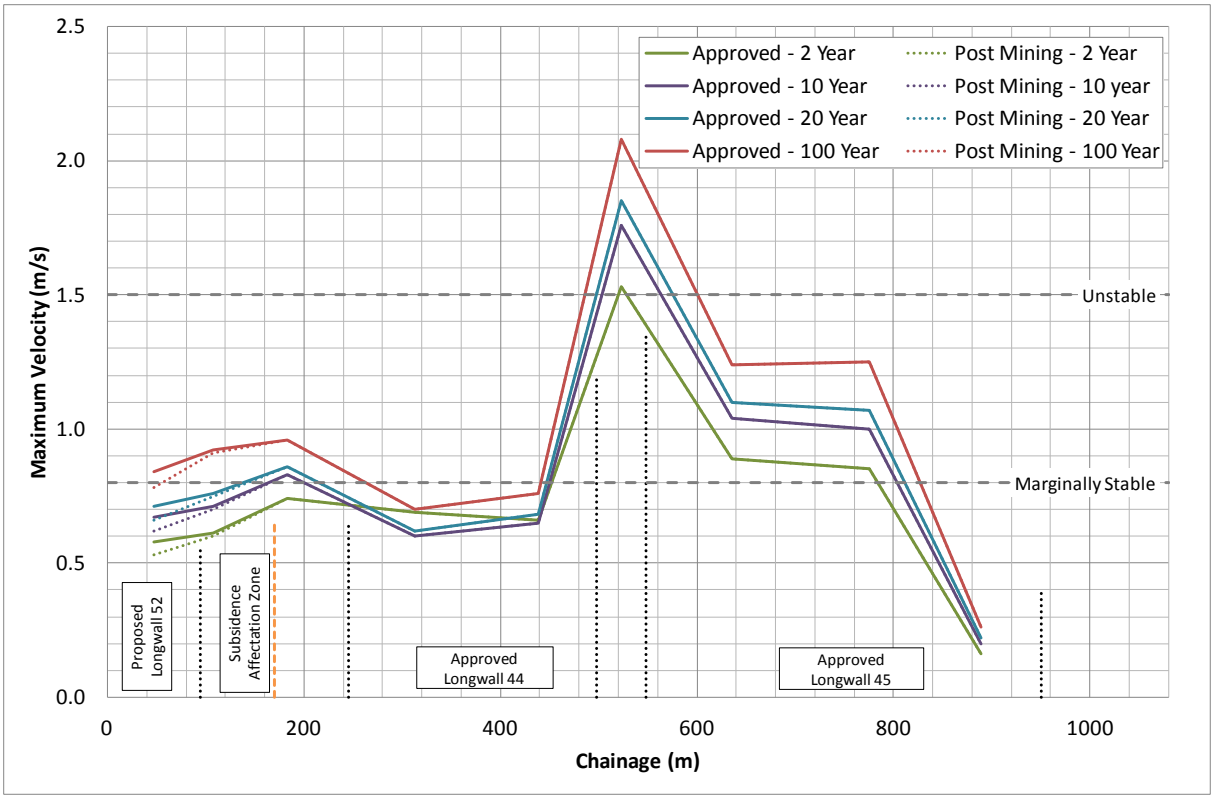

Chart 6.3 – Modelled Velocity for Watercourse 1

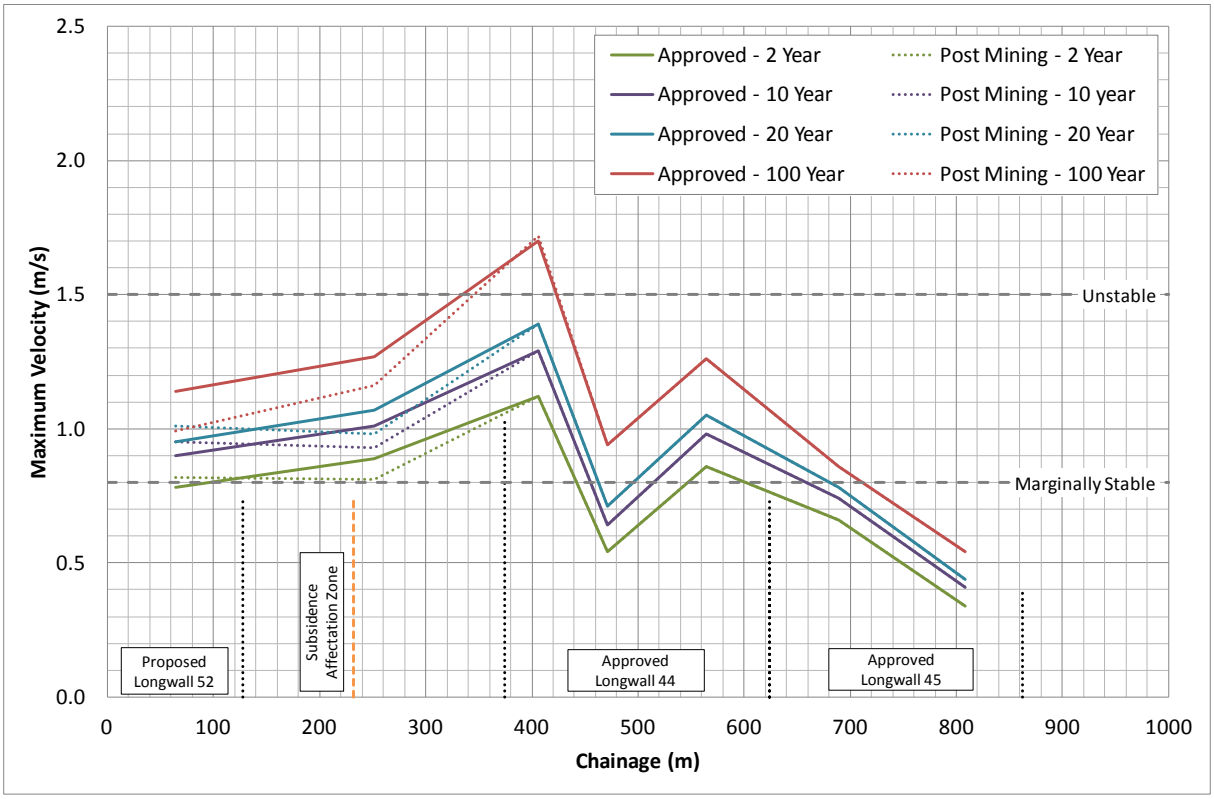

Chart 6.4 – Modelled Velocity for Watercourse 2

Potential Changes to Maximum Tractive Stresses due to the Project

The maximum modelled tractive stresses within the two reaches of Palmers Creek within and downstream of the subsidence affectation zone are shown in **Charts 6.5** and **6.6**.

The modelling indicates that within the subsidence affectation zone, the maximum modelled tractive stress within the Watercourse 1 reduces by up to approximately 7 N/m^2 (for the 100 year ARI design storm event (refer to **Chart 6.5**). Within Watercourse 2, the modelling indicates that the maximum modelled tractive stresses increase by up to approximately 6 N/m^2 for all scenarios up to and including the 20 year ARI design storm event, however the maximum modelled tractive stresses increase by approximately 20 N/m^2 for the 100 year ARI design storm event (refer to **Chart 6.6**).

Downstream of the subsidence affectation zone, the modelling indicates little change to the maximum modelled tractive stresses within Watercourses 1 and 2 (refer to **Charts 6.5** and **6.6**).

The modelled changes to the maximum modelled tractive stresses within the two tributaries of Palmers Creek do not result in changes to the estimated tractive stress stability category, either within the subsidence affectation zone or within the reaches downstream (refer to **Charts 6.5** and **6.6**). As a result, the predicted subsidence is not expected to impact on the stability of the watercourses within the subsidence affectation zone.

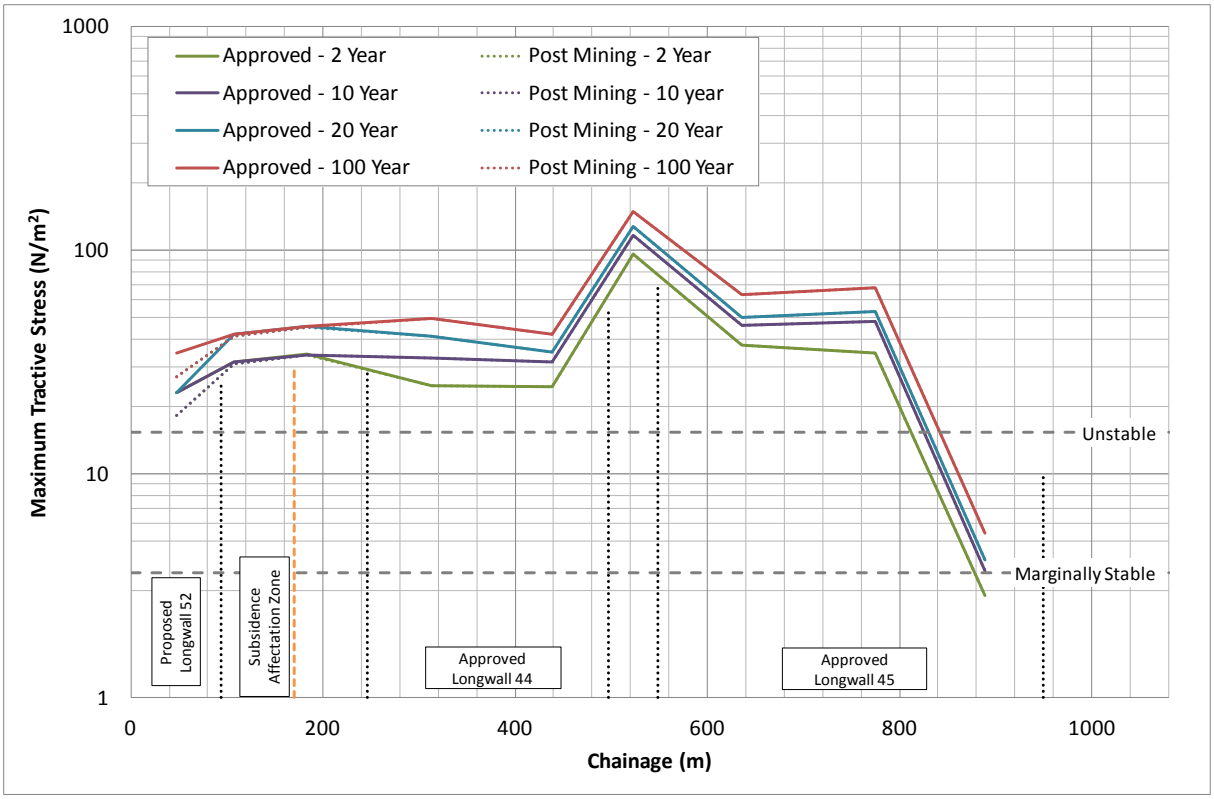

Chart 6.5 – Modelled Tractive Stress for Watercourse 1

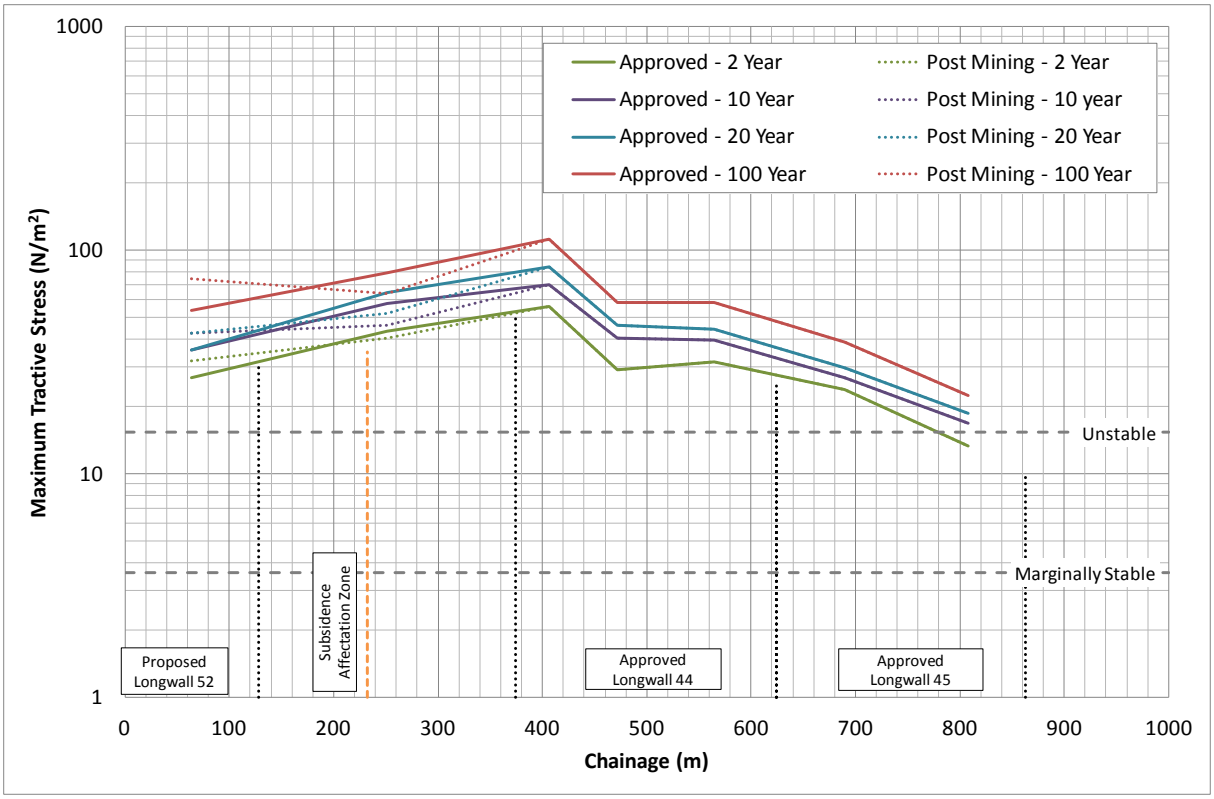

Chart 6.6 – Modelled Tractive Stress for Watercourse 2

6.5.4 Summary of Impacts

As discussed in **Section 6.2.1.1**, the soil characteristics indicate that the creek lines within the Project Area are potentially subject to erosion with the potential for erosion being increased where vegetation cover is absent. However, the predicted subsidence associated with the Project is not expected to result in significant changes to remnant ponding, flow volumes or flow characteristics within Palmers Creek. The potential risk of watercourse scouring within the two affected watercourses as a result of the predicted subsidence is considered to be minimal, meaning that increases in the sediment load within Palmers Creek are unlikely. As a result, impacts to the existing water quality within the Palmers Creek catchment are expected to be negligible.

6.5.5 Monitoring, Remediation, Licensing and Reporting

Taking into consideration the existing surface water regime, associated topography and the predicted impacts of subsidence on the drainage lines within the Project Area, it is considered unlikely that any remediation works will be required to rectify subsidence impacts, unless substantive cracking occurs in a watercourse. It is therefore considered appropriate that the existing surface water monitoring program can be extended to include the potential impacts of the Project. This existing program includes parameters such as creek cross-sections, longitudinal profile, geomorphic units, riparian vegetation, erosion or accretion, sediment type and the amount of exposed bedrock. WWC subsidence monitoring program requires that monitoring be conducted prior to the commencement of mining, immediately after the first post-mining storm event, three months to six months post mining and 12 months to 18 months post mining.

If subsidence remediation works are required, it is not considered practical to divert runoff from upstream catchment areas around potential impact areas due to the steepness of the catchment areas and surrounding topography and vegetation. Therefore, any remediation works would need to be managed in-stream. This situation is considered typical of the drainage lines within the existing WWC underground mining area. Where such works are required, appropriate sediment and erosion controls will be implemented to avoid impacts to downstream water quality until such time as the area affected by the works stabilised.

Where surface mitigation works are required to be undertaken, appropriate erosion and sediment control measures will be designed and implemented during site works and establishment of vegetation. All surface mitigation works will be undertaken in consultation with OEH and DRE when within the SSCA and with all works requiring the consent of OEH.

The existing surface water monitoring and watercourse remediation protocols in place for the existing operations at WWC and included in the SMP/Extraction Plan and existing WWC Surface Water Management Plan will be applied to the Project.

The Commonwealth Department of the Environment released the *Draft Significant Impact Guidelines: Coal Seam Gas and Large Coal Mining Developments – Impacts on Water Resources* for comment in June 2013. Although these guidelines are in draft form and may change, a review against these draft guidelines has been completed for the Project.

The surface water impact assessment indicates that the Project will have negligible impacts on flow regimes, downstream water users or water quality. Consequently, the Project is not considered to result in a significant impact on water resources as assessed against the draft guideline.

There is only one water sharing plan, *Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources 2009* prepared in accordance with the *Water Management Act 2000* which has relevance to the Project Area. Therefore, the surface waters of the Project Area are governed by the *Water Management Act 2000*. As no water surface water take is required for the Project, no licences under the *Water Management Act 2000* are required for the Project.

6.6 Groundwater

A groundwater impact assessment has been completed for the Project by Aurecon Australia. A summary of the key findings of the groundwater assessment is provided below, with the full report included in **Appendix 7**. The assessment determined the nature of the existing groundwater environment within and surrounding the Project Area, the interactions of the Project with groundwater and the potential for groundwater impacts. The assessment also reviewed the Project with respect to the NSW Aquifer Interference Policy and also with regard to the Commonwealth Department of the Environment *Draft Significant Impact Guidelines: Coal Seam Gas and Large Coal Mining Developments – Impacts on Water Resources.*

6.6.1 Existing Groundwater Environment

Historically, three potential sources of groundwater have been utilised within the Lake Macquarie area, namely:

- alluvial aquifers;
- near-surface weathered rock aquifer; and
- fractured rock aquifers (including coal seam aquifers).

A brief discussion on each of these aquifer types and their relevance to the Project is provided below. Further detailed discussion is provided in the groundwater assessment, included as **Appendix 7**.

Alluvial Aquifers

Alluvial sediments potentially carry the most important groundwater resource in the Newcastle/Lake Macquarie area. These sediments cover low-lying areas adjacent to the lake system and fill the broad valleys of the creeks that flow into the lake. The alluvial areas identified within and surrounding the Project Area are shown in **Figure 6.11**.

Two major catchment areas, Cockle Creek (and its tributaries including Burkes Creek and Diega Creek) and Palmers Creek (including Ryhope Creek and Central Creek) are located within the WWC mining lease.

As discussed in **Section 6.5**, the Project Area lies within the Palmers Creek catchment. The valley of Palmers Creek comprises a broad alluvial terrace which contains one major aquifer located to the south and southwest of the Project Area. The groundwater in this aquifer is exploited in several bores and is utilised for stock and domestic purposes. This aquifer is outside the WWC mining lease area, although LW 51 and LW 52 lie immediately north of the aquifer, adjacent to the mining lease boundary (refer to **Figure 6.11**).

Weathered Rock Aquifers

On a regional scale, the groundwater resource in the underlying weathered rock aquifer is considered of minimal importance (Aurecon 2013). Previous geotechnical investigations have confirmed that the Newcastle Coal Measures do not normally contain any significant quantities of groundwater, and the permeability of these rocks is generally less than 10^{-7}m/s (Aurecon 2013).

The lack of groundwater flow in the coal measure strata is due to the extremely low primary permeability of the rock material. As a result, most groundwater flow through the overburden strata is due to secondary or fracture permeability (through interconnecting defects such as joints and bedding).

Fracture permeability is most common in the weathered zone and in near surface strata where joints and fractures are likely to be open. This can form a near surface unconfined aquifer, termed the weathered rock aquifer, which may be intersected above the bedrock. The weathered rock layer is generally in the order of 10 metres deep throughout the region, and hence the aquifer, where it occurs, is limited to this zone.

Occasionally, flow from this aquifer is significant, and may emerge at the ground surface in the form of a spring. Groundwater flow rates from these springs are usually intermittent, and depend on the recent climatic conditions, while the water quality is poor to good. There are no known springs derived from the weathered rock layer in the vicinity of the LW 51 and LW 52, which confirms that the weathered rock aquifer is generally poorly developed in this area.

Although there is no significant weathered rock aquifer above LW 51 and LW 52, a well on a nearby private property, located approximately 180 metres south of LW 51, probably exploits a localised weathered rock aquifer that may be partially connected to the alluvium in Palmers Creek.

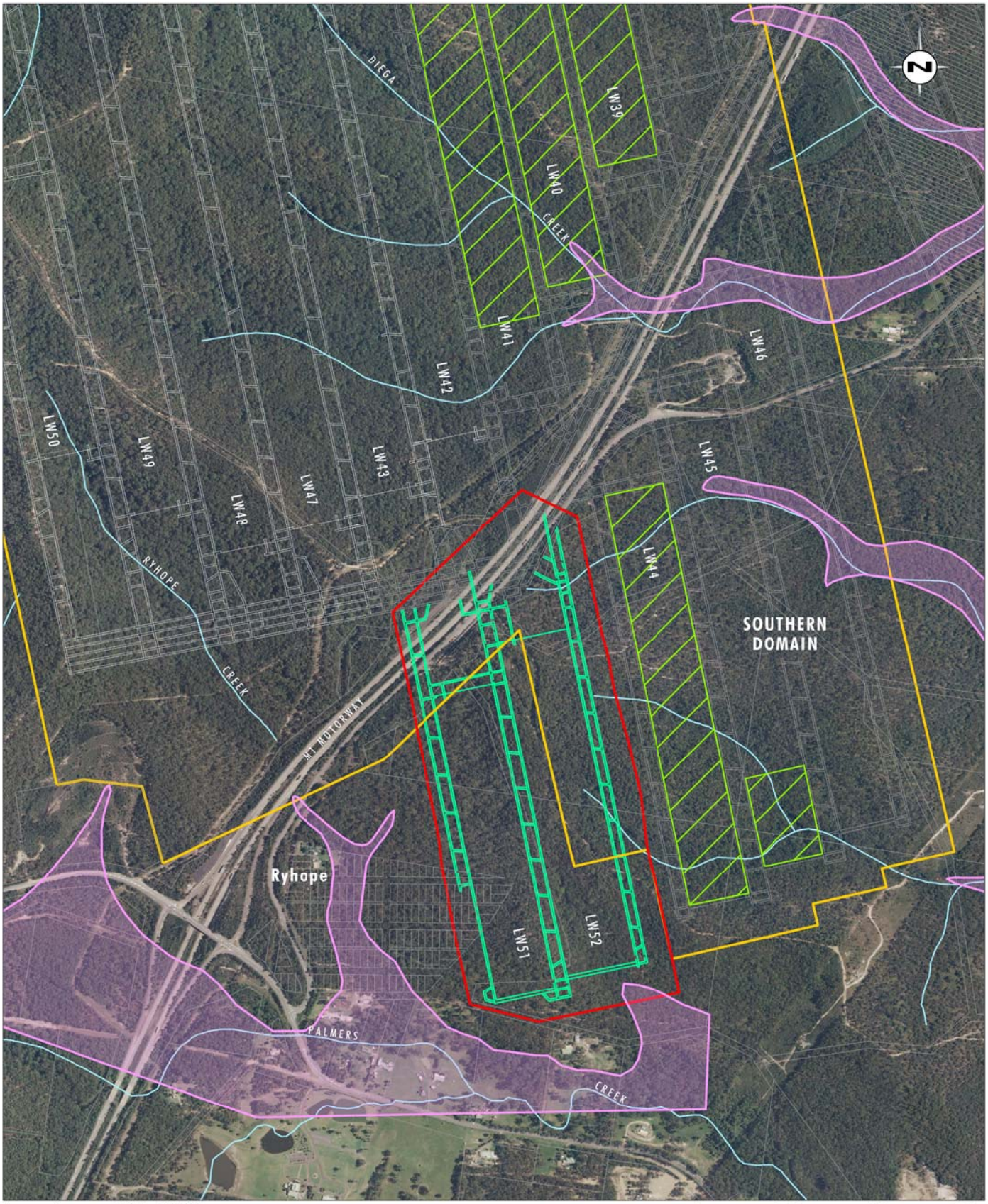

Image Source: OCAL (2008)
Data Source: OCAL (2013), LPI (2003), OEH (2013)

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Legend

- Project Area
- Approved Continued Underground Mining Area
- Approved Underground Workings in the West Borehole Seam
- Proposed Longwall Panels 51 and 52
- Longwall Progression as of October 2013
- Former Underground Workings
- Extent of Alluvium within the Continued Underground Mining Area

FIGURE 6.11

Alluvial Areas

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Fractured Rock Aquifers

The aquifers that typically occur at depth in the Newcastle Coal Measures are usually fractured rock aquifers. These include jointed coal seams and localised jointed or fractured zones, often adjacent to major faults. These aquifers have the potential for higher flows than the weathered rock aquifer since they are confined aquifers and are at a higher pressure. However, flows are often relatively small in these zones and water quality is generally poor, suitable only for stock use.

Normally, any groundwater bearing seam in the immediate overburden strata above a longwall panel will drain into the goaf (void area left after coal extraction) during extraction of the seam. Since very few major groundwater inflows have been experienced in the existing WWC workings to date, this confirms that the water-bearing coal seams are an insignificant groundwater source in this area, and there are no major fractured rock aquifers in the overburden strata above the existing workings. Were there any significant aquifer zones in the near roof strata, water inflows to the mine would be common and widespread.

Based on previous mining experience at WWC and also the results of recent exploratory boreholes carried out for the Project, the conditions in the LW 51 and LW 52 mining area are likely to be similar to the rest of the WWC, and there is no evidence of the existence of any significant fractured rock aquifers in the near-roof strata. Consequently, the risk of an adverse impact on any fractured rock aquifer is negligible.

Groundwater Dependent Ecosystems

There were no groundwater dependent ecosystems (GDEs) identified within Project Area and no GDEs are predicted to be adversely impacted by the Project.

6.6.1.1 Groundwater Usage

The extent of current groundwater usage within and surrounding the Project Area was determined as part of the groundwater assessment. The assessment found that:

- there are no licenced bores or groundwater users within the Project Area;
- the current usage of groundwater within the vicinity of the Project Area is minimal, and is limited to a bore located to the south of LW 51 (Slattery's bore – GW064025). The other registered water bore in the vicinity of the Project Area (GW063752) is not used as a water supply;
- while groundwater in alluvium is the most potentially important groundwater resource, most of the alluvium in the vicinity of the Project Area contains no aquifer zones that would provide a significant groundwater source, with the exception of the alluvial aquifer in Palmers Creek (which is located well south of the lease area); and
- the potential for future usage of weathered rock aquifers and fractured rock aquifers is considered to be negligible, due to their generally poor yield, quality and continuity.

While it is theoretically possible that there may be additional utilisation of the groundwater in the alluvium in or near the Project Area in the future (over and above the current utilisation), the probability of this is considered to be very low as:

- most of the water-bearing zones in the alluvium near the Project Area are contained in discontinuous lenses;

- the flow rates from most of the aquifer zones in the alluvium are unlikely to be economic; and

- other sources of water are available (surface water and rainwater).

6.6.2 Potential Groundwater Impacts

The groundwater assessment considered the potential impacts of the Project on each of the groundwater sources within and near to the Project Area. With regard to the Palmers Creek alluvial aquifer, the assessment found that due to the significant separation distance between the coal extraction area and the productive zone of the alluvial aquifer (approximately 170 metres) there is a very low probability of any adverse impact on normal flow rates in the alluvial aquifer. The assessment also found that the likelihood of any impacts on groundwater quality in the aquifer is negligible.

The assessment found in regard to the Ryhope Creek alluvium that there is no major aquifer zone identified in this alluvium, and that as the main part of the alluvium is located more than 300 metres to the west of the nearest longwall panel, any impacts are predicted to be negligible and unmeasurable.

With regard to the near-surface weathered rock aquifer and the bore on the Slattery property to the south of LW51, the assessment found that due to the significant separation distance between the coal extraction area and the bore (approximately 180 metres), the Project is not predicted to impact significantly on the aquifer that supplies the bore. Monitoring of this bore is proposed to confirm this prediction. No other groundwater bores have the potential to be adversely impacted by the Project.

With regard to the fractured rock aquifers (including coal seam aquifers), the assessment found that any minor groundwater within the strata above the mining area (both within the fracture zone and the hydraulically connected strata) would drain to the mining void. As discussed in **Section 6.6.1**, experience at WWC indicates that minimal groundwater inflows to the mine are expected in this area. As there is minimal groundwater in the fractured rock strata, the aquifer is low yielding and of poor quality, and there are no groundwater users for this aquifer, the assessment found that the impact of the Project on this aquifer was low.

6.6.2.1 Assessment of Regional Impact

Although the assessment concluded that the risk of any adverse impacts to the local groundwater regime in the vicinity of Project Area is low, for completeness, it also examined the risks on a regional scale. The two potentially relevant regional risk factors identified during this process were:

- any mining-related loss of groundwater from aquifers in the near-surface alluvial deposits may impact on the groundwater supplies and users of this resource further downstream; and

- any mining-related loss of groundwater from coal seam aquifers in the overburden above the West Borehole Seam may impact on the groundwater supplies in the coal seams and users of this resource in other parts of the basin.

The assessment considered these potential risks and found that the regional risk to the alluvial aquifers was deemed to be low as:

- no alluvial areas will be undermined by the Project;

- no major aquifer zones were identified in the alluvial areas that are adjacent to areas to be undermined by the Project;
- the probability of any adverse impacts on the alluvial aquifer in Palmers Creek was determined to be low;
- the total area of alluvium in the potentially impacted area relative to the total area of alluvium in the Palmers Creek catchment is very small; and
- the volume of groundwater in the Palmers Creek alluvium relative to the total alluvial groundwater volume in the region is minimal.

The assessment found that the regional risk to the coal seam aquifers was low as:

- coal seam aquifers in this region do not provide an important source of groundwater due to their poor quality and yield, and are only utilised intermittently;
- no significant coal seam aquifers have been identified in the overburden above the West Borehole Seam in the vicinity of the Project Area;
- there has already been significant coal extraction in the West Borehole Seam in this region, which would have depleted any groundwater resource in that seam and the overlying coal seams if any resource previously existed;
- the affected seams subcrop immediately to the west of the continued underground mining area so that there is minimal potential for drainage of groundwater resources up-dip; and
- the proposed mining area covers a relatively small area when compared to the total coal basin, so that any additional regional impact would be negligible.

6.6.2.2 Compliance with NSW Aquifer Interference Policy

The predicted groundwater impacts associated with the Project have been assessed in relation to the NSW Aquifer Interference Policy which states that any mining activity must consider 'Minimal Harm Criteria' with respect to groundwater sources.

The groundwater assessment found that there will be no measurable impacts on the groundwater level, flow or water quality in the Palmers Creek alluvial aquifer from the extraction of LW 51 and LW 52 due to the separation distance of the aquifer from the proposed extraction. Consequently, the minimal impact criteria will be met for the alluvial aquifer in Palmers Creek. No impacts were predicted for any other alluvial aquifers.

The Groundwater Assessment also concludes that the Project will meet the minimal impact criteria for the fractured rock aquifer.

6.6.2.3 Compliance with Commonwealth Draft Significant Impact Guidelines

The Department of the Environment released the *Draft Significant Impact Guidelines: Coal Seam Gas and Large Coal Mining Developments – Impacts on Water Resources* for comment in June 2013. Although these guidelines are in draft form and may change, an assessment against these draft guidelines was completed for the Project. The groundwater assessment found that the Project was unlikely to result in a significant impact on groundwater and therefore does not need to be referred to the Commonwealth Minister in regard to potential impacts on groundwater resources.

6.6.3 Management Strategies

Although the impact of the Project on groundwater is predicted to be low, the NSW Aquifer Interference Policy indicates that monitoring is required to demonstrate that the Project does not exceed the minimal harm criteria for the identified groundwater sources. Consequently, the following monitoring is recommended to be carried out to monitor the impacts (if any) of the extraction of LW 51 and LW 52.

Ryhope Creek

The alluvium in Ryhope Creek will not be undermined by any longwall panels, and it contains no major aquifer of significance. Nevertheless, it is deemed to be worthy of consideration for future monitoring, since:

- it flows into Palmers Creek, which contains a major alluvial aquifer;
- there is a slight possibility that the flow in the creek may be impacted by mining at shallow depths of cover in the western domain further upstream; and
- a local nursery utilises groundwater from the alluvium in the creek.

Although it is considered highly unlikely that there will be any significant impacts on the groundwater in the alluvium due to the extraction of LW 51 and LW 52, the factors noted above dictate that some monitoring should continue to be undertaken as a precaution. Consequently, three monitoring bores that were installed in the lower section of the creek in 2009 to monitor the groundwater in the alluvium (R1, R5 and Q2) should continue to be monitored until the extraction has been completed. One of these (R5) has been established near the groundwater-fed dam utilised by the Ryhope Nursery.

Palmers Creek

Like Ryhope Creek, Palmers Creek will not be undermined by any future longwall panels, the nearest of which will be located approximately 170 metres from the productive alluvial aquifer. Nevertheless, because of the importance of the alluvial aquifer in the creek and the shallow depth of cover, two new monitoring bores (P4 and GW063752) have been established in the main aquifer zone to confirm that any changes in groundwater level or quality are less than the minimal impact considerations for connected alluvial water sources. These should be monitored for groundwater level and water quality for the duration of the Project.

Slattery's bore

Slattery's bore is the registered bore that is closest to the proposed mine workings (No. 64025), being located approximately 180 metres to the south of the longwall panels. The groundwater level in this bore has been monitored since 2009, and monitoring should be continued into the future until extraction of LW 51 and LW 52 is completed. This monitoring should detect any impacts from the mining and confirm whether they are less than the minimal impact considerations for affected water supply works.

6.7 Other Environment and Community Issues

6.7.1 Land Resources and Agriculture

6.7.1.1 Soils

The soil types occurring within the Project Area are mapped on the Newcastle 1:100,000 Soil Landscape Map Sheet (Matthei 1995). Soil landscapes present within the Project Area are presented in **Figure 6.12** and include:

- Killingworth Soil Landscape; and
- Warners Bay Soil Landscape.

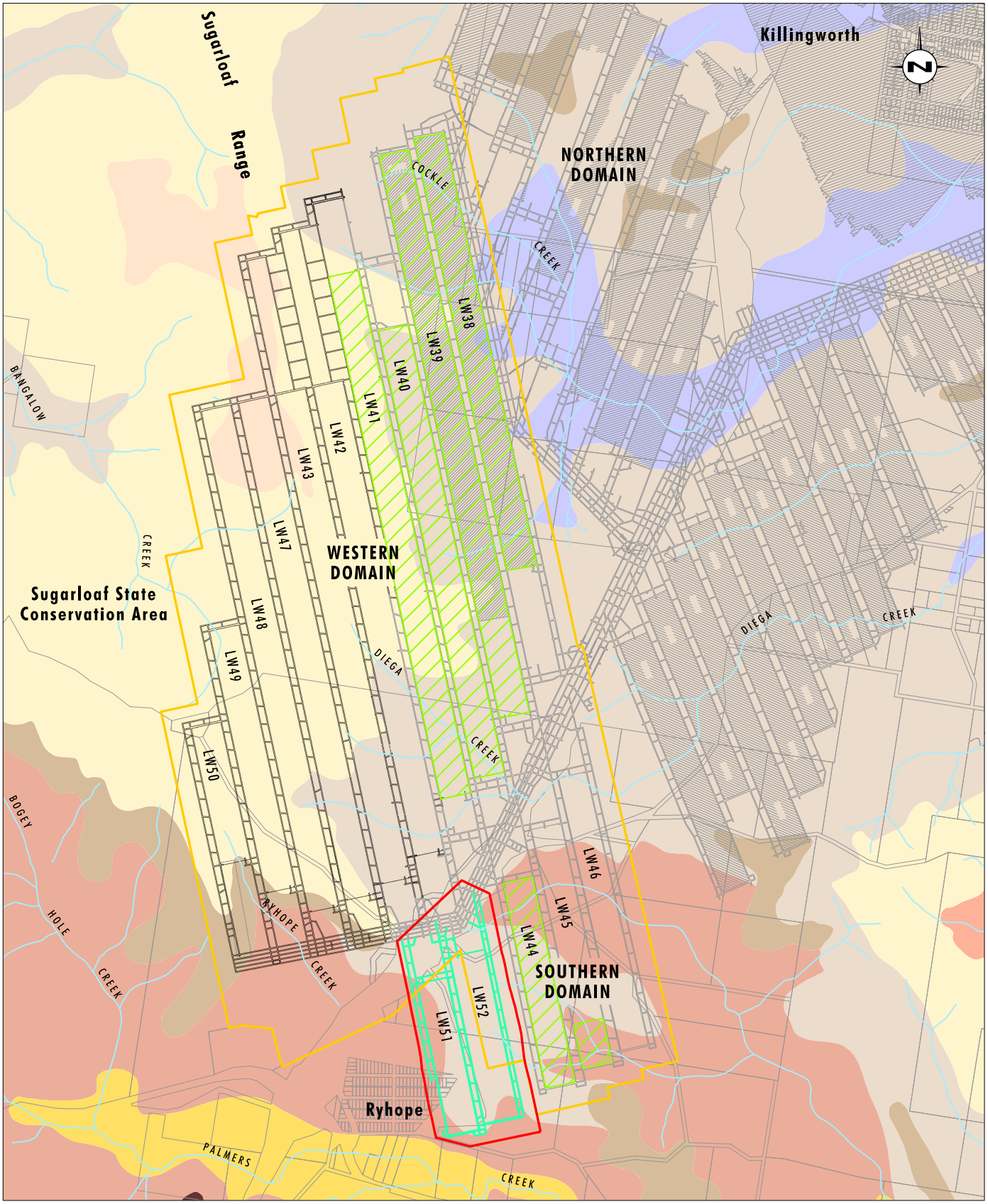
The majority of the Project Area is located within the Killingworth Soil Landscape (refer to **Figure 6.12**). The soils are generally shallow to moderately deep, well to imperfectly drained Yellow Podzolic Soils, Yellow Soloths, Gleyed Podzolic Soils and Gleyed Soloths on the crests and hillslopes, with shallow well-drained Structured Loams, Bleached Loams and Lithosols on some crests. The Killingworth and Killingworth variant soils have a high water erosion hazard, very strong acidity and low to very low fertility.

Some minor area of the Warners Bay Soil Landscape also occur within the Project Area (refer to **Figure 6.12**). The soils are moderately deep to deep, imperfectly to poorly drained and Gleyed Podzolic Soils, moderately well-drained Yellow Podzolic soils, and yellow Soloths with moderately deep, poorly drained Structured Loams in drainage lines. Water erosion hazard is moderate, with moderate gully erosion occurring in unvegetated drainage lines and moderate sheet and rill erosion occurring in disturbed, cleared areas. The Warners Bay soils have low to very low nutrient storage capacity and are extremely acidic.

Inspections of existing subsidence affected areas has indicated that limited transport of erosion occurs from subsidence cracking areas. Regardless, the subsidence monitoring program implemented at WWC identifies any significant erosion or sedimentation risk and the required management measures to mitigate this risk. Timely subsidence crack remediation is typically sufficient to mitigate erosion risk, however, other measures such as sediment and erosion control are implemented where necessary. This existing approach will be applied to mining within the Project Area.

6.7.1.2 Land Capability

Land capability is the ability of the land to maintain its productive potential under a specified use, without degradation. Climate, soils, geology, geomorphology, soil erosion, site and soil drainage characteristics and current land use data are all considered in determining land capability (Emery 1986). Eight classes of Rural land capability were defined by the then Soil Conservation Service for mapping rural lands (refer to **Table 6.5**). Land capability in the Project Area is shown on **Figure 6.13**.



Data Source: OCAL, Department of Lands (2006)

Legend

- Project Area
- Approved Continued Underground Mining Area
- Approved Underground Workings in the West Borehole Seam
- Longwall Progression as of October 2013
- Former Underground Workings
- Proposed Longwall Panels 51 and 52
- Drainage Lines

Soil Landscapes:

- Awaba
- Cockle Creek
- Gateshead
- Killingworth
- Killingworth Variant
- Sugarloaf
- Sugarloaf Variant
- Warners Bay
- Wyong

FIGURE 6.12

Soil Landscapes within the Continued Underground Mining Area and Project Area

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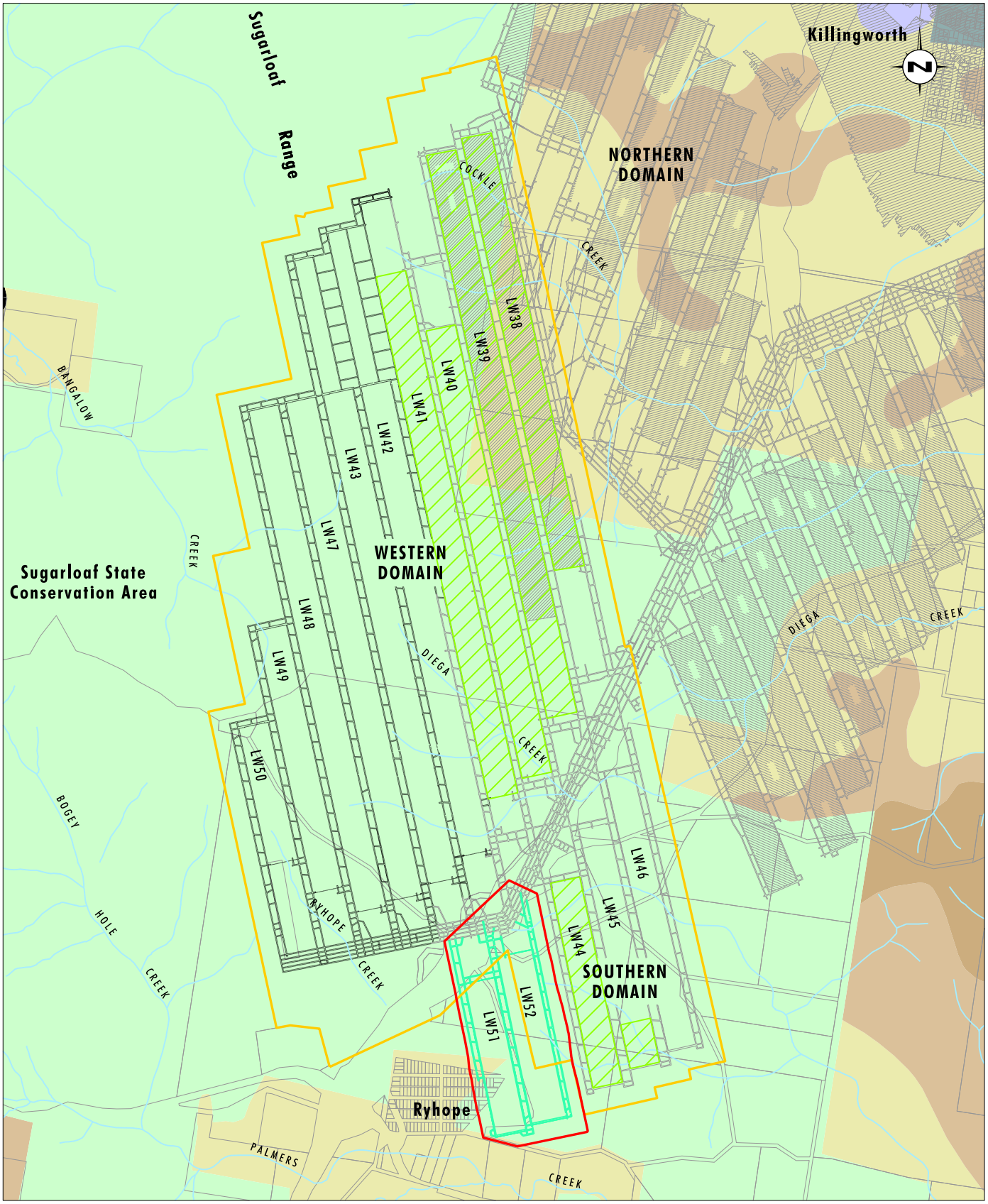

Data Source: OCAL, Department of Lands (2006)

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Legend

- Project Area
- Approved Continued Underground Mining Area
- Approved Underground Workings in the West Borehole Seam
- Longwall Progression as of October 2013
- Former Underground Workings
- Proposed Longwall Panels 51 and 52
- Drainage Lines

Land Capability:

- Mining and Quarrying Areas
- State Conservation Area
- Class IV - Suitable for Grazing with Occasional Cultivation
- Class VI - Suitable for Grazing with No Cultivation
- Urban Area
- Other

FIGURE 6.13

Existing Land Capability within the Project Area and Surrounds

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Table 6.5 – Rural Land Capability Classes

General Capability	Land Capability Classes	Interpretation and Implication
Suitable for regular cultivation	I	Suitable for a wide variety of uses. Where solids are fertile, has the highest potential for agriculture. Includes 'prime agricultural land.
	II	Usually gently sloping land suitable for a wide variety of agricultural uses. Includes 'prime agricultural land'.
	III	Sloping land suitable for cropping on a rotational basis. Soil erosion problems are severe. Generally fair to good agricultural land
Suitable for grazing and occasional cultivation	IV	Land not suitable for cultivation on a regular basis owing to limitations of slope gradient, soil erosion, shallowness or rockiness, climate, or a combination of these factors. Comprises the better classes of gazing land.
	V	Land not suitable for cultivation on a regular basis owing to considerable limitations of a slope gradient, soil erosion, shallowness or rockiness, climate, or a combination of these factors. Soil erosion problems are often severe. Production is generally lower than for grazing lands in Class IV.
Land best protected by green timber	VI	Generally comprises areas of steep slopes, shallow soils and/or rock outcrop.
Unsuitable for agricultural or pastoral uses	VII	Cliffs, lakes or swamps and other lands unsuitable for agricultural and pastoral production

Land within the Project Area is primarily part of the SSCA with a small portion of Class IV land located within LW 51 (refer to **Figure 6.13**). Class IV land is potentially suitable for grazing purposes but not suitable for cultivation on a regular basis. In this case, as discussed below, there is no agricultural use of the land within the Project Area with most of the area being managed for conservation. Following underground mining, the land capability within the subsidence affectation zone will remain unchanged. Therefore the Project is not expected to impact on land capability.

6.7.1.3 Agricultural Potential

There is not currently any agricultural use of the land within the Project Area. As discussed throughout this EA, the Project Area is located within an expansive tract of native vegetation associated with the Sugarloaf Range linking the Watagan Mountains to Mount Sugarloaf. The majority of the Project Area is part of the SSCA and is therefore not available for agricultural use. The remainder of the Project Area is either associated with infrastructure (e.g. roads) or is owned by LMCC. LMCC proposes to maintain its land holding as native vegetation and is currently investigating the potential to use this land as a biodiversity offset. Therefore, the potential for any future agricultural land uses in the Project Area is remote. Although the Project will result in subsidence impacts and some ground disturbance due to cracking and remediation works, relatively small areas will be impacted and there no major impacts to soil and surface water resources are predicted. Therefore, the Project is considered unlikely to significantly impact on the future agricultural potential of the land within the Project Area should future generations change its land use.

In regard to agricultural land outside the Project Area, the key aspect requiring consideration is the Palmers Creek alluvial area to the south. There is some limited agricultural activity in this alluvial area. As there will be no direct impact on this area due to the Project, the only potential impact relates to impacts on surface water and groundwater. As discussed in **Section 6.5**, no significant downstream surface water impacts are predicted as a result of the Project. In regard to potential groundwater impacts, the Project was designed to avoid impacting on the Palmers Creek alluvial aquifer and the groundwater assessment does not predict an adverse impact on this aquifer. There is also one privately owned bore that requires consideration in regard to the Project. As discussed in **Section 6.6.2**, this bore is approximately 180 metres from the longwall extraction area and the Project is not predicted to impact significantly on the aquifer that supplies the bore. Monitoring of this bore is proposed to confirm this prediction and in the unlikely event that an unpredicted significant impact occurs, OCAL will implement remedial actions in consultation with the owner as required by Condition 15 of Schedule 4 of the WWC Project Approval. No other groundwater bores have the potential to be adversely impacted by the Project.

Therefore, the Project is not predicted to result in any significant impacts on surrounding agricultural land uses.

6.7.1.4 LMCC Land

As discussed in **Section 1.3.3** there are several undeveloped properties within the Project Area owned by LMCC. Based on OCAL's discussions with LMCC, it is understood that LMCC is considering this land as a biodiversity offset for other developments in the Lake Macquarie LGA. Based on the findings of the subsidence assessment (refer to **Appendix 3**), it is estimated that cracks of up to 240 millimetres wide could develop on some of the lots owned by LMCC. Remediation of larger cracks may be required. The predicted tilts are likely to decrease the existing gradients on the lots by up to 5° (currently 10° to 20°) to leave a range of 5° to 15° after mining.

As discussed in **Section 6.3**, although subsidence will result in impacts to some ecological values, the Project is not expected to result in a significant loss of floristic diversity or community composition, or fauna habitat within the Project Area. Therefore, the Project is not incompatible with the use of this land as a biodiversity offset should this option be pursued by LMCC.

6.7.2 Visual Amenity

6.7.2.1 Existing Visual Amenity

The visual character of the broader WWC operational area is diverse, with a range of landforms, vegetative cover patterns and land uses resulting in variations in scenic quality. The majority of the area is, however, dominated by the Sugarloaf range which provides a high scenic quality consisting of heavily forested slopes and ridges that bound the western edge of the WWC operations area. The Project Area forms part of the lower slopes of the Sugarloaf Range and is covered with native vegetation. The northern part of the Project Area contains sections of the M1 Motorway and Wakefield Road which dominate the visual landscape in this area.

The dominant land uses within and adjacent to WWC operations include conservation (the SSCA), mining, rural residential holdings and the residential areas of Killingworth, Barnsley, Wakefield and Ryhope. The M1 Motorway and other services corridors such as transmission lines, are also a significant component of the visual character of the area. This infrastructure contrasts to the more natural surroundings of the SSCA.

When within the landscape above LW 51 and LW 52, the visual character is consistent with that of the broader SSCA area being a natural bushland setting with variability in vegetative patterns and topography, and with minimal areas of disturbance. Areas of disturbance are generally restricted to access tracks, trail bike tracks, some infrastructure corridors (e.g. roads and nearby powerlines) and more distant views of more major infrastructure such the M1 Motorway.

6.7.2.2 Visual Assessment

As the Project involves underground mining and does not include any changes to existing WWC surface infrastructure, it has a generally limited potential to result in significant visual impacts. Potential impacts are those associated with subsidence impacts (e.g. cracking, isolated tree falls, subsidence remediation works and associated activities). Due to the forested cover of the Project Area, there is limited potential for these impacts to be visible from outside of the Project Area with the key potential impacts therefore limited to users of the SSCA. As the Project Area is heavily vegetated, these areas will generally be visible for users of the SSCA only when in proximity to impacted areas.

Views of subsidence impact, subsidence remediation works, temporary safety fencing and signage will be available from within the SSCA above each longwall, when in the vicinity of these features. The subsidence remediation works themselves (e.g. grouted cracks) are visible but only from the immediate vicinity of the remediated area and are not likely to be visually intrusive. The temporary fencing and signage erected around subsidence areas is out of character for the 'natural' SSCA area. These safety controls are generally only visible from the close proximity of the affected areas and not from more broadly within the SSCA area. They are removed once subsidence and required remediation works are finished.

Overall, the Project is predicted to result in minimal visual impacts. There will be very limited impacts associated with views from outside the Project Area whilst there will be a moderate and very local impact on visual amenity for views from within the area above the mining area. This impact will only occur during mining and will only impact on people within the SSCA when they are in proximity to the affected areas.

6.7.3 Public Amenity

In accordance with OCAL's Public Safety Management Plan, the surface above longwall extraction areas is demarcated as a restricted access area until subsidence impacts are remediated and the area deemed safe for public use. Therefore, for the duration of mining of each longwall block, public access is restricted to part of the SSCA. The section of the SSCA to be undermined by longwall extraction is approximately 0.01 per cent of the total SSCA area, with access to this area to be restricted for approximately 6 months for each longwall panel.

There is no information available regarding the frequency of visitation to the section of the SSCA to be undermined by the Project, however based on anecdotal evidence it is considered that the area is not widely used by the public, with limited public usage recorded by OCAL during its activities in this area. It is noted that the gate providing access to this area from Wakefield Road is locked and therefore public vehicular access is limited.

The public safety measures implemented above longwall extraction areas such as safety fencing and signage, along with the visual impacts discussed in **Section 6.7.2**, affect public amenity within the SSCA in the vicinity of the mining area. This impact is mitigated as it is not a permanent impact, only occurring for the time required for mining and subsequent remediation work; a timeframe of approximately 6 months for each of the proposed longwall panel. OCAL also undertakes all works within the SSCA in consultation with OEH and seeks to undertake this work in a manner that minimises impacts on the public use of the SSCA.

6.7.4 Historic Heritage

6.7.4.1 Historical Context

The Project Area forms part of a landscape that was historically closely linked to both mining and forestry. The Sugarloaf Range was the traditional country of the Awabakal people prior to European contact and continues to be highly valued by Aboriginal people.

In 1800 Captain William Reid first discovered the coal resources of the Lake Macquarie area. Settlement in the area was not permitted by Governor Macquarie for security reasons until after the closure of the Newcastle penal settlement in favour of one at Port Macquarie. Apart from escaped convicts and their pursuers and hunting parties, few Europeans would have visited the area until the mid 1820s.

As the Lake Macquarie region did not offer the best conditions for agricultural development, by 1833 only 13 grants had been made to settlers. The first village to appear in the region of Lake Macquarie was Newport at the mouth of Dora Creek where farmers and timber getters formed a community in the early 1840s. In the 1860s there were several new subdivisions of Crown Lands under the Robertson Land Acts of 1861 which led to a number of new villages appearing as landowners were attracted to the areas opportunities to acquire a small holding and employment in the timber, mining, shipping or fishing industries.

The area that covers the present West Wallsend residential area was granted to the West Wallsend Coal Co. on 8 January 1889. West Wallsend was founded on coal mining and in July 1888 the West Wallsend Coal Co. colliery commenced production after several years of preparation. During 1886 and 1888 approximately 40 workers were employed on shaft sinking and foundation work for the start of the coal mines.

The timber industry was also historically regarded to be of high importance as the demand for timber in the Lake Macquarie area increased with the establishment of coal mining. The start of the railway system in NSW in 1855 also created an immediate demand for timber. The majority of timber was supplied to local underground mines for pit props, however with the advent of open cut mining and longwall mining techniques eventually arising, there became a substantial decrease in the demand for mining timbers (DECC 2008:2). If present, evidence of former sleeper cutting activities generally relates to the period between 1890 and 1930 during the peak period of railway expansion in NSW.

A Historical Heritage assessment was undertaken for the WWC Continued Operations EA by Umwelt (Umwelt 2010). The assessment was undertaken in accordance with all relevant guidelines and included a review of relevant heritage databases. The assessment also included a comprehensive site survey of the continued underground mining area.

Several trees with potential historical wounds, scars or surveyor's marks were the only potential historical heritage sites identified within the continued underground mining area. The wounds, scars or surveyor's marks include:

- a surveyor's blaze on a tree near Diega Creek (Tree 10/Diega Creek);
- a surveyor's blaze on a tree near Bangalow Creek (Tree 2/Bangalow Creek ST1);
- a wound likely made by timber getters for food storage on a tree near Diega Creek (Tree 6/Diega Creek ST3); and
- a burl removal wound on a tree near Bangalow Creek (Tree 9/Bangalow Creek ST3).

None of these sites occur in the Project Area.

An abandoned underground bord and pillar mine is also known to exist in the Great North Seam in the Western Domain. Again this site is outside the Project Area.

Mt Sugarloaf and the Sugarloaf Range is also a listed heritage item. Mt Sugarloaf and the Sugarloaf Range were assessed as having low state significance, high regional significance and very high local significance. There will be no impact on Mt Sugarloaf as a result of the Project.

6.7.4.2 Historic Heritage Assessment

As part of the historic heritage assessment, a review of relevant heritage databases was undertaken on the 22 November 2013 including:

- the NSW State Heritage Register (SHR) and the State Heritage Inventory maintained by the NSW Heritage Council;
- the Australian Heritage Database (including Commonwealth and National Heritage Lists and the Register of the National Estate (RNE)), which is maintained by the Department of Sustainability, Environment, Water, Population and Communities (DSEWPAC); and
- Lake Macquarie Local Environmental Plan (LEP) 2004.

The database review identified no sites/items subject to any form of statutory heritage listing within or in the immediate vicinity of the Project Area, with the closest heritage items located within West Killingworth and West Wallsend. As such, the Project is not expected to impact any listed State significant or locally significant historic heritage items.

An archaeological survey was conducted of the Project Area in conjunction with the Aboriginal archaeological survey. This survey did not identify any historic heritage sites. Therefore, the Project will not impact on any known historic heritage sites.

6.7.4.3 Management Strategy

Although no historic heritage sites are known to occur within the Project Area, WWC undertakes archaeological due diligence inspections of subsidence remediation areas. These inspections address both Aboriginal archaeology and historic heritage. In the unlikely event that any presently unknown historic heritages sites are identified as part of these inspections, these sites will be managed in accordance with the mitigation measures outlined within WWC's Heritage Management Plan.

6.7.5 Socio-economic

A detailed assessment of the socio-economic impacts of WWC's operation was undertaken as part of the WWCCOP EA (Umwelt 2010). As discussed throughout this EA, the Project is not extending the approved life of WWC as it is essentially replacing some of the approved coal that will not be mined. The Project will not therefore result in socio-economic impacts any greater of those associated with the currently approved operations.

The key economic benefits of WWC include the significant economic benefit to the State and region associated with job creation, expenditure, ongoing operational expenditure, and stable employee population associated with the Project. The Project will not change these existing benefits, including no change to employment at WWC, however, it will result in these benefits continuing for another 12 months. A detailed economic analysis completed for WWC (Gillespie Economics 2010) identified that WWC is anticipated to contribute:

- $448 million and $644 million in annual direct and indirect output or business turnover at a regional and State level, respectively;
- $214 million and $318 million in annual direct and indirect value added to regional and State level, respectively;
- $83 million and $143 million in annual direct and indirect household income at a regional and State level, respectively; and
- indirect and direct employment of approximately 775 and 1634 people at a regional and state level, respectively, over the life of the Project.

These benefits would continue for an additional 12 months with the Project, replacing the benefits that would otherwise be lost due to the reductions in the areas of coal to be extracted by WWC.

As the current workforce will not change as a result of the Project, existing services in the area that currently cater for the existing workforce will continue to provide their services without pressure or increased demand.

OCAL values its relationship with the local community and has an existing Social Involvement Plan (SIP) as part of its EMS for its operations. The SIP identifies the stakeholders with an interest in the WWC operations, assesses stakeholder needs and outlines the sites Stakeholder Engagement Strategy. The Stakeholder Engagement Strategy also incorporates the site's annual face to face consultation program and annual community donation and support programs. Consultation with relevant stakeholders includes affected landholders, the surrounding community, relevant government agencies, service providers and Aboriginal stakeholder groups.

Specifically for this Project, OCAL distributed a community newsletter that provided information about the Project and included an offer to meet and discuss the Project with any interested persons. OCAL also contacted the nearby landholders to the Project Area in the Ryhope area to provide them with a specific briefing. Issues raised by the community in regard to the Project included subsidence and potential groundwater impacts, in addition to general subsidence related impacts associated with WWC's broader mining operations.

OCAL will continue to engage with the community as part of the implementation of the Project. It is currently anticipated that this engagement will include the following:

- periodic distribution of a community newsletter;
- continued operation of a 24 hour community hotline for receipt of community complaints. WWC undertakes to respond to community complaints promptly following receipt. All complaints are investigated and the results of the investigation reported to the complainant in a timely manner; and
- reporting of all community complaints in the sites DP&I Annual Review as well as on the WWC website.

7.0 Summary of Environmental Monitoring and Management Measures

The WWC Project Approval contains a comprehensive set of conditions that specify the relevant monitoring and management measures that are to be implemented as part of the Project. These measures also incorporate the commitments made by OCAL in the 2010 EA and work in conjunction with measures required by WWC's other mining and environmental approvals including Environment Protection Licence, Mining Leases and water licences.

As discussed in **Section 2.1**, WWC also has a range of statutory management plans that outline the management and monitoring measures that will be applied to mining at WWC. These plans have been prepared in consultation with and approved by relevant government agencies and will be updated and applied to the Project.

As discussed in **Section 2.1**, WWC also has an existing monitoring program in place. The monitoring program meets the requirements of WWC's various environmental approvals and is outlined in the relevant environmental management plans. This monitoring program will be updated and applied to the Project.

WWC also has an internal Environmental Management System (EMS) prepared in general accordance with ISO14001, the international standard for EMS, which identifies the processes and procedures that need to be implemented to assist in minimising WWC's interaction with the local environment and community.

The above current approvals, management plans, management processes and monitoring programs provide a sound basis for the implementation of the required monitoring and management measures for the Project. All of these existing measures will be updated as appropriate and implemented for the Project.

In addition to these existing measures, the measures outlined below that are specific to the mining of LW 51 and LW 52 will be implemented as part of the Project.

<u>Subsidence</u>

- The Project will include implementation of subsidence management strategies and subsidence monitoring in accordance with the SMP/Extraction Plan that will be prepared for the Project and as outlined in **Section 6.2.5**. All relevant works within the SSCA will continue to be undertaken in accordance with consents issued by OEH.

<u>Ecology</u>

- Ecology due diligence inspections will be undertaken for any proposed surface disturbances (e.g. boreholes, subsidence monitoring lines) and for subsidence remediation works that may impact on ecological values. These ecological inspections will identify specific ecological values that may be impacted and allow specific strategies to minimise impacts to be determined and implemented.

- As with existing practice at WWC, to reduce the potential for ecological impact resulting from the subsidence remediation works, remediation works be undertaken either using manual techniques or using the smallest practical machinery.

- This existing ecological monitoring program will be applied to LW 51 and LW 52, with two permanent monitoring plots to be established above the longwall extraction area and monitored annually before, during and after mining.

- Consistent with the existing approach in place at WWC, as outlined in Commitment 6.4.1 of the WWCCOP EA, in the event that significant impacts on identified ecological values are identified and cannot be adequately remediated, WWC will engage a suitably qualified and experienced ecologist to prepare a Biodiversity Offset Strategy in consultation with OEH and DP&I.

Aboriginal Cultural Heritage and Archaeology

- WWC will revise the WWC ACHMP to include the Aboriginal cultural and archaeological management commitments made in this EA. The revised ACHMP will provide detailed management strategies for all identified Aboriginal archaeological sites within the Project Area. The ACHMP includes provisions for undertaking archaeological due diligence inspections prior to undertaking certain works associated with mining.

- Collection of the Palmers Creek IF5 surface artefact. The artefact will be returned to the Palmers Creek IF5 site area following cessation of subsidence remediation works. The artefact will be returned as close as possible to its collection location. A new site card will be provided to OEH identifying the new location.

- Monitoring of the scarred tree following subsidence to assess the level of impact (if any) and to employ the most appropriate subsidence mitigation for the ongoing care of the tree. Mitigation options following cessation of subsidence include:

    - if there are no obvious subsidence impacts to the tree or the soil profile in its surrounds post subsidence re-inspect the tree approximately one month and three months after undermining and if still in good health no further management is required; OR

    - if there are no obvious subsidence impacts to the tree but the soil profile in its surrounds has cracked, infill the cracks as soon as practicable with imported fill avoiding any damage to the tree. Re-inspect the tree approximately one month and three months after undermining and if still in good health no further management required; OR

    - if the tree has fallen and/or the tree is dying, with the assistance of a suitably qualified arboriculturalist remove the section of the tree with the scar. Treat the section of the tree removed for its preservation and in consultation with the registered Aboriginal parties determine an appropriate location for its ongoing storage.

- Implementation of the subsidence monitoring program to review the potential for any erosion and sedimentation from subsidence cracking, and the potential for sediment to enter the creeks upstream of the grinding groove sites. Appropriate erosion and sediment controls will be implemented where the potential for impact exists.

- Ongoing monitoring by the registered Aboriginal parties and a qualified archaeologist following the cessation of all subsidence impacts to record actual impacts to sites, if any, due to subsidence and identify any required management measures.

- Using clean imported fill, sourced from the closest available location, to repair soil cracking near Aboriginal sites, rather than ripping/dozing.

Surface Water

- Extend the existing surface water monitoring program to include the Project. This existing program includes parameters such as creek cross-sections, longitudinal profile, geomorphic units, riparian vegetation, erosion or accretion, sediment type and the amount of exposed bedrock. Monitoring is conducted prior to the commencement of mining, immediately after the first post-mining storm event, three months to six months post mining and 12 months to 18 months post mining.

- Where surface subsidence mitigation works are required to be undertaken, appropriate erosion and sediment control measures will be designed and implemented during site works and establishment of revegetation. All surface mitigation works will be undertaken in consultation with OEH and DRE when within the SSCA.

Groundwater

- Monitoring for groundwater level and water quality in the two monitoring bores installed in the Palmers Creek alluvium (P4 and GW063752) for the duration of the Project.

- Ongoing monitoring of the three monitoring bores in the lower section of the Ryhope Creek alluvium (R1, R5 and Q2) for the duration of the Project.

- Ongoing monitoring of groundwater level in Slattery's bore (No. 64025), located to the south of the Project Area, for the duration of the Project.

- In the unlikely event that an unpredicted significant impact occurs to Slattery's bore, OCAL will implement remedial actions in consultation with the owner as required by Condition 15 of Schedule 4 of the WWC Project Approval.

Historic Heritage

- Historic heritage due diligence inspections will be undertaken for any proposed surface disturbances (e.g. boreholes, subsidence monitoring lines) and for subsidence remediation works that may impact on historic heritage values. These inspections will be undertaken in conjunction with Aboriginal archaeology due diligence inspections.

- In the unlikely event that any presently unknown historic heritages sites are identified as part of these inspections, these sites will be managed in accordance with the mitigation measures outlined within WWC's Heritage Management Plan.

Community Engagement

- OCAL will continue to engage with the community as part of the implementation of the Project. It is currently anticipated that this engagement will include the following:

    - continued functionality of the WWC Community Consultative Committee;
    - periodic distribution of a community newsletter;
    - continued operation of a 24 hour community hotline for receipt of community complaints. WWC undertakes to respond to community complaints promptly following receipt. All complaints are investigated and the results of the investigation reported to the complainant in a timely manner; and
    - reporting of all community complaints in the sites DP&I Annual Review as well as on the WWC website.

8.0 Conclusion

8.1 Objects of the EP&A Act

The objects of the EP&A Act relevant to the Project encourage:

- the proper management, development and conservation of natural and artificial resources;
- the promotion and co-ordination of the orderly and economic use and development of land;
- the protection of the environment;
- ecologically sustainable development (refer to **Section 8.2**); and
- to provide increased opportunity for public involvement and participation in environmental planning and assessment.

The Project includes the ongoing development of WWC through the development of additional coal resources within existing mining lease areas, maximising the use of existing mining infrastructure. OCAL has sought to optimise the Project design to minimise environmental impacts by avoiding significant environmental, cultural and built features (e.g. Palmers Creek alluvium, Aboriginal grinding groove sites and Wakefield Road and the M1 Motorway), whilst maximising recovery of the coal resource. The target coal seam is the same coal seam currently mined by longwall methods at WWC and is a logical extension of the existing mining operations.

The environmental and social impacts associated with the Project have been comprehensively assessed as part of this EA (refer to **Section 6.0**) and OCAL has committed to appropriate ongoing environmental management and mitigation measures to minimise potential impacts and protect the environment (refer to **Section 7.0**). As outlined in **Section 5.0** of this EA, OCAL has undertaken an engagement process with a range of stakeholders including the surrounding community, with key issues raised considered and addressed in the EA. This process of ongoing public participation will continue through the exhibition of the EA and through OCAL's ongoing community engagement program.

8.2 Ecologically Sustainable Development

An objective of the EP&A Act is to encourage Ecologically Sustainable Development (ESD) within NSW. As outlined in **Section 1.4**, the Project requires approval from the Minister for Planning and Infrastructure under Section 75W of the EP&A Act. This section provides an assessment of the Project in relation to the principles of ESD.

To justify the Project with regard to the principles of ESD, the benefits of the Project in an environmental and socio-economic context should outweigh any negative impacts. The principles of ESD encompass the following:

- the precautionary principle;
- inter-generational equity;
- conservation of biological diversity; and
- valuation and pricing of resources.

Essentially, ESD requires that current and future generations should live in an environment that is of the same or improved quality than the one that is inherited.

8.2.1 The Precautionary Principle

The EP&A Regulation defines the precautionary principle as:

> 'if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In the application of the precautionary principle, public and private decisions should be guided by:
>
> (i) careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment, and
> (ii) an assessment of the risk-weighted consequences of various options.

In order to achieve a level of scientific certainty in relation to potential impacts associated with the Project, this EA has undertaken an extensive evaluation of all the key components of the Project. Detailed assessment of key issues and necessary management measures has been conducted and is documented in this EA.

The assessment process has involved a detailed study of the existing environment and the use of engineering and scientific modelling and investigation, to assess and determine potential impacts as a result of the Project.

The decision making process for the design, impact assessment and development of management processes has been transparent in the following respects:

- Government authorities, landholders potentially affected by the proposed development, the local community, the Aboriginal community and other stakeholders were consulted during EA preparation (refer to **Section 5.0**). This enabled comment and discussion regarding potential environmental impacts and proposed environmental management procedures;

- OCAL has designed and implemented a comprehensive Environmental Management System (EMS), and related environmental management programs, that seek to minimise the potential environmental and social impacts of its operation. The Project will incorporate the practices implemented and demonstrated to be effective at WWC and has built on learnings from past monitoring programs and liaison with stakeholders. The existing EMS will be revised to incorporate the additional controls outlined in this EA;

- this EA has been undertaken on the basis of the best available scientific information for the Project Area. Where uncertainty in the data used in the assessment has been identified, a conservative worst-case analysis has been undertaken and contingency measures have been identified to manage that uncertainty; and

- an auditing and review process is an integral component of the EMS at WWC providing for verification of project performance by independent auditors and relevant government agencies. The Project will implement an auditing and verification process consistent with that currently undertaken at the current WWC operations and as required by the existing WWC Project Approval.

As discussed in **Sections 2.1.1** and **6.2**, during past mining at WWC in LW 41, some unpredicted subsidence events occurred. The learnings from these unpredicted events have been incorporated into the Subsidence Assessment conducted by DGS for this Project. This includes the potential for VBM's associated with discontinuities in the strata and rigid block rotation being incorporated into the subsidence model resulting in the most up-to-date local scientific knowledge for subsidence being used to complete this assessment.

8.2.2 Intergenerational Equity

The EP&A Regulation defines the principal of intergenerational equity as:

> 'that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations.'

Intergenerational equity refers to equality between generations. It requires that the needs and requirements of today's generations do not compromise the needs and requirements of future generations in terms of health, biodiversity and productivity.

The objective of the Project is to allow for the efficient recovery of the coal resources within the Project Area in a manner that achieves the best practical safety, environmental, social and economic outcomes while aiming to minimise the associated environmental impacts. The environmental management measures discussed in **Sections 6.0** and **7.0** have been developed to minimise the impact on the environment.

The management of environmental issues as outlined in the EA will assist to maintain the health, diversity and productivity of the environment for future generations. The Project will also contribute to maintaining the economy and services in the community through the direct and flow on effects of employee and operational expenditure.

8.2.3 Conservation and Biological Diversity

The EP&A Regulation identifies that the principal of conservation of biological diversity and ecological integrity should be a fundamental consideration in the decision making process. The conservation of biological diversity refers to the maintenance of species richness, ecosystem diversity and health and the links and processes between them. All environmental components, ecosystems and habitat values potentially affected by the Project are described in the EA (refer in particular to **Section 6.3** and **Appendix 5**). Potential impacts are also outlined in the EA (refer to **Section 6.3**) and measures to ameliorate any negative impact are outlined in **Sections 6.3** and **7.0**.

The ecological assessment completed for the Project (refer to **Section 6.3**) found that although the Project will impact on ecological values, the majority of vegetation and fauna habitat in the Project Area will remain largely undisturbed. The assessment also found that the predicted impacts are not expected to result in a significant loss of floristic diversity or community composition, or fauna habitat within the Project Area, the SSCA or the region, and that the Project is not predicted to result in a significant impact on threatened species, EPs or TECs known or with potential to occur in or around the Project Area.

As outlined in **Section 7.0**, OCAL has committed to a range of measures to minimise the ecological impacts of the Project.

8.2.4 Valuation and Pricing of Resources

The goal of improved valuation has been defined in the EP&A Regulation as:

> 'that environmental factors should be included in the valuation of assets and services, such as:
> (i) polluter pays, that is, those who generate pollution and waste should bear the cost of containment, avoidance or abatement,
> (ii) the users of goods and services should pay prices based on the full life cycle of costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste,
> (iii) environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms, that enable those best placed to maximise benefits or minimise costs to develop their own solutions and responses to environmental problems'.

OCAL has valued the environmental resources by designing the Project to avoid and minimise potential environmental impacts as much as possible, whilst also providing for effective recovery of the coal resources at WWC. Where residual impacts remain, mitigation measures (refer to **Section 6.0** and **Section 7.0**) are proposed to further reduce potential impacts on the environment.

The polluter pays principle applies to the Project through the regulatory regime applying to WWC's Environment Protection Licence. Pricing of resources is also captured in the regulatory regime applying to groundwater extractions as fees are paid to the NSW Government for extracting groundwater. Project feasibility considerations have included the costs of management measures to minimise potential environmental and social impacts.

The Project also optimises the valuation and pricing of the coal resources by:

- optimising available use of the existing mining infrastructure, coal processing and transportation facilities to extract, wash coal and transport product coal to existing markets; and

- maximising the efficient extraction of the coal resource and avoiding the isolation and sterilisation of coal through effective mine planning.

8.3 Conclusion

The Project is an outcome of a detailed review undertaken of the WWC operations by OCAL, including review of the remaining coal resources within the WWC Mining Leases. As part of this review OCAL has identified that it will not mine some of the currently approved coal resources at WWC to provide protection for environmental features above the approved mining area and to ensure compliance with its Project Approval subsidence performance criteria. The approved areas of coal already not mined combined with those no longer planned to be mined, equates to approximately 3 Million tonnes of coal.

This review process also identified that with the recent return of an area previously sub-leased to the adjacent Newstan Colliery, two additional longwall blocks (LW 51 and LW 52) could be mined within the existing WWC mining lease area.

The conceptual mining layout for LW 51 and LW 52 was developed by OCAL following consideration of a range of features and the findings of environmental studies. Key environmental and infrastructure considerations for the mine plan design included:

- avoiding impacts to significant Aboriginal cultural heritage and archaeological sites located to the east of the proposed mining area;
- minimising potential impacts to identified areas of alluvium to the south of the Project Area along Palmers Creek;
- minimising potential impacts to Wakefield Road and the M1 Motorway to the north of the proposed mining area; and
- avoiding an area of low depth of cover to the west of the proposed mining area.

This EA has provided a detailed assessment of the potential environmental and social impacts associated with the Project and has identified appropriate mitigation and monitoring measures that will be implemented to minimise impacts.

The Project will provide for continued operations at WWC which provides the following benefits.

- ongoing employment of approximately 390 people during the mining of LW 51 and LW 52, with many more indirect jobs created through flow-on effects. The mining of LW 51 and LW 52 will take approximately 12 months;
- recovery of approximately 2.55 Mt of ROM coal;
- payment of significant royalties to the State of NSW due to the extraction of this coal. The existing WWC operations paid approximately $18 million in royalties in 2012 and 2013 financial reporting periods, with the estimated royalties for the predicted coal sales for LW 51 and LW 52 being approximately $6.6M;
- efficient and economic recovery of a valuable coal resource that is unlikely to be economically extracted by any other mining operation. The existing mine workings and mining infrastructure at WWC provide the opportunity to economically extract this resource;
- continued export earnings for Australia; and
- significant economic benefits to the local community through ongoing local employment, purchase of goods and services, and local expenditure both directly and through employee wages during the mining of LW 51 and LW 52.

9.0 References

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