

APPENDIX D

Appendix D - Subsidence Workshop Report

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TAHMOOR
UNDERGROUND

GLENCORE



July 2014

Tahmoor South Project
Subsidence Workshop

Tahmoor Underground

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1 INTRODUCTION

Tahmoor Coal owns and operates the Tahmoor Mine, an underground coal mine approximately 80 km south-west of Sydney, in the Southern Coalfields of NSW. Tahmoor Coal produces up to 2 million tonnes per annum (Mtpa) of product coal from its existing operations at the Tahmoor Mine, and undertakes underground mining under existing development consents, licences and the conditions of relevant mining leases.

Tahmoor Coal is seeking approval for the Tahmoor South Project (the Project), being the extension of underground coal mining at Tahmoor Mine, to the south and east of the existing Tahmoor Mine surface facilities area. The proposed development will continue to be accessed via the existing surface facilities at Tahmoor Mine, located between the towns of Tahmoor and Bargo.

The proposed development seeks to extend the life of underground mining at Tahmoor Mine until approximately 2040. The proposal will enable mining to be undertaken within the southern portion of Tahmoor Coal's existing lease areas and for operations and employment of the current workforce to continue for a further 18 years.

The proposed development will extend mining at Tahmoor Mine within the Project Area, using longwall methods, with the continued use of ancillary infrastructure at the existing Tahmoor Mine surface facilities area. The Project Area is adjacent and to the south of the Existing Tahmoor Approved Mining Area. It also overlaps a small area of the Existing Tahmoor Approved Mining Area comprising the surface facilities area, historical workings and other existing mine infrastructure.

The proposed development will use longwall mining to extract coal from the Bulli seam within the bounds of CCL 716 and CCL 747. Coal extraction of up to 4.4 Mtpa ROM is proposed as part of the development. Once the coal has been extracted and brought to the surface, it will be processed at Tahmoor Mine's existing Coal Handling and Preparation Plant (CHPP) and then transported via the existing rail loop, the Main Southern Railway and the Moss Vale to Unanderra Railway to Port Kembla for export to the international market.

The components of the proposed development comprise:

- Mine development including pit bottom redevelopment, vent shaft construction, pre-gas drainage and service connection
- Longwall mining in the Central and Eastern Domains
- Upgrades to the existing surface facilities area including:
 - upgrades to the CHPP
 - expansion of the existing reject emplacement area (REA)
 - additional mobile plant for coal handling
 - additions to the existing bathhouses, stores and associated access ways
 - upgrades to offsite service infrastructure, including electrical supply
- Rail transport of product coal to Port Kembla
- On-going exploration
- Mine closure and rehabilitation
- Environmental management

2 SOUTHERN COALFIELD INQUIRY

The Minister for Planning and the Minister for Primary Industries, during December 2006, directed that an Independent Expert Panel be constituted to:

1. *Undertake a strategic review of the impacts of underground mining in the Southern Coalfield on significant natural features (i.e. rivers and significant streams, swamps and cliff lines), with particular emphasis on risks to water flows, water quality and aquatic ecosystems; and*
2. *Provide advice on best practice in regard to:*
 - a) *assessment of subsidence impacts;*
 - b) *avoiding and/or minimising adverse impacts on significant natural features; and*
 - c) *management, monitoring and remediation of subsidence and subsidence-related impacts; and*
3. *Report on the social and economic significance to the region and the State of the coal resources in the Southern Coalfield.*

The terms of reference required the Panel to focus its examination on the subsidence-related impacts of underground mining on 'significant natural features'. These features were defined as 'rivers and significant streams, swamps and cliff lines'. Other natural features, for example plains, plateaus and general landforms, and any impacts of subsidence on infrastructure, buildings or other structures were not within the Panel's terms of reference. Similarly, impacts associated with constructing and operating surface facilities were considered beyond the scope of the inquiry.

It was also considered that certain values contributed to the significance of some natural features. These include values in respect of Aboriginal heritage, non-Aboriginal heritage, conservation, scenery, recreation and similar values.

The purpose of the Southern Coalfields Inquiry was to:

1. *Undertake a strategic review of the impacts of underground mining in the Southern Coalfields on significant natural features (i.e. rivers and significant streams, swamps and cliff lines), with particular emphasis on risks to water flows, water quality and aquatic ecosystems;*
2. *Provide advice on best practice in regard to:*
 - a. *Assessment of subsidence impacts;*
 - b. *Avoiding and/or minimising adverse impacts on significant natural features;*
 - c. *Management, monitoring and remediation of subsidence and subsidence-related impacts;*
3. *Report on the social and economic significance to the region and the State of the coal resources in the Southern Coalfields.*

The Panel used the term **subsidence effects** to describe subsidence deformation of the ground mass caused by mining, including all mining-induced ground movements such as vertical and horizontal displacements and curvature as measured by tilts and strains. The term **subsidence impact** was used to describe the physical changes to the ground and its surface caused by these subsidence effects.

The **environmental consequences** of these impacts include loss of surface flows to the subsurface, loss of standing pools, adverse water quality impacts, development of iron bacterial mats, cliff falls and rock falls, damage to Aboriginal heritage sites and impacts on aquatic ecology.

Due to the geology and geomorphology of the Southern Coalfield, non-conventional subsidence effects (including valley closure, upsidence and regional far-field horizontal displacement) regularly occur. Since unpredicted impacts of subsidence on rivers and

significant streams became apparent, the coal mining industry has made significant advances in its understanding of and ability to predict non-conventional subsidence effects.

The majority of subsidence impacts on significant natural features are associated with valley closure and upsidence effects, leading to impacts on rivers and significant streams and in particular the cracking of stream beds and underlying strata.

This has the potential to result in:

- loss or redirection of surface water flows;
- changes in water quality (particularly ferruginous springs and/or development of iron bacterial mats);
- loss of ecosystem functionality (e.g. loss of pool integrity and connectivity and changes in water quality); and
- loss of visual amenity.

The Southern Coalfields Inquiry in considering the natural features of the Southern Coalfields and the impacts of subsidence, concluded:

- the site conditions within the Southern Coalfields, a dissected landscape of incised rivers and gorge country as well as geological features including faults and dykes, give rise to non-conventional subsidence impacts such as valley closure, upsidence and regional far-field horizontal displacement; and
- it is the valley closure and upsidence effects from underground mining that create the majority of impacts on significant natural features such as the cracking of stream beds, rock falls from cliff lines and alteration of groundwater chemistry in shallow aquifers.

The Southern Coalfields Inquiry made recommendations regarding best practice in relation to the assessment of subsidence impacts, ways to minimise adverse impacts on significant natural features, and the management, monitoring and remediation of subsidence and subsidence related impacts.

3 SUBSIDENCE WORKSHOP

The principles of mine design for the proposed development involved a risk management approach in the context of recent publications regarding impacts of longwall mining in the Southern Coalfields. These include:

- the Southern Coalfields Inquiry (2006); and
- the Planning Assessment Commission reports for Metropolitan Coal Project and the Bulli Seam Operations Project.

The mine design for the proposed development took into account the geological constraints, the sensitivity and significance of the surface features as well as Risk Management Zones (RMZs) developed for those surface features.

To assist with the identification of the RMZs, the subsidence engineers and technical specialists for hydrology, geomorphology, groundwater, ecology and heritage collaborated during a three day long field visit to waterways within the Project Area. Subsequent to the field visit, two qualitative risk workshops were undertaken involving the relevant stakeholders.

The scope of the risk workshops was to identify significant natural features and development of associated RMZs. In accordance with the Southern Coalfields Inquiry, the risk workshop was limited to consideration of the natural features, including rivers, streams, swamps, cliff lines, Aboriginal heritage, conservation, scenic and recreational values. For each natural feature the potential consequences and causes were considered and significance and sensitivity assigned.

A key outcome of the collaboration between technical specialists included attendance at a subsidence workshop to facilitate the development of the RMZs.

The subsidence workshop was held over 3 days from 6 to 8 March 2013 and a follow session on 12 December 2013 for the following:

- Inspections of natural features within the Project Area led by the geomorphology technical specialist (Fluvial Systems Pty Ltd). Site inspections of natural stream catchments at Cow Dogtrap Creeks and Mermaid Pools. Site inspections of disturbed stream catchments along Eliza Creek was also conducted;
- Inspections of ecological features and riparian vegetation within the Project Area were conducted, led by the ecology technical specialist (Niche Environment & Heritage Pty Ltd). Site inspections conducted within Cow, Dogtrap and Eliza Creeks;
- Inspections of aboriginal heritage features within the Project Area were conducted, led by the aboriginal heritage technical specialist (Niche Environment & Heritage Pty Ltd). Site inspections conducted within Cow, Dogtrap and Eliza Creeks;
- Inspections of subsidence impacted streams at Myrtle and Redbank Creeks were conducted, led by the Tahmoor North's hydrogeology technical specialist (Geoterra Pty Ltd);
- Subsidence Workshop 1, a whole day workshop held to discuss and develop RMZs, led by a facilitator from SLR Consulting Australia Pty Ltd;
- Subsidence Workshop 2, a half day workshop held as a concluding session to discuss technical specialist reports in relation to RMZs developed and review the need for modifications to the mine plan. This workshop was also led by a facilitator from SLR Consulting Australia Pty Ltd

The Subsidence Workshop Risk Management Report is contained within Appendix 1.

The agenda for Subsidence Workshop 1 is contained within Appendix 2 and the workshop presentations are contained within Appendix 3.

Site photos of the Project team during the site inspections are outlined within Appendix 4.

The Subsidence Workshop 2 presentation is contained within Appendix 5.

The working group that took part in the workshops was made up of key stakeholders involved in the proposed development including Tahmoor Coal employees, technical specialists and EIS authors. The involvement of the key stakeholders ensured that the significance and sensitivity of natural features identified through the process were ranked by experienced technical specialists, who understand the proposed development, and who also have the authority to action key findings and outcomes that resulted from the risk workshop.

The workshop technical specialist attendees and area of technical expertise are outlined on Table 1.

Technical Specialist	Discipline	Attended Workshop 1	Attended Workshop 2
AECOM	Environmental Planning, EIS Preparation	Yes	Yes
Fluvial Systems	Geomorphology	Yes	No
Gilbert & Associates	Surface Water Resources	Yes	Yes
HydroSimulations	Groundwater	Yes	Yes
MSEC	Subsidence	Yes	Yes
SCT	Geotechnical	Yes	Yes
Geoterra	Hydrogeology, hydrology, geochemistry	Yes	No
Niche Environment & Heritage	Ecology and Aboriginal Heritage	Yes	Yes
SLR Consulting	Facilitator	Yes	Yes

Table 1: Subsidence Workshop - Technical Specialist

During the risk workshop the group conducted the following activities:

- identification of key elements and associated risk descriptions and consequences;
- identification of the cause;
- achieving group consensus on the significance and sensitivity for each potential risk; and
- identification of appropriate treatment plans.

During the risk workshops a traffic light approach was adopted and each element was ranked as either having a low, medium or high significance and sensitivity. Where an

element was identified as having a medium or high significance and/or sensitivity, a treatment plan was identified.

A number of significant or sensitive natural features were identified within the Project Area.

The identification of significant or sensitive items resulted in changes to the mine plan where possible, additional impact assessment, or the preparation of specific treatment plans.

Significant or sensitive items considered were:

- areas of high environmental and Aboriginal archaeology and cultural heritage significance;
- wetlands, swamps and water related ecosystems;
- significant watercourses ;
- significant groundwater resources;
- threatened and protected species;
- stability of escarpments and significant cliff lines, waterfalls, pagodas or steep slopes; and
- prescribed dams.

Significant or sensitive items and natural features that were assessed as being medium to high risk, and prompted consideration of modifications to the mine plan were:

- Pagodas, cliffs, steep slopes which were identified as a public safety risk. The mine plan was designed to minimise potential for impacts to significant cliffs along the Bargo and Nepean Rivers;
- Aboriginal rock shelters which were identified as areas of high archaeological and / or Aboriginal cultural heritage significance. The mine plan was designed to minimise potential for impacts to significant rock shelters Dogtrap Creek. Previous mining at similar depth of cover has shown minimal impacts in the vicinity of Tahmoor Mine;
- Watercourses directly overlying the longwalls where potential cracking in the rock bed and/or dewatering of pools may occur;
- Significant watercourses including the Bargo River and Nepean River. The mine plan was designed to minimise impacts to Bargo River and Nepean River by ensuring it was outside the zone of predicted impact; and
- Groundwater beneath Thirlmere Lakes.

These significant natural features informed the development RMZs for further assessment.

The RMZs identified via the risk assessment process are outlined in Appendix 6.

APPENDIX 1



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Tahmoor South Project Subsidence Risk Workshop

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Tahmoor South Project

Subsidence Risk Workshop

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1 INTRODUCTION

SLR Consulting Australia Pty Ltd (SLR) was engaged by Tahmoor Coal Pty Ltd (Tahmoor Coal) to facilitate a subsidence risk management zones workshop in March 2013. Tahmoor Coal is seeking approval for the Tahmoor South Project, being the extension of underground coal mining at Tahmoor Mine, to the south and east of the existing Tahmoor Mine surface facilities area. The subsidence risk workshop was undertaken to assist with the preparation of specialist studies to support the Environmental Impact Statement currently being prepared for the Tahmoor South Project.

The proposed development seeks to extend the life of underground mining at Tahmoor Mine until approximately 2040. The proposal will enable mining to be undertaken within the southern portion of Tahmoor Coal's existing lease areas and for operations and employment of the current workforce to continue for approximately a further 18 years.

The Stage 1 Workshop ran over three days and experts from a range of disciplines attended. The first two days were comprised of site inspections to view areas of potential natural significance that maybe subject to subsidence impacts, including areas of archaeological significance, habitat for threatened fauna and also creeks. In addition, areas previously subsided by the Tahmoor Mine workings were inspected.

The third day of the workshop included presentations by each of the technical disciplines and a half day subsidence risk workshop facilitated by SLR. During the Stage 1 Risk Workshop a number of areas were identified where further information was required to adequately determine the significance and sensitivity of the features to be impacted by subsidence. Between March and December 2013 further investigations were undertaken and the Stage 2 Risk Workshop was undertaken on 12 December 2013 to revisit the risk register developed in March 2013.

1.1 Project Background

On 6 December 2006, the NSW Government established an independent enquiry to assess impacts of underground mining due to concerns relating to the past and potential future impacts of subsidence on significant natural features in the Southern Coal Fields. The outcomes of the independent enquiry are presented on *Impacts of Underground Coal Mining on Natural Features in the Southern Coal Fields, Strategic Review* (July 2008).

The enquiry focused on defined significant natural features, including rivers and significant streams, swamps and cliff lines. In addition, certain local non-natural values were also considered, including Aboriginal, non-aboriginal, conservation, scenic and recreational values.

An outcome of the enquiry was that Risk Management Zones (RMZ) should be identified to focus assessment and management of potential subsidence related impacts on significant natural features. In particular, management of non-conventional subsidence effects, such as valley closure and upsubsidence.

It was concluded in the enquiry that RMZ should be identified for all significant environmental features sensitive to valley closure and subsidence, including rivers, significant streams, significant cliff lines and valley infill swamps. RMZ are to be defined by the outside extremity of the natural feature, being whichever is greater either 40 degrees angle from the vertical down of the coal seam or 400 m lateral distance from the feature at the surface. It is noted that RMZ's apply to all streams of a 3rd order or above.

To assist with the identification of the RMZ a qualitative risk workshop was undertaken. The risk workshop considered the sensitivity or the importance the community places on the features, and the environmental consequence of the impacts.

The RMZs are not intended to represent either a determination of significance or to suggest or require the exclusion of mining. The intent of the RMZs is to highlight areas where proposed mining requires careful assessment and management.

1.2 Nominated Coordinator

The nominated coordinator for the risk workshop was Ron Bush, the Approvals Manager for the Tahmoor South Project.

1.3 Scope, Aims and Methodology

The scope of the risk workshop was to identify significant natural features and development of associated RMZs. For each natural feature the potential consequences and causes were considered and significance and sensitivity assigned.

In accordance with the *Impacts of Underground Coal Mining on Natural Features in the Southern Coal Fields, Strategic Review* (July 2008) the risk workshop was limited to consideration of the natural features, including rivers, streams, swamps, cliff lines, Aboriginal heritage, conservation, scenic and recreational values.

During the risk workshop a traffic light approach was adopted and each element was ranked as either having a low, medium or high significance and sensitivity. Where an element was identified as having a medium or high significance and/or sensitivity, a treatment plan was identified.

1.4 External Facilitation

SLR was engaged by Tahmoor Coal to facilitate the subsidence risk workshop for the Tahmoor South Project. The first stage of the workshop was facilitated by Dean Fletcher (Principal Consultant) on 8 March 2013. The risk register was revisited on 12 December 2013 during the second stage of works and the register was updated based on further works undertaken between March and December 2013.

Dean has formal risk management training through Queensland University of Technology, and a proven track record of regulatory compliance. A copy of Dean's CV is provided as **Appendix A**.

2 WORKSHOP SESSIONS

2.1 Definition of Terms

The assessment of significance is subjective, as there is no guidance provided regarding this. In undertaking this risk workshop the following approach has been adopted.

Table 1 Significance and Sensitivity

Significance and Sensitivity	Subsidence Management and Controls
Not highly significant and/or not highly sensitive	Standard subsidence management
Highly significant and highly sensitive	Mining impacts maybe deemed unacceptable close to natural feature

In addition, the following terms were adopted throughout this risk workshop:

Risk Workshop is the formalised means by which the aspect of the project and their associated impacts are systematically identified, assessed, ranked according to perceived risks and addressed by means of appropriate and effective controls or management outcomes.

Risk is the chance of something happening that will have either a positive or negative impact upon the project. It involves consideration of the sources of the risk, assessing the consequences and considering the likelihood that an event that might occur which could give rise to a consequence.

2.2 The Working Group

Key stakeholders were invited to make up the working group and attend the workshop sessions held on 8 March 2013 and 12 December 2013. The involvement of key stakeholders ensures that the risks and associated significance and sensitivity identified through the process are ranked by experienced technical specialists, who understand the project, and who also have the authority to action key findings and outcomes that result from the review workshop. The workshop attendees are listed in **Table 1**.

Table 2 Subsidence Risk Workshop Team Members

Name	Organisation	Position	Qualifications	Related Experience	Years in Industry	8 March 2013 Workshop	12 December 2013 Workshop
Noel Merrick	Heritage Computing	Hydrogeologist	PhD	Groundwater	40	Yes	Yes
Kelly Pearsall	AECOM	EIS PM	Env. Sc/URTP	EIS/Planning	12	Yes	No
Tony Marszalek	Gilbert & Associates	Water Resource Engineer	BE/M Eng Sc	Surface Water	26	Yes	No
Lindsay Gilbert	Gilbert & Associates	Water Resource Engineer	BE/M Eng Sc	Surface Water	30	Yes	Yes
Elizabeth Thornton	AECOM	EIS Author	B Sc(Env)(Hon1)	EIS/Catchment Management/Water	8	Yes	Yes
Chris Gippel	Fluvial Systems	Geomorphologist	BSc(Hons), PhD	Geomorphology, hydrogeology	30	Yes	No
Chris Hammersley	Glencore	Approvals Coordinator	Env Sci/URTP	Approvals, EIS Planning	14	Yes	No
Sam Beresford	Glencore	Community Coordinator	B. Com	EIS/Consultation/Community	1	Yes	Yes
Ken Mills	SCT	Senior Geotechnical Engineer	BE PhD	Similar projects	33	Yes	Yes
Raymond Howard	Glencore	Mining Engineer	Mining Engineer	Mining Technical/Planning	25	Yes	No
Ben Streckeisen	Glencore	Project Manager	BE Civil MBA	Project Management/Project Controls	6	Yes	Yes
Andrew Dawkins	Geoterra	Principal Geoscientist	BSc MAPP Sc CP Eng	Hydrogeology, chemistry, hydrology	28	Yes	No

Name	Organisation	Position	Qualifications	Related Experience	Years in Industry	8 March 2013 Workshop	12 December 2013 Workshop
Ron Bush	Glencore	Approvals Manager	BSc MPlan PGC Eng	Geology, Environmental Planning	24	Yes	Yes
Rob Oliver	Glencore	Tech Services Manager	MSc Eng Geol/Grad Dip Mine Engineering	Mine Planning, Mine Engineering	10	Yes	Yes
Amy Louis	AECOM	EIS Tech Specialist Manager	B Env Sc	Environmental Planning and Impact Assessment	6	Yes	No
Daryl Kay	MSEC	Subsidence Engineer	BE Civil/LLB	Subsidence	14	Yes	Yes
Jamie Reeves	Niche	Archaeologist	BA (Hon)	Heritage Assessment	15	Yes	No
Renee Regal	Niche	Archaeologist	BA (Hon)	Heritage Assessment	7	Yes	Yes
Matt Russell	Niche	Aquatic Ecologist	B Sc	Aquatic Ecology	12	Yes	No
Luke Baker	Niche	Botanist	B Sc	Terrestrial Ecology	7	Yes	No
Matt Richardson	Niche	Ecologist	B Sc (Hons)	Ecology	15	No	Yes
Alexandra Frolich	AECOM	Environmental Scientist	B Sc (Marine Science)	Environmental Impact Assessment and Approvals	5	No	Yes
Claire Vahtra	AECOM	Environmental Scientist	B Sc (Physical Geography, Biological Science) (Hons)	Environmental Impact Assessment and Approvals	3	No	Yes
Dean Fletcher	SLR Consulting	Workshop Facilitator	B Sc Env Chem	Mine Closure, Workshop Facilitation	8	Yes	Yes
Joni Woollard	SLR Consulting	Workshop Facilitator	B Env Sc (Hon)	Mine Closure, Contaminated Land	8	Yes	Yes

2.3 Risk Workshop Process

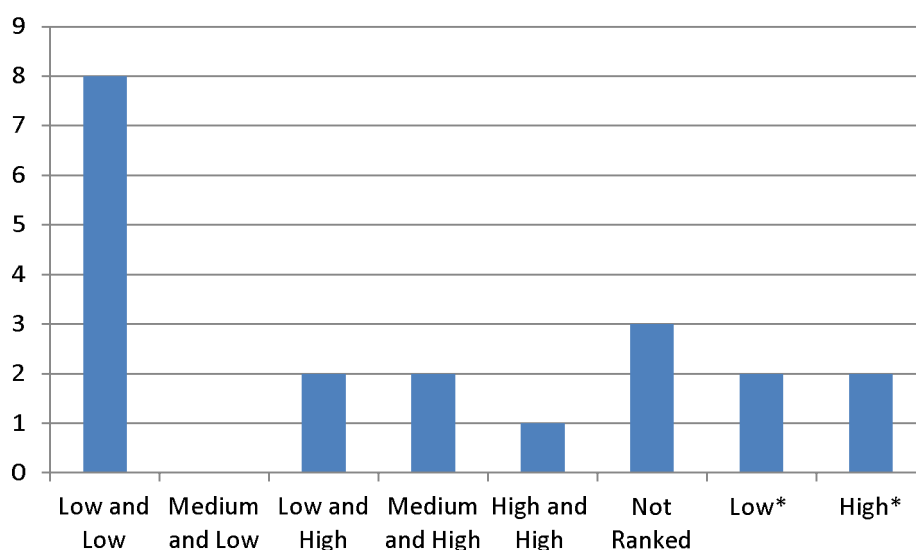
During the risk workshop the working group was commissioned with:

- Identifying key elements and associated risk descriptions and consequences;
- Identifying the cause;
- Achieving group consensus on the significance and sensitivity for each potential risk;
- Identifying appropriate treatment plans; and
- Assigning a treatment owner (for Stage 1 only).

3 STAGE 1 RISK WORKSHOP

The Stage 1 Risk Register is provided in **Appendix B**. During the Stage 1 Risk Workshop undertaken on 8 March 2013 twenty elements were assessed. A summary of the significance and sensitivity distribution is shown in **Figure 1**. It is noted that for four elements only sensitivity was ranked, as further consideration of significance for waterways was required. In addition, three elements were not ranked due to insufficient information.

Figure 1 Significance and Sensitivity Distribution for Stage 1



*Sensitivity ranked, further consideration of significance required.

Based on the outcomes of the significance and sensitivity analysis treatment plans and/or actions were identified. A summary of the treatment plans and/or actions is outlined below in **Table 3**.

Table 3 Action Plan from Stage 1

Key Element	Risk Description	Consequence	Cause	Treatment plans/tasks (description)
2. Areas of high environmental, heritage or archaeological significance	Potential damage to Aboriginal Heritage artefacts - Overhangs/rock shelters and art	Change in the art or the context of - cracks opening, change in hydrology, sheering/cracking of solid rock, rock falls	Subsidence compromises overhangs/rock shelters with Aboriginal artefacts	Develop a log of each individual art site and assign a significance and sensitivity value.
3. Wetlands, swamps and water related ecosystems	Stygofauna impacts	Potential change in habitat	Changed groundwater conditions	To be included in Niche Scope of Works
3. Wetlands, swamps and water related ecosystems	Potential damage to ponds and other sensitive ecosystems	Reduction in species diversity and abundance Reduced water quality Reduction of connectivity Reduction of habitat (ponds) Reduction of pool depth longevity	Subsidence causes: Reduced water quality Reduction of connectivity Reduction of habitat (ponds) Reduction of pool depth longevity	Define significance of water ways. Determine significance and sensitivity of each water course.
5. Significant water courses including surface flows, water quantity and quality and ecological integrity	Potential damage to rock beds in water courses	Reduction in species diversity and abundance Reduced water quality Reduction of connectivity Reduction of habitat (ponds) Reduction of pool depth longevity	Subsidence causes: Reduction of connectivity Reduction of habitat (ponds) Reduction of pool depth longevity	Define significance of water ways. Determine significance and sensitivity of each water course.
5. Significant water courses including surface flows, water quantity and quality and ecological integrity	Potential damage to knick points in water courses	Reduction in species diversity and abundance Reduced water quality Reduction of connectivity Reduction of habitat (ponds) Reduction of pool depth longevity	Subsidence causes: Reduction of connectivity Reduction of habitat (ponds) Reduction of pool depth longevity	Define significance of water ways. Determine significance and sensitivity of each water course.

Key Element	Risk Description	Consequence	Cause	Treatment plans/tasks (description)
5. Significant water courses including surface flows, water quantity and quality and ecological integrity	<p>Potential damage to hydraulic control points</p>	<p>Sub surface flow diversion</p>	<p>Subsidence related effects causes: Reduction of connectivity Reduction of habitat (ponds) Reduction of pool depth longevity Rock bed cracking</p>	<p>Define significance of water ways. Determine significance and sensitivity of each water course.</p>
6. Significant groundwater resources including groundwater levels and quality	<p>Reduction in base flow in water courses</p>	<p>Reduction in species diversity and abundance Reduced water quality Reduction of connectivity Reduction of habitat (ponds) Reduction of pool depth longevity</p>	<p>Aquifer dewatering</p>	<p>Define significance of water ways. Determine significance and sensitivity of each water course.</p>

4 WORKS COMPLETED BETWEEN MARCH AND DECEMBER 2013

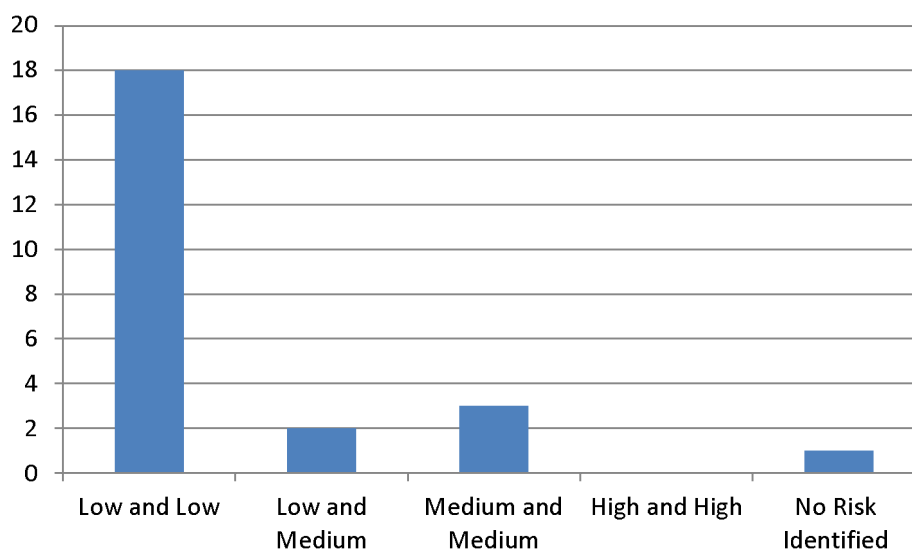
Between the Stage 1 Risk Workshop held in March 2013 and the Stage 2 Risk Workshop held in December 2013, further assessments were undertaken to address the treatments identified in Stage 1 workshop. Additional assessment was also undertaken during this period to facilitate the establishment of baseline conditions. The outcomes of further assessments undertaken during this period were considered during the Stage 2 risk workshop.

5 STAGE 2 RISK WORKSHOP

The Stage 2 Risk Workshop is provided in **Appendix C**. During the Stage 2 Risk Workshop, the risk worksheet developed during Stage 1 was revisited based on the outcomes of the further assessments outlined above. In addition, elements were added where relevant.

A summary of the significance and sensitivity distribution for Stage 2 is shown in **Figure 2**.

Figure 2 Significance and Sensitivity Distribution for Stage 2



In total 18 of the 25 elements assigned rankings, had low significance and low sensitivity. Two elements had a low and a medium ranking, three had both medium significance and sensitivity, and one element had high significance and high sensitivity.

Where the significance and/or the sensitivity were ranked as medium an appropriate treatment plan and/or task was identified. The treatments plan and/or tasks are summarised in **Table 4**.

Table 4 Stage 2 Outcomes

Key Element	Risk Description	Consequence	Cause	Significance	Sensitivity	Why?	Treatment plans/tasks (description)
2. Areas of high environmental, heritage or archaeological significance	Potential damage to Aboriginal Heritage - Overhangs/rock shelters and art	Change in the art or the context of - cracks opening, change in hydrology, shearing/cracking of solid rock, rock falls	Subsidence compromises overhangs/rock shelters with Aboriginal artefacts	Medium	Medium	Mine plan designed to reduce potential for impacts to the high significance features Historical mining at this depth of cover has shown minimal impacts in the vicinity of Tahmoor	Before and after longwall monitoring of significant features and assess on a longwall by longwall basis
3. Wetlands, swamps and water related ecosystems	Stygofauna impacts	Potential change in habitat and loss of Stygofauna	Changed groundwater conditions	Medium	Low	Stygofauna identified in one of the 13 bores sampled Located in shallow aquifer which indicates that it may only be temporarily impacted by mining	Stygofauna monitoring program to be included within the Tahmoor South monitoring plan
3. Wetlands, swamps and water related ecosystems	Potential damage to ponds and other sensitive ecosystems (riparian vegetation)	Reduction in species diversity and abundance Reduced water quality Reduction of connectivity Reduction of habitat (ponds) Reduction of pool depth longevity	Subsidence causes: Reduced water quality Reduction of connectivity Reduction of habitat (ponds) Reduction of pool depth longevity	Low	Low	Minor based on historical experience at this depth of cover Availability of water for riparian zones is unlikely to change - not drawing water directly from standing pools	Ecological monitoring program will include riparian ecosystem

Key Element	Risk Description	Consequence	Cause	Significance	Sensitivity	Why?	Treatment plans/tasks (description)
5. Significant water courses including surface flows, water quantity and quality and ecological integrity	Potential damage to rock beds in water courses	Reduction in species diversity and abundance Reduced water quality Reduction of connectivity Reduction of habitat (ponds) Reduction of pool depth longevity	Subsidence causes: Reduction of connectivity Reduction of habitat (ponds) Reduction of pool depth longevity	Medium	Medium	Potential cracking in rock beds and/or dewatering of pools, directly above long walls Potential loss of habitat for frogs previously identified impacts in the vicinity of Tahmoor	Development of a monitoring program and a TARP to manage potential impacts on rock beds in water courses
5. Significant water courses including surface flows, water quantity and quality and ecological integrity	Potential impacts on third order streams, including Dog Trap Creek, Tea Tree Hollow, Eliza Creek, Carters Creek, and Cow Creek	Reduction in flow	Subsidence related effects causes: Reduction of connectivity Reduction of habitat (ponds) Reduction of pool depth longevity Rock bed cracking	Low	Low	Knick points, rock slabs and pools are assessed above These are all third order (or less) streams Impacts are not expected to be greater than those currently managed at Tahmoor	Development of a monitoring program and an SMP, and to be addressed in the EIS
6. Significant groundwater resources including groundwater levels and quality	Possible reduction in groundwater pressure - effecting Thirlmere Lakes	Loss of water from the Thirlmere Lakes	Vertical connectivity Far field depressurisation	Medium	Medium	Mining at Tahmoor South is approximately 3 km from Thirlmere Lakes - minimising the potential for impacts No proven impacts from the current Tahmoor operations at approximately 600 m from the Thirlmere Lakes	Develop Thirlmere Lakes Monitoring Plan

Key Element	Risk Description	Consequence	Cause	Significance	Sensitivity	Why?	Treatment plans/tasks (description)
6. Significant groundwater resources including groundwater levels and quality	Subsidence impact on private extraction bores	Reduced and/or loss of access to groundwater	Aquifer dewatering Fracturing/shearing Depressurisation	Low	Medium	Indicative information from MSB shows bore replacement of one every six years in the Southern Coal Fields MSB are responsible for redrilling bores if sheared Resupply water in the event of reduced flow	On-going resupply of water where required

6 WAY FORWARD

Management strategies for the potential risks shown in **Table 4** will be outlined in the EIS and following approval the relevant control measures will be included in appropriate plans and/or strategies.

APPENDIX A DEAN FLETCHER CV

QUALIFICATIONS

Master Public Policy (Current)

BSc Environmental Analytical Chemistry,

BACKGROUND

Dean has been heavily involved in a range of domestic and international facility closure and rehabilitation planning projects as part of the environmental assessment (EA) process. He has formal risk management training through Queensland University of Technology holding a G2 (Certificate 4) qualification in risk assessment facilitation, and has a proven track record of regulatory compliance. With previous experience working on concept studies for new business opportunities incorporating technical feasibility, capital and operating expenditure and carbon footprint analysis, he also provides support to the GSSE special projects team.

Dean spent over 4 years working for BHP Billiton's Global Technology Group engaging stakeholders, motivating people and delivering technically challenging projects. Projects include decommissioning and re-commissioning site facilities, auditing and compliance, plant optimisation/sustainability and environmental chemistry. Dean has experience with ISO14001 compliance requirements and was involved in a comprehensive best practice audit of specific components of BHP Billiton's Chilean operations.

SPECIAL EXPERTISE

Risk and incident management; Rehabilitation and closure planning; Environmental approvals and regulatory compliance; Project and information management; Operational improvement and sustainability; Waste treatment and disposal; Dangerous Goods and Hazardous Substances management and training; Concept studies; technical feasibility, capital/operating expenditure and carbon footprint analysis; Inspections, auditing and reporting; Sampling, monitoring and reporting.

SELECTED PROJECT EXPERIENCE

Risk and Incident Management

- Xstrata Coal NSW Life of Mine Risk assessments
- Mt Owen Optimisation project feasibility risks and opportunities workshop
- United Colliery expansion project prefeasibility risks and opportunities workshop
- West Wallsend Colliery Geological Risks/Opportunities Workshop, Xstrata Coal
- Infrastructure corridor, concentrate pipeline, power line and roads, Tampakan, Philippines
- Xstrata Coal Chain Logistics Risks/Opportunities Workshop, Xstrata Coal
- Potential interruptions to the execution of life of mine plans, Xstrata Coal NSW (11 coal mines)
- 5 yearly comprehensive health and safety risk assessment, West Wallsend Colliery
- Engineering and construction of a storage facility for radioactive substances (DG Class 7.1)

Rehabilitation and Closure Planning

- Undertaking a full review of Mine Closure and Rehabilitation liability costs for all Xstrata Coal NSW sites for audit and accounting purposes
- Preparation of a Decommissioning and Rehabilitation Plan, Abbott Point Coal Terminal expansion project
- Preparation of a Decommissioning Plan final land-form chapter for Rio Tinto's Blair Athol Coal Mine,
- Co-ordination of the cost model development for detailed closure planning of Rio Tinto's Blair Athol Coal Mine
- Preparation of a Decommissioning and Rehabilitation Assessment for the Arrow Energy Bowen Coal Seam Gas (CSG) project

Environmental Approvals and Regulatory Compliance

- Preparation of a Rehabilitation Management Plan for the Adani Abbott Point Coal Terminal
- A Subsidence Management Plan for Ulan Coal Mine
- Preparation of a combined underground and open cut Mining Operations Plan (MOP) for Ulan Coal Mine
- Preparation of a construction environmental management plan, quality assurance plan, farm operations plan and handback plan
- Preparation of an operational waste management plan for the Moolarben Coal Project.

Operational Improvement and Sustainability

- Chemical analysis including method development, QA and QC, BHP Billiton
- Process optimisation and sustainability, BHP Billiton
- Materials handling (Mineral sands; Copper cathode; Solid liquid separation), BHP Billiton

Waste Treatment and Disposal

- Identifying and develop opportunities for recovering valuable commodities such as water, acid and saleable products, BHP Billiton
- Iron and heavy metal removal, BHP Billiton
- Disposal of a variety of acidic and basic process solids and solutions – engaging third party providers, BHP Billiton

Dangerous Goods and Hazardous Substances Management and Training

- Established a registry and control system for managing ionising radiation sources; ensuring compliance with NSW DECCW legislation, BHP Billiton
- Developed and implemented a competency based training package for DG Class 8 substances, BHP Billiton

Inspections, Auditing and Reporting

- Key contributor in a business improvement initiative for the BHP Billiton Base Metals group and a number of Workcover, ISO14001 and internal audits.

Sampling, Monitoring and Reporting

- Designing, installing and maintaining monitoring systems, BHP Billiton
- Collecting and analysing samples, and adjusting operating conditions as required, BHP Billiton

APPENDIX B STAGE 1 RISK REGISTER

6. Significant groundwater resources including groundwater levels and quality	11	Reduction in base flow in water courses	Reduction in species diversity and abundance Reduced water quality Reduction of connectivity Reduction of habitat (ponds) Reduction of pool depth longevity	Aquifer dewatering		Low	Define significance of water ways. Determine significance and sensitivity of each water course.	CG, TM, MR2
6. Significant groundwater resources including groundwater levels and quality	12	Deep aquifer	Regional reduction in GW level	Depressurisation	Low	Low		
6. Significant groundwater resources including groundwater levels and quality	13	Subsidence impact on private extraction bores	Reduced access and quality to GW	Aquifer dewatering Fracturing/sheering Depressurisation	Low	High		
7. Threatened and protected species under the Threatened Species Conservation Act 1995	14	Impact to EEC communities and/or endangered vegetation species	Vegetation die back	Subsidence causing release of gas into waterways Changes in hydrology	Low	Low		
7. Threatened and protected species under the Threatened Species Conservation Act 1995	15	Subsidence impact to fauna - Frogs/toadlets	Loss of habitat Loss of local populations	Subsidence causing pool draining Changes in water quality	Medium	High		
7. Threatened and protected species under the Threatened Species Conservation Act 1995	16	Subsidence impact to fauna - Bats	Loss of habitat from collapse of overhangs and infrastructure containing crevices	Collapsing of overhangs Damage to infrastructure	Low	Low		

7. Threatened and protected species under the Threatened Species Conservation Act 1995	17	Subsidence impact to fauna - Broad head snake	Loss of habitat	Cracking of surface rock	Low	Low			
7. Threatened and protected species under the Threatened Species Conservation Act 1999	18	Subsidence impact to fauna - Macquarie Perch	Consider at a later date						
8. The stability of escarpments and significant cliff lines, pagodas or steep slopes	19	Subsidence impacts to other cliffs (over 5 m high and 63 degrees)	Rock falls Collapse of overhangs Reduction in visual amenity Reduced public access due to safety concerns	Subsidence	Medium	High			
14. Prescribed dams (including stored waters and/or reservoirs) and/or structures referred to by the (Dams Safety Act 1978)	20	Potential far field impacts on Nepean Dam	Potential increase of leakage/reduction in dam yield	Far field depressurisation Vertical connectivity	Low	Low			

APPENDIX C STAGE 2 RISK REGISTER

Tahmoor Environmental		Subsidence						
Key Element	Sub Key Element (if applicable)	Risk Description	Consequence	Cause	Significance	Sensitivity	Why?	Treatment plans/tasks (description)
1. Public safety	1	Surface cracking (minor based on historical experience)	Additional risk due to mining - Personal injury (vehicle/horse/motorbike/walking)	Subsidence Surface cracking Unauthorised access	Low	Low	Minor based on historical experience at this depth of cover	
1. Public safety	2	Rock/tree fall (pagodas, cliffs, steep slopes)	Additional risk due to mining - Personal injury/fatality (vehicle/horse/motorbike/walking)	Subsidence Pagodas and steep slopes (private property) Unauthorised access	Low	Low	Mine plan designed to avoid these features	
2. Areas of high environmental, heritage or archaeological significance	3	Potential damage to Aboriginal Heritage items - Stone artefacts	Disturbance of artefacts	Subsidence	Low	Low	Loose fragments, depth of cover makes it difficult to identify changes Subsidence impacts on artefacts are negligible	Nil
2. Areas of high environmental, heritage or archaeological significance	4	Potential damage to Aboriginal Heritage - Overhangs/rock shelters and art	Change in the art or the context of - cracks opening, change in hydrology, shearing/cracking of solid rock, rock falls	Subsidence compromises overhangs/rock shelters with Aboriginal artefacts	Medium	Medium	Mine plan designed to reduce potential for impacts to the high significance features Historical mining at this depth of cover has shown minimal impacts in the vicinity of Tahmoor	Before and after longwall monitoring of significant features and assess on a longwall by longwall basis
3. Wetlands, swamps and water related ecosystems	5	Stygo fauna impacts	Potential change in habitat and loss of Stygo fauna	Changed groundwater conditions	Medium	Low	Stygo fauna identified in one of the 13 bores sampled Located in shallow aquifer which indicates that it may only be temporarily impacted by mining	Stygo fauna monitoring program to be included within the Tahmoor South monitoring plan
3. Wetlands, swamps and water related ecosystems	6	Potential damage to ponds and other sensitive ecosystems (riparian vegetation)	Reduction in species diversity and abundance Reduced water quality Reduction of connectivity Reduction of habitat (ponds) Reduction of pool depth longevity	Subsidence causes: Reduced water quality Reduction of connectivity Reduction of habitat (ponds) Reduction of pool depth longevity	Low	Low	Minor based on historical experience at this depth of cover Availability of water for riparian zones is unlikely to change - not drawing water directly from standing pools	Ecological monitoring program will include riparian ecosystem
4. Catchment areas causing or exacerbating erosion and drainage pattern changes	7	No risk identified by the working group						

5. Significant water courses including surface flows, water quantity and quality and ecological integrity	13	Potential impacts on third order streams, including Dog Trap Creek, Tea Tree Hollow, Eliza Creek, Carters Creek, and Cow Creek	Reduction in flow	Subsidence related effects causes: Reduction of connectivity Reduction of habitat (ponds) Reduction of pool depth longevity Rock bed cracking	Low	Low	Knick points, rock slabs and pools are assessed above These are all third order (or less) streams Impacts are not expected to be greater than those currently managed at Tahmoor	Development of a monitoring program and an SMP, and to be addressed in the EIS
6. Significant groundwater resources including groundwater levels and quality	14	Possible reduction in groundwater pressure - affecting Thirimere Lakes	Loss of water from the Thirimere Lakes	Vertical connectivity Far field depressurisation	Medium	Medium	Mining at Tahmoor South is approximately 3 km from Thirimere Lakes - minimising the potential for impacts No proven impacts from the current Tahmoor operations at approximately 600 m from the Thirimere Lakes	Develop Thirimere Lakes Monitoring Plan
6. Significant groundwater resources including groundwater levels and quality	15	Deep aquifer - below the Baldhill Claystone	Regional reduction in groundwater level	Depressurisation	Low	Low	No identified existing use of water within the deep aquifer Water quality is marginal	Nil
6. Significant groundwater resources including groundwater levels and quality	16	Subsidence impact on private extraction bores	Reduced and/or loss of access to groundwater	Aquifer dewatering Fracturing/shearing Depressurisation	Low	Medium	Indicative information from MSB shows bore replacement of one every six years in the Southern Coal Fields MSB are responsible for redrilling bores if sheared Resupply water in the event of reduced flow	On-going resupply of water where required
6. Significant groundwater resources including groundwater levels and quality	17	Subsidence impact on surface water base flow	Reduced and/or loss of surface water base flow	Aquifer dewatering and drawdown of the water table	Low	Low	Elsewhere in the Southern Coal Fields the drawdown has been negligible with respect to surface water base flow impacts Minor based on historical experience at this depth of cover	Nil
7. Threatened and protected species under the Threatened Species Conservation Act 1995 and EPBC	18	Impact to threatened communities and/or species	Vegetation die back	Subsidence causing release of gas into waterways Changes in hydrology	Low	Low	No Upland Swamps present within the Project Area. EEC's recorded within the Project Area are not sensitive to subsidence impacts.	Nil
7. Threatened and protected species under the Threatened Species Conservation Act 1995	19	Impact to Pomaderris brunnea due to subsidence (covered above under water dependent ecosystems)						

7. Threatened and protected species under the Threatened Species Conservation Act 1995	20	Subsidence impact to fauna - Giant Burrowing Frog and the Littlejohn's Tree frog (addressed above in element 9 Loss of pools)							
7. Threatened and protected species under the Threatened Species Conservation Act 1995	21	Subsidence impact to fauna - Bats	Potential loss of habitat from collapse of overhangs and infrastructure containing crevices	Collapsing of overhangs Damage to infrastructure	Low	Low	Not identified as in issue previously in the Southern Coal Fields	Nil	
7. Threatened and protected species under the Threatened Species Conservation Act 1995	22	Subsidence impact to fauna - Broad-headed Snake	Potential loss of habitat	Cracking of surface rock	Low	Low	Not identified as in issue previously in the Southern Coal Fields	Nil	
7. Threatened and protected species under the Threatened Species Conservation Act 1999	23	Subsidence impact to fauna - Macquarie Perch	Potential loss of habitat	Subsidence resulting in loss of flow and/or decreased water quality	Low	Low	With the exception of the Nepean River, this species has not been recorded in the subsidence impact area and is unlikely due to rock barriers. Is present in the Nepean River, however, unlikely to be impacted.	Nil	
8. The stability of escarpments and significant cliff lines, pagodas or steep slopes	24	Subsidence impacts to minor cliffs (over 10 m high, longer than 20 m and 63 degrees)	Rock falls Collapse of overhangs Reduction in visual amenity Reduced public access due to safety concerns	Subsidence	Low	Low	Minor based on historical experience at this depth of cover Limited number of minor cliffs located directly above longwalls	Nil	
8. The stability of escarpments and significant cliff lines, pagodas or steep slopes	25	Subsidence impacts to major cliffs (over 40 m high or longer than 200 m and 63 degrees) and in the Nepean River.	Rock falls Collapse of overhangs Reduction in visual amenity Reduced public access due to safety concerns	Subsidence	Low	Low	Minor based on historical experience at this depth of cover No major cliffs located directly above longwalls	Nil	

9. Prescribed dams (including stored waters and reservoirs) and/or structures referred to by the (Dams Safety Act 1978)	26	Potential far field impacts on Nepean Dam	Potential increase of leakage/reduction in dam yield	Far field depressurisation Vertical connectivity	Low	Low		
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APPENDIX 2

TAHMOOR SOUTH FEASIBILITY SUBSIDENCE WORKSHOP

Agenda of Meeting



Subject	Tahmoor South Project Subsidence Workshop		
Date	6,7 and 8 March 2013		
Venue	Various - See Below		
Participants	Organisation	Person	Expertise
	Xstrata Tahmoor	Ben Strecken Rob Oliver Raymond Howard Ron Bush Chris Hammersley Sam Beresford	Project Manager Tech Services Tech Services Approvals Approvals Community, Meeting Scribe
	GSS Environmental	Andrew Hutton	Meeting Facilitator
	AECOM	Kelly Pearsall Amy Louis Liz Thornton	EIS EIS EIS
	Niche Environmental	Matt Richardson Jamie Reeves Renee Regal	Ecology Archaeology Archaeology
	Fluvial Systems	Dr Chris Gippel	Geomorphology
	Gilbert & Associates	Lindsay Gilbert Tony Marszalek	Surface Water Surface Water
	MESC	Daryl Kay	Subsidence
	Heritage Computing	Dr Noel Merrick	Groundwater
	Geoterra	Andrew Dawkins	Hydrogeology, Subsidence
	SCT	Dr Ken Mills	Geotechnical, Subsidence

Wednesday 6 March

Time	Item	Who	Location
8.00	Arrival and Coffee	All	Tahmoor Conference Room 4
8.30	Safety Briefing & Overview of Site Inspections	Ron Bush	Tahmoor Conference Room 4
9.00	Site inspections of stream types and geomorphology features within Tahmoor South	Dr Chris Gippel	Various sites – Mini Bus Transport
12.30	Break - Lunch	All	Tahmoor Conference Room 4
2.00	Site inspections of stream types and geomorphology features within Tahmoor South	Dr Chris Gippel	Various sites - Mini Bus Transport
4.30	De-brief of day and close	All	Tahmoor Conference Room 4

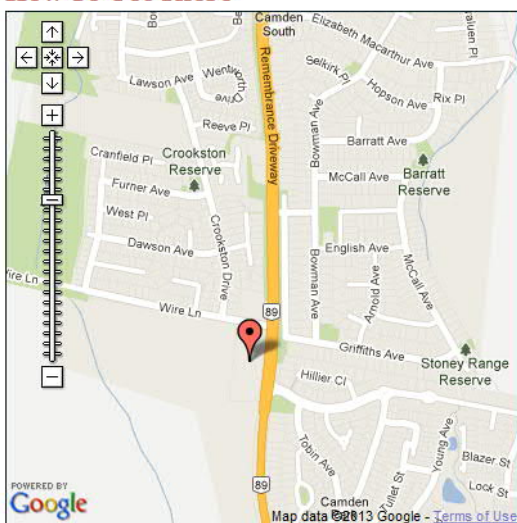
Thursday 7 March

Time	Item	Who	Location
8.00	Arrival and Coffee	All	Tahmoor Conference Room 4
8.30	Safety Briefing & Overview of Site Inspections	Ron Bush	Tahmoor Conference Room 4
9.00	Inspections of Tahmoor North streams and subsidence impact of current longwalls	Andrew Dawkins	Various sites - Mini Bus Transport
12.30	Break - Lunch	All	Tahmoor Conference Room 4
2.00	Inspections of aboriginal, heritage and ecology sites within Tahmoor South	Matt Richardson & Jamie Reeves	Various sites - Mini Bus Transport
4.30	De-brief of day and close	All	Tahmoor Conference Room 4

Friday 8 March			
Time	Item	Who	Location
8.00	Arrival and Coffee	All	Camden Valley Inn
8.30	Welcome & Outline of Day	Andrew Hutton Ron Bush	Camden Valley Inn
9.00	Overview of Tahmoor South Mine Plan and Mining Constraints	Rob Oliver	Camden Valley Inn
9.30	Overview Geomorphology Risk Management Zones	Dr Chris Gippel	Camden Valley Inn
10.00	Overview Ecology Risk Management Zones	Matt Richardson	Camden Valley Inn
10.30	Break - Morning Tea		
11.00	Overview Aboriginal & Heritage Risk Management Zones	Jamie Reeves	Camden Valley Inn
11.30	Overview Surface Water Risk Management Zones	Tony Marszalek	Camden Valley Inn
12.00	Overview Hydrogeological Conditions	Dr Noel Merrick	Camden Valley Inn
12.30	Break - Lunch		
1.15	Overview Subsidence Parameters for Tahmoor South Project	Daryl Kay	Camden Valley Inn
1.45	Risk Management Zone workshop – Part 1 <ul style="list-style-type: none"> • Review risk management zones overlain onto mine plan • Identify areas of RMZ constraints to mining 	All	Camden Valley Inn
2.30	Break - Afternoon Tea		
3.00	Risk Management Zone workshop – Part 2 <ul style="list-style-type: none"> • Discussion on any areas where mine plan needs to be modified • Mine Plan Refinement 	All	Camden Valley Inn
4.30	Workshop Summary & Close	Andrew Hutton Ron Bush	Camden Valley Inn

Venue Address: Camden Valley Inn – 290 Remembrance Drive, Camden Park

How To Get There



From **Sydney**, less than one hour's drive – take the M5 Motorway and then the Camden/Bulli exit onto Narellan Road. Head towards Narellan and turn left at the Camden By-Pass. Go straight through the lights located after the Macarthur Bridge (do not turn right at the lights). The Camden Valley Inn is located 2kms along on the right hand side of Remembrance Drive (also known as Old Hume Highway). Entry to the Lodge is via the driveway on Wire Lane.

From **Wollongong** or **Goulburn**, about a 35 minute drive – take Picton Road into the main street of Picton and turn right into Remembrance Drive (also known as Old Hume Highway). The Camden Valley Inn is located on the left hand side, approximately 10 minutes further along Remembrance Drive. Entry to the Lodge is via the driveway on Wire Lane.

APPENDIX 3

Tahmoor South Project Subsidence Workshop

8 March 2013



Introductions

Tahmoor South Project

- Facilitator
 - SLR GSS Environmental
- Xstrata Tahmoor South Team
 - Lead EIS Consultant
 - AECOM
 - Technical Specialists
 - Niche Environmental
 - Fluvial Systems
 - Gilbert & Associates
 - Heritage Computing
 - Geoterra
 - SCT
 - MSEC

Agenda

Tahmoor South Project



Friday 8 March		
Time	Item	Who
8.00	Arrival and Coffee	All
8.30	Welcome & Outline of Day	Dean Fletcher Ron Bush
9.00	Overview of Tahmoor South Mine Plan and Mining Constraints	Rob Oliver
9.30	Overview Geomorphology Risk Management Zones	Dr Chris Gippel
10.00	Overview Ecology Risk Management Zones	Matt Richardson
10.30	Break - Morning Tea	
11.00	Overview Aboriginal & Heritage Risk Management Zones	Jamie Reeves
11.30	Overview Surface Water Risk Management Zones	Tony Marszalek
12.00	Overview Hydrogeological Conditions	Dr Noel Merrick
12.30	Break - Lunch	
1.15	Overview Subsidence Parameters for Tahmoor South Project	Daryl Kay
1.45	Risk Management Zone workshop – Part 1 <ul style="list-style-type: none"> Review risk management zones overlain onto mine plan Identify areas of RMZ constraints to mining 	All
2.30	Break - Afternoon Tea	
3.00	Risk Management Zone workshop – Part 2 <ul style="list-style-type: none"> Discussion on any areas where mine plan needs to be modified Mine Plan Refinement 	All
4.30	Workshop Summary & Close	Dean Fletcher Ron Bush

Risk Management Zones

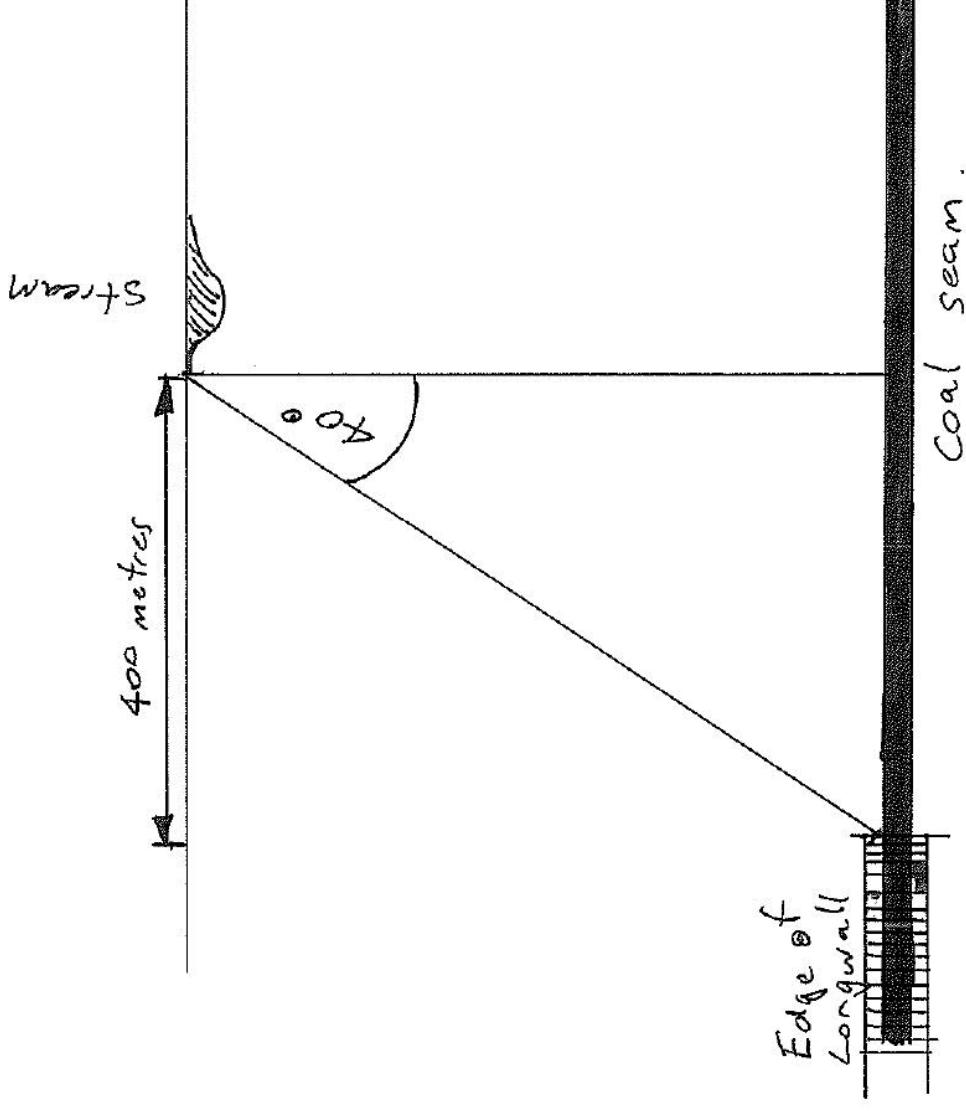
Tahmoor South Project

- **Southern Coalfields Inquiry July 2008**
- *Impacts of Underground Coal Mining on Natural Features in the Southern Coalfield*
 - Risk Management Zones (RMZ) should be defined from the outside extremity of the surface feature, either by a 40° angle from the vertical down to the coal seam which is proposed to be extracted, or by a surface lateral distance of 400 metres, whichever is the greater.
 - RMZ are appropriate to manage all subsidence effects, especially valley closure and upsidence.
 - RMZ not intended to represent either a determination of ‘significance’ or to suggest or require the exclusion of mining.
 - Purpose of RMZ is to flag that proposed mining within the zone requires careful assessment and management.

Risk Management Zones

Tahmoor South Project

- RMZs for:
 - Rivers
 - Streams – 3rd order and above
 - Cliff lines
 - Major overhangs
 - Valley infill swamps
 - Aboriginal heritage sites
 - Aquatic flora and fauna
 - Riparian zone ecology
 - Groundwater



Significance

Tahmoor South Project

Assessment of Significance

- Subjective
- No Guidelines

Significance	Subsidence Management & Controls
Not Highly Significant and/or Not Highly Sensitive	Standard subsidence management
Highly Significant and/or Sensitive	Strict subsidence management and performance standards
Highly Significant and Highly Sensitive	Mining impacts may be deemed unacceptable close to natural feature

Tahmoor South Project

Subsidence Workshop 6th to 8th March 2013

Mine Planning and Design



Mine Planning and Design

- **Geology**
 - Lithology
 - Structure (faults, dykes, plugs, etc..)
 - Coal Quality
 - Resource Recovery
- **Hydrogeology**
 - Aquifers Impacts
 - Height of Vertical Connection
 - Drawdown Impacts
- **Geotechnical**
 - Stress
 - Rockmass characteristics (i.e. strength, cleating, jointing, thickness, etc.)
 - Strategy
 - Barriers pillar design
 - Pillar design
 - Subsidence impacts (surface water, landscapes, infrastructure, etc.)

Mine Planning and Design cont.'

- **Gas**
 - Quantity
 - Pressures
 - Distribution
 - Design Constraints (drainage capacity, pre/post drainage design)
 - Greenhouse gas emissions
- **Ventilation**
 - Design Constraints (roadway heights, existing ventilation set-up, etc.)
 - Design Criteria / Duty (air quantity to longwall face, gateroads, heat load, etc.)
 - Strategy (vent shafts vs vent shaft / boosters, etc.)
 - Ventilation shaft locations

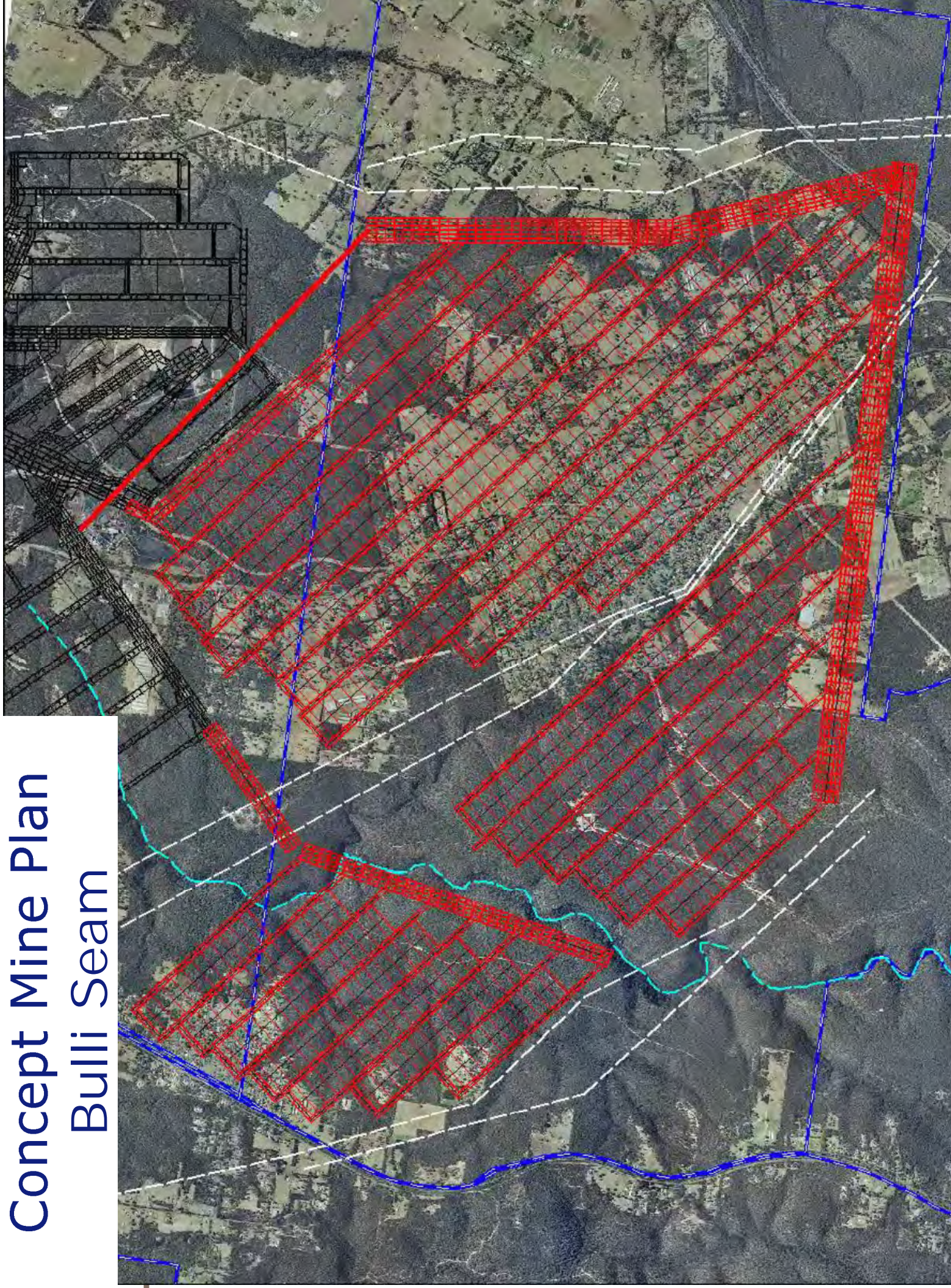
Mine Planning and Design cont.'

- **Production**
 - Equipment (conveyor belts, continuous miners, longwall, services, etc.) capacity, strategy, etc..
 - Organisational Structure
 - Coal Handling and Preparation Plant (CHPP)
 - Surface infrastructure
 - Financial
 - Other production constraints (power, water, air, etc.)
 - Productivity
- **Health and Safety**
 - Heat, dust, heat, etc..
 - Emergency escape and response
 - Traffic
 - Human impacts / workplaces

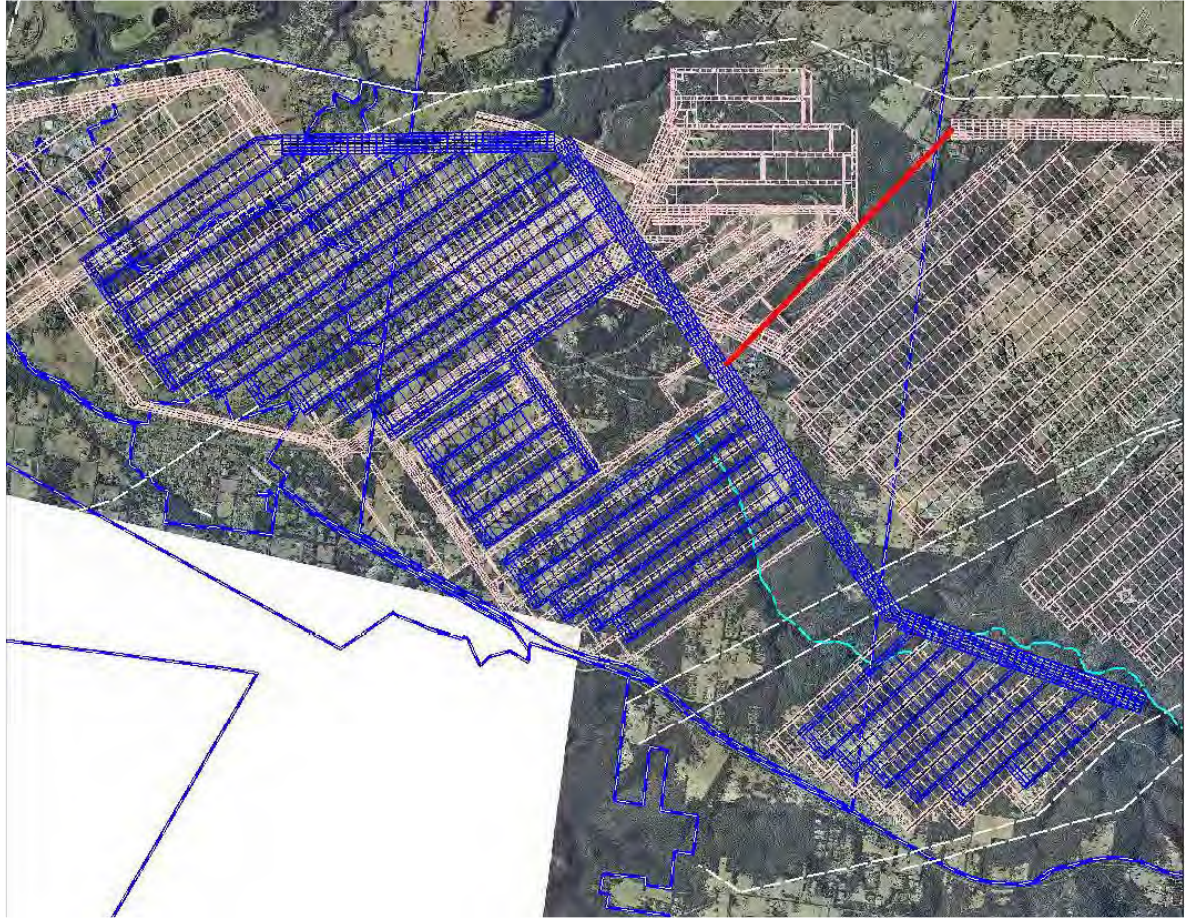
Mine Planning and Design cont.'

- **Environment**
 - Archaeological (Aboriginal, heritage, etc.)
 - Flora and Fauna
 - Mine discharge
 - Reject impalement
 - Community concerns
 - Noise and air
 - etc.
- **Legal and Permitting**
 - Licenses
 - Leases
 - Tenure
- **Etc.**

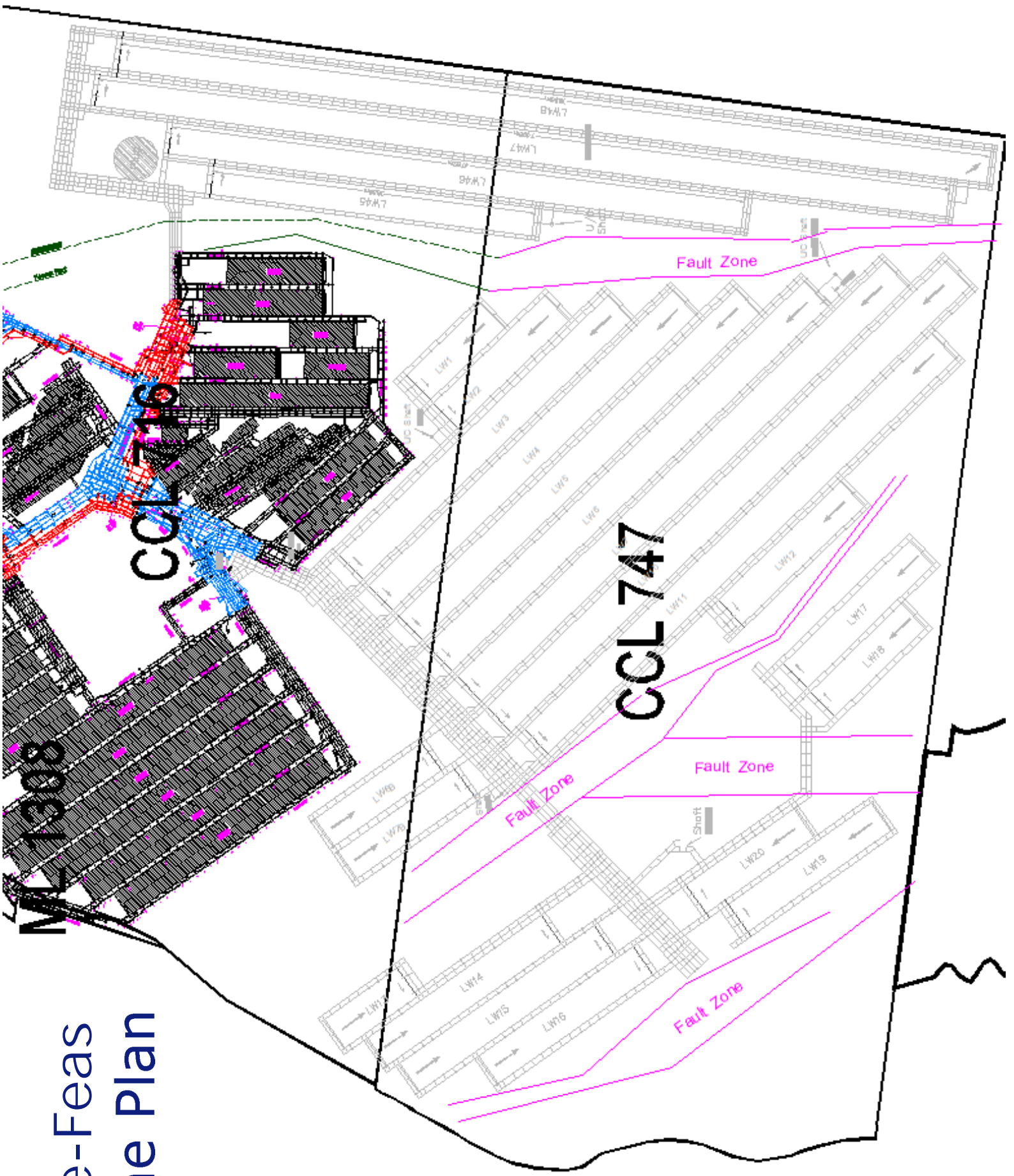
Concept Mine Plan Bulli Seam



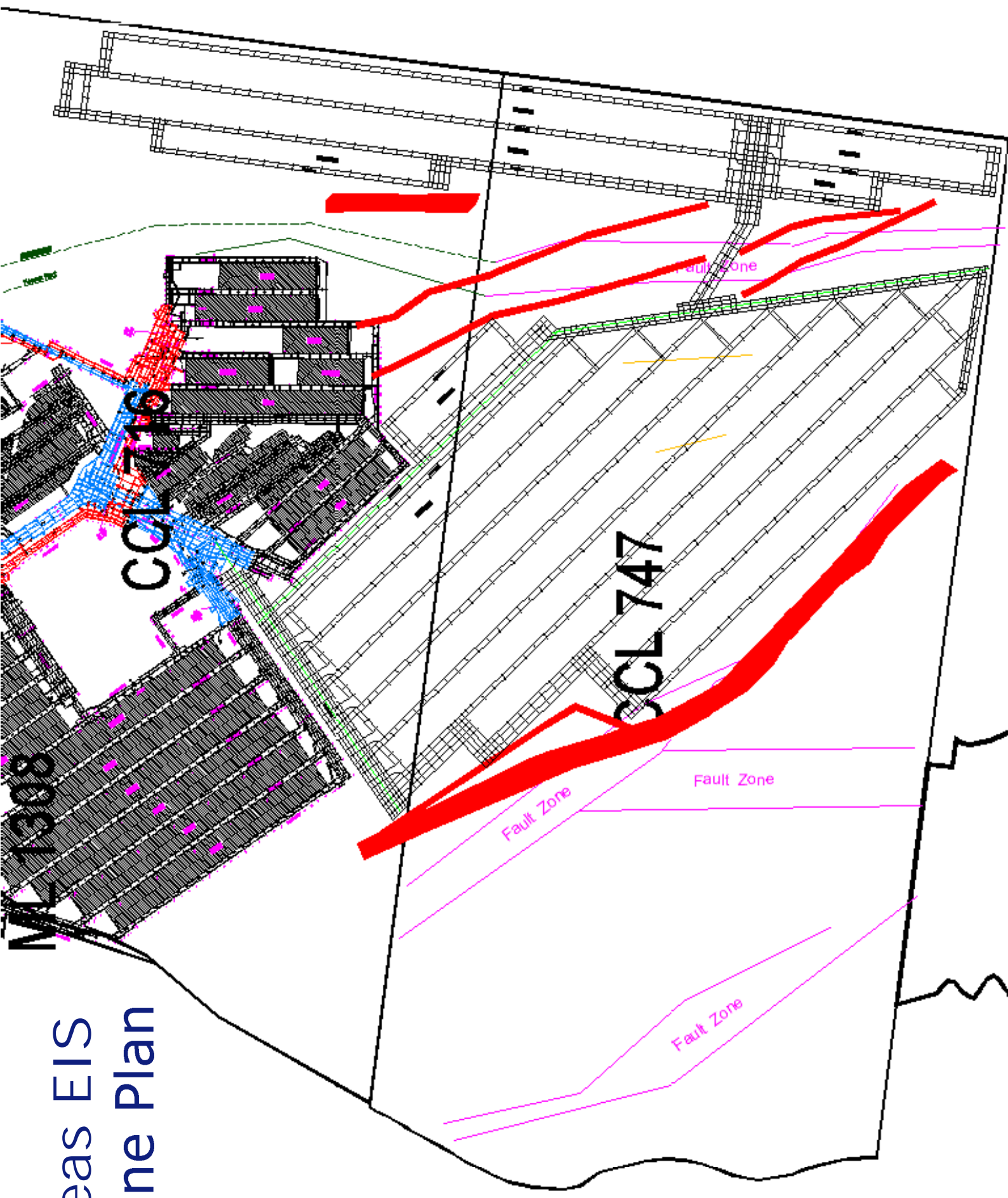
Concept Mine Plan Wongawilli



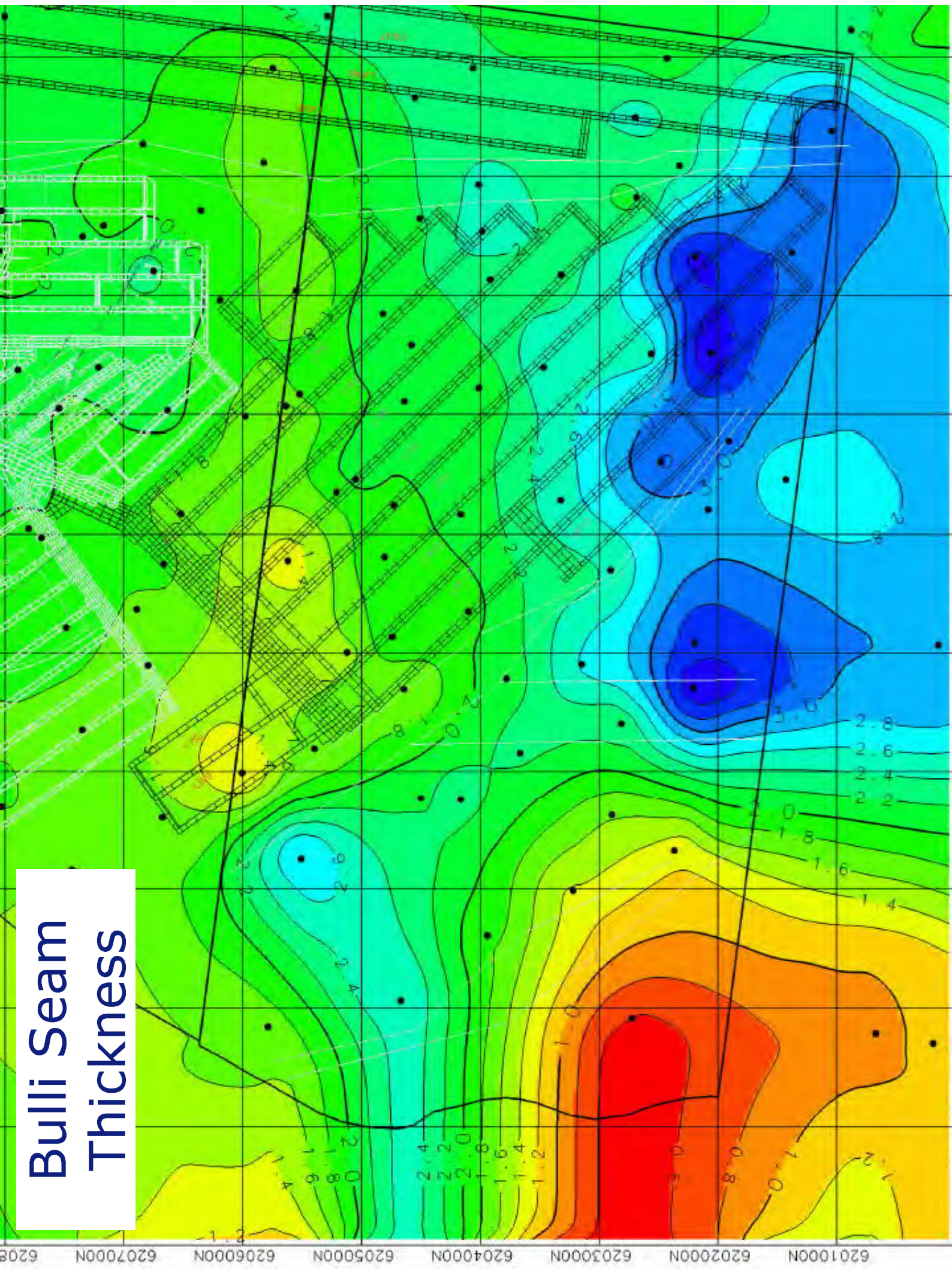
Pre-Feas Mine Plan



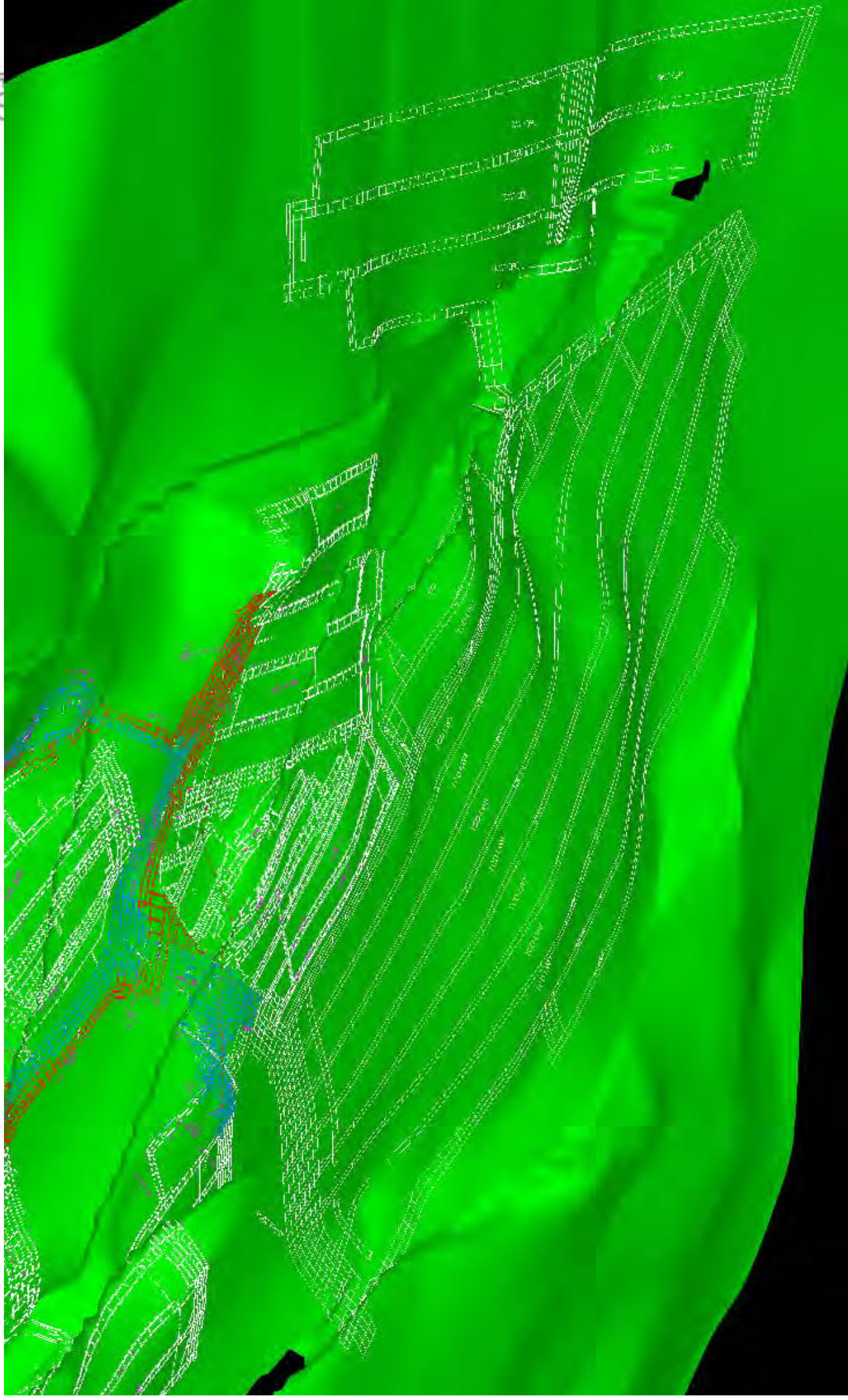
Feas EIS Mine Plan



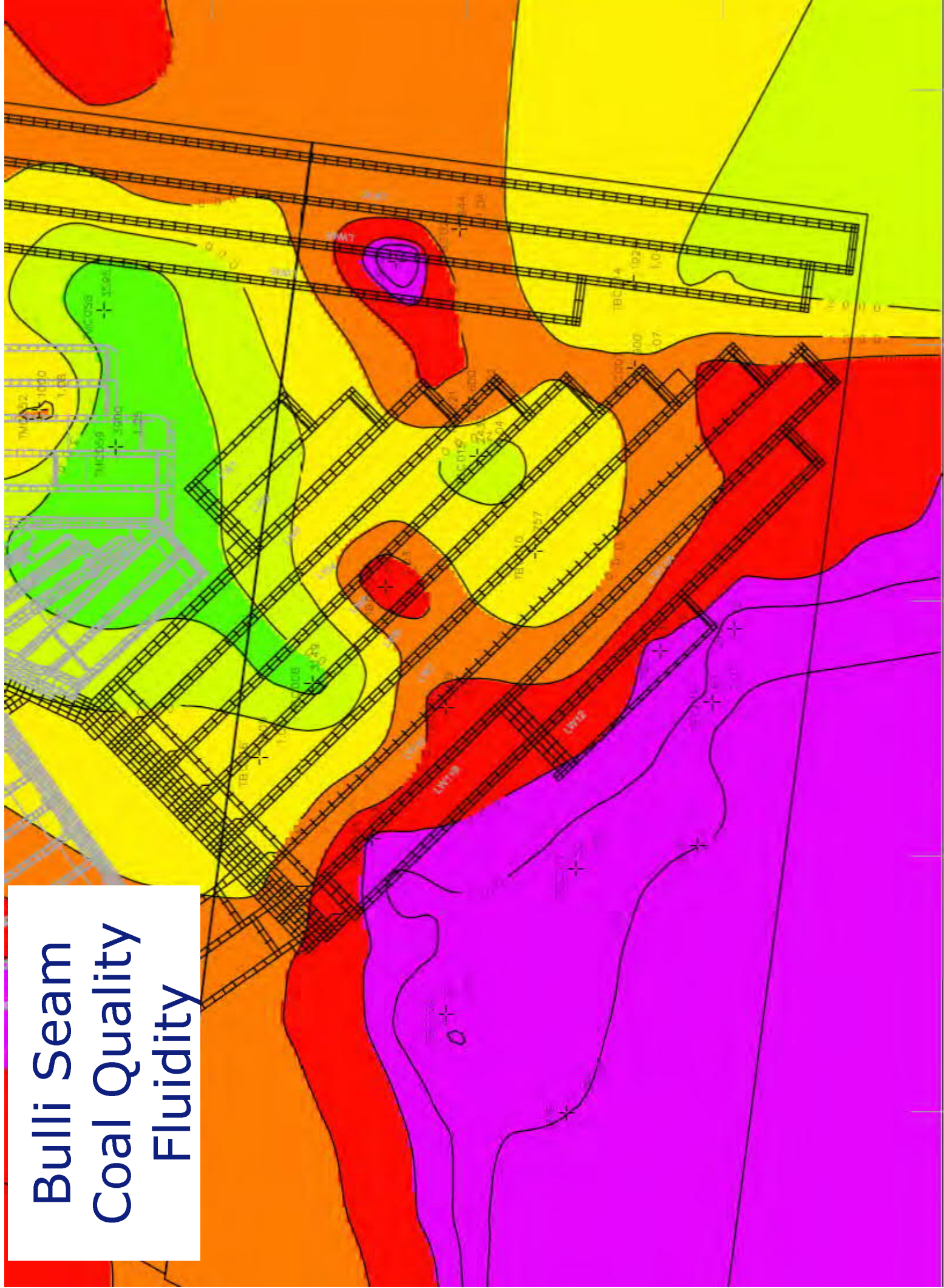
Bulli Seam Thickness



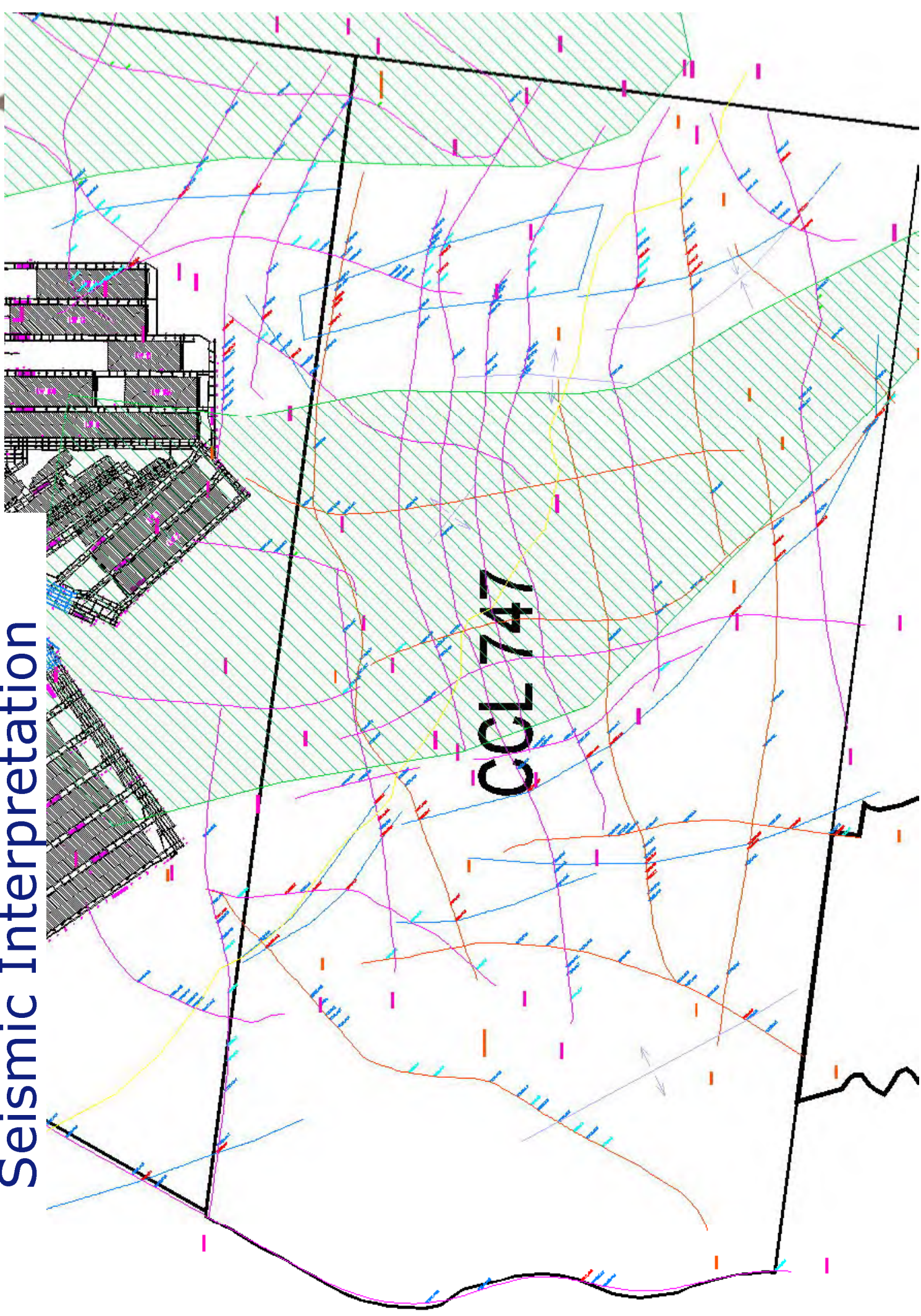
Bulli Seam Roof Contour

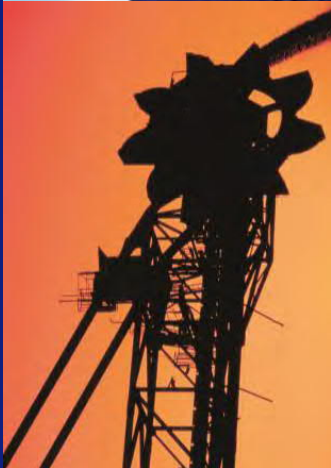


Bulli Seam Coal Quality Fluidity



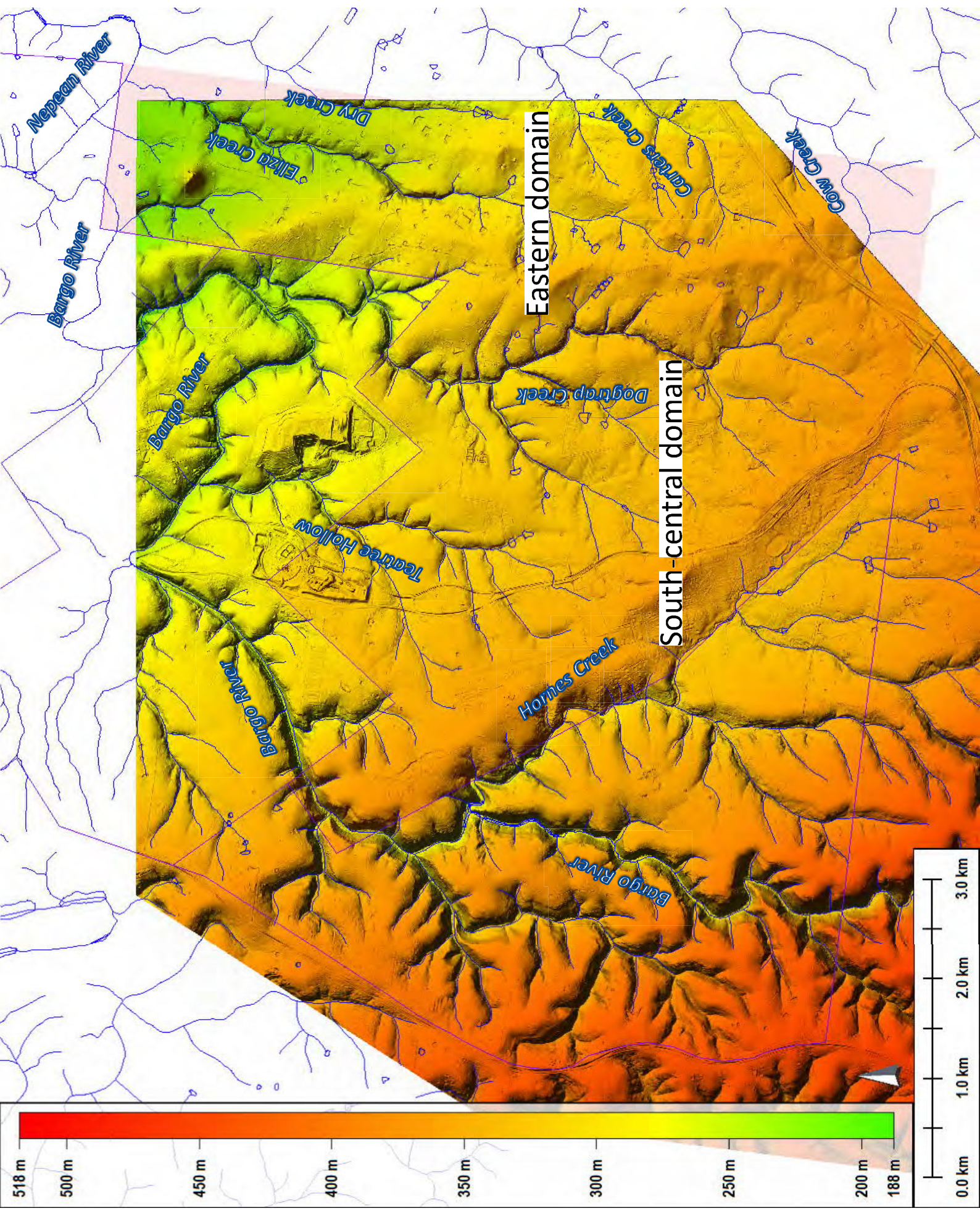
Seismic Interpretation





Geomorphology

- Characterise the existing streams
 - Stream geomorphic type (“Style”)
 - Types range in their fragility to disturbance
 - The types have typical assemblages of geomorphic units
- Locate stream units/reaches with values sensitive to subsidence
 - Rock beds at risk of cracking
 - Knickpoints at risk of accelerated migration
 - Hydraulic control points of pools at risk of subsidence or cracking
- Cliff lines
 - > 5 m high; > 2 in 1 slope (63°)
 - Locate and describe condition



Nepean River

Bargo River

Bargo River

Dry Creek
Eliza Creek

Tearec Hollow

Bargo River

Homes Creek

Dogtrap Creek

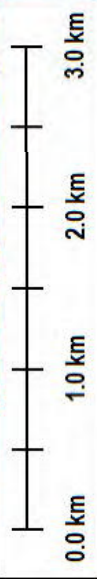
Eastern domain

South-central domain

Carrers Creek

Cow Creek

Bargo River



1. Plateau marshy swale (undisturbed)

2. Plateau pasture swale (disturbed)

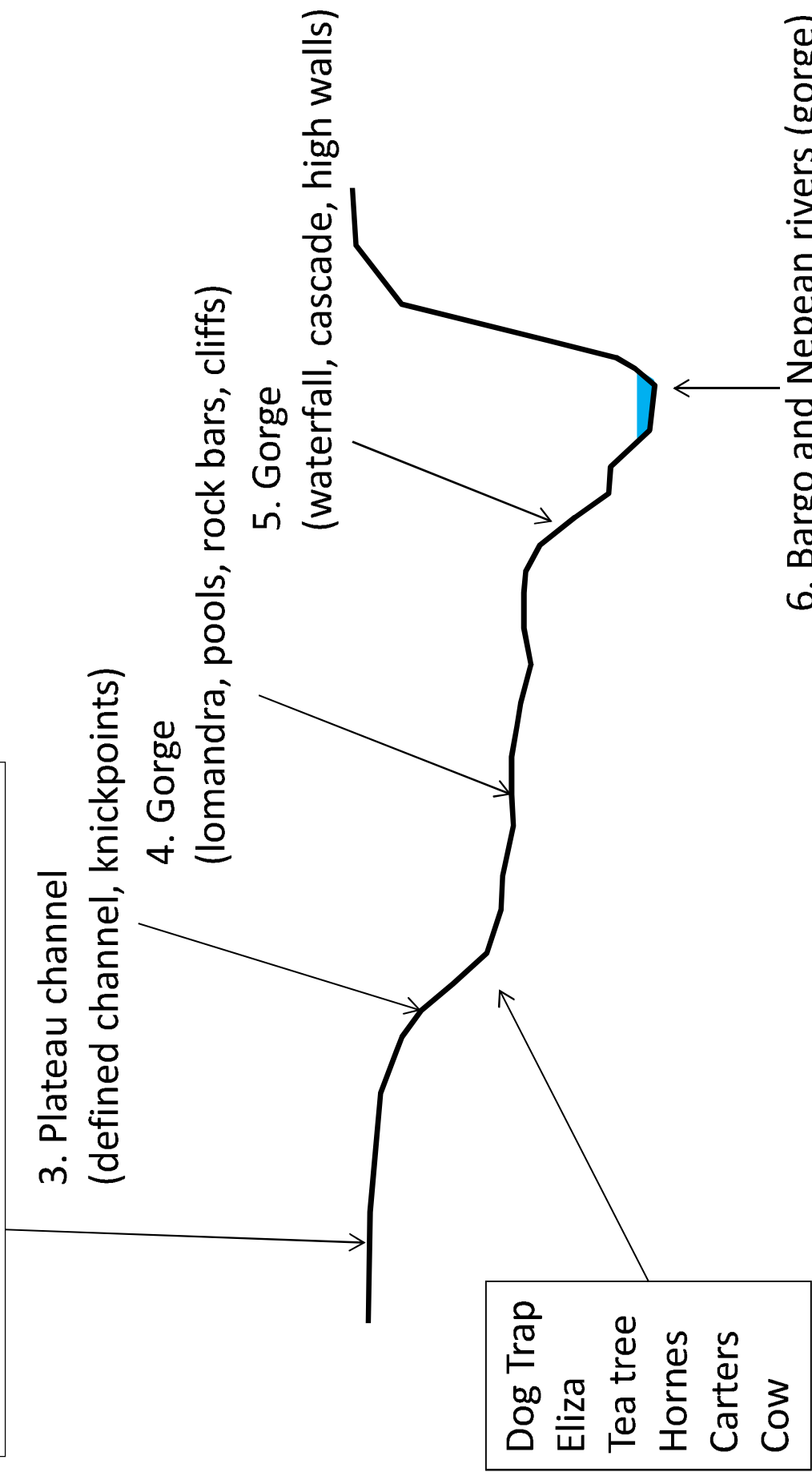
3. Plateau channel
(defined channel, knickpoints)

4. Gorge
(lomandra, pools, rock bars, cliffs)

5. Gorge
(waterfall, cascade, high walls)

6. Bargo and Nepean rivers (gorge)

Dog Trap
Eliza
Tea tree
Hornes
Carters
Cow



Plateau headwater streams

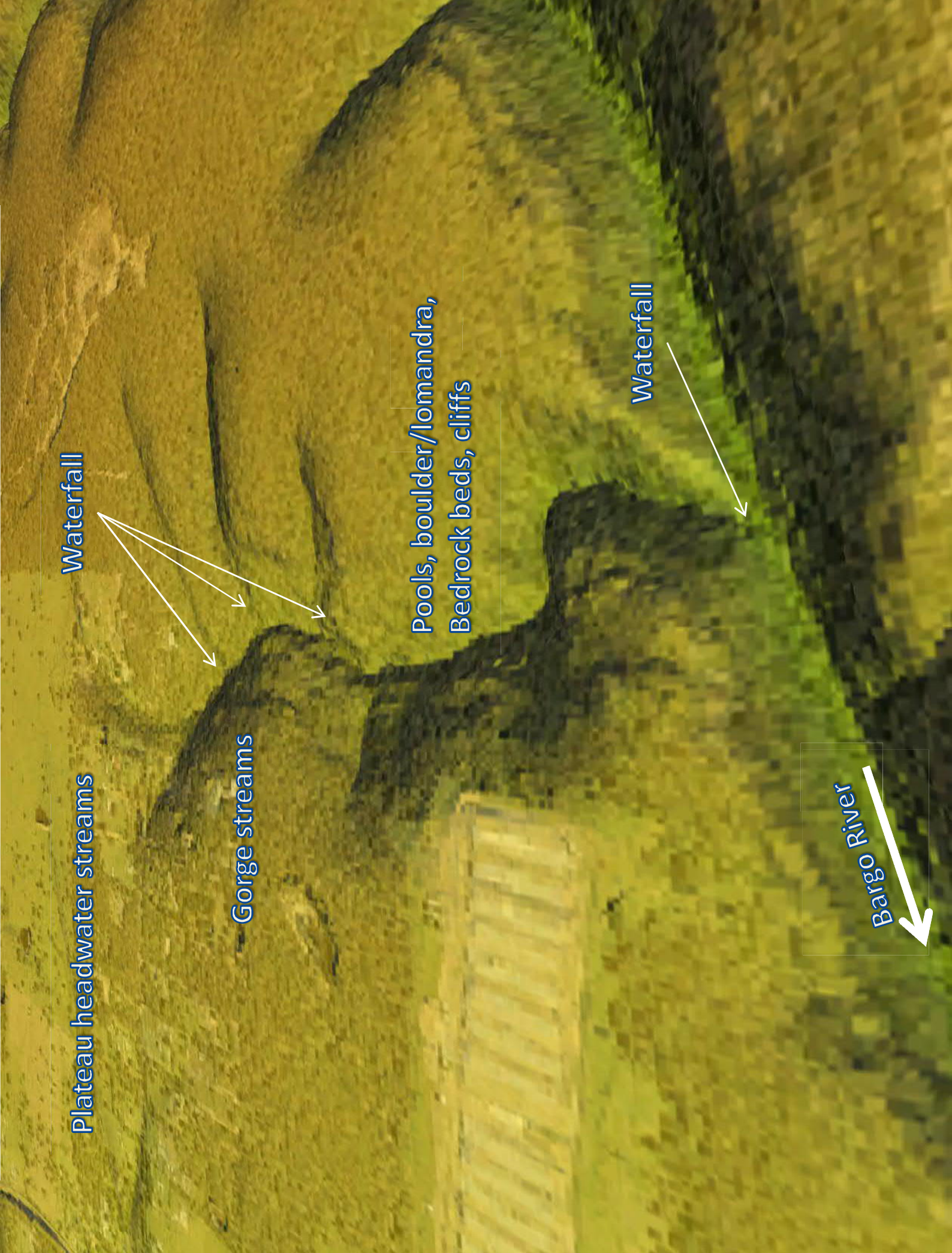
Waterfall

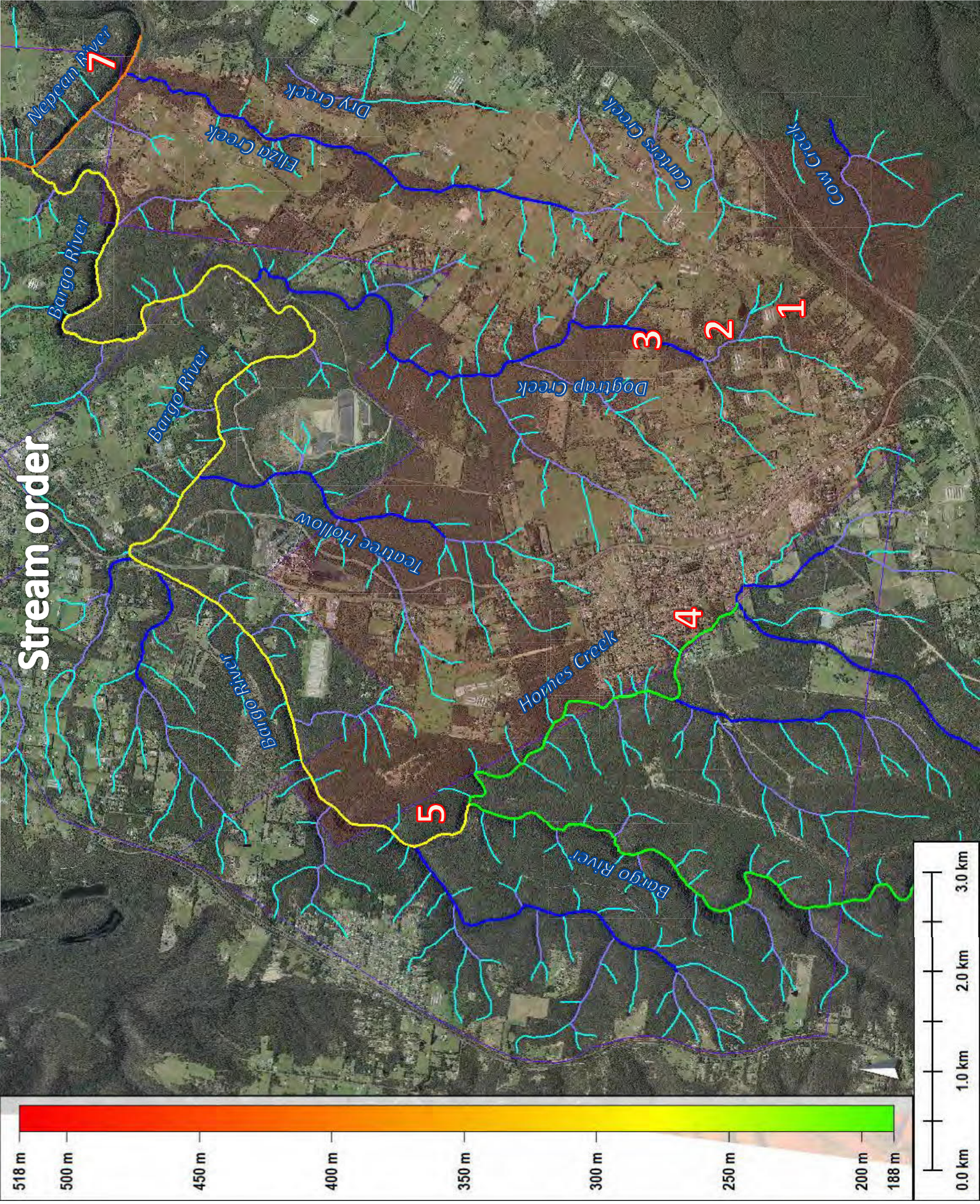
Gorge streams

Pools, boulder/lomandra,
Bedrock beds, cliffs

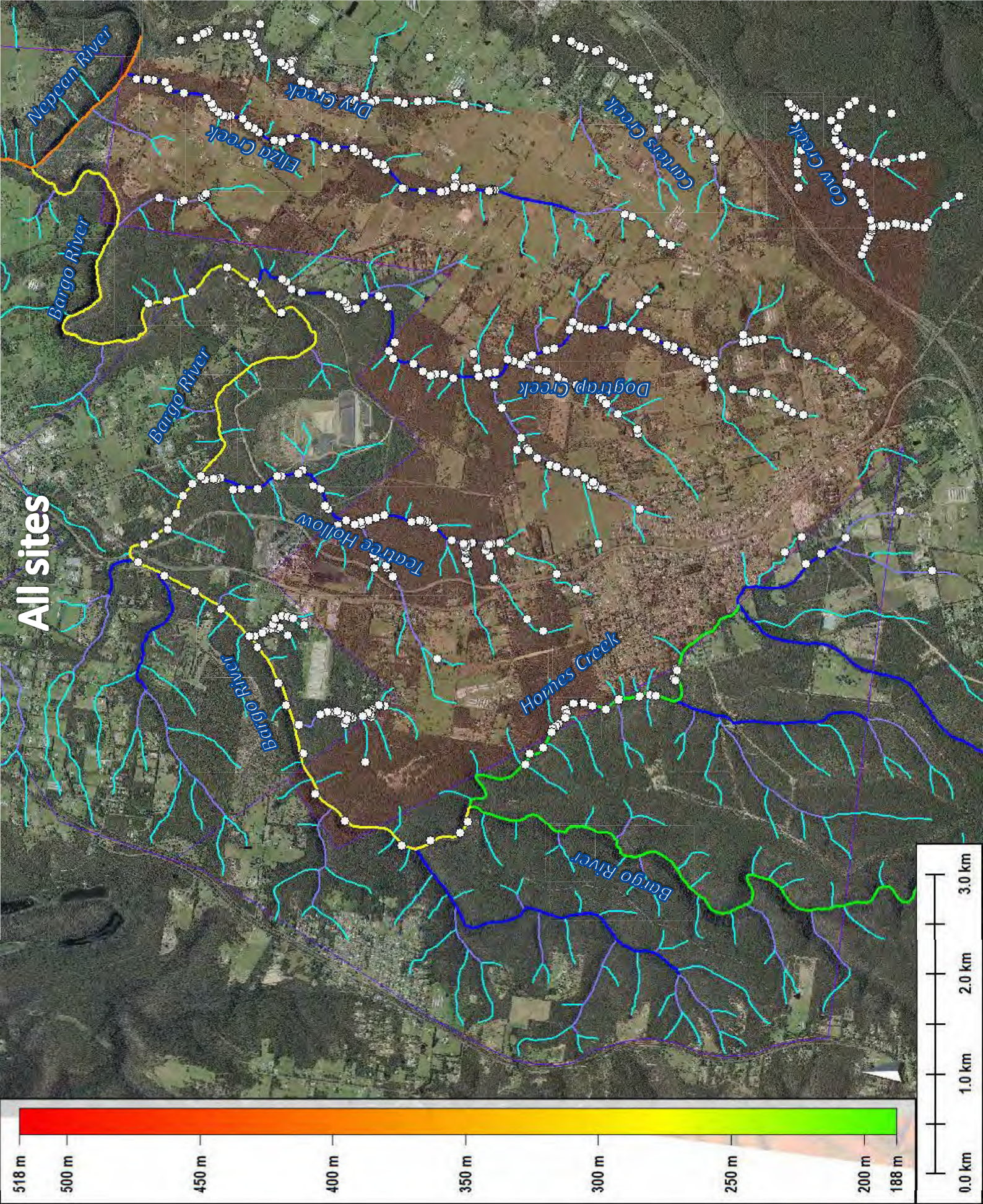
Waterfall

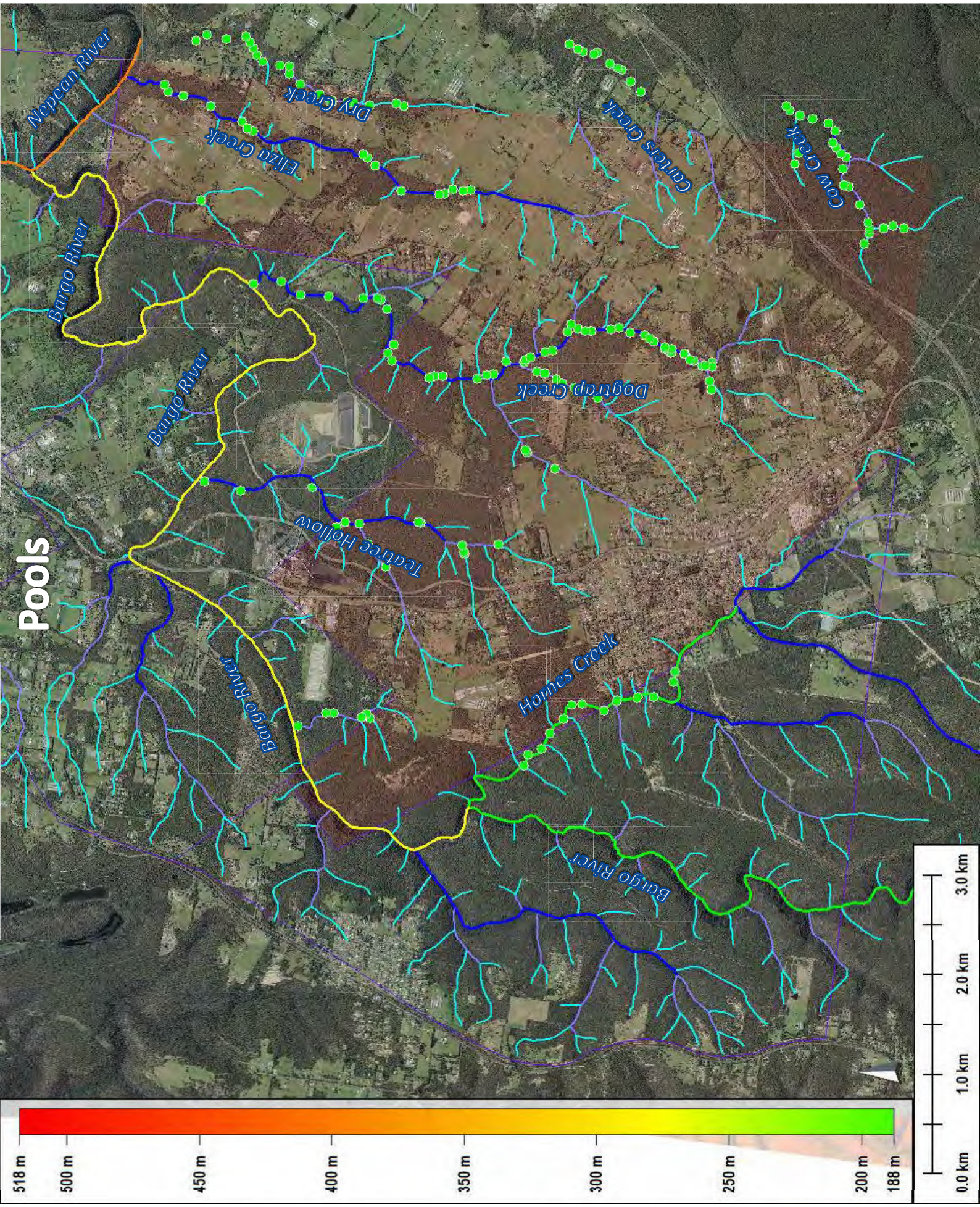
Bargo River



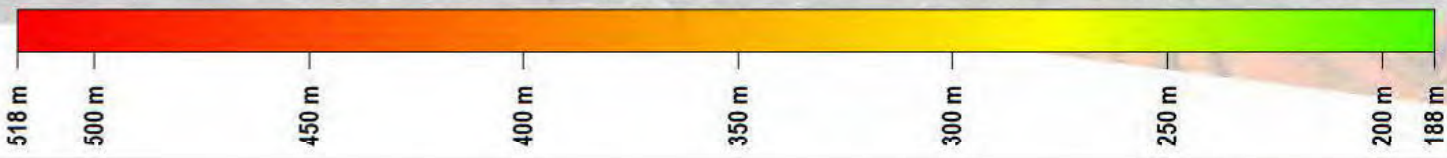


Stream order

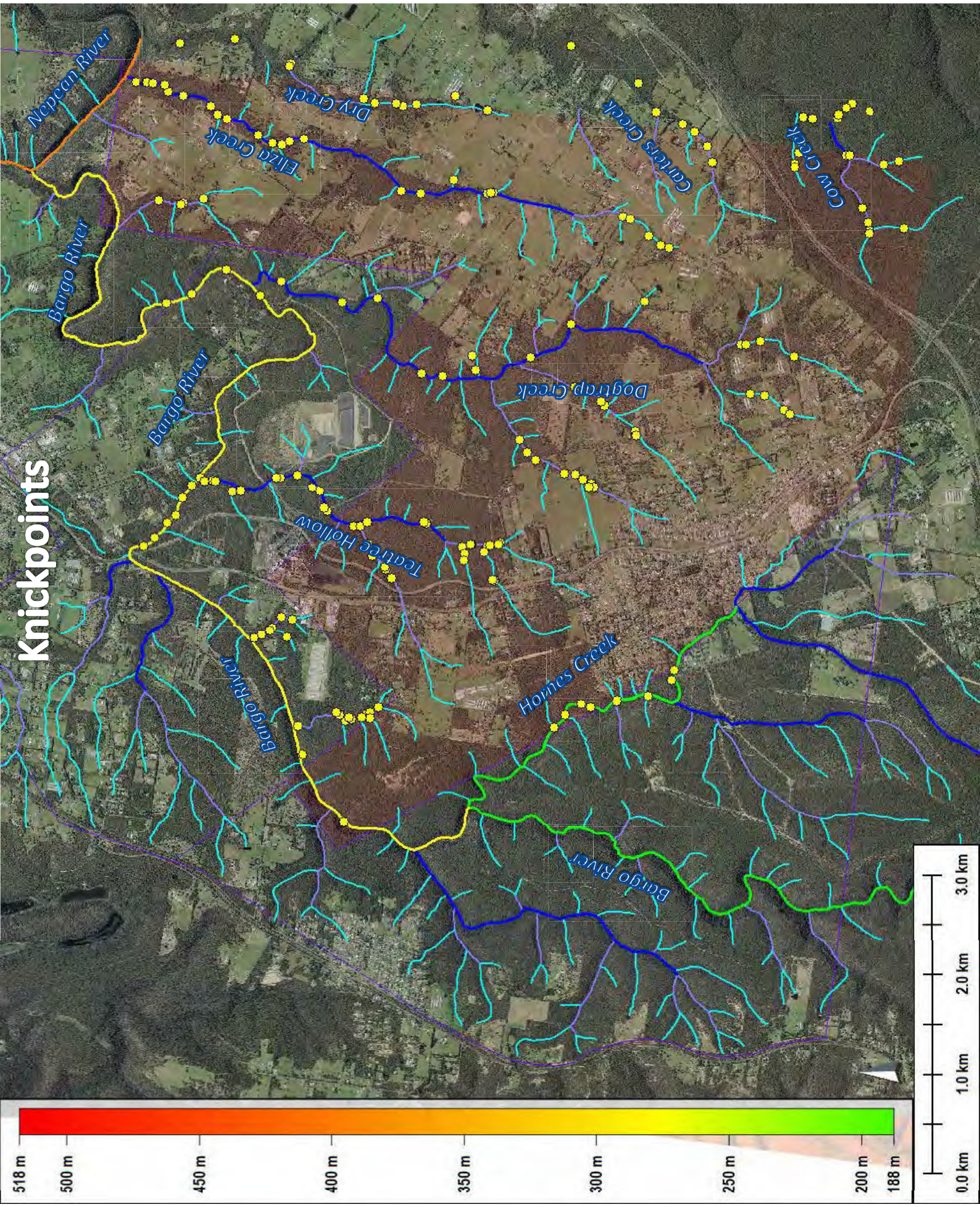




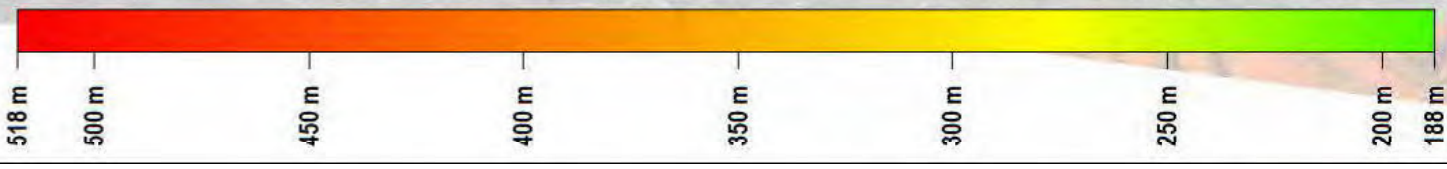
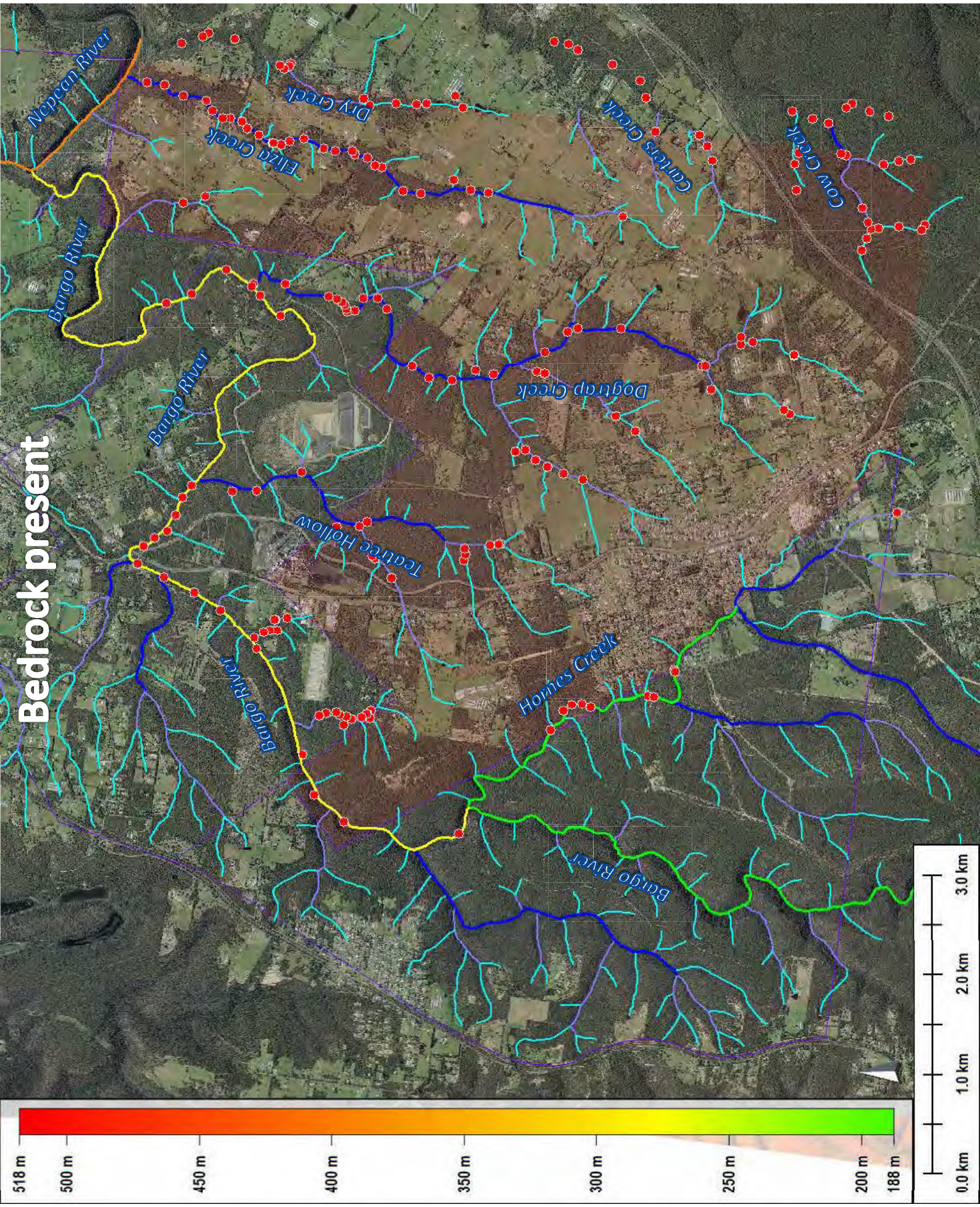
Pools



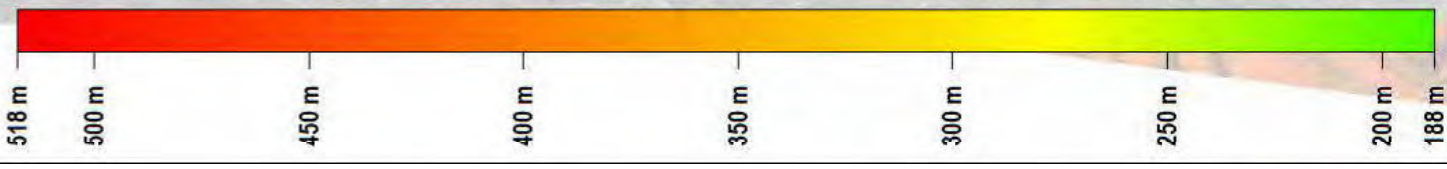
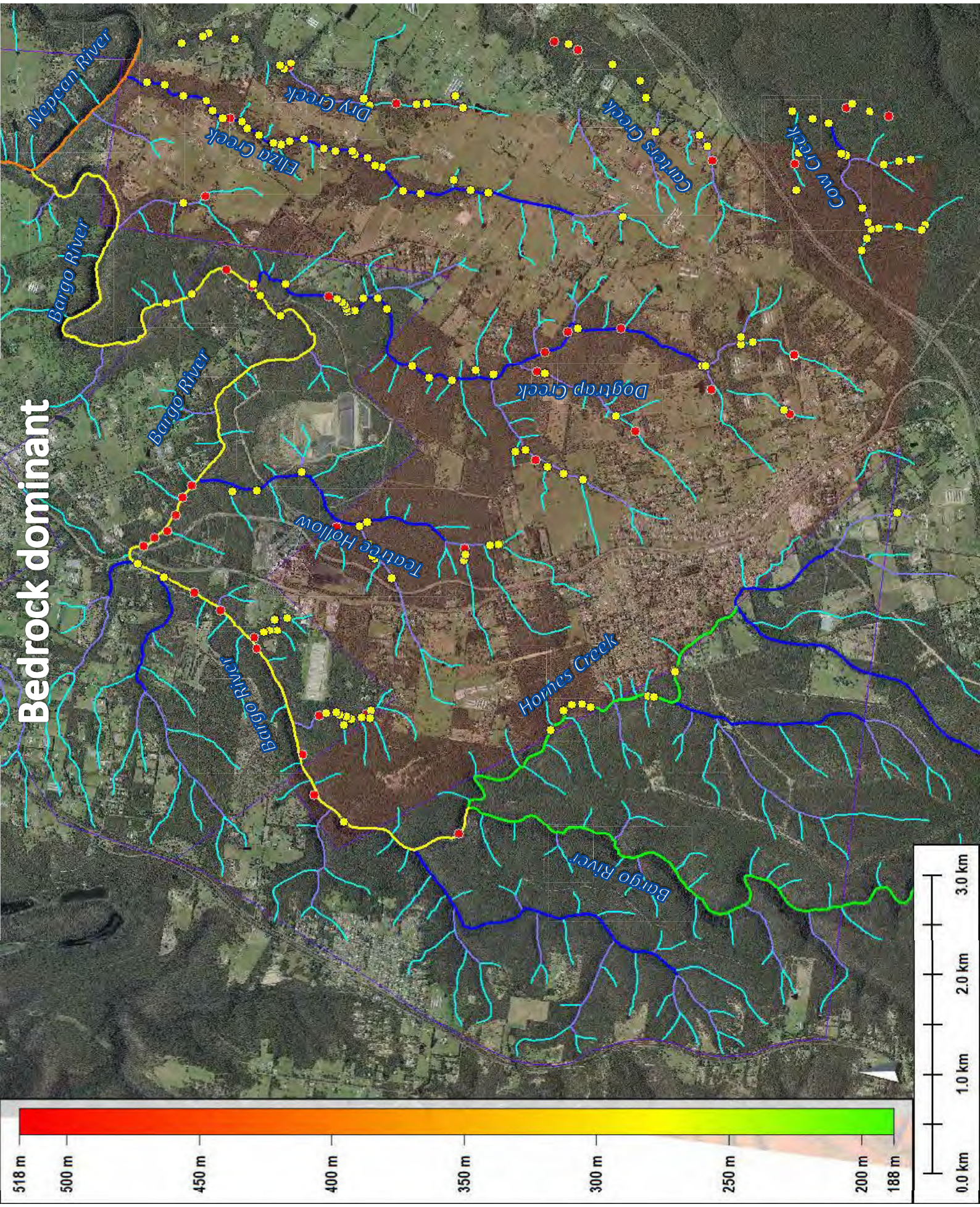
Knickpoints

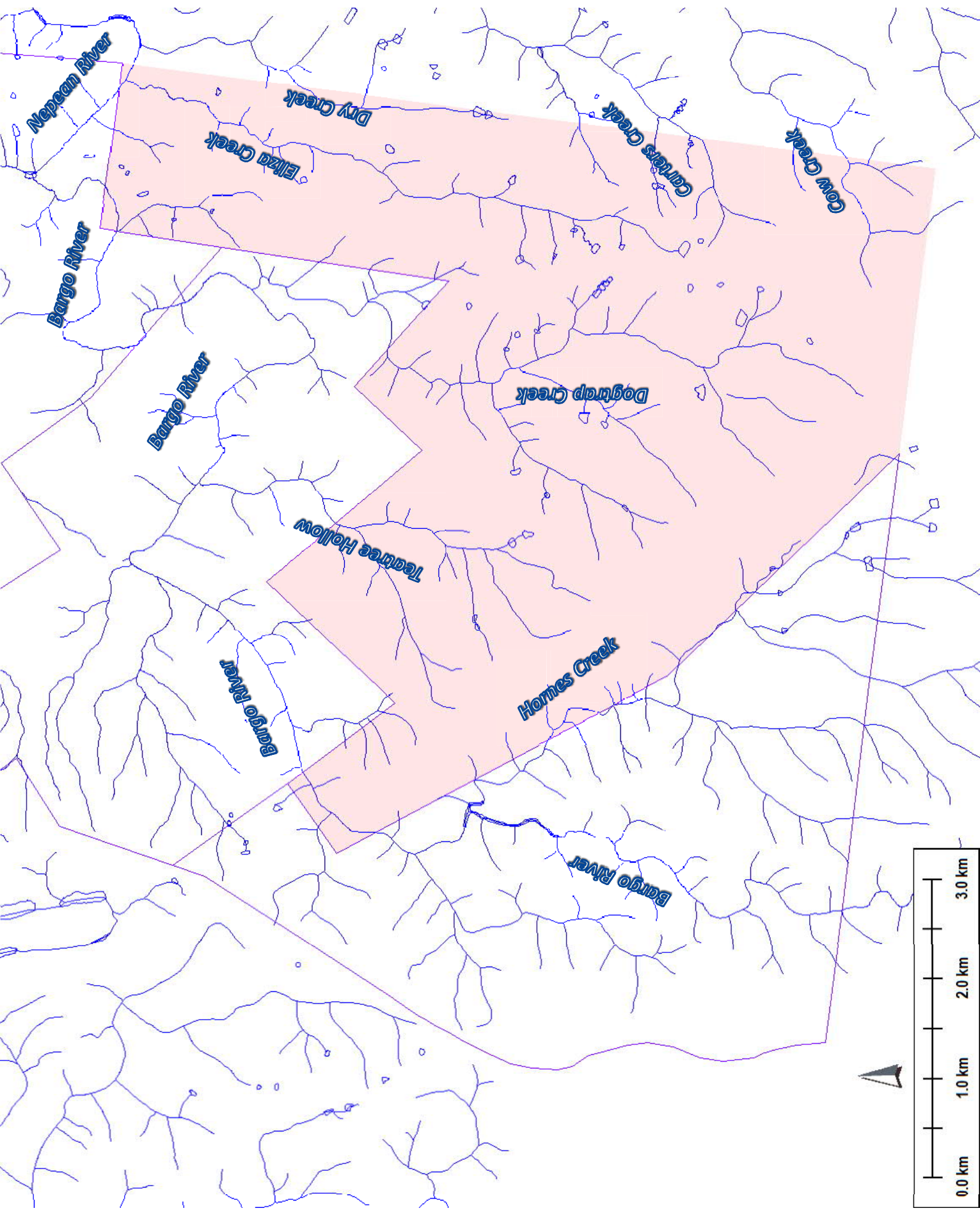


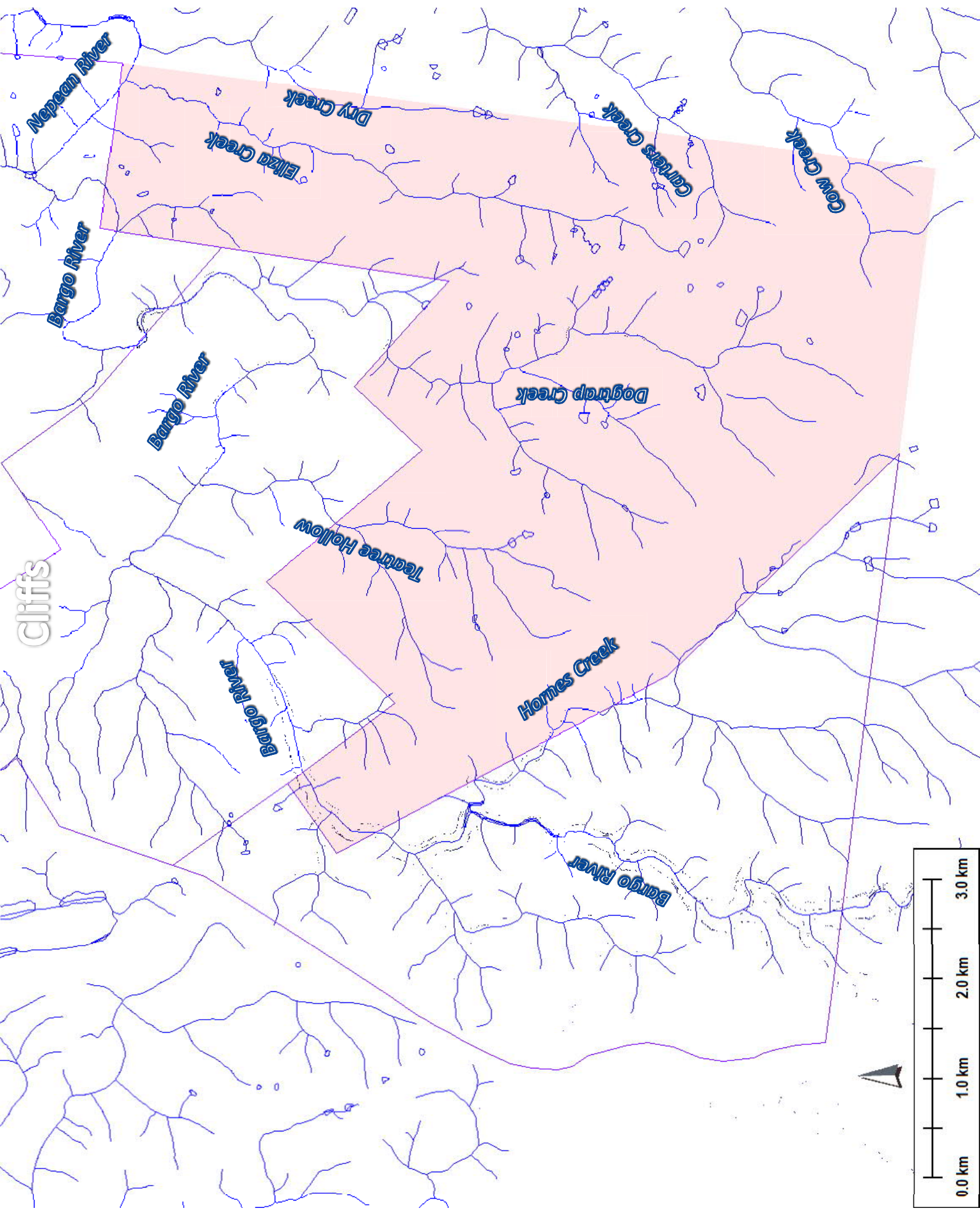
Bedrock present

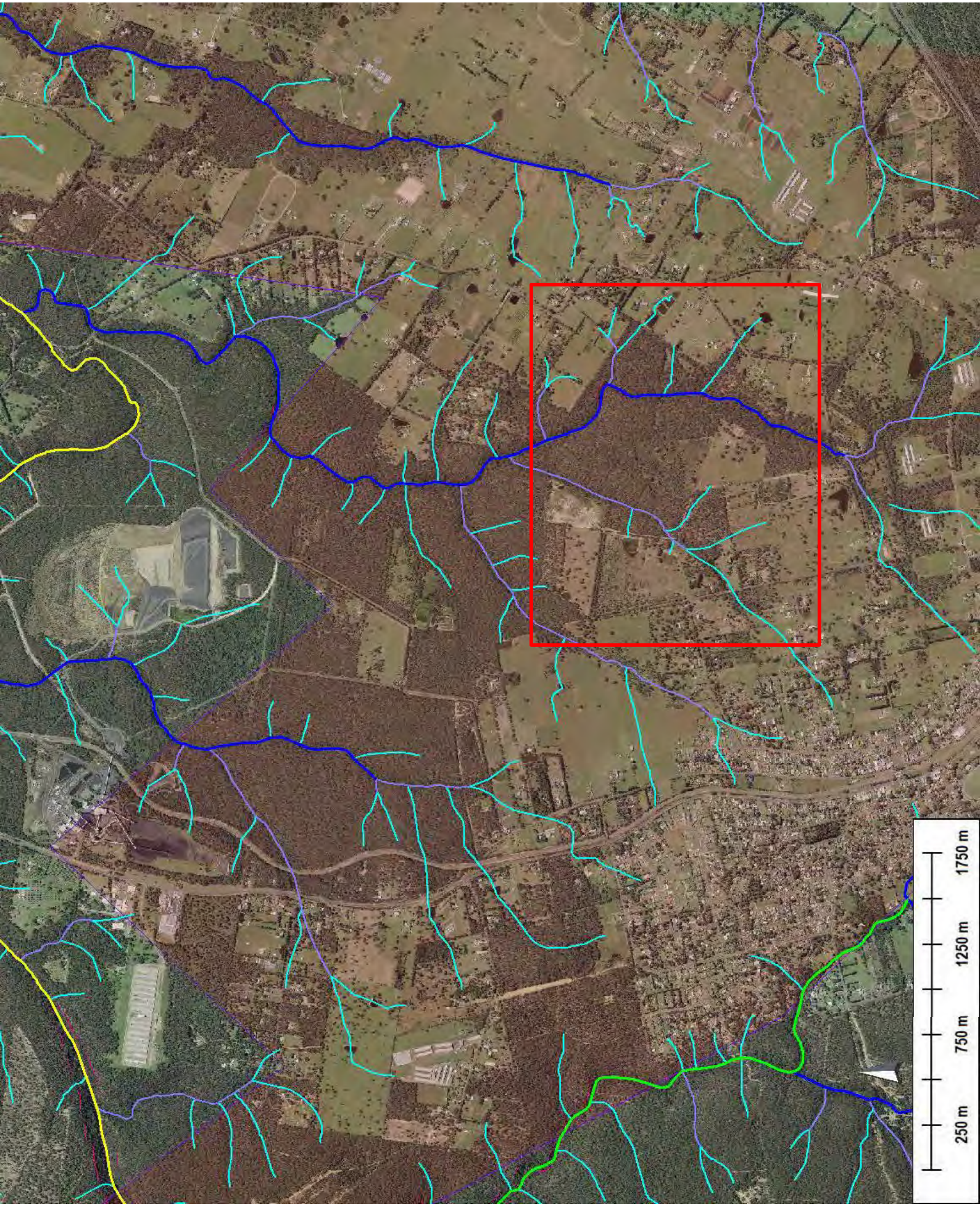


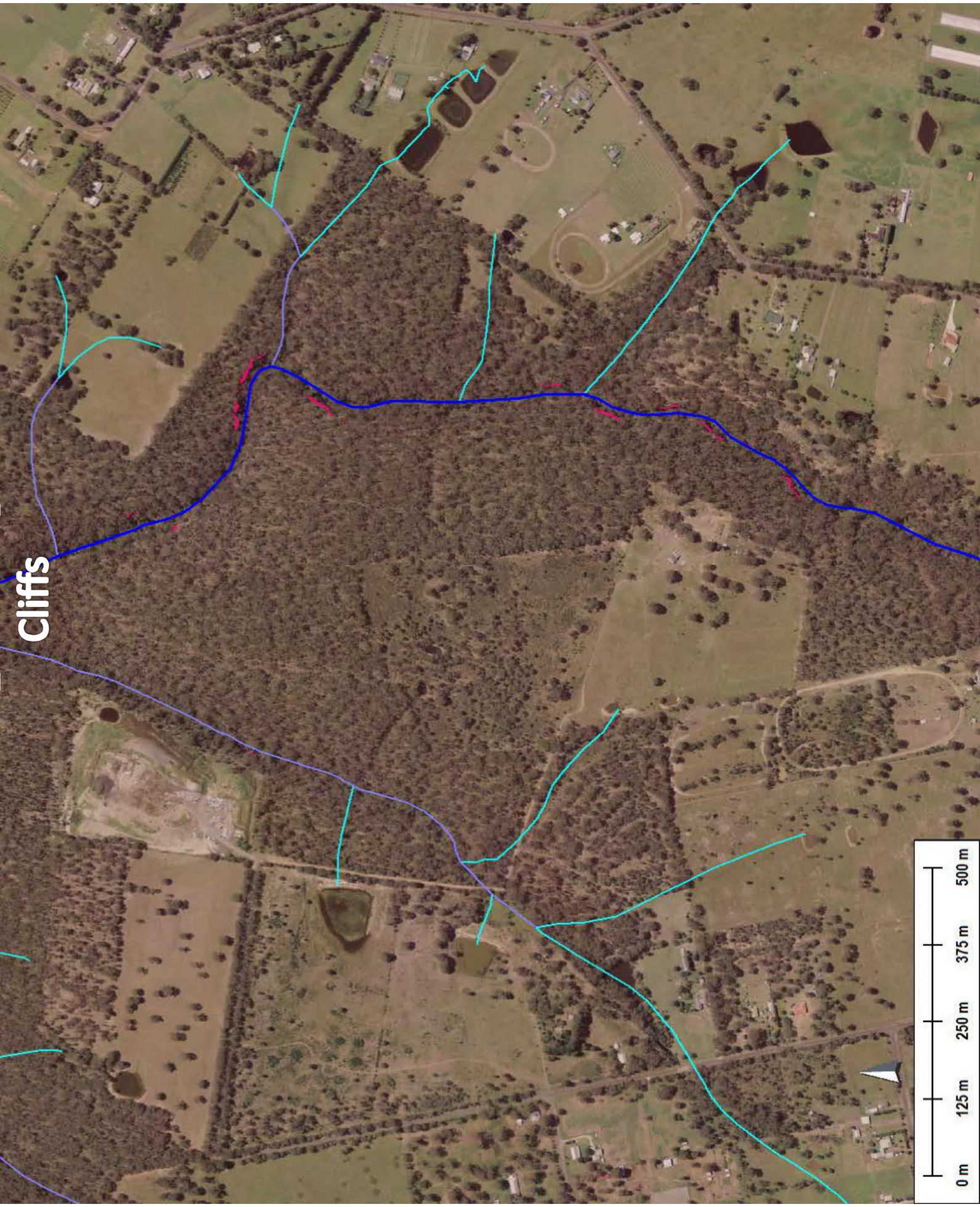
Bedrock dominant











Cliffs





Ecology and Heritage

Tahmoor South Project

Matt Richardson and Jamie Reeves

niche
Environment and Heritage

1. Ecology
 - terrestrial threatened species records
 - subsidence sensitive terrestrial species
 - EECs
 - aquatic threatened species
 - RMZ's
 - RMZ mitigation

2. Heritage
 - Indigenous Cultural Heritage
 - Non-indigenous



Ecology

niche
Environment and Heritage

Map 1: Threatened Flora and Fauna

Drawn by: RJ
Project Mgr: RR

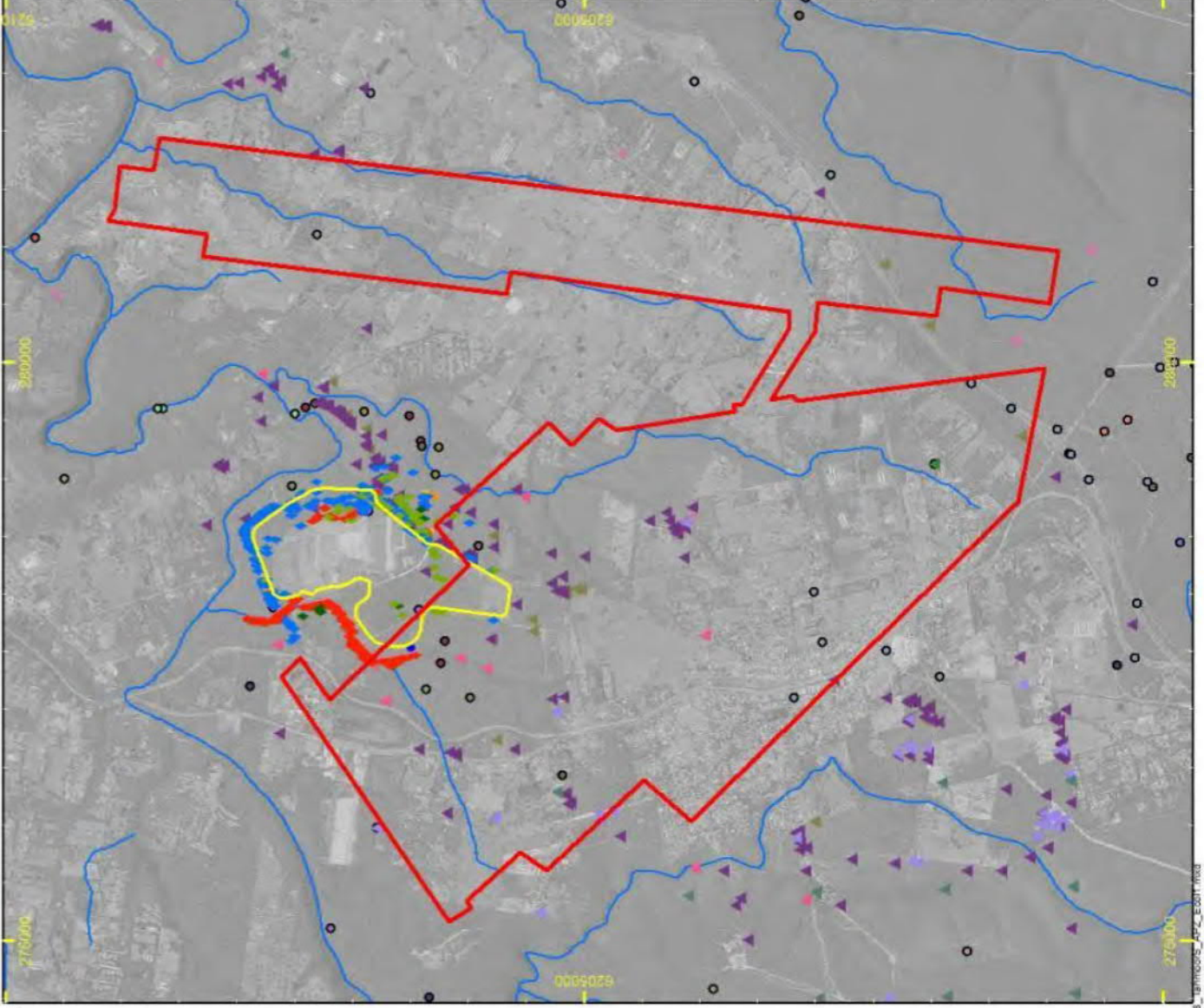
Date: 6/03/2013



niche
Environment and Heritage

Horizontal Datum:
GDA 1994 MGA Zone 56

Imagery: (c) Tahmoor Coal

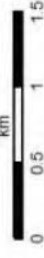


- Longwall Footprint
- REA
- Threatened Flora - Niche**
 - ◆ *Epacris purpurascens* var. *purpurascens*
 - ◆ *Grevillea parviflora* ssp. *parviflora*
 - ◆ *Persoonia bargoensis*
 - ◆ *Persoonia glaucescens*
 - ◆ *Pomaderris brunnea*
- Threatened Flora - Atlas**
 - ▲ *Epacris purpurascens* var. *purpurascens*
 - ▲ *Genoplesium baueri*
 - ▲ *Grevillea parviflora* subsp. *parviflora*
 - ▲ *Persoonia bargoensis*
 - ▲ *Persoonia glaucescens*
 - ▲ *Persoonia hirsuta*
 - ▲ *Pomaderris brunnea*
- Threatened Fauna - Niche**
 - East Coast Freetail Bat
 - Eastern Bent-wing Bat
 - Eastern Cave Bat
 - Eastern False Pipistrelle
 - Large-footed Myotis
 - Little Eagle
 - Powerful Owl
- Threatened Fauna - Atlas**
 - Black-chinned Honeyeater (eastern subspecies)
 - Broad-headed Snake
 - Brown Treecreeper (eastern subspecies)
 - Brush-tailed Belfong (South-East Mainland)
 - Bush Stone-curlew
 - Diamond Firetail
 - Eastern Bentwing-bat
 - Eastern False Pipistrelle
 - Eastern Freetail-bat
 - Eastern Pygmy-possum
 - Gang-gang Cockatoo
 - Greater Broad-nosed Bat
 - Koala
 - Large-eared Pied Bat
 - Little Eagle
 - Powerful Owl
 - Scarlet Robin
 - Sooty Tern
 - Southern Myotis
 - Spotted-tailed Quoll
 - Varied Sittella

Map 3: EEC

Drawn by: RJ
Project Mgr: RR

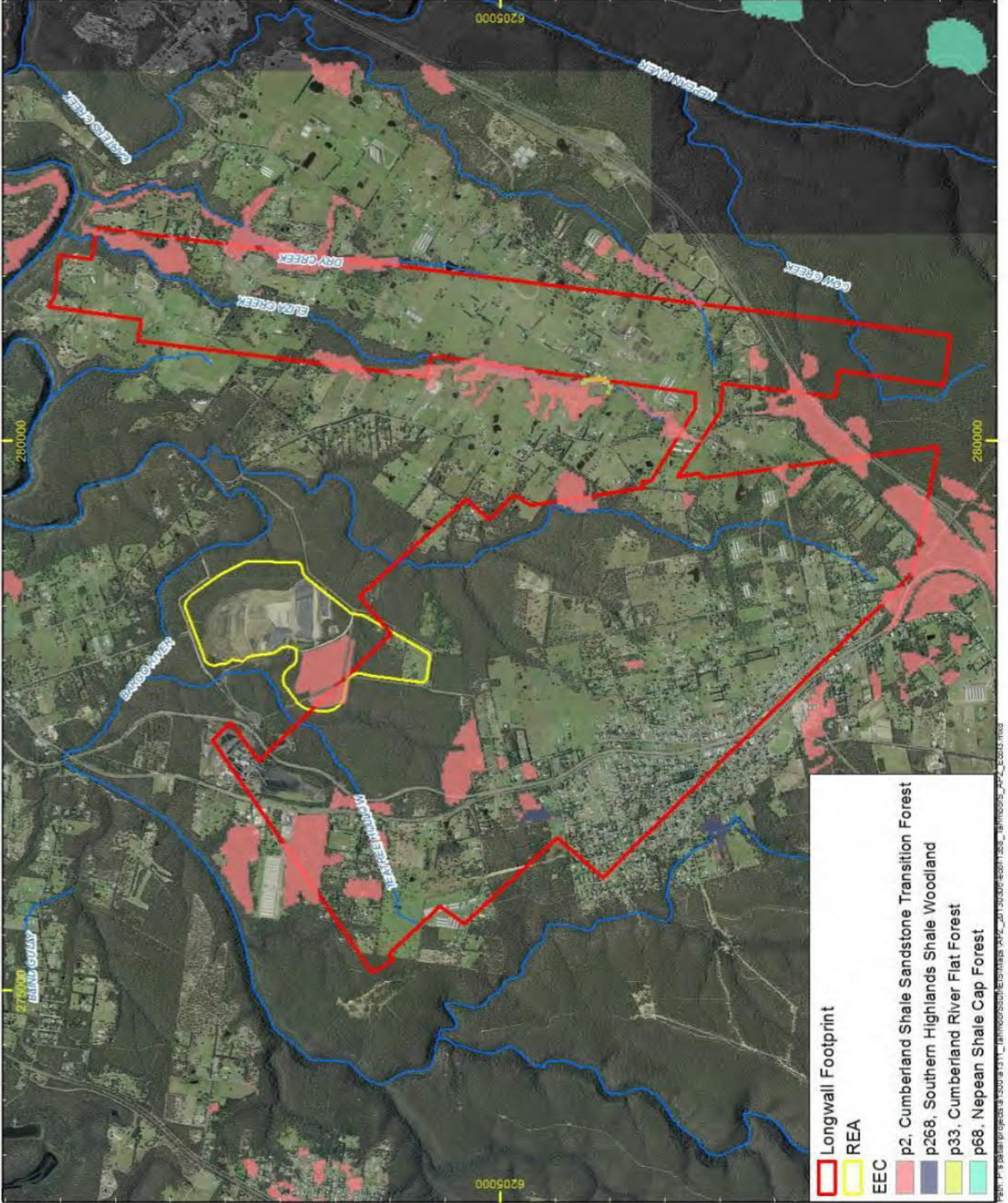
Date: 6/03/2013










niche
Environment and Heritage

Horizontal Datum:
GDA 1994 MGA Zone 56

Imagery: (c) Tahmoor Coal



-  Longwall Footprint
-  REA
-  EEC
-  p2, Cumberland Shale Sandstone Transition Forest
-  p268, Southern Highlands Shale Woodland
-  p33, Cumberland River Flat Forest
-  p68, Nepean Shale Cap Forest

1. Previous records in region for:
 - Adams Emerald Dragonfly
 - Sydney Hawk Dragonfly
 - Giant Dragonfly
 - Macquarie Perch
2. Not recorded to date
3. Not likely to occur

1. Impact assessment is defined by
consequence x likelihood x proportion x duration
1. RMZ can be reduced with further information relating to
 - subsidence prediction
 - geomorphological mapping/data
 - water quality/quantity assessment
 - rock mechanics
 - precedence



Heritage

niche
Environment and Heritage

**Map 2: ACH Potential
Subsidence Risk**

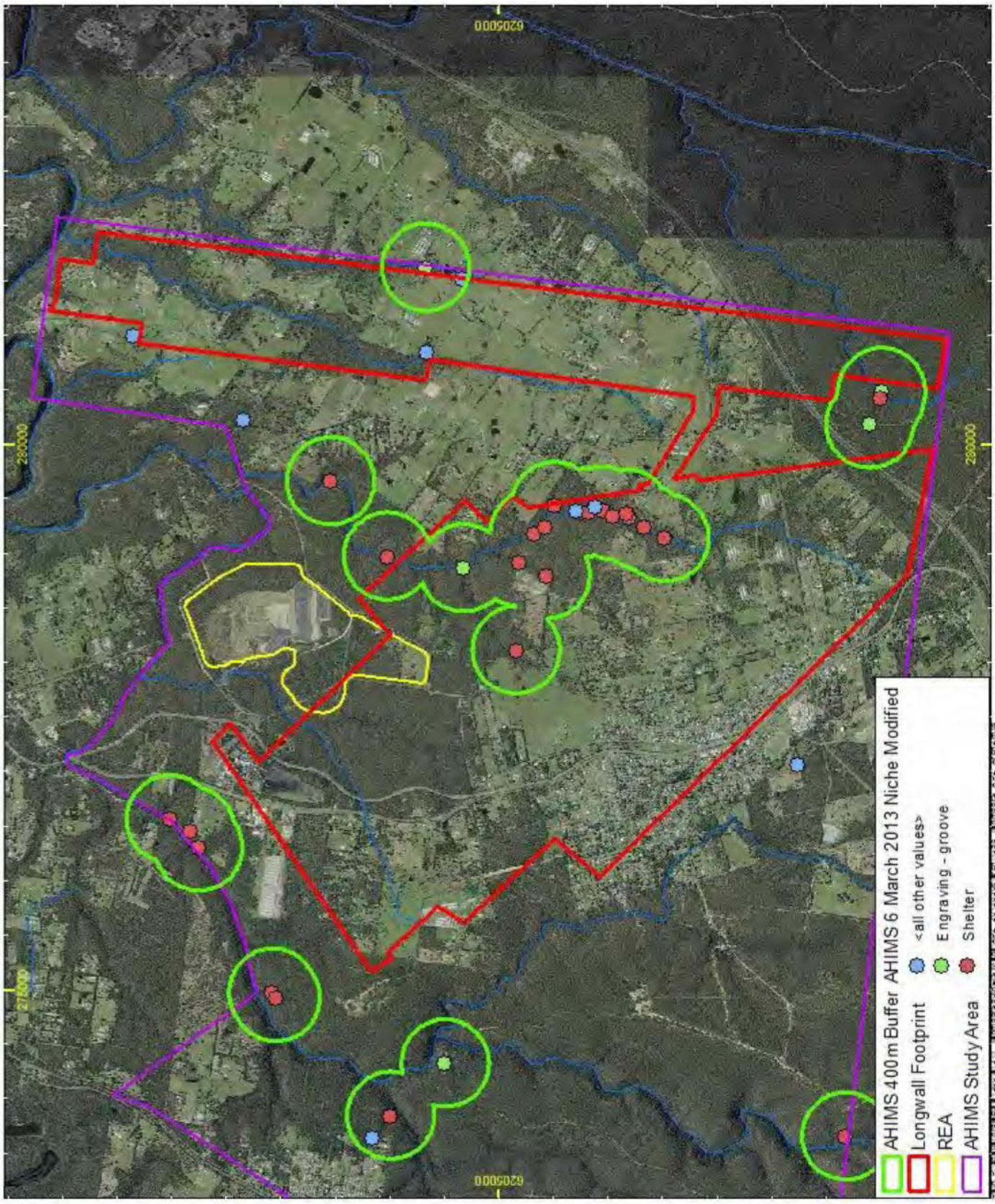
Drawn by: RJ
Project Mgr: RR
Date: 6/03/2013



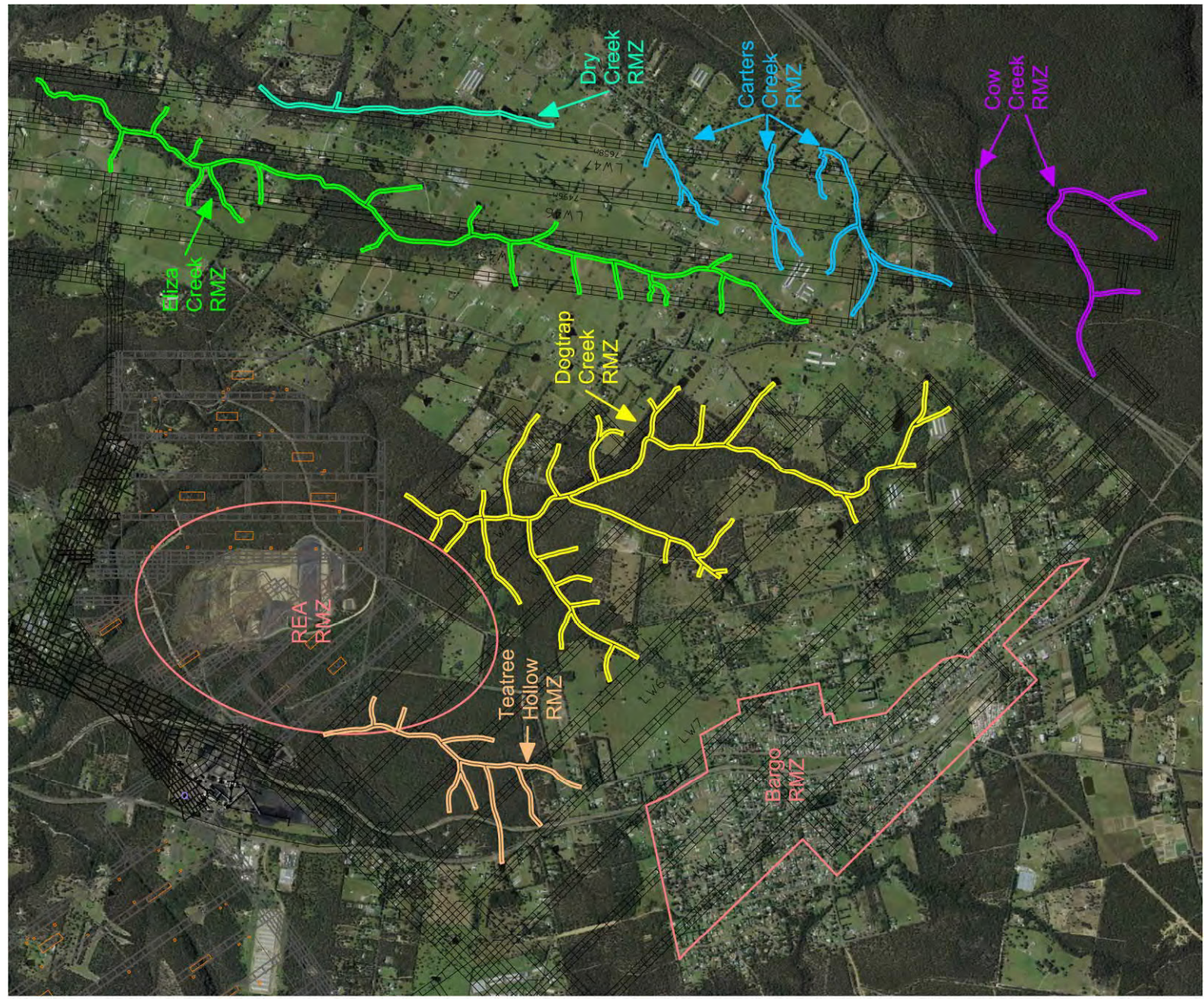
niche
Environmental and Heritage

Horizontal Datum:
GDA 1994 MGA Zone 56

Imagery: (c) Tahmoor Coal



- AHIMS 400m Buffer AHIMS 6 March 2013 Niche Modified
- Longwall Footprint
- REA
- AHIMS Study Area
- <all other values>
- Engraving - groove
- Shelter

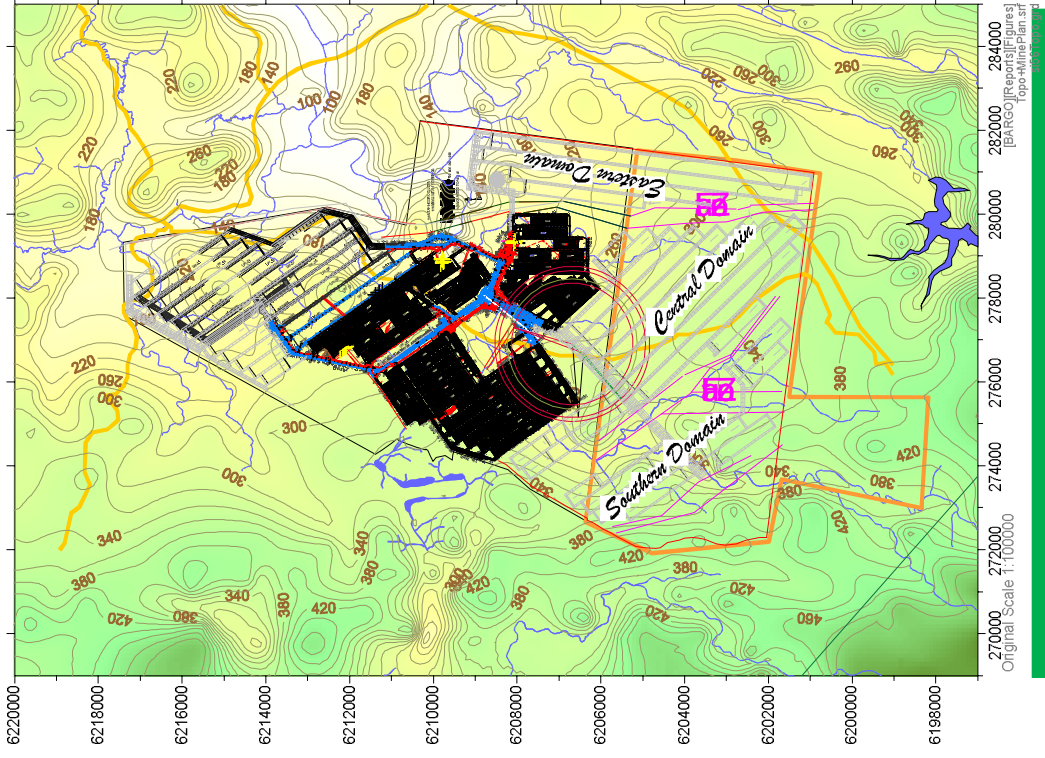


Tahmoor South Feasibility Subsidence Workshop

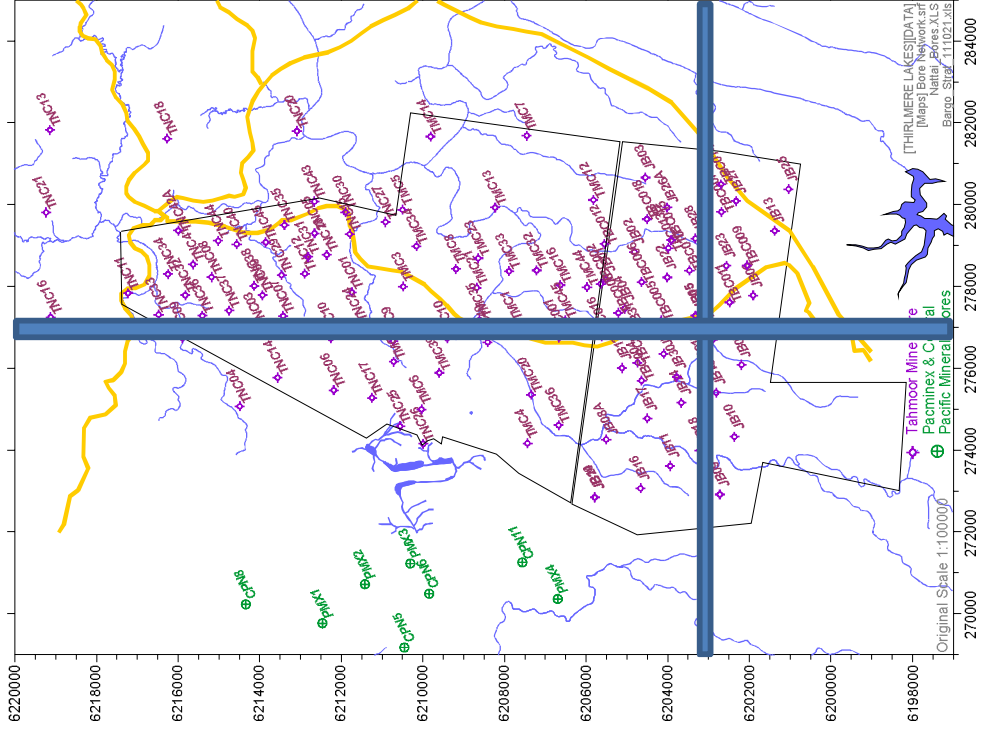
Overview – Hydrogeological Conditions



Pre-Feasibility Model Extent

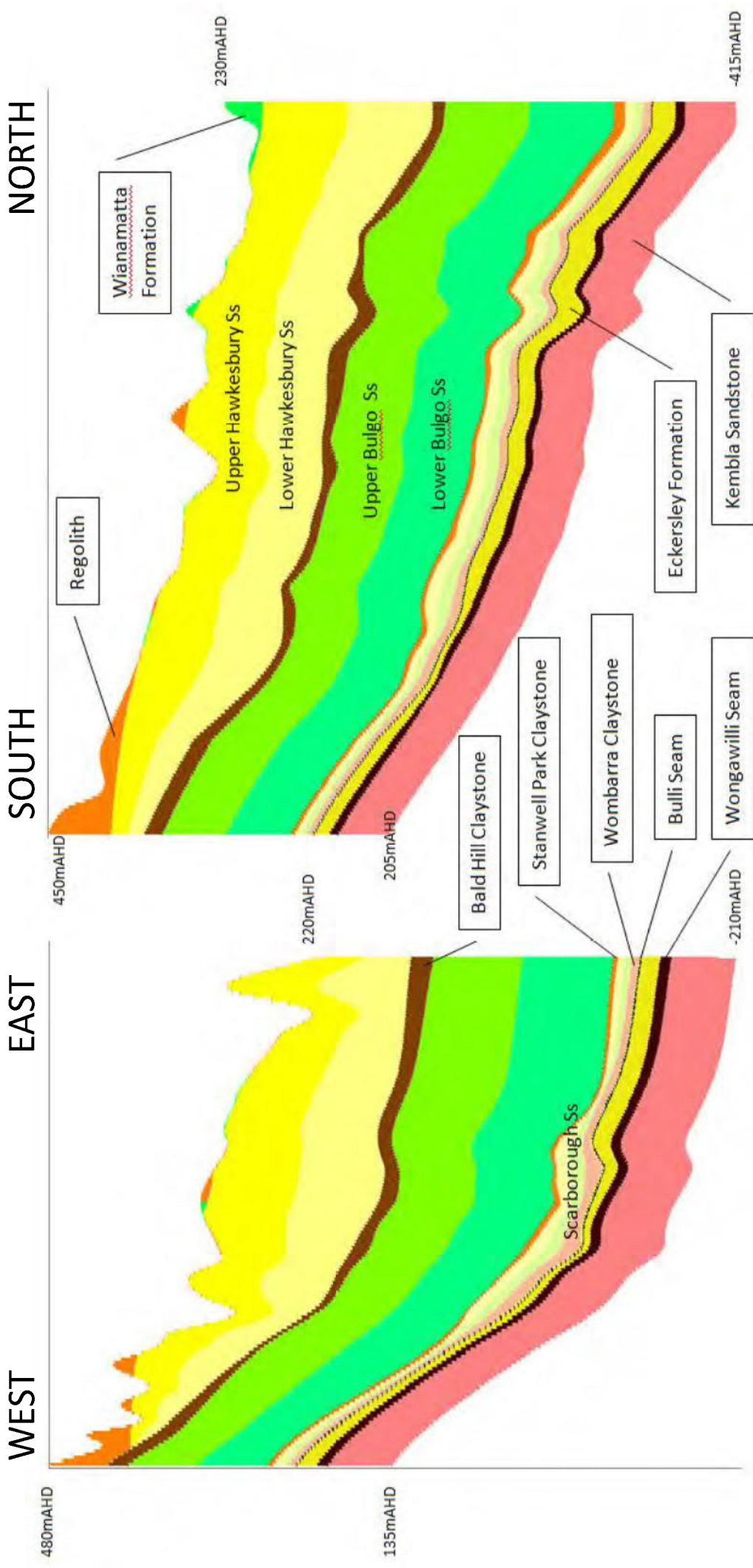


Study Area & Topography



Exploration Bores & Geological Model

Model Stratigraphy

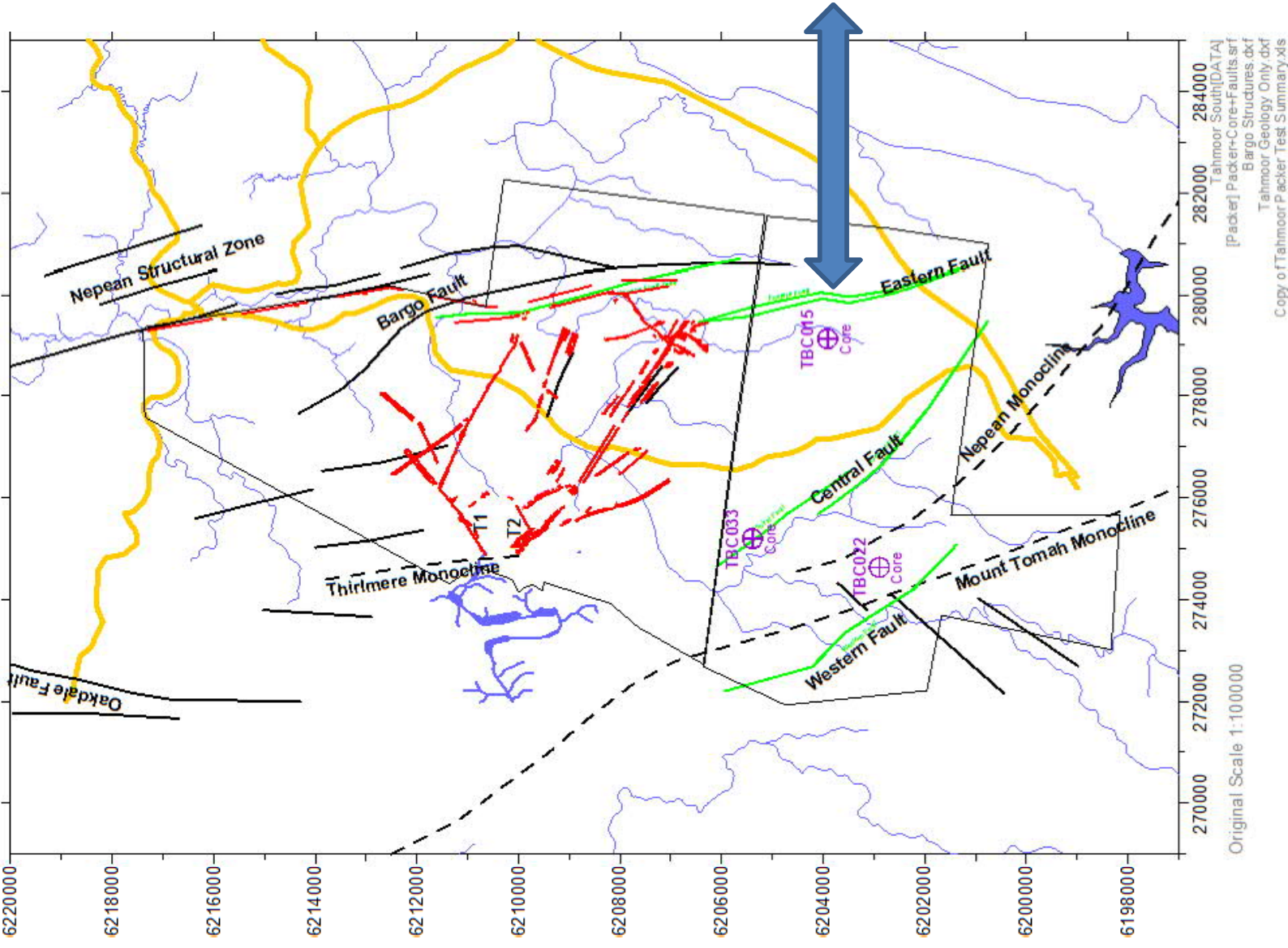


N 6203 500

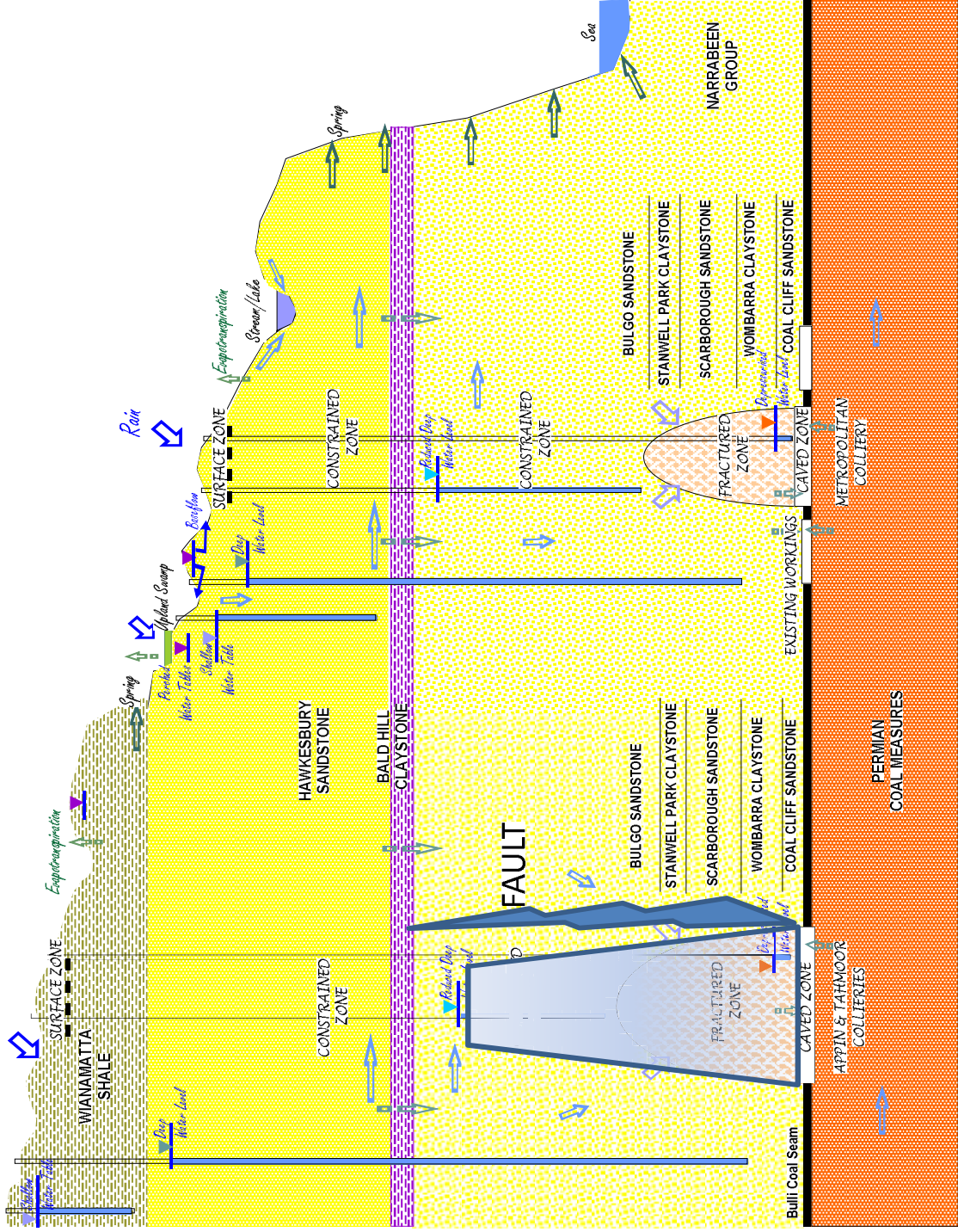
E 277 000

PACKER TESTS:
12 sites in North Tahmoor
26 sites in South Tahmoor

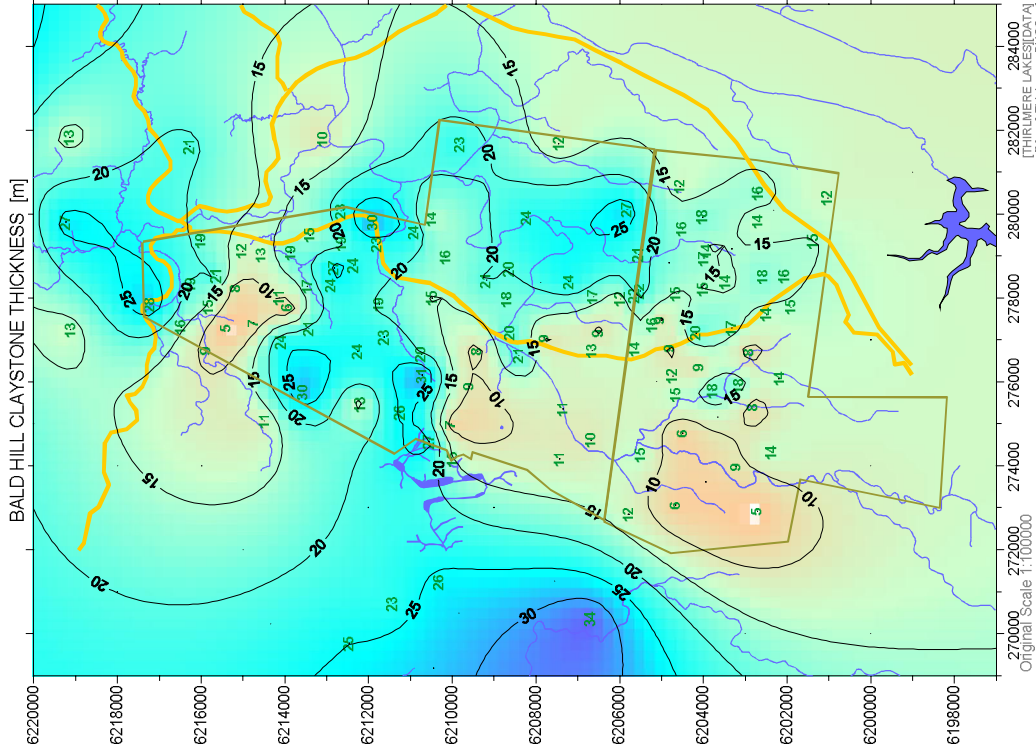
LABORATORY CORE PERMEABILITY MEASUREMENTS
3 sites in South Tahmoor



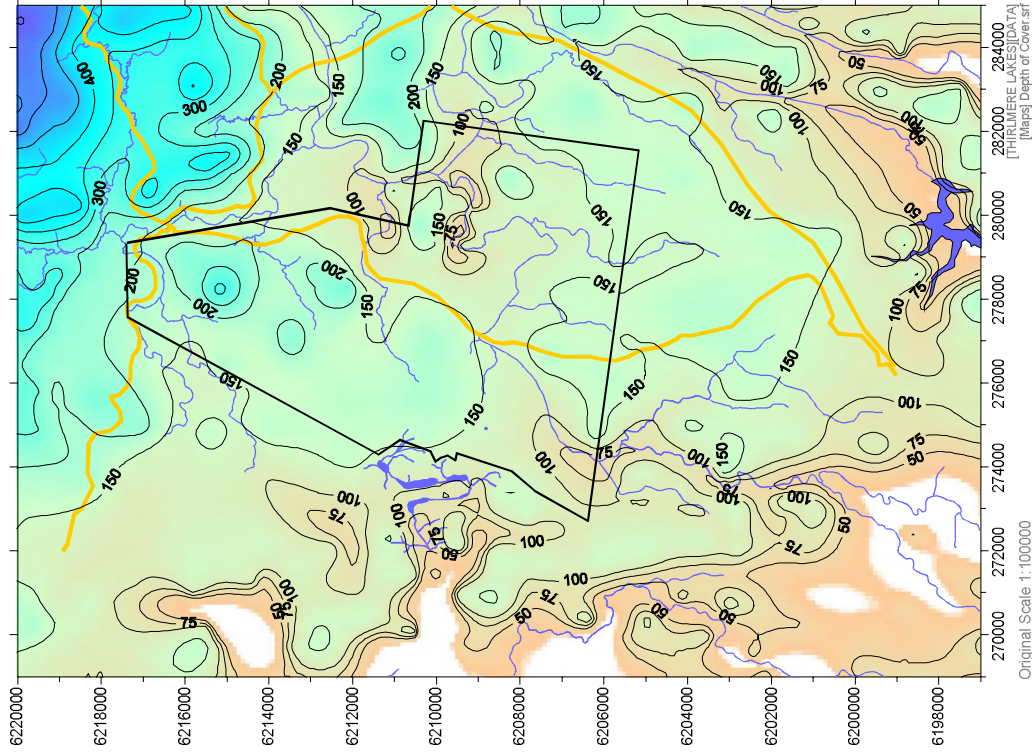
Conceptualisation



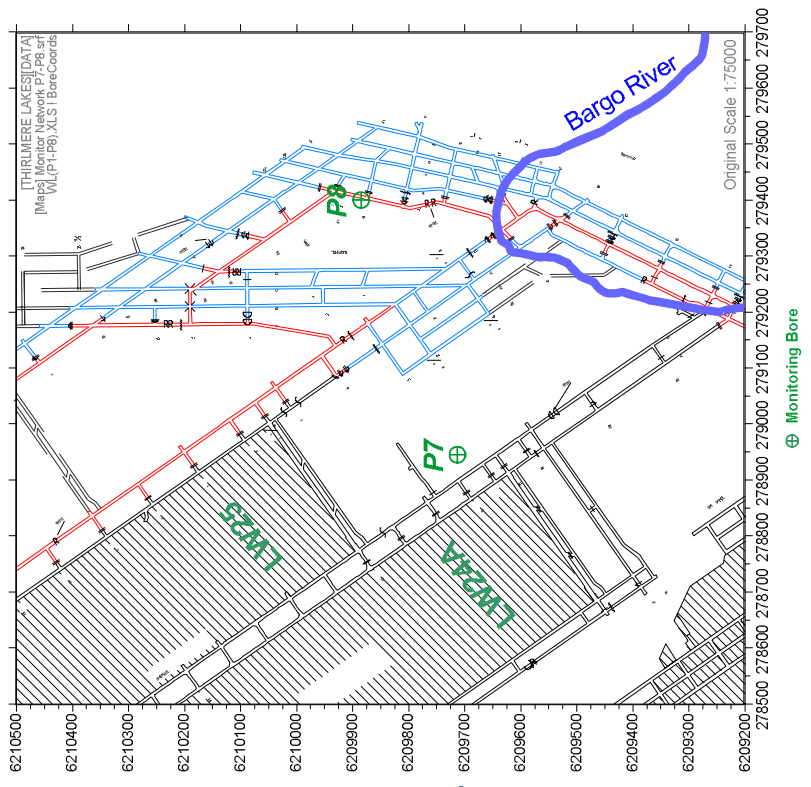
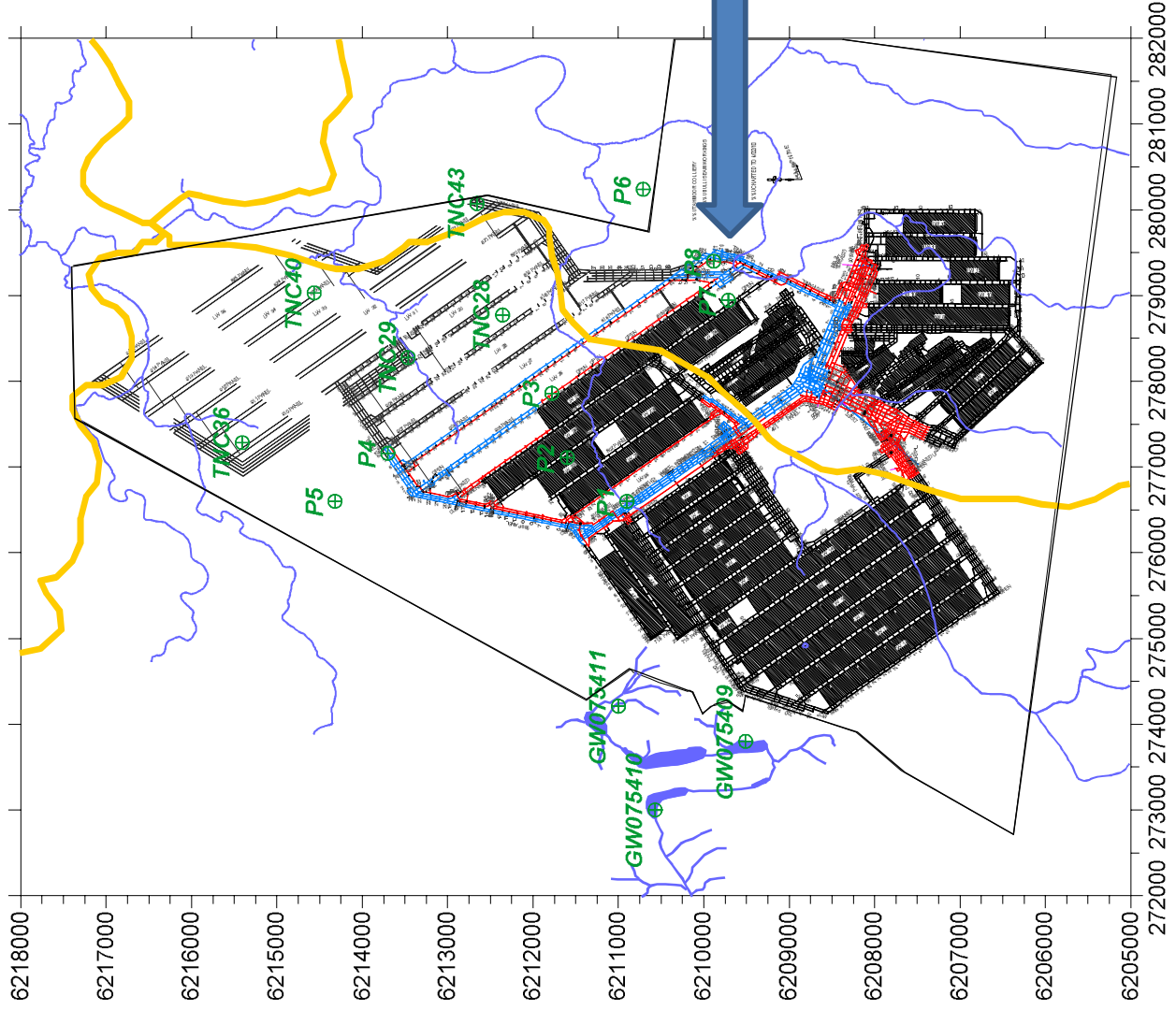
Bald Hill Claystone Barrier



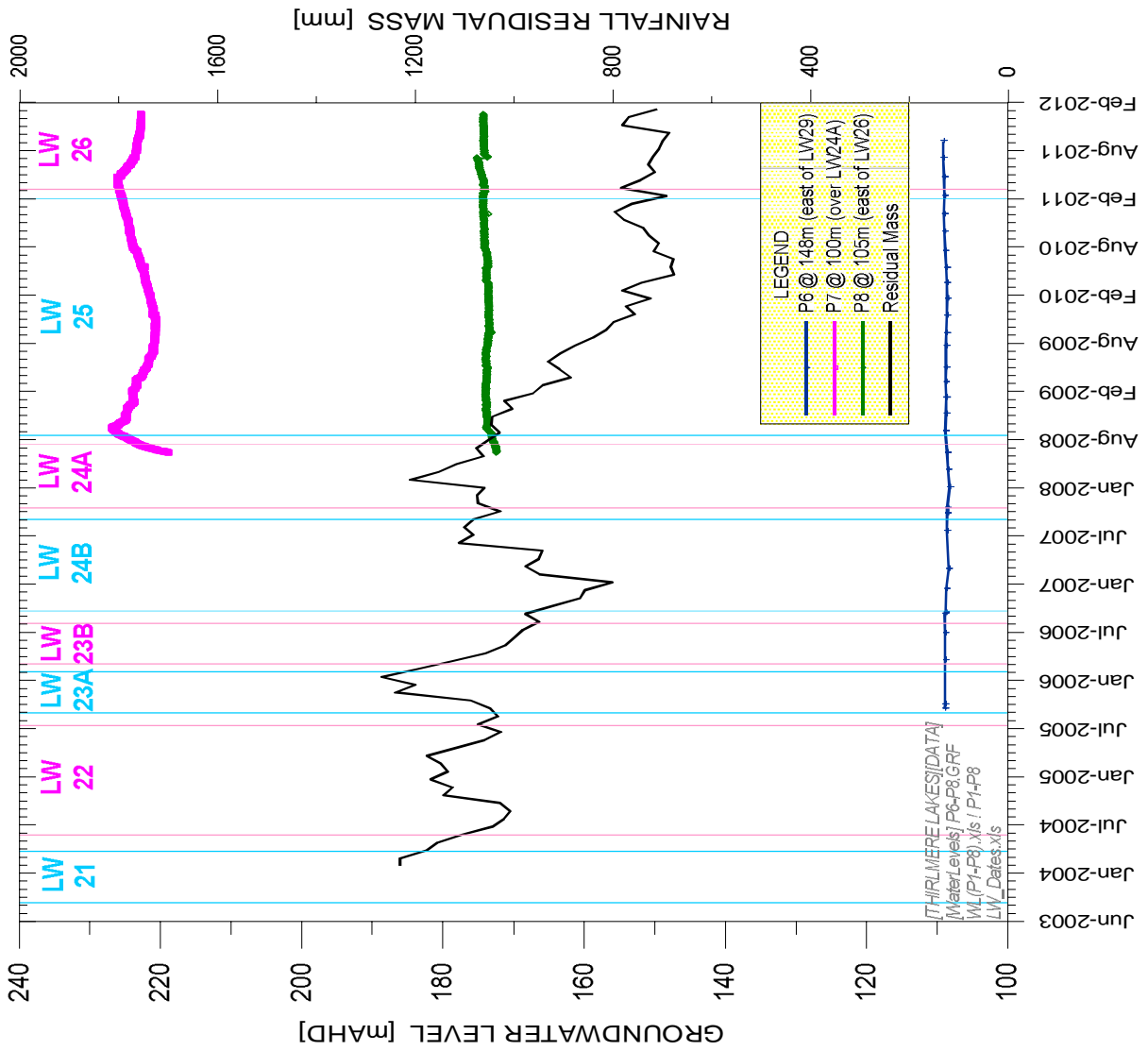
Thickness of Bald Hill Claystone



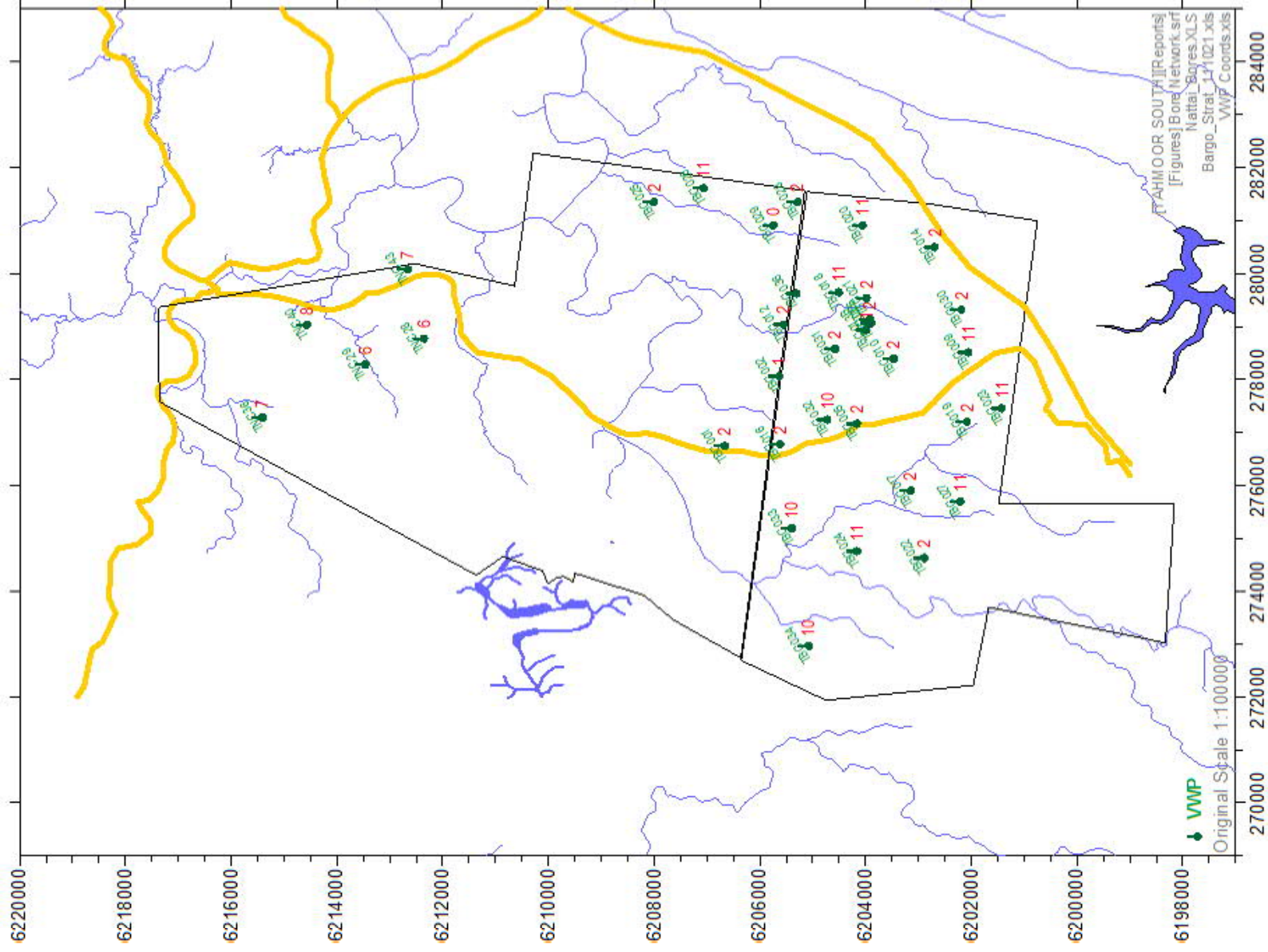
Depth to Bald Hill Claystone

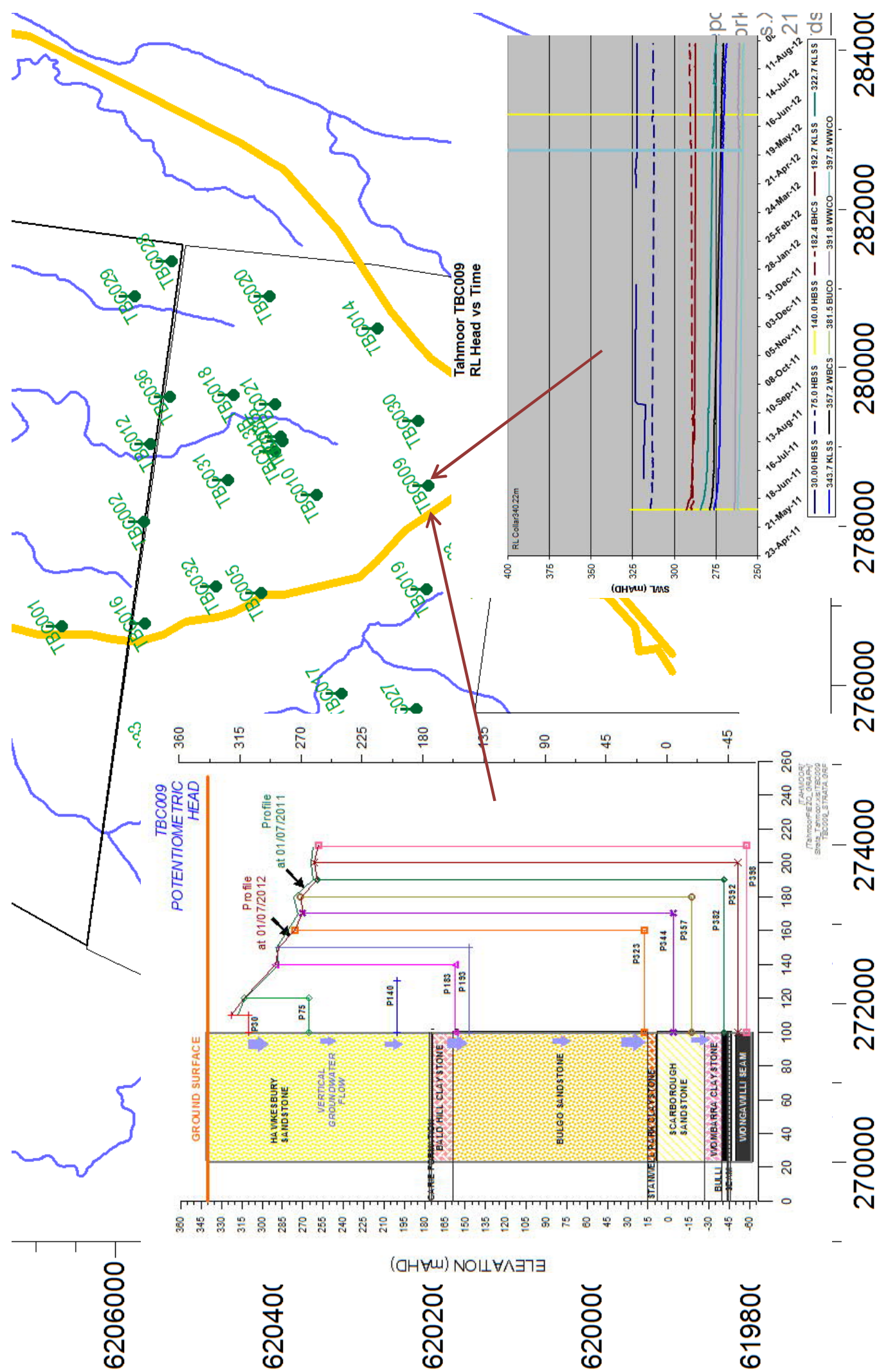


Mining and Background Effects



Vibrating Wire Piezometer Monitoring Sites





6206000

620400

620200

620000

619800

270000 272000 274000 276000 278000 280000 282000 284000



Tahmoor South Subsidence Workshop

Daryl Kay (MSEC)

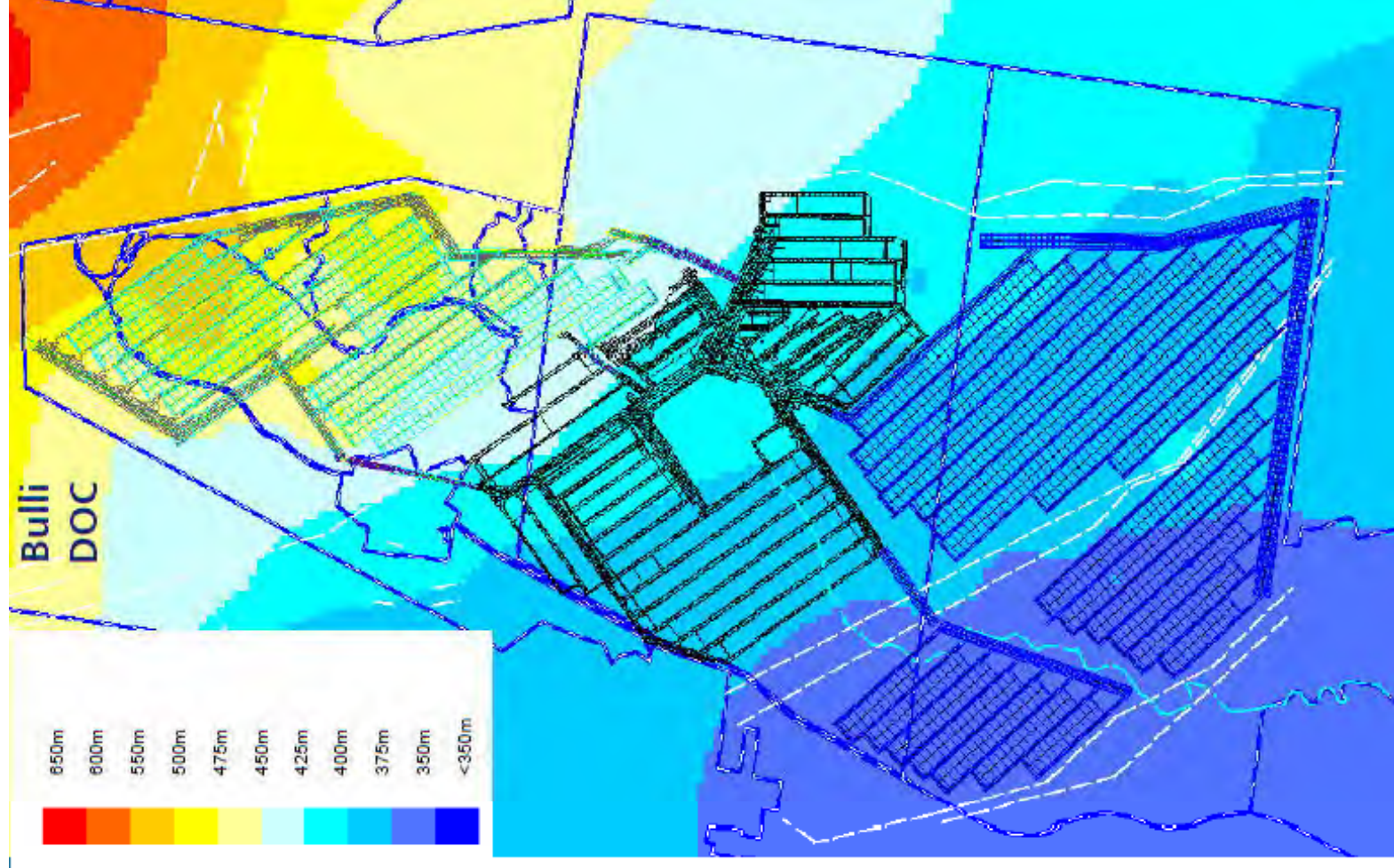


Friday 8th March 2013, Camden

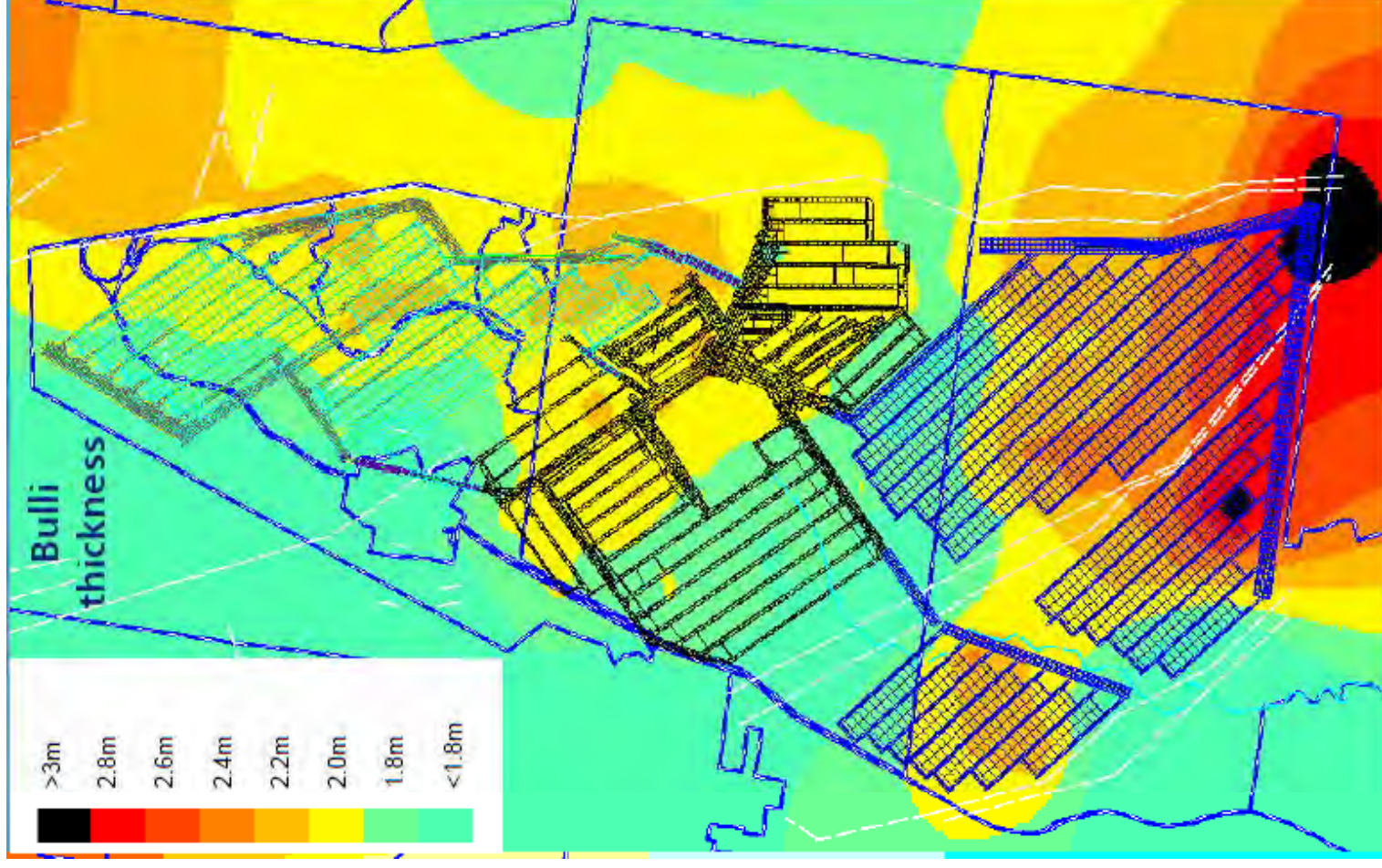
Outline

- Comparison of seam characteristics with Tahmoor North
- Comparison of subsidence predictions with Tahmoor North
- Comparison with predictions for Illawarra Coal Bulli Seam project (approved)
- Potential for increased subsidence at Tahmoor South

Depths of cover at Tahmoor South and Tahmoor North



Seam thicknesses at Tahmoor South and Tahmoor North



Subsidence Predictions - preliminary

- Panel width of 305m, chain pillar width of 40m

Parameter	Lease Area		
	Beneath Township	North-west of Township	South-east of Township
Subsidence (m)	1.4	1.2	2.0
Tilt (mm/m)	10	8	14
Minimum Radius of Curvature (km)	8 hogging 5 sagging	9 hogging 6 sagging	6 hogging 3.5 sagging
Conventional Strain (mm/m)	1.5 tensile 3 compressive	1 tensile 2.5 compressive	2 tensile 4 compressive

Not in current mine plan 

Comparison with Illawarra Coal Bulli Seam

Parameter	Tahmoor South	IC Bulli Seam	Comparison
Depth of cover (m)	350 to 375	300 to 850	TS generally shallower
Seam thickness (m)	1.8 to 2.8	1.5 to 3.6 (avg 2.0 – 3.0)	Averages are similar
LW Panel widths (m)	TBA (305m as starting point)	310 to 320	Similar
Predicted max subsidence (m)	1.2 to 1.4	1.2 to 1.6	Similar
Predicted max tilt (mm/m)	8 to 10	6.5 to 11	Similar
Predicted max “average” strains	1.5 tensile 3 compressive	1 to 2.4 tensile 2 to 5 compressive	Similar

APPENDIX 4

Tahmoor South Project

Subsidence Workshop – Site Inspections

Team Photo at Dogtrap Creek on 7 March 2013



Tahmoor South Project
Subsidence Workshop – Site Inspections
Cow Creek Inspection on 6 March 2013



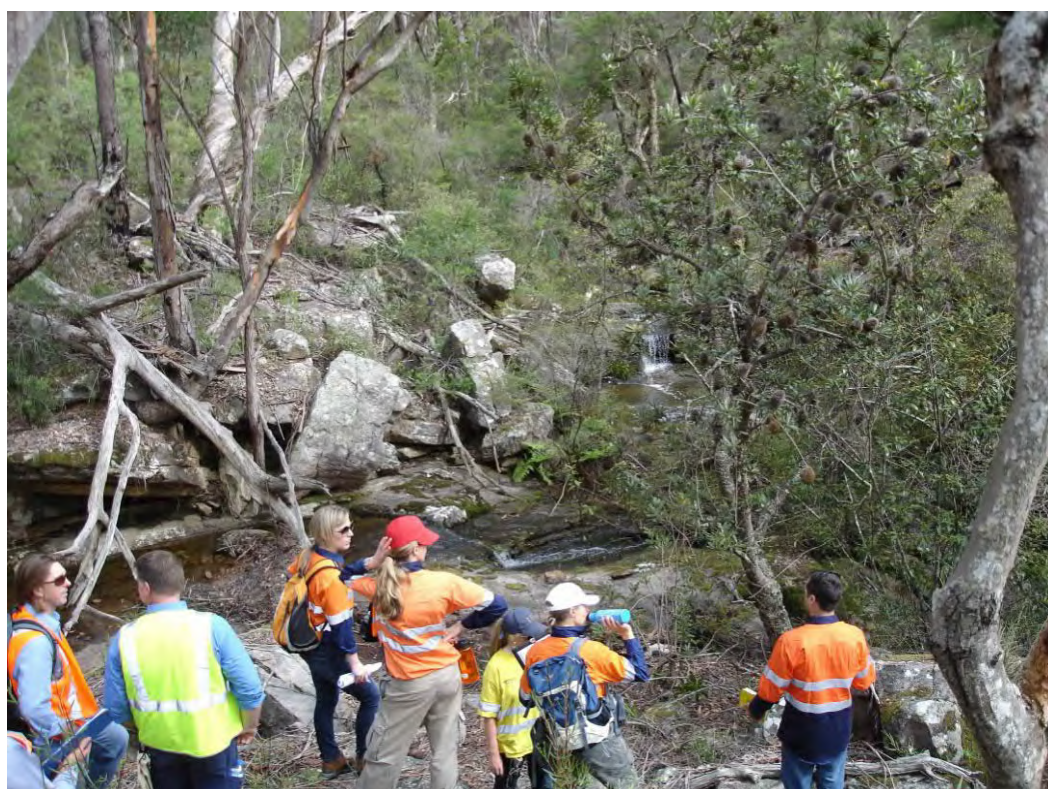
Tahmoor South Project
Subsidence Workshop – Site Inspections
Cow Creek Inspection on 6 March 2013



Tahmoor South Project
Subsidence Workshop – Site Inspections
Cow Creek Inspection on 6 March 2013



Tahmoor South Project
Subsidence Workshop – Site Inspections
Cow Creek Inspection on 6 March 2013



Tahmoor South Project
Subsidence Workshop – Site Inspections
Cow Creek Inspection on 6 March 2013



Tahmoor South Project
Subsidence Workshop – Site Inspections
Mermaid Pools Inspection on 6 March 2013



Tahmoor South Project
Subsidence Workshop – Site Inspections
Mermaid Pools Inspection on 6 March 2013



Tahmoor South Project
Subsidence Workshop – Site Inspections
Mermaid Pools Inspection on 6 March 2013



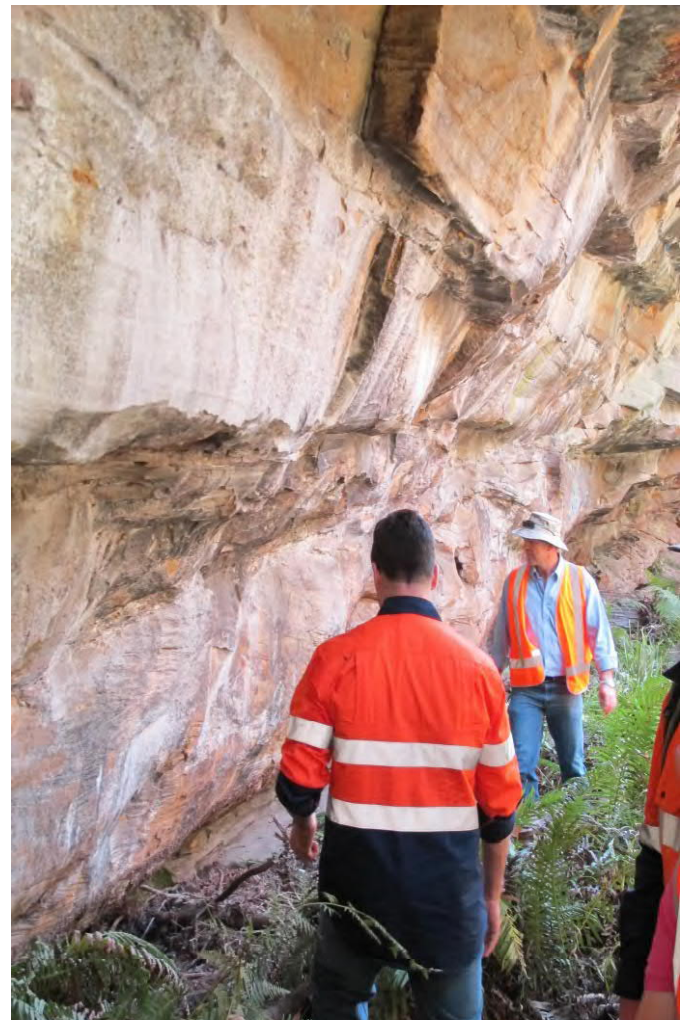
Tahmoor South Project
Subsidence Workshop – Site Inspections
Mermaid Pools Inspection on 6 March 2013



Tahmoor South Project
Subsidence Workshop – Site Inspections
Mermaid Pools Inspection on 6 March 2013



Tahmoor South Project
Subsidence Workshop – Site Inspections
Dogtrap Creek Inspection on 7 March 2013



Tahmoor South Project
Subsidence Workshop – Site Inspections
Dogtrap Creek Inspection on 7 March 2013



Tahmoor South Project
Subsidence Workshop – Site Inspections
Dogtrap Creek Inspection on 7 March 2013



Tahmoor South Project
Subsidence Workshop – Site Inspections
Dogtrap Creek Inspection on 7 March 2013



Tahmoor South Project
Subsidence Workshop – Site Inspections
Myrtle Creek Inspection on 7 March 2013



Tahmoor South Project
Subsidence Workshop – Site Inspections
Myrtle Creek Inspection on 7 March 2013



Tahmoor South Project
Subsidence Workshop – Site Inspections
Myrtle Creek Inspection on 7 March 2013



Tahmoor South Project
Subsidence Workshop – Site Inspections
Myrtle Creek Inspection on 7 March 2013



Tahmoor South Project
Subsidence Workshop – Site Inspections
Redbank Inspection on 7 March 2013



Tahmoor South Project
Subsidence Workshop – Site Inspections
Redbank Inspection on 7 March 2013



Tahmoor South Project
Subsidence Workshop – Site Inspections
Redbank Inspection on 7 March 2013



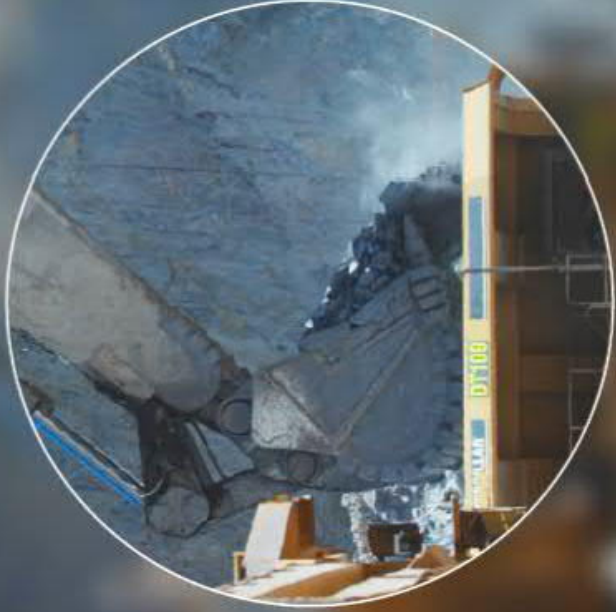
APPENDIX 5

GLENCORE



**Tahmoor South Project
Subsidence Workshop**

December 2013



Risk Management Zones

• **Southern Coalfields Inquiry July 2008**

• ***Impacts of Underground Coal Mining on Natural Features in the Southern Coalfield***

- Risk Management Zones (RMZ) should be defined from the outside extremity of the surface feature, either by a 40° angle from the vertical down to the coal seam which is proposed to be extracted, or by a surface lateral distance of 400 metres, whichever is the greater.
- RMZ are appropriate to manage all subsidence effects, especially valley closure and upsidence.
- RMZ not intended to represent either a determination of 'significance' or to suggest or require the exclusion of mining.
- **Purpose of RMZ is to flag that proposed mining within the zone requires careful assessment and management.**

Risk Management Zones

- RMZs for:
- *Rivers – 4th, 5th, 6th and 7th Order Streams*
 - *Streams – 3rd order*
 - *Minor Cliffs – higher than 10m and longer than 20 m*
 - *Major Cliffs – higher than 40m and longer than 200m*
 - *Waterfalls*
 - *Mermaids Pool*
 - *Valley infill swamps (None)*
 - *Aboriginal heritage sites – low significance*
 - *Aboriginal heritage sites – High significance*
 - *Riparian zone vegetation – Pomaderris brunnea*
 - *Groundwater GDE – Stygofauna*
 - *Giant Burrowing Frog*

Significance

Assessment of Significance

- Subjective
- No Guidelines

Significance	Subsidence Management & Controls
Not Highly Significant and/or Not Highly Sensitive	Standard subsidence management
Highly Significant and/or Sensitive	Strict subsidence management and performance standards
Highly Significant and Highly Sensitive	Mining impacts may be deemed unacceptable close to natural feature

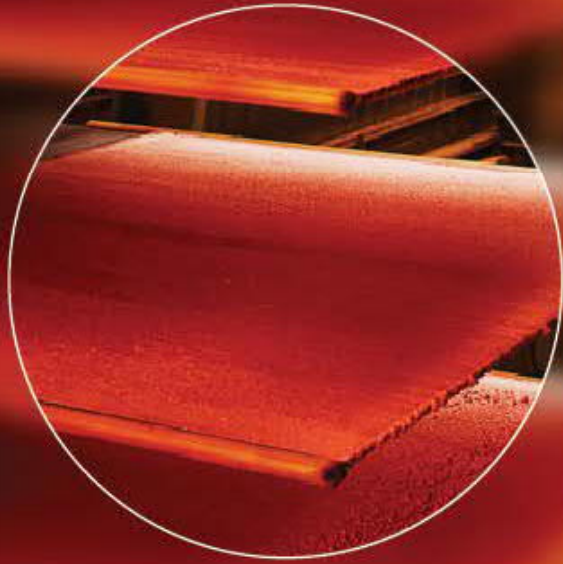
Risk Rating

<u>Likelihood Criteria</u>	
E	99% Probability
D	>50% and <99% Probability
C	>20% and <50% Probability
B	>1% and <20% Probability
A	<1% Probability

<u>Risk Matrix</u>	
E	11 16 20 23 25
D	7 12 17 21 24
C	4 8 13 18 22
B	2 5 9 14 19
A	1 3 6 10 15
	1 2 3 4 5

<u>Significance / Sensitivity</u>	
5	High
4	High Medium
3	Low Medium
2	Low
1	Not Applicable or Very Low

<u>Risk Classification</u>	
High Risk	
Medium Risk	
Low Risk	



END

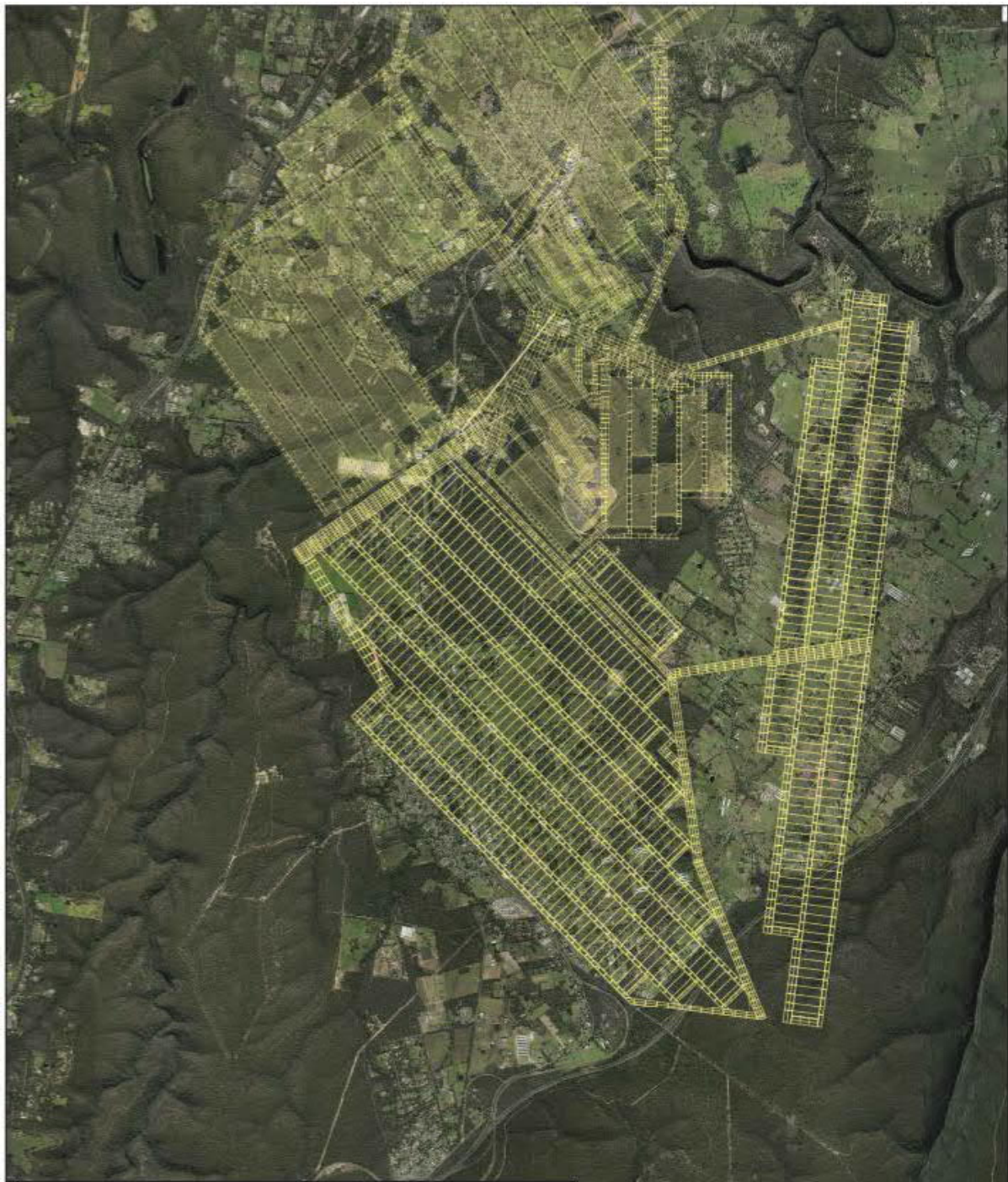
Tahmoor South Project

APPENDIX 6

Tahmoor South Project

Risk Management Zones

Tahmoor North & Tahmoor South Mine Plans



	3rd Order Stream		Giant Burrowing Frog		Stygofauna
	4th Order Stream		Waterfall		Archaeological Sites Low Significance
	5th Order Stream		Mermals Pools		Archaeological Sites High Significance
	7th Order Stream		Riparian Vegetation		Cliffs Minor
	Cliffs >200m long + >40m high				

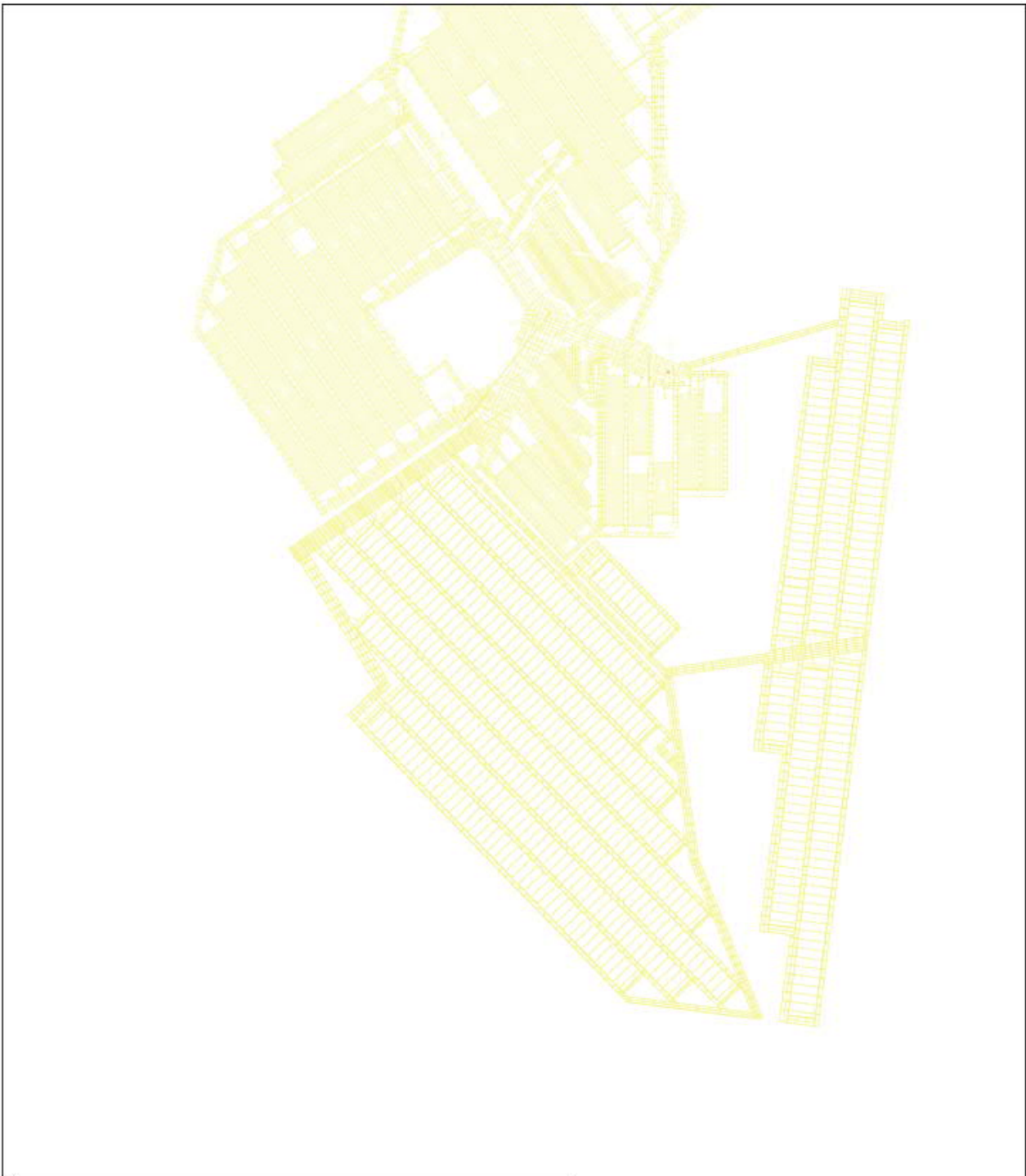
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Rev	Date	By	Description																				
Client No.	20151209e001																						
Scale	1:50,000																						

Risk Management Zones

Tahmoor South Project

Risk Management Zones

Tahmoor North & Tahmoor South Mine Plans



	3rd Order Stream		Giant Burrowing Frog		Stygotauna
	4rd Order Stream		Mermaids Pools		Waterfall
	5th Order Stream		Riparian Vegetation		Archaeological Sites Low Significance
	7th Order Stream				Archaeological Sites High Significance
	Cliffs Minor				
	Cliffs >200m long + >40m high				

Doc No	20131209m001
Rev	01
Issue Date	2013/12/09
Author	...
Checked By	...
Approved By	...

Tahmoor South Project
 Environmental Chemistry
 PO Box 130
 Tahmoor NSW 2579
 PH 62 4543 2100
 AEM 17 678 893 000

Risk Management Zones

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 The data and information provided herein are for general information only. The user of this information is advised to verify the accuracy and completeness of the information and to consult with a qualified professional for any specific advice or recommendations. The user of this information is advised to consult with a qualified professional for any specific advice or recommendations.

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Tahmoor South Project

Risk Management Zones

Streams - 4th Order



Tahmoor South Project

Risk Management Zones

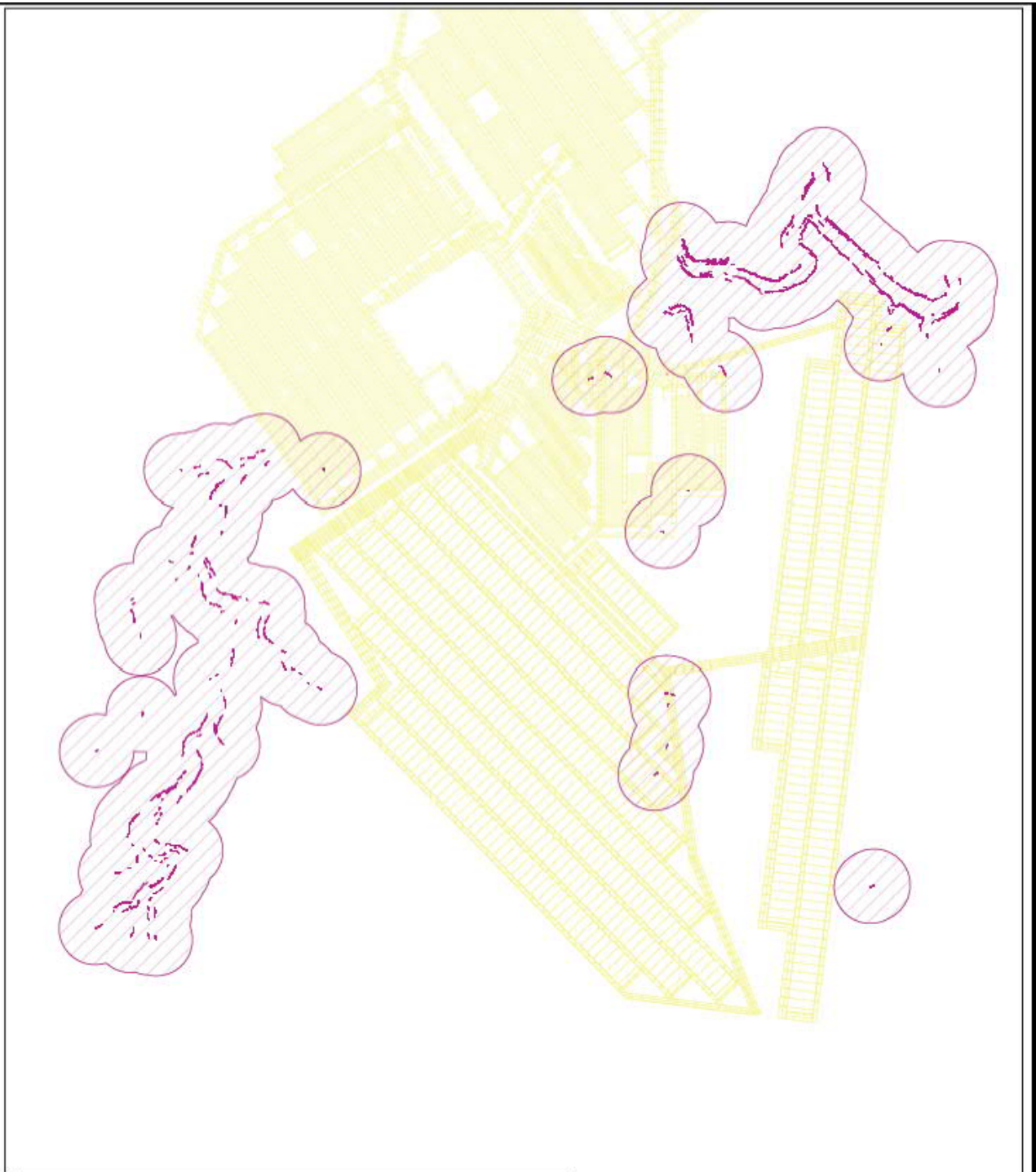
Streams - 7th Order



Tahmoor South Project

Risk Management Zones

Natural Features - Cliffs Minor



	3rd Order Stream		Giant Burrowing Frog		Stygofauna
	4rd Order Stream		Waterfall		Archaeological Sites Low Significance
	5th Order Stream		Mermakds Pools		Archaeological Sites High Significance
	7th Order Stream		Riparian Vegetation		
	Cliffs Minor				
	Cliffs >200m long + >40m high				

Rev	Date	By	Description

Approved	Checked	Date	Appr. Title	By	Date

Drawn By	20131209rc001
Scale	As Shown

TAHMOOR SOUTH PROJECT
 Project Manager: [Name]
 PO Box 128
 Tahmoor NSW 2573
 Ph: 02 9455 5122
 Web: www.ahm.com.au

Risk Management Zones

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Tahmoor South Project

Risk Management Zones

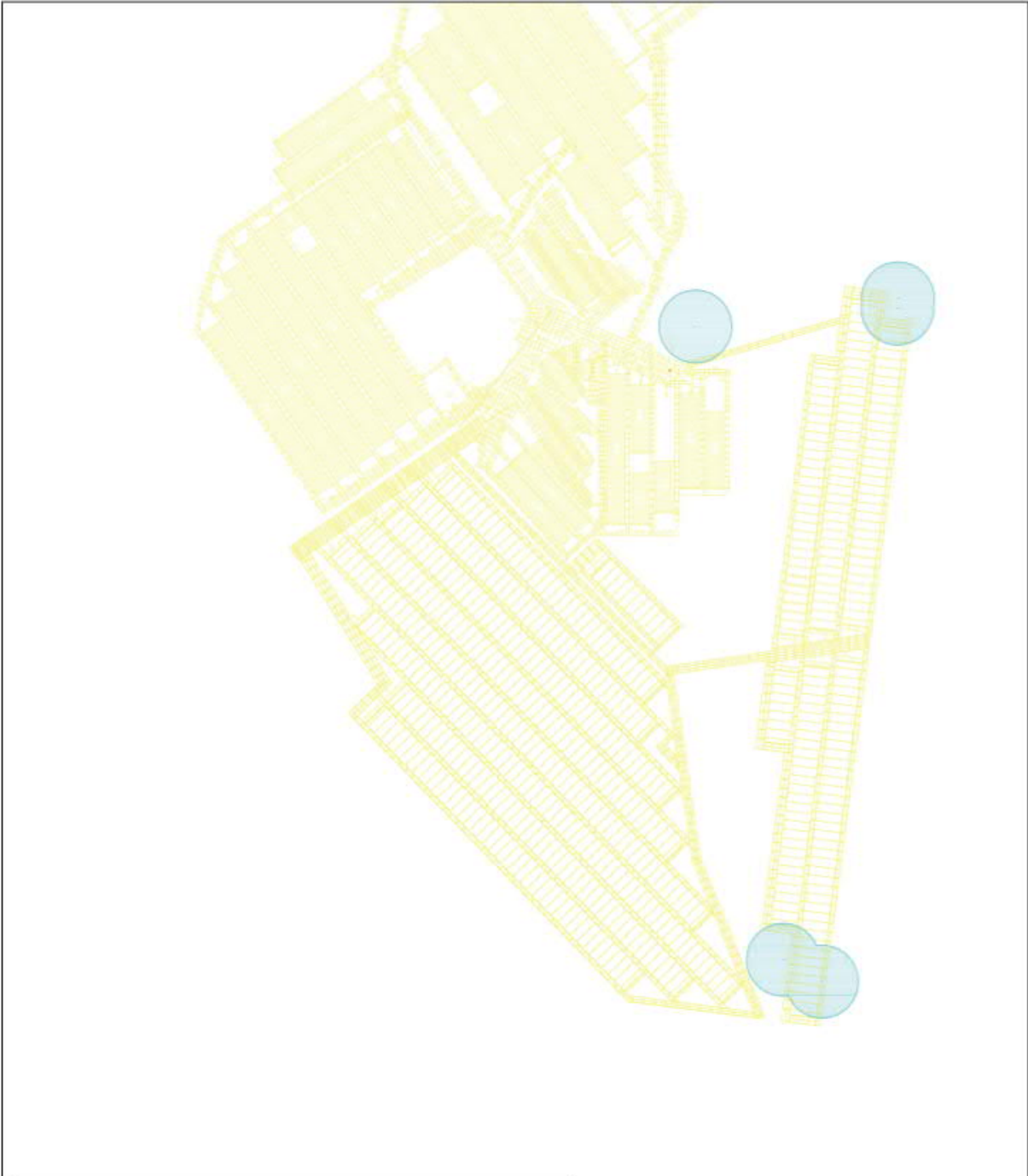
Natural Features - Cliffs > 200 m Long & 40 m High



Tahmoor South Project

Risk Management Zones

Natural Features - Waterfalls



	3rd Order Stream		Giant Burrowing Frog		Stygofauna
	4rd Order Stream		Waterfall		Archaeological Sites Low Significance
	5th Order Stream		Mermakids Pools		Archaeological Sites High Significance
	7th Order Stream		Riparian Vegetation		
	Cliffs Minor				
	Cliffs >200m long + >40m high				

Client	SR	SR	SR
Project No.	20151209rc001		
Revision	1	1	1

TAHMOOR SOUTH PROJECT
 Project Manager: [Name]
 Drawing No. 20151209rc001
 Date: 12/12/2015

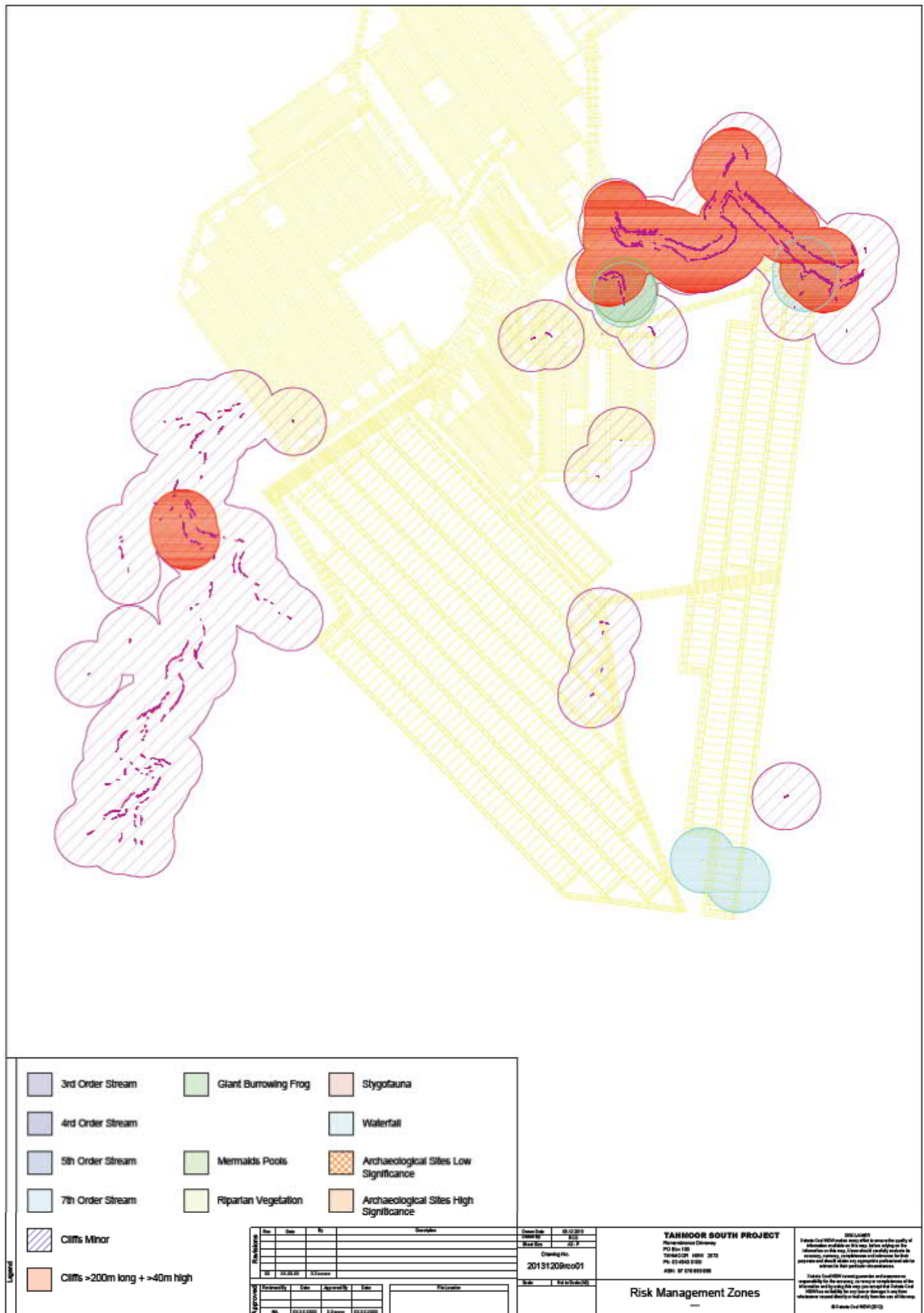
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Risk Management Zones

Tahmoor South Project

Risk Management Zones

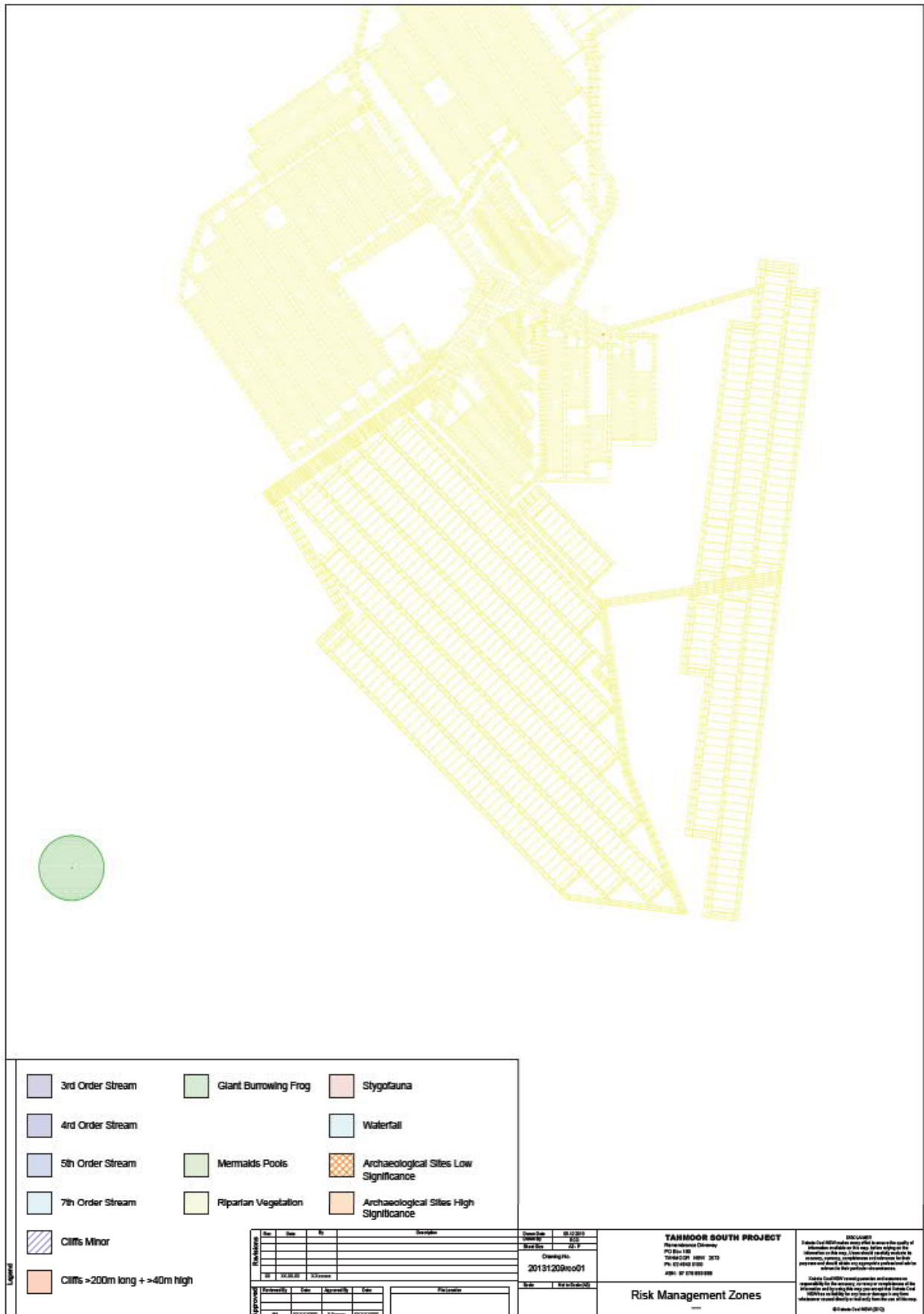
Natural Features – All Cliffs & Waterfalls & Mermaid Pools



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Risk Management Zones

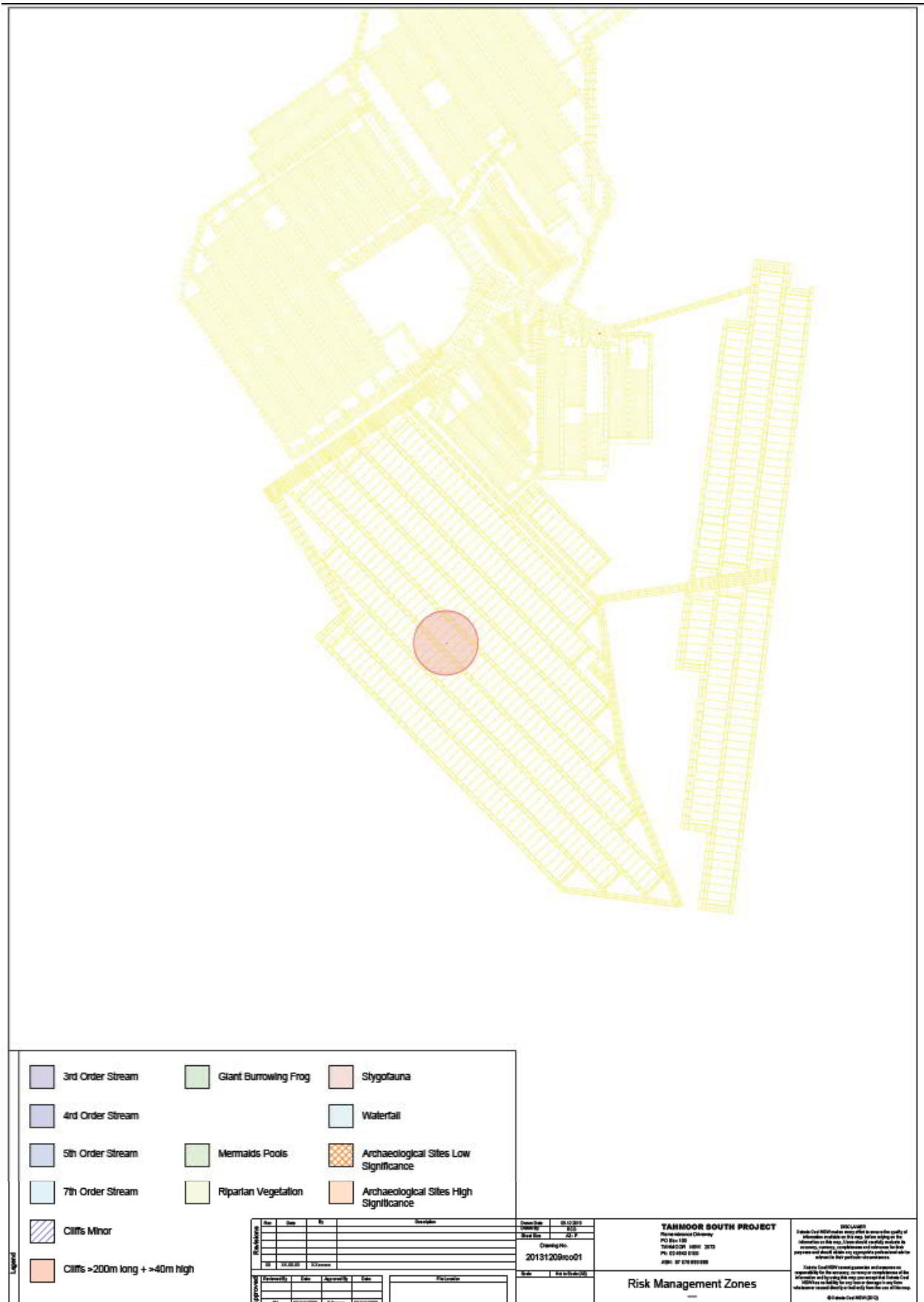
Ecology - Giant Burrowing Frog – Recorded Location



Tahmoor South Project

Risk Management Zones

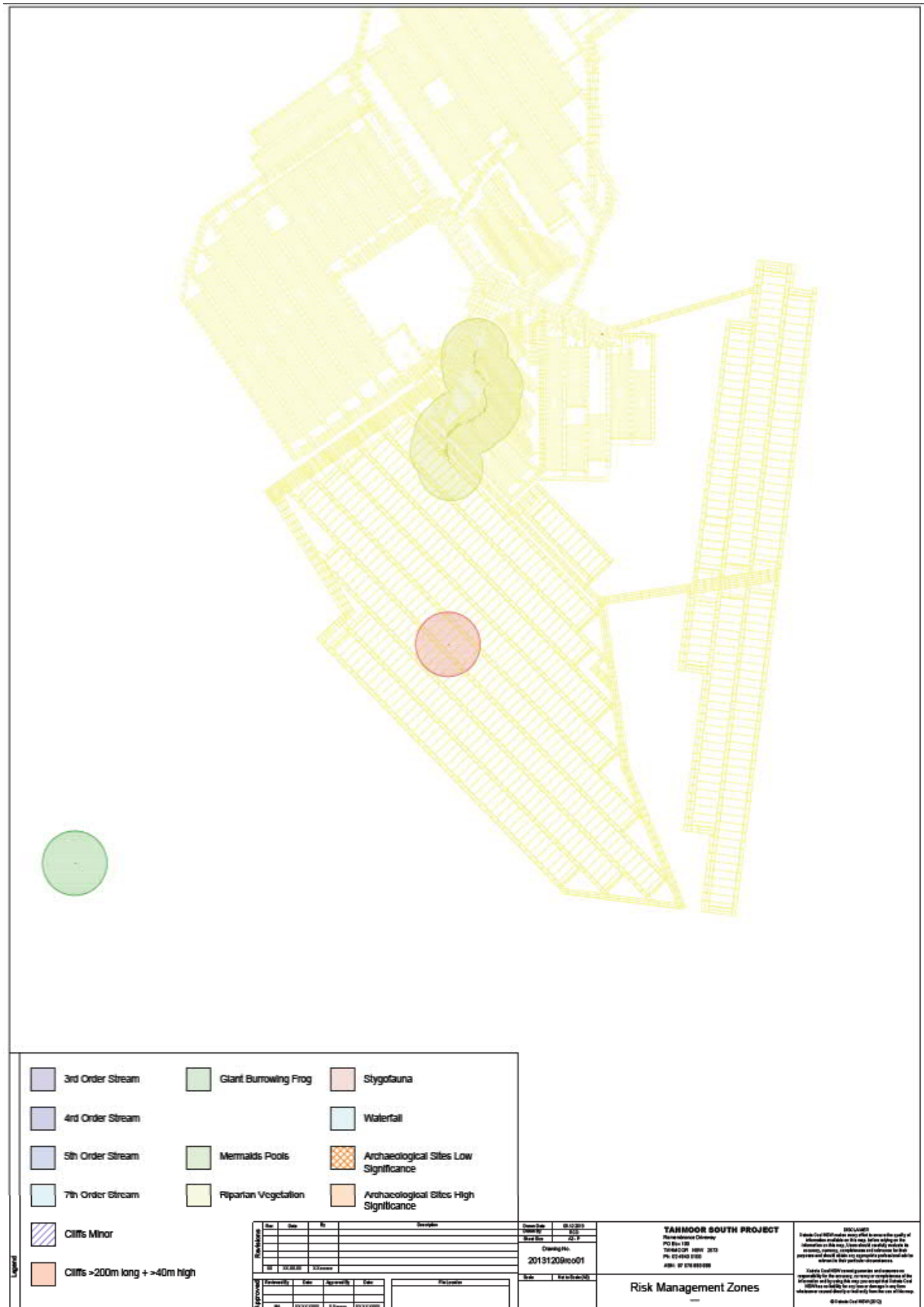
Ecology - Stygofauna Recorded Location



Tahmoor South Project

Risk Management Zones

Ecology - All Giant Burrowing Frog, Stygofauna and Riparian Veg.



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Risk Management Zones

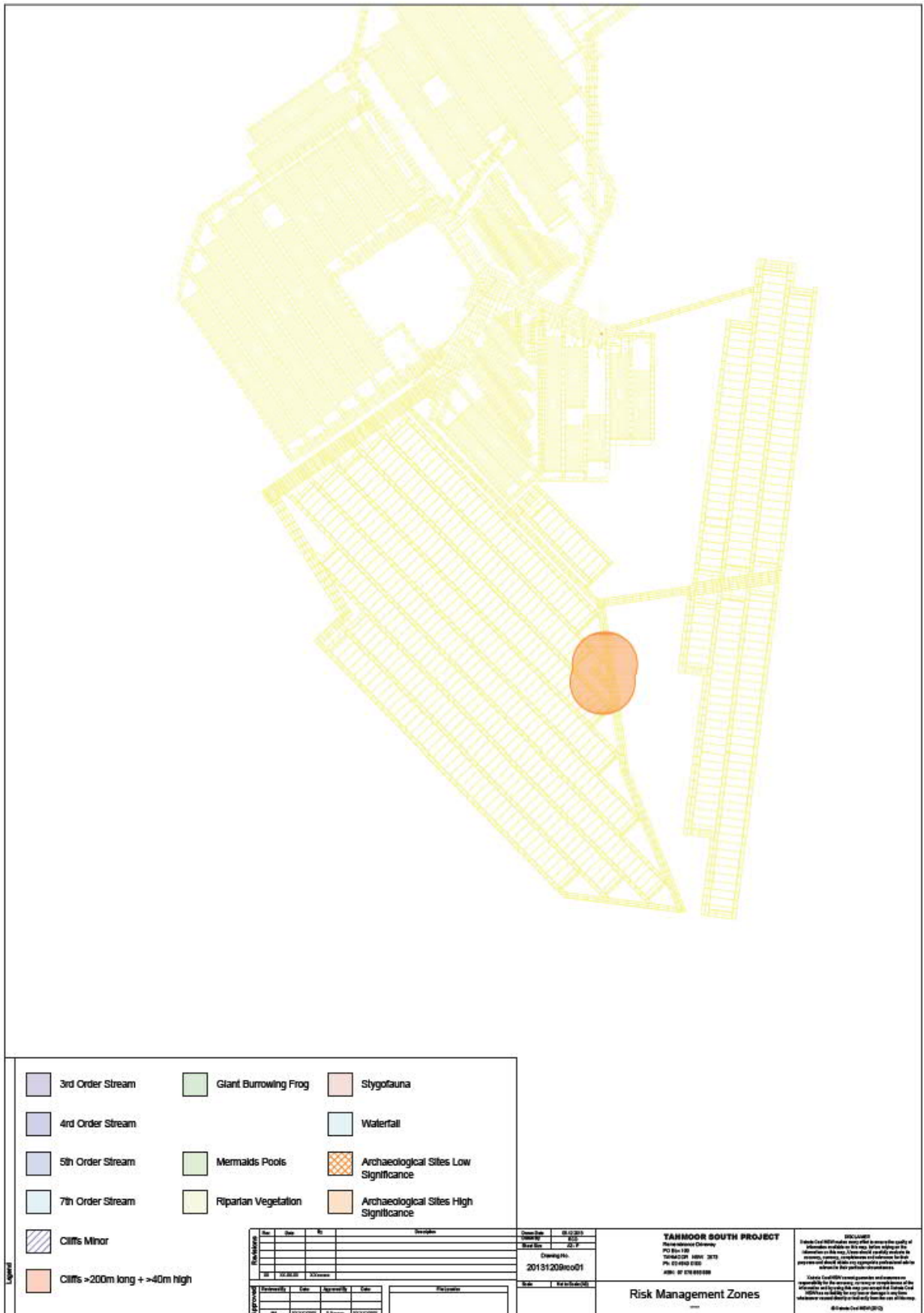
Archaeological Sites – Low Significance



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Risk Management Zones

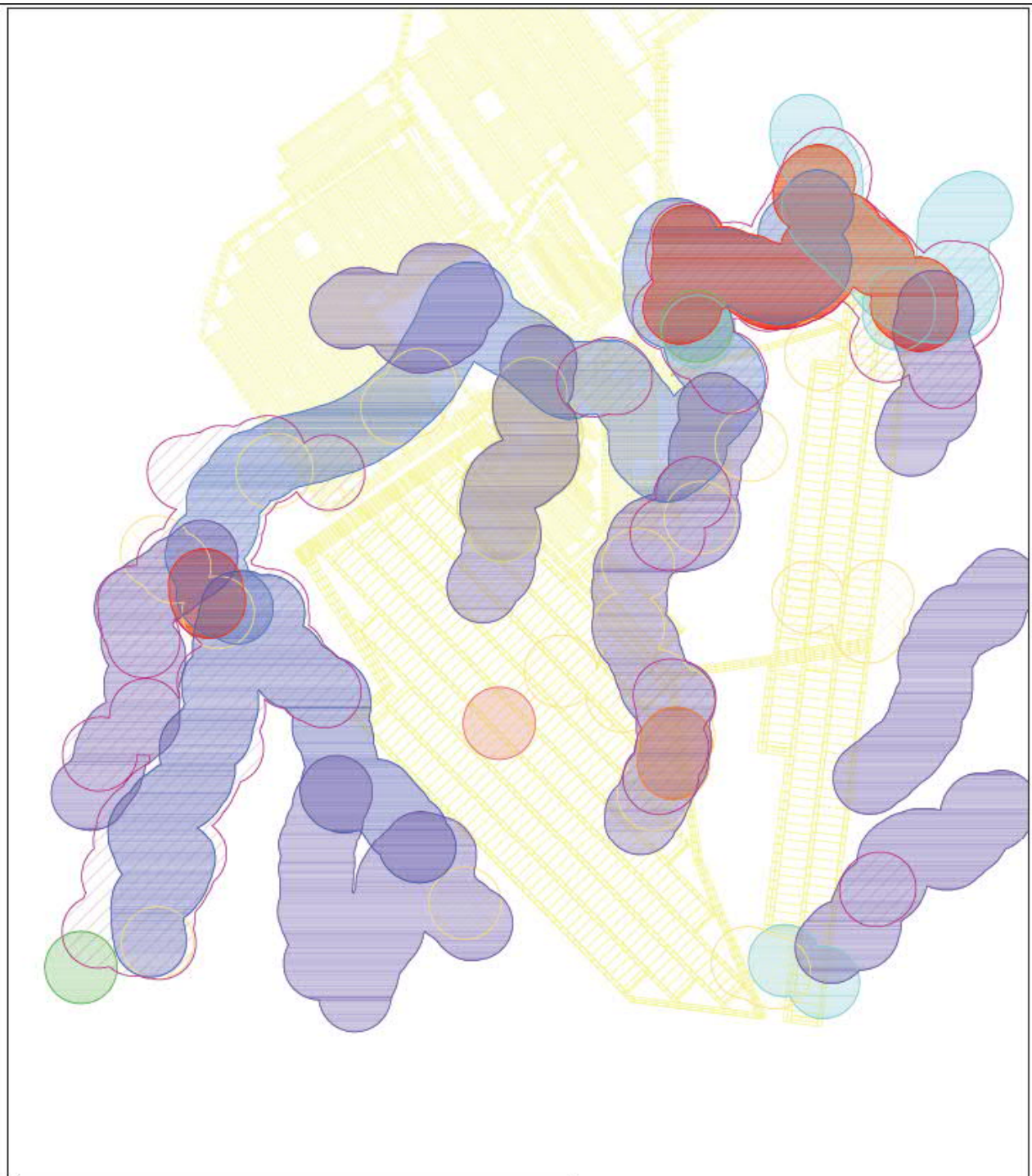
Archaeological Sites – High Significance



Tahmoor South Project

Risk Management Zones

All – Streams, Natural Features, Ecology & Archaeological Sites



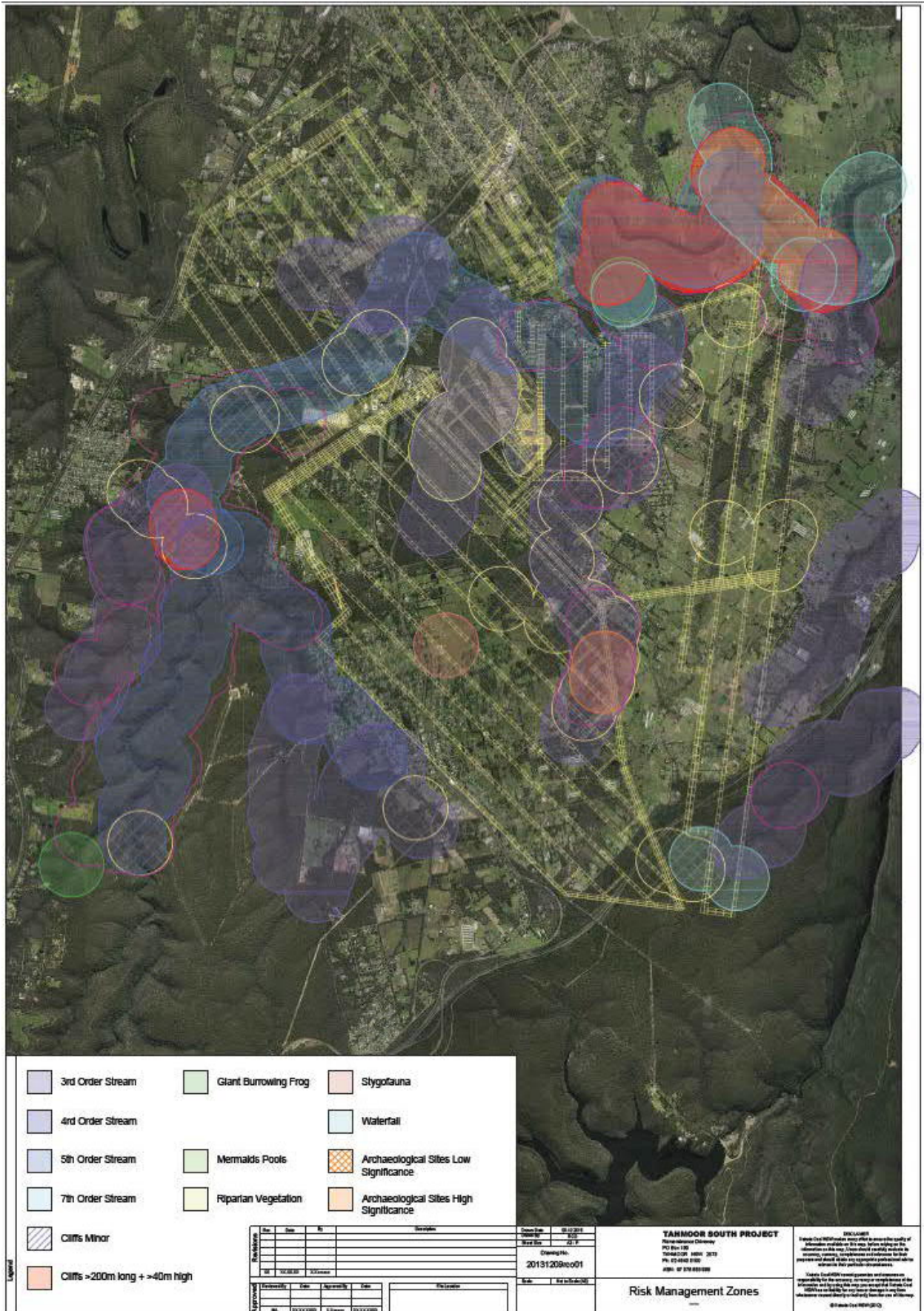
	3rd Order Stream		Giant Burrowing Frog		Stygofauna
	4th Order Stream		Mermakids Pools		Waterfall
	5th Order Stream		Riparian Vegetation		Archaeological Sites Low Significance
	7th Order Stream				Archaeological Sites High Significance
	Cliffs Minor				
	Cliffs >200m long + >40m high				

<table border="1"> <tr> <th>Rev</th> <th>Date</th> <th>By</th> <th>Description</th> </tr> <tr> <td> </td> <td> </td> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> <td> </td> <td> </td> </tr> </table>	Rev	Date	By	Description													<table border="1"> <tr> <td>Client Ref</td> <td>20131209rc001</td> </tr> <tr> <td>Drawing No.</td> <td>20131209rc001</td> </tr> <tr> <td>Scale</td> <td>1:1000</td> </tr> </table>	Client Ref	20131209rc001	Drawing No.	20131209rc001	Scale	1:1000	<p>TAHMOOR SOUTH PROJECT New South Wales PO Box 150 TAHMOOR NSW 2573 Ph: 61 629 620 000 Fax: 61 629 620 008</p>	<p>Risk Management Zones</p>	<p>DISCLAIMER The information contained in this document is for the use of the client only. It is not to be used for any other purpose. The client is responsible for the accuracy, completeness and timeliness of the information provided. The client is responsible for the interpretation and use of the information. The client is responsible for the interpretation and use of the information. The client is responsible for the interpretation and use of the information.</p>
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Risk Management Zones

All – Streams, Natural Features, Ecology & Archaeological Sites



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