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28 September 2017

20173040.001A/Eagleton/MLB17R66258

Eagleton Rock Syndicate Pty Ltd

Attention: Darren Williams

Email: darren@arbus.com.au

Subject: **Clarification for Eagleton Quarry Groundwater Modelling**
Eagleton Rock Quarry
13 Barleigh Ranch Way, Eagleton NSW

1. INTRODUCTION

Kleinfelder Australia Pty Ltd (Kleinfelder) was commissioned by Eagleton Rock Syndicate Pty Ltd to clarify some of the findings of groundwater modelling conducted at the Eagleton Rock Quarry (site) in the report "Numerical Groundwater Model for Eagleton Quarry" (David, 2016), this report will be herein described as the 'Groundwater Modelling Report'. The Groundwater Modelling Report was reviewed (SLR Consulting Australia Pty Ltd [SLR], 2016), and the review determined that the groundwater modelling and associated impact assessment were fit for purpose to address the requirements of the Secretary's Environmental Assessment Requirements (SEARs) and requirements of the NSW Department of Primary Industries (DPI) and the NSW Aquifer Interference Policy (NSW AIP). However, several items raised by the NSW Department of Planning and Environment (DPE) still required closure. The purpose of this letter is to clarify these items and provide an overview of the current status of the groundwater modelling and impact assessment for the proposed development.

2. SCOPE OF WORKS

Utilising existing available information, this letter report details the following information:

- Groundwater modelling background and current status of the various reports completed;
- Modelled groundwater inflow and potential impacts to surrounding groundwater users (i.e. surrounding groundwater bores and surface water base flow);
- Mitigation and monitoring;
- Responses to items raised by DPE that requiring addressing.

3. GROUNDWATER MODELLING AND PEER REVIEW

The following reports concerning groundwater have been prepared for the Eagleton Quarry and have been utilised in this review. Further information where necessary can be acquired directly from these assessments. A summary of the key elements and status of each report is provided below:

- URS Pty Ltd. Eagleton Quarry Hydrogeological Investigation (URS 2014).
  - Background and numerical model completed now superseded by David, 2016.
- SLR Consulting Australia Pty Ltd. Groundwater Assessment Peer Review. February 2016a (SLR, 2016a).
  - Review determined substantial revision of model setup and findings were required to meet requirements, this triggered the reports by Umwelt, 2016 and David, 2016.
- Umwelt Pty Ltd. Eagleton Hard Rock Quarry Water Assessment – Final. October 2016 (Umwelt, 2016).
  - Operational elements of the water management system superseded by SLR, 2017.
  - Information relating to statutory and regulatory requirements, existing surface water, flooding, erosion and sediment control methods and downstream user description remains current.
  - Relevant groundwater elements effectively replaced by this letter.
- David, K. Numerical Groundwater Model for Eagleton Quarry. October 2016 (David, 2016).
  - Current numerical model for the proposed quarry, supersedes the URS Report and is provided in **Appendix B**.
- SLR Consulting Australia Pty Ltd. Groundwater Assessment Peer Review. February 2016b (SLR, 2016b).
  - Determined David 2016 assessment fit for purpose to address the requirements of the SEARs and the NSW AIP. The peer review is provided in **Appendix C**.
- SLR Consulting Australia Pty Ltd. Eagleton Quarry Revised Water Assessment. 4 August 2017 (SLR, 2017).
  - Current report addressing the proposed water management system. Refer to Table 2 of that report for list of elements utilised from the previous Umwelt 2016 report.

Further review by DPE identified several additional matters that are resolved in this letter report. The matters raised are summarised in **Table 1** below with the location of information that clarifies these matters within this report provided.

Table 1: Summary of Issues and Location of Responses

Issue	Response Information
• Clarification is needed regarding drawdown predictions in relation to the project boundary and property/site boundaries. Various sections of the report provide conflicting information. For example: o Section 6.1 of the Umwelt Report and Section 4.1 of Appendix 1a indicate that zero drawdown is predicted beyond the property boundaries. o Section 4.2 indicates that drawdown extends approximately 200 m west, north and south of the site boundary. This section also states that there would be zero drawdown at 300 m form the eastern and southern project boundaries. o Section 4.1 states that the maximum predicted drawdown within the project boundary is 20 m at the end extraction. Section 6.1 of the Umwelt Report states that the maximum predicted drawdown at the end of extraction is 15 m. Please provide a clear figure indicating the extent of drawdown relative to the property boundary, and ensure that the reports use a consistent reference point (i.e. property boundary) for all predicted impacts.	**Section 4.2**
• Paragraph 2 of Section 4.2 of the report states that the closest private bore is over 1 km from the site. However, elsewhere, is it stated that the closest bore is 400 m to the south-east. Please clarify.	**Section 4.3**
• Table 2 indicates that GW79737 is a monitoring bore. Is this associated with Boral's Seaham Quarry?	**Section 4.3**

4. GROUNDWATER MODELLING RESULTS

4.1 Groundwater Inflow

Simulation of groundwater conditions and changes to the groundwater regime for the 30 year life of the quarry was undertaken using the Environmental Simulations, Inc. (ESI), Groundwater Vistas™ modelling platform (ESI, 2010) and the United States Geological Survey computer code MODFLOW-NWT (Niswonger et al., 2011). Model setup, calibration and sensitivity analysis is provided in the Groundwater Modelling Report (David, 2016).

The predictive model simulated the groundwater levels in the period from 2016 to completion of material extraction I 2046. Inflow rates over the life of the quarry were estimated based on quarry development stage and recharge and evapotranspiration rates were maintained at values equal to steady state yearly average values (**Table 2**).

Three model layers were constructed. Layer 1 was of variable thicknesses from 20 m to 92 m and represented the alluvium/colluvium/rhyolite/rhyodacite/conglomerate unconfined water

table aquifer. Layers 2 and 3 represented confined rhyolite/rhyodacite aquifers of 20 m thickness.

Table 2: Modelled groundwater inflow during quarrying

Year	Inflow Rate (m^3/day)	Inflow Rate (ML/year)
1	8.1	3.0
2	13.3	4.9
3	12.7	4.6
4	18.7	6.8
5	21.3	7.8
6	19.8	7.2
8	17.7	6.5
10	18.6	6.8
12	20.1	7.3
14	20.7	7.6
24	21.1	7.7
30	20.6	7.5

Notes:
m^3/day = cubic metres per day
ML/year = million litres per year

Groundwater inflow rates are predicted to range from 3.0 to 7.8 ML/year. This inflow is predicted to draw down the water table in the surrounding unconfined aquifer as defined in the following sections.

4.2 Groundwater Drawdown

The groundwater model was used to predict groundwater drawdown in the unconfined water table aquifer (alluvium/colluvium/rhyolite/rhyodacite/conglomerate – Layer 1) at 6 years, 30 years (end of rock extraction), and 20 years post extraction. Groundwater drawdown contours were generated within the Groundwater Modelling Report and these have been placed on a site figure to illustrate the extent of groundwater drawdown in relation to the Project Footprint (quarry extraction area) and Property Boundary (cadastral lot boundary) (**Figures 1** to **3**).

A summary of the predicted drawdown at different periods of the project life cycle is provided in **Table 3** below.

Table 3: Predicted Groundwater Drawdowns

Time	Project Footprint	Property Boundary	Maximum Predicted Drawdown (m)
6 Years of Extraction	No predicted drawdown ≥ 1 metre outside of Project Footprint.	No predicted drawdown ≥ 1 m outside of Property Boundary.	10
30 Years (End of Extraction)	The 1 m groundwater contour extends approximately 120 m south, 100 m west and 150 m north outside of the Project Footprint.	The 1 m groundwater contour extends approximately 100 m outside the western and 50 m outside the north eastern property boundaries.	20
20 Years Post Extraction	The 1 metre predicted groundwater drawdown contour extends approximately 130 m to the south and 160 m to the west and north outside of the Project Footprint.	The 1 m predicted groundwater drawdown contour extends approximately 150 m to the west and 80 m outside the north eastern property boundaries.	20

4.3 Impact on Groundwater Users

Previous searches of groundwater users have yielded differing results. URS (2014) conducted a search within a 1.5 km radius of the site and identified 14 groundwater bores, however minimal information on their location or use was provided. A search of the NSW DPI Office of Water database and the Australian Groundwater Explorer for registered groundwater bores within a 5 km radius of the Project Area in the Groundwater Modelling Report (David, 2016) found two bores, GW66683 and GW79737. Bore GW79737 is located at Boral Seaham Quarry. A search of these two databases was repeated and identified four registered groundwater bores within a 5 km radius. No associated geological or hydrogeological information was found other than that presented in **Table 4** below. The locations of these bores are presented on **Figures 1** to **3** and show that these bores are located outside the area where 1 m or more drawdown is expected from quarrying operations 6 years after commencement of extraction (**Figure 1**), at the end of extraction (**Figure 2**) and 20 years post extraction (**Figure 3**).

Table 4: Registered Groundwater Bores within 5 km radius of the Site

Bore ID	Lat.	Long.	Depth (m)	Drilled Date	Purpose	Status	Yield	Dist. from Site (km)
GW066683	-32.700917	151.783635	35	6/2/91	Water Supply – Stock, domestic	Functioning	0.9	**1.8**
GW079737	-32.677164	151.784583	20	29/10/99	Monitoring Bore	Unknown	-	**1.3**
GW060834	-32.657028	151.792523	30.5	1/2/85	Water Supply	Unknown	-	**3.3**
GW060853	-32.657306	151.787523	24.3	1/2/85	Water Supply	Unknown	-	**3.3**

Sources:

http://www.bom.gov.au/water/groundwater/explorer/map.shtml

http://allwaterdata.water.nsw.gov.au/water.stm

4.4 Impact on Surface Water Resources

The groundwater modelling assessed the impact on base flow to Seven Mile Creek. Discharge to Seven Mile Creek was calculated for the following three segments in the groundwater model:

- Seven Mile Creek upstream of the confluence with its southern tributary;
- The southern tributary up to the confluence with Seven Mile Creek; and
- The confluence of the Seven Mile Creek and its tributary to Grahamstown Dam.

Seven Mile Creek is ephemeral that loses groundwater in its upper reaches and receives a groundwater base flow contribution in its lower reach. The results of the groundwater modelling undertaken indicated that base flow to Seven Mile Creek would decrease by 0.75 m^3/day (0.27 ML/year) over the project duration of 30 years.

5. GROUNDWATER MONITORING

There are five groundwater monitoring bores at the site, GWB01, GWB03, GWB02, GWB04 and GWB05 that have been monitored once (URS, 2014). Quarrying activities will disturb bores GWB03, GWB04 and GWB05 within approximately the first three years of operations. All bores

should continue to be monitored prior to disruption. GWB04 will be re-established once extraction in its area has ceased and GWB03 and GWB05 will not be replaced.

The following groundwater parameters are proposed to be monitored at the indicated frequency:

- Water Level (quarterly)
- pH (bi-annually)
- Conductivity (bi-annually)
- Chloride (bi-annually)
- Arsenic (bi-annually)
- Total Phosphorus (bi-annually)
- Total Nitrogen NO_x, ammonia (bi-annually)

Monitoring data should be compared to historical results as well as the groundwater model predictions.

6. REFERENCES

David, K. Numerical Groundwater Model for Eagleton Quarry. October 2016.

Niswonger, R.G., S. Panday, and M. Ibaraki, 2011. MODFLOW-NWT, A Newton formulation for MODFLOW-2005: U.S. Geological Survey Techniques and Methods 6-A37, 44 p.

SLR Consulting Australia Pty Ltd. Groundwater Assessment Peer Review. February 2016a.

SLR Consulting Australia Pty Ltd. Groundwater Assessment Peer Review. February 2016b.

SLR Consulting Australia Pty Ltd. Eagleton Quarry Revised Water Assessment. 4 August 2017.

Umwelt Pty Ltd. Eagleton Hard Rock Quarry Water Assessment – Final. October 2016.

URS Pty Ltd. Eagleton Quarry Hydrogeological Investigation. 2014

If you require additional information or clarification, please contact the undersigned at (02) 4949 5200.

Sincerely,

Kleinfelder Australia Pty Ltd

Dr Tim Robson
Senior Hydrogeologist

Dr Jim Finegan, RPGeo
Principal Hydrogeologist

ATTACHMENTS

Figures

Figure 1: Groundwater Drawdown End Year 6

Figure 2: Groundwater Drawdown End of Extraction

Figure 3: Groundwater Drawdown 20 Years Post

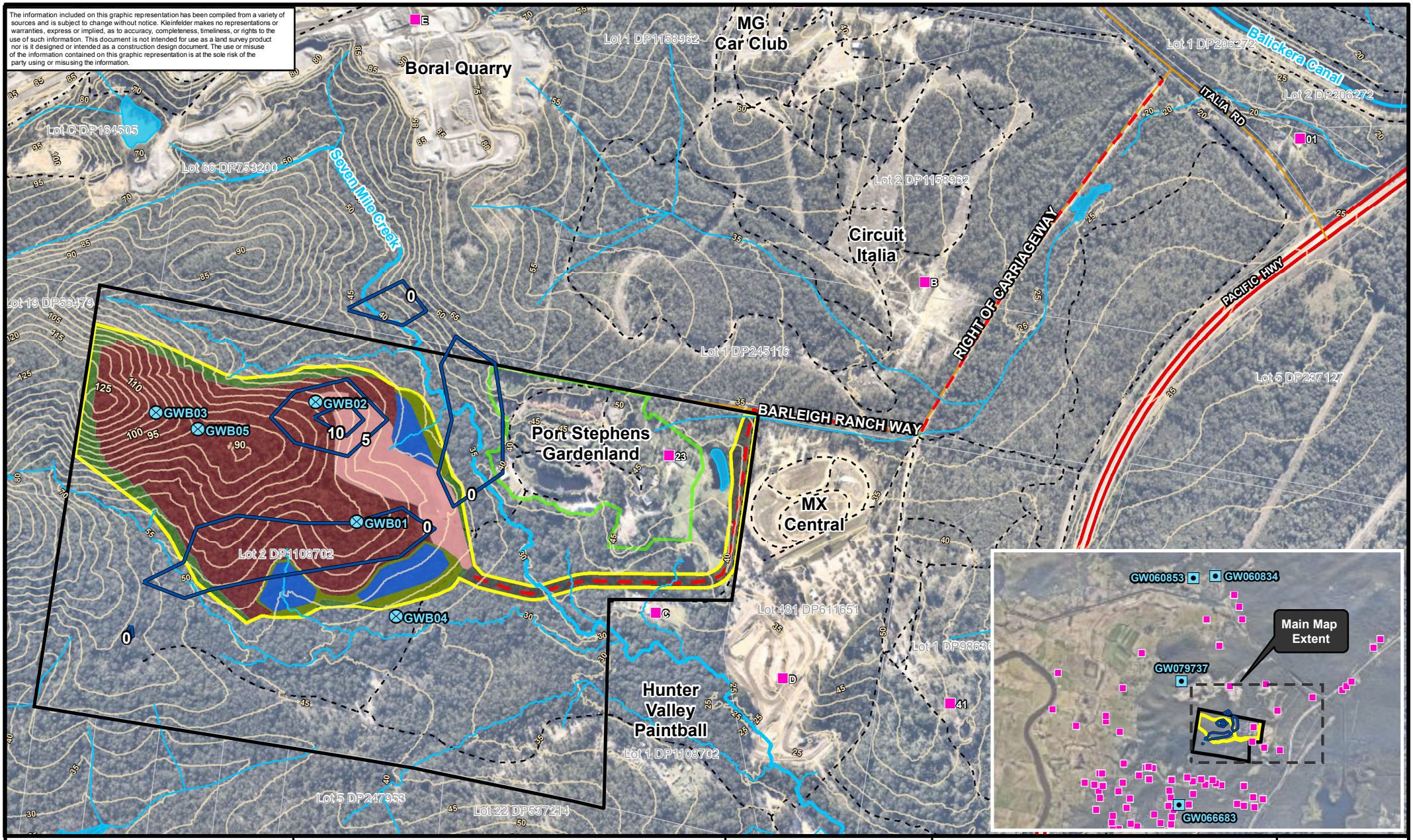
Appendices

Appendix A: Limitations

Appendix B: Groundwater Modelling Report

Appendix C: Groundwater Modelling Report Peer Review

FIGURES



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GDA 1994 MGA Zone 56

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- Subject Land (100.94 ha)
- Onsite Groundwater Monitoring Bores
- Registered Groundwater Bores
- Receptors
- Groundwater Drawdown Contours (David, 2016)
- Project Footprint
- Development Site - Access
- Development Site - Buffer
- Extraction Area
- Gardenland Boundary
- Processing Area
- Dam
- Landscaped Dam Batters
- Contours (5m)
- Lot Boundary
- Unnamed creek line
- Named creek line
- Site Access / Haulage
- Highway
- Local Road
- Track

PROJECT REFERENCE: 20173040

DATE DRAWN: 28/09/2017 16:21 Version 1

DRAWN BY: GJoyce

DATA SOURCE:
Nearmap - 2017
LPI - 2017
NSW DPI - 2017
BOM - 2017
David - 2016

Eagleton Quarry
Groundwater Drawdown
End Year 6

Eagleton Rock Syndicate Pty Ltd
Eagleton Quarry
13 Barleigh Ranch Way, Eagleton NSW

FIGURE:

1

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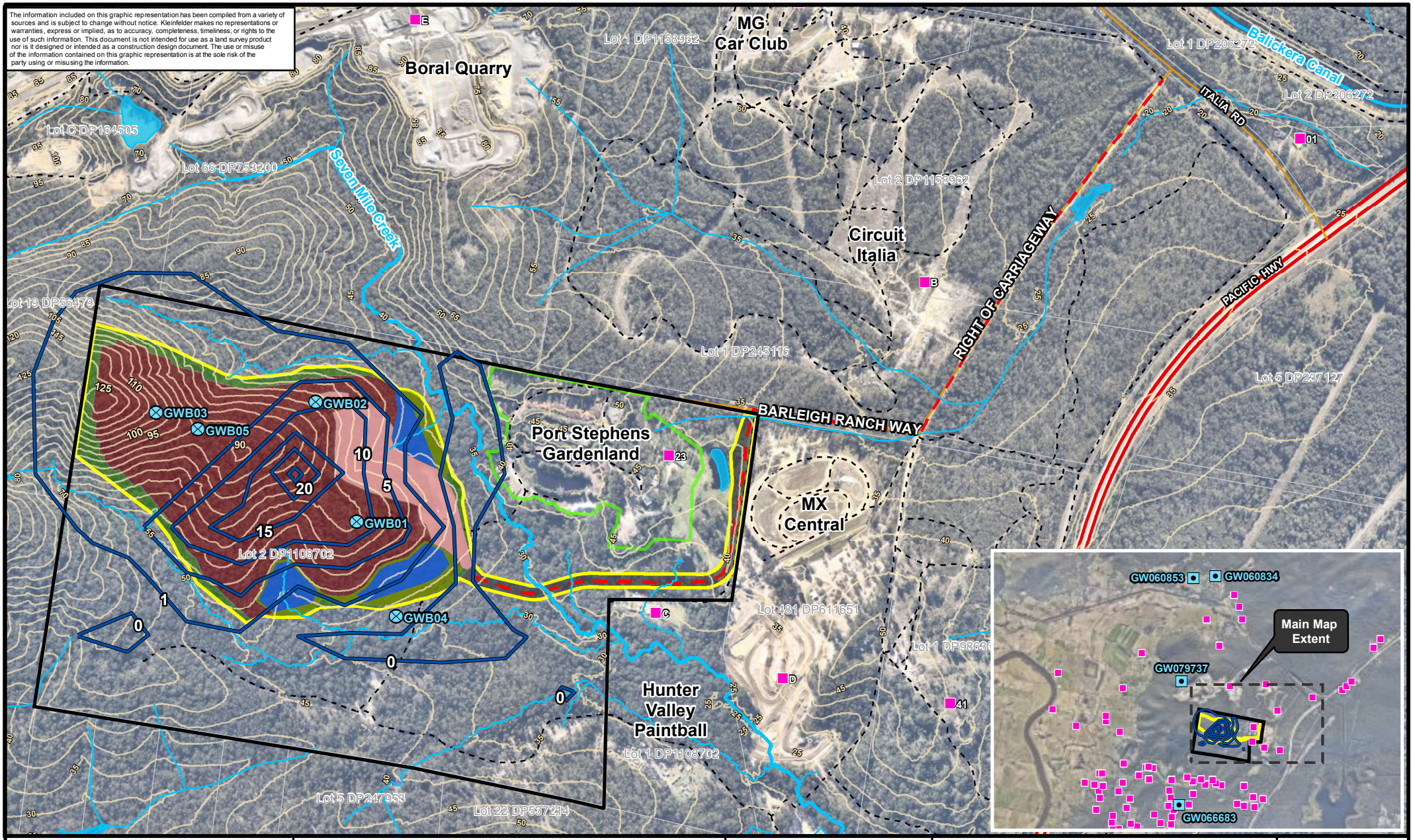

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- Unnamed creek line
- Named creek line
- Site Access / Haulage
- Highway
- Local Road
- Track

PROJECT REFERENCE: 20173040

DATE DRAWN: 28/09/2017 16:31 Version 1

DRAWN BY: GJoyce

DATA SOURCE:
Nearmap - 2017
LPI - 2017
NSW DPI - 2017
BOM - 2017
David - 2016

Eagleton Quarry
Groundwater Drawdown
End of Extraction (30 years)

Eagleton Rock Syndicate Pty Ltd
Eagleton Quarry
13 Barleigh Ranch Way, Eagleton NSW

FIGURE:

2

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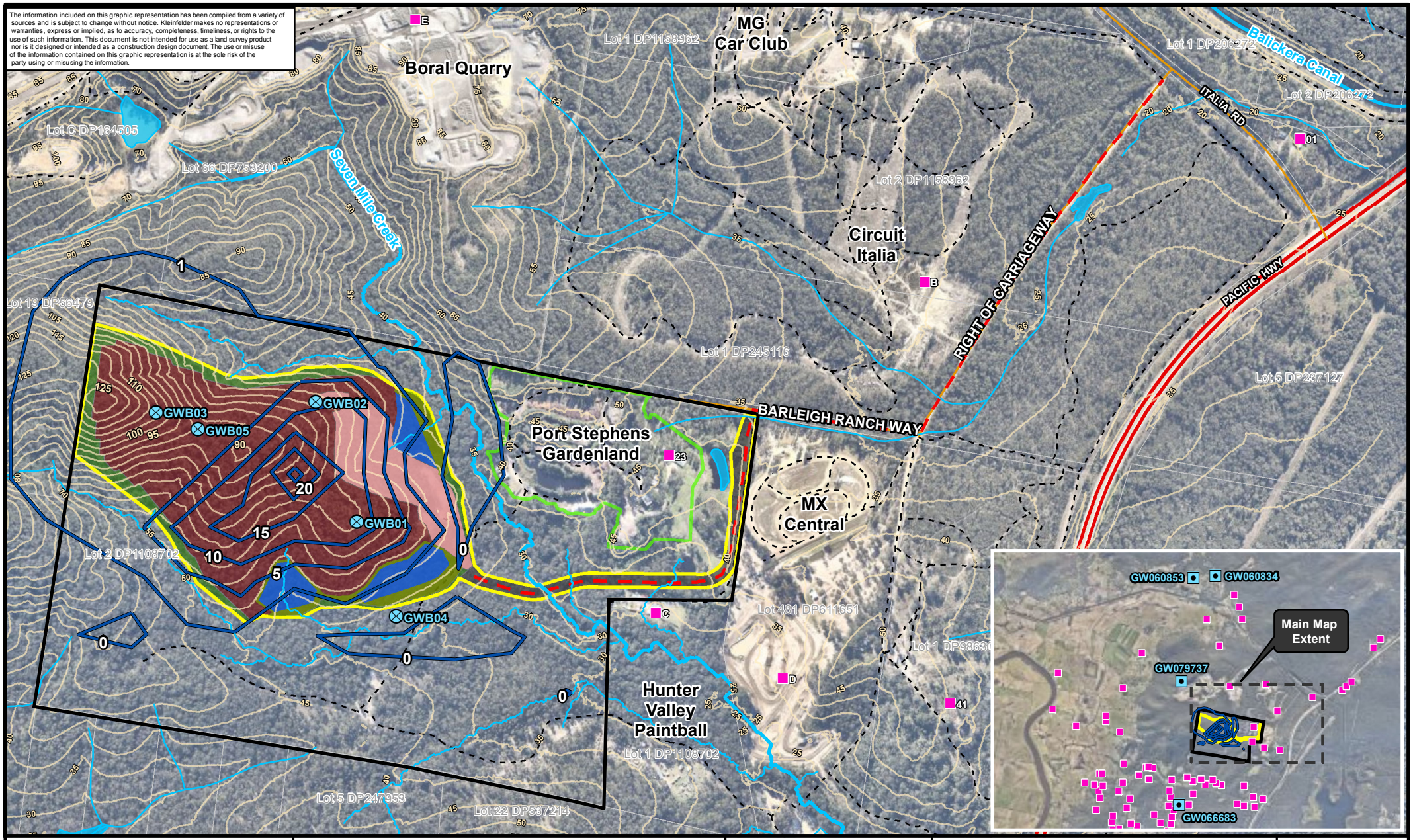

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GDA 1994 MGA Zone 56

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PROJECT REFERENCE: 20173040

DATE DRAWN: 28/09/2017 16:40 Version 1

DRAWN BY: GJoyce

DATA SOURCE:
Nearmap - 2017
LPI - 2017
NSW DPI - 2017
BOM - 2017
David - 2016

Eagleton Quarry
Groundwater Drawdown
20 Years Post End of Extraction

Eagleton Rock Syndicate Pty Ltd
Eagleton Quarry
13 Barleigh Ranch Way, Eagleton NSW

FIGURE:

3

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APPENDIX A: LIMITATIONS

LIMITATIONS

The findings and conclusions contained within this report are made following a review of information, reports, correspondence and data previously reported by third parties. Kleinfelder does not provide guarantees or assurances regarding the accuracy and validity of information and data obtained by third parties in previously commissioned investigations. The conclusions presented in this report are relevant to the conditions of the site and the state of legislation currently enacted as at the date of this report.

Kleinfelder has used a degree of skill and care ordinarily exercised by reputable members of our profession practicing in the same or similar locality.

Kleinfelder does not make any representation or warranty that the conclusions in this report will be applicable in the future as there may be changes in the condition of the site, applicable legislation or other factors that would affect the conclusions contained in this report.

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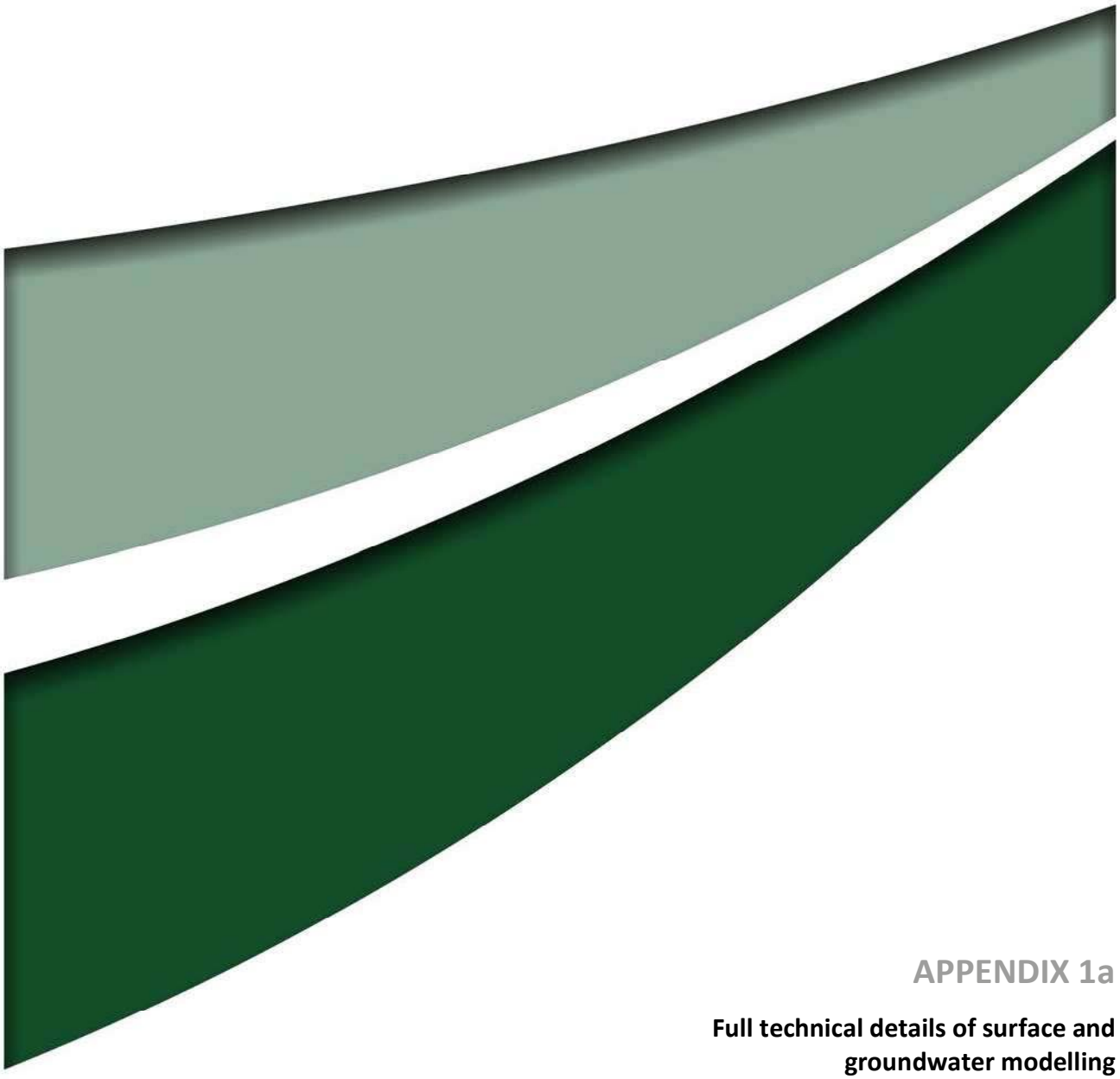
APPENDIX B: GROUNDWATER MODELLING REPORT



APPENDIX 1a

Full technical details of surface and groundwater modelling

NUMERICAL GROUNDWATER MODEL FOR EAGLETON QUARRY

FOR

Umwelt Australia Pty Ltd

By

Katarina David

RPGeo (Hydrogeology) No 10060

Report KD2016/5

Date October 2016

DOCUMENT REGISTER

Revision	Status	Date	Comments
A	Draft	8/8/2016	P. Jamieson, C.Pepper
B	Draft	22/8/2016	P Jamieson
C	Draft	23/8/2016	Independent review (SLR, 2016)
D	Final draft	10/10/2016	P. Jamieson
E	Final	11/10/2016	

Table of Contents

LIST OF FIGURES

LIST OF TABLES

1 INTRODUCTION

Eagleton Rock Syndicate is proposing to develop hard rock quarry at Eagleton, 30 km north of Newcastle, NSW. The surrounding area to the north, west and south of the proposed Eagleton quarry is covered by bushland and Boral operated Seaham Quarry is located approximately 600 m to the north.

URS (URS, 2014) have originally prepared the groundwater assessment including the development of a groundwater numerical model for Eagleton quarry. Subsequently, Eagleton Rock Syndicate Pty Ltd have in 2016 engaged SLR to undertake the independent review of Eagleton Quarry Hydrogeological Investigation Report (URS,2014) in accordance with Secretary's Environmental Assessment Requirements (SEAR). The review (SLR, 2016) found a number of deficiencies in the report and provided a series of recommendations to address those.

This groundwater modelling report has been prepared to support the Groundwater assessment as part of the Environmental Impact Statement (EIS) for the development of the Eagleton Quarry, and to address the recommendations in the independent review (SLR, 2016).

For the purpose of this report the Project Area represents the quarry footprint boundary which mainly represents the proposed extraction area, while Property Boundary includes wider area comprising other areas such as offices, parking and maintenance areas.

1.2 Scope and objectives

The scope of work for this numerical model is a combination of groundwater assessment requirements in support of EIS and a response to independent review. In particular this includes the following:

- Model development and calibration providing the targets for calibration and documentation of evapotranspiration rates used in the model;
- Presentation of calibrated steady state and predicted transient mass balance for the model, calibration results, justification for transient model run;
- Undertaking sensitivity analysis to hydraulic conductivity and river conductance;
- Assessment of groundwater inflows into proposed quarry development during and post operation;
- Running prediction scenarios during and post operation;
- Identification of potential impacts due to proposed quarry activities on the environment and private groundwater users during the operation and post operation; and
- Development of the model within the geology and hydrogeology context, considering explanation on groundwater flow between different units.

The objective of the model is to provide the information upon which the impact assessment can be undertaken and is based on the updated conceptual model developed by Umwelt.

1.3 Historical background to model development

Previous study undertaken at the Project Area was undertaken in 2013 by URS, and it included installation of four observation bores and one test bore, pump testing and hydraulic testing. Hydraulic testing data is not repored in the EA prepared by URS (URS, 2014) however a summary with a range of results is given.

2 HYDROGEOLOGICAL SETTING AND CONCEPTUALISATION

An overview of hydrogeological setting and an updated conceptual model are provided to support the model development as discussed in the following sections.

2.1 Rainfall and evaporation

The Williamtown station (SN061078) located 13 m from the Eagleton Quarry has long term meteorological data. The station has long term rainfall data since 1942 to present. The annual rainfall shows seasonal pattern with higher rainfall in summer and autumn and lower rainfall in winter.

Evaporation data (Class A evaporation pan) from Williamtown station (SN061078) located 13 km from the Project Area has been collected over 42 years.

Mean annual rainfall for all years on record is 1127 mm, while mean yearly evaporation is 1752 mm, indicating that on average there is an excess of evaporation over rainfall. Table 1 shows the comparison of rainfall and evaporation data.

Table 1 Monthly rainfall and evaporation (SN61031 and SN61078)

	Rainfall (mm)	Evaporation (mm)
Jan	101.7	207
Feb	119.2	186
Mar	118.2	150
Apr	111.8	114
May	112.2	81
June	121.3	75
July	72.5	78
Aug	74.6	108
Sept	60.5	141
Oct	72.7	168
Nov	83.4	189
Dec	79.8	216
Annual	1127	1752

2.2 Topography and drainage

The Project is located within the topographically elevated area dominated by a ridgeline at 130 mAHD sloping gently to the north and east to elevation of 30 mAHD. The area within the Property Boundary is drained by Seven Mile Creek which flows from the west to east with minor tributary joining at the southeast of the Project Area. The Seven Mile Creek ultimately drains to Grahamstown Dam further 2 km downstream.

Seven Mile Creek has been classified as ephemeral (URS, 2014), however it is considered that it is a significant contributor to groundwater system. This is based on the review of satellite images which

indicate the presence of up to 100 m wide vegetation zones coinciding with the creek lines (**Figure 1**). This indicates that at topographically elevated areas where groundwater is over 3 m below ground, creek is an important source of water for vegetation.

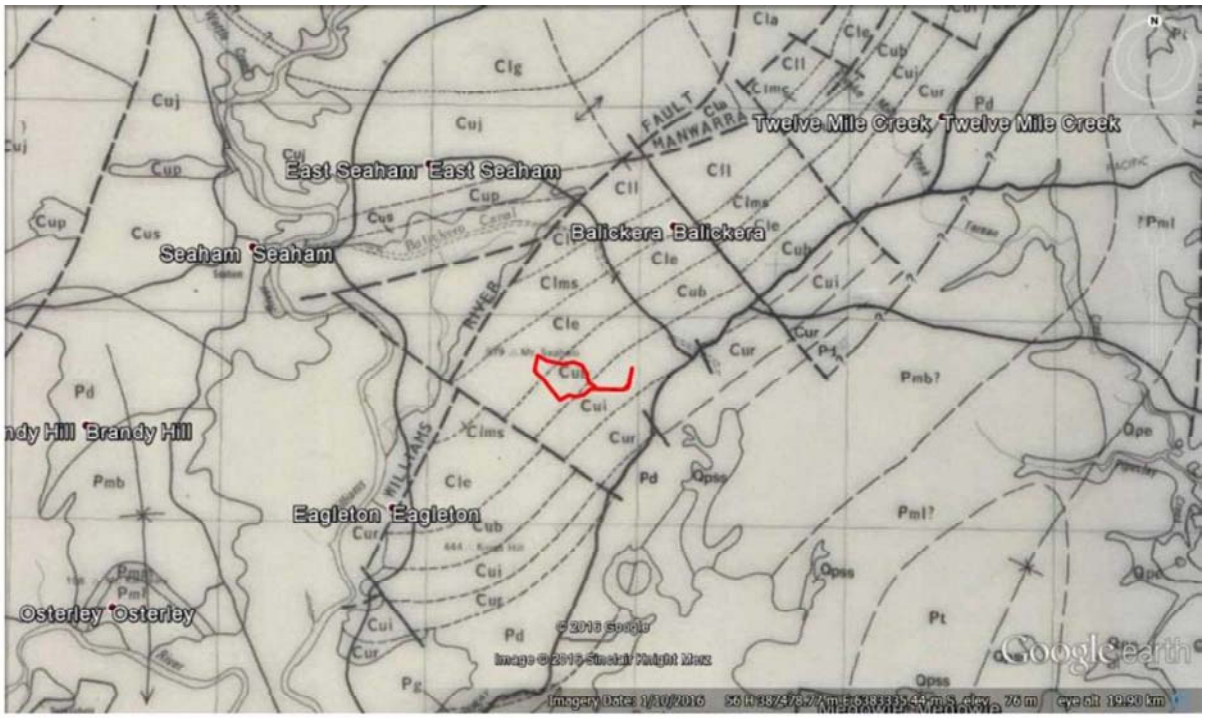
Figure 1 Satellite image of Project Area and creek related vegetation zones

2.3 Stratigraphy and lithology

Based on Newcastle 1:250,000 geology map, geology within the Property Boundary comprises south-easterly dipping reworked volcanoclastic and sedimentary strata.

Locally the Eagleton quarry is situated on faulted and gently folded carboniferous conglomerate and lithic sandstone of the Kings Hill group (Newcastle 1:100,000 geology map, Gorbert and Chesnut, 1975), underlain by volcanic rocks of the Gilmore volcanic group. The basement within the Propoerty Boundary comprises toscanite, rhyolite, pyroclastic and other volcanic rocks and these are part of the Eagleton volcanics. The rhyolite and rhyodacite subcrop at the northwest and west of the Project Area. Kings Hill Group which overlies Eagleton volcanics comprises Balickera Conglomerate (conglometrate, rhyolite, tuff and imbrignite) which subcrops elsewhere across the Project Area(**Figure 2**). This unit is adjacent to the Italia Road Formation subcropping to the east of the Project Area and comprising lithic sandstone, shale and coal.

Major structural feature to the west of the Project Area is the Williams River fault which strikes in the north-south direction. Locally across the Project Area, a number of parallel northwest-southeast striking faults cross cut the volcanic and sedimentary sequence.



LEGEND

Cll	Carboniferous lithic sandstone	Cuj/Cub	Kings Hill Group (Balickera) Conglomerate, tuff and shale	Pd	Dalwood Group Basalt, shale, sandstone
Clms/Cle	Gilmore volcanics	Cui/Cur	Kings Hill Group Claystone, chert , tuff, sandstone, conglomerate	Pmb	Branxton Formation Sandstone and conglomerates

Figure 2 Geology map (based on Gorbert and Chesnut, 1975)

2.4 Hydrogeology and conceptual model

The conceptual model developed by Umwelt is a simplified representation of the real groundwater system and identifies most important geological units and hydrogeological processes. A conceptual model summary of regional flow patterns and groundwater regime has been developed based on the review of existing hydrogeological data:

- Geological mapping (Newcastle NSW 1:100,000 Geological Sheet, Gorbert and Chesnut, 1975);
- Geological data and logs contained within Qualtest Laboratory (NSW) Pty Ltd (2016);
- A previous hydrogeological assessment for the Project Area undertaken by URS Australia Pty Ltd (2013); and
- Private bores sourced from Australian Groundwater Explorer (BoM, 2016) and DPI Water database

This conceptual model (**Figure 3**) forms the basis for the numerical groundwater flow model.

The hydrogeological regime of the model area comprises two main systems:

- Alluvial/colluvial aquifer system mainly found in the west and low laying areas. This unconsolidated sediment also includes wind blown sand associated with the Stockton sand dunes to the east of the Property Boundary, and alluvial sediments associated with the Williams River to the west of the Property Boundary.; and
- Sedimentary and volcanic sequence although of different lithology, due to its low permeability and porosity (Qualtest, 2016) is considered in this model as one groundwater flow unit.

Although groundwater levels are sustained by rainfall infiltration they are controlled by topography, geology and surface water levels in local creeks, rivers and dams. Locally, groundwater tends to mound beneath hills with ultimate discharge to creeks and loss by evapotranspiration where the water table is near the ground surface (typically less than 2.5 m below ground surface).

The groundwater dynamics is shown on a schematic cross section (**Figure 3**).

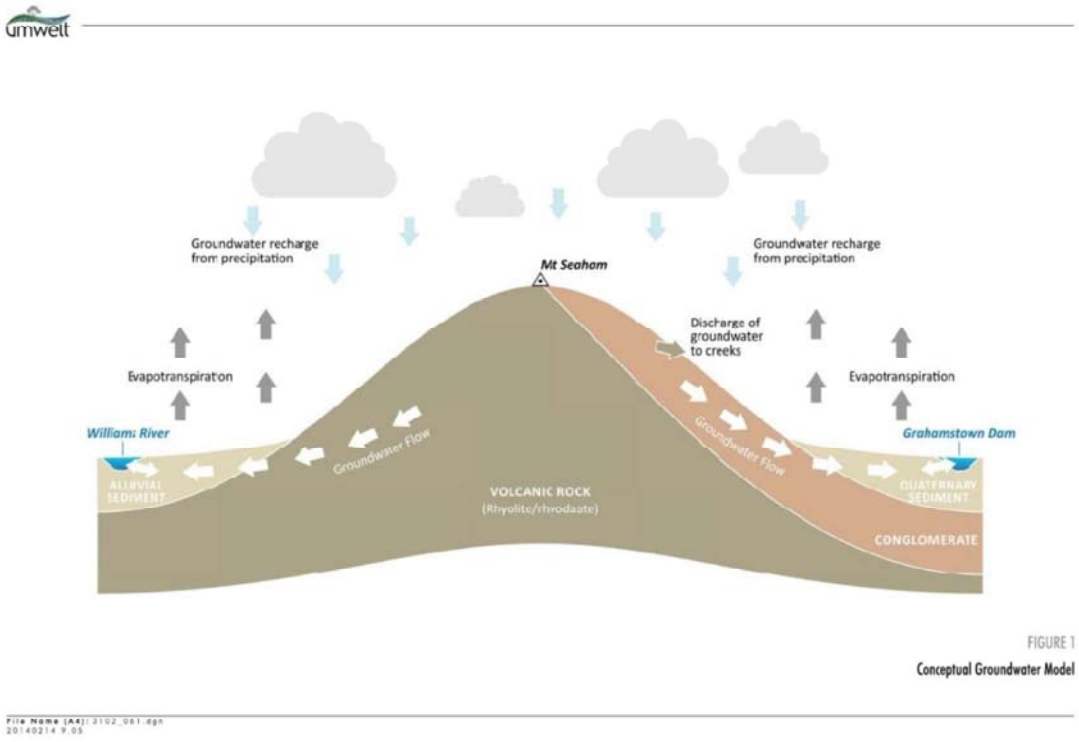


Figure 3 Schematic cross section representing conceptual groundwater model

2.4.1 Alluvial/Colluvial aquifer

Groundwater flow patterns within the shallow alluvial/colluvial aquifer likely reflect topographic levels and coincide with main drainage pathways. Given relatively higher permeability of the alluvial aquifer compared to volcanic/sedimentary hydrostratigraphic unit, it is considered that alluvial aquifer is mainly hydraulically independent from the sedimentary and volcanic sequence. However, where volcanic/sedimentary sequence is confined and underlies alluvium, the upward flow is expected. Similarly, where alluvium is in contact with weathered rock some hydraulic connection may exist.

The information on this hydrostratigraphic unit is mainly based on the surface water expression, presence of a number of creeks and naturally ponded water. Given the absence of mapped Quaternary deposition within the proximity of the William River indicates that it is derived mainly from in situ weathering of the underlying volcanics rather than from deposition of unconsolidated material. To the east this unit comprises wind-blown sands associated with Stockton Sand dunes.

2.4.2 Sedimentary and volcanic hydrostratigraphic unit

The Carboniferous sediments and volcanic units vary significantly in lithology and deposition, however they are of low permeability and porosity and therefore for the purpose of this study considered as one hydrostratigraphic unit. Petrographic analysis on a number of samples indicated that both rhyodacite and rhyolite are non-porous and unweathered (Qualtest, 2016). Within this unit the hydraulic conductivity (K) ranges within several orders of magnitude (URS, 2014), which is typical for volcanic rocks. Conglomerate contains volcanogenic fragments and zeolite in matrix. Zeolite is chemically unstable and due to surface exposure results in weathering ultimately reducing the permeability of conglomerate.

On the contact between conglomerate and rhyolite mapping has indicated a series of lava flows with prevailing sedimentary rock. Due to porous characteristics of lava flow, this zone is expected to weather more easily than rhyolite resulting in lower permeability.

Hydraulic conductivity of the rock generally decreases with depth of burial as the joints close and become less frequent. However in volcanic rocks the weathering on the surface will result in an increase in clay content and therefore lower hydraulic conductivity, compared to subcropping rocks.

Where this unit outcrops, it is unconfined. The piezometeric surface was obtained from four site bores installed in shallow unconfined zone. The piezometeric surface appears to reflect the topography with depth to water greatest at the elevated areas and closer to surface in low laying areas. This is supported by the fact that seeps and swamps are present in the low laying areas and intensely green patches are observed at the toe of the slopes indicating groundwater discharge (as observed on **Figure 1**).

2.5 Baseline groundwater data

There is a network of five installed monitoring bores within the Property Boundary, installed at different depths from 34.9 m to 69.8 m below ground level. One set of groundwater level data was taken in 2013, and indicates that the water level measured in MW3 (URS, 2013) is incorrect possibly due to surface water seeping in the monitoring bore. This bore was therefore excluded from further analysis. Further information on installation of these bores is provided in URS (2013).

2.5.1. Private groundwater bores

Based on the search of NSW DPI Office of Water database and the Australian Groundwater Explorer (Bureau of Meteorology) databases, within 5 km radius from the Project Area, two registered groundwater bores were identified (**Figure 4**). There is very limited information available for these two bores as presented in Table 2. It must be noted that previous groundwater search (URS, 2014) reported 14 groundwater bores within 1.5 km radius, however only one had information which was reported. None of the reported bores (URS, 2014) are shown on any of the maps nor is there further information on their location.

Table 2 Registered private groundwater bore summary (within 5 km radius)

Bore	Distance from the Project Area (m)	Purpose	Total depth (m)	Yield (L/s)
GW66683	1300	Stock/domestic	35	0.9
GW79737	650	Monitoring	20	

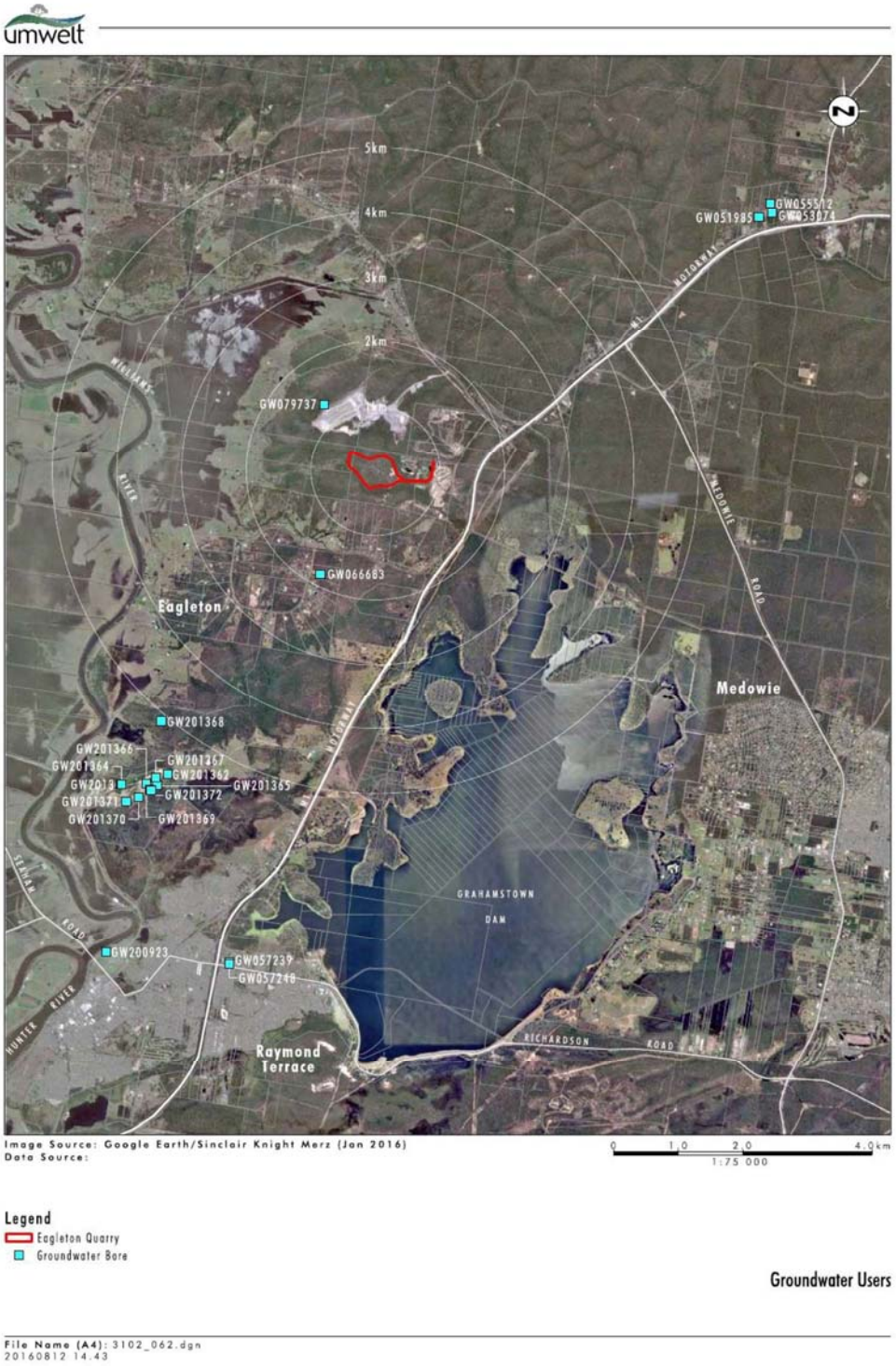


Figure 4 Private registered groundwater bores within 5 km radius from the Project Area

3 NUMERICAL GROUNDWATER MODEL

3.1 Choice of modelling software

The numerical groundwater flow model was developed using Groundwater Vista (Rambaugh 2010). Groundwater Vista is based on the MODFLOW code developed by the United States Geological Survey (McDonald and Harbaugh, 1988) and includes several modifications to address recognised limitations of MODFLOW. Of particular relevance to Eagleton Quarry is the ability of MODFLOW-NWT to account for unsaturated zone processes by solving equations based on the Newton-Raphson method (NWT). This program is intended for solving problems involving drying and rewetting nonlinearities of the unconfined groundwater-flow.

The initial data files, model grid and layers were prepared by Umwelt using Visual MODFLOW package. Such prepared model was calibrated and scenarios simulated using the Groundwater Vistas graphical user interface.

A numerical groundwater model was prepared in accordance with industry best practice and the Australian Groundwater Modelling Guidelines (Barnett, 2012). The model is classified as having a Class 1 confidence level due to the lack of data in the area of interest.

3.2 Model structure

The model grid is oriented with a y-axis pointing north; with a total domain of 9 km by 10 km. Model cells have a horizontal discretisation of 100 m throughout the model area. The calibrated model solves for a steady state distribution of piezometric heads indicative of the period when groundwater levels were recorded in early 2013. There are no transient groundwater level data available for this Project.

During steady state simulation each parameter and boundary condition are held constant. This steady state solution (piezometeric heads) is used as the initial condition for the predictive transient solution over the period 2016 to 2046 during which the excavation will proceed. This is the transient prediction period. It was considered that the rainfall and evapotranspiration had most influence on the site water balance and therefore using long term average rainfall and evapotranspiration data would assist in running the realistic prediction scenarios. Finally, a predictive simulation was run post operation for the period from 2046 for 20 years.

Each transient solution is divided into yearly stress periods for the first six years within which each parameter and boundary condition is held constant. After six years two-yearly stress periods are used as the detailed excavation progress was not available.

3.3 Model layers

The model domain and hydrostratigraphy were based upon the stratigraphy provided in the updated conceptual model and the initial data files, model grid and layers prepared by Umwelt. The domain encompasses a region around the Eagleton quarry, extending approximately 4 km to the north and south, and 6 km west to Williams River and 2 km to the east to Grahamstown dam. The model domain was chosen such that natural boundaries were used wherever possible.

Three layers were used to represent the stratigraphy from the surficial alluvium/colluvium , rhyolite and conglomerate to the deepest rhyolite-rhyodacite (Table 1). The topography of the grid (the elevation at the top of layer 1) was derived from topographic contours with 10 m resolution, and geologic mapping at 1:100,000 scale and local site mapping (Qualtest, 2016) provided surface lithology. The top of rhyolite/rhyodacite (Layer 2) was interpolated based on limited historical

borelogs in the quarry region and extrapolated elsewhere. Rhyolite/rhyodacite hydrostratigraphic unit was represented by two layers to allow more flexibility for calibration. The base of the model was set 40 m deeper than base of Layer 1 following its elevation contours. Intermediate layer conforms to the shape of the base of Layer 1, with typical thicknesses given in Table 3.

Table 3 Hydrostratigraphic layers

Layer	Lithology	Hydrostratigraphic Unit	Thickness
1	Alluivum/colluvium/Rhyolite/Rhyodacite/ Conglomerate	Unconfined aquifer	Variable 20 m to 92 m
2	Rhyolite/Rhyodacite	Confined aquifer	20
3	Rhyolite/Rhyodacite	Confined aquifer	20

3.4 Parameterisation

Material properties (hydraulic conductivity) are assumed to be constant in each layer. The field parameter data measured at the Eagleton quarry and literature values are given as a range of values only (URS, 2014); therefore starting hydraulic conductivity values were obtained from this range.

The final calibrated model parameters are further described in Section 3.6.2. A map showing the spatial distribution of K zones in layer 1 and a west-east cross-section through the proposed Quarry with K zones are given in **Figures 5** and **6**.

Table 4 Initial hydraulic conductivity

Lithology	Initial hydraulic conductivity (URS, 2014) m/day
Alluvium/colluvium	0.1 -10
Rhyolite	0.0004-0.2
Rhyodacite	0.0004-0.2
Conglomerate	0.02-0.2

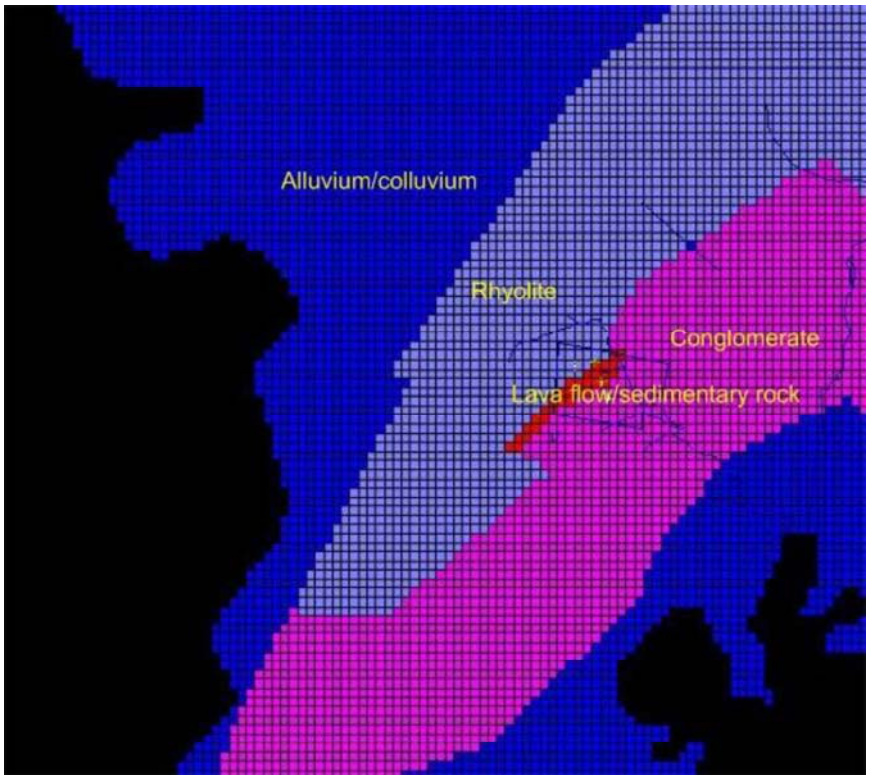


Figure 5 Map of hydraulic conductivity distribution in numerical model (Layer1)

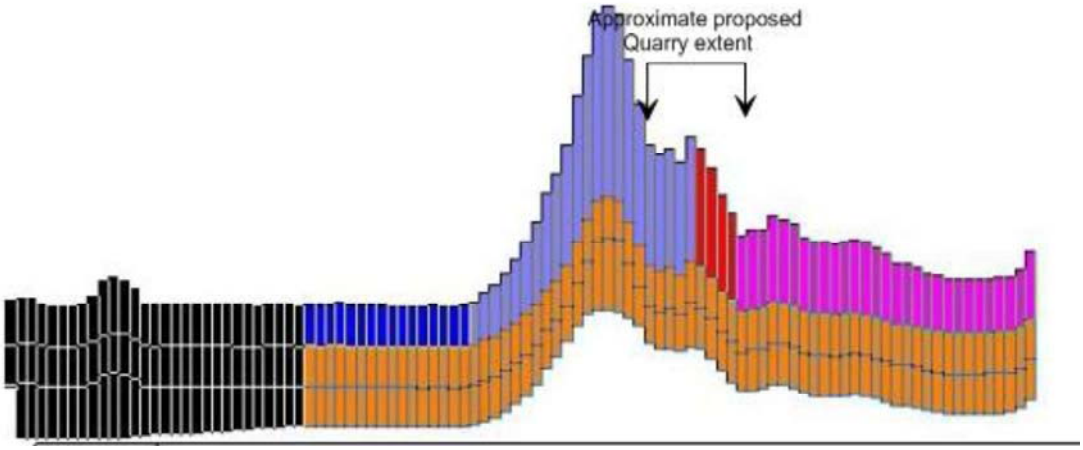


Figure 6 West-east cross section with hydraulic conductivity distribution through the proposed Quarry

3.5 Boundary conditions

3.5.1 Recharge and evapotranspiration

Recharge to groundwater is conceptualised as a constant fraction of annual rainfall. This fraction can vary as a function of soil type and land use. Within the model area the landuse is predominantly rural, either low laying vegetated plains or bushland. Following this assumption uniform fraction of annual rainfall was assigned within the groundwater model domain. The recharge was applied to the uppermost active layer.

For this study, average recharge as a fraction of rainfall was assumed to be within 5% to 10%. These percentages of rainfall were used for both the steady state and predictive transient conditions.

Transient recharge during the period of 2016 to 2046 uses the same total yearly rainfall at the Bureau of Meteorology Station Williamtown RAAF (Station 061078). For the post operational prediction period, same yearly rainfall was used.

Evapotranspiration is conceptualised to occur at a maximum rate if the water table is at the land surface and to occur at a rate that declines linearly with depth to water table to a value of zero at an extinction depth determined by the soil type and vegetation. It has been assumed that the maximal evaporation rate is 1,752 mm/yr. This value is based on data from the Williamtown RAAF (Station 061078) and represents the Pan A evaporation rate. Corrected evaporation rate for evaporation from natural body of water and shallow groundwater is estimated at 1314 mm (McMahon *et* al, 2013; Linacre, 2002). Evapotranspiration was set to a constant value over the model domain during the whole simulation period Evaporation extinction depth has been applied to the top of the model. One zone was created with 2.5 m extinction depth. The extinction depth was applied from model surface.

Recharge and evapotranspiration were not applied along the constant head boundaries.

3.5.2 Regional boundaries

Figure 7 presents boundary conditions setup in the model.

Constant Head boundary (CHB) conditions were developed from the known elevations of physical features – Williams River and Grahamstown Dam (see **Figure 7**) obtained from topographic map and applied in the model. CHBs head elevations were applied in Layer 1 as follows:

- Along the western boundary, CHB head elevation is 1 mAHD based on the topography map;
- Along the eastern and southern boundary coinciding with the extent of Grahamstown Dam, CHB head elevations are 4 mAHD based on the topography map.

In Layers 2 and 3, a no flow boundary was set at all sides of the model, due to lack of groundwater information and in the absence of known physical boundaries. The size of the model is large enough such that the distance to no flow boundaries is not impacted by the proposed Quarry area.

3.5.3 River

The location of the Seven Mile Creek and its extent was derived from the topographic map and applied using the RIV package of MODFLOW. River boundary condition was applied in the top layer which was in agreement with the elevation of the river stage.

Both Seven Mile Creek and its southern tributary were represented with river bottom set below the river stage -set 0.5 m below the river stage. Seven Mile Creek has been reported as ephemeral (URS, 2014) however it appears to support wide vegetation corridor (Figure 1), and receive baseflow further downstream. Therefore the river stage was not set equal to river bottom elevation.

River conductance depends upon the length and width of the river geometry passing through a computational cell, the thickness of the river bed, as well as the hydraulic conductivity. Therefore, the conductance value varies between 25 m^2/day to 70 m^2/day.

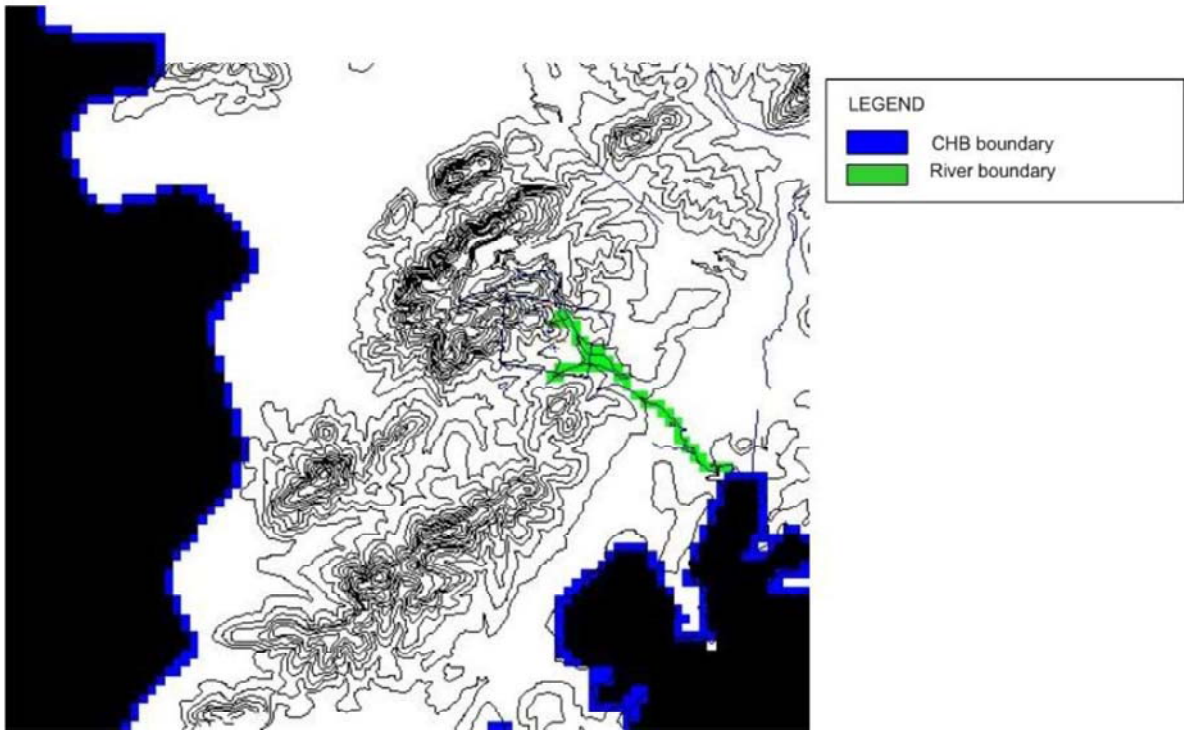


Figure 7 Groundwater model boundary conditions

3.6 Calibration

Model calibration involves changing model parameters within expected bounds until the model results fit historical measurements, such that the model can be accepted as a reasonable representation of the physical system of interest.

The historical measurements used as calibration targets were limited to local piezometric head measurements (one data point for each location) across the Project area that are indicative of the system in 2013. The model calibration was undertaken manually.

All hydraulic conductivity and recharge parameters were calibrated to obtain the lowest error between the modelling and observed calibration targets.

3.6.1 Calibration targets

Within the model domain, 5 head measurements are available to calibrate the steady state model however 4 were used as previously described in Section 3.2. Four of those are monitored bores: MW1, MW2, MW4 and MW5. All targets are located in layer 1.

Table 5 Steady state calibration targets

Name	Type	Water level (mAHD)
MW1	Monitoring Bore	55.48
MW2	Monitoring Bore	56.75
MW4	Monitoring Bore	35.63
MW5	Monitoring Bore	47.51

3.6.2. Calibration results

The final calibrated values of hydraulic conductivity, for the model layers are provided in Table 6. The final calibrated value for recharge was 7% of average yearly rainfall. **Figure 8** shows steady state groundwater head contours simulated in layer 1.

Final calibrated K_h for rhyodacite is lower than for rhyolite and this coincides with the mapped rhyodacite outcrop (Qualtest, 2016) where lava flow was identified intruded with sedimentary rocks. Higher lava porosity probably resulted in increased weathering, higher clay content therefore lower hydraulic conductivity. Underlying rhyodacite/rhyolite calibrated K_h is slightly higher than the outcropping unit, and this is attributed to presence of fractures in the subcropping volcanic rocks. This is expected as volcanic rocks relax with the pressure release resulting in jointing and fracturing. At the surface however the weathering will result in clay infilling the fractures and decreased hydraulic conductivity.

The values of specific storage (Freeze and Cherry, 1979) and specific yield (Morris and Johnson, 1967) were obtained from the literature as there was no field data available from the Eagleton Quarry.

Table 6 Calibrated parameters

Layer	Formation	Kh (m/day)	Kv (m/day)	Specific yield %	Specific storage (m^{-1})
1	Alluvium/colluvium	5	5	0.1	
1	Rhyolite	2×10^{-2}	1×10^{-2}	0.1	
1	Rhyodacite	1×10^{-3}	1×10^{-3}	0.1	
1	Conglomerate	8×10^{-3}	8×10^{-4}	0.1	
2	Rhyolite/Rhyodacite	4×10^{-3}	4×10^{-4}		1E-05
3	Rhyolite/Rhyodacite	2×10^{-3}	2×10^{-4}		1E-0.5

Table 7 Calibrated recharge and ET extinction depth

Recharge and ET Zones	Steady state Recharge Rate (mm/yr)	Extinction depth (m) for ET 1300 mm/year
Uniform recharge	79.9	
Extinction depth		2.5

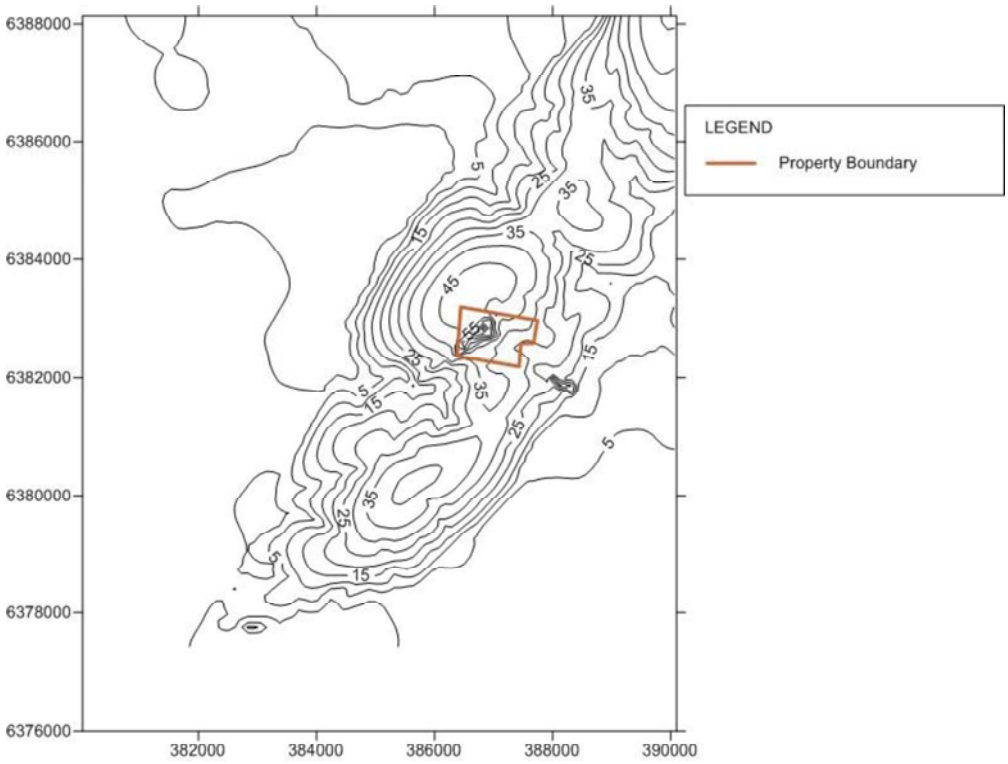


Figure 8 Steady state groundwater head (mAHD) in Layer1

Figure 9 presents the results for the steady state model calibration. A root mean square (RMS) error of 1.6 m was obtained with a scaled RMS of 7.7%. This level of error is considered acceptable given the range of error and assumptions in the study

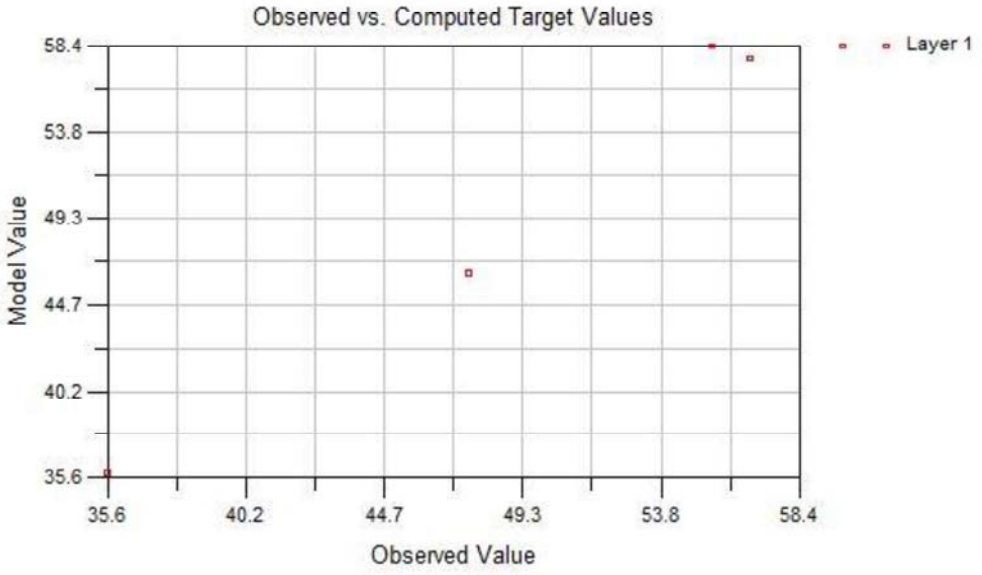


Figure 9 Steady state calibration: observed versus computed hea

3.6.3. Water balance

Groundwater discharge and recharge within the modelled groundwater system is implemented in the model through the following:

- Leakage from the Seven Mile Creek and baseflow contribution (represented by River package);
- Inflow/outflow through the constant head boundary from Williams River and Grahamstown Dam;
- Recharge; and
- Evapotranspiration

Table 8 presents the water balance for the steady state model. The total inflow to the aquifer system is approximately 24 ML/day, comprising predominantly of rainfall recharge (approximately 70%), and leakage from Williams River and Grahamstown Dam (23%) and Seven Mile Creek (7%). Outflow from the groundwater system is mainly via evapotranspiration (90%) and to a lesser extent laterally to Williams River and Grahamstown Dam (9%). This is as expected with a significant part of the model being located in the low laying area.

Table 8 Modelled water balance in steady state

Description	Inflow (m^3/day)	Outflow (m^3/day)
Recharge	16836	
ET		21649
Constant Head	5545	2330
River	1649	51
TOTAL	24030	24030
ERROR (%)	0.00003	

3.7 Sensitivity analysis

An auto sensitivity analysis was carried out in order to examine the sensitivity of the overall model to variations in horizontal and vertical hydraulic conductivity, and river conductance in each of the model zones and reaches. In addition, sensitivity analysis was undertaken to variation in recharge and evapotranspiration, given they are the major components of the water balance.

The sensitivity analysis involves comparison of the base case model to parameter changes for all zones of horizontal (K_h) and vertical (K_v) hydraulic conductivity and river conductance with multipliers of calibrated values of 0.1, 0.5, 2 and 10. For recharge and evapotranspiration the parameter changes comparison to base case model was undertaken using the following multipliers 0.3, 0.5, 0.8, 1.2 and 1.5. Summary graphs of the sensitivity results for the steady state model are provided in **Figures 10** to **14**.

Sensitivity analysis found the following:

- The model was generally insensitive to decreasing and increasing K_h , however it was found very sensitive to K_h of the underlying rhyolite/rhyodacite. Decreasing K_h by multiplier of 0.5 was relatively close to calibrated value however increasing K_h of this zone resulted in excessively high residual sum of squares ;
- Model was generally insensitive to decreasing and increasing K_v , but it was found very sensitive to K_v in the outcropping rhyodacite in particular to an increase in K_v
- The model is not very sensitive to a change in river conductance , with most sensitive reach being the Seven Mile Creek upstream of confluence with west-east running tributary
- The model is sensitive to recharge rate, in particular to lower recharge rate (using multiplier of 0.5 and 0.8), with decreasing sensitivity for higher recharge rate compared to base case
- Similarly model was sensitive to lower evaporation rates, using 0.5 and 0.8 multiplier, however not sensitive at higher rates. The improvement could be achieved in calibration with multiplier of 1.2, however this is not significant.

Overall the model is most sensitive to vertical and horizontal conductivity of the underlying rhyolite/rhyodacite and outcropping rhyodacite, and lower recharge and evaporation rates.

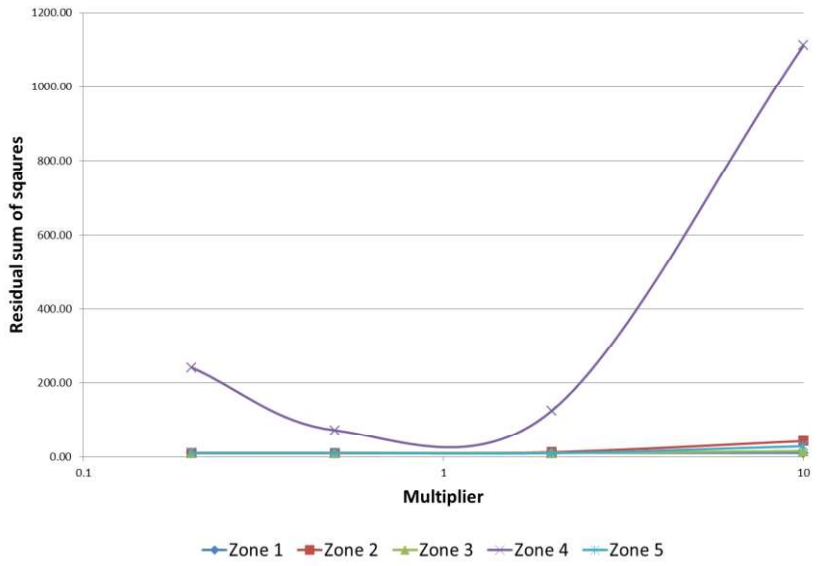


Figure 10 Sensitivity comparison to horizontal hydraulic conductivity

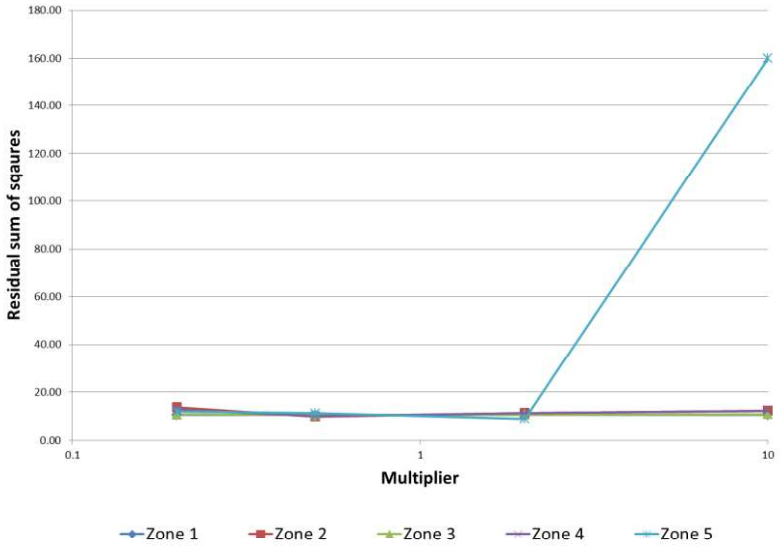


Figure 11 Sensitivity comparison to vertical hydraulic conductivity

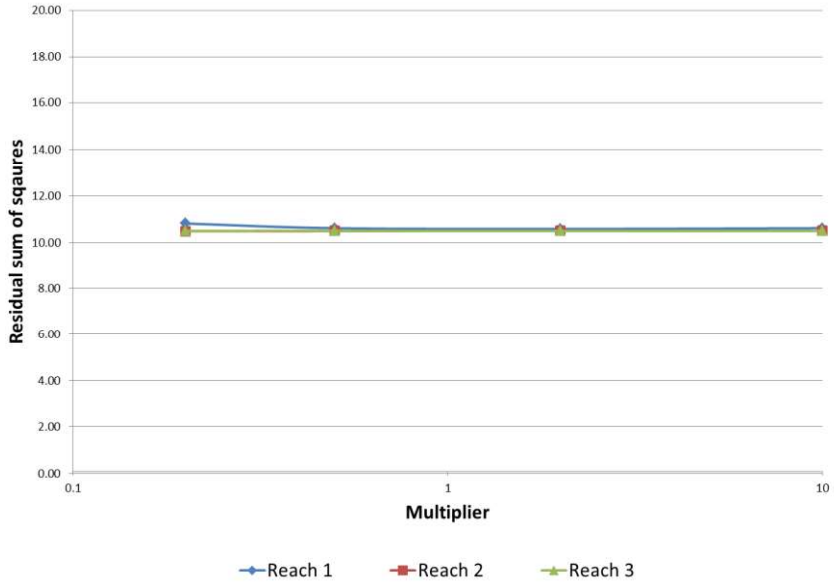


Figure 12 Sensitivity to river conductance

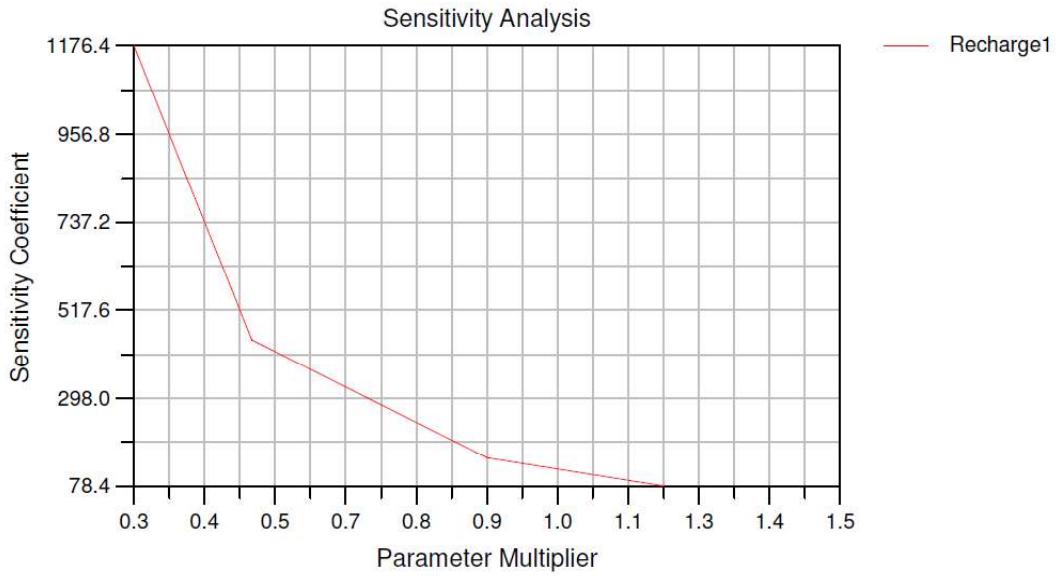


Figure 13 Sensitivity to recharge

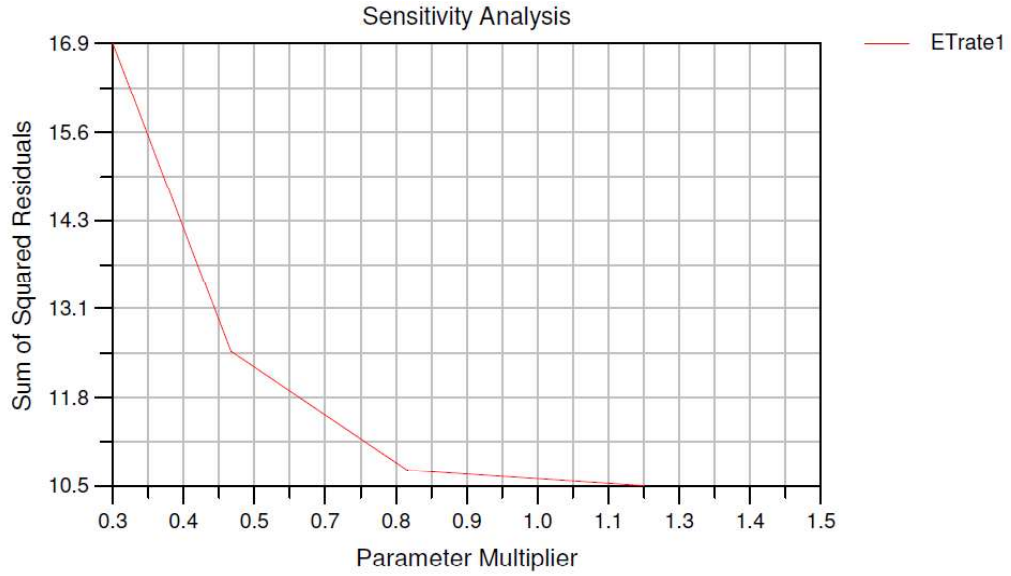


Figure 14 Model sensitivity to evaporation rate

3.8 Predictive simulations

3.8.1 Predictive simulation during operation

The predictive model simulates the groundwater levels in the period from 2016 to completion of material extraction in 2046. This covers the period of 30 years.

Quarry development is represented at yearly periods from Year 1 to Year 6 and followed by 2 year periods after this time, detailed development progress is provided in main report (Umwelt, 2016). The lower time resolution following 6 years of extraction is due to lack of detailed quarry layout and sequencing after this time period. Extraction of quarry material was represented in the model by DRN package. The drain elevation was set at 45 mAHD to coincide with the proposed base of quarry

development. The conductance was set at 1000 m^2/day to allow unrestricted outflow. A transient predictive run is performed where progressively more drain cells (used to represent the excavated material) are applied in accordance with the quarry development schedule (Umwelt, 2016).

During the predictive simulation period the Recharge and EVT rates are maintained at values equal to the steady state yearly average recharge and EVT rates. EVT extinction depth for the predictive run has been set up at 2.5 m below the Quarry floor, once the particular area was excavated. All other boundary conditions are maintained at the calibrated values.

The impacts of the extraction are the focus of the current investigation and only the impacts arising from this period and location are described here.

Table 9 lists the simulated groundwater inflow rates during the predictive model period. The inflow increases with increasing area of extraction and peaks at a rate of 21.1 m^3/day (7.7 ML/year) in Year 24 of the extraction.

Table 9 Predicted inflow during simulation

Period	Inflow Rate (m^3/day)
Year1	8.1
Year2	13.3
Year 3	12.7
Year 4	18.7
Year 5	21.3
Year 6	19.8
Year 8	17.7
Year 10	18.6
Year 12	20.1
Year 14	20.7
Year 24	21.1
Year 30	20.6

Table 10 presents the total water balance at the end of the extraction in Year 30.

Table 10 Modelled water balance at the end extraction (Year 30)

Description	Inflow (m^3/day)	Outflow (m^3/day)
Storage	9.1	2.6
Recharge	16827	
ET		22579
Constant Head	6905	2889
River	1821	73
Quarry inflow		20.65
TOTAL	25562.9	25562.9
ERROR (%)	0.00001	

Groundwater levels across the Project Area in Layer 1 after six years of extraction and at the end of extraction are shown in **Figure 15** and **16**, respectively. The drawdown that occurs during extraction in Layer 1 is shown in **Figures 17** and **18**. Depressurisation within layer 2 at the end of extraction is given in **Figure 19**. A maximum of 1 m drawdown is predicted to extend about 200 m west, north and

south of the Project Area boundary. Maximum extent of drawdown occurs at 300 m from the eastern, southern and western boundary.

The uncertainty in the predictive scenario has not been assessed, however based on the calibration fit, it is expected that 10% uncertainty exists in calibrated results. In addition, with the large area modelled and very limited data available the uncertainty in predictions will increase to moderate.

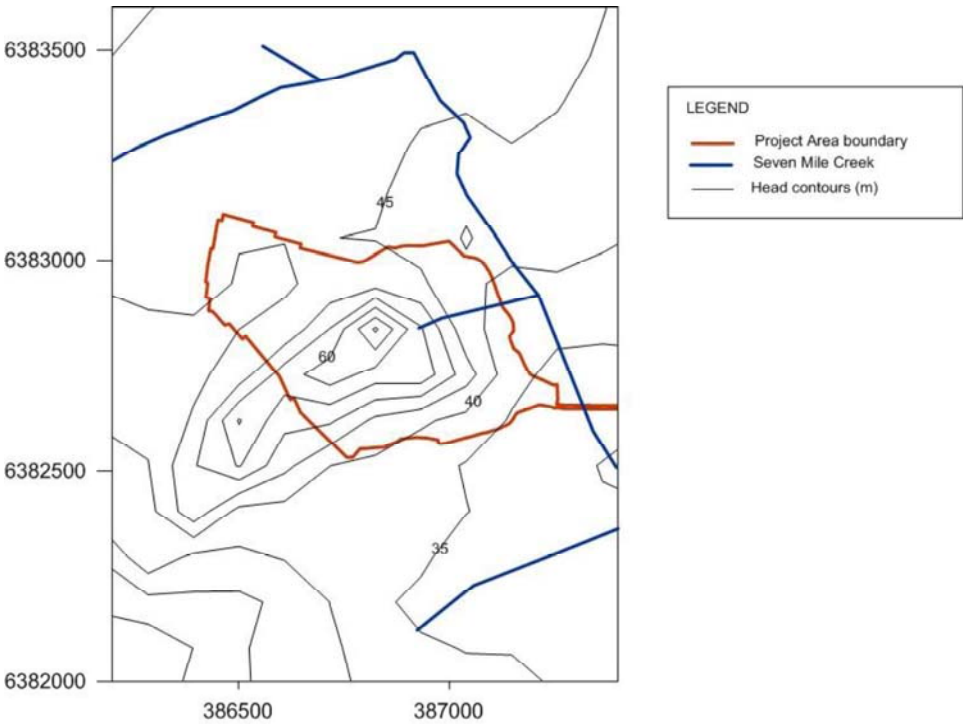


Figure 15 Groundwater heads in relation to Project Area boundary in Layer 1 at the end of Year 6

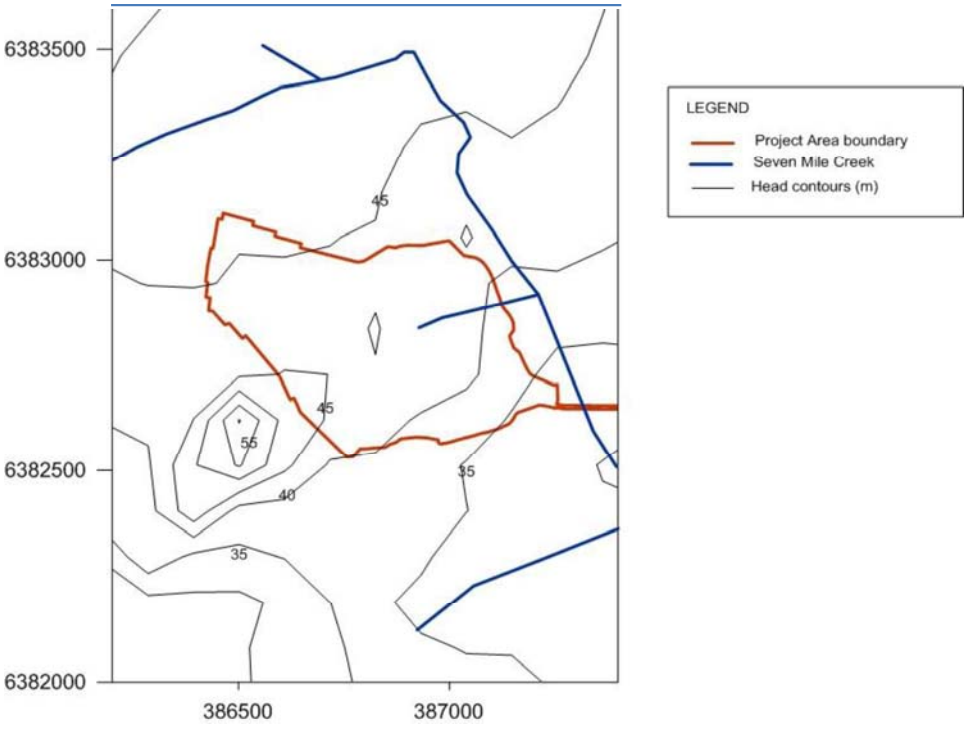


Figure 16 Groundwater heads in relation to Project Area boundary in Layer 1 at the end of extraction (Year 30)

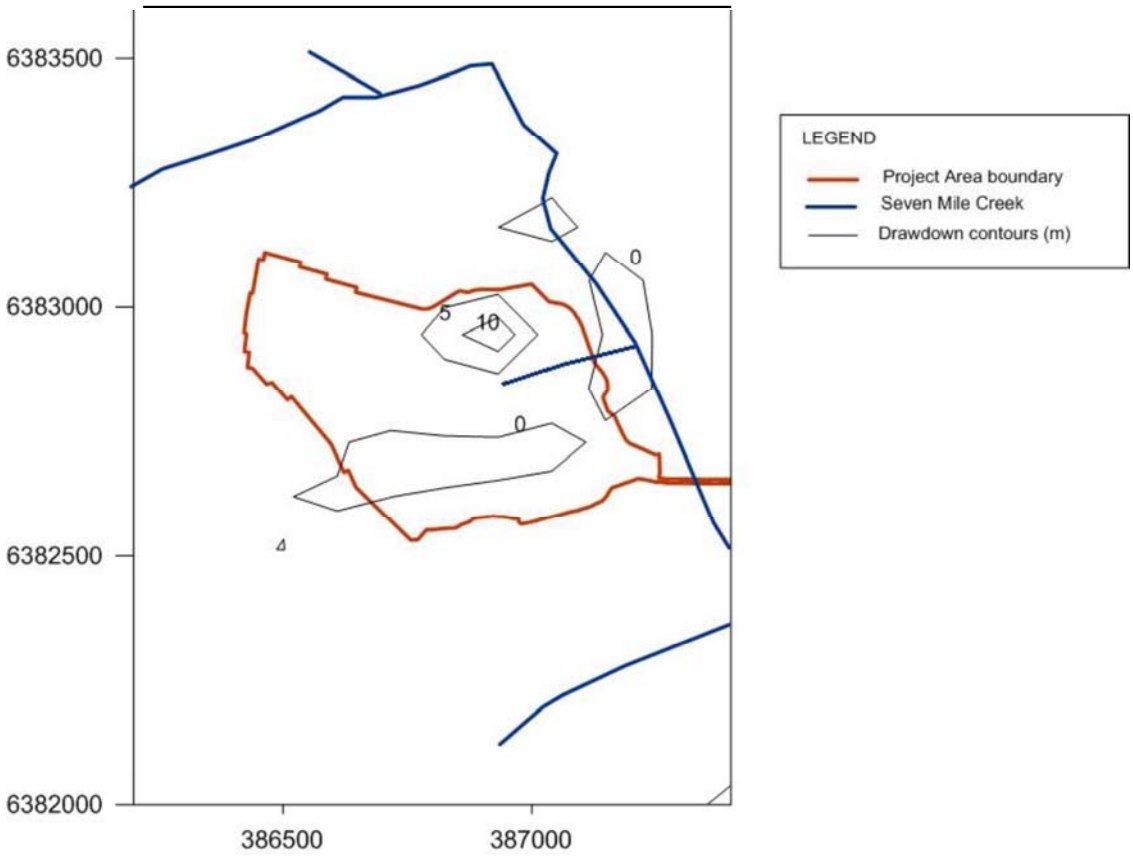


Figure 17 Drawdown in the Layer 1 at the end of Year 6

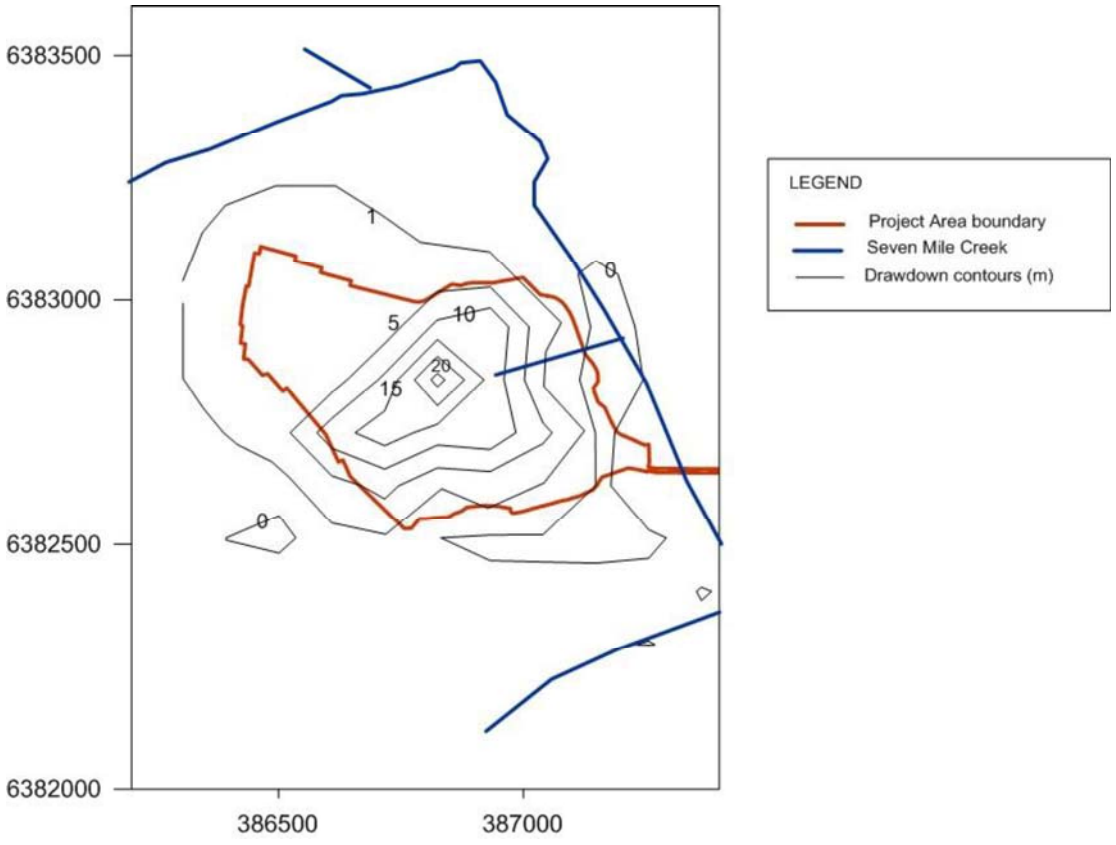


Figure 18 Drawdown in Layer 1 at the end of extraction period

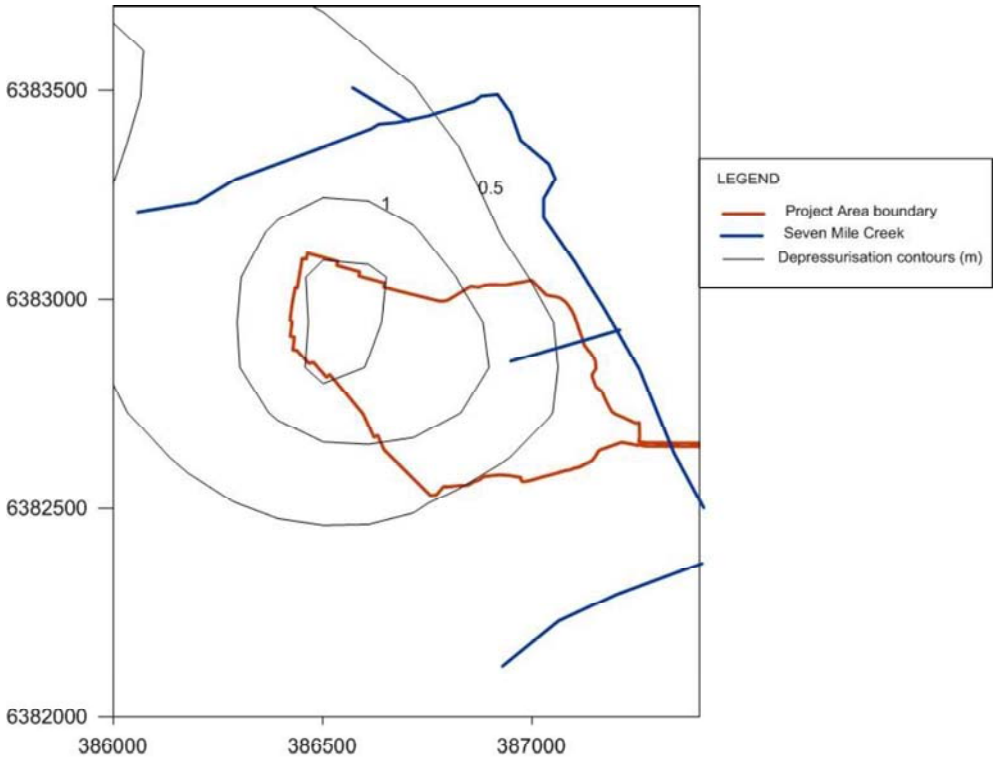


Figure 19 Depressurisation in Layer 2 at the end of extraction period

3.8.2. Predictive simulation post operation

Following the completion of extraction in Year 30 of operation, the quarry floor within the excavated area will be free draining sloping at approximately 1% to the southeast–east. Any groundwater that drains from the final landform benches in the west will be flowing to the dams. The final landform will be rehabilitated with native vegetation which will be progressively established as the final floor level is achieved. Further detail on final landform is provided in the (Umwelt, 2016).

Post operation period was simulated for 20 years following the completion of extraction, by keeping the drain package active to simulate the extracted material. Effectively, final gently sloping and free draining landform will allow any groundwater seepage to flow through the shallow topsoil, and in the case of full saturation provide overland flow to the dam.

Predictive simulation for the next 20 years results in the groundwater inflow to the excavated area of 19.9 m^3/day (7.2 ML/year). **Figure 20** shows the groundwater heads at the end of 20 years post operation and Figure 21 shows the drawdown contours at the end of 20 years post operation.

Following 20 years post operation the model predictions have reached equilibrium and no further drawdown is expected. This is demonstrated by review of the storage fluxes within the last transient period with inflow from the storage of 4.7 m^3/day and outflow of 1.5 m^3/day. The net change is minor and the groundwater system is considered to be in quasi-equilibrium state.

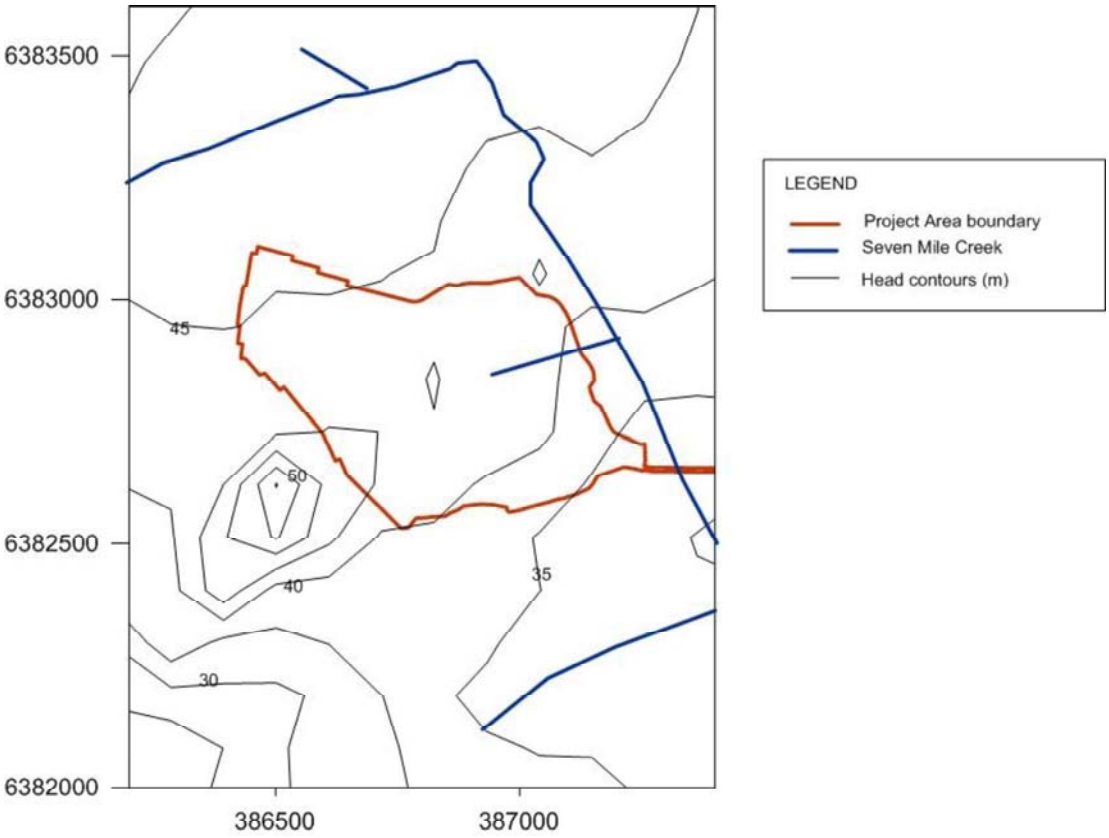


Figure 20 Groundwater heads at the Project Area in Layer 1 20 years post operation

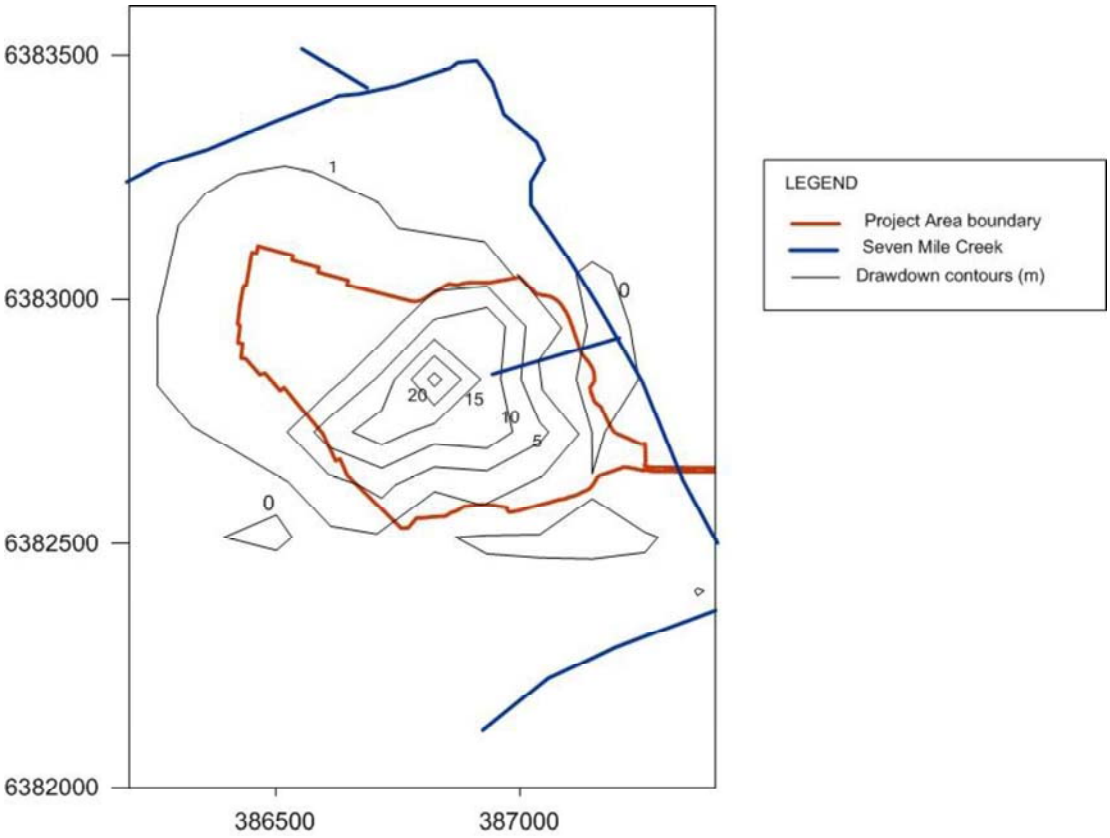


Figure 21 Drawdown map for the Project Area after 20 years post operation

3.9 Model assumptions and limitations

The following are the assumptions and limitations of the numerical model:

- The data used to calibrate the model comprised one set of groundwater level readings (five monitoring bores) of which four could be used with confidence.
- Hydraulic parameters were not available from testing program undertaken in 2013, only a summary of field and literature data was combined and summarised; therefore it may not be accurate;
- Specific storage and specific yield data was not available, therefore for transient model runs these parameters were estimated from literature;
- The surface water elevation of Williams River and Grahamstown Dam were obtained from topographic map, the accuracy of data is within 5 mAHD;
- The faults and other geology structures were not included in the groundwater model, as their exact location and the impact they have on the groundwater system is not well understood;
- Numerical model predictions results in this study are given as best estimate. A range of uncertainty exists in the model prediction and this uncertainty has not been assessed;
- Cumulative impact from the Boral quarry located 600 m to the north of the Proposal has not been assessed as there was no data in the public domain to include in the model.

4 IMPACT ASSESSMENT

4.1 Impact on groundwater levels

The proposal is for excavation within the Project Area boundary down to 45 mAHD, resulting in groundwater above this elevation to seep to the floor of the excavation. The groundwater inflow manifests as drawdown within the connected groundwater source. The main impact from the Proposal on the water levels will occur in the central area of the Project Area. Maximum predicted drawdown within the Project Area boundary is 20 m at the end of 30 years of extraction, and 5 m at the Project Area boundary. Relatively slow extraction progress over 30 years (considering the area) reduces the impact of drawdown significantly.

There is limited impact of drawdown outside of the Project Area boundary with a maximum impact on the southwestern Project Area boundary. Drawdown extends to approximately 200 m outside of the Project Area boundary however within the Property Boundary limit. Underlying rhyolite/rhyodacite remain confined, however 0.5 m depressurisation is predicted to extend to within 500 m northwest from the Project Area boundary.

The impact of other nearby projects (such as Boral quarry) and cumulative assessment have been addressed in this report through the use of most recent topographic map.

4.2 Impact on nearby groundwater bores

Figure 4 shows the location of the bores in the vicinity of the Property Boundary. Groundwater Atlas (BoM, 2016) and DPI Water database indicate the closest private bore is located about 400 m to the southeast of the Project Area (GW79737). The bore is installed at 20 m depth however no other

information is available. Next closest private bore is located approximately 1.4 km southwest of the Project Area, installed in fractured rock aquifer and used for stock and domestic purpose (GW66683).

The prediction simulation (**Figure 18**) indicates that drawdown at the end of extraction period extends to about 200 m west, north and south outside of the Site boundary with zero drawdown at around 300 m distance from the eastern and southern Project Area boundary. Based on the distance to the closest private bore of over 1 km negligible impact is predicted at any of the private bores.

4.3 Impact on baseflow

Discharge to river was calculated for three segments in the groundwater model:

- The first segment includes Seven Mile creek upstream to the confluence with its southern tributary; and
- The second segment consists of the southern tributary up to the confluence with Seven Mile creek;
- The third segment starts at the confluence of the Seven Mile Creek and its tributary to Grahamstown Dam.

Figure 5 shows Seven Mile creek represented in the model.

The overall change in combined flow to these three segments is presented in **Figure 22**. Although Seven Mile Creek is mainly ephemeral and losing in its upper reaches, it also receives minor baseflow contribution from groundwater, mainly in its lower reach. Results from predictive simulations show that there is minor baseflow loss to Seven Mile Creek from the Project with a decrease of 0.75 m^3/day (273 m^3/year) over the period of 30 years of Project.

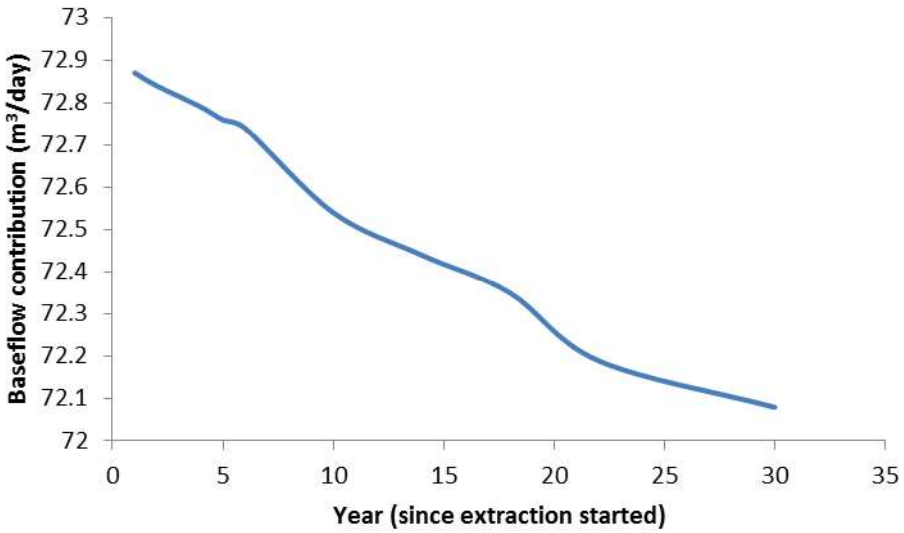


Figure 22 Baseflow to creek during transient predictive simulation

5 GROUNDWATER POLICY AND LICENSING

Groundwater within the Property Boundary is managed by Water Sharing Plan for the North Coast Fractured and Porous Rock Groundwater Sources under the Water Management Act (2000). The plan commenced in July 2016; it establishes rules for sharing water between different types of water and provides users with opportunities to trade water through separation of land and water.

During the proposed Eagleton Quarry development the predicted groundwater inflow is estimated to increase from 2.9 ML/year in Year 1 to 7.5 ML/year in Year 30 of extraction. Following cessation of extraction, the estimated groundwater inflow will continue at a steady 7.2 ML/year rate for the next 20 years. During the operation, predicted groundwater inflow will be sourced from volcanic/sedimentary (fractured rock/porous rock) source only. No interaction is predicted with alluvium/colluvium located over 1.9 km to the east and west of the Project boundary.

The total predicted volume of inflow during excavation will need to be licensed for take of groundwater from fractured/porous rock water sources, and water licences purchased on the open market.

In accordance with the aquifer interference policy (AIP) the take of water from any aquifer needs to be accounted for, licences obtained and any potential impact considered. AIP assessment requires that concept of "no more than minimal harm" be satisfied. Based on the bore yield (GW66683) this aquifer is considered to be less productive, and therefore minimal impact considerations have been developed accordingly. The AIP requires that no more than 10% cumulative variation in water table is exceeded at 40 m distance from high priority groundwater dependent ecosystems (GDEs) and/or 2 m cumulative decline at any water supply work. There is no high priority GDE or water supply work within 40 m from the Project and within the area where predicted drawdown will exceed 2 m. The policy also requires that cumulative pressure head decline does not exceed 2 m at any water supply work. This condition is also satisfied as the depressurisation within the confined fractured rock is predicted to be a maximum of 0.5 m after 30 years of material extraction within 500 m from the Project Area boundary, and zero at the closest water supply work (GW79737).

6 CONCLUSION

This groundwater modelling report represents an update on the existing groundwater modelling undertaken for the groundwater assessment for the development of the Eagleton Quarry (URS, 2014). The conceptual model was updated and the geometry of the numerical groundwater model was setup by Umwelt, with model calibration, sensitivity analysis and predictive analysis undertaken further to address the SEARs and comments provided in the independent review. The findings of the groundwater system analysis and numerical modelling are:

- Geology of the study area comprises Devonian volcanic and sedimentary rocks which outcrop over the Project area and also form the basement in this study. To the east and west of the Project Area, alluvial/colluvial sediments are identified. The volcanic and sedimentary sequence dips to the east. Several NW-SE trending lineaments are present in the study area however their surface expression is not evident on the satellite images.

- Two main hydrostratigraphic units exist in the study area: volcanic/sedimentary rock and alluvium/colluvium. Volcanic and sedimentary units are geologically different however in

terms of hydrogeological properties they are considered as one unit. This is based on low porosity, low matrix component and relatively low hydraulic conductivity. Alluvial/colluvial system is not considered to be in hydraulic connection with the volcanic/sedimentary unit. At the surface the volcanic/sedimentary hydrostratigraphic unit is unconfined with regional groundwater flow in the southeast direction across the Project area. At depth this unit is confined.

- Five groundwater bores were installed within the Property Boundary in 2013, with one water level reading undertaken from each of the bores in 2013. Groundwater level reading in MW3 is not considered accurate and is believed to be high due to surface water flow into the bore. It was therefore not considered further in modelling.

- Hydraulic testing was undertaken in 2013 by URS (2013) however this data was not available, only a summary of combined field and literature value data was provided. This data was used as a starting point in model calibration.

- Predicted groundwater inflow into the quarry is predicted to increase from 2.9 ML/year in Year 1 to 7.5 ML/year at the end of the extraction in Year 30. The source of groundwater is from volcanic/sedimentary hydrostratigraphic unit.

- Drawdown in the upper surficial unconfined layer is predicted to be a maximum 20 m within the Project boundary at the end of extraction in Year 30, reducing to 1 m at 200 m distance (to the north, west and south) outside of this boundary. Zero drawdown is predicted at 300 m from the eastern and southern boundary. Depressurisation within the underlying confined volcanic/sedimentary unit is 0.5 m at 500 m distance from the Project Area boundary.

- The impact of the final extraction on groundwater systems, private bores and baseflow has been assessed. Limited impact is predicted on Seven Miles Creek baseflow with a reduction of a maximum of 0.27 ML/year after about 25 years of extraction. Given that the creek is ephemeral and losing in the upper reach, the baseflow reduction will occur only in the lower reaches.

- The Project will need to purchase groundwater licences in accordance with Water Sharing Plan (Water Management Act (2000)) to cover long term interception of groundwater.

- The uncertainty in the predictive scenario has not been assessed, however based on the calibration fit 10% uncertainty exists in the calibrated results. With large area modelled and very limited data available, it is expected uncertainty in the predicted results will increase to moderate.

- AIP policy was considered, and Project assessed as being in the less productive groundwater source. The Project will not exceed thresholds for minimal impact, as both drawdown and depressurisation are below the limits set by the policy.

7 REFERENCES

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McMahon, T. A. , Peel, M.C. Lowe, L. Srikanthan, R and McVicar, T.R 2013 Estimating actual, potential, reference crop and pan evaporation, Hydrol. Earth Syst. Sci., 17, 1331–1363, 2013

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Qualtest, 2016 Preliminary Resource Assessment for proposed Eagleton Quarry , Balickera

SLR 2016 Groundwater assessment Peer Review, report prepared for Eaglton Rock Syndicate Pty Ltd

URS, 2014 Eagleton Quarry Hydrogeological Investigation, report prepared for Castle Quarry Products

DISCLAIMER

K. David has applied skills and standards appropriate for the Registered Professional Geoscientist (RPGeo) in the preparation of this report. The content of the report is governed by the scope of the study, previous numerical groundwater models and the data utilised in generating outcomes.

While the source of the historical data used in this report has been acknowledged in the report .the overall accuracy of the data can vary. K. David checked the data and undertook the analysis; however the application of these techniques does not negate the possibility that the analytical methods will be impacted by the errors in the supplied data. K. David does not accept responsibility for these types of errors. The methods used in the studies of natural environment, to analyse the subsurface data, often require simplification. As a result the predictions made in this report will also exhibit a level of uncertainty. The uncertainty will increase with longer prediction time.

This report, its findings and conclusions are the intellectual property of K. David. The report can be used by Eagleton Rock Syndicate Pty Ltd. The report should not be used for any other purpose other than that for which it was intended and should not be reproduced, except in full.

Katarina David

RPGeo (AIG)

APPENDIX 1b

CV – Katarina David

CURRICULUM VITAE

NAME: Katarina David

ADDRESS: 4/29 Portia Rd, Toongabbie, NSW

TELEPHONE: 0412 080 360

E-MAIL: katarinadavid@hotmail.com

DATE OF BIRTH: 3rd June 1969

NATIONALITY: Australian

Key Skills:

Katarina is a registered professional hydrogeologist (RPGeo) with over 19 years experience in hydrogeology and groundwater assessment. She has worked on a large range of water supply, transport, urban, irrigation, landfill and mining projects throughout her career. She has worked extensively on NSW, Queensland, South Australian and Victorian projects gaining a broad range of hydrogeology skills and in particular skills in the groundwater assessments, approvals and water supply. Her skills cover field investigations, bore field design, concept design, water supply options, numerical modelling, dewatering assessments, community consultation, performance assessment and project management.

Katarina's experience in hydrogeology is gained through her work on various quarries (Holcim and Boral, NSW and VIC), landfill projects (Tempe and Moomba), major infrastructure projects such as the Westconnex, Lane Cove Tunnel, Brisbane Airport Link and Melbourne Desalination Plant, irrigation (Griffith, NSW and Millmeran, QLD), water resource (Metropolitan Water Supply - Sydney Catchment Authority) and mining projects. This includes practical aspects such as designing and implementing monitoring programs, borehole pumping tests and borefield dewatering, through to conceptual model development and evaluation of environmental impacts using analytical and numerical modeling and environmental assessment techniques.

Katarina is also experienced in reviewing and developing environmental policy. She led the development of a policy document on the management of Hunter River salinity issues for the closure of open cut coal mines (2004).

Her key skills include:

- Water resources and groundwater supply
- Groundwater approvals for quarry and mining projects
- Monitoring programs design and hydraulic testing
- Feasibility studies for management options for mining and quarries
- Water resource management
- Dewatering for mining, quarries, infrastructure and residential development
- Numerical groundwater modelling
- Groundwater impact assessment
- Legislative and policy review
- Project management and community consultation.

Affiliations

International Association of Hydrogeologists- IAH NSW Committee President;
Australian Institute of Geoscientists-Federal Councilor (Director)
Registered Professional Geoscientist (Hydrogeology) RPGeo, No 10060

Education / Qualifications

2013- present PhD candidate in Hydrogeology, UNSW Australia

2000- 2001 Master of Science in Hydrogeology and Groundwater Management, National Centre for Groundwater Management
University of Technology, Sydney

Thesis titled *Experimental and Numerical Studies to Quantify Groundwater Salinity Distribution,* rated high distinction

1987 –1993 BSc. Hons, Graduate Engineer of Geology
Major in Engineering Geology and Hydrogeology,
Faculty of Mining, Geology and Petroleum Engineering,
University of Zagreb, Croatia

Other Professional Training:

Solute and Reactive Transport Modeling course, Sydney (2013)
1st FEFLOW users workshop Australia and New Zealand, Wasy, Sydney (2010)
Improving Hydrogeologic Analysis of Fractured Bedrock Systems, Midwest Geosciences group, Sydney (2008)
Mitigation of the Earthquake Effects in Towns and in Industrial Regional Districts, European Union and Centre for Advanced Academic Studies Dubrovnik, Croatia (2008)
Calibration and Uncertainty Evaluation in Groundwater Models- Water Framework Directive, Budapest, Hungary (2008)
Hydrogeological modelling course FEFLOW, IAH Conference, Portugal (2007)
Advanced hydrogeological modelling course Visual MODFLOW4.1 (2005)
Hydrogeological modelling course MODFLOW and Groundwater Vistas, 3rd Groundwater modelling school (2004)
Hydrogeological modelling software MODFLOW/MT3D, SURFER, RINVERT, WBNM
Developed a model of Serial Biological Concentration on project with CSIRO, Land and Water (2001)
Attended two months Sedimentology Course (Prof. Troger), University of Freiberg, Germany (1991)

Employment History:

March 2014 – current Principal consulting hydrogeologist (self-employed)

Major projects:

- Residential developments, NSW (various) – Groundwater assessment for the estimation of groundwater inflow into the basement prepared for the development approval
- Quarry developments (various NSW and QLD)- Groundwater assessment for development approval and ongoing groundwater support
- Landfill extensions, NSW (various) - Groundwater assessment for environmental impact statement

- Glencore, NSW- Groundwater investigation into the status of alluvium as a result of longwall development and groundwater investigation into the impacts to groundwater system

December 2012- March 2014 Principal hydrogeologist/Groundwater Team Leader, CDMSmith, Sydney

Major projects:

- Bega Shire Council, NSW -Groundwater investigation for sewage water treatment plant- impact of disposal of effluent dunal exfiltration system on groundwater , review of previous information and models, and design of groundwater monitoring system
- Boral, NSW- Groundwater assessment for Berrima Colliery Subsidence Management Plan – date analysis and interpretation, existing groundwater model update and preparation of technical report to address the impact of development of new mine areas
- Springsure Creek transport corridor, Queensland-Bandanna Energy. Groundwater assessment in support of voluntary impact assessment–study to assess the baseline conditions , development of potential impacts and mitigation measures for the project
- Lucas Heights Industrial Land Collection site, NSW- assessment of groundwater contamination, volume of leachate and assessment of potential remediation options
- EPA, NSW- Review of groundwater contamination and fate and transport of mercury at former chloralkali plant , Orica Botany- desktop review of hydrogeology , contamination, geochemical modeling and fate and transport of contaminants (mercury) , risk assessment and recommendations for further work
- Tamworth Council depot -Contaminated land investigation - assessment of groundwater conditions and aquifer properties related to migration of contaminants
- Springsure Creek Underground Coal Mine Project — Bandanna Energy, Queensland, Australia**.** Project Director for the groundwater component of the EIS, which included a revision of conceptual and numerical groundwater models to predict the potential impacts of proposed longwall mining operations on the existing groundwater resources and groundwater dependent ecosystems; community consultation during project exhibition;
- Metro Coal, QLD – Preparation of groundwater assessment for the EIS, groundwater monitoring network design, including the construction of standpipe and vibrating wire piezometers and pump testing for the groundwater assessment, development of site conceptual groundwater model
- Harcourt and Westside Coal Seam Gas Producers, QLD –Project Director: preparation and delivery of underground water impact reports (UWIR) for coal seam gas developments in the Bowen Basin. Reports included hydrogeological conceptualisation from existing and new field data, providing inputs to and managing development of a 3D groundwater model to represent the predicted impacts of groundwater abstraction on aquifers in the gas development area. The reports included recommendations for ongoing monitoring of groundwater as gas abstraction progresses. All reports we submitted to regulatory authorities for approval

August 2009 – November 2012 Principal hydrogeologist/Team leader, Aquaterra, Sydney

Major projects:

- Groundwater assessment for the design of residential development in Double Bay. Groundwater numerical model development and assessment of various options for dewatering scenarios to assist with the development application.
- Holcim, NSW – Groundwater assessment of inflows for the quarry in Dubbo
- Warkworth nitrate plant, NSW - groundwater contamination assessment and modelling of plume
- Centennial Coal, NSW -Technical team leader and project manager for six projects including open cut and underground coal mines (Western coalfields, NSW). The work includes development of groundwater studies for the environmental approvals including the project management and client

support, monitoring program design, conceptual model development, analytical and numerical modelling, and impact assessment, licensing and community consultation.

- Golden Cross, NSW- Development of water supply options and groundwater studies for environmental assessment for proposed Copper Hill open cut (NSW). The role includes project management and technical lead and assessment of options for the potential surface water and groundwater supply for the Project.
- Centennial Coal, NSW - Groundwater-surface water study for the Inglenook Project (NSW) – the project involved extensive water census, hydrogeochemical study using traditional geochemical analysis and the use of CFC tracers to assist in hydrogeological conceptualisation and conceptual model development.
- Mt. Penny coal project (open cut)- Technical lead and project manager for the groundwater assessment including the groundwater monitoring and testing program design and assistance with licensing and development of the conceptual model. Project management of all aspects of the project including groundwater modelling and impact assessment.
- Argent Minerals, NSW -Kempfield project (open cut silver mine)- Lead and project manager for groundwater assessment including the monitoring network design, conceptual model, water supply, conceptual and numerical model development, pump testing, licensing and preparation of impact assessment report.
- Enhance Place, NSW- Yarraboldy- Stage 1 and 2 coal mine (Lithgow, NSW)- Groundwater assessment Technical lead and project management of all aspects of the project, including monitoring network design, hydraulic testing, hydrogeological conceptualisation, conceptual and numerical modeling and impact assessment. Provision of technical advice in relation to regulation and licensing.
- Bulga Coal Mine, Broke, NSW (open cut and underground)- Groundwater assessment and specialist input interpreting the impact of gas wells and dewatering on water volumes and quality issues as part of a degassing of coal seams for methane gas drilling program, water management and NSW regulation related to gas fraccing, ongoing groundwater support for annual reporting and subsidence management plan.

February 2005 – August 2009 Principal and Senior hydrogeologist, Parsons Brinckerhoff, Sydney

Major projects:

- Nattai Valley, NSW, Sydney Catchment Authority (SCA)- Groundwater-surface water investigations,. Project manager for groundwater investigations in the Nattai Valley data collation, geochemical and hydrogeological analysis to assess the water quality within the Nattai catchment, project for Sydney Catchment Authority for Metropolitan Water Supply.
- Lane Cove Tunnel, Sydney, Thiess John Holland JV. Groundwater seepage investigations into the east cut and cover tunnel, recharge system design
- Airport Link, Brisconnections, QLD. Seepage estimation from proposed cutoff sections, 2D modelling using SEEPW to estimate the pressures and seepage to the road base and wall
- Emergency Drought Supply Evaluation: Lithgow Mine, Delta Electricity Feasibility investigations including estimating volumes potentially available within the mine void, a conceptual model, numerical FEFLOW model development and assessment of sustainable yield and placement of potential extraction bores
- Sewerfix Project, NSW Groundwater Modelling Technical Review. A groundwater model was developed using MODFLOW to estimate potential water inflow into the storage tunnel. Peer review of the model and reporting through conceptual model, model calibration and predictive simulations, along with the assessment of hydrogeology report.
- Avon Valley Project, WA, Great Southern Olive Holdings Pty Ltd -Groundwater Modelling Lead and Technical Review. A groundwater modelling support (MODFLOW) to estimate sustainable yield for the aquifer and to predict the aquifer drawdown following intensive pumping for irrigation.

- ❖ Hume Highway Duplication, Road and Transport Authority, NSW- Groundwater Assessment for Environmental Impact Statement, review of major aquifers, identification of salinity and waterlogging affected areas , development of management strategies
- ❖ Australian Olive Groves, Millmeran, QLD – assessing water supply options for irrigation of the olive farm, numerical modelling using MODFLOW to predict the influence of pumping on the aquifer and water users
- ❖ Melbourne Desalination Plant, VIC. Estimation of proposed desalination shaft groundwater inflows using MODFLOW numerical model.
- ❖ Warragamba, Wallacia, Upper Nepean and Illawarra, NSW, Sydney Catchment Authority (SCA)- Groundwater investigation, Drilling and pump testing and water quality program for Metropolitan Water Supply.
- ❖ Upper Nepean Groundwater Investigation Site, Sydney, Sydney Catchment Authority. Development of the conceptual model based on the extensive hydrogeological and geochemical investigations.
- ❖ Sutherland Shire Council, Menai, NSW- Groundwater Prospects Investigation. Groundwater investigation for drought relief, production bore installation, groundwater testing, reporting.
- ❖ Dubbo, NSW, Caltex -Groundwater Modelling Lead and Technical Review., A groundwater model was developed using WINFLOW and Bioscreen to estimate plume extent and to predict the plume migration following intensive pumping for irrigation.
- ❖ Caltex Service station, Mudgee- monitoring, modelling and remediation of active service station site
- ❖ Randwick residential development, Sydney, NSW – Dewatering design and investigations for the groundwater inflow into the basement , numerical modeling using MODFLOW for dewatering setup
- ❖ Dubbo, NSW, Caltex -Groundwater Investigations,. Groundwater modeling of contaminated plume using Bioscreen and Wintrans model.
- ❖ Moomba Landfill Groundwater Investigations, Moomba, SA, Santos. Groundwater modeling to assess the landfill leachate development and design of different capping options.
- ❖ Mudgee Service Station, NSW, Caltex -Groundwater Investigations,. Detailed review of local geology and hydrogeology and groundwater impacts, preparation of independent review report and recommendations to the monitoring program, ongoing monitoring and advising.
- ❖ Delta Power Station, Lithgow, NSW- Due diligence study of the likely long term availability of water from Clarence Mine for the supply to Delta Power
- ❖ Enertrade Powerstation, Townsville, QLD- Prepared Environmental Impact Statement for proposed power station
- ❖ Ulan Coal Mine project, Ulan, NSW- Water management strategy for Ulan Coal Mine and proposed Ulan power station, Ulan. Development of numerical groundwater model MODFLOW to assess future inflows into the mine and the effect of dewatering on the regional aquifer system. Assistance with the assessment of groundwater as the potential source for power station, groundwater monitoring system redesign

April 2003- February 2005 Hydrogeologist, Coffey Geosciences, Sydney

Major projects:

- ❖ Wingecarribee Swamp, SCA, NSW Groundwater assessment, managed environmentally sensitive hydrogeology project at Wingecarribee Swamp including geology and hydrogeology mapping and geophysical program to develop a conceptual model for the swamp.
- ❖ Murrumbidgee, Lower Murrumbidgee Groundwater Preservation Committee -Groundwater Preservation. Analysis of bore pumping and monitoring data, review of the groundwater management plan.
- ❖ Rylstone Spring, Bevco, AWBA Groundwater Assessment- Groundwater assessment of water supply.

- ❖ Campbelltown Residential Estate, NSW, Landcom -Groundwater Assessment. Preliminary groundwater assessment including bore testing for groundwater irrigation.
- ❖ Double Bay, NSW, JG Merit -. Hydrogeological report to design parameters to assess dewatering impact and the groundwater risk assessment due to construction of residential apartments
- ❖ Merrickville Council, NSW Tempe Lands Remediation - Production bore installation on the landfill, aquifer pump testing, interpretation and analysis of data, leachate discharge calculation and options for leachate extraction, cut-off wall performance testing, ongoing groundwater monitoring
- ❖ Shell Cove Harbour development - Swamp & wetland hydrogeological study, design of monitoring network, hydraulic testing and groundwater monitoring, numerical modelling using Visual MODFLOW, drawdown predictions for proposed excavations
- ❖ Landcom, Proposed development, Managed salinity investigation for proposed shopping center development
- ❖ Barrick Gold Mine, West Wyalong, NSW – Managed the program for design and installation of dewatering bores for mine dewatering.
- ❖ Ulan Coal Mine – Numerical modelling using Visual MODFLOW, prediction of inflow, study on surface water- groundwater interaction

April 2002- 2003 Project Officer, CNR, DLWC, Sydney

Research into the management of salinity issues for closure of open cut coal mines in the Hunter Valley (ACARP project)

Worked on:
- ❖ Examining mining related salinity issues within a catchment framework
- ❖ Comprehensive literature review to determine the current status of the understanding and management of salinity on open cut coal minesites, particularly relating to mine closure
- ❖ An assessment of the principles to address salinity on minesites during the developmental, operational and closure phases in order to minimise the post-mining impacts from salinity
- ❖ The development of guiding principles for the management of salinity on open cut coal minesites in the Hunter Region

Achievement:
- ❖ Produced a report that addresses: sources of salt to the Hunter River, relative contribution of salt on the mine site during current and post mining, development of guiding principles with potential to reduce salinisation on the mine site

November 2001 - April 2002 Hydrogeologist, CSIRO, Land and Water, Griffith

Assessment of options for the management and improvement of Green Gully,
Worked on:
- ❖ Compilation and hydrological appraisal of previous management options
- ❖ Hydrological data collection, interpretation and analysis- catchment, rainfall, bore log data, soil information, piezometric levels
- ❖ Field investigation and report writing for Murray Irrigation
- ❖ Feasibility study on different management options

Coleambally Outfall Drain Project, received recognition from UNESCO,
Worked on:
- ❖ Hydrological data compilation, interpretation of aquifer testing
- ❖ Soil and groundwater sampling and testing for salinity

- ❖ Geophysical , geochemical and hydrological data analysis and interpretation for remediation and protection of groundwater and land
- ❖ Report writing for government agencies and COD Water Association

October 2001 Geological Consultant, Geological Ore Search, Cobar

Worked on:

- ❖ Analysis, research and interpretation of geological data for mineral exploration at Byrock Prospect

January- September 2001 Research Work, CSIRO, Land and Water, Griffith

Hydrological work for Masters Project on groundwater occurrence and quantifying groundwater salinity distribution at SBC (effluent irrigation) site:

- ❖ Literature research
- ❖ Conducting hydraulic aquifer tests , analysis of tests and interpretation
- ❖ Water quality monitoring and interpretation
- ❖ Solute transport and flow modelling using MODFLOW/MT3D
- ❖ Report writing

October - December 2000 Compilation geologist, PASMINCO EXPLORATION, Cobar

- ❖ Compilation of historical data from open DMR reports, created geochemical database for assistance with geological exploration

October 2000 Part-time teacher, Western Institute of TAFE

- ❖ Teaching module Geophysical Instrument Operation for Geological Field Assistants
- ❖ Geotechnical field assistant course including the following modules: geology, geotechnical orientation, geophysical instruments operation, sampling techniques and map reading

April - October 2000 Environmental Scientist, PASMINCO ELURA MINE- Environmental Department, Cobar, NSW

Main tasks and achievements:

- ❖ Investigated seepage issues on the Tailings Dam
- ❖ Development of mine water balance (rainfall –runoff) model as part of the water management plan, report on findings
- ❖ Review and modification of water management plan
- ❖ Report on investigation for the evaluation of the quarry for the disposal of process water for the submission to the EPA
- ❖ Environmental monthly monitoring of groundwater, surface water, dust, soil, flora, and meteorology data
- ❖ Collection of samples and interpretation of results following the analysis
- ❖ Acid mine drainage and salinity issues
- ❖ Producing Annual Environmental Report

March 1999- March 2000 Compilation geologist, PASMINCO Exploration, Cobar

- ❖ Compilation and research of past exploration geochemical data , digital data management
- ❖ Writing statutory reports for the Department of Mineral Resources , NSW
- ❖ Working on MapInfo software program on creating geochemical thematic maps and sections
- ❖ Lead and supervised the field work on RAB exploration drilling program
- ❖ GIS and creating thematic maps and sections

June 1998- January 1999 Geologist, ELURA MINE –PASMINCO, Cobar, NSW

- Geotechnical diamond drill core logging , plotting and interpretation of geotechnical section for the mine shaft extension project
- Managing the mine database with DataShed software
- Logging underground production and exploration diamond drill core
- Managing the exploration percussion –drilling program

1997-1998 Graduate geologist, PEAK GOLD MINE, Cobar, NSW

- Working on determination of hydrothermal alterations on shallow RAB drill chips and diamond drill core samples (with PIMA instrument)

June- September 1994 Graduate geologist, COEUR GOLD- Golden Cross Mine, Waihi, NEW ZEALAND

- Geochemical study of epithermal gold deposits, plotting and interpretation of geochemical cross sections and long sections through the deposit

Skills Summary: Project Management, Computer skills: Microsoft Applications, MapInfo, SURFER, FEFLOW, MODFLOW/MT3D, WBNM, RINVERT, Groundwater VISTAS, Bioscreen, Biochlor, WINFLOW
Current drivers licence, green card, safety training for open cut coal mines and Senior First Aid

Publications and presentations:

David, K., Timms W and Barker A. (2015) Direct stable isotope porewater equilibration and identification of groundwater processes in heterogenous sedimentary rock, *Science of the Total Environment* 538 (2015) 1010-1023, http://linkinghub.elsevier.com/retrieve/pii/S0048969715305787

David, K., Liu, T., David, V. (2014) Use of several different methods for characterising a fractured rock aquifer, case study Kempfield, New South Wales, Australia, Chapter 19 in Fractured Rock Hydrogeology, International Asociation of Hydrogeologists Selected Papers, 20, Sharp J. (ed), In press

David, K (2013) Understanding saturation and hydraulic properties of historical mine workings**,** International Groundwater Congress, IAH, Perth, WA, September 2013

David, K (2012) Use of different methods for characterising the fractured rock aquifer, case study: Kempfield, NSW, International Groundwater Conference , GwFr2012, Prague.

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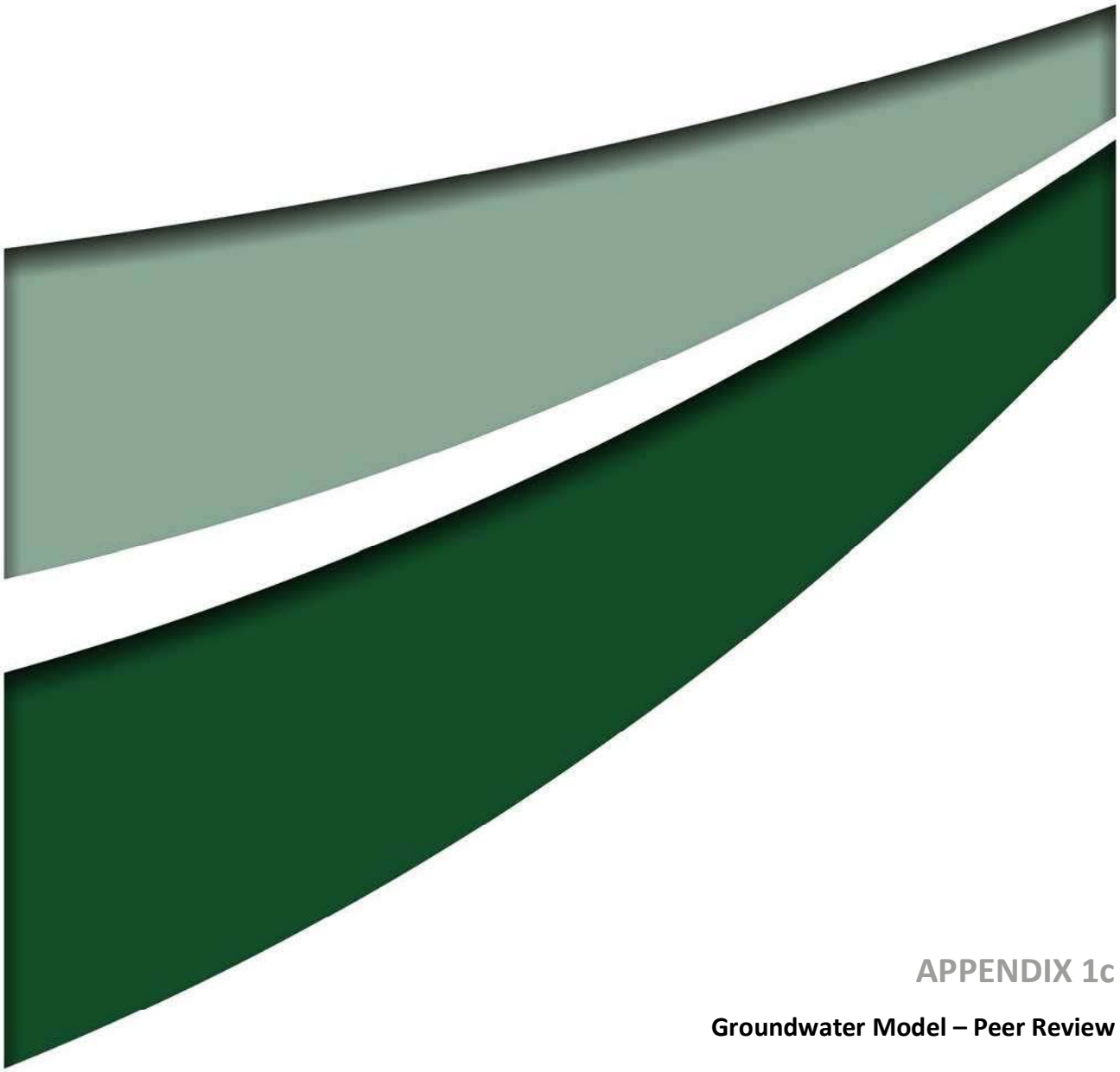

APPENDIX 1c

Groundwater Model – Peer Review

9 February 2016

620.11456-L01-v1.1 Groundwater Peer Review Letter 20160209.docx

Eagleton Rock Syndicate Pty Ltd
PO Box 898
Newcastle 2300

Attention: Murray Towndrow

Dear Murray

Groundwater Assessment Peer Review

SLR Consulting Australia Pty Ltd (SLR) have been commissioned by Eagleton Rock Syndicate Pty Ltd (Eagleton) to conduct an independent peer review of the Eagleton Quarry Hydrogeological Investigation Report prepared by URS (11 February 2014, URS) (report). The independent peer review is required to meet the Secretary's Environmental Assessment Requirements (SEARs) of the NSW Department of Primary Industries (DPI). DPI Water have requested that the SEARs, dated (30/10/2015), include "Full technical details and data of all surface and groundwater modelling, and an independent peer review."

The primary objective of the peer review is to evaluate the assessment's fit for purpose to meet the SEARs. A summary of the key SEARs, as they pertain to a groundwater assessment, is provided in **Table 1**, along with comments based upon the peer review regarding the adequacy of the assessment to meet the requirements.

Table 1 Summary of SEARs for groundwater impact assessment

SEAR	Peer Review Comments
Annual volumes of groundwater proposed to be taken by the activity from each groundwater source.	The report provides an estimate of between 43 and 48 m^3/day of water would be pumped from the quarry. This should be converted to an annual volume to be consistent with the request and consistent with standard licensing requirements. There is some question as to whether this is the full amount of take from groundwater, as evaporative losses are not discussed. The estimated take should account for annual evaporative losses during and after operations in addition to water pumping.
Assessment of any volumetric water licensing requirements (including those for ongoing water take following completion of the project).	The report recognises the need for licensing under the Water Management Act 2000 but does not provide a description on the availability of licensing, nor does it provide any method on how these licenses will be obtained. The report is also silent on the issue of ongoing water take following the completion of the project e.g. final void.

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A detailed assessment against the NSW Aquifer Interference Policy (2012) using DPI Water's assessment framework.	The report indicates that it has considered the NSW Aquifer Interference Policy (pg7) however at no stage later in the document is there a reference to how it was considered or assessed according to the assessment framework. Alternatively, it does not make mention why the Interference Policy and associated assessment framework are not applicable. It is important to explicitly make references to the assessment framework if used, or to make a comprehensive statement\justification why it is not applicable.
Assessment of impacts on surface and ground water sources (both water quality and quantity), related infrastructure, adjacent licensed water users, basic landholder rights, watercourses, riparian land, and groundwater dependent ecosystems, and measures proposed to reduce and mitigate these impacts.	The sole focus of the impact assessment section is on the potential impact to watercourses. These assessments are founded upon the validity of the model. The assessment indicates that a surface water management plan could potentially mitigate the estimated impacts to the creeks. The report states that a bore search indicated 14 registered bores within a 1.5km radius of the site. However, there is no discussion on the potential for impact (e.g. drawdown) within this search radius. There is no drawdown map provided for assessment. Although details were only available for 1 of the 14 registered bores, there is no discussion as to likelihood of the others existing and\or any need for further work to assess their location, use, etc. The report makes a brief mention of a swamp in the vicinity of the project but no assessment as to the potential for impact. The impact assessment does not make specific reference to risk of impacts to GDEs.
Full technical details and data of all surface and groundwater modelling, and an independent peer review.	Please refer to Modelling Review section following Table 1.
Proposed surface and groundwater monitoring activities and methodologies.	No groundwater monitoring or methodologies are proposed. Surface water monitoring and studies are recommended within the report.
Details of the final landform of the site, including final void management (where relevant) and rehabilitation measures.	The report makes no mention of final void management or rehabilitation measures.
Assessment of any potential cumulative impacts on water resources, and any proposed options to manage the cumulative impacts.	The report should make specific reference to the risk of cumulative impacts, even if it is to justify why the risk is minimal and not considered any further.

Modelling Review

The overall level of reporting is insufficient for a proper assessment of the adequacy of the numerical model. The reporting deficiencies fall within three broad categories:

- Conceptual Model
- Risk of Project
- Numerical model

Conceptual Model

The conceptual model is the most fundamental aspect of a groundwater impact assessment. It is the foundation upon which all other aspects rely, such as the risk of impact of the project, numerical model setup, calibration and justification, as well as the proposed mitigation and monitoring. Specific areas of concern are:

- No presentation of a published geology map;
- There is limited to no discussion of how each geologic unit acts as a water bearing unit nor is there discussion about the interconnectivity of geologic units. This is of particular importance since the model is set-up in a manner where each unit is setup in a vertical column as opposed to horizontal planes. Therefore, horizontal flow must cross geologic units.
- The cross-section (Figure 4) provides a number of conceptual questions that should be explained:
    - The highest topographic area is unconsolidated material, while the low-lying areas are hard rock, even to the same depths (mAHD) below ground surface. There is no explanation as to the evolution of how this has come to be in a geological/geomorphological sense.
    - How does the variation in expected hydraulic conductivities between consolidated and unconsolidated sediments at this site affect the flow of groundwater?
    - The water levels are a reflection of topography, as discussed in the report, however there is no explanation why they remain below ground surface as depicted in the cross-section. Are there surface expressions of water, i.e. springs, seeps, swamps, etc.? Alternatively, is there evaporation\evapotranspiration that is shaping the water levels according to topography?
- There is no discussion on evaporation or evapotranspiration (ET). ET is typically one of, if not the largest discharge component for groundwater in water table aquifers.
- The National Water Commission's *Groundwater Modelling Guidelines* (2013) and the *Framework for Assessing Local and Cumulative Effects on Groundwater Resources* (2011) should be consulted as guidelines on what is required for a conceptual model.

Risk of Project

As outlined in the National Water Commission's *Groundwater Modelling Guidelines* (2013) and the *Framework for Assessing Local and Cumulative Effects on Groundwater Resources* (2011), a risk assessment based upon the conceptual understanding of the system and project should be conducted. This risk assessment results in the justification of the level of effort required for the impact assessment, including but not limited to numerical modelling. In most cases it focusses the assessment on the highest areas of risk, and at the same time brings the intended audience for report (e.g. stakeholders) in line with the technical specialist conducting the assessment. From a numerical modelling standpoint, the risk assessment should define the levels of effort required for the model to be considered fit for purpose.

Numerical Model

It is not possible to provide a full evaluation of the numerical model and its adequacy to meet the SEARs for the reasons listed above, as well as the limited reporting of the numerical model, specifically:

- Evapotranspiration is not mentioned. It is unknown if it is used or not in the model. This should be fully documented and justified;
- There is no discussion on the target objectives for calibration;
- Justification should be made for using a steady state calibrated model to predict transient impacts during mining;
- There is no presentation of:
    - Calibrated mass balance of the model;
    - Predictive mass balance of the model;
    - Calibration criteria and matching;
    - Prediction of final voids; and
    - Drawdown maps and\or radius of impact.
- The sensitivity assessment seems to only assess predictive sensitivity to the Drain conductance. However there is no discussion on how sensitive calibration is to drain conductance. It is noted that the author indicates that the model calibration is essentially unconstrained as it relates to hydraulic conductivity and recharge, but doesn't offer a sufficient explanation or method used to justify why the model should be accepted as is. The sensitivities of conductivities and recharge are not then later explained or explored in predictive sensitivity.
- The report provides maps of calibrated recharge and hydraulic conductivities zones. Hydrogeologic justification needs to be provided for the varying zones other than it helped fit calibration.

Summary

In summary, it is my professional opinion that the report, in its current format, does not meet the conditions in the SEARs, nor does the assessment meet current industry practice for numerical modelling and the assessment of impacts to groundwater. At this stage I recommend that Eagleton commission URS or another consultant to complete the work following the guidance of:

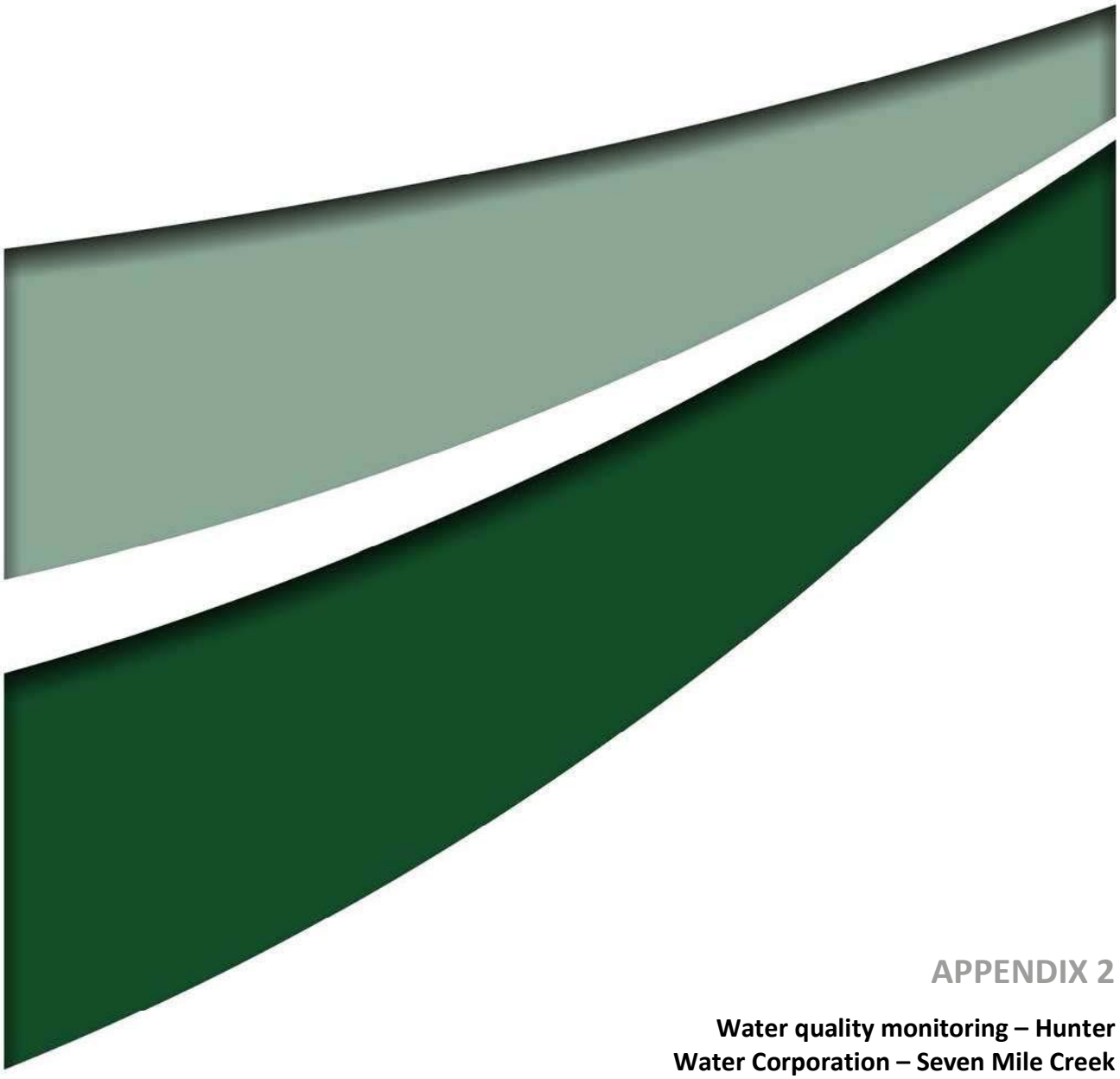
- National Water Commission's *Groundwater Modelling Guidelines* (2013)
- National Water Commission's *Framework for Assessing Local and Cumulative Effects on Groundwater Resources* (2011)
- DPI Water's assessment framework
- Secretary's Environmental Assessment Requirements (SEARs) of the NSW Department of Primary Industries (DPI)
- Other references as noted in the report.

Thank you for this opportunity to work with Eagleton and I look forward to working with you in the future. Should you have questions or require additional clarifications on the matters raised herein, please do not hesitate to contact me.

Yours sincerely

BRIAN RASK
Principal Hydrogeologist

Checked/
Authorised by: DL



APPENDIX 2

Water quality monitoring – Hunter Water Corporation – Seven Mile Creek and Nine Mile Creek

APPENDIX A – WATER QUALITY MONITORING DATA FOR SEVEN MILE AND NINE MILE CREEKS

Note:
Hunter Water's water quality data is presented in two ways. The first is the 'raw data' which are the actual recorded values, including those lower than the laboratory's 'limit of reporting' for that analyte. The second is the 'formatted data', which reports values less than the limit of reporting as <LOR. For completeness, both sets of data have been included in this document. Limits of reporting have changed for some nitrogen and phosphorus parameters between 2007 and 2013 but this has not affected the accuracy of the raw or the formatted data.

Abbreviations:

<	denotes limit of reporting (LOR)
est.	Estimate
Flow	Qualitative description of streamflow at time of sampling (2006-07)
EC	Electroconductivity (COND-W in Labdata)
E. coli MPN	Most Probable Number (ECCOLILERT in Labdata)
E. coli CFU	Colony Forming Units (E-COLI-W in Labdata)
FC	Presumptive Thermotolerant Coliforms (FC-PRE-W in Labdata)
NFR	Non Filterable Residue (Total Suspended Solids)
NH3	Ammonia
NO2	Nitrite
NO3	Nitrate
SRP	Soluble Reactive Phosphorus
TC	Thermotolerant (Faecal) Coliforms
TKN	Total Kjeldahl Nitrogen
TN	Total Nitrogen
TON	Total Oxidised Nitrogen
TP	Total Phosphorus
SECCHI-D	Secchi Disk depth of disappearance (transparency measurement)

Seven Mile Creek

Sub Site Desc	Sample Id	Date/Time Sampled	Date Sampled	E. coli (MPN/100mL) Raw	E. coli (MPN/100mL) Formatted	EC (uS/cm) Raw	EC (uS/cm) Formatted	ENTROCOCCI (col/100mL) Raw	ENTROCOCCI (col/100mL) Formatted	FC (CFU/100mL) Raw	FC (CFU/100mL) Formatted	FLOW (-) Raw	FLOW (-) Formatted	NFR (mg/L) Raw	NFR (mg/L) Formatted	NH3 (mg/L N) Raw	NH3 (mg/L N) Formatted
Seven Mile Ck @ Pacific Hwy	H0115191	6/08/2001 8:05	6-Aug-01			618	618							8	8	0.03	0.03
Seven Mile Ck @ Pacific Hwy	H0119316	18/10/2001 7:45	18-Oct-01			648	648							42	42	0.18	0.18
Seven Mile Ck @ Pacific Hwy	H0122659	22/11/2001 12:10	22-Nov-01			399	399							42	42	0.02	0.02
Seven Mile Ck @ Pacific Hwy	H0123401	13/12/2001 8:25	13-Dec-01			662	662							12	12	0.11	0.11
Seven Mile Ck @ Pacific Hwy	H0202486	5/02/2002 8:40	5-Feb-02			213	213							1315	1320	0.04	0.04
Seven Mile Ck @ Pacific Hwy	H0202404	21/02/2002 7:35	21-Feb-02			455	455							15	15	0.03	0.03
Seven Mile Ck @ Pacific Hwy	H0206289	11/04/2002 9:30	11-Apr-02			411	411							15	15	0.12	0.12
Seven Mile Ck @ Pacific Hwy	H0210240	4/06/2002 8:00	4-Jun-02			280	280							16	16	0.04	0.04
Seven Mile Creek	H0626634	12/12/2006 10:00	12-Dec-06			620	620					0	0	9	9	0.15	0.15
Seven Mile Creek	H0627420	26/12/2006 9:30	26-Dec-06			405	405					0	0	271	271	0.085	0.085
Seven Mile Creek	H0628428	9/01/2007 9:45	9-Jan-07			559	559					Nil	Nil	46	46	0.054	0.054
Seven Mile Creek	H0700884	23/01/2007 8:30	23-Jan-07			585	585					Light	Light	71	71	0.13	0.13
Seven Mile Creek	H0701987	6/02/2007 9:30	6-Feb-07			469	469					nil	nil	28	28	0.13	0.13
Seven Mile Creek	H0703026	20/02/2007 9:40	20-Feb-07			327	327					Nil	Nil	31	31	0.027	0.027
Seven Mile Creek	H0704096	6/03/2007 8:20	6-Mar-07			437	437					Light	Light	347	347	0.089	0.089
Seven Mile Creek	H0705142	20/03/2007 9:30	20-Mar-07			466	466					None	None	38	38	0.33	0.33
Seven Mile Creek	H0706216	3/04/2007 9:25	3-Apr-07			689	689					Nil	Nil	9	9	0.28	0.28
Seven Mile Creek	H0707382	17/04/2007 9:45	17-Apr-07			670	670					Nil	Nil	12	12	0.052	0.052
Seven Mile Creek	H0708564	1/05/2007 1:40	1-May-07			658	658					Nil	Nil	16	16	0.048	0.048
Seven Mile Creek	H0709758	15/05/2007 10:20	15-May-07			615	615					Light	Light	5	5	0.033	0.033
Seven Mile Creek	H0710924	29/05/2007 8:05	29-May-07			231	231					Nil	Nil	6	6	0.032	0.032
Seven Mile Creek	H0712077	12/06/2007 8:10	12-Jun-07			266	266					Medium	Medium	1	1	0.017	0.017
Seven Mile Creek	H0712917	26/06/2007 8:30	26-Jun-07			244	244					Medium	Medium	4	4	0.057	0.057
7-Mile Creek (Downstream)	H1302501	25/01/2013 0:00	25-Jan-13											114	114	0.14	0.14
7-Mile Creek (Downstream)	H1302883	30/01/2013 11:30	30-Jan-13							est. 450	est. 450			20	20	0.51	0.51
7-Mile Creek (Upstream)	H1302502	25/01/2013 0:00	25-Jan-13											44	44	0.13	0.13
Seven Mile Ck @ Pacific Hwy	H1517951	17/08/2015 11:20	17-Aug-15	<10	<10			est. 17	est. 17							0.19	0.19
Seven Mile Ck @ Pacific Hwy	H1518026	24/08/2015 8:55	24-Aug-15	2014	2014			600	600							0.002	<0.05
Seven Mile Ck @ Pacific Hwy	H1518366	31/08/2015 11:20	31-Aug-15	63	63			est. 130	est. 130							0.038	<0.05
Seven Mile Ck @ Pacific Hwy	H1519208	7/09/2015 9:55	7-Sep-15	1054	1054			530	530							0.02	<0.05
Seven Mile Ck @ Pacific Hwy	H1519806	14/09/2015 13:30	14-Sep-15	20	20			est. 150	est. 150							0.05	0.05
Seven Mile Ck @ Pacific Hwy	H1520429	21/09/2015 12:15	21-Sep-15	512	512			570	570							0.019	<0.05
Seven Mile Ck @ Pacific Hwy	H1520721	28/09/2015 7:30	28-Sep-15	20	20			est. 120	est. 120							0.023	<0.05
Seven Mile Ck @ Pacific Hwy	H1521362	8/10/2015 13:05	8-Oct-15	135	135			est 83	est 83							0.052	0.05
Seven Mile Ck @ Pacific Hwy	H1522170	12/10/2015 7:40	12-Oct-15	41	41			130	130							0.1	0.1
Seven Mile Ck @ Pacific Hwy	H1523010	19/10/2015 11:00	19-Oct-15	41	41			100	100							0.1	0.1
Seven Mile Ck @ Pacific Hwy	H1523323	26/10/2015 12:00	26-Oct-15	181	181			230	230							0.15	0.15
Seven Mile Ck @ Pacific Hwy	H1524047	3/11/2015 13:50	3-Nov-15	74	74			180	180							0.01	<0.05
Seven Mile Ck @ Pacific Hwy	H1524883	9/11/2015 13:10	9-Nov-15	862	862			810	810							0.06	0.06
Seven Mile Ck @ Pacific Hwy	H1525468	16/11/2015 11:40	16-Nov-15	839	839			420	420							0.02	<0.05
Seven Mile Ck @ Pacific Hwy	H1525862	23/11/2015 11:10	23-Nov-15	161	161			110	110							0.11	0.11
Seven Mile Ck @ Pacific Hwy	H1526322	30/11/2015 11:30	30-Nov-15	20	20			210	210							0.15	0.15
Seven Mile Ck @ Pacific Hwy	H1527094	7/12/2015 13:15	7-Dec-15	161	161			350	350							0.06	0.06
Seven Mile Ck @ Pacific Hwy	H1527774	14/12/2015 13:10	14-Dec-15	86	86			100	100							0.096	0.1
Seven Mile Ck @ Pacific Hwy	H1528327	21/12/2015 11:50	21-Dec-15	20	20			est. 73	est. 73							0.011	<0.05
Seven Mile Ck @ Pacific Hwy	H1529104	30/12/2015 12:55	30-Dec-15	121	121			140	140							0.03	<0.05
Seven Mile Ck @ Pacific Hwy	H1529688	4/01/2016 8:00	4-Jan-16	1081	1081			1700	1700							0.001	<0.05
Seven Mile Ck @ Pacific Hwy	H1600148	6/01/2016 15:40	6-Jan-16	16328	16328									97	97	0.12	0.12
Seven Mile Ck @ Pacific Hwy	H1600152	7/01/2016 7:40	7-Jan-16	9768	9768									78	78	0.14	0.14
Seven Mile Ck @ Pacific Hwy	H1600153	7/01/2016 14:00	7-Jan-16	2934	2934									51	51	0.12	0.12
Seven Mile Ck @ Pacific Hwy	H1600158	8/01/2016 7:40	8-Jan-16	558	558									24	24	0.12	0.12
Seven Mile Ck @ Pacific Hwy	H1600159	8/01/2016 14:30	8-Jan-16	626	626									43	43	0.1	0.1
Seven Mile Ck @ Pacific Hwy	H1601220	9/01/2016 8:00	9-Jan-16	544	544									67	67	0.06	0.06
Seven Mile Ck @ Pacific Hwy	H1601231	10/01/2016 8:00	10-Jan-16	366	366									27	27	0.013	<0.05
Seven Mile Ck @ Pacific Hwy	H1530302	11/01/2016 7:25	11-Jan-16	272	272									9	9	0.003	<0.05
Seven Mile Ck @ Pacific Hwy	H1601353	12/01/2016 12:45	12-Jan-16	82	82									6	6	0.006	<0.05
Seven Mile Ck @ Pacific Hwy	H1601461	14/01/2016 11:00	14-Jan-16	40	40									10	10	0.003	<0.05
Seven Mile Ck @ Pacific Hwy	H1530932	18/01/2016 11:25	18-Jan-16	98	98			220	220					27	27	0.007	<0.05
Seven Mile Ck @ Pacific Hwy	H1531481	25/01/2016 11:50	25-Jan-16	93	93			160	160							0.11	0.11
Seven Mile Ck @ Pacific Hwy	H1532097	1/02/2016 8:00	1-Feb-16	15	15			110	110							0.046	<0.05
Seven Mile Ck @ Pacific Hwy	H1532918	8/02/2016 7:25	8-Feb-16	122	122			est. 20	est. 20							0.072	0.07

Seven Mile Creek (continued)

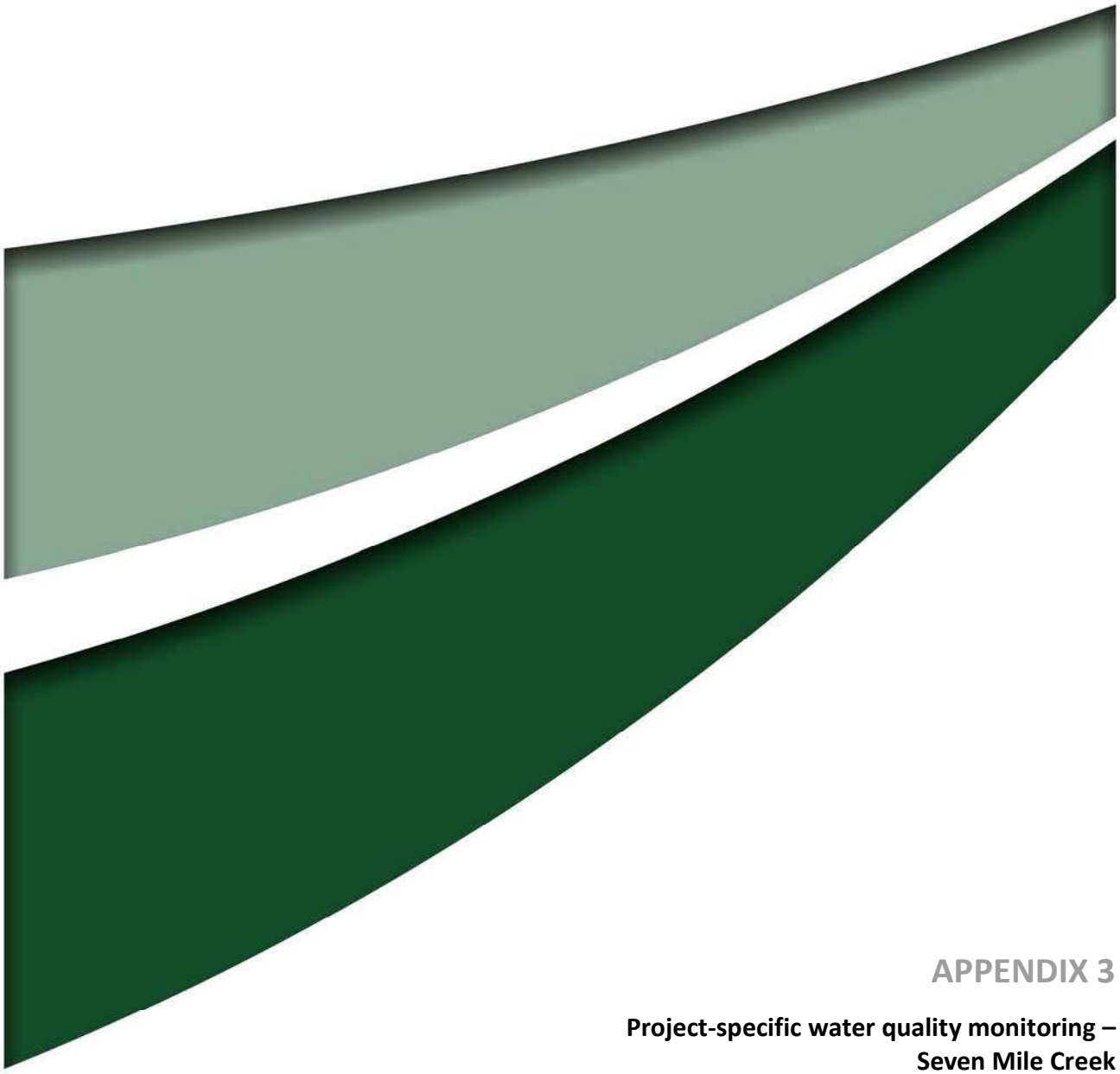
Date Sampled	NO2 (mg/L N) Raw	NO2(mg/L N) Formatted	NO3(mg/L N) Raw	NO3 (mg/L N) Formatted	pH (-) Raw	pH (-) Formatted	SECCHI-D (metres) Raw	SECCHI-D (metres) Formatted	SRP (mg/L P) Raw	SRP (mg/L P) Formatted	TKN (mg/L N) Raw	TKN (mg/L N) Formatted	TN (mg/L N) Raw	TN (mg/L N) Formatted	TON (mg/L N) Raw	TON (mg/L N) Formatted	TP-HIGH (mg/L P) Raw	TP-HIGH (mg/L P) Formatted	TURBIDITY (NTU) Raw	TURBIDITY (NTU) Formatted
6-Aug-01					7.3	7.3	0.15	0.15	<0.01	<0.01	0.38	0.38			0.08	0.08	0.04	0.04		
18-Oct-01					7.4	7.4	0.05	0.05	<0.01	<0.01	0.78	0.78			0.15	0.15	0.08	0.08		
22-Nov-01					7.4	7.4	0.05	0.05	0.01	0.01	0.83	0.83			0.9	0.9	0.11	0.11		
13-Dec-01					7.5	7.5	0.15	0.15	0.04	0.04	0.69	0.69			0.06	0.06	0.06	0.06		
5-Feb-02					6.4	6.4	0.05	0.05	0.03	0.03	1.21	1.21			0.14	0.14	0.13	0.13		
21-Feb-02					7.1	7.1	0.1	0.1	0.05	0.05	0.85	0.85			0.13	0.13	0.08	0.08		
11-Apr-02					7.2	7.2	0.15	0.15	0.08	0.08	0.56	0.56			0.19	0.19	0.08	0.08		
4-Jun-02					7.1	7.1	0.15	0.15	0.08	0.08	0.45	0.45			0.89	0.89	0.15	0.15		
12-Dec-06					7.3	7.3			0.036	0.036	0.92	0.92	0.95	0.95	0.028	0.028	0.07	0.07		
26-Dec-06					7.3	7.3			0.014	0.014	0.22	0.22	0.26	0.26	0.044	0.044	0.16	0.16		
9-Jan-07					7	7			0.011	0.011	1.29	1.29	1.3	1.3	0.02	0.02	0.054	0.054		
23-Jan-07					7.5	7.5			0.026	0.026	0.95	0.95	0.99	0.99	0.04	0.04	0.16	0.16		
6-Feb-07					7.4	7.4			0.012	0.012	0.53	0.53	0.56	0.56	0.031	0.031	0.038	0.038		
20-Feb-07					7.3	7.3			0.012	0.012	0.73	0.73	0.76	0.76	0.031	0.031	0.054	0.054		
6-Mar-07					7.1	7.1			0.013	0.013	1.4	1.4	1.5	1.5	0.12	0.12	0.084	0.084		
20-Mar-07					7.3	7.3			0.037	0.037	0.9	0.9	0.97	0.97	0.074	0.074	0.088	0.088		
3-Apr-07					7.6	7.6			0.013	0.013	0.5	0.5	0.61	0.61	0.11	0.11	0.037	0.037		
17-Apr-07					7.6	7.6			0.019	0.019	0.12	<0.20	0.22	0.22	0.22	0.22	0.032	0.032		
1-May-07					7	7			0.017	0.017	0.5	0.5	0.88	0.88	0.38	0.38	0.036	0.036		
15-May-07					7.7	7.7			0.039	0.039	0.62	0.62	2.02	2.02	1.4	1.4	0.053	0.053		
29-May-07					6.1	6.1			0.024	0.024	0.95	0.95	1.09	1.09	0.14	0.14	0.043	0.043		
12-Jun-07					7.3	7.3			0.003	0.003	0.9	0.9	0.92	0.92	0.012	0.012	0.013	0.013		
26-Jun-07					7	7			0.005	0.005	0.73	0.73	0.79	0.79	0.033	0.033	0.022	0.022		
25-Jan-13											3.4	3.4	3.5	3.5	0.12	0.12	0.18	0.18	1400	1400
30-Jan-13											1.4	1.4	2.9	2.9	1.5	1.5	0.08	0.08	65	65
25-Jan-13											3.9	3.9	4	4	0.09	0.09	0.14	0.14	1000	1000
17-Aug-15											0.6	0.6	0.79	0.79	0.19	0.19	0.082	0.08	280	280
24-Aug-15											1.8	1.8	2.14	2.1	0.34	0.34	0.12	0.12	3100	3100
31-Aug-15											0.7	0.7	0.98	0.98	0.28	0.28	0.052	0.05	250	250
7-Sep-15											0.92	0.9	1.2	1.2	0.28	0.28	0	<0.05	650	650
14-Sep-15									0.042	<0.05	1.1	1.1	1.28	1.3	0.18	0.18	0.096	0.1	250	250
21-Sep-15									0.033	<0.05	0.93	0.9	1.2	1.2	0.27	0.27	0.061	0.06	450	450
28-Sep-15									0.065	0.07	1	1	1.1	1.1	0.1	0.1	0.065	0.07	90	90
8-Oct-15									0.015	<0.05	0.84	0.8	0.99	0.99	0.15	0.15	0.057	0.06	70	70
12-Oct-15									0.095	0.1	0.78	0.8	0.99	0.99	0.21	0.21	0.13	0.13	58	58
19-Oct-15									0.03	<0.05	1.1	1.1	1.15	1.2	0.05	0.05	0.04	<0.05	46	46
26-Oct-15									0	<0.05	0.9	0.9	1.2	1.2	0.3	0.3	0.02	<0.05	750	750
3-Nov-15									0	<0.05	0.15	<0.5	0.16	<0.5	0.16	0.16	0.05	0.05	60	60
9-Nov-15									0.05	0.05	0.96	1	1.19	1.2	0.23	0.23	0.09	0.09	1300	1300
16-Nov-15									0.03	<0.05	1.1	1.1	1.16	1.2	0.06	0.06	0.04	<0.05	75	75
23-Nov-15									0.03	<0.05	<0.5	<0.5	0.13	<0.5	0.13	0.13	0.04	<0.05	65	65
30-Nov-15									0.045	<0.05	1.5	1.5	1.6	1.6	0.1	0.1	0.3	0.3	38	38
7-Dec-15									0.037	<0.05	0.67	0.7	0.84	0.84	0.17	0.17	0.046	<0.05	180	180
14-Dec-15									0.015	<0.05	0.69	0.7	0.94	0.94	0.25	0.25	0.083	0.08	151	151
21-Dec-15									0.023	<0.05	1.1	1.1	1.1	1.1	0.038	<0.05	0.37	0.37	110	110
30-Dec-15									0.031	<0.05	0.68	0.7	0.74	0.74	0.06	0.06	0.032	<0.05	200	200
4-Jan-16									0.048	<0.05	0.54	0.5	0.54	0.54	0.048	<0.05	0.064	0.06	12	12
6-Jan-16	0.04	0.04	0.33	0.33									1.5	1.5	0.37	0.37	0.26	0.26	150	150
7-Jan-16	0.017	<0.03	0.35	0.35									1.5	1.5	0.35	0.35	0.26	0.26	130	130
7-Jan-16	0.018	<0.03	0.27	0.27									1.5	1.5	0.27	0.27	0.24	0.24	103	103
8-Jan-16	0.03	0.03	0.43	0.43									1.5	1.5	0.46	0.46	0.26	0.26	86	86
8-Jan-16	0.02	<0.03	0.5	0.5									1.3	1.3	0.5	0.5	0.24	0.24	100	100
9-Jan-16	0.02	<0.03	0.66	0.66									1.3	1.3	0.66	0.66	0.12	0.12	86	86
10-Jan-16	0.008	<0.03	0.84	0.84									1.2	1.2	0.84	0.84	0.046	<0.05	80	80
11-Jan-16	0.013	<0.03	0.87	0.87					0.041	<0.05	0.27	<0.5	0.87	0.87	0.87	0.87	0.063	0.06	79	79
12-Jan-16	0	<0.03	0.83	0.83									0.3	0.3	0.83	0.83	0.065	0.07	75	75
14-Jan-16	0.01	<0.03	0.89	0.89									1	1	0.89	0.89	0.06	0.06	63	63
18-Jan-16	0.006	<0.03	0.59	0.59					0.046	<0.05	0.52	0.5	1.11	1.1	0.59	0.59	0.14	0.14	68	68
25-Jan-16									0.051	0.05	0.77	0.8	0.821	0.82	0.051	0.05	0.051	0.05	130	130
1-Feb-16									0.04	<0.05	0.34	<0.5	0.12	<0.5	0.12	0.12	0.092	0.09	46	46
8-Feb-16									0.036	<0.05	0.74	0.7	0.95	0.95	0.21	0.21	0.24	0.24	490	490

Nine Mile Creek

Sub Site Desc	Sample Id	Date Sampled	Date/Time Sampled	E. coli (MPN/100mL) Raw	E. coli (MPN/100mL) Formatted	EC (uS/cm) Raw	EC (uS/cm) Formatted	ENTROCOCCI (col/100mL) Raw	ENTROCOCCI (col/100mL) Formatted	FLOW (-) Raw	FLOW (-) Formatted	NFR (mg/L) Raw	NFR (mg/L) Formatted	NH3 (mg/L N) Raw	NH3 (mg/L N) Formatted
Nine Mile Ck @ Pacific Hwy	H0115192	6-Aug-01	6/08/2001 8:05			209	209					9	9	0.06	0.06
Nine Mile Ck @ Pacific Hwy	H0119317	18-Oct-01	18/10/2001 8:15			224	224					10	10	0.09	0.09
Nine Mile Ck @ Pacific Hwy	H0122660	22-Nov-01	22/11/2001 11:35			184	184					6	6	0.04	0.04
Nine Mile Ck @ Pacific Hwy	H0123402	13-Dec-01	13/12/2001 7:55			209	209					21	21	0.14	0.14
Nine Mile Ck @ Pacific Hwy	H0202487	5-Feb-02	5/02/2002 8:10			136	136					31	31	<0.02	<0.02
Nine Mile Ck @ Pacific Hwy	H0202405	21-Feb-02	21/02/2002 7:55			183	183					15	15	0.03	0.03
Nine Mile Ck @ Pacific Hwy	H0206290	11-Apr-02	11/04/2002 9:10			137	137					7	7	0.04	0.04
Nine Mile Ck @ Pacific Hwy	H0210241	4-Jun-02	4/06/2002 8:15			127	127					18	18	0.03	0.03
Nine Mile Creek	H0626633	12-Dec-06	12/12/2006 9:45			218	218			0	0	7	7	0.11	0.11
Nine Mile Creek	H0627419	26-Dec-06	26/12/2006 9:15			224	224			0	0	11	11	0.08	0.08
Nine Mile Creek	H0628427	9-Jan-07	9/01/2007 9:15			225	225			Nil	Nil	7	7	0.087	0.087
Nine Mile Creek	H0700883	23-Jan-07	23/01/2007 8:15			232	232			Nil	Nil	2	2	0.074	0.074
Nine Mile Creek	H0701986	6-Feb-07	6/02/2007 8:50			264	264			nil	nil	10	10	0.15	0.15
Nine Mile Creek	H0703025	20-Feb-07	20/02/2007 9:10			264	264			Nil	Nil	11	11	0.059	0.059
Nine Mile Creek	H0704095	6-Mar-07	6/03/2007 8:05			227	227			Light	Light	16	16	0.063	0.063
Nine Mile Creek	H0705141	20-Mar-07	20/03/2007 9:20			197	197			None	None	6	6	0.35	0.35
Nine Mile Creek	H0706215	3-Apr-07	3/04/2007 9:15			226	226			Nil	Nil	14	14	0.13	0.13
Nine Mile Creek	H0707381	17-Apr-07	17/04/2007 9:30			203	203			Nil	Nil	13	13	0.069	0.069
Nine Mile Creek	H0708563	1-May-07	1/05/2007 12:50			222	222			Nil	Nil	15	15	0.054	0.054
Nine Mile Creek	H0709757	15-May-07	15/05/2007 9:40			219	219			Nil	Nil	<1	<1	0.046	0.046
Nine Mile Creek	H0710923	29-May-07	29/05/2007 7:55			657	657			Nil	Nil	7	7	0.04	0.04
Nine Mile Creek	H0712076	12-Jun-07	12/06/2007 7:25			198	198			Medium	Medium	13	13	0.16	0.16
Nine Mile Creek	H0712916	26-Jun-07	26/06/2007 8:15			217	217			Medium	Medium	5	5	0.067	0.067
Nine Mile Ck @ Pacific Hwy	H1527978	3-Nov-15	3/11/2015 13:35	74	74			190	190					0.11	0.11
Nine Mile Ck @ Pacific Hwy	H1527979	9-Nov-15	9/11/2015 13:50	63	63			est 45	est 45					0.09	0.09
Nine Mile Ck @ Pacific Hwy	H1527980	16-Nov-15	16/11/2015 12:00	613	613			410	410					0.08	0.08
Nine Mile Ck @ Pacific Hwy	H1527981	23-Nov-15	23/11/2015 10:55	158	158			150	150					0.15	0.15
Nine Mile Ck @ Pacific Hwy	H1527982	30-Nov-15	30/11/2015 7:45	1112	1112			710	710					0.04	<0.05
Nine Mile Ck @ Pacific Hwy	H1527983	7-Dec-15	7/12/2015 13:00	20	20			est 73	est 73					0.05	0.05
Nine Mile Ck @ Pacific Hwy	H1527984	14-Dec-15	14/12/2015 12:55	20	20			<2	<2					0.029	<0.05
Nine Mile Ck @ Pacific Hwy	H1528328	21-Dec-15	21/12/2015 11:00	52	52			est. 54	est. 54					0.031	<0.05
Nine Mile Ck @ Pacific Hwy	H1529105	30-Dec-15	30/12/2015 12:40	10	10			160	160					0.03	<0.05
Nine Mile Ck @ Pacific Hwy	H1529689	4-Jan-16	4/01/2016 8:20	52	52			120	120					0.041	<0.05
Nine Mile Ck @ Pacific Hwy	H1600147	6-Jan-16	6/01/2016 15:20	244	244							50	50	0.008	<0.05
Nine Mile Ck @ Pacific Hwy	H1600154	7-Jan-16	7/01/2016 7:50	194	194							29	29	0.024	<0.05
Nine Mile Ck @ Pacific Hwy	H1600155	7-Jan-16	7/01/2016 14:00	244	244							20	20	0.026	<0.05
Nine Mile Ck @ Pacific Hwy	H1600156	8-Jan-16	8/01/2016 8:10	40	40							23	23	0.02	<0.05
Nine Mile Ck @ Pacific Hwy	H1600157	8-Jan-16	8/01/2016 14:15	148	148							21	21	0.05	0.05
Nine Mile Ck @ Pacific Hwy	H1601221	9-Jan-16	9/01/2016 8:15	40	40							19	19	0.02	<0.05
Nine Mile Ck @ Pacific Hwy	H1601232	10-Jan-16	10/01/2016 8:00	150	150							14	14	0.027	<0.05
Nine Mile Ck @ Pacific Hwy	H1530303	11-Jan-16	11/01/2016 7:40	62	62							10	10	0.58	0.58
Nine Mile Ck @ Pacific Hwy	H1601352	12-Jan-16	12/01/2016 12:30	148	148							5	5	0.026	<0.05
Nine Mile Ck @ Pacific Hwy	H1601460	14-Jan-16	14/01/2016 10:50	40	40							<1	<1	0.013	<0.05
Nine Mile Ck @ Pacific Hwy	H1530933	18-Jan-16	18/01/2016 11:10	110	110			330	330			21	21	0.021	<0.05
Nine Mile Ck @ Pacific Hwy	H1531482	25-Jan-16	25/01/2016 13:50	61	61			240	240					0.065	0.07
Nine Mile Ck @ Pacific Hwy	H1532098	1-Feb-16	1/02/2016 8:30	17	17			100	100					0.055	0.06
Nine Mile Ck @ Pacific Hwy	H1532919	8-Feb-16	8/02/2016 7:35	10	10			160	160					0.078	0.08

Nine Mile Creek continued

Date Sampled	NO2 (mg/L N) Raw	NO2 (mg/L N) Formatted	NO3 (mg/L N) Raw	NO3 (mg/L N) Formatted	pH (-) Raw	pH (-) Formatted	SECCHI-D (metres) Raw	SECCHI-D (metres) Formatted	SRP (mg/L P) Raw	SRP (mg/L P) Formatted	TKN (mg/L N) Raw	TKN (mg/L N) Formatted	TN (mg/L N) Raw	TN (mg/L N) Formatted	TON (mg/L N) Raw	TON (mg/L N) Formatted	TP (mg/L P) Raw	TP (mg/L P) Formatted	TURBIDITY (NTU) Raw	TURBIDITY (NTU) Formatted
6-Aug-01					6.2	6.2	0.2	0.2	<0.01	<0.01	0.49	0.49			0.04	0.04	0.04	0.04		
18-Oct-01					6.7	6.7	0.1	0.1	0.02	0.02	0.58	0.58			0.03	0.03	0.05	0.05		
22-Nov-01					6.1	6.1	0.05	0.05	0.01	0.01	0.81	0.81			0.04	0.04	0.04	0.04		
13-Dec-01					6.7	6.7	0.15	0.15	0.03	0.03	0.78	0.78			0.04	0.04	0.05	0.05		
5-Feb-02					6.2	6.2	0.1	0.1	<0.01	<0.01	0.47	0.47			0.02	0.02	0.05	0.05		
21-Feb-02					6.3	6.3	0.1	0.1	0.04	0.04	0.94	0.94			0.04	0.04	0.06	0.06		
11-Apr-02					6	6	0.2	0.2	0.03	0.03	0.84	0.84			0.03	0.03	0.03	0.03		
4-Jun-02					6	6	0.2	0.2	0.05	0.05	0.56	0.56			0.04	0.04	0.05	0.05		
12-Dec-06					6.6	6.6			0.034	0.034	0.9	0.9	0.93	0.93	0.028	0.028	0.044	0.044		
26-Dec-06					6.6	6.6			0.006	0.006	0.64	0.64	0.66	0.66	0.021	0.021	0.051	0.051		
9-Jan-07					6.7	6.7			0.009	0.009	0.95	0.95	0.98	0.98	0.029	0.029	0.032	0.032		
23-Jan-07					6.9	6.9			0.006	0.006	0.56	0.56	0.59	0.59	0.032	0.032	0.065	0.065		
6-Feb-07					7	7			0.012	0.012	0.81	0.81	0.84	0.84	0.031	0.031	0.059	0.059		
20-Feb-07					7	7			0.014	0.014	0.78	0.78	0.81	0.81	0.032	0.032	0.046	0.046		
6-Mar-07					7	7			0.014	0.014	1.46	1.46	1.5	1.5	0.05	0.05	0.034	0.034		
20-Mar-07					6.8	6.8			0.018	0.018	0.81	0.81	0.86	0.86	0.053	0.053	0.046	0.046		
3-Apr-07					6.1	6.1			0.019	0.019	0.5	0.5	0.54	0.54	0.038	0.038	0.047	0.047		
17-Apr-07					6.2	6.2			0.034	0.034	0.18	<0.20	<0.20	<0.20	0.036	0.036	0.039	0.039		
1-May-07					6.4	6.4			0.052	0.052	1.29	1.29	1.33	1.33	0.042	0.042	0.11	0.11		
15-May-07					6	6			0.022	0.022	0.73	0.73	0.75	0.75	0.023	0.023	0.042	0.042		
29-May-07					7.6	7.6			0.005	0.005	0.78	0.78	0.8	0.8	0.024	0.024	0.045	0.045		
12-Jun-07					5.7	5.7			0.04	0.04	0.81	0.81	0.97	0.97	0.042	0.042	0.03	0.03		
26-Jun-07					6	6			0.017	0.017	1.3	1.3	1.4	1.4	0.073	0.073	0.05	0.05		
3-Nov-15									0	<0.05	0.8	0.8	0.9	0.9	0.1	0.1	0.05	0.05	18	18
9-Nov-15									0.04	<0.05	0.95	1	1.01	1	0.06	0.06	0.05	0.05	20	20
16-Nov-15									0.07	0.07	1.3	1.3	1.3	1.3	0.019	<0.05	0.11	0.11	270	270
23-Nov-15									0.01	<0.05	<0.5	<0.5	0.05	<0.5	0.05	0.05	0.04	<0.05	45	45
30-Nov-15									0.031	<0.05	0.59	0.6	0.68	0.68	0.09	0.09	0.04	<0.05	95	95
7-Dec-15									0.036	<0.05	1.3	1.3	1.35	1.4	0.05	0.05	0.057	0.06	29	29
14-Dec-15									0.017	<0.05	1.8	1.8	1.852	1.9	0.052	0.05	0.15	0.15	32	32
21-Dec-15									0.022	<0.05	1.2	1.2	1.2	1.2	0	<0.05	0.1	0.1	25	25
30-Dec-15									0.021	<0.05	0.7	0.7	0.7	0.7	0.02	<0.05	0.048	<0.05	40	40
4-Jan-16									0.008	<0.05	0.81	0.8	0.81	0.81	0.024	<0.05	0.053	0.05	35	35
6-Jan-16	0.025	<0.03	0	<0.05							0.77	0.77	0.77	0.77	0.023	<0.05	0.11	0.11	80	80
7-Jan-16	0.031	0.03	0.13	0.13							0.85	0.85	0.85	0.85	0.16	0.16	0.091	0.09	60	60
7-Jan-16	0.017	<0.03	0	<0.05							0.88	0.88	0.88	0.88	0.001	<0.05	0.098	0.1	60	60
8-Jan-16	0.01	<0.03	0.09	0.09							0.96	0.96	0.96	0.96	0.09	0.09	0.13	0.13	65	65
8-Jan-16	0.02	<0.03	0.09	0.09							0.92	0.92	0.92	0.92	0.09	0.09	0.12	0.12	67	67
9-Jan-16	0.03	0.03	-0.03	<0.05							0.89	0.89	0.89	0.89	0.04	<0.05	0.15	0.15	66	66
10-Jan-16	0.019	<0.03	0	<0.05							0.89	0.89	0.89	0.89	0.019	<0.05	0.047	<0.05	65	65
11-Jan-16	0.018	<0.03	0	<0.05					0.034	<0.05	0.9	0.9	0.9	0.9	0.021	<0.05	0.055	0.06	63	63
12-Jan-16	0.018	<0.03	0	<0.05							0.99	0.99	0.99	0.99	0.021	<0.05	0.063	0.06	58	58
14-Jan-16	0.006	<0.03	0.08	0.08							0.9	0.9	0.9	0.9	0.081	0.08	0.057	0.06	50	50
18-Jan-16	0.006	<0.03	0.07	0.07					0.036	<0.05	1.2	1.2	1.271	1.3	0.071	0.07	0.11	0.11	75	75
25-Jan-16									0.02	<0.05	1.1	1.1	1.1	1.1	0	<0.05	0.02	<0.05	75	75
1-Feb-16									0.013	<0.05	0.85	0.9	0.96	0.96	0.11	0.11	0.1	0.1	56	56
8-Feb-16									0.029	<0.05	0.99	1	1.1	1.1	0.11	0.11	0.12	0.12	42	42



APPENDIX 3

Project-specific water quality monitoring – Seven Mile Creek

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES1535376**	Page	: 1 of 10
Client	: **UMWELT (AUSTRALIA) PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR PETER JAMIESON	Contact	:
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Project	: 3545/3102	QC Level	: NEPM 2013 B3 & ALS QC Standard
Order number	: ----	Date Samples Received	: 04-Nov-2015 16:00
C-O-C number	: ----	Date Analysis Commenced	: 04-Nov-2015
Sampler	: PETER JAMIESON	Issue Date	: 18-Nov-2015 11:02
Site	: ----		
		No. of samples received	: 6
Quote number	: ----	No. of samples analysed	: 6

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics
Pabi Subba	Senior Organic Chemist	Sydney Organics
Phalak Inthakesone	Laboratory Manager - Organics	Sydney Organics

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.

- EA016: Calculated TDS is determined from Electrical conductivity using a conversion factor of 0.65.
- Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ) is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benz(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.cd)pyrene (0.1), Dibenz(a.h)anthracene (1.0), Benzo(g.h.i)perylene (0.01). Less than LOR results for 'TEQ Zero' are treated as zero.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	CW1	CW2	SITE 1	SITE 2	SITE 3
			Client sampling date / time	04-Nov-2015 13:15	04-Nov-2015 13:30	04-Nov-2015 13:45	04-Nov-2015 14:10	04-Nov-2015 14:30
Compound	CAS Number	LOR	Unit	ES1535376-001	ES1535376-002	ES1535376-003	ES1535376-004	ES1535376-005
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	----	----	8.03	7.90	7.39
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	----	----	605	563	417
EA015: Total Dissolved Solids								
Total Dissolved Solids @180°C	----	10	mg/L	----	----	336	320	----
EA016: Calculated TDS (from Electrical Conductivity)								
Total Dissolved Solids (Calc.)	----	1	mg/L	----	----	----	----	271
EA025: Suspended Solids								
Suspended Solids (SS)	----	5	mg/L	----	----	<5	<5	998
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	----	----	56	52	38
ED093F: Dissolved Major Cations								
Sodium	7440-23-5	1	mg/L	----	----	87	83	68
Potassium	7440-09-7	1	mg/L	----	----	2	2	2
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	0.11	0.04	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	----	----	<0.01	<0.01	<0.01
EP005: Total Organic Carbon (TOC)								
Total Organic Carbon	----	1	mg/L	----	----	12	9	10
EP025: Oxygen - Dissolved (DO)								
Dissolved Oxygen	----	0.1	mg/L	----	----	8.5	8.0	8.1
EP026SP: Chemical Oxygen Demand (Spectrophotometric)								
Chemical Oxygen Demand	----	10	mg/L	----	----	21	25	109
EP030: Biochemical Oxygen Demand (BOD)								
Biochemical Oxygen Demand	----	2	mg/L	----	----	<2	13	<2
EP035G: Total Phenol by Discrete Analyser								
Phenols (Total)	----	0.05	mg/L	----	----	<0.05	<0.05	<0.05
EP068A: Organochlorine Pesticides (OC)								
alpha-BHC	319-84-6	0.5	µg/L	----	----	<0.5	<0.5	<0.5
Hexachlorobenzene (HCB)	118-74-1	0.5	µg/L	----	----	<0.5	<0.5	<0.5
beta-BHC	319-85-7	0.5	µg/L	----	----	<0.5	<0.5	<0.5
gamma-BHC	58-89-9	0.5	µg/L	----	----	<0.5	<0.5	<0.5

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	CW1	CW2	SITE 1	SITE 2	SITE 3
				Client sampling date / time	04-Nov-2015 13:15	04-Nov-2015 13:30	04-Nov-2015 13:45	04-Nov-2015 14:10	04-Nov-2015 14:30
Compound	CAS Number	LOR	Unit		ES1535376-001	ES1535376-002	ES1535376-003	ES1535376-004	ES1535376-005
					Result	Result	Result	Result	Result
EP068A: Organochlorine Pesticides (OC) - Continued									
delta-BHC	319-86-8	0.5	µg/L		----	----	<0.5	<0.5	<0.5
Heptachlor	76-44-8	0.5	µg/L		----	----	<0.5	<0.5	<0.5
Aldrin	309-00-2	0.5	µg/L		----	----	<0.5	<0.5	<0.5
Heptachlor epoxide	1024-57-3	0.5	µg/L		----	----	<0.5	<0.5	<0.5
trans-Chlordane	5103-74-2	0.5	µg/L		----	----	<0.5	<0.5	<0.5
alpha-Endosulfan	959-98-8	0.5	µg/L		----	----	<0.5	<0.5	<0.5
cis-Chlordane	5103-71-9	0.5	µg/L		----	----	<0.5	<0.5	<0.5
Dieldrin	60-57-1	0.5	µg/L		----	----	<0.5	<0.5	<0.5
4.4`-DDE	72-55-9	0.5	µg/L		----	----	<0.5	<0.5	<0.5
Endrin	72-20-8	0.5	µg/L		----	----	<0.5	<0.5	<0.5
beta-Endosulfan	33213-65-9	0.5	µg/L		----	----	<0.5	<0.5	<0.5
4.4`-DDD	72-54-8	0.5	µg/L		----	----	<0.5	<0.5	<0.5
Endrin aldehyde	7421-93-4	0.5	µg/L		----	----	<0.5	<0.5	<0.5
Endosulfan sulfate	1031-07-8	0.5	µg/L		----	----	<0.5	<0.5	<0.5
4.4`-DDT	50-29-3	2	µg/L		----	----	<2.0	<2.0	<2.0
Endrin ketone	53494-70-5	0.5	µg/L		----	----	<0.5	<0.5	<0.5
Methoxychlor	72-43-5	2	µg/L		----	----	<2.0	<2.0	<2.0
^ Total Chlordane (sum)	----	0.5	µg/L		----	----	<0.5	<0.5	<0.5
^ Sum of DDD + DDE + DDT	----	0.5	µg/L		----	----	<0.5	<0.5	<0.5
^ Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.5	µg/L		----	----	<0.5	<0.5	<0.5
EP068B: Organophosphorus Pesticides (OP)									
Dichlorvos	62-73-7	0.5	µg/L		----	----	<0.5	<0.5	<0.5
Demeton-S-methyl	919-86-8	0.5	µg/L		----	----	<0.5	<0.5	<0.5
Monocrotophos	6923-22-4	2	µg/L		----	----	<2.0	<2.0	<2.0
Dimethoate	60-51-5	0.5	µg/L		----	----	<0.5	<0.5	<0.5
Diazinon	333-41-5	0.5	µg/L		----	----	<0.5	<0.5	<0.5
Chlorpyrifos-methyl	5598-13-0	0.5	µg/L		----	----	<0.5	<0.5	<0.5
Parathion-methyl	298-00-0	2	µg/L		----	----	<2.0	<2.0	<2.0
Malathion	121-75-5	0.5	µg/L		----	----	<0.5	<0.5	<0.5
Fenthion	55-38-9	0.5	µg/L		----	----	<0.5	<0.5	<0.5
Chlorpyrifos	2921-88-2	0.5	µg/L		----	----	<0.5	<0.5	<0.5
Parathion	56-38-2	2	µg/L		----	----	<2.0	<2.0	<2.0
Pirimphos-ethyl	23505-41-1	0.5	µg/L		----	----	<0.5	<0.5	<0.5
Chlorfenvinphos	470-90-6	0.5	µg/L		----	----	<0.5	<0.5	<0.5
Bromophos-ethyl	4824-78-6	0.5	µg/L		----	----	<0.5	<0.5	<0.5

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	CW1	CW2	SITE 1	SITE 2	SITE 3
				Client sampling date / time	04-Nov-2015 13:15	04-Nov-2015 13:30	04-Nov-2015 13:45	04-Nov-2015 14:10	04-Nov-2015 14:30
Compound	CAS Number	LOR	Unit		ES1535376-001	ES1535376-002	ES1535376-003	ES1535376-004	ES1535376-005
					Result	Result	Result	Result	Result
EP068B: Organophosphorus Pesticides (OP) - Continued									
Fenamiphos	22224-92-6	0.5	µg/L		----	----	<0.5	<0.5	<0.5
Prothiofos	34643-46-4	0.5	µg/L		----	----	<0.5	<0.5	<0.5
Ethion	563-12-2	0.5	µg/L		----	----	<0.5	<0.5	<0.5
Carbophenothion	786-19-6	0.5	µg/L		----	----	<0.5	<0.5	<0.5
Azinphos Methyl	86-50-0	0.5	µg/L		----	----	<0.5	<0.5	<0.5
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons									
Naphthalene	91-20-3	1	µg/L		----	----	<1.0	<1.0	<1.0
Acenaphthylene	208-96-8	1	µg/L		----	----	<1.0	<1.0	<1.0
Acenaphthene	83-32-9	1	µg/L		----	----	<1.0	<1.0	<1.0
Fluorene	86-73-7	1	µg/L		----	----	<1.0	<1.0	<1.0
Phenanthrene	85-01-8	1	µg/L		----	----	<1.0	<1.0	<1.0
Anthracene	120-12-7	1	µg/L		----	----	<1.0	<1.0	<1.0
Fluoranthene	206-44-0	1	µg/L		----	----	<1.0	<1.0	<1.0
Pyrene	129-00-0	1	µg/L		----	----	<1.0	<1.0	<1.0
Benz(a)anthracene	56-55-3	1	µg/L		----	----	<1.0	<1.0	<1.0
Chrysene	218-01-9	1	µg/L		----	----	<1.0	<1.0	<1.0
Benzo(b+j)fluoranthene	205-99-2 205-82-3	1	µg/L		----	----	<1.0	<1.0	<1.0
Benzo(k)fluoranthene	207-08-9	1	µg/L		----	----	<1.0	<1.0	<1.0
Benzo(a)pyrene	50-32-8	0.5	µg/L		----	----	<0.5	<0.5	<0.5
Indeno(1.2.3.cd)pyrene	193-39-5	1	µg/L		----	----	<1.0	<1.0	<1.0
Dibenz(a.h)anthracene	53-70-3	1	µg/L		----	----	<1.0	<1.0	<1.0
Benzo(g.h.i)perylene	191-24-2	1	µg/L		----	----	<1.0	<1.0	<1.0
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	µg/L		----	----	<0.5	<0.5	<0.5
^ Benzo(a)pyrene TEQ (zero)	----	0.5	µg/L		----	----	<0.5	<0.5	<0.5
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	20	µg/L		----	----	<20	<20	<20
C10 - C14 Fraction	----	50	µg/L		----	----	<50	<50	<50
C15 - C28 Fraction	----	100	µg/L		----	----	<100	<100	<100
C29 - C36 Fraction	----	50	µg/L		----	----	<50	<50	<50
^ C10 - C36 Fraction (sum)	----	50	µg/L		----	----	<50	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
C6 - C10 Fraction	C6_C10	20	µg/L		----	----	<20	<20	<20
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L		----	----	<20	<20	<20

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	CW1	CW2	SITE 1	SITE 2	SITE 3
				Client sampling date / time	04-Nov-2015 13:15	04-Nov-2015 13:30	04-Nov-2015 13:45	04-Nov-2015 14:10	04-Nov-2015 14:30
Compound	CAS Number	LOR	Unit		ES1535376-001	ES1535376-002	ES1535376-003	ES1535376-004	ES1535376-005
					Result	Result	Result	Result	Result
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions - Continued									
>C10 - C16 Fraction	----	100	µg/L		----	----	<100	<100	<100
>C16 - C34 Fraction	----	100	µg/L		----	----	<100	<100	<100
>C34 - C40 Fraction	----	100	µg/L		----	----	<100	<100	<100
^ >C10 - C40 Fraction (sum)	----	100	µg/L		----	----	<100	<100	<100
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L		----	----	<100	<100	<100
EP080: BTEXN									
Benzene	71-43-2	1	µg/L		----	----	<1	<1	<1
Toluene	108-88-3	2	µg/L		----	----	<2	<2	<2
Ethylbenzene	100-41-4	2	µg/L		----	----	<2	<2	<2
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L		----	----	<2	<2	<2
ortho-Xylene	95-47-6	2	µg/L		----	----	<2	<2	<2
^ Total Xylenes	1330-20-7	2	µg/L		----	----	<2	<2	<2
^ Sum of BTEX	----	1	µg/L		----	----	<1	<1	<1
Naphthalene	91-20-3	5	µg/L		----	----	<5	<5	<5
EP068S: Organochlorine Pesticide Surrogate									
Dibromo-DDE	21655-73-2	0.5	%		----	----	99.1	120	101
EP068T: Organophosphorus Pesticide Surrogate									
DEF	78-48-8	0.5	%		----	----	99.3	91.1	97.2
EP075(SIM)S: Phenolic Compound Surrogates									
Phenol-d6	13127-88-3	1	%		----	----	21.6	28.2	23.1
2-Chlorophenol-D4	93951-73-6	1	%		----	----	43.8	61.0	50.3
2.4.6-Tribromophenol	118-79-6	1	%		----	----	42.8	59.5	52.3
EP075(SIM)T: PAH Surrogates									
2-Fluorobiphenyl	321-60-8	1	%		----	----	61.1	82.1	69.1
Anthracene-d10	1719-06-8	1	%		----	----	88.5	97.6	91.4
4-Terphenyl-d14	1718-51-0	1	%		----	----	77.6	90.1	76.3
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	2	%		----	----	102	108	111
Toluene-D8	2037-26-5	2	%		----	----	94.1	94.0	97.6
4-Bromofluorobenzene	460-00-4	2	%		----	----	96.1	98.7	98.7

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	SITE 4	-----	-----	-----	-----
				Client sampling date / time	04-Nov-2015 15:10	----	----	----	----
Compound	CAS Number	LOR	Unit		ES1535376-006	--------	--------	--------	--------
					Result	Result	Result	Result	Result
EA005P: pH by PC Titrator									
pH Value	----	0.01	pH Unit		7.41	----	----	----	----
EA010P: Conductivity by PC Titrator									
Electrical Conductivity @ 25°C	----	1	µS/cm		432	----	----	----	----
EA015: Total Dissolved Solids									
Total Dissolved Solids @180°C	----	10	mg/L		----	----	----	----	----
EA016: Calculated TDS (from Electrical Conductivity)									
Total Dissolved Solids (Calc.)	----	1	mg/L		281	----	----	----	----
EA025: Suspended Solids									
Suspended Solids (SS)	----	5	mg/L		372	----	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L		37	----	----	----	----
ED093F: Dissolved Major Cations									
Sodium	7440-23-5	1	mg/L		70	----	----	----	----
Potassium	7440-09-7	1	mg/L		2	----	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		----	----	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		<0.01	----	----	----	----
EP005: Total Organic Carbon (TOC)									
Total Organic Carbon	----	1	mg/L		11	----	----	----	----
EP025: Oxygen - Dissolved (DO)									
Dissolved Oxygen	----	0.1	mg/L		7.5	----	----	----	----
EP026SP: Chemical Oxygen Demand (Spectrophotometric)									
Chemical Oxygen Demand	----	10	mg/L		88	----	----	----	----
EP030: Biochemical Oxygen Demand (BOD)									
Biochemical Oxygen Demand	----	2	mg/L		<2	----	----	----	----
EP035G: Total Phenol by Discrete Analyser									
Phenols (Total)	----	0.05	mg/L		<0.05	----	----	----	----
EP068A: Organochlorine Pesticides (OC)									
alpha-BHC	319-84-6	0.5	µg/L		<0.5	----	----	----	----
Hexachlorobenzene (HCB)	118-74-1	0.5	µg/L		<0.5	----	----	----	----
beta-BHC	319-85-7	0.5	µg/L		<0.5	----	----	----	----
gamma-BHC	58-89-9	0.5	µg/L		<0.5	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	SITE 4	----	----	----	----
				Client sampling date / time	04-Nov-2015 15:10	----	----	----	----
Compound	CAS Number	LOR	Unit		ES1535376-006	--------	--------	--------	--------
					Result	Result	Result	Result	Result
EP068A: Organochlorine Pesticides (OC) - Continued									
delta-BHC	319-86-8	0.5	µg/L		<0.5	----	----	----	----
Heptachlor	76-44-8	0.5	µg/L		<0.5	----	----	----	----
Aldrin	309-00-2	0.5	µg/L		<0.5	----	----	----	----
Heptachlor epoxide	1024-57-3	0.5	µg/L		<0.5	----	----	----	----
trans-Chlordane	5103-74-2	0.5	µg/L		<0.5	----	----	----	----
alpha-Endosulfan	959-98-8	0.5	µg/L		<0.5	----	----	----	----
cis-Chlordane	5103-71-9	0.5	µg/L		<0.5	----	----	----	----
Dieldrin	60-57-1	0.5	µg/L		<0.5	----	----	----	----
4.4`-DDE	72-55-9	0.5	µg/L		<0.5	----	----	----	----
Endrin	72-20-8	0.5	µg/L		<0.5	----	----	----	----
beta-Endosulfan	33213-65-9	0.5	µg/L		<0.5	----	----	----	----
4.4`-DDD	72-54-8	0.5	µg/L		<0.5	----	----	----	----
Endrin aldehyde	7421-93-4	0.5	µg/L		<0.5	----	----	----	----
Endosulfan sulfate	1031-07-8	0.5	µg/L		<0.5	----	----	----	----
4.4`-DDT	50-29-3	2	µg/L		<2.0	----	----	----	----
Endrin ketone	53494-70-5	0.5	µg/L		<0.5	----	----	----	----
Methoxychlor	72-43-5	2	µg/L		<2.0	----	----	----	----
^ Total Chlordane (sum)	----	0.5	µg/L		<0.5	----	----	----	----
^ Sum of DDD + DDE + DDT	----	0.5	µg/L		<0.5	----	----	----	----
^ Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.5	µg/L		<0.5	----	----	----	----
EP068B: Organophosphorus Pesticides (OP)									
Dichlorvos	62-73-7	0.5	µg/L		<0.5	----	----	----	----
Demeton-S-methyl	919-86-8	0.5	µg/L		<0.5	----	----	----	----
Monocrotophos	6923-22-4	2	µg/L		<2.0	----	----	----	----
Dimethoate	60-51-5	0.5	µg/L		<0.5	----	----	----	----
Diazinon	333-41-5	0.5	µg/L		<0.5	----	----	----	----
Chlorpyrifos-methyl	5598-13-0	0.5	µg/L		<0.5	----	----	----	----
Parathion-methyl	298-00-0	2	µg/L		<2.0	----	----	----	----
Malathion	121-75-5	0.5	µg/L		<0.5	----	----	----	----
Fenthion	55-38-9	0.5	µg/L		<0.5	----	----	----	----
Chlorpyrifos	2921-88-2	0.5	µg/L		<0.5	----	----	----	----
Parathion	56-38-2	2	µg/L		<2.0	----	----	----	----
Pirimphos-ethyl	23505-41-1	0.5	µg/L		<0.5	----	----	----	----
Chlorfenvinphos	470-90-6	0.5	µg/L		<0.5	----	----	----	----
Bromophos-ethyl	4824-78-6	0.5	µg/L		<0.5	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	SITE 4	-----	-----	-----	-----
				Client sampling date / time	04-Nov-2015 15:10	----	----	----	----
Compound	CAS Number	LOR	Unit		ES1535376-006	--------	--------	--------	--------
					Result	Result	Result	Result	Result
EP068B: Organophosphorus Pesticides (OP) - Continued									
Fenamiphos	22224-92-6	0.5	µg/L		<0.5	----	----	----	----
Prothiofos	34643-46-4	0.5	µg/L		<0.5	----	----	----	----
Ethion	563-12-2	0.5	µg/L		<0.5	----	----	----	----
Carbophenothion	786-19-6	0.5	µg/L		<0.5	----	----	----	----
Azinphos Methyl	86-50-0	0.5	µg/L		<0.5	----	----	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons									
Naphthalene	91-20-3	1	µg/L		<1.0	----	----	----	----
Acenaphthylene	208-96-8	1	µg/L		<1.0	----	----	----	----
Acenaphthene	83-32-9	1	µg/L		<1.0	----	----	----	----
Fluorene	86-73-7	1	µg/L		<1.0	----	----	----	----
Phenanthrene	85-01-8	1	µg/L		<1.0	----	----	----	----
Anthracene	120-12-7	1	µg/L		<1.0	----	----	----	----
Fluoranthene	206-44-0	1	µg/L		<1.0	----	----	----	----
Pyrene	129-00-0	1	µg/L		<1.0	----	----	----	----
Benz(a)anthracene	56-55-3	1	µg/L		<1.0	----	----	----	----
Chrysene	218-01-9	1	µg/L		<1.0	----	----	----	----
Benzo(b+j)fluoranthene	205-99-2 205-82-3	1	µg/L		<1.0	----	----	----	----
Benzo(k)fluoranthene	207-08-9	1	µg/L		<1.0	----	----	----	----
Benzo(a)pyrene	50-32-8	0.5	µg/L		<0.5	----	----	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	1	µg/L		<1.0	----	----	----	----
Dibenz(a.h)anthracene	53-70-3	1	µg/L		<1.0	----	----	----	----
Benzo(g.h.i)perylene	191-24-2	1	µg/L		<1.0	----	----	----	----
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	µg/L		<0.5	----	----	----	----
^ Benzo(a)pyrene TEQ (zero)	----	0.5	µg/L		<0.5	----	----	----	----
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	20	µg/L		<20	----	----	----	----
C10 - C14 Fraction	----	50	µg/L		<50	----	----	----	----
C15 - C28 Fraction	----	100	µg/L		<100	----	----	----	----
C29 - C36 Fraction	----	50	µg/L		<50	----	----	----	----
^ C10 - C36 Fraction (sum)	----	50	µg/L		<50	----	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
C6 - C10 Fraction	C6_C10	20	µg/L		<20	----	----	----	----
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L		<20	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	SITE 4	----	----	----	----
				Client sampling date / time	04-Nov-2015 15:10	----	----	----	----
Compound	CAS Number	LOR	Unit		ES1535376-006	--------	--------	--------	--------
					Result	Result	Result	Result	Result
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions - Continued									
>C10 - C16 Fraction	----	100	µg/L		<100	----	----	----	----
>C16 - C34 Fraction	----	100	µg/L		<100	----	----	----	----
>C34 - C40 Fraction	----	100	µg/L		<100	----	----	----	----
^ >C10 - C40 Fraction (sum)	----	100	µg/L		<100	----	----	----	----
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L		<100	----	----	----	----
EP080: BTEXN									
Benzene	71-43-2	1	µg/L		<1	----	----	----	----
Toluene	108-88-3	2	µg/L		<2	----	----	----	----
Ethylbenzene	100-41-4	2	µg/L		<2	----	----	----	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L		<2	----	----	----	----
ortho-Xylene	95-47-6	2	µg/L		<2	----	----	----	----
^ Total Xylenes	1330-20-7	2	µg/L		<2	----	----	----	----
^ Sum of BTEX	----	1	µg/L		<1	----	----	----	----
Naphthalene	91-20-3	5	µg/L		<5	----	----	----	----
EP068S: Organochlorine Pesticide Surrogate									
Dibromo-DDE	21655-73-2	0.5	%		85.2	----	----	----	----
EP068T: Organophosphorus Pesticide Surrogate									
DEF	78-48-8	0.5	%		81.8	----	----	----	----
EP075(SIM)S: Phenolic Compound Surrogates									
Phenol-d6	13127-88-3	1	%		20.9	----	----	----	----
2-Chlorophenol-D4	93951-73-6	1	%		41.9	----	----	----	----
2.4.6-Tribromophenol	118-79-6	1	%		45.1	----	----	----	----
EP075(SIM)T: PAH Surrogates									
2-Fluorobiphenyl	321-60-8	1	%		57.0	----	----	----	----
Anthracene-d10	1719-06-8	1	%		71.3	----	----	----	----
4-Terphenyl-d14	1718-51-0	1	%		68.1	----	----	----	----
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	2	%		109	----	----	----	----
Toluene-D8	2037-26-5	2	%		91.5	----	----	----	----
4-Bromofluorobenzene	460-00-4	2	%		96.4	----	----	----	----

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES1536311**	Page	: 1 of 4
Amendment	: **1**		
Client	: **UMWELT (AUSTRALIA) PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR PETER JAMIESON	Contact	:
Address	: P O BOX 838 2/20 THE BOULEVARDE TORONTO NEW SOUTH WALES 2283	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: pjamieson@umwelt.com.au	E-mail	:
Telephone	: +61 02 4950 5322	Telephone	: +61-2-8784 8555
Facsimile	: +61 02 4950 5737	Facsimile	: +61-2-8784 8500
Project	: 3251A	QC Level	: NEPM 2013 B3 & ALS QC Standard
Order number	: ----	Date Samples Received	: 16-Nov-2015 12:50
C-O-C number	: ----	Date Analysis Commenced	: 16-Nov-2015
Sampler	: ----	Issue Date	: 14-Jan-2016 11:46
Site	: ----		
		No. of samples received	: 4
Quote number	: ----	No. of samples analysed	: 4

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Merrin Avery	Supervisor - Inorganic	Newcastle - Inorganics, Mayfield West, NSW
Pabi Subba	Senior Organic Chemist	Sydney Organics, Smithfield, NSW

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.

- TDS by method EA-015 may bias high for sample 3 and 4 due to the presence of fine particulate matter, which may pass through the prescribed GF/C paper.
- This report has been amended following the removal of some analytes and the addition of TN/TP.
- Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ) is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benz(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.cd)pyrene (0.1), Dibenz(a.h)anthracene (1.0), Benzo(g.h.i)perylene (0.01). Less than LOR results for 'TEQ Zero' are treated as zero.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	SITE 1	SITE 2	SITE 3	SITE 4	----
			Client sampling date / time	16-Nov-2015 10:22	16-Nov-2015 10:42	16-Nov-2015 11:10	16-Nov-2015 12:10	----
Compound	CAS Number	LOR	Unit	ES1536311-001	ES1536311-002	ES1536311-003	ES1536311-004	--------
				Result	Result	Result	Result	Result
EA005: pH								
pH Value	----	0.01	pH Unit	7.84	7.61	7.57	7.51	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	623	610	459	456	----
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	6	6	88	70	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	1.03	0.36	0.14	0.04	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	0.4	0.5	1.4	1.4	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ Total Nitrogen as N	----	0.1	mg/L	1.4	0.9	1.5	1.4	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	0.01	0.05	0.13	0.27	----
EP030: Biochemical Oxygen Demand (BOD)								
Biochemical Oxygen Demand	----	2	mg/L	<2	<2	<2	<2	----
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	<20	<20	<20	<20	----
C10 - C14 Fraction	----	50	µg/L	<50	<50	<50	<50	----
C15 - C28 Fraction	----	100	µg/L	<100	<100	<100	<100	----
C29 - C36 Fraction	----	50	µg/L	<50	<50	<50	<50	----
^ C10 - C36 Fraction (sum)	----	50	µg/L	<50	<50	<50	<50	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	<20	<20	----
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L	<20	<20	<20	<20	----
>C10 - C16 Fraction	----	100	µg/L	<100	<100	<100	<100	----
>C16 - C34 Fraction	----	100	µg/L	<100	<100	<100	<100	----
>C34 - C40 Fraction	----	100	µg/L	<100	<100	<100	<100	----
^ >C10 - C40 Fraction (sum)	----	100	µg/L	<100	<100	<100	<100	----
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L	<100	<100	<100	<100	----
EP080: BTEXN								
Benzene	71-43-2	1	µg/L	<1	<1	<1	<1	----
Toluene	108-88-3	2	µg/L	<2	<2	<2	<2	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	SITE 1	SITE 2	SITE 3	SITE 4	----
				Client sampling date / time	16-Nov-2015 10:22	16-Nov-2015 10:42	16-Nov-2015 11:10	16-Nov-2015 12:10	----
Compound	CAS Number	LOR	Unit		ES1536311-001	ES1536311-002	ES1536311-003	ES1536311-004	--------
					Result	Result	Result	Result	Result
EP080: BTEXN - Continued									
Ethylbenzene	100-41-4	2	µg/L		<2	<2	<2	<2	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L		<2	<2	<2	<2	----
ortho-Xylene	95-47-6	2	µg/L		<2	<2	<2	<2	----
^ Total Xylenes	1330-20-7	2	µg/L		<2	<2	<2	<2	----
^ Sum of BTEX	----	1	µg/L		<1	<1	<1	<1	----
Naphthalene	91-20-3	5	µg/L		<5	<5	<5	<5	----
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	2	%		90.8	115	102	95.5	----
Toluene-D8	2037-26-5	2	%		88.7	96.2	101	104	----
4-Bromofluorobenzene	460-00-4	2	%		84.2	106	103	102	----

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES1539501**	Page	: 1 of 4
Client	: **UMWELT (AUSTRALIA) PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: PETER WATERS	Contact	:
Address	: P O BOX 838 2/20 THE BOULEVARDE TORONTO NEW SOUTH WALES 2283	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: pwaters@umwelt.com.au	E-mail	:
Telephone	: 08 6260 0701	Telephone	: +61-2-8784 8555
Facsimile	: ----	Facsimile	: +61-2-8784 8500
Project	: 3251A	QC Level	: NEPM 2013 B3 & ALS QC Standard
Order number	: ----	Date Samples Received	: 23-Dec-2015 09:50
C-O-C number	: ----	Date Analysis Commenced	: 23-Dec-2015
Sampler	: ----	Issue Date	: 14-Jan-2016 11:45
Site	: ----		
		No. of samples received	: 4
Quote number	: ----	No. of samples analysed	: 4

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Edwandy Fadjar	Organic Coordinator	Sydney Organics, Smithfield, NSW
Hoa Nguyen	Senior Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Merrin Avery	Supervisor - Inorganic	Newcastle - Inorganics, Mayfield West, NSW

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

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Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	SITE 1	SITE 2	SITE 3	SITE 4	----
			Client sampling date / time	23-Dec-2015 07:15	23-Dec-2015 08:15	23-Dec-2015 08:50	23-Dec-2015 09:30	----
Compound	CAS Number	LOR	Unit	ES1539501-001	ES1539501-002	ES1539501-003	ES1539501-004	--------
				Result	Result	Result	Result	Result
EA005: pH								
pH Value	----	0.01	pH Unit	7.65	7.63	7.20	7.31	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	418	459	250	341	----
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	16	19	1200	379	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	0.02	0.01	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	0.86	0.45	0.08	0.08	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	0.86	0.45	0.10	0.09	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	0.7	0.7	2.2	1.4	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ Total Nitrogen as N	----	0.1	mg/L	1.6	1.2	2.3	1.5	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	0.04	0.05	0.26	0.16	----
EP030: Biochemical Oxygen Demand (BOD)								
Biochemical Oxygen Demand	----	2	mg/L	<2	<2	<2	<2	----
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	<20	<20	<20	<20	----
C10 - C14 Fraction	----	50	µg/L	<50	<50	<50	<50	----
C15 - C28 Fraction	----	100	µg/L	<100	<100	<100	<100	----
C29 - C36 Fraction	----	50	µg/L	<50	<50	<50	<50	----
^ C10 - C36 Fraction (sum)	----	50	µg/L	<50	<50	<50	<50	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	<20	<20	----
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L	<20	<20	<20	<20	----
>C10 - C16 Fraction	----	100	µg/L	<100	<100	<100	<100	----
>C16 - C34 Fraction	----	100	µg/L	<100	<100	<100	<100	----
>C34 - C40 Fraction	----	100	µg/L	<100	<100	<100	<100	----
^ >C10 - C40 Fraction (sum)	----	100	µg/L	<100	<100	<100	<100	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	SITE 1	SITE 2	SITE 3	SITE 4	----
				Client sampling date / time	23-Dec-2015 07:15	23-Dec-2015 08:15	23-Dec-2015 08:50	23-Dec-2015 09:30	----
Compound	CAS Number	LOR	Unit		ES1539501-001	ES1539501-002	ES1539501-003	ES1539501-004	--------
					Result	Result	Result	Result	Result
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions - Continued									
^ **>C10 - C16 Fraction minus Naphthalene (F2)**	----	100	µg/L		<100	<100	<100	<100	----
EP080: BTEXN									
Benzene	71-43-2	1	µg/L		<1	<1	<1	<1	----
Toluene	108-88-3	2	µg/L		<2	<2	<2	<2	----
Ethylbenzene	100-41-4	2	µg/L		<2	<2	<2	<2	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L		<2	<2	<2	<2	----
ortho-Xylene	95-47-6	2	µg/L		<2	<2	<2	<2	----
^ **Total Xylenes**	1330-20-7	2	µg/L		<2	<2	<2	<2	----
^ **Sum of BTEX**	----	1	µg/L		<1	<1	<1	<1	----
Naphthalene	91-20-3	5	µg/L		<5	<5	<5	<5	----
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	2	%		**91.3**	**91.6**	**95.8**	**93.5**	----
Toluene-D8	2037-26-5	2	%		**122**	**129**	**80.1**	**123**	----
4-Bromofluorobenzene	460-00-4	2	%		**97.6**	**104**	**99.6**	**102**	----

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES1600061**	Page	: 1 of 4
Client	: **UMWELT (AUSTRALIA) PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR PETER JAMIESON	Contact	:
Address	: P O BOX 838 2/20 THE BOULEVARDE TORONTO NEW SOUTH WALES 2283	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: pjamieson@umwelt.com.au	E-mail	:
Telephone	: +61 02 4950 5322	Telephone	: +61-2-8784 8555
Facsimile	: +61 02 4950 5737	Facsimile	: +61-2-8784 8500
Project	: 3251A	QC Level	: NEPM 2013 B3 & ALS QC Standard
Order number	: ----	Date Samples Received	: 04-Jan-2016 17:50
C-O-C number	: ----	Date Analysis Commenced	: 05-Jan-2016
Sampler	: DARREN WILLIAMS	Issue Date	: 14-Jan-2016 11:46
Site	: ----		
		No. of samples received	: 5
Quote number	: ----	No. of samples analysed	: 5

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

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Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Dianne Blane	Laboratory Coordinator (2IC)	Newcastle - Inorganics, Mayfield West, NSW
Edwandy Fadjar	Organic Coordinator	Sydney Organics, Smithfield, NSW
Hoa Nguyen	Senior Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Sanjeshni Jyoti	Senior Chemist Volatiles	Sydney Organics, Smithfield, NSW

General Comments

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Where moisture determination has been performed, results are reported on a dry weight basis.

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LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.

- EA005: Samples have been analysed outside recommended holding times and this must be taken into consideration when interpreting results.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5
			Client sampling date / time	04-Jan-2016 16:50	04-Jan-2016 16:30	04-Jan-2016 16:15	04-Jan-2016 16:00	04-Jan-2016 16:10
Compound	CAS Number	LOR	Unit	ES1600061-001	ES1600061-002	ES1600061-003	ES1600061-004	ES1600061-005
				Result	Result	Result	Result	Result
EA005: pH								
pH Value	----	0.01	pH Unit	7.87	7.66	7.47	7.36	7.08
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	584	572	440	376	229
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	<5	<5	708	870	<5
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	0.52	0.05	0.10	0.06	0.04
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	0.7	0.5	2.8	3.6	0.8
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ Total Nitrogen as N	----	0.1	mg/L	1.2	0.6	2.9	3.7	0.8
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	0.02	0.02	0.02	0.07	0.05
EP030: Biochemical Oxygen Demand (BOD)								
Biochemical Oxygen Demand	----	2	mg/L	<2	<2	<2	<2	<2
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	<20	<20	<20	<20	<20
C10 - C14 Fraction	----	50	µg/L	<50	<50	<50	<50	<50
C15 - C28 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
C29 - C36 Fraction	----	50	µg/L	<50	<50	<50	<50	<50
^ C10 - C36 Fraction (sum)	----	50	µg/L	<50	<50	<50	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	<20	<20	<20
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L	<20	<20	<20	<20	<20
>C10 - C16 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
>C16 - C34 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
>C34 - C40 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
^ >C10 - C40 Fraction (sum)	----	100	µg/L	<100	<100	<100	<100	<100
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L	<100	<100	<100	<100	<100
EP080: BTEXN								
Benzene	71-43-2	1	µg/L	<1	<1	<1	<1	<1
Toluene	108-88-3	2	µg/L	<2	<2	<2	<2	<2

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5
				Client sampling date / time	04-Jan-2016 16:50	04-Jan-2016 16:30	04-Jan-2016 16:15	04-Jan-2016 16:00	04-Jan-2016 16:10
Compound	CAS Number	LOR	Unit		ES1600061-001	ES1600061-002	ES1600061-003	ES1600061-004	ES1600061-005
					Result	Result	Result	Result	Result
EP080: BTEXN - Continued									
Ethylbenzene	100-41-4	2	µg/L		<2	<2	<2	<2	<2
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L		<2	<2	<2	<2	<2
ortho-Xylene	95-47-6	2	µg/L		<2	<2	<2	<2	<2
^ Total Xylenes	1330-20-7	2	µg/L		<2	<2	<2	<2	<2
^ Sum of BTEX	----	1	µg/L		<1	<1	<1	<1	<1
Naphthalene	91-20-3	5	µg/L		<5	<5	<5	<5	<5
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	2	%		125	121	125	119	123
Toluene-D8	2037-26-5	2	%		107	100	100	94.9	89.8
4-Bromofluorobenzene	460-00-4	2	%		94.0	89.2	90.6	85.8	90.1

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES1600138**	Page	: 1 of 4
Client	: **UMWELT (AUSTRALIA) PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR PETER JAMIESON	Contact	:
Address	: P O BOX 838 2/20 THE BOULEVARDE TORONTO NEW SOUTH WALES 2283	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: pjamieson@umwelt.com.au	E-mail	:
Telephone	: +61 02 4950 5322	Telephone	: +61-2-8784 8555
Facsimile	: +61 02 4950 5737	Facsimile	: +61-2-8784 8500
Project	: 3251A	QC Level	: NEPM 2013 B3 & ALS QC Standard
Order number	: ----	Date Samples Received	: 05-Jan-2016 16:45
C-O-C number	: ----	Date Analysis Commenced	: 05-Jan-2016
Sampler	: DARREN WILLIAMS	Issue Date	: 14-Jan-2016 11:45
Site	: ----		
		No. of samples received	: 5
Quote number	: ----	No. of samples analysed	: 5

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Dianne Blane	Laboratory Coordinator (2IC)	Newcastle - Inorganics, Mayfield West, NSW
Edwandy Fadjar	Organic Coordinator	Sydney Organics, Smithfield, NSW

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

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Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.

- Sampling time not provided. For operational reasons an assumed date/time (3pm on date of receipt) is used. Sample results may be affected if the analysis falls outside of actual holding time.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5
			Client sampling date / time	[05-Jan-2016]	[05-Jan-2016]	[05-Jan-2016]	[05-Jan-2016]	[05-Jan-2016]
Compound	CAS Number	LOR	Unit	ES1600138-001	ES1600138-002	ES1600138-003	ES1600138-004	ES1600138-005
				Result	Result	Result	Result	Result
EA005: pH								
pH Value	----	0.01	pH Unit	7.27	7.32	6.91	6.85	6.71
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	306	280	228	201	172
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	14	32	110	116	12
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	0.32	0.22	0.11	0.14	0.02
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	0.9	1.0	1.2	1.2	1.1
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ Total Nitrogen as N	----	0.1	mg/L	1.2	1.2	1.3	1.3	1.1
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	0.06	0.04	0.08	0.07	0.06
EP030: Biochemical Oxygen Demand (BOD)								
Biochemical Oxygen Demand	----	2	mg/L	<2	<2	<2	<2	<2
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	<20	<20	<20	<20	<20
C10 - C14 Fraction	----	50	µg/L	<50	<50	<50	<50	<50
C15 - C28 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
C29 - C36 Fraction	----	50	µg/L	<50	<50	<50	<50	<50
^ C10 - C36 Fraction (sum)	----	50	µg/L	<50	<50	<50	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	<20	<20	<20
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L	<20	<20	<20	<20	<20
>C10 - C16 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
>C16 - C34 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
>C34 - C40 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
^ >C10 - C40 Fraction (sum)	----	100	µg/L	<100	<100	<100	<100	<100
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L	<100	<100	<100	<100	<100
EP080: BTEXN								
Benzene	71-43-2	1	µg/L	<1	<1	<1	<1	<1
Toluene	108-88-3	2	µg/L	<2	<2	<2	<2	<2

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5
				Client sampling date / time	[05-Jan-2016]	[05-Jan-2016]	[05-Jan-2016]	[05-Jan-2016]	[05-Jan-2016]
Compound	CAS Number	LOR	Unit		ES1600138-001	ES1600138-002	ES1600138-003	ES1600138-004	ES1600138-005
					Result	Result	Result	Result	Result
EP080: BTEXN - Continued									
Ethylbenzene	100-41-4	2	µg/L		<2	<2	<2	<2	<2
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L		<2	<2	<2	<2	<2
ortho-Xylene	95-47-6	2	µg/L		<2	<2	<2	<2	<2
^ Total Xylenes	1330-20-7	2	µg/L		<2	<2	<2	<2	<2
^ Sum of BTEX	----	1	µg/L		<1	<1	<1	<1	<1
Naphthalene	91-20-3	5	µg/L		<5	<5	<5	<5	<5
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	2	%		116	111	113	124	124
Toluene-D8	2037-26-5	2	%		95.3	111	115	118	114
4-Bromofluorobenzene	460-00-4	2	%		102	96.9	96.9	101	96.9

ALS Environmental

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Address	: P O BOX 838 2/20 THE BOULEVARDE TORONTO NEW SOUTH WALES 2283	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: pwaters@umwelt.com.au	E-mail	:
Telephone	: 08 6260 0701	Telephone	: +61-2-8784 8555
Facsimile	: ----	Facsimile	: +61-2-8784 8500
Project	: 3241A	QC Level	: NEPM 2013 B3 & ALS QC Standard
Order number	: ----	Date Samples Received	: 06-Jan-2016 17:20
C-O-C number	: ----	Date Analysis Commenced	: 07-Jan-2016
Sampler	: DARREN WILLIAMS	Issue Date	: 14-Jan-2016 11:46
Site	: ----		
		No. of samples received	: 5
Quote number	: ----	No. of samples analysed	: 5

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Signatories

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Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Edwandy Fadjar	Organic Coordinator	Sydney Organics, Smithfield, NSW
Hoa Nguyen	Senior Inorganic Chemist	Sydney Inorganics, Smithfield, NSW

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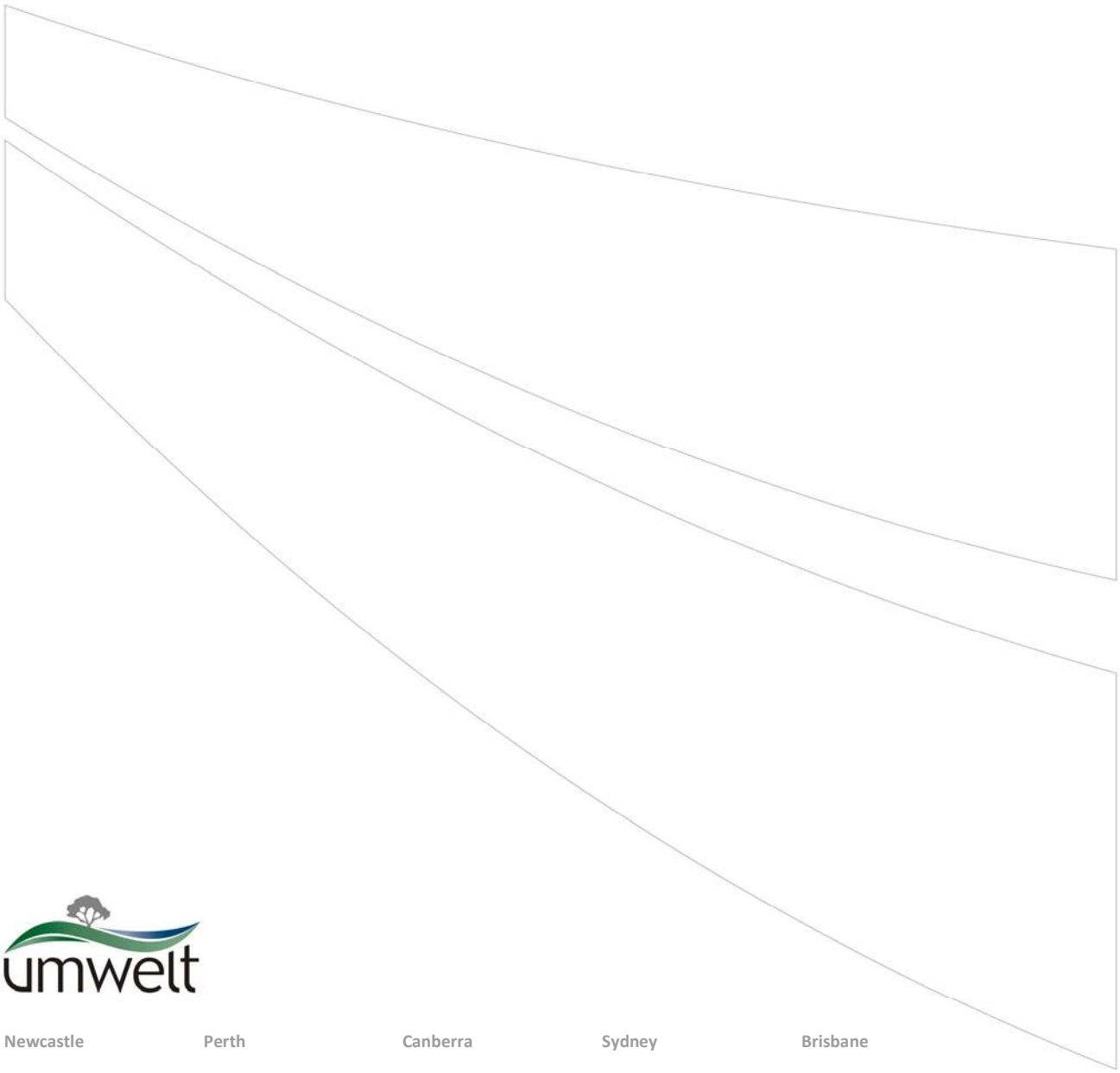
Compound	CAS Number	LOR	Unit	ES1600225-001	ES1600225-002	ES1600225-003	ES1600225-004	ES1600225-005
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	7.35	7.27	7.08	7.07	6.98
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	144	173	152	150	92
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	32	29	67	93	10
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	0.03	0.02	0.02	<0.01
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	0.32	0.43	0.36	0.35	0.02
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	0.32	0.46	0.38	0.37	0.02
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	1.3	2.2	1.8	1.8	0.9
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ Total Nitrogen as N	----	0.1	mg/L	1.6	2.7	2.2	2.2	0.9
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	0.10	0.41	0.26	0.25	0.05
EP030: Biochemical Oxygen Demand (BOD)								
Biochemical Oxygen Demand	----	2	mg/L	<2	<2	<2	<2	<2
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	<20	<20	<20	<20	<20
C10 - C14 Fraction	----	50	µg/L	<50	<50	<50	<50	<50
C15 - C28 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
C29 - C36 Fraction	----	50	µg/L	<50	<50	<50	<50	<50
^ C10 - C36 Fraction (sum)	----	50	µg/L	<50	<50	<50	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	<20	<20	<20
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L	<20	<20	<20	<20	<20
>C10 - C16 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
>C16 - C34 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
>C34 - C40 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
^ >C10 - C40 Fraction (sum)	----	100	µg/L	<100	<100	<100	<100	<100

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	Site 1	Site 2	Site 3	Site 4	Site 5
				Client sampling date / time	06-Jan-2016 15:00	06-Jan-2016 15:30	06-Jan-2016 15:50	06-Jan-2016 16:00	06-Jan-2016 16:10
Compound	CAS Number	LOR	Unit		ES1600225-001	ES1600225-002	ES1600225-003	ES1600225-004	ES1600225-005
					Result	Result	Result	Result	Result
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions - Continued									
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L		<100	<100	<100	<100	<100
EP080: BTEXN									
Benzene	71-43-2	1	µg/L		<1	<1	<1	<1	<1
Toluene	108-88-3	2	µg/L		<2	<2	<2	<2	<2
Ethylbenzene	100-41-4	2	µg/L		<2	<2	<2	<2	<2
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L		<2	<2	<2	<2	<2
ortho-Xylene	95-47-6	2	µg/L		<2	<2	<2	<2	<2
^ Total Xylenes	1330-20-7	2	µg/L		<2	<2	<2	<2	<2
^ Sum of BTEX	----	1	µg/L		<1	<1	<1	<1	<1
Naphthalene	91-20-3	5	µg/L		<5	<5	<5	<5	<5
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	2	%		111	126	108	116	112
Toluene-D8	2037-26-5	2	%		123	122	124	122	116
4-Bromofluorobenzene	460-00-4	2	%		114	124	109	118	110



umwelt

Newcastle	Perth	Canberra	Sydney	Brisbane
75 York Street Teralba NSW 2284	PO Box 8177 Subiaco East WA 6008 33 Ventnor Avenue West Perth WA 6005	PO Box 6135 56 Bluebell Street O'Connor ACT 2602	50 York Street Sydney NSW 2000	GPO Box 459 Brisbane QLD 4001
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APPENDIX C: GROUNDWATER MODELLING REPORT PEER REVIEW

24 October 2016

620.11517.0000-L01-v1.0.docx

Eagleton Rock Syndicate Pty Ltd
PO Box 898
Newcastle 2300

Attention: Murray Towndrow

Dear Murray

Groundwater Assessment Peer Review

SLR Consulting Australia Pty Ltd (SLR) were commissioned by Eagleton Rock Syndicate Pty Ltd (Eagleton) in January 2016 to conduct an independent peer review of the Eagleton Quarry Hydrogeological Investigation Report prepared by URS (11 February 2014, URS). The independent peer review was required to meet the Secretary's Environmental Assessment Requirements (SEARs) of the NSW Department of Primary Industries (DPI). DPI Water requested that the SEARs, dated 30/10/2015, include "*Full technical details and data of all surface and groundwater modelling, and an independent peer review*." SLR provided a peer review report (SLR, 9 February 2016) in which recommendations for further work were highlighted to meet the SEARs.

Eagleton engaged Umwelt to revise the groundwater impact assessment and associated modelling to meet the SEARs, specifically addressing the comments provided by SLR (9 February 2016). SLR has worked in consultation with Eagleton, and by extension Umwelt, on the revised impact assessment. Eagleton provided SLR with a final Water Assessment Report prepared by Umwelt (Umwelt, October 2016) (report) on the 13th of October 2016, which includes a groundwater impact assessment and the associated modelling report as an appendix.

This letter report herein is a documentation of the peer review of the Umwelt 2016 report, as it pertains to the groundwater impact assessment and the assessment's fit for purpose to meet the SEARs.

The primary objective of the peer review is to evaluate the assessment's fit for purpose to meet the SEARs. A summary of the key SEARs, as they pertain to a groundwater assessment, is provided in **Table 1**, along with comments based upon the peer review regarding the adequacy of the assessment to meet the requirements.

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(PO Box 26 Spring Hill QLD 4004) T: +61 7 3858 4800 F: +61 7 3858 4801
E: brisbane@slrconsulting.com www.slrconsulting.com
ABN 29 001 584 612

Table 1 Summary of SEARs for groundwater impact assessment

SEAR	Peer Review Comments
Annual volumes of groundwater proposed to be taken by the activity from each groundwater source.	The report provides an estimate of between 3.0 and 7.7 ML/year of water would be pumped from the quarry.
Assessment of any volumetric water licensing requirements (including those for ongoing water take following completion of the project).	Section 4.3 (Umwelt, 2016) provides a discussion and assessment of water licensing and requirements under the Water Sharing Plan for the Sydney Basin – North Coast Fractured and Porous Rock Groundwater Sources. The discussion is adequate and provides a recommendation for the acquisition of appropriate licenses.
A detailed assessment against the NSW Aquifer Interference Policy (2012) (NSW AIP) using DPI Water's assessment framework.	Section 4.4 (Umwelt, 2016) provides a summary of the groundwater impact assessment as it pertains to the NSW AIP. The summary is well presented and specifically addressed each point. The reader is referred to other sections for further details on how the conclusions are reached.
Assessment of impacts on surface and ground water sources (both water quality and quantity), related infrastructure, adjacent licensed water users, basic landholder rights, watercourses, riparian land, and groundwater dependent ecosystems, and measures proposed to reduce and mitigate these impacts.	The Umwelt 2016 report addresses all relevant matters listed in its impact assessment. Some comments are provided after **Table 1** regarding some reporting comments found during the peer review.
Full technical details and data of all surface and groundwater modelling, and an independent peer review.	Umwelt 2016 Appendix 1a provides a summary of the groundwater modelling. Please refer to comments after **Table 1** for peer review comments.
Proposed surface and groundwater monitoring activities and methodologies.	Section 7.3 (Umwelt, 2016) provides an overview of the proposed groundwater monitoring. Overall it is adequate. However the report could benefit from a description on how the proposed monitoring network addresses\monitors for the impacts predicted.
Details of the final landform of the site, including final void management (where relevant) and rehabilitation measures.	Section 3.3.5 and Section 6.9 (Umwelt, 2016) address final landform including final void management and rehabilitation measures adequately.
Assessment of any potential cumulative impacts on water resources, and any proposed options to manage the cumulative impacts.	Section 6.11 and Appendix 1a address cumulative impacts adequately.

Overall, the report addresses the SEARs for groundwater impact assessment. The information is presented in a reasonable manner for the reader to follow the assessment criteria and conclusions drawn from the assessment. However, a review of the report has resulted in the following comments:

- Table 4.1 – the response column that directs the reader to the sections where the issues are addressed should be updated.
- Section 4.2, pg 58, second paragraph, first sentence – The first sentence refers the reader to Figure 3 of Appendix 1a. I believe this should be Figure 4 of Appendix 1a.

- Section 4.2 and Section 6.1 – with each section it stated that modelling predicts zero drawdown outside of the Site boundary. This is not consistent with the modelling results presented in Appendix 1a, which specifically states there is drawdown outside the Project area. If there is a difference between the Site boundary and Project area this distinction should be made more clear to the reader.
- Section 4.2, last sentence – there appears to be a font size issue in text.
- Section 6.1.1 - The first sentence refers the reader to Figure 3 of Appendix 1a. I believe this should be Figure 4 of Appendix 1a.
- Section 6.1.2, pg 79 - The first sentence refers the reader to Figure 5 of Appendix 1a. I believe this should be Figure 7 of Appendix 1a.
- Section 6.1.2, pg 79, second paragraph - The first sentence refers the reader to Figure 16 of Appendix 1a. I believe this should be Figure 22 of Appendix 1a.
- Section 6.1 – this section would benefit from a summary of the impact assessment according to the NSW AIP previously assessed in section 4.4.
- Appendix 1a, Figures 15 and 16 – The figures and supporting text refer to groundwater head. Head is a measurement with reference to specific datum, typically a measurement of head pressure above a datum. It is assumed that the values presented are actually water levels in m AHD but this is not clear.

Appendix 1a provides sufficient detail on the conceptualisation, model setup, calibration, sensitivity analyses and predictive simulations for the reader to have a sufficient understanding the methodology used and the modelling results. The methods used are appropriate for the level of risk associated with the project as well as the hydrogeologic conceptualisation of the site and surrounding area.

While the peer review has provided some comments herein which would assist with the reporting of the groundwater impact assessment (above), the overall conclusion of the peer review is that the groundwater modelling, and associated impact assessment, is fit for purpose to address the requirements of the SEARs and NSW AIP.

Yours sincerely

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Checked/
Authorised by: DL

References

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URS. Eagleton Quarry Hydrogeological Investigation. Prepared for Castle Quarry Products. 11February 2014.

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