Report

Eagleton Quarry Hydrogeological Investigation

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Prepared for

Castle Quarry Products

Buildev
Newcastle

43207488

URS

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Abbreviations

Abbreviation	Description
CQP	Castle Quarry Products
DGRs	Director General Requirements
DPI	NSW Department of Primary Industries
EA	Environmental Assessment
GILs	Groundwater Investigation Levels
GPS	Global Positioning System
HSI	Hydrogeological Site Investigation
mAHD	meters above Australia Height Datum
NEPM 2013	amended National Environment Protection Measure 1999
NWQMS	National Water Quality Management Strategy
NSW	New South Wales
quarry	Eagleton Quarry
URS	URS Australia Pty Ltd

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Introduction

1.1 Background

URS Australia Pty Ltd (URS) was commissioned by Castle Quarry Products (CQP), associated with Buildev, to undertake a Hydrogeological Site Investigation (HSI) of the Eagleton Quarry (site) to support their revised Environmental Assessment (EA) submission.

CQP are proposing to develop a hard rock quarry at Killaloe Lane, Eagleton, approximately 30 km north of Newcastle, NSW. The site currently comprises a landscape supply business, a private residence and an extensive area of undisturbed bushland. Seaham Quarry, operated by Boral, is located to the immediate north of the proposed development. An initial EA for the proposed quarry development was submitted to the NSW Department of Primary Industries (DPI) in October 2012. This EA was deemed to be inadequate for public exhibition due to not having adequately addressed the initial and subsequently varied Director General Requirements (DGRs). In response to this finding, a revised HSI addressing key adequacy issues outlined in the DPI Eagleton Quarry Project: Adequacy of Environmental Assessment - Appendix 1 (Adequacy of Environmental Assessment) has been requested by the DPI prior to a revised EA being submitted. As part of this HSI, additional information on the site hydrogeological characteristics is required, which is the purpose of this report.

1.2 Environmental Assessment Context

The primary aim of this investigation is to support the revised EA for the proposed quarry development. The objectives and scope of works (**Section 1.3**) aim to address any potential impacts and risks that may arise due the proposed development.

To appreciate any potential impacts and risks, and to help to determine whether a potential impact is significant, the following Acts, Policy's, and Guidelines have been considered:

- Water Management Act – To ensure that the proposed development is ecologically sustainable.
- The NSW Aquifer Interference Policy – How the volumes of groundwater impacted will be licensed and accounted for, and also that the groundwater systems are minimally impacted.
- National Water Quality Management Strategy (NWQMS) – Ensure that water quality associated with the proposed development is properly managed.
- Water Sharing Plans – Linked to the Water Management Act; to ensure that the environment of the water resources are not impacted by the proposed development.
- The amended National Environment Protection Measure 1999 (NEPM, 2013) Groundwater Investigation Levels (drinking water) – guidelines to be used for the assessment of any potential groundwater samples collected as part of the investigation.

The NSW Aquifer Interference Policy is also important for consideration in that the policy outlines quantitatively whether any impacts are significant, alongside the NEPM 2013 criteria and NWQMS.

The nearest surface water receptors to the site are Seven Mile Creek, which intersects the site, and Coffs Harbour Creek which is located approximately 350m east. Both of these flow into the Grahamstown Dam, a drinking water supply for Newcastle, subsequently, NEPM - GIL – Drinking Water (2013) guidelines have been adopted for all groundwater samples collected as these are the most conservative.

1.3 Objectives and Scope of Works

As the primary aim is to support the revised EA for the proposed quarry development, the objectives of the groundwater investigations are as follows:

- Provide relevant site hydrogeological baseline data;
- Characterise groundwater quality at the project site;
- Identify and assess potential impacts generated by the proposed quarrying activities to environmental receptors and neighbouring stake holders;
- Gather appropriate data for hydrogeological modelling of groundwater inflows to the proposed quarry development; and
- Address additional groundwater related responses raised by the DPI in the Adequacy of Environmental Assessment document.

1.4 Previous Investigations

In July / August 2012, Coffey Environments undertook groundwater sampling and permeability testing in three existing monitoring boreholes at the quarry site. The results of this investigation formed part of the original EA submission (*JBA Planning October 2012)*.

Details of previous groundwater investigations undertaken in groundwater monitoring wells which existed on the site (BH101, BH102 and BH103) prior to drilling works was made available.

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Site Setting

2.1 Site Description

The proposed Eagleton Quarry is located approximately 30 km north of Newcastle, NSW. It is situated approximately 1.5 km to the west of the Pacific Highway and approximately 2.5 km northwest of Grahamstown Dam. The site currently comprises a landscape supply business, a private residence and an extensive area of undisturbed bushland. Seaham Quarry, operated by Boral, is located to the immediate north of the proposed development. The sites location is shown in **Figure 1**.

2.2 Topography

The topography of the local area is comprised of undulating elongated hills that trend predominantly northeast-southwest. The site is situated on a west to east trending spur, dropping in elevation from 120 meters above Australia Height Datum (mAHD) in the northwest to approximately 30 mAHD in the southeast.

2.3 Hydrology

Seven Mile Creek runs north to southeast through the site with a minor tributary running east-west. Downstream of the site Seven Mile Creek continues to the southeast, flowing into the Grahamstown Dam after approximately 2 km. The Creek is a minor ephemeral stream, however, water quality is significant as the proximity to Grahamstown Dam places the site within the Newcastle drinking water catchment. URS did not conduct any sampling of Seven Mile Creek due to the intermittent flow nature.

The JBA Planning Environmental Assessment Report outlines a Water Management System which includes controlled releases into Seven Mile Creek in accordance with an Environment Protection Licence (EPL). This will offset somewhat the effects of reduced baseflow.

2.4 Geology

Geology across the site varies, including sandstone, course conglomerate and fractured igneous rock. The stratigraphic sequence beneath the Eagleton Quarry area (youngest to oldest) is summarised in **Table 2-1** below.

Table 2-1 Regional geology of the Eagleton Quarry area

Formation	Description
Italia Road Formation	Comprising sandstone, shale and coal and sub cropping on the eastern side of the site
Balickera Conglomerate	Comprising course polymictic, conglomerate, tuff and ingnimbrite; subcropping through the mid regions of the site.
Eagleton Volcanics	Lithic sandstone, tuffs, rhyodacitic lavas, volcanic breccia and conglomerate; subcropping in the north western portion of the site.
Wallaringa Formation	Thickly bedded lithic sandstone, conglomerate and granitoids; subcropping to the north north west of the site.

2 Site Setting

Structurally, the site and local geology consists of a southeast-dipping package of volcanoclastic and sedimentary strata. The sedimentary strata comprise an overall fining-upwards sequence from conglomeratic sediments through to an interbedded sequence of claystones, siltstones, sandstones, and conglomerates.

Erosion of these units has created the predominantly northeast-southwest trending hills at and around the site. Cross-faulting and associated fracturing controlled drainage evolution, such as Seven Mile Creek, to produce the general northwest-southeast trending creeks in the area around the site.

The western Williams River Fault trends northeast-southwest along the western portion of the hills where the site is located. To the southwest of the site an unnamed cross fault trends perpendicular to the Williams River Fault. This fault has uplifted the volcaniclastic and sedimentary strata relative to these units that crop at and around the site.

Estuarine and alluvial sediments comprise the surficial and shallow geology in the low-lying areas flanking the hills where the site is located. These sediments consist of sands and gravels interbedded with clays and silts.

Site Investigations

The DGRs deemed the existing groundwater bore network insufficient for adequate characterisation of the underlying aquifer. In order to further characterise the hydrogeological conditions below the site URS designed a series of hydrogeological tests which would provide information that could be used in a hydrogeological conceptual model. A small network of monitoring bores were installed to facilitate these tests.

Site works began in February 2013, but were put on hold at Buildev's request until in October, 2013.

3.1 Drilling

Drilling works were conducted from 6th February to 11th February, 2013. The objective was to install a larger diameter test well and four surrounding observation wells of a smaller diameter. The site is heavily wooded which limited the locations of the monitoring wells.

Drilling of five wells was completed, four installed as observation wells, 50 mm in diameter (GWB01-GWB04) and one test well, 100 mm in diameter (GWB05). An existing well (BH103) was chosen as the best site for the test well and was redrilled using air hammer to the larger diameter. Locations of the wells are shown in **Figure 2, Appendix A**. Construction and lithology of the screened intervals are outlined below in Table 3.1. Detailed bore logs, including a cross section, are presented in **Appendix C**.

It is noted that lithology was recorded during drilling of all wells GWB01 to GWB05. The drilling method used was Air Hammer. Since drilling of GWB05 was a redevelopment and redrill of an existing well (formally BH103), lithological details for this well have been taken from the original drilling logs by Douglas Partners, July 2010 (**Appendix C**).

Table 3-1 Construction and lithology details of bores GWB01-GWB05

Bore ID	Drilled Depth (m)	Screen Interval (m)	Lithology of Screened Interval
GWB01	34.9	34.9 - 28.9	CONGLOMERATE: high strength, fresh gravelly sand matrix with igneous cobbles up to 190 mm
GWB02	40.2	40.2 - 34.2	RHYOLITE: fine grained, high strength igneous rock
GWB03	69.8	69.8 - 64.8	SAND: gravelly sand, medium to coarse grained with fine to medium igneous gravel and fine brown silt.
GWB04	40.0	40.0 - 34.0	CONGLOMERATE: high strength, fresh gravelly sand matrix with igneous cobbles up to 140 mm.
GWB05	48	48.0 – 42.0	RHYODACITE: slightly weathered, high to very high strength igneous rock with moderate fracturing.

3.1.1 Survey of Groundwater Boreholes

All five groundwater wells were surveyed by URS using a Trimble R4 GPS unit, details can be found in **Appendix B, Table 2**.

Survey data captured included;

- Natural surface elevation in mAHD;
- Top of casing (PVC) elevation in mAHD; and
- Monitoring bore location in GDA94 MGA Zone 56 coordinate system.

3.2 Groundwater Levels

Groundwater levels were gauged before testing began using an interface probe to measure depth to groundwater and total depth of well. Static water levels (SWLs) infer that the water table is a subdued expression of the surface topography with depths to water ranging between approximately 8 m below top of well casing (mbTOC) in the east of the site (GWB04) and 40 mbTOC in the steeper hills of the western portion of the site (GWB05). Water levels are shallower in the lower topography of the eastern portion of the site where the proposed quarry will be located.

Recorded groundwater heights are presented in **Appendix B, Table 3**.

3.3 Groundwater Sampling

Groundwater sampling was conducted on 22nd February, 2013 using low-flow sampling. Samples were taken from all five of the recently drilled and developed wells and were analysed for major ions, dissolved metals and nutrients. Samples were placed in laboratory-supplied bottles containing appropriate preservatives and stored on ice in a cooler while on-site and in transit to the laboratory. Samples collected for metals analysis were filtered on-site to 0.45µm before being transferred to preserved laboratory supplied bottles.

3.3.1 Results

As the site is within the catchment for Grahamstown Dam, analytical results were compared to the NEPM Drinking Water Guidelines (2013). All samples reported concentrations below the guidelines with the exception of slightly elevated concentrations of sulphate (550 mg/L) in borehole GWB01. Groundwater was reported as being fresh to slightly saline (465-6060 µS/cm) with neutral to alkaline pH (7.47-10.2). TDS ranged from 412 to 4100 mg/L.

Results are presented in **Appendix B, Table 1**.

3.4 Aquifer Testing

3.4.1 Methodology

A 24 hour constant rate test was proposed as the best way to characterise the hydrogeological conditions below site. A constant rate test is a pump test designed to determine transmissivity, hydraulic conductivity and storativity properties of an aquifer. An appropriately designed test well is pumped at a rate that provides steady flow rates and groundwater height, whilst surrounding boreholes are monitored for drawdown.

URS mobilised to site on the 29th October with the intention of beginning a 24 hour constant rate test on well GWB05, this was postponed due to extreme weather conditions. On 31st October we remobilised and began setup for the pumping test. Upon start-up it was quickly discovered there was insufficient groundwater recharge within the test well to perform an extended drawdown test. URS consulted with our Senior Hydrogeologist and reassessed our methodology to instead perform falling head tests on both the test well and the surrounding four observation wells. This involved adding a known volume of water to each well and, using dataloggers, recording the rate at which groundwater levels receded. The dataloggers where left in the wells for a period of four days before the data was retrieved. Although not as comprehensive a test as the 24 hour drawdown test, the falling head test still provides sufficient data to use in a Groundwater Flow Model.

Groundwater Flow Modelling

The computer code Visual MODFLOW Pro (version 2009.1)[1] was used to simulate three-dimensional steady-state groundwater flow. Note that whilst the volcanoclastic and sedimentary aquifers are fractured rock aquifers, for modelling purposes it was considered that these aquifers were sufficiently fractured to be equivalent to a porous medium.

4.1 Objectives

The main objective of the groundwater flow modelling was to evaluate the potential impact that quarry dewatering may have on baseflow to adjacent creeks and to groundwater uses in the area.

In order to meet the above objectives, the following tasks were completed to fulfil project objectives:

- A numerical groundwater flow model was constructed and calibrated to simulate long-term rainfall conditions and steady-state groundwater levels.
- The steady-state calibrated model was used to evaluate potential effects of quarry dewatering on groundwater users and baseflow to adjacent creeks, including Seven Mile Creek.
- Preparation of a Report on the outcome of the modelling.

4.2 Hydrogeology

4.2.1 Hydrogeological Units

Hydrogeological units are based upon lithology, observed groundwater elevations and the conceptual hydrogeological model presented in **Figure 5**.Three main hydrogeological units have been set out for modelling purposes:

- Volcanic/volcaniclastic rocks: variably weathered and fractured water table aquifer.
- Sedimentary rocks: variably weathered and fractured water table aquifer.
- Esturine/alluvial sediments: porous media water table aquifer.

4.2.2 Hydraulic Conductivities

The hydraulic conductivity and porosity values adopted in the model were based upon site-specific and literature values. The site-specific hydraulic conductivities have been based on the combination of results from slug tests and literature values, which vary as follows:

- Volcanic/volcaniclastic Aquifer**:** from 0.0004 m/d to 0.2 m/d.
- Sedimentary Aquifer**:** from 0.02 m/d to 0.2 m/d.
- Estuarine/alluvial Aquifer**:** dominated by the coarser sediments; literature values[2] ranging between 0.1 m/d and 10 m/d.

Hydraulic conductivity represents one of the calibration parameters; therefore, average values of hydraulic conductivities were initially specified for each formation/material and were modified during the calibration process.

[1] Schlumberger Water Services, 2009.
[2] Zheng, C., and Bennett, G. D., 1995, Applied Contaminant Transport Modelling, Van Nostrand Reinhold, 440 pgs.

4.2.3 Recharge and Discharge

Recharge occurs predominantly from precipitation, which averages approximately 815 mm/year. Discharge occurs to the creeks located in the hills at and around the site and surface-water bodies flanking the hills where the site is located (such as Mosman Swamp located to the west), Williams River and Grahamstown Reservoir located southeast of the site. URS understands that the Seven Mile Creek system is ephemeral (at least in the headwaters of the system flanking the site).

4.2.4 Groundwater Levels and Flow Patterns

Regional flow directions in the variably fractured rock aquifers are anticipated to be southeast towards the Grahamstown Reservoir and the South Pacific Ocean. Regional gradients in the aquifers are typically less than 1%.

In the variably fractured volcanic and conglomeratic aquifers, the static water levels (SWLs) measured in the site monitoring bores suggests that the water table is a subdued expression of the surface topography with depths to static water ranging between approximately 8 mbTOC measured in GWB04 (eastern portion of the site) and 40 mbTOC measured in GWB05 (western portion of the site). This subdued expression is assumed to reflect the interaction between aquifer hydraulic conductivity and local recharge.

Water levels are at or near the land surface in the low-lying land flanking the hills where the proposed quarry will be located.

4.2.5 Surrounding Groundwater Bore Records Search

A search for registered groundwater users located within a 1.5 km radius of the site was undertaken using the NSW Natural Resources Atlas on-line database (http://www.nratlas.nsw.gov.au/) maintained by the Department of Natural Resources, 30 January 2014.

The results indicate that there were fourteen off-site registered groundwater bores within a 1.5 km radius of the site. There is currently only information available for one of the fourteen registered groundwater bores identified. These bore with information is registered for monitoring use. The results of the search are summarised in **Table 4-1** and presented in **Figure 5**.

Table 4-1 Groundwater Bores within 1.5 km

Location (Relative to Site)	GW Bore Reference	Type	Use	Final Bore Depth (m)	Geological Material Comment	Standing Water Level
714 m north west	GW079737	Bore	Monitoring Bore	20	No Details	No Details

This bore has a registered depth of 20 m below ground surface. Under the Groundwater Model predicted pre-quarrying groundwater contours the groundwater depth in this area is approximately 25 mAHD, as shown in **Figure 12.** This indicates that the bore is well above the current depth to groundwater and as such won't be affected by dewatering.

4.2.6 Conceptual Hydrogeological Model

A conceptual hydrogeological model (CHM) for the site is presented in **Figure 5**. It should be noted that the CHM is a generalised diagrammatic representation of the geology and hydrogeology encountered beneath the site. Actual depths and geometry of the formations represented may vary at specific locations.

4.3 Groundwater Flow Model Design

4.3.1 Model Discretisation

The model domain extends to approximately 3 km around the site, as shown on **Figure 8**. The ground surface elevation data was imported into the model from State 10-m contour dataset. Horizontally, the model grid is subdivided into 151 rows and 149 columns (as presented on **Figure 8** and **9**). Horizontal cell sizes ranges between 5 m by 5 m (over the site) and 100 m by 100 m over the remainder of the model domain.

Details of the model domain, horizontal gridding and vertical layering are presented on Figure 8 through Figure 11.

Vertically, the model grid comprises three layers, with subsurface layer geometry based upon reported regional and local geology (refer **Figure 9**).

4.3.2 Boundary Conditions

The adopted boundary conditions simulating regional and local groundwater recharge and discharge comprised Constant Head Boundary, Recharge and Drain types.

Constant Head Boundaries simulating the lateral flow of groundwater at the edges of the active model domain were assigned along the Williams River and the Grahamstown Reservoir.

Recharge Boundaries were applied to the topmost active layer across the model domain as shown on **Figure 10**. Net recharge was assumed to range between 5 mm/year and 80 mm/year.

Drain cells were used to simulate baseflow into creeks near the site. The simulated creek bottom was assumed to be 1 m below the land surface of the cell containing the drain cell. Drain cells were also used to simulate dewatering of the quarry pit by setting the drain elevation to 44 mAHD, which is 1 m below the proposed minimum elevation of the quarry pit. Conductance for each drain cell was set to 0.1 m^2/day.

River cells were used to simulate creeks that were assumed to be perennial. River floor was assumed to be 1 m below the ground elevation of the cell containing the river cell. Conductance was set to 0.1 m^2/day.

4.3.3 Aquifer Properties

Values of hydraulic conductivity presented in **Section 4.2.2** were specified for each formation/material in the beginning of modelling and were modified during the calibration process.

4.4 Model Calibration and Sensitivity

Model calibration entails comparing model-predicted water levels to observed water levels, then adjusting selected model input parameters, then re-running the model to produce a new set of predicted water levels, which are again compared to the observed water levels.

Comparison of observed and predicted heads can be done by plotting predicted versus observed values and visually selecting the best match. Groundwater level gauging data for BH01 through BH03 and GWB01 through GWB05 were used as calibration targets.

The main input parameters varied during the steady-state flow model calibration were hydraulic conductivities and recharge. With this steady-state model an infinite combination of hydraulic conductivities and recharge will produce a reasonably calibrated model. Additional information, such as baseflow to creeks and rivers, can be used to constrain these input parameters and improve confidence in the model.

Initially, a uniform horizontal conductivity value of 0.5 m/d and a corresponding vertical conductivity value of 0.05 m/d were assigned. Model-predicted heads were too high. Therefore, these initial values for hydraulic conductivity were then assigned based on values to reflect literature values and interpretation of onsite hydrogeological tests, as discussed in **Section 4.2.2**.

Figure 11 shows the zones and associated values of the adopted hydraulic conductivity values. These values were nominated by varying the initial values of conductivity to improve model prediction of water levels at the site and surrounding areas.

Model sensitivity explores how model-predicted water levels respond to a systematic change in an input parameter. The calibrated model was used to explore model sensitivity to varying the conductance of the creeks simulated as drains. The initial conductance for each drain cell, of 0.1 m^2/day, was reduced by an order of magnitude to 0.01 m^2/day, after the model re-run.

4.5 Flow Modelling Results

Figure 12 shows a plan view of the model-predicted pre-quarrying, steady-state water-level elevation contours (in mAHD). These contours show that the excavation to the target elevation of 45 mAHD in the western portion of the proposed quarry would intersect the water table and require dewatering.

Figure 13 shows a plan view of steady-state water-level contours in response to pit dewatering to an elevation of 44 mAHD. **Figures 14** and **15** show east-west and north-south cross sections, respectively, through the site.

Figure 16 shows for each creek the location of the transition from perennial to ephemeral flow. Discussion for each creek segment follows.

4.5.1 7 Mile Creek East of the Proposed Quarry

For the reach of 7 Mile Creek east of the proposed quarry Figure 18 shows where the model predicts that 7 Mile creek floor is above the predicted steady-state water levels if the proposed quarry were dewatered to 44 mAHD. At the indicated location on the creek the predicted water level for the pre-quarry dewatering scenario is 45.09 mAHD with a creek (drain) invert at 45.28 mAHD, so groundwater flows into the creek.

4.5.2 Creek Immediately North of the Proposed Quarry

West of this location shown on **Figure 16** the model predicts that the creek floor is above the predicted steady-state water levels prior to quarry dewatering to 44 mAHD. At the indicated location on the creek with a creek (drain) invert at 44.66 mAHD, the predicted water level for the pre-quarry dewatering scenario is 44.78 mAHD and the predicted water level for dewatered quarry is 43.06 mAHD, so groundwater flows into the creek only for pre- dewatering of the quarry. The perennial portion of the creek shifts to the east, as indicated by the other callout shown on **Figure 16**.

4.5.3 Creek Immediately South of the Proposed Quarry

West of this location shown on **Figure 16** the model predicts that the creek floor is above the predicted steady-state water levels if the proposed quarry were dewatered to 44 mAHD. At the indicated location on the creek with a creek (drain) invert at 33.47 mAHD, the predicted water level for the pre-quarry dewatering scenario is 33.7 mAHD and the predicted water level for dewatered quarry is 33.57 mAHD, so groundwater flows into the creek both pre- and post-dewatering of the quarry, but a slightly lower water level (~0.13 m lower) with quarry dewatering to 44 mAHD.

4.6 Groundwater Flow Baseflow Evaluation

A comparison of model-predicted baseflow to nearby creeks under pre-quarrying steady-state conditions and steady-state conditions with quarry dewatering to 44 mAHD indicated the following:

Table 3-1 Predicted Creek Baseflow Changes – Baseflow Sensitivity to Drain Conductance

Creek Location	Pre-quarrying: baseflow (m^3/day) Using Drain Conductance of 0.1 m^2/day or 0.01 m^2/day	Quarry dewatering: baseflow (m^3/day) Using Drain Conductance of 0.1 m^2/day or 0.01 m^2/day	Predicted baseflow reduction (m^3/day) Using Drain Conductance of 0.1 m^2/day or 0.01 m^2/day
Seven Mile Creek north of site	6.2 / 3.0	2.0 / 1.3	4.2 / 1.7
Creek immediately north of site	8.1 / 4.2	4.4 / 2.5	3.7 / 1.7
Seven Mile Creek east of site	0.5 / 2.7	0.4 / 1.9	0.1 / 0.8
Creek immediately south of site	12.6 / 6.8	11.1 / 5.5	1.5 / 1.3
Quarry footprint requiring dewatering	0 / 0	43 / 48	Not applicable

Note that a limitation of the model is that streamflow data was not available for the Seven Mile Creek system. Therefore, further model calibration could not be undertaken because of the lack of flow measurements for any of the creeks. However, inspection of field photography does indicate that most of the creeks are ephemeral, which is predicted by the model based on the intersection of groundwater levels and creek floor elevations.

Model sensitivity to reducing conductance of the creeks around the proposed quarry modelled as drains indicated that reducing conductance by an order of magnitude generally reduced predicted baseflow by approximately 50% except for the reach of 7 Mile Creek east of the proposed quarry where baseflow increased in response to higher water levels next to the creek that compensated for the lower conductance.

The main impact to baseflow in the Seven Mile Creek system occurs to the east of the proposed quarry footprint. The model indicates that for each of the creeks in the 7 Mile Creek system the up-creek location of the transition from perennial to ephemeral conditions does not change significantly. The reduction in baseflow predicted by the model is in response to a lowering of water levels next to the perennial portion of each creek, which reduced the predicted baseflow going to that particular creek.

The model-predicted reductions in baseflow to these creeks can be used on a relative basis, which could then be used once baseflow measurements are available to evaluate more accurate reduction in baseflow estimates for the creeks.

4.7 Summary of Findings

The main objective of the groundwater flow modelling was to evaluate the potential impact that quarry dewatering may have on groundwater pumpers and baseflow to creeks near the site.

The reduction in model-predicted baseflow to the nearby creeks reflects lowering of the water table near each of the simulated creeks in response to quarry dewatering. Considering model limitations in the extent of the ephemeral versus perennial creeks and in representing ground-surface and corresponding creek elevations, the predicted water-table contours and predicted baseflows should be evaluated on an order-of-magnitude basis.

With these limitations, the model predicts that approximately 43 m^3/day would be pumped from the quarry during pit dewatering to an elevation of 44 mAHD. Quarry dewatering under steady-state conditions would reduce baseflow to:

- Seven Mile Creek north of the proposed quarry would reduce by approximately 68%.
- The creek immediately north of the proposed quarry would reduce by approximately 46%.
- Seven Mile Creek east of the proposed quarry would reduce by approximately 20%.
- The creek immediately south of the proposed quarry would reduce by approximately 12%.

The model-predicted groundwater levels indicate that the main impact to baseflow in the Seven Mile Creek system occurs to the northeast of the proposed quarry footprint. It is noted again that the model predictions are limited by the lack of availability of stream baseflow data for any of the surrounding creeks. The model-predicted reductions in baseflow to these creeks can be used on a relative basis to be refined once creek baseflow measurements are available. This would allow a more accurate evaluation of the reduction in baseflow estimates for the creeks.

4.8 Discussion

As discussed in **Section 4.7**, the groundwater flow model is limited by the by the lack of available stream baseflow data for any of the surrounding creeks. The model-predicted reductions in baseflow to these creeks are to be viewed as a relative measure of reductions in flow, which can be further refined with streamflow data. The predicted decreases in flow of between 12% and 68%, when applied to an ephemeral creek of this nature, equates to a low volume of water being lost to the system because of the very low initial volume.

The flow regimes in intermittent and ephemeral streams are important to river health and the ecosystems within, cease-to-flow periods are just as critical as flood events. A key aspect of managing ephemeral streams is assessing current conditions, including standing ponds, water quality parameters such as dissolved oxygen, and flow regimes. The progressive nature of the Eagleton Mine expansion allows adequate time with which to assess and monitor the Seven Mile Creek system and formulate an appropriate Stream Management Plan based on these observations.

As part of the Surface Water Management plan currently being prepared for the EA, a Stream Management Plan would address losses to the creek system with careful monitoring and controlled releases, aiming for no net loss or gain of temporal flow within the system.

Conclusions

Drilling works were conducted from 6th February to 11th February, 2013. Four 50mm monitoring wells and one 100mm test well were completed.

Groundwater height is a subdued expression of surface topography. Depths to water ranged between approximately 8 m mbTOC in the east of the site (GWB04) and 40 mbTOC in the steeper western portion of the site (GWB05).

The Groundwater Flow Model predicts that approximately 43 m^3/day would be pumped from the quarry during pit dewatering to an elevation of 44 mAHD.

The Groundwater Flow Model predicts that quarry dewatering under steady-state conditions would reduce baseflow to the surrounding creeks to between 12% and 68%. The model is limited by the lack of available stream flow data.

Although every effort has been made to provide an accurate representation a limitation of the model is that streamflow data was not available for the Seven Mile Creek system. Further calibration of the model could be undertaken once flow measurements for the creeks surrounding the site were available. Inspection of field photography indicates that most of the creeks are ephemeral, which is predicted by the model based on the intersection of groundwater levels and creek floor elevations.

Under the Water Management Act 2000 a water licence is required for the removal of water from an aquifer or the movement of water from one water source to another water source, such as, from an aquifer to a river. With careful management baseflow losses to the Seven Mile Creek system could be mitigated under an appropriate Surface Water Management Plan.

References

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http://www.google.com.au/url?sa=t&rct=j&q=&esrc=s&frm=1&source=web&cd=1&cad=rja&ved=0CCsQFjAA&url=http%3A%2F%2Fwww.resources.nsw.gov.au%2Fgeological%2Fgeological-maps%2F1-100-000%2Fnewcastle-1100-000-geological-map&ei=E2CBUsfTNPCziQfE6IGwAQ&usg=AFQjCNEGiN10Zgr7pa9dIZi22xoUKDT9hA&bvm=bv.56146854,d.aGc

Limitations

URS Australia Pty Ltd (URS) has prepared this report in accordance with the usual care and thoroughness of the consulting profession for the use of Castle Quarry Products.

Except as required by law, no third party may use or rely on, this Report unless otherwise agreed by URS in writing. Where such agreement is provided, URS will provide a letter of reliance to the agreed third party in the form required by URS.

It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this Report. It is prepared in accordance with the scope of work and for the purpose outlined in the contract dated 29th January 2013.

The methodology adopted and sources of information used by URS are outlined in this the Report.

Where this Report indicates that information has been provided to URS by third parties, URS has made no independent verification of this information unless required as part of the agreed scope of work. URS assumes no liability for any inaccuracies in or omissions to that information.

This Report was prepared between October 2013 and November 2013.The information in this Report is considered to be accurate at the date of issue and is in accordance with conditions at the site at the dates sampled. Opinions and recommendations presented herein apply to the site existing at the time of our investigation and cannot necessarily apply to site changes of which URS is not aware and has not had the opportunity to evaluate. This document and the information contained herein should only be regarded as validly representing the site conditions at the time of the investigation unless otherwise explicitly stated in a preceding section of this Report. URS disclaims responsibility for any changes that may have occurred after this time.

This Report should be read in full. No responsibility is accepted for use of any part of this Report in any other context or for any other purpose. This Report does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.

This Report contains information obtained by inspection, sampling, testing or other means of investigation. This information is directly relevant only to the points in the ground where they were obtained at the time of the assessment. The borehole logs indicate the inferred ground conditions only at the specific locations tested. The precision with which conditions are indicated depends largely on the uniformity of conditions and on the frequency and method of sampling as constrained by the project budget limitations. The behaviour of groundwater and some aspects of contaminants in soil and groundwater are complex. Our conclusions are based upon the analytical data presented in this Report and our experience. Future advances in regard to the understanding of chemicals and their behaviour, and changes in regulations affecting their management, could impact on our conclusions and recommendations regarding their potential presence on this site.

Where conditions encountered at the site are subsequently found to differ significantly from those anticipated in this Report, URS must be notified of any such findings and be provided with an opportunity to review the recommendations of this Report.

Whilst to the best of our knowledge information contained in this Report is accurate at the date of issue, subsurface conditions, including groundwater levels can change in a limited time.

7 Limitations

Therefore this document and the information contained herein should only be regarded as valid at the time of the investigation unless otherwise explicitly stated in this Report.

To the extent permitted by law, URS expressly disclaims and excludes liability for any loss, damage, cost or expenses suffered by any third party relating to or resulting from the use of, or reliance on, any information contained in this Report. URS does not admit that any action, liability or claim may exist or be available to any third party.

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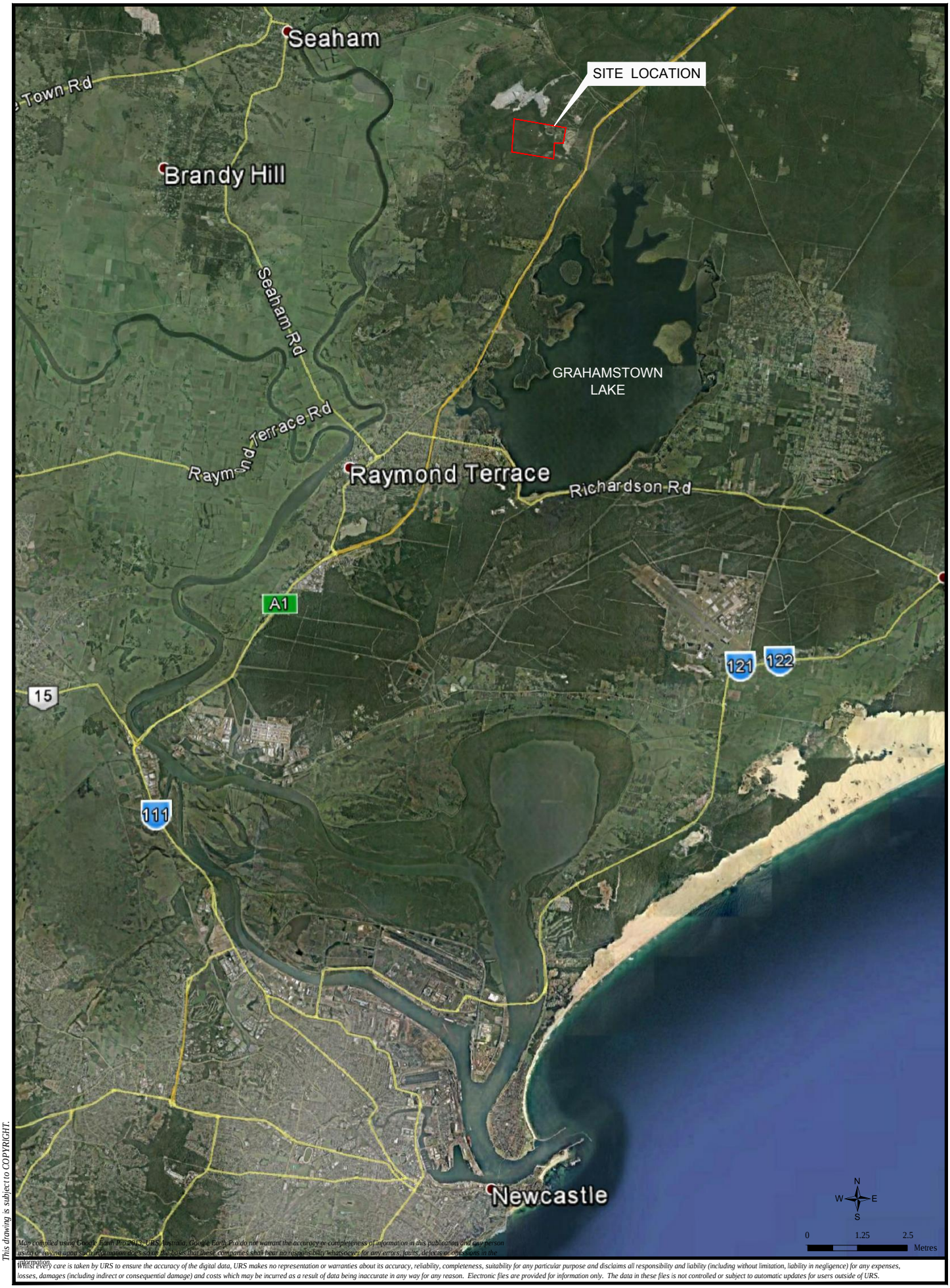
It is the responsibility of third parties to independently make inquiries or seek advice in relation to their particular requirements and proposed use of the relevant property.

Any estimates of potential costs which have been provided are presented as estimates only as at the date of the Report. Any cost estimates that have been provided may therefore vary from actual costs at the time of expenditure.

Appendix A Figures

New figure as of 11 February 2014:



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EAGLETON, N.S.W.

HYDROGEOLOGICAL
SITE INVESTIGATION

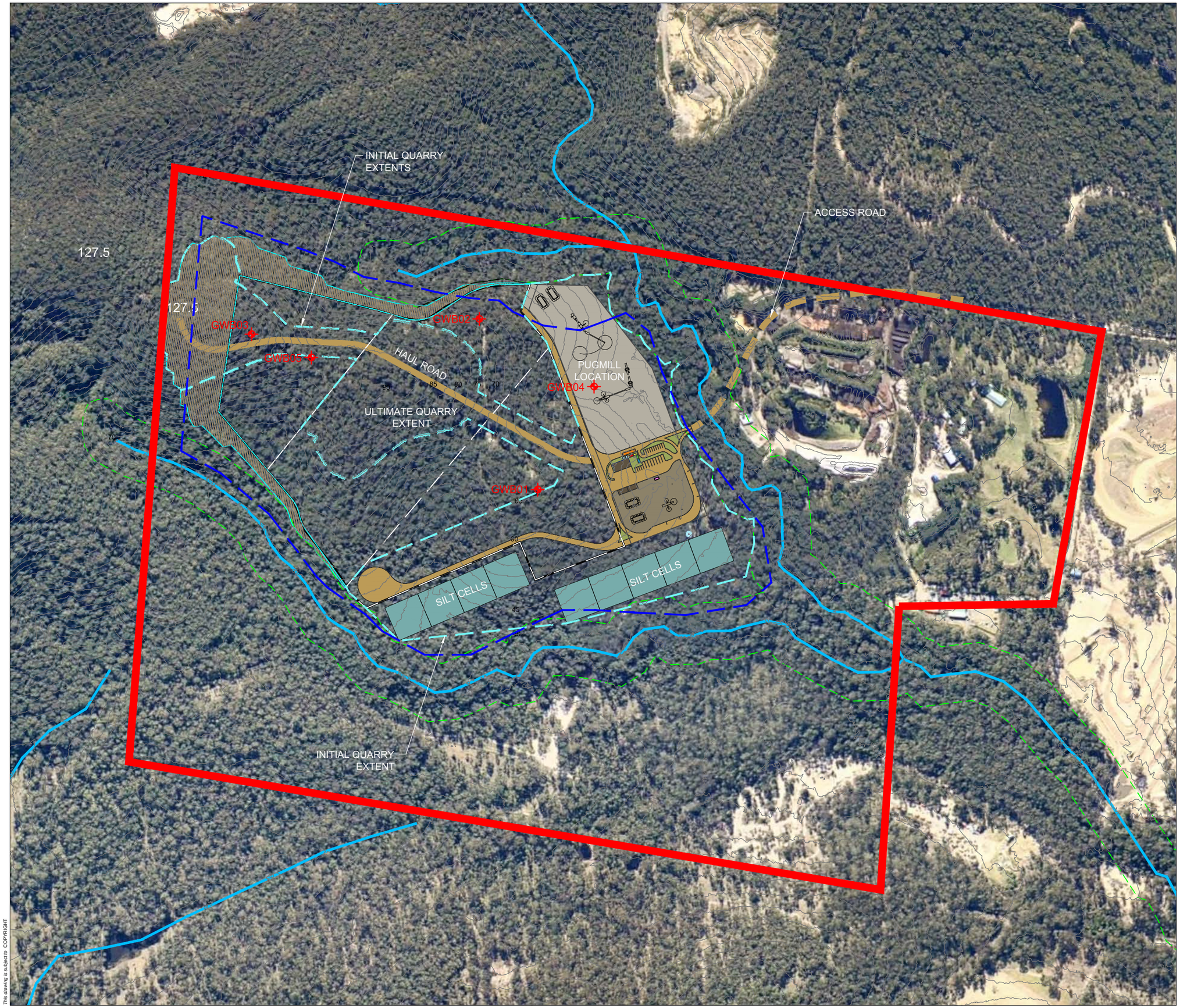
SITE LOCALITY MAP

URS

43207448

Figure: 1

File No: 43207448 Drawn: JG Approved: KH Date: 13.11.13 Rev. A A4



LEGEND

- Groundwater Monitoring Wells
- Potential Quarry Footprint
- Roads
- Watercourse
- Watercourse Buffer
- Site Boundary

N
W E
S

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Metres

Coordinate System: GDA 1994 MGA Zone 54
Projection: Transverse Mercator
Datum: GDA 1994
Units: Meter

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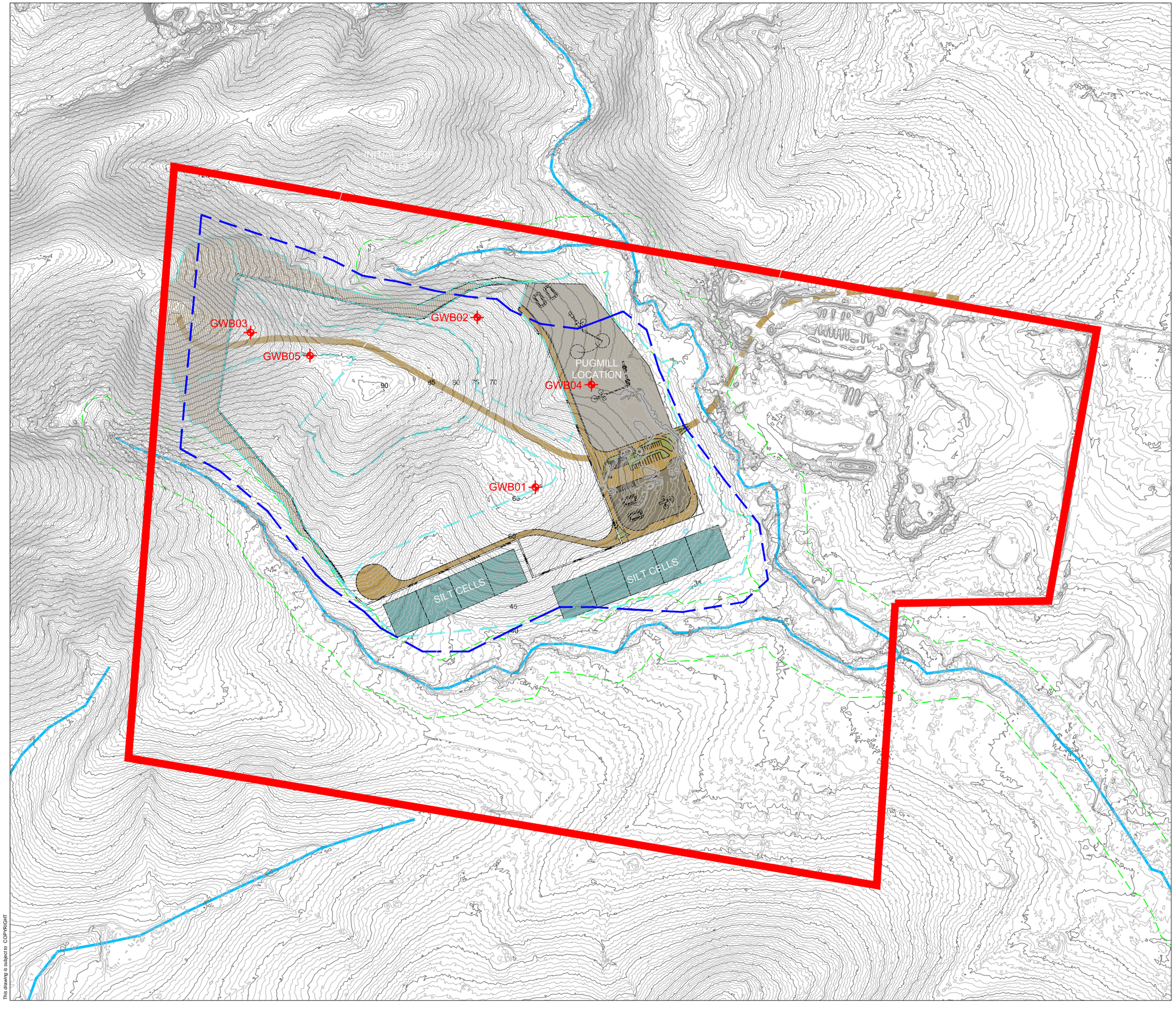
SITE LAYOUT

URS Figure: 2
Rev. A A3



LEGEND

- Groundwater Monitoring Wells
- Potential Quarry Footprint
- Roads
- Watercourse
- Watercourse Buffer
- Site Boundary

N
W E
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0 0.025 0.05 0.1
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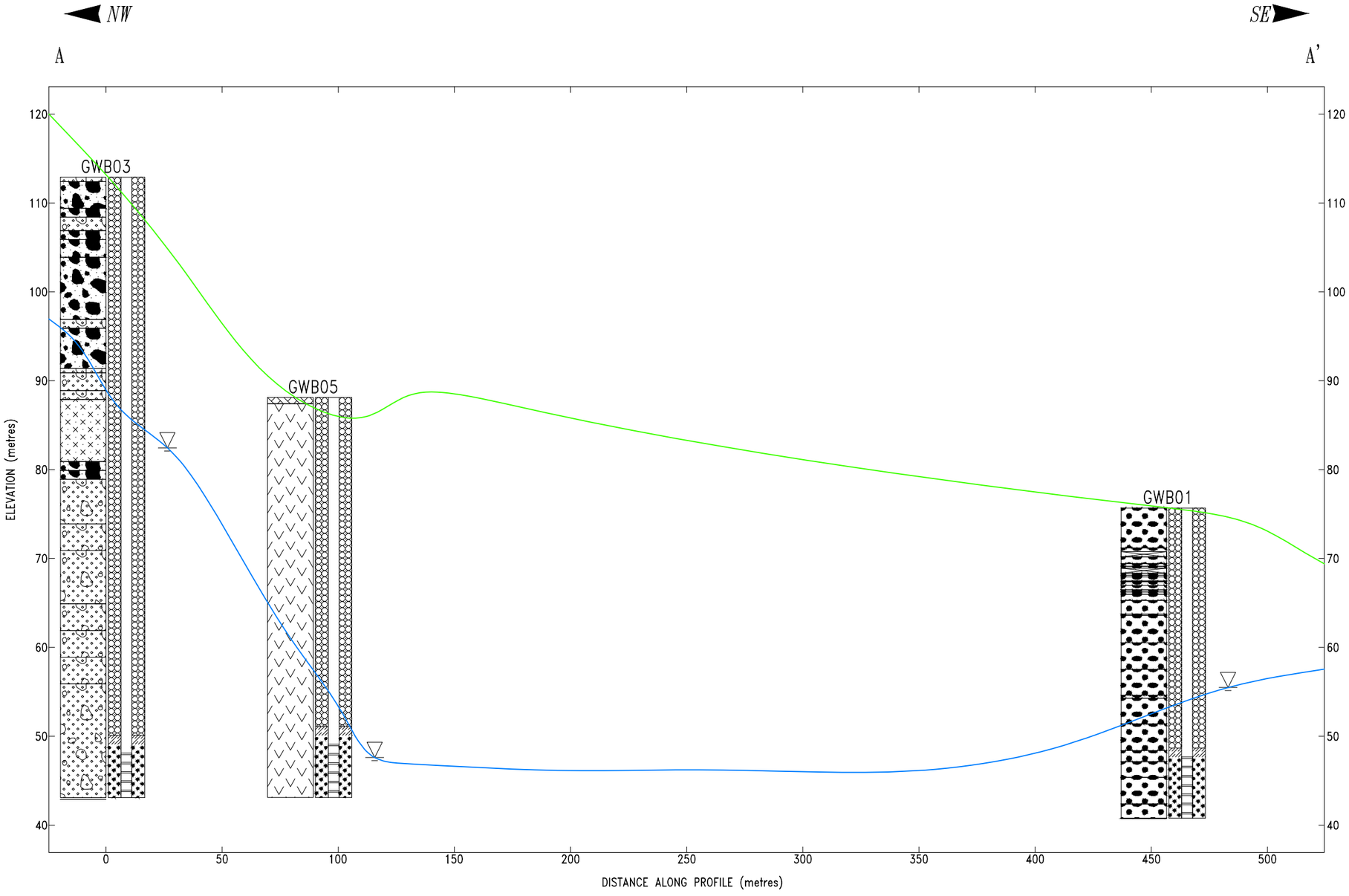
SITE TOPOGRAPHY LAYOUT

URS Figure: 3
Rev. A A3

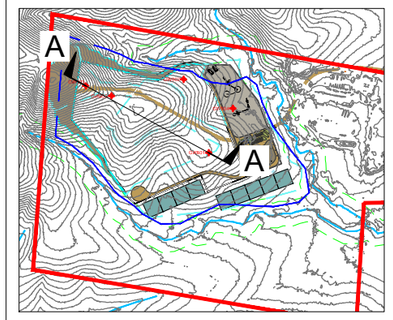


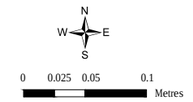
Lithology Graphics

- Conglomerate
- Silty Sand – Sandy Silt
- Core Loss pattern
- Fill
- USCS Well-graded Gravelly Sand
- Fine-grained Igneous Rock
- USCS Well-graded Sandy Gravel

Well Graphics

- 1 pipe, in cement/grout
- 1 pipe, in bentonite chips
- 1 pipe, slotted in gravel
- 1 pipe, in pea gravel





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EAGLETON QUARRY
CONCEPTUAL MODEL
NW-SE CROSS SECTION

URS | Figure: 4 | Rev. A | A3

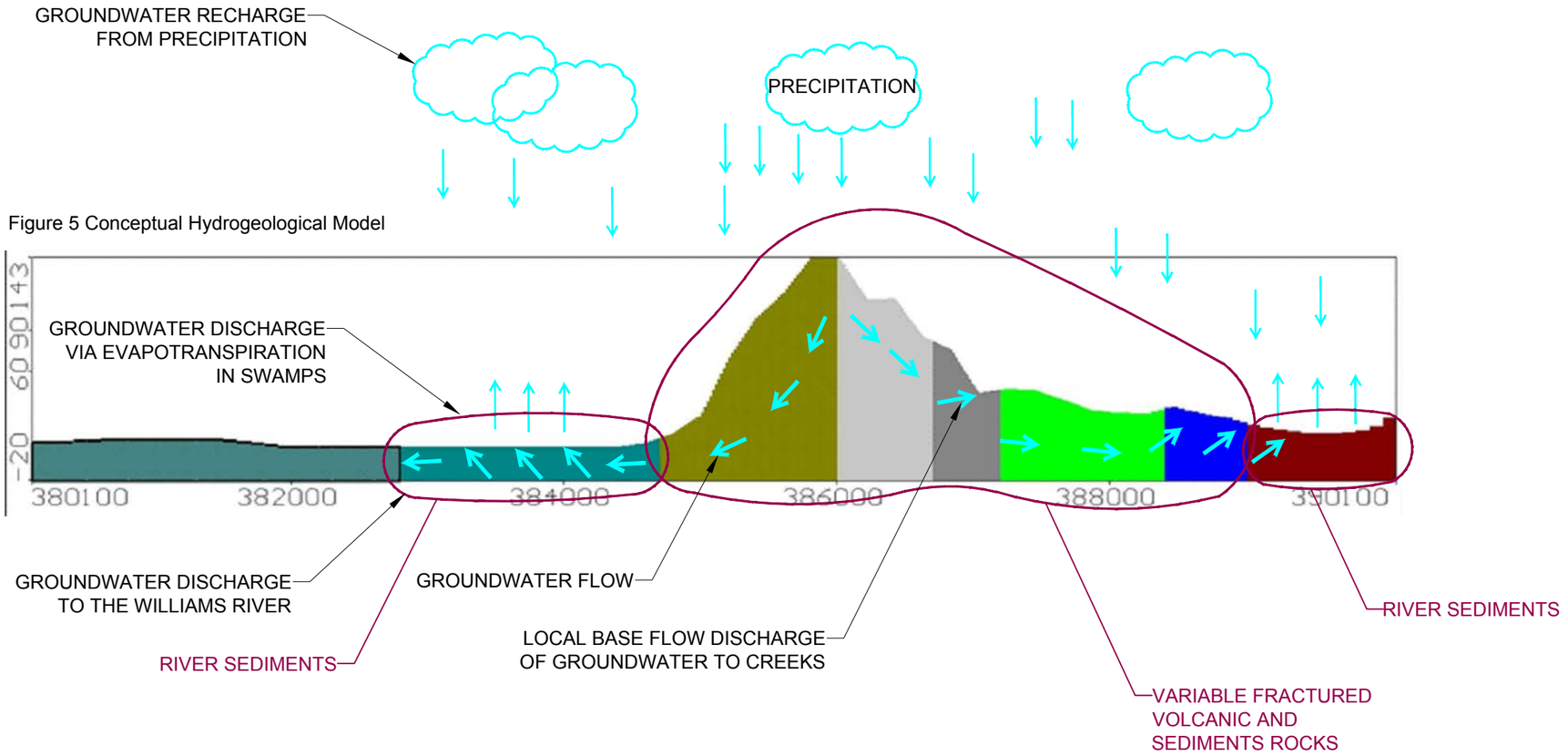

Figure 5 Conceptual Hydrogeological Model

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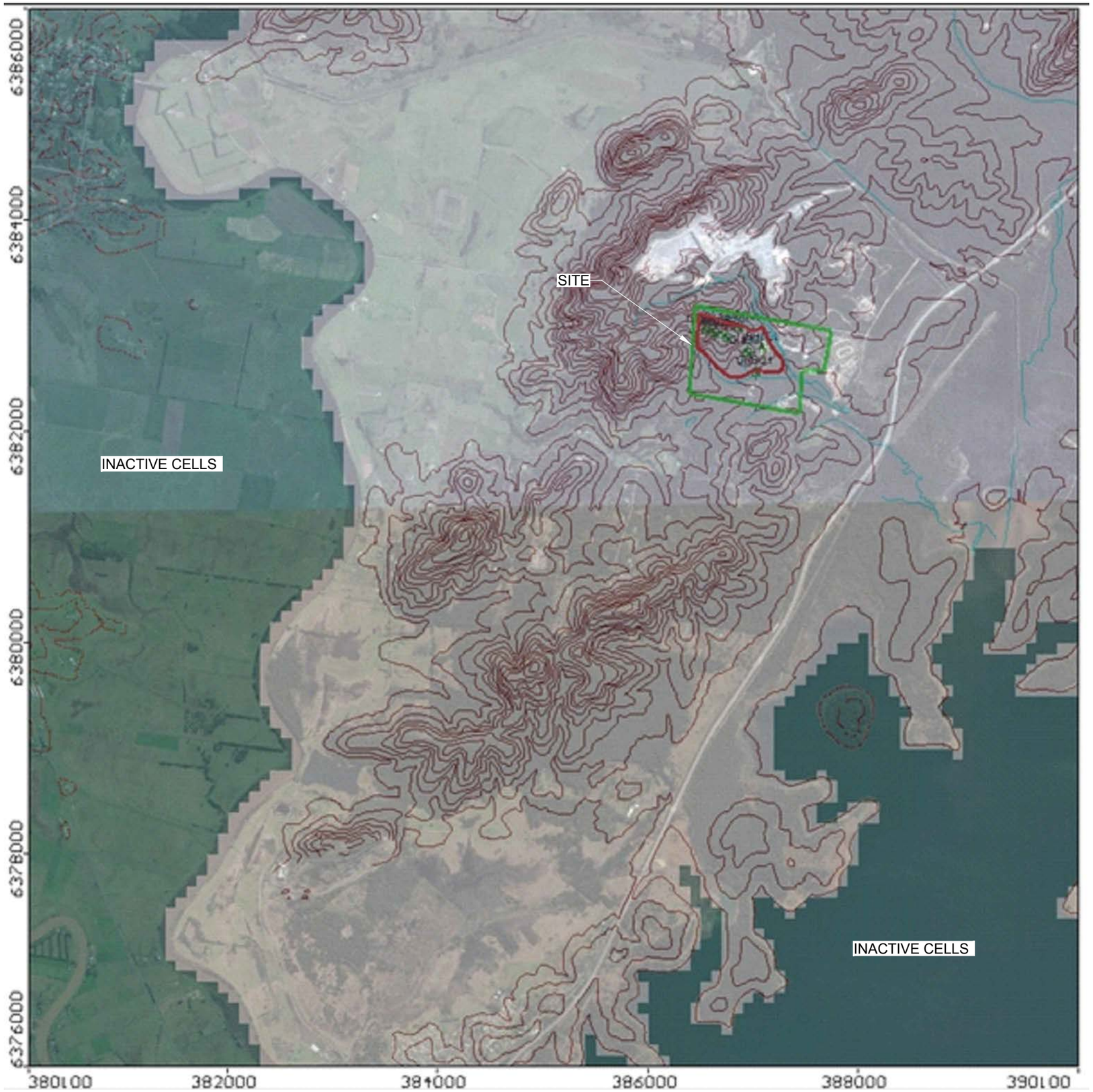
EAGLETON QUARRY
CONCEPTUAL MODEL
NW-SE CROSS SECTION

URS Figure: 5 Rev. A A3

Figure 6 - Model Domain



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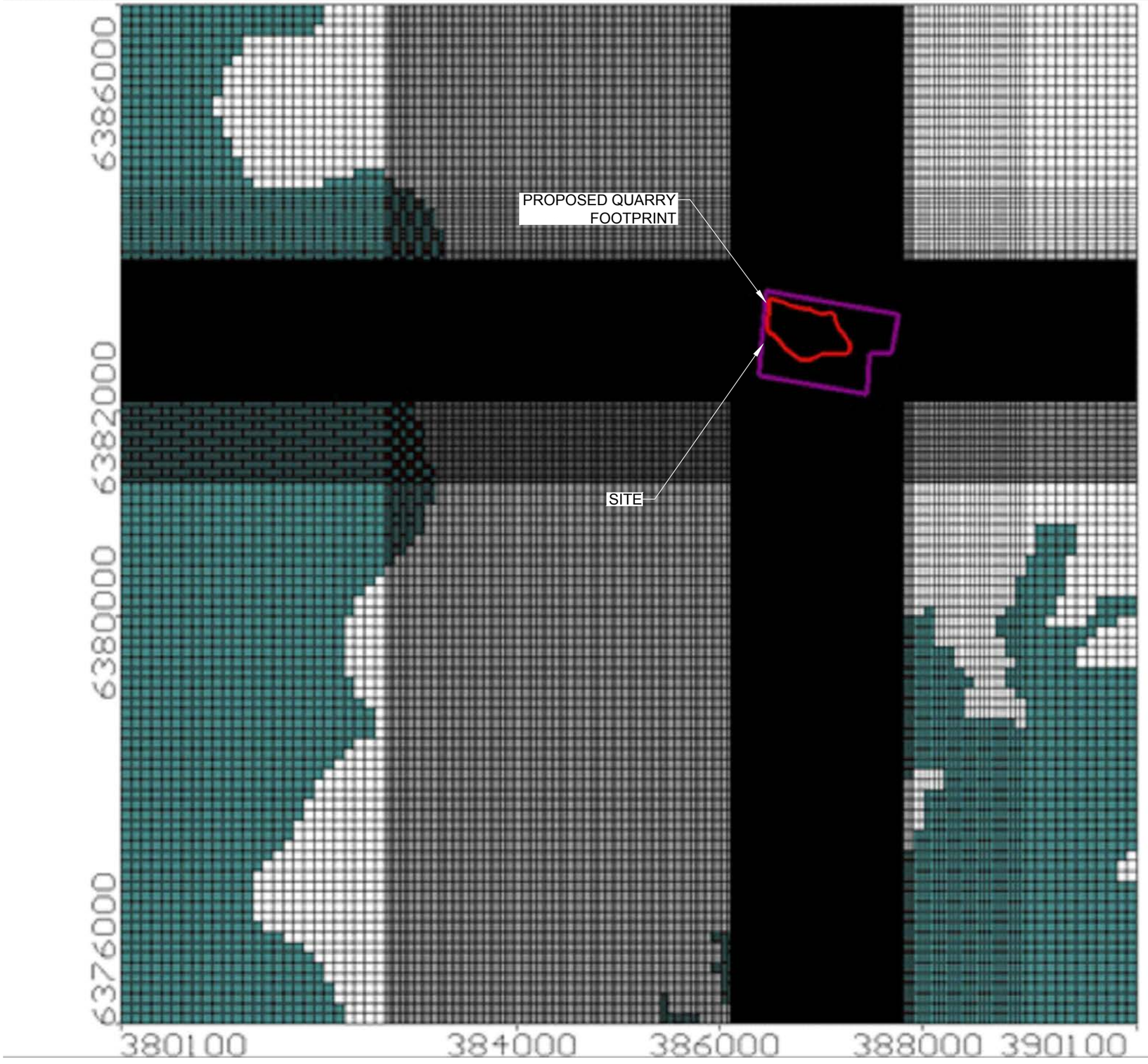
EAGLETON QUARRY
CONCEPTUAL MODEL
NW-SE CROSS SECTION

URS Figure: 6 Rev. A A3

Figure 7 - Model Horizontal Grid



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EAGLETON QUARRY
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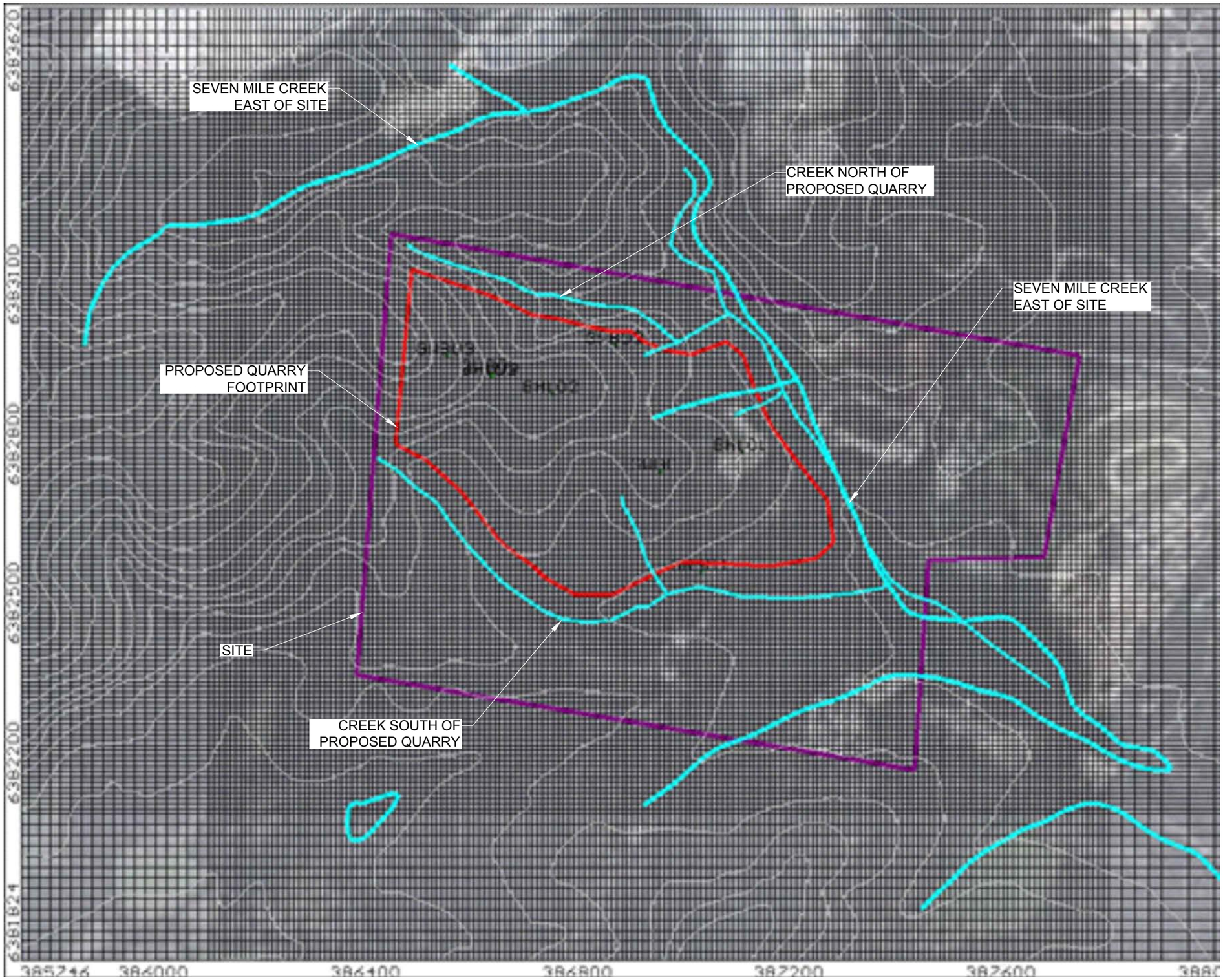
NW-SE CROSS SECTION

URS Figure: 7
Rev. A A3

Figure 8 - Model Horizontal Grid at Site



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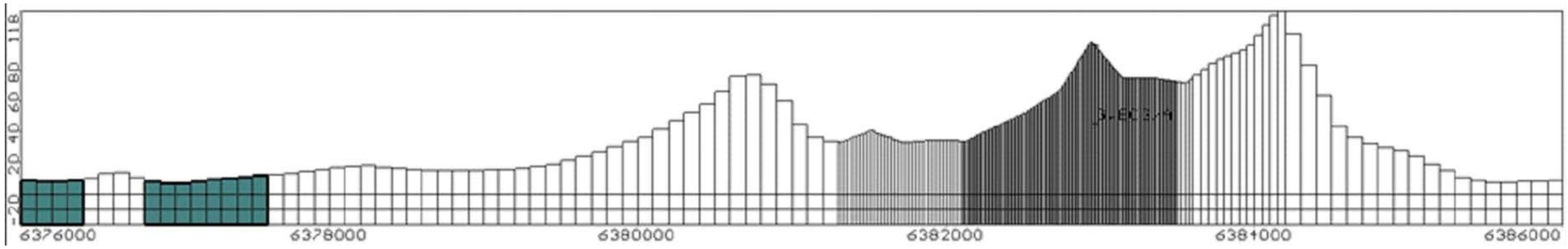
EAGLETON QUARRY
CONCEPTUAL MODEL
NW-SE CROSS SECTION

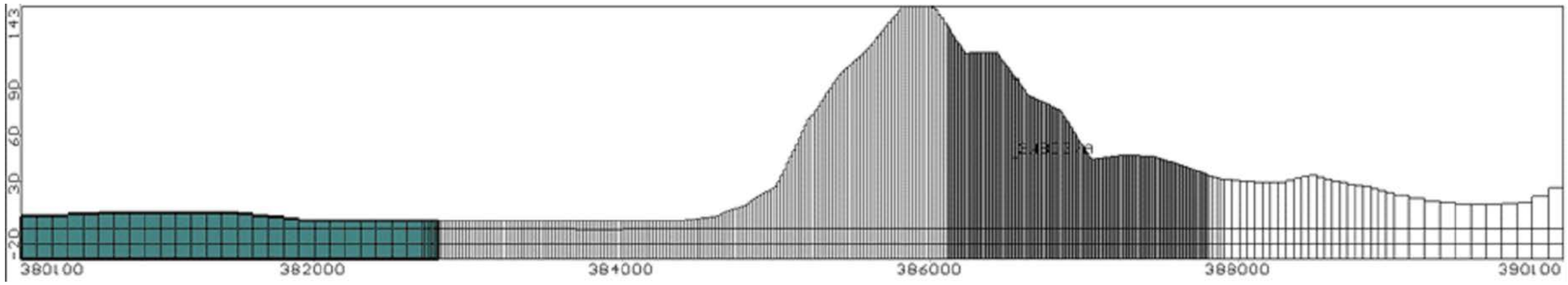
URS Figure: 8 Rev. A A3

Figure 9 - Model Vertical Layering

North-South Cross Section through Column 242 (GWB03)



East-West Cross Section through Row 68



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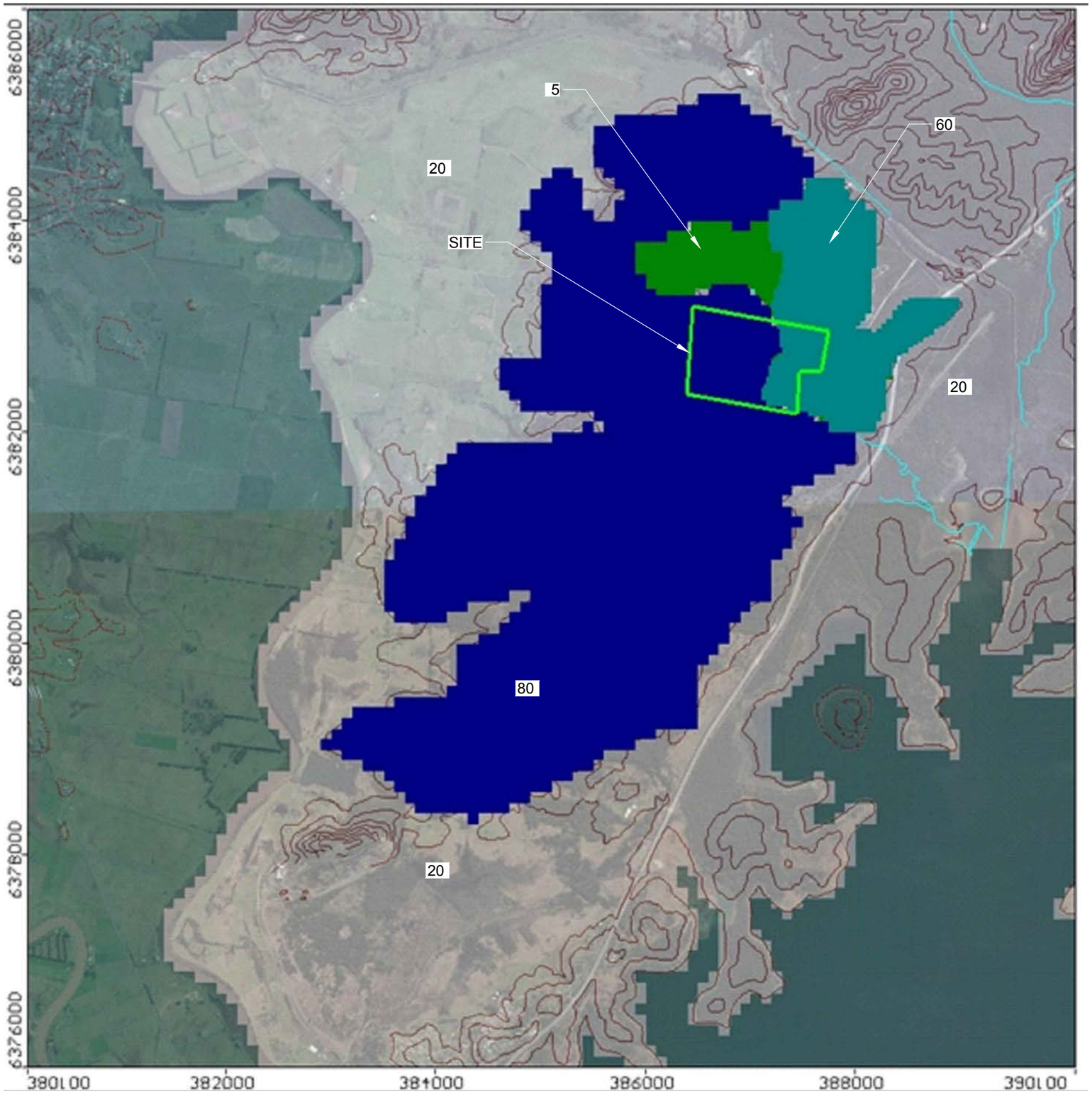
EAGLETON QUARRY
CONCEPTUAL MODEL
NW-SE CROSS SECTION

URS Figure: 9 Rev. A A3

Figure 10 – Adopted Recharge (mm/year)



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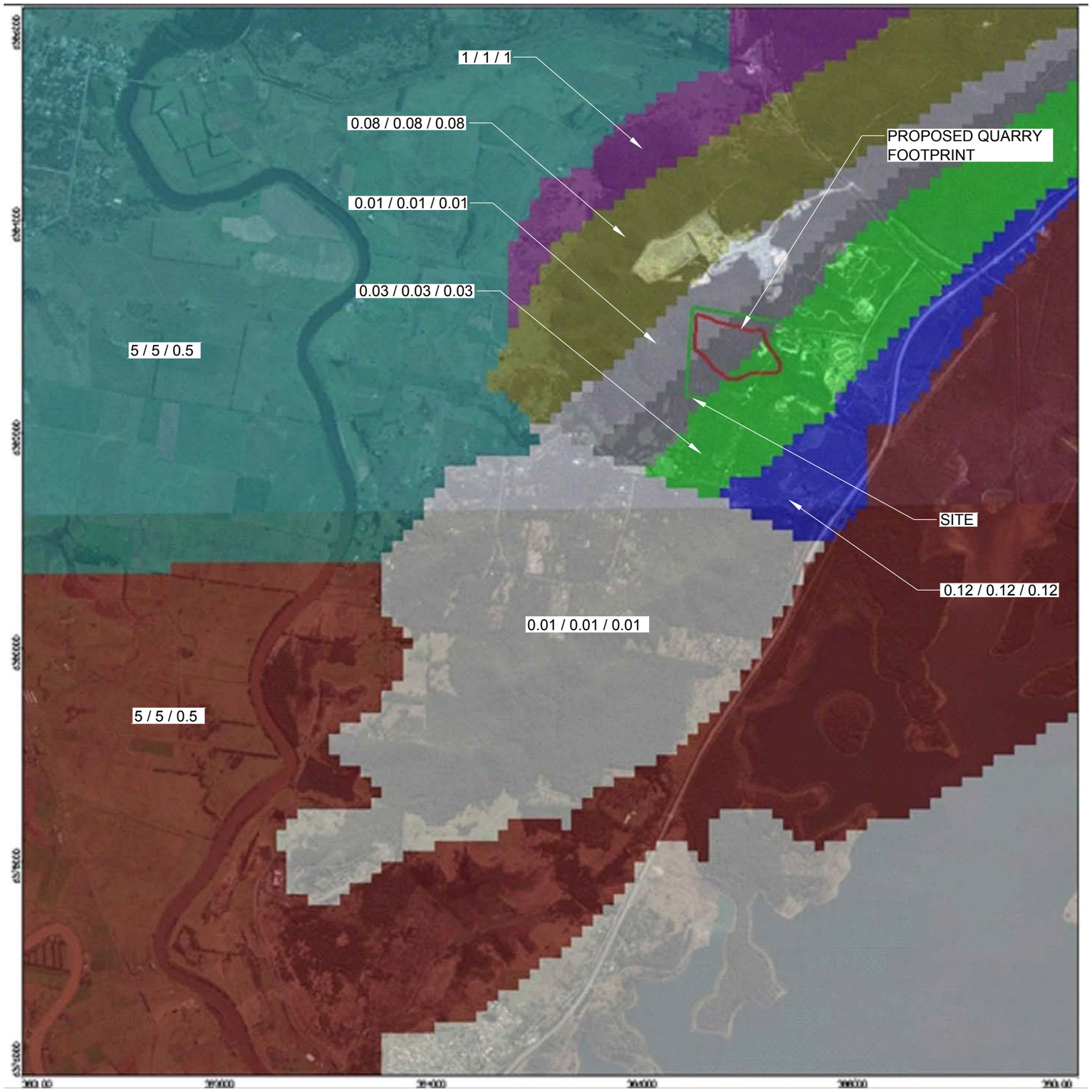
EAGLETON QUARRY
CONCEPTUAL MODEL
NW-SE CROSS SECTION

URS Figure: 10 Rev. A A3

Figure 11 – Adopted Hydraulic Conductivities: Kx/Ky/Kz (m/d)



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Metres

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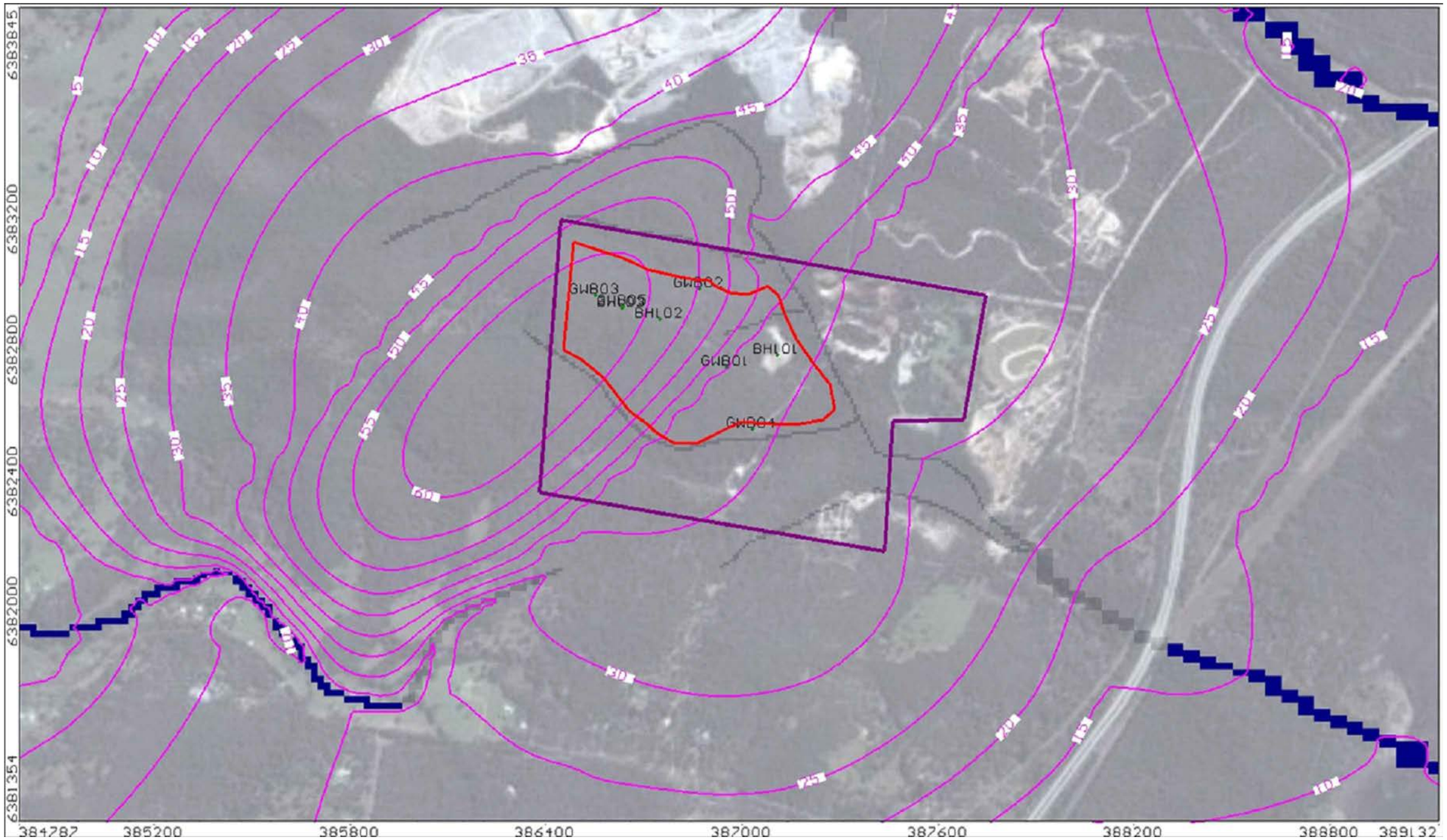
CONCEPTUAL MODEL
NW-SE CROSS SECTION

URS Figure: 11 Rev. A A3

Figure 12 – Predicted Pre-quarrying Steady-state Water-level Contours – Plan View



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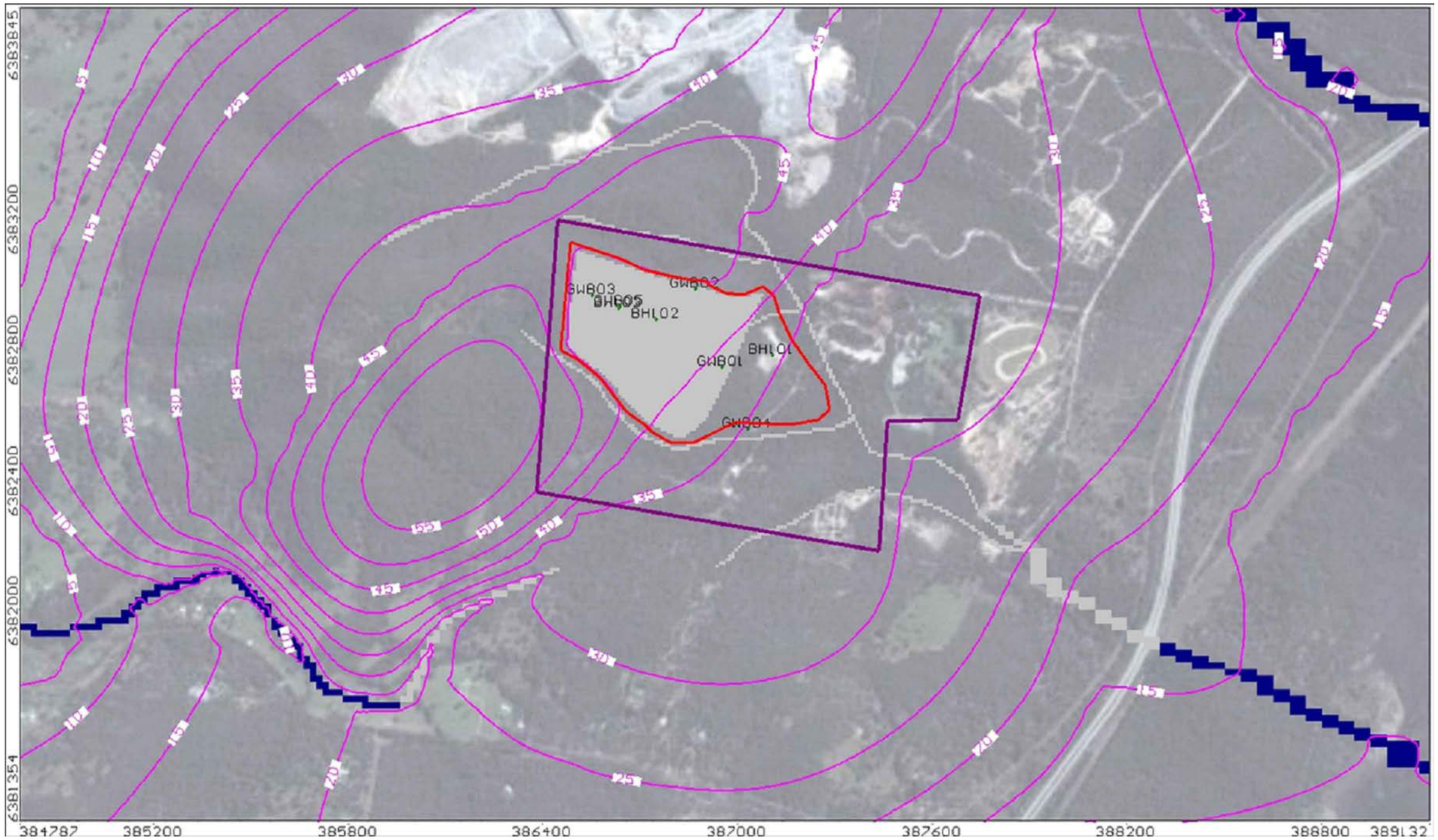
EAGLETON QUARRY
CONCEPTUAL MODEL
NW-SE CROSS SECTION

URS Figure: 12
Rev. A A3

Figure 13 – Predicted Dewatered Quarry Steady-state Water-level Contours – Plan View



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Metres

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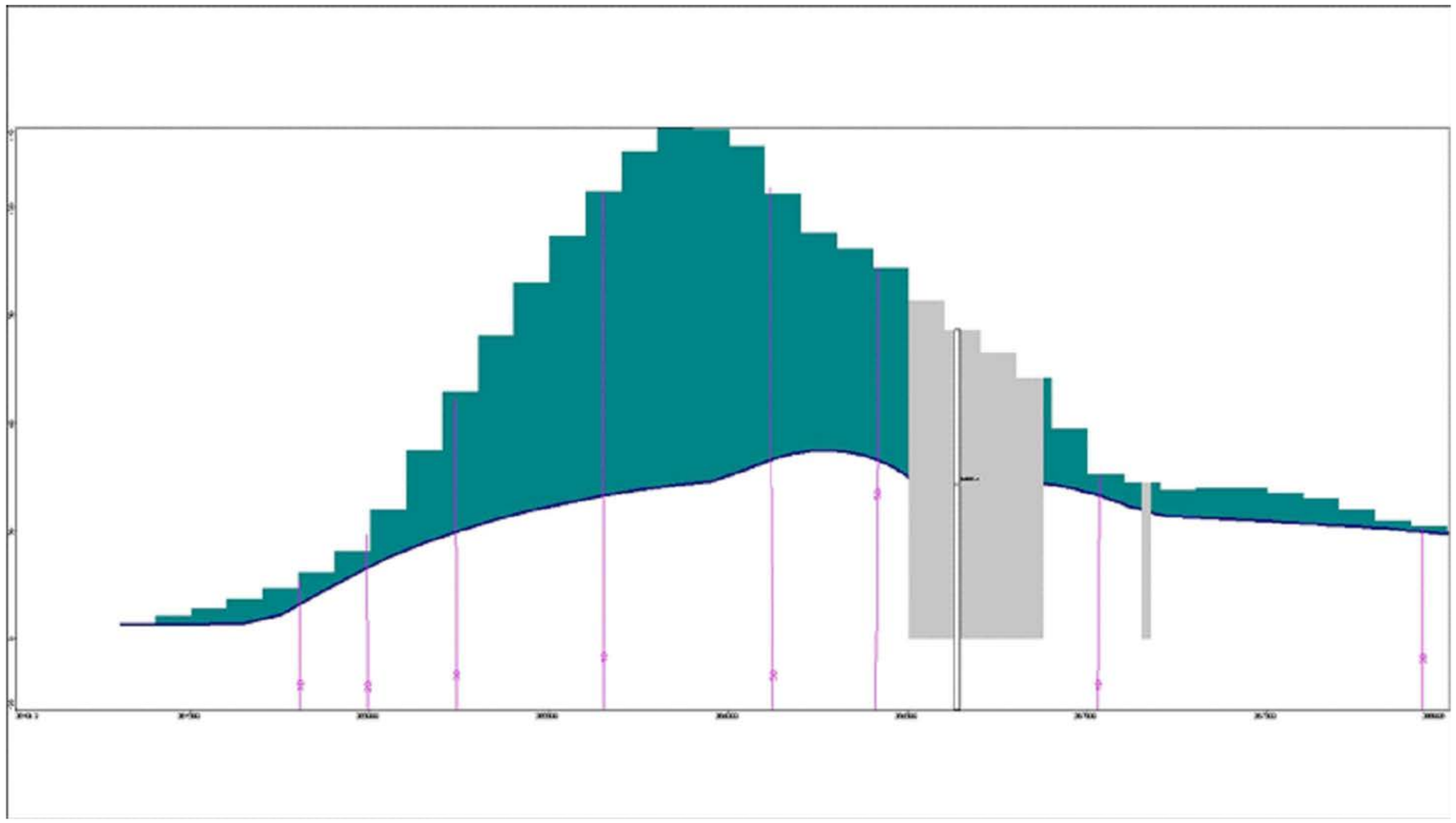
HYDROGEOLOGICAL SITE INVESTIGATION

EAGLETON QUARRY
CONCEPTUAL MODEL
NW-SE CROSS SECTION

URS Figure: 13
Rev. A A3

Figure 14 – Predicted Dewatered Quarry Steady-state Water-level Contours – East-West Cross Section through Site



0 0.025 0.05 0.1
Metres

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PATH: U:\JOBS\43207448\CAD\Working

FILE NO: 43207448

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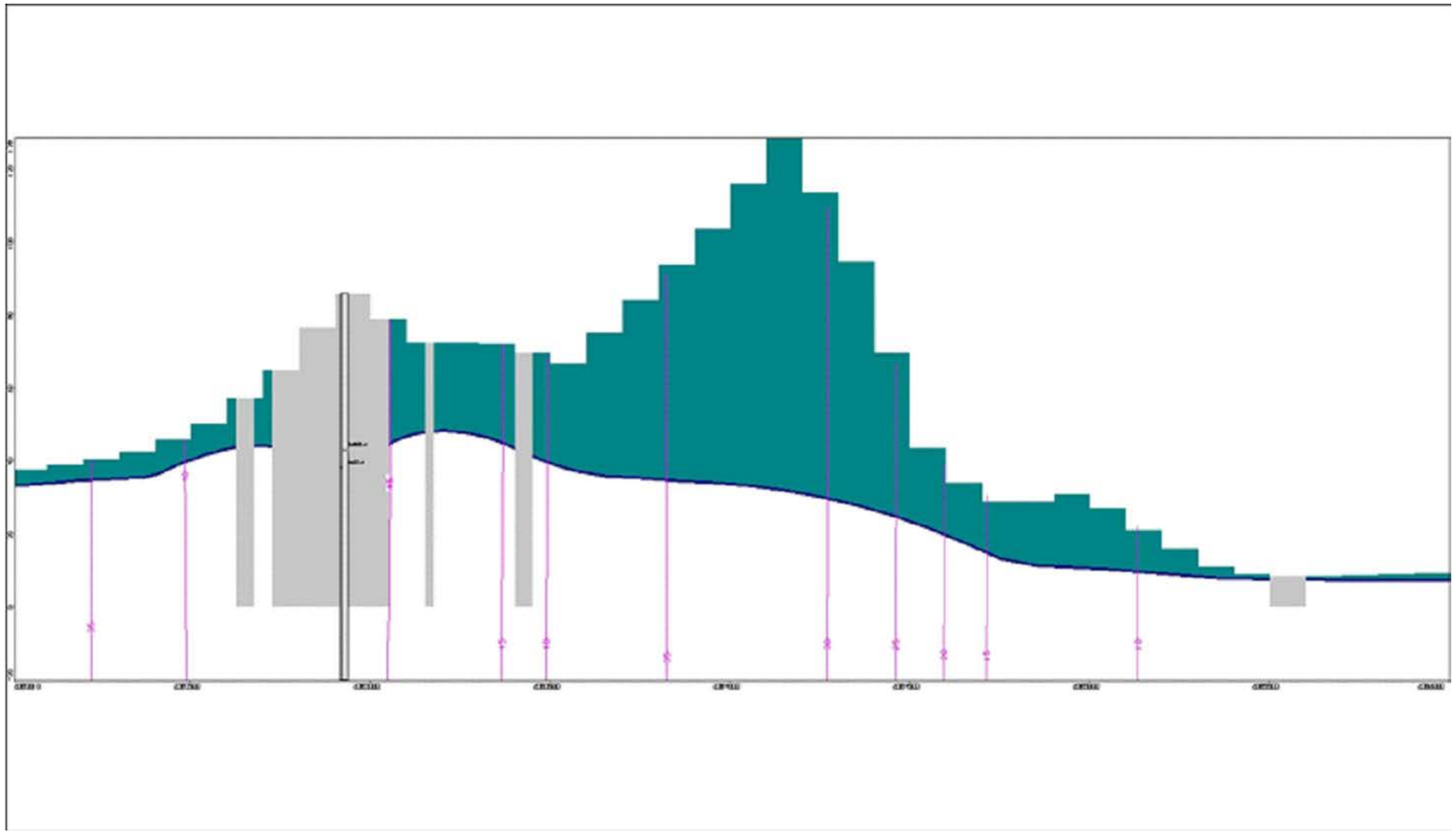
HYDROGEOLOGICAL SITE INVESTIGATION

EAGLETON QUARRY
CONCEPTUAL MODEL
NW-SE CROSS SECTION

URS Figure: 14
Rev. A A3

Figure 15 – Predicted Dewatered Quarry Steady-state Water-level Contours – North-South Cross Section through Site



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Metres

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Projection: Transverse Mercator
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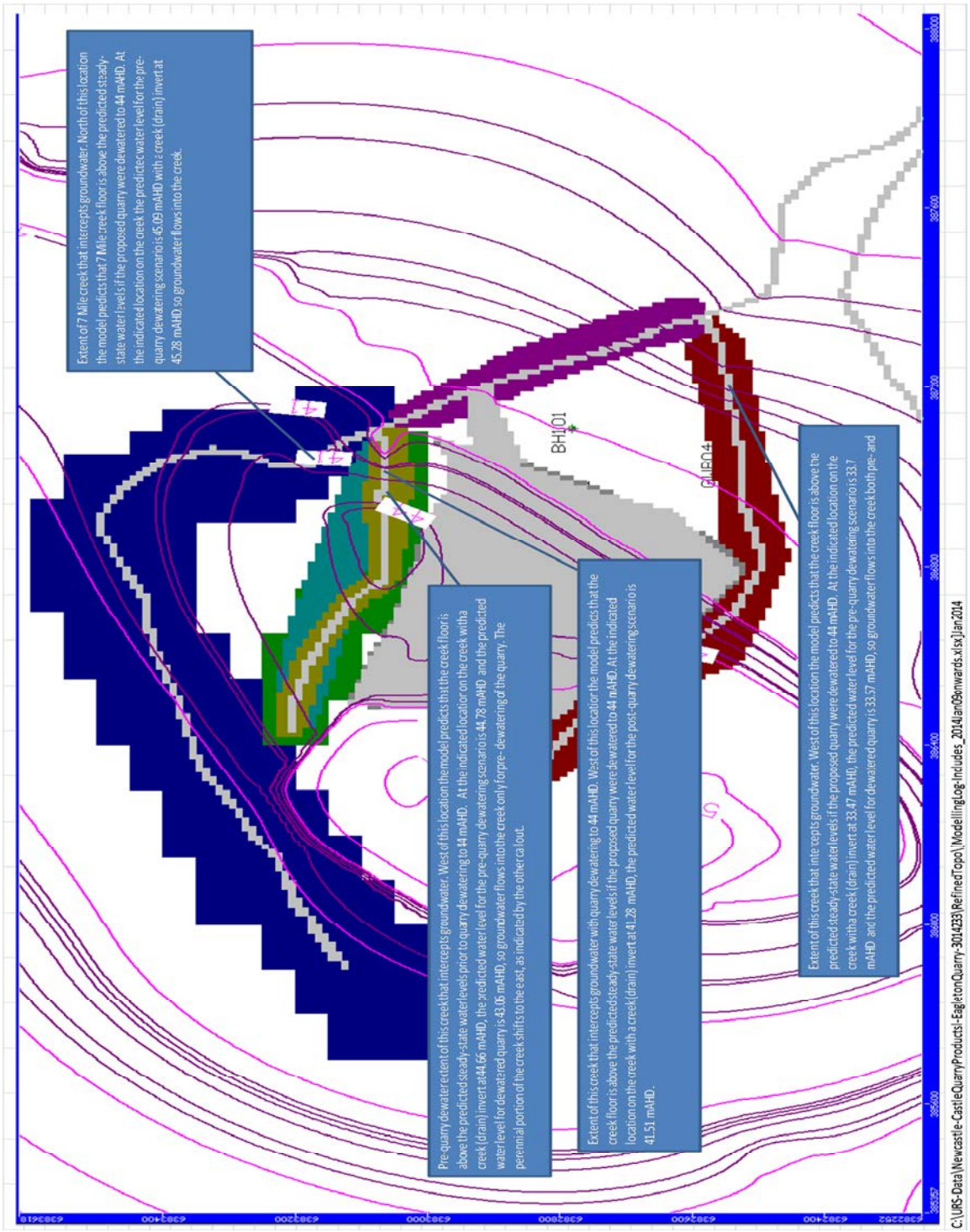
EAGLETON QUARRY
CONCEPTUAL MODEL
NW-SE CROSS SECTION

URS Figure: 15 Rev. A A3

Appendix A Figures

New figure as of 11 February 2014:

Figure 16 - Extent of Perennial Creeks: Pre- and Post-quarry Dewatering



B

Appendix B Tables

Table 1: Analytical Results - Groundwater
Sample Results - Metals, Nutrients
Eagleton Quarry
URS Job No.43207448

				pH	Conductivity	TDS	Alkalinity				Sulfate
				pH	Electrical Conductivity @ 25°C	Total Dissolved Solids @ 180°C	Hydroxide Alkalinity as CaCO3	Carbonate Alkalinity as CaCO3	Bicarbonate Alkalinity as CaCO3	Total Alkalinity as CaCO3	Sulfate as SO4
			LOR	0.01	1	10	1	1	1	1	1
			Units	pH Unit	µS/CM	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
			Action Levels								
			NEPM - GIL - DRINKING WATER (2013)								**500**
Sample Location	**Date Sampled**	**Sample ID**	**Sample Type**								
GWB01	22/02/2013	GWB01_130222	N	9.49	4820	3020	<1	114	78	192	**550**
GWB02	22/02/2013	GWB02_130222	N	7.48	465	412	<1	<1	73	73	22
GWB03	22/02/2013	GWB03_130222	N	9.23	2130	1290	<1	104	242	347	89
GWB04	22/02/2013	GWB04_130222	N	7.57	6060	3720	<1	<1	374	374	212
	22/02/2013	QC100_130222	FD	7.47	6080	4100	<1	<1	371	371	207
	22/02/2013	QC200_130222	FT	7.58	6060	3680	<1	<1	372	372	209
GWB05	22/02/2013	GWBO5/BH103_130222	N	10.2	1810	1080	12	122	<1	134	462
QAQC	22/02/2013	TRIP BLANK_130222	TB	-	-	-	-	-	-	-	-
	22/02/2013	TRIP SPIKE_130222	TS	-	-	-	-	-	-	-	-

Legend:
- Not analysed / not calculated
* LOR Exceeds Guideline Trigger Value
Sample Type: N - Primary, FD - Duplicate, FT - Triplicate

Action Levels:
NEPM - GIL - DRINKING WATER (2013)

Lab Qualifiers:
J - Estimated value.
*U - PQL raised due to matrix interference and analyte was analysed but not detected.

Table 1: Analytical Results - Groundwater
Sample Results - Metals, Nutrients
Eagleton Quarry
URS Job No.43207448

				Chloride	Dissolved Major Cations			
				Chloride	Calcium	Magnesium	Sodium	Potassium
			LOR	1	1	1	1	1
			Units	mg/L	mg/L	mg/L	mg/L	mg/L
			Action Levels					
			NEPM - GIL - DRINKING WATER (2013)					
Sample Location	**Date Sampled**	**Sample ID**	**Sample Type**					
GWB01	22/02/2013	GWB01_130222	N	1060	8	100	720	317
GWB02	22/02/2013	GWB02_130222	N	86	21	8	61	6
GWB03	22/02/2013	GWB03_130222	N	468	49	70	296	26
GWB04	22/02/2013	GWB04_130222	N	1630	224	190	796	20
	22/02/2013	QC100_130222	FD	1630	216	190	791	21
	22/02/2013	QC200_130222	FT	1610	222	193	784	18
GWB05	22/02/2013	GWBO5/BH103_130222	N	207	22	5	317	78
QAQC	22/02/2013	TRIP BLANK_130222	TB	-	-	-	-	-
	22/02/2013	TRIP SPIKE_130222	TS	-	-	-	-	-

Legend:
- Not analysed / not calculated
* LOR Exceeds Guideline Trigger Value
Sample Type: N - Primary, FD - Duplicate, FT - Triplicate

Action Levels:
NEPM - GIL - DRINKING WATER (2013)

Lab Qualifiers:
J - Estimated value.
*U - PQL raised due to matrix interference and analyte was analysed but not detected.

Table 1: Analytical Results - Groundwater
Sample Results - Metals, Nutrients
Eagleton Quarry
URS Job No.43207448

				BTEXN						
				Benzene	Toluene	Ethylbenzene	m&p-Xylene	ortho-Xylene	Sum of BTEX	Naphthalene
			LOR	1	2	2	2	2	1	5
			Units	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l
			Action Levels							
			NEPM - GIL - DRINKING WATER (2013)							
Sample Location	**Date Sampled**	**Sample ID**	**Sample Type**							
GWB01	22/02/2013	GWB01_130222	N	-	-	-	-	-	-	-
GWB02	22/02/2013	GWB02_130222	N	-	-	-	-	-	-	-
GWB03	22/02/2013	GWB03_130222	N	-	-	-	-	-	-	-
GWB04	22/02/2013	GWB04_130222	N	-	-	-	-	-	-	-
	22/02/2013	QC100_130222	FD	-	-	-	-	-	-	-
	22/02/2013	QC200_130222	FT	-	-	-	-	-	-	-
GWB05	22/02/2013	GWBO5/BH103_130222	N	-	-	-	-	-	-	-
QAQC	22/02/2013	TRIP BLANK_130222	TB	< 1	< 2	< 2	< 2	< 2	< 1 U	< 5 J
	22/02/2013	TRIP SPIKE_130222	TS	18	18	16	17	18	87	17

Legend:
- Not analysed / not calculated
* LOR Exceeds Guideline Trigger Value
Sample Type: N - Primary, FD - Duplicate, FT - Triplicate

Action Levels:
NEPM - GIL - DRINKING WATER (2013)

Lab Qualifiers:
J - Estimated value.
*U - PQL raised due to matrix interference and analyte was analysed but not detected.

Table 1: Analytical Results - Groundwater
Sample Results - Metals, Nutrients
Eagleton Quarry
URS Job No.43207448

				Metals							
				Arsenic	Cadmium	Chromium	Copper	Lead	Nickel	Zinc	Mercury
			LOR	0.01	0.005	0.01	0.01	0.01	0.01	0.01	0.0001
			Units	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
			Action Levels								
			NEPM - GIL - DRINKING WATER (2013)	0.01	0.002		2	0.01	0.02		0.001
Sample Location	**Date Sampled**	**Sample ID**	**Sample Type**								
GWB01	22/02/2013	GWB01_130222	N	< 0.01	< 0.005	0.726	0.004	0.002	0.001	0.01	< 0.0001
GWB02	22/02/2013	GWB02_130222	N	0.003	< 0.005	0.001	0.002	< 0.01	0.004	0.013	< 0.0001
GWB03	22/02/2013	GWB03_130222	N	< 0.01	< 0.005	0.032	0.003	< 0.01	0.001	0.067	< 0.0001
GWB04	22/02/2013	GWB04_130222	N	< 0.01	0.0001	< 0.01	0.003	< 0.01	0.006	0.022	< 0.0001
	22/02/2013	QC100_130222	FD	< 0.01	< 0.005	< 0.01	0.003	< 0.01	0.005	0.022	< 0.0001
	22/02/2013	QC200_130222	FT	< 0.01	< 0.005	< 0.01	0.002	< 0.01	0.006	0.026	< 0.0001
GWB05	22/02/2013	GWBO5/BH103_130222	N	0.006	< 0.005	0.094	0.002	< 0.01	0.001	< 0.01	< 0.0001
QAQC	22/02/2013	TRIP BLANK_130222	TB	-	-	-	-	-	-	-	-
	22/02/2013	TRIP SPIKE_130222	TS	-	-	-	-	-	-	-	-

Legend:
- Not analysed / not calculated
* LOR Exceeds Guideline Trigger Value
Sample Type: N - Primary, FD - Duplicate, FT - Triplicate

Action Levels:
NEPM - GIL - DRINKING WATER (2013)

Lab Qualifiers:
J - Estimated value.
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Table 1: Analytical Results - Groundwater
Sample Results - Metals, Nutrients
Eagleton Quarry
URS Job No.43207448

				Nutrients						PAHs
				Ammonia as N	Nitrate as N	Nitrite + Nitrate as N	Nitrite as N	Total Kjeldahl Nitrogen - Filtered	Total Nitrogen as N	Naphthalene
			LOR	0.01	0.01	0.01	0.01	0.1	0.1	5
			Units	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	ug/l
			Action Levels							
			NEPM - GIL - DRINKING WATER (2013)							
Sample Location	**Date Sampled**	**Sample ID**	**Sample Type**							
GWB01	22/02/2013	GWB01_130222	N	0.07	0.13	0.15	0.02	0.6	0.8	-
GWB02	22/02/2013	GWB02_130222	N	< 0.01	0.04	0.04	< 0.01	1.1	1.1	-
GWB03	22/02/2013	GWB03_130222	N	0.02	0.07	0.07	< 0.01	0.3	0.4	-
GWB04	22/02/2013	GWB04_130222	N	0.01	0.03	0.03	< 0.01	< 0.1	< 0.1 U	-
	22/02/2013	QC100_130222	FD	0.01	0.04	0.04	< 0.01	< 0.1	< 0.1 U	-
	22/02/2013	QC200_130222	FT	< 0.01	0.06	0.06	< 0.01	< 0.1	< 0.1 U	-
GWB05	22/02/2013	GWBO5/BH103_130222	N	0.76	0.11	0.12	0.01	2.2	2.3	-
QAQC	22/02/2013	TRIP BLANK_130222	TB	-	-	-	-	-	-	< 5 J
	22/02/2013	TRIP SPIKE_130222	TS	-	-	-	-	-	-	17

Legend:
- Not analysed / not calculated
* LOR Exceeds Guideline Trigger Value
Sample Type: N - Primary, FD - Duplicate, FT - Triplicate

Action Levels:
NEPM - GIL - DRINKING WATER (2013)

Lab Qualifiers:
J - Estimated value.
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Table 1: Analytical Results - Groundwater
Sample Results - Metals, Nutrients
Eagleton Quarry
URS Job No.43207448

				TPH	TRH - NEPM 2013		VOCs						
				C6 - C9 Fraction	C6 - C10 Fraction	C6 - C10 Fraction minus BTEX (F1)	Benzene	Toluene	Ethylbenzene	m & p-Xylene	ortho-Xylene	Total Xylene	Naphthalene
			LOR	20	20	20	1	2	2	2	2	2	5
			Units	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l
			Action Levels										
			NEPM - GIL - DRINKING WATER (2013)										
Sample Location	**Date Sampled**	**Sample ID**	**Sample Type**										
GWB01	22/02/2013	GWB01_130222	N	-	-	-	-	-	-	-	-	-	-
GWB02	22/02/2013	GWB02_130222	N	-	-	-	-	-	-	-	-	-	-
GWB03	22/02/2013	GWB03_130222	N	-	-	-	-	-	-	-	-	-	-
GWB04	22/02/2013	GWB04_130222	N	-	-	-	-	-	-	-	-	-	-
	22/02/2013	QC100_130222	FD	-	-	-	-	-	-	-	-	-	-
	22/02/2013	QC200_130222	FT	-	-	-	-	-	-	-	-	-	-
GWB05	22/02/2013	GWBO5/BH103_130222	N	-	-	-	-	-	-	-	-	-	-
QAQC	22/02/2013	TRIP BLANK_130222	TB	< 20	< 20	< 20 U	< 1	< 2	< 2	< 2	< 2	< 2 U	< 5 J
	22/02/2013	TRIP SPIKE_130222	TS	-	-	-	18	18	16	17	18	35	17

Legend:
- Not analysed / not calculated
* LOR Exceeds Guideline Trigger Value
Sample Type: N - Primary, FD - Duplicate, FT - Triplicate

Action Levels:
NEPM - GIL - DRINKING WATER (2013)

Lab Qualifiers:
J - Estimated value.
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Table 2 - Eagleton Quarry Survey Data

Location	Easting	Northing	TOC (mAHD)*	Ground Level (mAHD)	Total Well Depth (mbgs)
GWB01	386952.4	6382744.37	75.68	75.15	35.14
GWB02	386870.52	6382983.53	74.35	73.68	40.51
GWB03	386551.14	6382962.28	112.9	112.37	70.92
GWB04	387031.33	6382555.51	43.93	43.35	40.07
GWB05	386635.05	6382929.64	88.11	87.55	47.75

* 2m vertical accuracy

Table 3 - Eagleton Quarry Gauging Data

Location	Date	Time	Groundwater Depth (mbTOC)	Groundwater Depth (mAHD)
GWB01	30-Oct-13	12:31	20.21	55.47
	31-Oct-13	9:00	20.25	55.43
GWB02	30-Oct-13	12:11	17.64	56.71
	31-Oct-13	8:50	17.68	56.67
GWB03	30-Oct-13	11:50	30.46	82.44
	31-Oct-13	8:35	30.45	82.45
GWB04	30-Oct-13	12:52	8.29	35.64
	31-Oct-13	9:10	8.33	35.6
GWB05	30-Oct-13	13:15	40.45	47.66
	31-Oct-13	8:45	40.65	47.46

C

Appendix C Bore Logs

BOREHOLE GWB01

URS Australia Pty Ltd
53 Cleary Street, Hamilton, NSW 2303
Phone (02) 4985 3500
Fax (02) 4985 3555

Drilling Contractor: **Total Drilling Pty Ltd**

Drill Model: **HQ triple tube, wire line coring**
Drill Mount: **Hydropower**
Drill Fluid: **Water**

Bore Diameter: **50 mm**
Casing Size: **-**
Casing Depth: **35.00 m**
Borehole Inclination: **-90°**
Borehole Bearing: **-90°**

Logged By: **SS**
Checked By: **LC**
Date Started: **5/02/2013**
Date Finished: **8/02/2013**

Relative Level: **75.68 mRL**
Coordinates: **386952.4 mE**
6382744.37 mN
Coordinate System: **-**

Project Name: **Eagleton Quarry Hydrogeological Investigation**
Project Number: **43207448**
Client: **Buildev**
Location: **Eagleton Quarry**

DRILLING				MATERIAL DESCRIPTION						DISCONTINUITY DESCRIPTION	
METHOD	STANDPIPE/ WATER OBS	RUN / RECOVERY	SAMPLING/ TESTING	DEPTH (m)	GRAPHIC LOG	DESCRIPTION OF STRATA (**ROCK TYPE:** colour, fabric, grain size, inclusions)	WEATHERING	ESTIMATED STRENGTH (VL L M H VH EH)	RQD (%)	DEFECT SPACING (mm) (0-19, 20-49, 50-99, 100-199, 200-599, >600)	DEFECT DESCRIPTION (Defect type, inclination, shape, roughness, infill, thickness)
				0		CONGLOMERATE: Matrix supported, light brown becoming red-brown with depth, very low strength, extremely weathered. Recovered as slightly silty, gravelly SAND. Medium sand with trace of cobbles from 1.0 m.	XW				
				1							
				2							
				3							
				4							
HQ3		4.5 30% 4.9				CONGLOMERATE: Matrix supported, red/brown, very low strength, highly weathered. Gravelly sand matrix. Recovered as coarse igneous GRAVEL, with some gravelly sand (matrix washed out with drilling).	HW		0%		
HQ3		0% 5.5		5		Core loss	MW	CORE LOSS		CORE LOSS	
HQ3		54% 6.25				CONGLOMERATE: Matrix supported, red/brown/grey, very low strength, highly weathered. Gravelly matrix recovered as high strength igenous gravel and cobbles (matrix washed out with drilling). From 5.50 m to 5.70 m cobble/boulder of fine grained, light brown/grey, slightly weathered, very high strength igneous rock (possible rhyolite).	HW		0%		
HQ3		100% 6.55		6			MW		0%		
HQ3		100% 6.75				CONGLOMERATE: Cobble of fine grained, grey, high strength, moderately to slightly weathered. Fractured with Fe staining.	MW		0%		
HQ3		0% 7.35		7		CONGLOMERATE: Recovered as red/brown, high strength, moderately weathered, igneous gravel and cobbles (matrix washed out with drilling).		CORE LOSS		CORE LOSS	
HQ3		100% 7.55					MW		0%		
HQ3		40% 7.75				Core loss	MW		0%		
HQ3		45% 8.2		8		CONGLOMERATE: Recovered as red/brown/grey, high strength, moderately weathered, igneous gravel and cobbles (matrix washed out with drilling).	MW		0%		
HQ3		100% 8.7				CONGLOMERATE: Cobble of fine grained, pinkish grey, high strength, moderately weathered igneous rock (possible rhyolite).	SW		46%		J30 x2, tight, Fe J30, undulating, rough, Fe J35, undulating, rough, Fe
HQ3		100% 9.2		9		CONGLOMERATE: Matrix supported, pink/brown, medium strength, moderately weathered. Gravelly sand matrix.	SW		0%		J50, planar, rough, Fe
HQ3		100% 9.45				CONGLOMERATE: Cobble of mottled brown/grey/green, high strength, porphyritic igneous rock (possible rhyolite).	SW		0%		J50, planar, rough, Fe Cobble debonded from matrix (1 mm), Fe
		80% 9.7									

BOREHOLE GWB01

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Project No.: 43207448

Project Name: Eagleton Quarry Hydrogeological Investigation

DRILLING

METHOD	STANDPIPE/ WATER OBS	RUN / RECOVERY	SAMPLING/ TESTING
HQ3		100%	
		10.4	
HQ3		100%	
		11.95	
		100% 12.1	
HQ3		100%	
		15.15	
HQ3		100%	
		18.15	
HQ3		100%	
		21.05	
HQ3		100%	
		21.4	

MATERIAL DESCRIPTION

DEPTH (m)	GRAPHIC LOG	DESCRIPTION OF STRATA (**ROCK TYPE:** colour, fabric, grain size, inclusions)	WEATHERING	ESTIMATED STRENGTH (VL L M H VH EH)	RQD (%)
		CONGLOMERATE: Matrix supported, pink/brown, high strength, moderately weathered. Gravelly sand matrix with high strength igneous cobbles.	SW		51%
11		CONGLOMERATE: Matrix supported, pink/brown, high strength, slightly weathered. Gravelly sand matrix with high strength igneous cobbles.			11%
		CONGLOMERATE: Boulders of fine grained, grey/green, very high strength, slightly weathered igneous rock.			
12		CONGLOMERATE: Matrix supported, pink/brown, high strength, slightly weathered. Gravelly sand matrix, with high strength igneous cobbles (up to 80 mm).	SW FR		0%
		CONGLOMERATE: Matrix supported, pink/brown, high strength, slightly weathered. Gravelly sand matrix with grey/brown to greenish grey very high strength igneous cobbles (up to 70 mm). *continued from previous page*			
13		CONGLOMERATE: Matrix supported, pink/brown, high strength, slightly weathered. Gravelly sand matrix with very high strength igneous cobbles (up to 120mm).			
		From 10.40m to 10.65m Cobble of fine grained, brown/grey speckled red, very high strength, slightly weathered igneous rock (possible rhyolite).			83%
14		From 10.75 m to 11.05 m Cobble of fine grained, pink/brown mottled white, very high strength igneous rock (possible rhyolite).			
		From 11.77 m to 11.95 m Cobble of fine grained, pink/brown mottled white, very high strength igneous rock (possible rhyolite).			
15		CONGLOMERATE: Matrix supported, pink/brown, high strength, slightly weathered. Gravelly sand matrix with high strength igneous cobbles. Recovered as fragmented igneous cobbles with some sand and gravel.	FR		
		CONGLOMERATE: Matrix supported, pink/brown, high strength, fresh. Gravelly sand matrix with very high strength igneous cobbles.			
16		CONGLOMERATE: Matrix supported, pink/brown, very high strength, fresh. Gravelly sand matrix with very high strength igneous cobbles.			90%
		From 15.15 m to 15.55 m Boulder of fine grained, grey/dark grey with white mottling, high strength igneous rock (possible rhyolite).			
17		From 16.40 m to 16.95 m boulder of high fractured, fine grained, dark grey with green specks, very high strength igneous rock (possible rhyolite).			
		From 17.40 m to 17.72 m boulder of fine grained, dark grey/grey mottled white, very high strength igneous rock (possible rhyolite).	FR		
18		CONGLOMERATE: Matrix supported, red/pink brown, high strength, fresh. Gravelly sand matrix with very high strength igneous cobbles (up to 190 mm).			
		From 19.75 m to 20.10 m predominantly gravelly sand matrix, red brown.			90%
19		From 20.32 m to 20.53 m Boulder of fine grained, dark grey mottled white, high strength igneous rock (possible rhyolite).			
		From 20.53 m to 20.93 m predominantly laminated (laminations 30 degrees) gravelly sand matrix, red brown.	FR		
20		CONGLOMERATE: Matrix supported, red/pink brown, high strength, fresh. Gravelly sand matrix with very high strength igneous cobbles.	FR		100%
		From 21.12 m to 22.82 m Boulder of fine grained, dark grey/black mottled white, high strength			
21					

DISCONTINUITY DESCRIPTION

DEFECT SPACING (mm): 0-19 | 20-49 | 50-99 | 100-199 | 200-599 | >600

DEFECT DESCRIPTION (Defect type, inclination, shape, roughness, infill, thickness)
J30, undulating, rough, Fe
J35, undulating, rough, Fe
J35, planar, rough, Fe
Cobble debonded from matrix
Cobble debonded from matrix (1 mm)
J25, tight
J30, undulating, rough, Fe
J50, healed, calcite infill (2 mm)
J20, undulating, rough, discoloured
J20, undulating, rough, discoloured
J55, healed, calcite infill (<1 mm)
J35, planar, rough, discoloured
J50, healed
J45, planar, rough, discoloured
J50, healed
J25, planar, rough, Fe
Posssible J35, planar, rough
J55, healed
J50, planar, rough, calcite infill
Conjugate Joints, J40, J50, closed, healed, quartz infill
Fractured zone, subparallel joints 20 - 30 degrees, calcite infill, discoloured
J40, healed, calcite infill
J40, healed, calcite infill
J40, healed, calcite infill
J35, tight
J10, calcite infill
J40, calcite infill
J18, rough, stepped
J30, undulating, rough
Possible J8, undulating, smooth
J50, undulating, rough, Fe
J8, planar, rough, Fe
J48, undulating, rough
Possible J40

BOREHOLE GWB01

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Project No.: 43207448

Project Name: Eagleton Quarry Hydrogeological Investigation

DRILLING				MATERIAL DESCRIPTION					DISCONTINUITY DESCRIPTION	
METHOD	STANDPIPE/ WATER OBS	RUN / RECOVERY	SAMPLING/ TESTING	DEPTH (m)	GRAPHIC LOG	DESCRIPTION OF STRATA (**ROCK TYPE:** colour, fabric, grain size, inclusions)	WEATHERING	ESTIMATED STRENGTH (VL L M H VH EH)	RQD (%)	DEFECT SPACING (mm) (0-19, 20-49, 50-99, 100-199, 200-599, >600)	DEFECT DESCRIPTION (Defect type, inclination, shape, roughness, infill, thickness)
HQ3		100%		23		igneous rock. CONGLOMERATE: Matrix supported, red/pink brown, high strength, fresh. Gravelly sand matrix with very high strength igneous cobbles. *continued from previous page* From 22.12 m to 22.82 m Boulder of fine grained, dark grey, grey/black with white mottling, very high strength igneous rock (possible rhyolite).			96%		J50, undulating, smooth J70, healed, calcite infill Possible J24 J38, undulating, smooth
		24.3		24							
HQ3		100%		25		CONGLOMERATE: Matrix supported, red/brown, very high strength, fresh. Gravelly sand matrix, with very high strength igneous cobbles (up to 170 mm). From 24.38 m to 24.95 m predominantly gravelly sand matrix.	FR				J30, healed J30, healed J20, subparallel, healed, calcite infill (1 mm) J30, undulating, slickensided J48, healed, calcite infill (1 mm)
				26		From 25.55 m to 25.85 m Boulder of fine grained, grey/dark grey mottled white, very high strength igneous rock (possible rhyolite).			92%		J26, planar, slickensided J20, undulating, rough, Fe J40, undulating, rough, Fe
		27.3		27		From 26.45 m to 26.95 m predominantly gravelly sand matrix.					J50, healed, calcite infill (2 mm) J26, undulating, rough
HQ3		100%		28		CONGLOMERATE: Matrix supported, red/orange/brown, high strength, fresh. Gravelly sand matrix with very high strength igneous cobbles (up to 150 mm).	FR		98%		Calcite veining 20 - 40 degrees Calcite veining 20 - 40 degrees Calcite veining 20 - 40 degrees Calcite veining 20 - 40 degrees J20, healed, calcite infill Calcite veining 20 - 40 degrees J50, planar, slickensided, Fe
		28.55		29		CONGLOMERATE: Matrix supported, red/orange/brown, high strength, fresh. Gravelly sand matrix, with very high strength igneous cobbles ((up to 110 mm). From 28.80 m to 29.92 m Boulder of fine grained, dark grey/grey with white mottling, very high strength, igneous rock (possible rhyolite). From 29.24 m to 29.46 m Boulder of fine grained, dark grey/grey with white mottling, very high strength igneous rock (possible rhyolite).	FR				
HQ3		100%		30					97%		J40, healed, calcite infill J60, healed, calcite infill J45, healed, calcite infill
		30.3		31		CONGLOMERATE: Matrix supported, red/orange/brown, high strength, fresh. Gravelly sand matrix with very high strength cobbles (up to 190 mm). From 30.5 m to 30.9 m Boulder of fine grained, dark grey/grey with white mottling, very high strength igneous rock (possible rhyolite).	FR				J42, undulating, smooth J20, healed, calcite infill (2 mm) J20, healed, calcite infill (2 mm) J45, healed, calcite infill (<1 mm) J45, healed, calcite infill (<1 mm) J24, planar, slickensided, Fe J4, undulating, rough, Fe
HQ3		100%		32		From 31.65 m to 32.0 m Boulder of fine grained, dark grey/grey with white mottling, very high strength igneous rock (possible rhyolite).			100%		J45, healed, calcite infill Calcite vein, 74 degrees J46, planar, rough, Fe
		33.3		33		From 32.78 m to 33.17 m Boulder of fine grained, dark grey/grey with white mottling, very high strength igneous rock (possible rhyolite).					J22, undulating, slickensided
						CONGLOMERATE: Matrix supported, red/orange/brown, high strength, fresh. Gravelly sand matrix with very high strength igneous cobbles (up to 190 mm).	FR				J44, healed, calcite infilled

CORED HOLE (MELB GEOTECH) SEP 09 J:\NWC\43207448\5 WORKS\DRILLING\GINT\GINT LOGS\GINT PROJECT AND LIBRARY FILE FOR LOGS\EAGLETON QAURRY - CORED LOGS.GPJ URS1.GDT 15/11/13

BOREHOLE GWB01

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Project No.: **43207448**

Project Name: **Eagleton Quarry Hydrogeological Investigation**

DRILLING				MATERIAL DESCRIPTION						DISCONTINUITY DESCRIPTION	
METHOD	STANDPIPE/ WATER OBS	RUN / RECOVERY	SAMPLING/ TESTING	DEPTH (m)	GRAPHIC LOG	DESCRIPTION OF STRATA (**ROCK TYPE:** colour, fabric, grain size, inclusions)	WEATHERING	ESTIMATED STRENGTH (VL L M H VH EH)	RQD (%)	DEFECT SPACING (mm) (0-19 20-49 50-99 100-199 200-599 >600)	DEFECT DESCRIPTION (Defect type, inclination, shape, roughness, infill, thickness)
HQ3		100%				From 33.30 m to 33.60 m Boulder, fine grained, grey/dark grey mottled white, very high strength igneous rock. CONGLOMERATE: Matrix supported, red/orange/brown, high strength, fresh. Gravelly sand matrix with very high strength igneous cobbles (up to 190 mm). *continued from previous page* From 34.56 m Predominantly gravelly sand matrix, fine grained gravel. Final depth of well - 34.9 mbgl.			94%		
				35							
				36							
				37							
				38							
				39							
				40							
				41							
				42							
				43							
				44							
				45							

BOREHOLE GWB02

URS Australia Pty Ltd
53 Cleary Street, Hamilton, NSW 2303
Phone (02) 4985 3500
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Drilling Contractor: **Total Drilling Pty Ltd**

Drill Model:	HQ triple tube, wire line coring	Bore Diameter:	50 mm
Drill Mount:	Hydropower	Casing Size:	-
Drill Fluid:	Water	Casing Depth:	40.20 m
		Borehole Inclination:	-90°
		Borehole Bearing:	-90°

Logged By:	SS
Checked By:	LC
Date Started:	11/02/2013
Date Finished:	15/02/2013
Relative Level:	74.35 mRL
Coordinates:	386870.52 mE
	6382983.53 mN
Coordinate System:	-

Project Name:	Eagleton Quarry Hydrogeological Investigation
Project Number:	43207448
Client:	Buildev
Location:	Eagleton Quarry

DRILLING				MATERIAL DESCRIPTION						DISCONTINUITY DESCRIPTION	
METHOD	STANDPIPE/ WATER OBS	RUN / RECOVERY	SAMPLING/ TESTING	DEPTH (m)	GRAPHIC LOG	DESCRIPTION OF STRATA (**ROCK TYPE:** colour, fabric, grain size, inclusions)	WEATHERING	ESTIMATED STRENGTH (VL L M H VH EH)	RQD (%)	DEFECT SPACING (mm) (0-19, 20-49, 50-99, 100-199, 200-599, >600)	DEFECT DESCRIPTION (Defect type, inclination, shape, roughness, infill, thickness)
HQ3		1.9		1		CONGLOMERATE: Matrix supported, brown, very low strength, highly weathered. Recovered as silty, gravelly, clayey SAND. Medium sand with fine to medium subangular to subrounded gravel and medium plasticity silt.	HW				
						CONGLOMERATE: Matrix supported, red/brown, very low strength, highly weathered. Recovered as silty SAND. Medium sand with low plasticity silt.					
						Core loss		CORE LOSS		CORE LOSS	
HQ3		63% 2.55		2		CONGLOMERATE: Matrix supported, red/brown, very low strength, highly weathered. Gravelly sand matrix, with very high strength igneous cobbles (up to 90 mm).	HW		0%		Gravel debonded from matrix Cobbles debonded from matrix
HQ3		90% 5.55		3		CONGLOMERATE: Matrix supported, pink/grey/brown, very low strength, highly weathered. Gravelly sand matrix, with very high strength igneous cobbles (up to 110 mm). From 2.55 m to 2.83 m Boulder of fine grained, grey/pink with white mottling, very high strength (possible rhyolite).	HW		60%		Gravel and cobbles debonded from matrix J30, undulating, rough J10, undulating, rough Cobbles debonded from matrix J54
HQ3		100% 6.55		6		CONGLOMERATE: Matrix supported, pink/grey/brown, very low strength, highly weathered. Gravelly sand matrix, with very high strength igneous cobbles (up to 120 mm). From 5.85 m to 6.17 m boulder of fine grained, light pink/brown with white and yellow mottling, very high strength porphyritic igneous rock (possible rhyolite).	HW		25%		STZ
HQ3		95% 8.4		7		CONGLOMERATE: Matrix supported, pink/grey/brown, very low strength, highly weathered. Gravelly sand matrix, with very high strength igneous cobbles (up to 140 mm). From 6.55 m to 7.00 m Boulder of fine grained, dark pink/brown with white and yellow mottling, very high strength porphyritic igneous rock (possible rhyolite). From 7.28 m to 7.55 m Boulder of fine grained, pink/grey, high strength, porphyritic igenous rock (possible rhyolite).	HW		36%		J36, planar, rough, Fe J12, planar, rough STZ J32, calcite healed
HQ3		94% 9.2		9		CONGLOMERATE: Matrix supported, pink/grey/brown, very low strength, moderately weathered. Gravelly sand matrix, with very high strength igneous cobbles (up to 50 mm). From 8.40 m to 8.85 m Boulder of fine grained, dark pink/brown with cream mottling, very high strength porphyritic igneous rock (possible rhyolite). From 8.85 m to 9.20 m predominantly sandy gravel matrix.	MW MW		28%		J64, planar, smooth, Fe STZ J16 J58, calcite healed

BOREHOLE GWB02

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53 Cleary Street, Hamilton, NSW 2303
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Project No.: 43207448

Project Name: Eagleton Quarry Hydrogeological Investigation

DRILLING				MATERIAL DESCRIPTION					DISCONTINUITY DESCRIPTION	
METHOD	STANDPIPE/ WATER OBS	RUN / RECOVERY	SAMPLING/ TESTING	DEPTH (m)	GRAPHIC LOG	DESCRIPTION OF STRATA (**ROCK TYPE:** colour, fabric, grain size, inclusions)	WEATHERING	ESTIMATED STRENGTH (VL L M H VH EH)	RQD (%)	DEFECT SPACING (mm) (0-19, 20-49, 50-99, 100-199, 200-599, >600)	DEFECT DESCRIPTION (Defect type, inclination, shape, roughness, infill, thickness)
HQ3		100%		11		CONGLOMERATE: Matrix supported, very low strength, moderately weathered. Gravelly sand matrix, with very high strength igneous cobbles (up to 150 mm). *continued from previous page* From 10.42 m to 10.67 m Boulder of fine grained, pink/brown, very high strength porphyritic igneous rock (possible rhyolite).			46%		Calcite healed fractures J24, planar, rough, some calcite J44, calcite healed, sinusoidal J50, calcite healed STZ
		12.2		12							
HQ3		100%		13		VOLCANIC BRECCIA: Fine grained, pink/brown, very high strength, fresh with angular to subrounded clasts of porphyritic igenous rock (up to 150 mm) .	FR		87%		J60 J22, undulating, rough BZ J70, planar, rough
		13.3									
HQ3		100%		14		VOLCANIC BRECCIA: Fine grained, pink/grey/brown, very high strength, fresh with angular to subrounded clasts of porphyritic igenous rock (up to 170 mm).	FR		96%		
		15.2		15							
HQ3		100%		16		VOLCANIC BRECCIA: Fine grained, pink/grey/brown, very high strength, fresh with angular to subrounded clasts of porphyritic igenous rock (up to 170 mm). From 15.42 m to 15.64 m Boulder of fine grained, pink/brown, very high strength porphyritic igneous rock (possible rhyolite). From 15.97 m to 16.32 m Boulder of fine grained, pink/brown, very high strength porphyritic igneous rock (possible rhyolite). From 16.46 m to 16.62 m Boulder of fine grained, cream/pink/brown, very high strength porphyritic igneous rock (possible rhyolite). From 16.91 m to 17.23 m Boulder of fine grained, cream/pink/brown, very high strength porphyritic igenous rock (possible rhyolite). From 17.34 m to 17.56 m Boulder of fine grained pink/grey, very high strength porphyritic igenous rock (possible rhyolite).	FR		88%		J58, partially calcite healed J44 J52, Fe J44, Fe J64
		18.2		17							
				18							
HQ3		100%		19		VOLCANIC BRECCIA: Fine grained, pink/red brown, very high strength, fresh with angular to subrounded clasts of porphyritic igenous rock (up to 170 mm). From 18.32 m to 18.53 m Boulder of fine grained, grey, very high strength porphyritic igenous rock (possible rhyolite). From 19.72 m matrix becoming pink/grey.	FR		96%		J8, stepped, slickensided, Fe J16, undulating, rough, Fe J72, Fe
				20							
		21.2		21							
						VOLCANIC BRECCIA: Fine grained, pink/red brown, very high strength, fresh with angular to rounded clasts of porphyritic igenous rock (up to 50 mm).	FR				

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Project No.: 43207448

Project Name: Eagleton Quarry Hydrogeological Investigation

DRILLING				MATERIAL DESCRIPTION						DISCONTINUITY DESCRIPTION	
METHOD	STANDPIPE/ WATER OBS	RUN / RECOVERY	SAMPLING/ TESTING	DEPTH (m)	GRAPHIC LOG	DESCRIPTION OF STRATA (**ROCK TYPE:** colour, fabric, grain size, inclusions)	WEATHERING	ESTIMATED STRENGTH (VL L M H VH EH)	RQD (%)	DEFECT SPACING (mm) (0-19, 20-49, 50-99, 100-199, 200-599, >600)	DEFECT DESCRIPTION (Defect type, inclination, shape, roughness, infill, thickness)
HQ3		100%		23		VOLCANIC BRECCIA: Fine grained, pink/red brown, very high strength, fresh with angular to rounded clasts of porphyritic igenous rock (up to 50 mm). *continued from previous page*			96%		J40, undulating, rough, fresh J38, undulating, rough
		24.2		24							
HQ3		100%		25		VOLCANIC BRECCIA: Fine grained, pink/red brown, very high strength, fresh with angular to rounded clasts of porphyritic igenous rock (up to 70 mm).	FR		97%		
		27.2		26							
HQ3		100%		27		VOLCANIC BRECCIA: Fine grained, orange/red, high strength, fresh with angular to subrounded clasts of porphyritic igenous rock (up to 150 mm).	FR		92%		
		30.2		28							
HQ3		100%		29		From 29.49 m to 30.20 m AGGLOMERTATE/VOLCANIC BRECCIA: Fine grained, grey/green, weak, moderately weathered with subangular to rounded cobbles of very high strength porphyritic igneous rock (up to 190 mm). From 29.50 m Becoming grey in colour, slightly weathered. From 29.72 m to 29.92 m Boulder of fine grained, grey, very high strength porphyritic igneous rock (possible rhyolite).	MW/SW				J6, stepped, rough, Fe
		33.2		31		AGGLOMERTATE/VOLCANIC BRECCIA: Fine grained, grey/green, weak, moderately weathered with subangular to rounded cobbles of very high strength porphyritic igneous rock (up to 190 mm). From 30.87 m to 31.06 m Boulder of fine grained, pale pink/grey, very high strength porphyritic igneous rock (possible rhyolite). From 31.42 m to 31.55 m Boulder of fine grained, pink/grey, very high strength porphyritic igneous rock (possible rhyolite). From 31.55 m to 31.70 m Highly weathered. From 32.47 m to 32.48 m Recovered as grey/green silty sand. From 32.48 m to 33.20 m Highly weathered, becoming red/grey.	HW		91%		J30, planar, rough
				33		RHYOLITE/RHYODACITE: Fine grained, porphyritic, pink/brown, high strength, slightly weathered. From 33.96 m to 34.02 m Becoming purple/brown.	SW				

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Project No.: 43207448

Project Name: Eagleton Quarry Hydrogeological Investigation

DRILLING				MATERIAL DESCRIPTION						DISCONTINUITY DESCRIPTION	
METHOD	STANDPIPE/ WATER OBS	RUN / RECOVERY	SAMPLING/ TESTING	DEPTH (m)	GRAPHIC LOG	DESCRIPTION OF STRATA (**ROCK TYPE:** colour, fabric, grain size, inclusions)	WEATHERING	ESTIMATED STRENGTH (VL L M H VH EH)	RQD (%)	DEFECT SPACING (mm) (0-19, 20-49, 50-99, 100-199, 200-599, >600)	DEFECT DESCRIPTION (Defect type, inclination, shape, roughness, infill, thickness)
HQ3		100%		34		RHYOLITE/RHYODACITE: Fine grained, porphyritic, pink/brown, high strength, slightly weathered. *continued from previous page* From 34.02 m Becoming red/pink with depth, becoming less weathered with depth.			88%		J54 J24, calcite healed
		35		35		RHYOLITE/RHYODACITE: Fine to medium grained, porphyritic, red/pink, high strength, fresh.	FR				J36, calcite healed
HQ3		100%							100%		
		36.2		36							J44, calcite healed J72, calcite healed
HQ3		100%		37		RHYOLITE/RHYODACITE: Fine to medium grained, porphyritic, red/pink, very high strength, fresh.	FR				
				38		From 37.56 m to 37.62 m green/grey area of bleaching/discolouration. From 37.78 m to 37.87 m green/grey with red/pink area of bleaching/discolouration. From 38.58 m Becoming red/pink.			96%		J44
				39		From 38.78 m Becoming grey/green with grey/purple.	FR				
HQ3						RHYODACITE: Fine grained, porphyritic, purple/pink, very high strength, fresh. From 39.10 m Predominately grey/green.			92%		J48, planar, calcite J70, unbroken, planar
				40		From 39.85 m Predominately purple/pink. From 40.16 m Predominately grey/green.					J60, planar, smooth, calcite
						Final depth of well - 40.2 mbgl.					
				41							
				42							
				43							
				44							
				45							

CORED HOLE (MELB GEOTECH) SEP 09 J:\NWC\43207448\5 WORKS\DRILLING\GINT\GINT LOGS\GINT PROJECT AND LIBRARY FILE FOR LOGS\EAGLETON QAURRY - CORED LOGS.GPJ URS1.GDT 15/11/13

BOREHOLE GWB03

URS Australia PTY LTD
Level 4, 226 Adelaide Terrace, Perth, WA
Phone (08) 9326 0100
Fax (08) 9326 0296

Drilling Contractor: **Total Drilling Pty Ltd**

Drill Model: **Air Hammer**
Drill Mount: **Hydropower**
Drill Fluid: **Air compressor**

Bore Diameter: **100 mm**
Casing Size: **100 mm**
Casing Depth: **69.80 m**
Borehole Inclination: **-90°**
Borehole Bearing: **-90°**

Logged By: **SS**
Checked By: **LC**
Date Started: **13/02/2013**
Date Finished: **18/02/2013**

Relative Level: **112.90 mRL**
Coordinates: **386551.14 mE**
6382962.28 mN
Coordinate System: **-**

Project Name: **Eagleton Quarry Hydrogeological Investigation**
Project Number: **43207448**
Client: **Buildev**
Location: **Eagleton Quarry**

DRILLING				MATERIAL DESCRIPTION					ADDITIONAL INFO.
METHOD	STANDPIPE/ WATER OBS	SAMPLING/ TESTING	DEPTH (m)	GRAPHIC LOG	GROUP SYM.	DESCRIPTION OF STRATA (**SOIL TYPE:** plasticity or particle size, colour, secondary and minor components, structure and other features)	MOISTURE	CONSISTENCY/ REL. DENS.	ADDITIONAL OBSERVATIONS & COMMENTS
			1			Recovered as slightly silty, gravelly SAND: Medium to coarse, orange/brown sand, with fine to medium, subangular to subrounded gravel and medium plasticity, brown silt.			
			2			Recovered as sandy igneous GRAVEL: Fine to medium, subangular to subrounded grey/white/pink gravel, with medium to coarse sand, distinctly weathered.			
			3						
			4			At 3.5m becoming pink/grey.			
			5			At 4.5m becoming gravelly SAND.			
			6			At 6.0m becoming sandy GRAVEL.			
			7			Sand becoming grey/pink. Gravel becoming white/grey/pink.			
			8						
			9			At 9.0m becoming grey/yellow/brown.			
			10						
			11						
			12						
			13						
			14						
			15						
			16			Recovered as gravelly SAND: Medium to coarse light pink/brown sand, with fine subangular to subrounded gravel.			
			17			Recovered as sandy GRAVEL: Fine to medium dark pink/brown gravel, with medium to coarse sand.			
			18						
			19						
			20						
			21						
			22			Recovered as slightly silty gravelly SAND: Medium, pink/grey sand, with fine, subangular to subrounded gravel. Subangular to subrounded gravel			
			23			At 22.0m becoming gravelly sand.			
			24			At 24.0m becoming slightly gravelly sand.			
			25			Recovered as slightly gravelly sandy SILT: Low plasticity, dark green/grey silt with fine, subangular to subrounded gravel and medium sand.			
			26						
			27						
			28						
			29						

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Project No.: **43207448**

Project Name: **Eagleton Quarry Hydrogeological Investigation**

DRILLING				MATERIAL DESCRIPTION					ADDITIONAL INFO.
METHOD	STANDPIPE/ WATER OBS	SAMPLING/ TESTING	DEPTH (m)	GRAPHIC LOG	GROUP SYM.	DESCRIPTION OF STRATA (**SOIL TYPE:** plasticity or particle size, colour, secondary and minor components, structure and other features)	MOISTURE	CONSISTENCY/ REL. DENS.	ADDITIONAL OBSERVATIONS & COMMENTS
	▼		31			Recovered as slightly gravelly sandy SILT: Low plasticity, dark green/grey silt with fine, subangular to subrounded gravel and medium sand. *continued from previous page*			
			32			Recovered as slightly silty sandy GRAVEL: Fine, angular to subrounded, grey gravel, with fine silt and medium to coarse sand.			
			33			At 33.0m becoming red/pink.			
			34			Recovered as slightly gravelly SAND: Medium to coarse, red/brown sand, with angular to subrounded gravel.			
			35						
			36						
			37						
			38						
			39			Recovered as slightly gravelly, silty SAND: Medium to coarse, orange/brown sand, fine to medium, subangular to angular igneous gravel and fine, medium plasticity silt.			
			40						
			41						
			42			Recovered as slightly gravelly SAND: Medium to coarse, brown sand, with fine to medium, subangular to subrounded gravel.			
			43						
			44						
			45						
			46						
			47						
			48			At 48.0m becoming silty.			
			49						
			50						
			51			Recovered as gravelly SAND: Medium to coarse, brown sand, with fine to medium subangular to subrounded gravel.			
			52						
			53						
			54			Recovered as slightly gravelly SAND: Medium to coarse, brown sand, with igneous, fine, subangular to subrounded gravel.			
			55						
			56						
			57			Recovered as slightly gravelly, slightly silty SAND: Medium to coarse, brown sand, with fine to medium, subangular to subrounded, red/orange, igneous gravel and fine, brown silt.			
			58						
			59						
			60						
			61						
			62						
			63						
			64						
			65						

BOREHOLE GWB03

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Project No.: **43207448**

Project Name: **Eagleton Quarry Hydrogeological Investigation**

DRILLING				MATERIAL DESCRIPTION					ADDITIONAL INFO.
METHOD	STANDPIPE/ WATER OBS	SAMPLING/ TESTING	DEPTH (m)	GRAPHIC LOG	GROUP SYM.	DESCRIPTION OF STRATA (**SOIL TYPE:** plasticity or particle size, colour, secondary and minor components, structure and other features)	MOISTURE	CONSISTENCY/ REL. DENS.	ADDITIONAL OBSERVATIONS & COMMENTS
			67			Recovered as slightly gravelly, slightly silty SAND: Medium to coarse, brown sand, with fine to medium, subangular to subrounded, red/orange, igneous gravel and fine, brown silt. *continued from previous page*			
			68						
			69						
			70			Final depth of well - 69.8 mbgl.			
			71						
			72						
			73						
			74						
			75						
			76						
			77						
			78						
			79						
			80						
			81						
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			83						
			84						
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			90						
			91						
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			93						
			94						
			95						
			96						
			97						
			98						
			99						
			100						
			101						

BOREHOLE GWB04

URS Australia Pty Ltd
53 Cleary Street, Hamilton, NSW 2303
Phone (02) 4985 3500
Fax (02) 4985 3555

Drilling Contractor: **Total Drilling Pty Ltd**

Drill Model:	**HQ triple tube, wire line coring**	Bore Diameter:	**50 mm**
Drill Mount:	**Hydropower**	Casing Size:	**-**
Drill Fluid:	**Water**	Casing Depth:	**40.00 m**
		Borehole Inclination:	**-90°**
		Borehole Bearing:	**-90°**

Logged By:	**SS**
Checked By:	**LC**
Date Started:	**5/02/2013**
Date Finished:	**8/02/2013**
Relative Level:	**43.93 mRL**
Coordinates:	**387031.33 mE**
	6382555.51 mN
Coordinate System:	**-**

Project Name:	**Eagleton Quarry Hydrogeological Investigation**
Project Number:	**43207448**
Client:	**Buildev**
Location:	**Eagleton Quarry**

DRILLING				MATERIAL DESCRIPTION						DISCONTINUITY DESCRIPTION	
METHOD	STANDPIPE/ WATER OBS	RUN / RECOVERY	SAMPLING/ TESTING	DEPTH (m)	GRAPHIC LOG	DESCRIPTION OF STRATA (**ROCK TYPE:** colour, fabric, grain size, inclusions)	WEATHERING	ESTIMATED STRENGTH (VL L M H VH EH)	RQD (%)	DEFECT SPACING (mm) (0-19, 20-49, 50-99, 100-199, 200-599, >600)	DEFECT DESCRIPTION (Defect type, inclination, shape, roughness, infill, thickness)
HQ3				0		FILL; Compacted tiles and tile fragments.	HW				
HQ3				1		Silty gravelly sandy CLAY; Low to medium plasticity, grey/brown, with medium sand and fine to medium, subangular to subrounded gravel of tiles.					
HQ3				3		CONGLOMERATE; Matrix supported, grey/brown, very low strength, highly weathered. Recovered as slightly silty gravelly SAND, fine grained sand, with fine to medium grained, subangular to subrounded gravel.					
HQ3				5		Core loss.		CORE LOSS		CORE LOSS	
HQ3		5.8 0% 6.6		6		CONGLOMERATE: Matrix supported, grey/brown, very low strength, moderately weathered. Silty sand matrix with very high strength igneous cobbles (up to 50 mm).	MW		90%		
						Core loss.		CORE LOSS		CORE LOSS	
HQ3		25% 7.3		7		CONGLOMERATE: Matrix supported, yellow/brown, low strength, moderately weathered. Clayey sandy gravel matrix with high strength igneous cobbles (up to 30 mm).	MW		15%		
						Core loss.		CORE LOSS		CORE LOSS	
HQ3		41% 8.65		8		CONGLOMERATE: Matrix supported, grey/brown, low strength, slightly weathered. Silty sand matrix with high strength igneous cobbles (up to 180 mm). From 7.30 m to 7.50 m Boulder of fine grained, pale pink, high strength, slightly weathered porphyritic igneous rock (possibly rhyolite). From 7.65 m to 8.20 m recovered as coarse sand and subangular to subrounded gravel.	SW		21%		
						Core loss.		CORE LOSS		CORE LOSS	
				9		CONGLOMERATE: Matrix supported, red/brown, low strength, moderately weathered. Sandy gravel matrix with very high strength igneous cobbles (up to 40 mm). Recovered as slightly silty sandy subangular gravel. Fine to medium orange/grey/Brown gravel, with fine to coarse brown sand with clayey	MW				

BOREHOLE GWB04

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Project No.: 43207448

Project Name: Eagleton Quarry Hydrogeological Investigation

DRILLING				MATERIAL DESCRIPTION					DISCONTINUITY DESCRIPTION	
METHOD	STANDPIPE/ WATER OBS	RUN / RECOVERY	SAMPLING/ TESTING	DEPTH (m)	GRAPHIC LOG	DESCRIPTION OF STRATA (**ROCK TYPE:** colour, fabric, grain size, inclusions)	WEATHERING	ESTIMATED STRENGTH (VL L M H VH EH)	RQD (%)	DEFECT SPACING (mm) (0-19, 20-49, 50-99, 100-199, 200-599, >600)	DEFECT DESCRIPTION (Defect type, inclination, shape, roughness, infill, thickness)
HQ3		31%		11		sand clasts and fine to medium plasticity brown silt. CONGLOMERATE: Matrix supported, red/brown, low strength, moderately weathered. Sandy gravel matrix with very high strength igneous cobbles (up to 40 mm). *continued from previous page*			0%		
				12		Recovered as fine to medium, grey/brown gravel with fine to coarse brown sand.					
				13		From 13.00 m becoming pink/grey.					
				14							
		14.9		15		CONGLOMERATE: Matrix supported, red/brown, high strength, fresh. Gravelly sand matrix with very high strength igneous cobbles (up to 140 mm).	FR				Small cobbles debonded from matrix (50 mm)
HQ3		92%							54%		J12 J30 Cobble debonded from matrix (70 mm) Cobble debonded from matrix (140 mm) J38
		16.2		16							
HQ3		100%		17		CONGLOMERATE: Matrix supported, red/brown, high strength, fresh. Gravelly sand matrix with very high strength igneous cobbles (up to 180 mm).	FR		84%		J42, calcite healed Cobble debonded from matrix (50 mm) J44, calcite healed Cobble debonded from matrix
		18.15		18		CONGLOMERATE: Matrix supported, red/brown, high strength, fresh. Gravelly sand matrix with very high strength igneous cobbles (up to 170 mm).	FR				STZ
HQ3		100%		19					85%		J28 Cobbles debonded from matrix J30
				20							J40 J44 J32, rough J22, calcite healed
		20.8				From 20.63 m to 20.80 m Boulder of fine grained, grey with white mottling, high strength porphyritic igneous rock (possibly rhyolite).	FR				J42
HQ3				21		CONGLOMERATE: Matrix supported, red/brown, very high strength, fresh. Gravelly sand matrix with very high strength igneous cobbles. From 21.80 m to 22.02 m Boulder of fine grained.					Cobble debonded from matrix (60 mm) J30, undulating, smooth J34, planar, smooth, Fe J38, planar, rough

BOREHOLE GWB04

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DRILLING				MATERIAL DESCRIPTION						DISCONTINUITY DESCRIPTION	
METHOD	STANDPIPE/ WATER OBS	RUN / RECOVERY	SAMPLING/ TESTING	DEPTH (m)	GRAPHIC LOG	DESCRIPTION OF STRATA (**ROCK TYPE:** colour, fabric, grain size, inclusions)	WEATHERING	ESTIMATED STRENGTH (VL L M H VH EH)	RQD (%)	DEFECT SPACING (mm) (0-19, 20-49, 50-99, 100-199, 200-599, >600)	DEFECT DESCRIPTION (Defect type, inclination, shape, roughness, infill, thickness)
HQ3		100%		23		dark grey/grey with white mottling, high strength porphyritic igneous rock (possibly rhyolite). CONGLOMERATE: Matrix supported, red/brown, very high strength, fresh. Gravelly sand matrix with very high strength igneous cobbles. *continued from previous page*			98%		J20, undulating, rough J36, planar, rough
						CONGLOMERATE: Matrix supported, red/brown, very high strength, fresh. Gravelly sand matrix with very high strength igneous cobbles (up to 150 mm).					Cobbles debonded from matrix (50 mm)
		23.9		24		From 24.23 m to 24.44 m Boulder of fine grained, grey/dark grey with white mottling, high strength porphyritic igneous rock (possibly rhyolite).	FR				
		100%		25					77%		J30, undulating, rough, Fe Cobbles debonded from matrix
		27		27		AGGLOMERATE: Fine grained, pink/grey, high strength, fresh with subangular to rounded cobbles of very high strength porphyritic igneous rock (up to 150 mm).	FR				J6, planar, rough
		100%		28					93%		J32, undulating, rough, Fe Cobbles debonded from matrix J36, undulating, rough, Fe J20, undulating, rough, Fe J30, planar J22, undulating, Fe J38, planar
		30		30		CONGLOMERATE: Matrix supported, red/pink/brown, high strength, fresh. Gravelly sand matrix with very high strength igneous cobbles (up to 140 mm). From 30.30 m to 30.40 m Boulder of fine grained, white with black mottling, very high strength, porphyritic igneous rock (possibly rhyolite).	FR				J24, undulating, rough J44, planar
HQ3		100%		32					96%		
		33.05		33		CONGLOMERATE: Matrix supported, red/pink/brown, high strength, fresh. Gravelly sand matrix with very high strength igneous cobbles (up to 140 mm).	FR				Cobbles debonded from matrix J38, partially planar and smooth,

CORED HOLE (MELB GEOTECH) SEP 09 J:\NWC\43207448\5 WORKS\DRILLING\GINT\GINT LOGS\GINT PROJECT AND LIBRARY FILE FOR LOGS\EAGLETON QAURRY - CORED LOGS.GPJ URS1.GDT 15/11/13

BOREHOLE GWB04

URS Australia Pty Ltd
53 Cleary Street, Hamilton, NSW 2303
Phone (02) 4985 3500
Fax (02) 4985 3555

Project No.: 43207448

Project Name: Eagleton Quarry Hydrogeological Investigation

DRILLING				MATERIAL DESCRIPTION						DISCONTINUITY DESCRIPTION	
METHOD	STANDPIPE/ WATER OBS	RUN / RECOVERY	SAMPLING/ TESTING	DEPTH (m)	GRAPHIC LOG	DESCRIPTION OF STRATA (**ROCK TYPE:** colour, fabric, grain size, inclusions)	WEATHERING	ESTIMATED STRENGTH (VL L M H VH EH)	RQD (%)	DEFECT SPACING (mm) (0-19, 20-49, 50-99, 100-199, 200-599, >600)	DEFECT DESCRIPTION (Defect type, inclination, shape, roughness, infill, thickness)
HQ3		100%		34		CONGLOMERATE: Matrix supported, red/pink/brown, high strength, fresh. Gravelly sand matrix with very high strength igneous cobbles (up to 140 mm). *continued from previous page*			92%		partially undulating/rough J16
		34.85									J30, calcite healed
				35		From 34.00 m to 34.33 m Boulder of fine grained, grey/dark grey with white and black mottling, high strength porphyritic igneous rock (possibly rhyolite).	FR				J32, Fe
HQ3		100%				From 34.40 m to 34.60 m Boulder of fine to medium grained, white with black mottling igneous rock (possibly rhyolite).			98%		J4, undulating, rough, Fe
											J50, undulating, rough, Fe
											J66, Fe
		36.1		36		CONGLOMERATE: Matrix supported, orange/brown, high strength, fresh. Gravelly sand matrix with very high strength igneous cobbles (up to 110 mm).	FR				
						From 35.78 m to 36.00 m Boulder of fine to medium grained, white with black mottling igneous rock (possibly rhyolite).					J22, calcite infilled
HQ3		100%									J22, calcite infilled
											BZ
				37		CONGLOMERATE: Matrix supported, orange/brown, high strength, fresh. Gravelly sand matrix with very high strength igneous cobbles (up to 110 mm).			82%		
						From 36.20 m to 36.40 m Boulder of fine to medium grained, white with black mottling igneous rock (possibly rhyolite).					J40, planar, Fe
		37.9									J18, stepped, rough, Fe
				38		AGGLOMERATE: Fine grained, pink/grey, high strength, fresh with subangular to rounded cobbles of very high strength porphyritic igneous rock (up to 140 mm).	FR				J50, planar, rough
HQ3		100%				Cobbles debonded from matrix from 38.40 m to 38.70 m.					Cobbles debonded from matrix
											J14, undulating, rough
				39					86%		J40, undulating, rough
											J10, stepped, smooth
				40		Final depth of well - 40.0 mbgl.					
				41							
				42							
				43							
				44							
				45							

CORED HOLE (MELB GEOTECH) SEP 09 J:\NWC\43207448\5 WORKS\DRILLING\GINT\GINT LOGS\GINT PROJECT AND LIBRARY FILE FOR LOGS\EAGLETON QAURRY - CORED LOGS.GPJ URS1.GDT 15/11/13

BOREHOLE GWB05

URS Australia PTY LTD
Level 4, 226 Adelaide Terrace, Perth, WA
Phone (08) 9326 0100
Fax (08) 9326 0296

Drilling Contractor: **Total Drilling Pty Ltd**

Drill Model: **Air Hammer**
Drill Mount: **Hydropower**
Drill Fluid: **Air compressor**

Bore Diameter: **50 mm**
Casing Size: **100 mm**
Casing Depth: **45.00 m**
Borehole Inclination: **-90°**
Borehole Bearing: **-90°**

Logged By: **SS**
Checked By: **LC**
Date Started: **11/02/2013**
Date Finished: **15/02/2013**

Relative Level: **88.11 mRL**
Coordinates: **386635.05 mE**
6382929.64 mN
Coordinate System: **-**

Project Name: **Eagleton Quarry Hydrogeological Investigation**
Project Number: **43207448**
Client: **Buildev**
Location: **Eagleton Quarry**

DRILLING				MATERIAL DESCRIPTION					ADDITIONAL INFO.
METHOD	STANDPIPE/ WATER OBS	SAMPLING/ TESTING	DEPTH (m)	GRAPHIC LOG	GROUP SYM.	DESCRIPTION OF STRATA (**SOIL TYPE:** plasticity or particle size, colour, secondary and minor components, structure and other features)	MOISTURE	CONSISTENCY/ REL. DENS.	ADDITIONAL OBSERVATIONS & COMMENTS
			1–8			Recovered as sandy GRAVEL: Fine to medium, subangular to angular, white/pink igneous gravel.			
			9–11			Recovered as sandy GRAVEL: Becoming grey/brown.			
			12–15			Recovered as sandy GRAVEL: Becoming blue/grey.			
			16–27			Recovered as sandy GRAVEL: Becoming pink/grey, porphyritic.			
			28–29			Recovered as sandy GRAVEL: Becoming red/grey.			

BOREHOLE GWB05

URS Australia PTY LTD
Level 4, 226 Adelaide Terrace, Perth, WA
Phone (08) 9326 0100
Fax (08) 9326 0296

Project No.: **43207448**

Project Name: **Eagleton Quarry Hydrogeological Investigation**

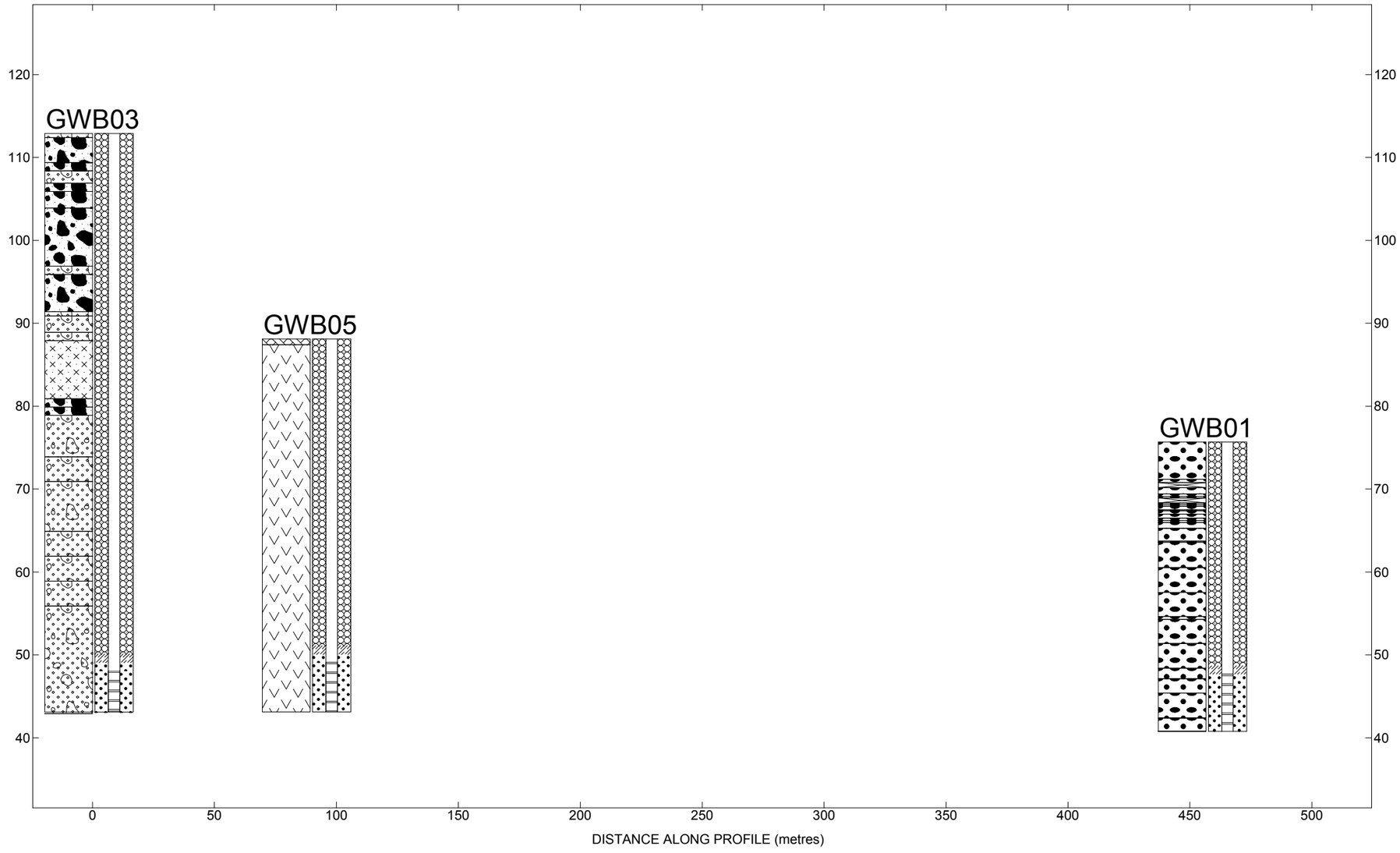
DRILLING				MATERIAL DESCRIPTION					ADDITIONAL INFO.
METHOD	STANDPIPE/ WATER OBS	SAMPLING/ TESTING	DEPTH (m)	GRAPHIC LOG	GROUP SYM.	DESCRIPTION OF STRATA (**SOIL TYPE:** plasticity or particle size, colour, secondary and minor components, structure and other features)	MOISTURE	CONSISTENCY/ REL. DENS.	ADDITIONAL OBSERVATIONS & COMMENTS
			31			Recovered as sandy GRAVEL: Becoming red/grey. *continued from previous page*			
			45			Final depth of well - 45.0 mbgl.			

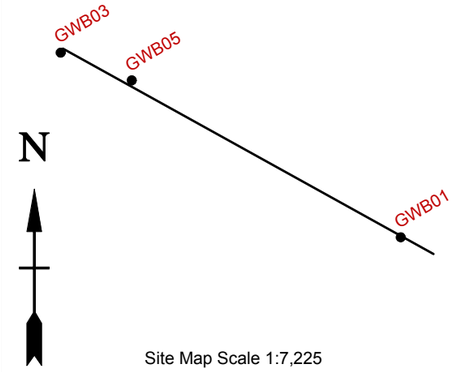
◄ North West

South East ►

A

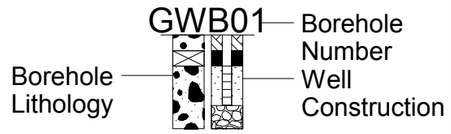
A'





Site Map Scale 1:7,225

Explanation:



Horizontal Scale (metres)

Vertical Exaggeration: 3.5x

It is noted that lithology was recorded during drilling of these wells, due to the nature the drilling method (air hammer) used during redrilling of GWB05 (formally BH103), lithological details were taken from the original drilling logs recorded by Douglas Partners, July 2010 (Appendix C).

Lithology Graphics

- Conglomerate
- Core Loss pattern
- Well-graded Gravelly Sand
- Well-graded Sandy Gravel
- Silty Sand - Sandy Silt
- Fill
- Fine-grained Igneous Rock

Well Graphics

- 1 pipe, in cement/grout
- 1 pipe, in bentonite chips
- 1 pipe, slotted in gravel
- 1 pipe, in pea gravel

URS

Eagleton Quarry Cross Section A-A'
Figure Title

Eagleton Quarry
Hydrogeological Investigation

JOB NUMBER	PLATE NUMBER
43207448	Plate A-1

Appendix D Laboratory Data

Environmental Division

SAMPLE RECEIPT NOTIFICATION (SRN)

Comprehensive Report

Work Order : **ES1304056**

Client	: **URS AUSTRALIA (NSW) PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: HARRY EGAN	Contact	: Client Services
Address	: LEVEL 4, 407 PACIFIC HIGHWAY ARTARMON NSW, AUSTRALIA 2064	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: harry.egan@urs.com	E-mail	: sydney@alsglobal.com
Telephone	: +61 02 8925 5500	Telephone	: +61-2-8784 8555
Facsimile	: +61 02 8925 5555	Facsimile	: +61-2-8784 8500
Project	: 43207448	Page	: 1 of 3
Order number	: ----		
C-O-C number	: ----	Quote number	: ES2012URSNSW0279 (EN/001/12)
Site	: ----		
Sampler	: ----	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement

Dates

Date Samples Received	: 22-FEB-2013	Issue Date	: 22-FEB-2013 21:47
Client Requested Due Date	: 01-MAR-2013	Scheduled Reporting Date	: **01-MAR-2013**

Delivery Details

Mode of Delivery	: Carrier	Temperature	: 5.6' C SYD
No. of coolers/boxes	: ----	No. of samples received	: 9
Security Seal	: Intact.	No. of samples analysed	: 9

General Comments

- This report contains the following information:
  - Sample Container(s)/Preservation Non-Compliances
  - Summary of Sample(s) and Requested Analysis
  - Proactive Holding Time Report
  - Requested Deliverables
- **Samples received in appropriately pretreated and preserved containers.**
- **Please refer to the Proactive Holding Time Report table below which summarises breaches of recommended holding times that have occurred prior to samples/instructions being received at the laboratory. The absence of this summary table indicates that all samples have been received within the recommended holding times for the analysis requested.**
- **Sample(s) requiring volatile organic compound analysis received in airtight containers (ZHE).**
- Please direct any queries you have regarding this work order to the above ALS laboratory contact.
- Analytical work for this work order will be conducted at ALS Sydney.
- Sample Disposal - Aqueous (14 days), Solid (60 days) from date of completion of work order.

Sample Container(s)/Preservation Non-Compliances

All comparisons are made against pretreatment/preservation AS, APHA, USEPA standards.

- **No sample container / preservation non-compliance exist.**

Summary of Sample(s) and Requested Analysis

Some items described below may be part of a laboratory process neccessary for the execution of client requested tasks. Packages may contain additional analyses, such as the determination of moisture content and preparation tasks, that are included in the package.
If no sampling time is provided, the sampling time will default to 15:00 on the date of sampling. If no sampling date is provided, the sampling date will be assumed by the laboratory for processing purposes and will be shown bracketed without a time component.

Matrix: **WATER**

Laboratory sample ID	Client sampling date / time	Client sample ID	WATER - EA005P pH (PC)	WATER - EA010P Conductivity (PC)	WATER - EA015H Total Dissolved Solids - High Level	WATER - EK055G Ammonia as N By Discrete Analyser	WATER - EK058G Nitrate as N by Discrete Analyser	WATER - EK062G Total Nitrogen as N (TKN + NOx	WATER - EK067G Total Phosphorus as P By Discrete	WATER - EK071G Reactive Phosphorus by Discrete
ES1304056-001	22-FEB-2013 10:00	GWB04_130222	✓	✓	✓	✓	✓	✓	✓	✓
ES1304056-002	22-FEB-2013 10:30	GWBO5/BH103_130222	✓	✓	✓	✓	✓	✓	✓	✓
ES1304056-003	[22-FEB-2013]	QC100_130222	✓	✓	✓	✓	✓	✓	✓	✓
ES1304056-004	[22-FEB-2013]	QC200_130222	✓	✓	✓	✓	✓	✓	✓	✓
ES1304056-005	22-FEB-2013 10:45	GWB03_130222	✓	✓	✓	✓	✓	✓	✓	✓
ES1304056-006	22-FEB-2013 11:15	GWB02_130222	✓	✓	✓	✓	✓	✓	✓	✓
ES1304056-007	22-FEB-2013 11:50	GWB01_130222	✓	✓	✓	✓	✓	✓	✓	✓

Matrix: **WATER**

Laboratory sample ID	Client sampling date / time	Client sample ID	WATER - EN055 - PG Ionic Balance by ED037P, ED041G,	WATER - EP080 BTEX	WATER - NT-01 Maior Cations (Ca, Mg, Na, K)	WATER - NT-02 Maior Anions (Chloride, Sulphate,	WATER - W-02 8 Metals	WATER - W-18 TPH(C6 - C9)/BTEX
ES1304056-001	22-FEB-2013 10:00	GWB04_130222	✓		✓	✓	✓	
ES1304056-002	22-FEB-2013 10:30	GWBO5/BH103_130222	✓		✓	✓	✓	
ES1304056-003	[22-FEB-2013]	QC100_130222	✓		✓	✓	✓	
ES1304056-004	[22-FEB-2013]	QC200_130222	✓		✓	✓	✓	
ES1304056-005	22-FEB-2013 10:45	GWB03_130222	✓		✓	✓	✓	
ES1304056-006	22-FEB-2013 11:15	GWB02_130222	✓		✓	✓	✓	
ES1304056-007	22-FEB-2013 11:50	GWB01_130222	✓		✓	✓	✓	
ES1304056-008	[22-FEB-2013]	TRIP SPIKE_130222		✓				
ES1304056-009	[22-FEB-2013]	TRIP BLANK_130222						✓

Proactive Holding Time Report

Sample(s) have been received within the recommended holding times for the requested analysis.

Requested Deliverables

EQUIS URS_EDMS		
- EDI Format - EQUIS V5 URS (EQUIS_V5_URS)	Email	glenyss.weeks@alsglobal.com
HARRY EGAN		
- *AU Certificate of Analysis - NATA (COA)	Email	harry.egan@urs.com
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	harry.egan@urs.com
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	harry.egan@urs.com
- A4 - AU Sample Receipt Notification - Environmental HT (SRN	Email	harry.egan@urs.com
- A4 - AU Tax Invoice (INV)	Email	harry.egan@urs.com
- Chain of Custody (CoC) (COC)	Email	harry.egan@urs.com
- EDI Format - ENMRG (ENMRG)	Email	harry.egan@urs.com
THE ACCOUNTS PAYABLE		
- A4 - AU Tax Invoice (INV)	Email	sydney_accounts@urscorp.com

CERTIFICATE OF ANALYSIS

Work Order	: **ES1304056**	Page	: 1 of 8
Amendment	: **1**		
Client	: **URS AUSTRALIA (NSW) PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: HARRY EGAN	Contact	: Client Services
Address	: Supplier ID number - 1179447 LEVEL 4, 407 PACIFIC HIGHWAY ARTARMON NSW, AUSTRALIA 2064	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: harry.egan@urs.com	E-mail	: sydney@alsglobal.com
Telephone	: +61 02 8925 5500	Telephone	: +61-2-8784 8555
Facsimile	: +61 02 8925 5555	Facsimile	: +61-2-8784 8500
Project	: 43207448	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Order number	: 43207448		
C-O-C number	: ----	Date Samples Received	: 22-FEB-2013
Sampler	: ----	Issue Date	: 13-NOV-2013
Site	: ----		
		No. of samples received	: 9
Quote number	: EN/001/12	No. of samples analysed	: 9

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

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

- **EA015 TDS may bias high for sample ID GWB02_130222 due to the presence of fine particulate matter, which may pass through the prescribed GF/C paper.**
- **Sample TRIP SPIKE contains volatile compounds spiked into the sample containers prior to dispatch from the laboratory. BTEX compounds spiked at 20 ug/L.**
- **This report has been amended and re-released to allow additional pertinent comments to be added to the report. All analysis results are as per the previous report.**

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
Ashesh Patel	Inorganic Chemist	Sydney Inorganics
Dianne Blane	Laboratory Coordinator (2IC)	Newcastle
Eric Chau	Metals Team Leader	Melbourne Inorganics
Hoa Nguyen	Senior Inorganic Chemist	Sydney Inorganics
Pabi Subba	Senior Organic Chemist	Sydney Organics
Raymond Commodor	Instrument Chemist	Sydney Inorganics

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	GWB04_130222	GWBO5/BH103_130222	QC100_130222	QC200_130222	GWB03_130222
				Client sampling date / time	22-FEB-2013 10:00	22-FEB-2013 10:30	[22-FEB-2013]	[22-FEB-2013]	22-FEB-2013 10:45
Compound	CAS Number	LOR	Unit		ES1304056-001	ES1304056-002	ES1304056-003	ES1304056-004	ES1304056-005
EA005: pH									
pH Value	----	0.01	pH Unit		7.57	10.2	7.47	7.58	9.23
EA010P: Conductivity by PC Titrator									
Electrical Conductivity @ 25°C	----	1	µS/cm		6060	1810	6080	6060	2130
EA015: Total Dissolved Solids									
Total Dissolved Solids @180°C	----	10	mg/L		3720	1080	4100	3680	1290
ED037P: Alkalinity by PC Titrator									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L		<1	12	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L		<1	122	<1	<1	104
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L		374	<1	371	372	242
Total Alkalinity as CaCO3	----	1	mg/L		374	134	371	372	347
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L		212	462	207	209	89
ED045G: Chloride Discrete analyser									
Chloride	16887-00-6	1	mg/L		1630	207	1630	1610	468
ED093F: Dissolved Major Cations									
Calcium	7440-70-2	1	mg/L		224	22	216	222	49
Magnesium	7439-95-4	1	mg/L		190	5	190	193	70
Sodium	7440-23-5	1	mg/L		796	317	791	784	296
Potassium	7440-09-7	1	mg/L		20	78	21	18	26
EG020F: Dissolved Metals by ICP-MS									
Arsenic	7440-38-2	0.001	mg/L		<0.001	0.006	<0.001	<0.001	<0.001
Cadmium	7440-43-9	0.0001	mg/L		0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	7440-47-3	0.001	mg/L		<0.001	0.094	<0.001	<0.001	0.032
Copper	7440-50-8	0.001	mg/L		0.003	0.002	0.003	0.002	0.003
Nickel	7440-02-0	0.001	mg/L		0.006	0.001	0.005	0.006	0.001
Lead	7439-92-1	0.001	mg/L		<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	7440-66-6	0.005	mg/L		0.022	<0.005	0.022	0.026	0.067
EG035F: Dissolved Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L		0.01	0.76	0.01	<0.01	0.02
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	----	0.01	mg/L		<0.01	0.01	<0.01	<0.01	<0.01

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	GWB04_130222	GWBO5/BH103_130222	QC100_130222	QC200_130222	GWB03_130222
				Client sampling date / time	22-FEB-2013 10:00	22-FEB-2013 10:30	[22-FEB-2013]	[22-FEB-2013]	22-FEB-2013 10:45
Compound	CAS Number	LOR	Unit		ES1304056-001	ES1304056-002	ES1304056-003	ES1304056-004	ES1304056-005
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L		**0.03**	**0.11**	**0.04**	**0.06**	**0.07**
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		**0.03**	**0.12**	**0.04**	**0.06**	**0.07**
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		<0.1	**2.2**	<0.1	<0.1	**0.3**
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		<0.1	**2.3**	<0.1	<0.1	**0.4**
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		<0.01	**0.19**	**0.02**	**0.02**	**0.05**
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	<0.01	<0.01
EN055: Ionic Balance									
Total Anions	----	0.01	meq/L		**57.9**	**18.1**	**57.7**	**57.2**	**22.0**
Total Cations	----	0.01	meq/L		**62.0**	**17.3**	**61.4**	**61.5**	**21.8**
Ionic Balance	----	0.01	%		**3.41**	**2.40**	**3.07**	**3.64**	**0.57**

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	GWB02_130222	GWB01_130222	TRIP SPIKE_130222	TRIP BLANK_130222	----
				Client sampling date / time	22-FEB-2013 11:15	22-FEB-2013 11:50	[22-FEB-2013]	[22-FEB-2013]	----
Compound	CAS Number	LOR	Unit		ES1304056-006	ES1304056-007	ES1304056-008	ES1304056-009	----
EA005: pH									
pH Value	----	0.01	pH Unit		**7.48**	**9.49**	----	----	----
EA010P: Conductivity by PC Titrator									
Electrical Conductivity @ 25°C	----	1	µS/cm		**465**	**4820**	----	----	----
EA015: Total Dissolved Solids									
Total Dissolved Solids @180°C	----	10	mg/L		**412**	**3020**	----	----	----
ED037P: Alkalinity by PC Titrator									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L		<1	<1	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L		<1	**114**	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L		**73**	**78**	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L		**73**	**192**	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L		**22**	**550**	----	----	----
ED045G: Chloride Discrete analyser									
Chloride	16887-00-6	1	mg/L		**86**	**1060**	----	----	----
ED093F: Dissolved Major Cations									
Calcium	7440-70-2	1	mg/L		**21**	**8**	----	----	----
Magnesium	7439-95-4	1	mg/L		**8**	**100**	----	----	----
Sodium	7440-23-5	1	mg/L		**61**	**720**	----	----	----
Potassium	7440-09-7	1	mg/L		**6**	**317**	----	----	----
EG020F: Dissolved Metals by ICP-MS									
Arsenic	7440-38-2	0.001	mg/L		**0.003**	<0.001	----	----	----
Cadmium	7440-43-9	0.0001	mg/L		<0.0001	<0.0001	----	----	----
Chromium	7440-47-3	0.001	mg/L		**0.001**	**0.726**	----	----	----
Copper	7440-50-8	0.001	mg/L		**0.002**	**0.004**	----	----	----
Nickel	7440-02-0	0.001	mg/L		**0.004**	**0.001**	----	----	----
Lead	7439-92-1	0.001	mg/L		<0.001	**0.002**	----	----	----
Zinc	7440-66-6	0.005	mg/L		**0.013**	**0.010**	----	----	----
EG035F: Dissolved Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	<0.0001	----	----	----
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L		<0.01	**0.07**	----	----	----
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	----	0.01	mg/L		<0.01	**0.02**	----	----	----

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)

Compound	CAS Number	LOR	Unit	Client sample ID	GWB02_130222	GWB01_130222	TRIP SPIKE_130222	TRIP BLANK_130222	----
				Client sampling date / time	22-FEB-2013 11:15	22-FEB-2013 11:50	[22-FEB-2013]	[22-FEB-2013]	----
					ES1304056-006	ES1304056-007	ES1304056-008	ES1304056-009	----
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L		**0.04**	**0.13**	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		**0.04**	**0.15**	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		**1.1**	**0.6**	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ **Total Nitrogen as N**	----	0.1	mg/L		**1.1**	**0.8**	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		**0.38**	**0.02**	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		**0.20**	<0.01	----	----	----
EN055: Ionic Balance									
Total Anions	----	0.01	meq/L		**4.34**	**45.2**	----	----	----
Total Cations	----	0.01	meq/L		**4.51**	**48.1**	----	----	----
Ionic Balance	----	0.01	%		**1.92**	**3.07**	----	----	----
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	20	µg/L		----	----	----	<20	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft									
C6 - C10 Fraction	C6_C10	20	µg/L		----	----	----	<20	----
^ **C6 - C10 Fraction minus BTEX (F1)**	C6_C10-BTEX	20	µg/L		----	----	----	<20	----
EP080: BTEXN									
Benzene	71-43-2	1	µg/L		----	----	**18**	<1	----
Toluene	108-88-3	2	µg/L		----	----	**18**	<2	----
Ethylbenzene	100-41-4	2	µg/L		----	----	**16**	<2	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L		----	----	**17**	<2	----
ortho-Xylene	95-47-6	2	µg/L		----	----	**18**	<2	----
^ **Total Xylenes**	1330-20-7	2	µg/L		----	----	**35**	<2	----
^ **Sum of BTEX**	----	1	µg/L		----	----	**87**	<1	----
Naphthalene	91-20-3	5	µg/L		----	----	**17**	<5	----
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	0.1	%		----	----	**99.8**	**86.4**	----
Toluene-D8	2037-26-5	0.1	%		----	----	**111**	**98.0**	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	GWB02_130222	GWB01_130222	TRIP SPIKE_130222	TRIP BLANK_130222	----
			Client sampling date / time	22-FEB-2013 11:15	22-FEB-2013 11:50	[22-FEB-2013]	[22-FEB-2013]	----
Compound	CAS Number	LOR	Unit	ES1304056-006	ES1304056-007	ES1304056-008	ES1304056-009	----
EP080S: TPH(V)/BTEX Surrogates - Continued								
4-Bromofluorobenzene	460-00-4	0.1	%	----	----	**111**	**97.1**	----

Surrogate Control Limits

Sub-Matrix: **WATER**

Compound	CAS Number	Recovery Limits (%) Low	High
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	71	137
Toluene-D8	2037-26-5	79	131
4-Bromofluorobenzene	460-00-4	70	128

QUALITY CONTROL REPORT

Work Order	: **ES1304056**	Page	: 1 of 10
Amendment	: **1**		
Client	: **URS AUSTRALIA (NSW) PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: HARRY EGAN	Contact	: Client Services
Address	: Supplier ID number - 1179447 LEVEL 4, 407 PACIFIC HIGHWAY ARTARMON NSW, AUSTRALIA 2064	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: harry.egan@urs.com	E-mail	: sydney@alsglobal.com
Telephone	: +61 02 8925 5500	Telephone	: +61-2-8784 8555
Facsimile	: +61 02 8925 5555	Facsimile	: +61-2-8784 8500
Project	: 43207448	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Site	: ----		
C-O-C number	: ----	Date Samples Received	: 22-FEB-2013
Sampler	: ----	Issue Date	: 13-NOV-2013
Order number	: 43207448		
		No. of samples received	: 9
Quote number	: EN/001/12	No. of samples analysed	: 9

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

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.

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
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
RPD = Relative Percentage Difference
# = Indicates failed QC

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
Ashesh Patel	Inorganic Chemist	Sydney Inorganics
Dianne Blane	Laboratory Coordinator (2IC)	Newcastle
Eric Chau	Metals Team Leader	Melbourne Inorganics
Hoa Nguyen	Senior Inorganic Chemist	Sydney Inorganics
Pabi Subba	Senior Organic Chemist	Sydney Organics
Raymond Commodor	Instrument Chemist	Sydney Inorganics

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR:- No Limit; Result between 10 and 20 times LOR:- 0% - 50%; Result > 20 times LOR:- 0% - 20%.

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EA005: pH (QC Lot: 2744559)									
EN1300709-001	Anonymous	EA005: pH Value	----	0.01	pH Unit	7.90	7.92	0.2	0% - 20%
ES1303967-001	Anonymous	EA005: pH Value	----	0.01	pH Unit	7.68	7.68	0.0	0% - 20%
EA010P: Conductivity by PC Titrator (QC Lot: 2744850)									
ES1304038-001	Anonymous	EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	612	621	1.5	0% - 20%
ES1304056-003	QC100_130222	EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	6080	6060	0.4	0% - 20%
EA015: Total Dissolved Solids (QC Lot: 2746334)									
ES1304056-001	GWB04_130222	EA015H: Total Dissolved Solids @180°C	----	10	mg/L	3720	3210	14.7	0% - 20%
ED037P: Alkalinity by PC Titrator (QC Lot: 2744849)									
ES1303994-007	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	54	54	0.0	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	54	54	0.0	0% - 20%
ES1304038-001	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	290	286	1.3	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	290	286	1.3	0% - 20%
ED037P: Alkalinity by PC Titrator (QC Lot: 2744853)									
ES1304056-003	QC100_130222	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	371	370	0.3	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	371	370	0.3	0% - 20%
ES1304133-002	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	99	99	0.0	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	99	99	0.0	0% - 20%
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 2743908)									
ES1303970-001	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	41	41	0.0	0% - 20%
ES1304059-001	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	52	52	0.0	0% - 20%
ED045G: Chloride Discrete analyser (QC Lot: 2743907)									
ES1303970-001	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	228	227	0.0	0% - 20%
ES1304059-001	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	61	61	0.0	0% - 20%
ED093F: Dissolved Major Cations (QC Lot: 2743904)									
ES1303970-001	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	26	30	15.0	0% - 20%
		ED093F: Magnesium	7439-95-4	1	mg/L	52	52	0.0	0% - 20%
		ED093F: Sodium	7440-23-5	1	mg/L	234	236	0.8	0% - 20%

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
ED093F: Dissolved Major Cations (QC Lot: 2743904) - continued									
ES1303970-001	Anonymous	ED093F: Potassium	7440-09-7	1	mg/L	6	6	0.0	No Limit
ES1304134-001	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	129	138	6.6	0% - 20%
		ED093F: Magnesium	7439-95-4	1	mg/L	964	962	0.2	0% - 20%
		ED093F: Sodium	7440-23-5	1	mg/L	4670	4540	2.8	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	41	40	0.0	0% - 20%
EG020F: Dissolved Metals by ICP-MS (QC Lot: 2744160)									
ES1304056-001	GWB04_130222	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	0.0001	0.0001	0.0	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	0.003	0.002	0.0	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	0.006	0.005	0.0	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	0.022	0.020	7.8	No Limit
ES1304107-004	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	0.002	0.002	0.0	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	0.001	0.001	0.0	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	0.006	0.006	0.0	No Limit
EG035F: Dissolved Mercury by FIMS (QC Lot: 2744159)									
ES1304056-002	GWBO5/BH103_130222	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
ES1304107-004	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	0.0002	0.0002	0.0	No Limit
EK055G: Ammonia as N by Discrete Analyser (QC Lot: 2744218)									
ES1304056-001	GWB04_130222	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	0.01	0.01	0.0	No Limit
ES1304107-003	Anonymous	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	0.07	0.04	60.5	0% - 20%
EK057G: Nitrite as N by Discrete Analyser (QC Lot: 2743905)									
ES1303970-001	Anonymous	EK057G: Nitrite as N	----	0.01	mg/L	<0.01	<0.01	0.0	No Limit
ES1304059-001	Anonymous	EK057G: Nitrite as N	----	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 2744217)									
ES1304056-001	GWB04_130222	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	0.03	0.02	0.0	0% - 20%
ES1304107-003	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	1.74	1.85	6.2	0% - 20%
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QC Lot: 2746162)									
ES1304056-001	GWB04_130222	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	<0.1	0.0	No Limit
ME1300299-003	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	0.8	0.9	13.4	No Limit
EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 2746163)									
ES1304056-001	GWB04_130222	EK067G: Total Phosphorus as P	----	0.01	mg/L	<0.01	0.01	0.0	No Limit
ME1300299-003	Anonymous	EK067G: Total Phosphorus as P	----	0.01	mg/L	0.05	0.09	52.4	No Limit
EK071G: Reactive Phosphorus as P by discrete analyser (QC Lot: 2743906)									

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EK071G: Reactive Phosphorus as P by discrete analyser (QC Lot: 2743906) - continued									
ES1303970-001	Anonymous	EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	0.10	0.10	0.0	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 2744132)									
ES1303967-001	Anonymous	EP080: C6 - C9 Fraction	----	20	µg/L	<20	<20	0.0	No Limit
ES1304074-002	Anonymous	EP080: C6 - C9 Fraction	----	20	µg/L	<20	<20	0.0	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft (QC Lot: 2744132)									
ES1303967-001	Anonymous	EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	0.0	No Limit
ES1304074-002	Anonymous	EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	0.0	No Limit
EP080: BTEXN (QC Lot: 2744132)									
ES1303967-001	Anonymous	EP080: Benzene	71-43-2	1	µg/L	<1	<1	0.0	No Limit
		EP080: Toluene	108-88-3	2	µg/L	<2	<2	0.0	No Limit
		EP080: Ethylbenzene	100-41-4	2	µg/L	<2	<2	0.0	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	0.0	No Limit
		EP080: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.0	No Limit
		EP080: Naphthalene	91-20-3	5	µg/L	<5	<5	0.0	No Limit
ES1304074-002	Anonymous	EP080: Benzene	71-43-2	1	µg/L	<1	<1	0.0	No Limit
		EP080: Toluene	108-88-3	2	µg/L	<2	<2	0.0	No Limit
		EP080: Ethylbenzene	100-41-4	2	µg/L	<2	<2	0.0	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	0.0	No Limit
		EP080: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.0	No Limit
		EP080: Naphthalene	91-20-3	5	µg/L	<5	<5	0.0	No Limit

Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EA010P: Conductivity by PC Titrator (QCLot: 2744850)								
EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	<1	2000 µS/cm	99.9	96	110
EA015: Total Dissolved Solids (QCLot: 2746334)								
EA015H: Total Dissolved Solids @180°C	----	10	mg/L	<10	293 mg/L	99.0	71	119
ED037P: Alkalinity by PC Titrator (QCLot: 2744849)								
ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	----	200 mg/L	100	74	110
ED037P: Alkalinity by PC Titrator (QCLot: 2744853)								
ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	----	200 mg/L	96.4	74	110
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 2743908)								
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	25 mg/L	105	84	124
ED045G: Chloride Discrete analyser (QCLot: 2743907)								
ED045G: Chloride	16887-00-6	1	mg/L	<1	1000 mg/L	98.9	84	122
ED093F: Dissolved Major Cations (QCLot: 2743904)								
ED093F: Calcium	7440-70-2	1	mg/L	<1	50 mg/L	107	85	111
ED093F: Magnesium	7439-95-4	1	mg/L	<1	50 mg/L	107	87	111
ED093F: Sodium	7440-23-5	1	mg/L	<1	50 mg/L	104	79	109
ED093F: Potassium	7440-09-7	1	mg/L	<1	50 mg/L	99.0	86	112
EG020F: Dissolved Metals by ICP-MS (QCLot: 2744160)								
EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	92.8	80	118
EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	90.9	82	114
EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	89.3	80	114
EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	0.1 mg/L	94.4	79	115
EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	94.9	81	113
EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	93.8	80	116
EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	0.1 mg/L	88.8	75	121
EG035F: Dissolved Mercury by FIMS (QCLot: 2744159)								
EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.010 mg/L	101	72	120
EK055G: Ammonia as N by Discrete Analyser (QCLot: 2744218)								
EK055G: Ammonia as N	7664-41-7	0.01	mg/L	<0.01	1.00 mg/L	98.2	89	113
EK057G: Nitrite as N by Discrete Analyser (QCLot: 2743905)								
EK057G: Nitrite as N	----	0.01	mg/L	<0.01	0.5 mg/L	98.0	87	119
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 2744217)								
EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	0.1 mg/L	120	86	124
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 2746162)								

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Recovery Limits (%): Low	Recovery Limits (%): High
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 2746162) - continued								
EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	5 mg/L	114	66	119
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 2746163)								
EK067G: Total Phosphorus as P	----	0.01	mg/L	<0.01	1.0 mg/L	113	69	117
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 2743906)								
EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	0.50 mg/L	104	86	124
EP080/071: Total Petroleum Hydrocarbons (QCLot: 2744132)								
EP080: C6 - C9 Fraction	----	20	µg/L	<20	260 µg/L	83.8	75	127
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft (QCLot: 2744132)								
EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	310 µg/L	84.6	75	127
EP080: BTEXN (QCLot: 2744132)								
EP080: Benzene	71-43-2	1	µg/L	<1	10 µg/L	82.4	70	124
EP080: Toluene	108-88-3	2	µg/L	<2	10 µg/L	84.8	66	132
EP080: Ethylbenzene	100-41-4	2	µg/L	<2	10 µg/L	82.6	70	120
EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	10 µg/L	85.8	69	121
EP080: ortho-Xylene	95-47-6	2	µg/L	<2	10 µg/L	85.8	72	122
EP080: Naphthalene	91-20-3	5	µg/L	<5	10 µg/L	88.1	70	124

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **WATER**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report: Spike Concentration	SpikeRecovery(%): MS	Recovery Limits (%): Low	Recovery Limits (%): High
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 2743908)							
ES1303970-001	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	10 mg/L	# Not Determined	70	130
ED045G: Chloride Discrete analyser (QCLot: 2743907)							
ES1303970-001	Anonymous	ED045G: Chloride	16887-00-6	250 mg/L	94.5	70	130
EG020F: Dissolved Metals by ICP-MS (QCLot: 2744160)							
ES1304056-001	GWB04_130222	EG020A-F: Arsenic	7440-38-2	0.2 mg/L	107	70	130
		EG020A-F: Cadmium	7440-43-9	0.05 mg/L	88.0	70	130
		EG020A-F: Chromium	7440-47-3	0.2 mg/L	95.0	70	130
		EG020A-F: Copper	7440-50-8	0.2 mg/L	96.7	70	130
		EG020A-F: Lead	7439-92-1	0.2 mg/L	90.5	70	130
		EG020A-F: Nickel	7440-02-0	0.2 mg/L	98.7	70	130

Sub-Matrix: **WATER**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report: Spike Concentration	SpikeRecovery(%): MS	Recovery Limits (%): Low	Recovery Limits (%): High
EG020F: Dissolved Metals by ICP-MS (QCLot: 2744160) - continued							
ES1304056-001	GWB04_130222	EG020A-F: Zinc	7440-66-6	0.2 mg/L	86.3	70	130
EG035F: Dissolved Mercury by FIMS (QCLot: 2744159)							
ES1304056-002	GWBO5/BH103_130222	EG035F: Mercury	7439-97-6	0.0100 mg/L	103	70	130
EK055G: Ammonia as N by Discrete Analyser (QCLot: 2744218)							
ES1304056-001	GWB04_130222	EK055G: Ammonia as N	7664-41-7	1.00 mg/L	85.1	70	130
EK057G: Nitrite as N by Discrete Analyser (QCLot: 2743905)							
ES1303970-001	Anonymous	EK057G: Nitrite as N	----	0.5 mg/L	93.4	70	130
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 2744217)							
ES1304056-001	GWB04_130222	EK059G: Nitrite + Nitrate as N	----	0.1 mg/L	122	70	130
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 2746162)							
ES1304056-001	GWB04_130222	EK061G: Total Kjeldahl Nitrogen as N	----	5 mg/L	111	70	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 2746163)							
ES1304056-001	GWB04_130222	EK067G: Total Phosphorus as P	----	1.00 mg/L	112	70	130
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 2743906)							
ES1303970-001	Anonymous	EK071G: Reactive Phosphorus as P	14265-44-2	0.50 mg/L	95.4	70	130
EP080/071: Total Petroleum Hydrocarbons (QCLot: 2744132)							
ES1303967-001	Anonymous	EP080: C6 - C9 Fraction	----	325 µg/L	114	70	130
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft (QCLot: 2744132)							
ES1303967-001	Anonymous	EP080: C6 - C10 Fraction	C6_C10	375 µg/L	114	70	130
EP080: BTEXN (QCLot: 2744132)							
ES1303967-001	Anonymous	EP080: Benzene	71-43-2	25 µg/L	96.3	70	130
		EP080: Toluene	108-88-3	25 µg/L	114	70	130
		EP080: Ethylbenzene	100-41-4	25 µg/L	99.2	70	130
		EP080: meta- & para-Xylene	108-38-3 106-42-3	25 µg/L	102	70	130
		EP080: ortho-Xylene	95-47-6	25 µg/L	99.9	70	130
		EP080: Naphthalene	91-20-3	25 µg/L	88.7	70	130

Matrix Spike (MS) and Matrix Spike Duplicate (MSD) Report

The quality control term Matrix Spike (MS) and Matrix Spike Duplicate (MSD) refers to intralaboratory split samples spiked with a representative set of target analytes. The purpose of these QC parameters are to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **WATER**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Matrix Spike (MS) and Matrix Spike Duplicate (MSD) Report: Spike Concentration	Spike Recovery (%): MS	Spike Recovery (%): MSD	Recovery Limits (%): Low	Recovery Limits (%): High	RPDs (%): Value	RPDs (%): Control Limit

Sub-Matrix: **WATER**

				Matrix Spike (MS) and Matrix Spike Duplicate (MSD) Report						
				Spike	Spike Recovery (%)		Recovery Limits (%)		RPDs (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	MSD	Low	High	Value	Control Limit
EK057G: Nitrite as N by Discrete Analyser (QCLot: 2743905)										
ES1303970-001	Anonymous	EK057G: Nitrite as N	----	0.5 mg/L	93.4	----	70	130	----	----
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 2743906)										
ES1303970-001	Anonymous	EK071G: Reactive Phosphorus as P	14265-44-2	0.50 mg/L	95.4	----	70	130	----	----
ED045G: Chloride Discrete analyser (QCLot: 2743907)										
ES1303970-001	Anonymous	ED045G: Chloride	16887-00-6	250 mg/L	94.5	----	70	130	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 2743908)										
ES1303970-001	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	10 mg/L	# Not Determined	----	70	130	----	----
EP080/071: Total Petroleum Hydrocarbons (QCLot: 2744132)										
ES1303967-001	Anonymous	EP080: C6 - C9 Fraction	----	325 µg/L	114	----	70	130	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft (QCLot: 2744132)										
ES1303967-001	Anonymous	EP080: C6 - C10 Fraction	C6_C10	375 µg/L	114	----	70	130	----	----
EP080: BTEXN (QCLot: 2744132)										
ES1303967-001	Anonymous	EP080: Benzene	71-43-2	25 µg/L	96.3	----	70	130	----	----
		EP080: Toluene	108-88-3	25 µg/L	114	----	70	130	----	----
		EP080: Ethylbenzene	100-41-4	25 µg/L	99.2	----	70	130	----	----
		EP080: meta- & para-Xylene	108-38-3 106-42-3	25 µg/L	102	----	70	130	----	----
		EP080: ortho-Xylene	95-47-6	25 µg/L	99.9	----	70	130	----	----
		EP080: Naphthalene	91-20-3	25 µg/L	88.7	----	70	130	----	----
EG035F: Dissolved Mercury by FIMS (QCLot: 2744159)										
ES1304056-002	GWBO5/BH103_130222	EG035F: Mercury	7439-97-6	0.0100 mg/L	103	----	70	130	----	----
EG020F: Dissolved Metals by ICP-MS (QCLot: 2744160)										
ES1304056-001	GWB04_130222	EG020A-F: Arsenic	7440-38-2	0.2 mg/L	107	----	70	130	----	----
		EG020A-F: Cadmium	7440-43-9	0.05 mg/L	88.0	----	70	130	----	----
		EG020A-F: Chromium	7440-47-3	0.2 mg/L	95.0	----	70	130	----	----
		EG020A-F: Copper	7440-50-8	0.2 mg/L	96.7	----	70	130	----	----
		EG020A-F: Lead	7439-92-1	0.2 mg/L	90.5	----	70	130	----	----
		EG020A-F: Nickel	7440-02-0	0.2 mg/L	98.7	----	70	130	----	----
		EG020A-F: Zinc	7440-66-6	0.2 mg/L	86.3	----	70	130	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 2744217)										
ES1304056-001	GWB04_130222	EK059G: Nitrite + Nitrate as N	----	0.1 mg/L	122	----	70	130	----	----
EK055G: Ammonia as N by Discrete Analyser (QCLot: 2744218)										
ES1304056-001	GWB04_130222	EK055G: Ammonia as N	7664-41-7	1.00 mg/L	85.1	----	70	130	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 2746162)										
ES1304056-001	GWB04_130222	EK061G: Total Kjeldahl Nitrogen as N	----	5 mg/L	111	----	70	130	----	----
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 2746163)										

Sub-Matrix: **WATER**

				Matrix Spike (MS) and Matrix Spike Duplicate (MSD) Report						
				Spike	Spike Recovery (%)		Recovery Limits (%)		RPDs (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	MSD	Low	High	Value	Control Limit
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 2746163) - continued										
ES1304056-001	GWB04_130222	EK067G: Total Phosphorus as P	----	1.00 mg/L	112	----	70	130	----	----

INTERPRETIVE QUALITY CONTROL REPORT

Work Order	: **ES1304056**	Page	: 1 of 9
Amendment	: **1**		
Client	: URS AUSTRALIA (NSW) PTY LTD	Laboratory	: Environmental Division Sydney
Contact	: HARRY EGAN	Contact	: Client Services
Address	: Supplier ID number - 1179447 LEVEL 4, 407 PACIFIC HIGHWAY ARTARMON NSW, AUSTRALIA 2064	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: harry.egan@urs.com	E-mail	: sydney@alsglobal.com
Telephone	: +61 02 8925 5500	Telephone	: +61-2-8784 8555
Facsimile	: +61 02 8925 5555	Facsimile	: +61-2-8784 8500
Project	: 43207448	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Site	: ----		
C-O-C number	: ----	Date Samples Received	: 22-FEB-2013
Sampler	: ----	Issue Date	: 13-NOV-2013
Order number	: 43207448		
		No. of samples received	: 9
Quote number	: EN/001/12	No. of samples analysed	: 9

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Interpretive Quality Control Report contains the following information:

- Analysis Holding Time Compliance
- Quality Control Parameter Frequency Compliance
- Brief Method Summaries
- Summary of Outliers

Analysis Holding Time Compliance

This report summarizes extraction / preparation and analysis times and compares each with recommended holding times (USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA005: pH							
Clear Plastic Bottle - Natural (EA005)							
GWB04_130222, QC100_130222, GWB03_130222, GWB01_130222, GWBO5/BH103_130222, QC200_130222, GWB02_130222,	**22-FEB-2013**	**----**	----	----	**22-FEB-2013**	22-FEB-2013	✓
EA010P: Conductivity by PC Titrator							
Clear Plastic Bottle - Natural (EA010-P)							
GWB04_130222, QC100_130222, GWB03_130222, GWB01_130222, GWBO5/BH103_130222, QC200_130222, GWB02_130222,	**22-FEB-2013**	**---**	22-MAR-2013	----	**25-FEB-2013**	22-MAR-2013	✓
EA015: Total Dissolved Solids							
Clear Plastic Bottle - Natural (EA015H)							
GWB04_130222, QC100_130222, GWB03_130222, GWB01_130222, GWBO5/BH103_130222, QC200_130222, GWB02_130222,	**22-FEB-2013**	**---**	01-MAR-2013	----	**26-FEB-2013**	01-MAR-2013	✓
ED037P: Alkalinity by PC Titrator							
Clear Plastic Bottle - Natural (ED037-P)							
GWB04_130222, QC100_130222, GWB03_130222, GWB01_130222, GWBO5/BH103_130222, QC200_130222, GWB02_130222,	**22-FEB-2013**	**---**	08-MAR-2013	----	**25-FEB-2013**	08-MAR-2013	✓
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA							
Clear Plastic Bottle - Natural (ED041G)							
GWB04_130222, QC100_130222, GWB03_130222, GWB01_130222, GWBO5/BH103_130222, QC200_130222, GWB02_130222,	**22-FEB-2013**	**---**	22-MAR-2013	----	**25-FEB-2013**	22-MAR-2013	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
ED045G: Chloride Discrete analyser							
Clear Plastic Bottle - Natural (ED045G)							
GWB04_130222, GWBO5/BH103_130222, QC100_130222, QC200_130222, GWB03_130222, GWB02_130222, GWB01_130222	**22-FEB-2013**	---	22-MAR-2013	----	**25-FEB-2013**	22-MAR-2013	✓
ED093F: Dissolved Major Cations							
Clear Plastic Bottle - Natural (ED093F)							
GWB04_130222, GWBO5/BH103_130222, QC100_130222, QC200_130222, GWB03_130222, GWB02_130222, GWB01_130222	**22-FEB-2013**	---	01-MAR-2013	----	**27-FEB-2013**	01-MAR-2013	✓
EG020F: Dissolved Metals by ICP-MS							
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F)							
GWB04_130222, GWBO5/BH103_130222, QC100_130222, QC200_130222, GWB03_130222, GWB02_130222, GWB01_130222	**22-FEB-2013**	---	21-AUG-2013	----	**25-FEB-2013**	21-AUG-2013	✓
EG035F: Dissolved Mercury by FIMS							
Clear Plastic Bottle - Nitric Acid; Filtered (EG035F)							
GWB04_130222, GWBO5/BH103_130222, QC100_130222, QC200_130222, GWB03_130222, GWB02_130222, GWB01_130222	**22-FEB-2013**	---	22-MAR-2013	----	**26-FEB-2013**	22-MAR-2013	✓
EK055G: Ammonia as N by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK055G)							
GWB04_130222, GWBO5/BH103_130222, QC100_130222, QC200_130222, GWB03_130222, GWB02_130222, GWB01_130222	**22-FEB-2013**	---	22-MAR-2013	----	**25-FEB-2013**	22-MAR-2013	✓
EK057G: Nitrite as N by Discrete Analyser							
Clear Plastic Bottle - Natural (EK057G)							
GWB04_130222, GWBO5/BH103_130222, QC100_130222, QC200_130222, GWB03_130222, GWB02_130222, GWB01_130222	**22-FEB-2013**	---	24-FEB-2013	----	**23-FEB-2013**	24-FEB-2013	✓
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK059G)							
GWB04_130222, GWBO5/BH103_130222, QC100_130222, QC200_130222, GWB03_130222, GWB02_130222, GWB01_130222	**22-FEB-2013**	---	22-MAR-2013	----	**25-FEB-2013**	22-MAR-2013	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK061G)							
GWB04_130222, GWBO5/BH103_130222, QC100_130222, QC200_130222, GWB03_130222, GWB02_130222, GWB01_130222	**22-FEB-2013**	**26-FEB-2013**	22-MAR-2013	✓	**26-FEB-2013**	22-MAR-2013	✓
EK067G: Total Phosphorus as P by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK067G)							
GWB04_130222, GWBO5/BH103_130222, QC100_130222, QC200_130222, GWB03_130222, GWB02_130222, GWB01_130222	**22-FEB-2013**	**26-FEB-2013**	22-MAR-2013	✓	**26-FEB-2013**	22-MAR-2013	✓
EK071G: Reactive Phosphorus as P by discrete analyser							
Clear Plastic Bottle - Natural (EK071G)							
GWB04_130222, GWBO5/BH103_130222, QC100_130222, QC200_130222, GWB03_130222, GWB02_130222, GWB01_130222	**22-FEB-2013**	**---**	24-FEB-2013	----	**23-FEB-2013**	24-FEB-2013	✓
EP080: BTEXN							
Amber VOC Vial - Sulfuric Acid (EP080)							
TRIP SPIKE_130222, TRIP BLANK_130222	**22-FEB-2013**	**25-FEB-2013**	08-MAR-2013	✓	**25-FEB-2013**	08-MAR-2013	✓
EP080/071: Total Petroleum Hydrocarbons							
Amber VOC Vial - Sulfuric Acid (EP080)							
TRIP BLANK_130222	**22-FEB-2013**	**25-FEB-2013**	08-MAR-2013	✓	**25-FEB-2013**	08-MAR-2013	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(where) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Alkalinity by PC Titrator	ED037-P	4	40	**10.0**	**10.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Ammonia as N by Discrete analyser	EK055G	2	19	**10.5**	**10.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Chloride by Discrete Analyser	ED045G	2	11	**18.2**	**10.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Conductivity by PC Titrator	EA010-P	2	16	**12.5**	**10.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Dissolved Mercury by FIMS	EG035F	2	19	**10.5**	**10.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	19	**10.5**	**10.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Major Cations - Dissolved	ED093F	2	11	**18.2**	**10.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	2	19	**10.5**	**10.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Nitrite as N by Discrete Analyser	EK057G	2	11	**18.2**	**10.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
pH	EA005	2	16	**12.5**	**10.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	9	**11.1**	**10.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	11	**18.2**	**10.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Total Dissolved Solids (High Level)	EA015H	1	7	**14.3**	**10.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	2	20	**10.0**	**10.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Total Phosphorus as P By Discrete Analyser	EK067G	2	20	**10.0**	**10.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
TPH Volatiles/BTEX	EP080	2	20	**10.0**	**10.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Laboratory Control Samples (LCS)							
Alkalinity by PC Titrator	ED037-P	2	40	**5.0**	**5.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Ammonia as N by Discrete analyser	EK055G	1	19	**5.3**	**5.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Chloride by Discrete Analyser	ED045G	2	11	**18.2**	**10.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Conductivity by PC Titrator	EA010-P	1	16	**6.3**	**5.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Dissolved Mercury by FIMS	EG035F	1	19	**5.3**	**5.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	19	**5.3**	**5.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Major Cations - Dissolved	ED093F	1	11	**9.1**	**5.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	19	**5.3**	**5.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Nitrite as N by Discrete Analyser	EK057G	1	11	**9.1**	**5.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	9	**11.1**	**5.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	11	**9.1**	**5.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Total Dissolved Solids (High Level)	EA015H	2	7	**28.6**	**10.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	3	20	**15.0**	**15.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Total Phosphorus as P By Discrete Analyser	EK067G	2	20	**10.0**	**15.0**	×	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
TPH Volatiles/BTEX	EP080	1	20	**5.0**	**5.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Method Blanks (MB)							
Ammonia as N by Discrete analyser	EK055G	1	19	**5.3**	**5.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Chloride by Discrete Analyser	ED045G	1	11	**9.1**	**5.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Conductivity by PC Titrator	EA010-P	1	16	**6.3**	**5.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Method Blanks (MB) - Continued							
Dissolved Mercury by FIMS	EG035F	1	19	**5.3**	**5.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	19	**5.3**	**5.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Major Cations - Dissolved	ED093F	1	11	**9.1**	**5.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	19	**5.3**	**5.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Nitrite as N by Discrete Analyser	EK057G	1	11	**9.1**	**5.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	9	**11.1**	**5.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	11	**9.1**	**5.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Total Dissolved Solids (High Level)	EA015H	1	7	**14.3**	**5.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	20	**5.0**	**5.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Total Phosphorus as P By Discrete Analyser	EK067G	1	20	**5.0**	**5.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
TPH Volatiles/BTEX	EP080	1	20	**5.0**	**5.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Matrix Spikes (MS)							
Ammonia as N by Discrete analyser	EK055G	1	19	**5.3**	**5.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Chloride by Discrete Analyser	ED045G	1	11	**9.1**	**5.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Dissolved Mercury by FIMS	EG035F	1	19	**5.3**	**5.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	19	**5.3**	**5.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	19	**5.3**	**5.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Nitrite as N by Discrete Analyser	EK057G	1	11	**9.1**	**5.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	9	**11.1**	**5.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	11	**9.1**	**5.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	20	**5.0**	**5.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Total Phosphorus as P By Discrete Analyser	EK067G	1	20	**5.0**	**5.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
TPH Volatiles/BTEX	EP080	1	20	**5.0**	**5.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
pH	EA005	WATER	APHA 21st ed. 4500 H+ B. pH of water samples is determined by ISE either manually or by automated pH meter. This method is compliant with NEPM (2013) Schedule B(3) (Appdx. 2)
Conductivity by PC Titrator	EA010-P	WATER	APHA 21st ed., 2510 B This procedure determines conductivity by automated ISE. This method is compliant with NEPM (2013) Schedule B(3) (Appdx. 2)
Total Dissolved Solids (High Level)	EA015H	WATER	In-House, APHA 21st ed., 2540C A gravimetric procedure that determines the amount of `filterable` residue in an aqueous sample. A well-mixed sample is filtered through a glass fibre filter (1.2um). The filtrate is evaporated to dryness and dried to constant weight at 180+/-5C. This method is compliant with NEPM (2013) Schedule B(3) (Appdx. 2)
Alkalinity by PC Titrator	ED037-P	WATER	APHA 21st ed., 2320 B This procedure determines alkalinity by automated measurement (e.g. PC Titrate) using pH 4.5 for indicating the total alkalinity end-point. This method is compliant with NEPM (2013) Schedule B(3) (Appdx. 2)
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	WATER	APHA 21st ed., 4500-SO4 Dissolved sulfate is determined in a 0.45um filtered sample. Sulfate ions are converted to a barium sulfate suspension in an acetic acid medium with barium chloride. Light absorbance of the BaSO4 suspension is measured by a photometer and the SO4-2 concentration is determined by comparison of the reading with a standard curve. This method is compliant with NEPM (2013) Schedule B(3) (Appdx. 2)
Chloride by Discrete Analyser	ED045G	WATER	APHA 21st ed., 4500 Cl - G.The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride.in the presence of ferric ions the librated thiocynate forms highly-coloured ferric thiocynate which is measured at 480 nm APHA 21st edition seal method 2 017-1-L april 2003
Major Cations - Dissolved	ED093F	WATER	Major Cations is determined based on APHA 21st ed., 3120; USEPA SW 846 - 6010 The ICPAES technique ionises the 0.45um filtered sample atoms emitting a characteristic spectrum. This spectrum is then compared against matrix matched standards for quantification. This method is compliant with NEPM (2013) Schedule B(3) (Appdx. 2) Sodium Adsorption Ratio is calculated from Ca, Mg and Na which determined by ALS in house method QWI-EN/ED093F. This method is compliant with NEPM (2013) Schedule B(3) (Appdx. 2) Hardness parameters are calculated based on APHA 21st ed., 2340 B. This method is compliant with NEPM (2013) Schedule B(3) (Appdx. 2)
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	(APHA 21st ed., 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020): Samples are 0.45 um filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.

Analytical Methods	Method	Matrix	Method Descriptions
Dissolved Mercury by FIMS	EG035F	WATER	AS 3550, APHA 21st ed. 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) Samples are 0.45 um filtered prior to analysis. FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the filtered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3) (Appdx. 2)
Ammonia as N by Discrete analyser	EK055G	WATER	APHA 21st ed., 4500-NH3 G Ammonia is determined by direct colorimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3) (Appdx. 2)
Nitrite as N by Discrete Analyser	EK057G	WATER	APHA 21st ed., 4500-NO2- B. Nitrite is determined by direct colourimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3) (Appdx. 2)
Nitrate as N by Discrete Analyser	EK058G	WATER	APHA 21st ed., 4500-NO3- F. Nitrate is reduced to nitrite by way of a chemical reduction followed by quantification by Discrete Analyser. Nitrite is determined seperately by direct colourimetry and result for Nitrate calculated as the difference between the two results. This method is compliant with NEPM (2013) Schedule B(3) (Appdx. 2)
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	WATER	APHA 21st ed., 4500-NO3- F. Combined oxidised Nitrogen (NO2+NO3) is determined by Chemical Reduction and direct colourimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3) (Appdx. 2)
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	WATER	APHA 21st ed., 4500-Norg D (In house). An aliquot of sample is digested using a high temperature Kjeldahl digestion to convert nitrogenous compounds to ammonia. Ammonia is determined colorimetrically by discrete analyser. This method is compliant with NEPM (2013) Schedule B(3) (Appdx. 2)
Total Nitrogen as N (TKN + Nox) By Discrete Analyser	EK062G	WATER	APHA 21st ed., 4500-Norg / 4500-NO3-. This method is compliant with NEPM (2013) Schedule B(3) (Appdx. 2)
Total Phosphorus as P By Discrete Analyser	EK067G	WATER	APHA 21st ed., 4500-P H, Jirka et al (1976), Zhang et al (2006). This procedure involves sulphuric acid digestion of a sample aliquot to break phosphorus down to orthophosphate. The orthophosphate reacts with ammonium molybdate and antimony potassium tartrate to form a complex which is then reduced and its concentration measured at 880nm using discrete analyser. This method is compliant with NEPM (2013) Schedule B(3) (Appdx. 2)
Reactive Phosphorus as P-By Discrete Analyser	EK071G	WATER	APHA 21st ed., 4500-P F Ammonium molybdate and potassium antimonyl tartrate reacts in acid medium with othophosphate to form a heteropoly acid -phosphomolybdic acid - which is reduced to intensely coloured molybdenum blue by ascorbic acid. Quantification is by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3) (Appdx. 2)
Ionic Balance by PCT DA and Turbi SO4 DA	EN055 - PG	WATER	APHA 21st Ed. 1030F. The Ionic Balance is calculated based on the major Anions and Cations. The major anions include Alkalinity, Chloride and Sulfate which determined by PCT and DA. The Cations are determined by Turbi SO4 by DA. This method is compliant with NEPM (2013) Schedule B(3) (Appdx. 2)
TPH Volatiles/BTEX	EP080	WATER	USEPA SW 846 - 8260B Water samples are directly purged prior to analysis by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. Alternatively, a sample is equilibrated in a headspace vial and a portion of the headspace determined by GCMS analysis. This method is compliant with NEPM (2013) Schedule B(3) (Appdx. 2)

Preparation Methods	Method	Matrix	Method Descriptions
TKN/TP Digestion	EK061/EK067	WATER	APHA 21st ed., 4500 Norg - D; APHA 21st ed., 4500 P - H. This method is compliant with NEPM (2013) Schedule B(3) (Appdx. 2)
Volatiles Water Preparation	ORG16-W	WATER	A 5 mL aliquot or 5 mL of a diluted sample is added to a 40 mL VOC vial for sparging.

Summary of Outliers

Outliers : Quality Control Samples

The following report highlights outliers flagged in the Quality Control (QC) Report. Surrogate recovery limits are static and based on USEPA SW 846 or ALS-QWI/EN/38 (in the absence of specific USEPA limits). This report displays QC Outliers (breaches) only.

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **WATER**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Matrix Spike (MS) Recoveries							
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA	ES1303970-001	Anonymous	**Sulfate as SO4 - Turbidimetric**	14808-79-8	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**

- **For all matrices, no Method Blank value outliers occur.**
- **For all matrices, no Duplicate outliers occur.**
- **For all matrices, no Laboratory Control outliers occur.**

Regular Sample Surrogates

- **For all regular sample matrices, no surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

This report displays Holding Time breaches only. Only the respective Extraction / Preparation and/or Analysis component is/are displayed.

- **No Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

The following report highlights breaches in the Frequency of Quality Control Samples.

Matrix: **WATER**

Quality Control Sample Type	Count		Rate (%)		Quality Control Specification
Method	QC	Regular	Actual	Expected	
Laboratory Control Samples (LCS)					
Total Phosphorus as P By Discrete Analyser	2	20	10.0	15.0	NEPM 2013 Schedule B(3) and ALS QCS3 requirement

CHAIN OF CUSTODY - ORICA

CONSULTANT:	URS Australia 407 Pacific Hwy Artarmon, NSW	ALS Laboratory: (Circle Laboratory - see address below)	Brisbane / Melbourne / Sydney	TURNAROUND REQUIREMENTS (mark Due date or 'X') Non Standard (List due date) Standard - 5 day TAT: X	FOR LABORATORY USE ONLY (Circle) Custody Seal Intact? Yes No NA Free ice / frozen icebricks present upon receipt? Y (Yes) No NA Random Sample Temperature on Receipt 16 °C
PHONE NO:	4985 3500	Electronic Formats:	EQUIS	COC SEQUENCE NUMBER (Circle) COC: (1) 2 3 4 5 6 7 8 OF: (1) 2 3 4 5 6 7 8	
FAX NO:	4985 3555	Results email:			
PROJECT NO:	43207448	ALS Quote Number	N/A	RELINQUISHED BY: [signature] DATE: 10/1/2013 TIME: 13:10	RECEIVED BY: Jessie Hayes DATE: 22/2/13 TIME: 1:15pm
CONSULTANT PM:	Harry Egan	Site	Eagleton Quarry	RELINQUISHED BY: Jessie Hayes DATE: 22/2/13 TIME: 5pm	RECEIVED BY: Rani DATE: 22-2-13 TIME: 19:00
SAMPLER:	Harry Egan, Anna Bissett				

COMMENTS: Email Results to: Harry.Egan@urs.com

Expect High Ammonia and Nitrate results

LAB ID	SAMPLE ID	DATE	TIME	MATRIX (Solid / Water)	CONTAINER TYPE & PRESERVATIVE (SOLID / WATER): 1L Plastic green label	200ml purple label plastic	60ml Red label	60ml glass vial	Total No of Containers	Ph, EC, TDS	Major Cations and Anions (Na, K, Ca, Mg, Cl, SO4, NO3, CO3, HCO3)	Speciated Nitrogen (Ammonia, Nitrite, total nitrogen)	Phosphorus (Orthophosphate and total phosphorus)	Dissolved Metals	OTHER - see comments if insufficient room to record details	HOLD	Additional information e.g. elevated PID readings, gross contamination suspected, total metals required etc.
1	GWB04_130222	22/02/2013	10:00	W	2	1	1		4	✓	✓	✓	✓	✓			
2	GWB05/BH103_130222	22/02/2013	10:30	W	2	1	1		4	✓	✓	✓	✓	✓			
3	QC100_130222	22/02/2013	/	W	2	1	1		4	✓	✓	✓	✓	✓			
4	QC200_130222	22/02/2013	/	W	2	1	1		4	✓	✓	✓	✓	✓			
5	GWB03_130222	22/02/2013	10:45	W	2	1	1		4	✓	✓	✓	✓	✓			
6	GWB02_130222	22/02/2013	11:15	W	2	1	1		4	✓	✓	✓	✓	✓			
7	GWB01_130222	22/02/2013	11:50	W	2	1	1		4	✓	✓	✓	✓	✓			
8	TRIP SPIKE_130222	22/02/2013	/	W				2	2								
9	TRIPBLANK_130222	22/02/2013	/	W				2	2								
		22/02/2013		W													
		22/02/2013		W													
		22/02/2013		W													
		22/02/2013		W													
		22/02/2013		W													
	TOTAL																

Environmental Division
Sydney
Work Order
ES1304056

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Appendix E Data Validation

URS

DATA VALIDATION SUMMARY

Note: Data validation assesses each analyte in terms of all the data validation variables and only the exceedances and outliers are reported in this form.

Project Name:	Eagleton Quarry Hydrogeological Assessment	**Project/Task Number:**	43207448
Primary Laboratory:	ALS	**Batch/Ref. Number(s):**	ES1304056
Secondary Laboratory:	None		
Date Sampled:	22/02/013	**Sample Type:**	Water

Sample Handling, Receipt and Holding Times	**Yes/No**	**Comments**
COC completed adequately	Yes	
All requested analysis conducted	Yes	
Samples received intact and chilled	Yes	ALS: 5.6°C samples chilled and intact
Samples analysed within appropriate holding times per analytical methods.	Yes	
Samples volumes sufficient for QC analysis?	Yes	
Are there any non-NATA accredited methods used?	No	
Have chromatograms for positive TPH been supplied?	N/A	
Laboratory reports signed by an authorised person	Yes	

# of Primary Samples	**# of QAQC**	**# of Field Duplicate (FD)**	**# of Field Triplcate (FT)**
5	2	2	-

Method Blank (MB), Rinsate Blank (RB), Trip Blank (TB), Field Blank (FB)

Laboratory/SampleType	**Comments**
ALS - water	
TRIPBLANK_130222	All blanks were less than the LOR.

Laboratory Control Samples (LCS)

Laboratory	**Comments**
ALS	All LCS recoveries were within acceptable control limits.

Matrix Spike (MS)

Laboratory/Analyte	**Comments**
ALS	
URS - Dissolved Metals, Ammonia as N, Nitrite plus Nitrate as N, TKN, Total Phosphorous as P, *Anonymous* - Sulfate, Chloride, Nitrite as N, Reactive Phosphorous as P, TPH/TRH (C6-C10), BTEXN	MS were conducted on URS and anonymous samples for analytic suites (as listed) and were within acceptable control limits with the following exceptions: The MS recovery of Sulfate as SO4 in an anonymous could not be determined due to the background level being greater than or equal to 4x spike level.

Trip Spike /Control Trip Spike

Analyte	**% Recovery**	**Comments**
Benzene	90	The % recovery is within acceptable control limits (70-130%).
Toluene	90	The % recovery is within acceptable control limits (70-130%).
Ethylbenzene	80	The % recovery is within acceptable control limits (70-130%).
meta&para-xylene	85	The % recovery is within acceptable control limits (70-130%).
ortho-xylene	90	The % recovery is within acceptable control limits (70-130%).

Laboratory Duplicates

Laboratory/Analyte	**Comments**
ALS	
URS - Conductivity TDS, Alkalinity, Dissolved Metals, Ammonia, Nitrite plus Nitrate, TKN, Total Phosphorous, *Anonymous* - pH, Sulfate, Chloride, Dissolved major Cations, Nitrite as N, Reactive P, TPH/TRH (C6-C10), BTEXN	LDs were conducted on URS and anonymous samples for analytic suites (as listed) and were within acceptable control limits.

Field Duplicates

Primary Laboratory Duplicates (FD)

Sample Pair	**Comments**
GWB04_130222 / QC100_130222	All intra-laboratory duplicate RPD calculations were within acceptable LOR based control limits.
GWB04_130222 / QC200_130222	All intra-laboratory duplicate RPD calculations were within acceptable LOR based control limits.

Secondary Laboratory Duplicates (FT)

Sample Pair	**Comments**
N/A	-

Surrogate Monitoring Compound Analyses

Analyte	**Comments**
ALS	All surrogate recoveries were within acceptable control limits.

Overall Comments

*As stated by ALS: TDS analysis may bias high for sample ID GWB02_130222 due to the presence of fine particulate matter, which may pass through the prescribed GF/C paper.

*As stated by ALS: Sample TRIP SPIKE contains volatile compounds spiked into the sample containers prior to dispatch from the laboratory. BTEX compounds spiked at 20 ug/L.

The sample receipt temperature (5.6°C) was above the URS standard of 4°C. As the samples were stored on ice from time of collection and then stored under laboratory conditions (refrigerated to 4°C) prior to analysis it is not expected to affect the data quality of the batch.

The frequency of LCS for total phosphorus analysis did not meet the expected rate (10% actual Vs 15% expected). As this is only a minor discrepancy and all other QAQC for the batch met required frequencies it is not likely to affect the data quality of the batch.

This batch is considered to be acceptable for environmental interpretative use.

Note: When concentrations are less than LOR for both the primary and secondary results, no RPDs are calculated.

Performed By:	Simon Shepherd	Checked By:	Shannon Higgs
Date:	13-Nov-13	Date:	14/11/2013

Location		GWB04	GWB04	GWB04
Sample ID		GWB04_130222	QC100_130222	QC200_130222
Date Sampled		22/02/2013	22/02/2013	22/02/2013
Sample Type		**Primary**	**Secondary**	**Tertiary**

Analyte	LOR1	LOR2	LOR3	Units				Primary vs. Duplicate RPDs	Primary vs. Duplicate Assessment	Primary vs. Triplicate RPDs	Primary vs. Triplicate Assessment
Ammonia as N	0.01	0.01	0.01	mg/l	0.01	0.01	< 0.01	0.00%	Pass	0.00%	Pass
Bicarbonate Alkalinity as CaCO3	1	1	1	mg/l	374	371	372	0.81%	Pass	0.54%	Pass
Cadmium, D	0.0001	0.0001	0.0001	mg/l	0.0001	< 0.0001	< 0.0001	0.00%	Pass	0.00%	Pass
Calcium, D	1	1	1	mg/l	224	216	222	3.64%	Pass	0.90%	Pass
Chloride	1	1	1	mg/l	1630	1630	1610	0.00%	Pass	1.23%	Pass
Copper, D	0.001	0.001	0.001	mg/l	0.003	0.003	0.002	0.00%	Pass	40.00%	Pass-1
Electrical Conductivity	1	1	1	us/cm	6060	6080	6060	0.33%	Pass	0.00%	Pass
Ionic Balance	0.01	0.01	0.01	%	3.41	3.07	3.64	10.49%	Pass	6.52%	Pass
Magnesium, D	1	1	1	mg/l	190	190	193	0.00%	Pass	1.57%	Pass
Nickel, D	0.001	0.001	0.001	mg/l	0.006	0.005	0.006	18.18%	Pass	0.00%	Pass
Nitrate as N	0.01	0.01	0.01	mg/l	0.03	0.04	0.06	28.57%	Pass	66.67%	Pass-1
Nitrite + Nitrate as N	0.01	0.01	0.01	mg/l	0.03	0.04	0.06	28.57%	Pass	66.67%	Pass-1
pH Value	0.01	0.01	0.01	pH unit	7.57	7.47	7.58	1.33%	Pass	0.13%	Pass
Potassium, D	1	1	1	mg/l	20	21	18	4.88%	Pass	10.53%	Pass
Sodium, D	1	1	1	mg/l	796	791	784	0.63%	Pass	1.52%	Pass
Sulphate as SO4 2-, D	1	1	1	mg/l	212	207	209	2.39%	Pass	1.43%	Pass
Total Alkalinity as CaCO3	1	1	1	mg/l	374	371	372	0.81%	Pass	0.54%	Pass
Total Anions	0.01	0.01	0.01	MEQ/L	57.9	57.7	57.2	0.35%	Pass	1.22%	Pass
Total Cations	0.01	0.01	0.01	MEQ/L	62	61.4	61.5	0.97%	Pass	0.81%	Pass
Total Dissolved Solids, T	10	10	10	mg/l	3720	4100	3680	9.72%	Pass	1.08%	Pass
Total Phosphorus as P	0.01	0.01	0.01	mg/l	< 0.01	0.02	0.02	66.67%	Pass-1	66.67%	Pass-1
Zinc, D	0.005	0.005	0.005	mg/l	0.022	0.022	0.026	0.00%	Pass	16.67%	Pass

Legend:

RPD Control Limits
Pass - RPD <= 30%
Pass-1 - RPD > 30%, Analysis results < 10 times Detection Limit
Pass-2 - RPD > 30% and RPD <= 50%, Analysis result > 10 times Detection Limit and < 20 times Detection Limit
Exceeds RPD Control Limits

Appendix F Core Photo Plates

Plates – Eagleton

Proposed Quarry

17 Killaloe Lane Via, Italia Road, Eagleton, NSW

Plate 1: GWB01 - 4.5 m to 9.2 m

Plate 2: GWB01 – 9.2 m to 12.1 m

Plates – Eagleton

Proposed Quarry

17 Killaloe Lane Via, Italia Road, Eagleton, NSW

Plate 3: GWB01 – 12.10 m to 15.15 m

Plate 4: GWB01 – 15.15 m to 18.15 m

Plates – Eagleton

Proposed Quarry

17 Killaloe Lane Via, Italia Road, Eagleton, NSW

Plate 5: GWB01 – 18.15 m to 21.45 m

Plate 6: GWB01 – 21.45 m to 27.3 m

Plates – Eagleton

Proposed Quarry

17 Killaloe Lane Via, Italia Road, Eagleton, NSW

Plate 7: GWB01 – 27.3 m to 30.3 m

Plate 8: GWB01 – 30.3 m to 33.3 m

Plates – Eagleton

Proposed Quarry

17 Killaloe Lane Via, Italia Road, Eagleton, NSW

Plate 9: GWB01 – 33.3 m to 34.9 m

Plate 10: GWB02 – 1.6 m to 2.55 m

Plates – Eagleton

Proposed Quarry

17 Killaloe Lane Via, Italia Road, Eagleton, NSW

Plate 11: GWB02 – 2.55 m to 6.55 m

Plate 12: GWB02 – 6.55 m to 9.20 m

Plate 13: GWB02 – 9.20 m to 12.20 m

Plate 14: GWB02 – 12.20 m to 15.20 m

Plates – Eagleton

Proposed Quarry

17 Killaloe Lane Via, Italia Road, Eagleton, NSW

Plate 15: GWB02 – 15.20 m to 18.20 m

Plate 16: GWB02 – 18.20 m to 21.20 m

Plate 17: GWB02 – 21.20 m to 24.20 m

Plate 18: GWB02 – 24.20 m to 27.20 m

Plate 19: GWB02 – 27.20 m to 30.20 m

Plate 20: GWB02 – 30.20 m to 33.20 m

Plates – Eagleton

Proposed Quarry

17 Killaloe Lane Via, Italia Road, Eagleton, NSW

Plate 21: GWB02 – 33.20 m to 36.20 m

Plate 22: GWB02 – 36.20 m to 39.00 m

Plates – Eagleton

Proposed Quarry

17 Killaloe Lane Via, Italia Road, Eagleton, NSW

Plate 23: GWB02 - 39.00 m to 40.20 m

Plate 24: GWB04 - 5.80 m to 8.85 m

Plates – Eagleton

Proposed Quarry

17 Killaloe Lane Via, Italia Road, Eagleton, NSW

Plate 25: GWB04 – 14.9 m to 18.15 m

Plate 26: GWB04 – 18.15 m to 20.80 m

Plates – Eagleton

Proposed Quarry

17 Killaloe Lane Via, Italia Road, Eagleton, NSW

Plate 27: GWB04 – 20.80 m to 23.90 m

Plate 28: GWB04 – 23.90 m to 27.00 m

Plates – Eagleton

Proposed Quarry

17 Killaloe Lane Via, Italia Road, Eagleton, NSW

Plate 29: GWB04 – 27.00 m to 30.00 m

Plate 30: GWB04 – 30.00 m to 33.05 m

Plates – Eagleton

Proposed Quarry

17 Killaloe Lane Via, Italia Road, Eagleton, NSW

Plate 31: GWB04 – 33.05 m to 36.10 m

Plate 32: GWB04 – 36.10 m to 37.90 m

Plates – Eagleton

Proposed Quarry

17 Killaloe Lane Via, Italia Road, Eagleton, NSW

Plate 33: GWB04 – 37.90 m to 40.00 m

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