Appendix 6 Hydrogeolocial Open Pit Dewatering Investigation, Nolans Bore, Via Aileron, NT, (Environmental Earth Sciences, July 2011)

ENVIRONMENTAL EARTH SCIENCES
THE KNOW AND THE HOW

REPORT NO. 610012

HYDROGEOLOGICAL OPEN PIT DEWATERING INVESTIGATION, NOLAN'S BORE, VIA AILERON, NT

ENVIRONMENTAL EARTH SCIENCES QLD
REPORT TO ARAFURA RESOURCES LIMITED
JULY 2011
VERSION 1

Glaeba (07) Pty Ltd trading as Environmental Earth Sciences QLD
Unit 3, 1 Ross Street, Newstead QLD 4006 PO Box 3207, Newstead, QLD 4006
P. 61 7 3852 6666 F. 61 7 3852 5666 E. eesqld@eesi.biz
www.environmentalearthsciences.com

EXECUTIVE SUMMARY

Establishment of site groundwater testing infrastructure

The stated objectives for this project of:

- managing and supervising bore installation, testing and monitoring; and
- providing observation bores in the pit area for on-going monitoring of static water levels (SWL) and quality,

have been achieved. In addition, a production well (204 mm or 8" diameter, 70 m deep) that would be suitable for initial dewatering has also been provided.

Physical aquifer parameter estimation

Further to the above, the hydraulic properties of the aquifer have been estimated and consequent dewatering predictions made, resulting in a simple dewatering design involving either abstraction from well/s within the mineralisation zone, and/ or in-pit sump pump/s.

The Conceptual Hydrogeological Model (CHM) indicates that:

- the aquifer is limited in areal extent (expected to be on the order of 100 m to the west, north and south and 500 m to the east of well NBGW819);
- the combination of the high permeability and limited extent of the aquifer are beneficial for dewatering because the drawdown cone around the point or points of groundwater extraction is expected be relatively flat;
- the aquifer is thought to approximately correspond to the ore body and surrounding rocks have a much lower permeability, therefore dewatering of the ore body using wells screened outside the ore body is not expected to be feasible;
- although a dewatering rate of 10 L/sec (864 m^3/day, 0.32 ML/a) would likely be required for a period of months to draw the groundwater level down by 100+ m using bores within the ore body, a more "as needs" approach (e.g. sump pump) is likely to be feasible;
- using an "as-needs" approach, lower pumping rates would be likely for longer (possibly intermittent) periods for the life of excavation and pit deepening within the mineralised zone;
- higher pumping rates would decrease dewatering times; and
- the greatest potential for hydraulic conditions to be altered is considered to be as a result of precipitation and run-off increasing recharge to the pit (noting that run-off from outside the pit can be controlled), however this can be mitigated by increasing dewatering rates.

Aquifer chemical data and on-going requirements

Baseline chemical groundwater data indicates that the aquifer discharge is not suitable for human consumption (4,430 mg/L TDS) and that incidental ingestion of more than 100 mL/day could have health implications associated with detected dissolved uranium (U) concentrations. This finding should be reflected in Workplace Health & Safety (WHS) documentation for the site. In addition, based on U and fluoride (F) levels (as well as TDS) this water is marginal to not suitable as a stock watering resource (beef cattle assumed).

Should groundwater from the site be used to water stock, it is recommended that it be shandied and retested prior to use.

It is recommended that a groundwater level and quality monitoring program be initiated to collect pre-mining data (and be continued for the life of the mine and post-mining). This should involve quarterly monitoring of all 10 bores for SWL and a list of field and laboratory determined parameters that are detailed in the recommendations section of this report (which compliment the baseline analysis reported and discussed herein).

All bores need to be surveyed for height to Australian Height Datum (AHD), and the data should be reviewed by a hydrogeologist at least on an annual basis.

It is recommended that the requirements of GHD (2010) be specifically addressed in a separate, stand alone, document that incorporates the findings of this dewatering assessment report. The report should include a site water balance, and interpretation of on-going physical and chemical data collection from the monitoring program to be implemented as per the above recommendations.

Concluding statement

Due to the nature of the aquifer (bounded on all sides by an aquitard of host rock), impacts of dewatering on downstream resources such as the Woodforde River and western Ti Tree Basin are expected to be insignificant, other than for a potential increase in discharge to Kerosene Creek if the abstracted groundwater is not used on-site. If undertaken this is expected to be at a maximum long-term rate of 0.32 ML/a, however due to water quality issues (TDS 4,430 mg/L and dissolved U 0.334 mg/L) it is recommended that abstracted groundwater not be discharged to the ecosystem (without appropriate treatment). In addition, it is also assumed that Kerosene Creek will be appropriately diverted around the pit.

The above prediction needs to be continually assessed, pre-, during- and post-mining, through on-going groundwater level and quality monitoring, and as per the above recommendations.

Project Manager
Katy Kijek
Hydrogeologist

Project Director / Internal Reviewer
Mark Stuckey
Principal Hydrogeologist

Technical Reviewer 1
Alan Wade
Principal Hydrogeologist

Technical Reviewer 2
Geordie McMillan
Senior Hydrogeologist
610012 Report

TABLE OF CONTENTS

FIGURES

TABLES

APPENDICES

1 INTRODUCTION

Environmental Earth Sciences was engaged by Arafura Resources Ltd (Arafura) to conduct a hydrogeological investigation at the proposed Nolan's Bore open cut mine for the purpose of estimating requirements for dewatering during mine operations. Groundwater extracted for the dewatering may also be used to supplement the processing plant.

The Nolan's Bore deposit is located approximately 135km to the northwest of Alice Springs, Northern Territory, and consists of a rare earth elements, phosphate and uranium ore body deposited in a structurally complex metamorphic province of the Arunta structural block. The regional locality of the site is presented on Figure 1.

It is expected that substantial dewatering of weathered and fractured rock formations will be required to enable production from the proposed mine pit, which is currently designed to a depth of up to 150 metres below ground surface. Depending on the calculated (mid- to long-term) potential rate of groundwater inflows to the pit, dewatering is likely to be required from abstraction bores prior to commencement of mining. Alternatively, depending upon inflow rates to the open cut, dewatering via in-pit sump pump/s may be sufficient. It may also be possible to use part or all of this water in the mining process.

Our proposal submission (Environmental Earth Sciences, March 2010) provided for a hydrogeological dewatering investigation of the proposed area of the open cut pit at the location of Nolan's Bore, and installation of a pastoral bore at a separate location to replace the Nolan's Bore. Since this time the scope has changed, with Environmental Earth Sciences undertaking the mine pit dewatering investigation only.

2 OBJECTIVE

The following are the objectives for this project:

1. Manage and supervise installation of bores and supervise testing and monitoring;
2. Provide indicative measures of the permeability and storage properties of the Nolan's deposit and host rocks containing the local Nolan's aquifer (predominantly apatite and mylonite aquifer materials and gneissic aquitard materials);
3. Prepare a dewatering design and conceptual hydrogeological model (CHM) for the pit area that will:
    a) highlight potential hydraulic issues that may impact open cut mining;
    b) indicate the spacial distribution and controls on the water bearing zones within the Nolans deposit; and
    c) consider if significant change may occur over time that might impact mining activities;
4. Provide baseline data for future groundwater monitoring and future groundwater modelling including predictive quality and recovery models;
5. Provide monitoring bores in the pit area for on-going groundwater monitoring (level and quality). This should enable characterisation of the water quality and variability; and
6. Provide an understanding of the connectivity of the Nolans aquifer system and its relationship to the Ti Tree basin to enable some predictive statements for the EIS.

3 SCOPE OF WORKS

To achieve the stated objectives, Environmental Earth Sciences undertook the following program of work:

Stage 1 – Project inception

- Conduct a desktop investigation of existing information, including geological, hydrogeological, and surface catchment data, and anecdotal information from Arafura Resources, to help determine optimal bore locations.

Stage 2 – Drilling program – Nolan's Site

- Undertake site inductions by all Environmental Earth Sciences staff who will be working on site.
- Liaise with Arafura Resources representatives on site or via telephone or email throughout the investigation.
- Supervise pegging and drilling of bores, and provide bore logs (including approximate GPS coordinates) for:
    - 9 observation bores to a maximum depth of 120 mbgs in the Nolan's Bore pit area; and
    - 1 abstraction bore to a maximum depth of 125 mbgs in the Nolan's Bore pit area.
- Supervise and monitor airlift and recovery testing of all bores.
- Provide design specifications for construction of all bores, in accordance with LWBC (2003). Supervise development for all bores.

Stage 3 – Pumping test

- Design, supervise and monitor pumping tests for one abstraction well in the pit area, including water abstraction rates, drawdown levels in pumping and observation bores and water quality field parameters (pH, EC, Oxidation-Reduction Potential, Dissolved Oxygen and Temperature), over a nominal period of up to 200 hours (8 days including set-up, step-drawdown tests and 7 days of constant discharge test).
- Sample groundwater from the abstraction well in the pit area during the pumping test, and submit for analysis of additional parameters relevant to its suitability for re-use, storage and disposal during dewatering activities (including Total Dissolved Solids, Total Suspended Solids, Major Cations and Anions, Hardness, Alkalinity, Sodium Adsorption Ratio, Langelier Saturation Index and Ryzner Index).

Stage 4 – Assessment and reporting

- Assess the results of drilling, airlift testing, well construction, pumping test and water quality with respect to implications for dewatering in the pit area.
- Prepare a site hydrogeological conceptual model, to be used as a guide in designing further hydrogeological investigations and dewatering activities in the pit area.
- Report on the results of the dewatering investigation, providing recommendations for design of a dewatering well-field and further hydrogeological work required.

4 BACKGROUND ON METHODOLOGY

4.1 Background to the purpose of work components

Due to the potential for inflows of groundwater (which may be significant and long-term) into the proposed open cut pit at Nolan's Bore, hydraulic testing is required to ascertain both the potential rate of inflow and the consequent method/s of dewatering that will be necessary to ensure the pit is not flooded or stability compromised.

The order of testing undertaken as part of this project, in terms of rigour of data and hence reliability of results is, from least to most reliable:

- Air lift yield testing during drilling;
- Slug testing single bores following observation or monitoring well installation;
- Pumping tests utilising an abstraction and nine surrounding observation bores to measure a response from pumping at various radial distances (and depths) from the point of abstraction, involving:
    - an initial step drawdown test (increasing the rate of pumping at specified time intervals); and
    - constant discharge test (constant pumping rate) over 7 days (10,080 minutes or three log-cycles of time); followed by
    - observation of recovery.

The quality and rigour of data obtained from a pumping test far outweighs any other form of hydraulic testing, particularly for the following major reasons:

- observing pressure changes at radial distances from a point of abstraction allows assessment of 'actual' conditions in the aquifer with regards to isotrophy and homogeneity (particularly fracture systems), rather than imparting pressure and measuring response at a single point (all other methods) from which extrapolation must be made;
- allows for preliminary design of dewatering infrastructure, pumping and drawdown requirements;
- determination of transmissivity (KD) and storativity (S) in addition to hydraulic conductivity (K);
- a step-drawdown followed by constant discharge test allows observation of the development of steady-state aquifer conditions (minimal drawdown at a given pumping rate) at progressively increasing pumping rates, until the specific capacity (SC) of the abstraction well is maximised;
- accurate estimation of the locations of barrier and recharge boundaries of the aquifer being pumped; and
- estimation of mid- to longer-term sustainable yield of the aquifer, which is vital for planning with respect to both mid- to long-term dewatering and water supply scenarios.

4.2 Methodology

The following aspects are noted:

Drilling program

1. The target area for the dewatering investigation was focused primarily on the initial proposed pit, rather than the entire Nolan's Bore Project area. If the whole area of the mineable resource were investigated, a considerably larger number of wells would have been required.
2. Wells were constructed inside the pit area to provide accurate information for pumping test analysis and on the potential locations and magnitude of groundwater influx during pit excavations. These wells can be retained for ongoing monitoring (or abstraction) purposes, and periodically truncated without significant disruption to mining activities.
3. Most observation wells were placed relatively close (10-50 m distance) to the abstraction well to ensure sufficient water level response will be achieved during the pumping test. Their locations were primarily determined in consideration of the pumping test rather than suitability for future monitoring. If more regional monitoring of water levels or water quality is required, additional wells should be constructed for this purpose.
4. The completed well collars need to be surveyed for x, y and z coordinates as soon as practicable after completion by a qualified surveyor (if this has not already been undertaken).

Pumping test

1. The applicable abstraction rate for the pumping test was determined from the results of drilling and well construction, and the initial step tests of one hour duration over four steps, in order to determine an appropriate rate for the constant discharge test.
2. Only a single successfully performed constant rate test is required for meaningful results. A successful test is one where the pumping rate was sustained without the well running dry, and drawdown responses were obtained in as many observation wells as possible. Ideally, the drawdowns will stabilise before the completion of the test, but this is not always achievable, and the results can still be interpreted.
3. A recovery test was performed after the pumping test to provide additional data on how the system re-equilibrates after dewatering. This involved the use of data loggers left in the abstraction and monitoring bores for a period of up to one week after the cessation of pumping.
4. Drawdowns from the pumping test were monitored using automated pressure loggers, as well as by regular use of a manual dip meter to confirm the automated data. Barometric pressure was also be monitored using an automated logger to compensate for atmospheric changes during the test.
5. Water quality was determined during the test, with a sample also submitted for laboratory analysis.

5 DRILLING PROGRAM

5.1 Scope of drilling program

The original scope of the drilling program was to install nine observation bores and one abstraction bore within the Nolan's Bore identified mineralisation zone, known as the 'Central North Zone'. The final location of these observation bores and abstraction point is provided on the attached Figure 2.

5.2 Drilling preliminaries – site selection

Prior to drilling, a site selection walk over was conducted with Environmental Earth Sciences hydrogeologists and Arafura Resources staff to identify current exploration bore locations, the extent of the exploration within the mineralised zone (which will form the future open cut pit), and to discuss potential new groundwater investigation bore sites. Decisions were based on existing information about the extent of the resource at the time. A basic conceptualisation of the potential mineralised zone approximately oriented WSW to ENE guided selection of the new bore sites.

Site selection was based on the need to place the monitoring wells close enough to the abstraction bore to observe a response during pumping, but far enough to enable the determination of any boundary conditions encountered. Future monitoring for groundwater quality and level was not a consideration in the placement of observation and abstraction points for the pumping test.

5.3 Drilling details – method and equipment

Drilling and bore construction was undertaken by H2O Drilling (Darwin), and Environmental Earth Sciences undertook the role of supervising hydrogeologist. Details of the drilling and construction are provided in the following section and bore logs and bore construction diagrams are provided in Appendices A (observation bores) and B (abstraction well).

Reverse circulation (RC) down-hole hammer methods were used to drill all the monitoring wells and abstraction bore. The monitoring wells were drilled using a UDR DE810 rig used predominantly for minerals exploration drilling. See Photograph 1 in Appendix F.

Bores were drilled to a nominal depth of approximately 6 m BGL using the solid flight auger (SFA) method after which a PVC or steel collar was installed and cemented into the ground, prior to any deeper drilling.

To determine an approximate yield (relating only to the rock directly adjacent to the drilled hole), airlift tests were conducted during drilling. This was generally performed when a significant change or increase in water volume was encountered. Of particular importance was the recording of yields from the abstraction bore. This is discussed further in Section 5.6.

5.4 Monitoring well installation

Nine (9) monitoring wells (NBGW810 – NBGW818) were constructed during the 2010 program. Bore completion depths were up to 120 m and encountered both the mineralised apatite zone and gneissic granite; the local host rock.

Holes were drilled using a 4” (~100 mm) bit. If bridging or hole collapse occurred during the removal of the drill string, the hole was reamed using HWT 5¼” (~133 mm OD) temporary steel casing. This allowed casing and gravel pack to be installed into the hole, down the annulus of the HWT casing, thereby removing the risk of further collapse. Upon placement of the piezometer screen and casing, and gravel pack, the HWT casing was able to be safely removed.

The observation bores were constructed with lengths of 2” (50 mm) diameter Class 18 uPVC casing with up to 30 m of Class 18 uPVC factory slotted screen.

Gravel pack was used to fill the bore annulus around the screen. The gravel pack was extended up to 14 m BGL in some wells to allow for a greater connectivity across the aquifer of interest. A bentonite seal was installed for approximately 1 m above the gravel pack then the remainder of the hole backfilled with cuttings and sealed at the surface with grout and a steel monument.

Further preliminary findings of drilling can be found in Environmental Earth Sciences (June 2010) Section 5.0.

5.5 Abstraction bore installation

One abstraction bore (NBGW819) was drilled and constructed within the mineralised zone of the Nolan's Bore proposed pit site in March 2011. The bore was drilled using a 10" (~254 mm) diameter drill bit to 70 m BGL and terminated when it intersected an angled RC exploration hole (NBRC188 – see Figure 4). Further details are provided below and in Appendix B.

The abstraction bore was constructed using 8" (~204 mm OD) mild steel casing, with 30 m of oxy-cut slotted screen. Slotted screen was placed across areas of highest groundwater inflow rates that were recorded during the drilling.

The slotted screen was made up of vertically placed slots along the 6 m lengths of casing. In order to increase the open-area of the slots, Environmental Earth Sciences requested the slotted area be doubled along 3 lengths of the casing. This was done by oxy-cutting slots adjacent to the previously cut slots (see Photograph 2, Appendix F). As a result, the open area of the slotted casing increased from 1.5% to 2.3%, thus allowing more water to enter the screen during pumping.

Gravel pack was used to fill the entire bore annulus to near surface and completed with a grout seal at the surface.

5.6 Airlifting and development

Following bore construction, the monitoring bores and abstraction bore were airlifted and developed using rigorous surging techniques. The methods are described below.

5.6.1 Observation bores

All bores were developed for at least 60 minutes using an air compressor with air delivered via polypipe to the screened interval. A combination of airlifting and surging (lifting water to top of bore and then shutting off the air to allow the water to fall) was used. Generally, bores drilled predominantly within the mineralised apatite required more development due to the higher volumes of sediment produced during drilling.

Development continued until the purge water was clear and low in fines in accordance with LWBC (2003).

5.6.2 Abstraction well

Airlift yields during the drilling of the abstraction bore (NBGW819) were measured to be up to 20 L/sec in the open hole at 70 mBGL. Groundwater was encountered during drilling at approximately 21 mBGL, with yields increasing from 1.5 L/sec at 21m BGL, to 13 L/sec at 33m BGL and 20 L/sec at 62 mBGL. The static water level (SWL) was observed at approximately 13.5 m BGL.

Following construction, development took place for more than 2 hours. Development consisted of airlifting for approximately 10 minutes at each 6 m rod length beginning from 40 m BGL. The flow rate increased with depth, up to ~20 L/sec. The abstraction bore was ultimately surged and pumped at full depth by air lifting.

Purged groundwater was directed into a sump close to the abstraction bore where the rate of outflow was estimated using a stopwatch and 20 L bucket (see Photographs 3 to 5, Appendix F). The produced water was then pumped to a dam approximately 200 m from the drill site.

Environmental Earth Sciences bore logs, including construction details and airlift yield information for all bores are provided in Appendices A (observation bores) and B (abstraction well).

6 AQUIFER HYDRAULIC TESTING

6.1 Introduction

As part of the initial site visit in April/ May 2010 to install the observation bore network, a series of preliminary aquifer tests were undertaken to assist in assessing the likely range of hydraulic parameters in the area of interest (i.e. the Central North Zone). This included falling head tests on all nine monitoring bores, and a constant head and recovery test on existing bore NBRC067 (see Figures 2 and 3 for location). Pumping during this test was undertaken for an hour at a rate of 2.5 L/sec (9000 L/hour or 216 m^3/day), followed by monitoring of full recovery. This is discussed further in Section 6.2.1.

Note that the original proposal (Environmental Earth Sciences, March 2010, Appendices A and B) indicated that the preferred method of single bore aquifer physical testing was to undertake Packer testing, however the drilling company (H2O) decided against this option.

To further assess the aquifer hydraulics following observation bore installation and preliminary physical testing, an abstraction well was installed, and a pumping test was undertaken. Bore NBGW819 was pumped for a week (followed by a week of monitoring of recovery) while drawdowns were monitored in multiple (9) observation bores to evaluate the aquifer properties of the mineralised rock (the apatite), and verify the approximate extent of the aquifer. This information was then used to evaluate dewatering requirements. The pumping test is discussed further in Section 6.3.

6.2 Physical parameter data collection – single bore tests

Falling head tests were undertaken by adding a slug or volume of water (generally >50 L) to the bores whilst monitoring the change in water level over time. Testing was conducted on all nine observation bores. In addition, as mentioned above, a one hour constant discharge and subsequent recovery test was performed on an existing bore that was fitted with a pump placed at approximately 20 m BGL.

The pumping bore is denoted as bore NBRC067 (recovery was monitored in this bore after one hour of pumping at 9000 L/hour which achieved 6.47 m of drawdown) and bore NBRC387 was utilised as an observation point (located 76 m from the pumping bore, in which 0.077 m of drawdown was observed after one hour). The location of these bores is

provided on Figures 2 and 3, whilst full details of the analysis are given in Environmental Earth Sciences (June 2010), which is included as Appendix C of this report.

In summary, the constant discharge and recovery test reported hydraulic conductivity (K), transmissivity (KD) and storativity (S) values in the range of 0.9-5.9 m/day (average 3.2 m/day), 14-88 m^2/day (average 47 m^2/day) and 0.0008-0.0127 (average 0.007) respectively. The slug tests recorded values for K in the range of 0.2 to 0.95 m/day, and KD of 21-62 m^2/day in apatite zones.

6.3 Physical parameter data collection – aquifer pumping test

Testing was conducted according to Standards Australia (1990) and with reference to Osborne (1993). A step-drawdown test consisting of four one-hour steps was undertaken initially. Groundwater levels then recovered overnight and the 7-day constant rate test began the following day. The purpose of the pumping test was to evaluate aquifer properties and boundary conditions in order to predict dewatering requirements for the proposed mine.

6.3.1 Equipment

The equipment used for the pumping test included a trailer mounted pumping rig which used an electric submersible pump, capable of pumping at up to ~10 L/sec against a head of tens of metres. The pump intake was set at approximately 40 m BGL.

Water was discharged from a 100 mm circular orifice weir with an 80 mm diameter orifice plate. The pumping rate was measured using the orifice weir (see photographs 3-5 in Appendix F).

Pressure transducers (data loggers) were used to measure the change in water levels for the duration of the tests. Pressure transducers were positioned in all of the observation bores on steel cables, and one was attached to the rising main of the pumping well. Bores NBGW819, NBGW810 and NBGW818 were equipped with direct read cables, allowing the loggers to transmit real-time data to a field laptop without disrupting the loggers. This precise information provided a clear view of the aquifer behaviour during pumping and recovery.

6.3.2 Step drawdown test

The four rates of pumping for the step drawdown test were 6.5 L/sec, 8.6 L/sec, 10.0 L/sec and 13.5 L/sec. The duration of each step was exactly one hour.

6.3.3 Constant discharge test

This test commenced on 13 March 2011 at a rate of 10.0 L/sec for the first 3.5 days (84 hours) which was subsequently reduced to 6.5 L/sec, for the remaining 3.5 days. The rate was reduced after 3.5 days because aquifer boundary conditions caused greater drawdown than predicted from the step test, such that 10 L/s was considered likely to be unsustainable for the full duration of one week. That is, the specific capacity (SC) of the pumping bore was predicted to be exceeded prior to the completion of the test.

6.4 Potential recharge

6.4.1 Rainfall events

Throughout the drilling and pump testing of abstraction bore NBGW819, significant rainfall events occurred and an ephemeral stream (Kerosene Creek) within 120 m of the test bore was flowing. At the time, there was discussion between Environmental Earth Sciences and

Arafura Resources staff as to whether the testing should be terminated and recommenced at a later date, in order to avoid the possibility of recharge from rainfall. However, it was decided to proceed with the pump testing, albeit during very heavy and lengthy rainfall periods. It is likely that both direct rainfall recharge and stream leakage affected the monitored groundwater levels.

Water levels measured during a pumping test cannot be corrected for unique fluctuations due to heavy rainfall or the sudden rise of a nearby river that is in hydraulic connection with the aquifer (Kruseman and de Ridder, 2000, p47). A test often has to be repeated as data could be distorted by the rainfall impact on the site.

6.4.2 Recirculation of discharge water

Discharge water from the pumping test was diverted by a drain cut into the ground surface, and was directed in a south westerly direction towards Kerosene Creek. Although lining of the drain with an impermeable plastic liner was considered, this was not considered viable prior to commencement of testing due to time constraints.

7 GROUNDWATER CHEMISTRY

7.1 Field chemistry

Throughout the installation of the observation bores and the abstraction bore, as well as during pumping, field salinity was monitored through measurement of electrolytic conductivity (EC). Field EC data collected during bore installation is presented on the logs in Appendices A and B of this report. These logs show that EC ranged between 4,550 and 6,500 µS/cm for all measurements. EC was also measured during the constant discharge test performed on bore NBRC067 in April 2010, ranging between 6,000-6,320 µS/cm.

In addition to the above data, field chemistry was recorded during the pumping test, and a sample collected on the fourth day of the test. This sample was delivered to ALS in Brisbane for analysis. The field chemical data from the pumping test confirmed that EC ranged between 4,900 and 6,750 µS/cm for the duration of the test, with pH ranging between 6.77 and 8.24, oxidation-reduction potential (ORP) between -93 and 60 mV, dissolved oxygen between 2.7 and 6.1 mg/L, and temperature between 28.8 and 29.3℃.

7.2 Laboratory data

The chain of custody, sample receipt notification, results transcripts and quality control data for the analysis undertaken are presented in Appendix E of this report. In summary, minor holding time exceedences occurred for the following parameters: pH, total dissolved salts (TDS), total suspended solids (TSS), turbidity, ammonia (NH_3) and phosphate (PO_4), however all other parameters were analysed within the required timeframe.

Comparison of field and laboratory chemistry confirmed that the sample remained relatively stable during transit, and results can consequently be relied upon. Field and laboratory pH measurements (7.42 and 7.86 respectively) had a relative percentage difference (RPD) of 2.88%, whilst field EC (6,017 µS/cm) and laboratory determined TDS (4,430 mg/L) had a relationship of 0.74, which is well within the allowable range of 0.55-0.80.

The data were also compared to previous samples collected from four RC holes in 2005. A summary of pertinent results, compared to relevant beneficial use criteria, is provided in Tables 1 and 2. Observation of this data indicates that, based on the assumption that beef cattle are the major potential receptor to groundwater at the site, concentrations of uranium (U) and fluoride (F) exceed the stock-watering criteria. The TDS data indicates that groundwater at the site is marginally suitable as a drinking source for beef cattle given that the ideal maximum TDS is 4000 mg/L, with health and consumption issues expected to occur above 5000 mg/L TDS (ANZECC/ ARMCANZ 2000, p9.3-11).

In addition, concentrations of sodium (Na), chloride (Cl), F, U and iodide (I) also exceed the drinking water criteria. However, as this resource is clearly not suitable for human consumption based on TDS alone, the relevant criterion for human exposure is considered to be recreational water. This criteria is developed under the assumption that incidental ingestion will be a maximum of 10% of consumption for drinking purposes (200 mL/day compared to 2 L/day, after NHMRC 2008). Based on this interpretation, all parameters are at suitable concentrations for human exposure, other than U.

Based on the above discussion, it can be concluded that the suitability of groundwater at the site as a drinking source for beef cattle is marginal at best, with health concerns associated with F and U levels in particular. Based on concentrations of U alone, it is recommended that this water not be ingested by humans at rates of any more than 100 mL/day.

Due to its brackish salinity (TDS 4,430 mg/L), abstracted groundwater is considered unsuitable for discharge to waterways due to the potential for (surface water and groundwater dependent) ecosystem impacts.

In addition to those dissolved species that have been compared to existing water quality criteria, no such criteria were cited for some chemicals including rubidium (Rb), strontium (Sr) and bromide (Br). There is no known health or ecological impacts associated with Rb, Sr or Br (ANZECC/ ARMCANZ 2000, Drever 1997, Hem 1992, NHMRC/ NRMMC 2004, NHMRC 2008).

Whilst concentrations of Br in rainwater are expected to range between 5 and >150 µg/L, concentrations in seawater and geothermal water can be 65 and >20 mg/L respectively (Hem 1992, p146). As such, the concentrations detected in groundwater on-site (Table 2) are expected to be background and not of concern. Likewise for Sr, background concentrations are expected to be in the order of 0.1 mg/L, with concentrations up to 52 mg/L found in drinking supply wells with no adverse effect on health (Hem 1992, p135).

The water chemistry (ionic balance) at each location is similar and considered to be indicative of background conditions for the aquifer in this region, as shown in Chart 1. Chart 1 demonstrates that the water chemistry in the pumping bore NBGW819 in March 2011 was Na-Cl >Mg-SO_4 >Ca-HCO_3. This is similar to previous results, particularly bores NBRC050 and NBRC063, with bore NBRC067 being Na-Cl(HCO_3) >Mg-SO_4 and bore NBGW068 Na-HCO_3(Cl) >Mg-NO_3 >Ca-SO_4.

Based on the data obtained, this water is hard (hardness 1,286 mg/L as $CaCO_3$, permanent hardness 472 mg/L as $CaCO_3$), poses a potential alkali hazard (SAR 12.6) and has a minor potential for encrustation (Ryzner Index 5.38, Langelier Saturation Index 1.24). Suspended solids was 20 mg/L and turbidity 3.8 NTU.

TABLE 1 NOLANS BORE GROUNDWATER RESULTS – DISSOLVED HEAVY METALS AND ARSENIC

Bore	Date	As	Au	Ba	Cu	Cd	Cr	Hg	Mn	Ni	Pb	Rb	Sr	U	Zn
NBRC050*	26/06/05	0.043	<0.0001	3.65	0.178	0.00044	0.121	0.0004	6.97*	0.113	0.850*	1.380	10.1	0.772*	0.334
NBRC063*	06/07/05	0.0094	<0.0001	0.123	0.053	<0.0002	0.005	<0.0002	0.590	0.008	0.069	0.021	3.52	0.449*	0.017
NBRC068*	14/07/05	0.0063	<0.0001	0.154	0.038	<0.0002	0.010	<0.0002	0.511	0.008	0.106*	0.018	2.20	0.149	0.022
NBRC067*	15/07/05	0.0096	<0.0001	0.029	0.0056	<0.0002	<0.002	<0.0002	0.005	0.002	0.001	0.009	2.63	0.491*	0.020
NBGW819	16/03/11	0.001	<0.001	—	<0.001	<0.0001	0.002	0.0002	0.004	<0.001	<0.001	0.010	4.24	0.334	<0.005
Criteria															
Ecological		0.024	NE	NE	[1]0.020	[1]0.003	NE	0.0006	1.9	[1]0.160	[1]0.186	NE	NE	0.0005^	[1]0.117
Health		0.007	NE	0.7	2	0.002	0.05	0.001	0.1	0.02	0.01	NE	NE	0.02	3.0
Recreation		0.07	NE	**7.0**	20	0.02	0.5	0.01	**1.0**	0.2	0.1	NE	NE	0.2	30
Livestock		**0.5**	NE	NE	**0.5**	**0.01**	**1.0**	**0.002**	NE	**1.0**	**0.1**	NE	NE	**0.2**	**20**

Note(s): 1. all table entries in mg/L; [1] adjusted for hardness according to ANZECC/ ARMCANZ (2000) Table 3.4.3; NE no criteria exist; — not analysed
2. shaded values exceed relevant criteria; **bold** values indicate relevant (most sensitive) criteria
3. * total metals only determined, hence results indicative only; ^ low reliability value to be used as an indicative interim working level
4. see Appendix E for full transcripts – all results not presented for the 2011 sampling event were non-detectable (ND)

TABLE 2 NOLANS BORE GROUNDWATER RESULTS – INORGANIC CHEMISTRY (CATIONS AND ANIONS)

Bore	Date	pH	TDS	Na	Ca	Mg	K	NH_3	Cl	SO_4	HCO_3	NO_3	PO_4	F	Br	I
NBRC050	26/06/05	8.0	5210	1200	174	259	26.1	0.08	1940	944	908	31	0.15	2.7	12.0	1.41*
NBRC063	06/07/05	8.1	3680	911	101	191	37	0.015	1290	673	901	44	0.09	3.5	8.23	1.24*
NBRC068	14/07/05	8.1	1610	421	78.4	79.5	16.3	0.005	341	181	710	80	0.11	3.3	2.72	0.68
NBRC067	15/07/05	7.7	3990	1060	73.8	162	50.5	0.005	1330	648	1060	45	0.12	3.9	8.19	1.19*
NBGW819	16/03/11	7.9	4430	1040	166	212	36	0.01	1490	694	975	37	0.06	3.0	12.7	0.40
Criteria																
Ecological		6.5-7.5	NE	NE	NE	NE	NE	0.78	NE	NE	NE	31.9[3]	NE	NE	NE	NE
Health		6.5-8.5	1000	**180**	NE	NE	NE	0.5	**250**	500	NE	50	NE	1.5	NE	0.1
Recreation		**6.5-8.5**	NE	NE	NE	NE	NE	**5.0**	NE	5000	NE	500	NE	15	NE	**1.0**
Livestock		NE	**5000^**	NE	**1000**	NE	NE	NE	NE	**1000**	NE	**400**	NE	**2.0**	NE	NE

Note(s): 1. all table entries in mg/L except pH and Hardness (mg $CaCO_3$/L); — not analysed
2. shaded values relevant criteria; **bold** values indicate relevant criteria; ^ beef cattle assumed; * total analysis only performed, may be an over-estimate
3. [3] value derived after Hickey (2002); NH_4-N x 1.29 = NH_4; NH_3-N x 1.21 = NH_3; NO_2-N x 3.3 = NO_2; NO_3-N x 4.43 = NO_3
4. see Appendix E for full transcripts

Only pH, nitrate (NO_3) and dissolved U exceed ecological criteria in the sample collected during the pumping test in March 2011. As such, in general and based on one result, groundwater quality is not expected to impact significantly on ecological receptors.

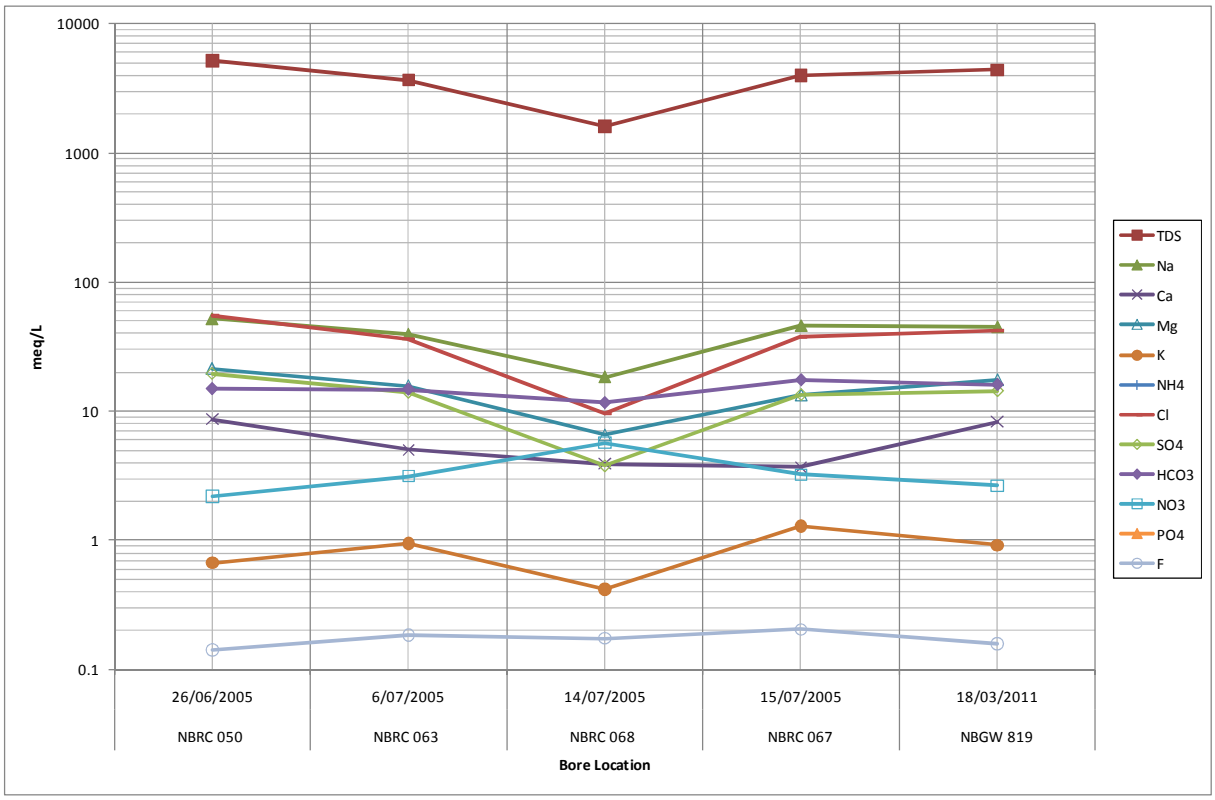


Chart 1: groundwater ionic chemistry, Nolan's Bore

8 RESULTS AND CONCEPTUAL MODEL

8.1 Conceptual model

A conceptual hydrogeological model (CHM) was developed following the initial drilling program to install the observation bores in April/ May 2010, and presented in Environmental Earth Sciences (June 2010). The June 2010 report is included as Appendix C of this document. Figure 2 of that report provided an indication of the plan view of the area where the mineralised apatite and mylonite zone outcropped at the surface, whilst Figures 3a and 3b provided a cross-section (N-S and E-W respectively) of the approximate extent of sub-cropping of the mineralised zone beneath the host gneissic granite, based on observation bore installation.

It was apparent from the observation bore installation program that the mineralised zone is likely to be hydraulically classified as an aquifer and the host gneissic granite as an aquitard. As such, the aquifer would appear to have a very limited areal extent.

Following the completion of the abstraction well (NBGW819) installation and performance of the constant discharge test, and in consideration of the large quantity of geological information available for the mineralisation zone and surrounds, the CHM has been refined slightly.

Figure 4 of this report provides a N-S cross-section of the mineralised zone (location of the cross-section indicated on both Figure 3 and Figure 4), sourced from the geological interpretation performed by Arafura Resources. This figure (along with Figures 2 and 3, and Figure D1 of Appendix D, of this report) demonstrates the extent of outcrop and subcrop of the mineralised zone that has been confirmed to contain an aquifer. The surrounding gneissic granite has been confirmed as an aquitard.

Therefore, the CHM developed for the mine site is both a plan view of the site (Figures 2 and 3, Figure 2 of Appendix C, and Figure D1 of Appendix D), and a cross section of the sub-cropping aquifer extent (Figure 4, and Figures 3a and 3b of Appendix C). The location of the abstraction bore and monitoring bores have been plotted by field GPS, and the conceptualisation of the mineralisation and resource maps, mine design and cross sections have been based on Arafura Resources Ltd (2011) data from 2008 available on the website. No further current information was provided to Environmental Earth Sciences upon request.

The fractured mineralised zone is interpreted to be a permeable fractured rock aquifer. The extent of the aquifer corresponds to the extent of the mineralised zone. Therefore, it has at least three boundaries to the north, south and west. It is likely there is also a boundary to the east, at a further distance. It is also expected that due to the porous nature of soils in the area and the surface outcropping of the apatite, that the aquifer will be recharged directly from surface infiltration during rainfall events, and as leakage when Kerosene Creek is running.

8.2 Potentiometric surface

Whilst groundwater levels were measured constantly in all ten bores utilised in this investigation, no survey height data has been provided, and as such the potentiometric surface of the aquifer and aquitard cannot be determined at this stage. Groundwater pressure gradient is important to determine, in order to assist in estimating recharge and potential discharge sources, as well as rates of groundwater migration. As such, it is recommended that all bores be surveyed to Australian Height Datum (AHD) to within 0.01m.

8.3 Evaluation of aquifer properties from pumping test data

Observation bores NBGW810, NBGW812, NBGW813, NBGW815, NBGW817 and NBGW818 all showed a significant response to the pumping of abstraction well NBGW819, consistent with these bores being screened in the same aquifer. The response in bores NBGW811 and NBGW816, tens of metres to the north of the pumping bore, was more subdued than in other bores located close to the pumping bore.

Bore NBGW814, to the west, has negligible drawdown, which is evidence that this bore is not screened in the same aquifer, i.e. it is beyond the extent or close to the boundary of the aquifer being tested. This is confirmed by observation of the log for this bore (Appendix A), which shows that the base of the aquifer is at close to 40 m, indicating that the aquifer thickness at this point is 20 m and lensing out with the mineralisation zone to the west. The depth of the aquifer at the nearest point to the east (bore NBGW817 – see Figure 2) is 70 m, whilst it is up to 110 m deep in bore NBGW812 (see logs in Appendix A).

Bore NBGW817 also showed a relatively subdued response to pumping, however this is expected as this bore is screened entirely in the underlying gneissic granite aquitard from 90 to 120 m depth (the aquifer was observed from 30-70 m depth – see Appendix A).

Drawdowns from two key observation bores (NBGW813 and NBGW818) were analysed for aquifer properties and boundary conditions using the Theis analysis. Aquifer properties and boundary locations and types were adjusted until a reasonable fit was obtained to the observed data. Table 3 summarises the results of the pumping test analyses. Appendix D provides details of the analysis, along with Figure D1 which shows the predicted aquifer boundaries based on the pumping test analysis.

TABLE 3 RESULTS OF PUMPING TEST ANALYSES

Parameter/ Bore	NBGW818	NBGW813
Transmissivity (KD in m^2/day)	320	340
Storativity (S)	1.5E-3	2.0E-3
Approximate boundary locations relative to pumping bore	No-flow boundaries @ 49 m west, 115 m north, 75 m south; recharge boundary @ 1150 m east	No-flow boundaries @ 109 m west, 95 m north, 75 m south; recharge boundary @ 950 m east

Note(s): the precise boundaries listed above represent the best fit obtained to the pumping test data using a model where sharp boundaries surround an aquifer with uniform aquifer properties. The analytical program used does not have the capability to simulate gradual thinning of an aquifer. Therefore, these boundaries should not be interpreted as precise locations of the edges of the aquifer

It was found that, in both cases, it was necessary to incorporate a recharge boundary at a distance of several hundred metres to obtain a reasonable match to the late-time drawdown and recovery data. In reality this is unlikely to be a true recharge boundary, i.e. a permanent source of recharge at a fixed location. A more likely explanation for the late-time attenuation of drawdown, and accelerated recovery during the pumping test, is that recharge due to precipitation during the test was the cause. This possibly includes leakage sourced from both Kerosene Creek (which was flowing during the test) and run-off from water abstracted during the pumping test (refer to Section 6.4 above).

The ore body is known, from exploration drilling, to be bounded in all directions by the gneissic granite host rock. This occurs within approximately 1 km of the test site and the extension of a high permeability zone beyond the boundaries of the ore body is unlikely. The pumping test did not reveal evidence of a fourth boundary. However, it is likely that the effect of recharge during the test masked the effect of this boundary.

9 DEWATERING PREDICTION

The parameters and boundaries derived from the pumping test were used to predict conditions during long-term dewatering. The best fit of the computed to the observed data during the test was obtained from the analysis of the data from bore NBGW818. Therefore, the parameters and boundary conditions obtained from this analysis were the primary inputs used in the forward prediction.

In forward predictions to evaluate dewatering, continuous pumping was simulated at a constant rate. A target of at least 140 m of drawdown was assumed at bore NBGW819 and at least 125 m of drawdown 100 m east of bore NBGW819 within one year of the start of pumping.

Three scenarios were simulated, as described in Table 4, which presents a broad range of dewatering rates and durations of pumping, reflecting the broad range of climatic conditions that could be experienced during dewatering.

TABLE 4 FORWARD PREDICTIONS OF DEWATERING

Assumed Conditions	Pumping rate (L/s)	Approximate time to reach maximum drawdown
Scenario 1. No recharge, ore body bounded in 3 directions, i.e. no-flow boundaries @ 49 m west, 115 m north, 75 m south of NBGW819	10	One year
Scenario 2. No recharge, fully bounded system in all 4 directions, i.e. no-flow boundaries @ 49 m west, 115 m north, 75 m south, AND @ 1150 m east of NBGW819	10	Two months
Scenario 3. Constant recharge @ 1150 m east, and no-flow boundaries in 3 directions @ 49 m west, 115 m north and 75 m south of NBGW819	85	Groundwater levels stabilise within two weeks due to recharge source

In reality, the total volume to be pumped, the pumping rate, and the time taken for the drawdown to reach target levels will all be sensitive to the recharge from rainfall and associated recharge from runoff that take place during dewatering. However, the rainfall experienced before, during and after the pumping test is considered unusual. Therefore, although Scenario 3 best represents the conditions observed during the test, it is considered unlikely to be representative of conditions during dewatering. None of the above scenarios consider leakage from the rocks surrounding the ore body.

In reality, from Scenarios 1 and 2, it is considered likely that dewatering to 100+ metres of drawdown would require pumping at a total rate in the order of 10 L/s (864 m^3/day or 0.32 ML/a) for a period of months, or at a higher rate for a shorter period. Bore NBGW819 would likely be a suitable bore for initial dewatering, however this bore only extends to a depth of 70 m due to the intersection of an angled RC exploration hole (NBRC188) at about 72 m during drilling.

Due to the high transmissivity of the ore body, dewatering is likely to be straightforward and additional dewatering bores may not be necessary initially. However, as bore NBGW819 has a limited depth, it would eventually need deepening or replacing with a deeper bore. An alternate method of dewatering is “in-pit”, i.e., dewatering from a sump pump within the deepest part of the pit as the excavation proceeds.

The ore body can be considered as a large “bathtub”. If dewatering takes place during a dry season with limited precipitation, it can be expected that the relationship between the drawdown and the duration of pumping will be almost linear (see Aqtesolv outputs in Appendix D). However, during periods of wet weather, recharge could significantly attenuate the dewatering drawdown and result in an increased rate of pumping to achieve a specific drawdown. This recharge effect can be minimised by suitable controls over surface water drainage, such as diverting waterways away from the ore body.

The areal extent of the aquifer based on the mineralisation zone and pumping test analyses is expected to be in the order of 100 m to the north, west and south and several hundred metres to the east of bore NBGW819. The combination of the high permeability and limited extent of the aquifer are beneficial for dewatering because the drawdown cone around the point or points of groundwater extraction is expected be relatively flat. However, this also

means that any dewatering bores need to be placed within the mineralisation envelope to be effective.

If bores are to be used for dewatering, the most practical targets for the dewatering bore screens are likely to be relatively thin zones around the perimeter of the ore body which may not be economical to mine but which are connected to the main ore body.

10 CONCLUSION AND RECOMMENDATIONS

10.1 Conclusion

The hydraulic properties of the aquifer have been estimated and consequent dewatering predictions made, resulting in a simple dewatering design involving either abstraction from well/s within the mineralisation zone, and/ or in-pit sump pumps.

The Conceptual Hydrogeological Model (CHM) indicates that:

- the aquifer is limited in areal extent (expected to be in the order of 100 m to the west, north and south and 500 m to the east of bore NBGW819);
- the combination of the high permeability and limited extent of the aquifer are beneficial for dewatering because the drawdown cone around the point or points of groundwater extraction is expected be relatively flat;
- the aquifer is thought to approximately correspond to the ore body and surrounding rocks have a much lower permeability, therefore dewatering of the ore body using wells screened outside the ore body is not expected to be feasible;
- although a dewatering rate of 10 L/sec (864 m^3/day, 0.32 ML/a) would likely be required for a period of months to draw the groundwater level down by 100+ m using bores within the ore body, a more “as needs” approach (e.g. sump pump) is likely to be feasible;
- using an “as-needs” approach, lower pumping rates would be likely for longer (possibly intermittent) periods for the life of excavation and pit deepening within the mineralised zone;
- higher pumping rates would decrease dewatering times; and
- the greatest potential for hydraulic conditions to be altered is considered to be as a result of precipitation and run-off increasing recharge to the pit (noting that run-off from outside the pit can be controlled), however this can be mitigated by increasing dewatering rates.

Due to the nature of the aquifer (bounded on all sides by an aquitard of host rock), impacts of dewatering on downstream resources such as the Woodforde River and western Ti Tree Basin are expected to be insignificant, other than for a potential increase in discharge to Kerosene Creek if the abstracted groundwater is not used on-site. If undertaken this is expected to be at a maximum long-term rate of 0.32 ML/a, however due to water quality issues (TDS 4,430 mg/L and dissolved U 0.334 mg/L) it is recommended that abstracted groundwater not be discharged to the ecosystem. In addition, it is also assumed that Kerosene Creek will be appropriately diverted around the pit.

This prediction needs to be continually assessed, pre-, during- and post-mining, through on-going groundwater level and quality monitoring (see below).

Baseline chemical groundwater data indicates that the aquifer discharge is not suitable for human consumption (average 3,800 mg/L TDS) and that incidental ingestion of more than 100 mL/day could have health implications associated with detected dissolved U concentrations. This finding should be reflected in Workplace Health & Safety (WHS) documentation for the site. In addition, based on U and F levels (as well as TDS) this water is marginal to not suitable as a stock watering resource (beef cattle assumed). Should groundwater from the site be used to water stock, it is recommended that it be shandied and retested prior to use.

10.2 Recommendations

It is recommended that a groundwater level and quality monitoring program be initiated to collect pre-mining data (and be continued for the life of the mine and post-mining). This should involve quarterly monitoring of all 10 bores for SWL and the following parameters:

- Field determined pH, electrolytic conductivity (EC), oxidation-reduction potential (ORP), dissolved oxygen (DO), temperature and turbidity; and
- Laboratory determined:
    - pH, TDS, cations (Na, Ca, K, Mg), anions (Cl, SO_4, PO_4, F, Br, I), alkalinity (HCO_3 [and CO_3 for pH >8.5]), and nutrients (NH_3, NO_3, NO_2); and
    - dissolved heavy metals (Al, As, Au, Ba, Cu, Cd, Cr, Fe, Hg, Mn, Ni, Pb, Rb, Sr, U, Zn).

Several or all of the existing wells could be used for this purpose, if practical. All bores need to be surveyed for height to Australian Height Datum (AHD), and the data should be reviewed by a hydrogeologist at least on an annual basis.

Once survey data for the bores is obtained, further hydrogeological assessment should be undertaken to address outstanding requirements of the EIS guidelines document (GHD 2010). This report addresses all items required as detailed in the above objectives and scope of works, and concludes that potential impacts from the mine on the surrounding environment as a result of dewatering are expected to be acceptable based on the scope undertaken. However, “on-going modelling” (GHD 2010, Appendix K, 2.2.1.3 Dot 5) is considered necessary (including as part of post-closure pit configuration and flooding impact predictions).

On-going modelling would include assessment of the aquifer/ aquitard potentiometric surface over time and development of hydrographs, as well as development of a water balance (GHD 2010, Appendix K, 2.2.1.2 Dot 4) for the site once expected water use is known (e.g. Kerosene Creek diversion, percentages of dewatering discharges planned to be used in the plant and released to the environment or storage facilities, and surface water management). Potential impacts as a result of the varying potential water uses at the site will need to be assessed through additional modelling once this information is known.

It is expected that the potential receptors that have the potential to be impacted by dewatering and associated discharge or use of the produced water at the site are limited to:

- stock watering (addressed herein but a management plan and on-going monitoring required);

- human health (addressed herein but requires incorporation in to WHS methodology and on-going monitoring);
- groundwater dependent ecosystems (GDEs) of the western Ti Tree Basin (this is not expected to be significant due to distance from the site and the limited extent of the site aquifer); and
- surface water ecosystems.

Due to its salinity, the water produced from dewatering would be likely to have an impact on ecosystems along any waterway to which it is discharged. Therefore, we recommend that the produced water is not discharged to any waterway without shandying to a concentration that has been demonstrated to have no significant impact.

The final recommendation of this report is that the requirements of GHD (2010) be specifically addressed in a separate, stand alone, document that incorporates the findings of this dewatering assessment report. The report should include a site water balance, and interpretation of on-going physical and chemical data collection from the monitoring program to be implemented as per the above recommendations.

11 LIMITATIONS

This report has been prepared by Environmental Earth Sciences QLD ABN 109 442 284 in response to and subject to the following limitations:

1. The specific instructions received from Arafura Resources Limited;
2. The specific scope of works set out in PO61011 v2 issued by Environmental Earth Sciences for and on behalf of Arafura Resources Ltd;
3. May not be relied upon by any third party not named in this report for any purpose except with the prior written consent of Environmental Earth Sciences QLD (which consent may or may not be given at the discretion of Environmental Earth Sciences QLD);
4. This report comprises the formal report, documentation sections, tables, figures and appendices as referred to in the index to this report and must not be released to any third party or copied in part without all the material included in this report for any reason;
5. The report only relates to the site referred to in the scope of works being located at Nolans Bore Mine Site, Aileron Station, Northern Territory (“the site”);
6. The report relates to the site as at the date of the report as conditions may change thereafter due to natural processes and/or site activities;
7. No warranty or guarantee is made in regard to any other use than as specified in the scope of works and only applies to the depth tested and reported in this report;
8. Pump testing was undertaken during a period of relatively wet weather with significant rainfall and flow in local creeks taking place before, during and after the testing. There was evidence of groundwater recharge taking place during the test. Although this added some uncertainty to the quantitative analysis of aquifer properties and boundaries, it had the beneficial effect of demonstrating that, for dewatering purposes, the total duration, rate, and volume of pumping will be largely dependent on whether significant precipitation takes place at the time. The rate of pumping for dewatering is expected to be on the order of 10+ L/s for a period of months. The rate of recharge to the ore body is due

mainly to precipitation and runoff, but also to leakage from the lower permeability materials surrounding the ore body.

9. Groundwater abstracted during the pumping test was not diverted in a drain that was entirely sealed to prevent preferential recharge. Despite efforts to re-divert the groundwater further away from the pumping site, or to use a sealed-lined drain, this was not undertaken. It is likely that some short circuiting of produced water occurred, which, in conjunction with heavy rainfall events, could impact on the pumping test results;
10. This report does not include a potentiometric surface generated from the monitoring well data, as the elevation of the well locations has not been surveyed (or at least reported to Environmental Earth Sciences), therefore it does not include an interpretation of baseline groundwater flow direction;
11. Groundwater tested on the site was determined to have potential health implications in terms of human contact and stock watering. Therefore this report recommends actions to alleviate any concerns, and Environmental Earth Sciences is not responsible if these recommendations are not followed; and
12. Our General Limitations set out at the back of the body of this report.

12 REFERENCES

Arafura Resources Ltd (2011) Website http://www.arafuraresources.com.au/. Viewed 16 May 2011.

Australian and New Zealand Environment and Conservation Council (ANZECC)/ Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*. National Water Quality Management Strategy.

Drever, J I (1997) *The geochemistry of natural waters*. Third Edition. Prentice Hall.

Environmental Earth Sciences (March 2010) *Hydrogeological open pit dewatering, pastoral bore, and mine supply investigations – proposed scope of works, Nolan's Bore project, via Aileron, NT*. Proposal to Arafura Resources Ltd.

Environmental Earth Sciences (June 2010) *Work progress report for open pit dewatering investigation at Nolan's Bore, via Aileron, NT*. Letter report to Arafura Resources Ltd.

Environmental Earth Sciences (March 2011) *Scope of abstraction bore installation program for the pit dewatering investigation at Nolan's Bore, via Aileron, NT*. Correspondence to Arafura Resources Ltd.

GHD (2010) *EIS guidelines for studies – Appendix K (Hydrogeology)*. Report to Arafura Resources for Nolan's Rare Earth Project, July 2010.

Hem J D (1992) *Study and interpretation of the chemical characteristics of natural water*. Third Edition. US Geological Survey Water-Supply Paper 2254.

Kruseman G P and de Ridder N A (2000) *Analysis and Evaluation of Pumping Test Data*. Second Edition. International Institute for Land Reclamation and Improvement.

Land and Water Biodiversity Committee (LWBC) (2003) *Minimum Construction Requirements for Water Bores in Australia*. Edition 2.

National Health and Medical Research Council (NHMRC)/ National Resource Management Ministerial Council (NRMMC) (2004) *Australian Drinking Water Guidelines*. National Water Quality Management Strategy.

NHMRC (2008) *Guidelines for managing risks in recreational water*. Australian Government, February 2008.

Osborne, P S (1993) *Suggested operating procedures for aquifer pumping tests*. United States Environmental Protection Agency (US EPA) Ground Water Issue.

Standards Australia (1990) *Test pumping of water wells*. Australian Standard AS 2368 – 1990.

13 GLOSSARY OF TERMS

The following descriptions are of terms used in the text of this report. A list of the references used in providing this glossary is presented in Section 12 of this report.

Anisotropy condition in which one or more properties vary according to direction.

Aquifer rock or sediment in a formation, group of formations, or part of a formation which is saturated and sufficiently permeable to transmit economic quantities of water to wells and springs.

Aquifer, confined aquifer that is overlain by a confining bed with significantly lower hydraulic conductivity than the aquifer.

Aquifer, perched region in the unsaturated zone where the soil is locally saturated because it overlies soil or rock of low permeability.

Aquitard a unit of low-permeability that can store groundwater and also transmit it slowly.

Borehole an uncased well drill hole.

Bore. A hydraulic structure that facilitates the monitoring of groundwater level, collection of groundwater samples, or the extraction (or injection) of groundwater. Also known as a Well.

Confined Aquifer. An aquifer that is confined between two low-permeability aquitards. The groundwater in these aquifers is usually under hydraulic pressure, i.e. its hydraulic head is above the top of the aquifer.

Confining layer. A layer with low vertical hydraulic conductivity that is stratigraphically adjacent to one or more aquifers. A confining layer is an aquitard. It may lie above or below the aquifer.

Drawdown. Lowering of hydraulic head.

Electrical Conductivity (EC). The EC of water is a measure of its ability to conduct an electric current. This property is related to the ionic content of the sample, which is in turn a function of the total dissolved (ionisable) solids (TDS) concentration. An estimate of TDS in fresh water can be obtained by multiplying EC by 0.65.

Ephemeral stream a stream that flows only during periods of precipitation and briefly thereafter, or during periods of elevated water-table levels when the stream is in direct hydraulic connection with the underlying unconfined aquifer (i.e. receives base-flow).

Fracture break in the geological formation, e.g. a shear or a fault.

Gradient rate of inclination of a slope. The degree of deviation from the horizontal; also refers to pressure.

Groundwater. The water held in the pores in the ground below the water table.

Hydraulic Head. The sum of the elevation head and the pressure head at a point in an aquifer. This is typically reported as an elevation above a fixed datum, such as sea level.

Hydraulic conductivity. A coefficient describing the rate at which water can move through a permeable medium. It has units of length per time.

Permeability. Property of porous medium relating to its ability to transmit or conduct liquid (usually water) under the influence of a driving force. Where water is the fluid, this is effectively the hydraulic conductivity.

Piezometer a cased borehole with a short slotted screen for measuring standing water level (SWL), which represents a potentiometric surface or elevation of the water table; also used to obtain sample of groundwater for quality assessment.

Piezometric or Potentiometric Surface. A surface that represents the level to which water will rise in cased bores. The water table is the potentiometric surface in an unconfined aquifer.

Purge (wells) pumping out well water to remove drilling debris or impurities; also conducted to bring fresh groundwater into the casing for sample collection. The later ensures that a more representative sample of an aquifer is taken.

Recharge Area location of the replenishment of an aquifer by a natural process such as addition of water at the ground surface, or by an artificial system such as addition through a well

Recovery rate at which a water level in a well rises after pumping ceases.

Saturated Zone zone in which the rock or soil pores are filled (saturated) with water.

Storativity volume of water stored or released by an aquifer per unit volume (of porous medium) per unit change in head.

Stratigraphy vertical sequence of geological units.

Suspended Solids (SS) matter which is suspended in water which will not pass through a 0.45 µm filter membrane.

Total Dissolved Salts (TDS) total dissolved salts comprise dissociated compounds and undissociated compounds, but not suspended material, colloids or dissolved gases.

Transmissivity rate at which water is transmitted through a unit width aquifer under a unit hydraulic gradient.

Unconfined aquifer. An aquifer in which the water table forms the upper boundary.

Unsaturated zone. The zone between the land surface and the water table, in which the rock or soil pores contain both air and water.

Water table interface between the saturated zone and unsaturated zones. The surface in an aquifer at which pore water pressure is equal to atmospheric pressure.

Well. A hydraulic structure that facilitates the monitoring of groundwater level, collection of groundwater samples, or the extraction (or injection) of groundwater. Also known as a Bore.

ENVIRONMENTAL EARTH SCIENCES GENERAL LIMITATIONS

Scope of services

The work presented in this report is Environmental Earth Sciences response to the specific scope of works requested by, planned with and approved by the client. It cannot be relied on by any other third party for any purpose except with our prior written consent. Client may distribute this report to other parties and in doing so warrants that the report is suitable for the purpose it was intended for. However, any party wishing to rely on this report should contact us to determine the suitability of this report for their specific purpose.

Data should not be separated from the report

A report is provided inclusive of all documentation sections, limitations, tables, figures and appendices and should not be provided or copied in part without all supporting documentation for any reason, because misinterpretation may occur.

Interpretations and conclusions regarding subsurface conditions

On all sites, non-uniformity of the vertical and horizontal hydrogeological conditions is encountered. Hence, no monitoring can eliminate the possibility that the data obtained are not totally representative of ground and/or groundwater conditions. The interpretations and conclusions herein are based upon the available data and are, therefore, merely indicative of the conditions from the available data at the time of preparing the report. Also, it should be recognised that the data reviewed are from a limited time period and that site conditions can change with time.

Problems with interpretation by others

Advice and interpretation is provided on the basis that subsequent work will be undertaken by Environmental Earth Sciences QLD. This will identify variances, maintain consistency in how data is interpreted, conduct additional tests that may be necessary and recommend solutions to problems encountered on site. Other parties may misinterpret our work and we cannot be responsible for how the information in this report is used. If further data is collected or comes to light we reserve the right to alter their conclusions.

Obtain regulatory approval

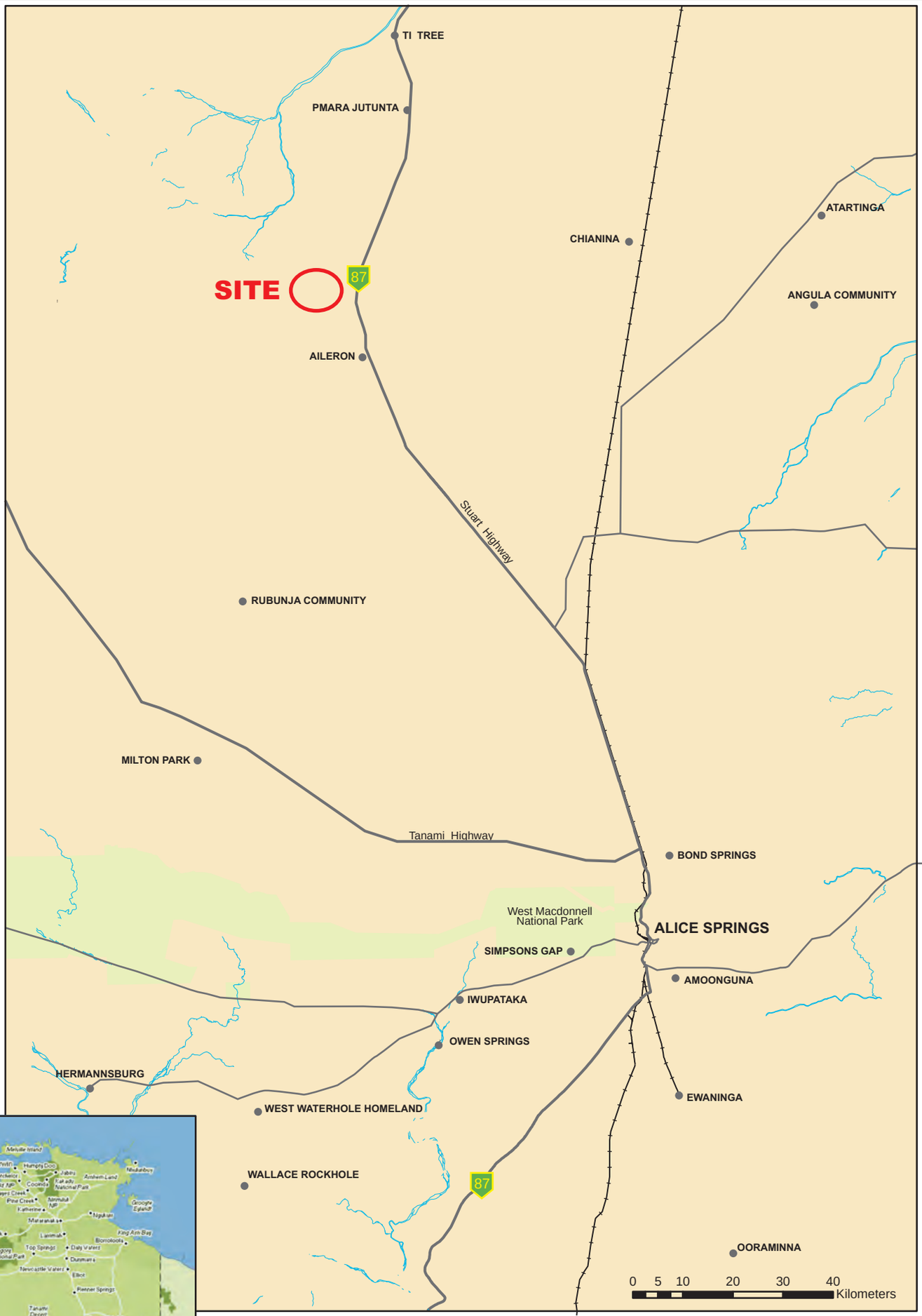
The investigation and remediation of contaminated sites is a field in which legislation and interpretation of legislation is changing rapidly. Our interpretation of the investigation findings should not be taken to be that of any other party. When approval from a statutory authority is required for a project, that approval should be directly sought by the client.

Limit of liability

This study has been carried out to a particular scope of works at a specified site and should not be used for any other purpose. This report is provided on the condition that Environmental Earth Sciences QLD disclaims all liability to any person or entity other than the client in respect of anything done or omitted to be done and of the consequence of anything done or omitted to be done by any such person in reliance, whether in whole or in part, on the contents of this report. Furthermore, Environmental Earth Sciences QLD disclaims all liability in respect of anything done or omitted to be done and of the consequence of anything done or omitted to be done by the client, or any such person in reliance, whether in whole or any part of the contents of this report of all matters not stated in the brief outlined in Environmental Earth Sciences QLD's proposal number and according to Environmental Earth Sciences general terms and conditions and special terms and conditions for contaminated sites.

To the maximum extent permitted by law, we exclude all liability of whatever nature, whether in contract, tort or otherwise, for the acts, omissions or default, whether negligent or otherwise for any loss or damage whatsoever that may arise in any way in connection with the supply of services. Under circumstances where liability cannot be excluded, such liability is limited to the value of the purchased service.

FIGURES

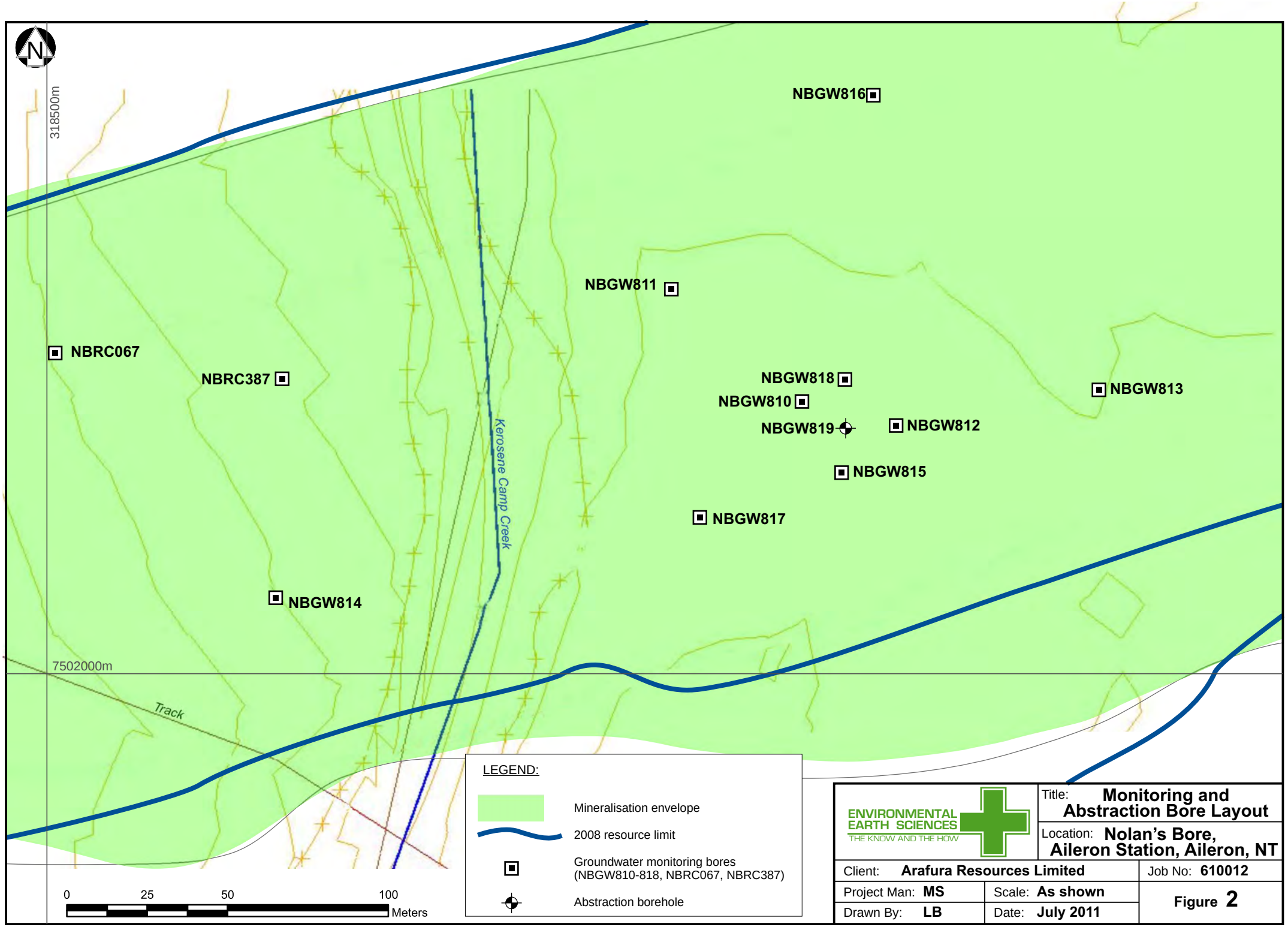


ENVIRONMENTAL EARTH SCIENCES
THE KNOW AND THE HOW

Title: **Locality Map**

Location: **Nolan's Bore, Aileron Station, Aileron, NT**

Client: **Arafura Resources Limited**		Job No: **610012**
Project Man: **MS**	Scale: **As shown**	**Figure 1**
Drawn By: **LB**	Date: **July 2011**	



ENVIRONMENTAL EARTH SCIENCES
THE KNOW AND THE HOW

Title: **Monitoring and Abstraction Bore Layout**

Location: **Nolan's Bore, Aileron Station, Aileron, NT**

Client: **Arafura Resources Limited**		Job No: **610012**
Project Man: **MS**	Scale: **As shown**	Figure **2**
Drawn By: **LB**	Date: **July 2011**	

318500m

7502000m

A

B

NBGW816

NBRD036

NBDH027

NBRD018

NBGW811

NBRC041

NBDH148

NBDH167

NBRC067

NBDH037

NBRC050

NBDH162

NBRC387

NBDH026

NBRC022

NBGW818

NBGW813

NBRC043

NBRC032

NBGW810

NBGW812

NBGW819

NBRC019

NBRC014

NBDH159

NBDH154

NBDH024

Kerosene Camp Creek

NBGW815

NBDH161

NBRD038

NBRC028

NBGW817

NBRC030

NBRC003

NBRC031

NBGW814

NBRC023

NBRC047

Track

LEGEND:

- Mineralisation envelope
- 2008 resource limit
- Groundwater monitoring bores (NBGW810-817, NBRC067, NBRC387)
- Exploration boreholes (subset used in geological interpretation and for position reference)
- Abstraction borehole
- Cross section location (refer Figure 4)

0 25 50 100 Meters

ENVIRONMENTAL EARTH SCIENCES
THE KNOW AND THE HOW

Title: **Plan View for Conceptual Hydrogeological Model**

Location: **Nolan's Bore, Aileron Station, Aileron, NT**

Client: **Arafura Resources Limited**

Job No: **610012**

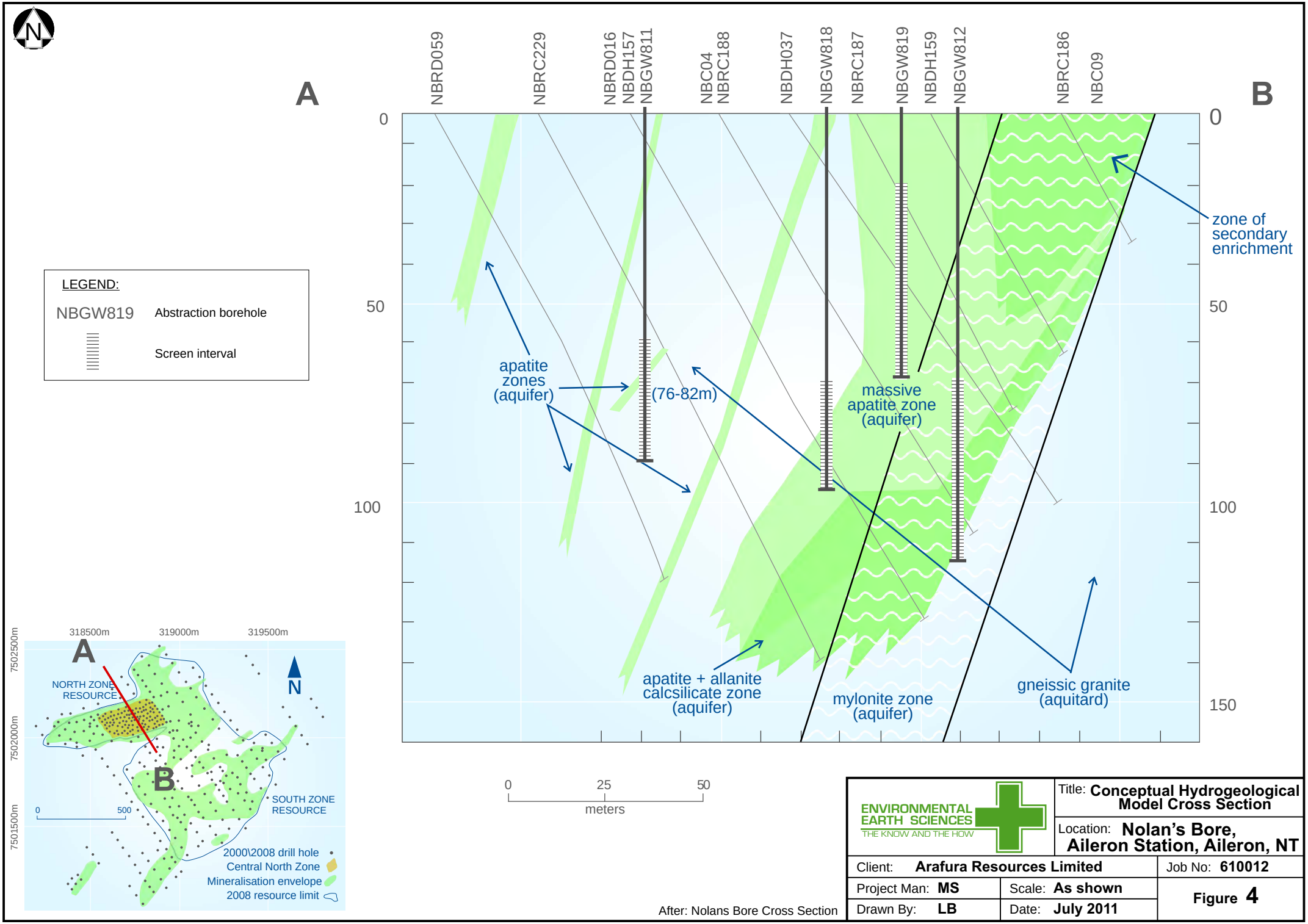
Project Man: **MS**

Scale: **As shown**

Drawn By: **LB**

Date: **July 2011**

Figure 3



After: Nolans Bore Cross Section

ENVIRONMENTAL EARTH SCIENCES
THE KNOW AND THE HOW

Title: **Conceptual Hydrogeological Model Cross Section**

Location: **Nolan's Bore, Aileron Station, Aileron, NT**

Client: **Arafura Resources Limited**		Job No: **610012**
Project Man: **MS**	Scale: **As shown**	**Figure 4**
Drawn By: **LB**	Date: **July 2011**	

APPENDIX A GEOLOGICAL BORELOGS – MONITORING WELLS

Hydrogeological Borehole Log

ENVIRONMENTAL EARTH SCIENCES
THE KNOW AND THE HOW

LOCATION Aileron, NT	**CLIENT** Arafura Resources	**PROJECT:** Nolans Bore Hydrogeological Investigation	**Logged by** KK
DATE COMMENCED 25/04/2010	**JOB NUMBER** 610012		
DATE COMPLETED 28/04/2010	**METHOD** RC	**BORE NO. NBGW810** **PAGE:** 1 of 3 **GPS** 22°34'41.82"S **COORD** 133°14'13.23"E	**Proj. Manager** MS
DRILLING COMPANY H2O	**DRILLER** Trevor		

LITHOLOGICAL DESCRIPTION	DEPTH (M)	WEATHERING/ OXIDATION	FRACTURING	SWL (Date)/ WATER STRUCK	AIRLIFTED YIELD (L/s)	EC (µS/cm)	SOIL/ROCK SAMPLES	WATER SAMPLES	CONSTRUCTION DETAILS	COMMENTS
sandy silt with subangular gravel parent rock, fragments of quartz and apatite	2									
soft, light green blue apatite	4									
soft, white mylonite with some remnant quartz and mineral kaolinite.	6									
white, soft, white mylonite with some remnant quartz and mineral kaolinite. Slightly higher quartz %, minor apatite	8									
mylonite, white, soft	10									
soft, quartz and mylonite, quartz grains show weathering on faces, some darker grains	12			28/04/10						Water level after development
soft, clear, dark quartz and soft dark grey clay, micaceous (biotite)/platy	14									
light yellow-brown, soft quartz and mylonite with some dark grey clay	16	SW								
clear, yellow quartz with grey micaceous clays, some green and blue apatite and gneiss	18									
white and cream mylonite and deeply-weathered quartz with iron quartz fabric throughout	20	SW-DW								
clear quartz and white mylonite with Fe-staining on some surfaces	22	DW-SW								
less Fe-staining, clear quartz and white mylonite	24									
brown apatite	26	Fe-staining								
siliceous mylonite with Fe-staining interfingered with brown apatite	28	Fe-staining							Bentonite	
dark grey quartz and some green apatite	30									
	32	SW								
	34	SW-DW		25/04/10						Initial water strike High Geiger reading
	36								Gravel Pack	
	38									
	40									
	42									

NOTE: This bore log is for environmental purposes only and is not intended to provide geotechnical information.

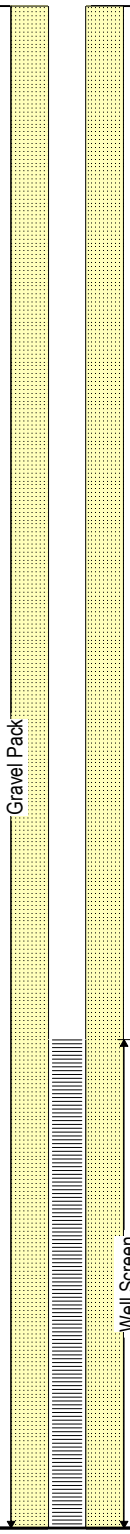
Legend
1) FR - Fresh rock
2) SW - Slightly weathered
3) MW - Moderately weathered
4) SW - Slightly weathered
5) RS - Residual rock

Hydrogeological Borehole Log

ENVIRONMENTAL EARTH SCIENCES
THE KNOW AND THE HOW

LOCATION Aileron, NT	**CLIENT** Arafura Resources	**PROJECT:** Nolans Bore Hydrogeological Investigation			**Logged by** KK
DATE COMMENCED 25/04/2010	**JOB NUMBER** 610012				
DATE COMPLETED 28/04/2010	**METHOD** RC	**BORE NO. NBGW810**	**PAGE:** 2 of 3	**GPS** 22°34'41.82"S **COORD** 133°14'13.23"E	**Proj. Manager** MS
DRILLING COMPANY H2O	**DRILLER** Trevor				

LITHOLOGICAL DESCRIPTION	GRAPHIC LOG	DEPTH (M)	WEATHERING/ OXIDATION	FRACTURING	SWL (Date)/ WATER STRUCK	AIRLIFTED YIELD (L/s)	EC (µS/cm)	SOIL/ROCK SAMPLES	WATER SAMPLES	CONSTRUCTION DETAILS	COMMENTS
brown apatite, minor white mylonite		44									
light brow interfingered apatite and quartz		46									
brown apatite		48									
light brown apatite and white mylonite											
brown apatite, quartz, Fe-staining		50	Fe-staining								
light brown highly weathered apatite band 'puggy'		52									
very soft brown and green apatite											
very soft green apatite		54									
		56									
white and Fe-stained mylonite with minor apatite			Fe-staining								
		58	Fe-staining			2.5	6,350				
white and Fe-stained mylonite with green apatite and high quartz content			SW								
mylonite, white and Fe-stained		60									
		62									
		64									
massive brown and green apatite		66									
		68									
		70									
		72									
		74									
		76									
		78									
		80									
		82									
		84									



NOTE: This bore log is for environmental purposes only and is not intended to provide geotechnical information.

Legend
1) FR - Fresh rock
2) SW - Slightly weathered
3) MW - Moderately weathered
4) SW - Slightly weathered
5) RS - Residual rock

Hydrogeological Borehole Log

ENVIRONMENTAL EARTH SCIENCES
THE KNOW AND THE HOW

LOCATION Aileron, NT	**CLIENT** Arafura Resources	**PROJECT:** Nolans Bore Hydrogeological Investigation			**Logged by** KK
DATE COMMENCED 25/04/2010	**JOB NUMBER** 610012				
DATE COMPLETED 28/04/2010	**METHOD** RC	**BORE NO. NBGW810**	**PAGE:** 3 of 3	**GPS** 22°34'41.82"S **COORD** 133°14'13.23"E	**Proj. Manager** MS
DRILLING COMPANY H2O	**DRILLER** Trevor				

LITHOLOGICAL DESCRIPTION	GRAPHIC LOG	DEPTH (M)	WEATHERING/ OXIDATION	FRACTURING	SWL (Date)/ WATER STRUCK	AIRLIFTED YIELD (L/s)	EC (µS/cm)	SOIL/ROCK SAMPLES	WATER SAMPLES	CONSTRUCTION DETAILS	COMMENTS
massive brown and green apatite with increasing quartz		86 88									
very hard dark grey quartz, mica and feldspar (gneiss) with Ca-Si		90									
moderately Ca-Si altered gneiss		92 94									
very hard dark grey moderately Ca-Si altered gneiss with green epidote and allanite		96									
Fe-stained Ca-Si gneiss		98									
banded green epidote (Ca-Si) and gneiss		100					6,110				
green Ca-Si altered gneiss with biotite		102									
hard green grey Ca-Si altered gneiss, light grey, clear quartz		104									
hard white to clear quartz vein and green epidote		106 108 110 112 114								Well Screen 'Sump'	
EOH at 114.4m		116 118 120 122 124 126									Hole terminated at 114.4m Drilling into hard competent rock

NOTE: This bore log is for environmental purposes only and is not intended to provide geotechnical information.

Legend
1) FR - Fresh rock
2) SW - Slightly weathered
3) MW - Moderately weathered
4) SW - Slightly weathered
5) RS - Residual rock

Hydrogeological Borehole Log

ENVIRONMENTAL EARTH SCIENCES
THE KNOW AND THE HOW

LOCATION Aileron, NT	**CLIENT** Arafura Resources	**PROJECT:** Nolans Bore Hydrogeological Investigation			**Logged by** KK / YY
DATE COMMENCED 28/04/2010	**JOB NUMBER** 610012				
DATE COMPLETED 29/04/2010	**METHOD** RC	**BORE NO. NBGW811**	**PAGE:** 1 of 3	**GPS** 22°34'40.57" **COORD** 133°14'11.68"E	**Proj. Manager** MS
DRILLING COMPANY H2O	**DRILLER** Trevor				

LITHOLOGICAL DESCRIPTION	GRAPHIC LOG	DEPTH (M)	WEATHERING/ OXIDATION	FRACTURING	SWL (Date)/ WATER STRUCK	AIRLIFTED YIELD (L/s)	EC (µS/cm)	SOIL/ROCK SAMPLES	WATER SAMPLES	CONSTRUCTION DETAILS	COMMENTS
sandly silt with subangular gravel											
hard, white and Fe-stained, grey quartz, mica and feldspar (gneiss)		2, 4, 6									
very hard Fe-stained gneiss (granite), sugary texture		8, 10	FR								
very hard, white and Fe-stained, grey quartz (gneiss)		12, 14, 16	SW-FR		30/04/10 (SWL TOC)					Bentonite	WL after development
hard, slightly weathered gneiss		18									
hard dark grey white quartz (gneiss) with thin bands of apatite		20, 22, 24			28/04/10						Initial water strike
soft, moist (not wet) brown and green apatite (mineralised zone)		26	SW							Gravel Pack	
massive, slightly harder and green apatite		28, 30, 32									
hard Fe-stained gneiss (quartz, biotite, feldspar) with black, dark grey allanite		34, 36	SW								
soft-hard Fe-stained gneiss interbedded thin layers of hard green apatite (approx. 40%) with some quartz grains		38	FR								
gneiss, banded quartz and dark biotite		40, 42									

NOTE: This bore log is for environmental purposes only and is not intended to provide geotechnical information.

Legend
1) FR - Fresh rock
2) SW - Slightly weathered
3) MW - Moderately weathered
4) SW - Slightly weathered
5) RS - Residual rock

Hydrogeological Borehole Log

ENVIRONMENTAL EARTH SCIENCES
THE KNOW AND THE HOW

LOCATION Aileron, NT	**CLIENT** Arafura Resources	**PROJECT:** Nolans Bore Hydrogeological Investigation		**Logged by** KK / YY
DATE COMMENCED 28/04/2010	**JOB NUMBER** 610012			
DATE COMPLETED 29/04/2010	**METHOD** RC	**BORE NO. NBGW811**	**PAGE:** 2 of 3	**GPS** 22°34'40.57" **COORD** 133°14'11.68"E
DRILLING COMPANY H2O	**DRILLER** Trevor			**Proj. Manager** MS

LITHOLOGICAL DESCRIPTION	GRAPHIC LOG	DEPTH (M)	WEATHERING/ OXIDATION	FRACTURING	SWL (Date)/ WATER STRUCK	AIRLIFTED YIELD (L/s)	EC (µS/cm)	SOIL/ROCK SAMPLES	WATER SAMPLES	CONSTRUCTION DETAILS	COMMENTS
gneiss with small cubic sliver unidentifiable mineral and very little apatite (<5%)		44	FR								
		46									
		48									
		50									
gneiss with dark grey, very fine grained allanite		52									
gneiss		54									
		56									
		58									
gneiss with some Fe-staining		60	Fe-staining		29/04/10	0.5					Water strike. Low yield
pink feldspar in gneiss		62									
gneiss with Fe-staining		64	FR-SW Fe-staining								
		66									
		68									
		70									
		72									
		74									
highly weathered cream apatite and white kaolinite		76	SW								Dry High Geiger reading 3µSv/h
gneiss and some dark grey allanite		78									
		80									Very dry. No indication of inflow
very hard band of green apatite in gneiss											
kaolinised quartz, white		82									
gneiss with some yellow ore mineralised gneiss		84									

Gravel Pack
Well Screen

NOTE: This bore log is for environmental purposes only and is not intended to provide geotechnical information.

Legend
1) FR - Fresh rock
2) SW - Slightly weathered
3) MW - Moderately weathered
4) SW - Slightly weathered
5) RS - Residual rock

Hydrogeological Borehole Log

ENVIRONMENTAL EARTH SCIENCES
THE KNOW AND THE HOW

LOCATION Aileron, NT	**CLIENT** Arafura Resources	**PROJECT:** Nolans Bore Hydrogeological Investigation			**Logged by** KK / YY
DATE COMMENCED 28/04/2010	**JOB NUMBER** 610012				
DATE COMPLETED 29/04/2010	**METHOD** RC	**BORE NO. NBGW811**	**PAGE:** 3 of 3	**GPS** 22°34'40.57" **COORD** 133°14'11.68"E	**Proj. Manager** MS
DRILLING COMPANY H2O	**DRILLER** Trevor				

LITHOLOGICAL DESCRIPTION	GRAPHIC LOG	DEPTH (M)	WEATHERING/ OXIDATION	FRACTURING	SWL (Date)/ WATER STRUCK	AIRLIFTED YIELD (L/s)	EC (µS/cm)	SOIL/ROCK SAMPLES	WATER SAMPLES	CONSTRUCTION DETAILS	COMMENTS
gneiss, hard		86 88 90				0.2				Sump	Dry cuttings
EOH at 90.4m		92 94 96 98 100 102 104 106 108 110 112 114 116 118 120 122 124 126									Well Development Duration of development = 25mins Very competent rock EC #1 = 5,280 µS/cm at 25.6°C Airlift yield #1 = 0.33-0.4L/s

NOTE: This bore log is for environmental purposes only and is not intended to provide geotechnical information.

Legend
1) FR - Fresh rock
2) SW - Slightly weathered
3) MW - Moderately weathered
4) SW - Slightly weathered
5) RS - Residual rock

Hydrogeological Borehole Log

ENVIRONMENTAL EARTH SCIENCES
THE KNOW AND THE HOW

LOCATION Aileron, NT	**CLIENT** Arafura Resources	**PROJECT:** Nolans Bore Hydrogeological Investigation		**Logged by** KK / YY
DATE COMMENCED 30/04/2010	**JOB NUMBER** 610012			
DATE COMPLETED 02/05/2010	**METHOD** RC	**BORE NO. NBGW812**	**PAGE:** 1 of 3	**GPS** 22°34'41.98"S **COORD** 133°14'14.17"E
DRILLING COMPANY H2O	**DRILLER** Trevor			**Proj. Manager** MS

LITHOLOGICAL DESCRIPTION	GRAPHIC LOG	DEPTH (M)	WEATHERING/ OXIDATION	FRACTURING	SWL (Date)/ WATER STRUCK	AIRLIFTED YIELD (L/s)	EC (µS/cm)	SOIL/ROCK SAMPLES	WATER SAMPLES	CONSTRUCTION DETAILS	COMMENTS
top soil. red silty sand with weathered parent rock, apatite		2								Bentonite	Outer PVC casing (0-5m) Back filled with drill cuttings
red to yellow, brown, very loose silt with some rock fragments		4									
loose, yellow, brown silt and residual rock - white mylonite and some fresh rock fragmetns		6									
soft, white-yellow mylonite		8	SW								
soft, brown apatite and white mylonite		10	FR SW								Easy drilling
very soft green brown apatite		12	DW		03/05/10						
soft green-brown and yellow-brown apatite with some deeply weathered quartz mineralization.		14 16 18 20	SW								High Geiger reading
soft-hard quartz, green apatite and some kaolinite		22 24	DW		01/05/10						23m. Distinct change in lithology
light green, 'puggy' apatite		26 28									
highly weathered quartz, clear, white and pink with some green apatite, minor mylonite		30	SW - DW							Gravel Pack	
soft, highly weathered brown-green apatite with quartz and kaolinite		32 34									
as above, banded highly weathered		36 38									
extremely weathered and very soft green brown 'puggy' apatite		40 42	EW								

NOTE: This bore log is for environmental purposes only and is not intended to provide geotechnical information.

Legend
1) FR - Fresh rock
2) SW - Slightly weathered
3) MW - Moderately weathered
4) SW - Slightly weathered
5) RS - Residual rock

Hydrogeological Borehole Log

ENVIRONMENTAL EARTH SCIENCES
THE KNOW AND THE HOW

LOCATION Aileron, NT	**CLIENT** Arafura Resources	**PROJECT:** Nolans Bore Hydrogeological Investigation			**Logged by** KK / YY
DATE COMMENCED 30/04/2010	**JOB NUMBER** 610012				
DATE COMPLETED 02/05/2010	**METHOD** RC	**BORE NO. NBGW812**	**PAGE:** 2 of 3	**GPS** 22°34'41.98"S **COORD** 133°14'14.17"E	**Proj. Manager** MS
DRILLING COMPANY H2O	**DRILLER** Trevor				

LITHOLOGICAL DESCRIPTION	GRAPHIC LOG	DEPTH (M)	WEATHERING/ OXIDATION	FRACTURING	SWL (Date)/ WATER STRUCK	AIRLIFTED YIELD (L/s)	EC (µS/cm)	SOIL/ROCK SAMPLES	WATER SAMPLES	CONSTRUCTION DETAILS	COMMENTS
very soft, extremely weathered massive green brown apatite with some slightly harder bands (very puggy)		44 46 48 50 52 54 56 58 60 62 64 66 68 70 72 74 76 78 80 82	EW							Gravel Pack Well Screen	Constant water inflow
dry zone, slightly harder apatite		84									Dry zone

NOTE: This bore log is for environmental purposes only and is not intended to provide geotechnical information.

Legend
1) FR - Fresh rock
2) SW - Slightly weathered
3) MW - Moderately weathered
4) SW - Slightly weathered
5) RS - Residual rock

Hydrogeological Borehole Log

ENVIRONMENTAL EARTH SCIENCES
THE KNOW AND THE HOW

LOCATION Aileron, NT	**CLIENT** Arafura Resources	**PROJECT:** Nolans Bore Hydrogeological Investigation			**Logged by** KK / YY
DATE COMMENCED 30/04/2010	**JOB NUMBER** 610012				
DATE COMPLETED 02/05/2010	**METHOD** RC	**BORE NO. NBGW812**	**PAGE:** 3 of 3	**GPS** 22°34'41.98"S **COORD** 133°14'14.17"E	**Proj. Manager** MS
DRILLING COMPANY H2O	**DRILLER** Trevor				

LITHOLOGICAL DESCRIPTION	GRAPHIC LOG	DEPTH (M)	WEATHERING/ OXIDATION	FRACTURING	SWL (Date)/ WATER STRUCK	AIRLIFTED YIELD (L/s)	EC (µS/cm)	SOIL/ROCK SAMPLES	WATER SAMPLES	CONSTRUCTION DETAILS	COMMENTS
slightly drier band, slightly more competent rock (brown green apatite)		86									
bright green apatite		88									
hard-dark apatite, massive, relatively fresh with mimimum weathering		90									
		92	RS to SW								
soft brown apatite banded with soft green apatite		94									
		96									
		98									
soft, extremely weathered brown green massive apatite		100	EW			3.0L/s					
very soft bright green apatite		102									
		104									
dark olive green, grey, black rock (allanite), quartz with some mica (light platy shinny lusture)		106									105m. Distinct boundary Low Geiger reading
		108									
very hard quartz, biotite, muscovite and feldspar (gneiss)		110									
		112									
		114				2.2L/s				Well Screen 'Sump'	
EOH at 114.40m		116									
		118									
		120									
		122									
		124									
		126									

NOTE: This bore log is for environmental purposes only and is not intended to provide geotechnical information.

Legend
1) FR - Fresh rock
2) SW - Slightly weathered
3) MW - Moderately weathered
4) SW - Slightly weathered
5) RS - Residual rock

Hydrogeological Borehole Log

ENVIRONMENTAL EARTH SCIENCES
THE KNOW AND THE HOW

LOCATION Aileron, Northern Terriotory	**CLIENT** Arafura Resources	**PROJECT:** Nolans Bore Hydrogeological Investigation		**Logged by** KK
DATE COMMENCED 03/05/2010	**JOB NUMBER** 610012			
DATE COMPLETED 05/05/2010	**METHOD** RC	**BORE NO. NBGW813**	**PAGE:** 1 of 3	**GPS** 22°34'41.66"S **COORD** 133°14'16.38"E
DRILLING COMPANY H2O	**DRILLER** Trevor			**Proj. Manager** MS

LITHOLOGICAL DESCRIPTION	DEPTH (M)	WEATHERING/ OXIDATION	FRACTURING	SWL (Date)/ WATER STRUCK	AIRLIFTED YIELD (L/s)	EC (µS/cm)	SOIL/ROCK SAMPLES	WATER SAMPLES	CONSTRUCTION DETAILS	COMMENTS
red slity sand and gravel with rock fragments from parent material	2									Distinct colour change
light green and brown apatite with quartz fragments	4									Low Geiger reading
grey to dark grey hard rock showing some alteration banded with yellow, brown mineralised zone including biotite	6	SW								
green, brown slightly weathered and altered fine grained rock	8									
dark grey-black allanite and clay	10									
soft, green and brown apatite with quartz, feldspar and darker mineralized rock fragments	12	SW								
soft, distinctly weathered rock - mainly brown and green apatite, some quartz banding	14	DW		03/05/10 11.15am 05/05/10						Intersected subvertical geotechnical hole at 15m
	16									
	18									
soft, bright green and white powdery mylonite	20	SW								
soft, brown, green apatite banded with quartz gienss	22									
light grey with banded altered mylonite	24									
light grey with banded altered mylonite, becoming harder	26	SW								Low yield. Approx 0.1L/s
dark grey, clear and yellow opaque quartz with some Fe-staining with highly weathered zone	28	Fe-staining								
gneiss, light quartz with brown soft biotite (with small yellow, gold (high lusture) flakes	30									
quartz with fragments of gneiss										
quartz with fragments of allanite	32									
	34									
soft, highly weathered gneiss	36	DW								
		RS								
hard, dark grey allanite and apatite with some Fe-staining	38									
soft, green-brown apatite with highly weathered gneiss	40									Relatively low yield. Approx. 0.2L/s
	42									

Bentonite

Gravel Pack

NOTE: This bore log is for environmental purposes only and is not intended to provide geotechnical information.

Legend
1) FR - Fresh rock
2) SW - Slightly weathered
3) MW - Moderately weathered
4) SW - Slightly weathered
5) RS - Residual rock

Hydrogeological Borehole Log

ENVIRONMENTAL EARTH SCIENCES
THE KNOW AND THE HOW

LOCATION Aileron, Northern Terriotory	**CLIENT** Arafura Resources	**PROJECT:** Nolans Bore Hydrogeological Investigation		**Logged by** KK
DATE COMMENCED 03/05/2010	**JOB NUMBER** 610012			
DATE COMPLETED 05/05/2010	**METHOD** RC	**BORE NO. NBGW813**	**PAGE:** 2 of 3	**GPS** 22°34'41.66"S **COORD** 133°14'16.38"E
DRILLING COMPANY H2O	**DRILLER** Trevor			**Proj. Manager** MS

LITHOLOGICAL DESCRIPTION	GRAPHIC LOG	DEPTH (M)	WEATHERING/ OXIDATION	FRACTURING	SWL (Date)/ WATER STRUCK	AIRLIFTED YIELD (L/s)	EC (µS/cm)	SOIL/ROCK SAMPLES	WATER SAMPLES	CONSTRUCTION DETAILS	COMMENTS
white-yellow powdery and puggy kaolinite		44									
soft, white Fe-stained kaolinite		46									Low Geiger reading
dark grey-green, higlyly altered mylonite, some apatite / Ca-Si mineralisation, clear quartz		48					6,460				27.1 °C
mylonite and quartz		50									
		52									
soft to hard brown apatite with very soft, highly weathered light brown puggy residual clay		54									
		56									
		58									
quartz, light grey, white and clear		60									
very soft, and puggy, white creamy textured kaolinite		62	RS							Gravel Pack	
brown and green weathered apatite, some clay		64									Low Geiger reading
very soft and puggy brown apatite		66	RS								
very soft and puggy brown and green apatite		68									
dark olive green to dark grey, black extremely fine-grained, possibily slightly Ca-Si altered gneiss with apatite		70									
		72									
light grey, pink quartz with biotite flecks, some Ca-Si altered gneiss		74									
		76									Low Geiger reading
hard, very hard gneiss (quartz, biotite, feldspar) clear, white and dark grey		78	FR								
		80									
gneiss with light brown, green fine-grained rock		82				0.3-0.4					
granite/gneiss with pink quartz (or feldspar)		84									

NOTE: This bore log is for environmental purposes only and is not intended to provide geotechnical information.

Legend
1) FR - Fresh rock
2) SW - Slightly weathered
3) MW - Moderately weathered
4) SW - Slightly weathered
5) RS - Residual rock

Hydrogeological Borehole Log

ENVIRONMENTAL EARTH SCIENCES
THE KNOW AND THE HOW

LOCATION Aileron, Northern Terriotory	**CLIENT** Arafura Resources	**PROJECT:** Nolans Bore Hydrogeological Investigation		**Logged by** KK
DATE COMMENCED 03/05/2010	**JOB NUMBER** 610012			
DATE COMPLETED 05/05/2010	**METHOD** RC	**BORE NO. NBGW813**	**PAGE:** 3 of 3	**GPS** 22°34'41.66"S **COORD** 133°14'16.38"E
DRILLING COMPANY H2O	**DRILLER** Trevor			**Proj. Manager** MS

LITHOLOGICAL DESCRIPTION	GRAPHIC LOG	DEPTH (M)	WEATHERING/ OXIDATION	FRACTURING	SWL (Date)/ WATER STRUCK	AIRLIFTED YIELD (L/s)	EC (µS/cm)	SOIL/ROCK SAMPLES	WATER SAMPLES	CONSTRUCTION DETAILS	COMMENTS
hard quartz, clear green dark grey mica, biotite, some pink , bright green minerals		86									85-88m. Mineralogy of granite/gneiss changed with each meter between blue, pink, green, grey minerals
Ca-Si altered (blue, green) gneiss		88									
		90									
hard, light yellow, brown, extremely fine-grained rock with some mica / apatite		92									High Geiger reading
hard, dark green moderately altered Ca-Si gneiss		94	Fe-staining								
as above, some Fe-staining											
hard, dark green, fine-grained Ca-Si altered gneiss (sugary texture)		96									
small band of apatite within Ca-Si altered gneiss, light-grey quartz with biotite		98									
gneiss		100									
		102									
		104									
dark grey, very fine-grained allanite		106									
		108									
		110									
		112									
		114									
		116				1.0					
		118					6,210				
EOH at 120m		120									
		122									
		124									
		126									

Well Screen
Sump

NOTE: This bore log is for environmental purposes only and is not intended to provide geotechnical information.

Legend
1) FR - Fresh rock
2) SW - Slightly weathered
3) MW - Moderately weathered
4) SW - Slightly weathered
5) RS - Residual rock

Hydrogeological Borehole Log

ENVIRONMENTAL EARTH SCIENCES
THE KNOW AND THE HOW

LOCATION Aileron, Northern Terriotory	**CLIENT** Arafura Resources	**PROJECT:** Nolans Bore Hydrogeological Investigation	**Logged by** KK
DATE COMMENCED 05/05/2010	**JOB NUMBER** 610012		
DATE COMPLETED 07/05/2010	**METHOD** RC	**BORE NO. NBGW814** **PAGE:** 1 of 3 **GPS** 22°34'43.72"S **COORD** 133°14'7.44"E	**Proj. Manager** MS
DRILLING COMPANY H2O	**DRILLER** Jarrod		

LITHOLOGICAL DESCRIPTION	DEPTH (M)	WEATHERING/ OXIDATION	FRACTURING	SWL (Date)/ WATER STRUCK	AIRLIFTED YIELD (L/s)	EC (µS/cm)	SOIL/ROCK SAMPLES	WATER SAMPLES	CONSTRUCTION DETAILS	COMMENTS
top soil. red, silty sand and gravel with rock fragments from weathered parent rock. Fe-staining (red), grey, dark rock, apatite, quartz	2	Fe-staining								
dary grey to black allanite, Fe-staining on quartz	4	Fe-staining								
green and brown apatite, slightly weathered rock	6	SW								
	8	SW								
hard, dark grey-black allanite with bands of green and brown apatite	10									
	12	SW								
brown and green apatite	14			07/05/10 (SWL TOC)						
brown and green apatite with bands of white mylonite, Fe-staining and some clear quartz	16			06/05/10 (mBGL)						
	18									
hard, brown, green and cream apatite with some kaolinite bands	20	SW							Bentonite	Water strike at 19mBGL Very low yield. <0.1L/s
hard and soft bands of brown, green and cream apatite, slightly weathered, light yellow-brown quartz, small bands of very soft, white kaolinite	22	SW								
hard, green and some cream apatite with some yellow, brown altered quartz	24									
	26									
green apatite and kaolinite and quartz	28									
	30									
brown apatite with koalinite and quartz	32									
	34									
brown apatite with some clear quartz and white kaolinite	36									
soft green apatite and slightly harder quartz		MW								
soft green apatite										
soft green apatite	38									
quartz, biotite, feldspar, some kaolinite and brown apatite	40									
green 'sugary' textured quartz, Ca-Si altered	42	Fe-staining							Gravel Pack	Quartz and gneiss type minerals beginning to appear

NOTE: This bore log is for environmental purposes only and is not intended to provide geotechnical information.

Legend
1) FR - Fresh rock
2) SW - Slightly weathered
3) MW - Moderately weathered
4) SW - Slightly weathered
5) RS - Residual rock

Hydrogeological Borehole Log

ENVIRONMENTAL EARTH SCIENCES
THE KNOW AND THE HOW

LOCATION Aileron, Northern Terriotory	**CLIENT** Arafura Resources	**PROJECT:** Nolans Bore Hydrogeological Investigation		**Logged by** KK
DATE COMMENCED 05/05/2010	**JOB NUMBER** 610012			
DATE COMPLETED 07/05/2010	**METHOD** RC	**BORE NO. NBGW814**	**PAGE:** 2 of 3	**GPS** 22°34'43.72"S **COORD** 133°14'7.44"E
DRILLING COMPANY H2O	**DRILLER** Jarrod			**Proj. Manager** MS

LITHOLOGICAL DESCRIPTION	DEPTH (M)	WEATHERING/ OXIDATION	FRACTURING	SWL (Date)/ WATER STRUCK	AIRLIFTED YIELD (L/s)	EC (µS/cm)	SOIL/ROCK SAMPLES	WATER SAMPLES	CONSTRUCTION DETAILS	COMMENTS
hard Fe-stained quartz with some green and brown apatite banding	44	HW								42-44m. Noticeable change in lithology
Fe-stained quartz, biotite, mica and feldspar (green)	46	Fe-staining								44m. Highly weathered zone. Soft cuttings, lots of mud/slurry in returns. Possible contact zone
gneiss with variable proportions of Fe-stained, clear and pink quartz, biotite feldspar	48									
	50									
	52									
gneiss with variable proportions of Fe-stained, clear and pink quartz, biotite feldspar with light green, 'sugary' Ca-Si altered gneiss	54									
gneiss and slightly altered quartz and white mylonite	56									
gneiss with increasing biotite	58									
gneiss with fe-stained quartz	60	Fe-stained								
gneiss with fragments of quartz, feldspar and biotite	62									
	64									
gneiss with Ca-Si	66	Fe-staining								
gneiss with fe-staining										
gneiss	68									
	70									
gneiss with Ca-Si										
gneiss	72					5,820				Drilling rate increased. Softer zone
	74									
	76									
	78									
gneiss with very high biotite and mica content (black, shiny, flaky)	80									Slightly softer drilling. High concentration of biotite and mica in samples after content washing out in sieve (biotite)
	82									
	84									

Gravel Pack

Well Screen

NOTE: This bore log is for environmental purposes only and is not intended to provide geotechnical information.

Legend
1) FR - Fresh rock
2) SW - Slightly weathered
3) MW - Moderately weathered
4) SW - Slightly weathered
5) RS - Residual rock

Hydrogeological Borehole Log

ENVIRONMENTAL EARTH SCIENCES
THE KNOW AND THE HOW

LOCATION Aileron, Northern Terriotory	**CLIENT** Arafura Resources	**PROJECT:** Nolans Bore Hydrogeological Investigation			**Logged by** KK
DATE COMMENCED 05/05/2010	**JOB NUMBER** 610012				
DATE COMPLETED 07/05/2010	**METHOD** RC	**BORE NO. NBGW814**	**PAGE:** 3 of 3	**GPS** 22°34'43.72"S **COORD** 133°14'7.44"E	**Proj. Manager** MS
DRILLING COMPANY H2O	**DRILLER** Jarrod				

LITHOLOGICAL DESCRIPTION	GRAPHIC LOG	DEPTH (M)	WEATHERING/ OXIDATION	FRACTURING	SWL (Date)/ WATER STRUCK	AIRLIFTED YIELD (L/s)	EC (µS/cm)	SOIL/ROCK SAMPLES	WATER SAMPLES	CONSTRUCTION DETAILS	COMMENTS
gneiss with very high biotite and mica content (black, shiny, flaky) and very high biotite content		86 88 90					5,600				27.3 °C Still hard, slow drilling
gneiss with very high biotite and mica content (black, shiny, flaky). Biotite content slightly lower, very fine-grained		92 94 96 98 100 102								Well Screen 'Sump'	
EOH at 102.4mBGL		104 106 108 110 112 114 116 118 120 122 124 126									Bore development commenced on 07/05/10 at 10:25am 07/05/10 Duration of airlift = 30mins. Water became clear of sediment. Airlift rate #1 = 0.5L/s at 10:30am Airlift rate #2 = 0.454L/s at 11:00am EC #1 = 5,830 µS/cm EC #2 = 6,000 µS/cm SWL after development = 14.22m (most likely still recovering)

NOTE: This bore log is for environmental purposes only and is not intended to provide geotechnical information.

Legend
1) FR - Fresh rock
2) SW - Slightly weathered
3) MW - Moderately weathered
4) SW - Slightly weathered
5) RS - Residual rock

Hydrogeological Borehole Log

ENVIRONMENTAL EARTH SCIENCES
THE KNOW AND THE HOW

LOCATION Aileron, NT	**CLIENT** Arafura Resources	**PROJECT:** Nolans Bore Hydrogeologiccal Investigation		**Logged by** KK / YY
DATE COMMENCED 07/05/2010	**JOB NUMBER** 610012			
DATE COMPLETED 09/05/2010	**METHOD** RC	**BORE NO. NBGW815**	**PAGE:** 1 of 3	**GPS COORD** 22°34'42.50"S 133°14'13.59"E
DRILLING COMPANY H2O	**DRILLER** Trevor			**Proj. Manager** MS

LITHOLOGICAL DESCRIPTION	DEPTH (M)	WEATHERING/ OXIDATION	FRACTURING	SWL (Date)/ WATER STRUCK	AIRLIFTED YIELD (L/s)	EC (µS/cm)	SOIL/ROCK SAMPLES	WATER SAMPLES	CONSTRUCTION DETAILS	COMMENTS
top soil, red silty sand and parent rock (20-50mm)		Fe-staining								
red and brown apatite. Fe-staining	2									
brown apatite, slightly weathered										
green, blue apatite (very fine grained)	4	SW								
green, blue and cream apatite	6	SW								
massive green apatite										
green apatite with some Fe-staining	8	SW								
green and brown apatite										
green and brown apatite with traces of mylonite	10									
hard green and brown apatite										
soft white mylonite and brown green apatite	12			08/05/2010						13-14m. Cuttings becoming moist
brown green apatite with some Fe-staining	14	SW								Approx. SWL TOC 1hr after airlift
soft white mylonite and some remnant quartz, soft to hard green and brown apatite	16	SW DW								
brown apatite	18									
brown apatite with minor mylonite	20								Bentonite	
soft, puggy, light green-white mylonite and green apatite	22	DW		08/05/2010						Cuttings becoming moist)no water but cold, wet and weathered cuttings present)
white, cream mylonite and deeply weathered clear quartz with soft brown apatite	24 26									
brown apatite		SW								
brown apatite	28	DW								
cream and brown apatite	30									High Geiger reading
brown apatite, slightly weathered, 'puggy/	32 34	SW							Gravel Pack	
white, soft mylonite with some clear quartz, some Ca-Si alteration	36					5,600				
mylonite and quartz and some brown apatite										
clear quartz and white mylonite with Fe-stained quartz banding	38			08/05/2010						
white mylonite, some quartz, minor cream apatite	40									High volume of water encountered. Possible aquifer
	42									

NOTE: This bore log is for environmental purposes only and is not intended to provide geotechnical information.

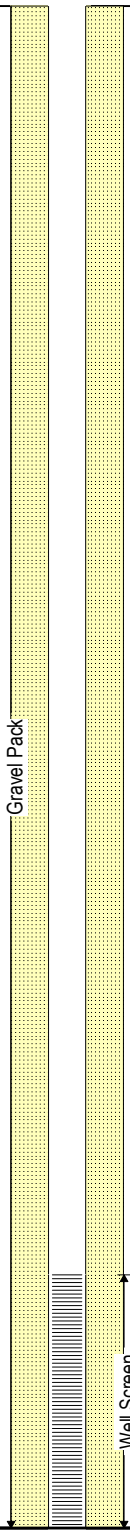
Legend
1) FR - Fresh rock
2) SW - Slightly weathered
3) MW - Moderately weathered
4) SW - Slightly weathered
5) RS - Residual rock

Hydrogeological Borehole Log

ENVIRONMENTAL EARTH SCIENCES
THE KNOW AND THE HOW

LOCATION Aileron, NT	**CLIENT** Arafura Resources	**PROJECT:** Nolans Bore Hydrogeologiccal Investigation			**Logged by** KK / YY
DATE COMMENCED 07/05/2010	**JOB NUMBER** 610012				
DATE COMPLETED 09/05/2010	**METHOD** RC	**BORE NO. NBGW815**	**PAGE:** 2 of 3	**GPS** 22°34'42.50"S **COORD** 133°14'13.59"E	**Proj. Manager** MS
DRILLING COMPANY H2O	**DRILLER** Trevor				

LITHOLOGICAL DESCRIPTION	DEPTH (M)	WEATHERING/ OXIDATION	FRACTURING	SWL (Date)/ WATER STRUCK	AIRLIFTED YIELD (L/s)	EC (µS/cm)	SOIL/ROCK SAMPLES	WATER SAMPLES	CONSTRUCTION DETAILS	COMMENTS
soft mylonite with Fe-staining, some green and brown apatite		Fe-staining								
white mylonite with Fe-banding, clear quartz and soft brown apatite	44									
	46									
	48									
white mylonite with Fe-banding, clear quartz and soft brown apatite with some Ca-Si alteration, increasing apatite content	50	SW								Cuttings slightly drier
distinctly weathered brown apatite with Fe-stained mylonite	52	Fe-staining								
very soft green, brown apatite with Fe-staining	54	Fe-staining								
clear quartz banded mylonite with brown Fe-staining. Very pale light green, very fine grained and banded with quartz fabric.	56	Fe-staining								
	58									
clear quartz with soft white mylonite banding	60									Possible boundary. Much drier cuttings and harder rock
	62									
	64									
light blue, green Ca-Si altered gneiss with some Fe-staining	66	Fe-staining								85m. Significant change in lithology - more competent, fine-grained rock
	68					5,790				
Purple, light blue brown, fine grained, slightly-weathered to distinctly-weathered apatite	70	SW - DW								
	72									
hard, light green-grey, Ca-Si altered gneiss slight grey and clear quartz	74									
hard, clear to yellow , grey quartz with some Fe-staining	76	Fe-staining								
gneiss - quartz, black biotite and feldspar, some Ca-Si alteration	78									
brown, green biotite gneiss and light green, grey clear quartz, slightly weathered	80									Very hard drilling
	82	SW				5,880				
hard, dark grey quartz and feldspar (gneiss), moderately Ca-Si altered with high Fe-staining	84	Fe-staining								84m. Driller noticed fracturing / broken rocks



NOTE: This bore log is for environmental purposes only and is not intended to provide geotechnical information.

Legend
1) FR - Fresh rock
2) SW - Slightly weathered
3) MW - Moderately weathered
4) SW - Slightly weathered
5) RS - Residual rock

Hydrogeological Borehole Log

ENVIRONMENTAL EARTH SCIENCES
THE KNOW AND THE HOW

LOCATION Aileron, NT	**CLIENT** Arafura Resources	**PROJECT:** Nolans Bore Hydrogeologiccal Investigation			**Logged by** KK / YY
DATE COMMENCED 07/05/2010	**JOB NUMBER** 610012				
DATE COMPLETED 09/05/2010	**METHOD** RC	**BORE NO. NBGW815**	**PAGE:** 3 of 3	**GPS** 22°34'42.50"S **COORD** 133°14'13.59"E	**Proj. Manager** MS
DRILLING COMPANY H2O	**DRILLER** Trevor				

LITHOLOGICAL DESCRIPTION	GRAPHIC LOG	DEPTH (M)	WEATHERING/ OXIDATION	FRACTURING	SWL (Date)/ WATER STRUCK	AIRLIFTED YIELD (L/s)	EC (µS/cm)	SOIL/ROCK SAMPLES	WATER SAMPLES	CONSTRUCTION DETAILS	COMMENTS
as above, with high Fe-staining		86	Fe-staining								
very hard green grey Ca-Si altered gneiss, clear and light grey quartz		88									
gneiss (quartz, biotite, pink quartz), some Ca-Si chlorite-epidote altered quartz		90									
very hard gneiss (quartz, mica, biotite, green Ca-Si altered quartz)		92 94 96 98				<0.5	5,560			Well Screen	
gneiss (quartz, light green Ca-Si altered quartz)		100 102									
gneiss with less Ca-Si (green), more biotite (black)		104 106 108								Sump	
EOH at 108.6m		110 112 114 116 118 120 122 124 126									Bore development EC # 1 = 5,680 µS/cm at 28.9°C EC # 2 = 6,300 µS/cm at 26.0°C Airlift rate # 1 = 0.55L/s Airlift rate # 2 = 0.50L/s Approx. SWL 1hr after airlift = 13.75 m TOC (Casing depth will change when completed)

NOTE: This bore log is for environmental purposes only and is not intended to provide geotechnical information.

Legend
1) FR - Fresh rock
2) SW - Slightly weathered
3) MW - Moderately weathered
4) SW - Slightly weathered
5) RS - Residual rock

Hydrogeological Borehole Log

ENVIRONMENTAL EARTH SCIENCES
THE KNOW AND THE HOW

LOCATION Aileron, Northern Terriotory	**CLIENT** Arafura Resources	**PROJECT:** Nolans Bore Hydrogeological Investigation		**Logged by** KK / YY / AK
DATE COMMENCED 09/05/2010	**JOB NUMBER** 610012			
DATE COMPLETED 13/05/2010	**METHOD** RC	**BORE NO. NBGW816**	**PAGE:** 1 of 3	**GPS** 22°34'38.68"S **COORD** 133°14'13.98"E
DRILLING COMPANY H2O	**DRILLER** Trevor			**Proj. Manager** MS

LITHOLOGICAL DESCRIPTION	GRAPHIC LOG	DEPTH (M)	WEATHERING/ OXIDATION	FRACTURING	SWL (Date)/ WATER STRUCK	AIRLIFTED YIELD (L/s)	EC (µS/cm)	SOIL/ROCK SAMPLES	WATER SAMPLES	CONSTRUCTION DETAILS	COMMENTS
red sandy silt with parent rock up to 100mm in diameter, fragments of quartz and feldspar		2	FR								
hard biotite gneiss (cream, pink quartz, biotite, some feldspar) Fe-staining		4	Fe-staining								
		6									
		8									
		10			8:00am 14/05/2010						
hard biotite gneiss (cream, pink quartz, biotite, some feldspar)		12									
		14									
hard biotite gneiss (cream, pink quartz, biotite, some feldspar) with some mica (muscovite)		16	FR								
hard biotite gneiss (cream, pink quartz, biotite, some feldspar) Fe-staining with sulphid / sulfidic minerals veining (1mm thick)		18								Bentonite	
hard biotite gneiss (white quartz, biotite, feldspar)		20									
hard, dark-grey mafic, fine-grained rock with yellow veining (gold coloured), 1mm think, high lusture (shiny), some Ca-Si alteration, quartz bands. Sulphide / sulfidic mineral has a cubic shape		22									
hard biotite gneiss (cream, pink quartz, biotite, some feldspar) Fe-staining, dark and light coloured banded		24									
		26									
		28									
		30								Gravel Pack	
hard biotite gneiss (cream, pink quartz, biotite, some feldspar) Fe-staining, dark and light coloured bande, more Fe-staining		32	Fe-staining		10/05/2010						Fe-staining on cutting faces, appears more 'broken-up' - possibly associated with water inflow
		34					6,200 @ 35.9°C				
		36	Fe-staining			<0.1					Driller noted rocks were very 'notchy' (broken-up, as seen in cuttings). A lot of Fe-staining on faces
		38									
Slight Ca-Si alteration on some quartz, yellow-veining (cubic shape) <0.5mm in size		40	Fe-staining								
Gneiss, some light green alteration with high Fe-staining		42	FR								

NOTE: This bore log is for environmental purposes only and is not intended to provide geotechnical information.

Legend
1) FR - Fresh rock
2) SW - Slightly weathered
3) MW - Moderately weathered
4) SW - Slightly weathered
5) RS - Residual rock

Hydrogeological Borehole Log

ENVIRONMENTAL EARTH SCIENCES
THE KNOW AND THE HOW

LOCATION Aileron, Northern Terriotory	**CLIENT** Arafura Resources	**PROJECT:** Nolans Bore Hydrogeological Investigation		**Logged by** KK / YY / AK
DATE COMMENCED 09/05/2010	**JOB NUMBER** 610012			
DATE COMPLETED 13/05/2010	**METHOD** RC	**BORE NO. NBGW816**	**PAGE:** 2 of 3	**GPS** 22°34'38.68"S **COORD** 133°14'13.98"E
DRILLING COMPANY H2O	**DRILLER** Trevor			**Proj. Manager** MS

LITHOLOGICAL DESCRIPTION	GRAPHIC LOG	DEPTH (M)	WEATHERING/ OXIDATION	FRACTURING	SWL (Date)/ WATER STRUCK	AIRLIFTED YIELD (L/s)	EC (µS/cm)	SOIL/ROCK SAMPLES	WATER SAMPLES	CONSTRUCTION DETAILS	COMMENTS
gneiss with white quartz, biotite, feldspar			Fe-staining								
gneiss with pink quartz, sliver / gold veining		44									
		46									
		48		F			6,040 @ 31.9°C				Possibily high water bearing zone - rock very broken up, wetter zone
		50									
green and brown apatite, softer (still competent), some Fe-staining in faces		52	Fe-staining SW								Distinct boundary
brown and green apatite		54									
cream and brown apatite with minor quartz		56					6,070 @ 29.2 °C				
cream and brown apatite with quartz and allanite		58									
cream and green apatite with quartz, green epidote and dark grey allanite		60	Fe-staining								
gneiss with Fe-staining											
altered gneiss with apatite and some epidote		62	Fe-staining								
gneiss with minor Fe-staining and some epidote		64									
gneiss		66									
gneiss with dark grey/black allanite, minor Ca-Si alteration (green)		68									
quartz-rich gneiss											
gneiss with moderate Ca-Si alteration		70									
cream apatite		72									
gneiss with moderate Ca-Si alteration		74									
gneiss with cream apatite		76									
gneiss with grey allanite and some epidote		78									
gneiss with cream apatite		80									
altered gienss with cream apatite		82									
cream apatite											
gneiss with cream apatite		84									

Gravel Pack

NOTE: This bore log is for environmental purposes only and is not intended to provide geotechnical information.

Legend
1) FR - Fresh rock
2) SW - Slightly weathered
3) MW - Moderately weathered
4) SW - Slightly weathered
5) RS - Residual rock

Hydrogeological Borehole Log

ENVIRONMENTAL EARTH SCIENCES
THE KNOW AND THE HOW

LOCATION Aileron, Northern Terriotory	**CLIENT** Arafura Resources	**PROJECT:** Nolans Bore Hydrogeological Investigation			**Logged by** KK / YY / AK
DATE COMMENCED 09/05/2010	**JOB NUMBER** 610012				
DATE COMPLETED 13/05/2010	**METHOD** RC	**BORE NO. NBGW816**	**PAGE:** 3 of 3	**GPS** 22°34'38.68"S **COORD** 133°14'13.98"E	**Proj. Manager** MS
DRILLING COMPANY H2O	**DRILLER** Trevor				

LITHOLOGICAL DESCRIPTION	GRAPHIC LOG	DEPTH (M)	WEATHERING/ OXIDATION	FRACTURING	SWL (Date)/ WATER STRUCK	AIRLIFTED YIELD (L/s)	EC (µS/cm)	SOIL/ROCK SAMPLES	WATER SAMPLES	CONSTRUCTION DETAILS	COMMENTS
green apatite with minor gneiss		92									slightly softer drililng - still competent rock
gneiss		94									
		96				0.5-1.0					
		98									
		100									
		102									
colourless mineral with orthorhombic symmetry, soft, glassy, with 5% apatite		104									
green apatite and gneiss		106									
		108									
		110									Bore development 13/05/2010 Duration of airlift = 30 mins EC after 15 mins = 6,400 µS/cm at 26.5°C; discharge = 0.4L/s EC after 25 mins = 6,500 µS/cm at 26.9°C; discharge = 0.416L/s
		112									
		114									
		116									
		118									
		120								Well Screen 'Sump'	
EOH at 121.0m		122									
		124									
		126									

NOTE: This bore log is for environmental purposes only and is not intended to provide geotechnical information.

Legend
1) FR - Fresh rock
2) SW - Slightly weathered
3) MW - Moderately weathered
4) SW - Slightly weathered
5) RS - Residual rock

Hydrogeological Borehole Log

ENVIRONMENTAL EARTH SCIENCES
THE KNOW AND THE HOW

LOCATION Aileron, NT	**CLIENT** Arafura Resources	**PROJECT:** Nolans Bore Hydrogeological Investigation		**Logged by** AK
DATE COMMENCED 14/05/2010	**JOB NUMBER** 610012			
DATE COMPLETED 15/05/2010	**METHOD** RC	**BORE NO. NBGW817**	**PAGE:** 1 of 3	**GPS** 22°34'42.91"S **COORD** 133°14'11.98"E	**Proj. Manager** MS
DRILLING COMPANY H2O	**DRILLER** Trevor			

LITHOLOGICAL DESCRIPTION	GRAPHIC LOG	DEPTH (M)	WEATHERING/ OXIDATION	FRACTURING	SWL (Date)/ WATER STRUCK	AIRLIFTED YIELD (L/s)	EC (µS/cm)	SOIL/ROCK SAMPLES	WATER SAMPLES	CONSTRUCTION DETAILS	COMMENTS
red sandy clayey silt with quartz fragments											
white mylonite with quartz lenses		2									
		4									
green and cream weathered apatite / mylonite with minor quartz		6									high Geiger reading
white mylonite / kaolinite with residual quartz		8									
		10									
light green and cream apatite with residual quartz and brown clay. hard		12	brown clay								high Geiger reading
		14									
light green and cream apatite with residual quartz and less clay		16	Fe-staining								
weathered green apatite		18									
cream and green apatite		20									
cream and green apatite with quartz lenses		22									
brown and cream and green apatite		24									
white altered rock with kaolinite, quartz and apatite		26	Fe-staining								
white kaolanite with soft, green apatite		28			14/05/2010						
hard, white mylonite with quartz lenses		30									
white mylonite with green apatite		32									
brown apatite with fragments of clay and quartz		34									high Geiger reading dry
white mylonite		36									
green and white altered mylonite with clay											
brown and green apatite with clay		38									
brown apatite		40		inflow zone. 1-2L/s							
green apatite with brown clay		42	brown clay								

NOTE: This bore log is for environmental purposes only and is not intended to provide geotechnical information.

Legend
1) FR - Fresh rock
2) SW - Slightly weathered
3) MW - Moderately weathered
4) SW - Slightly weathered
5) RS - Residual rock

Hydrogeological Borehole Log

ENVIRONMENTAL EARTH SCIENCES
THE KNOW AND THE HOW

LOCATION Aileron, NT	**CLIENT** Arafura Resources	**PROJECT:** Nolans Bore Hydrogeological Investigation			**Logged by** AK
DATE COMMENCED 14/05/2010	**JOB NUMBER** 610012				
DATE COMPLETED 15/05/2010	**METHOD** RC	**BORE NO. NBGW817**	**PAGE:** 2 of 3	**GPS** 22°34'42.91"S **COORD** 133°14'11.98"E	**Proj. Manager** MS
DRILLING COMPANY H2O	**DRILLER** Trevor				

LITHOLOGICAL DESCRIPTION	GRAPHIC LOG	DEPTH (M)	WEATHERING/ OXIDATION	FRACTURING	SWL (Date)/ WATER STRUCK	AIRLIFTED YIELD (L/s)	EC (µS/cm)	SOIL/ROCK SAMPLES	WATER SAMPLES	CONSTRUCTION DETAILS	COMMENTS
green and brown apatite with brown clay											
altered green and brown apatite with minor clay		44	brown clay RS								
		46									almost dry
		48	RS brown clay								high Geiger reading
		50									very high Geiger reading (10mSv/h)
		52	brown clay RS								
cream and brown apatite with quartz		54									
		56									
		58									
		60									
green and brown apatite		62		inflow zone. 0.5L/s							61-63m inflow zone. 0.5L/s yield.
		64									
		66									
gneiss		68									
		70									
		72									
		74									
		76									
		78									
		80									
		82									
gneiss with cream apatite		84									high Geiger reading

NOTE: This bore log is for environmental purposes only and is not intended to provide geotechnical information.

Legend
1) FR - Fresh rock
2) SW - Slightly weathered
3) MW - Moderately weathered
4) SW - Slightly weathered
5) RS - Residual rock

Hydrogeological Borehole Log

ENVIRONMENTAL EARTH SCIENCES
THE KNOW AND THE HOW

LOCATION Aileron, NT	**CLIENT** Arafura Resources	**PROJECT:** Nolans Bore Hydrogeological Investigation			**Logged by** AK
DATE COMMENCED 14/05/2010	**JOB NUMBER** 610012				
DATE COMPLETED 15/05/2010	**METHOD** RC	**BORE NO. NBGW817**	**PAGE:** 3 of 3	**GPS** 22°34'42.91"S **COORD** 133°14'11.98"E	**Proj. Manager** MS
DRILLING COMPANY H2O	**DRILLER** Trevor				

LITHOLOGICAL DESCRIPTION	GRAPHIC LOG	DEPTH (M)	WEATHERING/ OXIDATION	FRACTURING	SWL (Date)/ WATER STRUCK	AIRLIFTED YIELD (L/s)	EC (µS/cm)	SOIL/ROCK SAMPLES	WATER SAMPLES	CONSTRUCTION DETAILS	COMMENTS
green gneiss with minor apatite and epidote											
gneiss with green alteration		86									
green altered gneiss with quartz											
green altered gienss, brown apatite		88									10mSv/h Geiger reading
cream apatite											
green gienss with cream apatite		90									
altered green gneiss with minor cream apatite											
green gneiss with minor apatite		92									10mSv/h Geiger reading
altered green gneiss with minor cream apatite											
green gienss with feldspar		94									
		96									
		98									
gneiss with cream apatite											
gneiss with fragments of feldspar and biotite		100		dry							
		102									
gneiss		104									
gneiss with ore mineral grains		106									
gneiss with iron-staining			Fe-staining								
gneiss		108		1L/s							
gneiss with iron-staining		110	Fe-staining								
gneiss		112									
gneiss with green alteration and ore mineral grains		114									
gneiss with brown apatite, epidote, feldspar, sulfide mineral grains		116		1-2L/s							
gneiss with biotite pegmatites, feldspar, quartz		118									
		120								Bentonite, Gravel Pack, Well Screen, Sump	
EOH at 120.4 m		122									
		124									
		126									

NOTE: This bore log is for environmental purposes only and is not intended to provide geotechnical information.

Legend
1) FR - Fresh rock
2) SW - Slightly weathered
3) MW - Moderately weathered
4) SW - Slightly weathered
5) RS - Residual rock

Hydrogeological Borehole Log

ENVIRONMENTAL EARTH SCIENCES
THE KNOW AND THE HOW

LOCATION Aileron, NT	**CLIENT** Arafura Resources	**PROJECT:** Nolans Bore Hydrogeological Investigation			**Logged by** JS
DATE COMMENCED 16/5/10	**JOB NUMBER** 610012				
DATE COMPLETED 21/5/10	**METHOD** RC	**BORE NO. NBGW818**	**PAGE:** 1 of 3	**GPS** 22°34'40.95"S **COORD** 133°14'14.13"E	**Proj. Manager** MS
DRILLING COMPANY H2O	**DRILLER** Trevor				

LITHOLOGICAL DESCRIPTION	GRAPHIC LOG	DEPTH (M)	WEATHERING/ OXIDATION	FRACTURING	SWL (Date)/ WATER STRUCK	AIRLIFTED YIELD (L/s)	EC (µS/cm)	SOIL/ROCK SAMPLES	WATER SAMPLES	CONSTRUCTION DETAILS	COMMENTS
red- brown sandy silt, subangular quartz gravel, minor brown apatite		2									
heavily weathered gneiss with minor red-brown, white, grey,weathered apatite		4									
heavily weathered gneiss with kaolinite lense		6									
		8									
heavily weathered gneiss with larger apatite lense		10									
		12			22/05/2010						
		14									
heavily weathered gneiss with kaolinite lenses with quartz, very soft biotite, micaceous clays		16									
		18									
kaolinite and grey micaceous clays		20									
weathered gneiss, predominantly quartz with biotite		22									
		24									
		26									
		28									
		30									
		32									
		34			16/05/2010						
weathered gneiss with possible Ca-Si alteration clayey		36									
brown apatite with approx. 40% quartz		38									Water strike. Yield was less than 0.1L/s
		40									
		42									

NOTE: This bore log is for environmental purposes only and is not intended to provide geotechnical information.

Legend
1) FR - Fresh rock
2) SW - Slightly weathered
3) MW - Moderately weathered
4) SW - Slightly weathered
5) RS - Residual rock

Hydrogeological Borehole Log

ENVIRONMENTAL EARTH SCIENCES
THE KNOW AND THE HOW

LOCATION Aileron, NT	**CLIENT** Arafura Resources	**PROJECT:** Nolans Bore Hydrogeological Investigation		**Logged by** JS
DATE COMMENCED 16/5/10	**JOB NUMBER** 610012			
DATE COMPLETED 21/5/10	**METHOD** RC	**BORE NO. NBGW818**	**PAGE:** 2 of 3	**GPS** 22°34'40.95"S **COORD** 133°14'14.13"E
DRILLING COMPANY H2O	**DRILLER** Trevor			**Proj. Manager** MS

LITHOLOGICAL DESCRIPTION	GRAPHIC LOG	DEPTH (M)	WEATHERING/ OXIDATION	FRACTURING	SWL (Date)/ WATER STRUCK	AIRLIFTED YIELD (L/s)	EC (µS/cm)	SOIL/ROCK SAMPLES	WATER SAMPLES	CONSTRUCTION DETAILS	COMMENTS
kaolinitic , weathered clayey brown apatite		44									
gneiss with minor Fe-staining		46	Fe-staining								Hard drilling
		48									
		50									
		52									
		54									
		56									
		58									
		60									
		62									
		64									
		66			16/05/2010					Bentonite	
gneiss with extensive weathering, fractures, fragments of grey clay		68	MW	F							
brown apatite with 30% quartz		70									Soft drilling
		72									
brown apatite with approx. 30% kaolanitic clay		74									
brown apatite with traces of weathering, iron-staining											
heavily weathered, clayey brown apatite		76									
cream apatite		78								Gravel Pack / Well Screen	
heavily weathered, clayey, brown, white apatite		80									
blue-brown apatite		82									
		84									

NOTE: This bore log is for environmental purposes only and is not intended to provide geotechnical information.

Legend
1) FR - Fresh rock
2) SW - Slightly weathered
3) MW - Moderately weathered
4) SW - Slightly weathered
5) RS - Residual rock

Hydrogeological Borehole Log

ENVIRONMENTAL EARTH SCIENCES
THE KNOW AND THE HOW

LOCATION Aileron, NT	**CLIENT** Arafura Resources	**PROJECT:** Nolans Bore Hydrogeological Investigation			**Logged by** JS
DATE COMMENCED 16/5/10	**JOB NUMBER** 610012				
DATE COMPLETED 21/5/10	**METHOD** RC	**BORE NO. NBGW818**	**PAGE:** 3 of 3	**GPS** 22°34'40.95"S **COORD** 133°14'14.13"E	**Proj. Manager** MS
DRILLING COMPANY H2O	**DRILLER** Trevor				

LITHOLOGICAL DESCRIPTION	GRAPHIC LOG	DEPTH (M)	WEATHERING/ OXIDATION	FRACTURING	SWL (Date)/ WATER STRUCK	AIRLIFTED YIELD (L/s)	EC (µS/cm)	SOIL/ROCK SAMPLES	WATER SAMPLES	CONSTRUCTION DETAILS	COMMENTS
heavily Fe-stained apatite fragments of white kaolinite within apatite		86 88 90			21/05/2010						
gneiss with traces of apatite and Ca-Si altered. Soil became harder with depth		92 94 96								Sump	Water strike at 91-97m
EOH at 97m		98 100 102 104 106 108 110 112 114 116 118 120 122 124 126									

NOTE: This bore log is for environmental purposes only and is not intended to provide geotechnical information.

Legend
1) FR - Fresh rock
2) SW - Slightly weathered
3) MW - Moderately weathered
4) SW - Slightly weathered
5) RS - Residual rock

APPENDIX B GEOLOGICAL BORELOGS – ABSTRACTION BORE

Hydrogeological Borehole Log

ENVIRONMENTAL EARTH SCIENCES
THE KNOW AND THE HOW

LOCATION	**CLIENT** Arafura	**PROJECT:** Nolans Bore Hydrogeological Investigation		**Logged by** KK
DATE COMMENCED 4/3/11	**JOB NUMBER** 610012			
DATE COMPLETED	**METHOD** Hammer	**BORE NO. NBGW819**	**PAGE:** 1 of 2 **COORDINATES**	**Proj. Manager** MS
DRILLING COMPANY H20	**DRILLER** Jack Quinn			

LITHOLOGICAL DESCRIPTION	GRAPHIC LOG	DEPTH (M)	WEATHERING/ OXIDATION	FRACTURING	SWL (Date)/ WATER STRUCK	AIRLIFTED YIELD	EC	SOIL/ROCK SAMPLES	WATER SAMPLES	CONSTRUCTION DETAILS	COMMENTS
NATURAL Loose, rubbly apatite & quartz in silty sandy matrix		2 4 6 8									Cemented 12" steel collar to 6 m 10" RC down hole hammer 8" mild steel casing 4-6 mm diameter gravel pack to surface
Hard, slightly weathered brown and grey apatite		10									
Brown and green banded apatite, no weathering		12 14 16 18 20			1.5L/s		5,045 us/cm				Water strike, wet samples, water flowed out at 15 m
Massive brown and green apatite with some white mylonite		22 24 26			ATD	10L/s 10L/s					Water strike at 21 m Vertical single slotted mild steel casing Air lifting hole for 20 minutes, flow increased
Brown apatite, some mylonite, iron oxide staining		28									Vertical double slotted mild steel casing
Massive brown apatite, some cream apatite bands		30 32 34				13L/s	4,549 us/cm				

NOTE: This bore log is for environmental purposes only and is not intended to provide geotechnical information.

Hydrogeological Borehole Log

ENVIRONMENTAL EARTH SCIENCES
THE KNOW AND THE HOW

LOCATION	**CLIENT** Arafura	**PROJECT:** Nolans Bore Hydrogeological Investigation		**Logged by** KK
DATE COMMENCED 4/3/11	**JOB NUMBER** 610012			
DATE COMPLETED	**METHOD** Hammer	**BORE NO. NBGW819**	**PAGE:** 2 of 2 **COORDINATES**	**Proj. Manager** MS
DRILLING COMPANY H20	**DRILLER** Jack Quinn			

LITHOLOGICAL DESCRIPTION	GRAPHIC LOG	DEPTH (M)	WEATHERING/ OXIDATION	FRACTURING	SWL (Date)/ WATER STRUCK	AIRLIFTED YIELD	EC	SOIL/ROCK SAMPLES	WATER SAMPLES	CONSTRUCTION DETAILS	COMMENTS
Brown apatite with mylonite, some iron oxide staining		37					4,549 us/cm				
		39									
Massive brown apatite with some mylonite		41				14L/s					
		43									
Hard, brittle brown apatite with kaolinite and some bands of cream apatite		45									
Massive brown apatite with some allanite or dark faces (alteration on some fragments)		47									Vertical single slotted mild steel casing
		49									Colour change in water
Brown apatite, kaolinite, clear quartz (<5%), dark rock (allanite?)		51									
Brown apatite, bands of kaolinite		53									
		55									
Clear and milky quartz, kaolinite and mylonite with some brown apatite bands		57					5,715 us/cm				
		59									Vertical double slotted mild steel casing
White kaolinite, clear and milky quartz, some mylonite altered quartz		61				18L/s					
Hard band of quartz						20L/s					
Softer, fractured rock, slightly weathered		63									
Banded clear quartz with darker bands of allanite, dark hard allanite, possible gniess											
Grey-green banded gneiss with quartz veining, minor brown apatite. Biotite within gniess		65									
Hard grey-green gniess, quartz and some mylonite		67									Harder drilling
		69									EOH @ 70.0 mBGL (NBRC188)

NOTE: This bore log is for environmental purposes only and is not intended to provide geotechnical information.

APPENDIX C AQUIFER TESTING LETTER REPORT (610012 L1, 2010)

ENVIRONMENTAL EARTH SCIENCES
THE KNOW AND THE HOW

11 June 2010

Arafura Resources Ltd.
18 Menmuir Street
WINNELLIE NT 0820

Attention: **Brian Fowler**
Manager Sustainability

Dear Brian

Work progress report for hydrogeological open pit de-watering investigation at Nolan's Bore, via Aileron, NT

This letter report outlines the work that has been conducted by Environmental Earth Sciences as part of the hydrogeological open pit de-watering investigation at Nolan's Bore in Aileron, NT (Figure 1 in Attachment 1). It also provides some preliminary aquifer testing data and analysis which was conducted at the site. Also included in this report are the draft bore logs of the nine (9) monitoring bores currently drilled (Attachment 2), and some raw data from the aquifer testing and the subsequent analysis (Attachment 3). Attachment 1 contains figures including topographical features, and conceptual site cross sections across the proposed first stage pit site.

1.0 Introduction

During the field work component (22 April – 21 May 2010), Environmental Earth Sciences undertook the supervision of the drilling and construction of nine groundwater monitoring bores for the purpose of the de-watering investigation. The location of the drilled bores is shown in Figure 2, with a number of previously drilled exploration bores also provided for reference and to assist in development of the conceptual site hydrogeological model.

In addition to the drilling supervision, numerous hydraulic tests were undertaken on the drilled bores as well as pre-existing exploration bores that were deemed as competent and representative of the underlying aquifer(s). The data obtained from the testing was subsequently analysed and the findings are summarised below, with some raw data and interpretation provided in Attachment 3.

2.0 Objectives of drilling program (installation of monitoring bores)

This section provides a brief outline of the objectives of the drilling program. Details of the drilling and construction are provided in the following sections and bore logs and piezometer construction diagrams are provided in appended attachments. The objective of the in-pit drilling program is to provide fundamental and stratigraphic data to assist in the development of the conceptual hydrogeological model and provide data for analytical interpretation. This in turn will allow for dewatering design based on proposed development of the pit during mining operations.

Other objectives include proving an appropriate number and distribution of bores to be able to:

- define the extent of the drawdown cone created during pumping from the abstraction bore at a constant discharge rate and define the geometry, anisotropy and hydraulics of the **aquifer(s)** within the pit area; and
- assess drawdown in the **aquitard** (gneiss) and other possible boundary conditions during the pumping test and enable calculation of aquitard parameters.

3.0 Scope of Phase 1 drilling program

The first component of the drilling program for Nolan's Bore comprised the installation of nine monitoring bores, drilled to depths between 90.4 and 120 metres below ground level (m BGL). Subsequent phases will include the installation and development of the abstraction bore, and the eight day pumping and recovery test.

4.0 Bore construction

Bore depths were based on the geology encountered at that individual location. Bores were designed and constructed to conform to the *Minimum Construction Requirements for Water Bores in Australia* (LWBC, 2003). The bore design ensured that the aquifer to be monitored was sealed from any overlying aquifers, and all bores were constructed using 50mm diameter Class 18 uPVC casing and screen.

The bores were intentionally terminated at specific depths to achieve representative aquifer inflow rates, either as an average for the entire depth, or for separate aquifers/ aquitards.

The boreholes were screened across the aquifers/ aquitards as follows:

- Apatite – NBGW812, NBGW818;
- Gneiss – NBGW813, NBGW 816 and NBGW817; and
- Entire saturated area (apatite and gneiss) – NBGW810 (predominantly apatite), NBGW811 (predominantly gneiss), NBGW814 (predominantly gneiss) and NBGW815 (predominantly gneiss).

5.0 Preliminary findings of drilling

The drilling results indicated that two main water-bearing zones of interest were present to 120 mBGL. These are defined as the apatite (mineralised zone) and gneiss host unit. Moist cuttings were encountered between 15-30 mBGL and groundwater static water levels (SWL) were found to be approximately 13 mBGL following piezometer construction. This information suggests that the groundwater units encountered (within weathered and mineralised zones in apatite, and fractures with apatite lensing in gneiss) are under hydraulic pressure.

Figure 2 presents the locations of the installed monitoring points and also provides an indication of areas of surface outcropping in the local area. Where apatite outcrops at or very near to the surface it has been hypothesised that the aquifer contained within the mineralised zones will be in direct hydraulic connection to the surface via a 'leaky' unsaturated zone. Note that this includes a section of Kerosene Creek. Where the gneiss outcrops at the surface the aquifer is either absent or sub-crops beneath the gneiss (i.e. at these points the aquifer in the mineralised zone will be semi-confined beneath the gneiss aquitard).

Figures 3a and 3b provide a plan view of the occurrence of stratigraphy with depth across the central mineralised zone. Note, it has been assumed that in general (based on field observations and limited hydraulic testing) the apatite mineralised and weathered zones will have a higher hydraulic conductivity (K) than the surrounding gneiss, however the gneiss (being a fractured flow system) is likely to contain water filled fractures with significant K at discrete intervals. This is supported by observation of iron stained water-bearing fractures within the gneiss at discrete intervals, as well as apatite (and other mineral) lenses within the gneiss.

6.0 Aquifer testing

Aquifer testing was mainly undertaken by falling head tests (FHT) whereby a volume of water is added to the well and the rate (time, in seconds) at which the water falls back to a state of equilibrium (static water level) is measured. By using a number of analytical models and statistics, an estimate of the hydraulic conductivity (K) of the aquifer(s) can be achieved.

Another single test was undertaken using the bore (NBRC067) currently used for pumping and refilling the tank on-site in conjunction with a nearby bore (76 metres distant) used as an observation point (NBRC387).

A discussion on the results of the aquifer testing can be found in the following section.

7.0 Discussion of results

Aquifer hydraulics were estimated using a number of analytical methods. Tabulated results summaries for average hydraulic conductivities (K) and transmissivity's (KD) based on constant discharge and recovery, and slug, tests can be found in Tables 1 and 2 respectively. Of note, comparison of constant discharge and slug test results suggests that the slug tests may underestimate K by up to an order of magnitude. This is an expected outcome and will be further assessed as part of the pumping test.

TABLE 1 NBRC067 AND NBRC387 CONSTANT DISCHARGE AND RECOVERY TEST RESULTS

Location	Method	Δs	r	Q	KD	D	K	S
Units	-	m	m	m^3/day	m^2/day	m	m/day	-
067/387	Theim	1.2	76	216	67	15	4.5	-
067	Theim	0.9	0	216	44	15	2.9	-
067	Jacob	0.9	0	216	44	15	2.9	-
387	Jacob	0.113	76	216	-	15	-	0.0008
067	Jacob	0.9	0	216	88	15	5.9	-
387	Jacob	0.113	76	216	-	15	-	0.0127
067	Theis	1.45	0	216	27	15	1.8	-
067	Theis	2.8	0	216	14	15	0.9	-
067	Theis	0.85	0	216	47	15	3.1	-
Mean				216	47	15	3.2	0.007
StDev					24		1.6	0.008
CV					0.5		0.5	1.3

Note(s): Δs drawdown per log time cycle; r radius of distance from pumping to observation bore; Q pumping discharge rate; K hydraulic conductivity; D depth; KD transmissivity; S storativity; CV coefficient of variation; see Figure 2 for locations

TABLE 2 SLUG TEST RESULTS SUMMARY

Bore ID	K	D	KD	Lithology (thickness)	Geology/ Hydraulic Unit	Yield	Method
Unit	m/day	m	m^2/day	m	-	L/sec	-
NBGW810	0.43	98	42	0-88	Apatite	2-5	airlift
				88-115	Gneiss /apatite lenses		
				35-88(53)	Aquifer		
				88-115(27)	Aquitard		
NBGW811	0.062	107	7	0-90	Gneiss w/apatite lenses	0.2-0.5	airlift
				20-90(70)	Aquitard		
NBGW812	0.362	86	31	0-108	Apatite	2.2-3.0	airlift
				108-114	Gneiss/allenite		
				28-108(80)	Aquifer		
				108-114(6)	Aquitard		
NBGW813	0.075	90	7	0-120	Gneiss and lenses	0.1	airlift
				0-120	Mixed/aquitard	0.3-0.4	airlift
						1	airlift
NBGW814	0.193	92	18	0-45	Apatite	0.5	airlift
				45-102	Gneiss		
				19-45(26)	Aquifer		
				45-102(57)	Aquitard		
NBGW815	0.065	60	3.9	0-60	Apatite	0.5	airlift
				60-109	Gneiss		
				24-60(36)	Aquifer		
				60-109(49)	Aquitard		
NBGW816	0.040	97	3.9	0-121	Gneiss	0.5-1.0	airlift
				35-121(86)	Aquitard		
NBGW817	0.15	69	11	0-67	Apatite	1.0-2.0	airlift
				67-119	Gneiss w/apatite	0.5	airlift
				38-42/60-67(11)	Aquifer		
				87-119(32)	Aquitard		
NBGW818	0.13	57	7	0-37	Gneiss	0.93	Jacob
				37-45	Apatite		
				45-69	Gneiss		
				69-91	Apatite		
				91-97	Gneiss		
				37-45/69-91(30)	Aquifer		
				46-47/56-57/67-68/91-97(9)	Aquitard		
				65-97(32)	Screened zone		

Note(s): K hydraulic conductivity; D depth; KD transmissivity; see Figure 2 for locations

Overall, hydraulic conductivity can be grouped into the two main water bearing zones (inferred to be an aquifer and aquitard encountered in the mineralised zone and the gneiss respectively). This is supported by the recovery curve for bore NBRC067, which was pumped for one hour at a rate of 2.5 L/sec (9000 L/hour or 216 m^3/day). This curve has been reproduced as Chart 1 in this report.

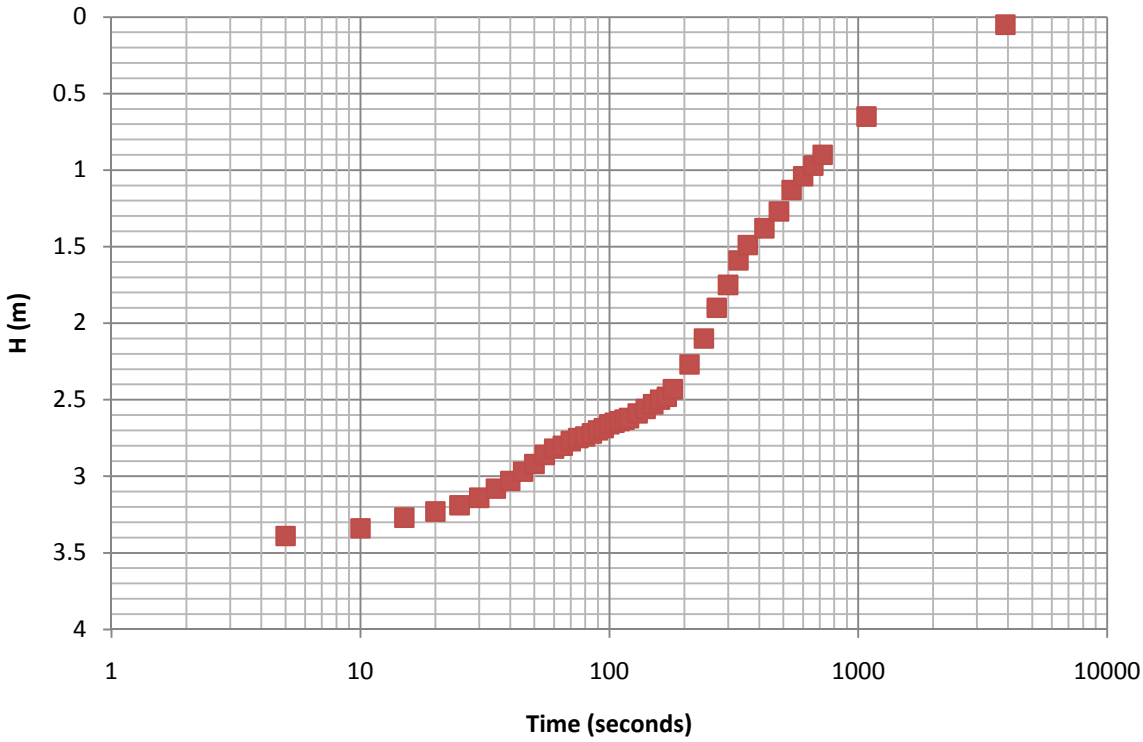


Chart 1: recovery data for pumping bore NBRC067

Chart 1 indicates that (in conjunction with observation of exploration drilling logs) bore NBRC067 is likely installed in the gneiss, and a boundary condition between the gneiss and apatite can be observed in the recovery data presented in Chart 1 (at approximately 200 seconds). This indicates varying hydraulic properties between the two units, with faster recovery observed in the apatite. This hypothesis will be further examined as part of the planned pumping test.

8.0 Conclusions

The results and information obtained from the first component of fieldwork and data analysis provide an estimate of hydraulic conductivities and transmissivities for the mineralised zone and interbedded gneiss found on-site. The results will allow us to better estimate the abstraction rates at which the pumping bore should be tested during the eight day constant discharge and recovery test.

9.0 Limitations

This letter report has been prepared by Environmental Earth Sciences QLD ABN 41 109 442 284 in response to and subject to the following limitations:

1. The specific instructions received from Arafura Resources Ltd;
2. The specific scope of works set out in PO610011 v2 issued by Environmental Earth Sciences on 19 March 2010;

3. May not be relied upon by any third party not named in this report for any purpose except with the prior written consent of Environmental Earth Sciences QLD (which consent may or may not be given at the discretion of Environmental Earth Sciences QLD);
4. This report comprises the formal report, documentation sections, tables, figures and appendices as referred to in the index to this report and must not be released to any third party or copied in part without all the material included in this report for any reason;
5. The report only relates to the site referred to in the scope of works being located at Nolan's Bore via Aileron, NT ("the site");
6. The report relates to the site as at the date of the report as conditions may change thereafter due to natural processes and/or site activities;
7. No warranty or guarantee is made in regard to any other use than as specified in the scope of works and only applies to the depth tested and reported in this report,
8. Fill, soil, groundwater and rock to the depth tested on the site may be fit for the use specified in this report. Unless it is expressly stated in this report, the fill, soil and/or rock may not be suitable for classification as clean fill if deposited off site; and
9. Our General Limitations set out at the back of the body of this report.

Should you have any further queries, please do not hesitate to contact us on (07) 3852 6666.

On behalf of
Environmental Earth Sciences QLD

Project Manager
Katy Kijek
Hydrogeologist

Project Director / Internal Reviewer
Mark Stuckey
Principal Hydrogeologist
610012 L1.docx

10.0 Glossary of terms

The following descriptions are of terms used in the text of this report.

Abrupt boundary boundary is less than 2 cm wide.

Anisotropy condition in which one or more properties vary according to direction.

Aquifer rock or sediment in a formation, group of formations, or part of a formation which is saturated and sufficiently permeable to transmit economic quantities of water to wells and springs.

Aquifer, confined aquifer that is overlain by a confining bed with significantly lower hydraulic conductivity than the aquifer.

Aquifer, perched region in the unsaturated zone where the soil is locally saturated because it overlies soil or rock of low permeability.

Aquitard a unit of low-permeability that can store groundwater and also transmit it slowly.

Borehole an uncased well drill hole.

Capillary Fringe zone immediately above the water table, upward into which water is drawn by capillary forces.

Conductivity (EC) conductivity of water is an expression of its ability to conduct an electric current. This property is related to the ionic content of the sample, which is in turn a function of the total dissolved (ionisable) solids (TDS) concentration. An estimate of TDS in fresh water can be obtained by multiplying EC by 0.65.

Confined Aquifer an aquifer whose upper and/or lower boundaries are confined by an almost impermeable geological formation, e.g. a clay layer. The water in these aquifers is usually under hydraulic pressure, e.g. artesian or sub-artesian conditions.

Confining layer an aquitard or sparingly permeable layer that confines the limits of an aquifer.

Drawdown lowering of a water table by pumping from one or more wells.

Electrolytic conductivity (EC) measure of the extent to which water conducts an electrical current and is related to the total concentration and relative proportions of the dissolved ionised substances within the water, and the temperature at which the determination is made.

Flow path direction in which groundwater is moving.

Fracture break in the geological formation, e.g. a shear or a fault.

Gradient rate of inclination of a slope. The degree of deviation from the horizontal; also refers to pressure.

Groundwater water held in the pores of an aquifer.

Hydraulic Head. The sum of the head's (potentials) at a point in an aquifer.

Hydraulic conductivity rate of water movement through soil.

Infiltration passage of water, under the influence of gravity, from the land surface into the subsurface.

Perched Aquifer (or water table) a body of water located above an impermeable geological formation. These perched aquifers (or water tables) are nearly always seasonal or periodic.

Permeability property of porous medium relating to its ability to transmit or conduct liquid (usually water) under the influence of a driving force. Also refereed to as hydraulic conductivity.

Piezometer a cased borehole with a short slotted screen for measuring standing water level (SWL), which represents a potentiometric surface or elevation of the water table; also used to obtain sample of groundwater for quality assessment.

Potentiometric Surface water level that represents the standing or total hydraulic standing head. In an aquifer system it represents the levels to which water will rise in tightly cased

Purge (wells) pumping out well water to remove drilling debris or impurities; also conducted to bring fresh groundwater into the casing for sample collection. The later ensures that a more representative sample of an aquifer is taken.

Recharge Area location of the replenishment of an aquifer by a natural process such as addition of water at the ground surface, or by an artificial system such as addition through a well

Recovery rate at which a water level in a well rises after pumping ceases.

Storativity volume of water stored or released by an aquifer per unit volume (of porous medium) per unit change in head.

Stratigraphy vertical sequence of geological units.

Total Dissolved Salts (TDS) total dissolved salts comprise dissociated compounds and undissociated compounds, but not suspended material, colloids or dissolved gases.

Transmissivity rate at which water is transmitted through a unit width aquifer under a unit hydraulic gradient.

Unsaturated zone vadose zone. The zone between the land surface and the water table, in which the rock or soil pores contain both air and water.

Vadose zone zone containing water under pressure less than that of the atmosphere, including soil water, intermediate vadose water, and capillary water. This zone is limited above by the land surface and below by the surface of the zone of saturation, that is the water table.

Water table interface between the saturated zone and unsaturated zones. The surface in an aquifer at which pore water pressure is equal to atmospheric pressure.

ENVIRONMENTAL EARTH SCIENCES GENERAL LIMITATIONS

Scope of services

The work presented in this report is Environmental Earth Sciences response to the specific scope of works requested by, planned with and approved by the client. It cannot be relied on by any other third party for any purpose except with our prior written consent. Client may distribute this report to other parties and in doing so warrants that the report is suitable for the purpose it was intended for. However, any party wishing to rely on this report should contact us to determine the suitability of this report for their specific purpose.

Data should not be separated from the report

A report is provided inclusive of all documentation sections, limitations, tables, figures and appendices and should not be provided or copied in part without all supporting documentation for any reason, because misinterpretation may occur.

Subsurface conditions change

Understanding an environmental study will reduce exposure to the risk of the presence of contaminated soil and or groundwater. However, contaminants may be present in areas that were not investigated, or may migrate to other areas. Analysis cannot cover every type of contaminant that could possibly be present. When combined with field observations, field measurements and professional judgement, this approach increases the probability of identifying contaminated soil and or groundwater. Under no circumstances can it be considered that these findings represent the actual condition of the site at all points.

Environmental studies identify actual sub-surface conditions only at those points where samples are taken, when they are taken. Actual conditions between sampling locations differ from those inferred because no professional, no matter how qualified, and no sub-surface exploration program, no matter how comprehensive, can reveal what is hidden below the ground surface. The actual interface between materials may be far more gradual or abrupt than an assessment indicates. Actual conditions in areas not sampled may differ from that predicted. Nothing can be done to prevent the unanticipated. However, steps can be taken to help minimize the impact. For this reason, site owners should retain our services.

Problems with interpretation by others

Advice and interpretation is provided on the basis that subsequent work will be undertaken by Environmental Earth Sciences NSW. This will identify variances, maintain consistency in how data is interpreted, conduct additional tests that may be necessary and recommend solutions to problems encountered on site. Other parties may misinterpret our work and we cannot be responsible for how the information in this report is used. If further data is collected or comes to light we reserve the right to alter their conclusions.

Obtain regulatory approval

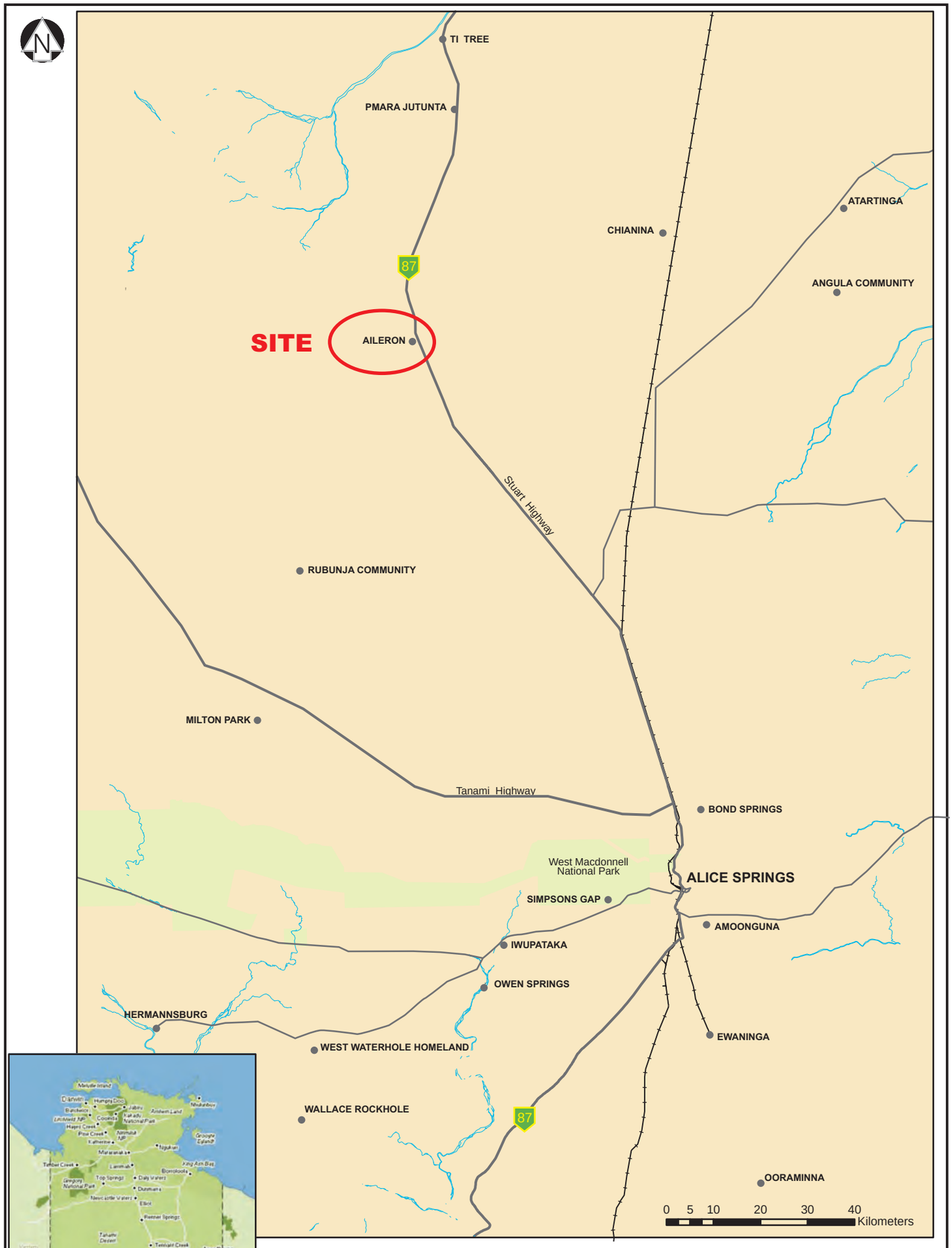
The investigation and remediation of contaminated sites is a field in which legislation and interpretation of legislation is changing rapidly. Our interpretation of the investigation findings should not be taken to be that of any other party. When approval from a statutory authority is required for a project, that approval should be directly sought by the client.

Limit of liability

This study has been carried out to a particular scope of works at a specified site and should not be used for any other purpose. This report is provided on the condition that Environmental Earth Sciences NSW disclaims all liability to any person or entity other than the client in respect of anything done or omitted to be done and of the consequence of anything done or omitted to be done by any such person in reliance, whether in whole or in part, on the contents of this report. Furthermore, Environmental Earth Sciences NSW disclaims all liability in respect of anything done or omitted to be done and of the consequence of anything done or omitted to be done by the client, or any such person in reliance, whether in whole or any part of the contents of this report of all matters not stated in the brief outlined in Environmental Earth Sciences NSW's proposal number and according to Environmental Earth Sciences general terms and conditions and special terms and conditions for contaminated sites.

To the maximum extent permitted by law, we exclude all liability of whatever nature, whether in contract, tort or otherwise, for the acts, omissions or default, whether negligent or otherwise for any loss or damage whatsoever that may arise in any way in connection with the supply of services. Under circumstances where liability cannot be excluded, such liability is limited to the value of the purchased service.

ATTACHMENT 1 DRAFT FIGURES

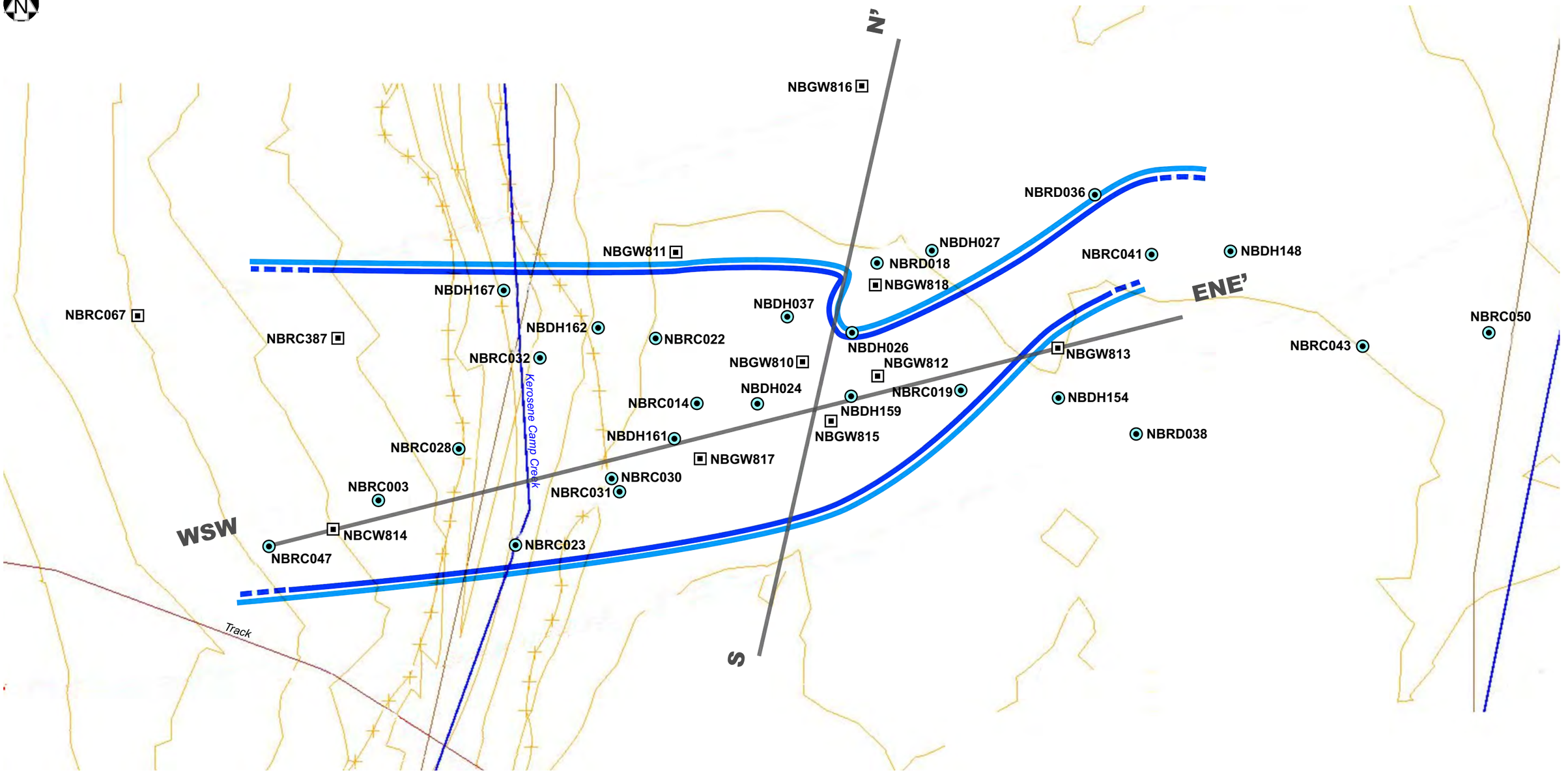


ENVIRONMENTAL EARTH SCIENCES
THE KNOW AND THE HOW

Title: **Locality Map**

Location: **Nolan's Bore, Aileron Station, Aileron, NT**

Client: **Arafura Resources Limited**		Job No: **610012**
Project Man: **MS**	Scale: **As shown**	**Figure 1**
Drawn By: **LB**	Date: **June 2010**	

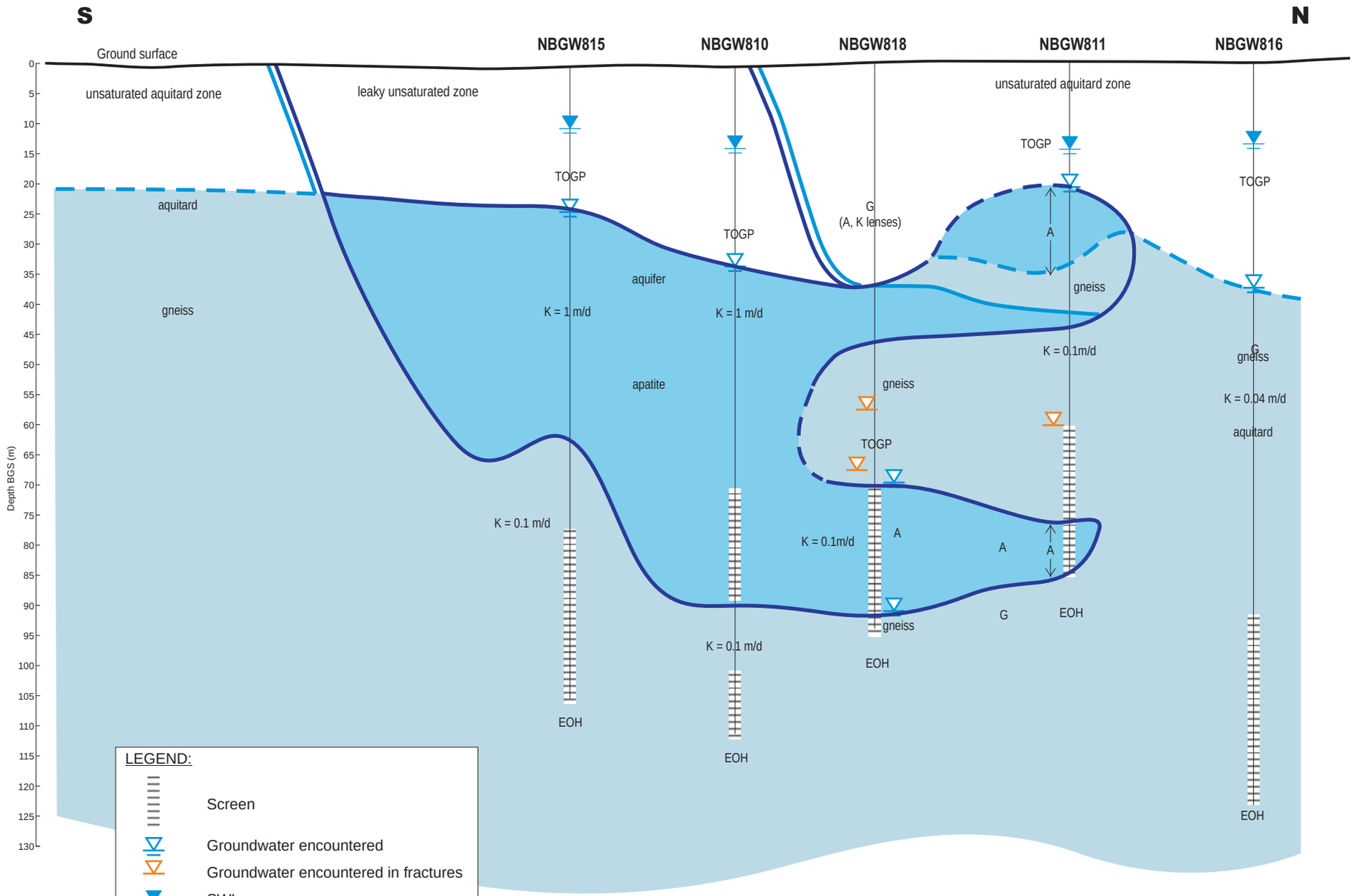


LEGEND:

- Outcropping apatite, indicating leaking semi-confined or un-confined aquifer
- Gneiss at surface, aquifer absent or sub-cropping (semi-confined)
- Groundwater monitoring bores (NBGW810-817, NBRC067, NBRC387)
- Exploration boreholes (subset used in geological interpretation and for position reference)
- Refer Figure 3a and 3b for detail

ENVIRONMENTAL EARTH SCIENCES
THE KNOW AND THE HOW

Title: **Site Features, Bore Locations and Topography**		
Location: **Nolan's Bore, Aileron Station, Aileron, NT**		
Client: **Arafura Resources Limited**		Job No: **610012**
Project Man: **MS**	Scale: **As shown**	**Figure 2**
Drawn By: **LB**	Date: **June 2010**	

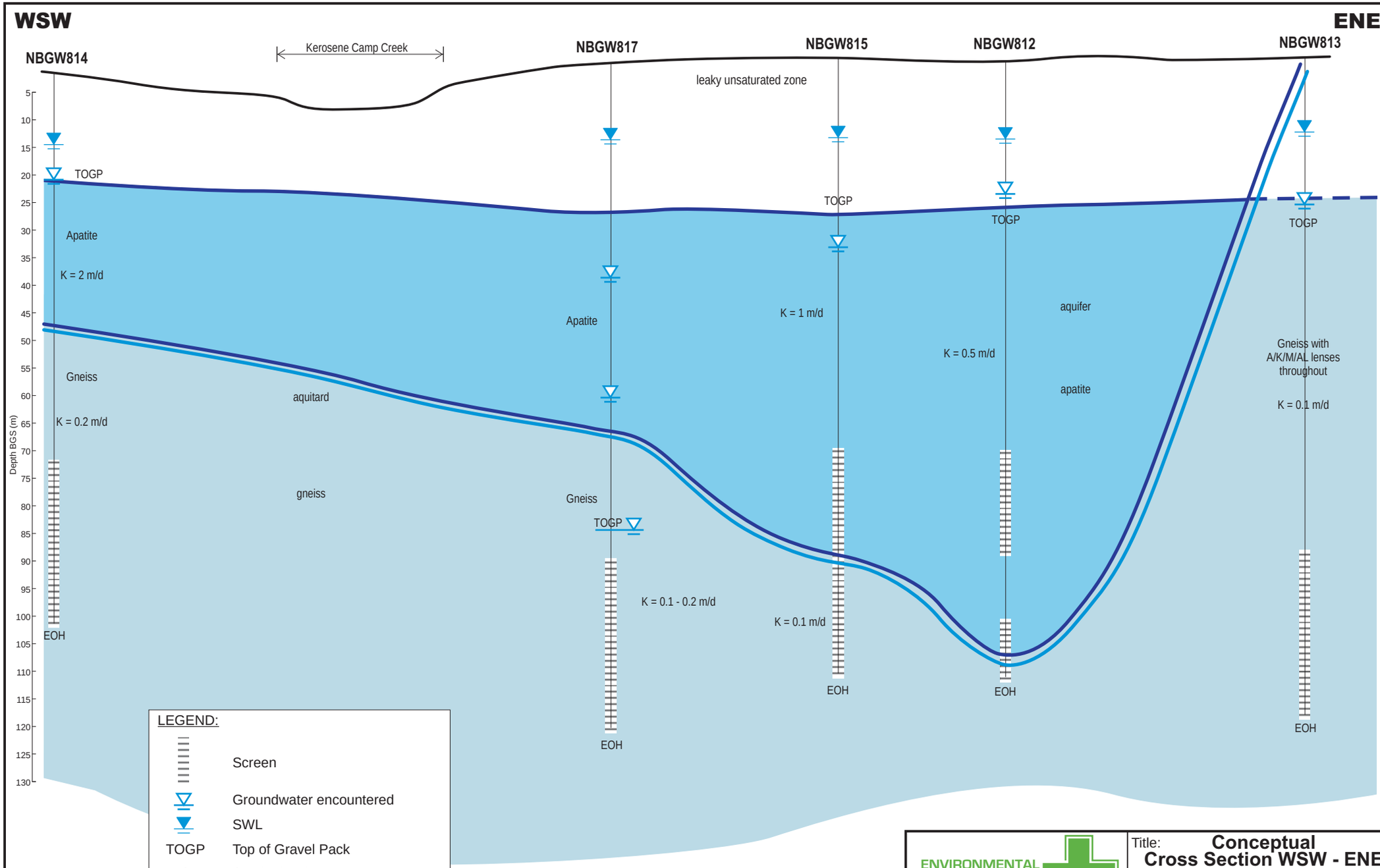


ENVIRONMENTAL EARTH SCIENCES
THE KNOW AND THE HOW

Title: **Conceptual Cross Section S - N'**

Location: **Nolan's Bore, Aileron Station, Aileron, NT**

Client: **Arafura Resources Limited**		Job No: **610012**
Project Man: **MS**	Scale: **As shown**	**Figure 3a**
Drawn By: **LB**	Date: **June 2010**	



ENVIRONMENTAL EARTH SCIENCES
THE KNOW AND THE HOW

Title: **Conceptual Cross Section WSW - ENE**

Location: **Nolan's Bore, Aileron Station, Aileron, NT**

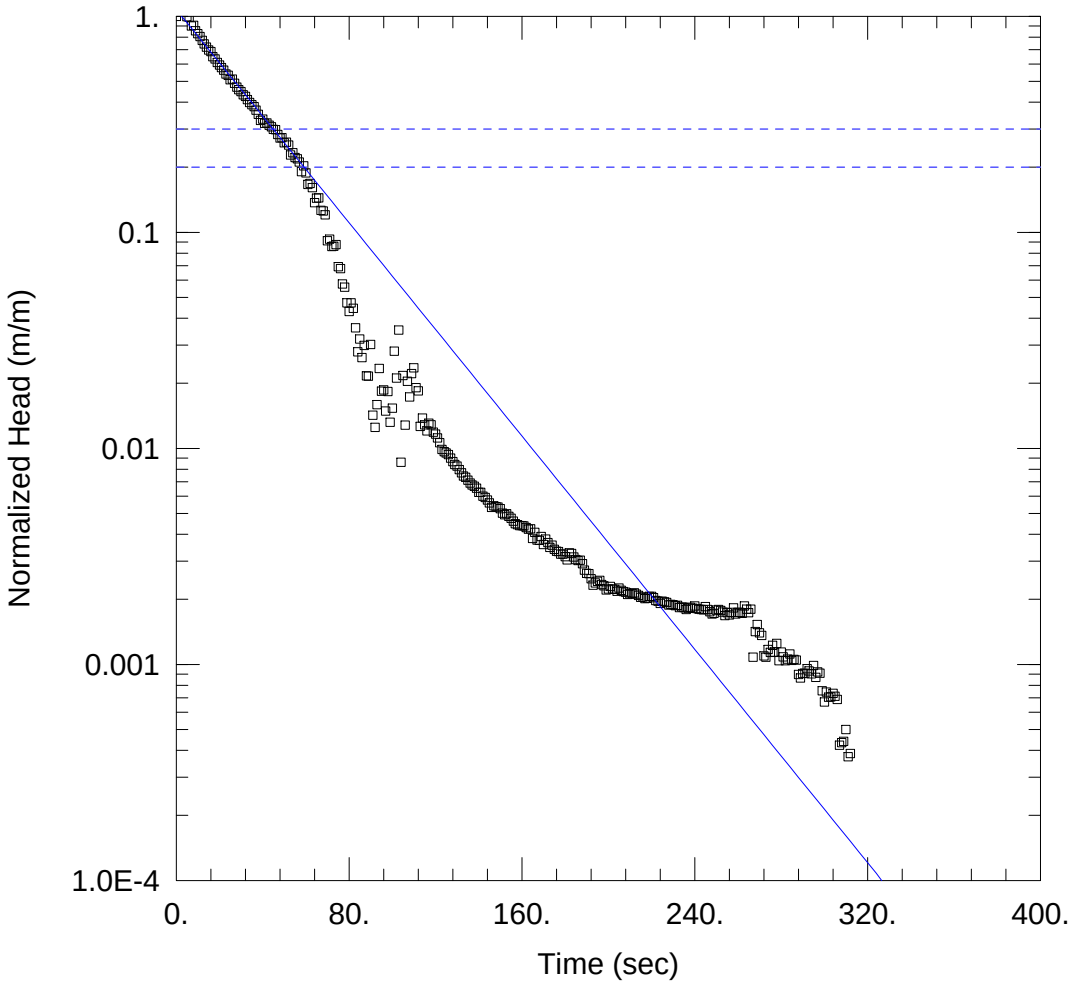
Client: **Arafura Resources Limited**		Job No: **610012**
Project Man: **MS**	Scale: **As shown**	**Figure 3b**
Drawn By: **LB**	Date: **June 2010**	

ATTACHMENT 2 DRAFT BORELOGS

ATTACHMENT 3 AQUIFER TESTING DATA SUMMARY

time (min)	Location/s	Theim (1906) - steady state contant t varying r										
		r1 (m)	r2 (m)	s1 (m)	s2 (m)	Q (m3/d)	KD (m2/d)	K (m/d)	D (m)	KD (m2/d)	S	
67	NBRC067/387	0.1	76	3.47	0.077	216	67.13	4.48	15	67.13		
		Theim (1906) - steady state contant r varying t										
		deltaS (m)	r (m)			Q (m3/d)	KD (m2/d)	K (m/d)				
	NBRC067	0.90	0			216	43.93	2.93	15	43.93		
	NBRC387	0.08	76			216	494.18	32.95	15	494.18	not valid as drawdown	
											see chart 's (m)'	
		Theim (1906) - steady state contant t varying r - chart										
		deltaS (m)				Q (m3/d)	KD (m2/d)	K (m/d)				
67	NBRC387	0.08				216	988.35	65.89	15	988.35	as above	
		Neuman (1972) unsteady state flow curve fitting										
	Neuman A	sa	W(ua,B)	1/ua	t (d)	r	KD (m2/d)	K (m/d)	Sa			Sa+Sy (S)
	GW34	0.18	1	1	0.0021	1	2.17	1.08	0.0182	2.17	0.0182	0.0459
	GW23	0.18	1	1	0.0043	3	2.17	1.08	0.0041	2.17	0.0041	0.0102
	Neuman B	sb	W(ub,B)	1/ub	t (d)	r	KD (m2/d)	K (m/d)	Sy			Sy/Sa
	GW34	0.18	1	1	0.0032	1	2.17	1.08	0.0277	2.17	0.0277	1.52
	GW23	0.17	1	10	0.0597	3	2.29	1.15	0.0061	2.29	0.0061	1.47
e		Theis (1935) unsteady state flow curve fitting										
		s	W(u)	1/u	t/r2 (d/m2)	r	KD (m2/d)	K (m/d)	S			
	GW34	0.46	1	2	0.000215	1	0.85	0.42	0.00036	0.85	0.0004	
	GW23	0.06	0.1	1	0.000156	3	0.65	0.32	0.00041	0.65	0.0004	
e		Jacob (Cooper and Jacob 1946) - unsteady state flow constant r varying t										
		deltaS (m)	r (m)			Q (m3/d)	KD (m2/d)	K (m/d)	S			D (m)
	NBRC067	0.90	0			216	43.93	2.93		43.93		15
	NBRC387	0.113	76			216	349.86	23.32	0.0008	349.86	0.0008	15
		Jacob (Cooper and Jacob 1946) - unsteady state flow constant t varying r										
		deltaS (m)	r (m)			Q (m3/d)	KD (m2/d)	K (m/d)	S			
67	NBRC067	0.90	0			216	87.85	5.86		87.85		15
67	NBRC387	0.113	76			216	699.72	46.65	0.0127	699.72	0.0127	15
		Theis Recovery										
		deltaS (m)				Q (m3/d)	KD (m2/d)	K (m/d)				
	NBRC067	1.45				216	27.26	1.82		27.26		15
early	NBRC067	2.8				216	14.12	0.94		14.12		15
late	NBRC067	0.85				216	46.51	3.10		46.51		15
	NBRC387	0.092				216	429.72	28.65		429.72		15
					Average			**3.15**		**47.25**	**0.0067**	
					St Dev			1.62		24.37	0.0084	
					CV			0.52		0.52	1.25	

Bore ID	Test-type	K-value (m/day)	Part of curve (from-to - sec)	aquifer thickness (D)	KD	Lithology				Yield (L/sec)		K (m/d)
NBGW810	BR1	0.69840	0-80	120	83.808	0-88	Apatite			2-5 L/s	airlift	0.32-0.81
	Hv1	**0.94720**	0-80	120	113.664	88-115	Gneiss w/apatite lenses			0.7 L/sec	Jacob	0.11
	Hv2	0.51390	100-180	120	61.668	35-88(53)	**Aquifer**					
	Hv	0.17260	170-255	120	20.712	88-115(27)	**Aquitard**					
	Hv	0.11570	0-35	53	6.1321							
	BR	0.11640	0-50	53	6.1692							
Average		0.43		97.67	41.74							
StDev		0.35		34.60								
CV		0.82		0.35								
NBGW811	BR1	0.09284	0-170	157	14.57588	0-90	Gneiss w/apatite lenses			0.2-0.5	airlift	0.04
	BR w Butler correction	0.03817	0-170	157	5.99269	20-90(70)	**Aquitard**			0.09-0.6	Jacob	0.05
	Hv	**0.11460**	0-160	157	17.9922					0.3-1.6	Jacob	0.04
	Hv	0.03520	0-100	70	2.464							
	BR	0.03330	0-100	70	2.331							
	Hv2	0.05030	0-150	70	3.521							
	BR2	0.07170	0-150	70	5.019							
Average		0.062		107.29	6.68							
StDev		0.032		46.50								
CV		0.51		0.43								
NBGW812	BR1	0.39990	0-60	92.42	36.959	0-108	Apatite			2.2-3.0	airlift	0.3
	Hv1	0.47260	0-60	92.42	43.678	108-114	Gneiss/allenite			2.9	Jacob	0.31
	Hv	0.25630	0-13	80	20.504	28-108(80)	**Aquifer**					
	BR	0.31920	0-30	80	25.536	108-114(6)	Aquitard					
Average		0.362		86.21	31.21							
StDev		0.094		7.17								
CV		0.26		0.08								
NBGW813	BR1	0.06481	0-200	140	9.0734	0-120	Gneiss and apatite/mylonite/kaolinite/allanite lenses					
	Hv1	0.07579	0-200	140	10.6106	0-120	**Mixed/aquitard**			0.1	airlift	
	Hv	0.05680	0-200	40	2.272					0.3-0.4	airlift	
	BR	0.10370	0-150	40	4.148					1	airlift	
										0.46	Jacob	0.1
Average		0.075		90.00	6.77					0.046	Jacob	0.1
StDev		0.020		57.74								
CV		0.27		0.64								
NBGW814	BR1	0.13980	5.0-50	136.37	19.064526	0-45	Apatite			0.5	airlift	
	BR2	0.17420	40-200	136.37	23.755654	45-102	Gneiss			0.5	Jacob	0.2682
	Hv1	0.17530	10.0-80	136.37	23.905661	19-45(26)	**Aquifer**					
	Hv	0.17460	0-40	26	4.5396	45-102(57)	**Aquitard**					
	BR	0.29940	0-40	26	7.7844							
Average		0.193		92.22	17.77							
StDev		0.062		60.45								
CV		0.32		0.66								
NBGW815	BR1	0.06892	60-160	94.93	6.5425756	0-60	Apatite			0.5	airlift	
	BR2	0.07505	60-160	36	2.7018	60-109	Gneiss			0.12-1.2	Jacob	0.0467
	Hv1	0.07723	55-200	94.93	7.3314439	24-60(36)	Aquifer					
	Hv	0.05000	0-100	36	1.8	60-109(49)	**Aquitard**					
	BR	0.05260	0-100	36	1.8936							
Average		0.065		59.57	3.86							
StDev		0.013		32.28								
CV		0.20		0.54								
NBGW816	BR1	0.05830	60-210	107.67	6.277161	0-121	Gneiss			0.5-1.0	airlift	
	Hv1	0.06364	60-210	107.67	6.8521188	35-121(86)	**Aquitard**			0.15-1.2	Jacob	0.02
	Hv	0.01950	0-100	86	1.677							
	BR	0.02040	0-200	86	1.7544							
Average		0.040		96.84	3.92							
StDev		0.024		12.51								
CV		0.59		0.13								
NBGW817	BR1	0.09952	40-150	106.955	10.6441616	0-67	Apatite		Apatite	1.0-2.0	airlift	
	BR1b	0.10770	40-150	32	3.4464	67-119	Gneiss w/apatite		Apatite	0.5	airlift	
	Hv1	0.11730	40-150	106.955	12.5458215	38-42/60-67(11)	Aquifer		Gneiss	0.5	airlift	
	Hv2	0.37480	80-190	106.955	40.086734	87-119(32)	**Aquitard**		Gneiss	1	airlift	
	Hv2	0.11670	40-100	32	3.7344				Gneiss	1.0-2.0	airlift	
	BR2	0.10350	40-100	32	3.312					3.5	Jacob	0.1044
Average		0.153		69.48	10.65							
StDev		0.109		41.05								
CV		0.71		0.59								
NBGW818	BR1	0.11450	0-300	83.735	9.5876575	0-37	Gneiss			0.93	Jacob	0.1609
NBGW818	BR2	0.12000	0-210	30	3.6	37-45	Apatite					
	Hv1	0.12930	0-230	83.735	10.8269355	45-69	Gneiss					
	KGS Model	0.1348	10-230	83.735	11.287478	69-91	Apatite					
	Hv	0.12010	0-100	30	3.603	91-97	Gneiss					
	BR	0.16360	0-11	30	4.908	37-45/69-91(30)	**Aquifer**					
						46-47/56-57/67-68/91-97(9)	Aquitard					
Average		0.130		56.87	7.41	65-97(32)	screened zone					
StDev		0.018		29.43								
CV		0.14		0.52								



WELL TEST ANALYSIS

Data Set: C:\...\NBGW810_BR1.aqt
Date: 06/11/10 Time: 17:03:34

PROJECT INFORMATION

Company: Environmental Earth Sciences
Client: Arafura Resources
Project: 610012
Location: Aileron
Test Well: NBGW810
Test Date: 12/05/10

AQUIFER DATA

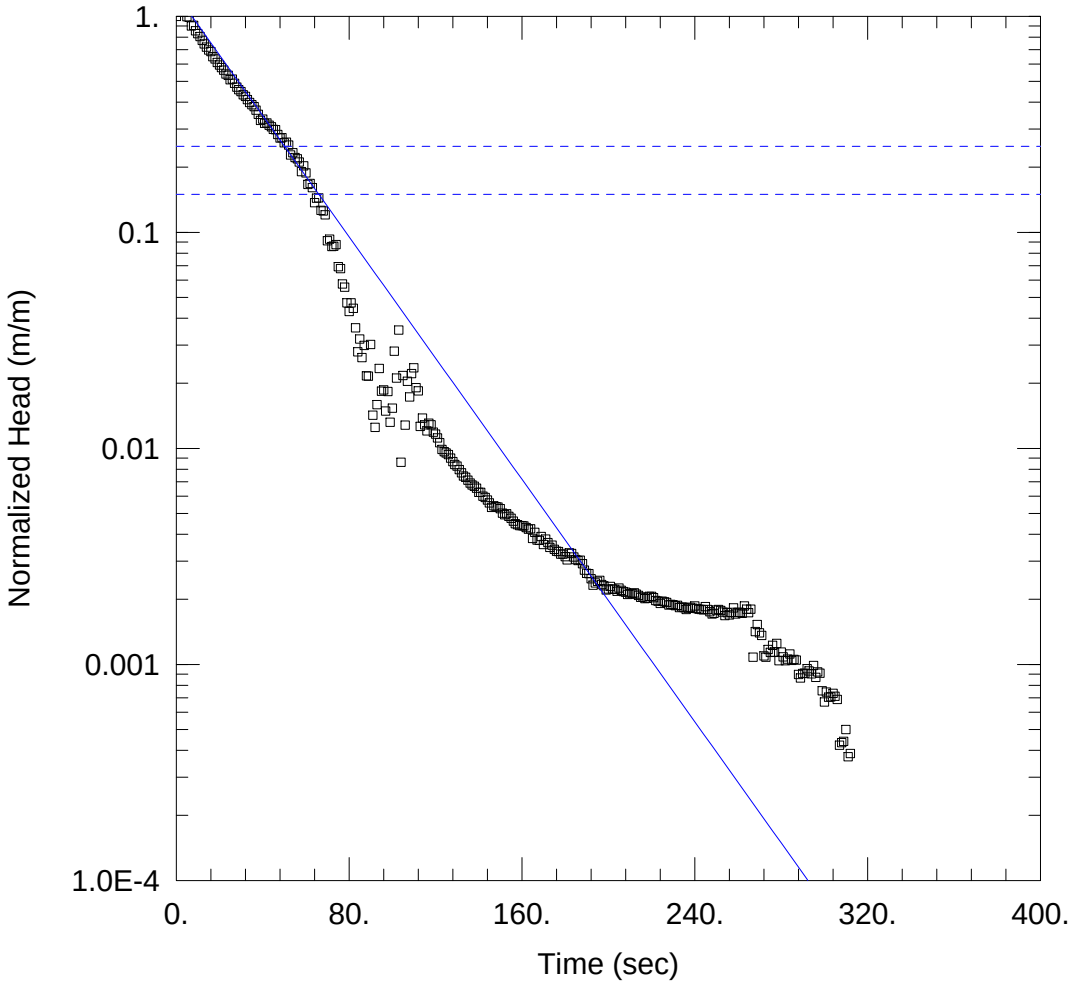
Saturated Thickness: 120. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (NBGW810)

Initial Displacement: 8.855 m
Total Well Penetration Depth: 100.6 m
Casing Radius: 0.0665 m
Static Water Column Height: 101. m
Screen Length: 42. m
Well Radius: 0.0665 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.6984 m/day
y0 = 9.508 m



WELL TEST ANALYSIS

Data Set: C:\...\NBGW810_Hv1.aqt
Date: 06/11/10 Time: 17:04:31

PROJECT INFORMATION

Company: Environmental Earth Sciences
Client: Arafura Resources
Project: 610012
Location: Aileron
Test Well: NBGW810
Test Date: 12/05/10

AQUIFER DATA

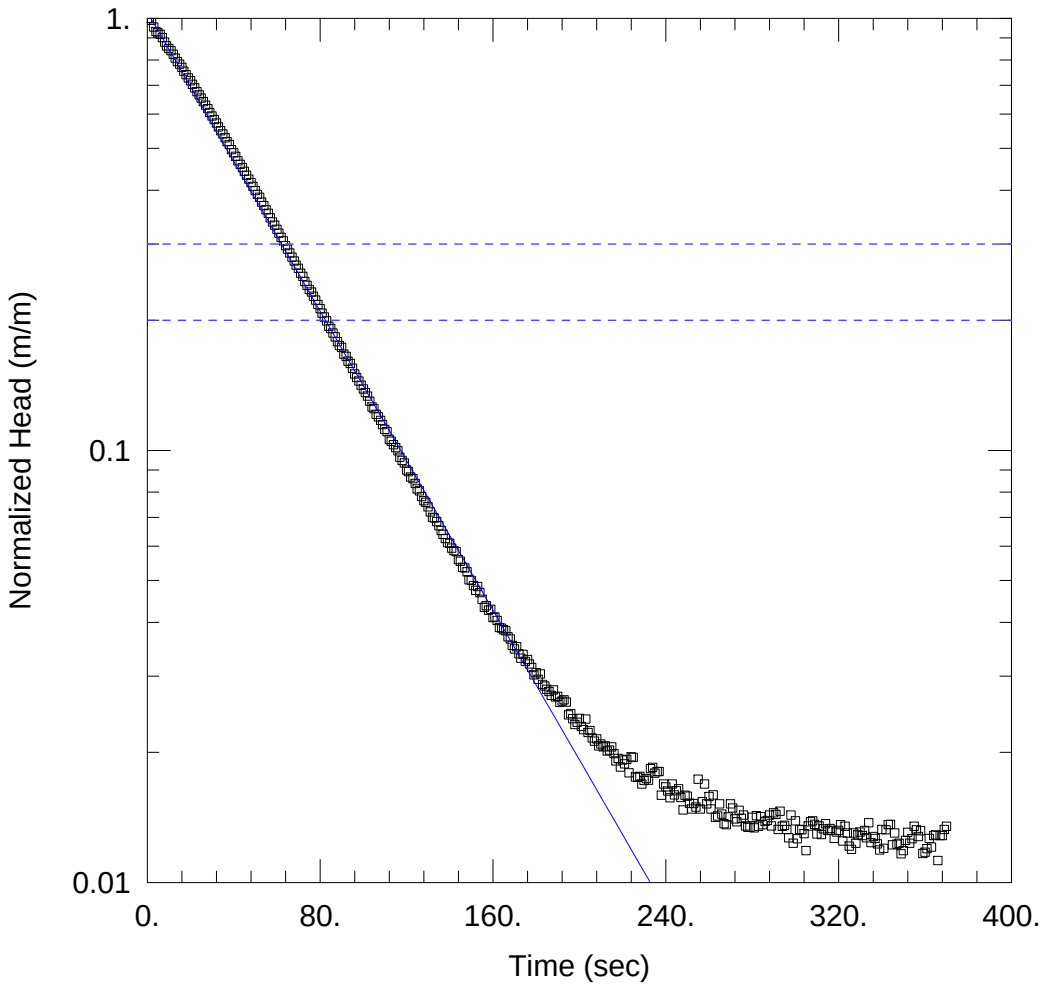
Saturated Thickness: 120. m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (NBGW810)

Initial Displacement: 8.855 m
Total Well Penetration Depth: 100.6 m
Casing Radius: 0.0665 m
Static Water Column Height: 101. m
Screen Length: 42. m
Well Radius: 0.0665 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 0.9472 m/day
y0 = 11.16 m



WELL TEST ANALYSIS

Data Set: C:\...\NBGW811_BR.aqt
Date: 06/11/10 Time: 17:05:15

PROJECT INFORMATION

Company: Environmental Earth Sciences
Client: Arafura Resources
Project: 610012
Location: Aileron
Test Well: NBGW811
Test Date: 12/05/10

AQUIFER DATA

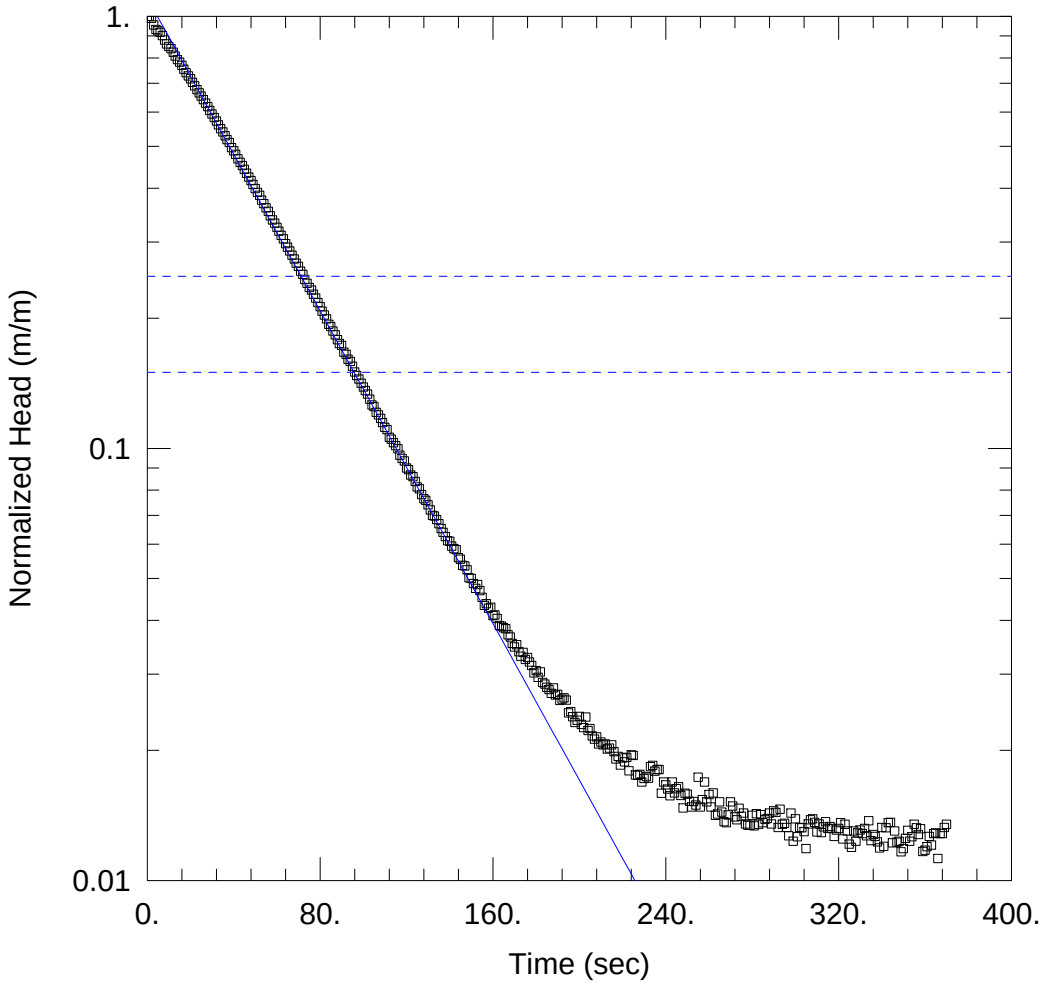
Saturated Thickness: 157. m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (NBGW811)

Initial Displacement: 2.378 m
Total Well Penetration Depth: 105.9 m
Casing Radius: 0.025 m
Static Water Column Height: 77.31 m
Screen Length: 30. m
Well Radius: 0.0665 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.09284 m/day
y0 = 2.459 m



WELL TEST ANALYSIS

Data Set: C:\...\NBGW811_Hv.aqt
Date: 06/11/10 Time: 17:05:26

PROJECT INFORMATION

Company: Environmental Earth Sciences
Client: Arafura Resources
Project: 610012
Location: Aileron
Test Well: NBGW811
Test Date: 12/05/10

AQUIFER DATA

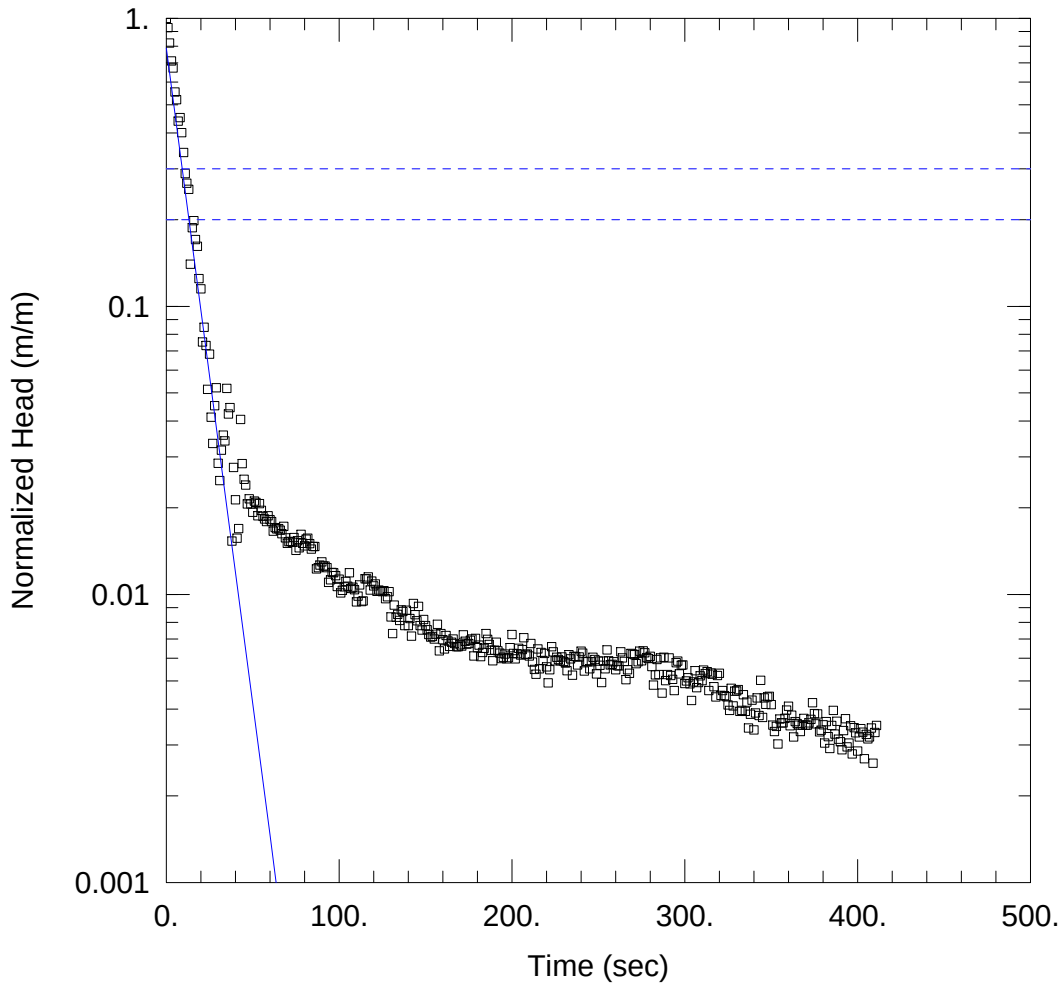
Saturated Thickness: 157. m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (NBGW811)

Initial Displacement: 2.378 m
Total Well Penetration Depth: 105.9 m
Casing Radius: 0.025 m
Static Water Column Height: 77.31 m
Screen Length: 30. m
Well Radius: 0.0665 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 0.1146 m/day
y0 = 2.621 m



WELL TEST ANALYSIS

Data Set: C:\...\NBGW812_BR1.aqt
Date: 06/11/10 Time: 17:05:58

PROJECT INFORMATION

Company: Environmental Earth Sciences
Client: Arafura Resources
Project: 610012
Location: Aileron
Test Well: NBGW812
Test Date: 12/05/10

AQUIFER DATA

Saturated Thickness: 92.42 m Anisotropy Ratio (Kz/Kr): 1.

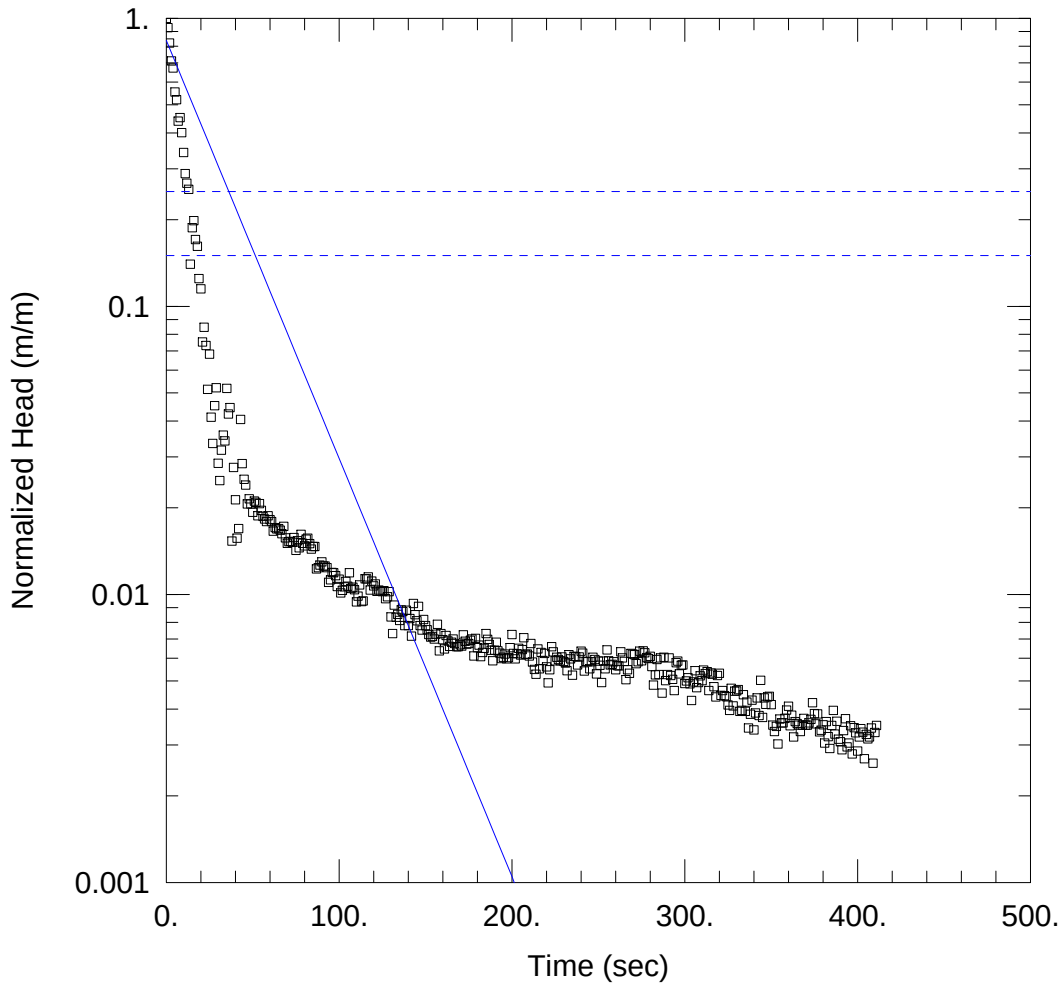
WELL DATA (NBGW812)

Initial Displacement: 5.393 m
Total Well Penetration Depth: 99.42 m
Casing Radius: 0.025 m
Static Water Column Height: 100.8 m
Screen Length: 42. m
Well Radius: 0.0665 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.3999 m/day y0 = 4.244 m



WELL TEST ANALYSIS

Data Set: C:\...\NBGW812_Hv1.aqt
Date: 06/11/10 Time: 17:05:49

PROJECT INFORMATION

Company: Environmental Earth Sciences
Client: Arafura Resources
Project: 610012
Location: Aileron
Test Well: NBGW812
Test Date: 12/05/10

AQUIFER DATA

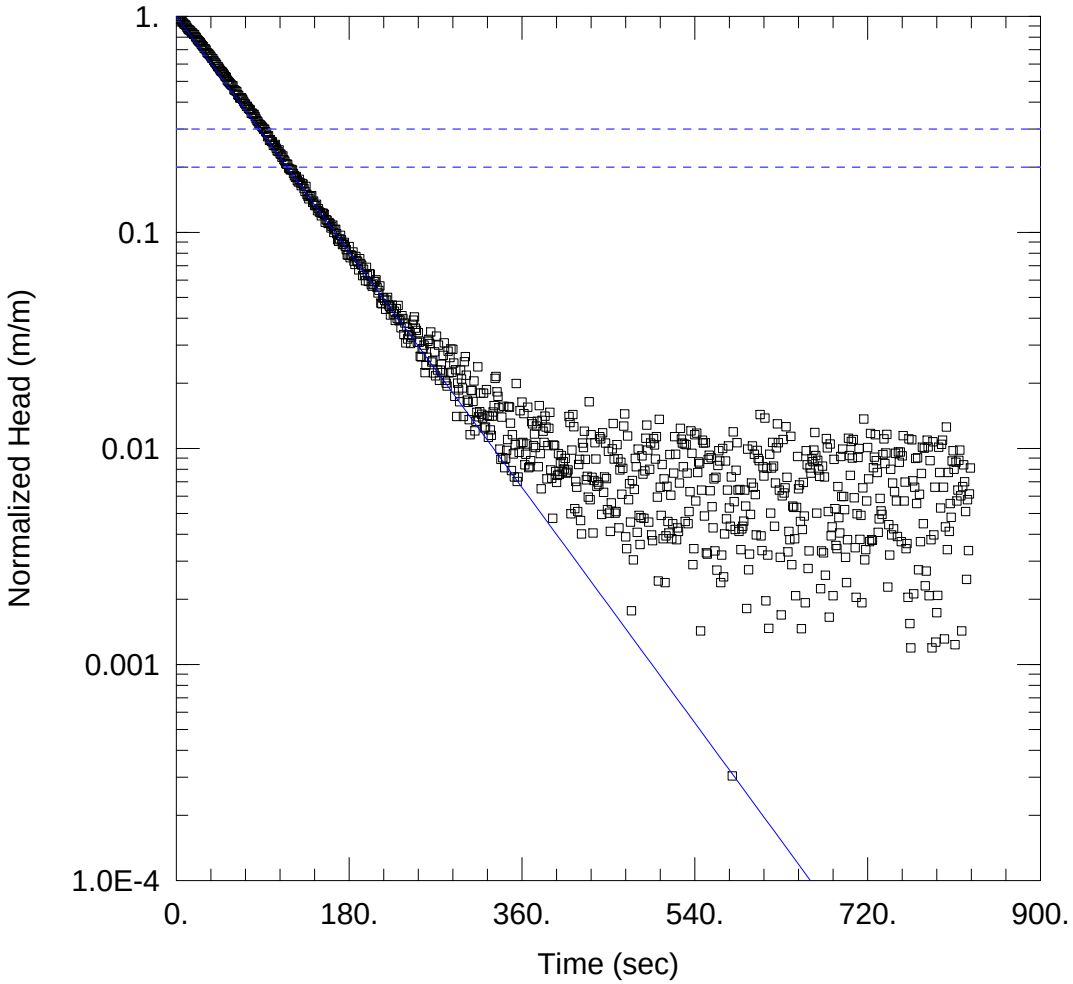
Saturated Thickness: 92.42 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (NBGW812)

Initial Displacement: 5.393 m
Total Well Penetration Depth: 99.42 m
Casing Radius: 0.025 m
Static Water Column Height: 100.8 m
Screen Length: 42. m
Well Radius: 0.0665 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 0.1534 m/day
y0 = 4.515 m



WELL TEST ANALYSIS

Data Set: C:\...\NBGW813_BR.aqt
Date: 06/11/10 Time: 17:06:42

PROJECT INFORMATION

Company: Environmental Earth Sciences
Client: Arafura Resources
Project: 610012
Location: Aileron
Test Well: NBGW813
Test Date: 12/05/10

AQUIFER DATA

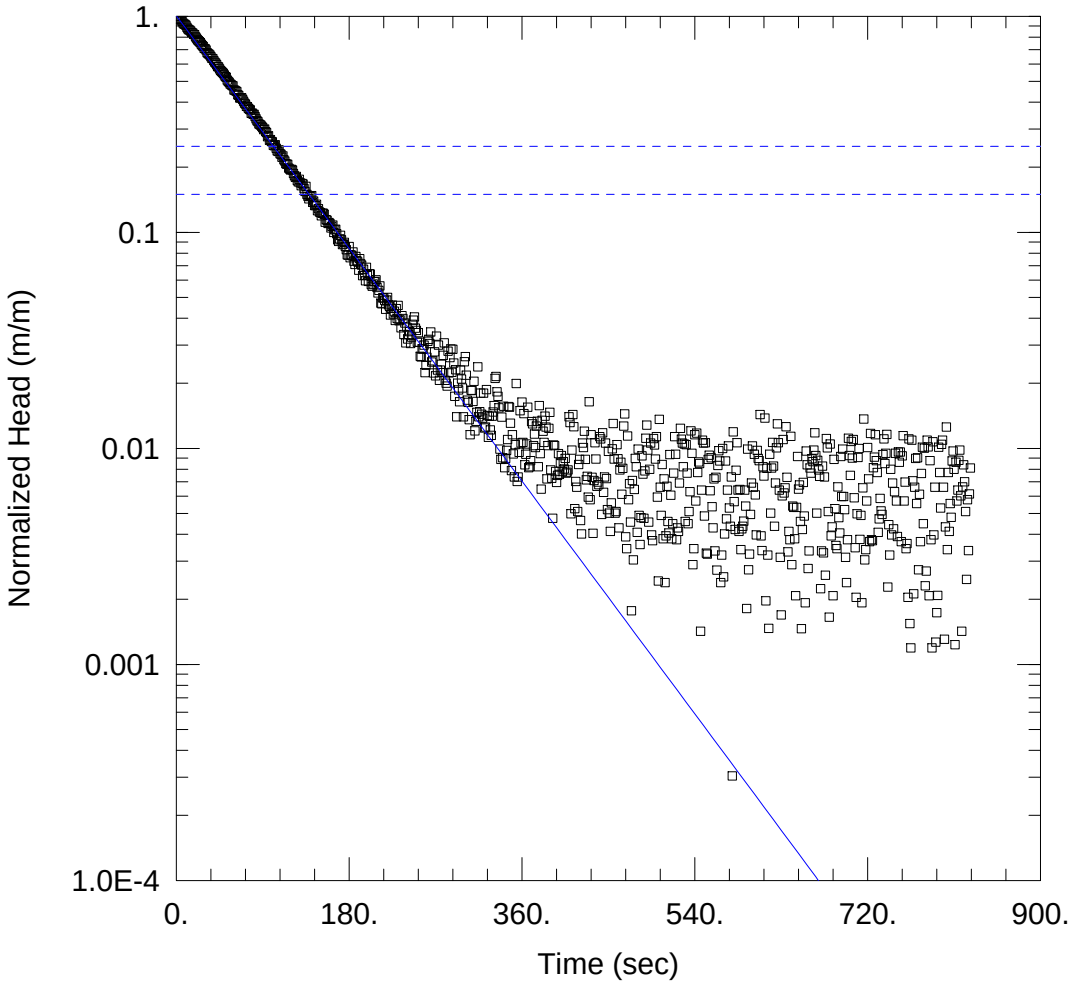
Saturated Thickness: 140. m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (NBGW813)

Initial Displacement: 2.23 m
Total Well Penetration Depth: 105.9 m
Casing Radius: 0.025 m
Static Water Column Height: 106.9 m
Screen Length: 30. m
Well Radius: 0.0665 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.06497 m/day
y0 = 2.227 m



WELL TEST ANALYSIS

Data Set: C:\...\NBGW813_Hv.aqt
Date: 06/11/10 Time: 17:06:31

PROJECT INFORMATION

Company: Environmental Earth Sciences
Client: Arafura Resources
Project: 610012
Location: Aileron
Test Well: NBGW813
Test Date: 12/05/10

AQUIFER DATA

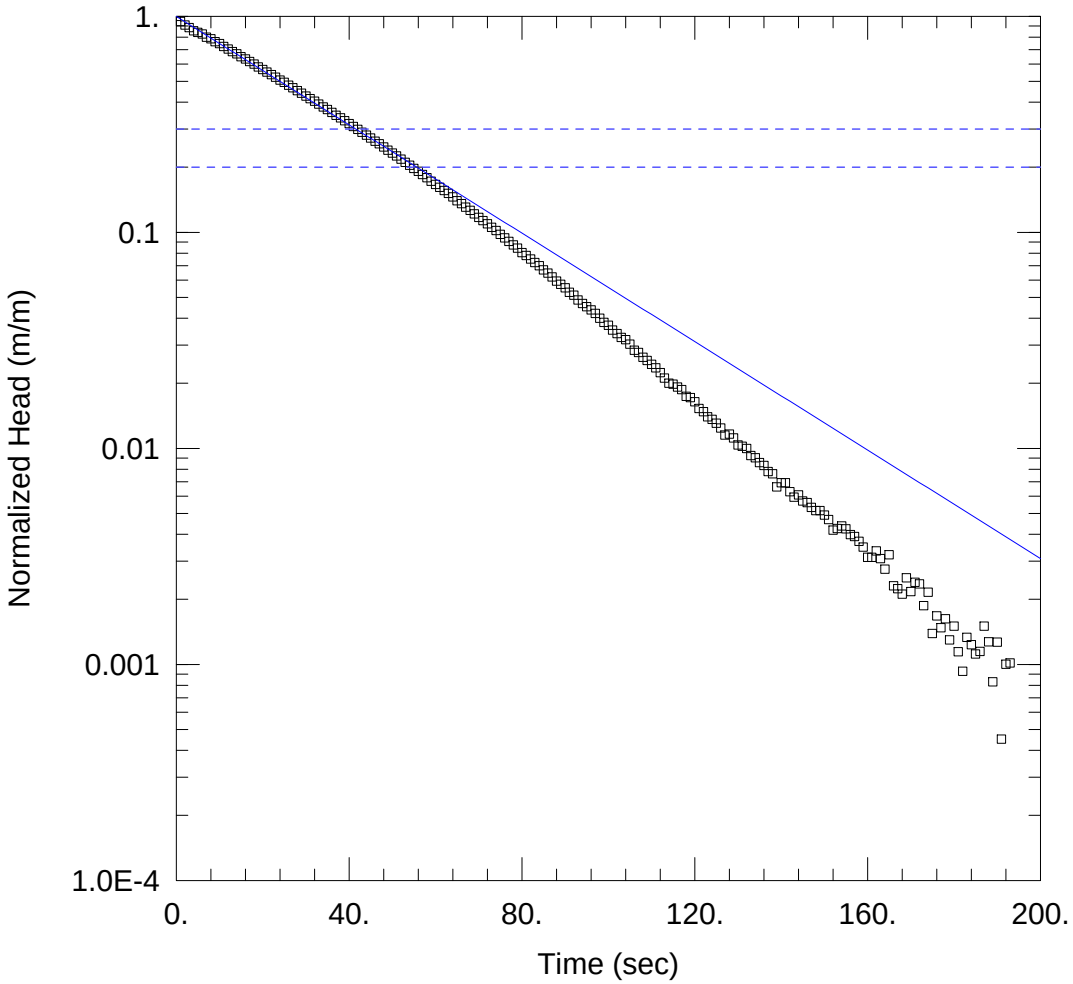
Saturated Thickness: 140. m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (NBGW813)

Initial Displacement: 2.23 m
Total Well Penetration Depth: 105.9 m
Casing Radius: 0.025 m
Static Water Column Height: 106.9 m
Screen Length: 30. m
Well Radius: 0.0665 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 0.07579 m/day
y0 = 2.243 m



WELL TEST ANALYSIS

Data Set: C:\...\NBGW814_BR1.aqt
Date: 06/11/10 Time: 17:07:10

PROJECT INFORMATION

Company: Environmental Earth Sciences
Client: Arafura Resources
Project: 610012
Location: Aileron
Test Well: NBGW814
Test Date: 12/05/10

AQUIFER DATA

Saturated Thickness: 136.4 m Anisotropy Ratio (Kz/Kr): 1.

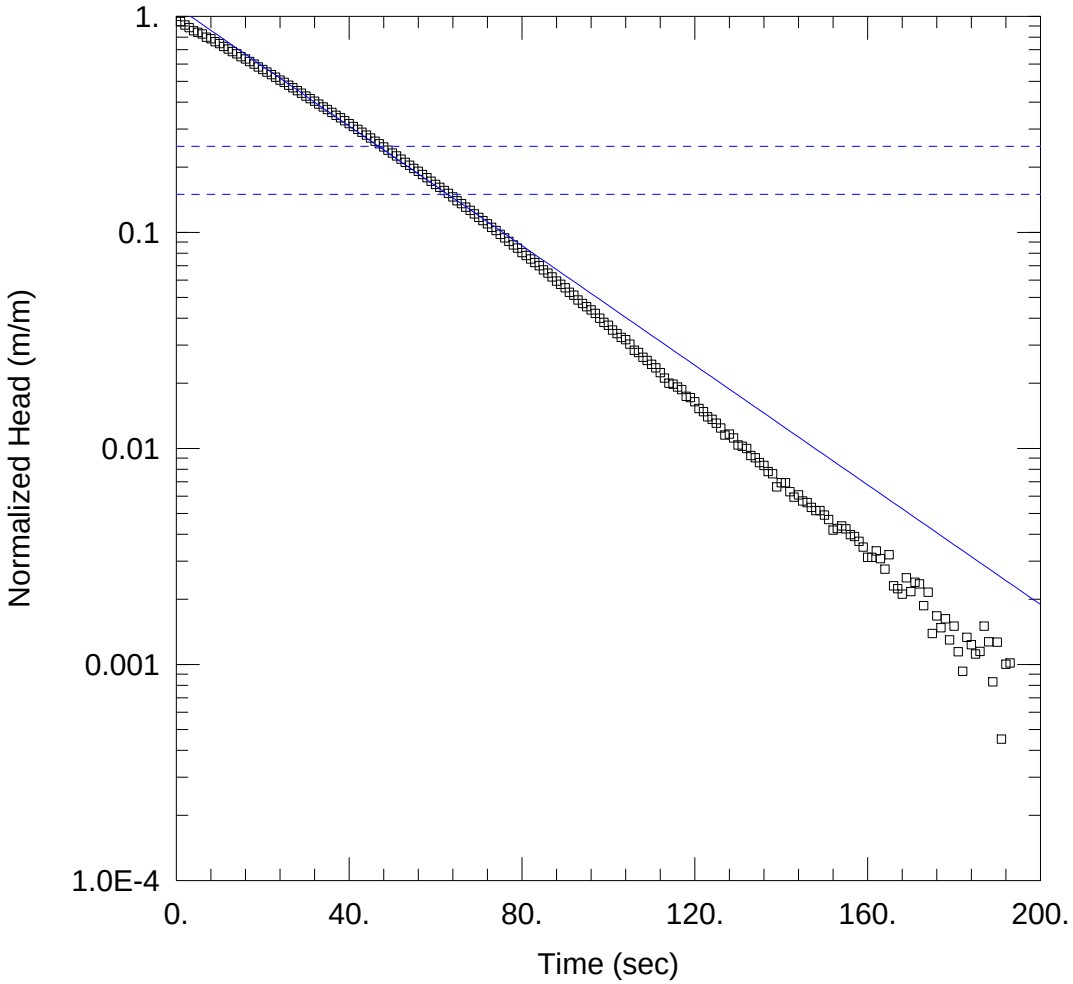
WELL DATA (NBGW814)

Initial Displacement: 5.276 m
Total Well Penetration Depth: 87.77 m
Casing Radius: 0.025 m
Static Water Column Height: 88.77 m
Screen Length: 30. m
Well Radius: 0.0665 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.1319 m/day y0 = 5.269 m



WELL TEST ANALYSIS

Data Set: C:\...\NBGW814_HV1.aqt
Date: 06/11/10 Time: 17:07:01

PROJECT INFORMATION

Company: Environmental Earth Sciences
Client: Arafura Resources
Project: 610012
Location: Aileron
Test Well: NBGW814
Test Date: 12/05/10

AQUIFER DATA

Saturated Thickness: 136.4 m Anisotropy Ratio (Kz/Kr): 1.

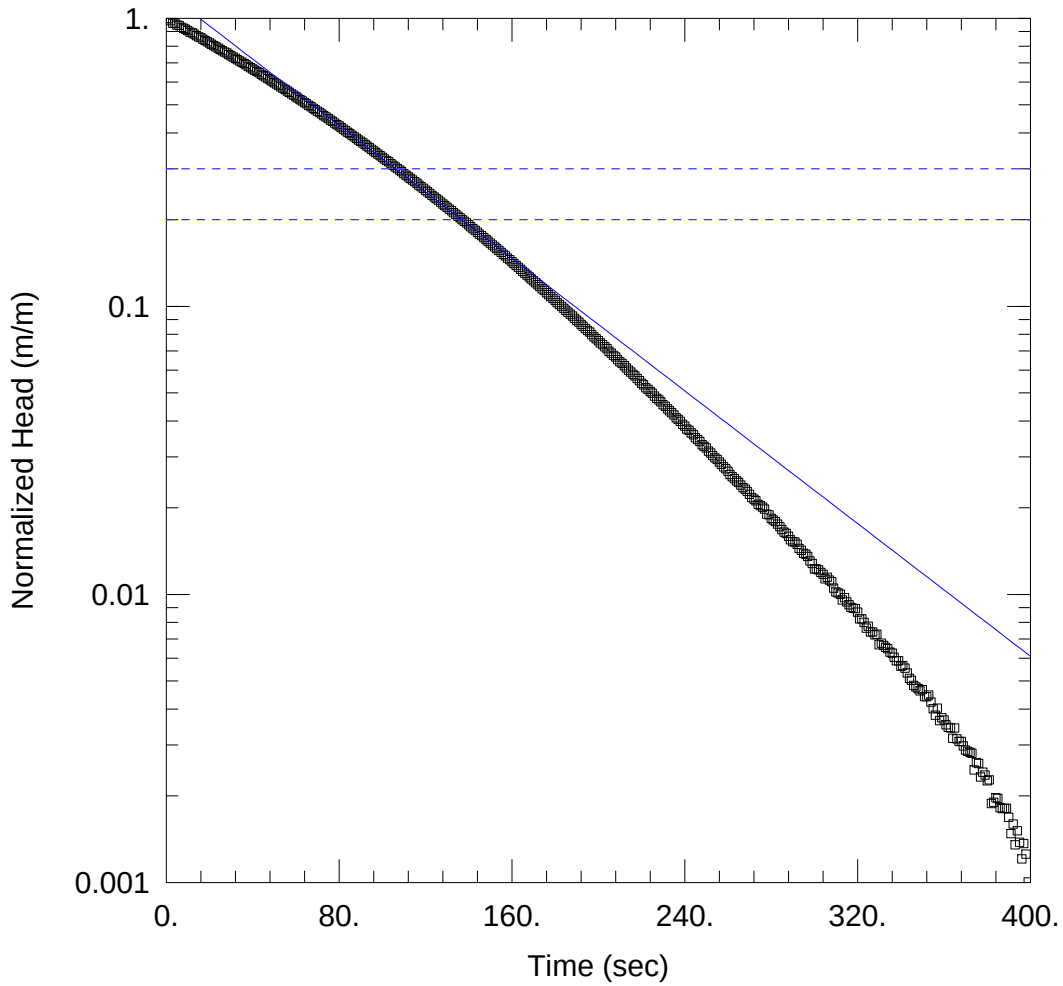
WELL DATA (NBGW814)

Initial Displacement: 5.276 m
Total Well Penetration Depth: 87.77 m
Casing Radius: 0.025 m
Static Water Column Height: 88.77 m
Screen Length: 30. m
Well Radius: 0.0665 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 0.1753 m/day y0 = 5.857 m



WELL TEST ANALYSIS

Data Set: C:\...\NBGW815_BR1.aqt
Date: 06/11/10 Time: 17:07:39

PROJECT INFORMATION

Company: Environmental Earth Sciences
Client: Arafura Resources
Project: 610012
Location: Aileron
Test Well: NBGW815
Test Date: 12/05/10

AQUIFER DATA

Saturated Thickness: 94.93 m Anisotropy Ratio (Kz/Kr): 0.5957

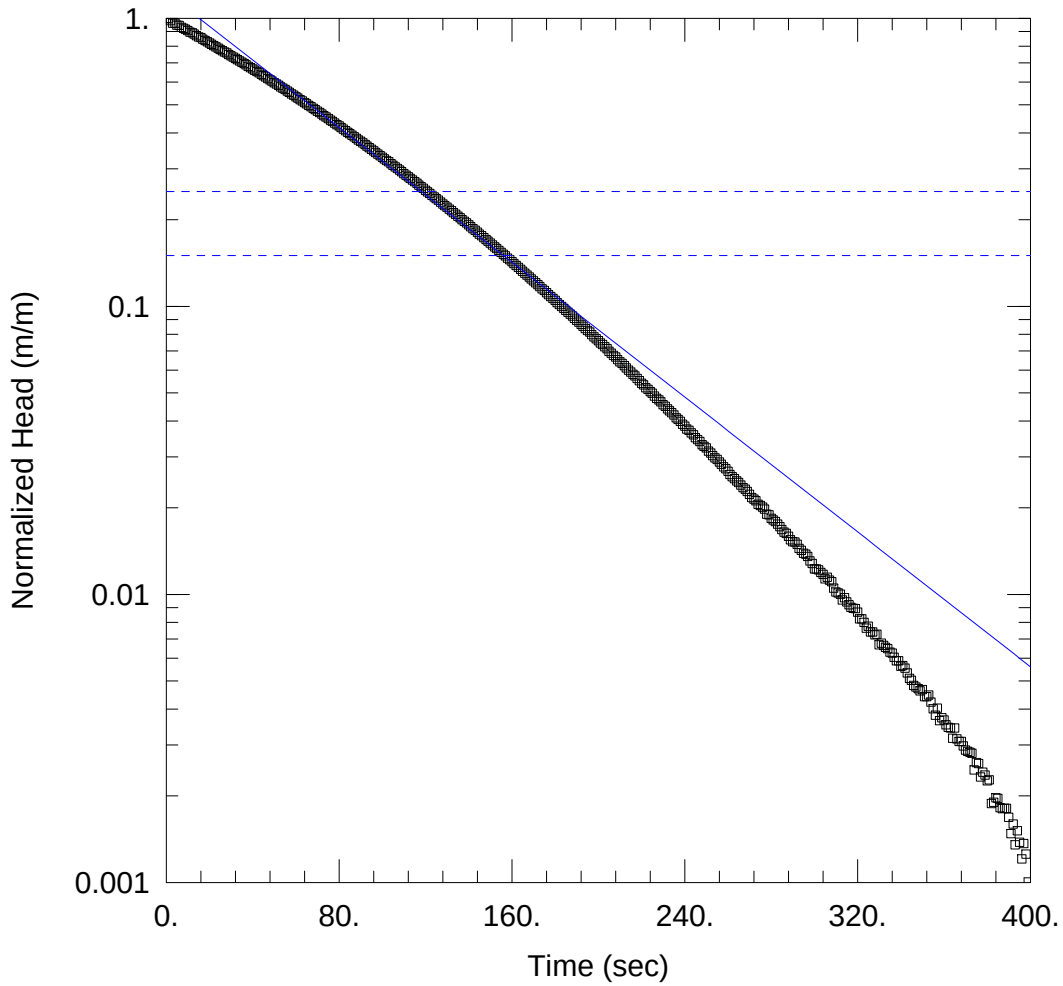
WELL DATA (NBGW815)

Initial Displacement: 12.38 m
Total Well Penetration Depth: 93.73 m
Casing Radius: 0.025 m
Static Water Column Height: 94.93 m
Screen Length: 30. m
Well Radius: 0.0665 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.06892 m/day y0 = 15.17 m



WELL TEST ANALYSIS

Data Set: C:\...\NBGW815_Hv1.aqt
Date: 06/11/10 Time: 17:07:29

PROJECT INFORMATION

Company: Environmental Earth Sciences
Client: Arafura Resources
Project: 610012
Location: Aileron
Test Well: NBGW815
Test Date: 12/05/10

AQUIFER DATA

Saturated Thickness: 94.93 m Anisotropy Ratio (Kz/Kr): 0.5957

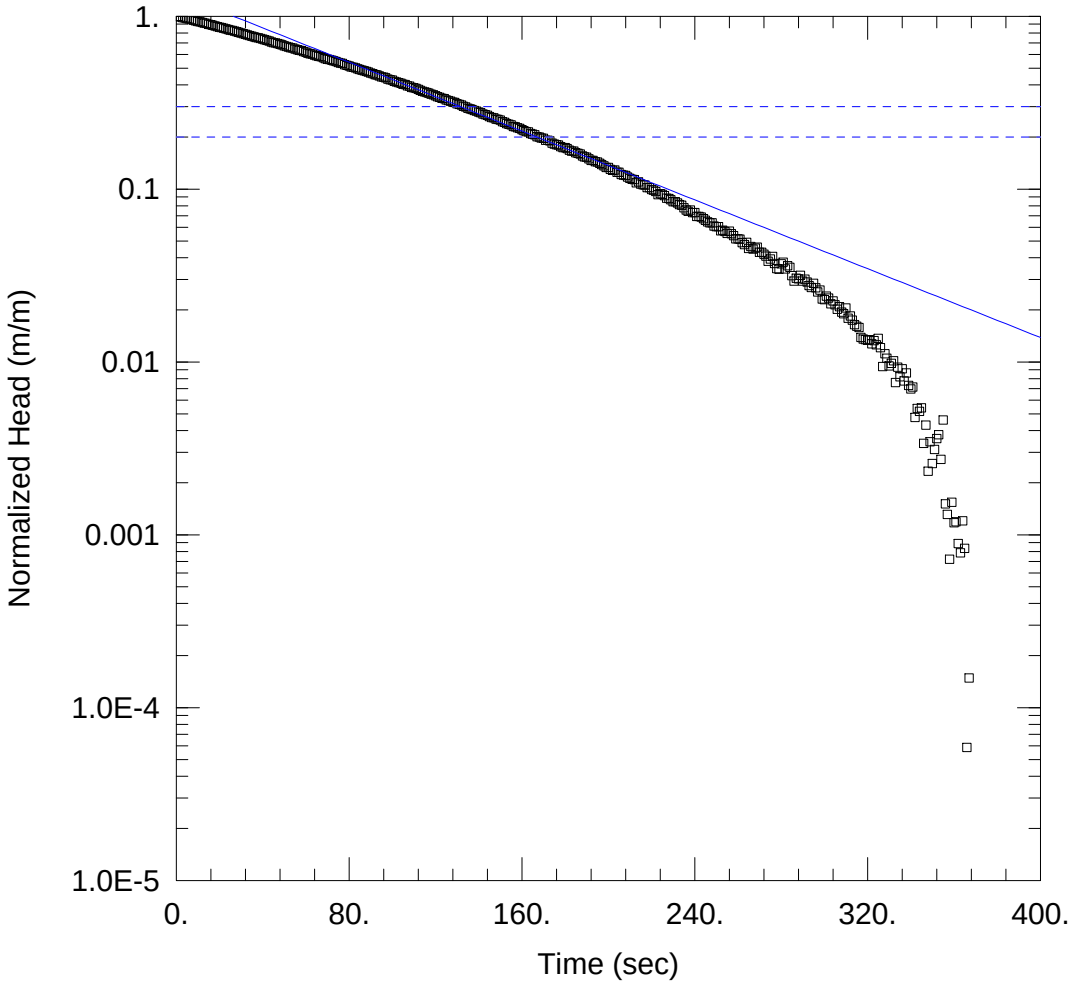
WELL DATA (NBGW815)

Initial Displacement: 12.38 m
Total Well Penetration Depth: 93.73 m
Casing Radius: 0.025 m
Static Water Column Height: 94.93 m
Screen Length: 30. m
Well Radius: 0.0665 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 0.07723 m/day y0 = 15.18 m



WELL TEST ANALYSIS

Data Set: C:\...\NBGW816_BR1.aqt
Date: 06/11/10 Time: 17:08:11

PROJECT INFORMATION

Company: Environmental Earth Sciences
Client: Arafura Resources
Project: 610012
Location: Aileron
Test Well: NBGW816
Test Date: 12/05/10

AQUIFER DATA

Saturated Thickness: 107.7 m Anisotropy Ratio (Kz/Kr): 1.

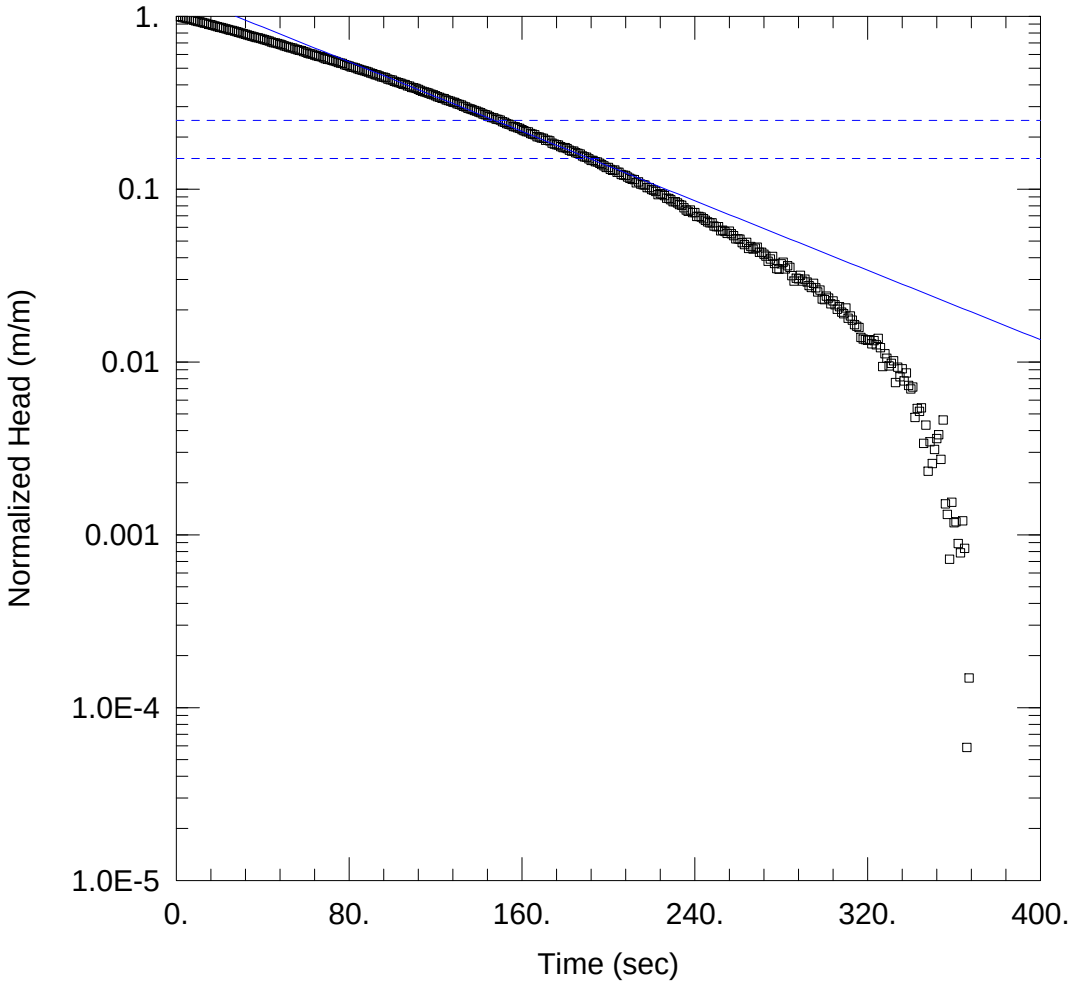
WELL DATA (NBGW816)

Initial Displacement: 12.42 m
Total Well Penetration Depth: 107. m
Casing Radius: 0.025 m
Static Water Column Height: 107.7 m
Screen Length: 30. m
Well Radius: 0.0665 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.0583 m/day y0 = 16.83 m



WELL TEST ANALYSIS

Data Set: C:\...\NBGW816_Hv1.aqt
Date: 06/11/10 Time: 17:08:01

PROJECT INFORMATION

Company: Environmental Earth Sciences
Client: Arafura Resources
Project: 610012
Location: Aileron
Test Well: NBGW816
Test Date: 12/05/10

AQUIFER DATA

Saturated Thickness: 107.7 m Anisotropy Ratio (Kz/Kr): 1.

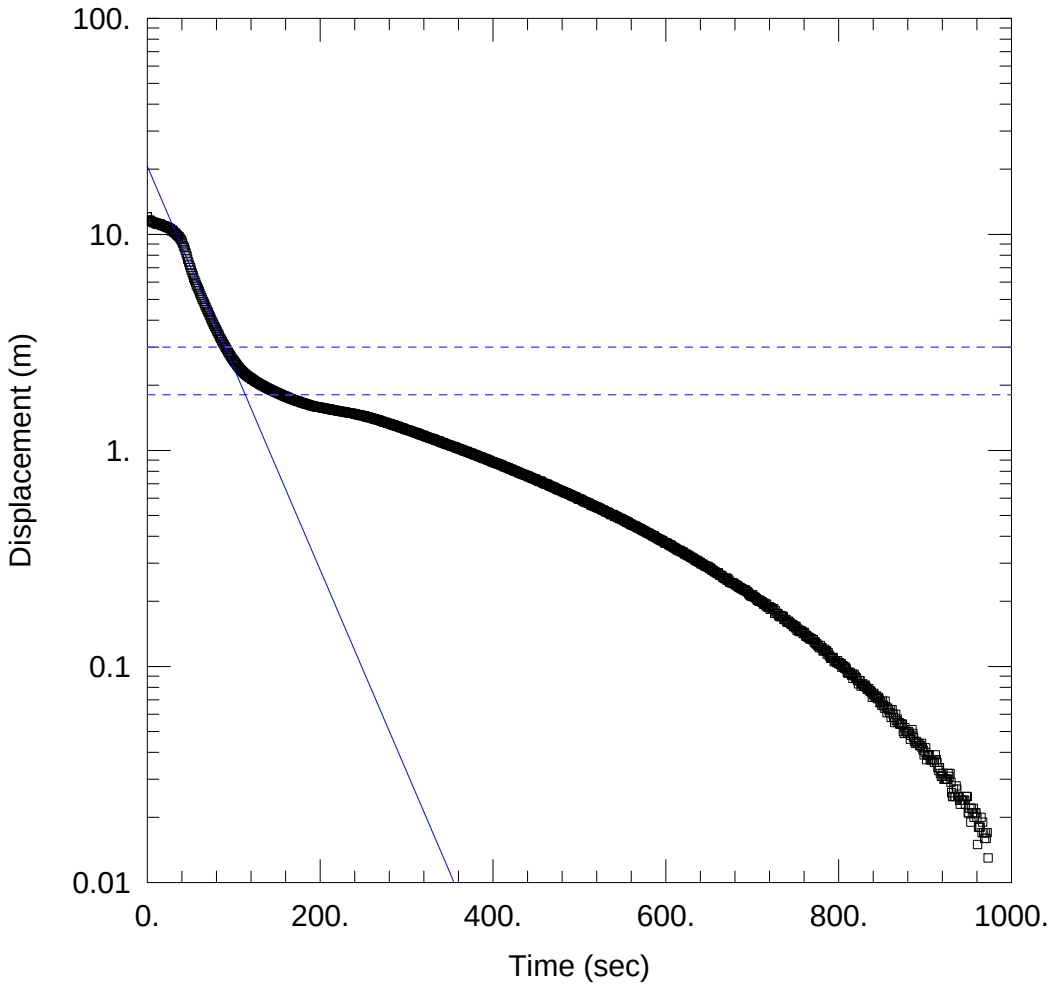
WELL DATA (NBGW816)

Initial Displacement: 12.42 m
Total Well Penetration Depth: 107. m
Casing Radius: 0.025 m
Static Water Column Height: 107.7 m
Screen Length: 30. m
Well Radius: 0.0665 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 0.06364 m/day y0 = 17.07 m



WELL TEST ANALYSIS

Data Set: C:\...\NBGW817_Hv1.aqt
Date: 06/11/10 Time: 17:09:34

PROJECT INFORMATION

Company: Environmental Earth Sciences
Client: Arafura Resources
Project: 610012
Location: Aileron
Test Well: NBGW817
Test Date: 12/05/10

AQUIFER DATA

Saturated Thickness: 107. m Anisotropy Ratio (Kz/Kr): 1.

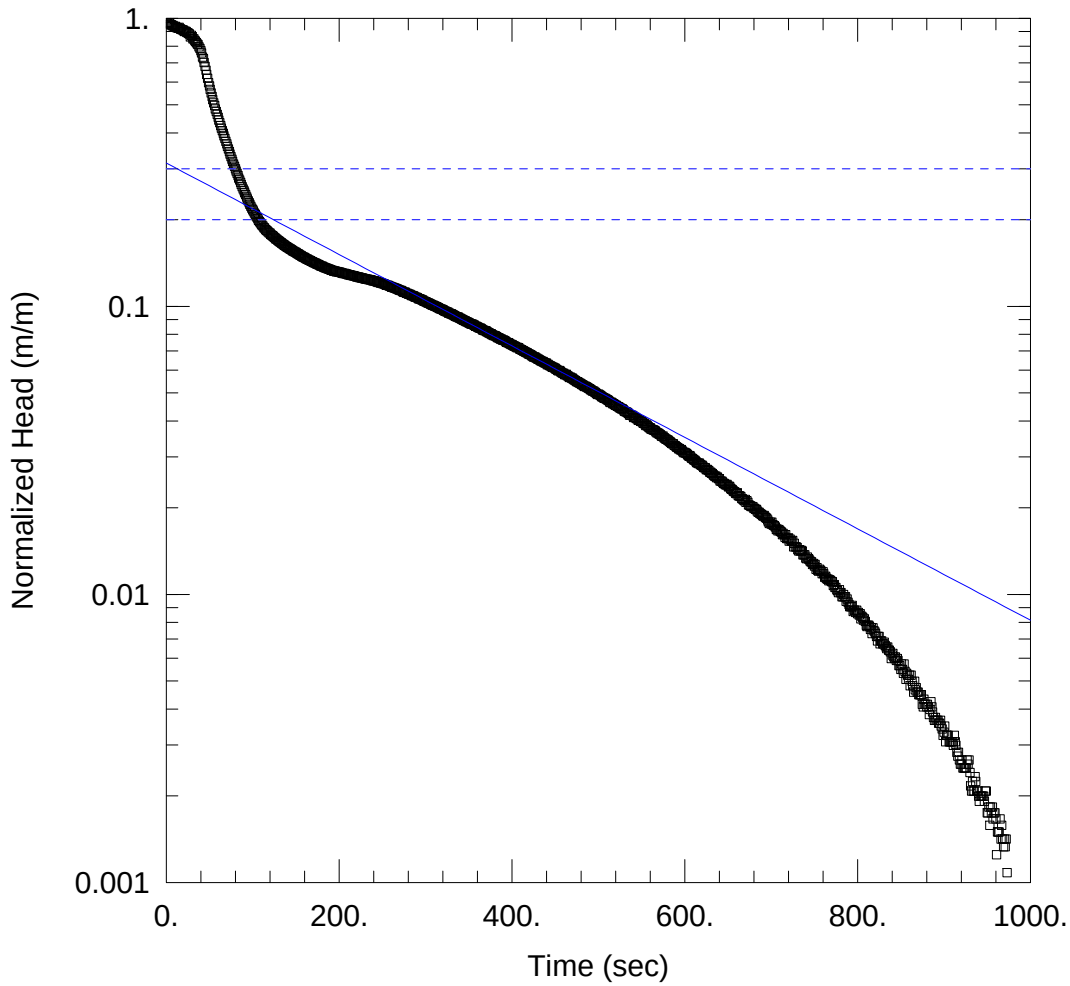
WELL DATA (NBGW817)

Initial Displacement: 12.03 m
Total Well Penetration Depth: 105.6 m
Casing Radius: 0.025 m
Static Water Column Height: 107. m
Screen Length: 30. m
Well Radius: 0.0665 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 0.1182 m/day y0 = 20.62 m



WELL TEST ANALYSIS

Data Set: C:\...\NBGW817_BR2.aqt
Date: 06/11/10 Time: 17:09:22

PROJECT INFORMATION

Company: Environmental Earth Sciences
Client: Arafura Resources
Project: 610012
Location: Aileron
Test Well: NBGW817
Test Date: 12/05/10

AQUIFER DATA

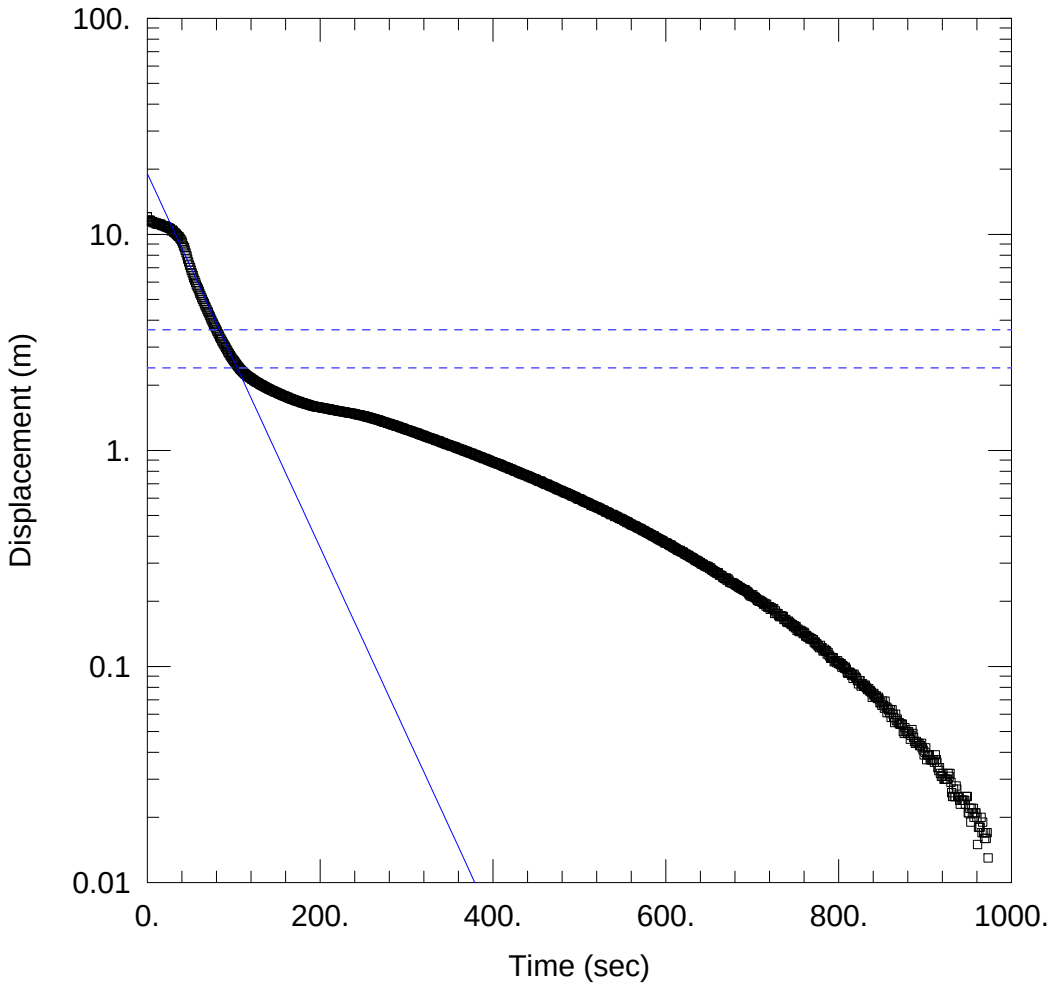
Saturated Thickness: 107. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (NBGW817)

Initial Displacement: 12.03 m
Total Well Penetration Depth: 105.6 m
Casing Radius: 0.025 m
Static Water Column Height: 107. m
Screen Length: 30. m
Well Radius: 0.0665 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.01825 m/day
y0 = 3.78 m



WELL TEST ANALYSIS

Data Set: C:\...\NBGW817_BR1.aqt
Date: 06/11/10 Time: 17:09:44

PROJECT INFORMATION

Company: Environmental Earth Sciences
Client: Arafura Resources
Project: 610012
Location: Aileron
Test Well: NBGW817
Test Date: 12/05/10

AQUIFER DATA

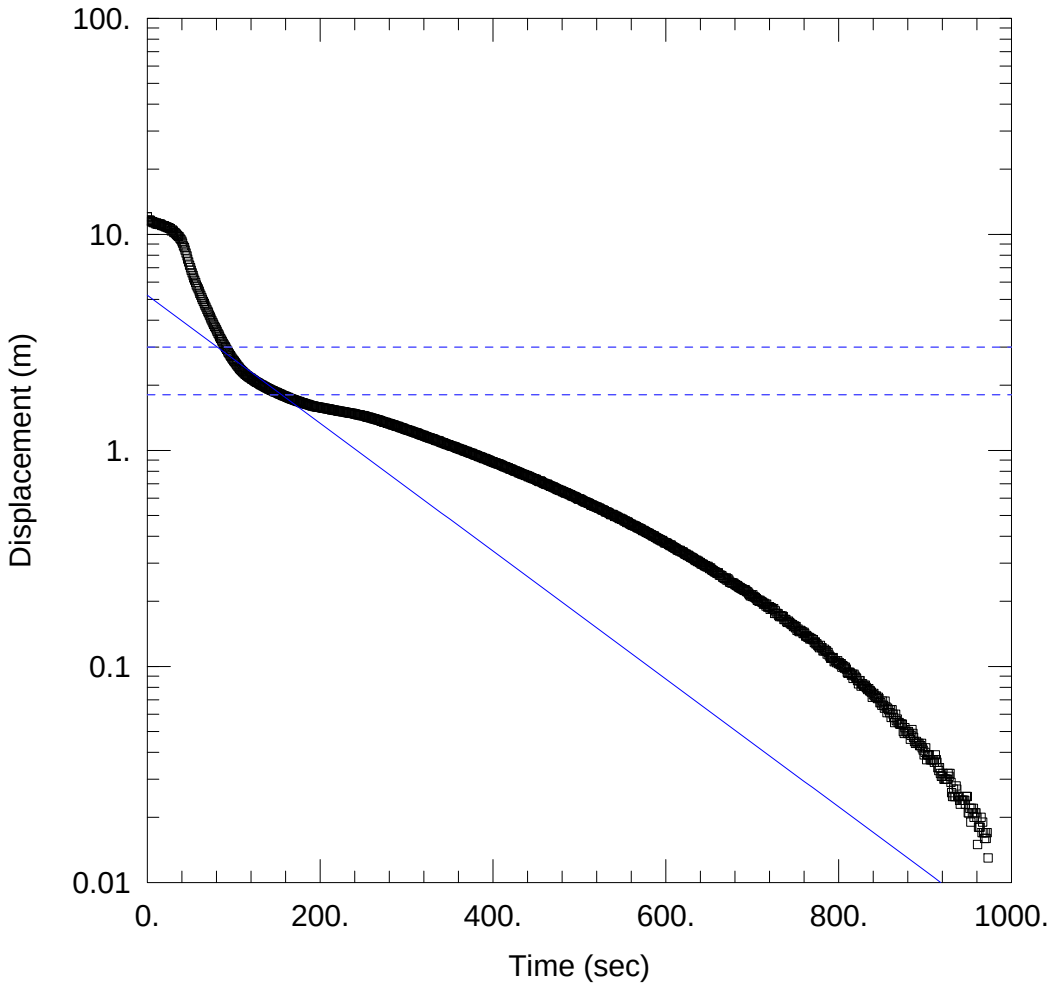
Saturated Thickness: 107. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (NBGW817)

Initial Displacement: 12.03 m
Total Well Penetration Depth: 105.6 m
Casing Radius: 0.025 m
Static Water Column Height: 107. m
Screen Length: 30. m
Well Radius: 0.0665 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.09952 m/day
y0 = 19.11 m



WELL TEST ANALYSIS

Data Set: C:\...\NBGW817_Hv2.aqt
Date: 06/11/10 Time: 17:09:12

PROJECT INFORMATION

Company: Environmental Earth Sciences
Client: Arafura Resources
Project: 610012
Location: Aileron
Test Well: NBGW817
Test Date: 12/05/10

AQUIFER DATA

Saturated Thickness: 107. m Anisotropy Ratio (Kz/Kr): 1.

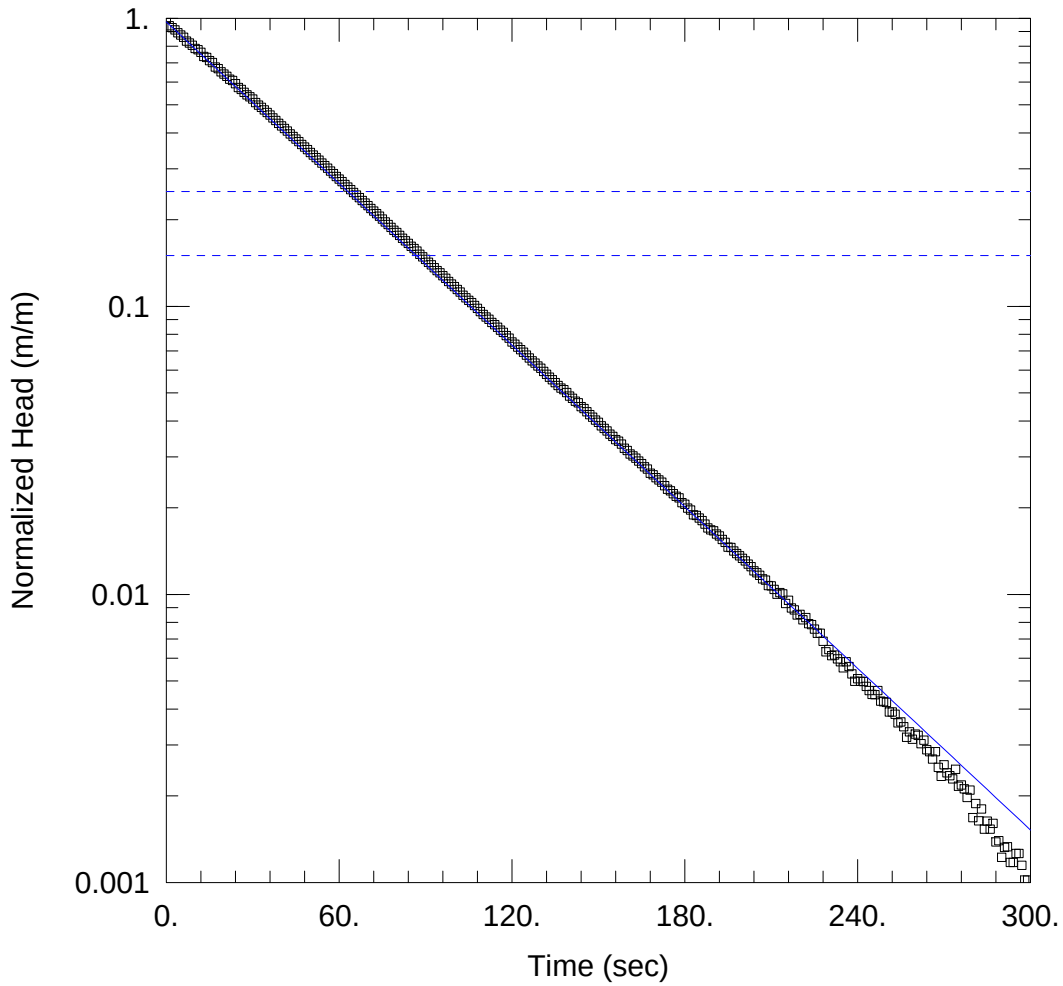
WELL DATA (NBGW817)

Initial Displacement: 12.03 m
Total Well Penetration Depth: 105.6 m
Casing Radius: 0.025 m
Static Water Column Height: 107. m
Screen Length: 30. m
Well Radius: 0.0665 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 0.03748 m/day y0 = 5.215 m



WELL TEST ANALYSIS

Data Set: C:\...\NBGW818_Hv.aqt
Date: 06/11/10 Time: 17:10:35

PROJECT INFORMATION

Company: Environmental Earth Sciences
Client: Arafura Resources
Project: 610012
Location: Aileron
Test Well: NBGW818
Test Date: 12/05/10

AQUIFER DATA

Saturated Thickness: 83.73 m Anisotropy Ratio (Kz/Kr): 1.

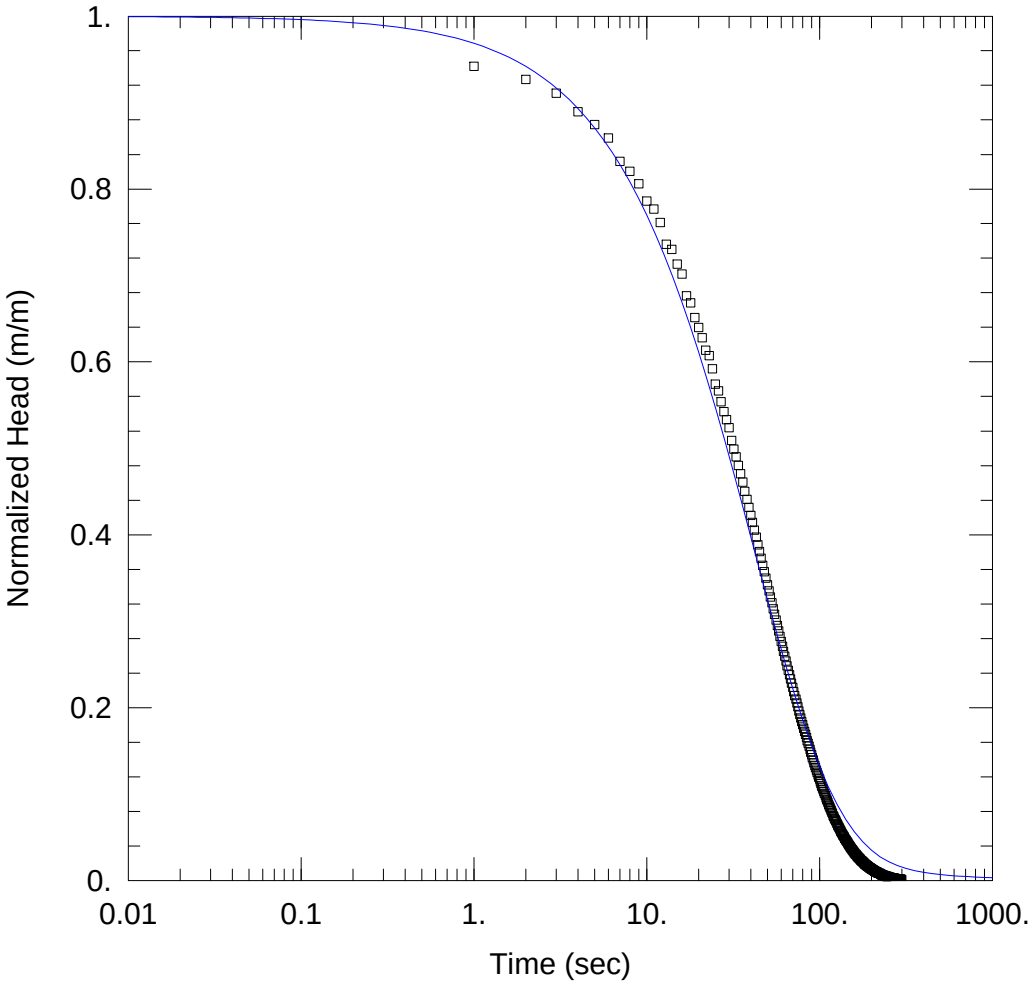
WELL DATA (NBGW818)

Initial Displacement: 12.01 m
Total Well Penetration Depth: 81.73 m
Casing Radius: 0.025 m
Static Water Column Height: 83.73 m
Screen Length: 27. m
Well Radius: 0.0665 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 0.1293 m/day y0 = 11.67 m



WELL TEST ANALYSIS

Data Set: C:\...\NBGW818_Cooper.aqt
Date: 06/11/10 Time: 17:10:24

PROJECT INFORMATION

Company: Environmental Earth Sciences
Client: Arafura Resources
Project: 610012
Location: Aileron
Test Well: NBGW818
Test Date: 12/05/10

AQUIFER DATA

Saturated Thickness: 83.73 m Anisotropy Ratio (Kz/Kr): 1.

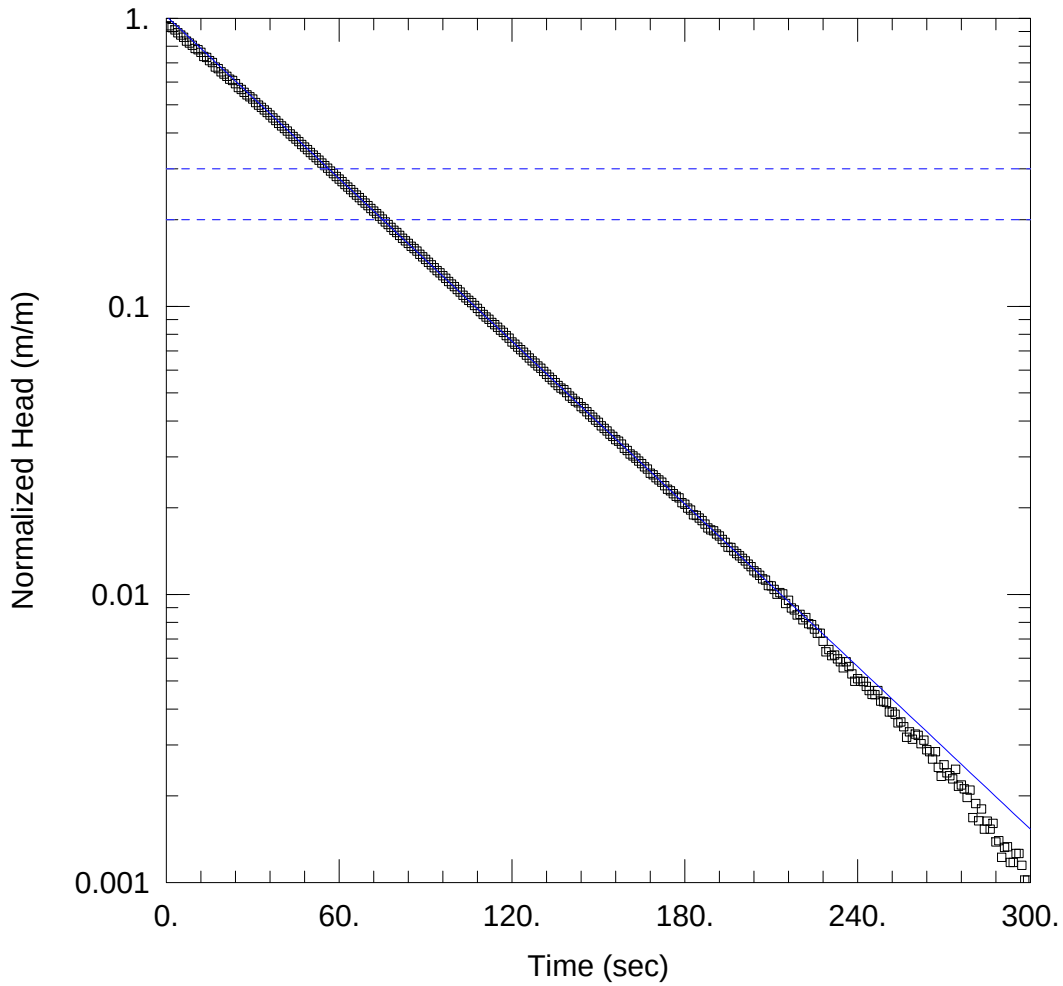
WELL DATA (NBGW818)

Initial Displacement: 12.01 m
Total Well Penetration Depth: 81.73 m
Casing Radius: 0.025 m
Static Water Column Height: 83.73 m
Screen Length: 27. m
Well Radius: 0.0665 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined Solution Method: Cooper-Bredehoeft-Papadopulos

T = 4.783 m^2/day S = 1.66E-7



WELL TEST ANALYSIS

Data Set: C:\...\NBGW818_BR.aqt
Date: 06/11/10 Time: 17:10:49

PROJECT INFORMATION

Company: Environmental Earth Sciences
Client: Arafura Resources
Project: 610012
Location: Aileron
Test Well: NBGW818
Test Date: 12/05/10

AQUIFER DATA

Saturated Thickness: 83.73 m Anisotropy Ratio (Kz/Kr): 1.

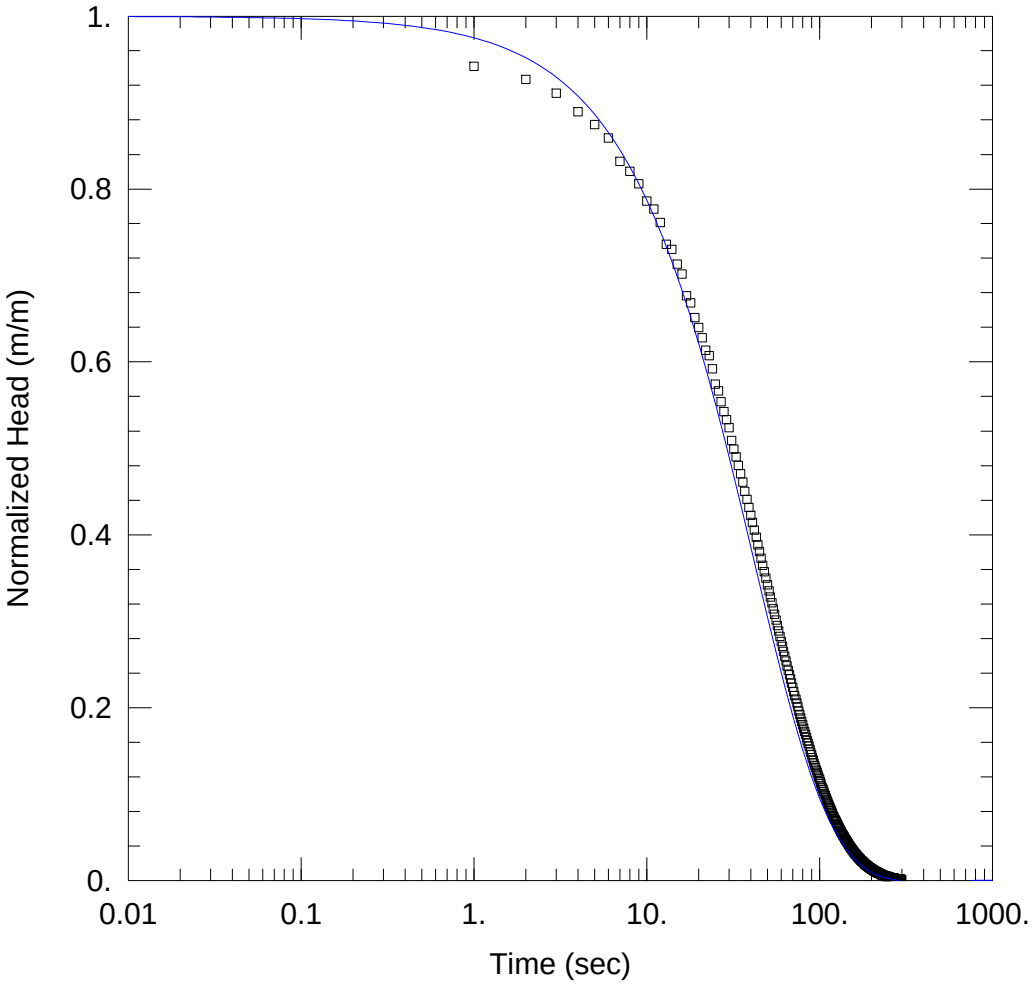
WELL DATA (NBGW818)

Initial Displacement: 12.01 m
Total Well Penetration Depth: 81.73 m
Casing Radius: 0.025 m
Static Water Column Height: 83.73 m
Screen Length: 27. m
Well Radius: 0.0665 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.1145 m/day y0 = 12.23 m



WELL TEST ANALYSIS

Data Set: C:\...\NBGW818_KGS.aqt
Date: 06/11/10 Time: 17:10:13

PROJECT INFORMATION

Company: Environmental Earth Sciences
Client: Arafura Resources
Project: 610012
Location: Aileron
Test Well: NBGW818
Test Date: 12/05/10

AQUIFER DATA

Saturated Thickness: 83.73 m

WELL DATA (NBGW818)

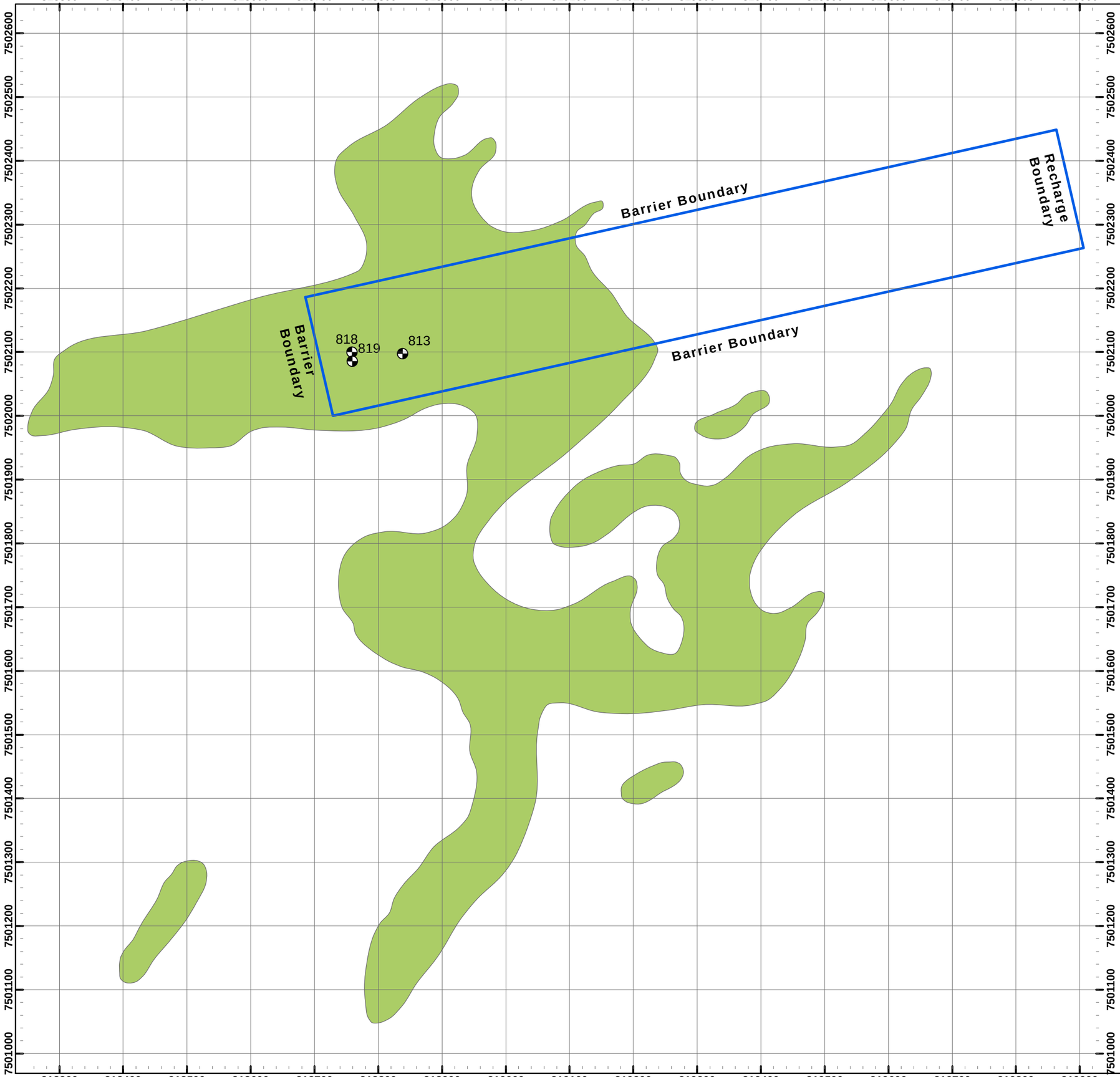
Initial Displacement: 12.01 m
Total Well Penetration Depth: 81.73 m
Casing Radius: 0.025 m
Well Skin Radius: 0.0665 m
Static Water Column Height: 83.73 m
Screen Length: 27. m
Well Radius: 0.0665 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model w/skin

Kr = 0.1424 m/day
Kz/Kr = 1.
Ss' = 0.001 m^{-1}
Ss = 8.652E-10 m^{-1}
Kr' = 0.06818 m/day
Kz/Kr' = 1.

APPENDIX D AQUIFER PROPERTY AND FORWARD PREDICTION ANALYSES



Legend

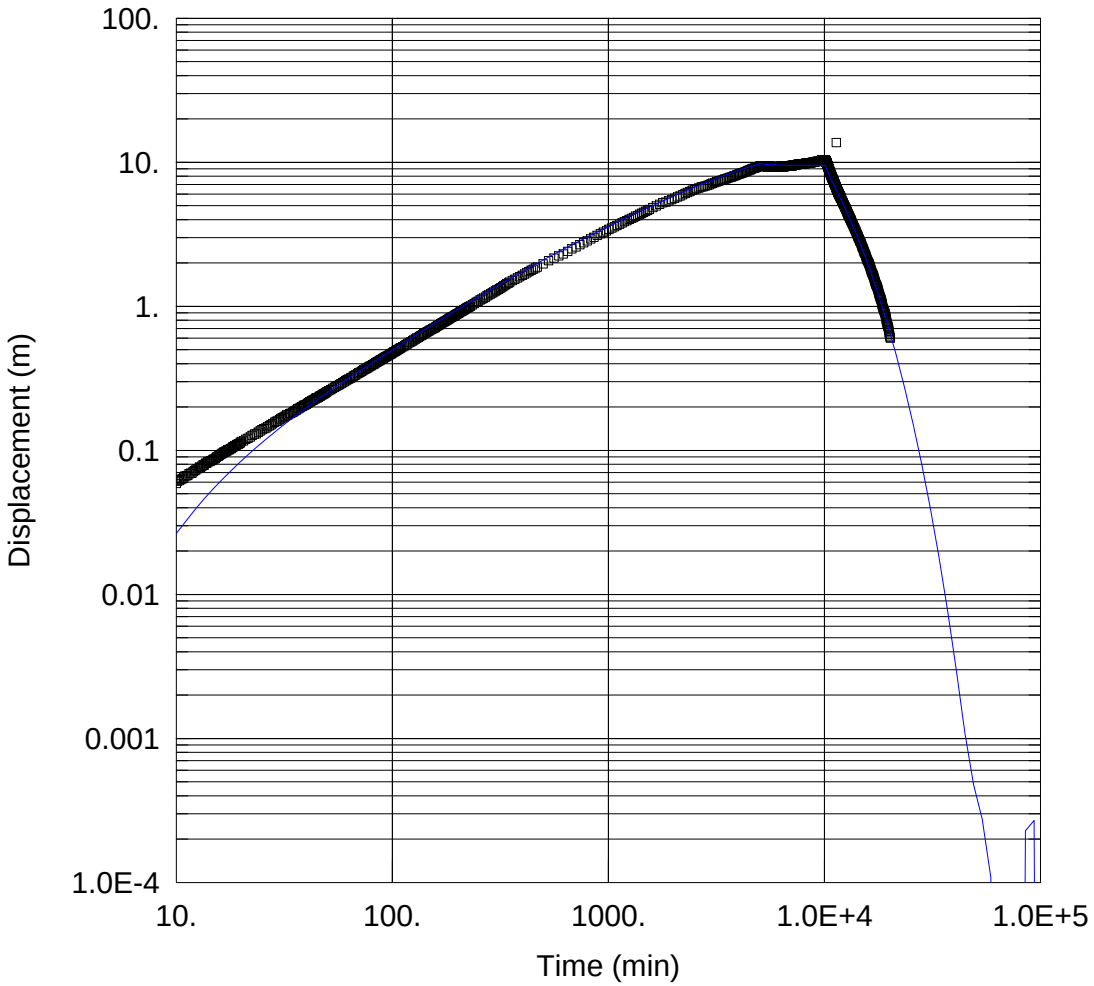
- Mineralisation envelope
- Boundaries
- Bore Locations

0 125 250 500 Meters

ENVIRONMENTAL EARTH SCIENCES
THE KNOW AND THE HOW

Title: Boundaries used in analysis of 818	
Location: Arafura, NT	
Client: Arafura Resources	Job number: 610012
Proj Man: KK	Source: Environmental Earth Sciences
Drawn by: PF	Date: July 2011

Figure D1



WELL TEST ANALYSIS

Data Set: C:\...\NBGW813_theis.aqt
Date: 07/11/11 Time: 14:56:41

PROJECT INFORMATION

Company: Environmental Earth Sciences
Client: Arafura Resources
Project: 610012
Location: Aileron Station
Test Date: 13/03/2010

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
NBGW819	549	145

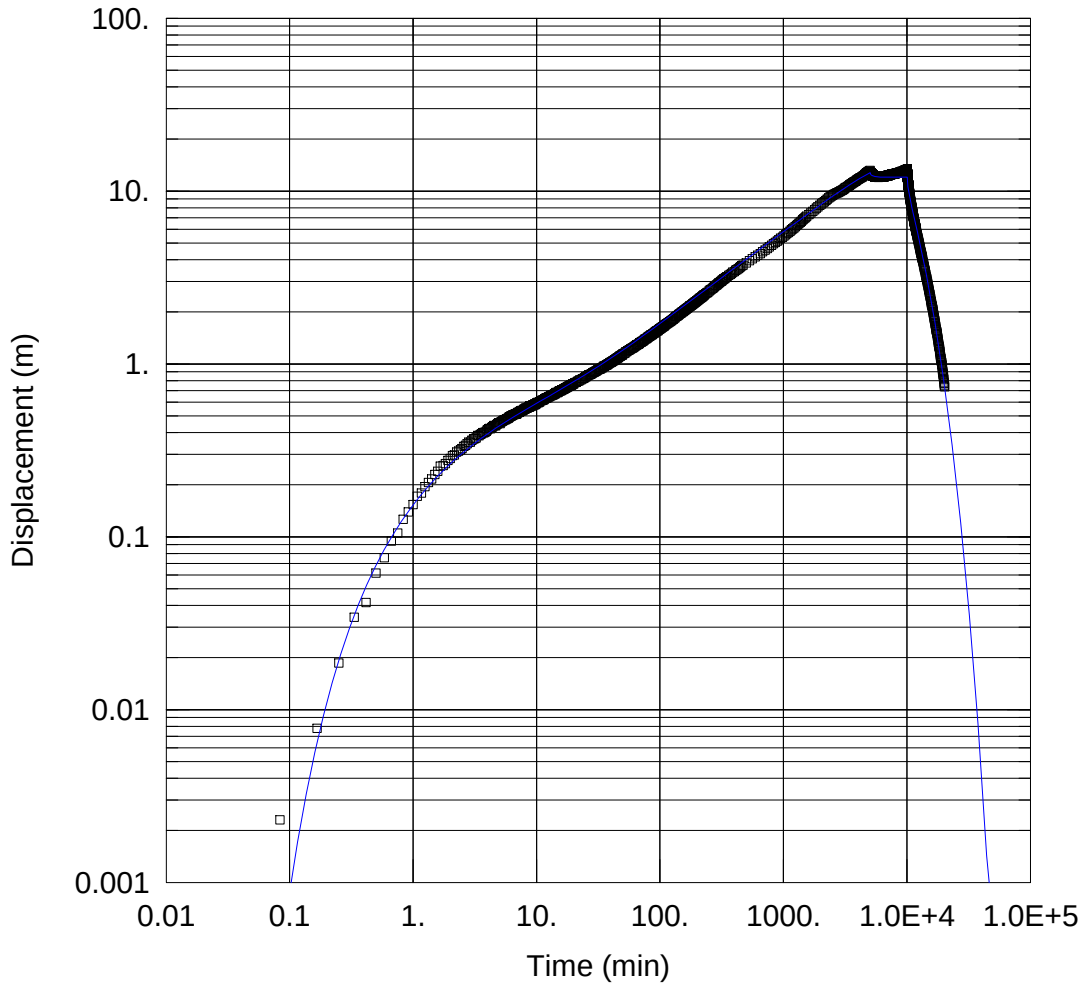
Observation Wells

Well Name	X (m)	Y (m)
▫ NBGW813	628	139

SOLUTION

Aquifer Model: Confined
Solution Method: Theis

T = 340. m^2/day
S = 0.002
Kz/Kr = 1.
b = 120. m



WELL TEST ANALYSIS

Data Set: C:\...\NBGW818_theis.aqt
Date: 07/11/11 Time: 14:56:07

PROJECT INFORMATION

Company: Environmental Earth Sciences
Client: Arafura Resources
Project: 610012
Location: Aileron Station
Test Date: 13/03/2010

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
NBGW819	549	145

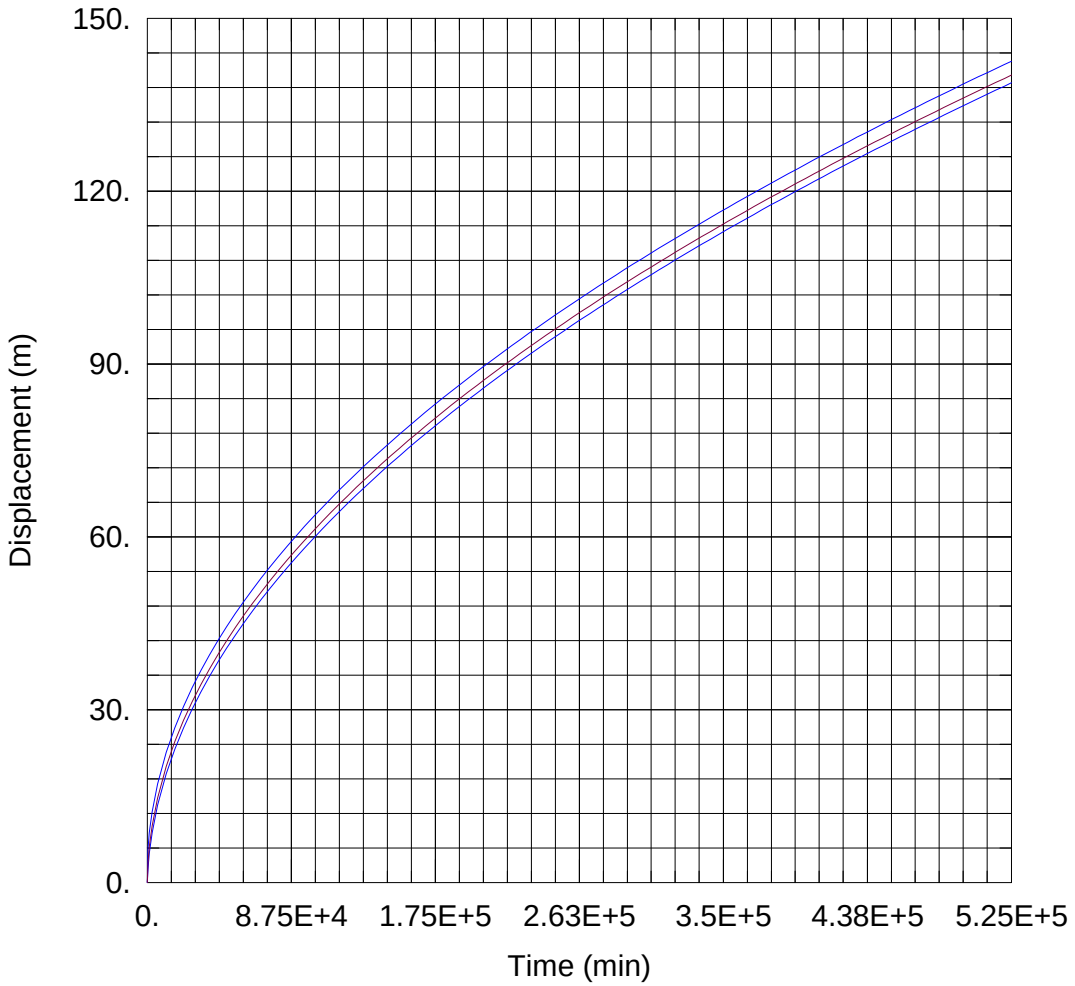
Observation Wells

Well Name	X (m)	Y (m)
▫ NBGW818	552	160

SOLUTION

Aquifer Model: Confined
Solution Method: Theis

T = 322.6 m^2/day
S = 0.0015
Kz/Kr = 1.
b = 120. m



WELL TEST ANALYSIS

Data Set: C:\...\NBGW818_theis_forward_no_recharge.aqt
Date: 07/11/11 Time: 15:00:21

PROJECT INFORMATION

Company: Environmental Earth Sciences
Client: Arafura Resources
Project: 610012
Location: Aileron Station
Test Date: 13/03/2010

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
NBGW819	549	145

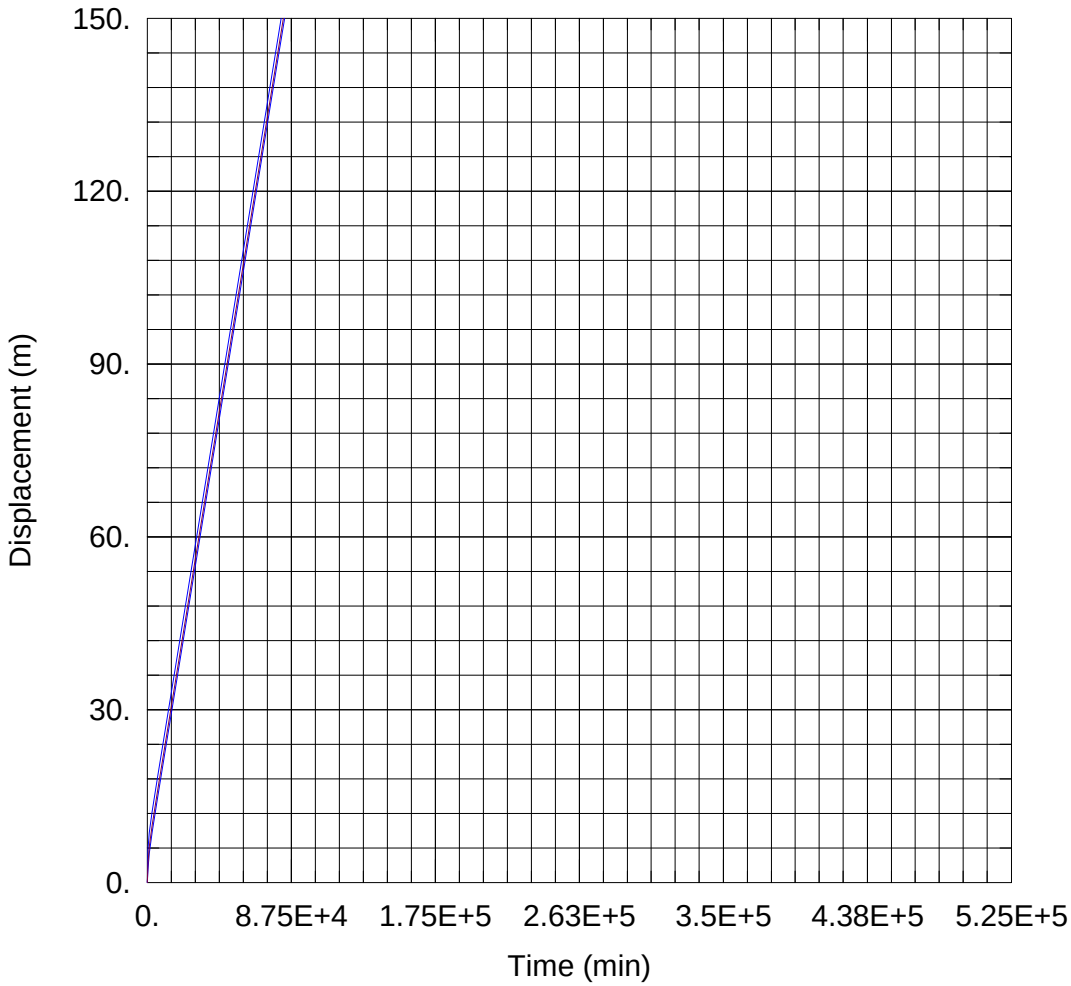
Observation Wells

Well Name	X (m)	Y (m)
▫ NBGW819	549	145
▫ Obs 1	649	145
▫ Obs 2	549	95

SOLUTION

Aquifer Model: Confined
Solution Method: Theis

T = 322.6 m^2/day
S = 0.0015
Kz/Kr = 1.
b = 120. m



WELL TEST ANALYSIS

Data Set: C:\...\NBGW818_theis_forward_no_recharge_4noflowbnds.aqt
Date: 07/11/11 Time: 14:59:08

PROJECT INFORMATION

Company: Environmental Earth Sciences
Client: Arafura Resources
Project: 610012
Location: Aileron Station
Test Date: 13/03/2010

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
NBGW819	549	145

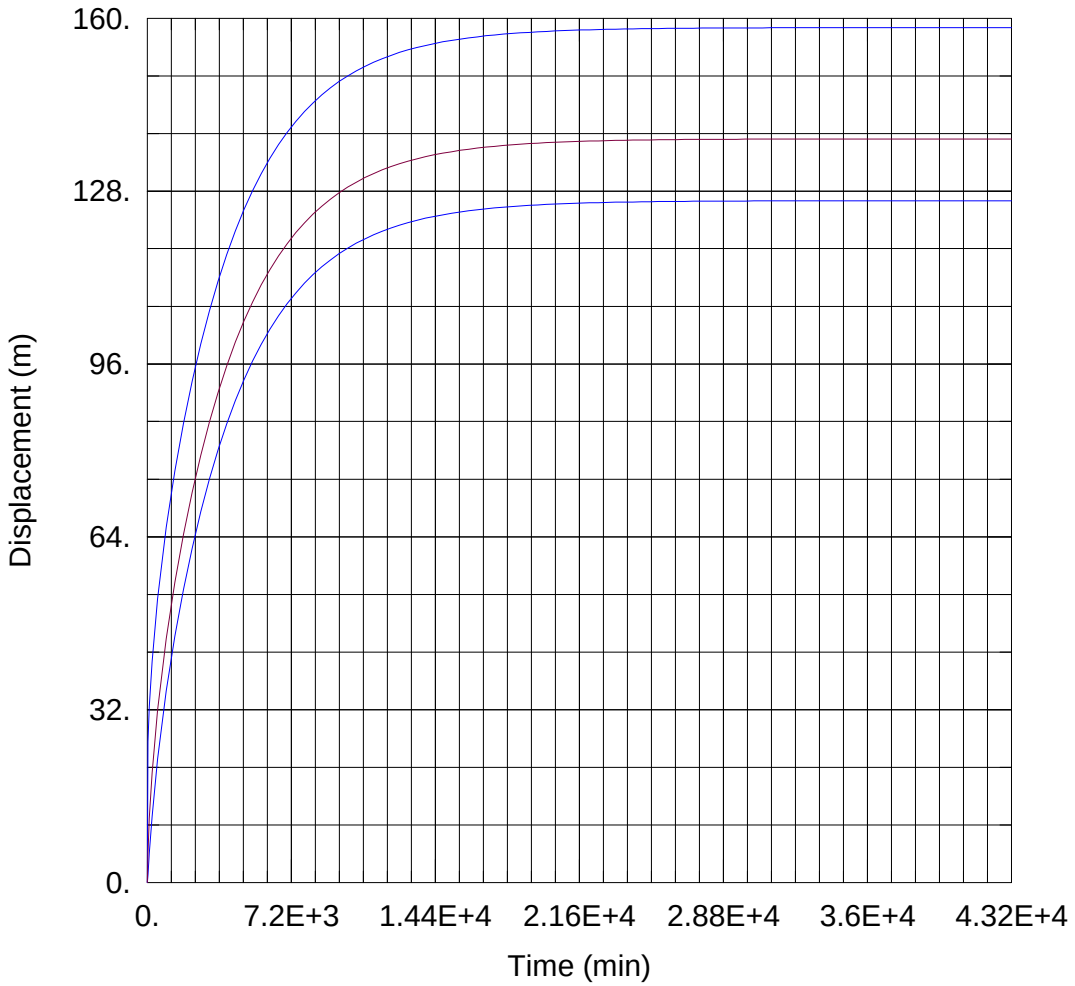
Observation Wells

Well Name	X (m)	Y (m)
▫ NBGW819	549	145
▫ Obs 1	649	145
▫ Obs 2	549	95

SOLUTION

Aquifer Model: Confined
Solution Method: Theis

T = 322.6 m^2/day
S = 0.0015
Kz/Kr = 1.
b = 120. m



WELL TEST ANALYSIS

Data Set: C:\...\NBGW818_theis_forward_with_recharge.aqt
Date: 07/11/11 Time: 14:55:11

PROJECT INFORMATION

Company: Environmental Earth Sciences
Client: Arafura Resources
Project: 610012
Location: Aileron Station
Test Date: 13/03/2010

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
NBGW819	549	145

Observation Wells

Well Name	X (m)	Y (m)
▫ NBGW819	549	145
▫ Obs 1	649	145
▫ Obs 2	549	95

SOLUTION

Aquifer Model: Confined
Solution Method: Theis

T = 322.6 m^2/day
S = 0.0015
Kz/Kr = 1.
b = 120. m

APPENDIX E LABORATORY TRANSCRIPTS AND CHAIN OF CUSTODY FORMS

CERTIFICATE OF ANALYSIS

Work Order	: **EB1105257**	Page	: 1 of 5
Client	: **ENVIRONMENTAL EARTH SCIENCES**	Laboratory	: Environmental Division Brisbane
Contact	: MR MARK STUCKEY	Contact	: Bryn Stephens
Address	: Unit 3/ 1 Ross Street NEWSTEAD QLD, AUSTRALIA 4006	Address	: 32 Shand Street Stafford QLD Australia 4053
E-mail	: mstuckey@eesi.biz	E-mail	: Bryn.Stephens@alsglobal.com
Telephone	: +61 3852 6666	Telephone	: +617 3243 7125
Facsimile	: +61 07 38656300	Facsimile	: +617 3243 7181
Project	: 610012	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 18-MAR-2011
Sampler	: Katy Kijek	Issue Date	: 30-MAR-2011
Site	: Nolans bore		
		No. of samples received	: 1
Quote number	: EN/010/10	No. of samples analysed	: 1

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

NATA Accredited Laboratory 825

This document is issued in accordance with NATA accreditation requirements.

Accredited for compliance with ISO/IEC 17025.

Signatories

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

Signatories	*Position*	*Accreditation Category*
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics
Kim McCabe	Senior Inorganic Chemist	WB Water Lab Brisbane

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 insuffient 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

Analytical Results

Sub-Matrix: **WATER**

Compound	CAS Number	LOR	Unit	Client sample ID: NBGW 819	----	----	----	----
				Client sampling date / time: 16-MAR-2011 09:45	----	----	----	----
				EB1105257-001	----	----	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**7.86**	----	----	----	----
EA015: Total Dissolved Solids								
^ Total Dissolved Solids @180°C	GIS-210-010	5	mg/L	**4430**	----	----	----	----
EA025: Suspended Solids								
^ Suspended Solids (SS)	----	5	mg/L	**20**	----	----	----	----
EA045: Turbidity								
Turbidity	----	0.1	NTU	**3.8**	----	----	----	----
ED009: Anions								
Bromide	24959-67-9	0.02	mg/L	**12.7**	----	----	----	----
Iodide	20461-54-5	0.010	mg/L	**0.400**	----	----	----	----
ED037P: Alkalinity by PC Titrator								
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**800**	----	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**800**	----	----	----	----
ED040F: Dissolved Major Anions								
Sulfate as SO4 2-	14808-79-8	1	mg/L	**694**	----	----	----	----
Silicon	7440-21-3	0.05	mg/L	**35.0**	----	----	----	----
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	1	mg/L	**1490**	----	----	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**166**	----	----	----	----
Magnesium	7439-95-4	1	mg/L	**212**	----	----	----	----
Sodium	7440-23-5	1	mg/L	**1040**	----	----	----	----
Potassium	7440-09-7	1	mg/L	**36**	----	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	<0.01	----	----	----	----
Arsenic	7440-38-2	0.001	mg/L	**0.001**	----	----	----	----
Bismuth	7440-69-9	0.001	mg/L	<0.001	----	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	----	----	----	----
Chromium	7440-47-3	0.001	mg/L	**0.002**	----	----	----	----
Cerium	7440-45-1	0.001	mg/L	<0.001	----	----	----	----
Copper	7440-50-8	0.001	mg/L	<0.001	----	----	----	----
Caesium	7440-46-2	0.001	mg/L	<0.001	----	----	----	----
Manganese	7439-96-5	0.001	mg/L	**0.004**	----	----	----	----
Nickel	7440-02-0	0.001	mg/L	<0.001	----	----	----	----
Dysprosium	7429-91-6	0.001	mg/L	<0.001	----	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	----	----	----	----
Erbium	7440-52-0	0.001	mg/L	<0.001	----	----	----	----

Analytical Results

Sub-Matrix: WATER				Client sample ID	NBGW 819	----	----	----	----
				Client sampling date / time	16-MAR-2011 09:45	----	----	----	----
Compound	CAS Number	LOR	Unit		EB1105257-001	----	----	----	----
EG020F: Dissolved Metals by ICP-MS - Continued									
Europium	7440-53-1	0.001	mg/L		<0.001	----	----	----	----
Gadolinium	7440-54-2	0.001	mg/L		<0.001	----	----	----	----
Hafnium	7440-58-6	0.01	mg/L		<0.01	----	----	----	----
Holmium	7440-60-0	0.001	mg/L		<0.001	----	----	----	----
Zinc	7440-66-6	0.005	mg/L		<0.005	----	----	----	----
Lanthanum	7439-91-0	0.001	mg/L		<0.001	----	----	----	----
Lutetium	7439-94-3	0.001	mg/L		<0.001	----	----	----	----
Neodymium	7440-00-8	0.001	mg/L		<0.001	----	----	----	----
Praseodymium	7440-10-0	0.001	mg/L		<0.001	----	----	----	----
Rubidium	7440-17-7	0.001	mg/L		**0.010**	----	----	----	----
Samarium	7440-19-9	0.001	mg/L		<0.001	----	----	----	----
Silver	7440-22-4	0.001	mg/L		<0.001	----	----	----	----
Strontium	7440-24-6	0.001	mg/L		**4.24**	----	----	----	----
Terbium	7440-27-9	0.001	mg/L		<0.001	----	----	----	----
Thorium	7440-29-1	0.001	mg/L		<0.001	----	----	----	----
Thulium	7440-30-4	0.001	mg/L		<0.001	----	----	----	----
Titanium	7440-32-6	0.01	mg/L		<0.01	----	----	----	----
Uranium	7440-61-1	0.001	mg/L		**0.334**	----	----	----	----
Ytterbium	7440-64-4	0.001	mg/L		<0.001	----	----	----	----
Yttrium	7440-65-5	0.001	mg/L		<0.001	----	----	----	----
Zirconium	7440-67-7	0.005	mg/L		<0.005	----	----	----	----
Iron	7439-89-6	0.05	mg/L		<0.05	----	----	----	----
Gold	7440-57-5	0.001	mg/L		<0.001	----	----	----	----
Tungsten	7440-33-7	0.001	mg/L		<0.001	----	----	----	----
Tantalum	7440-25-7	0.001	mg/L		<0.001	----	----	----	----
EG035F: Dissolved Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		**0.0002**	----	----	----	----
EG052F: Dissolved Silica by ICPAES									
^ Silica	7631-86-9	0.1	mg/L		**75.0**	----	----	----	----
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L		**3.0**	----	----	----	----
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L		<0.01	----	----	----	----
EK058G: Nitrate as N by Discrete Analyser									
^ Nitrate as N	14797-55-8	0.01	mg/L		**8.37**	----	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	----	0.01	mg/L		**0.02**	----	----	----	----

Analytical Results

Sub-Matrix: **WATER**

Compound	CAS Number	LOR	Unit	Client sample ID: NBGW 819	----	----	----	----
				Client sampling date / time: 16-MAR-2011 09:45	----	----	----	----
				EB1105257-001	**----**	**----**	**----**	**----**
EN055: Ionic Balance								
^ Total Anions	----	0.01	meq/L	**72.5**	----	----	----	----
^ Total Cations	----	0.01	meq/L	**72.0**	----	----	----	----
^ Ionic Balance	----	0.01	%	**0.33**	----	----	----	----

CHAIN OF CUSTODY - ANALYSIS REQUEST FORM

ENVIRONMENTAL EARTH SCIENCES
THE KNOW AND THE HOW

Job #: 610012 Site Location: Nolans bore. Sampler: Katy Kijek.

Date: 18/8/2011 Laboratory: ALS Report To: mstuckey@eesi.biz

Sample ID	pH	Sample Description: SOIL	WATER	SEDIMENT	Analysis Required: TSS	Turbidity	Silica by ICPOES	Additional metals by ICPMS 0.45µ dissolved	Bromide IC	Iodide IC	EES Ionic balance.	EES dissolved metals.				ANTICIPATED RESULTS/ TURNAROUND TIME
NBAW 819			✓		✓	✓	✓	✓	✓	✓	✓	✓				
TOTAL			1		1	1	1	1	1	1	1	1				

Environmental Division
Brisbane
Work Order
EB1105257

Telephone : +61-7-3243 7222

Turn Around: **NORMAL / 3 DAYS / 48 HRS / 24 HRS** Sheet: 1 of 1

Comments: EES Ionic balance - pH TDS Na Ca Mg K NH_4 Cl SO_4 HCO_3 NO_3 NO_2 F PO_4
EES dissolved Metals - Al As Mn Fe Cd Cr Cu Pb Ni Hg Zn (11)
Additional dissolved metals - Ag Au B Ba Be Bi Ce Co Dy Er Eu Gd Hf Ho La Li Lu Mo Nd Pr Rb Sb Se Sm Sn Sr Ta Tb Th Ti Tl Tm U V W Y Yb Zr (39)
(as per email communication with Bryn Stephens).

	Time	Date	Lab Supervisor:
Left EES Site:			
Transported By:			**We can be contacted on:**
Received Lab:			**Phone: (07) 3852 6666**
Fax Results Rec'd			**Fax: (07) 3852 5666**
Typed Results Rec'd			**Email: eesqld@eesi.biz**

SAMPLE RECEIPT NOTIFICATION (SRN)

Comprehensive Report

Work Order : **EB1105257**

Client	: **ENVIRONMENTAL EARTH SCIENCES**	Laboratory	: Environmental Division Brisbane
Contact	: MR MARK STUCKEY	Contact	: Bryn Stephens
Address	: Unit 3/ 1 Ross Street NEWSTEAD QLD, AUSTRALIA 4006	Address	: 32 Shand Street Stafford QLD Australia 4053
E-mail	: mstuckey@eesi.biz	E-mail	: Bryn.Stephens@alsglobal.com
Telephone	: +61 3852 6666	Telephone	: +617 3243 7125
Facsimile	: +61 07 38656300	Facsimile	: +617 3243 7181
Project	: 610012	Page	: 1 of 2
Order number	: ----		
C-O-C number	: ----	Quote number	: ES2010ENVEAR0204 (EN/010/10)
Site	: Nolans bore		
Sampler	: Katy Kijek	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement

Dates

Date Samples Received	: 18-MAR-2011	Issue Date	: 21-MAR-2011 14:56
Client Requested Due Date	: 28-MAR-2011	Scheduled Reporting Date	: **28-MAR-2011**

Delivery Details

Mode of Delivery	: Carrier	Temperature	: 16.0°C
No. of coolers/boxes	: 1 MEDIUM	No. of samples received	: 1
Security Seal	: Intact.	No. of samples analysed	: 1

General Comments

- This report contains the following information:
  - Sample Container(s)/Preservation Non-Compliances
  - Summary of Sample(s) and Requested Analysis
  - Requested Deliverables
- **Sample containers do not comply to pretreatment / preservation standards (AS, APHA, USEPA). Please refer to the Sample Container(s)/Preservation Non-Compliance Log at the end of this report for details.**
- **Breaches in recommended extraction / analysis holding times have occurred.**
- **pH holding time is six hours after sampling.**
- Discounted Package Prices apply only when specific ALS Group Codes ('W', 'S', 'NT' suites) are referenced on COCs.
- Please direct any turn around / technical queries to the laboratory contact designated above.
- Please direct any queries related to sample condition / numbering / breakages to Matt Goodwin.
- Analytical work for this work order will be conducted at ALS Brisbane.
- Sample Disposal - Aqueous (14 days), Solid (90 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.

Method / Client sample ID	Sample Container Received	Preferred Sample Container for Analysis
ED009 : Standard Anions		
NBGW 819	- White Plastic Bottle - Unpreserved	- Clear Plastic Bottle - Natural
ED009-X : Standard Anions (Extended Method)		
NBGW 819	- White Plastic Bottle - Unpreserved	- Clear Plastic Bottle - Natural
EG020A-F : Dissolved Metals by ICP-MS - Suite A		
NBGW 819	- White Plastic Bottle - Unpreserved	- Clear Plastic Bottle - Nitric Acid; Filtered
EG020B-F : Dissolved Metals by ICP-MS - Suite B		
NBGW 819	- White Plastic Bottle - Unpreserved	- Clear Plastic Bottle - Nitric Acid; Filtered
EG020D-F : Dissolved Metals by ICP-MS - Suite D		
NBGW 819	- White Plastic Bottle - Unpreserved	- Clear Plastic Bottle - Nitric Acid; Filtered
EG020E-F : Dissolved Metals by ICP-MS - Suite E		
NBGW 819	- White Plastic Bottle - Unpreserved	- Clear Plastic Bottle - Nitric Acid; Filtered
EG035F : Dissolved Mercury by FIMS		
NBGW 819	- White Plastic Bottle - Unpreserved	- Clear Plastic Bottle - Nitric Acid; Filtered
EK055G : Ammonia as N by Discrete analyser		
NBGW 819	- White Plastic Bottle - Unpreserved	- Clear Plastic Bottle - Sulphuric Acid

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.
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.

Matrix: **WATER**

Laboratory sample ID	Client sampling date / time	Client sample ID	WATER - EA025H Suspended Solids (High Level)	WATER - EA045 Turbidity	WATER - ED009 Standard Anions	WATER - ED009-X Standard Anions (Extended method	WATER - EES (EB) Heavy Metalls EES Heavy Metals Package	WATER - EES (EB) Ionic Balance EES Ionic Balance	WATER - EG020F Dissolved Metals by ICPMS	WATER - EG052 Silica (Total Dissolved) by ICPAES
EB1105257-001	16-MAR-2011 09:45	NBGW 819	✓	✓	✓	✓	✓	✓	✓	✓

Requested Deliverables

MR MARK STUCKEY

- *AU Certificate of Analysis - NATA (COA)	Email	mstuckey@eesi.biz
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	mstuckey@eesi.biz
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	mstuckey@eesi.biz
- A4 - AU Sample Receipt Notification - Environmental (SRN)	Email	mstuckey@eesi.biz
- A4 - AU Tax Invoice (INV)	Email	mstuckey@eesi.biz
- Chain of Custody (CoC) (COC)	Email	mstuckey@eesi.biz
- EDI Format - ENMRG (ENMRG)	Email	mstuckey@eesi.biz
- EDI Format - ESDAT (ESDAT)	Email	mstuckey@eesi.biz

THE RESULTS ADDRESS

- *AU Certificate of Analysis - NATA (COA)	Email	eesqld@eesi.biz
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	eesqld@eesi.biz
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	eesqld@eesi.biz
- A4 - AU Sample Receipt Notification - Environmental (SRN)	Email	eesqld@eesi.biz
- A4 - AU Tax Invoice (INV)	Email	eesqld@eesi.biz
- Chain of Custody (CoC) (COC)	Email	eesqld@eesi.biz
- EDI Format - ENMRG (ENMRG)	Email	eesqld@eesi.biz
- EDI Format - ESDAT (ESDAT)	Email	eesqld@eesi.biz

QUALITY CONTROL REPORT

Work Order	: **EB1105257**	Page	: 1 of 10
Client	: **ENVIRONMENTAL EARTH SCIENCES**	Laboratory	: Environmental Division Brisbane
Contact	: MR MARK STUCKEY	Contact	: Bryn Stephens
Address	: Unit 3/ 1 Ross Street NEWSTEAD QLD, AUSTRALIA 4006	Address	: 32 Shand Street Stafford QLD Australia 4053
E-mail	: mstuckey@eesi.biz	E-mail	: Bryn.Stephens@alsglobal.com
Telephone	: +61 3852 6666	Telephone	: +617 3243 7125
Facsimile	: +61 07 38656300	Facsimile	: +617 3243 7181
Project	: 610012	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Site	: Nolans bore		
C-O-C number	: ----	Date Samples Received	: 18-MAR-2011
Sampler	: Katy Kijek	Issue Date	: 30-MAR-2011
Order number	: ----		
		No. of samples received	: 1
Quote number	: EN/010/10	No. of samples analysed	: 1

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

NATA Accredited Laboratory 825

This document is issued in accordance with NATA accreditation requirements.

Accredited for compliance with ISO/IEC 17025.

Signatories

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

Signatories	*Position*	*Accreditation Category*
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics
Kim McCabe	Senior Inorganic Chemist	WB Water Lab Brisbane

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 insuffient 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

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 (%)*
EA005P: pH by PC Titrator (QC Lot: 1717747)									
EB1105256-001	Anonymous	EA005-P: pH Value	----	0.01	pH Unit	8.13	8.22	1.1	0% - 20%
EB1105262-001	Anonymous	EA005-P: pH Value	----	0.01	pH Unit	5.98	5.85	2.1	0% - 20%
EA015: Total Dissolved Solids (QC Lot: 1723162)									
EB1105195-011	Anonymous	EA015H: Total Dissolved Solids @180°C	GIS-210-010	5	mg/L	1510	1530	1.2	0% - 20%
EB1105195-020	Anonymous	EA015H: Total Dissolved Solids @180°C	GIS-210-010	5	mg/L	736	628	15.8	0% - 20%
EA025: Suspended Solids (QC Lot: 1721423)									
EB1105208-001	Anonymous	EA025H: Suspended Solids (SS)	----	5	mg/L	<5	<5	0.0	No Limit
EB1105257-001	NBGW 819	EA025H: Suspended Solids (SS)	----	5	mg/L	20	19	6.4	No Limit
EA045: Turbidity (QC Lot: 1715311)									
EB1105161-001	Anonymous	EA045: Turbidity	----	0.1	NTU	1.1	1.3	16.7	0% - 50%
EB1105180-003	Anonymous	EA045: Turbidity	----	0.1	NTU	1200	1200	0.0	0% - 20%
ED009: Anions (QC Lot: 1718276)									
EB1105196-001	Anonymous	ED009-X: Iodide	20461-54-5	0.010	mg/L	<0.010	<0.010	0.0	No Limit
EB1105325-001	Anonymous	ED009-X: Iodide	20461-54-5	0.010	mg/L	<0.100	<0.100	0.0	No Limit
ED009: Anions (QC Lot: 1718292)									
EB1105143-001	Anonymous	ED009: Bromide	24959-67-9	0.02	mg/L	<0.02	<0.02	0.0	No Limit
ED037P: Alkalinity by PC Titrator (QC Lot: 1717744)									
EB1105224-001	Anonymous	ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	28	27	3.6	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	28	27	3.6	0% - 20%
EB1105225-028	Anonymous	ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	72	74	2.7	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	72	74	2.7	0% - 20%
ED040F: Dissolved Major Anions (QC Lot: 1716241)									
EB1105257-001	NBGW 819	ED040F: Silicon	7440-21-3	0.05	mg/L	35.0	35.2	0.3	0% - 20%
		ED040F: Sulfate as SO4 2-	14808-79-8	1	mg/L	694	697	0.4	0% - 20%
EB1105262-009	Anonymous	ED040F: Silicon	7440-21-3	0.05	mg/L	11.5	11.6	0.8	0% - 20%
		ED040F: Sulfate as SO4 2-	14808-79-8	1	mg/L	8	8	0.0	No Limit
ED045G: Chloride Discrete analyser (QC Lot: 1716245)									
EB1105257-001	NBGW 819	ED045G: Chloride	16887-00-6	1	mg/L	1490	1500	0.7	0% - 20%
EB1105262-009	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	3	3	0.0	No Limit
ED093F: Dissolved Major Cations (QC Lot: 1716242)									
EB1105257-001	NBGW 819	ED093F: Calcium	7440-70-2	1	mg/L	166	166	0.0	0% - 20%
		ED093F: Magnesium	7439-95-4	1	mg/L	212	212	0.0	0% - 20%
		ED093F: Sodium	7440-23-5	1	mg/L	1040	1040	0.4	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	36	37	0.0	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: 1716242) - continued									
EB1105262-009	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	6	6	0.0	No Limit
		ED093F: Magnesium	7439-95-4	1	mg/L	2	2	0.0	No Limit
		ED093F: Sodium	7440-23-5	1	mg/L	3	3	0.0	No Limit
		ED093F: Potassium	7440-09-7	1	mg/L	3	4	0.0	No Limit
EG020F: Dissolved Metals by ICP-MS (QC Lot: 1715602)									
EB1104979-001	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	<0.001	<0.001	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: Manganese	7439-96-5	0.001	mg/L	0.005	0.005	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	<0.005	<0.005	0.0	No Limit
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	0.01	0.02	57.3	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	0.06	0.07	0.0	No Limit
EB1104979-012	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	<0.001	<0.001	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: Manganese	7439-96-5	0.001	mg/L	0.009	0.009	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	<0.005	0.005	0.0	No Limit
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	0.02	<0.01	0.0	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	0.07	0.06	15.1	No Limit
EG020F: Dissolved Metals by ICP-MS (QC Lot: 1715603)									
EB1104979-001	Anonymous	EG020B-F: Bismuth	7440-69-9	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020B-F: Cerium	7440-45-1	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020B-F: Caesium	7440-46-2	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020B-F: Rubidium	7440-17-7	0.001	mg/L	0.002	0.002	0.0	No Limit
		EG020B-F: Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020B-F: Strontium	7440-24-6	0.001	mg/L	0.087	0.086	0.0	0% - 20%
		EG020B-F: Thorium	7440-29-1	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020B-F: Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020B-F: Titanium	7440-32-6	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EB1104979-012	Anonymous	EG020B-F: Bismuth	7440-69-9	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020B-F: Cerium	7440-45-1	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020B-F: Caesium	7440-46-2	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020B-F: Rubidium	7440-17-7	0.001	mg/L	0.002	0.002	0.0	No Limit

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 (%)*
EG020F: Dissolved Metals by ICP-MS (QC Lot: 1715603) - continued									
EB1104979-012	Anonymous	EG020B-F: Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020B-F: Strontium	7440-24-6	0.001	mg/L	0.142	0.143	0.0	0% - 20%
		EG020B-F: Thorium	7440-29-1	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020B-F: Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020B-F: Titanium	7440-32-6	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EG020F: Dissolved Metals by ICP-MS (QC Lot: 1715604)									
EB1104979-001	Anonymous	EG020D-F: Dysprosium	7429-91-6	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020D-F: Erbium	7440-52-0	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020D-F: Europium	7440-53-1	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020D-F: Gadolinium	7440-54-2	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020D-F: Holmium	7440-60-0	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020D-F: Lanthanum	7439-91-0	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020D-F: Lutetium	7439-94-3	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020D-F: Neodymium	7440-00-8	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020D-F: Praseodymium	7440-10-0	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020D-F: Samarium	7440-19-9	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020D-F: Terbium	7440-27-9	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020D-F: Thulium	7440-30-4	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020D-F: Ytterbium	7440-64-4	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020D-F: Yttrium	7440-65-5	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020D-F: Zirconium	7440-67-7	0.005	mg/L	<0.005	<0.005	0.0	No Limit
		EG020D-F: Hafnium	7440-58-6	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EB1104979-012	Anonymous	EG020D-F: Dysprosium	7429-91-6	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020D-F: Erbium	7440-52-0	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020D-F: Europium	7440-53-1	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020D-F: Gadolinium	7440-54-2	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020D-F: Holmium	7440-60-0	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020D-F: Lanthanum	7439-91-0	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020D-F: Lutetium	7439-94-3	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020D-F: Neodymium	7440-00-8	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020D-F: Praseodymium	7440-10-0	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020D-F: Samarium	7440-19-9	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020D-F: Terbium	7440-27-9	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020D-F: Thulium	7440-30-4	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020D-F: Ytterbium	7440-64-4	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020D-F: Yttrium	7440-65-5	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020D-F: Zirconium	7440-67-7	0.005	mg/L	<0.005	<0.005	0.0	No Limit
		EG020D-F: Hafnium	7440-58-6	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EG020F: Dissolved Metals by ICP-MS (QC Lot: 1715605)									

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 (%)*
EG020F: Dissolved Metals by ICP-MS (QC Lot: 1715605) - continued									
EB1104979-001	Anonymous	EG020E-F: Gold	7440-57-5	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020E-F: Tungsten	7440-33-7	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020E-F: Tantalum	7440-25-7	0.001	mg/L	<0.001	<0.001	0.0	No Limit
EB1104979-012	Anonymous	EG020E-F: Gold	7440-57-5	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020E-F: Tungsten	7440-33-7	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020E-F: Tantalum	7440-25-7	0.001	mg/L	<0.001	<0.001	0.0	No Limit
EG035F: Dissolved Mercury by FIMS (QC Lot: 1715601)									
EB1104979-001	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
EB1104979-013	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
EK040P: Fluoride by PC Titrator (QC Lot: 1717748)									
EB1105262-001	Anonymous	EK040P: Fluoride	16984-48-8	0.1	mg/L	0.3	0.2	0.0	No Limit
EB1105262-010	Anonymous	EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	<0.1	0.0	No Limit
EK055G: Ammonia as N by Discrete Analyser (QC Lot: 1716256)									
EB1104915-001	Anonymous	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	0.13	0.11	18.8	0% - 50%
EK071G: Reactive Phosphorus as P by discrete analyser (QC Lot: 1716244)									
EB1105257-001	NBGW 819	EK071G: Reactive Phosphorus as P	----	0.01	mg/L	0.02	0.02	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
EA005P: pH by PC Titrator (QCLot: 1717747)								
EA005-P: pH Value	----	0.01	pH Unit	----	7 pH Unit	101	99	101
EA015: Total Dissolved Solids (QCLot: 1723162)								
EA015H: Total Dissolved Solids @180°C	GIS-210-010	5	mg/L	<5	2000 mg/L	94.2	86	106
EA025: Suspended Solids (QCLot: 1721423)								
EA025H: Suspended Solids (SS)	----	5	mg/L	<5	150 mg/L	107	86	108
EA045: Turbidity (QCLot: 1715311)								
EA045: Turbidity	----	0.1	NTU	<0.1	40.0 NTU	100	96	104
ED009: Anions (QCLot: 1718276)								
ED009-X: Iodide	20461-54-5	0.01	mg/L	<0.010	----	----	----	----
ED009: Anions (QCLot: 1718292)								
ED009: Bromide	24959-67-9	0.02	mg/L	<0.02	2.0 mg/L	130	70	130
ED037P: Alkalinity by PC Titrator (QCLot: 1717744)								
ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	----	200 mg/L	95.0	83	111
ED040F: Dissolved Major Anions (QCLot: 1716241)								
ED040F: Sulfate as SO4 2-	14808-79-8	1	mg/L	<1	----	----	----	----
ED040F: Silicon	7440-21-3	0.05	mg/L	<0.05	----	----	----	----
ED045G: Chloride Discrete analyser (QCLot: 1716245)								
ED045G: Chloride	16887-00-6	1	mg/L	<1	1000 mg/L	98.0	70	128
ED093F: Dissolved Major Cations (QCLot: 1716242)								
ED093F: Calcium	7440-70-2	1	mg/L	<1	----	----	----	----
ED093F: Magnesium	7439-95-4	1	mg/L	<1	----	----	----	----
ED093F: Sodium	7440-23-5	1	mg/L	<1	----	----	----	----
ED093F: Potassium	7440-09-7	1	mg/L	<1	----	----	----	----
EG020F: Dissolved Metals by ICP-MS (QCLot: 1715602)								
EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.500 mg/L	95.0	81	130
EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.100 mg/L	100	85	124
EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.100 mg/L	99.6	88	117
EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	0.100 mg/L	93.6	88	127
EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	0.200 mg/L	100	86	118
EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	0.100 mg/L	103	89	113
EG020A-F: Manganese	7439-96-5	0.001	mg/L	<0.001	0.100 mg/L	111	83	123
EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	0.100 mg/L	100	88	119
EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	0.200 mg/L	109	85	130

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
				Result	Concentration	LCS	Low	High
EG020F: Dissolved Metals by ICP-MS (QCLot: 1715602) - continued								
EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	0.50 mg/L	110	79	128
EG020F: Dissolved Metals by ICP-MS (QCLot: 1715603)								
EG020B-F: Bismuth	7440-69-9	0.001	mg/L	<0.001	0.100 mg/L	114	87	123
EG020B-F: Cerium	7440-45-1	0.001	mg/L	<0.001	----	----	----	----
EG020B-F: Caesium	7440-46-2	0.001	mg/L	<0.001	----	----	----	----
EG020B-F: Rubidium	7440-17-7	0.001	mg/L	<0.001	----	----	----	----
EG020B-F: Silver	7440-22-4	0.001	mg/L	<0.001	0.100 mg/L	98.5	70	130
EG020B-F: Strontium	7440-24-6	0.001	mg/L	<0.001	0.500 mg/L	95.0	85	119
EG020B-F: Thorium	7440-29-1	0.001	mg/L	<0.001	----	----	----	----
EG020B-F: Titanium	7440-32-6	0.01	mg/L	<0.01	0.100 mg/L	88.9	77	125
EG020B-F: Uranium	7440-61-1	0.001	mg/L	<0.001	----	----	----	----
EG020F: Dissolved Metals by ICP-MS (QCLot: 1715604)								
EG020D-F: Dysprosium	7429-91-6	0.001	mg/L	<0.001	----	----	----	----
EG020D-F: Erbium	7440-52-0	0.001	mg/L	<0.001	----	----	----	----
EG020D-F: Europium	7440-53-1	0.001	mg/L	<0.001	----	----	----	----
EG020D-F: Gadolinium	7440-54-2	0.001	mg/L	<0.001	----	----	----	----
EG020D-F: Hafnium	7440-58-6	0.01	mg/L	<0.01	----	----	----	----
EG020D-F: Holmium	7440-60-0	0.001	mg/L	<0.001	----	----	----	----
EG020D-F: Lanthanum	7439-91-0	0.001	mg/L	<0.001	----	----	----	----
EG020D-F: Lutetium	7439-94-3	0.001	mg/L	<0.001	----	----	----	----
EG020D-F: Neodymium	7440-00-8	0.001	mg/L	<0.001	----	----	----	----
EG020D-F: Praseodymium	7440-10-0	0.001	mg/L	<0.001	----	----	----	----
EG020D-F: Samarium	7440-19-9	0.001	mg/L	<0.001	----	----	----	----
EG020D-F: Terbium	7440-27-9	0.001	mg/L	<0.001	----	----	----	----
EG020D-F: Thulium	7440-30-4	0.001	mg/L	<0.001	----	----	----	----
EG020D-F: Ytterbium	7440-64-4	0.001	mg/L	<0.001	----	----	----	----
EG020D-F: Yttrium	7440-65-5	0.001	mg/L	<0.001	----	----	----	----
EG020D-F: Zirconium	7440-67-7	0.005	mg/L	<0.005	----	----	----	----
EG020F: Dissolved Metals by ICP-MS (QCLot: 1715605)								
EG020E-F: Gold	7440-57-5	0.001	mg/L	<0.001	----	----	----	----
EG020E-F: Tungsten	7440-33-7	0.001	mg/L	<0.001	----	----	----	----
EG020E-F: Tantalum	7440-25-7	0.001	mg/L	<0.001	----	----	----	----
EG035F: Dissolved Mercury by FIMS (QCLot: 1715601)								
EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.010 mg/L	102	84	116
EK040P: Fluoride by PC Titrator (QCLot: 1717748)								
EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	10 mg/L	100	75	123
EK055G: Ammonia as N by Discrete Analyser (QCLot: 1716256)								
EK055G: Ammonia as N	7664-41-7	0.01	mg/L	<0.01	0.5 mg/L	97.2	70	129

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
				Result	Concentration	LCS	Low	High
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 1716244)								
EK071G: Reactive Phosphorus as P	----	0.01	mg/L	<0.01	0.5 mg/L	92.8	74	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**

				Matrix Spike (MS) Report			
				Spike	Spike Recovery (%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
ED009: Anions (QCLot: 1718292)							
EB1105257-001	NBGW 819	ED009: Bromide	24959-67-9	10 mg/L	124	70	130
ED045G: Chloride Discrete analyser (QCLot: 1716245)							
EB1105262-001	Anonymous	ED045G: Chloride	16887-00-6	400 mg/L	106	70	130
EG020F: Dissolved Metals by ICP-MS (QCLot: 1715602)							
EB1104979-005	Anonymous	EG020A-F: Aluminium	7429-90-5	0.500 mg/L	93.7	70	130
		EG020A-F: Arsenic	7440-38-2	0.100 mg/L	97.8	70	130
		EG020A-F: Cadmium	7440-43-9	0.100 mg/L	96.2	70	130
		EG020A-F: Chromium	7440-47-3	0.100 mg/L	90.3	70	130
		EG020A-F: Copper	7440-50-8	0.200 mg/L	96.6	70	130
		EG020A-F: Lead	7439-92-1	0.100 mg/L	86.6	70	130
		EG020A-F: Manganese	7439-96-5	0.100 mg/L	100	70	130
		EG020A-F: Nickel	7440-02-0	0.100 mg/L	96.8	70	130
		EG020A-F: Zinc	7440-66-6	0.200 mg/L	101	70	130
EG035F: Dissolved Mercury by FIMS (QCLot: 1715601)							
EB1104979-002	Anonymous	EG035F: Mercury	7439-97-6	0.010 mg/L	110	70	130
EK040P: Fluoride by PC Titrator (QCLot: 1717748)							
EB1105257-001	NBGW 819	EK040P: Fluoride	16984-48-8	4.9 mg/L	121	70	130
EK055G: Ammonia as N by Discrete Analyser (QCLot: 1716256)							
EB1105257-001	NBGW 819	EK055G: Ammonia as N	7664-41-7	0.4 mg/L	96.3	70	130

INTERPRETIVE QUALITY CONTROL REPORT

Work Order	: **EB1105257**	Page	: 1 of 9
Client	: ENVIRONMENTAL EARTH SCIENCES	Laboratory	: Environmental Division Brisbane
Contact	: MR MARK STUCKEY	Contact	: Bryn Stephens
Address	: Unit 3/ 1 Ross Street NEWSTEAD QLD, AUSTRALIA 4006	Address	: 32 Shand Street Stafford QLD Australia 4053
E-mail	: mstuckey@eesi.biz	E-mail	: Bryn.Stephens@alsglobal.com
Telephone	: +61 3852 6666	Telephone	: +617 3243 7125
Facsimile	: +61 07 38656300	Facsimile	: +617 3243 7181
Project	: 610012	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Site	: Nolans bore		
C-O-C number	: ----	Date Samples Received	: 18-MAR-2011
Sampler	: Katy Kijek	Issue Date	: 30-MAR-2011
Order number	: ----		
		No. of samples received	: 1
Quote number	: EN/010/10	No. of samples analysed	: 1

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

The following report summarises extraction / preparation and analysis times and compares with recommended holding times. Dates reported represent first date of extraction or analysis and precludes subsequent dilutions and reruns. Information is also provided re the sample container (preservative) from which the analysis aliquot was taken. Elapsed period to analysis represents number of days from sampling where no extraction / digestion is involved or period from extraction / digestion where this is present. For composite samples, sampling date is assumed to be that of the oldest sample contributing to the composite. Sample date for laboratory produced leachates is assumed as the completion date of the leaching process. Outliers for holding time are based on USEPA SW 846, APHA, AS and NEPM (1999). A listing of breaches is provided in the Summary of Outliers.

Holding times for leachate methods (excluding elutriates) vary according to the analytes being determined on the resulting solution. For non-volatile analytes, the holding time compliance assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These soil holding times are: Organics (14 days); Mercury (28 days) & other metals (180 days). A recorded breach therefore does not guarantee a breach for all non-volatile parameters.

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
EA005P: pH by PC Titrator							
White Plastic Bottle - Unpreserved NBGW 819	**16-MAR-2011**	---	16-MAR-2011	----	**22-MAR-2011**	16-MAR-2011	×
EA015: Total Dissolved Solids							
White Plastic Bottle - Unpreserved NBGW 819	**16-MAR-2011**	----	----	----	**25-MAR-2011**	23-MAR-2011	×
EA025: Suspended Solids							
White Plastic Bottle - Unpreserved NBGW 819	**16-MAR-2011**	----	----	----	**24-MAR-2011**	23-MAR-2011	×
EA045: Turbidity							
White Plastic Bottle - Unpreserved NBGW 819	**16-MAR-2011**	----	----	----	**21-MAR-2011**	18-MAR-2011	×
ED009: Anions							
White Plastic Bottle - Unpreserved NBGW 819	**16-MAR-2011**	----	----	----	**23-MAR-2011**	13-APR-2011	✓
ED037P: Alkalinity by PC Titrator							
White Plastic Bottle - Unpreserved NBGW 819	**16-MAR-2011**	---	30-MAR-2011	----	**22-MAR-2011**	30-MAR-2011	✓
ED040F: Dissolved Major Anions							
White Plastic Bottle - Unpreserved NBGW 819	**16-MAR-2011**	---	13-APR-2011	----	**22-MAR-2011**	13-APR-2011	✓
ED045G: Chloride Discrete analyser							
White Plastic Bottle - Unpreserved NBGW 819	**16-MAR-2011**	---	13-APR-2011	----	**22-MAR-2011**	13-APR-2011	✓
ED093F: Dissolved Major Cations							
White Plastic Bottle - Unpreserved NBGW 819	**16-MAR-2011**	---	23-MAR-2011	----	**22-MAR-2011**	23-MAR-2011	✓
EG020F: Dissolved Metals by ICP-MS							
White Plastic Bottle - Unpreserved NBGW 819	**16-MAR-2011**	---	12-SEP-2011	----	**22-MAR-2011**	12-SEP-2011	✓

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
EG035F: Dissolved Mercury by FIMS							
White Plastic Bottle - Unpreserved							
NBGW 819	**16-MAR-2011**	**---**	13-APR-2011	----	**22-MAR-2011**	13-APR-2011	✓
EK040P: Fluoride by PC Titrator							
White Plastic Bottle - Unpreserved							
NBGW 819	**16-MAR-2011**	**---**	13-APR-2011	----	**22-MAR-2011**	13-APR-2011	✓
EK055G: Ammonia as N by Discrete Analyser							
White Plastic Bottle - Unpreserved							
NBGW 819	**16-MAR-2011**	**---**	17-MAR-2011	----	**22-MAR-2011**	17-MAR-2011	×
EK071G: Reactive Phosphorus as P by discrete analyser							
White Plastic Bottle - Unpreserved							
NBGW 819	**16-MAR-2011**	**---**	18-MAR-2011	----	**22-MAR-2011**	18-MAR-2011	×

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	2	20	**10.0**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Ammonia as N by Discrete analyser	EK055G	1	2	**50.0**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Chloride by Discrete Analyser	ED045G	2	20	**10.0**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Mercury by FIMS	EG035F	2	19	**10.5**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	19	**10.5**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite B	EG020B-F	2	19	**10.5**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite D	EG020D-F	2	19	**10.5**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite E	EG020E-F	2	19	**10.5**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Fluoride by PC Titrator	EK040P	2	19	**10.5**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Major Anions - Dissolved	ED040F	2	20	**10.0**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Major Cations - Dissolved	ED093F	2	20	**10.0**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	2	18	**11.1**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
pH by PC Titrator	EA005-P	2	20	**10.0**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	1	**100.0**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Standard Anions	ED009	1	2	**50.0**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Standard Anions (Extended Method)	ED009-X	2	17	**11.8**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Suspended Solids (High Level)	EA025H	2	20	**10.0**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Dissolved Solids (High Level)	EA015H	2	20	**10.0**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Turbidity	EA045	2	20	**10.0**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Laboratory Control Samples (LCS)							
Alkalinity by PC Titrator	ED037-P	1	20	**5.0**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Ammonia as N by Discrete analyser	EK055G	1	2	**50.0**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Chloride by Discrete Analyser	ED045G	2	20	**10.0**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Mercury by FIMS	EG035F	1	19	**5.3**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	19	**5.3**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite B	EG020B-F	1	19	**5.3**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Fluoride by PC Titrator	EK040P	1	19	**5.3**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	18	**5.6**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
pH by PC Titrator	EA005-P	2	20	**10.0**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	1	**100.0**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Standard Anions	ED009	1	2	**50.0**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Standard Anions (Extended Method)	ED009-X	1	17	**5.9**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Suspended Solids (High Level)	EA025H	1	20	**5.0**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Dissolved Solids (High Level)	EA015H	1	20	**5.0**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Turbidity	EA045	1	20	**5.0**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Method Blanks (MB)							
Ammonia as N by Discrete analyser	EK055G	1	2	**50.0**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Chloride by Discrete Analyser	ED045G	1	20	**5.0**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Mercury by FIMS	EG035F	1	19	**5.3**	**5.0**	✓	NEPM 1999 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 Metals by ICP-MS - Suite A	EG020A-F	1	19	**5.3**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite B	EG020B-F	1	19	**5.3**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite D	EG020D-F	1	19	**5.3**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite E	EG020E-F	1	19	**5.3**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Fluoride by PC Titrator	EK040P	1	19	**5.3**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Major Anions - Dissolved	ED040F	1	20	**5.0**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Major Cations - Dissolved	ED093F	1	20	**5.0**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	18	**5.6**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	1	**100.0**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Standard Anions	ED009	1	2	**50.0**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Standard Anions (Extended Method)	ED009-X	1	17	**5.9**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Suspended Solids (High Level)	EA025H	1	20	**5.0**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Dissolved Solids (High Level)	EA015H	1	20	**5.0**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Turbidity	EA045	1	20	**5.0**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Matrix Spikes (MS)							
Ammonia as N by Discrete analyser	EK055G	1	2	**50.0**	**5.0**	✓	ALS QCS3 requirement
Chloride by Discrete Analyser	ED045G	1	20	**5.0**	**5.0**	✓	ALS QCS3 requirement
Dissolved Mercury by FIMS	EG035F	1	19	**5.3**	**5.0**	✓	ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	19	**5.3**	**5.0**	✓	ALS QCS3 requirement
Fluoride by PC Titrator	EK040P	1	19	**5.3**	**5.0**	✓	ALS QCS3 requirement
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	18	**5.6**	**5.0**	✓	ALS QCS3 requirement
Standard Anions	ED009	1	2	**50.0**	**5.0**	✓	ALS QCS3 requirement
Standard Anions (Extended Method)	ED009-X	1	17	**5.9**	**5.0**	✓	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 by PC Titrator	EA005-P	WATER	APHA 21st ed. 4500 H+ B. This procedure determines pH of water samples by automated ISE. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Total Dissolved Solids (High Level)	EA015H	WATER	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 (1999) Schedule B(3) (Appdx. 2)
Suspended Solids (High Level)	EA025H	WATER	APHA 21st ed., 2540D A gravimetric procedure employed to determine the amount of `non-filterable` residue in a aqueous sample. The prescribed GFC (1.2um) filter is rinsed with deionised water, oven dried and weighed prior to analysis. A well-mixed sample is filtered through a glass fibre filter (1.2um). The residue on the filter paper is dried at 104+/-2C . This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Turbidity	EA045	WATER	APHA 21st ed., 2130 B. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Standard Anions	ED009	WATER	APHA 21st ed., 4110. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Standard Anions (Extended Method)	ED009-X	WATER	APHA 21st ed., 4110. This method is compliant with NEPM (1999) 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 (1999) Schedule B(3) (Appdx. 2)
Major Anions - Dissolved	ED040F	WATER	APHA 21st ed., 3120. The 0.45um filtered samples are determined by ICP/AES for Sulfur and/or Silcon content and reported as Sulfate and/or Silica after conversion by gravimetric factor.
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	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 (1999) 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.
Dissolved Metals by ICP-MS - Suite B	EG020B-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.
Dissolved Metals by ICP-MS - Suite D	EG020D-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.
Dissolved Metals by ICP-MS - Suite E	EG020E-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 (1999) Schedule B(3) (Appdx. 2)
Silica (Total Dissolved) by ICPAES	EG052F	WATER	APHA 21st ed., 4500-SiO2. Silica (Total) determined by calculation from Silicon by ICPAES.
Fluoride by PC Titrator	EK040P	WATER	APHA 21st ed., 4500 F--C CDTA is added to the sample to provide a uniform ionic strength background, adjust pH, and break up complexes. Fluoride concentration is determined by either manual or automatic ISE measurement. This method is compliant with NEPM (1999) 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 (1999) 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 (1999) 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 cadmium reduction column 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 (1999) 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 Cadmium Reduction and direct colourimetry by Discrete Analyser. This method is compliant with NEPM (1999) 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 (1999) Schedule B(3) (Appdx. 2)
Ionic Balance by PCT DA and ICPAES	EN055 - DA	WATER	APHA 21st Ed. 1030F. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)

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 SW846 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

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

Matrix: **WATER**

Method	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)	Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
EA005P: pH by PC Titrator						
White Plastic Bottle - Unpreserved NBGW 819	----	----	----	22-MAR-2011	16-MAR-2011	**6**
EA015: Total Dissolved Solids						
White Plastic Bottle - Unpreserved NBGW 819	----	----	----	25-MAR-2011	23-MAR-2011	**2**
EA025: Suspended Solids						
White Plastic Bottle - Unpreserved NBGW 819	----	----	----	24-MAR-2011	23-MAR-2011	**1**
EA045: Turbidity						
White Plastic Bottle - Unpreserved NBGW 819	----	----	----	21-MAR-2011	18-MAR-2011	**3**
EG020F: Dissolved Metals by ICP-MS						
White Plastic Bottle - Unpreserved NBGW 819	----	----	----	22-MAR-2011	17-MAR-2011	**5**
EK055G: Ammonia as N by Discrete Analyser						
White Plastic Bottle - Unpreserved NBGW 819	----	----	----	22-MAR-2011	17-MAR-2011	**5**
EK071G: Reactive Phosphorus as P by discrete analyser						
White Plastic Bottle - Unpreserved NBGW 819	----	----	----	22-MAR-2011	18-MAR-2011	**4**

Outliers : Frequency of Quality Control Samples

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

- **No Quality Control Sample Frequency Outliers exist.**

Hanna Instrument HI 9828

≈ 36,000 L/hr = 36 m³/hr NBGW819 - pumping bore

ENVIRONMENTAL EARTH SCIENCES
THE KNOW AND THE HOW

Field Chemical Characteristics for Water Samples

Job No: 610012 | Date: 13/3/11 | Sampled By: KK | Client: Arahura | Site: NOLANS BORE

Sample No	Type + Depth	Container + Additive	Time	Water Level (m)	Stickup (m)	Volume Purged (L)	Temp C	pH	~~pe mV~~ ORP	Dissolved Oxygen (ppm)	EC uScm⁻¹	Odour	Colour	Comments
	test			~~20~~ 22	500mm	60,000L								
	pumping bore.		1:20pm			↳	28.83	7.72	-76.1	4.78	5331	none	clear	10 L/sec pumped since 11am now 1pm
			1:50pm		~~43~~ 100,800		28.77	7.42	39.7	2.84	5768	slight - like Cl	clear	
							28.86	7.82	-71.4	3.74	5331	slight	clear	
			4:18pm				28.75	8.24	-92.8	6.11	4894	none	"	EC fluctuating a bit
	date 15/3		7:10am		10L/sec x 44 hrs		28.88	7.39	-78	3.83	5840	"	"	
			7:55am				28.87	7.73	-80.1	4.45	5606	"	"	
			12:10pm				29.02	8.05	-87.4	~~4.11~~	5765	"	"	
		16/3	7:40am		69hrs x 10L/sec		28.91	7.26	-22.6	2.09	6276	"	"	
	SAMPLES		12pm				29.07	7.99	-84.2	~~68.9~~ %	5542	"	"	
	←		2:50pm				29.01	7.42	-53.8	3.13	6017	"	"	SAMPLES taken 4 corder tomorrow
	@3pm 18/3		8:40am				29.16	6.77	28.3	~~2.67~~	6749	"	"	reduced to 7.5L/sec @11pm on 16/3
			1:35pm				29.22	~~7.68~~	-64.5 ~~-70.2~~	4.53	6368	"	"	
			4:15pm				29.25	6.97	-52.5	3.56	6601	none	"	
	19/3		8:10am				29.13	6.86	-80.8	3.51	6566	"	"	
			11:45am				29.23	7.33	-64.0	3.93	6364	"	"	

~~Additives~~
~~W = no additives~~
X = conc. HNO_3
Y = NaOH
Z = $Na_2S_2O_3$

Type
SW = Surface water
SWC = Creek
SWP = Pond
SWD = Dam
SWL = Puddle
~~GW = Groundwater~~
GWA = Artesian
GWS = Sub-artesian

Sampling device
B = Bailer
P = Piston
S = Spring
~~SP = Submersible pump~~
GD = Gas drive
GL = Gas lift
SL = Suction lift
PD = Positive displacement
G = Grab

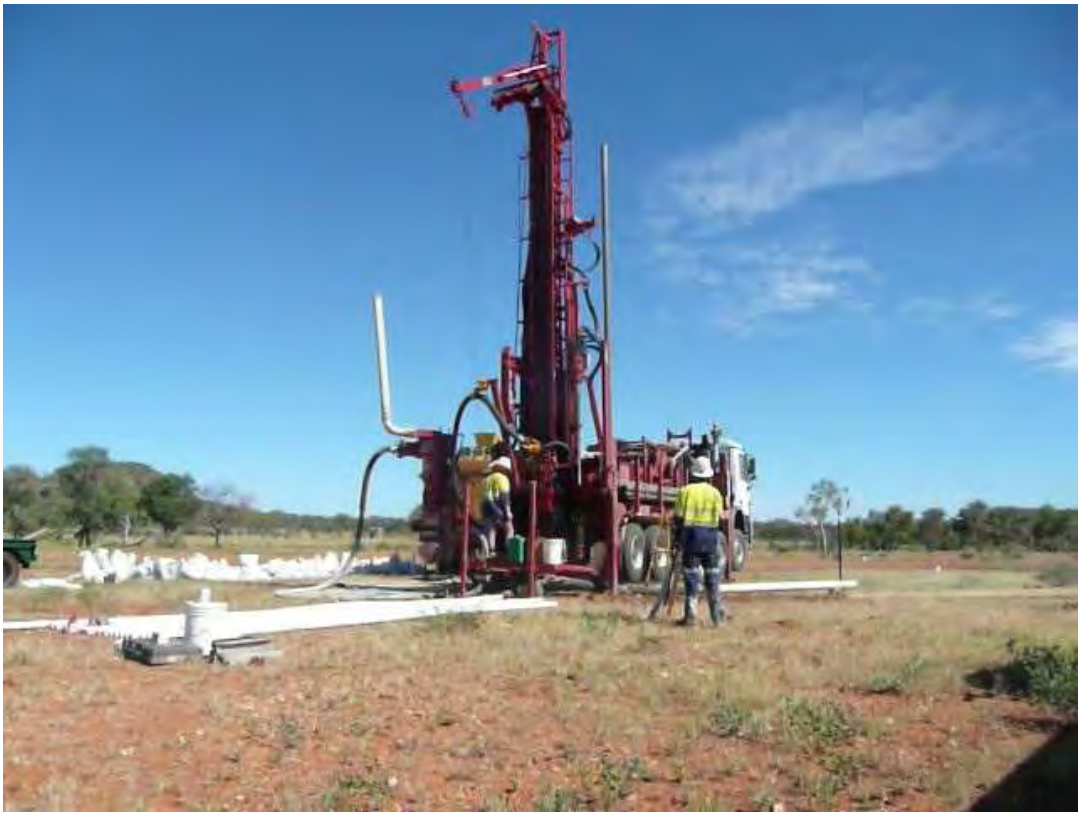
~~Sampling Container~~
~~P = Polyethylene~~
G = Amber glass

Field Parameters
Field parameters will be measured ex-situ in in-line flow cells with the following stabilisation criteria (adapted from EPA Victoria Publication 669)
±10% DO when >1ppm (no criteria for<1ppm)
±10% Turbidity
±3% EC
±0.05 pH
±10mV
The meter will be calibrated every three bores or daily (whichever occurs first) in accordance with the

QUT FORMS

APPENDIX F PHOTOGRAPHS

Photograph 1: Minerals exploration RC drilling rig, observation bore installation (2010)



Photograph 2: Mild steel slotted casing with additional oxy-cut slots for increased open-area

Photograph 3: Measuring yield using 20L bucket and stopwatch

Photograph 4: pumping test setup

Photograph 5: circular orifice weir piezometer tube and scale