NEW HOPE GROUP

Appendix H

Revised Groundwater Monitoring and Impact Management Plan

GROUNDWATER MONITORING AND IMPACT MANAGEMENT PLAN

New Acland Coal Mine Stage 3 Project

AUGUST 2014

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1. Introduction

This Groundwater Monitoring and Impact Management Plan (GMIMP) has been prepared to address the issues associated with the predicted impacts on groundwater at and surrounding the revised Project site from the proposed Stage 3 Expansion, south and west of New Acland Coal Pty Ltd's (NAC) current mining operation. It sets out the groundwater monitoring program for the revised Project site and the associated groundwater impact triggers that will invoke further assessment and groundwater impact management. The GMIMP is designed to provide consistency with the revised Project's Environmental Management Plan (EMP) and regulatory requirements.

Groundwater management plans are typically prepared following the issue of an Environmental Authority (EA) and address the relevant conditions stipulated therein. This plan has been developed as part of the Environmental Impact Statement (EIS) process and will be amended and finalised as necessary following the issue of a new draft Environmental Authority (EA) for the revised Project site.

The GMIMP will be administered as a supporting document to the revised Project's Plan of Operations.

The existing Mine currently operates under EA EMPL00335713 which covers Mining Leases (MLs) 50170 and 50216 immediately to the north of the revised Project area. The existing EA includes a number of conditions relating to groundwater monitoring and groundwater impact triggers. These conditions have been incorporated into the GMIMP for the revised Project site.

The GMIMP is structured as follows.

- Section 2: describes the principal aquifers of interest around the revised Project site, local use of groundwater, and the predicted impacts on groundwater from the revised Project's operations.
- Section 3: describes the groundwater monitoring program for the revised Project site including monitoring locations, monitoring frequency, and the parameters to be recorded/analysed.
- Section 4: sets out the groundwater impact triggers and protocols for investigating, and if required, mitigating the impacts on groundwater from the revised Project's operations.
- Section 5: describes the process of continual review and improvement of the GMIMP to ensure it continues to meet its objectives.

2. Predicted Impacts on Groundwater Levels

This section provides a summary of the five aquifers of interest in the vicinity of the revised Project site, the local use of groundwater and the predicted impacts from the revised Project's operations on these aquifers.

2.1. Principal Aquifers of Interest at the revised Project site

In the vicinity of the revised Project site, three of the principal aquifers of interest – the Walloon Coal Measures, the Marburg Sandstone, and the Helidon Sandstone – are subartesian aquifers within the Great Artesian Basin Groundwater Management Unit (GAB GMU). The *Water Resource (Great Artesian Basin) Plan 2006*, a subordinate regulation to the Water Act (2000), covers the management of all artesian and subartesian water in the vicinity of the revised Project site. Any future authority for water take will have to adhere to the relevant requirements of these regulations.

To implement the *Water Resource (Great Artesian Basin) Plan 2006*, the Queensland Government has produced the Great Artesian Basin Resource Operations Plan (GABROP). This plan came into force during early 2007 and was amended during late 2012. The GABROP applies to artesian, subartesian and spring connected water, and provides processes for dealing with unallocated water reserves (general and State). The GABROP subdivides the GAB GMU into 25 management areas. The revised Project is located within the Eastern Downs Management Area of the GAB GMU for the purposes of the *Water Resource (Great Artesian Basin) Plan 2006*.

The revised Project access to unallocated general and State water reserves is very limited as a consequence of the status of the Eastern Downs Management Area. Capping of abstraction volumes is employed to prevent overexploitation of groundwater and is essential for the Eastern Downs Management Area, which is currently over allocated.

Water within the groundwater systems in the vicinity of the revised Project site is also managed in line with the sustainable diversion limits identified in the Murray Darling Basin Plan.

In addition to the three subartesian GAB aquifers at the revised Project site, the Tertiary Basalt and Quaternary Alluvium aquifers in the vicinity of the revised Project site contribute to the local hydrological environment.

The Quaternary Alluvial aquifer is not present within the revised Project site, except potentially for a very small portion of the far southeastern corner. However, to the south and north of the revised Project site, the Alluvial aquifer is associated with the Oakey and Myall Creeks and is known to support significant groundwater abstraction. Groundwater contained within the Quaternary Alluvium associated with Oakey Creek is managed under the Oakey Creek groundwater management area (Oakey Creek GMA). The water resource cap of the Oakey Creek GMA applies to abstraction for the mining, oil and gas industries.

The Tertiary Basalt aquifer is only present to a minor extent within the northwest of the revised Project site, however the aquifer becomes prolific immediately west of the revised Project site. Groundwater contained within the Tertiary Basalt aquifer is managed under the Eastern Downs Management Area. As previously explained, the water resource cap of the Eastern Downs Management Area applies to abstraction for the mining, oil and gas industries.

Quaternary Alluvial Aquifers

Quaternary alluvium across the revised Project site is limited in extent and thickness and is not considered to possess significant potential to supply water. The nearest alluvium supporting groundwater supplies is the Oakey Creek Alluvium to the south-east of the revised Project site where the alluvium reaches a maximum thickness of 60 m. The proposed mine pits will not intersect this aquifer, with the closest occurrence of the Alluvial aquifer occurring approximately 2 km from the southernmost proposed mining area. Oakey Creek is an ephemeral watercourse located approximately 10 km to the south-east of the revised Project area and has been characterised in previous studies as a losing stream, i.e. water flow in the creek is not derived from groundwater, but rather shallow alluvial groundwater receives recharge from the creek.

Tertiary Basalt Aquifer

Tertiary Basalts are present in the north and west of the revised Project site and become more prevalent to the west of the revised Project site, varying in thickness up to 90 m. These occurrences are the result of Tertiary lava flows which have infilled pre-Tertiary age palaeo channels (ancient former drainage systems). The basalts are discrete lava flows interbedded with clay horizons which have the potential to act as aquitards (impermeable layers) within the basalt aquifer.

NAC currently draws groundwater from the basalt aquifer for potable water supply under a licensed allocation of 160 ML/year. In general, NAC only uses around 11 ML/year from the basalt aquifer for potable water production (based on recorded 2012 abstraction). The basalt aquifer is used by local landowners, predominantly to the west of the site, for private water supply.

Walloon Coal Measures Aquifer

The Walloon Coal Measures consist of grey and light grey shales, siltstones, fine clayey sandstones, carbonaceous shales, mudstones and coal seams. The coal seams are laterally continuous but are characterised by rapid lateral variation of the interseam sediment thickness. The Walloon Coal Measures comprises three major coal intervals – Waipanna, Acland-Sabine and Balgowan. The revised Project site will extract coal from the Acland-Sabine interval of the Lower Walloon Coal Measures.

The Walloon Coal Measures is a subartesian aquifer within the GAB of particular interest with regard to potential groundwater impacts from mining activities, as it is continuous across the revised Project site and surrounding area, and is widely exploited by surrounding properties for water supply.

At its deepest point the revised Project will mine down to approximately 75 m below ground surface (i.e. as the deepest economically recoverable coal). The Mine currently utilises groundwater that seeps into the active mine pits from the coal measures, mainly for dust suppression purposes.

Marburg Sandstone Aquifer

The Marburg Sandstone is a confined subartesian aquifer. It underlies the Walloon Coal Measures and consists of sandstone, minor coal, and conglomerate rock types. The productive water bearing units are interbedded with low permeability rock units such as mudstone, siltstone and shale.

Aquitards (low permeability strata) within and below the overlying Walloon Coal Measures act as effective confining layers for the Marburg Sandstone aquifer which occurs at a depth of approximately 150 mBGL within the revised Project site, generally 75 m below the bottom of active mine pits.

In the past, the Mine regularly extracted groundwater from the Marburg Sandstone aquifer for coal washing. This practice has been significantly reduced following a water supply agreement with the Toowoomba Regional Council (TRC) for the supply of recycled water from the Wetalla Water Reclamation Facility (WWRF). Groundwater levels in the Marburg Sandstone aquifer in the vicinity of the revised Project site have and are predicted to continue to recover as a result of the significant reduction in abstraction.

Helidon Sandstone Aquifer

The Helidon Sandstone aquifer lies approximately 500–600 m below ground level at the revised Project site and is isolated from the overlying aquifers by the relatively impermeable Evergreen Formation which is approximately 200 m thick. This subartesian aquifer is extensive within the area and is utilised for a number of large commercial/industrial abstractions within this portion of the Eastern Downs GMA (e.g. Beef City Abattoir).

In the past, the Mine regularly extracted groundwater from the Helidon Sandstone aquifer primarily for coal washing purposes. This practice has been significantly reduced following a water supply agreement with the TRC for the supply of recycled water from the WWRF. NAC will maintain its licence arrangements for the Helidon Sandstone aquifer as an emergency water supply. To facilitate this arrangement, NAC will run periodic abstraction campaigns up to a total of approximately 30 ML/year to keep pumping equipment operational. Groundwater levels in the Helidon Sandstone aquifer in the vicinity of the revised Project site are predicted to recover as a result of the significant reduction in abstraction.

As a condition of NAC's abstraction licence, groundwater modelling has been required to evaluate the impact of abstraction from the Helidon Sandstone aquifer and its interaction with other abstractions from this aquifer within the Eastern Downs GMA. This information has been reported to the then Department of Environment and Resource Management (DERM).

Based on the depth of the Helidon Sandstone Aquifer and the presence of a significant aquitard (Evergreen Formation), the mining of coal across the revised Project site is not anticipated to have any impact on water levels in this aquifer.

2.2. Current and Future Groundwater Use at the Mine

The Mine's main operational water supply is recycled water from the WWRF, which has been secured for the life of the revised Project through a long term agreement with the TRC. NAC also supplements its operational water supply with recycled water from its in-pit tailings dam, limited extraction from shallow groundwater sources (e.g. Tertiary Basalt for potable supply), and surface water captured in environmental and other dams. As previously explained, prior to the agreement with the TRC, groundwater was the main water source for the Mine.

NAC currently holds water licences to extract groundwater from the Tertiary Basalt, the Marburg Sandstone, and the Helidon Sandstone aquifers. NAC's actual groundwater abstraction from the Helidon Sandstone aquifer is well below its 710 ML allocation, with a recorded usage of about 17 ML in 2012.

The current allocation from the Marburg Sandstone aquifer is 271 ML/year. NAC reduced its original allocation of 571 ML/year from the Marburg Sandstone aquifer during 2009. Groundwater abstraction for 2012 amounted to 10.5 ML from the Marburg Sandstone. As explained previously, NAC has a licence to extract 160 ML/year from the Tertiary Basalt, but utilises around 11 ML/year.

Groundwater abstraction from the Marburg and Helidon Sandstone aquifers has reduced to a small percentage of the licensed allocation with the commissioning of the WWRF pipeline in 2009. As a result, the revised Project's dependence on the local Eastern Downs GMA is minimal, with the usage figures for 2012 being representative of future usage (including for the revised Project), alleviating potential long term pressure on these aquifers. The abstraction of water from the Tertiary Basalt aquifer for potable use at the revised Project site will continue at 2012 rates of around 11 ML/year. All NAC's groundwater abstraction is conducted within its legal allocated limits under the *Water Act 2000*.

2.3. Groundwater Use around the revised Project Site

A search of the Department of Natural Resources and Mines (DNRM) bore database was conducted to identify groundwater bores in the vicinity of the revised Project site. Table 2-1 summarises the bores identified from the DNRM database within a zone extending 8 km beyond the revised Project's mining lease application area (50232). The location of all bores outside the revised Project area, including the current Mine site, is shown on Figure 2-1 Predicted Groundwater Drawdown in the Vicinity of the Mine in the Tertiary Basalt Aquifer for 2030

Figure 2-2 and Figure 2-3. It should be noted that it is considered highly likely that other non-registered bores may also exist.

Table 2-1 DNRM Database - Bores within 8 km of New Acland Coal Mine[1]

Aquifer	Existing bores	Proposed bores
Quaternary Alluvium	159	0
Tertiary Basalt	81	0
Walloon Coal Measures	132	1
Marburg Sandstone	44	0
Helidon Sandstone	1	0
Not defined[2]	413	26
Total:	857	

Notes: 1. Not including bores listed as ‘abandoned and destroyed’.

2. The DNRM database only identifies the source aquifers for around 50% of the bores within 8km of the mining leases.

The Walloon Coal Measures aquifer supplies both fresh and brackish water and is utilised extensively in the vicinity of the revised Project site for stock and domestic supply. It is considered likely that a large proportion of the bores identified in Table 2-1, for which source aquifer details are not available, abstract water from the Walloon Coal Measures aquifer. The DNRM bore data suggest that this aquifer generally produces yields between 0.1 L/sec and 5.4 L/sec, on average lower than yields from other aquifers in the database search area. Water quality is generally listed in the DNRM database as “potable” with some occurrences of “brackish” water for this aquifer.

Figure 2-1 Predicted Groundwater Drawdown in the Vicinity of the Mine in the Tertiary Basalt Aquifer for 2030

Figure 2-2 shows a concentration of bores that abstract from the Oakey Creek Alluvium, which occurs 3-5km south and south-east of the revised Project site. Limited data on water quality in the Oakey Creek Alluvium indicates that the water is generally 'potable', as qualitatively listed in the DNRM database.

The expanse of Tertiary Basalt to the west and north-west of the revised Project site supports water supplies for stock watering and potable supply. Groundwater in the Tertiary Basalt aquifer is generally of potable quality. The yield from the basalt bores ranges from 0.1 L/sec to 15.6 L/sec but is typically less than 3 L/sec, and is highly dependent on the degree of fracturing encountered. Exploration activities by NAC's sister company, New Hope Exploration Pty Ltd, observed that water storage within the Tertiary Basalt aquifer was discretely located in association with fracture zones within the basalt. It is considered likely that some of the bores identified in Table 2-1 for which the source aquifer is not defined intersect the Tertiary Basalt aquifer.

The majority of the Marburg Sandstone bores are located to the east of the revised Project site (Figure 2-1 Predicted Groundwater Drawdown in the Vicinity of the Mine in the Tertiary Basalt Aquifer for 2030

Figure 2-2). The DNRM bore database shows that this aquifer is generally qualitatively listed in the database as being of ‘potable’ quality, and yields range from 0.4 L/sec to 10.7 L/sec. It is considered likely that some of the bores identified in Table 2-1 for which the source aquifer is not defined intersect the Marburg Sandstone aquifer.

The nearest bore (apart from those owned and operated by NAC) which abstract from the Helidon Sandstone aquifer is located 6.5 km south of the revised Project site in the area of the Oakey township. Other known bores in accessing the Helidon Sandstone are located approximately 15 km to the east (Toowoomba Cooby Dam Bore and Hampton Irrigators), and 15 km to the south (Beef City Abattoir) of the revised Project site.

2.4. Predicted Impacts on Groundwater Levels and Users

As excavation of the revised Project’s active mine pits proceeds below the Walloon Coal Measure’s water table, groundwater will discharge into the pits. Dewatering of the Walloon Coal Measures aquifer will result in the lowering of groundwater levels in the aquifer in the immediate vicinity of the revised Project site. Groundwater levels in the Tertiary Basalt and Marburg Sandstone aquifers around the revised Project site will also be affected by dewatering the Walloon Coal Measures due to induced through-flow and leakage of groundwater from these aquifers to the Walloon Coal Measures.

Mining is planned to advance in a general north to south direction for the revised Project. The active mine pits will be excavated as a progressive series of strips that advance across the Walloon Coal Measures aquifer (resource area). As each active mine pit (new strip) advances, the previous strip is backfilled with mined material and rehabilitated. Following cessation of mining, groundwater will continue to discharge to the rehabilitated final voids, driven by evaporative discharge from the pit lakes that will form in the voids. A steady state equilibrium will be reached where the pit lake levels recover to an equilibrium where evaporation from the lakes balances groundwater inflow, at a level below that of the pre-mining water table.

The revised Project’s EIS (SKM 2013) included the development and calibration of a transient groundwater flow model to predict groundwater drawdown in the surrounding aquifers over the life of the revised Project and following closure. The model and its predictions were updated as part of the AEIS (Jacobs SKM, 2014). The model is subdivided vertically into four separate layers which represent the separate hydrogeological units. The revised Project’s timescale extends to 2030 and is incorporated within the model by using mining zones which are activated according to the mining schedule and de-activated as they are rehabilitated.

Impacts on groundwater levels will vary spatially over time as the mined area migrates across the revised Project site. The model predicts the greatest impacts on groundwater levels surrounding the revised Project will occur around 2030 at the end of mining. This corresponds to the Life of Mine Plan when the deepest areas of working will result in the most widespread drawdown.

Full details of the model, model calibration, predicted impacts on groundwater over the life of the revised Project are presented in the updated modelling report, presented as Appendix F of the AEIS (Jacobs SKM, 2014).

Predicted Impacts on the Alluvial Aquifer

A small amount of drawdown within the alluvium, less than 2 m, is predicted in an isolated area in the vicinity of Lagoon Creek adjacent the southwest of the revised Project site. As detailed in the EIS, previous groundwater investigations and a general lack of DNRM-registered bores in this area suggest that the alluvium associated with Lagoon Creek is dry; it is therefore likely that the predictions of drawdown in this area are a modelling artefact related to layering and model setup. The impact of predicted groundwater drawdown associated with the revised Project mining activities on the alluvium of Oakey and Myall Creeks (including their tributaries of Doctors, Lagoon and Spring Creeks) is also represented by the predicted change in flows in the Oakey and Myall Creeks. Model results indicate that no additional losses to baseflow as a result of the revised Project are expected to occur above any historic or current impacts. Overall, model results indicate very little to no impact to the alluvial aquifer from the revised Project.

Predicted Impacts on the Tertiary Basalt Aquifer – 2030

The predicted drawdown in the Tertiary Basalt aquifer for the year 2030, which represents both the end of mining and the time of maximum predicted impact from the revised Project's operation, is presented in Figure 2-1 Predicted Groundwater Drawdown in the Vicinity of the Mine in the Tertiary Basalt Aquifer for 2030

Figure 2-2. For the Tertiary Basalt aquifer, groundwater drawdown is limited to the area northwest of the revised Project site. Drawdown of up to 6 m in the Basalt is limited to within the northern part of the revised Project site, with drawdowns of between 1 and 5 m extending around 2 m from the boundary of the revised Project site. Drawdown exceeding greater than 5 m does not occur outside of the revised Project site. There are only 3 non-APC DNRM-registered bores beyond the revised Project boundary that are predicted to experience drawdowns from mining activity of between 1 and 2 m for the time of deepest working across the widest area (2030).

Drawdowns of the order predicted in the Tertiary Basalt aquifer are not considered to be significant in terms of affecting the yield or access to groundwater in existing bores abstracting from the Tertiary Basalt aquifer. Importantly, current investigations demonstrate that the existing third party utilisation of groundwater sourced from the Tertiary Basalt aquifer should not be impacted by the revised Project.

Predicted Impacts on the Walloon Coal Measures Aquifer – 2030

The predicted drawdown in the Walloon Coal Measures aquifer for the year 2030, which represents both the end of mining and the time of maximum predicted impact from the revised Project's operation, is presented in Figure 2-2

Figure 2-2 shows that drawdowns in excess of 5 m outside of the revised Project site are restricted to areas less than 3 km to the west and northwest. There are only 9 non-APC DNRM-registered bores beyond the revised Project boundary that are predicted to experience drawdowns from mining activity greater than 2 m for the time of deepest working across the widest area (2030). This number of bores excludes those bores in the DNRM database without defined source aquifers. The 1 m predicted drawdown contour in the Walloon Coal Measures aquifer is reasonably widespread to the west and northwest of the revised Project site, extending up to 7 km from the lease boundaries.

Drawdowns of the order predicted in the Walloon Coal Measures aquifer are not considered to be significant in terms of affecting the yield or access to groundwater in existing bores abstracting from this aquifer outside of the revised Project site lease boundary, except for bores on properties within 1 to 2 km of the western and eastern lease boundaries. Importantly, current investigations demonstrate that the existing utilisation of groundwater sourced from the Walloon Coal Measures should not be significantly impacted by the revised Project.

Predicted Impacts on the Marburg Sandstone Aquifer – 2030

Figure 2-3 presents the predicted drawdown in the Marburg Sandstone aquifer for the year 2030, which represents both the end of mining and the time of maximum predicted impact from the revised Project's operation. The Marburg Sandstone aquifer is situated approximately 75 m below the lowest level of working in the Walloon Coal Measures aquifer. Drawdowns are predicted to be much less in this aquifer beneath the active mine pits and do not exceed 3 m. Low levels of drawdown in the Marburg Sandstone aquifer (more than 1 m) are expected to propagate up to 5 km from the revised Project site.

Figure 2-3 indicates a limited number of Marburg Sandstone bores in the immediate vicinity of the revised Project site, within only 1 non-APC DNRM-registered bore predicted to experience drawdowns from mining activity greater than 2 m for the time of deepest working across the widest area (2030). However, it is acknowledged that some of the bores from the DNRM database shown on Figure 2-1 have no details of their source aquifer may abstract from the Marburg Sandstone aquifer.

Drawdowns of the order predicted in the Marburg Sandstone aquifer are not considered to be significant in terms of affecting the yield or access to groundwater in existing bores abstracting from the Marburg Sandstone aquifer. Importantly, current investigations demonstrate that the existing third party utilisation of groundwater sourced from the Marburg Sandstone aquifer should not be impacted by the revised Project.

Predicted Impacts on the Helidon Sandstone Aquifer

The Helidon Sandstone aquifer is not represented in the groundwater model as it lies some 200 m below the base of the Marburg Sandstone aquifer, and separating these two units is the relatively low permeability Evergreen Formation. The revised Project site is therefore not anticipated to have any significant impact on the Helidon Sandstone aquifer. NAC's current abstraction from this aquifer has substantially reduced prior to the revised Project's implementation resulting in the recovery of groundwater levels and the alleviation of some resource pressure on this GAB aquifer.

Impacts on Groundwater Levels – Post Mining

After cessation of mining in 2030, groundwater levels are predicted to gradually recover so that for the most part there is less than 10 m residual drawdown outside the revised Project's boundaries in the Walloon Coal Measures aquifer. Recovery to pre-mining conditions throughout the revised Project site is limited by evapotranspirative losses from the depressed landforms (rehabilitated final voids). Due to the high regional potential evapotranspiration rate, groundwater discharge to the depressed landforms is predicted continue at a rate of around 1 ML/day. Drawdown adjacent the last areas to be mined is predicted to remain relatively minor (approximately 2 to 6 m) due to the ongoing evaporation-driven groundwater discharge into the depressed landforms. Permanent lakes are predicted to form in all three depressed landforms (rehabilitated final voids). The maximum depths of the lakes that are predicted to form are around 33 m in the Manningvale West depressed landform, 18 m in the Manningvale East depressed landform, and 22 m in the Willeroo depressed landform. Groundwater level recovery within the depressed landforms remains at 2 to 6 m below the level of the pre-mining water table in the long term, due to the ongoing evapotranspirative groundwater discharge. As a result, the depressed landforms form a depression of the potentiometric surface within the vicinity of the depressed landforms and act as a groundwater sink that will not permit any pooled water within or adjacent to the depressed landforms to flow outwards into the regional groundwater system.

The 1 m drawdown extent in the Walloon Coal Measures aquifer is predicted to remain at approximately 6 km from the revised Project boundary at its greatest (western) extent in the long term post-mining due to ongoing evapotranspiration-driven groundwater discharge to the depressed landforms. Within the Tertiary Basalt and Marburg Sandstone aquifers, groundwater levels recover such that maximum drawdowns do not exceed much more than 2 to 3 m for either aquifer in the long term. However, the extent of drawdown for these two aquifers, modelled as the 1 m drawdown contour, in the long term remains at a similar proximal distance from the revised Project site as at the final year of mining. The groundwater system is expected to recover post-mining to a new steady state-equilibrium such that no additional groundwater impacts are expected other than those that exist at the end of mining in 2030.

Impacts on Groundwater Quality

The drawdown of groundwater levels in the Walloon Coal Measures aquifer around the revised Project's depressed landforms will result in the movement of groundwater towards these depressed landforms. The aquifers surrounding the revised Project site will continue to receive recharge via the same processes that occurred prior to the operational phase of the revised Project (via rainfall infiltration over time). Therefore, the groundwater quality in the vicinity of the revised Project site is not anticipated to be affected as a result of mining.

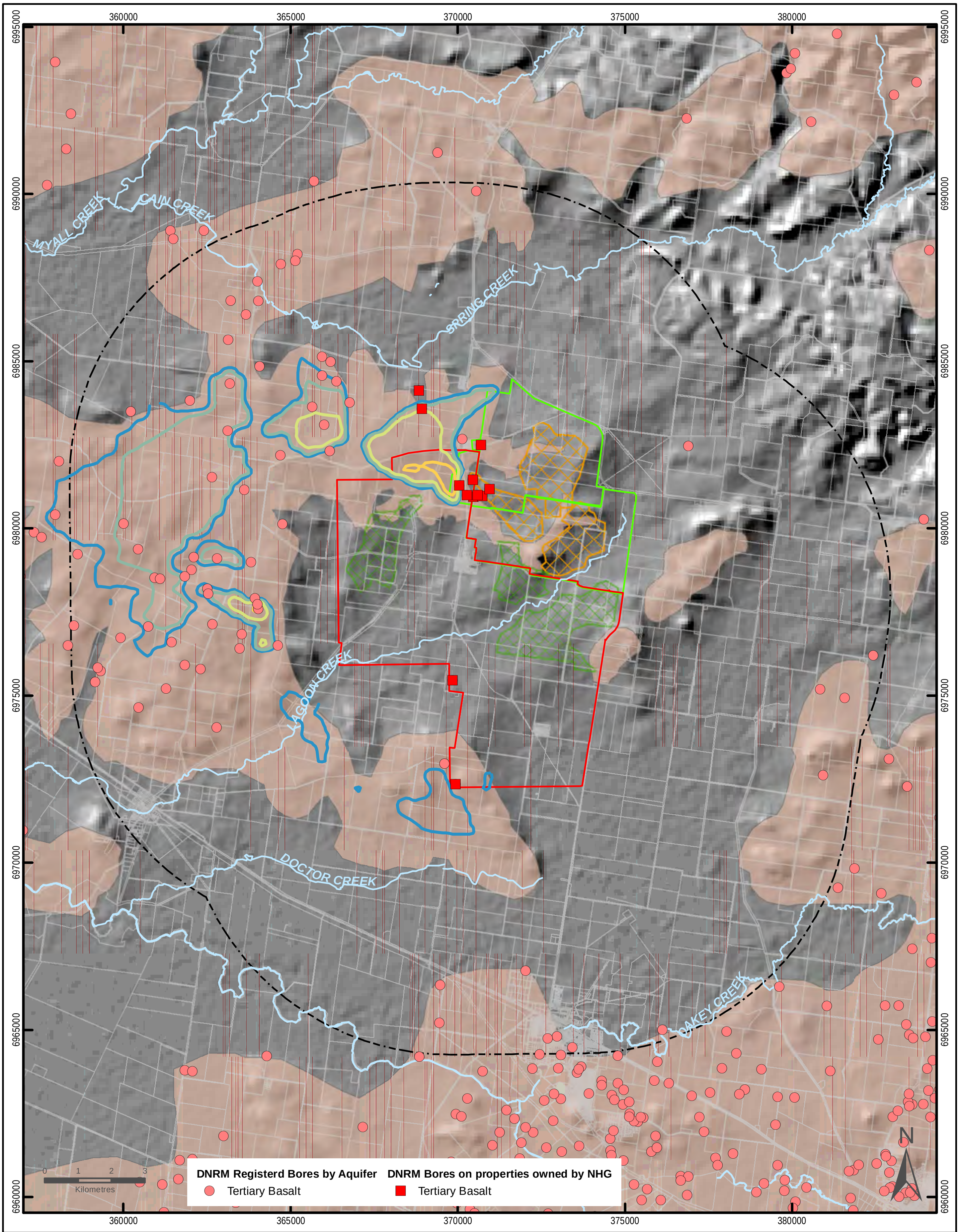
As the Marburg Sandstone aquifer is confined by the overlying lower Walloon Coal Measures, the potential for impacts on water quality within this aquifer from the revised Project's mining activity is considered negligible.

The operational phase of the revised Project is not expected to impact on groundwater quality.

Water captured within the revised Project's depressed landforms (former final voids) possesses the potential to be saline owing to inflows of saline groundwater from the Walloon Coal Measures aquifer. This captured water may be further concentrated over time due to the region's high evaporation rate which exceeds the rate of groundwater inflow. Similarly, dilution of the captured water is expected during extended periods of rainfall. The depressed landforms will act as groundwater sinks with a permanent drawdown relative to the surrounding aquifer, and as a result, will not permit pooled water to flow outwards into the regional system. Therefore, any pooled saline water should remain confined within the depressed landforms and not have an impact on the water quality of the surrounding aquifers.

From an acid rock drainage perspective, it is unlikely that any water captured in the revised Project's depressed landforms will become acidic from oxidation of pyrites in the Walloon Coal Measures aquifer because of the neutralising effect of the surrounding sediments which are naturally alkaline. To date, NAC has not experienced any occurrences of acid rock drainage at New Acland Coal Mine.

Groundwater quality will continue to be monitored throughout the life of the revised Project to identify trends and assess whether impacts are occurring over time.



LEGEND

Predicted Drawdown Contour (m)

- 1
- 2
- 5
- 10
- 20
- 30

- Watercourse
- New Acland Coal Mine - Stage 3
- New Acland Coal Mine Stage 3 - 8km Buffer
- New Acland Coal Mine
- Cadastre
- Modelled extent of Basalt occurance
- Stage 3 Pit Areas
- Existing Permission

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NEW ACLAND COAL MINE
STAGE 3 PROJECT

Figure 2-1 - Predicted Drawdown in the Tertiary Basalt 2030 (End of Mining)

Scale 1:150,000 on A4

Projection: Australian Geodetic Datum – Zone 56 (AGD84)

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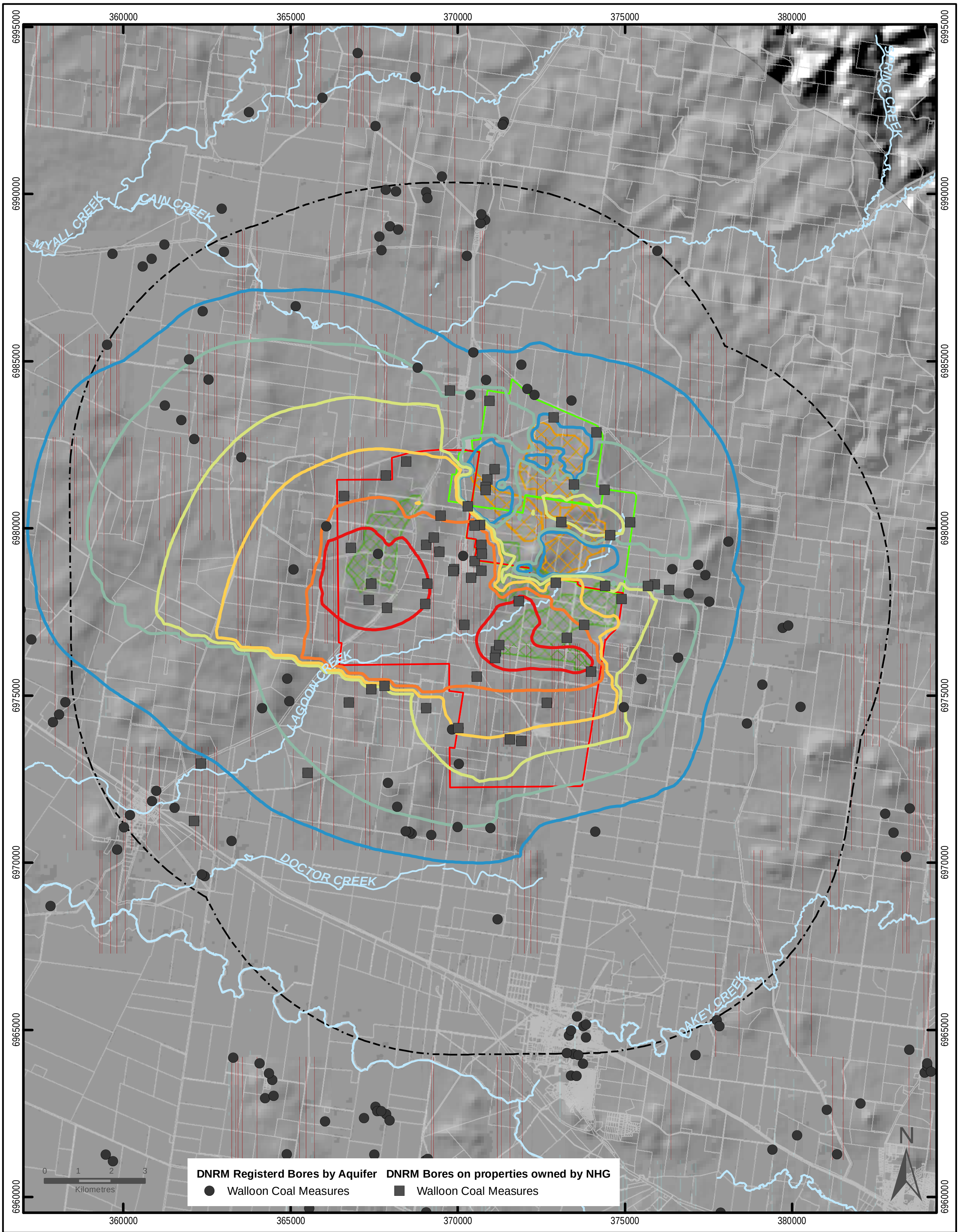

LEGEND

Predicted Drawdown Contour (m)

- 1
- 2
- 5
- 10
- 20
- 30

- Watercourse
- New Acland Coal Mine - Stage 3
- New Acland Coal Mine Stage 3 - 8km Buffer
- New Acland Coal Mine
- Cadastre
- Modelled extent of Walloon Coal Measures
- Stage 3 Pit Areas
- Existing Permission

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NEW ACLAND COAL MINE STAGE 3 PROJECT

Figure 2-2 - Predicted Drawdown in the Walloon Coal Measures 2030 (End of Mining)

Scale 1:150,000 on A4
Projection: Australian Geodetic Datum – Zone 56 (AGD84)

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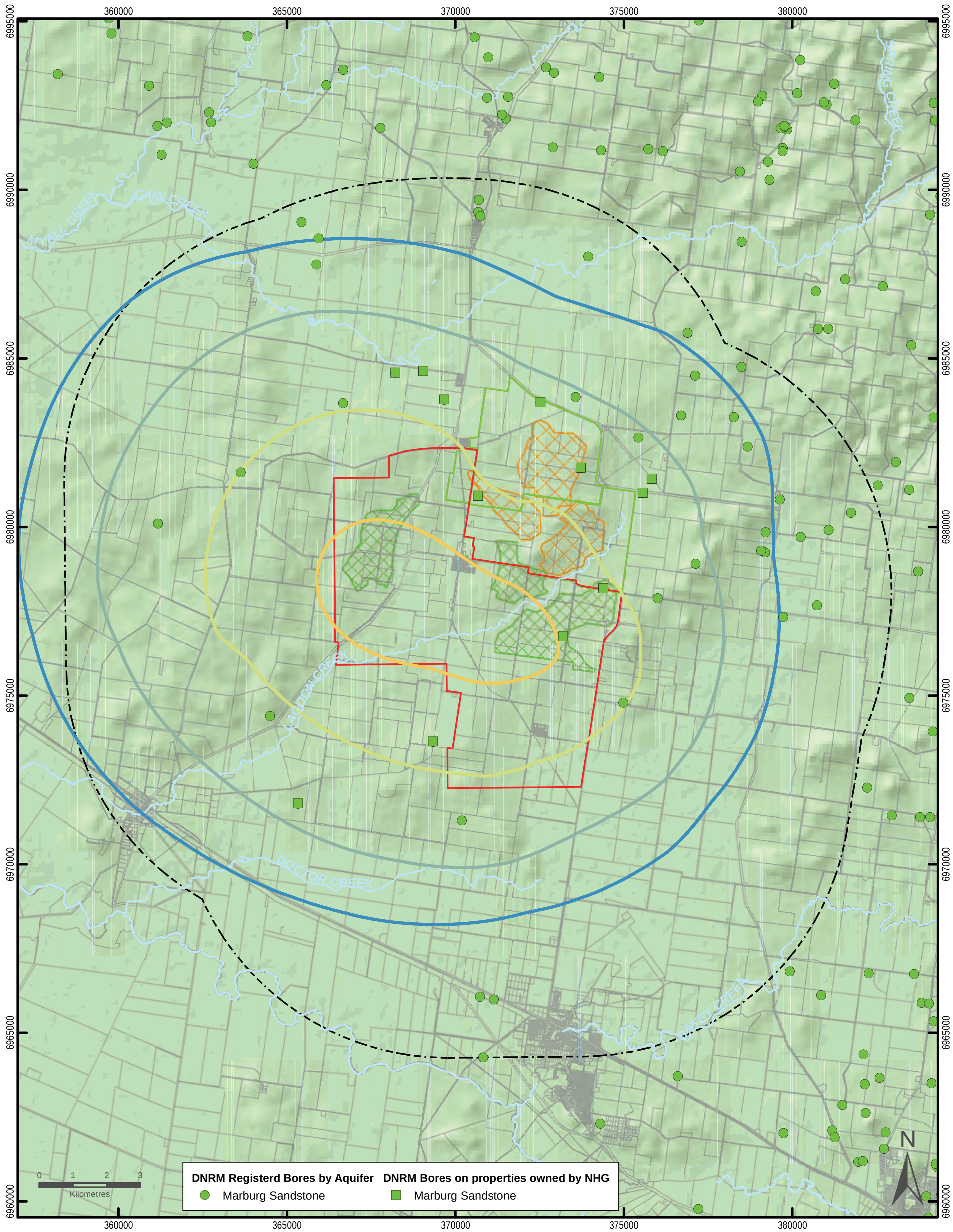

LEGEND

Predicted Drawdown Contour (m)

- 1
- 2
- 5
- 10
- 20
- 30

- Watercourse
- New Acland Coal Mine - Stage 3
- New Acland Coal Mine Stage 3 - 8km Buffer
- New Acland Coal Mine
- Cadastre
- Stage 3 Pit Areas
- Existing Permission
- Modelled extent of Marburg Sandstone

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NEW ACLAND COAL MINE STAGE 3 PROJECT

Figure 2-3 - Predicted Drawdown in the Marburg Sandstone 2030 (End of Mining)

Scale 1:150,000 on A4

Projection: Australian Geodetic Datum – Zone 56 (AGD84)

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Produced: 28/08/2014

3. Groundwater Monitoring Program

3.1. Existing Groundwater Conditions

Baseline groundwater monitoring was undertaken as part of the revised Project's EIS (SKM 2013). The methodology undertaken for the assessment of groundwater resources included:

- the review of geological, hydrogeological and groundwater quality data collected for the current Mine;
- the review of other background data available on local hydrogeology and groundwater use;
- the installation of four production and 11 observation bores to characterise the local hydrogeology around the revised Project site;
- the undertaking of aquifer pumping tests to determine aquifer parameters; and
- the formulation of a hydrogeological conceptual model to serve as the basis for a numerical model.

The detail of the baseline groundwater assessment is presented within Chapter 6 Groundwater Resources of the revised Project's EIS (SKM 2013).

Baselines have been defined for monitoring bores associated with the groundwater monitoring program for existing operations at New Acland Coal Mine. Long term monitoring of bores for the expanded groundwater monitoring program which covers the revised Project will be undertaken to establish bore-specific groundwater level and quality baselines. The Life of Mine Plan will allow sufficient time for parameter baselines to be established in advance of any potential impacts from mining across the revised Project area.

Groundwater Levels in the Walloon Coal Measures across the revised Project Site

Groundwater level data for the Walloon Coal Measures aquifer across the revised Project site indicate that currently the general direction of groundwater flow is southerly, falling from an elevation of around 430 mAHD in the north to 390 mAHD in the south. This direction of flow is consistent with a fall in the topographic elevation and geological dip across the revised Project Site. The long term data for monitoring bores indicate that the current mining operations on ML 50170 (Stage 1) and ML50216 (Stage 2) are not currently having a significant drawdown impact on groundwater levels in the Walloon Coal Measures aquifer within the revised Project site.

Groundwater Quality

A groundwater monitoring program is currently undertaken in accordance with EA EPML00335713 for the current mining operation. This monitoring has provided sufficient data to define bore-specific baseline concentrations for the monitored parameters, and these are detailed in the regular groundwater monitoring reports prepared by independent consultants, Waste Solutions Australia (WSA). NAC's current groundwater monitoring program is regulated by the the Department of Environment and Heritage Protection (DEHP). In 2012, WSA prepared a comprehensive review of groundwater quality monitoring undertaken to date at the Mine in order to review and if necessary establish new groundwater quality background limits. This report is presented as Appendix A.

Walloon Coal Measures Aquifer

Water quality for the Walloon Coal Measures aquifer shows typically neutral to slightly alkaline pH, with values generally falling within the potable range (6.5 to 8.5). Electrical conductivity (EC) values range from 530 µS/cm to 11,700 µS/cm but more typically range from 3,000 µS/cm to 6,000 µS/cm, reflecting the slightly brackish to brackish nature of the groundwater where naturally occurring sodium and chloride are the dominant ions. The majority of the bores currently monitored have total dissolved solids (TDS) levels below 4,000 mg/L, which indicates the quality is suitable for watering livestock. At TDS levels between 4,000 mg/L and 10,000 mg/L, animals may have an initial reluctance to drink but should adapt to these conditions without adverse effects.

Water supplies from Walloon Coal Measures aquifer include some of potable quality but the typically brackish nature of the groundwater from this aquifer means supplies are mainly used for stock watering.

Tertiary Basalt Aquifer

The bores in the Tertiary Basalt aquifer currently monitored under the existing groundwater monitoring program yield water of essentially neutral pH (between 7.0 and 8.0). Salinity in the Tertiary Basalt aquifer is generally lower than the Walloon Coal Measures aquifer, with EC and TDS ranging from 1,400 µS/cm to 4,300 µS/cm and 870 mg/L to 2,900 mg/L, respectively.

3.2. Groundwater Monitoring Program

The groundwater monitoring program for the revised Project combines the current monitoring program for the existing Mine with an extended network of monitoring bores enclosing the revised Project area. Data collected from the groundwater monitoring program will:

- be operated in accordance with the revised Project's approved EA;
- be collated into six monthly and annual reviews of groundwater monitoring;
- be used in the continued development and refinement of groundwater impact assessment criteria and investigation triggers;
- enable verification and refinement of the groundwater modelling predictions presented in the revised Project's AEIS (Jacobs SKM 2014); and
- be collated into a database that will be made available to the administering authority on request.

The groundwater monitoring program conforms to Conditions C21 to C33 of the current EA EMPL00335713 for New Acland Coal Mine. Table 3-1 summarises the bores that will be monitored, monitoring parameters, and frequency. The groundwater monitoring program combines the existing monitoring bores together with an additional 15 bores that have been installed around the revised Project area. In addition, a further 16 bores will be added to the monitoring network which brings the total number of bores included in the groundwater monitoring program to 46. Proposed additional monitoring bore locations have been chosen based on model drawdown predictions and presence of aquifers and receptors of interest. The monitoring program for new bores will be established prior to the commencement of the revised Project's mining schedule to ensure there is sufficient baseline information on groundwater levels and quality for those bores.

Table 3-1 Groundwater Monitoring Schedule

Monitoring Point	Aquifer	Parameter and Monitoring Frequency	Justification
Bores monitored under current monitoring program (Compliance and Reference bores)			
2289P	Coal Measures	Groundwater levels: **monthly**. Groundwater quality: **six monthly** to include: Al, As, Ca, Se, Cl, Cu, F, Fe, Total N, K, Mg, Mn, Na, SO4, HCO3, TDS, EC, pH	Existing long-term monitoring bore
2291P	Coal Measures		Existing long-term monitoring bore
18P	Coal Measures		Existing long-term monitoring bore
25P	Basalt		Existing long-term monitoring bore
26P	Coal Measures		Existing long-term monitoring bore
27P	Coal Measures		Existing long-term monitoring bore
28P	Coal Measures		Existing long-term monitoring bore
843	Basalt		Existing long-term monitoring bore
848	Coal Measures		Existing long-term monitoring bore
81P	Coal Measures		Existing long-term monitoring bore
82P	Coal Measures		Existing long-term monitoring bore
83P	Coal Measures		Existing long-term monitoring bore
84P	Basalt		Existing long-term monitoring bore
BMH1	Basalt		Existing long-term monitoring bore
CSMH1	Coal Measures		Existing long-term off lease monitoring bore
Existing Stage 3 monitoring bores to be incorporated into the revised Project's monitoring program			
109P	Basalt	Groundwater levels: **monthly**. Groundwater quality: **six monthly** to include: Al, As, Ca, Se, Cl, Cu, F, Fe, Total N, K, Mg, Mn, Na, SO4, HCO3, TDS, EC, pH	Existing bore. Located in an area of significant predicted drawdown close to early Stage 3 workings; will be used to check against model predictions and as an early warning bore for off-lease drawdown propagation.
112PGC	Coal Measures		Existing bore. Located within the centre of Stage 3 pits close to the area of peak

Monitoring Point	Aquifer	Parameter and Monitoring Frequency	Justification
			predicted Walloon drawdown.
114P	Coal Measures		Existing bore. Located close to the area of peak predicted Walloon drawdown.
116P	Coal Measures		Existing bore. Used to monitor south-eastwards propagation of drawdown.
119PGC	Coal Measures		Existing bore. Used to monitor southwards propagation of drawdown.
120WB	Coal Measures		Existing bore. Used to monitor south-westwards propagation of drawdown.
121WB	Coal Measures		Existing bore. Located within the centre of Stage 3 pits close to the area of peak predicted Walloon drawdown.

Monitoring Point	Aquifer	Parameter and Monitoring Frequency	Justification
Proposed additional monitoring points which will be monitored as part of the revised Project's monitoring program			
1A	Basalt	Groundwater levels: **monthly**. Groundwater quality: **six monthly** to include: Al, As, Ca, Se, Cl, Cu, F, Fe, Total N, K, Mg, Mn, Na, SO4, HCO3, TDS, EC, pH	Located between Stage 3 workings and nearby landholder receptors. Used as an early warning bore. In combination with bore 1B, allows assessment of vertical connectivity between Basalt and Walloons.
1B	Coal Measures		Located between Stage 3 workings and nearby landholder receptors. Used as an early warning bore to monitor for westwards propagation of drawdown. In combination with bore 1A, allows assessment of vertical connectivity between Basalt and Walloons.
2A	Basalt		Located between Stage 3 workings and nearby landholder receptors. Used as an early warning bore to monitor for westwards propagation of drawdown. In combination with bore 2B, allows assessment of vertical connectivity between Basalt and Walloons.
2B	Coal Measures		Located between Stage 3 workings and nearby landholder receptors. Used as an early warning bore to monitor for westwards propagation of drawdown. In combination with bore 2A, allows assessment of vertical connectivity between Basalt and Walloons.
3A	Basalt		Bore to monitor for off-lease propagation of drawdown to the southwest. In combination with bore 3B, allows assessment of vertical connectivity between Basalt and Walloons.
3B	Coal Measures		Bore to monitor for off-lease propagation of drawdown to the southwest. In combination with bore 3A, allows assessment of vertical connectivity between Basalt and Walloons.
4A	Basalt		Bore to monitor for off-lease propagation of drawdown to the southwest. In combination with bore 4B, allows assessment of vertical connectivity between Basalt and Walloons.
4B	Coal Measures		Bore to monitor for off-lease propagation of drawdown to the southwest. In combination with bore 4A, allows assessment of vertical connectivity between Basalt and Walloons. In combination with bore 4C, allows assessment of vertical connectivity between Walloons and Marburg Sandstone.
4C	Marburg Sandstone		Bore to monitor for off-lease propagation of drawdown to the southwest. In combination with bore 4B, allows assessment of vertical

Monitoring Point	Aquifer	Parameter and Monitoring Frequency	Justification
			connectivity between Walloons and Marburg Sandstone.
5A	Oakey Creek Alluvium		Bore to monitor for Oakey Creek Alluvium at its closest point to the revised Project's pits. In combination with bore 5B, allows assessment of vertical connectivity between Alluvium and Walloons.
5B	Coal Measures		Bore to monitor for propagation of drawdown to the southeast. In combination with bore 5A, allows assessment of vertical connectivity between Alluvium and Walloons. In combination with bore 5C, allows assessment of vertical connectivity between Walloons and Marburg Sandstone.
5C	Marburg Sandstone		Bore to monitor for propagation of drawdown to the southeast. In combination with bore 5B, allows assessment of vertical connectivity between Walloons and Marburg Sandstone.
6	Coal Measures		Bore to monitor for off-lease propagation of drawdown to the east.
7A	Basalt		Bore used to monitor for north-westwards propagation of drawdown. In combination with bore 7B, allows assessment of vertical connectivity between Basalt and Walloons.
7B	Coal Measures		Bore used to monitor for north-westwards propagation of drawdown. In combination with bore 7A, allows assessment of vertical connectivity between Basalt and Walloons.
8	Mine Pit Backfill		In light of apparent mounding of groundwater within previously worked and backfilled mine areas, bore proposed to monitor for and confirm/disprove such mounding.

Aluminium (Al), Arsenic (As), Selenium (Se), Copper (Cu), Fluorine (F), Iron (F), Total Nitrogen (Total N), Manganese (Mn); Calcium (Ca), Chloride (Cl), Potassium (K), Magnesium (Mg), Sodium (Na), Sulphate (SO4), Bicarbonate (HCO3), Carbonate (CO3), Total Dissolved Solids (TDS), Electrical Conductivity (EC); Acidity/Alkalinity (pH).

The locations of the monitoring bores in Table 3-1 are presented in Figure 3-1. The final location of the proposed additional bores may vary slightly depending on land access and proximity to local groundwater users. These bores will be individually identified in accordance with the bore naming convention at the revised Project site.

The existing Mine EA reference bores (BMH1 and CSMH1) are located within the predicted zone of groundwater drawdown from operation of the revised Project. NAC will accordingly re-assess the location of these reference bores and if necessary install new reference bores outside the revised Project's predicted zone of groundwater drawdown.

The groundwater monitoring network will:

- be installed and maintained by a person possessing appropriate qualifications and experience in the fields of hydrogeology and groundwater monitoring program design to be able to competently make recommendations about these matters;
- be constructed in accordance with methods prescribed in the latest edition of ”Minimum Construction Requirements for Water Bores in Australia” (National Uniform Drillers Licensing Committee, 2012) by an appropriately qualified driller; and
- include a sufficient number of ‘bores of compliance’ that are located at an appropriate distance from potential sources of impact from mining activities and provide the following:
    - representative groundwater samples from the uppermost aquifer;
    - background water quality in hydraulically up-gradient or background bore(s) that have not been affected by any mining activities conducted by NAC; and
    - the quality of groundwater down gradient of potential sources of contamination including groundwater passing the relevant bore(s) of compliance.

Groundwater monitoring will be undertaken by appropriately qualified personnel. Groundwater level measurements, sample collection, storage and transportation will be undertaken in accordance with procedures conforming to the current industry standard: AS/NZS 5667.1, .11 1998.

The data gathered from the groundwater monitoring program will be collated into a database which will include:

- a site plan showing sample locations;
- tabulated results of the monitoring compared with applicable background/trigger levels;
- all data collected during each monitoring round;
- a record of chain of custody of the samples from sampling through to analysis;
- laboratory analysis certificates;
- groundwater monitoring program reports, and
- a description of the procedures, methods and calculations used.

Groundwater sample analysis will continue to be undertaken by a laboratory accredited by the National Association of Testing Authorities (NATA). Field measurement of water quality parameters is undertaken using appropriate field equipment that is maintained and calibrated in accordance with the manufacturer’s recommendations.

- Data collected from landholder bores, wells, and waterholes will be used in conjunction with the groundwater impact investigation procedure to determine if contingency measures are required.

Alluvium

The nearest alluvium with significant groundwater supplies is associated with Oakey Creek in the south-west of the revised Project site. A new monitoring bore installed at location 5A (Figure 3-1) will monitor groundwater levels and quality in the Oakey Creek Alluvium. Groundwater levels in the coal measures between the active mine pits and the Oakey Creek Alluvium will be monitored at bores 119PGC and 116P and directly beneath the alluvium at Location 5B.

Basalt

Eight basalt bores will be monitored, including five new bores strategically located in areas of predicted drawdown and/or sensitive receptors (Figure 3-1). Groundwater levels will be monitored on a monthly basis and samples will be collected and submitted for the analytical suite set out in Table 3-1 every six months.

Coal Measures

The groundwater monitoring program includes 22 coal measures bores of which seven are new, strategically located in areas of predicted drawdown and/or sensitive receptors (Table 3-1 and Figure 3-1). Groundwater levels will be monitored on a monthly basis and samples will be collected and submitted for the analytical suite set out in Table 3-1 every six months.

Marburg Sandstone

The Mine currently abstracts groundwater from the Marburg Sandstone aquifer for the purpose of coal washing. NAC currently possesses an allocation of 271 ML/year for this aquifer. For the revised Project's future operation, abstraction from the Marburg Sandstone aquifer will range around 10 ML/year for maintenance purposes. 2 new groundwater monitoring bores will be installed in the southwest and southeast of the revised Project site, to monitor this aquifer and confirm predictions of minimal impacts. The locations of these bores have been strategically chosen in areas of predicted drawdown and/or sensitive receptors, and in conjunction with other shallower monitoring bores to allow assessment and confirmation of vertical gradients and hydraulic separation between the overlying aquifers.

Landholder Bores

NAC will undertake a landholder bore assessment program to characterise each and every private bore predicted to be impacted by operation of the revised Project. This will include those bores that are currently within the maximum extent of predicted drawdown (for the Walloon Coal Measures with a 1 m cutoff) but that currently do not have a source aquifer assigned in the DNRM registered bore database, so that groundwater drawdown predictions can be made for these 'unknown aquifer' bores during the first groundwater model update (see Table 3-2).

The assessment program will collect information such as bore condition, usage, source aquifer, and water level and quality information. Following this assessment program, groundwater monitoring will be undertaken at selected landholder bores surrounding the revised Project site, following consultation with relevant landholders. Primarily this will include monitoring of groundwater levels and quality in order to assess potential impacts from mine dewatering. Landholder bores targeted for monitoring will primarily be those taking water from the coal measures and basalt but may include some bores in the Marburg Sandstone or alluvial aquifers.

3.3. Groundwater Impact Prediction, Validation and Review

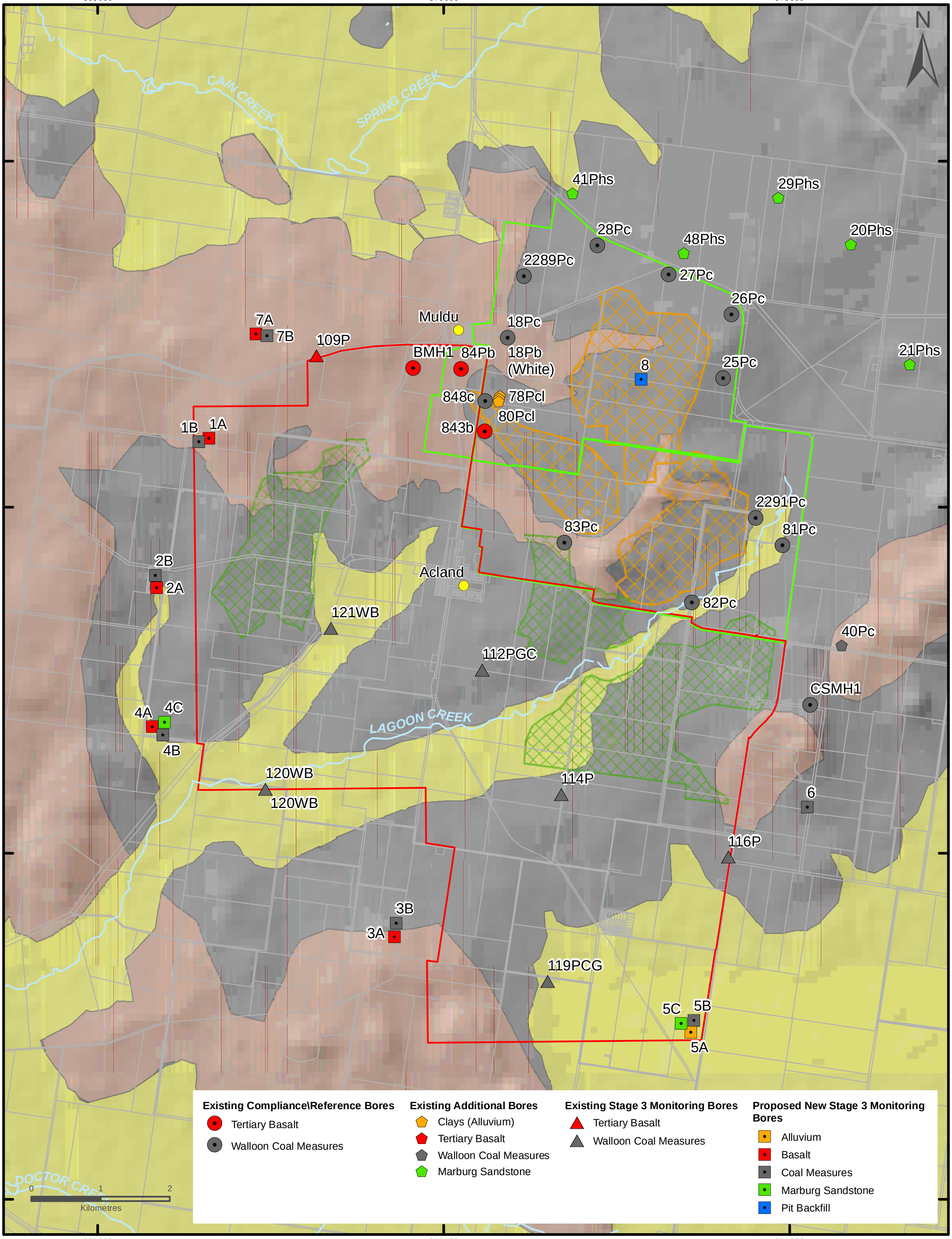
Chapter 6 Groundwater Resources of the revised Project's EIS (SKM 2013) included the development of a multilayer time variant groundwater flow model to simulate the effects of mining activities on the local aquifers and to estimate the potential quantity of groundwater inflow to the active mine pits and depressed landforms

During the life of the revised Project, data collected through the groundwater monitoring program, will be used to update and refine this model and it's predictions to reflect the actual activities undertaken on site (e.g. mine development and sump locations) and the results of regular groundwater monitoring.

The need to review and update the revised Project's model will depend on the stage of the revised Project's mine development, changes in the depth of working, and availability and results of new monitoring data. For example, at the conclusion of the installation program for new monitoring bores for the revised Project, the data collected from the monitoring program will be used to immediately refine the model and produce a revised impact assessment. Table 3-2 presents the proposed schedule for groundwater impact prediction, validation and review. The results of any groundwater model verification and refinement, or the justification that this action is not necessary, will be documented, and as required, presented to DEHP (regulatory authority under the *Environmental Protection Act 1994*) and/or NRM (regulatory authority under the *Water Act 2000*).

Table 3-2 Schedule for Groundwater Impact Prediction, Validation and Review

Model Revision	Timing
Initial Review	At the conclusion of the revised monitoring network installation program
2nd Review	After one (1) year of operation of the revised Project
3rd and subsequent Reviews	Every three (3) years or if deemed necessary under the Groundwater Impact Investigation Procedure as described in **Section 4.2**



LEGEND

- Towns and Localities
- Watercourse
- New Acland Coal Mine
- New Aland Coal Mine-Stage 3
- Existing Permission
- Stage 3 Pit Areas
- Cadastre
- Alluvium (Qa)
- Basalt (Tm)
- Walloon Subgroup (Jw)
- Marburg Sandstone (Jbm)

NEW HOPE GROUP

SINCLAIR KNIGHT MERZ SKM

NEW ACLAND COAL MINE STAGE 3 PROJECT

Figure 3-1 - Proposed Monitoring Locations

Scale 1:75,000 on A4

Projection: Australian Geodetic Datum – Zone 56 (AGD84)

Path: I:\QENV2\Projects\QE06644\Spatial\ArcGIS\01_Figures\03_AEIS\06_GroundwaterResources\GMIMP Update\140527_NewHope_Groundwater_GWMIMP_Figure3-1_ProposedMonitoringLocations.mxd

Produced: 28/08/2014

4. Groundwater Impact Triggers and Investigation Protocols

4.1. Groundwater Impact Criteria and Triggers

Groundwater monitoring will be undertaken for the revised Project in accordance with the groundwater monitoring program. Impact assessment criteria for groundwater levels and quality, where not already established, will be developed using statistical analysis of the baseline data and the predicted effects presented in the revised Project's AEIS (Jacobs SKM 2014).

Triggers will be used to determine if the groundwater impact investigation procedure should be initiated.

These triggers include:

- breaching of relevant conditions of the EA;
- substantial variance from the predicted groundwater drawdown effects presented in the revised Project's AEIS (Jacobs SKM 2014) or subsequent impact assessment updates; or
- when a legitimate complaint is received from a local landholder who is a groundwater user. It should be noted under the current Water Act (2000) framework there are no fixed trigger points for Make Good related to private landholder bores; the current Water Act trigger point depends solely on whether an existing supply is unduly impacted.

4.1.1. Groundwater Quality Triggers

Nine bores (18P, 27P, 28P, 843, 848, 81P, 82P, 83P and 84P) within the groundwater monitoring program have had background concentrations defined for the water quality parameters set out in Table 4-1. The upper and lower background concentrations were defined on the basis of six-monthly sampling over a four-year period and are reported in Appendix A. The groundwater monitoring requirements of the current EA EPML00335713 for the Mine sets limits for each of the water quality parameters included within the groundwater monitoring program (Table 4-1).

Table 4-1 Groundwater Quality Monitoring Limits

Parameter	Limit
Aluminium (Al) Arsenic (As) Selenium (Se) Copper (Cu) Fluoride (F) Iron (Fe) Total nitrogen (N) Manganese (Mn)	+ / - 20% of background concentration

Parameter	Limit
Calcium (Ca) Chloride (Cl) Potassium (K) Magnesium (Mg) Sodium (Na) Sulphate (SO4) Bicarbonate (HCO3) TDS	+ / - 10% of background concentration
Electrical conductivity (EC, µS/cm)	+/- 0.5 for coal measures aquifers, +/-1 for basalt aquifers

Groundwater quality monitoring limits for new monitoring bores (including all Stage 3 monitoring bores) will be established and used following collection of a minimum of three years of data and appropriate analysis. As groundwater quality limits are established, they will be used in reporting requirements.

4.1.2. Groundwater Level Triggers

The current groundwater level trigger set out in EA EPML00335713 – C26 for current mining operations will continue to apply. The EA states:

"..on lease groundwater levels must be monitored and compared with two bores located off-lease and within the same aquifer. The difference in the variation of drawdown from on-lease bores compared to the variation in off-lease bores within any one month sampling period should be no greater than one metre. Where a difference of more than one metre is identified and that difference is not the result of pumping of licensed bores, the administering authority must be notified within 14 days of completion of monitoring".

Four off lease Tertiary Basalt aquifer monitoring bores and five off lease Walloon Coal Measures aquifer monitoring bores will form an essential component of the 44 monitoring bores included in the groundwater monitoring program.

Groundwater level triggers will also be set on the basis of predicted drawdown in the Walloon Coal Measures and Tertiary Basalt aquifers. The selection of key monitoring bores will be based on at least two years of monthly groundwater level monitoring data. Modelled predictions of drawdown in the Walloon Coal Measures and Tertiary Basalt aquifers at these locations will be defined. When 75% of the predicated drawdown at these monitoring bores has been observed for three consecutive monthly monitoring events, the groundwater impact investigation protocol will be triggered.

4.1.3. Landholder Complaints

In the event that a legitimate groundwater-related complaint is received from a local landholder, the relevant data will be reviewed by an appropriately qualified person who will determine if the groundwater impact investigation protocol should be initiated. Each new complaint will be compiled into a register and updated as required based on the management actions completed. The complaints register will be maintained for audit purposes.

4.2. Groundwater Impact Investigation Procedure

The groundwater impact investigation procedure will be implemented in response to an exceedence of a relevant trigger (groundwater quality or groundwater level) or a legitimate complaint from a landholder (groundwater related). The relevant data set will be reviewed by an appropriately qualified environmental specialist who will determine if further investigation is necessary. The groundwater impact investigation procedure will follow the following framework.

- If a trigger or trend is identified in a data set, or a landholder complaint received, the first step will be to verify the data if it appears anomalous. A resample/re-test/re-measure will be conducted where appropriate.
- Where monitoring results indicate that a groundwater level has breached the reporting trigger, the administering authority must be notified within 14 days of completion of monitoring or as otherwise stated in the revised Project's EA.
- In relation to groundwater quality triggers, if the groundwater contaminant trigger levels defined in Table 2 are exceeded then an investigation into the potential for environmental harm will be completed and sent to the administering authority within 3 months of receiving the analysis results (Condition C29 EPML00335713).
- Once the validity of the breach in groundwater level triggers or a landholder complaint has been verified, a preliminary assessment will be undertaken by an appropriately qualified specialist involving the evaluation of the monitoring results/complaint in conjunction with mining activities being undertaken at the time, baseline groundwater monitoring results, groundwater data for surrounding locations, local use of groundwater, the prevailing and preceding meteorological conditions, and other factors affecting the local hydrogeological regime.
- The preliminary investigation may deem that further additional investigation and monitoring is required to determine the cause of the 'activation' of the trigger and whether or not it is directly related to mining activities.
- If the investigations deem that triggers have been 'activated' as a result of mining activities, contingency measures may need to be implemented.
- Additional monitoring may be implemented to measure the effectiveness of contingency measures (i.e. if deemed necessary).
- In the event that trigger levels or impact assessment criteria continue to be exceeded, further investigations may be undertaken (i.e. a process of continual improvement or adjustment of the relevant triggers if warranted).
- The results of any breaches of trigger levels and investigations will be documented for reporting and audit purposes.
- If a definite case of material or serious environmental harm or the potential for material or serious environmental harm is clearly established by a groundwater investigation into an exceedance of a relevant trigger (groundwater quality or groundwater level) or a legitimate complaint, NAC will ensure the notification requirements of Section 320 of the *Environmental Protection Act 1994* are fully addressed.

4.3. Mitigation

In the event that a formal groundwater investigation conclusively identifies that the revised Project's mining operations have adversely impacted a neighbouring groundwater user (affected groundwater user), NAC will attempt in 'good faith' to negotiate suitable mitigation measures in a timely manner to rectify the identified groundwater problem. NAC may involve an appropriately qualified environmental specialist to assist with development of the mitigation measures. The development of suitable mitigation measures will be based on the outcomes of an appropriate scientific investigation.

Possible mitigation measures that may be applied by NAC include:

- the refurbishment of an existing groundwater bore;
- the installation of a new groundwater bore;
- the establishment of an alternative water supply arrangement; and/or
- the use of another mutually agreed form of mitigation.

NAC will ensure as a minimum that the proposed mitigation measures are acceptable to the affected groundwater user, and if acceptable, will enter into a legal agreement for the installation of the proposed mitigation measures at NAC's expense. NAC will also ensure the proposed mitigation measures are commensurate with the identified groundwater loss.

NAC may be required to install interim mitigation measures until the permanent mitigation measures have been developed and installed. As required, NAC will seek agreement with the affected groundwater user and pay all reasonable cost for the use of any interim mitigation measures.

If agreement cannot be reached with the affected groundwater user in relation to the proposed mitigation measures, NAC will facilitate some form of legal disputes resolution for the matter.

NAC will ensure the administering authority is fully advised about the details and progress of these types of groundwater matters.

NAC is committed to rectifying all groundwater problems that are legitimately attributed to the revised Project's mining operations through proper scientific evaluation, in an appropriate timeframe, using accepted and practical mitigation measures, and to the satisfaction of the affected groundwater user.

4.4. Groundwater Complaints Management Process

Groundwater complaints that are believed to be attributed to the operation of New Acland Coal Mine (Mine) should be immediately reported to NAC. Groundwater complaints may be reported verbally by telephone (1 800 882 142 or Oakey Community Office: 07 4691 3445) or in writing using e-mail (community@newhopegroup.com.au) or letter (New Acland Coal Pty Ltd, PO Box 47, Ipswich, Qld 4305). NAC has provided its near neighbours with general and special 24 hour contact numbers. NAC will continue this practice for the revised Project.

The general details of the groundwater complaint need to be provided at the time of reporting the complaint to NAC. NAC will make all reasonable efforts to ensure the reported groundwater complaint is managed in a timely and appropriate manner. NAC's Environmental Officer (EO) is responsible for environmental complaints management at the Mine.

NAC will record the details of the groundwater complaint in the Mine's complaint database (register) and review this information. As required, NAC will re-contact the complainant about the groundwater complaint to obtain all the necessary details to decide the next course of action. Depending on the severity of the groundwater complaint, NAC as a courtesy may also advise the Toowoomba Office of the DEHP about the matter. As required, the New Hope Group's Corporate Environmental Team may assist with management of the groundwater complaint.

NAC's investigation of the groundwater complaint is designed to establish the legitimacy of the complaint, and if legitimate, whether the Mine is directly or indirectly responsible for the complaint. If current evidence or further scientific investigation establishes NAC is responsible for the groundwater complaint, NAC will advise the complainant, the Toowoomba Office of the DEHP and follow the mitigation strategy outlined in Section 4.4 of this Plan. If current evidence or further scientific investigation establishes NAC is not responsible for the groundwater complaint, NAC will advise the complainant in a timely manner, and depending on circumstances, the Toowoomba Office of the DEHP.

At the cessation of the complaint investigation process, NAC will record all the relevant details about the groundwater complaint in the Mine's complaint database, including all management actions undertaken, the final outcomes of the complaint investigation process, the details of any required follow-up or on-going management actions, and whether the complaint is 'closed off' to the satisfaction of the complainant. NAC maintains the Mine's complaint database for issue analysis, regulatory and audit purposes.

Importantly, NAC is committed to working with its near neighbours to resolve genuine issues as they arise in relation to the operation of the Mine.

5. Review and Improvement Process

5.1. Review of the Groundwater Monitoring and Impact Management Plan

NAC will conduct an annual review of the environmental performance of the revised Project. The annual review will address the performance of the GMIMP and will:

- include a comprehensive review of the monitoring results and complaints records for the revised Project over the year, including a comparison of these results against the:
- relevant statutory requirements, limits or performance measures/criteria,
- monitoring results of previous years, and
- relevance to the revised Project's EA;
- identify any non-compliance over the last year, and describe what actions were (or are being) taken to ensure compliance;
- identify any trends in the monitoring data over the life of the revised Project;
- identify any discrepancies between the predicted and actual impacts of the revised Project, and analyse the potential cause of any significant discrepancies (validate model);
- describe mitigation measures that have or are being implemented to address breaches of any groundwater impact triggers; and
- review the condition and extent of the groundwater monitoring network in the context of meeting its objectives.

Over the lifespan of the revised Project (approximately 16 years of working) and the post closure monitoring period, it is inevitable that groundwater monitoring bores will become unserviceable and need to be replaced. NAC will proactively maintain the groundwater monitoring network, replacing bores as necessary, and use the regular review of monitoring data to inform the location of additional monitoring bores, if required.

As required, NAC may update or revise the GMIMP based on the outcomes of the annual review process. The DEHP will be consulted in relation to any significant changes to the GMIMP and as necessary will be re-issued any new versions of the document.

Appendix A Waste Solutions Australia (2012) - Establishment of Groundwater Quality Background Limits

ESTABLISHMENT OF GROUNDWATER QUALITY BACKGROUND LIMITS (2012)



waste solutions
AUSTRALIA PTY LTD

NEW ACLAND COAL PTY LTD
RN12 / W316-14 / 01
December 2012

Document Control Summary Sheet

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Status	**Revision**	**Date**	**Author**	**Verified**
Final	0	19 December 2012	Patrick Mason	Paul Smith

Table of Contents

List of Appendices

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List of Acronyms/Abbreviations

NAC	New Acland Coal Pty Ltd
BOM	Bureau of Meteorology
DERM	Department of Environment and Resource Management (formerly EPA)
DEHP	Department of Environment and Heritage Protection (formerly DERM)
EA	Environmental Authority
EC	Electrical Conductivity
LOR	Limit of Reporting
mBTOC	meters Below Top Of Casing
NATA	National Association of Testing Authorities
QA	Quality Assurance
QC	Quality Control
RPD	Relative Percent Difference
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
WSA	Waste Solutions Australia Pty Ltd

1 INTRODUCTION

Waste Solutions Australia Pty Ltd (WSA) was commissioned by New Acland Coal Pty Ltd (NAC) to set background limits for monitoring bores within their compliance borefield network. This report includes background limits for monitoring bore CSMH1, with background limits for monitoring bores 2289, 2291, and BMH1 determined in the July 2012 revision of this report. It was determined following field investigations in the October 2012 routine monitoring round that bailing is the only suitable method to purge and sample CSMH1. Therefore data collected up to date from this bore can be considered acceptable and background values can be established for this bore as three years of data has been obtained (as stipulated in condition C31 in the site EA).

Setting of these background limits was conducted in accordance with sections C21 to C33 (specifically C31) of the Department of Environment and Heritage Protection (DEHP, formally DERM) Environmental Authority (EA #MIN100550507) effective 22 July 2011. It should be noted that the off-lease groundwater monitoring bores (BMH1 and CSMH1) are not required to have background limits set as stipulated in the NAC's EA (refer to C31), NAC are setting values for these bores at their own initiative.

Background limits have been set for all monitoring bores within the compliance network, with the exception of 25P (limited field data available as this bore regularly goes dry) and 26P (this bore has been historically dry during each monitoring round). Setting of these background limits was reported in *Establishment of Groundwater Quality Background Limits (WSA September 2008 and July 2012)*.This report will include the analysis and results outlined in these reports and will be a compendium of all results. The results from the WSA 2008 report were rechecked for the July 2012 revision and six errors were detected, these have now been corrected. Modification of these values has not resulted in any additional exceedances of routine monitoring results prior to and including the April 2012 monitoring round.

The location of the bores on-site is shown in Figure 1 Compliance Borefield Plan.

2 SCOPE OF WORK

The scope of works comprised of the following:

- Document the previous background limit determinations and historical correspondence with Department of Environment and Heritage Protection (DEHP) pertaining to these values.

- Compilation of analytical results and tabulation of new background limits for monitoring bore CSMH1. The background limits determined in WSA 2008 and those for 2289, 2291, and BMH1, determined in the July 2012 revision of this report, will remain unchanged.

- An encompassing report will be produced incorporating the data from WSA 2008 and 2012 and will include tabulation of new background limits results for monitoring bore CSMH1. This report will also be suitable for submission to DEHP. This data will be incorporated into the next round of routine groundwater monitoring at the NAC site (October 2012) for comparison with the new sampling data.

3 DEVELOPMENT OF BACKGROUND LIMITS

Background limits were developed for the following monitoring bores in WSA 2008: 16P (now decommissioned and replaced by 2291, with the first sampling in June 2009), 18P Coal, 27P, 28P, 81P, 82P, 83P, 84P, 843, and 848. 15P was decommissioned (due to inundation with water from the nearby environmental dam) and replaced by 2289 (with the first sampling in April 2009). The WSA 2008 derived background limits statistically analysed five years of data obtained from the compliance bores across the site. Background limits were developed for 2289, 2291, and BMH1 determined in the July 2012 revision of this report using data collected from 2008/2009 to April 2012.

This review has included the statistical assessment of information to identify trends and establish background limits for water quality parameters. The following sections describe the data used and the methodology chosen for derivation of the background limits.

3.1 Data Collection and Analysis

Data for the 2008 derived background limits was obtained principally from routine (6 monthly) groundwater sampling performed by WSA. Simmonds & Bristow Pty Ltd conducted laboratory analyses over this period. Data for the 2012 derived background limits was obtained from in-house sampling by NAC up to December 2010 when WSA undertook groundwater sampling; the only exception was the April 2008 sampling of BMH1 and CSMH1, which was undertaken by WSA. BMH1 and CSMH1 were not sampled over the period sampling was undertaken by NAC. As this bore is not required to have background limits determined, the smaller sample set for statistical analysis is not considered significant. Simmonds & Bristow Pty Ltd was used for sample analysis up to December 2010, and then from June 2011, Australian Laboratory Services (ALS) was used for sample analysis. Background limit values for 2289, 2291, and BMH1 were determined following the April 2012 routine groundwater monitoring round and values for CSMH1 were determined following the October 2012 routine groundwater monitoring round.

3.2 Statistical Analysis Methodology

A statistical analysis was performed using boxplots to analyse the variance of the data. Boxplots are used to highlight the centre and the symmetry of data sets as well as any outliers. Boxplots were generated from data collected at each compliance bore. The boxes shown on the plots for individual boreholes surround the area on the graph occupied by 80% of the sample results for each ion. This was done to help highlight any data points that are anomalously large or small, as they lie outside the box range. The generic boxplot is broken up into quartiles, with 50% of the data outlying the box area. With some of the sample ranges in these data sets only consisting of a small number of points then only three points would be left in the box. This small amount of data is not enough to establish a trend in the results. It was decided to select 80% as the cut-off value for the plotting of the data due to the limited size of the smaller data sets. However, the cut-off value is still high enough to highlight the extreme outliers on the graphs and remove them from the box without excluding relevant results. If values for all the data sets over time were below the laboratory limit of reporting (LOR), the LOR value has been adopted for the analyte value in absence of data.

Each background upper and lower limit nominated (refer to ***Appendix A***) was determined by selecting the maximum (90^{th} percentile) and minimum (10^{th} percentile) values in the box from each boxplot. These values, based on the statistical analysis, were selected as they provided the most conservative estimate of a value that is representative of the borehole location whilst not being an outlier. These are more realistic values than the mean or median value for the site. If the mean or median value had been taken as the baseline amount then there would be regular exceedances because half of the data that has been obtained at each bore location is over that value. This method discounts extreme outliers that are anomalous and are far too high to be used in generating a realistic background limit.

To produce these boxplots the median and lower and upper percentile cut-off values had to be calculated for each test parameter. As mentioned above, the majority of the lower and upper 10 percent of the data lie outside of the boxes. When the variation in data sets is very low, it is possible that the minimum and the bottom 10th percentile value are the same. The minimum and maximum 10th percentile values are used to determine the boundaries of the boxplots. The boxplots for all of the compliance bores can be seen in ***Appendix B***. Individual box plots were generated for each borehole for the following parameters:

- pH[1];
- Electrical conductivity (EC);
- Total Dissolved Solids (TDS);
- Major ions: calcium (Ca), , sodium (Na), potassium (K), chlorine (Cl), sulphate (SO4), bicarbonate (HCO3),
- Minor ions: Total Nitrogen (Total N), fluorine (F);
- Dissolved metals: aluminium (Al), arsenic (As), copper (Cu), iron (Fe), magnesium (Mg), manganese (Mn) and selenium (Se).

All of the data contained within the boxes is considered to be representative for that analyte for that compliance bore. It can be seen in the boxplots that these values vary from bore to bore for the same analyte. Variability in each parameter was considered too high when comparing multiple bore locations and was deemed to be unusable in establishing aquifer specific values. For this reason it was decided that the establishment of borehole specific data sets would be more appropriate. The historical data tables used to generate these statistics and the boxplots data are shown in ***Appendix C***.

The size of the boxes are indicative of the amount of variation in the data set, the larger the size of the box on the graph, the greater the variation in the values. The background limit ranges for each analyte in the compliance bores is determined to be between 10% less than to 10% greater than the box boundary values for the major ions. For the minor ions and metals the background limit ranges extends to 20% less than to 20% greater than the box boundary values for each analyte. These values were considered to reflect the individual hydrochemistry at each bore and provide an indicator if there is change in groundwater chemistry.

3.3 Correspondence with DEHP

After submission of Establishment of Groundwater Quality Background Limits (WSA

[1] Note that pH, as well as standing water level, do not require baseline limit determinations as stipulated in Schedule C – Table 7 in the EA. However, for completeness baseline limits have been determined for the analytical parameter pH.

September 2008), DEHP (then the Environmental Protection Agency) responded to NAC with comments on the derivation of the background limits as stated in the WSA 2008 report. This correspondence is provided in ***Appendix D***. WSA responded to these comments in two letters, dated 26th November 2008 and 8th January 2009 to NAC as provided in ***Appendix E***. These letters aimed to justify the statistical methodology used and no further correspondence was received from DEHP and has therefore been considered to have provided resolution to comments offered by the DEHP (former Environmental Protection Agency).

4 DISCUSSION

Most of the bores show elevated levels of aluminium and iron, as compared to other dissolved metal concentrations such as arsenic, copper and selenium. Levels of these parameters can become elevated following the field filtration process as very fine clay particles carrying metal ions pass through the standard 0.45-micron filter into the sample, skewing the concentration observed. Therefore, the concentration of these two parameters is likely controlled by physical processes (i.e. the level of sediment in the sample resulting from borehole purging), it was recommended in WSA 2008 that no background limits be placed on these two parameters, however for report completeness values, they have been derived.

At the time of compiling this report, two compliance bores (25P and 26P) listed in Schedule C Table 5: On-Lease Groundwater Monitoring Locations and Frequency within Environmental Authority # MIM800317705, have not yielded sufficient data to successfully generate background limits. This was due to the limited amount of samples collected from compliance bores 25P and 26P.

5 CONCLUSION & RECOMMENDATIONS

WSA has reviewed the appropriate sampling data for the compliance bores at the site and implemented a statistical assessment to produce background limits for each compliance bore. The compendium of the baseline limits, including the newly derived limits for monitoring bore CSMH1, are shown in ***Appendix A***. The technique of using boxplots to highlight the spread and symmetry of data sets is recognised and accepted. It is a commonly used method for statistical analysis.

The method of chemical data analysis yields both a ‘lower’ and ‘higher’ background value. With the exception of pH (which does not require determination of a background limit, however has been included for data completeness), any increase in concentration above the ‘higher’ value should be investigated. If concentrations decrease below the ‘lower’ background value, quality of water will be improving and hence should not be of concern.

After assessing the variation in the data from bore to bore, it was concluded that there was no possibility of having only one baseline limit per analyte for each aquifer across the whole site. It was decided that limits would be set for each individual bore.

6 LIMITATIONS

Waste Solutions Australia Pty Ltd has prepared this report for the use of New Acland Coal Pty Ltd and the Department of Environment and Heritage Protection in accordance with generally accepted consulting practice. No other warranty, expressed or implied, is made as to the professional advice included in this report. This report may not contain sufficient information for purposes other than for the client and its respective consulting advisers.

The accuracy of the assessment made in this report is dependent upon the accuracy and reliability of evidence drawn together from a number of sources. The field investigations on which this report is based were restricted to a level of detail appropriate for the project.

Waste Solutions Australia Pty Ltd has taken steps to ensure the accuracy and reliability of field observations and investigations. It is important, however, that the limitations of the assessment be clearly recognised when the findings of this study are being interpreted. This report is based on information derived partly from others over which Waste Solutions Australia Pty Ltd had no control.

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Legend:

18c Bore Location and name, "c" refer to coal aquifer monitoring bore

Map courtesy of New Acland Coal

waste solutions AUSTRALIA PTY LTD		New Acland Coal Pty Ltd		
		Compliance Borefield Map		
		Establishment of Groundwater Quality Background Limits (2012)		
Drawn by: PM	Approved: PS	Date: December 2012	Job: W 316-14	Figure 1

APPENDIX A

GROUNDWATER QUALITY BACKGROUND LIMITS

Borehole 18P (Coal)				
Analyte	**Units**	**Statistically Derived Background Limits**	**Actual Background Limits***	**Monitoring Frequency**
pH		7.28 - 10% to 8.61 + 10%	6.6 – 9.5	Half Yearly
EC	µS/cm	593 - 10% to 841 + 10%	534 – 925	Half Yearly
TDS	mg/L	333.8 - 10% to 961 + 10%	300 – 1057	Half Yearly
Ca	mg/L	6.7 - 10% to 18.1 + 10%	6 – 20	Half Yearly
Mg	mg/L	1.86 - 10% to 3.22 + 10%	1.7 – 3.5	Half Yearly
Na	mg/L	90.7 - 10% to 151 + 10%	82 – 166	Half Yearly
K	mg/L	2.64 - 10% to 5.24 + 10%	2.4 – 5.8	Half Yearly
Cl	mg/L	92 - 10% to 385 + 10%	83 – 424	Half Yearly
HCO3	mg/L	64 - 10% to 152.9 + 10%	58 – 168	Half Yearly
SO4	mg/L	5.45 - 10% to 18.4 + 10%	4.9 – 20	Half Yearly
F	mg/L	0.1 - 20% to 0.42 + 20%	0.08 – 0.51	Half Yearly
Al	µg/L	18.7 - 20% to 1350 + 20%	15 – 1620	Half Yearly
As	µg/L	2.59 - 20% to 9 + 20%	2.1 – 11	Half Yearly
Cu	µg/L	1.68 - 20% to 35.2 + 20%	1.3 – 42	Half Yearly
Fe	µg/L	108.9 - 20% to 1620 + 20%	87 – 1944	Half Yearly
Mn	µg/L	4.76 - 20% to 68.6 + 20%	3.8 – 82	Half Yearly
Se	µg/L	2 - 20% to 5.9 + 20%	1.6 – 7.1	Half Yearly
Total N	mg/L	0.434 - 20% to 3.26 + 20%	0.35 – 3.9	Half Yearly

* Please note that the Actual Background Limit values have been rounded. For values below 1 they are rounded to 2 decimal places, for values below 10 they are rounded to 1 decimal place and for values above 10 they are rounded to the nearest integer.

Borehole 27P (Coal)				
Analyte	**Units**	**Statistically Derived Background Limits**	**Actual Background Limits***	**Monitoring Frequency**
pH		7 - 10% to 7.6 + 10%	6.3 – 8.4	Half Yearly
EC	µS/cm	9080 - 10% to 10010 + 10%	8172 – 10110	Half Yearly
TDS	mg/L	5035 - 10% to 6412.2 + 10%	4532 – 7053	Half Yearly
Ca	mg/L	388 - 10% to 507 + 10%	349 – 558	Half Yearly
Mg	mg/L	190 - 10% to 230 + 10%	171 – 257	Half Yearly
Na	mg/L	1390 - 10% to 1600 + 10%	1251 – 1760	Half Yearly
K	mg/L	19.9 - 10% to 36.8 + 10%	18 – 41	Half Yearly
Cl	mg/L	2480 - 10% to 2880 + 10%	2232 – 3168	Half Yearly
HCO3	mg/L	289 - 10% to 461 + 10%	260 – 507	Half Yearly
SO4	mg/L	578 - 10% to 713 + 10%	520 – 784	Half Yearly
F	mg/L	0.1 - 20% to 0.203 + 20%	0.08 – 0.24	Half Yearly
Al	µg/L	14.2 - 20% to 151600 + 20%	11 – 181920	Half Yearly
As	µg/L	18.2 - 20% to 129.2 + 20%	15 – 155	Half Yearly
Cu	µg/L	3.98 - 20% to 335 + 20%	3.2 – 402	Half Yearly
Fe	µg/L	1400 - 20% to 163920 + 20%	1120 – 196704	Half Yearly
Mn	µg/L	88.9 - 20% to 956 + 20%	71 – 1147	Half Yearly
Se	µg/L	7.95 - 20% to 157.7 + 20%	6.4 – 189	Half Yearly
Total N	mg/L	1.38 - 20% to 4.18 + 20%	1.1 – 5	Half Yearly

* Please note that the Actual Background Limit values have been rounded. For values below 1 they are rounded to 2 decimal places, for values below 10 they are rounded to 1 decimal place and for values above 10 they are rounded to the nearest integer.

Borehole 28P (Coal)				
Analyte	**Units**	**Statistically Derived Background Limits**	**Actual Background Limits***	**Monitoring Frequency**
pH		7.28 - 10% to 7.9 +10%	6.6 – 8.7	Half Yearly
EC	µS/cm	8520 - 10% to 9300 + 10%	7668 – 10230	Half Yearly
TDS	mg/L	4808.8 - 10% to 6060 +10%	4327 – 6666	Half Yearly
Ca	mg/L	210 - 10% to 312 + 10%	189 – 343	Half Yearly
Mg	mg/L	204 - 10% to 278 + 10%	184 – 306	Half Yearly
Na	mg/L	1280 - 10% to 1720 + 10%	1152 – 1892	Half Yearly
K	mg/L	17.4 - 10% to 46.8 + 10%	16 – 52	Half Yearly
Cl	mg/L	2080 - 10% to 2720 + 10%	1872 – 2992	Half Yearly
HCO3	mg/L	689.6 - 10% to 992 + 10%	621 – 1091	Half Yearly
SO4	mg/L	366 - 10% to 630 + 10%	329 – 693	Half Yearly
F	mg/L	0.1 - 20% to 0.1 + 20%	0.08 – 0.12	Half Yearly
Al	µg/L	18.4 - 20% to 360576 + 20%	15 – 432691	Half Yearly
As	µg/L	16.1 - 20% to 179.7 + 20%	13 – 216	Half Yearly
Cu	µg/L	3.18 - 20% to 484.2 + 20%	2.5 – 581	Half Yearly
Fe	µg/L	952 - 20% to 306240 +20%	762 – 367488	Half Yearly
Mn	µg/L	6 - 20% to 1616 +20%	4.8 – 1939	Half Yearly
Se	µg/L	11.6 - 20% to 235 + 20%	9.3 – 282	Half Yearly
Total N	mg/L	0.93 - 20% to 2.76 + 20%	0.74 – 3.3	Half Yearly

* Please note that the Actual Background Limit values have been rounded. For values below 1 they are rounded to 2 decimal places, for values below 10 they are rounded to 1 decimal place and for values above 10 they are rounded to the nearest integer.

Borehole 843 (Basalt)				
Analyte	**Units**	**Statistically Derived Background Limits**	**Actual Background Limits***	**Monitoring Frequency**
pH		7.29 -10% to 7.9 + 10%	6.6 – 8.6	Half Yearly
EC	µS/cm	3290 - 10% to 4210 + 10%	2961 – 4631	Half Yearly
TDS	mg/L	1799.6 - 10% to 2600 + 10%	1620 – 2860	Half Yearly
Ca	mg/L	129 - 10% to 290 +10%	116 – 319	Half Yearly
Mg	mg/L	167 - 10% to 203 + 10%	150 – 223	Half Yearly
Na	mg/L	239 - 10% to 332 + 10%	215 – 365	Half Yearly
K	mg/L	1.1 - 10% to 4.93 + 10%	0.99 – 5.4	Half Yearly
Cl	mg/L	642 - 10% to 943 + 10%	578 – 1037	Half Yearly
HCO3	mg/L	544 - 10% to 828.9 + 10%	490 – 912	Half Yearly
SO4	mg/L	100 - 10% to 151 + 10%	90 – 166	Half Yearly
F	mg/L	0.39 - 20% to 0.9 + 20%	0.31 – 1.1	Half Yearly
Al	µg/L	13.5 - 20% to 36162 + 20%	11 – 79556	Half Yearly
As	µg/L	4.96 - 20% to 46 + 20%	3.9 – 55	Half Yearly
Cu	µg/L	2.32 - 20% to 136.8 + 20%	1.9 – 164	Half Yearly
Fe	µg/L	400 - 20% to 40020 + 20%	320 – 48024	Half Yearly
Mn	µg/L	8.8 - 20% to 1772 + 20%	7 – 2126	Half Yearly
Se	µg/L	5.6 - 20% to 162.8 + 20%	4.5 – 195	Half Yearly
Total N	mg/L	4.5 - 20% to 14.1 + 20%	3.6 – 17	Half Yearly

* Please note that the Actual Background Limit values have been rounded. For values below 1 they are rounded to 2 decimal places, for values below 10 they are rounded to 1 decimal place and for values above 10 they are rounded to the nearest integer.

Borehole 848 (Coal)				
Analyte	**Units**	**Statistically Derived Background Limits**	**Actual Background Limits***	**Monitoring Frequency**
pH		7.28 - 10% to 8.2 + 10%	6.6 – 9.1	Half Yearly
EC	µS/cm	3270 - 10% to 5330 + 10%	2943 – 5863	Half Yearly
TDS	mg/L	2060 - 10% to 3069.6 + 10%	1854 – 3377	Half Yearly
Ca	mg/L	77.4 - 10% to 173 + 10%	70 – 190	Half Yearly
Mg	mg/L	77.9 - 10% to 181 + 10%	70 – 199	Half Yearly
Na	mg/L	427 - 10% to 694 + 10%	384 – 763	Half Yearly
K	mg/L	2.18 - 10% to 7.03 + 10%	1.9 – 7.7	Half Yearly
Cl	mg/L	644 - 10% to 1210 + 10%	580 – 1331	Half Yearly
HCO3	mg/L	582.6 - 10% to 850.7 + 10%	524 – 936	Half Yearly
SO4	mg/L	69 – 10% to 148 + 10%	62 – 163	Half Yearly
F	mg/L	0.2 - 20% to 1.01 + 20%	0.16 – 1.2	Half Yearly
Al	µg/L	8.6 - 20% to 374 + 20%	6.9 – 449	Half Yearly
As	µg/L	7.02 - 20% to 29 + 20%	5.6 – 35	Half Yearly
Cu	µg/L	1.88 - 20% to 16.2 + 20%	1.5 – 19	Half Yearly
Fe	µg/L	278 - 20% to 5460 + 20%	222 – 6552	Half Yearly
Mn	µg/L	7.28 - 20% to 120 + 20%	5.8 – 144	Half Yearly
Se	µg/L	5 - 20% to 21 + 20%	4 – 25	Half Yearly
Total N	mg/L	0.99 - 20% to 8.22 + 20%	0.8 – 9.9	Half Yearly

* Please note that the Actual Background Limit values have been rounded. For values below 1 they are rounded to 2 decimal places, for values below 10 they are rounded to 1 decimal place and for values above 10 they are rounded to the nearest integer.

Borehole 81P (Coal)				
Analyte	**Units**	**Statistically Derived Background Limits**	**Actual Background Limits***	**Monitoring Frequency**
pH		7.35 - 10% to 8.05 + 10%	6.6 – 8.9	Half Yearly
EC	µS/cm	6150 - 10% to 6800 + 10%	5535 – 7480	Half Yearly
TDS	mg/L	3145 - 10% to 3800 + 10%	2831 – 4180	Half Yearly
Ca	mg/L	200 - 10% to 235 + 10%	180 – 259	Half Yearly
Mg	mg/L	92 - 10% to 100 + 10%	83 – 110	Half Yearly
Na	mg/L	810 - 10% to 980 + 10%	729 – 1078	Half Yearly
K	mg/L	12 - 10% to 16 + 10%	11 – 18	Half Yearly
Cl	mg/L	1600 - 10% to 1800 + 10%	1440 – 1980	Half Yearly
HCO3	mg/L	312.5 - 10% to 400 + 10%	281 – 440	Half Yearly
SO4	mg/L	230 - 10% to 265 + 10%	207 – 292	Half Yearly
F	mg/L	0.11 - 20% to 0.19 + 20%	0.09 – 0.23	Half Yearly
Al	µg/L	20.4 - 20% to 58.2 + 20%	16 – 70	Half Yearly
As	µg/L	10.08 - 20% to 17.1 + 20%	8.1 – 21	Half Yearly
Cu	µg/L	2.12 - 20% to 3.8 + 20%	1.7 – 4.6	Half Yearly
Fe	µg/L	676 - 20% to 1460 + 20%	541 – 1752	Half Yearly
Mn	µg/L	142 - 20% to 442 + 20%	114 – 530	Half Yearly
Se	µg/L	6.9 - 20% to 38.4 + 20%	5.5 – 46	Half Yearly
Total N	mg/L	1.17 - 20% to 1.95 + 20%	0.94 – 2.5	Half Yearly

* Please note that the Actual Background Limit values have been rounded. For values below 1 they are rounded to 2 decimal places, for values below 10 they are rounded to 1 decimal place and for values above 10 they are rounded to the nearest integer.

Borehole 82P (Coal)				
Analyte	**Units**	**Statistically Derived Background Limits**	**Actual Background Limits***	**Monitoring Frequency**
pH		7.65 - 10% to 7.9 + 10%	6.9 – 8.7	Half Yearly
EC	µS/cm	5350 - 10% to 5950 + 10%	4815 – 6545	Half Yearly
TDS	mg/L	3246.5 - 10% to 3550 + 10%	2921 – 3905	Half Yearly
Ca	mg/L	125 - 10% to 145 + 10%	113 – 160	Half Yearly
Mg	mg/L	130 - 10% to 140 + 10%	117 – 154	Half Yearly
Na	mg/L	755 - 10% to 880 + 10%	680 – 968	Half Yearly
K	mg/L	5.55 - 10% to 6.9 + 10%	4.9 – 7.6	Half Yearly
Cl	mg/L	1100 - 10% to 1200 + 10%	990 – 1320	Half Yearly
HCO3	mg/L	764.5 - 10% to 916.5 + 10%	688 – 1008	Half Yearly
SO4	mg/L	430 - 10% to 505 + 10%	387 – 556	Half Yearly
F	mg/L	0.22 - 20% to 0.525 + 20%	0.17 – 0.6	Half Yearly
Al	µg/L	10 - 20% to 78 +20%	8 – 94	Half Yearly
As	µg/L	6.66 - 20% to 11.6 + 20%	5.3 – 14	Half Yearly
Cu	µg/L	2.38 - 20% to 4.4 + 20%	1.9 – 5.3	Half Yearly
Fe	µg/L	740 - 20% to 2400 + 20%	592 – 2880	Half Yearly
Mn	µg/L	56.5 - 20% to 145 + 20%	45 – 174	Half Yearly
Se	µg/L	6.3 - 20% to 25.5 + 20%	5 – 31	Half Yearly
Total N	mg/L	0.74 - 20% to 1.55 + 20%	0.6 – 1.9	Half Yearly

* Please note that the Actual Background Limit values have been rounded. For values below 1 they are rounded to 2 decimal places, for values below 10 they are rounded to 1 decimal place and for values above 10 they are rounded to the nearest integer.

Borehole 83P (Coal)				
Analyte	**Units**	**Statistically Derived Background Limits**	**Actual Background Limits***	**Monitoring Frequency**
pH		7.25 - 10% to 8.15 + 10%	6.6 – 9	Half Yearly
EC	µS/cm	1070 - 10% to 1500 + 10%	963 – 1650	Half Yearly
TDS	mg/L	652.5 - 10% to 1080 + 10%	587 – 1188	Half Yearly
Ca	mg/L	50 - 10% to 113 +10%	45 – 124	Half Yearly
Mg	mg/L	28.5 - 10% to 58.5 + 10%	26 – 64	Half Yearly
Na	mg/L	99.5 - 10% to 130 +10%	90 – 143	Half Yearly
K	mg/L	2.85 - 10% to 6 + 10%	2.6 – 6.6	Half Yearly
Cl	mg/L	115 - 10% to 160 + 10%	104 – 176	Half Yearly
HCO3	mg/L	356.5 - 10% to 644.5 + 10%	321 – 709	Half Yearly
SO4	mg/L	15.6 - 10% to 26.8 + 10%	14 – 30	Half Yearly
F	mg/L	0.15 - 20% to 0.305 + 20%	0.12 – 0.36	Half Yearly
Al	µg/L	23.5 - 20% to 308 + 20%	19 – 370	Half Yearly
As	µg/L	1.42 - 20% to 1.9 + 20%	1.1 – 2.3	Half Yearly
Cu	µg/L	1.04 - 20% to 2.64 + 20%	0.83 – 3.2	Half Yearly
Fe	µg/L	410 - 20% to 935 + 20%	328 – 1122	Half Yearly
Mn	µg/L	32 - 20% to 84.5 + 20%	26 – 101	Half Yearly
Se	µg/L	3 - 20% to 3 + 20%	2.4 – 3.6	Half Yearly
Total N	mg/L	0.405 - 20% to 11.6 + 20%	0.32 – 14	Half Yearly

* Please note that the Actual Background Limit values have been rounded. For values below 1 they are rounded to 2 decimal places, for values below 10 they are rounded to 1 decimal place and for values above 10 they are rounded to the nearest integer.

Borehole 84P (Basalt)				
Analyte	**Units**	**Statistically Derived Background Limits**	**Actual Background Limits***	**Monitoring Frequency**
pH		7.65 - 10% to 7.9 + 10%	6.9 – 8.7	Half Yearly
EC	µS/cm	2500 - 10% to 3450 +10%	2250 – 3795	Half Yearly
TDS	mg/L	1142.5 -10% to 2100 +10%	1028 – 2310	Half Yearly
Ca	mg/L	130 -10% to 225 +10%	117 – 248	Half Yearly
Mg	mg/L	125 -10% to 195 +10%	113 – 215	Half Yearly
Na	mg/L	150 -10% to 210 +10%	135 – 231	Half Yearly
K	mg/L	2.65 - 10% to 3.6 +10%	3.2 – 3.9	Half Yearly
Cl	mg/L	420 - 10% to 765 +10%	378 – 842	Half Yearly
HCO3	mg/L	387.5 - 10% to 599 + 10%	349 – 659	Half Yearly
SO4	mg/L	88 - 10% to 220 +10%	79 – 242	Half Yearly
F	mg/L	0.16 - 20% to 0.25 + 20%	0.13 – 0.3	Half Yearly
Al	µg/L	10.85 -20% to 18.5 + 20%	8.7 – 22	Half Yearly
As	µg/L	5 - 20% to 7.9 +20%	4 – 9.5	Half Yearly
Cu	µg/L	2.08 - 20% to 3.68 + 20%	1.7 – 4.5	Half Yearly
Fe	µg/L	630 - 20% to 12000 +20%	504 – 1440	Half Yearly
Mn	µg/L	12 - 20% to 37 + 20%	9.6 – 44	Half Yearly
Se	µg/L	5.5 - 20% to 20 + 20%	4.4 – 24	Half Yearly
Total N	mg/L	2.4 - 20% to 3.25 + 20%	1.9 – 3.9	Half Yearly

* Please note that the Actual Background Limit values have been rounded. For values below 1 they are rounded to 2 decimal places, for values below 10 they are rounded to 1 decimal place and for values above 10 they are rounded to the nearest integer.

Borehole 2289 (Coal)				
Analyte	**Units**	**Statistically Derived Background Limits**	**Actual Background Limits***	**Monitoring Frequency**
pH		6.424 - 10% to 7.58 + 10%	5.8 – 8.3	Half Yearly
EC	µS/cm	6120 - 10% to 17400 +10%	5508 – 19140	Half Yearly
TDS	mg/L	3500 -10% to 11960 +10%	3150 – 13156	Half Yearly
Ca	mg/L	185.6 -10% to 779.2 +10%	167 – 857	Half Yearly
Mg	mg/L	6.4 -10% to 742.6 +10%	5.8 – 817	Half Yearly
Na	mg/L	706 -10% to 2578 +10%	635 – 2836	Half Yearly
K	mg/L	11.8 - 10% to 17.4 +10%	11 – 19	Half Yearly
Cl	mg/L	1700 - 10% to 5834 +10%	1530 – 6417	Half Yearly
HCO3	mg/L	159.097 - 10% to 324 + 10%	143 – 356	Half Yearly
SO4	mg/L	350 - 10% to 2358 +10%	315 – 2594	Half Yearly
F	mg/L	0.14 - 20% to 0.42 + 20%	0.11 – 0.5	Half Yearly
Al	µg/L	10.32 -20% to 236 + 20%	8.3 – 283	Half Yearly
As	µg/L	1 - 20% to 1 +20%	0.8 – 1.2	Half Yearly
Cu	µg/L	3.5 - 20% to 13.5 + 20%	2.8 – 16.2	Half Yearly
Fe	µg/L	1182 - 20% to 3540 +20%	946 – 4248	Half Yearly
Mn	µg/L	233.2 - 20% to 1012.4 + 20%	187 – 1215	Half Yearly
Se	µg/L	22.4 - 20% to 36.4 + 20%	18 – 44	Half Yearly
Total N	mg/L	1 - 20% to 4.8 + 20%	0.8 – 5.8	Half Yearly

* Please note that the Actual Background Limit values have been rounded. For values below 1 they are rounded to 2 decimal places, for values below 10 they are rounded to 1 decimal place and for values above 10 they are rounded to the nearest integer.

Borehole 2291 (Coal)				
Analyte	**Units**	**Statistically Derived Background Limits**	**Actual Background Limits***	**Monitoring Frequency**
pH		7.2 - 10% to 7.82 + 10%	6.5 – 8.6	Half Yearly
EC	µS/cm	7360 - 10% to 7840 +10%	6624 – 8624	Half Yearly
TDS	mg/L	4380 -10% to 4900 +10%	3942 – 5390	Half Yearly
Ca	mg/L	230 -10% to 253 +10%	207 – 278	Half Yearly
Mg	mg/L	133 -10% to 145 +10%	120 – 160	Half Yearly
Na	mg/L	1130 -10% to 1400 +10%	1017 – 1540	Half Yearly
K	mg/L	13 - 10% to 17 +10%	12 – 19	Half Yearly
Cl	mg/L	2040 - 10% to 2200 +10%	1836 – 2420	Half Yearly
HCO3	mg/L	509 - 10% to 549.323 + 10%	458 – 604	Half Yearly
SO4	mg/L	290.5 - 10% to 379 +10%	261 – 417	Half Yearly
F	mg/L	0.248 - 20% to 0.472 + 20%	0.20 – 0.57	Half Yearly
Al	µg/L	9.4 -20% to 734 + 20%	7.5 – 881	Half Yearly
As	µg/L	1 - 20% to 1 +20%	0.8 – 1.2	Half Yearly
Cu	µg/L	4.23 - 20% to 5 + 20%	3.4 – 6	Half Yearly
Fe	µg/L	2435 - 20% to 5125 +20%	1948 – 6150	Half Yearly
Mn	µg/L	48.5 - 20% to 100 + 20%	39 – 120	Half Yearly
Se	µg/L	45.2 - 20% to 62.8 + 20%	36 – 75	Half Yearly
Total N	mg/L	1.05 - 20% to 6.25 + 20%	0.84 – 7.5	Half Yearly

Arsenic results were all below the LOR, therefore the LOR value has been adopted for the analyte value in absence of data.

* Please note that the Actual Background Limit values have been rounded. For values below 1 they are rounded to 2 decimal places, for values below 10 they are rounded to 1 decimal place and for values above 10 they are rounded to the nearest integer.

Borehole BMH1 (Basalt)				
Analyte	**Units**	**Statistically Derived Background Limits**	**Actual Background Limits***	**Monitoring Frequency**
pH		7.811 - 10% to 8.041 + 10%	7.0 – 8.8	Half Yearly
EC	µS/cm	1295 - 10% to 1490 +10%	1166 – 1639	Half Yearly
TDS	mg/L	803.1 -10% to 1186.9 +10%	723 – 1306	Half Yearly
Ca	mg/L	88.6 -10% to 101.4 +10%	80 – 112	Half Yearly
Mg	mg/L	64 -10% to 90.2 +10%	58 – 99	Half Yearly
Na	mg/L	86.4 -10% to 181.9 +10%	78 – 200	Half Yearly
K	mg/L	1 - 10% to 1.98 +10%	0.9 – 2.2	Half Yearly
Cl	mg/L	85.6 - 10% to 95.2 +10%	77 – 105	Half Yearly
HCO3	mg/L	698.1224 - 10% to 825.3 + 10%	628 – 908	Half Yearly
SO4	mg/L	11 - 10% to 20.7 +10%	9.9 – 23	Half Yearly
F	mg/L	0.13 - 20% to 0.27 + 20%	0.1 – 0.32	Half Yearly
Al	µg/L	13 -20% to 37 + 20%	10 – 44	Half Yearly
As	µg/L	1 - 20% to 1 +20%	0.8 – 1.2	Half Yearly
Cu	µg/L	1.1 - 20% to 1.9 + 20%	0.88 – 2.3	Half Yearly
Fe	µg/L	340 - 20% to 340 +20%	272 – 408	Half Yearly
Mn	µg/L	4.2 - 20% to 71.6 + 20%	3.4 – 86	Half Yearly
Se	µg/L	10 - 20% to 10 + 20%	8 – 12	Half Yearly
Total N	mg/L	9.75 - 20% to 17.01 + 20%	7.8 – 20	Half Yearly

Arsenic results were all below the LOR, therefore the LOR value has been adopted for the analyte value in absence of data.

* Please note that the Actual Background Limit values have been rounded. For values below 1 they are rounded to 2 decimal places, for values below 10 they are rounded to 1 decimal place and for values above 10 they are rounded to the nearest integer.

Borehole CSMH1 (Coal)				
Analyte	**Units**	**Statistically Derived Background Limits**	**Actual Background Limits***	**Monitoring Frequency**
pH		7.58 - 10% to 7.80 + 10%	6.8 – 8.6	Half Yearly
EC	µS/cm	4280 - 10% to 5388 +10%	3852 – 5927	Half Yearly
TDS	mg/L	2660 -10% to 3580 +10%	2394 – 3938	Half Yearly
Ca	mg/L	176.4 -10% to 282.6 +10%	159 – 311	Half Yearly
Mg	mg/L	126.4 -10% to 223.2 +10%	114 – 246	Half Yearly
Na	mg/L	542.4 -10% to 631.8 +10%	488 – 695	Half Yearly
K	mg/L	9.1 - 10% to 11.2 +10%	8.2 – 12	Half Yearly
Cl	mg/L	916 - 10% to 1374 + 10%	824 – 1511	Half Yearly
HCO3	mg/L	467 - 10% to 658 + 10%	420 – 724	Half Yearly
SO4	mg/L	290.4 - 10% to 501.4 +10%	261 – 552	Half Yearly
F	mg/L	0.1 - 20% to 0.16 + 20%	0.08 – 0.19	Half Yearly
Al	µg/L	10 - 20% to 106 + 20%	8 – 127	Half Yearly
As	µg/L	1 - 20% to 1 + 20%	0.8 – 1.2	Half Yearly
Cu	µg/L	1 - 20% to 2.6 + 20%	0.8 – 3.1	Half Yearly
Fe	µg/L	54 - 20% to 438 + 20%	43 – 526	Half Yearly
Mn	µg/L	133 - 20% to 506.8 + 20%	106 – 608	Half Yearly
Se	µg/L	10 - 20% to 12.4 + 20%	8 – 15	Half Yearly
Total N	mg/L	3.62 - 20% to 11.18 + 20%	2.9 – 13	Half Yearly

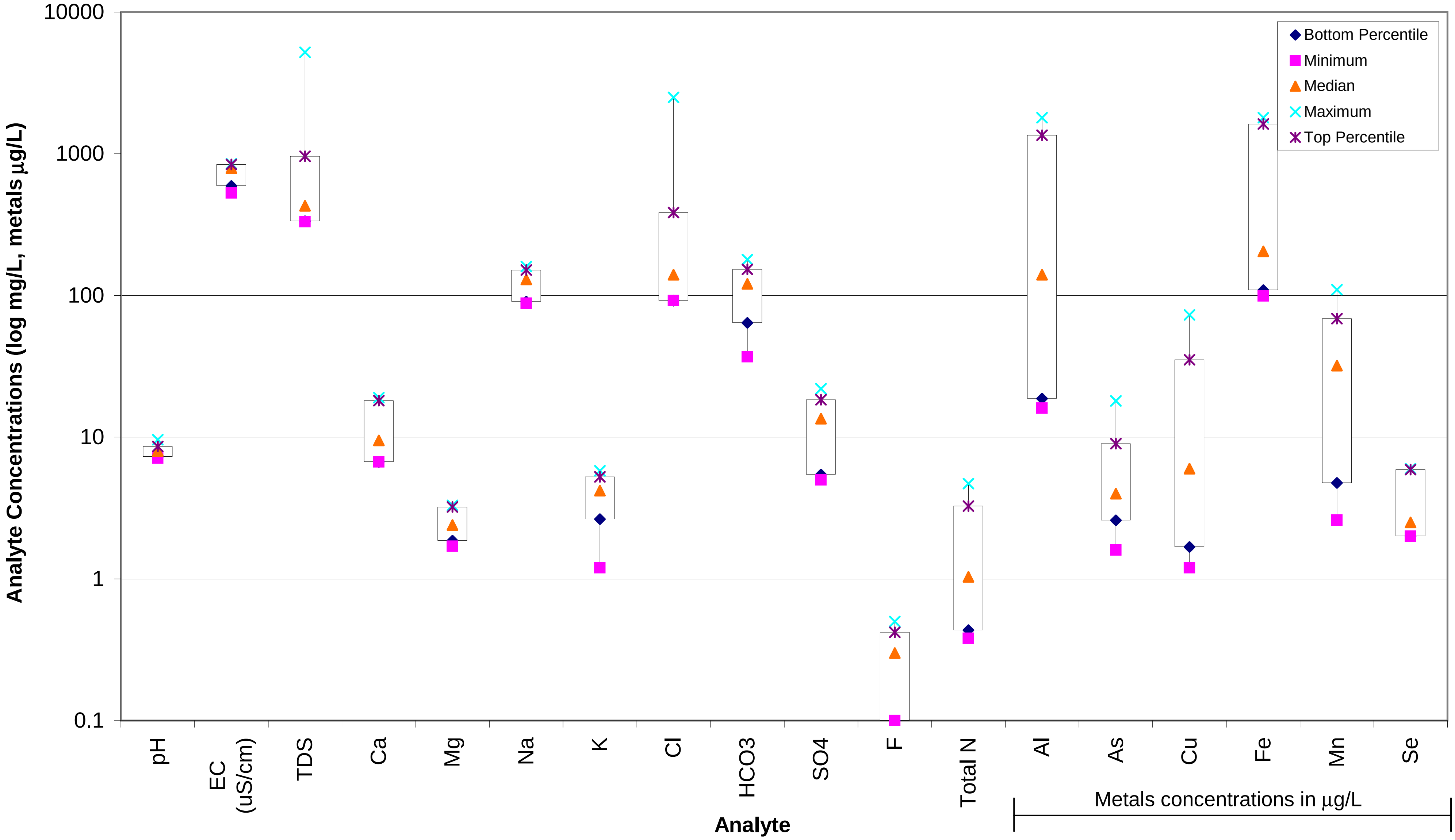
Arsenic results were all below the LOR, therefore the LOR value has been adopted for the analyte value in absence of data.

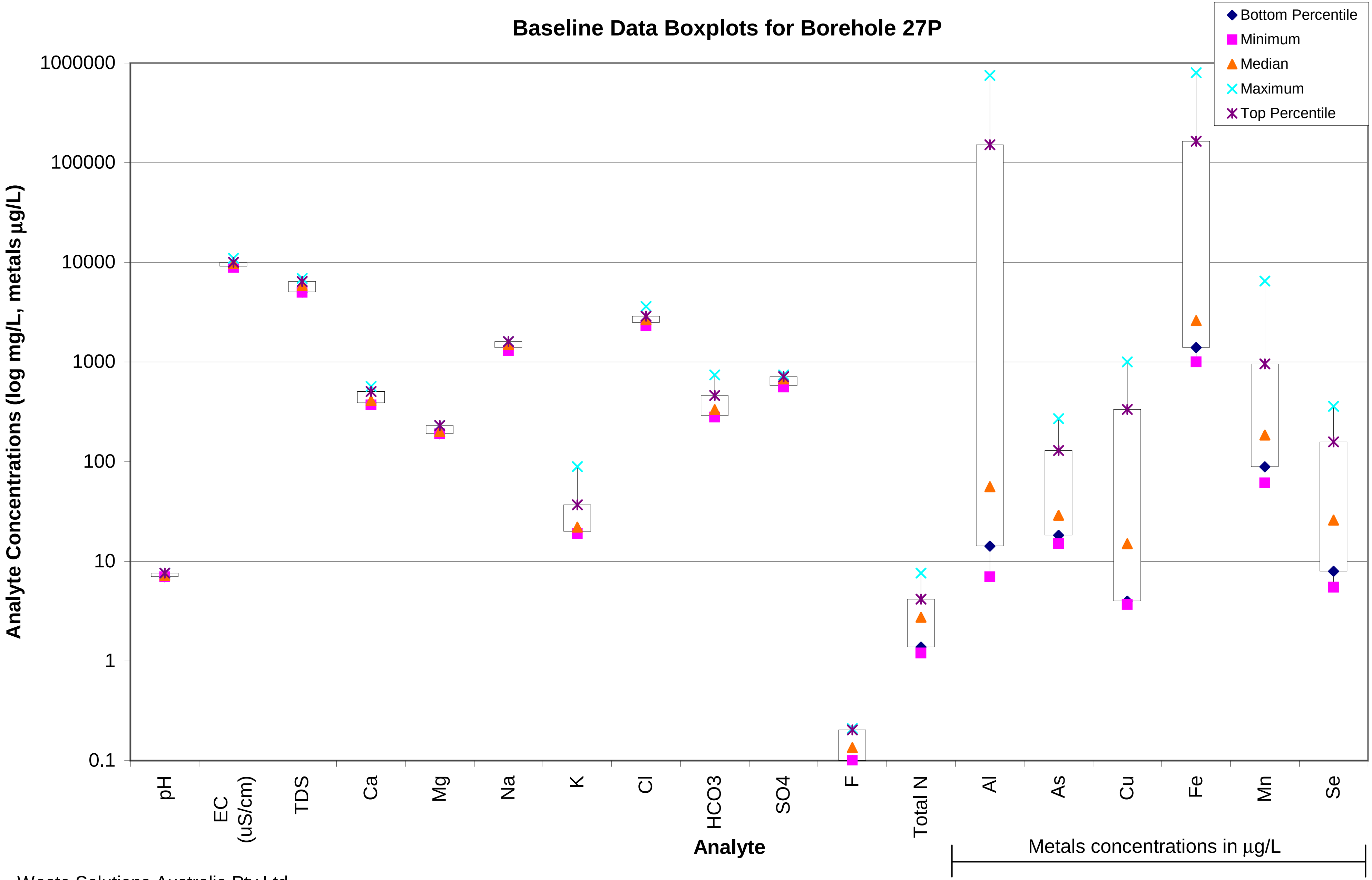
* Please note that the Actual Background Limit values have been rounded. For values below 1 they are rounded to 2 decimal places, for values below 10 they are rounded to 1 decimal place and for values above 10 they are rounded to the nearest integer.

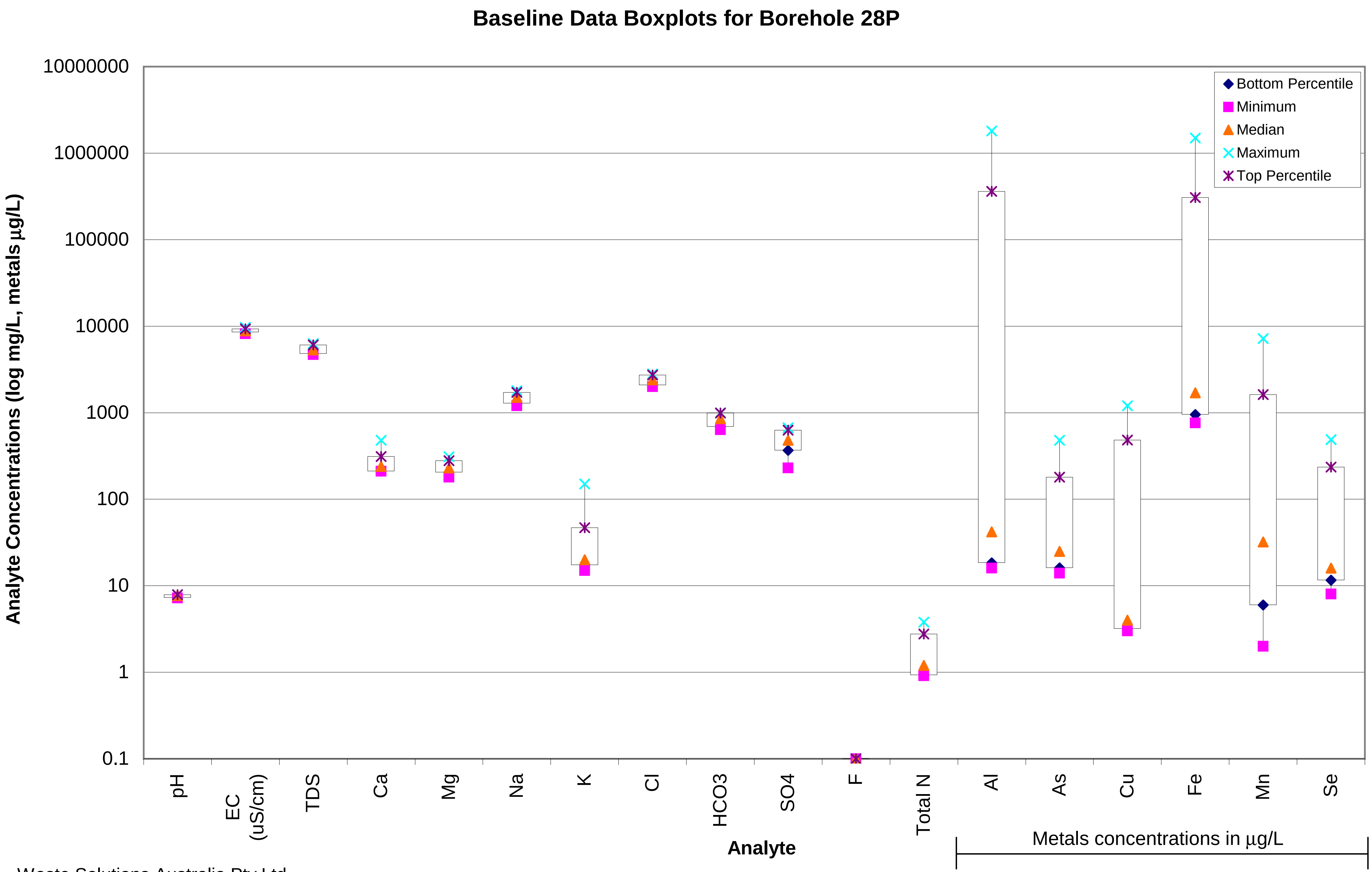
APPENDIX B

MONITORING BORE BOXPLOTS FOR EACH ANALYTE

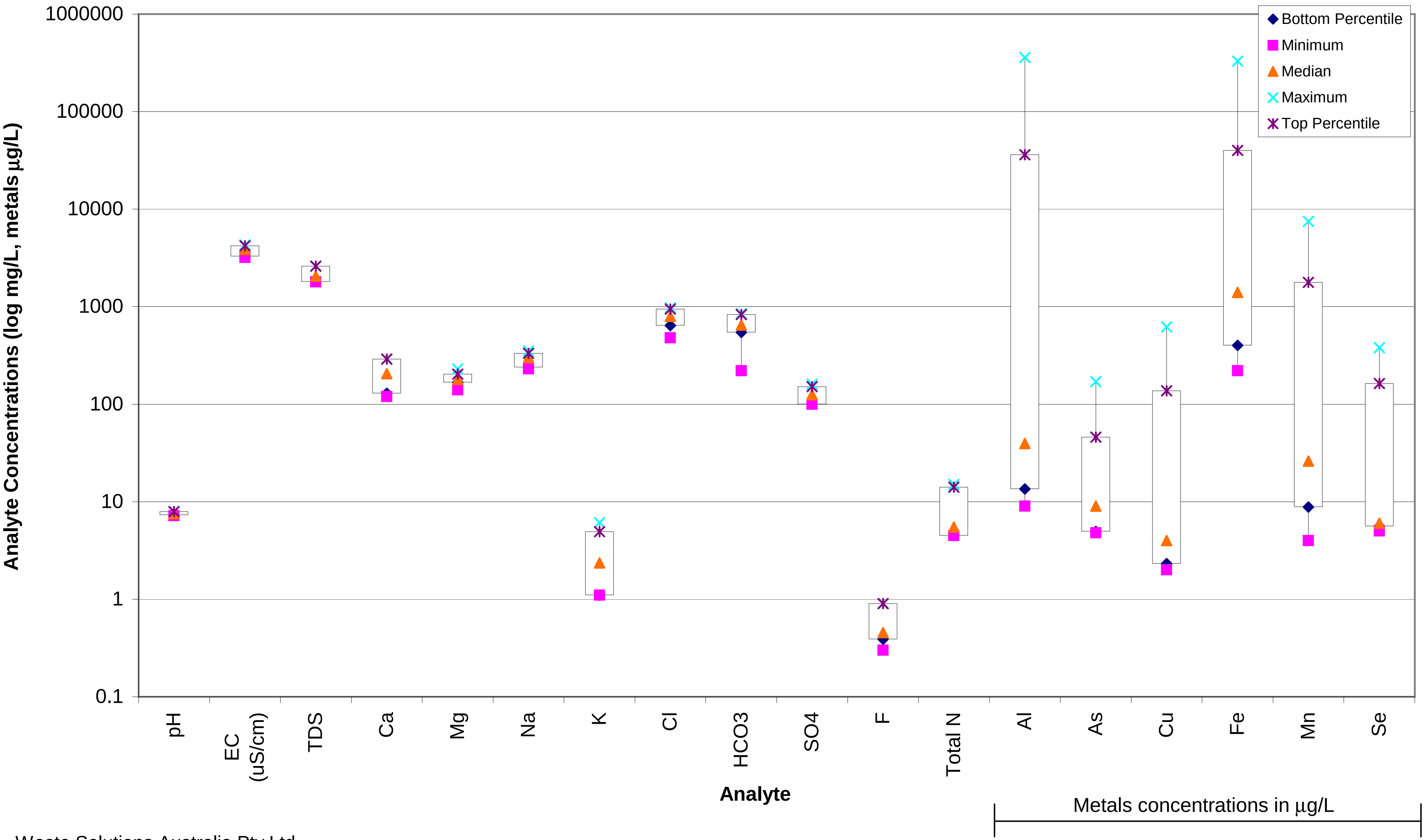
Baseline Data Boxplots for Borehole 18P (Coal)

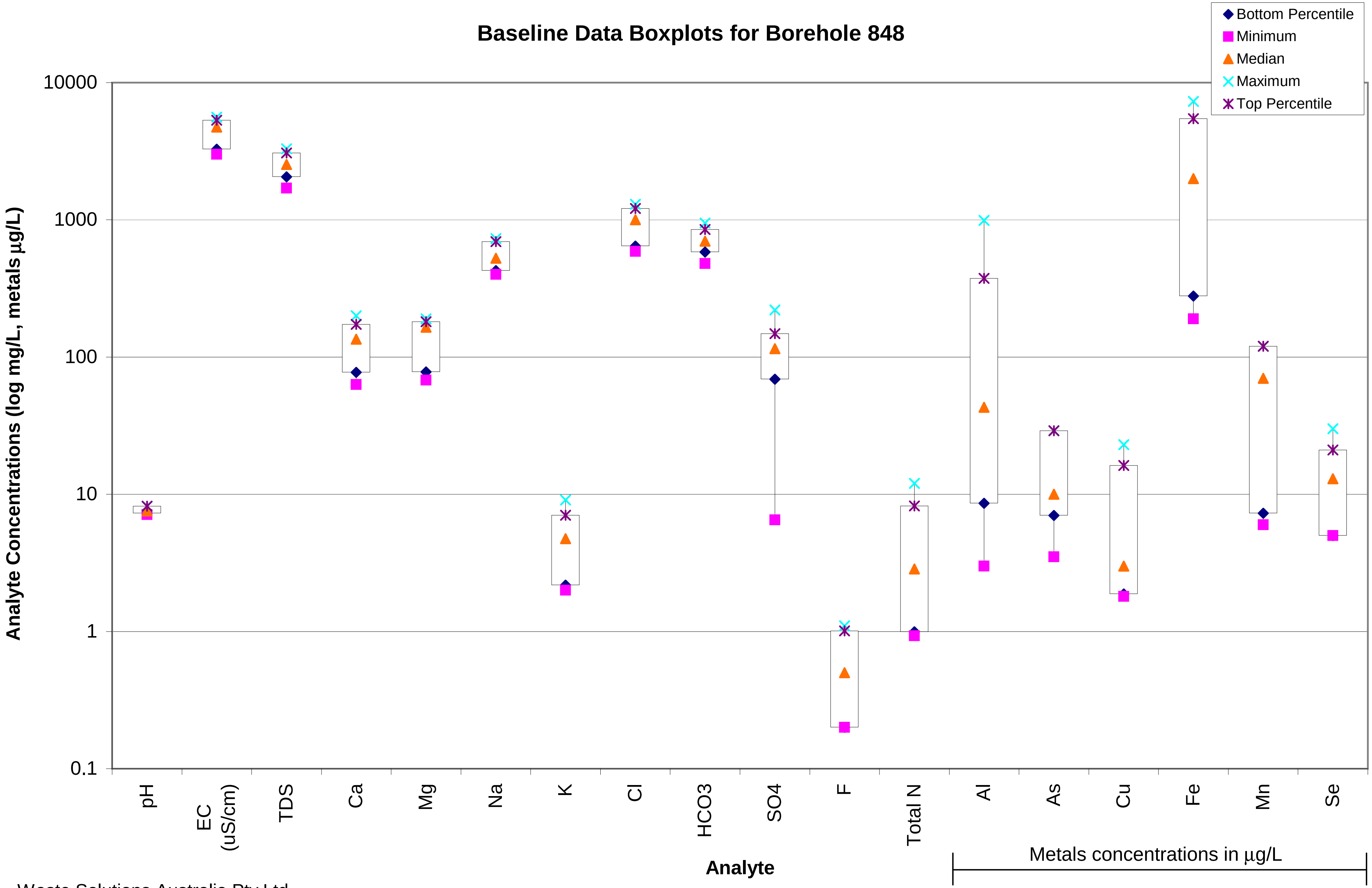


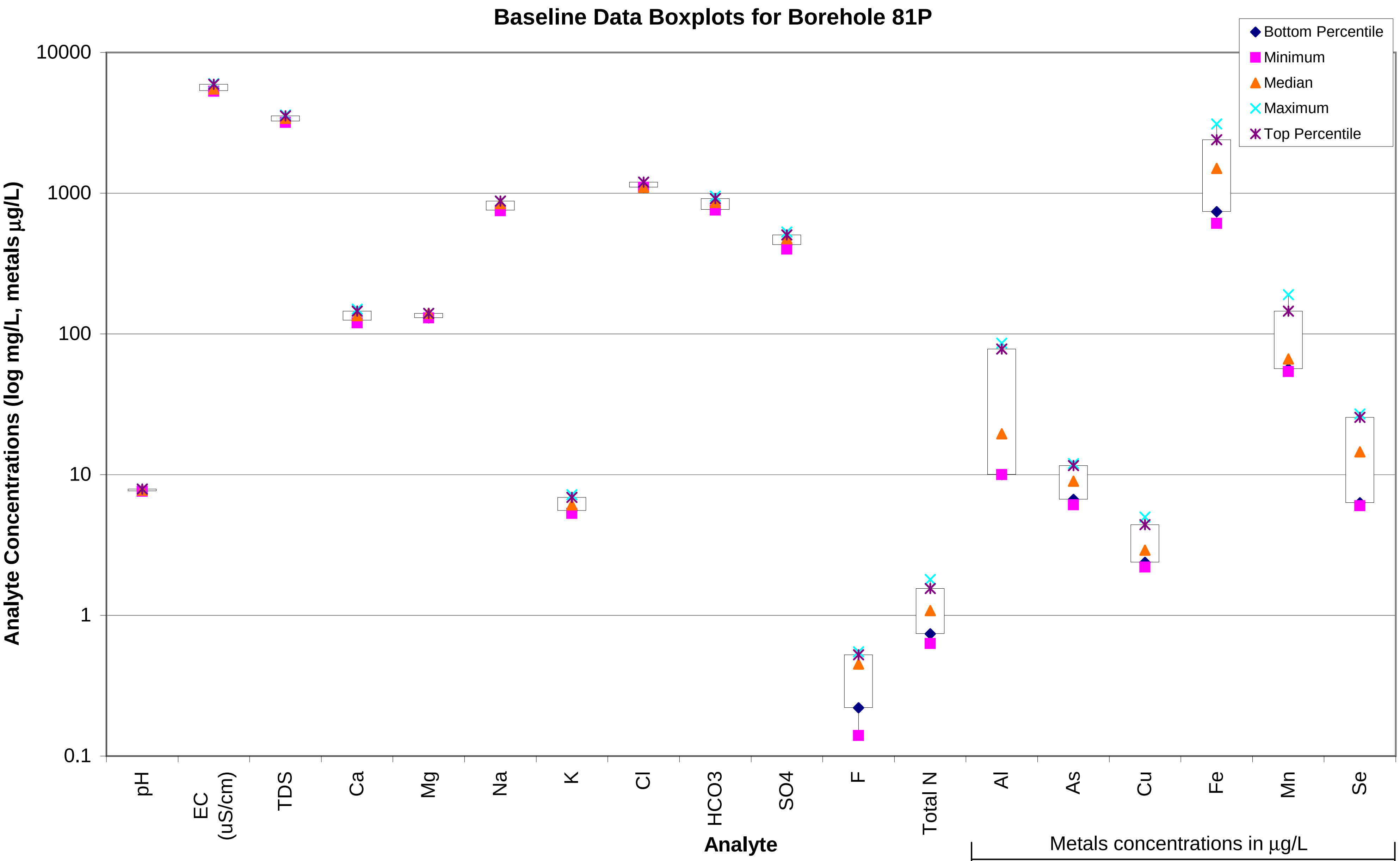

Baseline Data Boxplots for Borehole 27P
Bottom Percentile
Minimum
Median
Maximum
Top Percentile
Analyte Concentrations (log mg/L, metals µg/L)
1000000
100000
10000
1000
100
10
1
0.1
pH
EC (uS/cm)
TDS
Ca
Mg
Na
K
Cl
HCO3
SO4
F
Total N
Al
As
Cu
Fe
Mn
Se
Analyte
Metals concentrations in µg/L

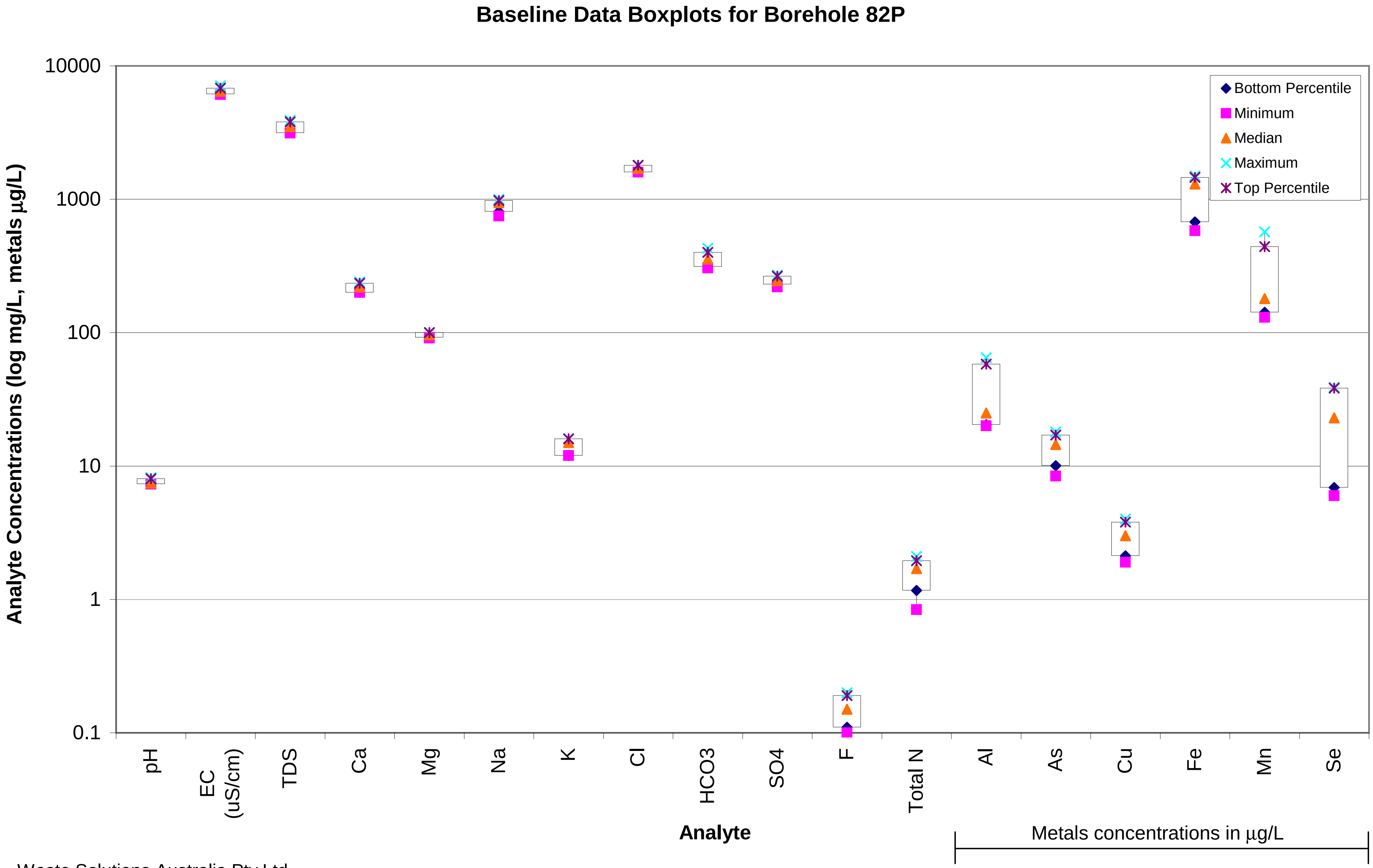

Baseline Data Boxplots for Borehole 28P
Analyte Concentrations (log mg/L, metals µg/L)
10000000
1000000
100000
10000
1000
100
10
1
0.1
Bottom Percentile
Minimum
Median
Maximum
Top Percentile
pH
EC (uS/cm)
TDS
Ca
Mg
Na
K
Cl
HCO3
SO4
F
Total N
Al
As
Cu
Fe
Mn
Se
Analyte
Metals concentrations in µg/L

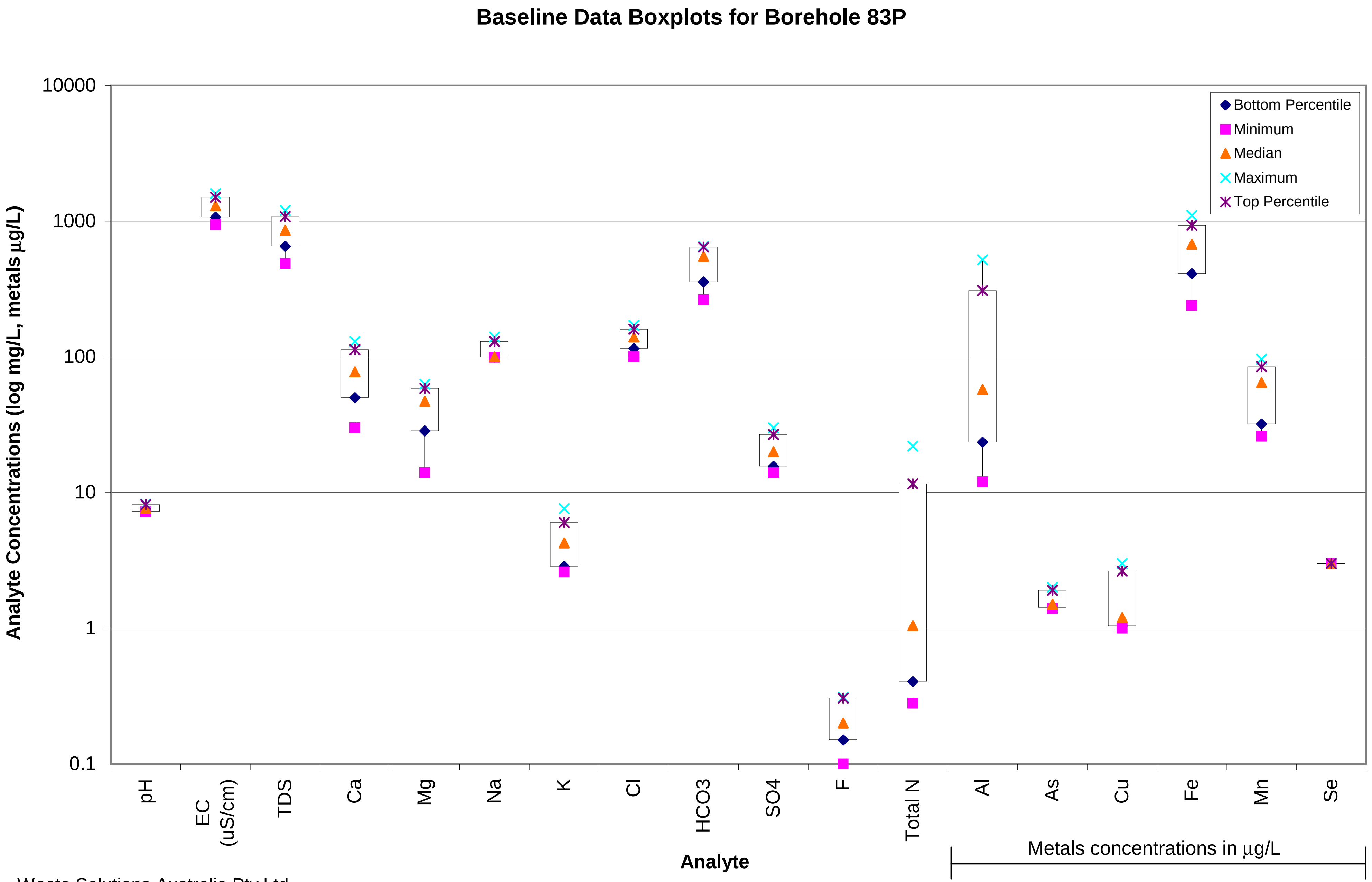
Baseline Data Boxplots for Borehole 843

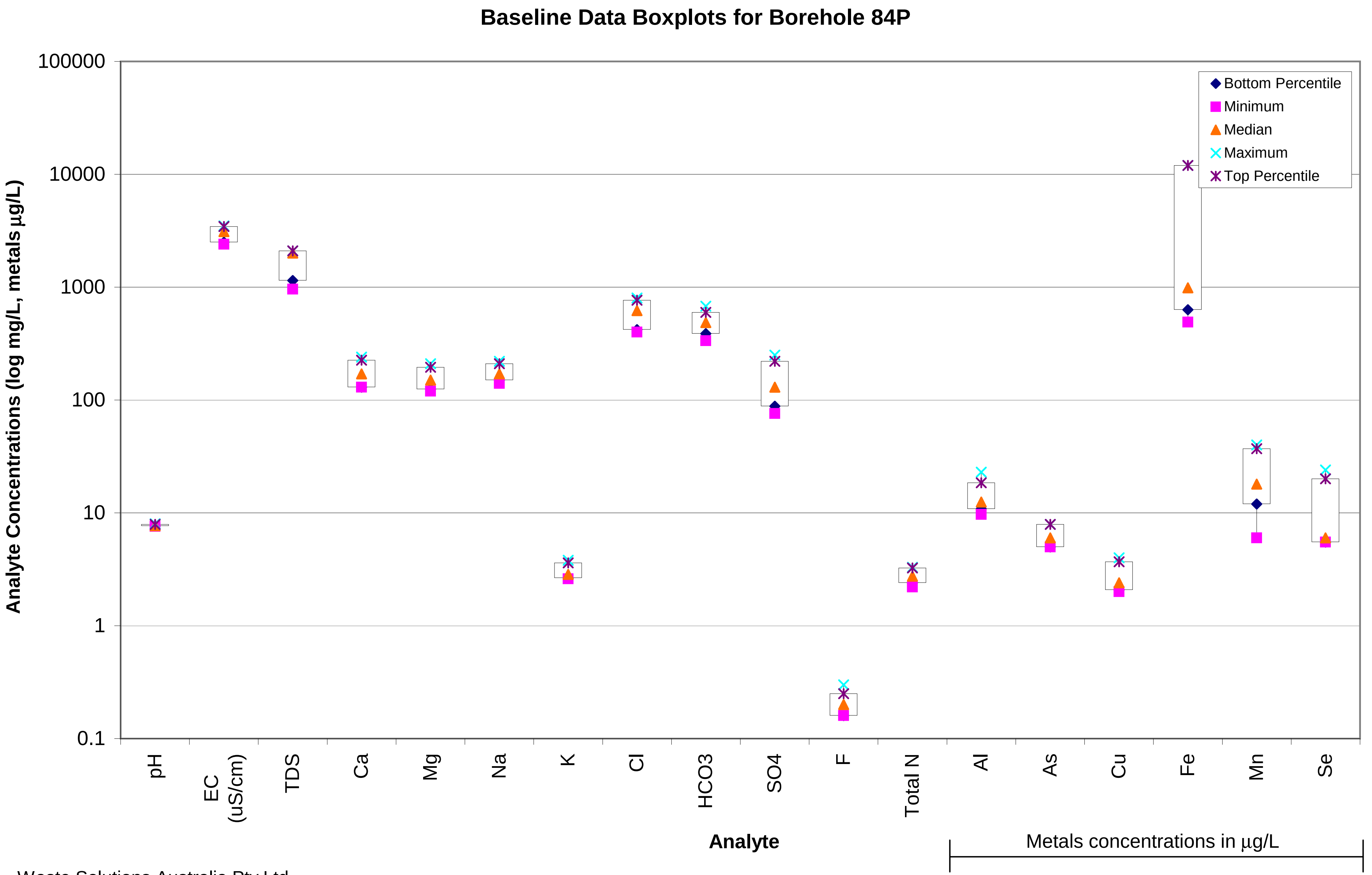


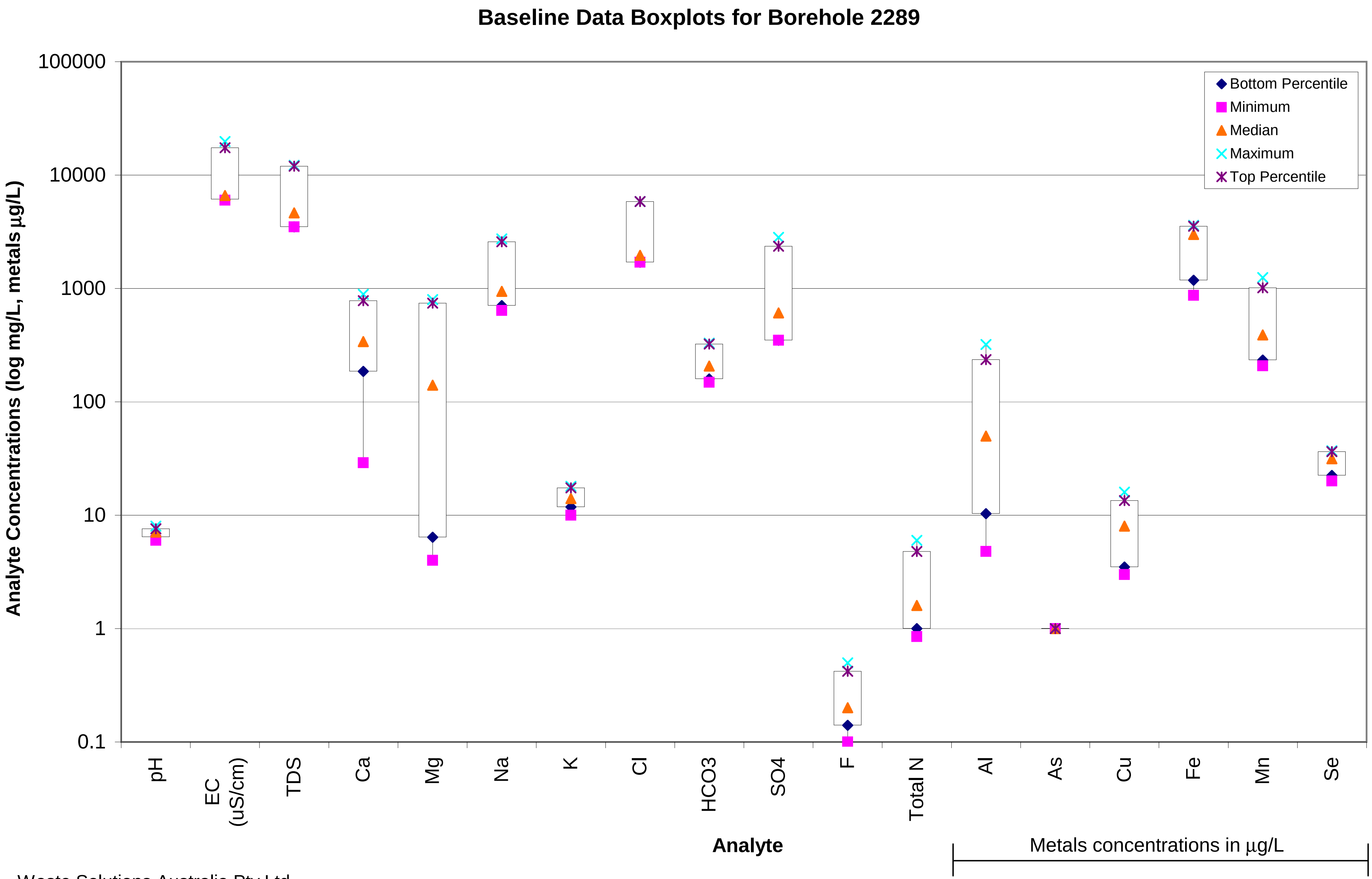

Baseline Data Boxplots for Borehole 848
Bottom Percentile
Minimum
Median
Maximum
Top Percentile
Analyte Concentrations (log mg/L, metals µg/L)
10000
1000
100
10
1
0.1
pH
EC (uS/cm)
TDS
Ca
Mg
Na
K
Cl
HCO3
SO4
F
Total N
Al
As
Cu
Fe
Mn
Se
Metals concentrations in µg/L
Analyte

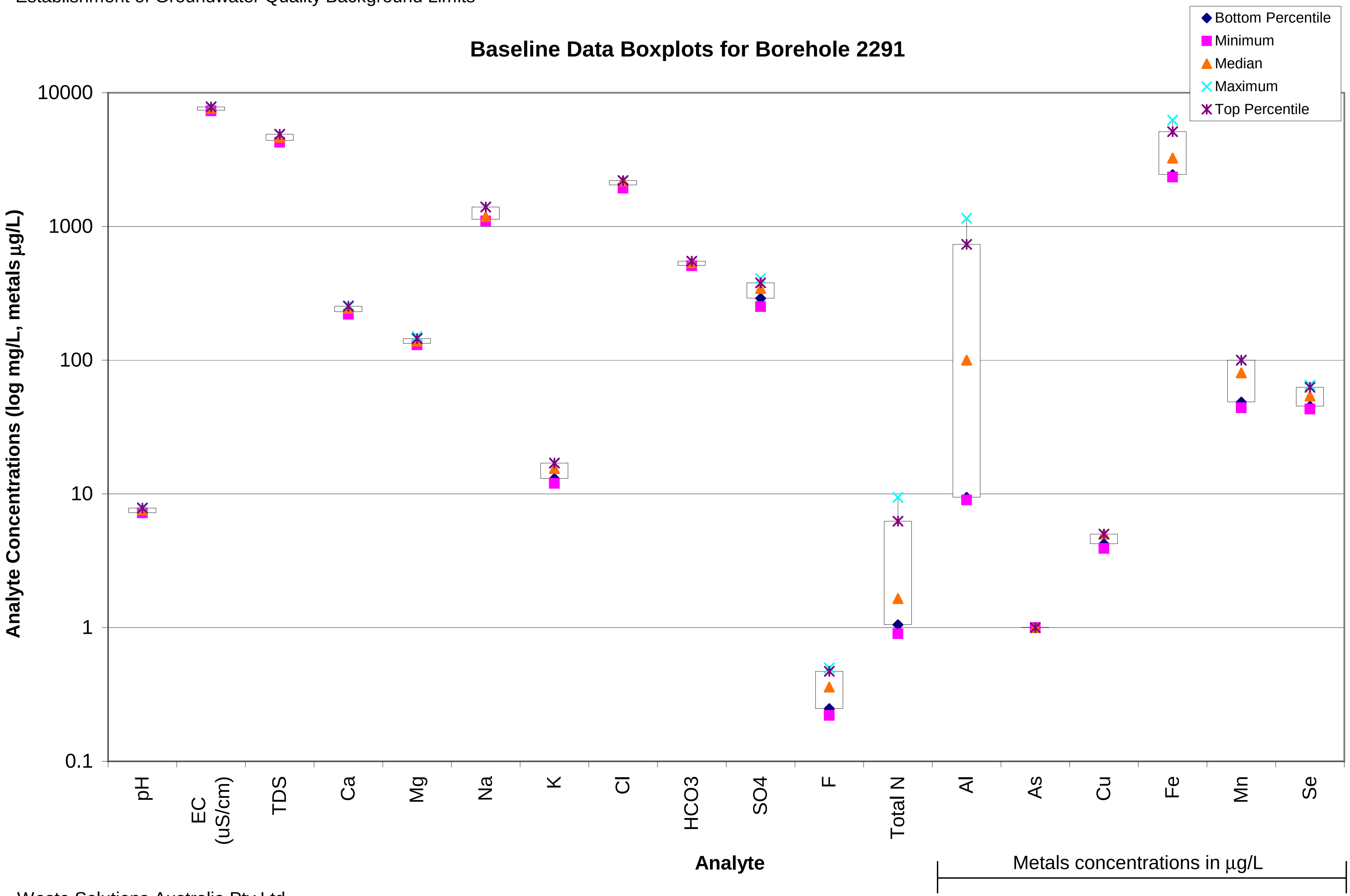

Baseline Data Boxplots for Borehole 81P
Bottom Percentile
Minimum
Median
Maximum
Top Percentile
Analyte Concentrations (log mg/L, metals µg/L)
10000
1000
100
10
1
0.1
pH
EC (uS/cm)
TDS
Ca
Mg
Na
K
Cl
HCO3
SO4
F
Total N
Al
As
Cu
Fe
Mn
Se
Analyte
Metals concentrations in µg/L

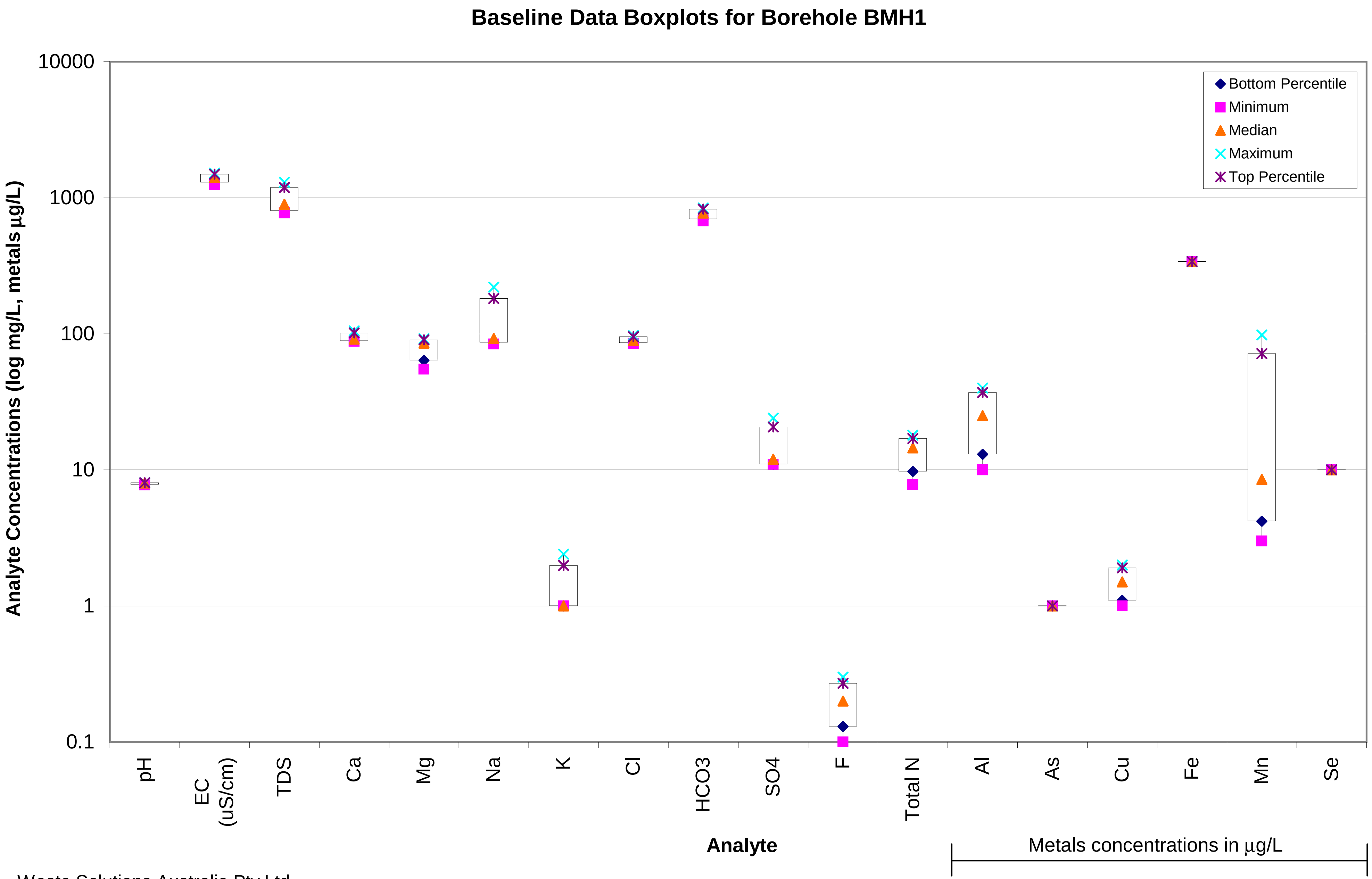

Baseline Data Boxplots for Borehole 82P
Analyte Concentrations (log mg/L, metals µg/L)
10000
1000
100
10
1
0.1
Bottom Percentile
Minimum
Median
Maximum
Top Percentile
pH
EC (uS/cm)
TDS
Ca
Mg
Na
K
Cl
HCO3
SO4
F
Total N
Al
As
Cu
Fe
Mn
Se
Analyte
Metals concentrations in µg/L

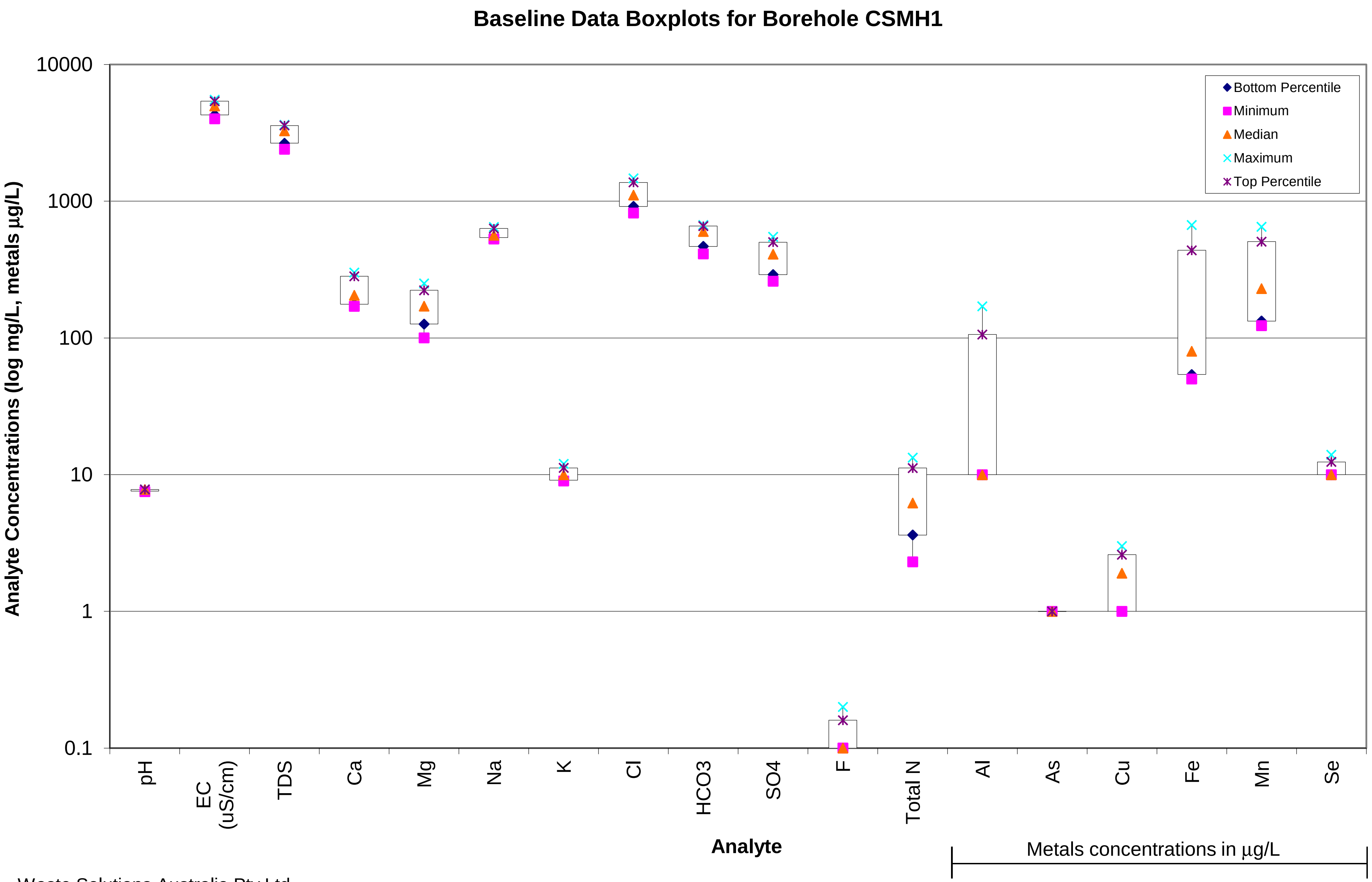

Baseline Data Boxplots for Borehole 83P
Analyte Concentrations (log mg/L, metals µg/L)
10000
1000
100
10
1
0.1
Bottom Percentile
Minimum
Median
Maximum
Top Percentile
pH
EC (uS/cm)
TDS
Ca
Mg
Na
K
Cl
HCO3
SO4
F
Total N
Al
As
Cu
Fe
Mn
Se
Analyte
Metals concentrations in µg/L


Baseline Data Boxplots for Borehole 84P
Analyte Concentrations (log mg/L, metals µg/L)
100000
10000
1000
100
10
1
0.1
Bottom Percentile
Minimum
Median
Maximum
Top Percentile
pH
EC (uS/cm)
TDS
Ca
Mg
Na
K
Cl
HCO3
SO4
F
Total N
Al
As
Cu
Fe
Mn
Se
Analyte
Metals concentrations in µg/L


Baseline Data Boxplots for Borehole 2289
Analyte Concentrations (log mg/L, metals µg/L)
100000
10000
1000
100
10
1
0.1
Bottom Percentile
Minimum
Median
Maximum
Top Percentile
pH
EC (uS/cm)
TDS
Ca
Mg
Na
K
Cl
HCO3
SO4
F
Total N
Al
As
Cu
Fe
Mn
Se
Analyte
Metals concentrations in µg/L


Baseline Data Boxplots for Borehole 2291
Bottom Percentile
Minimum
Median
Maximum
Top Percentile
Analyte Concentrations (log mg/L, metals µg/L)
10000
1000
100
10
1
0.1
pH
EC (uS/cm)
TDS
Ca
Mg
Na
K
Cl
HCO3
SO4
F
Total N
Al
As
Cu
Fe
Mn
Se
Analyte
Metals concentrations in µg/L


Baseline Data Boxplots for Borehole BMH1
Analyte Concentrations (log mg/L, metals µg/L)
10000
1000
100
10
1
0.1
Bottom Percentile
Minimum
Median
Maximum
Top Percentile
pH
EC (uS/cm)
TDS
Ca
Mg
Na
K
Cl
HCO3
SO4
F
Total N
Al
As
Cu
Fe
Mn
Se
Analyte
Metals concentrations in µg/L


Baseline Data Boxplots for Borehole CSMH1
Analyte Concentrations (log mg/L, metals µg/L)
10000
1000
100
10
1
0.1
Bottom Percentile
Minimum
Median
Maximum
Top Percentile
pH
EC (uS/cm)
TDS
Ca
Mg
Na
K
Cl
HCO3
SO4
F
Total N
Al
As
Cu
Fe
Mn
Se
Analyte
Metals concentrations in µg/L

APPENDIX C

DATA TABLES

Groundwater Bore No. 18P (Coal)

		28/08/2003	3/03/2004	8/09/2004	13/04/2005	12/10/2005	28/04/2006	25/10/2006	18/04/2007	17/10/2007	15/04/2008	Calculated Statistical Values				
Parameter	**Units**											Bottom Percentile	Minimum	Median	Maximum	Top Percentile
pH	pH units	7.1	7.3	8.2	8	8.5	7.7	8.3	9.6	8	7.7	7.28	7.1	8	9.6	8.61
EC	mS/cm	600	530	810	790	820	790	850	720	770	840	593	530	790	850	841
TDS	mg/L	332	334	474	431	403	360	430	5200	430	490	333.8	332	430	5200	961
Major Ions																
Ca	mg/L	19	9.2	18	9.6	6.7	6.7	11	7.4	9.4	11	6.7	6.7	9.5	19	18.1
Mg	mg/L	3	1.9	3.2	2	2	1.7	3.3	<1	2.5	2.4	1.86	1.7	2.4	3.3	3.22
Na	mg/L	88	91	130	130	130	110	130	150	150	160	90.7	88	130	160	151
K	mg/L	3	1.2	5.8	5.1	4.7	3	4.1	<1	4.3	4.2	2.64	1.2	4.2	5.8	5.24
Cl	mg/L	92	92	150	140	130	120	150	2500	140	150	92	92	140	2500	385
HCO_3	mg/L	122	67	179	132	117	134	120	37	120	150	64	37	121	179	152.9
SO_4	mg/L	5	11	5.5	22	16	16	17	18	5.9	6	5.45	5	13.5	22	18.4
Minor Ions																
F	mg/L	0.3	0.3	0.4	0.1	0.5	0.4	<0.1	0.17	0.1	0.2	0.1	0.1	0.3	0.5	0.42
Total N	mg/L	3.1	0.38	0.87	1.2	1.7	0.53	0.83	0.44	1.3	4.7	0.434	0.38	1.035	4.7	3.26
Dissolved Metals																
Al	mg/L	1300	19	16	1800	150	750	130	77	590	24	18.7	16	140	1800	1350
As	mg/L	5	4	18	8	3	4	3.6	4.4	2.7	1.6	2.59	1.6	4	18	9
Cu	mg/L	73	5	8	10	2	6	<2	<2	<2	1.2	1.68	1.2	6	73	35.2
Fe	mg/L	110	180	1800	1600	160	800	180	99	490	230	108.9	99	205	1800	1620
Mn	mg/L	5	110	39	37	14	27	14	2.6	56	64	4.76	2.6	32	110	68.6
Se	mg/L	2	2	<1	6	3	2	<5	<5	<5	5.8	2	2	2.5	6	5.9

N.B. Values highlighted in red indicate potentially erroneous analysis readings.

Groundwater Bore No. 27P (Coal)

		28/08/2003	3/03/2004	8/09/2004	13/04/2005	12/10/2005	28/04/2006	25/10/2006	18/04/2007	17/10/2007	15/04/2008	Calculated Statistical Values				
Parameter	**Units**											Bottom Percentile	Minimum	Median	Maximum	Top Percentile
pH	pH units	7	7	7.4	7	7.5	7.6	7.2	7	7.6	7.3	7	7	7.25	7.6	7.6
EC	mS/cm	11000	9800	9900	9300	9700	9700	9200	9700	9100	8900	9080	8900	9700	11000	10010
TDS	mg/L	5597	6900	5040	6358	5430	4990	5900	6100	5800	5900	5035	4990	5850	6900	6412.2
Major Ions																
Ca	mg/L	390	400	370	500	390	420	570	430	410	410	388	370	410	570	507
Mg	mg/L	190	210	200	230	200	200	230	190	190	200	190	190	200	230	230
Na	mg/L	1400	1500	1500	1600	1600	1500	1300	1600	1500	1600	1390	1300	1500	1600	1600
K	mg/L	22	20	21	89	23	19	31	21	22	24	19.9	19	22	89	36.8
Cl	mg/L	2600	2300	2600	3600	2800	2500	2500	2700	2700	2700	2480	2300	2650	3600	2880
HCO_3	mg/L	414	390	327	328	314	337	740	430	290	280	289	280	332.5	740	461
SO_4	mg/L	580	580	590	740	690	690	560	670	710	680	578	560	675	740	713
Minor Ions																
F	mg/L	<0.1	0.1	0.2	<0.1	0.1	0.1	0.21	0.17	0.2	0.1	0.1	0.1	0.135	0.21	0.203
Total N	mg/L	1.2	1.8	2.5	7.6	3.7	3.8	3	3	1.4	2.4	1.38	1.2	2.75	7.6	4.18
Dissolved Metals																
Al	mg/L	640		7	750000	46	56	2000	140	16	25	14.2	7	56	750000	151600
As	mg/L	29	94	54	270	33	21	19	25	15	<1	18.2	15	29	270	129.2
Cu	mg/L	35	20	50	1000	10	8	<2	4.1	<2	3.7	3.98	3.7	15	1000	335
Fe	mg/L	2600		4200	800000	2100	2600	2700	4900	1000	1500	1400	1000	2600	800000	163920
Mn	mg/L	160	330	200	6500	170	98	340	300	92	61	88.9	61	185	6500	956
Se	mg/L	16	36	<10	360	15	9	5.5	<5	71	58	7.95	5.5	26	360	157.7

Groundwater Bore No. 28P (Coal)

		28/08/2003	3/03/2004	8/09/2004	13/04/2005	12/10/2005	28/04/2006	25/10/2006	18/04/2007	17/10/2007	15/04/2008	Calculated Statistical Values				
Parameter	**Units**											Bottom Percentile	Minimum	Median	Maximum	Top Percentile
pH	pH units	7.5	N/S	7.7	7.7	7.9	7.8	7.2	7.9	7.3	7.3	7.28	7.2	7.7	7.9	7.9
EC	mS/cm	9200	N/S	8700	9100	8800	8600	9700	8200	9100	8700	8520	8200	8800	9700	9300
TDS	mg/L	4836	N/S	5301	5836	5129	5051	5400	4700	6000	6300	4808.8	4700	5301	6300	6060
Major Ions																
Ca	mg/L	230	N/S	240	480	210	210	260	230	260	270	210	210	240	480	312
Mg	mg/L	180	N/S	210	310	220	230	220	230	230	270	204	180	230	310	278
Na	mg/L	1200	N/S	1400	1800	1500	1700	1300	1500	1500	1500	1280	1200	1500	1800	1720
K	mg/L	20	N/S	20	150	19	15	19	21	18	20	17.4	15	20	150	46.8
Cl	mg/L	2000	N/S	2700	2800	2400	2100	2300	2500	2400	2500	2080	2000	2400	2800	2720
HCO_3	mg/L	968	N/S	769	636	703	897	850	770	990	1000	689.6	636	850	1000	992
SO_4	mg/L	230	N/S	400	440	490	480	430	610	620	670	366	230	480	670	630
Minor Ions																
F	mg/L	0.1	N/S	0.1	<0.1	0.1	0.1	<0.1	<0.1	<0.1	<0.1	0.1	0.1	0.1	0.1	0.1
Total N	mg/L	2.5	N/S	1.2	3.8	1.9	1.2	1.1	0.93	0.91	1.7	0.926	0.91	1.2	3.8	2.76
Dissolved Metals																
Al	mg/L	400	N/S	16	1800000	23	71	720	42	19	42	18.4	16	42	1800000	360576
As	mg/L	19	N/S	51	480	27	17	26	24	14	<1	16.1	14	25	480	179.7
Cu	mg/L	<1	N/S	6	1200	4	7	<2	3.8	3.3	3	3.18	3	4	1200	484.2
Fe	mg/L	1500	N/S	7800	1500000	1700	1500	1000	760	4300	5800	952	760	1700	1500000	306240
Mn	mg/L	140	N/S	2	7200	8	7	220	19	32	33	6	2	32	7200	1616
Se	mg/L	16	N/S	<5	490	14	8	14	<5	65	45	11.6	8	16	490	235

Groundwater Bore No. 843 (Basalt)

		28/08/2003	3/03/2004	8/09/2004	13/04/2005	12/10/2005	28/04/2006	25/10/2006	18/04/2007	17/10/2007	15/04/2008	Calculated Statistical Values				
Parameter	**Units**											Bottom Percentile	Minimum	Median	Maximum	Top Percentile
pH	pH units	7.2	7.4	7.7	7.6	7.9	7.8	7.5	7.5	7.9	7.3	7.29	7.2	7.55	7.9	7.9
EC	mS/cm	3200	3500	3700	4000	4100	4300	4200	4200	3700	3300	3290	3200	3850	4300	4210
TDS	mg/L	1912	2205	1796	1990	2040	2070	2600	2600	2100	1800	1799.6	1796	2055	2600	2600
Major Ions																
Ca	mg/L	130	290	270	290	240	290	170	170	160	120	129	120	205	290	290
Mg	mg/L	140	230	180	190	180	200	170	170	170	180	167	140	180	230	203
Na	mg/L	230	270	240	300	330	300	310	310	300	350	239	230	300	350	332
K	mg/L	2	3.4	6.1	4.8	2.7	2.6	1.1	1.1	2.1	1.9	1.1	1.1	2.35	6.1	4.93
Cl	mg/L	480	660	810	940	970	910	780	780	740	870	642	480	795	970	943
HCO_3	mg/L	827	691	603	580	587	846	700	700	600	220	544	220	647	846	828.9
SO_4	mg/L	100	100	130	160	140	150	120	120	130	120	100	100	125	160	151
Minor Ions																
F	mg/L	0.6	0.9	0.8	0.3	0.4	0.9	0.41	0.41	0.5	0.4	0.39	0.3	0.455	0.9	0.9
Total N	mg/L	5.2	4.5	5.8	14	10	15	5.2	5.2	4.5	7.1	4.5	4.5	5.5	15	14.1
Dissolved Metals																
Al	mg/L	180	9	23	360000	20	14	56	56	70	18	13.5	9	39.5	360000	36162
As	mg/L	5	9	15	170	13	11	6.4	6.4	4.8	<1	4.96	4.8	9	170	46
Cu	mg/L	2	16	7	620	4	4	2.4	2.4	<2	3.3	2.32	2	4	620	136.8
Fe	mg/L	790	220	7800	330000	1900	1600	1400	1400	420	510	400	220	1400	330000	40020
Mn	mg/L	120	340	<1	7500	4	10	26	26	27	17	8.8	4	26	7500	1772
Se	mg/L	6	5	<50	380	6	6	<5	<5	18	14	5.6	5	6	380	162.8

Groundwater Bore No. 848 (Coal)

		28/08/2003	3/03/2004	8/09/2004	13/04/2005	12/10/2005	28/04/2006	25/10/2006	18/04/2007	17/10/2007	15/04/2008	Calculated Statistical Values				
Parameter	**Units**											Bottom Percentile	Minimum	Median	Maximum	Top Percentile
pH	pH units	7.3	7.1	7.8	7.4	7.6	7.5	7.5	8.1	8.2	8.2	7.28	7.1	7.55	8.2	8.2
EC	mS/cm	5600	5200	5300	4700	4800	4500	5100	3300	3000	3700	3270	3000	4750	5600	5330
TDS	mg/L	3044	3300	2802	2567	2313	2228	2600	2100	1700	2500	2060	1700	2533.5	3300	3069.6
Major Ions																
Ca	mg/L	90	140	130	200	170	160	160	79	63	87	77.4	63	135	200	173
Mg	mg/L	160	170	170	190	180	170	160	79	68	120	77.9	68	165	190	181
Na	mg/L	730	670	690	540	430	510	440	450	400	600	427	400	525	730	694
K	mg/L	2	4.5	5	9.1	6.8	6.6	6.4	3.9	4.1	2.2	2.18	2	4.75	9.1	7.03
Cl	mg/L	1000	1100	1300	1200	1100	910	1000	650	590	790	644	590	1000	1300	1210
HCO_3	mg/L	947	732	697	594	641	810	700	660	480	840	582.6	480	698.5	947	850.7
SO_4	mg/L	110	140	6.5	220	130	130	120	77	76	84	69.05	6.5	115	220	148
Minor Ions																
F	mg/L	1.1	0.6	1	0.2	0.2	0.2	0.23	0.74	0.4	1	0.2	0.2	0.5	1.1	1.01
Total N	mg/L	7.8	1	3.7	2.1	1.8	0.93	1	5.6	3.6	12	0.993	0.93	2.85	12	8.22
Dissolved Metals																
Al	mg/L	190		3	990	220	54	18	43	42	10	8.6	3	43	990	374
As	mg/L	11	29	29	18	10	9	8.3	7.9	3.5	<1	7.02	3.5	10	29	29
Cu	mg/L	<1	<1	6	23	2	3	<2	<2	<2	1.8	1.88	1.8	3	23	16.2
Fe	mg/L	460		5000	7300	3900	4100	1300	2000	190	300	278	190	2000	7300	5460
Mn	mg/L	6	70	<1	120	110	120	99	39	27	7.6	7.28	6	70	120	120
Se	mg/L	13	7	<5	30	5	5	<5	<5	15	15	5	5	13	30	21

Groundwater Bore No. 81P (Coal)

		28/08/2003	3/03/2004	8/09/2004	13/04/2005	12/10/2005	28/04/2006	25/10/2006	18/04/2007	17/10/2007	15/04/2008	Calculated Statistical Values				
Parameter	**Units**											Bottom Percentile	Minimum	Median	Maximum	Top Percentile
pH	pH units	N/S	N/S	N/S	N/S	8.2	7.9	7.4	7.3	7.5	7.4	7.35	7.3	7.45	8.2	8.05
EC	mS/cm	N/S	N/S	N/S	N/S	6400	6500	7100	6200	6100	6500	6150	6100	6450	7100	6800
TDS	mg/L	N/S	N/S	N/S	N/S	3129	3161	3400	3900	3600	3700	3145	3129	3500	3900	3800
Major Ions																
Ca	mg/L	N/S	N/S	N/S	N/S	230	230	240	200	200	210	200	200	220	240	235
Mg	mg/L	N/S	N/S	N/S	N/S	97	91	100	93	96	100	92	91	96.5	100	100
Na	mg/L	N/S	N/S	N/S	N/S	750	1000	870	960	940	940	810	750	940	1000	980
K	mg/L	N/S	N/S	N/S	N/S	12	16	16	14	12	16	12	12	15	16	16
Cl	mg/L	N/S	N/S	N/S	N/S	1800	1600	1600	1800	1700	1700	1600	1600	1700	1800	1800
HCO_3	mg/L	N/S	N/S	N/S	N/S	305	361	430	320	350	370	312.5	305	355.5	430	400
SO_4	mg/L	N/S	N/S	N/S	N/S	250	240	220	240	270	260	230	220	245	270	265
Minor Ions																
F	mg/L	N/S	N/S	N/S	N/S	0.1	0.2	<0.1	<0.1	<0.1	<0.1	0.11	0.1	0.15	0.2	0.19
Total N	mg/L	N/S	N/S	N/S	N/S	1.5	1.7	1.7	2.1	0.84	1.8	1.17	0.84	1.7	2.1	1.95
Dissolved Metals																
Al	mg/L	N/S	N/S	N/S	N/S	20	21	<1	48	65	25	20.4	20	25	65	58.2
As	mg/L	N/S	N/S	N/S	N/S	18	14	<1	15	8.4	<1	10.08	8.4	14.5	18	17.1
Cu	mg/L	N/S	N/S	N/S	N/S	3	4	<2	<2	<2	1.9	2.12	1.9	3	4	3.8
Fe	mg/L	N/S	N/S	N/S	N/S	1500	1400	<5	580	820	1300	676	580	1300	1500	1460
Mn	mg/L	N/S	N/S	N/S	N/S	570	130	<1	250	180	160	142	130	180	570	442
Se	mg/L	N/S	N/S	N/S	N/S	9	6	<5	<5	37	39	6.9	6	23	39	38.4

Groundwater Bore No. 82P (Coal)

		28/08/2003	3/03/2004	8/09/2004	13/04/2005	12/10/2005	28/04/2006	25/10/2006	18/04/2007	17/10/2007	15/04/2008	Calculated Statistical Values				
Parameter	**Units**											Bottom Percentile	Minimum	Median	Maximum	Top Percentile
pH	pH units	N/S	N/S	N/S	N/S	7.7	7.6	7.8	7.7	7.9	7.9	7.65	7.6	7.75	7.9	7.9
EC	mS/cm	N/S	N/S	N/S	N/S	5900	5600	6000	5400	5300	5400	5350	5300	5500	6000	5950
TDS	mg/L	N/S	N/S	N/S	N/S	3185	3308	3400	3400	3600	3500	3246.5	3185	3400	3600	3550
Major Ions																
Ca	mg/L	N/S	N/S	N/S	N/S	140	130	130	120	150	140	125	120	135	150	145
Mg	mg/L	N/S	N/S	N/S	N/S	140	140	140	130	130	140	130	130	140	140	140
Na	mg/L	N/S	N/S	N/S	N/S	750	880	760	850	840	880	755	750	845	880	880
K	mg/L	N/S	N/S	N/S	N/S	6.4	5.3	5.8	5.8	7.2	6.6	5.55	5.3	6.1	7.2	6.9
Cl	mg/L	N/S	N/S	N/S	N/S	1200	1100	1100	1200	1100	1100	1100	1100	1100	1200	1200
HCO_3	mg/L	N/S	N/S	N/S	N/S	759	953	880	770	880	840	764.5	759	860	953	916.5
SO_4	mg/L	N/S	N/S	N/S	N/S	460	530	400	480	470	480	430	400	475	530	505
Minor Ions																
F	mg/L	N/S	N/S	N/S	N/S	0.5	0.4	0.14	0.55	0.3	0.5	0.22	0.14	0.45	0.55	0.525
Total N	mg/L	N/S	N/S	N/S	N/S	1.3	1.8	0.63	0.85	0.86	1.3	0.74	0.63	1.08	1.8	1.55
Dissolved Metals																
Al	mg/L	N/S	N/S	N/S	N/S	10	86	70	15	10	24	10	10	19.5	86	78
As	mg/L	N/S	N/S	N/S	N/S	11	9	7.5	12	6.1	<1	6.66	6.1	9	12	11.6
Cu	mg/L	N/S	N/S	N/S	N/S	3	5	<2	2.2	<2	2.8	2.38	2.2	2.9	5	4.4
Fe	mg/L	N/S	N/S	N/S	N/S	870	3100	1600	1700	610	1400	740	610	1500	3100	2400
Mn	mg/L	N/S	N/S	N/S	N/S	54	60	59	73	190	100	56.5	54	66.5	190	145
Se	mg/L	N/S	N/S	N/S	N/S	7	6	<5	<5	27	22	6.3	6	14.5	27	25.5

Groundwater Bore No. 83P (Coal)

		28/08/2003	3/03/2004	8/09/2004	13/04/2005	12/10/2005	28/04/2006	25/10/2006	18/04/2007	17/10/2007	15/04/2008	Calculated Statistical Values				
Parameter	**Units**											Bottom Percentile	Minimum	Median	Maximum	Top Percentile
pH	pH units	N/S	N/S	N/S	N/S	8.2	8.1	7.3	7.8	7.5	7.2	7.25	7.2	7.65	8.2	8.15
EC	mS/cm	N/S	N/S	N/S	N/S	940	1200	1600	1400	1300	1300	1070	940	1300	1600	1500
TDS	mg/L	N/S	N/S	N/S	N/S	485	830	1200	880	820	960	652.5	485	855	1200	1080
Major Ions																
Ca	mg/L	N/S	N/S	N/S	N/S	30	70	130	82	73	96	50	30	77.5	130	113
Mg	mg/L	N/S	N/S	N/S	N/S	14	44	63	54	43	50	28.5	14	47	63	58.5
Na	mg/L	N/S	N/S	N/S	N/S	100	100	120	140	99	100	99.5	99	100	140	130
K	mg/L	N/S	N/S	N/S	N/S	2.6	3.1	7.6	4.4	4.2	4.3	2.85	2.6	4.25	7.6	6
Cl	mg/L	N/S	N/S	N/S	N/S	100	140	170	150	130	140	115	100	140	170	160
HCO_3	mg/L	N/S	N/S	N/S	N/S	263	639	650	550	450	550	356.5	263	550	650	644.5
SO_4	mg/L	N/S	N/S	N/S	N/S	14	<50	30	22	20	18	15.6	14	20	30	26.8
Minor Ions																
F	mg/L	N/S	N/S	N/S	N/S	0.2	0.1	0.2	0.31	0.2	0.3	0.15	0.1	0.2	0.31	0.305
Total N	mg/L	N/S	N/S	N/S	N/S	1.2	1.1	0.53	22	0.28	0.99	0.405	0.28	1.045	22	11.6
Dissolved Metals																
Al	mg/L	N/S	N/S	N/S	N/S	35	74	520	96	12	41	23.5	12	57.5	520	308
As	mg/L	N/S	N/S	N/S	N/S	<1	2	1.4	1.5	<1	<1	1.42	1.4	1.5	2	1.9
Cu	mg/L	N/S	N/S	N/S	N/S	1	3	<2	<2	<2	1.2	1.04	1	1.2	3	2.64
Fe	mg/L	N/S	N/S	N/S	N/S	240	580	1100	770	690	660	410	240	675	1100	935
Mn	mg/L	N/S	N/S	N/S	N/S	26	38	96	59	70	73	32	26	64.5	96	84.5
Se	mg/L	N/S	N/S	N/S	N/S	3	3	<5	<5	<5	<5	3	3	3	3	3

Groundwater Bore No. 84P (Basalt)

		28/08/2003	3/03/2004	8/09/2004	13/04/2005	12/10/2005	28/04/2006	25/10/2006	18/04/2007	17/10/2007	15/04/2008	Calculated Statistical Values				
Parameter	**Units**											Bottom Percentile	Minimum	Median	Maximum	Top Percentile
pH	pH units	N/S	N/S	N/S	N/S	8	7.6	7.7	7.7	7.8	7.7	7.65	7.6	7.7	8	7.9
EC	mS/cm	N/S	N/S	N/S	N/S	2400	2600	3100	3100	3400	3500	2500	2400	3100	3500	3450
TDS	mg/L	N/S	N/S	N/S	N/S	961	1324	2100	2100	2000	2000	1142.5	961	2000	2100	2100
Major Ions																
Ca	mg/L	N/S	N/S	N/S	N/S	130	130	170	170	210	240	130	130	170	240	225
Mg	mg/L	N/S	N/S	N/S	N/S	120	130	150	150	180	210	125	120	150	210	195
Na	mg/L	N/S	N/S	N/S	N/S	140	220	170	170	160	200	150	140	170	220	210
K	mg/L	N/S	N/S	N/S	N/S	3	2.6	2.7	2.7	3.4	3.8	2.65	2.6	2.85	3.8	3.6
Cl	mg/L	N/S	N/S	N/S	N/S	400	440	620	620	730	800	420	400	620	800	765
HCO_3	mg/L	N/S	N/S	N/S	N/S	335	678	520	520	450	440	387.5	335	485	678	599
SO_4	mg/L	N/S	N/S	N/S	N/S	76	100	130	130	190	250	88	76	130	250	220
Minor Ions																
F	mg/L	N/S	N/S	N/S	N/S	0.3	0.2	0.16	0.16	0.2	0.2	0.16	0.16	0.2	0.3	0.25
Total N	mg/L	N/S	N/S	N/S	N/S	3.2	2.9	2.6	2.6	2.2	3.3	2.4	2.2	2.75	3.3	3.25
Dissolved Metals																
Al	mg/L	N/S	N/S	N/S	N/S	23	13	12	12	14	9.7	10.85	9.7	12.5	23	18.5
As	mg/L	N/S	N/S	N/S	N/S	5	6	7.9	7.9	5	<1	5	5	6	7.9	7.9
Cu	mg/L	N/S	N/S	N/S	N/S	2	4	<2	<2	<2	2.4	2.08	2	2.4	4	3.68
Fe	mg/L	N/S	N/S	N/S	N/S	970	1000	12000	12000	490	770	630	490	985	12000	12000
Mn	mg/L	N/S	N/S	N/S	N/S	6	34	18	18	18	40	12	6	18	40	37
Se	mg/L	N/S	N/S	N/S	N/S	6	6	5.5	5.5	24	16	5.5	5.5	6	24	20

Groundwater Bore No. 2289 (Coal)

		1/04/2009	1/12/2009	1/06/2010	13/12/2010	22/06/2011	14/12/2011	16/04/2012				Calculated Statistical Values				
Parameter	**Units**											Bottom Percentile	Minimum	Median	Maximum	Top Percentile
pH	pH units	8	7.3	7.1	6.7	6.01	7.01	7.2				6.424	6.01	7.1	8	7.58
EC	mS/cm	6600	6000	6200	6200	19800	15800	7150				6120	6000	6600	19800	17400
TDS	mg/L	3500	3500	3700	5700	12200	11800	4650				3500	3500	4650	12200	11960
Major Ions																
Ca	mg/L	340	290	400	29	889	706	309				185.6	29	340	889	779.2
Mg	mg/L	140	130	8	4	799	705	182				6.4	4	140	799	742.6
Na	mg/L	640	780	750	1100	2740	2470	944				706	640	944	2740	2578
K	mg/L	14	17	13	18	17	10	14				11.8	10	14	18	17.4
Cl	mg/L	1700	1700	1700	2100	5830	5840	1960				1700	1700	1960	5840	5834
HCO_3	mg/L	290	330	320	207.3	166	172	149				159	149	207.3	330	324
SO_4	mg/L	350	350	370	660	2820	2050	609				350	350	609	2820	2358
Minor Ions																
F	mg/L	<0.1	<0.1	0.5	0.1	0.2	0.3	0.2				0.14	0.1	0.2	0.5	0.42
Total N	mg/L	1.6	1.1	0.85	2.2	6	4	1.2				1	0.85	1.6	6	4.8
Dissolved Metals																
Al	mg/L	4.8	180	14	320	50	30	80				10.32	4.8	50	320	236
As	mg/L	<1	<1	<1	<1	1	1	<1				1	1	1	1	1
Cu	mg/L	<1	7	3	11	16	9	4				3.5	3	8	16	13.5
Fe	mg/L	3000	3500	3600	3000	2250	870	1390				1182	870	3000	3600	3540
Mn	mg/L	390	270	390	250	1250	854	208				233.2	208	390	1250	1012.4
Se	mg/L	28	35	37	20	<10	<10	<10				22.4	20	31.5	37	36.4

N.B. Values highlighted in red indicate potentially erroneous analysis readings. Values in blue indicate calculated TDS.

Groundwater Bore No. 2291 (Coal)

		9/06/2009	17/12/2009	1/07/2010	23/06/2011	13/12/2011	17/04/2012					Calculated Statistical Values				
Parameter	**Units**											Bottom Percentile	Minimum	Median	Maximum	Top Percentile
pH	pH units	7.6	7.2	7.2	7.61	7.9	7.74					7.2	7.2	7.605	7.9	7.82
EC	mS/cm	7900	7400	7700	7780	7320	7630					7360	7320	7665	7900	7840
TDS	mg/L	4700	4900	4600	4250	4510	4900					4380	4250	4650	4900	4900
Major Ions																
Ca	mg/L	220	240	250	256	247	240					230	220	243.5	256	253
Mg	mg/L	140	150	130	136	137	140					133	130	138.5	150	145
Na	mg/L	1400	1400	1100	1200	1160	1170					1130	1100	1185	1400	1400
K	mg/L	15	14	12	17	16	17					13	12	15.5	17	17
Cl	mg/L	2200	2200	2200	1930	2150	2180					2040	1930	2190	2200	2200
HCO_3	mg/L	510	540	550	508	530	549					509	508	535	550	549
SO_4	mg/L	330	350	340	346	251	408					290.5	251	343	408	379
Minor Ions																
F	mg/L	<0.1	0.5	0.22	<0.1	<0.1	<0.1					0.248	0.22	0.36	0.5	0.472
Total N	mg/L	9.4	0.9	1.2	1.5	1.8	3.1					1.05	0.9	1.65	9.4	6.25
Dissolved Metals																
Al	mg/L	100	110	9	<10	1150	10					9.4	9	100	1150	734
As	mg/L	<1	<1	1	<1	<1	<1					1	1	1	1	1
Cu	mg/L	3.9	5	5	<1	5	<1					4.23	3.9	5	5	5
Fe	mg/L	3200	3300	4000	2340	6250	2530					2435	2340	3250	6250	5125
Mn	mg/L	100	76	85	44	100	53					48.5	44	80.5	100	100
Se	mg/L	43	65	54	<10	<10	<10					45.2	43	54	65	62.8

Groundwater Bore No. BMH1 (Basalt)

		16/04/2008	22/06/2011	14/12/2011	17/04/2012							Calculated Statistical Values				
Parameter	**Units**											Bottom Percentile	Minimum	Median	Maximum	Top Percentile
pH	pH units	8	8.02	8.05	7.73							7.811	7.73	8.01	8.05	8.041
EC	mS/cm	1400	1520	1250	1420							1295	1250	1410	1520	1490
TDS	mg/L	1300	871	774	923							803.1	774	897	1300	1186.9
Major Ions																
Ca	mg/L	88	105	93	90							88.6	88	91.5	105	101.4
Mg	mg/L	55	92	85	86							64	55	85.5	92	90.2
Na	mg/L	220	92	84	93							86.4	84	92.5	220	181.9
K	mg/L	2.4	1	1	1							1	1	1	2.4	1.98
Cl	mg/L	85	91	97	87							85.6	85	89	97	95.2
HCO_3	mg/L	840	791	675	751							698	675	771	840	825
SO_4	mg/L	11	13	11	24							11	11	12	24	20.7
Minor Ions																
F	mg/L	0.1	0.3	0.2	0.2							0.13	0.1	0.2	0.3	0.27
Total N	mg/L	18	14.7	7.8	14.3							9.75	7.8	14.5	18	17.01
Dissolved Metals																
Al	mg/L	40	<10	10	<10							13	10	25	40	37
As	mg/L	<1	<1	<1	<1							1	1	1	1	1
Cu	mg/L	1	2	<1	<1							1.1	1	1.5	2	1.9
Fe	mg/L	340	<50	<50	<50							340	340	340	340	340
Mn	mg/L	98	7	10	3							4.2	3	8.5	98	71.6
Se	mg/L	<5	<10	<10	<10							10	10	10	10	10

N.B. Values in blue indicate calculated TDS.

Groundwater Bore No. CSMH1 (Coal)

		16/04/2008	**23/06/2011**	**12/12/2011**	**18/04/2012**	**16/10/2012**						**Calculated Statistical Values**				
Parameter	**Units**											Bottom Percentile	Minimum	Median	Maximum	Top Percentile
pH	pH units	7.5	7.79	7.7	7.8	7.79						7.58	7.50	7.79	7.80	7.80
EC	mS/cm	4000	5190	5520	4980	4700						4280	4000	4980	5520	5388
TDS	mg/L	2400	3050	3620	3520	3270						2660	2400	3270	3620	3580
Major Ions																
Ca	mg/L	170	255	301	205	186						176.4	170	205	301	282.6
Mg	mg/L	100	171	250	183	166						126.4	100	171	250	223.2
Na	mg/L	530	609	647	565	561						542.4	530	565	647	631.8
K	mg/L	9.3	10	12	10	9						9.1	9.0	10.0	12.0	11.2
Cl	mg/L	820	1110	1470	1230	1060						916	820	1110	1470	1374
HCO_3	mg/L	550	670	640	601	412						467	412	601	670	658
SO_4	mg/L	260	410	336	430	549						290.4	260	410	549	501.4
Minor Ions																
F	mg/L	0.1	0.2	0.1	<0.1	<0.1						0.1	0.1	0.1	0.2	0.16
Total N	mg/L	2.3	13.3	6.2	5.6	8						3.62	2.3	6.2	13.3	11.18
Dissolved Metals																
Al	mg/L	170	<10	<10	<10	<10						10	10	10	170	106
As	mg/L	<1	<1	<1	<1	<1						1	1	1	1	1
Cu	mg/L	1.9	<1	<1	2	3						1	1	1.9	3	2.6
Fe	mg/L	670	<50	60	80	90						54	50	80	670	438
Mn	mg/L	650	292	230	148	123						133	123	230	650	506.8
Se	mg/L	14	<10	<10	<10	<10						10	10	10	14	12.4

APPENDIX D

DEHP RESPONSE TO WSA 2008 REPORT

Queensland Government

Environmental Protection Agency
Incorporating the
Queensland Parks and Wildlife Service

Enquiries Sarah Horton
Telephone (07) 4699 4354
Your reference
Our reference TWB741 vol 19

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14 November 2008

Mr Paul Statham
New Acland Coal Pty Ltd
PO Box 47
IPSWICH QLD 4305

Dear Paul

I refer to your letter dated 8 September 2008 and attached report "Establishment of Groundwater Quality Background Limits" prepared by Waste Solutions Australia Pty Ltd. The Environmental Protection Agency (EPA) has reviewed this report and provides the following comment.

The report states that the first objective of the study was to review, statistically analyse and interpret groundwater quality information generated from monitoring and sampling of ten (10) compliance bores within the monitoring bore field. The second objective of the study was to generate and recommend a set of groundwater quality background limits where sufficient groundwater data sets were available. It is understood that Waste Solutions Australia Pty Ltd reviewed four years of monitoring data with most analytes required to be tested half yearly which constitutes eight (8) data points for most quality characteristics.

Condition C24 of your environmental authority (EA) requires the establishment of background contaminant limits for a set of quality characteristics as shown below –

(C24) Conduct monitoring and keep records of groundwater quality for the relevant bores of compliance for the aquifers. All determinations of groundwater quality must be:

- (i) conducted for the water quality characteristics and at the minimum frequency stated in **Schedule C – Table 7**;
- (ii) taken from sufficient monitoring points and / or well to obtain representative samples of groundwater both up-gradient and down-gradient of the potential influence;
- (iii) carried out with sufficient regularity and spatial and temporal replication to make statistically valid conclusions about the presence or absence of contamination or other impact.
- (iv) carried out with sufficient number of sampling events to determine ambient groundwater quality and level prior to any development of the site occurring.
- (v) followed by an assessment of whether or not there has been any statistically significant adverse change compared to background values at locations hydraulically down gradient of the potential sources of contamination for each quality characteristic in **Schedule C – Table 7**.

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Schedule C - Table 7: Groundwater Monitoring Limits and Frequencies

Quality Characteristic	Units	Contaminant Limits and Groundwater level	Monitoring Frequency
Al	mg/L	+/- 20% of background	Half Yearly
As	mg/L	+/- 20% of background	Half Yearly
Ca	mg/L	+/- 10% of background	Half Yearly
Se	mg/L	+/- 20% of background	Half Yearly
Cl	mg/L	+/- 10% of background	Half Yearly
Cu	mg/L	+/- 20% of background	Half Yearly
F	mg/L	+/- 20% of background	Half Yearly
Fe	mg/L	+/- 20% of background	Half Yearly
Total N	mg/L	+/- 20% of background	Half Yearly
K	mg/L	+/- 10% of background	Half Yearly
Mg	mg/L	+/- 10% of background	Half Yearly
Mn	mg/L	+/- 20% of background	Half Yearly
Na	mg/L	+/- 10% of background	Half Yearly
SO_4	mg/L	+/- 10% of background	Half Yearly
HCO_3	mg/L	+/- 10% of background	Half Yearly
TDS	mg/L	+/- 10% of background	Half Yearly
EC	µS/cm	+/- 0.5 for coal measures aquifers +/- 1 for basalt aquifers	Quarterly
pH	unit		Quarterly
Standing water level	cm		Monthly

The report states that due to large variations in data from bore to bore there was no possibility of having only one baseline ('Background') limit per analyte for all aquifers but it suggested that specific data sets for each borehole for each quality characteristic be set. This recommendation is supported with box plots for the baseline data. The report also suggests that no background limits be placed on aluminium and iron because of elevated levels of these analytes in results that could possibly be caused by very fine clay particles carrying metal ions passing through the standard 0.45 micron filter that are generated during the purging of boreholes.

The report provides no discussion demonstrating there is sufficient amount of data for each borehole upon which to make any statistically valid conclusions for appropriate setting of background limits. Nor does the report comment on whether the existing bores are located within the same confined aquifer and at appropriate distance/s from potential sources of impact from mining activities to provide representative groundwater samples from the aquifers potentially affected.

It is understood based on your advice that two off lease reference bores were drilled at the beginning of this year and will be tested half yearly for variation in drawdown. Also these bores will not be monitored for quality characteristics listed in Schedule C Table 7 as this is not required by the EA.

In order to set meaningful background limits for groundwater quality, the requirements of condition C24(in particular ii – iv) should be addressed by demonstrating that groundwater quality has been determined by obtaining a representative number of samples both up-gradient and down-gradient of the potential influence i.e. mining activities. The report should have discussed whether there is sufficient regularity and spatial and temporal replication of data to make statistically valid conclusions about the presence or absence of contamination or other impact and to determine ambient groundwater quality and level prior to any development of the site occurring.

EA Amendment for Stage 3
Given that NAC has applied for an amendment of the existing EA for Stage 3 Environmental Impact Statement (EIS) relating to mining lease application 50232, it would be an opportune time to review the EA conditions for groundwater quality and for NAC to provide more meaningful information on the mine sites groundwater regime and potential vulnerability from mine activities.

Assuming there was currently sufficient data available, the use of time series plots of water parameters and groundwater levels would help determine how much variation in water quality parameters over time are due to recharge and water level variations i.e. is it trending up/down, are there random fluctuations or are the variations linked to changes in water levels. Also comparisons over time (e.g. pre-mine, mine life and post mine) could illustrate any affect of mine activities while monitoring of water quality in more distant bores might show effects of climate/recharge.

In order to address the potential for greater impacts on groundwater from Stage 3 and provide more meaningful interpretation of monitoring results it is envisaged that the amended EA will have additional conditions addressing relevant impacts and may take a different approach to setting background values for groundwater quality. A more appropriate method of assessing potential impact on groundwater from mining activities could be the setting of 'groundwater investigation trigger levels' for certain parameters that if exceeded would trigger an investigation into the potential for environmental harm as a result of the exceedance. These groundwater trigger levels would be based on monitoring results considered to be sufficient to assess natural variations in quality verus possible releases from mining activities.

To provide some interim assessment for Stage 3 the EIS should at least provide cross sections showing natural topography, future mine depths and tailings and water storages versus the various aquifers being monitored (now and in the future). Three-dimensional (3D) visualisation would assist but cross sections and plans would suffice.

In the interim it would seem reasonable to consider the application of some interim trigger values until sufficient data is available. This should be considered in light of the fact that Stage 3 will result in a much larger mine footprint and more potential sources of impact on groundwater. Therefore more on and off lease bores (up and down gradient of the potential source of contaminants) will need to be drilled and monitored over time. The addition of these monitoring bores should assist in gathering more data on the groundwater regime and the effect of variations in flow and climate on groundwater quality. It is expected that the draft EIS document for Stage 3 will address potential impacts on groundwater and include the location of a number of additional on and off lease boreholes that will be monitoring for the relevant parameters.

With only eight data points collected for each borehole and quality characteristic, it is considered that an insufficient number of data points have been collected to date to allow the setting of scientifically valid background limits. A minimum of eighteen (18) data points should be collected before any valid limits/trigger levels can be set. The amended EA could include a quarterly monitoring frequency for parameters. Once sufficient data has been collected to allow finalisation of groundwater contaminant trigger levels, New Acland Coal could apply for the frequency of monitoring to be reduced.

It is suggested that a meeting be held to discuss these issues to determine a way forward for conducting and assessing future groundwater monitoring and determining appropriate background limits or trigger values for ambient groundwater quality.

If you have any queries regarding the above matters please contact Sarah Horton on 4699 4354.

Yours sincerely

Chris Hill
Regional Manager
Western Region
Environmental Services

APPENDIX E

WSA RESPONSE TO NAC (2 LETTER REPORTS)

26 November 2008

Mr Paul Statham
New Acland Coal Pty Ltd
PO Box 47
Ipswich Qld 4305

Dear Mr Statham,

WASTE SOLUTIONS AUSTRALIA RESPONSE TO COMMENTS FROM THE EPA

1. The EPA made the comment that there was no discussion about whether or not there was a sufficient amount of data available to perform a statistical analysis. The baseline values report was produced by WSA for NAC in compliance with Condition C31 of the NAC Environmental Authority (EA). This condition states that the baseline value for the groundwater contaminant limits is to be determined by sampling for a period of three years from the reference bores listed in Schedule C-Table 5. This has been completed. The method chosen was deemed to be the most suitable considering the limited data available. It showed the symmetry of the data as well as any trends and highlighted the majority of the data while excluding outliers (anomalous readings). With the small size of the sample set available to use for each bore there is some variance in the data. This indicates that a larger sample set size would be better for the optimal accuracy of results. As the baseline values were an EA requirement after 3 years of sampling, more data was not available at the time of completing the report.

2. The baseline values report describes whether the two sets of monitoring bores are located in the basalt or the coal measures aquifers. These bores match Table 5 in Schedule C of the New Acland EA. The monitoring bores are located generally on the lease boundary so as to be able to quantify any impact of mining activity moving off-site. This is considered to be an appropriate monitoring strategy.

3. With regard to the EPA comments about the off-lease bores in Schedule C Table 6 Off Lease Groundwater Monitoring Locations and Frequency. WSA is offering to commence monitoring the bores for groundwater contamination if required by the EPA.

4. In response to the comments regarding the accuracy of determining the groundwater quality by sampling up gradient and down gradient of the mining activity, the 6 monthly sampling regime was agreed by the EPA. This is described in Schedule C-Table 7. Due to the fact that samples were taken every 6 months and the EA required a baseline value to be determined after 3 years of sampling, only 8-10 samples were available for each bore at the time of submitting the report. The monitoring bores are located both up gradient and down gradient of the mining activity.

5. The statistical accuracy of the report is inhibited by the EA requirement to produce a baseline values report after 3 years of the commencement of sampling the bores of compliance. The spatial location of the bores and the sampling schedule were agreed to by the EPA is included in the EA. This led to the conclusion that the EPA agreed to the validity of the data that would be produced and that there was a suitable amount of data available to produce a baseline values study. Otherwise this would have been mentioned in the EA and a more rigorous sampling schedule required. The existing sampling regime has been set up to sample at the end of both the wet and dry seasons to provide representative results based on the seasonal variation of the groundwater chemistry.

6. The baseline values produced by WSA based on analysis of the available sample data should be used as interim trigger values for the mine site until more data is generated.

7. There were 8-10 data points collected for each borehole in six-monthly intervals. This sampling frequency is regarded s adequate throughout the industry and was the amount agreed to by the EPA in this timeframe.

8. Why have 18 data points been suggested? It is known that the sample size is linked to the amount of variance (standard deviation) in the data set. The more variance, the greater the sample size required to ensure accuracy. The mathematical formula to deem sample size is:

$$S_{\bar{x}} = \frac{S_x}{\sqrt{N}}$$

Where S_x is the standard deviation, N is the sample size and $S_{\bar{x}}$ is the critical value and is dependent on the confidence level that is desired. The higher the confidence level required, the larger the sample set needed. Has the EPA set a particular confidence level and margin of error for the baseline values? This is required before a sample set size can be determined. WSA performed a power analysis using the above equation, with the standard deviation from the samples taken so far. For a confidence level of 1% (very low confidence), the results of the power analysis indicate that over 1000 samples would be required to characterise the background levels of all desired analytes. To achieve a 95% confidence level (statistical standard) using this method, a sample size in excess of 100,000 data sets, which is driven by the standard deviations that currently exceeds 3,000 for some of the test parameters (Fe, Mn and EC in particular).

References

Park, H. M. (2008) Hypothesis Testing and Statistical Power of a Test, The Trustees of Indiana University, http://www.indiana.edu/~statmath/stat/all/power/power.pdf, Accessed 26/11/2008.

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8 January 2009

Mr Paul Statham
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PO Box 47
Ipswich Qld 4305

Dear Mr Statham,

Re. Condition (C31) New Acland Coal Pty Ltd Environmental Authority MIM800317705

Waste Solutions Australia Pty Ltd (WSA) has compiled the following summary note at the request of Paul Statham (New Acland Coal Pty Ltd). The content of this note summarises the reasoning behind two recommendations that were made following submission of a report addressing the requirements of condition (C31) entitled, '*Establishment of Groundwater Quality Background Limits'* to the Environmental Protection Agency (EPA). The recommendations were made following a meeting between Paul Statham, Paul Smith (WSA) and the Environmental Protection Agency (EPA) on Friday 19th December 2009.

The first recommendation states that no 'contaminant trigger levels' should be placed on iron (Fe) and aluminium (Al) due to physical processes driving considerable fluctuations in recorded concentrations. Levels of these parameters can become elevated in very turbid groundwater samples following field filtration as very fine clay particles carrying metal ions pass through the standard 0.45-micron filter into the sample, skewing the observed concentration. The variability of these parameters was considered too high to statistically generate reliable 'background limits'. In the absence of specific 'background limits' for Fe and Al, it is recommended that these parameters continue to be analysed for in the routine monitoring, so that compliance with Schedule C is maintained.

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The second recommendation states that if concentrations decrease below the 'lower' background value, the quality of water would be considered to be improving and therefore would not constitute non-compliance. The reasoning behind this stems from the method of statistical analysis chosen. The use of boxplots highlights the spread and symmetry of data sets that yields both a 'lower' and 'higher' background value (minimum and maximum 10^{th} percentile). With the exception of pH, only increases in concentrations above the 'higher' value should constitute an environmental non-compliance. However, it is recommended that although the lower limits will not be 'actioned' the concentrations observed from the routine monitoring will still be compared to these values so that progressive trends within the data sets can be identified.

If you have any questions about the above recommendation, please contact WSA.

Yours Sincerely,

…………………………..… **……………………………..**

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