APPENDIX B: DESCRIPTION OF THE EXISTING HYDROGEOLOGICAL ENVIRONMENT

1. Regional Setting

The surface topography of the Ashton Coal Project (ACP) generally dips to the west and is gently undulating across most of the underground mine area. Surface elevation varies between approximately 100m Australian Height Datum (AHD) along the eastern ridge to around 50m AHD near the Hunter River end of Bowmans Creek. East of the underground mine area there is a steeper slope above Glennies Creek and to the south steeper slopes are found leading down to the alluvial flats adjacent to the Hunter River. The topography flattens around Bowmans Creek, and rises again on the north western side around Upper Liddell Seam LW8.

The project area includes three major watercourses; the Hunter River to the south of the Mine and two tributary streams; Glennies Creek to the east of the underground mine, and Bowmans Creek across the western part of the underground mine area.

2. Climate

2.1 Rainfall and Evaporation

The climate of the region is temperate with hot summers and cool winters. The average daily maximum temperature ranges from 31.7ºC in January to 17.4ºC in July.

Rainfall data from the Jerry's Plains weather station, situated approximately 14km to the southwest of the ACP is summarised in **Table B1**. The table lists the mean monthly rainfall and mean annual rainfall, based on more than 100 years of rainfall data since 1884. Evaporation data (pan evaporation records) are available from Scone, approximately 100km west of the ACP. Additionally, **Table B1** shows that there is generally an excess of evaporation over rainfall in most months, although rainfall and potential evaporation are close to being in balance in the winter months (June and July).

Table B1 Long-term Average Monthly Rainfall at Jerry's Plains and Evaporation at Scone (mm)

Site	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Rainfall*	77.0	72.4	58.3	44.5	40.9	48.1	43.5	36.4	41.7	52.1	60.3	68.2	643.7
Pan Evaporation	220	174	155	105	68	48	56	84	117	155	183	220	1606
Balance	-143	-101	-97	-61	-27	0	-12	-47	-75	-103	-123	-152	-962

Source: Bureau of Meteorology (BOM August 2011)

Note: *Rainfall – BOM Jerrys Plains Meteorological Station; Evaporation – BOM Scone SCS Meteorological Station

2.2 Geology

The study area is located within the Hunter Valley Coalfield of the Sydney Basin. The Permian aged coal reserves within the ACP mining lease are mostly within the Foybrook Formation of the Vane Sub-Group (Hebden to Lemington seams), with limited occurrence of the Bayswater Seam which is the basal unit of the Jerry's Plains Sub-Group. Both sub-groups are part of the Whittingham Coal Measures, the basal coal-bearing sequence of the Singleton Supergroup. Regional surface geology is shown on **Figure B1**.

The major mineable coal seams considered suitable for longwall mining are (in descending stratigraphic order) the Pikes Gully (PG), Upper Liddell (ULD), Upper Lower Liddell, and Lower

Barrett Seams. The Bayswater Seam, which is stratigraphically higher than the PG Seam, was previously mined in the former Bayswater Mine open cut, and is currently being mined at the Narama Mine open cut, both west of the Project area. The Bayswater Seam has only a limited presence in the south-western corner of the ACP underground mine area. The Lemington Seams (seams 1 to 19), consisting of minor seams of varying thickness, are located stratigraphically between the PG Seam and the base of the Bayswater Seam, and are present in the overburden across the mining area. Some of the Lemington Seams are mined in the ACP North East Open Cut (NEOC) located north of the New England Highway.

Target coal seams are separated by interburden sediments, which comprise sandstone, siltstone, conglomerate, mudstone and shale, as well as occasional minor coal seams. A representative geological cross section through the area is presented in **Figure B2**.

The predominant regional geological structures in the area are the:

- Bayswater Syncline, the axis of which is located west of the ACP in the Ravensworth South and Narama mines;
- Camberwell Anticline, which passes to the east, through Camberwell village and the Camberwell Mine open cut; and
- Glennies Creek Syncline further to the east (**Figure B1**).

The axes of these structures run from north to south and north north-west to south south-east. The coal seams to be mined at the ACP are outcropping in the study area on the western and north-eastern limbs of the Camberwell anticline. These subcrops for the PG and ULD seams are shown in **Figure B3**. The regional geology has been extrapolated out to the boundary of the study area utilising published mapping and geological references sourced from various public company reports.

No major faults, other significant structures or igneous intrusions (dykes or sills) are known to occur in the mining area, although minor dykes and small scale structures such as rolls or folds in the seams may be encountered in the Mine. One water-bearing, low angle shear zone has been encountered in the PG Seam in the north-west main headings, which can also be seen at its outcrop within the NEOC pit.

The ULD Seam ranges up to 3.2m in thickness, with an average of 2.2m. The ULD Seam outcrops/subcrops to the east of the ACP (**Figure B3**) and has a depth to approximately 240m (-180mAHD) in the south west corner of the underground mine area. The interburden sequences between the seams vary in thickness between 7m and 63m. A summary of the mean seam/interburden/overburden depths and thicknesses is listed in **Table B2**.

Table B2 Thicknesses of Coal Seam and Interburden Layers in the ACP Area (m)

Geological Units	Mean	Minimum	Maximum
Pikes Gully overburden (Pikes Gully to base of alluvium)	Variable from 0 to 200m, due to dip on strata		
Pikes Gully	2.2	1.8	3.0
Interburden (Upper Liddell to Pikes Gully)	36	13	63
Upper Liddell Seam	2.2		3.2
Interburden (Upper Lower Liddell to Upper Liddell)	28	7	47
Upper Lower Liddell Seam	2.1		6.1
Interburden (Lower Barrett to Upper Lower Liddell)	40	24	62

Geological Units	Mean	Minimum	Maximum
Lower Barrett Seam	2.2		5.9

Within the Extraction Plan area, alluvium occurs in association with the Hunter River and its tributaries: Bowmans Creek and Glennies Creek.

Investigation drilling of the Bowmans Creek alluvium (Aquaterra, 2008b) indicated up to approximately 15m of sandy silts, silts and silty clays, with occasional horizons of silty sands and gravels. The maximum recorded saturated thickness is 4.5m.

Investigation drilling of the Glennies Creek floodplain and regolith indicated up to approximately 8 to 10m of sandy silts, silts and silty clays, generally overlying coarse sandy gravels. The maximum recorded saturated thickness is 6m.

The Hunter River alluvium was found to be comprised mainly of clay and silty clay, with gravel horizons and is generally more permeable than the Bowmans Creek alluvium. A basal gravel horizon 8.5m thick was drilled in borehole RA27. The saturated thickness in this borehole was 6m; however it is possible that greater saturated thicknesses may occur.

3. Overview of the Main Hydrogeological Units

Two distinct aquifer systems occur within or near the Extraction Plan area:

- A fractured rock aquifer system hosted in the coal measures with groundwater flow mainly in the coal seams; and
- Shallow alluvial aquifer systems in the unconsolidated sediments of Bowmans Creek, Glennies Creek and the Hunter River.

Some ‘perched’ groundwater can exist within the upper weathered mantle of the Permian coal measures, although occurrence is limited and a perched water table was not encountered in every borehole.

3.1 Permian Coal Measures

The hydraulic conductivity of the coal measures is generally low, with rock mass hydraulic conductivities more than two orders of magnitude lower than the unconsolidated alluvial aquifers. Within the coal measures the most permeable horizons are the coal seams, which commonly have hydraulic conductivity one to two orders of magnitude higher than the interburden/overburden siltstones, shales and sandstone units. The coal seams are generally more brittle and more densely fractured than the overburden and interburden strata, which results in the higher hydraulic conductivity associated with these formations.

Within the coal seams the groundwater flow is predominantly through cleat fractures with very little evidence of major structure-related fracturing. Due to the laminar nature of the coal measures groundwater flow generally occurs within, or along the boundaries between, stratigraphic layers. This means that effective rock-mass vertical hydraulic conductivity is significantly lower than the horizontal hydraulic conductivity (typically three or more orders of magnitude lower).

3.2 Alluvium

Bowmans Creek

The Bowmans Creek alluvium is characterised by fine silts, sometimes containing large cobbles, and silty sands. The presence of fine silts and clays as a matrix around the cobbles and sands has a strong moderating influence on hydraulic conductivity.

The lateral extent of saturated Bowmans Creek alluvium has been determined through a combination of mediums. These include aerial photography, aeromagnetic survey, ground mapping, the results of exploration drilling, and monitoring of groundwater level trends over a range of climatic conditions (Aquaterra, 2008). The limit of saturated alluvium for Bowmans Creek is indicated on **Figure B4**. Limits are based on July 2007 groundwater levels, which represents the highest point in groundwater levels over the period during which monitoring records have been maintained at the ACP (since 2001).

The alluvium merges with colluvium along the flanks of the floodplain. The demarcation between alluvium and colluvium has been determined generally on the basis of lithology, groundwater level and salinity.

Drilling and aeromagnetic investigations (HLA Envirosciences, 2001; Aquaterra, 2008) have revealed that there is a sharp demarcation between the Bowmans Creek alluvium and the Hunter River alluvium. The sharp line of demarcation extends across the confluence, with no evidence for an embayment of Hunter River alluvium into the Bowmans Creek valley.

Contours of the base of alluvium beneath the Bowmans Creek floodplain (**Figure B5**) show a clear incised valley profile, with the course of the incised valley not coincident with the present drainage line in all locations. The saturated thickness of the alluvium reaches a maximum of around 4.5m.

Glennies Creek

The Glennies Creek alluvium generally occurs in association with the deposition of palaeo-sediments near the Creek. These deposits occur within two main terraces, a lower terrace adjacent to the Creek, and an upper terrace that merges with colluvium then regolith associated with the slopes of the rising Permian subcrop. The terraces are tiered, with an elevation change between terraces of 1 to 3m. The contours of the base of alluvium beside Glennies Creek are shown in **Figure B5**.

The meander of Glennies Creek that runs closest to ULD LW1 is incised to the edge of the alluvium with some Permian bedrock visible in the stream banks. This is close to the subcrop of the PG Seam, as shown in **Figure B3**. Some enhanced hydraulic connectivity between Glennies Creek and the Permian subcrop has been allowed for in the modelling assessment described in **Appendix C** of this report.

Investigations for the SEOC project showed that the alluvium associated with Glennies Creek has a highly variable hydraulic conductivity, which appears to have been caused by palaeo-geomorphology and drainage conditions during the deposition of the alluvium. This variability in hydraulic conductivity has also been included within the groundwater modelling assessment for the ULD Extraction Plan groundwater impact assessment.

Hunter River

The limited investigations into the Hunter River alluvium near the Site indicate that it is deeper and generally more permeable than both the Bowmans Creek and Glennies Creek alluvium. Floodplain alluvium of the Hunter River was extensively tested at the neighbouring Hunter Valley No.1 Mine in 1992. Those results indicated that ‘typical’ basal sands and gravels are present within the alluvium, resulting in hydraulic conductivity some two to four times that of the current day river bed sediments.

4. Current Groundwater Use

4.1 Census and NoW Registered Sites

Information on registered groundwater users in close proximity to the proposed mining area was sought as part of the 2001 EIS and 2009 SEOC investigations. A further record search of the NSW Office of Water (NoW) database was conducted as part of this study, which did not reveal any new registered users.

There are no registered bores within 2km from the centre proposed mining area, and only six bores within 4km of the Site (**Figure B6**). The closest is a shallow well in the Glennies Creek alluvium, located in Camberwell Village to the north east of the underground mine and south of the NEOC (registered bore GW064515). This well was installed in 1919 and consists of a concrete riser. The well was originally used for domestic purposes, however it is not known if the well is still operational.

Two more registered bores, which are associated with the Bowmans Creek alluvium, are located to the north of the New England Highway bridge over Bowmans Creek. Another is in the Hunter River alluvium on the southern side of the Hunter River. Several bores also exist far to the northeast and northwest within the Bowmans Creek and Glennies Creek alluvium.

There is an unregistered well on the ACOL lease, referred to as the ‘Ashton Well’. This well was installed some time ago within the Bowmans Creek alluvium to supply water to the dairy and two houses, all of which are now abandoned.

4.2 Other Coal Mines

The closest active coal mines to the Extraction Plan area are the Ravensworth Underground Mine (RUM) and the Narama Open Cut Mine, both of which are located to the west of the ACP. The Narama Open Cut is still operating and recovers coal from the upper seams (Bayswater etc). The RUM workings are currently within the PG Seam and mining is planned to progress into the ULD, Middle Liddell and Lower Barrett seams over a longer timescale than in the ACP proposals.

Groundwater use at these mines are not known, although would be more significantly affected by their own mining activities than by any activity associated with the ACP.

5. Groundwater Levels and Flow Patterns

Groundwater levels were initially collected during the EIS studies in 2000 and 2001, with routine monitoring across the area commencing in 2003. Extensive data on groundwater levels have been gathered and the monitoring network expanded significantly during subsequent EA and SMP investigations.

5.1 Pre-Mining Conditions

Data from the 2001 EIS

The earliest records for the Site derive from the EIS groundwater investigations (pre-2001). These consisted mainly of open boreholes, and the water levels would represent a composite of the potentiometric heads throughout the Permian, albeit probably dominated by the most permeable coal seam intersected in each hole. However, three screened piezometer readings were taken in boreholes WML19a (Lower Barrett Seam), WML20 and WML21 (PG Seam). These indicated potentiometric heads between 61mAHD and 65mAHD. The open borehole monitoring data collected within the Permian showed groundwater levels in the range 54 to 68mAHD, with one reading (WML011, located to the north east of Arties Pit) at 78mAHD. Based on these levels, groundwater gradients appear to be to the south and south west.

Data from the Bowmans Creek alluvium boreholes indicated groundwater levels in the range 55 to 60mAHD. Data from the PG Seam borehole WML21 and the Bowmans Creek alluvium boreholes RM08 and RM09 near the same location revealed a significant upwards gradient from the deeper Permian to the Bowmans Creek alluvium (approximately 4 or 5m head difference).

Data from the ACP Monitoring Network Prior to the Start of Underground Mining (2006-2007)

The installation of the groundwater monitoring network prior to the start of underground mining at the ACP has provided significantly more potentiometric data for specific horizons within the Permian strata. Most of these monitoring bores were installed after a number of years of open cut mining and therefore do not directly indicate pre-mining groundwater levels. However, using a backwards extrapolation of trends, and by reference to the piezometric head profiles, it has been possible to infer indicative pre-mining levels at several locations. This provides an adequate 'baseline' against which to assess groundwater impacts due to underground mining.

The groundwater levels within the coal measures above the underground mining area prior to the start of underground mining is shown on **Figure B7**. Groundwater levels in the PG Seam had already been slightly affected by the NEOC and underground development headings by the time underground coal extraction started, although most of the monitoring points were sufficiently far from this area to provide a reasonable indication of groundwater levels prior to underground mining effects.

These groundwater levels show that the pre-mining Permian potentiometric surface was between 55 and 65mAHD. There was a slight mounding of the water table surface above PG LW2, where the water table was around 65mAHD, compared with 55-60mAHD in the south western end of the mine area. The groundwater levels in the PG Seam beneath the Glennies Creek alluvium were approximately 52mAHD or higher.

Alluvium groundwater levels around Bowmans Creek were generally well below the deeper Permian groundwater levels, and in some areas appear to have been slightly higher than those in the shallow, weathered Permian, as illustrated on **Figures B8** and **B9**. These graphs are composite plots of the paired alluvium/coal measures piezometers T1-A and P, T2-A and P, T3-A and P, and T4-A and P, together with other piezometers close to these sites. At the T1 site, the alluvium and Permian groundwater levels were virtually the same, however at the other three sites the alluvium water level was 0.4 to 0.5m higher than the water level in the shallow, weathered Permian. In these areas, the near-surface weathered Permian has the character more of a granular aquifer and is recharged from above by downward percolation of rainfall, rather than by flow along the bedding from up-dip areas, as is the case with the deeper Permian below the base of weathering.

Records of groundwater levels in the deeper Permian beneath the Bowmans Creek valley indicate that groundwater heads were generally higher than those in the alluvium and there was a trend of increasing potentiometric head with depth. Composite hydrograph plots for the WML111 and WML112 sites are shown in **Figure B10**. These sites are where vibrating wire piezometers are installed in various Lemington Seams and standpipe piezometers monitor water levels in the alluvium and near-surface weathered coal measures. These bores are located well away from the open cut and underground operations and had not experienced significant impacts from the ACP's mining activity prior to 2008. The shallow seams (Bayswater and upper Lemington seams) however, may have been affected by adjacent mining operations (Narama or Hunter Valley Operations (HVO No.1)).

The alluvium groundwater level was seen to be higher than the Bayswater Seam and upper Lemington seams, where as the deeper Lemington Seams had increasingly higher heads. However, even in the case of the Bayswater and upper Lemington seams, extrapolation of the hydrograph trends indicates that these seams would also have had heads higher than the alluvium prior to the commencement of mining at the ACP.

Overall a pre-mining condition is indicated where subcropping Permian coal seams are recharged by rainfall infiltrating the seams in outcrop/subcrop areas. Low mobility of groundwater within the strata at depth means that groundwater heads in the Permian are largely controlled by the physical elevation of these recharge areas. Hence, in low topographic areas such as the Bowmans Creek valley, the Permian had higher potentiometric heads than the alluvium driven by the topographically higher recharge zones.

The Permian aquifers discharge at a slow rate to the rivers and creeks, limited by the low vertical hydraulic conductivies and groundwater pressures in discharge areas are therefore largely controlled by river/creek water levels.

Water table contours for the Bowmans Creek alluvium in January 2008, are shown in **Figure B11**. The contours show a gradient from north to south (i.e. upstream to downstream), and also with a component of gradient towards Bowmans Creek. Groundwater elevations ranged from around 62mAHD at the upstream end near New England Highway to around 50mAHD at the downstream end near the confluence with the Hunter River.

In the Glennies Creek area to the east of the Project site, groundwater levels in the upper part of the Permian coal measures and the weathered regolith also tended to reflect the local topography, with higher groundwater levels in elevated areas and lower levels in the valleys. Groundwater flow within the Glennies Creek alluvium is generally towards Glennies Creek and downstream along the valley, although the gradients are relatively flat.

Groundwater levels in the coal measures at depth in the Glennies Creek area are again more regionally-controlled, and are independent of the local topography. The multi-level vibrating wire piezometer bore WMLC144 located between the proposed SEOC and Glennies Creek (**Figure B12**) had a water level approximately 6m higher than Glennies Creek before it was grouted prior to installation (i.e. water level 58.5mAHD compared with the Creek water level of 52.5mAHD).

6. Surface Water Features

6.1 Glennies Creek

Glennies Creek is a permanent watercourse with a catchment area of several hundred square kilometres. The Glennies Creek Dam is located upstream of the Site, so flow is partly regulated by the Dam releases. Glennies Creek is located outside the mining area, although approaches to within approximately 150m of the LW1 goaf edge about halfway along the panel. The PG Seam is believed to outcrop or subcrop below the bed of Glennies Creek over part of the section closest to LW1 as shown in **Figure B3**. The overburden cover depth at the PG LW1 goaf edge is approximately 70m at the point closest to Glennies Creek.

The ULD and Upper Lower Liddell Seams are also thought to subcrop beneath the Glennies Creek floodplain (**Figure B3**). These subcrops are several hundred metres further to the east of the PG subcrop, and have a much shorter intersection with the Creek than the PG Seam.

6.2 Hunter River

The Hunter River is located to the south of the proposed mining area. The closest point of the longwall mine is the start corner of LW5, which is approximately 310m from the Hunter River and 200m from the edge of the Hunter River alluvium. The PG overburden depth at this point is approximately 150 to 155m.

The southern end of LW1 is situated approximately 515m from Hunter River and at least 480m from the edge of Hunter River alluvium. The overburden depth at the southern end of LW1 is approximately 50 to 80m.

6.3 Bowmans Creek

Bowmans Creek flows south-westwards across the western part of the mining area. It comprises a river channel that is incised some 2 to 5m below the surrounding topography. The channel comprises a series of ponds retained behind cobble bars that are often vegetated. Some rock bars also occur within the channel, however not in the sections of the proposed Creek diversions. Hydraulic connection between the alluvium and underlying Permian strata is relatively low due to the silt and clay matrix in the alluvial material.

There is a significant thickness of Permian interburden between Bowmans Creek and the uppermost target coal seam (PG Seam).

7. Groundwater Dependant Ecosystems

Shallow groundwater in the alluvium is utilised by trees and shrubs along the bank of Bowmans Creek and Glennies Creek. Some of the deeper pools in Bowmans Creek are also maintained throughout drought conditions by groundwater flow from the alluvium (and in some cases the Permian, as shown by the high drought salinities in surface water monitoring point SM4). Some of these pools form natural drought refuges for aquatic species and are used as drinking sources by terrestrial animals such as cattle and kangaroos during drought conditions (HLA, 2001).

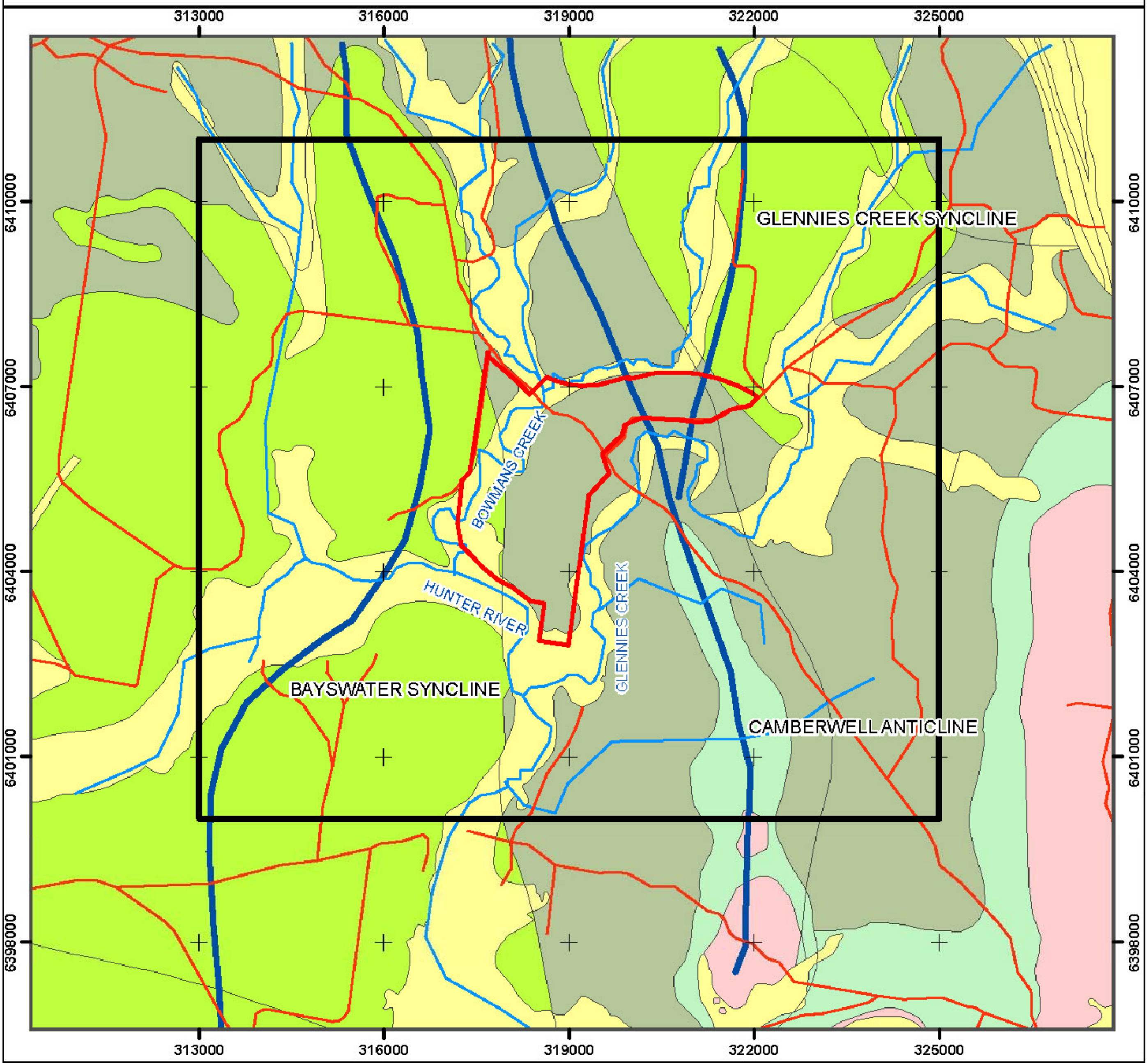
Two stands of River Red Gum have been surveyed alongside the southern reaches of Bowmans Creek near the confluence with the Hunter River, and a small isolated stand of River Red Gums have been recorded along the eastern side of Glennies Creek. The exact location of these is described within the ecology specialist report written for the 2009 EA. Impacts on alluvial groundwater levels within these areas are predicted to be less than 0.5m, which is not considered sufficient to detrimentally affect the River Red Gums.

References

Aquaterra, 2008. 'Ashton Underground Mine: Bowmans Creek Alluvium Investigation'. Report submitted to ACOL.

Aquaterra, 2008b. 'Ashton Underground Mine Pikes Gully Seam Groundwater Modelling Report' Report submitted to ACOL in support of the Longwall/Miniwall 5-9 SMP Application.

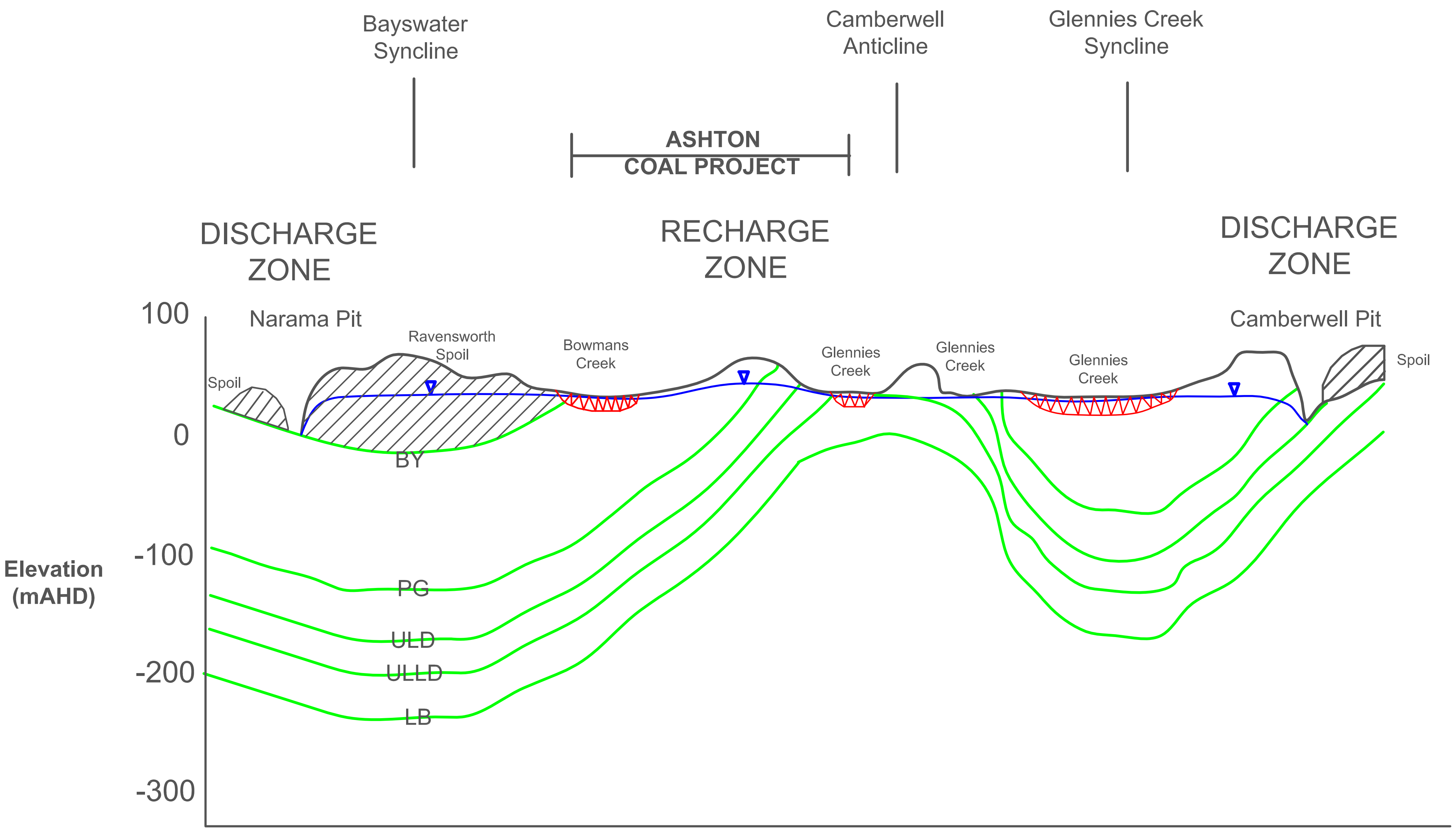
HLA Envirosciences, 2001. 'Ashton Coal Project: Groundwater Hydrology and Impact Assessment'. Appendix H Report submitted in support of the 2002 Ashton Coal Project EIS.



Legend

- Ashton Mine Lease
- Model Boundary
- Roads
- Watercourses
- Geological Structure
- Alluvium
- Denman Formation (limited outcrop)
- Jerry's Plains Sub-Group
- Archerfield Sanstone (limited outcrop)
- Vane Sub-Group (Foybrook Formation)
- Saltwater Creek Formation
- Mulbring Siltstone

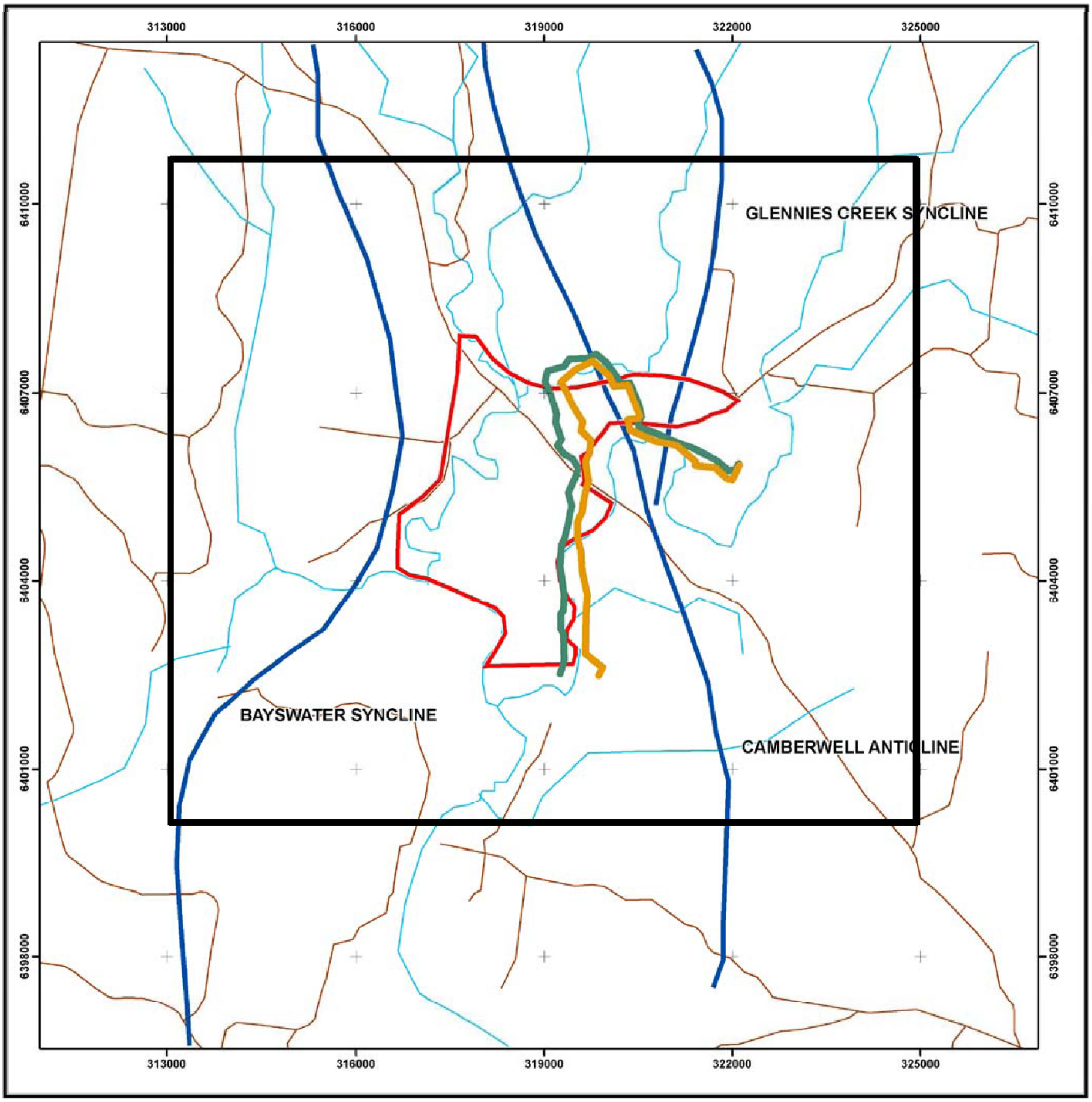
Date:	28 August 2009	Scale:	as indicated	**Ashton Coal Operations Ltd**
Initials:	HZ	Job No:	S55J	**Regional Geology**
Drawing No:	S55F-009	Rev:	0	
RPS Aquaterra				**Figure B1**



Legend

Water Table
Creek Alluvium
Coal Seam

Date: 6 August 2009	Scale: as shown	Ashton Coal Operations Ltd
Initials: JVDA	Job No: S55F	Representative Geological Cross-Section
Drawing No: S55F-10a	Rev: 0	
RPS Aquaterra		Figure B2

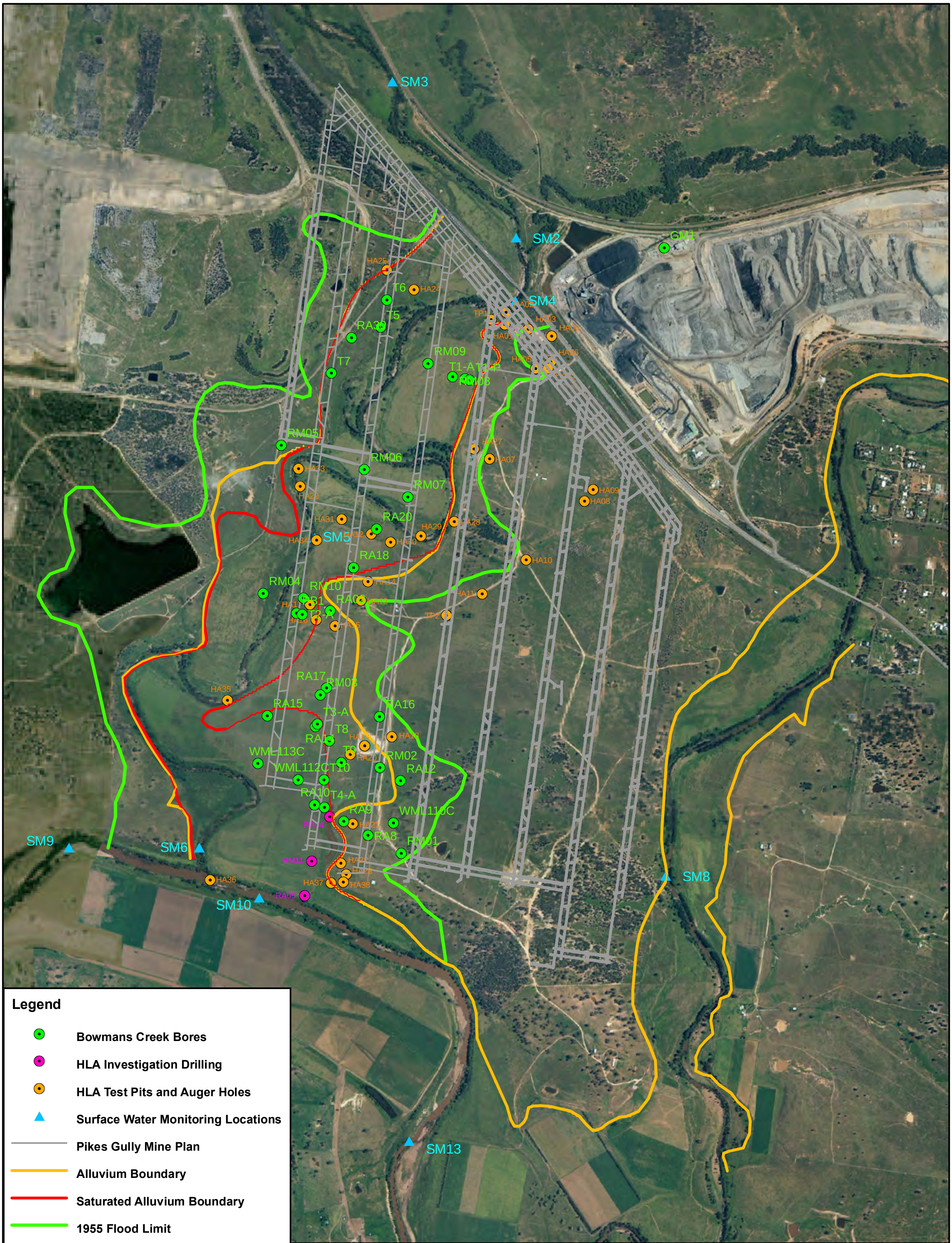


N

Legend

- Model outline
- Ashton Coal Project
- Geological Structure
- Roads
- Watercourses
- Upper Liddell Coal Seam Outcrop/Subcrop
- Pikes Gully Coal Seam Outcrop/Subcrop

Date: 16 September 2009	Scale: as indicated	**Ashton Coal Operations Ltd**
Initials: HZ	Job No: S55J	**Approximate Sub Crop for Pikes Gully and Upper Liddell Seam**
Drawing No: S55J-007	Rev: 0	
RPS Aquaterra		**Figure B3**



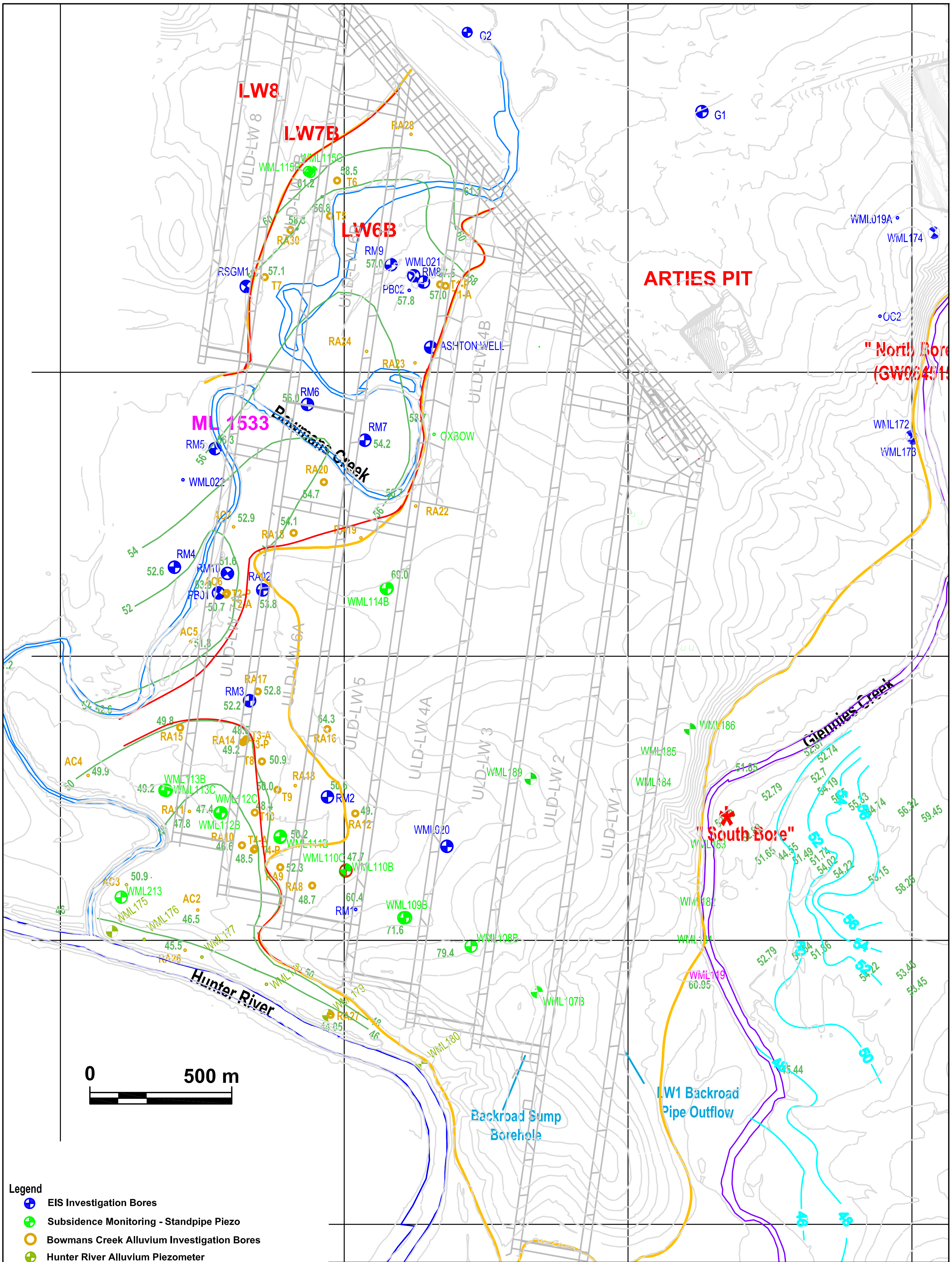
Date:	17 June 2011	Scale:	As Shown
Initials:	HZ	Job No.:	S55J
Drawing No.:	S55J-404	Rev:	A

RPS Aquaterra

Ashton Coal Operations Ltd

Limits of Saturated Alluvium

Figure B4

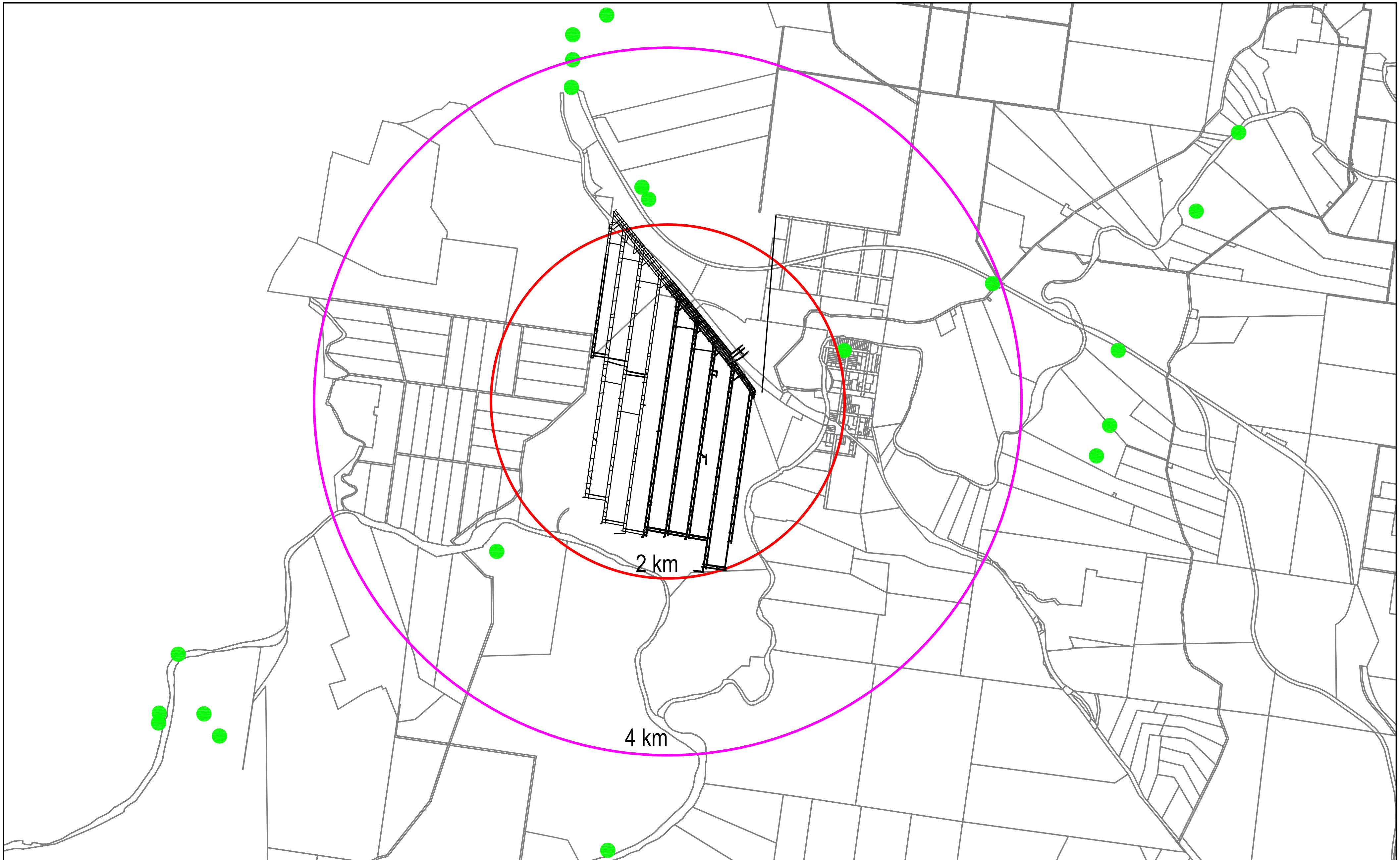


Legend

- EIS Investigation Bores
- Subsidence Monitoring - Standpipe Piezo
- Bowmans Creek Alluvium Investigation Bores
- Hunter River Alluvium Piezometer
- Abandoned / Lost Bore
- Alluvium Boundary
- Boundary of Saturated Alluvium
- 50 Contour of Base of Glennies Ck Alluvium (mAHD)
- Contours of Base of Bowmans Ck Alluvium (mAHD)

Date: 11 July 2011	Scale: as shown	Ashton Coal Operations Ltd
Initials: HZ	Job No: S55J	Contours of the Base of the Alluvium
Drawing No: S55J-002	Revision: A	

Figure B5



Legend

- 2 km radius
- 4 km radius
- Registered Bores
- Cadastre

Date:	18 May 2011	Scale:	As Shown	**Ashton Coal Operations Ltd**
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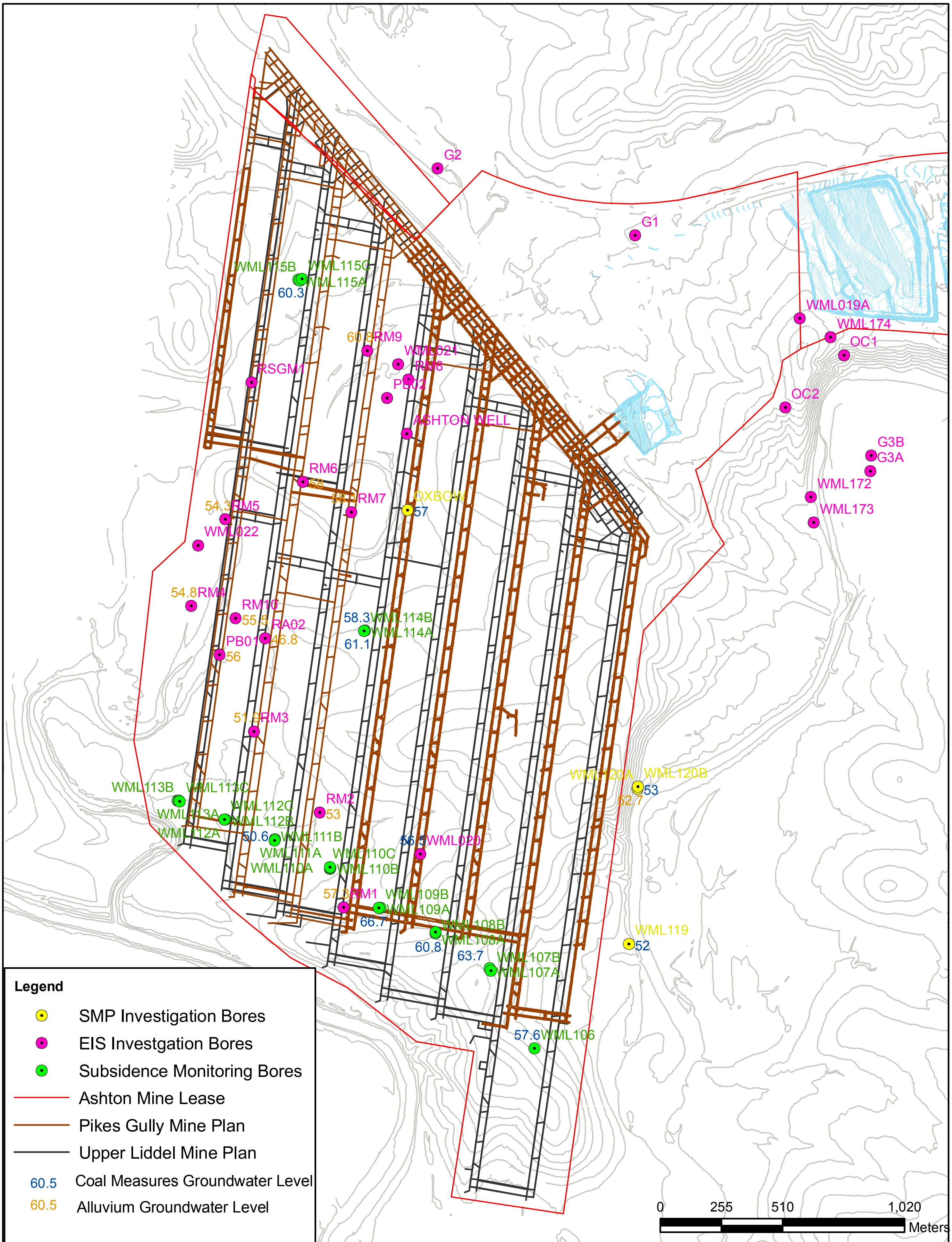
Drawing No:	S55J-003	Rev:	A	
RPS Aquaterra				**Figure B6**



Legend

- SMP Investigation Bores
- EIS Investgation Bores
- Subsidence Monitoring Bores
- Ashton Mine Lease
- Pikes Gully Mine Plan
- Upper Liddel Mine Plan
- 60.5 Coal Measures Groundwater Level
- 60.5 Alluvium Groundwater Level

Date:	17 June 2011	Scale:	As Shown	**Ashton Coal Operations Ltd**
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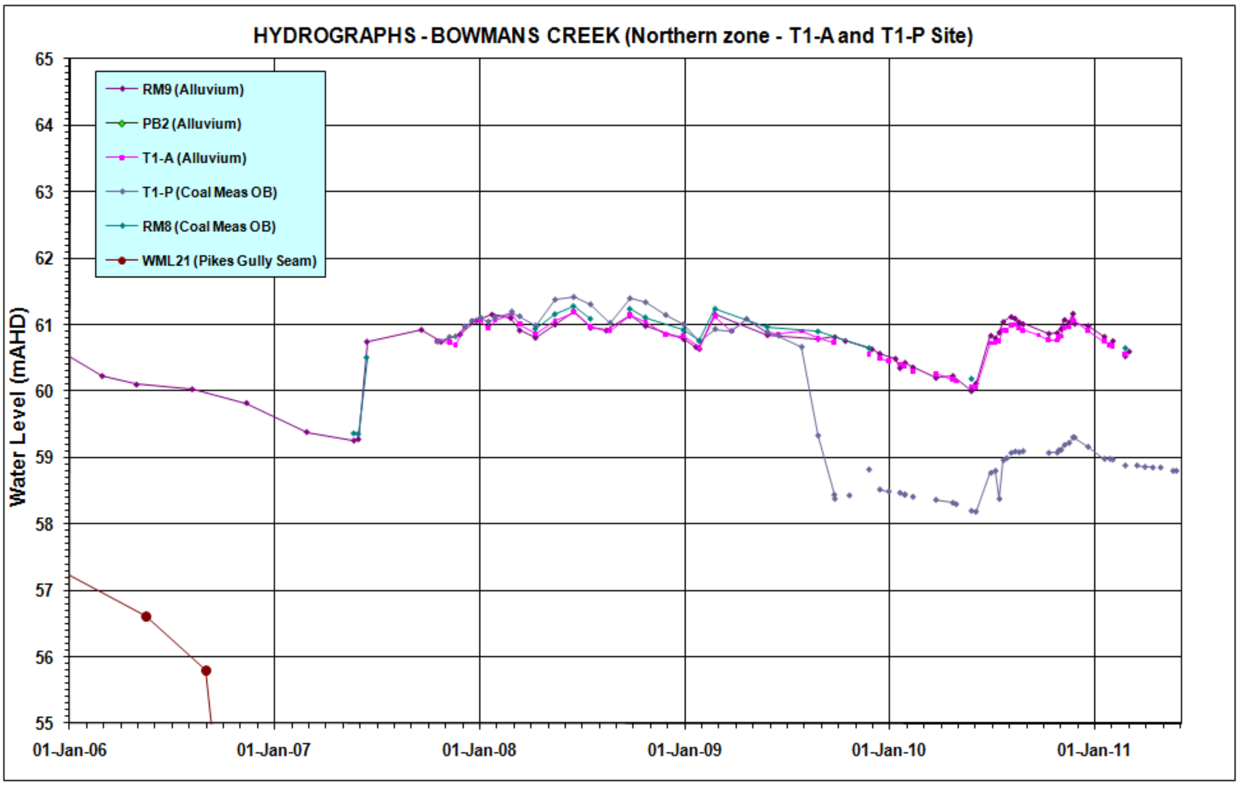
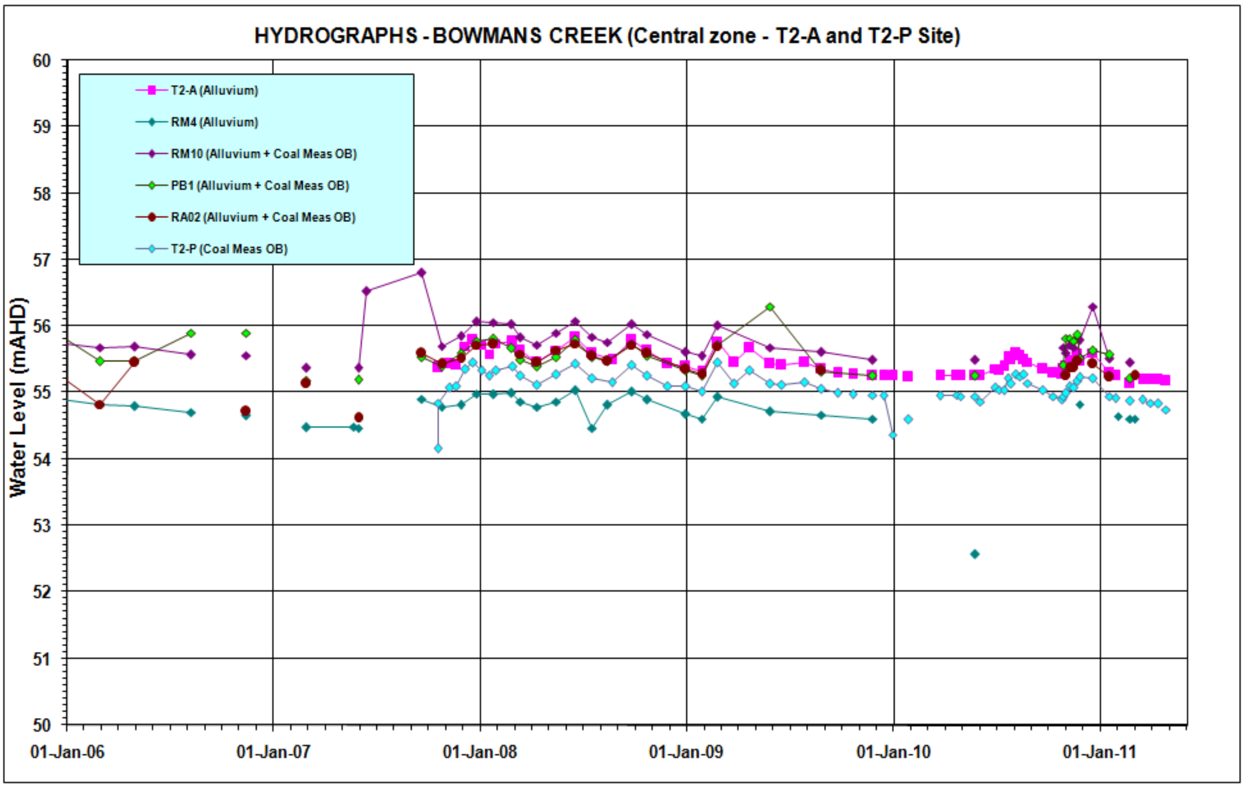
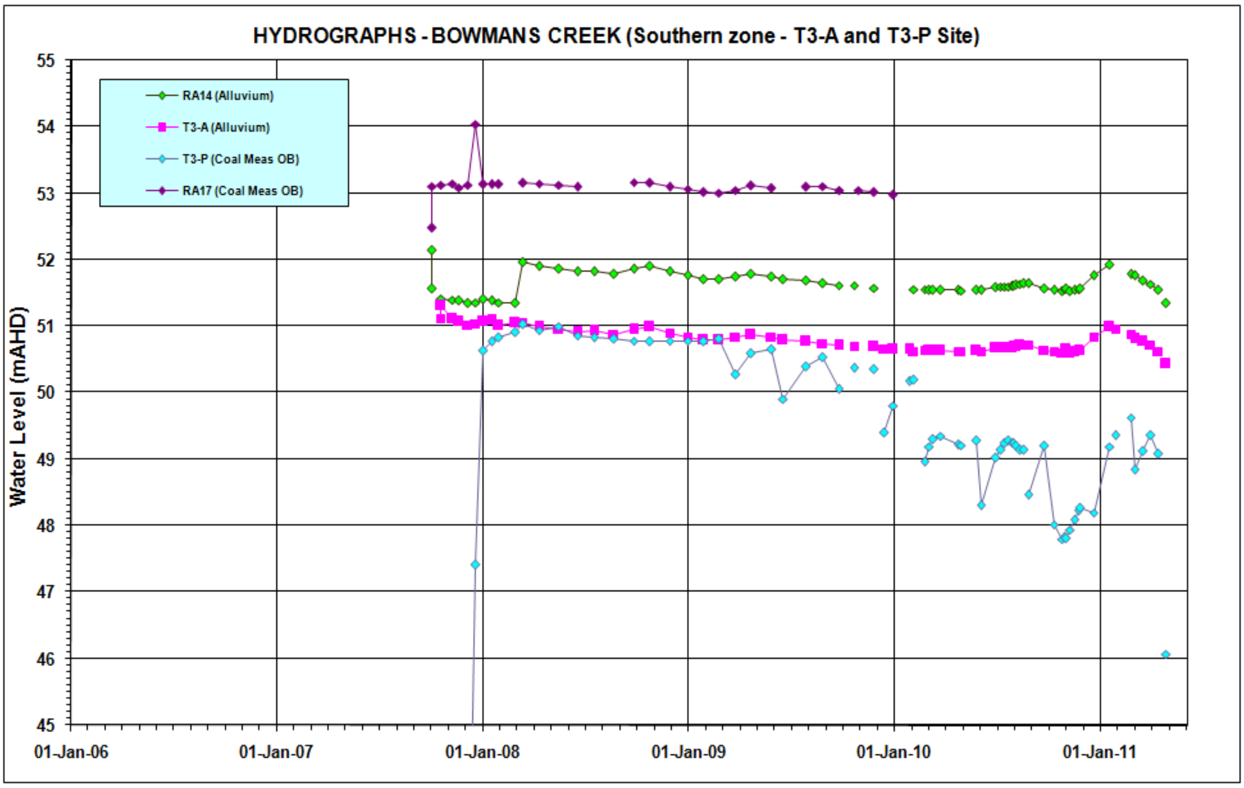
Drawing No.:	S55J-405	Rev:	A	
RPS Aquaterra				**Figure B7**

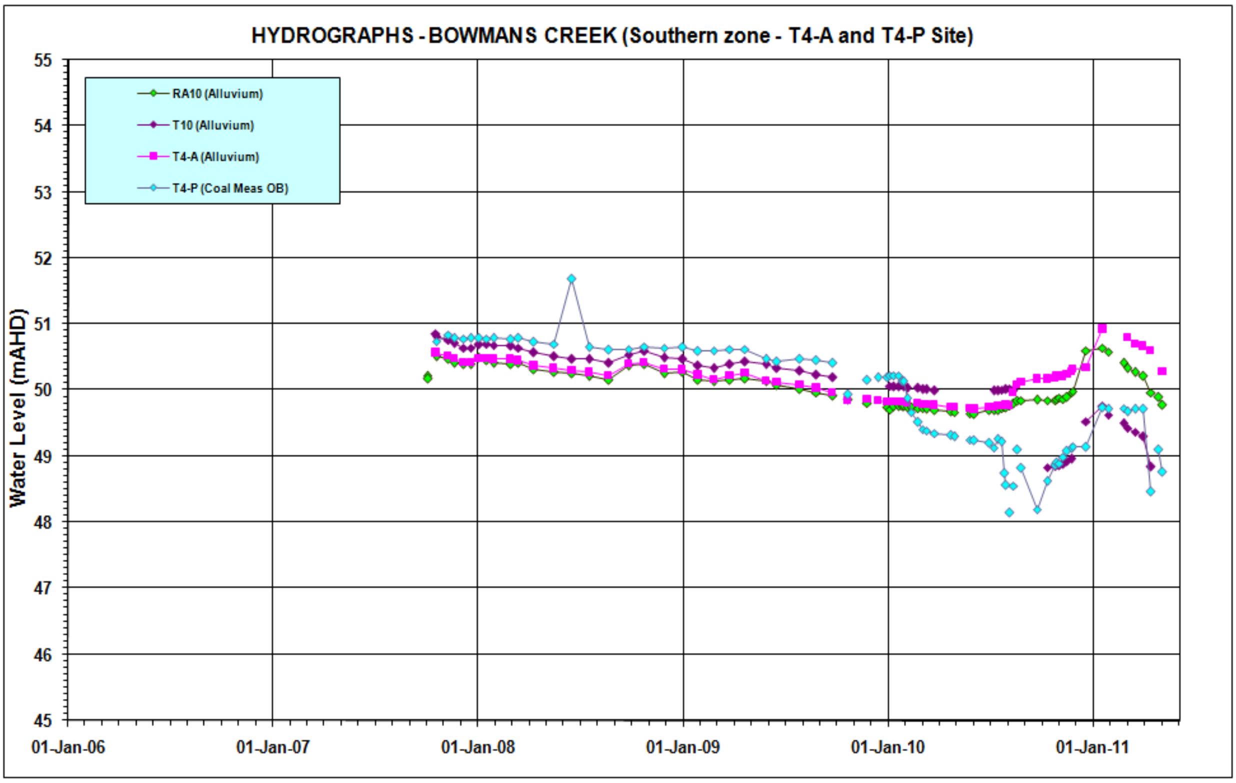




RPS Aquaterra

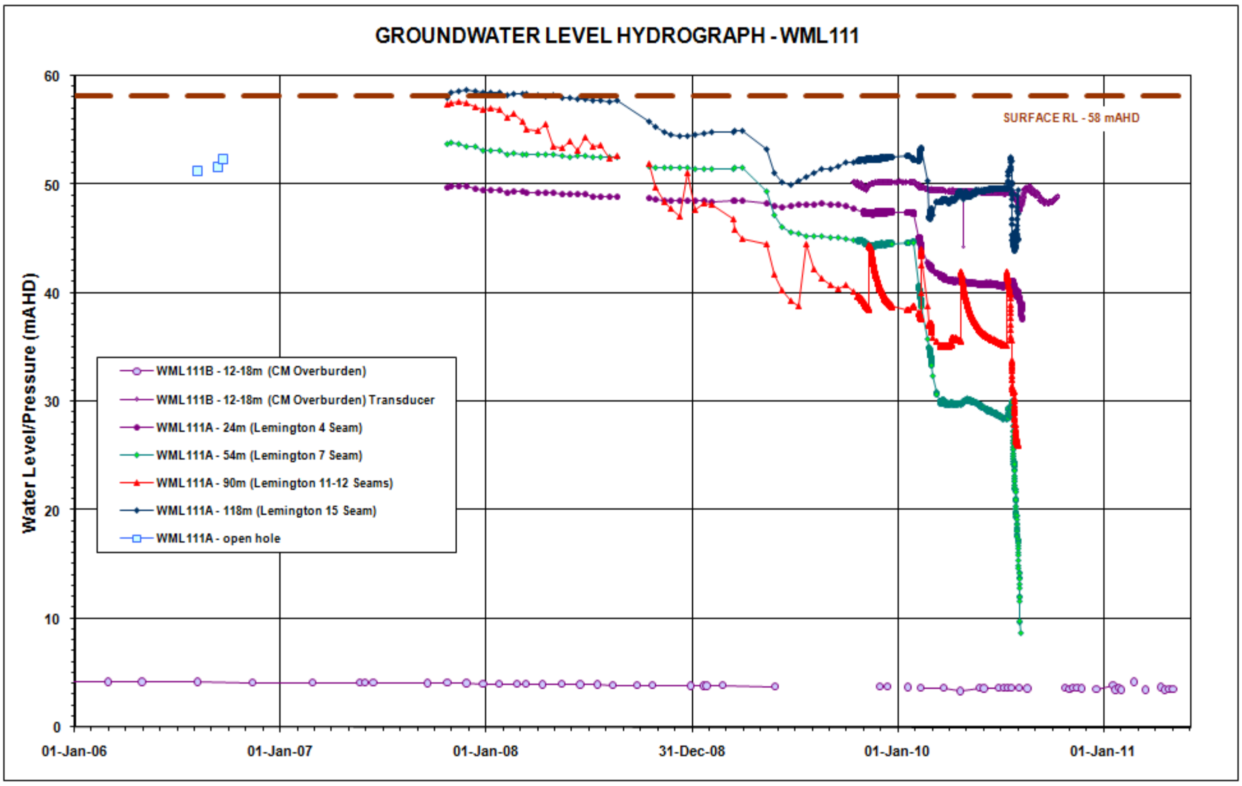
Bowmans Creek Alluvium Hydrographs (T1-A and P, T2-A and P) FIGURE B8

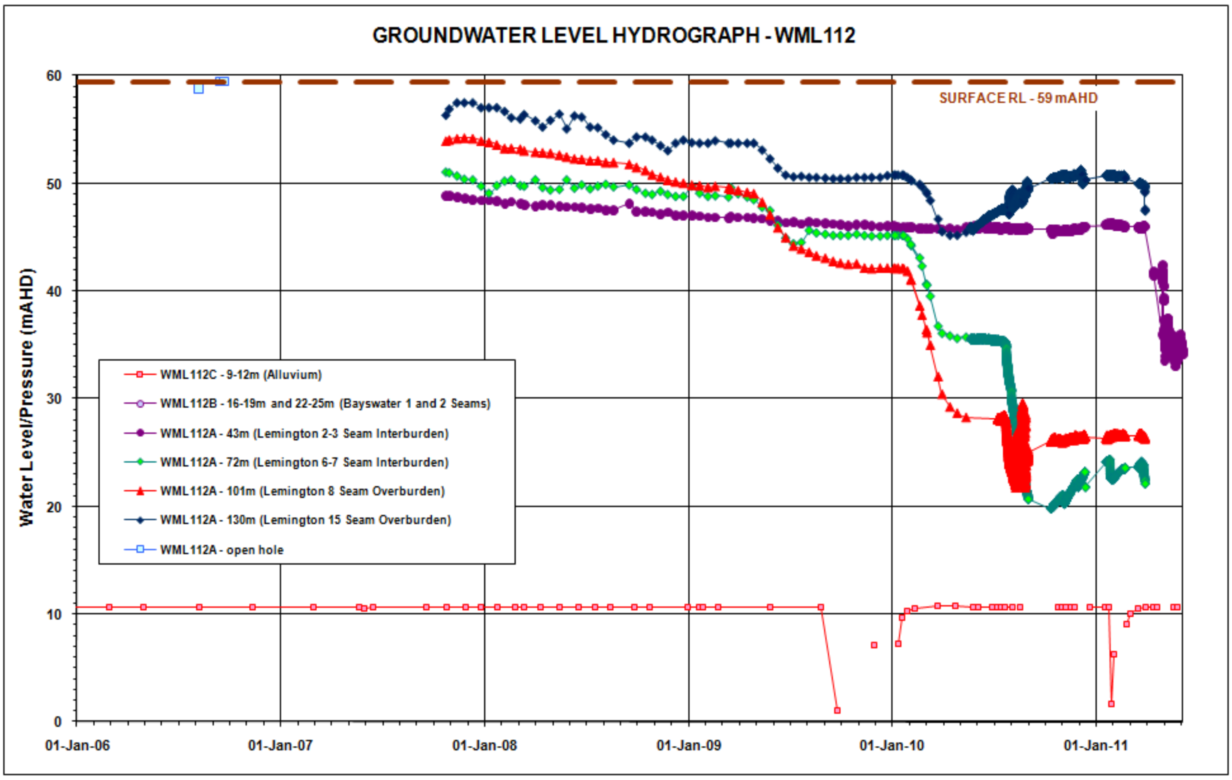




RPS Aquaterra

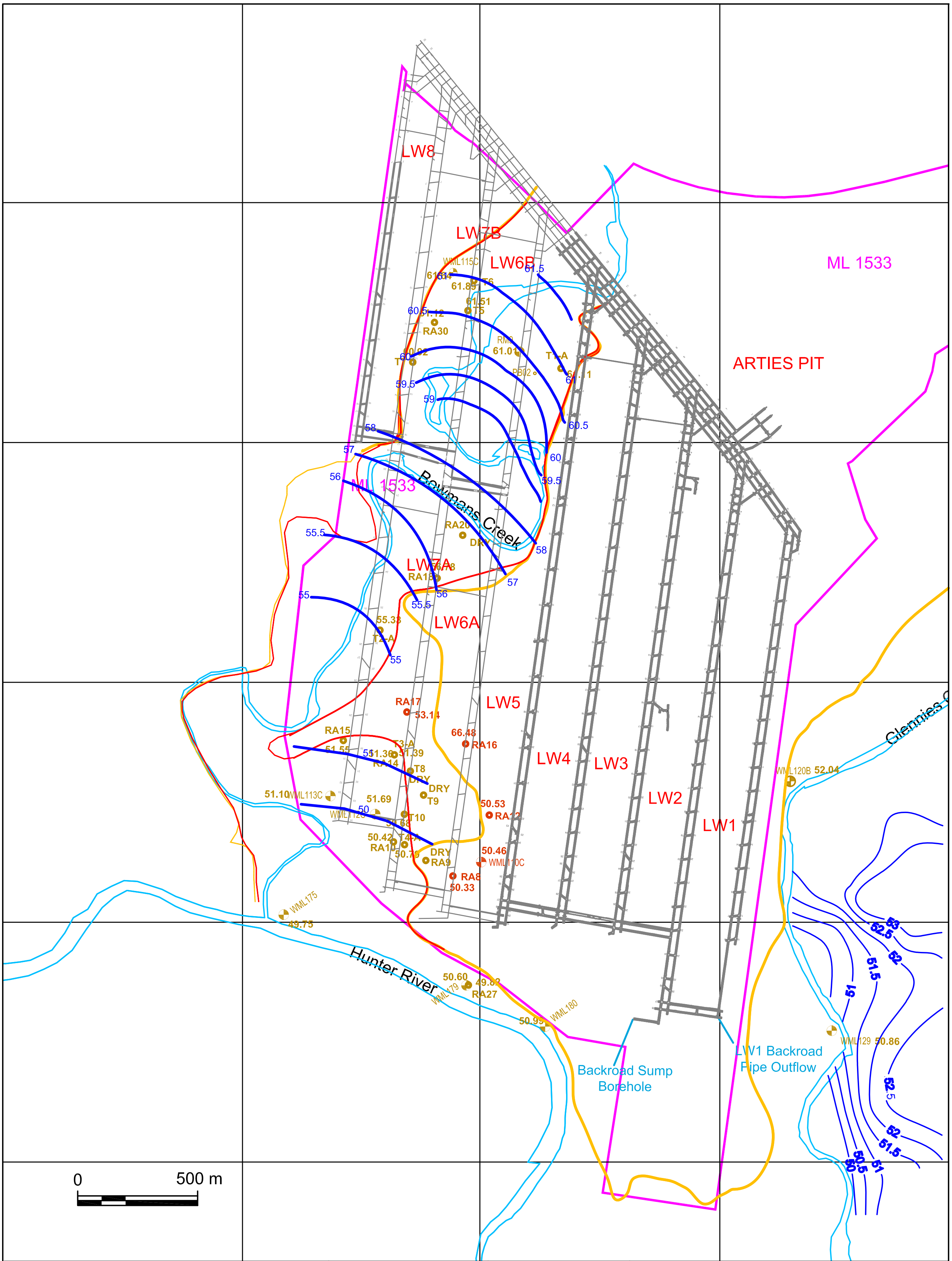
Bowmans Creek Alluvium Hydrographs (T3-A and P, T4-A and P) FIGURE B9





RPS Aquaterra

Bowmans Creek Alluvium Hydrographs WML111 and WML112 FIGURE B10

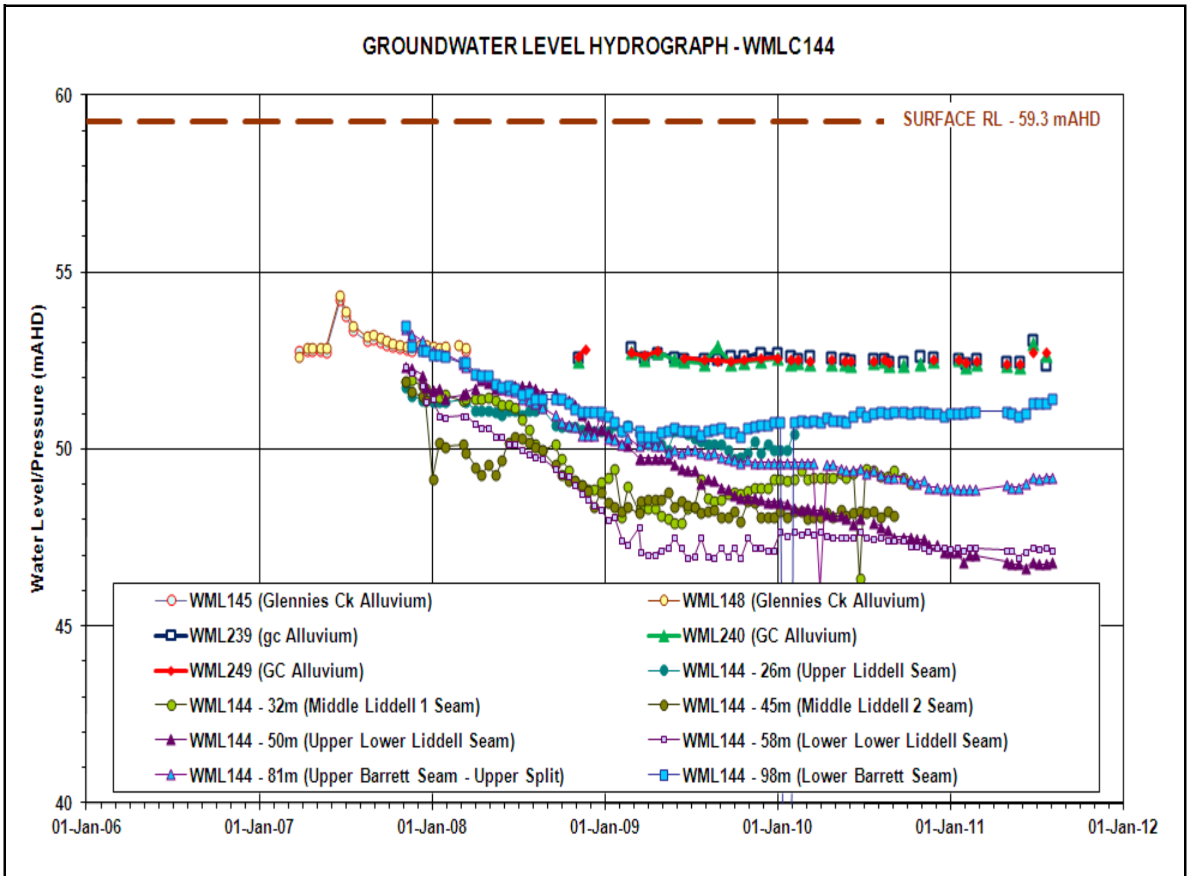


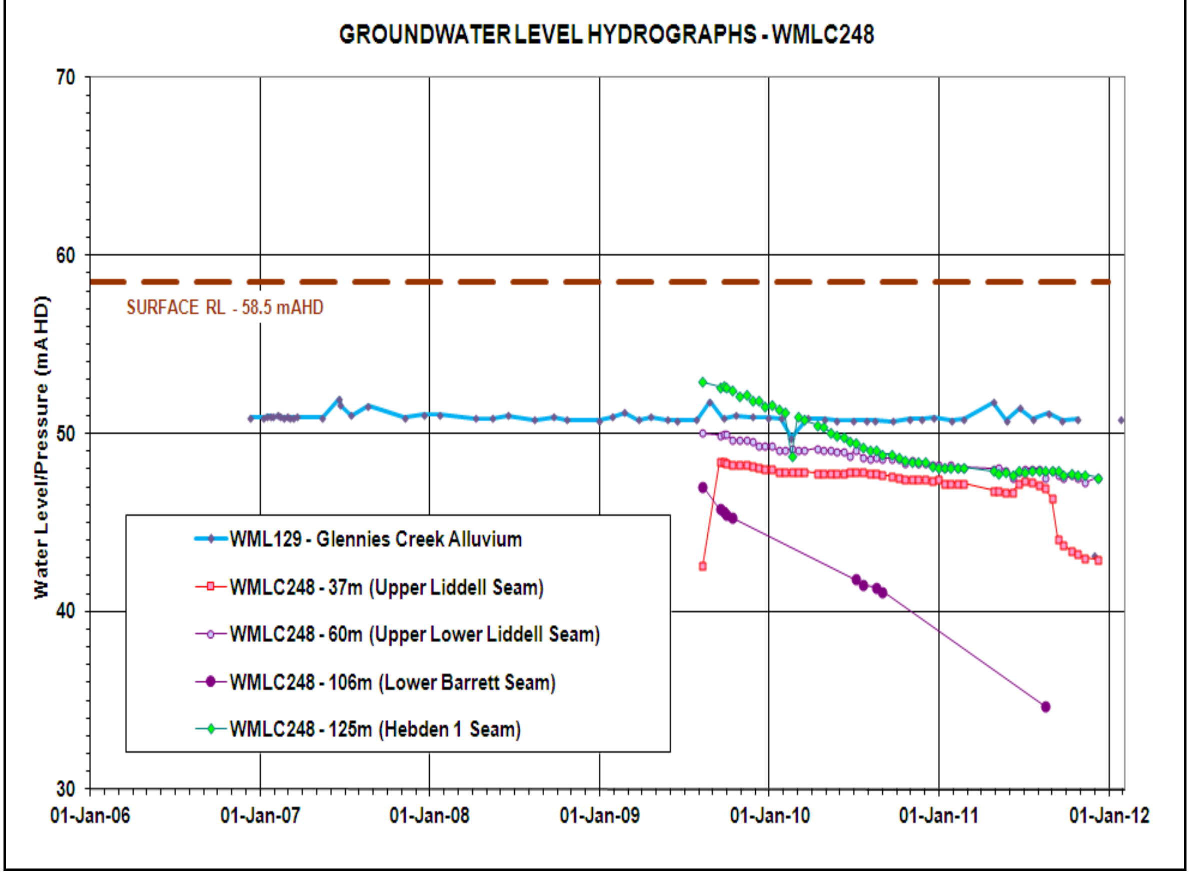
Legend

- Alluvium Piezometer
- Alluvium Piezometer
- Colluvium Piezometer
- Alluvium Groundwater Level (mAHD)
- Boundary of Alluvium
- Boundary of Saturated Alluvium

Date:	25 May 2011	Scale:	as shown	**Ashton Coal Operations Ltd**
Initials:	HZ	Job No:	S55J	Alluvium Groundwater Contours (mAHD)
Drawing No:	S55J-005	Revision:	A	

Figure B11





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Hydrographs for WMLC144 and WMLC248 FIGURE B12