Appendix A

Groundwater Modelling Report HydroSimulations

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Bloomfield Colliery Extension

Groundwater Modelling Assessment

FOR

AECOM and

The Bloomfield Group

BY

NPM Technical Pty Ltd

trading as

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1 INTRODUCTION

The Bloomfield Colliery (Bloomfield) is an existing open cut mining operation located near Buttai in the Hunter Valley of New South Wales (NSW), about 25 kilometres (km) north-west of Newcastle, and about 5 km south of Maitland. The project site is located a few kilometres west of the M1 Motorway and immediately North of John Renshaw Drive (B68 Freeway) (**Figure 1).**

Bloomfield is one of two open cut coal mines owned by its parent company, Big Ben Holdings Pty Limited. It produces approximately 0.6 million tonnes of product coal per annum (Mtpa) by open cut methods. Coal has been mined on the site for approximately 170 years. Underground mining commenced in 1937 to the west and north-west of current open cut mining (**Figure 2**), and the last coal extracted from underground operations was in 1992. Bloomfield produces mainly thermal coal with some semi-soft coking coal, principally for the Asian export market.

The current operation consists of open cut mining, a Coal Handling and Preparation Plant (CHPP) and a rail loading facility that transports processed coal to the Port of Newcastle. The open cut commenced operations in 1964 and has continued to the present day. Part 3A approval was granted in September 2009, with three Modification approvals since then (May 2011, March 2012, February 2013). The 2009 approval (07_0087) was supported by a Groundwater Impact Assessment conducted by Peter Dundon & Associates Pty Ltd with groundwater modelling conducted by Aquaterra Consulting Pty Ltd (Aquaterra, 2008).

The continued use of the coal washery and rail loading facility (including the management of water associated with the washery, coarse reject and tailings disposal, and coal handling) was approved in June 2007 as part of the Abel Underground Mine project. Bloomfield is currently progressing its approved open cut mining program and is actively rehabilitating former mining areas on the site.

This Modification seeks extension of open cut mining operations approximately 200 metres (m) to the west, to the boundary of the lease (**Figure 3**). Over this interval, the deepest mining of the Big Ben Seam will step up to the Donaldson Seam to allow for the Big Ben Seam having been mined previously by underground mining methods.

This report is limited to the *Groundwater Modelling Assessment* of open cut mining, taking into account the cumulative effects of neighbouring underground mines. The focus of the modelling is on cumulative and incremental impacts to the baseflow/leakage interactions with Hexham Swamp and key watercourses, with quantification of likely mine inflow, groundwater heads generally and drawdowns at registered bores. The groundwater takes from each designated water source are quantified and provided as an input for assessment of licensing requirements in the *Groundwater Impact Assessment* prepared by AECOM. Similarly, quantification of other groundwater impacts is passed to AECOM for assessment in accordance with the Aquifer Interference Policy (NSW Government, 2012).

1.1 Interaction of Bloomfield with District Mines

Other mines in the vicinity of Bloomfield are located on **Figure 1**. Coal from the Bloomfield Colliery, together with coal from the Donaldson open cut mine, the Abel underground mine and the Tasman underground mine, is processed through the Bloomfield CHPP.

The tailings from the CHPP are disposed at the Bloomfield site. Until mid-2007, tailings were deposited predominantly underground in former workings, but are now deposited in abandoned open cuts on the Bloomfield site. Water is recovered from the tailings and recycled through the CHPP.

For assessment of cumulative effects, all neighbouring underground and open cut mines are included in the numerical groundwater model.

1.2 Scope of Work

The tasks to be addressed to achieve the objectives of the groundwater modelling study are:

- Modification of the existing numerical groundwater model used for previous investigations at Abel Mine.
- Contraction of the southern extent of the model from northing 6350000 to 6357425 (to reduce prohibitive model size).
- A re-build of the model geometry in the Bloomfield area using the latest geological model in that area.
- Inclusion of historical Big Ben underground works (not in the current Abel model).
- Inclusion of a dyke in the Bloomfield area (not in the current Abel model).
- Retention of MODFLOW-SURFACT software for consistency with previous assessments, with use of the TMP facility for time-varying changes in permeability and storage to represent open cut infill (and underground fracturing);
- Extension of model calibration from December 2015 to April 2017.
- Construction of prediction models for all mines, with and without Bloomfield operations.
- Prediction model for the proposed extension at Bloomfield plus the approved operations at Abel and Donaldson.
- Construction of a recovery model for the Bloomfield extension and neighbouring mines.

2 HYDROGEOLOGICAL ANALYSIS

2.1 Geology

The Bloomfield Colliery is located in the Newcastle Coalfield where the Permian Tomago Coal Measures are dominant (**Figure 4**). The target seams at Bloomfield are the Big Ben, Donaldson, Elwells Creek (EC), Whites Creek (WC) and Upper and Lower Buttai Coal Seams (C, B, A seams) (Aquaterra, 2008). The strata of the coal measures dip towards the south and south-west.

Quaternary alluvial deposits of gravel, sand, silt and clay are most pronounced to the west of Bloomfield along Wallis Creek, and far to the east associated with the Hunter River (**Figure 1**). The underlying interburden sediments consist of mudstone, siltstone and sandstone (Aquaterra, 2008).

Surface topography in the Bloomfield project area ranges from less than 20 mAHD (Australian Height Datum) to more than 80 mAHD.

2.2 Hydrology

Lake Kennerson and Lake Foster (**Figure 3**) are the major mine water storage facilities on site. Water is pumped from the open cut pits through open drains to Lake Kennerson. Runoff from disturbed areas is also transferred to Lake Kennerson, where suspended solids are allowed to settle. From there, water feeds to Lake Foster by controlled release. Lake Foster also receives decant water from the tailings dam (**Figure 3**). From there, water is pumped to the CHPP for use in coal processing and dust suppression.

Mine water is discharged under Environmental Protection Licence (EPL 396) into Four Mile Creek via an open drain (**Figure 5**).

Four Mile Creek, the main stream near the site, has been diverted around Lake Foster by a series of drains and levees. Diversion banks and channels have been constructed to direct runoff from undisturbed and rehabilitated areas away from operational areas and mine water storages. This clean water is directed into clean water dams or natural watercourses. The major clean water storage dam is Possums Puddle which overflows into a natural drainage system. No clean water is used for operational purposes.

Other watercourses in the vicinity of Bloomfield and the district mines are located on **Figure 5**. Creeks are generally ephemeral and are sustained by runoff and occasional baseflow contributed by groundwater discharge during wet conditions.

The Bloomfield area consists of low undulating hills and is bordered by Buttai Creek and Four Mile Creek catchments to the west and east, respectively. Buttai Creek drains westwards into Wallis Creek and then into Hunter River east of Maitland. Four Mile Creek drains eastwards into the Hunter River floodplain east of Morpeth.

2.3 Hydrogeology

Shallow groundwater is present in alluvial, swamp, floodplain and estuarine sediments. Groundwater also appears locally in the shallow weathered Permian, which extends to depths of 10-20 m (Aquaterra, 2008). Shallow groundwater levels are topographically controlled. Deeper groundwater is present in the coal measures, with relatively higher permeability in the coal seams.

The Bloomfield groundwater monitoring network consists of five standpipe piezometers (measured quarterly) and five bores instrumented with datalogged vibrating wire piezometers (VWPs). Their locations are shown in **Figure 6**. The potentiometric heads within the coal measures show a progressive decline with depth, with stronger vertical gradients on the southern boundary of the lease (at VW5 and VW6, close to Abel workings) and minimal gradients at the western sites.

Many monitoring bores show evidence of depressurisation due to mining (**Appendix B**). Drawdowns due to mining range from 10 m to about 60 m. Shallow alluvium and regolith bores do not show mining effects. This indicates limited hydraulic connectivity between the alluvium/weathered overburden and the deeper coal measures.

Aquaterra (2008) reported representative properties for the main hydrogeological units based on hydraulic testing on the Bloomfield site, supplemented by previous investigations for the

Abel and Donaldson projects, and experience in other parts of the Hunter Valley coalfields. Representative values are summarised in **Table 1**.

Table 1
Representative Properties of Hydrogeological Units

Units	Horizontal Hydraulic Conductivity (m/d)	Storage Coefficient [-]	Specific Yield [%]
Coal Seams	0.01 to 0.1	0.0001	1
Interburden (Undisturbed)	0.001	0.00001	0.5
Interburden (Disturbed by subsidence from underground mining)	0.1 to 10	0.0001	1 to 5
Alluvium	1 to 5	0.0001	10

Note: Vertical hydraulic conductivity for coal measure units are generally less than one tenth of the value of horizontal hydraulic conductivity

Groundwater within the coal measures is controlled by recharge-discharge processes, with the highest groundwater levels in the northern parts of the lease where the coal measures outcrop. Under pre-mining conditions, the lateral hydraulic gradient would have been to the south and south-east. Open cut mining has created groundwater sinks which have reversed the natural groundwater flow directions.

2.4 Recharge

The surficial alluvial aquifers and outcrop areas are recharged from rainfall. Most likely the alluvial aquifers are in hydraulic continuity with Wallis Creek to the west and Hexham Swamp to the east. The shallow aquifer system normally discharges to the streams, although during wet periods stream flow may contribute some recharge to these alluvial aquifers for short periods while stream water levels are temporarily higher than the adjacent alluvium groundwater levels. Stream flows from runoff are generally short-lived after rainfall events.

Coal seams are recharged directly from rainfall only where they are outcropping or subcropping on the north-eastern side of the lease. At depth, coal seams are recharged by lateral flow down-gradient from the outcrop areas, and vertical flow through the overburden. Rainfall recharge rates within the hard rock outcrop area are expected to be relatively low (1-10 mm/a).

Long term records of rainfall data are available for several nearby stations, the closest being the East Maitland Bowling Club (station 061034) about 5 km north-east of Bloomfield. **Table 2** lists the mean monthly and annual rainfall, based on more than 90 years of daily rainfall data from 1902 to closure of the station in 1994.

Table 2
Mean Monthly Rainfall at East Maitland Bowling Club (mm)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Mean (mm)	89.0	94.1	96.5	87.4	70.3	84.2	58.1	52.2	54.8	65.5	61.6	81.3	889.9

2.5 Groundwater Discharge

Groundwater discharge can occur by evapotranspiration in areas of shallow water table, or spring flow where the water table intersects the land surface, or through baseflow contributions to watercourses. Open cut mining facilitates groundwater losses by evaporation from in-pit pools or seepage faces on excavation walls, or direct pump-out.

Due to naturally high groundwater salinity and low bore yields, there is no significant groundwater abstraction other than coal mine dewatering. Only a few stock/domestic bores are registered in the government bore database.

Average A Class pan evaporation data are available for Cessnock (station 061242) and Paterson (station 061250). **Table 3** summarises mean monthly evaporation rates, giving an average of about 4 mm/day (1,460 mm/a).

Table 3
Mean Daily Evaporation Data for Cessnock and Paterson Stations (mm/day)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cessnock [1966-2012]	5.7	4.9	3.9	2.8	1.9	1.5	1.7	2.5	3.5	4.3	5.0	5.7
Paterson [1967-2017]	6.2	5.3	4.2	3.2	2.4	2.1	2.4	3.3	4.4	5.2	5.8	6.6

The actual evapotranspiration (ET) in the district is approximately 800 mm/a according to BoM (2017). The definition for actual ET is: "... the ET that actually takes place, under the condition of existing water supply, from an area so large that the effects of any upwind boundary transitions are negligible and local variations are integrated to an areal average. For example, this represents the ET which would occur over a large area of land under existing (mean) rainfall conditions."

3 GROUNDWATER SIMULATION MODEL

3.1 Existing Groundwater Models

The 2009 approval (07_0087) was supported by a Groundwater Impact Assessment conducted by Peter Dundon & Associates Pty Ltd with groundwater modelling conducted by Aquaterra (2008). Key features of the original Bloomfield groundwater model were:

- MODFLOW-SURFACT software
- Extent 14 km x 14.5 km
- Cell size 25 m x 25 m to 100 m x 100 m
- 276 rows, 277 columns, 8 layers; 612,000 model cells
- Boundary set at deepest coal seam outcrop limits
- Boundary set at Wallis Creek and Hexham Swamp
- Inclusion of Donaldson and Abel mines.

The original Bloomfield model was developed from an earlier model for the Abel Mine. Subsequently, there have been various modifications (in lateral and vertical extent) to this model for more detailed assessments of the Abel, Donaldson and Tasman Mines.

A more extensive groundwater model with 20 layers was developed by RPS Aquaterra (2013) for the Abel Underground Mine MOD3 (known as the 'A33' model). HydroSimulations (2015) modified and partially recalibrated this model for a modified mine plan with different sequencing at Abel and Tasman. For approved mining, changes were made to the height of continuous fracturing above Abel underground panels.

3.2 Current Model

The current regional model that includes Bloomfield, Donaldson, Abel and Tasman Mines was modified and partially recalibrated by HydroSimulations in 2016, with emphasis on the Abel Mine.

The model domain is discretised into about 1.9 million cells comprising 347 rows, 332 columns and 20 layers. The dimensions of the model cells are varied from 50 m in the Abel mining area to 112.5 m near the boundaries. The cell sizes at Bloomfield range from 50 m x 50 m to 100 m x 100 m.

The model layers represent the following lithologies:

- Layer 1: Alluvium and regolith
- Layer 2: Overburden and coal seams above Fassifern Seam
- Layer 3: Fassifern Seam
- Layers 4 to 6: Fassifern – West Borehole interburden
- Layer 7: West Borehole Seam
- Layer 8: West Borehole – Sandgate interburden
- Layer 9: Sandgate Seam
- Layer 10 to 12: Sandgate – Donaldson interburden
- Layer 13: Upper Donaldson Seam
- Layer 14: Upper Donaldson – Lower Donaldson interburden
- Layer 15: Lower Donaldson Seam
- Layer 16: Donaldson – Big Ben interburden
- Layer 17: Big Ben Seam
- Layer 18: Big Ben – Ashtonfield interburden
- Layer 19: Ashtonfield Seam
- Layer 20: Basal Layer

The current model extends to northing 6374000 which is 2km north of the Bloomfield mining lease and about 4 km north of active mining.

3.3 Modified Model

Several modifications have been made to the current model to improve its suitability for assessing the effects of mining at Bloomfield. The following changes were made:

- A re-build of the model geometry in the Bloomfield area only.
- Inclusion of old Big Ben underground works (not in the current Abel model).
- Inclusion of a dyke in the Bloomfield area (not in the current Abel model).

- Contraction of the southern extent of the model from northing 6350000 to 6357420. This reduced the very large number of model cells which exceed the industry benchmark of 1 million cells[1]. Models with more than this limit are prone to numerical instability, longer runtimes, excessive memory requirements and more difficult post-processing. This contraction does not affect the results of interest.

- Extension of model calibration from December 2015 to April 2017.

No changes were considered necessary for the following features:

- Position of the northern boundary at northing 6374000.

- Cell sizes (maximum 100 m x 100 m at Bloomfield).

- Inclusion of Donaldson, Abel and Tasman mines for cumulative impact assessment.

Given the differences in coal seam nomenclature between the district collieries, a comparison was made between Bloomfield floor levels for the “Donaldson” seam and the “Big Ben” seam to infer the corresponding seams to the south. This process uncovered a very poor representation of the Bloomfield seams in the current Abel groundwater model. As a result, it has not been possible to definitively correlate northern and southern seams. The Bloomfield “Big Ben” seam is considered to match the Ashtonfield seam in the Abel mode. Model layer floor levels have been modified to match actual Bloomfield levels.

The lithologies in the new Bloomfield model are designated as follows at the Bloomfield Colliery, with typical coal thicknesses (in parentheses):

- Layer 1: Alluvium and regolith
- Layer 2: Overburden and above coal seams
- Layer 3: C seams (1.0 m)
- Layers 4 to 6: C – B interburden
- Layer 7: B seams (1.0 m)
- Layer 8: B – A interburden
- Layer 9: A seam (0.5 m)
- Layer 10 to 12: A – C Interburden
- Layer 13: WC seams (2.0 m)
- Layer 14: WC – EC Interburden
- Layer 15: EC seams (1.5 m)
- Layer 16: EC - Donaldson interburden
- Layer 17: Donaldson seams (1.5 m)
- Layer 18: Donaldson - Big Ben interburden
- Layer 19: Big Ben seams (3.0 m)
- Layer 20: Basement – Wallis Creek Subgroup.

3.4 Methodology

Groundwater modelling has been conducted in accordance with the Australian Groundwater Modelling Guidelines (Barnett *et al.*, 2012) and the Murray-Darling Basin Commission

[1] However, the number of active cells remains high at 1.46 million.

(MDBC) Groundwater Flow Modelling Guideline (MDBC, 2001). Under the earlier MDBC modelling guidelines, the model is best categorised as an Impact Assessment Model of medium complexity. That guide describes this model type as follows:

> "*Impact Assessment model - a moderate complexity model, requiring more data and a better understanding of the groundwater system dynamics, and suitable for predicting the impacts of proposed developments or management policies.*"

The more recent guidelines do not classify complexity as such, but focus on 'confidence'. This model has a reasonable amount of groundwater level data but it is not calibrated against stream baseflow or mine inflow[2]. The model is complex due to the large number of mines in the area and the low permeability strata of the Newcastle Coal Measures.

Four model variants were developed:

1. Transient calibration model from January 2006 to April 2017.

2. Prediction model for the proposed extension at Bloomfield plus the approved operations at Abel, Donaldson and Tasman.

3. Recovery model for the Bloomfield extension and neighbouring mines (based on the final heads of model #2).

4. Null model, consisting of models #1, #2 and #3 in sequence with the exclusion of all Bloomfield operations since 2006.

For model #1, particular attention was paid to good calibration at the bores in the Bloomfield monitoring network.

Differencing the results from models #2 and #3, with model #4, allowed isolation of the impacts due to the Bloomfield extension alone.

3.5 Software

MODFLOW-SURFACT software has been retained for consistency with previous assessments, with use of the TMP facility for time-varying changes in permeability and storage to represent open cut infill (and district underground fracturing).

Numerical modelling has been undertaken using the Groundwater Vistas (Version 6.96) software interface (Environmental Simulations Inc, 2011) in conjunction with MODFLOW-SURFACT (Version 4), distributed by HydroGeoLogic Inc (Virginia, USA). MODFLOW-SURFACT is an advanced version of the popular MODFLOW code developed by the United States Geological Survey (USGS). MODFLOW is the most widely used code for groundwater modelling and is considered an industry standard.

MODFLOW-SURFACT is a three-dimensional model able to simulate variably saturated flow and can handle desaturation and resaturation of multiple hydrogeological layers without the "dry cell" problems of 'standard' MODFLOW. This is pertinent to the depressurisation associated with longwall mining and the desaturation that occurs within and along the edge of open cut mines. 'Standard' versions of MODFLOW can handle depressurisation and desaturation to some extent, but model cells that are dewatered (reduced below atmospheric

[2] See Section 6 for the assigned model class

pressure) are replaced by “dry” cells, which can interfere with the simulation of various processes and also cause model instability.

3.6 Model Layers and Geometry

The new Bloomfield model covers an area of about 380 km^2 and extends 23.0 km from west to east and 16.6 km from south to north (**Figure 1**, **Figure 7**). The model has a total of 1,812,720 cells across 20 layers (**Table 4**), with 1,459,120 cells active (**Figure 8**). Model cells are not uniform, varying from 50 m to 112.5 m. The model grid consists of 273 rows and 332 columns, without any rotation.

Table 4
Model Layers and Formations

LAYER	FORMATION
1	Alluvium and regolith
2	Overburden and above coal seams
3	C seams
4	C – B interburden
5	
6	
7	B seams
8	B - A interburden
9	A seam
10	A – WC Interburden
11	
12	
13	Whites Creek Seam
14	WC – EC interburden
15	Elwells Creek
16	EC - Donaldson interburden
17	Donaldson seams
18	Donaldson - Big Ben interburden
19	Big Ben seams
20	Basal Layer (Wallis Creek Subgroup)

3.7 Model Simulation Period and Timing

Simulation commences at 1 January 2006 and ends at 31 December 2031 (**Table 5**). The first 17 stress periods (SP1 to SP17) are used for transient calibration (to the end of 2017), initially in six-monthly steps and then in annual steps (from 2011).

The model prediction assumes that Bloomfield mining would continue until December 2025 - stress period (SP) 25. District mines are assumed to continue until December 2031 (SP31). During the prediction period, all stress periods are annual.

Post-mining recovery is simulated at SP32 (until 2132) with a single 100-year stress period. During this time, final voids are simulated at Bloomfield and Donaldson.

Table 5 shows the assumed schedules of the various mines and model stress period definition.

Table 5
Mine Evolution and Model Stress Period Definition

	Stress Period	From	To	Days	Mine Sequencing
CALIBRATION		-	31/12/2005	-	
	1	1/01/2006	30/06/2006	181	Donaldson OC; Bloomfield OC
	2	1/07/2006	31/12/2006	184	Donaldson OC; Bloomfield OC
	3	1/01/2007	30/06/2007	181	Tasman Fassifern UG; Donaldson OC; Bloomfield OC
	4	1/07/2007	31/12/2007	184	Tasman Fassifern UG; Donaldson OC; Bloomfield OC
	5	1/01/2008	30/06/2008	182	Abel UG; Tasman Fassifern UG; Donaldson OC; Bloomfield OC
	6	1/07/2008	31/12/2008	184	Abel UG; Tasman Fassifern UG; Donaldson OC; Bloomfield OC
	7	1/01/2009	30/06/2009	181	Abel UG; Tasman Fassifern UG; Donaldson OC; Bloomfield OC
	8	1/07/2009	31/12/2009	184	Abel UG; Tasman Fassifern UG; Donaldson OC; Bloomfield OC
	9	1/01/2010	30/06/2010	181	Abel UG; Tasman Fassifern UG; Donaldson OC; Bloomfield OC
	10	1/07/2010	31/12/2010	184	Abel UG; Tasman Fassifern UG; Donaldson OC; Bloomfield OC
	11	1/01/2011	31/12/2011	365	Abel Upper/ Donaldson UG; Tasman Fassifern UG; Donaldson OC; Bloomfield OC
	12	1/01/2012	31/12/2012	366	Abel Upper/ Donaldson UG; Tasman Fassifern UG; Donaldson OC; Bloomfield OC
	13	1/01/2013	31/12/2013	365	Abel Upper/ Donaldson UG; Tasman Fassifern UG; Donaldson OC; Bloomfield OC
	14	1/01/2014	31/12/2014	365	Abel Upper/ Donaldson UG; Tasman Fassifern UG; Donaldson OC; Bloomfield OC
	15	1/01/2015	31/12/2015	365	Abel Upper/ Donaldson UG; Abel Lower/Donaldson UG; Tasman Fassifern UG; Donaldson OC; Bloomfield OC
	16	1/01/2016	31/12/2016	366	Abel Upper/ Donaldson UG; Abel Lower/Donaldson UG; Tasman Fassifern UG; Donaldson OC; Bloomfield OC
	17	1/01/2017	31/12/2017	365	Abel Upper/ Donaldson UG; Abel Lower/Donaldson UG; Tasman Fassifern UG; Donaldson OC; Bloomfield OC
PREDICTION	18	1/01/2018	31/12/2018	365	Abel Upper/ Donaldson UG; Abel Lower/Donaldson UG; Tasman Extension West Borehole UG; Final Void; Bloomfield OC
	19	1/01/2019	31/12/2019	365	Abel Upper/ Donaldson UG; Abel Lower/Donaldson UG; Tasman Extension West Borehole UG; Final Void; Bloomfield OC
	20	1/01/2020	31/12/2020	366	Abel Upper/ Donaldson UG; Abel Lower/Donaldson UG; Tasman Extension West Borehole UG; Final Void; Bloomfield OC
	21	1/01/2021	31/12/2021	365	Abel Upper/ Donaldson UG; Abel Lower/Donaldson UG; Tasman Extension West Borehole UG; Final Void; Bloomfield OC
	22	1/01/2022	31/12/2022	365	Abel Upper/ Donaldson UG; Abel Lower/Donaldson UG; Tasman Extension West Borehole UG; Final Void; Bloomfield OC
	23	1/01/2023	31/12/2023	365	Abel Upper/ Donaldson UG; Abel Lower/Donaldson UG; Tasman Extension West Borehole UG; Final Void; Bloomfield OC
	24	1/01/2024	31/12/2024	366	Abel Upper/ Donaldson UG; Abel Lower/Donaldson UG; Tasman Extension West Borehole UG; Final Void; Bloomfield OC
	25	1/01/2025	31/12/2025	365	Abel Upper/ Donaldson UG; Abel Lower/Donaldson UG; Tasman Extension West Borehole UG; Final Void; Bloomfield OC
	26	1/01/2026	31/12/2026	365	Abel Upper/ Donaldson UG; Abel Lower/Donaldson UG; Tasman Extension West Borehole UG; Final Void; Bloomfield OC
	27	1/01/2027	31/12/2027	365	Abel Upper/ Donaldson UG; Abel Lower/Donaldson UG; Tasman Extension West Borehole UG; Final Void; Bloomfield OC
	28	1/01/2028	31/12/2028	366	Abel Upper/ Donaldson UG; Abel Lower/Donaldson UG; Tasman Extension West Borehole UG; Final Void; Bloomfield OC
	29	1/01/2029	31/12/2029	365	Abel Upper/ Donaldson UG; Abel Lower/Donaldson UG; Tasman Extension West Borehole UG; Final Void; Bloomfield OC
	30	1/01/2030	31/12/2030	365	Abel Upper/ Donaldson UG; Abel Lower/Donaldson UG; Tasman Extension West Borehole UG; Final Void; Bloomfield OC
	31	1/01/2031	31/12/2031	365	Abel Upper/ Donaldson UG; Abel Lower/Donaldson UG; Tasman Extension West Borehole UG; Final Void; Bloomfield OC
	32	1/01/2032	31/12/2032	36525	Post-mining Recovery; Final Void; Bloomfield OC

3.8 Model Stresses and Boundary Conditions

3.8.1 Inactive Areas

Inactive areas are defined to the east of Hunter River and to the west of Wallis Creek (**Figure 7**).

3.8.2 Watercourses

The numerical model incorporates river/aquifer interactions, to enable quantification of the impacts of mining on surface water features. This is important to assess whether mining is likely to lower water levels and reduce baseflow to permanent streams.

MODFLOW River (RIV) cells are applied along the various watercourses in this area, as well as to represent Hexham Swamp. Bed conductance for all watercourses and the swamp are set to 25 m^2/d. The river stage heights are set generally at riverbed elevations except for the swamp which is given 0.5 m water depth. This practice means that “river” boundaries act in the same way as MODFLOW “drains”, and allow baseflow (groundwater discharge) but do not allow leakage from the watercourse to the aquifer (unless stage is greater than bed elevation).

All River cells are within Layer 1.

3.8.3 Rainfall Recharge and Evapotranspiration

For all model variants, rainfall recharge is applied to each active model cell as a percentage of long-term average rainfall using the MODFLOW Recharge (RCH) package. No changes were made to the recharge rates adopted in the previous A33 model, which had 11 distinct recharge zones with a median rate of 0.7% of annual rainfall.

Evapotranspiration (ET) from shallow water tables has been simulated using the MODFLOW EVT package. Two conceptual zones have been set based on geological outcrop. Maximum extinction depths, that is the depths to which MODFLOW-SURFACT will attempt to take ET from the water table, are assumed to be 3 m for the alluvium and 1.8 m for hard rock outcrop (regolith) areas. The corresponding maximum ET rates are 248 and 274 mm/a, unchanged from those adopted in the A33 model.

New recharge zones are set up in the Bloomfield mine area during mine progression to negate recharge during active mining, and to enhance recharge to spoil after a delay of five years. Spoil recharge is applied as 5% of mean annual rainfall.

3.8.4 Open Cut Mining

MODFLOW Drain (DRN) cells are used to simulate both open cut and underground mining, with the drain invert at the base of the relevant coal seam for each mine in the area. The Bloomfield open cut mine is set from regolith (layer 1) to the Big Ben seam (layer 19) as the maximum vertical extent. Underground mining is applied in layers 3 (Tasman), 7 (Tasman), 13 (Abel) and 15 (Abel).

MODFLOW Drains are progressed in accordance with mine progression plans. Open cut drain cell conductance was set to 1000 m^2/d to allow free drainage into pits. Generally, these drains remain active up to eight years from the beginning of their activation. After that time, spoil is emplaced in the void. The TMP package is used to allocate enhanced transmissive and storage properties to the spoil.

The temporal progression of Bloomfield open cut mining is illustrated in **Appendix A**.

3.8.5 Hydraulic Properties

While the hydraulic conductivities of the A33 model have been retained as much as possible, some changes were necessary to improve model calibration at Bloomfield. Also, several local features were not present in the A33 model:

- Historical open cut areas (**Figure 2**) (given hydraulic conductivity 1 m/day).
- Historical underground Big Ben mining areas (**Figure 2**) (given hydraulic conductivity 10 m/day).
- A north-westerly trending dyke (**Figure 7**) (given leakage coefficient 10^{-5} d^{-1}).

Spoil hydraulic conductivity is set at 1 m/day in both horizontal and vertical directions.

4 MODEL CALIBRATION

4.1 Current Abel Model

Steady state (or baseline 'long-term') calibration as the first stage of the calibration process was carried out against 60 targets, using a combination of auto-sensitivity analysis and manual modification of model zones and parameters. The steady state calibrated model yielded a 'scaled root mean squared error'(SRMS) value of 4.5% which is below the target 10% SRMS suggested in the MDBC flow model guideline (MDBC, 2001).

Transient model calibration was carried out in order to achieve a history match to the reported observed groundwater levels during the period January 2006 to June 2012 inclusive (RPS Aquaterra, 2013). The calibration was done against 2,606 target water levels, using a combination of auto-sensitivity analysis and manual modification of zones and model parameters. These targets were distributed throughout the model layers in the form of 88 groundwater hydrographs.

The SRMS value for the RPS Aquaterra (2013) six-year transient calibration period was 4.3% (within the target range of 0-10%).

4.2 New Bloomfield Model

Calibration of the modified groundwater model has focused on 'history matching' of model outputs against the following Bloomfield-specific data:

- Groundwater levels for standpipes: SP2-1, SP2-2, SP3-1, SP4-2 and SP7-1.
- Groundwater levels for vibrating wire piezometers: VW1, VW5, VW6, VW7 and VW8.

Standpipe and bore VWP locations are presented in **Figure 6**. There is no reliable baseflow data from around the site against which to calibrate the model for fluxes. Nor is there a reliable mine inflow time series for calibration.

To get a sensible initial head for the Bloomfield transient model, steady state calibration was carried out by a manual method.

Transient model calibration was designed to match recorded groundwater levels during the period January 2006 to April 2017 against 18 target water levels, using manual modification of zones and model parameters. These targets were distributed through four of the model layers:

- Alluvium and regolith (Layer 1): 2 targets
- WC seams (Layer 13): 3 targets
- Donaldson seams (Layer 17): 7 targets
- Big Ben seams (Layer 19): 6 targets

All horizontal and vertical hydraulic conductivities were allowed to vary during the calibration process. The final hydraulic conductivities in the model are presented in **Table 4.**

Table 6
Hydraulic Conductivities for Initial and Calibrated Models

ZONE	DESCRIPTION	Initial [m/d]		Calibrated [m/d]	
		K_H	K_V	K_H	K_V
1	Alluvium	1.00E-02	1.00E-03	1.00E-03	1.00E-04
20	River bank Alluvium	2.00E-01	1.00E-02	1.00E-01	1.00E-01
55	Whites Creek Seam	5.00E-02	1.00E-03	5.00E-02	5.00E-03
56	Whites Creek Seam	1.00E-02	5.00E-03	1.00E-04	1.00E-05
7	Interburden	2.00E-04	2.00E-05	1.00E-04	1.00E-05
14	Donaldson Seam	5.00E-02	5.00E-03	5.00E-03	5.00E-05
29	Donaldson Seam	5.00E-03	3.00E-04	5.00E-03	5.00E-04
15	Interburden	1.00E-04	5.00E-05	5.00E-03	5.00E-05
17	Big Ben Seam	5.00E-02	8.00E-03	1.00E-02	8.00E-04

K_H = horizontal hydraulic conductivity; K_V = vertical hydraulic conductivity

4.3 Model Performance

4.3.1 Statistics

The Bloomfield model takes approximately 4.5 hours to run, covering both the historical phase (2006-2017) and the predictive phase (out to the year 2031). The 100-year recovery phase takes an extra 2 hours.

During the historical phase (2006-2017), the model has a mass balance error of 0.2%, which is well below the accepted threshold of 1-2% (Barnett *et al.*, 2012).

The statistical performance for the 12-year calibration period is 10.4 %RMS and 9.8 mRMS (with 18 water level targets, 611 observations) for the local Bloomfield area. For all 3,983 observations across the full model area, the calibration performance statistics are 4.1 %RMS and 12.7 mRMS.

Scattergrams are displayed in **Figure 9.**

4.3.2 Mine Inflow

A graph of the modelled inflows to the Bloomfield open cut mine is presented in **Figure 10**. During the 2006 – 2017 calibration period, simulated inflow is predicted to have averaged 1.1 ML/d (420 ML/a) with a peak of about 1.6 ML/d (570 ML/a).

The pattern of inflow agrees with the previous Bloomfield model (Aquaterra, 2008) from 2007 to 2017, where the average was 1.4 ML/d (510 ML/d) and the peak was predicted to be about 2.0 ML/d (730 ML/a).

These rates do not account for evaporative losses from the floor and walls of the pits.

4.3.3 Groundwater Levels

Appendix B (**Figures B1** to **B7**) presents hydrographs for the relevant monitoring bores in the Bloomfield monitoring network (bore locations are shown on **Figure 6**):

- Standpipes SP4-2 and SP7-1 : for Alluvium and Regolith
- Bores VW5(62m), VW6(96m) and VW7(70m) : for Whites Creek Seam
- Standpipes SP2-1, SP3-1, bores VW1(35m), VW5(71m), VW6(114m), VW7(95m) and VW8(83m): for Donaldson Seam
- Standpipe SP2-2, bores VW1(46m), VW5(89m), VW6(128m), VW7(107m) and VW8(97m): for Big Ben Seam

These charts include both simulated and measured responses. As modelled groundwater levels are calculated on an annual basis, they cannot simulate the short-term climate variations seen in the measured hydrographs.

The overall trends of the simulated groundwater levels at the bores in alluvium and regolith match well with those measured. Standpipe SP4-2 (depth 9 m) near Four Mile creek shows a rising trend for groundwater level which probably correlates with river stage. The simulated water level matches very well with this trend. SP7-1 (depth 11 m) is positioned on the western border of the open cut operations. Its simulated water level indicates the westward progression of mining.

The overall magnitudes and trends of simulated groundwater levels at VW6(96m) and VW7(70m) in the Whites Creek Seam are perfectly matched with the measured levels. The water level patterns are showing a clear mining effect in both simulated and measured cases. An exception is bore VW5(62m) where the simulated level is showing a mining effect but the measured level is not affected.

Five of the seven bores in the Donaldson Seam are well-matched with the measured groundwater levels. Mining effects are undoubtedly visible for VW1(35m), VW5(71m), VW6(114m) and VW7(95m). Exceptions are standpipe SP2-1 (depth 65 m) and VW8(83m). SP2-1 is surrounded by historical open-cut and underground mining. Considering the position of SP2-1, the simulated water level reasonably shows drawdown but the lack of any measured drawdown suggests that recovery from historical mining might already have occurred.

In the Big Ben seam the simulated water levels at VW1(46m), VW5(89m), VW6(128m) and VW7(107m) match very well with the measured levels. As in the Donaldson seam, the bore water levels in the Big Ben seam show clear mining effects. The poor agreement at SP2-2 (depth 85 m) suggests that recovery might already have occurred from past mining in this seam at this location. VW8 responses, however, indicate residual effects from previous Buchanan mining of the Big Ben seam.

4.3.4 Groundwater Surface Water Interaction

With all district mines active during the calibration period, simulated groundwater-surface water interactions with watercourses in the Bloomfield area are presented in **Table 7.**

Table 7
Modelled Groundwater-Surface Water Interaction (2006-2017)

WATERCOURSE	MODELLED RIVER AQUIFER INTERACTION [kL/d]	COMMENT
	AVERAGE (2006-2017)	
BUTTAI CREEK	0.01	Losing stream
FOUR MILE CREEK	-0.24	Gaining stream
WALLIS CREEK	-0.02	Gaining Stream
WEAKLEYS FLAT CREEK	-20	Gaining Stream
VINEY CREEK	-0.02	Gaining Stream
BLUEGUM CREEK	-0.26	Gaining Stream
MINMI CREEK	-2.6	Gaining Stream
HEXHAM SWAMP	7,080	Losing system

These results suggest that all watercourses other than Buttai Creek and Hexham Swamp are simulated as gaining systems, at least as an 'average' condition across the 6-12 months model stress periods. However, the baseflow magnitudes are very low.

The locations of the creeks are presented in **Figure 5**.

4.3.5 Water Balance

A water budget for the entire model domain, averaged over the calibration period, is presented in the **Table 8**.

The water balance suggests that rainfall recharge is a small component (17%) of the water balance, and that leakage from the water bodies are the more substantial sources of groundwater replenishment (66%). Mine inflow of 15% (to all mines, not just Bloomfield) and evapotranspiration (57%) are the main discharge processes. The loss from storage (about 1.3 ML/d) is about half of the total mine inflow.

Table 8
Calibrated Model Water Balance (2006-2017)

COMPONENT	IN [ML/d]	OUT [ML/d]	NET [ML/d]
Drains (Mine inflow)	-	2.66	
Recharge (Direct Rainfall)	2.96	-	
Rejected Recharge	-	0.92	
Evapotranspiration (ET)	-	10.35	
River (Leakage / Baseflow)	11.23	4.21	
Constant Head (CHD)	2.87	0.16	
Regional Groundwater Flow (GHB)	-	0.02	
Storage			1.26 LOSS
TOTAL	17.06	18.31	1.25

5 PREDICTIVE MODELLING

5.1 Mining Schedule

A summary of the mining schedule that has been used for the Bloomfield mine and all other nearby mines is provided in **Table 5**Error! Reference source not found.. This outlines the sequencing of cumulative stresses and the transient simulation setup for calibration, prediction and recovery phases of the model. The predictive model simulates the period from January 2018 to December 2031, with completion of Bloomfield mining assumed at December 2025.

5.1.1 Prediction

Transient stress periods 18-31 are set for the predictive period from 2018 to 2031 to allow representation of the extraction and dewatering of the open cut extension. These stress periods are annual.

5.1.2 Recovery

Post-mining recovery is simulated at stress period 32 (2032-2132) with a single 100-year stress period.

Snapshots of Bloomfield open-cut mine progression are presented in **Appendix A**.

5.2 Modelling Approach

Two main predictive model scenarios were run:

1. a run with the modified Bloomfield mine plan and all other active mines; and
2. a ‘No-mining’ or ‘Null’ run without the past or future Bloomfield mining but with all other surrounding mines active.

Comparison of scenarios 1 and 2 allows the net impact on the hydrogeological environment to be evaluated separately from the effects of Bloomfield alone.

5.3 Model Implementation

As in the calibration model (**Section** 4), active mine areas were simulated in the model using MODFLOW drain cells with the invert elevation set at the floor of the relevant coal seam layer and drain cell conductance was set to 1000 m^2/d to allow a free-draining condition.

5.4 Water Balance

Shown in **Table 9** is the water balance averaged over the 2006-2025 period, when Bloomfield mining is assumed to end. The water balance reports the inflows, outflows and change in storage over the entire model domain.

The total inflow to the groundwater system within the model extent is approximately 17 ML/day, of which rainfall recharge is about 17% and leakage from water bodies provides around 66%. Groundwater discharge is dominated by evapotranspiration which is about 52% of total outflow. Mine inflow is around 22% of the total water balance. The loss from storage (about 2.8 ML/d) is about two-thirds of the total mine inflow and about twice the loss during the calibration period (to 2017).

Table 9
Predictive Model Water Balance (2006-2031)

COMPONENT	IN [ML/d]	OUT [ML/d]	NET [ML/d]
Drains (Mine inflow)	-	4.39	
Recharge (Direct Rainfall)	2.96	-	
Rejected Recharge	-	0.92	
Evapotranspiration (ET)	-	10.36	
River (Leakage / Baseflow)	11.23	4.21	
Constant Head (CHD)	2.87	0.16	
Regional GW flow (GHB)	-	0.01	
Storage			2.84 LOSS
TOTAL	17.06	20.06	2.94

Apart from mine inflow, which has increased from about 2.7 to about 4.4 ML/day, there is very little difference in other water balance components from those in the calibration period. This indicates that district mining is not having any significant effect overall on other components of the water balance.

5.5 Predicted Drawdowns

Predicted groundwater heads have been extracted from the model to show groundwater level and drawdown contour maps at the completion of Bloomfield mining (December 2025).

Water level maps are presented in **Appendix C** (**Figures C1** to **C8**) for model layers 1, 3, 7, 9, 13, 15, 17 and 19.

Drawdown maps, relative to the model-predicted levels at 2006, are presented in **Appendix D** (**Figures D1** to **D8**) for model layers 1, 3, 7, 9, 13, 15, 17 and 19.

Appendix B shows groundwater level hydrographs for the standpipes and vibrating wire piezometers in the Bloomfield monitoring network.

Drawdowns due to Bloomfield mining are expected to reach a maximum at Mine Year 20 (year 2025), at which time mining from the southern end of the extension area is scheduled to cease, and groundwater levels would start to recover.

The drawdown map (**Figure D1**) for the surficial aquifer Layer 1 (alluvium and regolith) shows a limited area of drawdown in the Bloomfield extension area and the location of the final void where the drawdown is about 100 m. Significant drawdown is also evident within the lease area to the north-west of extension mining, coincident with historical open cut and underground mining. Drawdown from open cut mining is propagating into the high-permeability underground voids, with some spatial confinement offered by a north-westerly trending dyke. The drawdown is generally less than 0.5 m outside the Bloomfield lease boundary except for the south-west corner where a 2-m drawdown contour extends off-lease. The 2 m of drawdown extends beneath Buttai Creek for a distance of about 600 m. As this creek is simulated as a losing system, no additional leakage loss is anticipated from the stream. However, alluvial take is likely and this is quantified in **Section 5.10**.

The predicted drawdown effects on the surficial aquifer are not expected to have any adverse impact on groundwater dependent ecosystems because the groundwater levels are already well below ground surface. Close to Buttai Creek, the water table depth at the site of VW8 was 9 m in 2007, and the depth to water at SP7-1 was 10 m in 2015.

Another area of significant drawdown (**Figure D1**) is associated with the Donaldson open cut and final void. There is no overlap of the water table drawdowns produced by the various mines.

5.6 Predicted Drawdowns at Registered Bores

Predicted drawdowns at the end of mining at registered bores within 5 km of Bloomfield are listed in **Table 10** and posted on the map at **Figure 11**. These values are cumulative drawdowns from all mining activities. As there is no overlap of water table effects between the various mines, the cause of the drawdown is clear from an inspection of **Figure 11** in terms of proximity to the nearest mine.

Most of the drawdowns calculated by the model are much less than 1 m, while drawdowns greater than 1 m and up to 2 m are predicted at three bores (GW078047, GW078128 and GW078044), which is within the Aquifer Inference Policy's 2 m threshold.

Large predicted drawdowns of 20 m and 17 m at bores GW078124 and GW078123 are due to the final void at the Donaldson mine.

Table 10
Predicted Drawdown [m] at Registered Bores at the End of Bloomfield mining

REGISTERED BORE NAME	AQUIFER	EASTING [MGA]	NORTHING [MGA]	BORE DEPTH (m)	DRILLED YEAR	PREDICTED DRAWDOWN (m) [Year 2025]
GW200415	Alluvium	369986	6373738	20.1	10/09/2004	< 1
GW078120	Alluvium	371176	6368590	24	14/11/1997	< 1
GW080034	Alluvium	365222	6370959	*	*	< 1
GW078125	Alluvium	370970	6368464	30	14/11/1997	< 1
GW058760	Alluvium	371142	6371207	33	1/10/1983	< 1
GW061307	Alluvium	371299	6371148	30	1/10/1984	< 1
GW200414	Alluvium	369960	6373761	10	9/09/2004	< 1
GW078123	Alluvium	369309	6368165	33	14/11/1997	17
GW051647	Alluvium	362896	6373006	12	1/09/1980	< 1
GW078047	Alluvium	370784	6368800	54.3	14/11/1997	1.5
GW078122	Alluvium	368666	6367663	35.4	14/11/1997	< 1
GW078124	Alluvium	369883	6368018	40	14/11/1997	20
GW078045	Alluvium	371836	6369892	30.5	14/11/1997	< 1
GW078128	Alluvium	370912	6366923	30	14/11/1997	2
GW051353	Alluvium	365986	6365810	49.7	1/11/1980	< 1
GW079892	Alluvium	366598	6372257	6.69	1800-01-01	< 1
GW078046	Alluvium	368651	6368741	30.4	14/11/1997	< 1
GW079948	Alluvium	370081	6372613	*	*	< 1
GW078044	Alluvium	370428	6370151	30.1	14/11/1997	1.4
GW078127	Alluvium	369073	6366406	30	14/11/1997	< 1
GW078126	Alluvium	371890	6367736	30	14/11/1997	< 1
GW078121	Alluvium	368619	6367262	43	14/11/1997	< 1

* Not available

5.7 Groundwater Hydrographs

Predicted groundwater hydrographs at Bloomfield monitoring bores are shown in **Appendix B** (**Figures B1-B7)**. These figures show groundwater levels in the alluvium and regolith (Layer 1), Whites Creek seam (Layer 13), Elwells Creek seams (Layer 15), Donaldson seams (Layer 17) and Big Ben seam (Layer 19). Bore locations are on **Figure 6**.

Alluvium and Regolith (Layer 1) [**Figure B1**]

The standpipe SP4-2 is located near Four Mile creek. It is more likely that the water level in this bore is influenced by water level in the creek, when it flows. The simulated hydrograph shows a rising trend for some years, followed by stabilisation.

SP7-1 is located at the western border of the Bloomfield mine. The prediction and recovery stages of the simulated hydrograph suggest that the water level will decline due to mining and not recover significantly. This bore would remain within the zone of influence of the final void.

Whites Creek Seam (Layer 13) [**Figure B2**]

All three VWP sites lie along the southern boundary of the Bloomfield lease. All simulated hydrographs show significant mining effects, with the degree of recovery being minimal but increasing from east to west, due to the effects of adjacent underground mining.

Donaldson Seam (Layer 17) [**Figures B3-B5**]

Four out of seven bores (SP2-1, VW1(35m), VW6(114m) and VW7(95m)) in this layer show slow water level recovery post-mining. Water levels at bores SP3-1 and VW5(71m) show no sign of recovery. Most bores are influenced by adjacent underground mining.

Big Ben Seam (Layer 19) [**Figures B6-B7**]

All simulated hydrographs show significant declines due to mining, with slow or negligible recovery in some cases. Most bores are influenced by adjacent or historical underground mining.

5.8 Baseflow Capture

Watercourses have been set up in the model to accept baseflow if groundwater levels exceed riverbed elevations, but not to allow leakage given that most streams are ephemeral. The model can predict reductions to baseflow for gaining streams, but cannot predict increases in leakage from losing streams. Where the water table is disconnected from a losing stream, mining cannot induce any additional leakage. **Table 7** has noted that the only simulated losing systems are Buttai Creek and Hexham Swamp.

Baseflows have been extracted from the model for both the mining and the null simulations, for cumulative stresses imposed by all mines.

The status of Four Mile Creek is predicted to have converted from gaining to losing status around 2011. This means that its average baseflow of 0.24 kL/day (**Table 7)** would have been lost at that time. This is equivalent to only 0.1 ML/a.

All other watercourses had negligible differences between the null and mining runs, indicating that Bloomfield mining is having an insignificant effect on baseflow capture. The strongest effect was observed at Weakleys Flat Creek where the loss was only 0.12 kL/day (0.04 ML/a).

The leakages from Hexham Swamp differed by no more than 1 kL/day (from 7,080 kL/day in **Table 10**) between null and mining simulations. This would be within numerical error bounds.

5.9 Predicted Mine Inflow

The predicted groundwater inflows[3] to the Bloomfield Mine are listed in **Table 11** and are graphed in **Figure 10**.

The simulated inflows are predicted to increase from about 0.9 ML/d at the start of open cut mining activities in year 2006 to peak about 1.6 ML/d (year 2013) during the calibration period, with a peak of about 1.5 ML/d in the prediction period. These rates do not take into account the evaporative losses that would occur when the groundwater discharges are exposed to the atmosphere. At the end of mining at year 2025 the inflow is predicted to be about 1.0 ML/d.

[3] Time-weighted averages

There is expected to be a slight drop (by about 2%) in the future peak inflow compared to what should already have occurred. The expected maximum for licensing purposes is 561 ML/a.

Aquaterra (2008) conducted a sensitivity analysis which found that peak inflow could increase by about 10% for higher horizontal hydraulic conductivity and by about 5% for higher vertical hydraulic conductivity.

Table 11
Bloomfield Mine Inflow Rates
[2006-2132]

	MINE YEAR	STRESS PERIOD	MINE-INFLOW [ML/d]	MINE-INFLOW [ML/year]
CALIBRATION	2006	2	0.88	322
	2007	4	0.82	300
	2008	6	0.85	312
	2009	8	0.87	318
	2010	10	0.92	336
	2011	11	1.18	430
	2012	12	1.40	513
	2013	13	**1.57**	**572 max**
	2014	14	1.51	551
	2015	15	1.40	511
	2016	16	1.20	440
	2017	17	1.24	455
PREDICTION	2018	18	1.42	520
	2019	19	1.42	520
	2020	20	**1.54**	**561 max**
	2021	21	1.53	559
	2022	22	1.16	423
	2023	23	0.69	253
	2024	24	1.00	367
	2025	25	1.00	367
	2026	26	0	0
	2027	27	0	0
	2028	28	0	0
	2029	29	0	0
	2030	30	0	0
	2031	31	0	0
RECOVERY	2032-2132	32	0	0

5.10 Alluvial Takes

The alluvium of both the Wallis Creek Water Source and the Newcastle Water Source (along the lower Hunter) are classified as 'Highly Productive' by DPI Water (**Figure 12)**. The calculated alluvial takes (rounded to the nearest ML/a) for separate simulation phases are recorded in **Table 12** and graphed in **Figure 13** and **Figure 14**. These takes are due only to Bloomfield mining.

For licensing purposes, the additional maximum take from the Wallis Creek Water Source is predicted to be about 18 ML/a (26-8 ML/a) after 2017, and the additional maximum take from the Newcastle Water Source is predicted to be about 8 ML/a (8-0.2 ML/a).

Table 12
Modelled Alluvial Takes

	WALLIS CREEK WATER SOURCE **TAKE** EXTRA LEAKAGE [ML/YEAR]		NEWCASTLE WATER SOURCE **TAKE** LESS UPFLOW [ML/YEAR]	
	CALIBRATION PERIOD [2006-2017]	**PREDICTION AND RECOVERY PERIOD [2018-2132]**	**CALIBRATION PERIOD [2006-2017]**	**PREDICTION AND RECOVERY PERIOD [2018-2132]**
MAXIMUM	**8**	**26**	**0.2**	**8**
MEAN	**4**	**12**	**0.0**	**2**

5.11 Final Void

The final void at Bloomfield is certain to remain a sink. It would have the effect of a long-term and widespread lowering of the water table, as indicated in **Figure C9** in **Appendix C**.

The hydrograph for a hypothetical monitoring point within the final void is shown in **Figure 15**. This shows recovery of only about 15 m after 100 years, with a void lake water surface around -40 mAHD.

6 LIMITATIONS

Model confidence has been assessed in terms of the attributes of Class 1, 2 and 3 models in the model classification system of Barnett *et al.* (2012). A self-assessment is offered at **Table 13**.

As all models would have elements of Class 1, Class 2 and/or Class3 attributes, it is not possible to assign a model uniquely to a particular class. For the Bloomfield model, the occurrences of performance indicators are quantified here:

- Class 1 : 4 items [25%]
- Class 2 : 5 items [31%]
- Class 3 : 7 items [44%]

Although the classification system points to Class 3, subjective assessment would rate the model more as Class 1-2 for the following reasons:

- Mine inflow rates are not readily available for calibration purposes.
- Baseflow estimates are not ground-truthed.
- No seasonality has been attempted in replicating the detail observed in monitoring bore hydrographs.
- There is uncertainty as to the details for historical mining.
- The groundwater system is complex as the result of a large number of previous and current simultaneous mining operations.

Table 13 Model Confidence Classification

CLASS	DATA	CALIBRATION	PREDICTION	INDICATORS
1 [count 4]	Not much. Sparse. No metered usage. Remote climate data.	Not possible. Large error statistic. Inadequate data spread. Targets incompatible with model purpose. [No inflow record]	Timeframe >> calibration Long stress periods. Transient prediction but steady-state calibration. Bad verification.	Timeframe > 10x Stresses > 5x Mass balance > 1% (or single 5%) Properties <> field. Bad discretisation. No review.
2 [count 5]	Some. Poor coverage. Some usage info. Baseflow estimates.	Partial performance. Long-term trends wrong. Short time record. Weak seasonal replication. No use of targets compatible with model purpose.	Timeframe > calibration. Long stress periods. New stresses not in calibration. Poor verification.	Timeframe = 3-10x Stresses = 2-5x Mass balance < 1% Some properties <> field measurements. Some key coarse discretisation. Review by hydrogeo.
3 [count 7]	Lots. Good aquifer geometry. Good usage info. Local climate info. K measurements. Hi-res DEM.	Good performance stats. Long-term trends replicated. Seasonal fluctuations OK. Present day data targets. Head and flux targets.	Timeframe ~ calibration. Similar stress periods. Similar stresses to those in calibration. Steady-state prediction consistent with steady-state calibration. Good verification.	Timeframe < 3x Stresses < 2x Mass balance < 0.5% Properties ~ field measurements. Some key coarse discretisation. Review by modeller.

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FIGURES

Figures 1 to 15

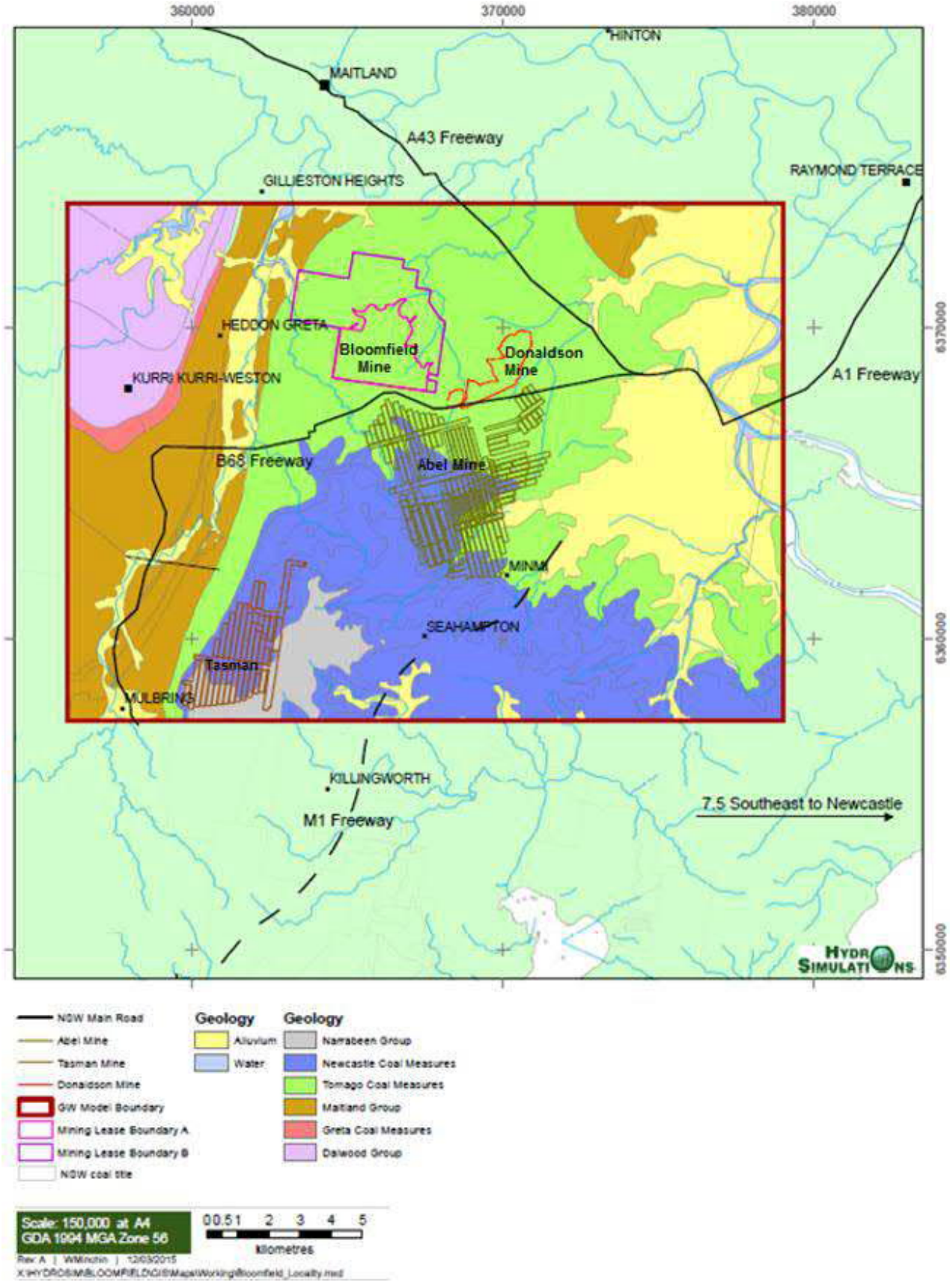


Figure 1. Location Plan

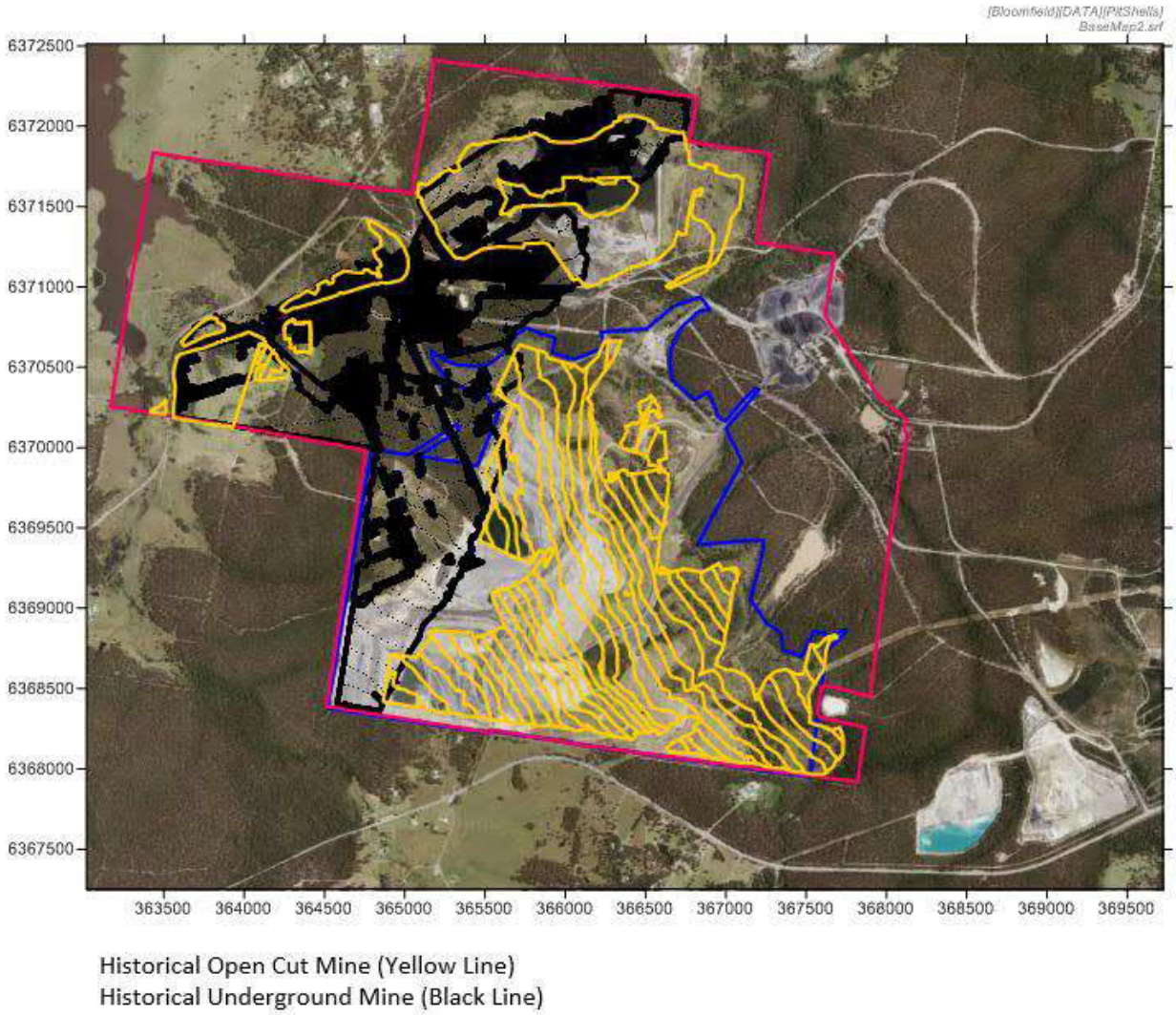


Figure 2. Historical Bloomfield Mining

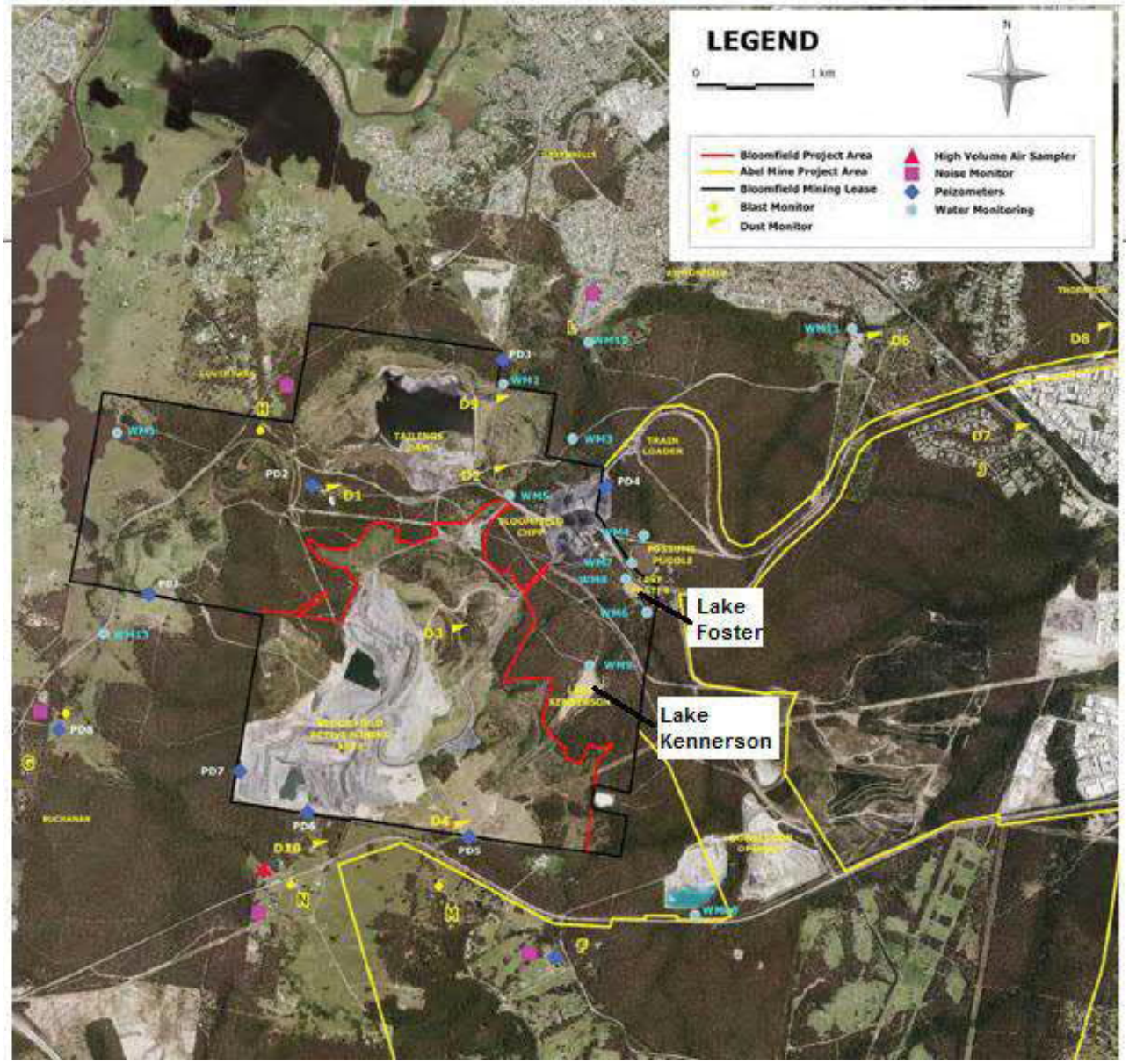


Figure 3. Lease Boundaries and Environmental Monitoring Sites [Bloomfield, 2015]

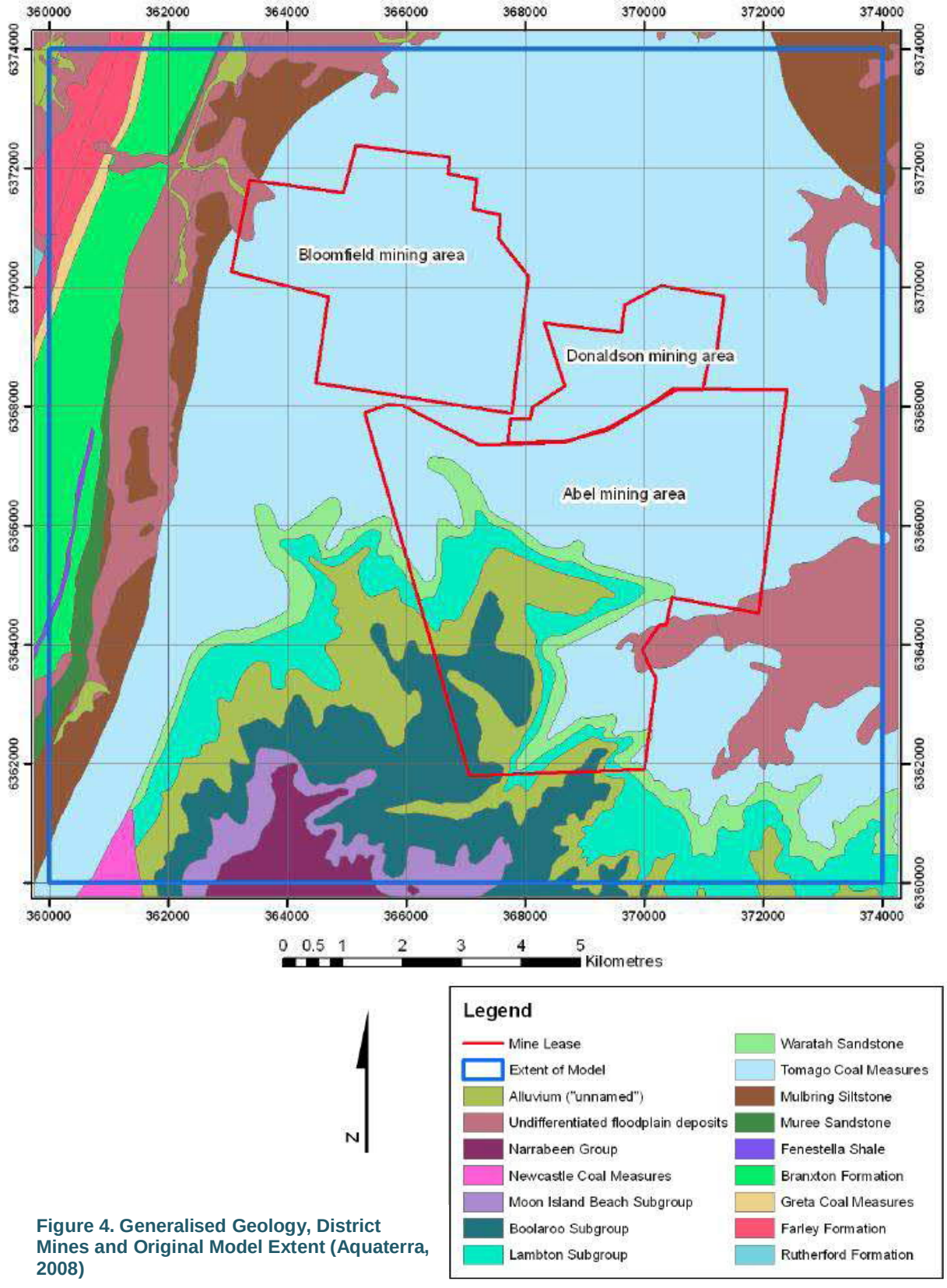


Figure 4. Generalised Geology, District Mines and Original Model Extent (Aquaterra, 2008)

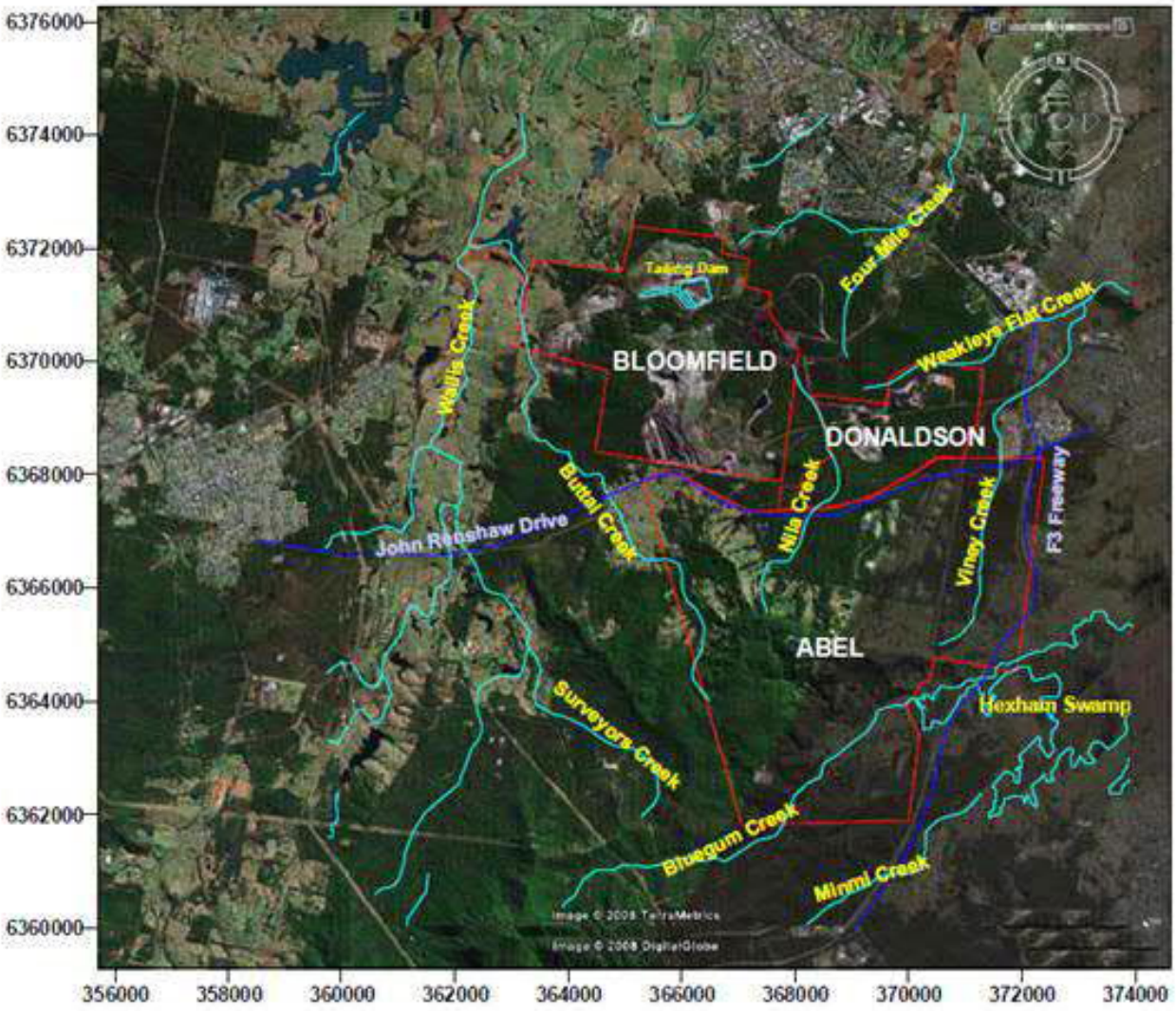


Figure 5. Watercourses (Aquaterra, 2008)

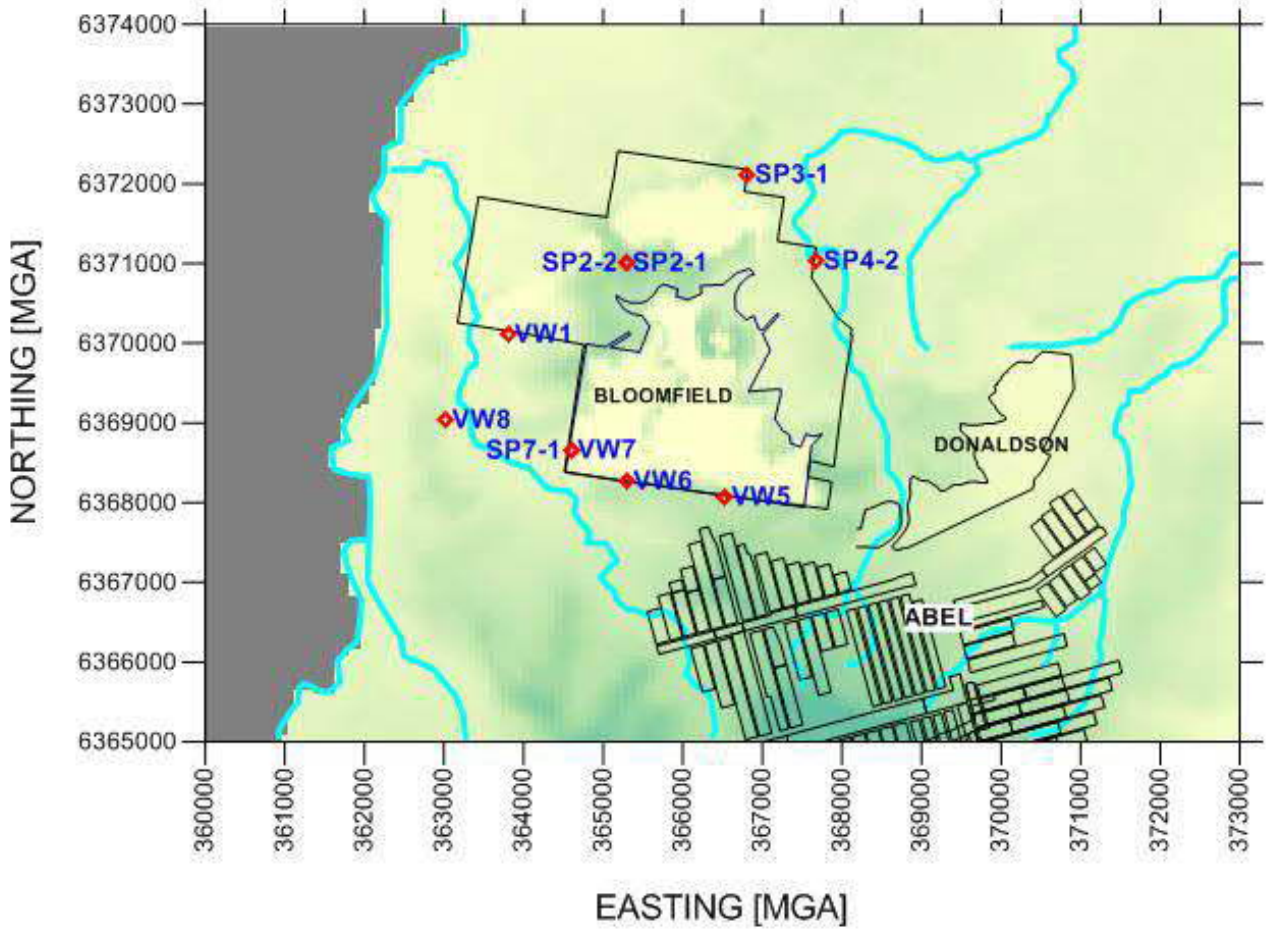


Figure 6. Bloomfield Groundwater Monitoring Network

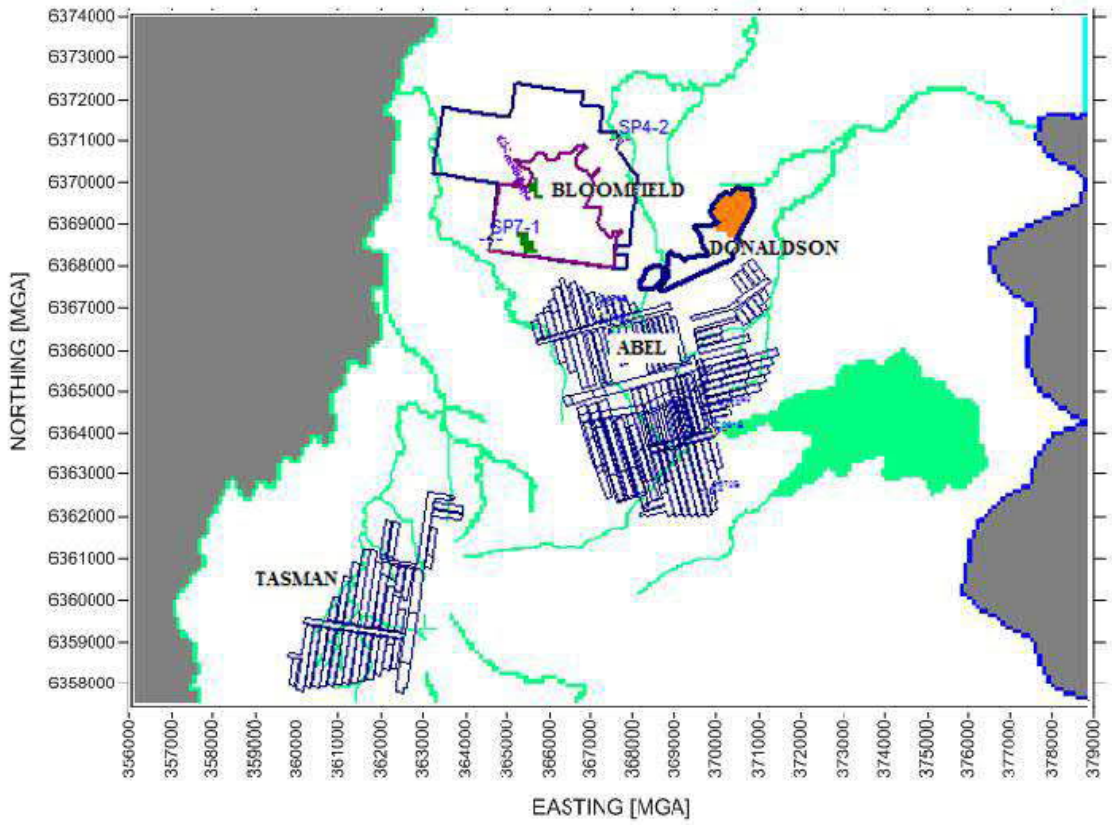


Figure 7. Bloomfield Groundwater Model Extent

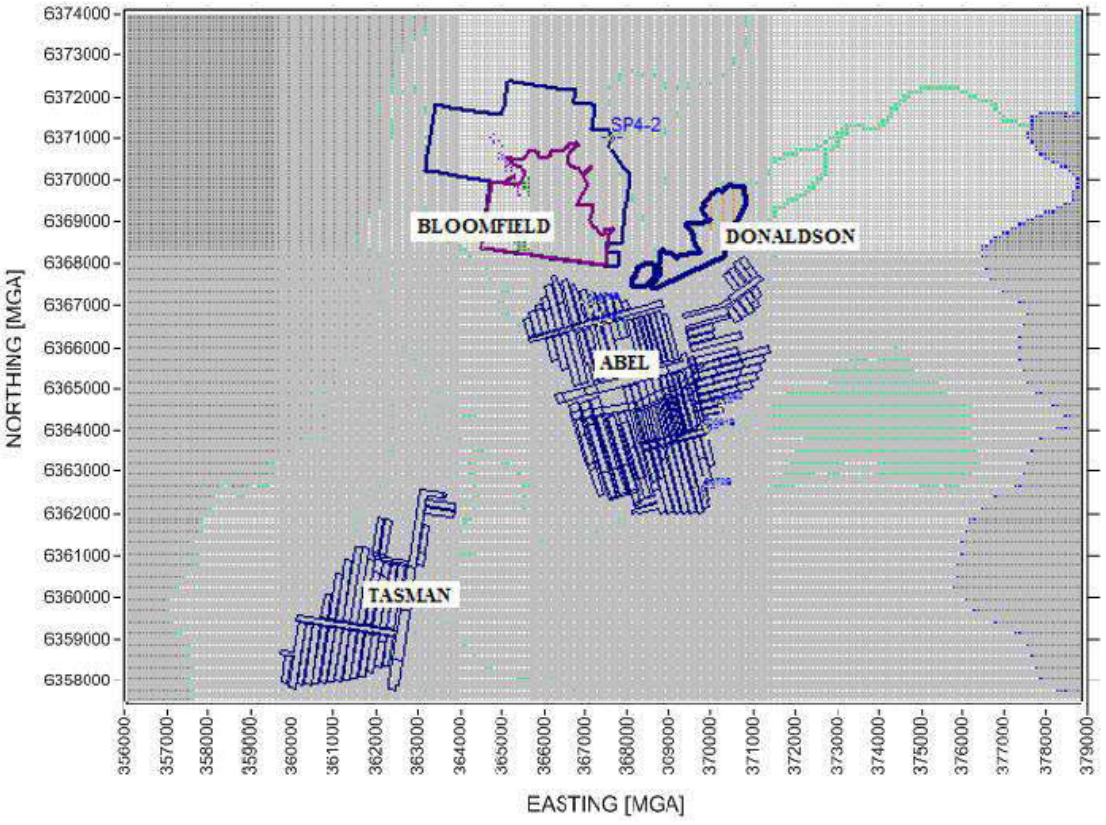


Figure 8. Bloomfield Groundwater Model Grid

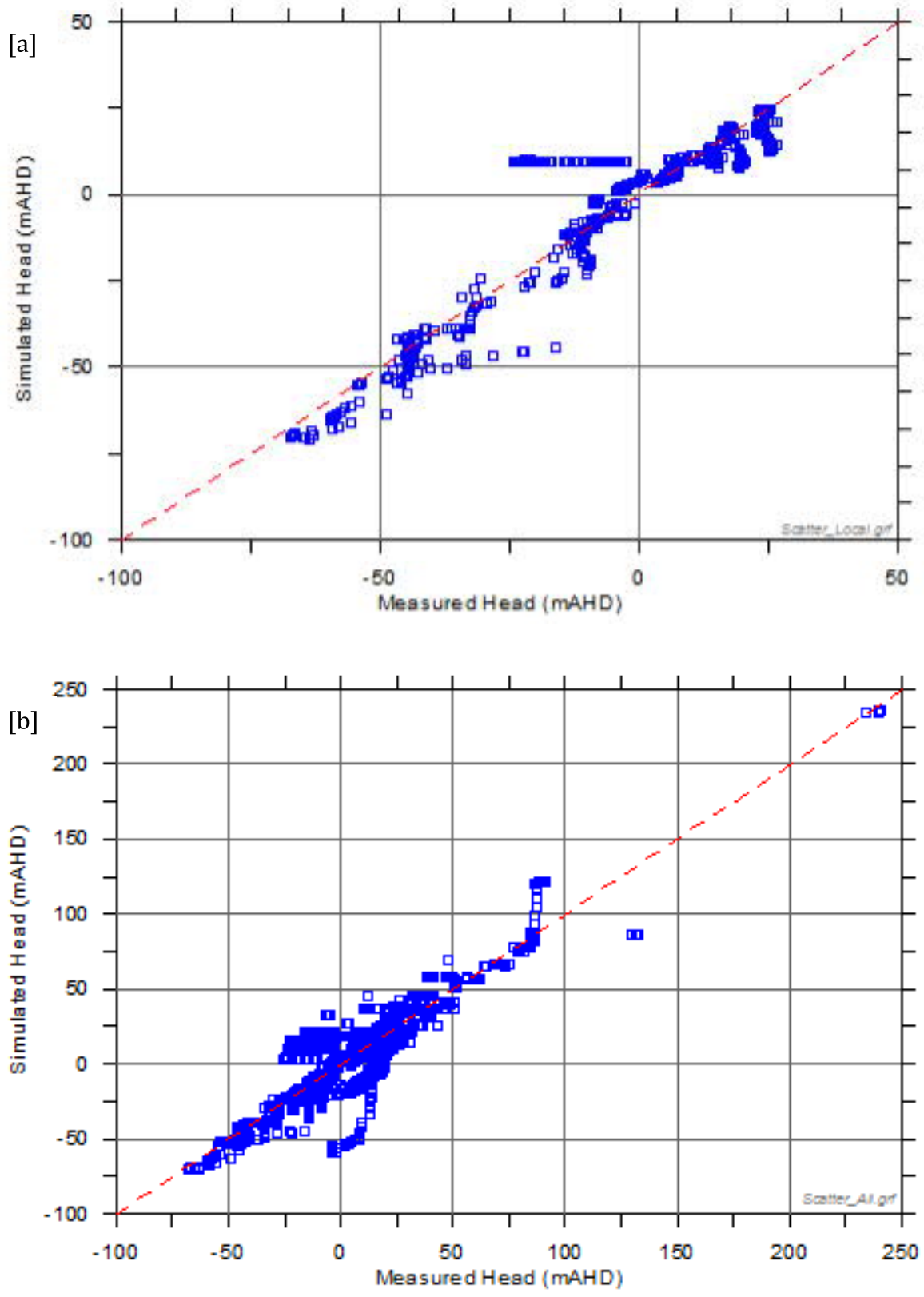


Figure 9. Calibration Scattergrams [a] Bloomfield Bores; [b] Regional Bores

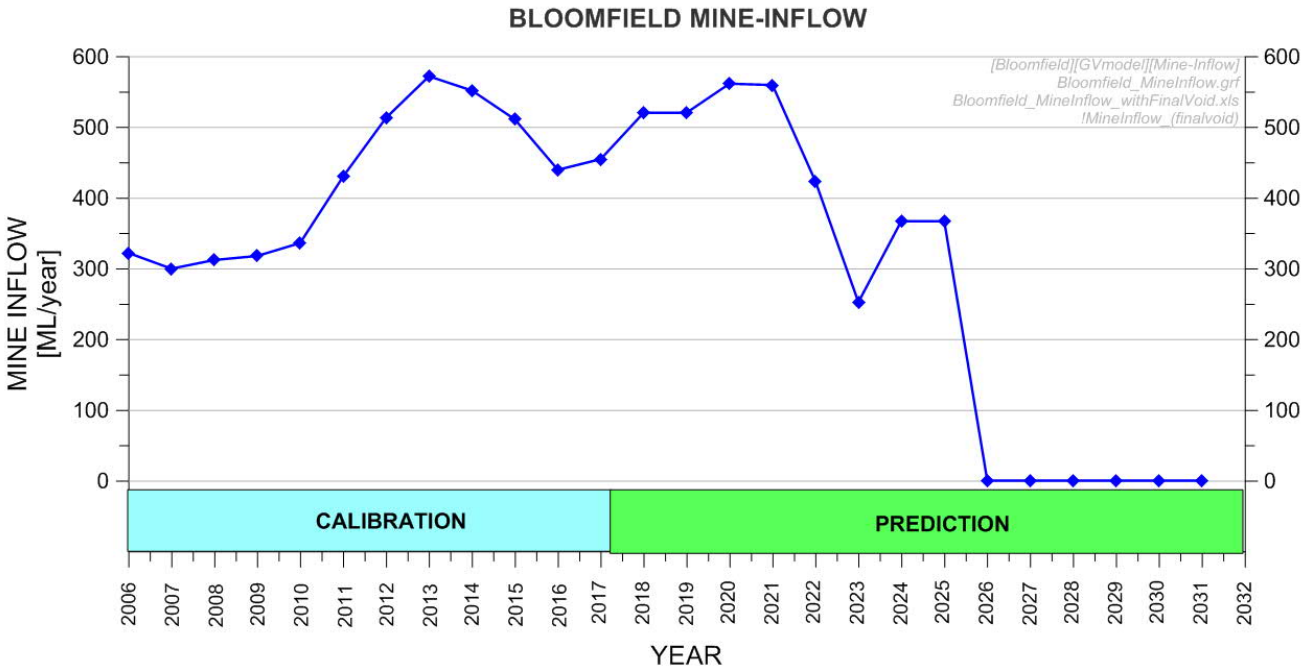


Figure 10. Modelled Mine Inflows for the Bloomfield Mine

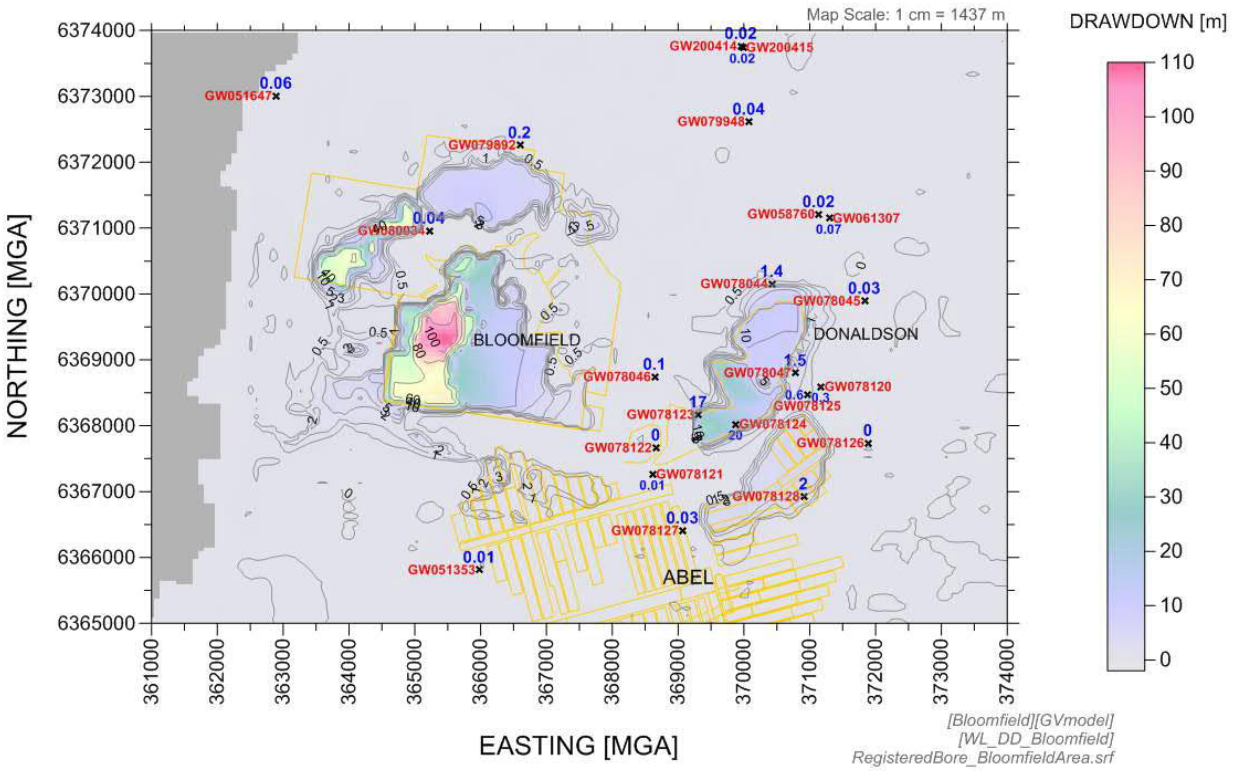


Figure 11. Predicted Drawdown at Registered Bores [in Alluvium and Regolith, Layer 1] at the End of Mining (Year 2025)

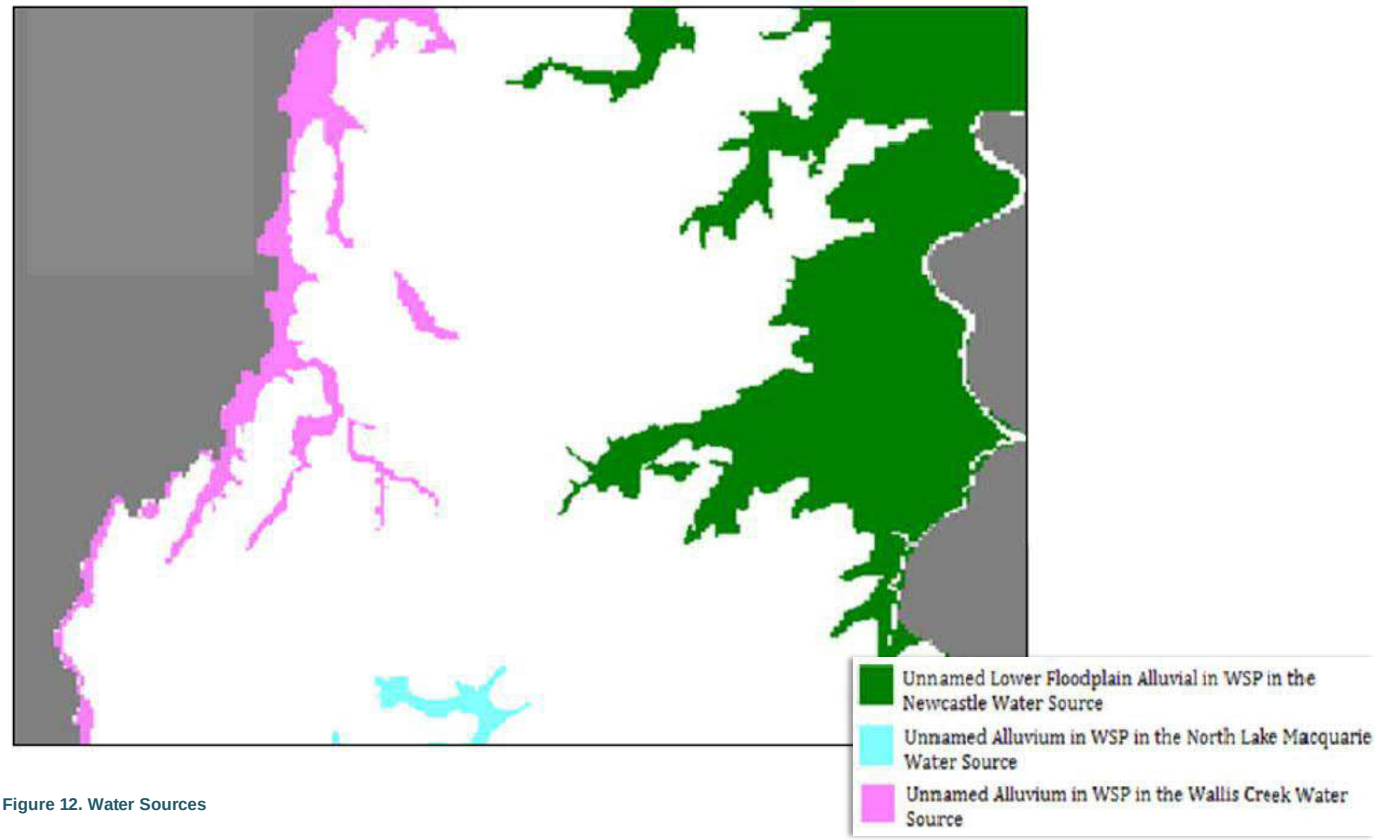


Figure 12. Water Sources

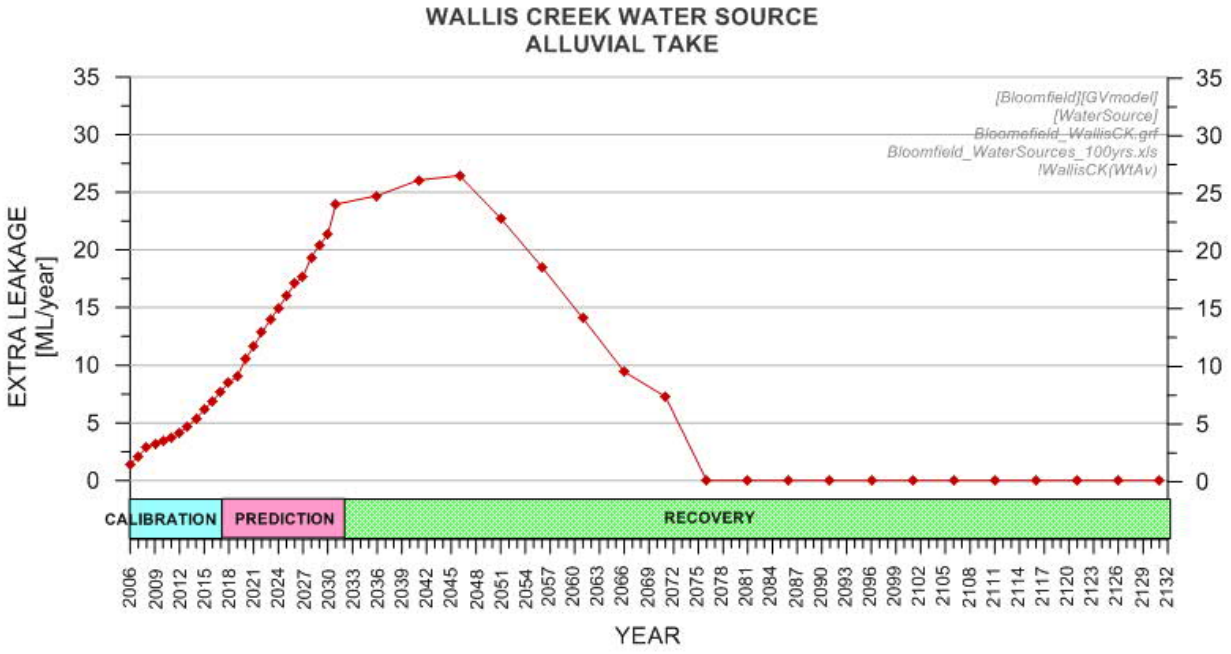


Figure 13. Wallis Creek Water Source Alluvial Take

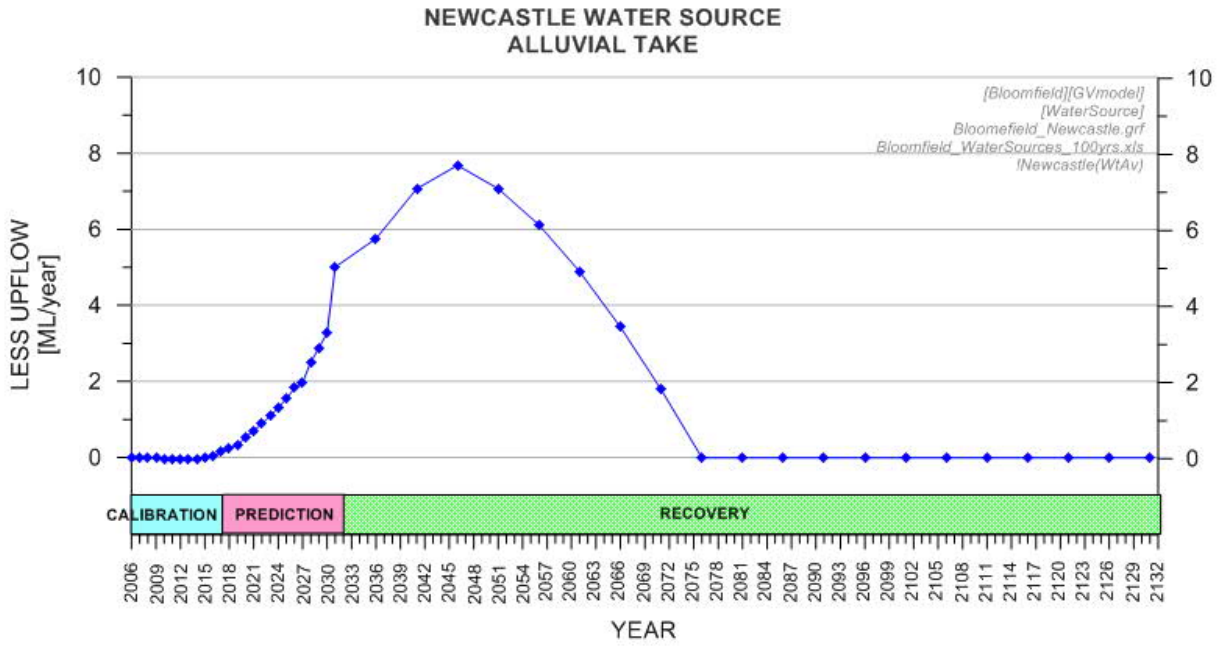
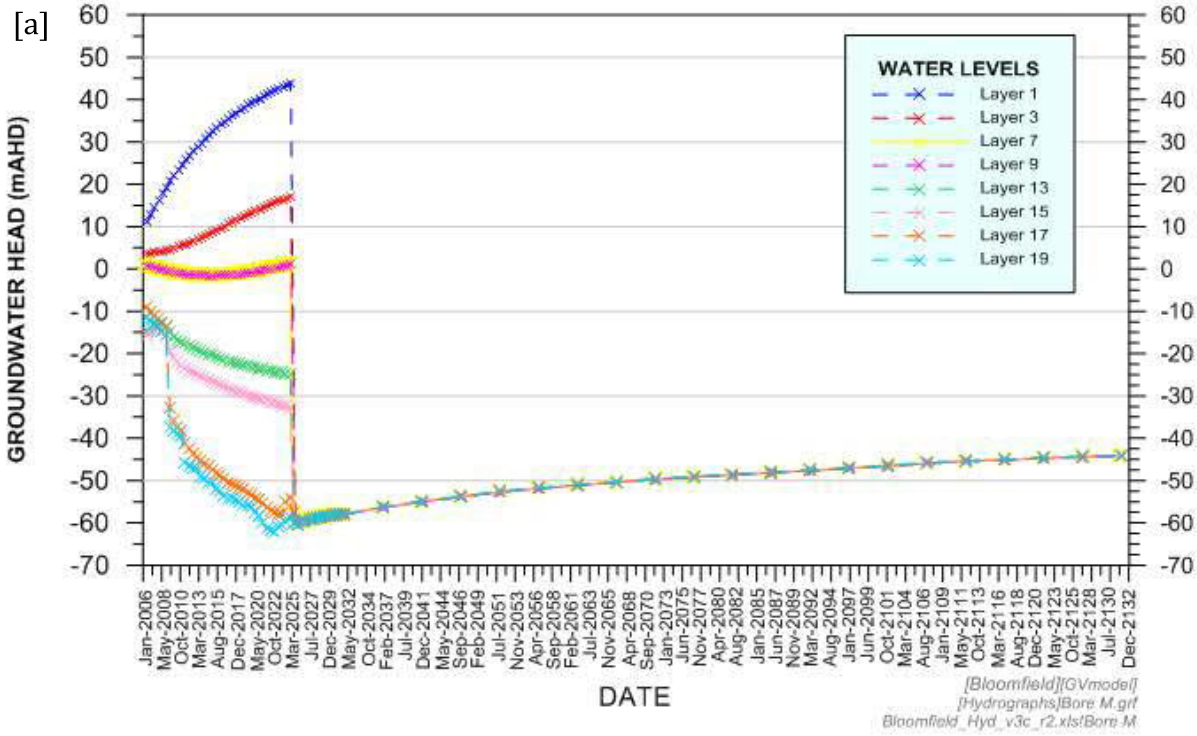


Figure 14. Newcastle Water Source Alluvial Take

[a]



[b]

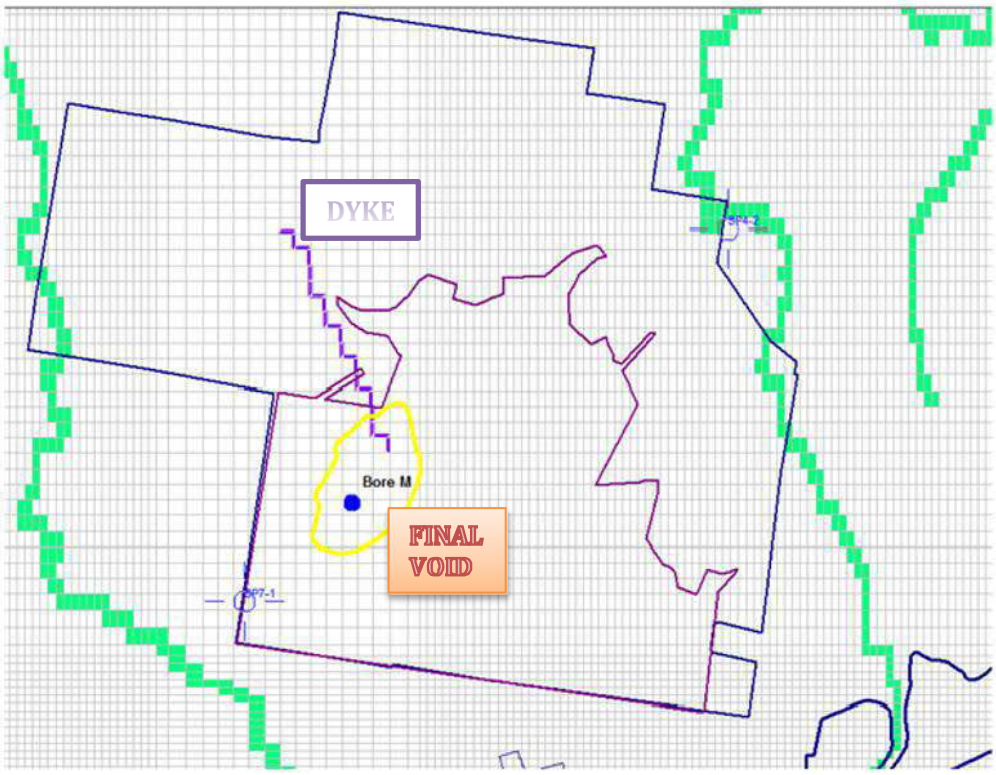


Figure 15. Simulated Recovery Hydrograph at Site M [a] within the Final Void [b]

APPENDIX A

Mining Progression

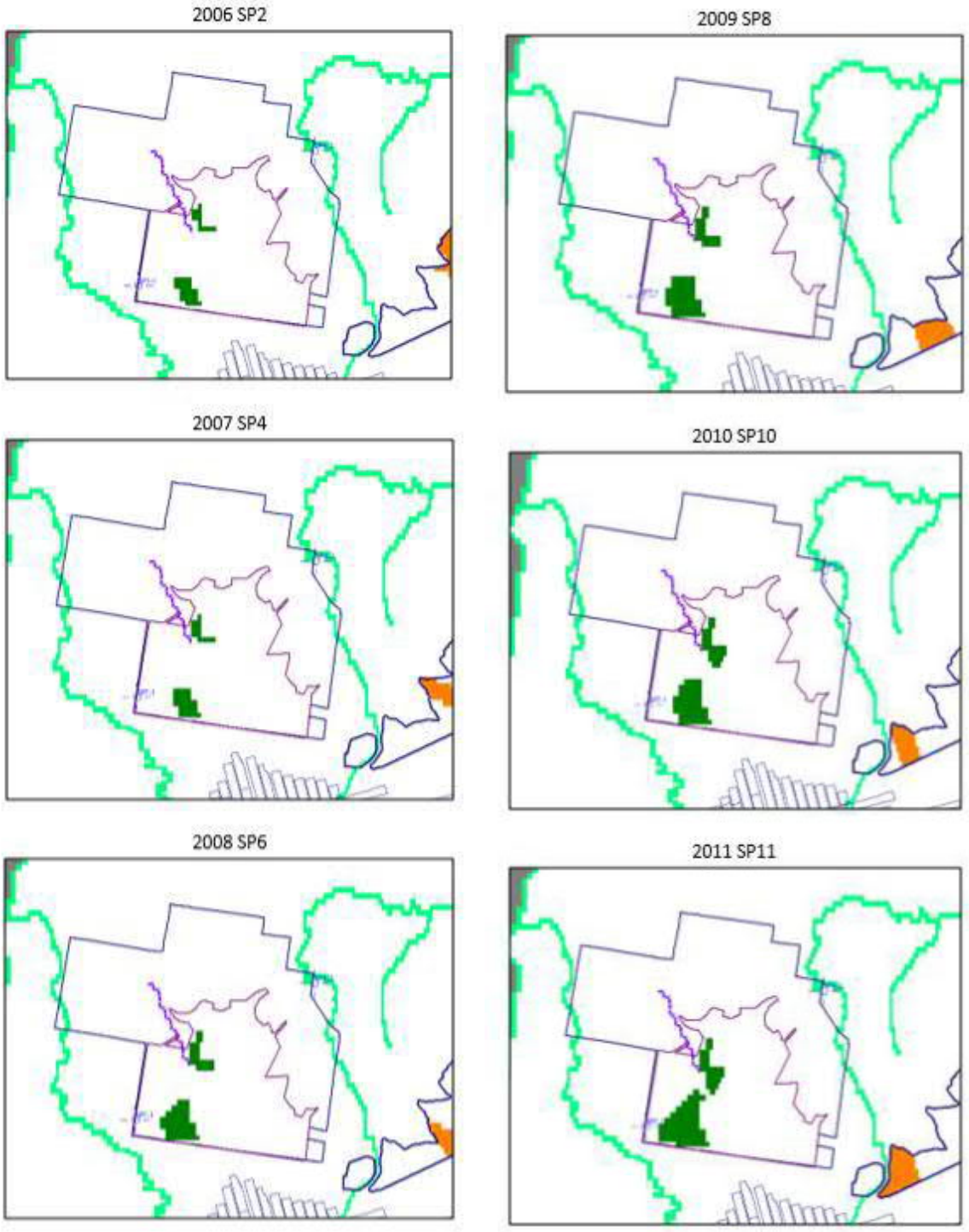


Figure A1. Mining Progression 2006 to 2011

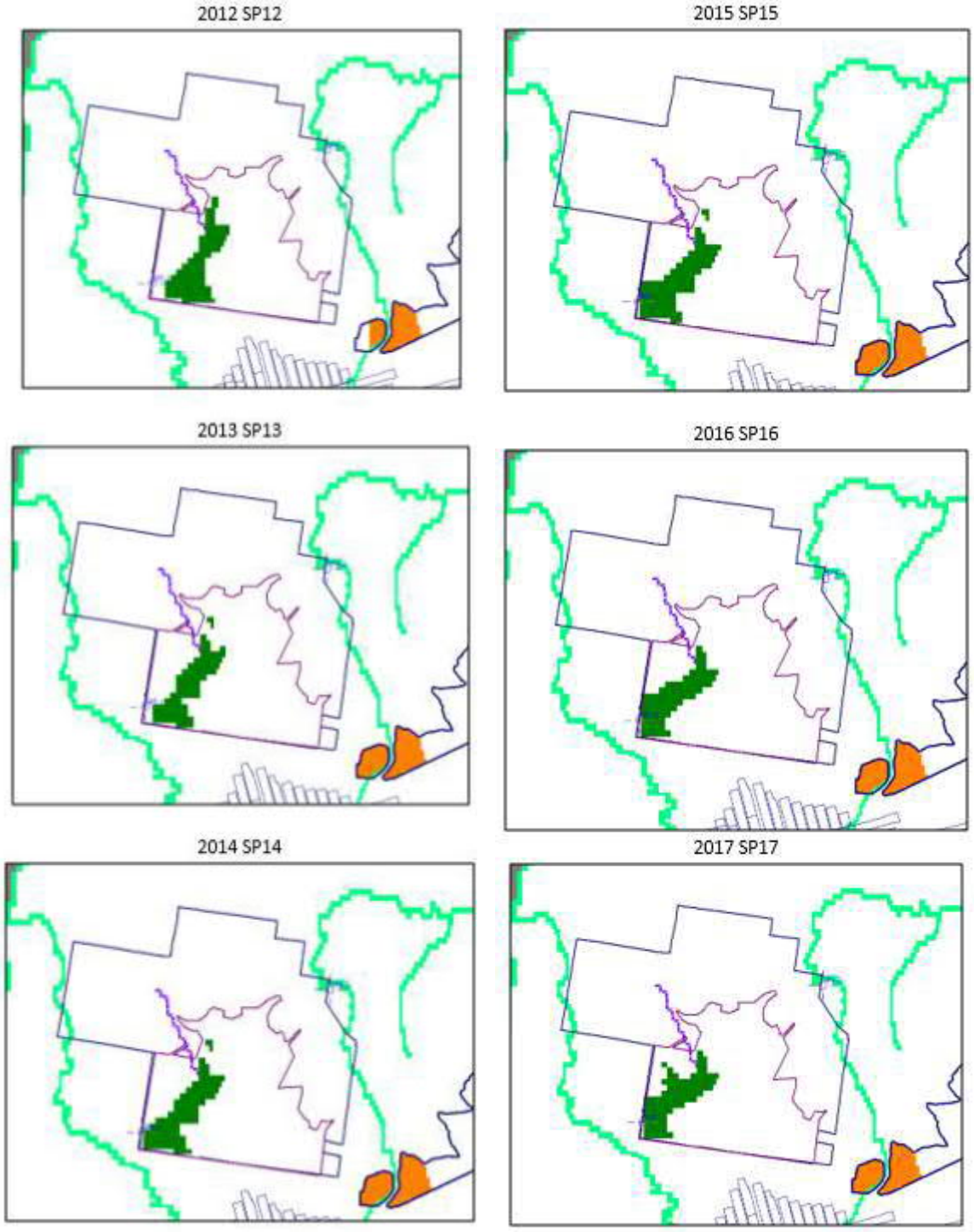


Figure A2. Mining Progression 2012 to 2017

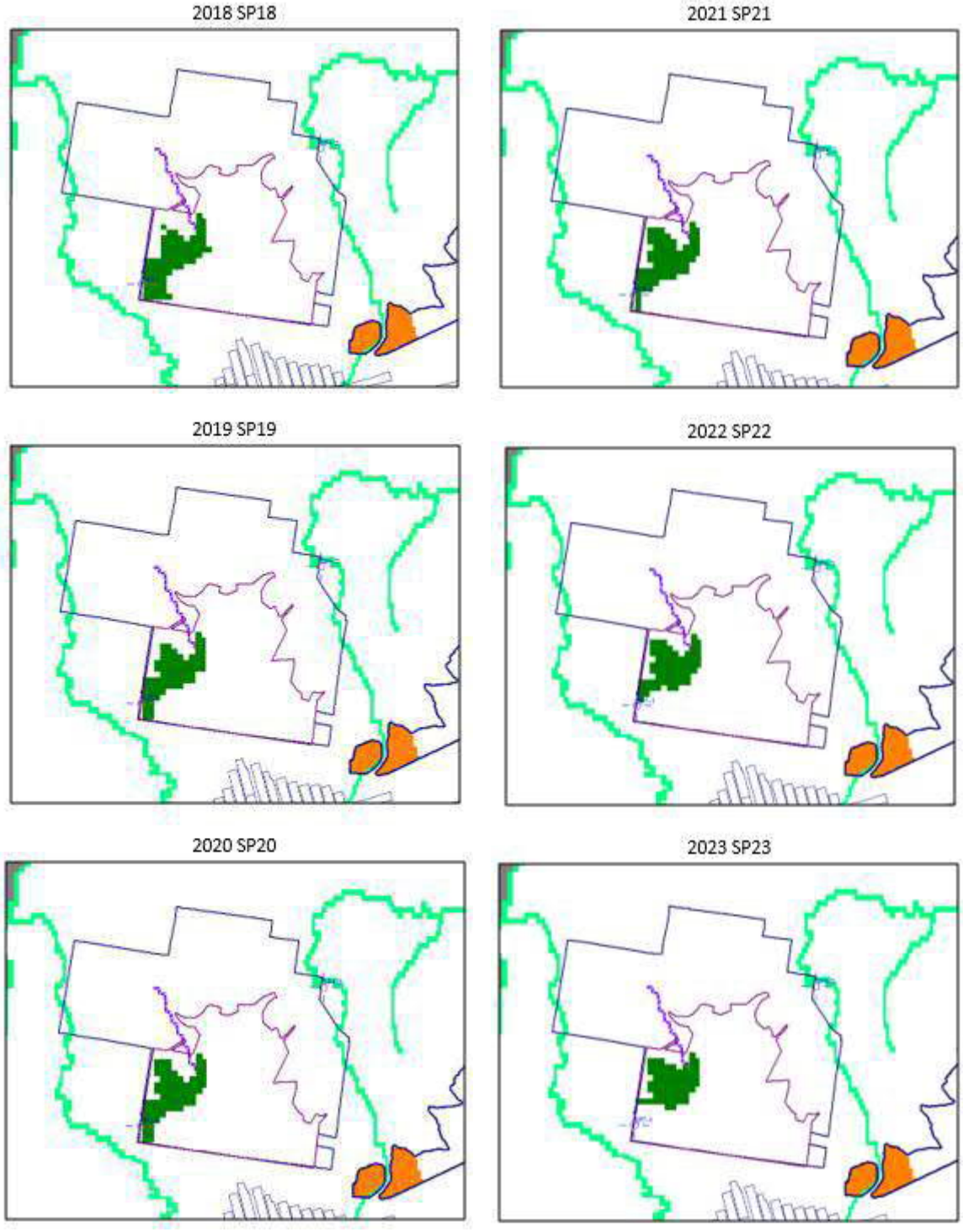


Figure A3. Mining Progression 2018 to 2023

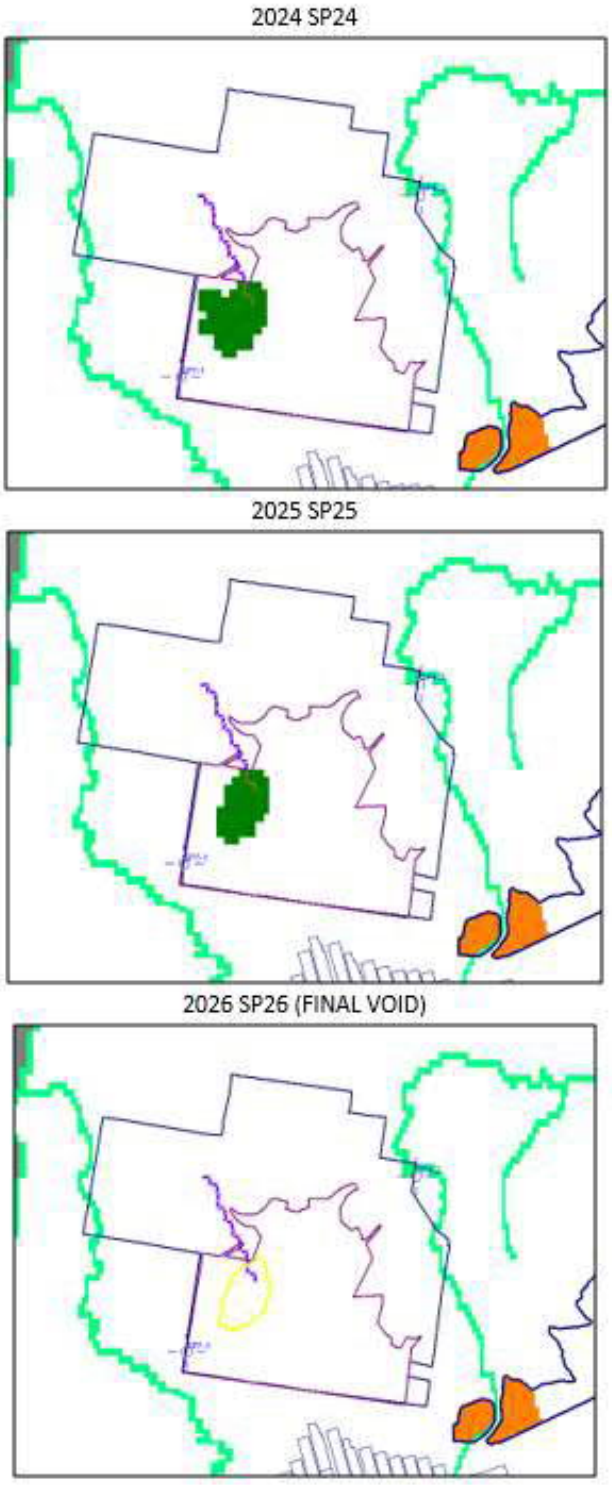


Figure A4. Mining Progression 2024 to 2025 and Final Void Location (SP26-SP32)

APPENDIX B

Groundwater Level Hydrographs

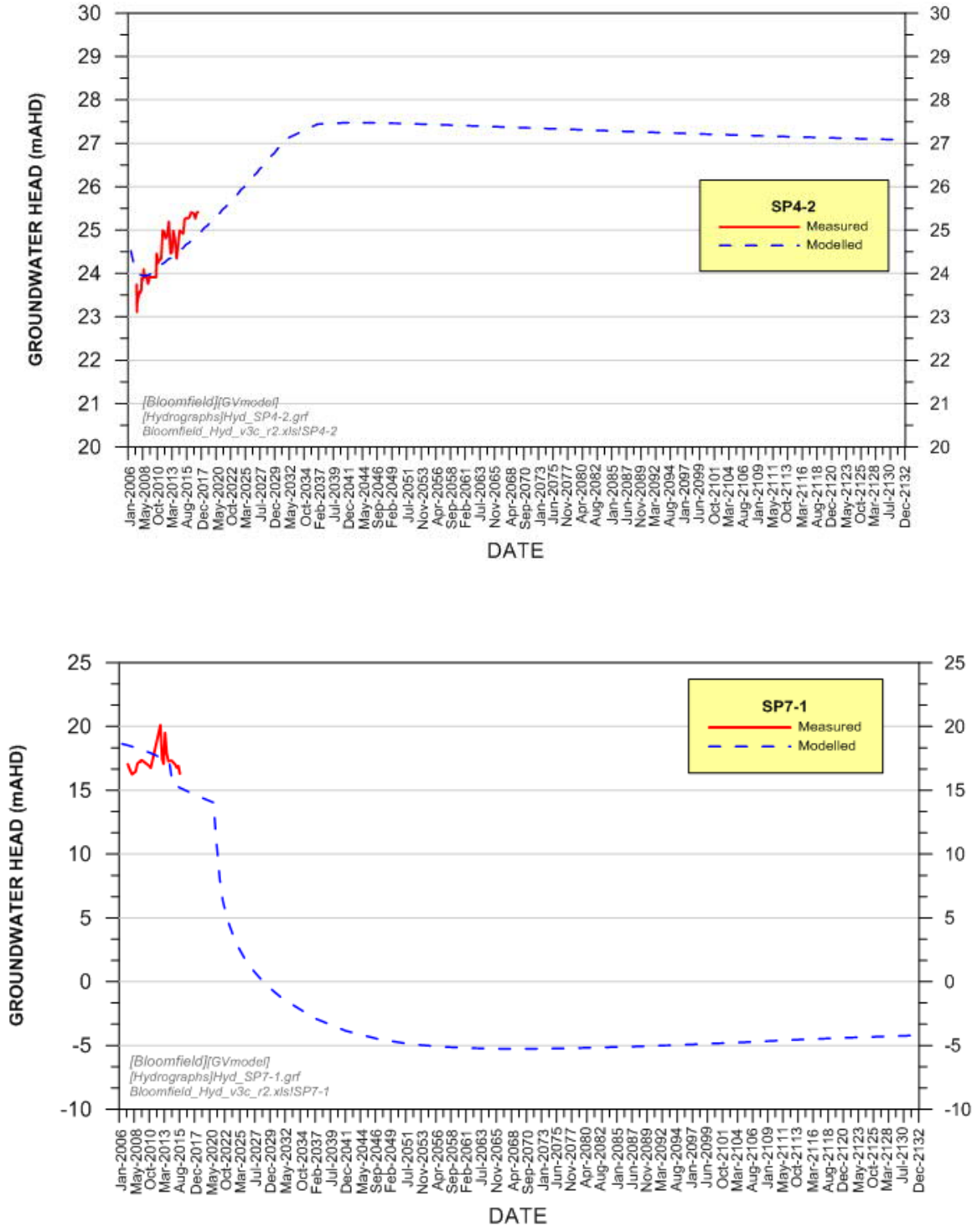


Figure B1. Measured and Simulated Hydrographs for Standpipes SP4-2 and SP7-1 in Alluvium and Regolith [Layer1]

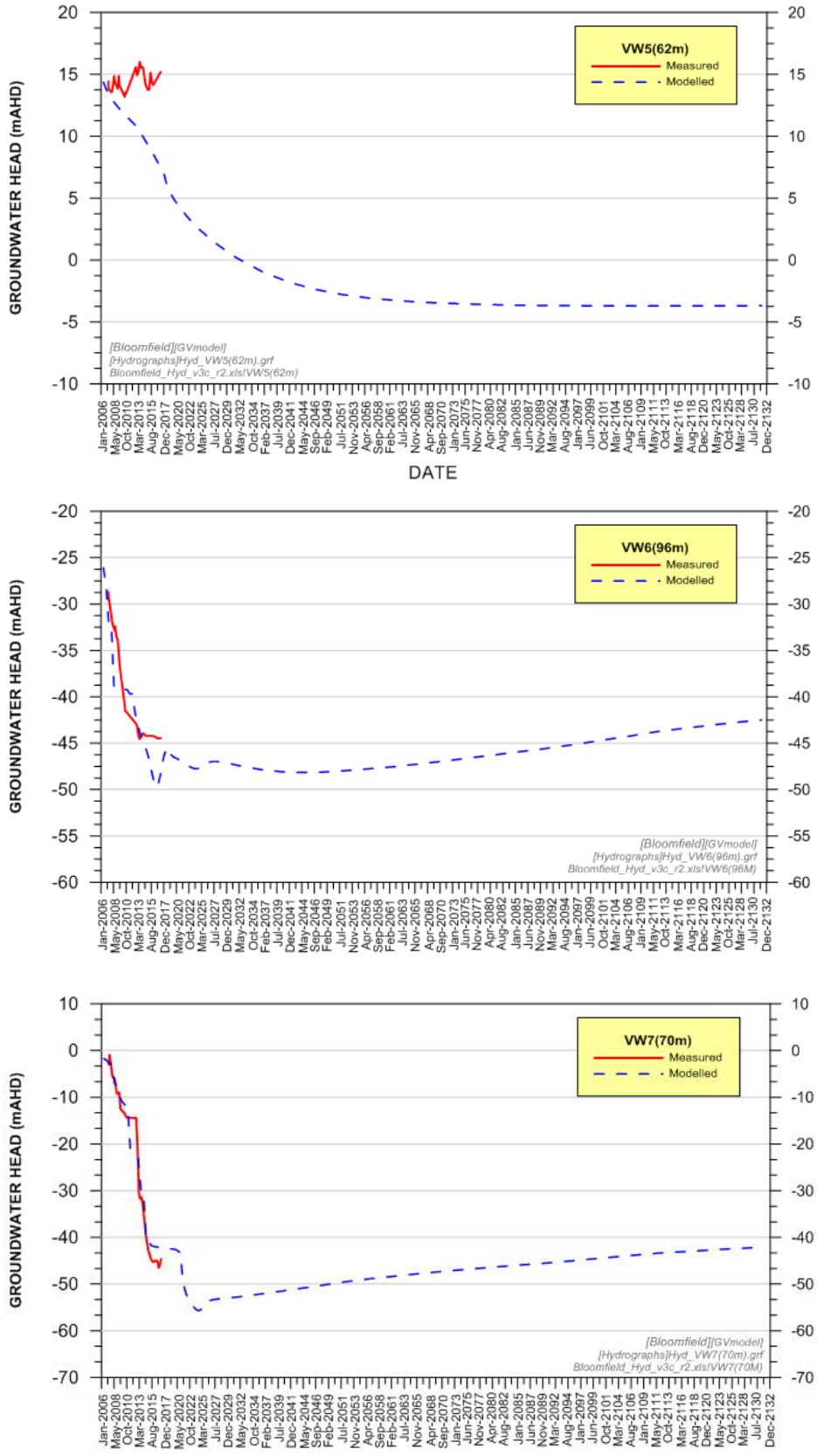


Figure B2. Measured and Simulated Hydrographs for VW5(62m), VW6(96m) and VW7(70m) at Whites Creek Seam [Layer13]

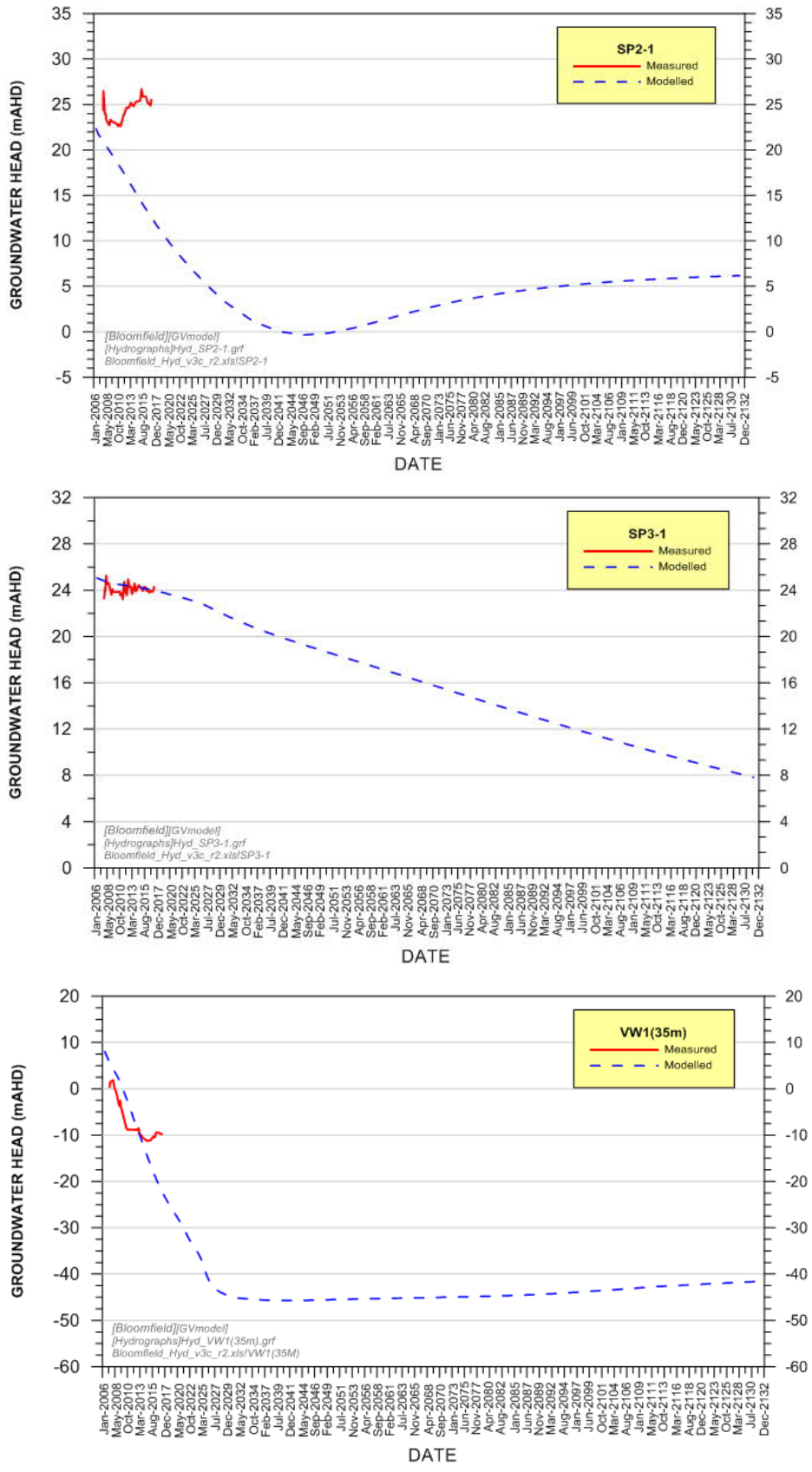


Figure B3. Measured and Simulated Hydrographs for Standpipes SP2-1 and SP3-1, and VW1(35m) at Donaldson Seam [Layer17]

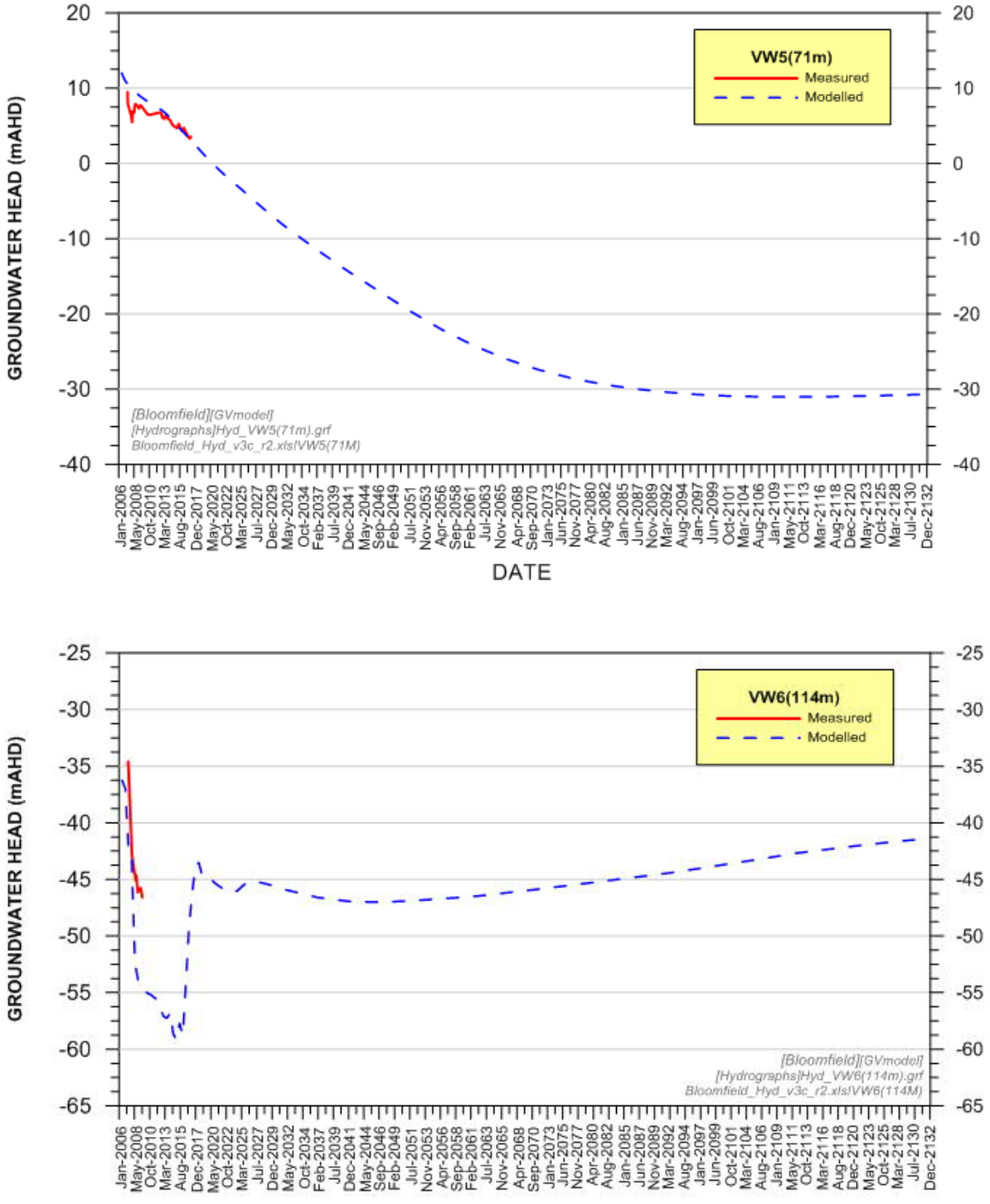


Figure B4. Measured and Simulated Hydrographs for VW5(71m) and VW6(114m) at Donaldson Seam [Layer17]

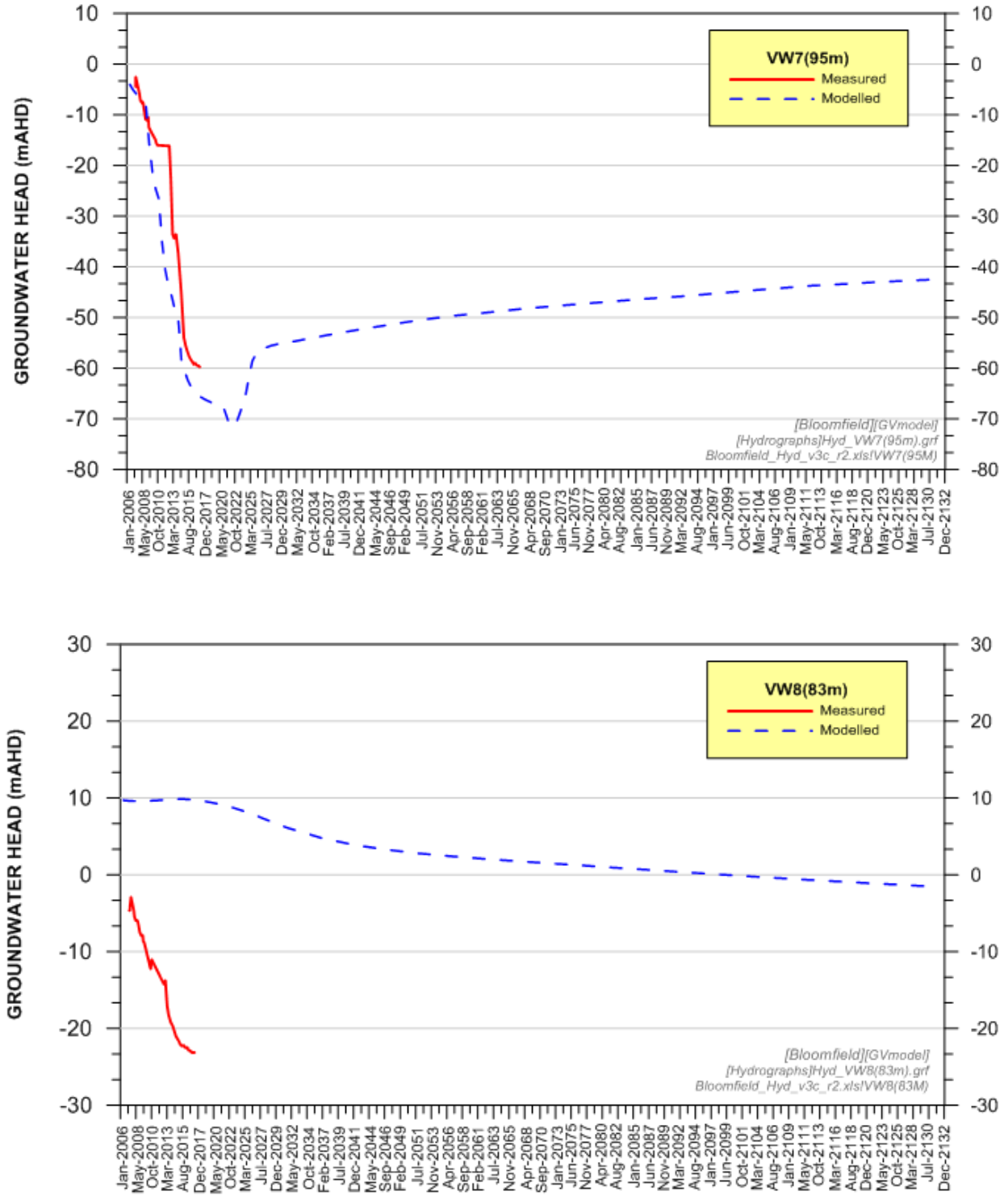


Figure B5. Measured and Simulated Hydrographs for VW7(95m) and VW8(83m) at Donaldson Seam [Layer17]

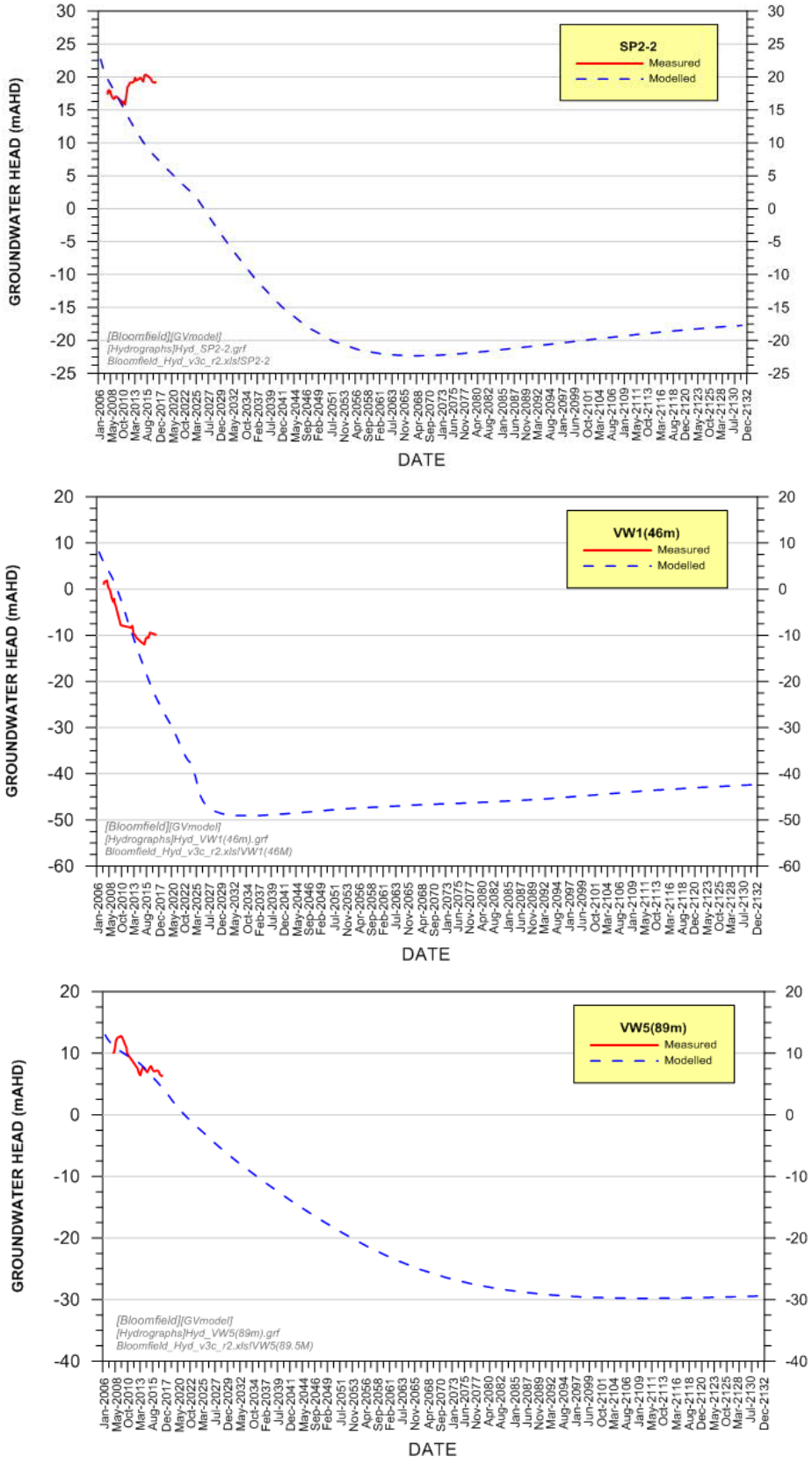


Figure B6. Measured and Simulated Hydrographs for Standpipe SP2-2, VW1(46m) and VW5(89m) at Big Ben Seam [Layer19]

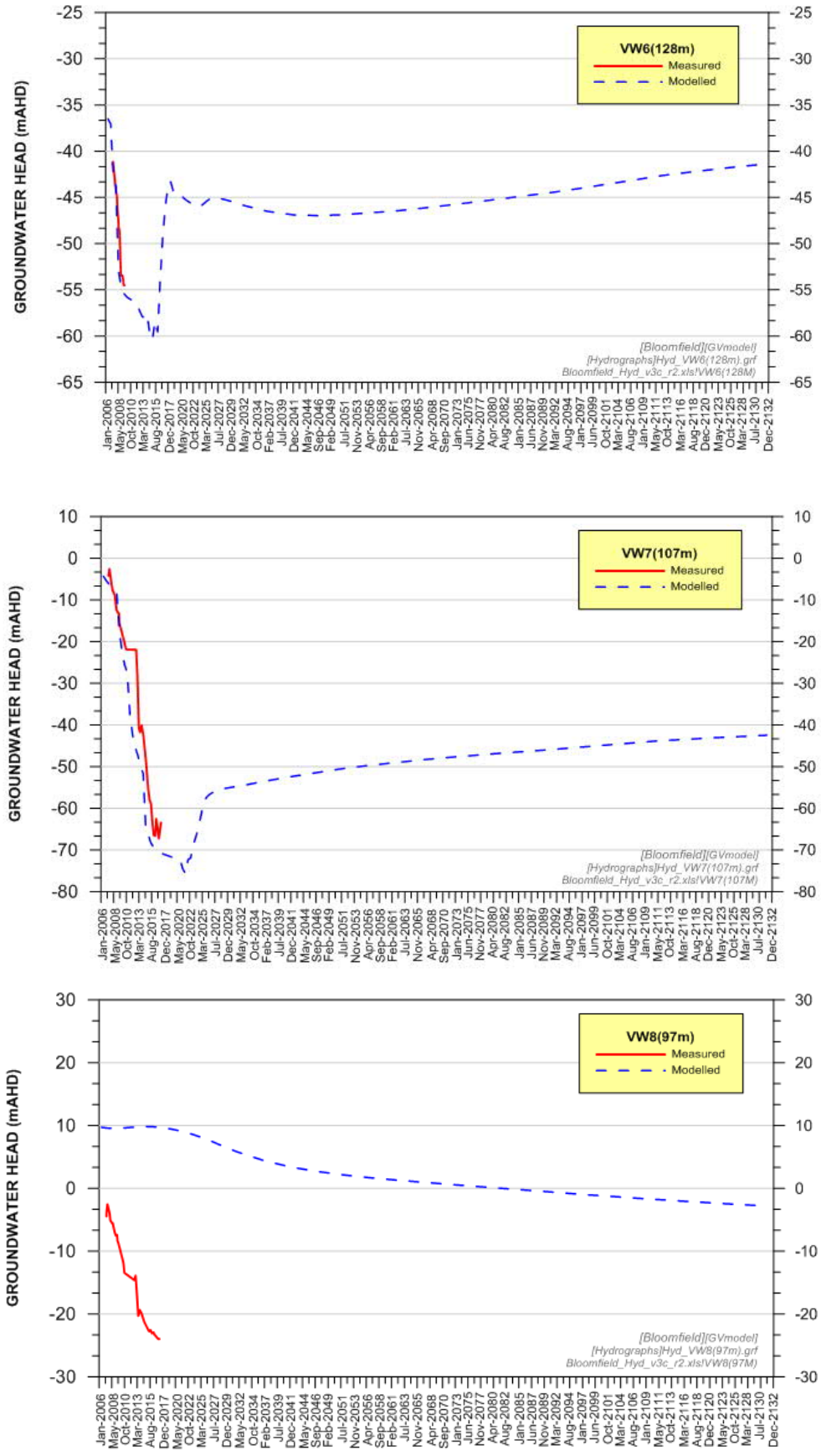


Figure B7. Measured and Simulated Hydrographs for VW6(128m), VW7(107m) and VW8(97m) at Big Ben Seam [Layer19]

APPENDIX C

Simulated Groundwater Level Maps

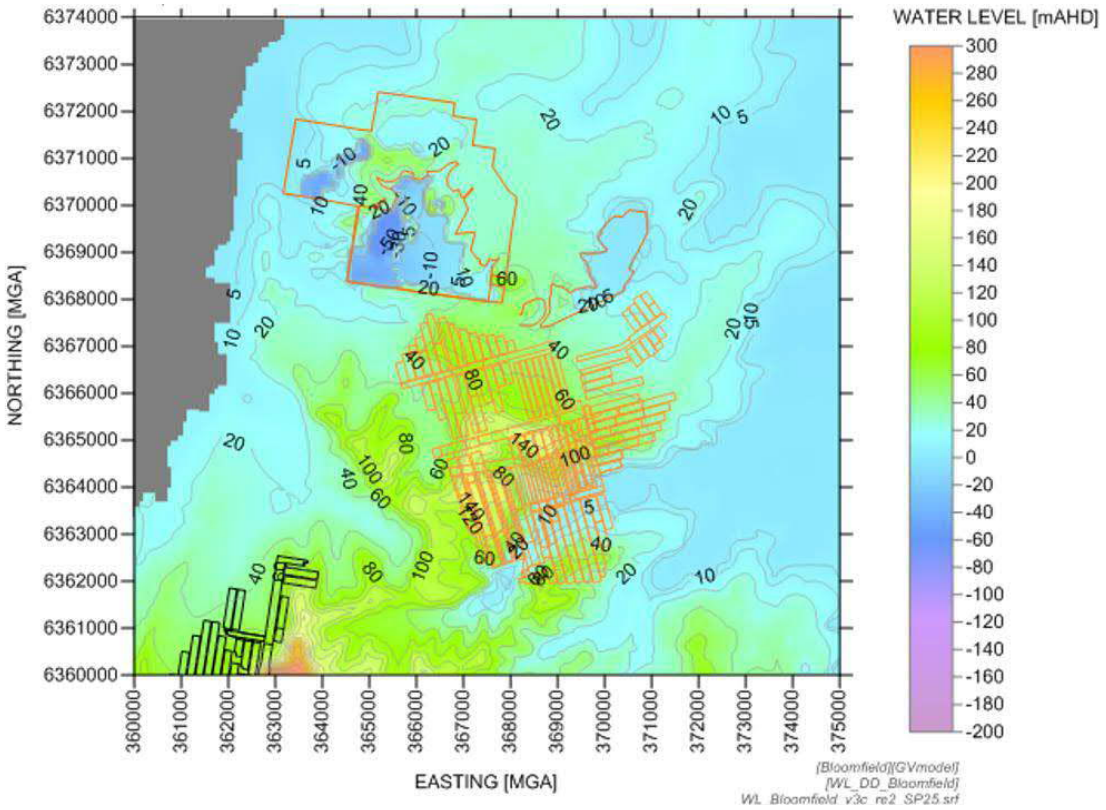


Figure C2. Predicted Water Levels in Alluvium and Regolith [Layer 1] at the End of Mining (Year2025)

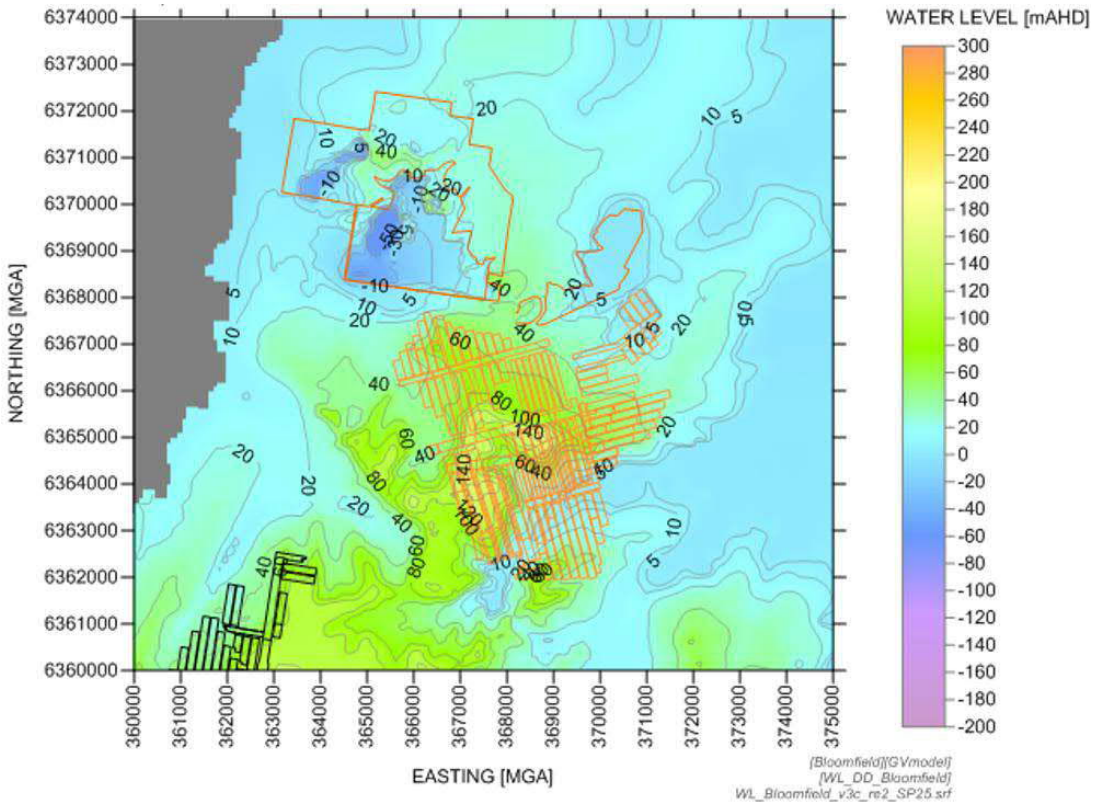


Figure C2. Predicted Water Levels in C Seam [Layer 3] at the End of Mining (Year2025)

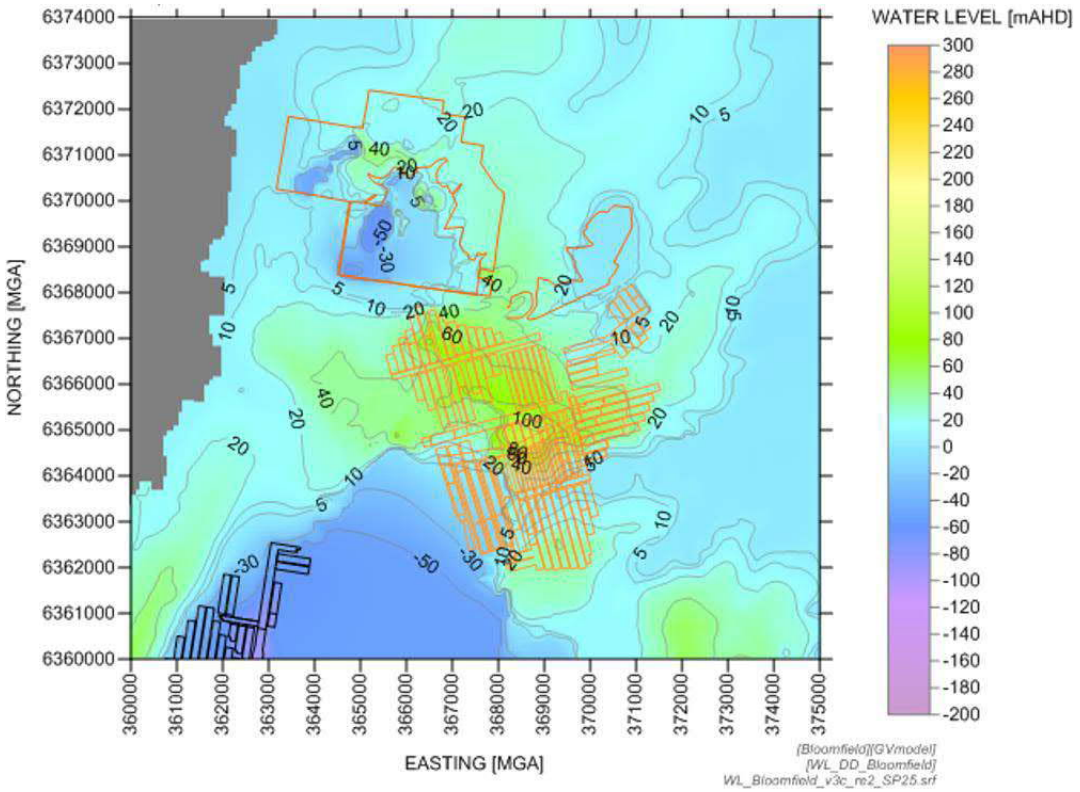


Figure C3. Predicted Water Levels in B Seam [Layer 7] at the End of Mining (Year2025)

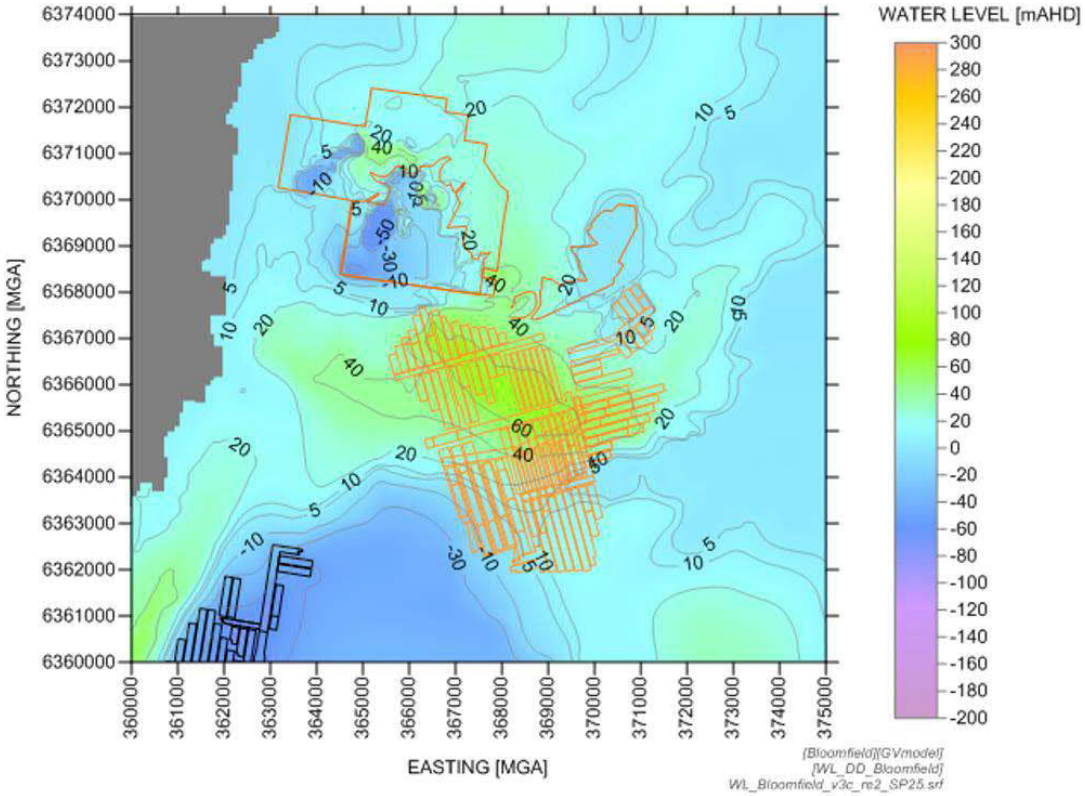


Figure C4. Predicted Water Levels in A Seam [Layer 9] at the End of Mining (Year2025)

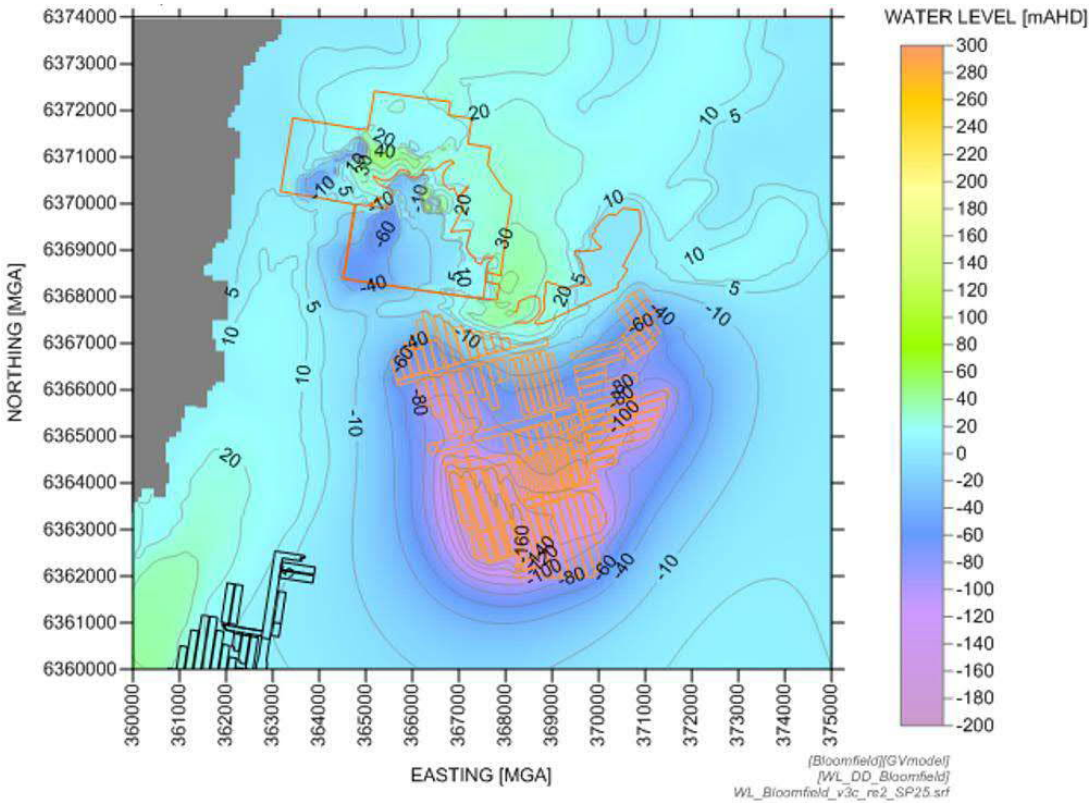


Figure C5. Predicted Water Levels in Whites Creek Seam [Layer 13] at the End of Mining (Year2025)

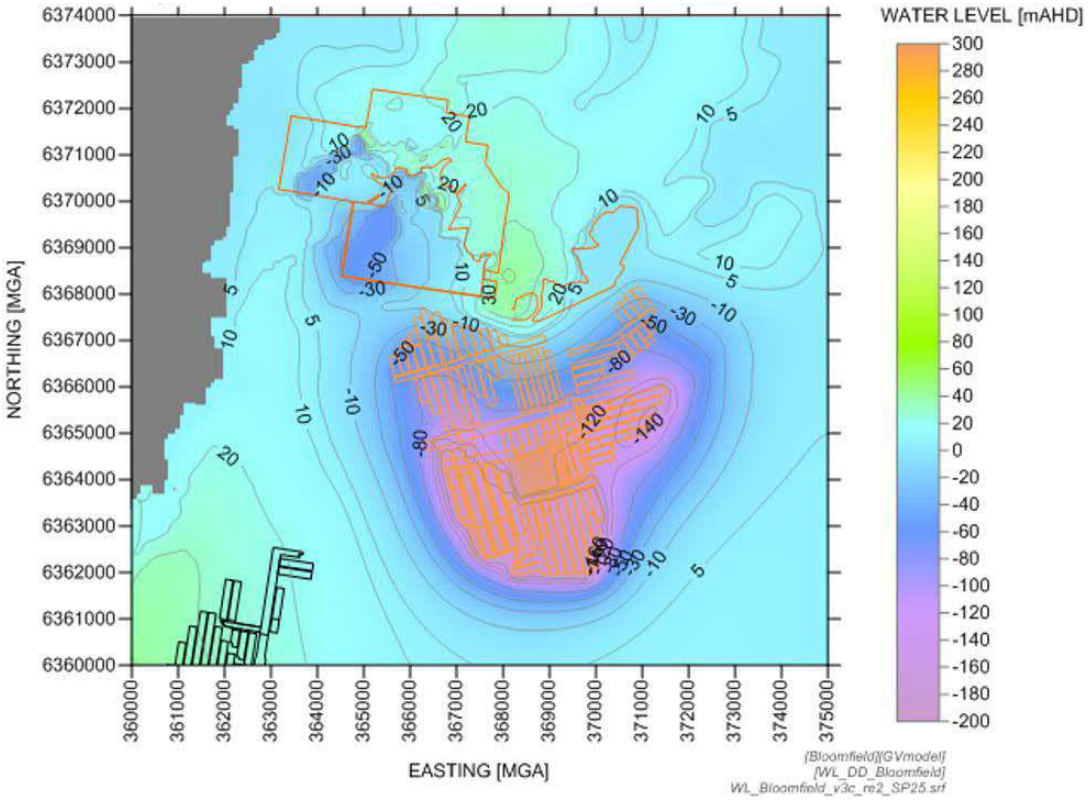


Figure C6. Predicted Water Levels in EC Seam [Layer 15] at the End of Mining (Year2025)

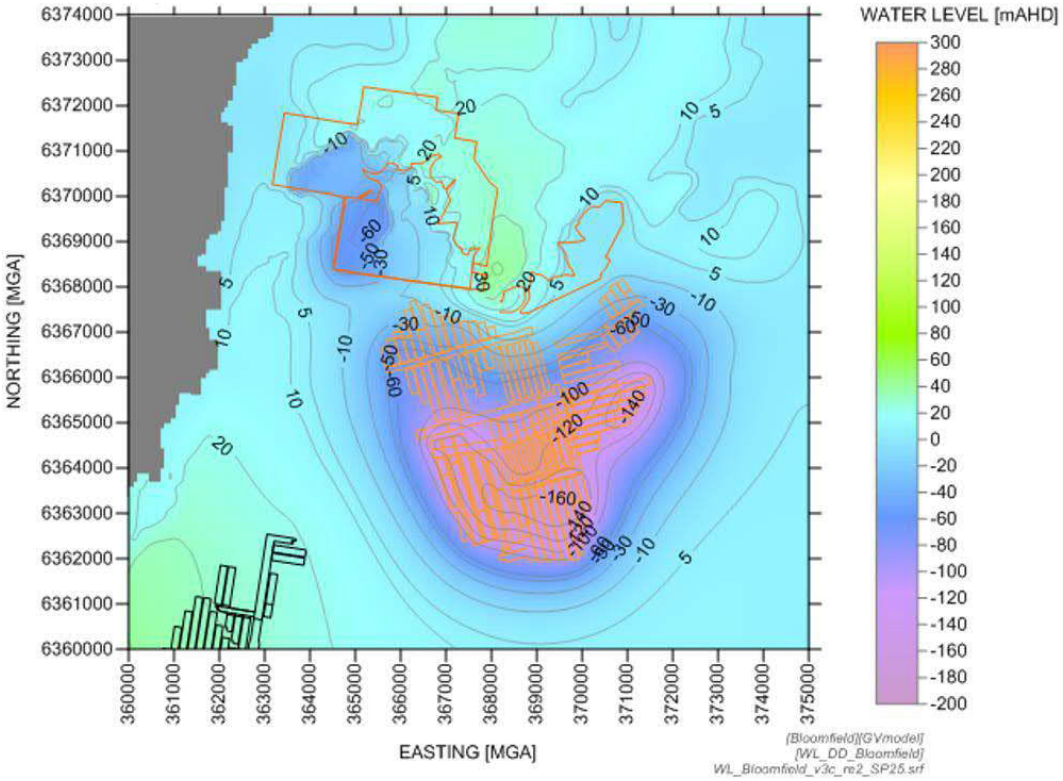


Figure C7. Predicted Water Levels in Donaldson Seam [Layer 17] at the End of Mining (Year2025)

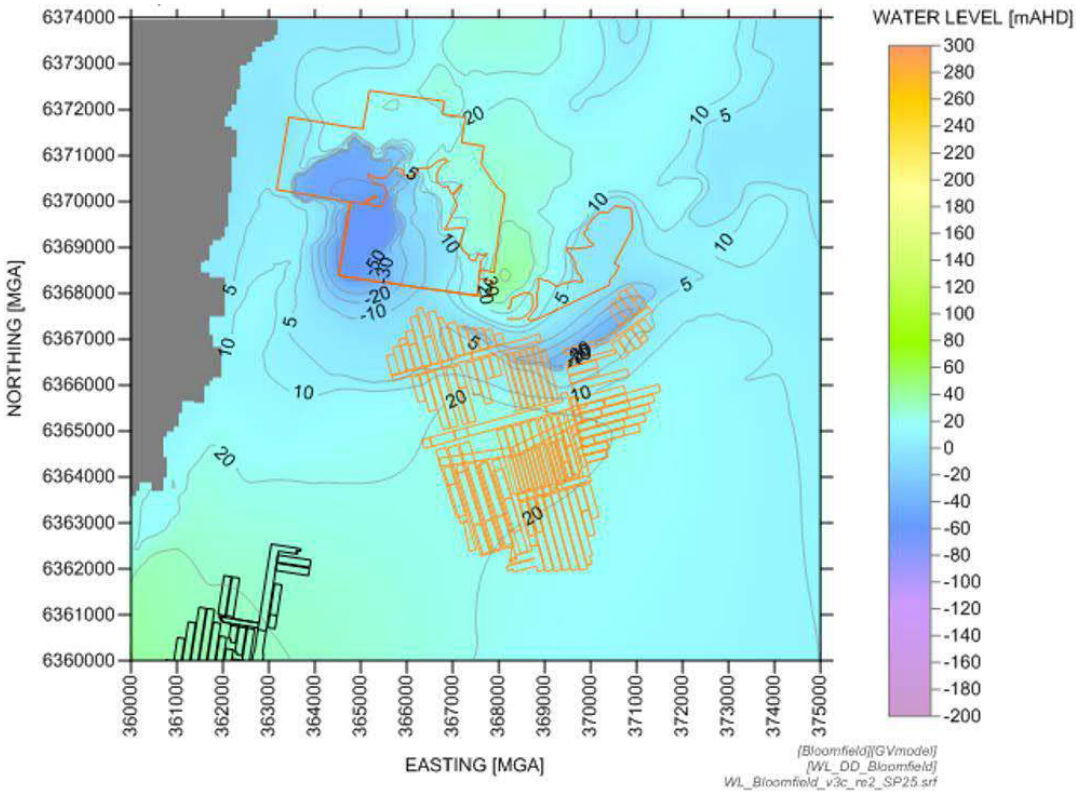


Figure C8. Predicted Water Levels in Big Ben Seam [Layer 19] at the End of Mining (Year2025)

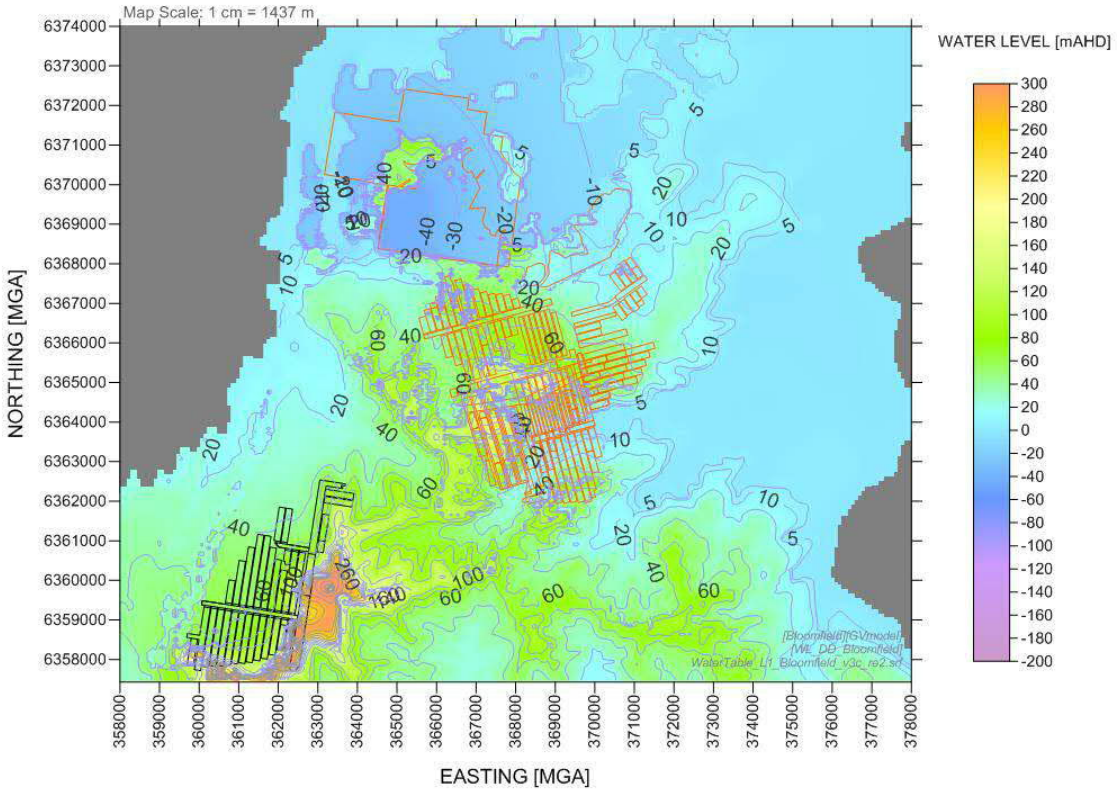


Figure C9. Predicted Water Table at the End of Recovery (100 years)

APPENDIX D

Predicted Groundwater Drawdown Maps

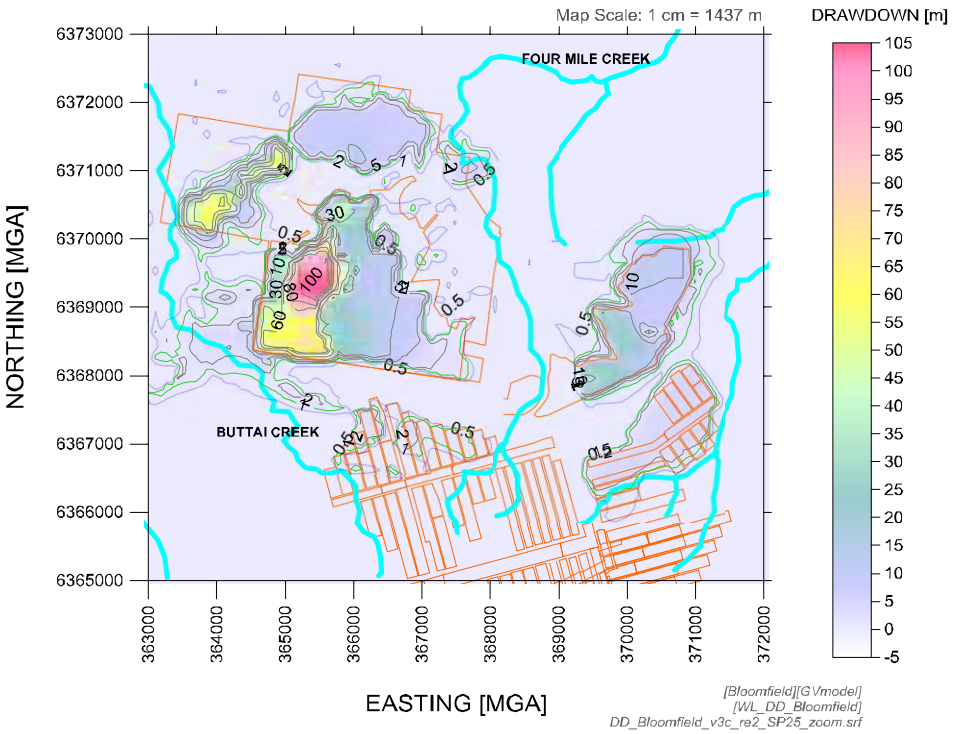


Figure D3. Predicted Drawdowns in Alluvium and Regolith [Layer 1] at the End of Mining (Year2025)

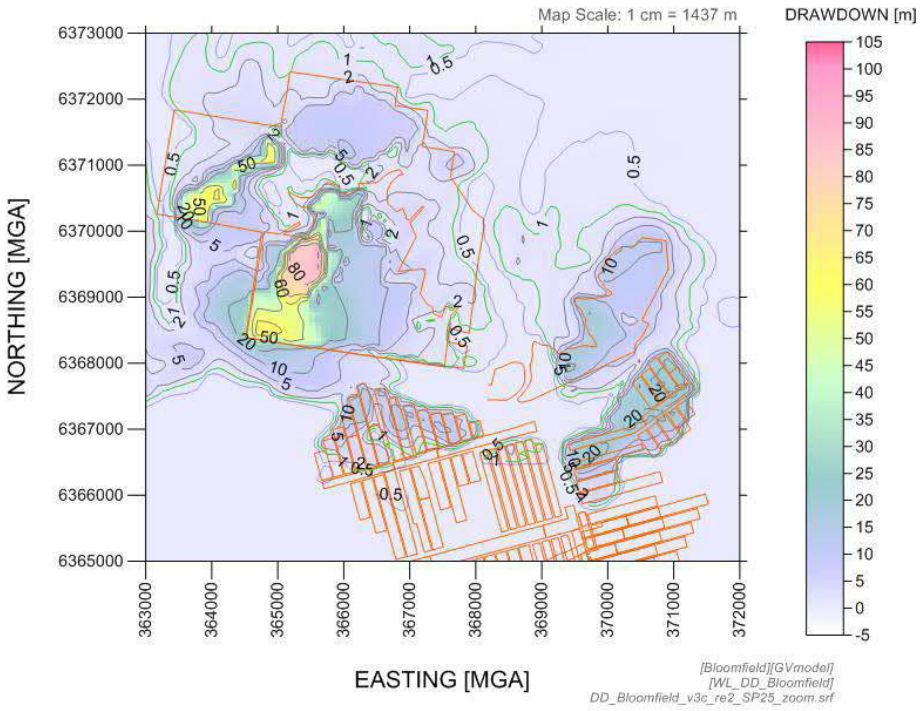


Figure D2. Predicted Drawdowns in C Seam [Layer 3] at the End of Mining (Year2025)

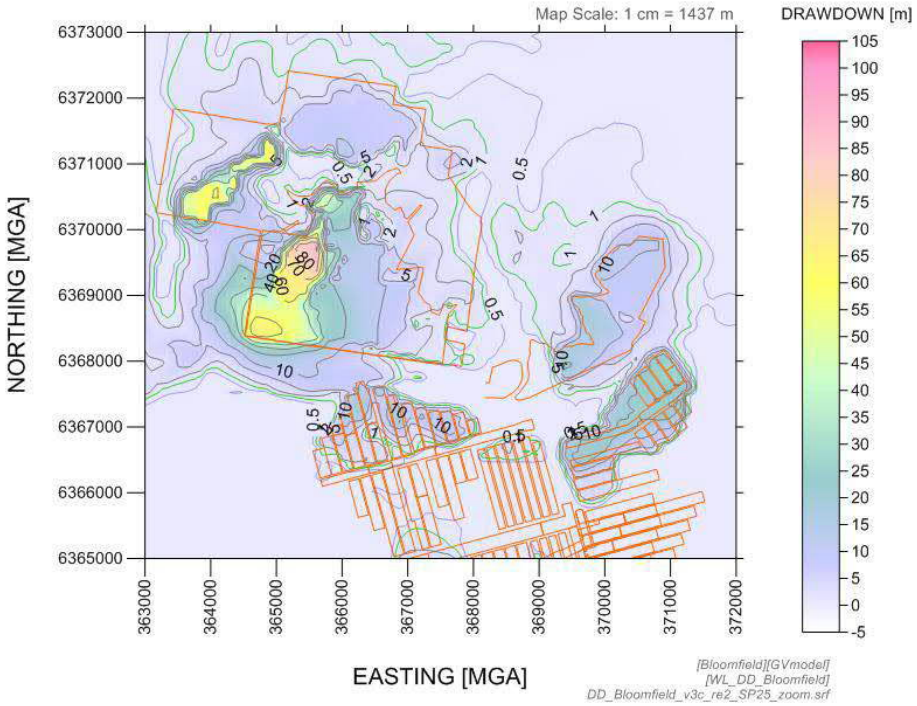


Figure D3. Predicted Drawdowns in B Seam [Layer 7] at the End of Mining (Year2025)

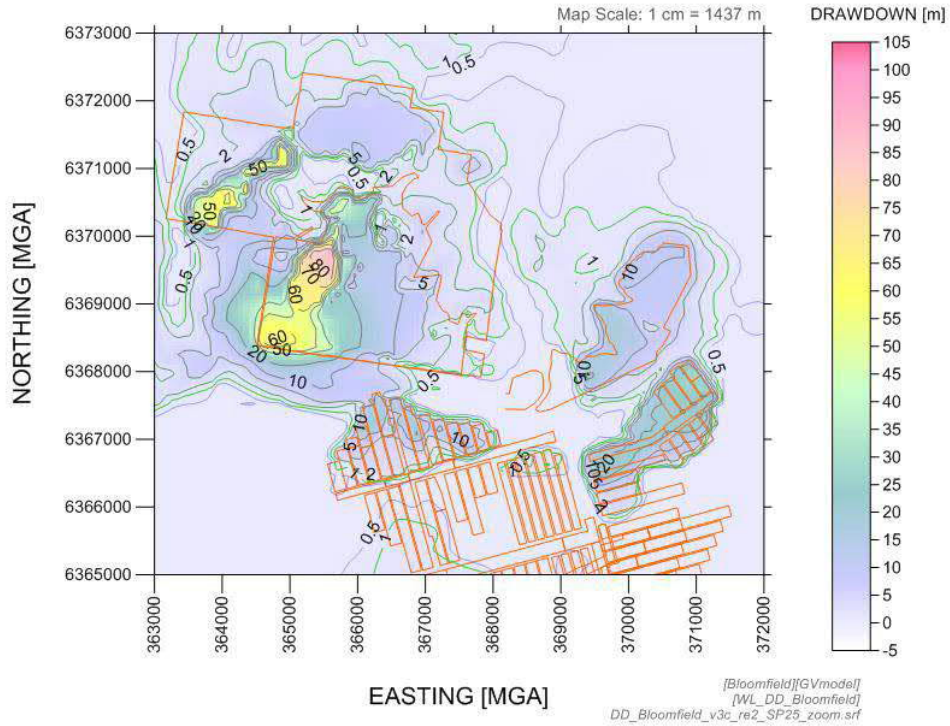


Figure D4. Predicted Drawdowns in A Seam [Layer 9] at the End of Mining (Year2025)

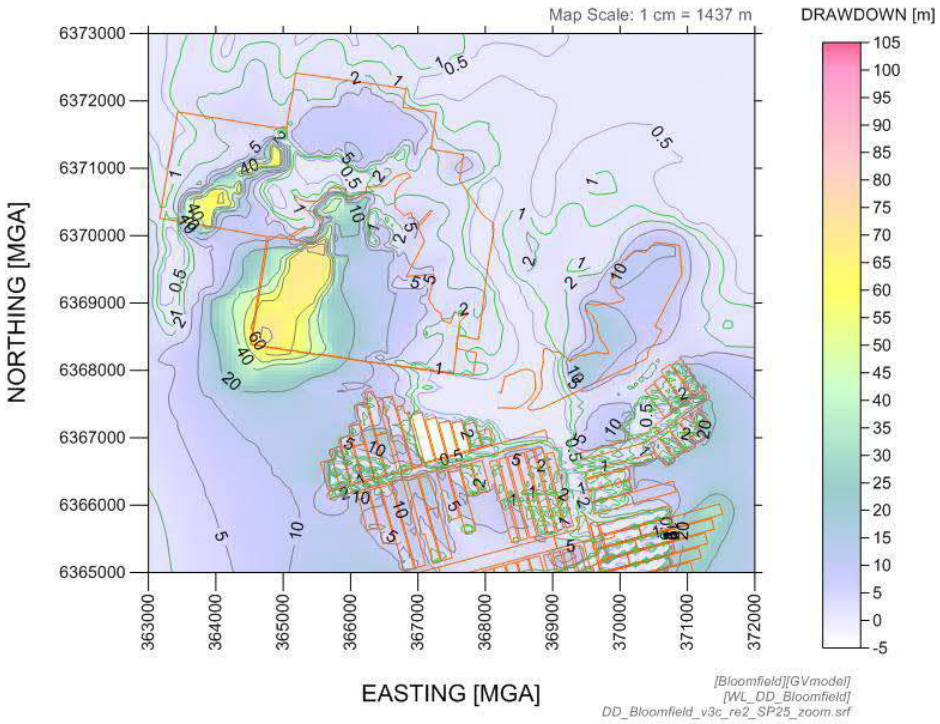


Figure D5. Predicted Drawdowns in Whites Creek Seam [Layer 13] at the End of Mining (Year2025)

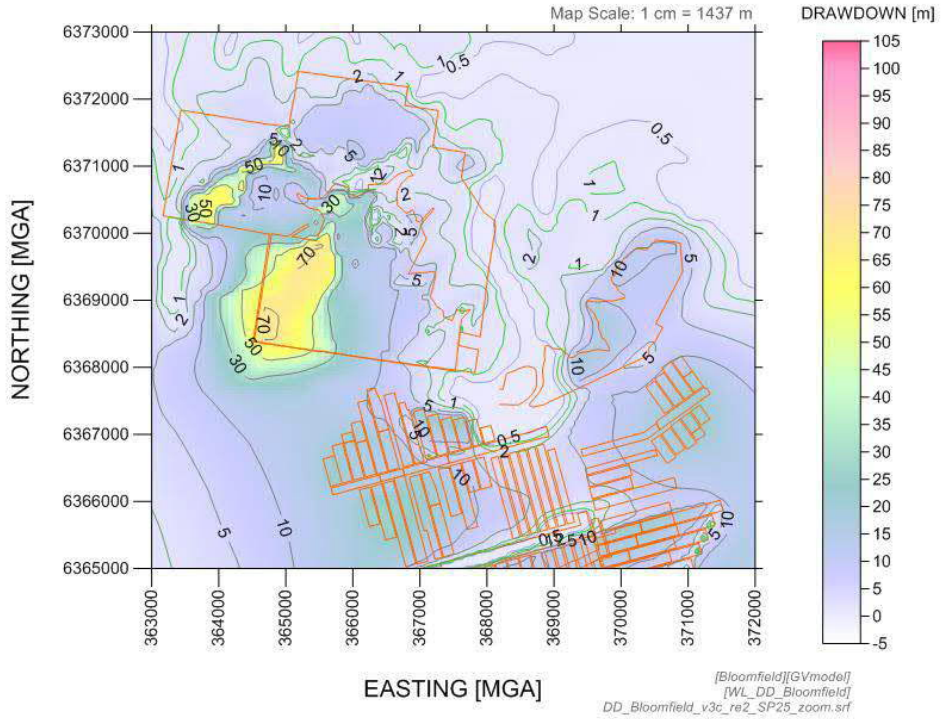


Figure D6. Predicted Drawdowns in EC Seam [Layer 15] at the End of Mining (Year2025)

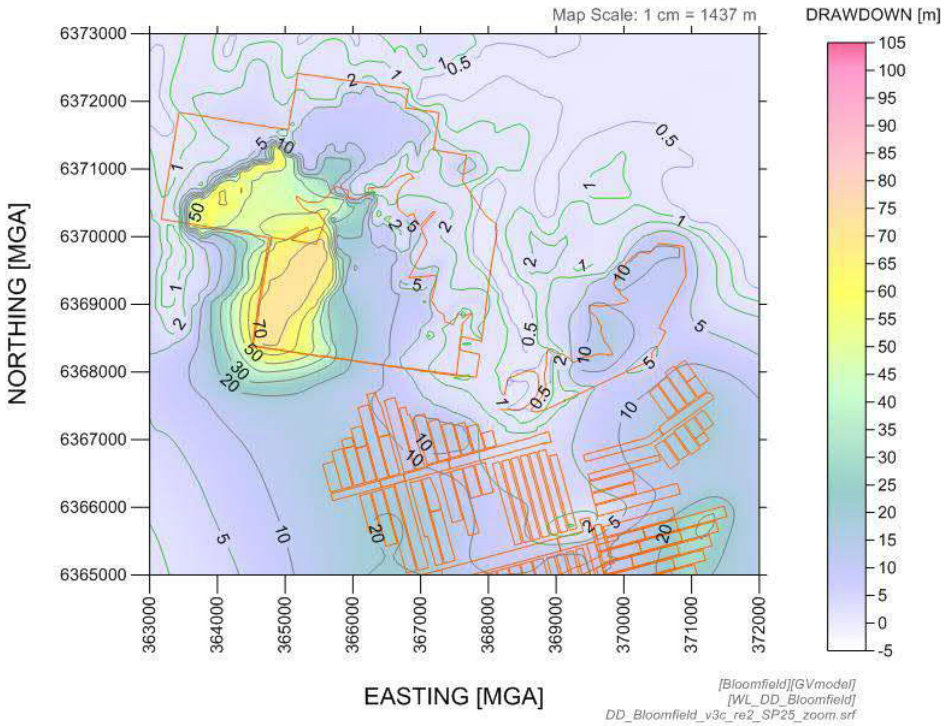


Figure D7. Predicted Drawdowns in Donaldson Seam [Layer 17] at the End of Mining (Year2025)

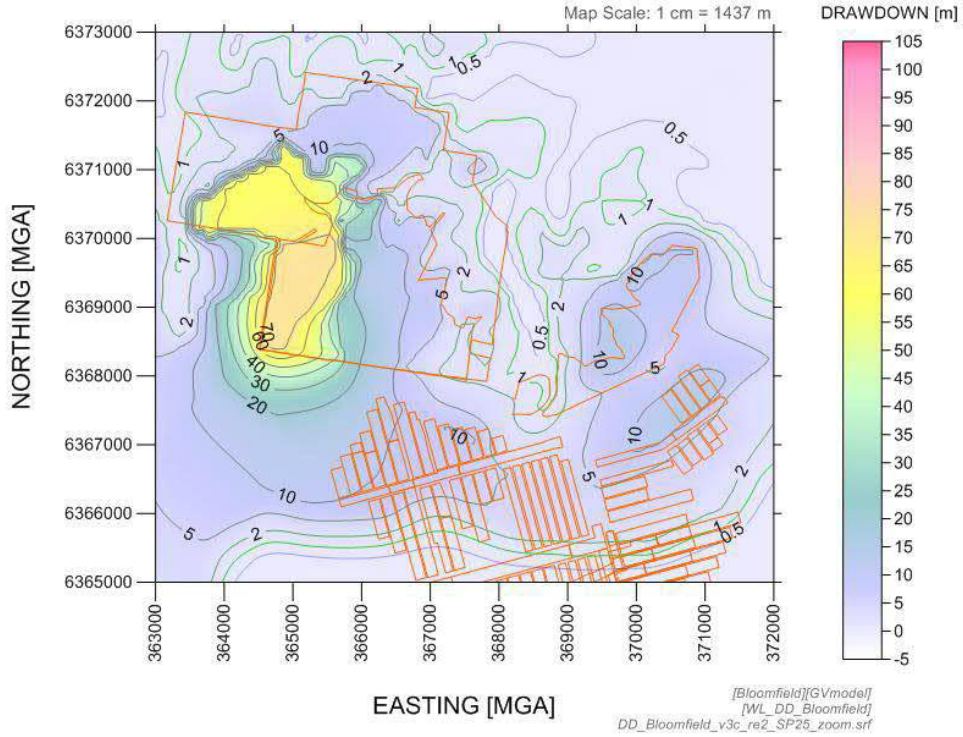


Figure D8. Predicted Drawdowns in Big Ben Seam [Layer 19] at the End of Mining (Year2025)

Appendix B

EPL No. 396

Appendix B EPL No. 396

Environment Protection Licence

Licence - 396

Licence Details	
Number:	396
Anniversary Date:	31-December

Licensee

BLOOMFIELD COLLIERIES PTY LTD

PO BOX 4

EAST MAITLAND NSW 2323

Premises

BLOOMFIELD COLLIERY

FOUR MILE CREEK ROAD

ASHTONFIELD NSW 2323

Scheduled Activity

Coal works

Mining for coal

Fee Based Activity	Scale
Coal works	> 2000000-5000000 T annual handing capacity
Mining for coal	> 500000-2000000 T annual production capacity

Region

North - Hunter

Ground Floor, NSW Govt Offices, 117 Bull Street
NEWCASTLE WEST NSW 2302

Phone: (02) 4908 6800

Fax: (02) 4908 6810

PO Box 488G NEWCASTLE

NSW 2300

Environment Protection Licence

Licence - 396

Environment Protection Licence

Licence - 396

Environment Protection Licence

Licence - 396

Information about this licence

Dictionary

A definition of terms used in the licence can be found in the dictionary at the end of this licence.

Responsibilities of licensee

Separate to the requirements of this licence, general obligations of licensees are set out in the Protection of the Environment Operations Act 1997 ("the Act") and the Regulations made under the Act. These include obligations to:

- ensure persons associated with you comply with this licence, as set out in section 64 of the Act;
- control the pollution of waters and the pollution of air (see for example sections 120 - 132 of the Act);
- report incidents causing or threatening material environmental harm to the environment, as set out in Part 5.7 of the Act.

Variation of licence conditions

The licence holder can apply to vary the conditions of this licence. An application form for this purpose is available from the EPA.

The EPA may also vary the conditions of the licence at any time by written notice without an application being made.

Where a licence has been granted in relation to development which was assessed under the Environmental Planning and Assessment Act 1979 in accordance with the procedures applying to integrated development, the EPA may not impose conditions which are inconsistent with the development consent conditions until the licence is first reviewed under Part 3.6 of the Act.

Duration of licence

This licence will remain in force until the licence is surrendered by the licence holder or until it is suspended or revoked by the EPA or the Minister. A licence may only be surrendered with the written approval of the EPA.

Licence review

The Act requires that the EPA review your licence at least every 5 years after the issue of the licence, as set out in Part 3.6 and Schedule 5 of the Act. You will receive advance notice of the licence review.

Fees and annual return to be sent to the EPA

For each licence fee period you must pay:

- an administrative fee; and
- a load-based fee (if applicable).

Environment Protection Licence

Licence - 396

The EPA publication “A Guide to Licensing” contains information about how to calculate your licence fees. The licence requires that an Annual Return, comprising a Statement of Compliance and a summary of any monitoring required by the licence (including the recording of complaints), be submitted to the EPA. The Annual Return must be submitted within 60 days after the end of each reporting period. See condition R1 regarding the Annual Return reporting requirements.

Usually the licence fee period is the same as the reporting period.

Transfer of licence

The licence holder can apply to transfer the licence to another person. An application form for this purpose is available from the EPA.

Public register and access to monitoring data

Part 9.5 of the Act requires the EPA to keep a public register of details and decisions of the EPA in relation to, for example:

- licence applications;
- licence conditions and variations;
- statements of compliance;
- load based licensing information; and
- load reduction agreements.

Under s320 of the Act application can be made to the EPA for access to monitoring data which has been submitted to the EPA by licensees.

This licence is issued to:

BLOOMFIELD COLLIERIES PTY LTD
PO BOX 4
EAST MAITLAND NSW 2323

subject to the conditions which follow.

Environment Protection Licence

Licence - 396

1 Administrative Conditions

A1 What the licence authorises and regulates

A1.1 This licence authorises the carrying out of the scheduled activities listed below at the premises specified in A2. The activities are listed according to their scheduled activity classification, fee-based activity classification and the scale of the operation.

Unless otherwise further restricted by a condition of this licence, the scale at which the activity is carried out must not exceed the maximum scale specified in this condition.

Scheduled Activity	Fee Based Activity	Scale
Coal works	Coal works	> 2000000 - 5000000 T annual handing capacity
Mining for coal	Mining for coal	> 500000 - 2000000 T annual production capacity

A2 Premises or plant to which this licence applies

A2.1 The licence applies to the following premises:

Premises Details
BLOOMFIELD COLLIERY
FOUR MILE CREEK ROAD
ASHTONFIELD
NSW 2323
AS DESCRIBED BY COORDINATES AND MAP ON DOCUMENT DATED DEC-14 AND REGISTERED IN THE EPA RECORDS SYSTEM AS DOC17/425999

A3 Information supplied to the EPA

A3.1 Works and activities must be carried out in accordance with the proposal contained in the licence application, except as expressly provided by a condition of this licence.

In this condition the reference to "the licence application" includes a reference to:
a) the applications for any licences (including former pollution control approvals) which this licence replaces under the Protection of the Environment Operations (Savings and Transitional) Regulation 1998; and
b) the licence information form provided by the licensee to the EPA to assist the EPA in connection with the issuing of this licence.

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2 Discharges to Air and Water and Applications to Land

P1 Location of monitoring/discharge points and areas

P1.1 The following utilisation areas referred to in the table below are identified in this licence for the purposes of the monitoring and/or the setting of limits for any application of solids or liquids to the utilisation area.

P1.2 The following points referred to in the table are identified in this licence for the purposes of the monitoring and/or the setting of limits for discharges of pollutants to water from the point.

Water and land

EPA Identification no.	Type of Monitoring Point	Type of Discharge Point	Location Description
1	Discharge to waters under wet weather conditions Volume monitoring Discharge quality monitoring	Discharge to waters under wet weather conditions Volume monitoring Discharge quality monitoring	Lake Forster pipe labelled as EPA ID 1 on document dated Dec-14 and registered in the EPA Records System as DOC17/425999
2	Ambient water quality monitoring.		Four Mile Creek located 500m upstream of the current New England Highway culvert for Four Mile Creek and identified as EPA ID 2 on document dated Dec-14 and registered in the EPA Records System as DOC17/425999

P1.3 The following points referred to in the table below are identified in this licence for the purposes of weather and/or noise monitoring and/or setting limits for the emission of noise from the premises.

Noise/Weather

EPA identification no.	Type of monitoring point	Location description
3	Air blast overpressure & ground vibration peak particle velocity monitoring	Monitoring location identified as "Mt Vincent Road" in the document titled "Bloomfield Collieries Pty Ltd, EPL 396, Blast Monitoring Site Location Plan, 12 January 2015"
4	Air blast overpressure & ground vibration peak particle velocity monitoring	Monitoring location identified as "McNaughtons" in the document titled "Bloomfield Collieries Pty Ltd, EPL 396, Blast Monitoring Site Location Plan, 12 January 2015"
5	Air blast overpressure & ground vibration peak particle velocity monitoring	Monitoring location identified as "Elliots" in the document titled "Bloomfield Collieries Pty Ltd, EPL 396, Blast Monitoring Site Location Plan, 12 January 2015"

6	Air blast overpressure & ground vibration peak particle velocity monitoring	Monitoring location identified as "Richards" in the document titled "Bloomfield Collieries Pty Ltd, EPL 396, Blast Monitoring Site Location Plan, 12 January 2015"

3 Limit Conditions

L1 Pollution of waters

L1.1 Except as may be expressly provided in any other condition of this licence, the licensee must comply with section 120 of the Protection of the Environment Operations Act 1997.

L2 Concentration limits

L2.1 For each monitoring/discharge point or utilisation area specified in the table\s below (by a point number), the concentration of a pollutant discharged at that point, or applied to that area, must not exceed the concentration limits specified for that pollutant in the table.

L2.2 Where a pH quality limit is specified in the table, the specified percentage of samples must be within the specified ranges.

L2.3 To avoid any doubt, this condition does not authorise the pollution of waters by any pollutant other than those specified in the table\s.

L2.4 Water and/or Land Concentration Limits

POINT 1

Pollutant	Units of Measure	50 percentile concentration limit	90 percentile concentration limit	3DGM concentration limit	100 percentile concentration limit
Conductivity	microsiemens per centimetre				6000
Filterable iron	milligrams per litre				1.0
pH	pH				6.5-8.5
Total suspended solids	milligrams per litre				30

L3 Volume and mass limits

L3.1 For each discharge point or utilisation area specified below (by a point number), the volume/mass of:
a) liquids discharged to water; or;
b) solids or liquids applied to the area;
must not exceed the volume/mass limit specified for that discharge point or area.

Point	Unit of Measure	Volume/Mass Limit
1	kilolitres per day	40000

L3.2 Discharge from Point 1 as referred to in Condition L3.1 is only permitted under the following conditions:

- in wet weather conditions following 10mm or greater 24 hours rainfall event in the catchment in the first 24 hour period following the rainfall event; and

- in wet weather conditions following a 15mm or greater 24 hours rainfall event in the catchment in the second 24 hour period following the rainfall event; and

- in wet weather conditions following a 20mm or greater 24 hours rainfall event in the catchment in the third 24 hour period following the rainfall event.

L4 Blasting

L4.1 Blasting in or on the premises must only be carried out between 9:00 hours and 17:00 hours, Monday to Saturday. Blasting in or on the premises must not take place on Sundays or Public Holidays without the prior approval of the EPA.

L4.2 The airblast overpressure level from blasting operations in or on the premises must not exceed:
115 dB (Lin Peak) for more than 5% of the total number of blasts during each reporting period;
at either monitoring point 3, 4, 5 or 6 in Condition P1.3.

L4.3 The airblast overpressure level from blasting operations in or on the premises must not exceed:
120 dB (Lin Peak) at any time;
at either monitoring point 3, 4, 5 or 6 in Condition P1.3.

L4.4 The ground vibration peak particle velocity from blasting operations carried out in or on the premises must not exceed:
5 mm/second for more than 5% of the total number of blasts during each reporting period;
at either monitoring point 3, 4, 5 or 6 in Condition P1.3.

L4.5 The ground vibration peak particle velocity from blasting operations carried out in or on the premises must not exceed:
10 mm/second at any time;
at either monitoring point 3, 4, 5 or 6 in Condition P1.3.

L4.6 Offensive blast fume must not be emitted from the premises.

Definition:

Offensive blast fume means post-blast gases from the detonation of explosives at the premises that by reason of their nature, duration, character or quality, or the time at which they are emitted, or any other circumstances:
1. *are harmful to (or likely to be harmful to) a person that is outside the premises from which it is emitted, or*
2. *interferes unreasonably with (or is likely to interfere unreasonably with) the comfort or repose of a person who is outside the premises from which it is emitted.*

4 Operating Conditions

O1 Activities must be carried out in a competent manner

O1.1 Licensed activities must be carried out in a competent manner.
This includes:
a) the processing, handling, movement and storage of materials and substances used to carry out the activity; and
b) the treatment, storage, processing, reprocessing, transport and disposal of waste generated by the activity.

O2 Maintenance of plant and equipment

O2.1 All plant and equipment installed at the premises or used in connection with the licensed activity:
a) must be maintained in a proper and efficient condition; and
b) must be operated in a proper and efficient manner.

O3 Dust

O3.1 The premises must be maintained in a condition which minimises or prevents the emission of dust from the premises.

5 Monitoring and Recording Conditions

M1 Monitoring records

M1.1 The results of any monitoring required to be conducted by this licence or a load calculation protocol must be recorded and retained as set out in this condition.

M1.2 All records required to be kept by this licence must be:
a) in a legible form, or in a form that can readily be reduced to a legible form;

b) kept for at least 4 years after the monitoring or event to which they relate took place; and
c) produced in a legible form to any authorised officer of the EPA who asks to see them.

M1.3 The following records must be kept in respect of any samples required to be collected for the purposes of this licence:
a) the date(s) on which the sample was taken;
b) the time(s) at which the sample was collected;
c) the point at which the sample was taken; and
d) the name of the person who collected the sample.

M2 Requirement to monitor concentration of pollutants discharged

M2.1 For each monitoring/discharge point or utilisation area specified below (by a point number), the licensee must monitor (by sampling and obtaining results by analysis) the concentration of each pollutant specified in Column 1. The licensee must use the sampling method, units of measure, and sample at the frequency, specified opposite in the other columns:

M2.2 Water and/ or Land Monitoring Requirements

POINT 1

Pollutant	Units of measure	Frequency	Sampling Method
Conductivity	microsiemens per centimetre	Daily during any discharge	Grab sample
Filterable iron	milligrams per litre	Daily during any discharge	Grab sample
pH	pH	Daily during any discharge	Grab sample
Total suspended solids	milligrams per litre	Daily during any discharge	Grab sample

POINT 2

Pollutant	Units of measure	Frequency	Sampling Method
Conductivity	microsiemens per centimetre	Continuous during discharge	In line instrumentation
pH	pH	Daily during any discharge	Grab sample
Total suspended solids	milligrams per litre	Daily during any discharge	Grab sample

M3 Testing methods - concentration limits

M3.1 Subject to any express provision to the contrary in this licence, monitoring for the concentration of a

pollutant discharged to waters or applied to a utilisation area must be done in accordance with the Approved Methods Publication unless another method has been approved by the EPA in writing before any tests are conducted.

M4 Recording of pollution complaints

M4.1 The licensee must keep a legible record of all complaints made to the licensee or any employee or agent of the licensee in relation to pollution arising from any activity to which this licence applies.

M4.2 The record must include details of the following:
a) the date and time of the complaint;
b) the method by which the complaint was made;
c) any personal details of the complainant which were provided by the complainant or, if no such details were provided, a note to that effect;
d) the nature of the complaint;
e) the action taken by the licensee in relation to the complaint, including any follow-up contact with the complainant; and
f) if no action was taken by the licensee, the reasons why no action was taken.

M4.3 The record of a complaint must be kept for at least 4 years after the complaint was made.

M4.4 The record must be produced to any authorised officer of the EPA who asks to see them.

M5 Telephone complaints line

M5.1 The licensee must operate during its operating hours a telephone complaints line for the purpose of receiving any complaints from members of the public in relation to activities conducted at the premises or by the vehicle or mobile plant, unless otherwise specified in the licence.

M5.2 The licensee must notify the public of the complaints line telephone number and the fact that it is a complaints line so that the impacted community knows how to make a complaint.

M5.3 The preceding two conditions do not apply until 3 months after: the date of the issue of this licence.

M6 Requirement to monitor volume or mass

M6.1 For each discharge point or utilisation area specified below, the licensee must monitor:
a) the volume of liquids discharged to water or applied to the area;
b) the mass of solids applied to the area;
c) the mass of pollutants emitted to the air;
at the frequency and using the method and units of measure, specified below.

POINT 1

Frequency	Unit of Measure	Sampling Method

Daily during any discharge	kilolitres per day	By Calculation (volume flow rate or pump capacity multiplied by operating time)

POINT 2

Frequency	Unit of Measure	Sampling Method
Daily during any discharge	kilolitres per day	In line instrumentation

M7 Blasting

M7.1 To determine compliance with conditions L4.2 and L4.3:
a) Airblast overpressure and ground vibration levels must be measured and electronically recorded for monitoring points 3, 4, 5 and 6 for the parameters specified in Column 1 of the table below; and
b) The licensee must use the units of measure, sampling method, and sample at the frequency specified opposite in the other columns.

Parameter	Units of Measure	Frequency	Sampling Method
Airblast Overpressure	Decibels (Linear Peak)	All blasts	Australian Standard AS 2187.2-2006
Ground Vibration Peak Particle Velocity	millimetres/second	All blasts	Australian Standard AS 2187.2-2006

6 Reporting Conditions

R1 Annual return documents

R1.1 The licensee must complete and supply to the EPA an Annual Return in the approved form comprising:
1. a Statement of Compliance,
2. a Monitoring and Complaints Summary,
3. a Statement of Compliance - Licence Conditions,
4. a Statement of Compliance - Load based Fee,
5. a Statement of Compliance - Requirement to Prepare Pollution Incident Response Management Plan,
6. a Statement of Compliance - Requirement to Publish Pollution Monitoring Data; and
7. a Statement of Compliance - Environmental Management Systems and Practices.

At the end of each reporting period, the EPA will provide to the licensee a copy of the form that must be completed and returned to the EPA.

R1.2 An Annual Return must be prepared in respect of each reporting period, except as provided below.

Note: The term "reporting period" is defined in the dictionary at the end of this licence. Do not complete the Annual Return until after the end of the reporting period.

R1.3 Where this licence is transferred from the licensee to a new licensee:
a) the transferring licensee must prepare an Annual Return for the period commencing on the first day of

the reporting period and ending on the date the application for the transfer of the licence to the new licensee is granted; and
b) the new licensee must prepare an Annual Return for the period commencing on the date the application for the transfer of the licence is granted and ending on the last day of the reporting period.

Note: An application to transfer a licence must be made in the approved form for this purpose.

R1.4 Where this licence is surrendered by the licensee or revoked by the EPA or Minister, the licensee must prepare an Annual Return in respect of the period commencing on the first day of the reporting period and ending on:
a) in relation to the surrender of a licence - the date when notice in writing of approval of the surrender is given; or
b) in relation to the revocation of the licence - the date from which notice revoking the licence operates.

R1.5 The Annual Return for the reporting period must be supplied to the EPA via eConnect *EPA* or by registered post not later than 60 days after the end of each reporting period or in the case of a transferring licence not later than 60 days after the date the transfer was granted (the 'due date').

R1.6 The licensee must retain a copy of the Annual Return supplied to the EPA for a period of at least 4 years after the Annual Return was due to be supplied to the EPA.

R1.7 Within the Annual Return, the Statements of Compliance must be certified and the Monitoring and Complaints Summary must be signed by:
a) the licence holder; or
b) by a person approved in writing by the EPA to sign on behalf of the licence holder.

R2 Notification of environmental harm

R2.1 Notifications must be made by telephoning the Environment Line service on 131 555.

R2.2 The licensee must provide written details of the notification to the EPA within 7 days of the date on which the incident occurred.

Note: The licensee or its employees must notify all relevant authorities of incidents causing or threatening material harm to the environment immediately after the person becomes aware of the incident in accordance with the requirements of Part 5.7 of the Act.

R3 Written report

R3.1 Where an authorised officer of the EPA suspects on reasonable grounds that:
a) where this licence applies to premises, an event has occurred at the premises; or
b) where this licence applies to vehicles or mobile plant, an event has occurred in connection with the carrying out of the activities authorised by this licence,
and the event has caused, is causing or is likely to cause material harm to the environment (whether the harm occurs on or off premises to which the licence applies), the authorised officer may request a written report of the event.

R3.2 The licensee must make all reasonable inquiries in relation to the event and supply the report to the EPA within such time as may be specified in the request.

R3.3 The request may require a report which includes any or all of the following information:
a) the cause, time and duration of the event;
b) the type, volume and concentration of every pollutant discharged as a result of the event;
c) the name, address and business hours telephone number of employees or agents of the licensee, or a specified class of them, who witnessed the event;
d) the name, address and business hours telephone number of every other person (of whom the licensee is aware) who witnessed the event, unless the licensee has been unable to obtain that information after making reasonable effort;
e) action taken by the licensee in relation to the event, including any follow-up contact with any complainants;
f) details of any measure taken or proposed to be taken to prevent or mitigate against a recurrence of such an event; and
g) any other relevant matters.

R3.4 The EPA may make a written request for further details in relation to any of the above matters if it is not satisfied with the report provided by the licensee. The licensee must provide such further details to the EPA within the time specified in the request.

R4 Other reporting conditions

R4.1 Reporting blasting limit exceedence

The licensee must report any exceedence of the licence blasting limits to the regional office of the EPA as soon as practicable after the exceedence becomes known to the licensee or to one of the licensee's employees or agents.

7 General Conditions

G1 Copy of licence kept at the premises or plant

G1.1 A copy of this licence must be kept at the premises to which the licence applies.

G1.2 The licence must be produced to any authorised officer of the EPA who asks to see it.

G1.3 The licence must be available for inspection by any employee or agent of the licensee working at the premises.

8 Pollution Studies and Reduction Programs

U1 Coal Mine Wind Erosion of Exposed Land Assessment

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U1.1 The licensee must undertake the following steps:

1. Calculate the wind erosion exposed surface area (in hectares) within the premises as of 31 December 2014.
2. Determine the wind erosion exposed surface area (in hectares) predicted as at 31 December 2014 within the licensee's Environmental Assessment for the premises.
3. Compare the areas calculated in steps 1 and 2.
4. Submit a written report to the EPA at hunter.region@epa.nsw.gov.au containing the analysis required in steps 1 to 3, by 29 May 2015.

The report submitted to the EPA must be accompanied by spatial data to confirm the wind erosion exposed surface area calculations. The following data is required:

- Shapefiles showing the premises boundary.
- Shapefiles showing the wind erosion exposed area within the premises as of 31 December 2014.
- Shapefiles showing areas classified as stabilised surface as of 31 December 2014.
- Details of any studies undertaken to verify that the areas of stabilised surface meet the definition.

Note: *Environmental Assessment* means any environmental assessment document prepared in order to gain approval or consent under the Environmental Planning and Assessment Act (1979) under which the licensee currently operates at the premises. If the predictions made in this document do not correspond to the current year of mine operation, the licensee should extrapolate between predictions.

Stabilised Surface means any previously disturbed surface area which shows visual or other evidence of surface crusting and is resistant to wind-driven fugitive dust and is demonstrated to be stabilised. Stabilisation can be determined in accordance with one or more of the applicable test methods contained in the Rule 403 Implementation Handbook located at: www.capcoa.org/Docs/SCAQMD%20r403%20handbook.doc.

Wind Erosion Exposed Surface Area means the portion of the premises surface which has been physically moved, uncovered, destabilised or otherwise modified from its natural state, thereby increasing the potential for fugitive particulate matter emissions, but excluding areas which have been:

- paved or covered by a permanent building or structure;
- maintained with a vegetative ground cover of at least 50% of ground cover for particular areas. Vegetative ground cover can be determined in accordance with the standardised procedure for revegetation assessment contained in Atyeo C. & Thackway R. (2009) located at: http://data.daff.gov.au/data/warehouse/pe_brs90000004196/revegetationManual200906_20100410_ap14.pdf or
- classified as a stabilised surface.

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Dictionary

General Dictionary

3DGM [in relation to a concentration limit]	Means the three day geometric mean, which is calculated by multiplying the results of the analysis of three samples collected on consecutive days and then taking the cubed root of that amount. Where one or more of the samples is zero or below the detection limit for the analysis, then 1 or the detection limit respectively should be used in place of those samples
Act	Means the Protection of the Environment Operations Act 1997
activity	Means a scheduled or non-scheduled activity within the meaning of the Protection of the Environment Operations Act 1997
actual load	Has the same meaning as in the Protection of the Environment Operations (General) Regulation 2009
AM	Together with a number, means an ambient air monitoring method of that number prescribed by the *Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales*.
AMG	Australian Map Grid
anniversary date	The anniversary date is the anniversary each year of the date of issue of the licence. In the case of a licence continued in force by the Protection of the Environment Operations Act 1997, the date of issue of the licence is the first anniversary of the date of issue or last renewal of the licence following the commencement of the Act.
annual return	Is defined in R1.1
Approved Methods Publication	Has the same meaning as in the Protection of the Environment Operations (General) Regulation 2009
assessable pollutants	Has the same meaning as in the Protection of the Environment Operations (General) Regulation 2009
BOD	Means biochemical oxygen demand
CEM	Together with a number, means a continuous emission monitoring method of that number prescribed by the *Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales*.
COD	Means chemical oxygen demand
composite sample	Unless otherwise specifically approved in writing by the EPA, a sample consisting of 24 individual samples collected at hourly intervals and each having an equivalent volume.
cond.	Means conductivity
environment	Has the same meaning as in the Protection of the Environment Operations Act 1997
environment protection legislation	Has the same meaning as in the Protection of the Environment Administration Act 1991
EPA	Means Environment Protection Authority of New South Wales.
fee-based activity classification	Means the numbered short descriptions in Schedule 1 of the Protection of the Environment Operations (General) Regulation 2009.
general solid waste (non-putrescible)	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997

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flow weighted composite sample	Means a sample whose composites are sized in proportion to the flow at each composites time of collection.
general solid waste (putrescible)	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environmen t Operations Act 1997
grab sample	Means a single sample taken at a point at a single time
hazardous waste	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
licensee	Means the licence holder describe d at the front of this licence
load calculation protocol	Has the same meaning as in the Protection of the Environment Operations (General) Regulation 2009
local authority	Has the same meaning as in the Protection of the Environment Operations Act 1997
material harm	Has the same meaning as in section 147 Protection of the Environment Operations Act 1997
MBAS	Means methylene blue active substances
Minister	Means the Minister administering the Protection of the Environment Operations Act 1997
mobile plant	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
motor vehicle	Has the same meaning as in the Protection of the Environment Operations Act 1997
O&G	Means oil and grease
percentile [in relation to a concentration limit of a sample]	Means that percentage [eg.50%] of the number of samples taken that must meet the concentration limit specified in the licence for that pollutant over a specified period of time. In this licence, the specified period of time is the Reporting Period unless otherwise stated in this licence.
plant	Includes all plant within the meaning of the Protection of the Environment Operations Act 1997 as well as motor vehicles.
pollution of waters [or water pollution]	Has the same meaning as in the Protection of the Environment Operations Act 1997
premises	Means the premises described in condition A2.1
public authority	Has the same meaning as in the Protection of the Environment Operations Act 1997
regional office	Means the relevant EPA office referred to in the Contacting the EPA document accompanying this licence
reporting period	For the purposes of this licence, the reporting period means the period of 12 months after the issue of the licence, and each subsequent period of 12 mo nths. In the case of a licence continued in force by the Protection of the Environment Operations Act 1997, the date of issue of the licence is the first anniversary of the date of issue or last renewal of the licence following the commencement of the Act.
restricted solid waste	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
scheduled activity	Means an activity listed in Schedule 1 of the Protection of the Environment Operations Act 1997
special waste	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
TM	Together with a number, means a test method of that number prescribed by the *Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales*.

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TSP	Means total suspended particles
TSS	Means total suspended solids
Type 1 substance	Means the elements antimony, arsenic, cadmium, lead or mercury or any compound containing one or more of those elements
Type 2 substance	Means the elements beryllium, chromium, cobalt, manganese, nickel, selenium, tin or vanadium or any compound containing one or more of those elements
utilisation area	Means any area shown as a utilisation area on a map submitted with the application for this licence
waste	Has the same meaning as in the Protection of the Environment Operations Act 1997
waste type	Means liquid, restricted solid waste, general solid waste (putrescible), general solid waste (non - putrescible), special waste or hazardous waste

Ms Debbie Maddison

Environment Protection Authority

(By Delegation)

Date of this edition: 05-April-2000

Environment Protection Licence

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End Notes

1	Licence varied by notice V/M upgrade, issued on 07-Jul-2000, which came into effect on 07-Jul-2000.
2	Licence varied by notice 1005836, issued on 21-Nov-2001, which came into effect on 21-Nov-2001.
3	Licence varied by notice 1032965, issued on 09-Dec-2003, which came into effect on 03-Jan-2004.
4	Licence varied by notice 1042169, issued on 22-Dec-2004, which came into effect on 16-Jan-2005.
5	Condition A1.3 Not applicable varied by notice issued on <issue date> which came into effect on <effective date>
6	Licence varied by notice 1104182, issued on 18-Nov-2009, which came into effect on 18-Nov-2009.
7	Licence varied by notice 1501185 issued on 02-Dec-2011
8	Licence varied by notice 1506512 issued on 21-Mar-2013
9	Licence varied by notice 1516491 issued on 08-Oct-2013
10	Licence varied by notice 1522189 issued on 16-Oct-2014
11	Licence varied by notice 1527795 issued on 05-Feb-2015
12	Licence varied by notice 1530063 issued on 27-Apr-2015
13	Licence varied by notice 1547417 issued on 17-Aug-2017

Appendix C

Bloomfield Piezometer Logs

Appendix C Bloomfield Piezometer Logs

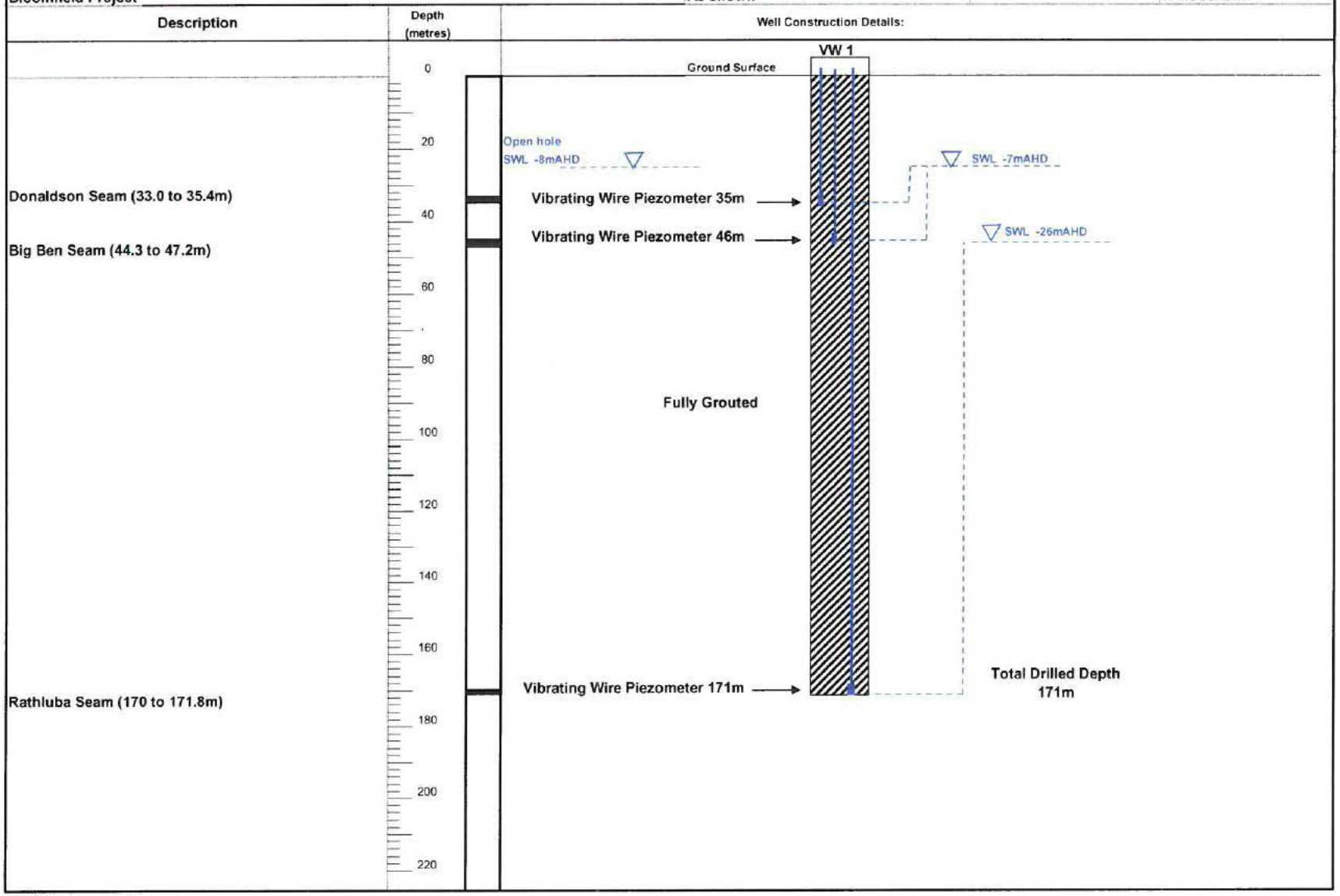
Aquaterra Consulting Pty Ltd
Logging Sheet

BORES: Site 1

Project No:	S05

Client:	Bore:	Elevation (GL):	Elevation (TOC):	Stickup:	Drilling Contractor:	Date Started:	Date Finished:
Bloomfield Collieries Pty Ltd	VW 1	17.4 mAHD			Hunter Drilling Services	27-Mar-07	12-Apr-07

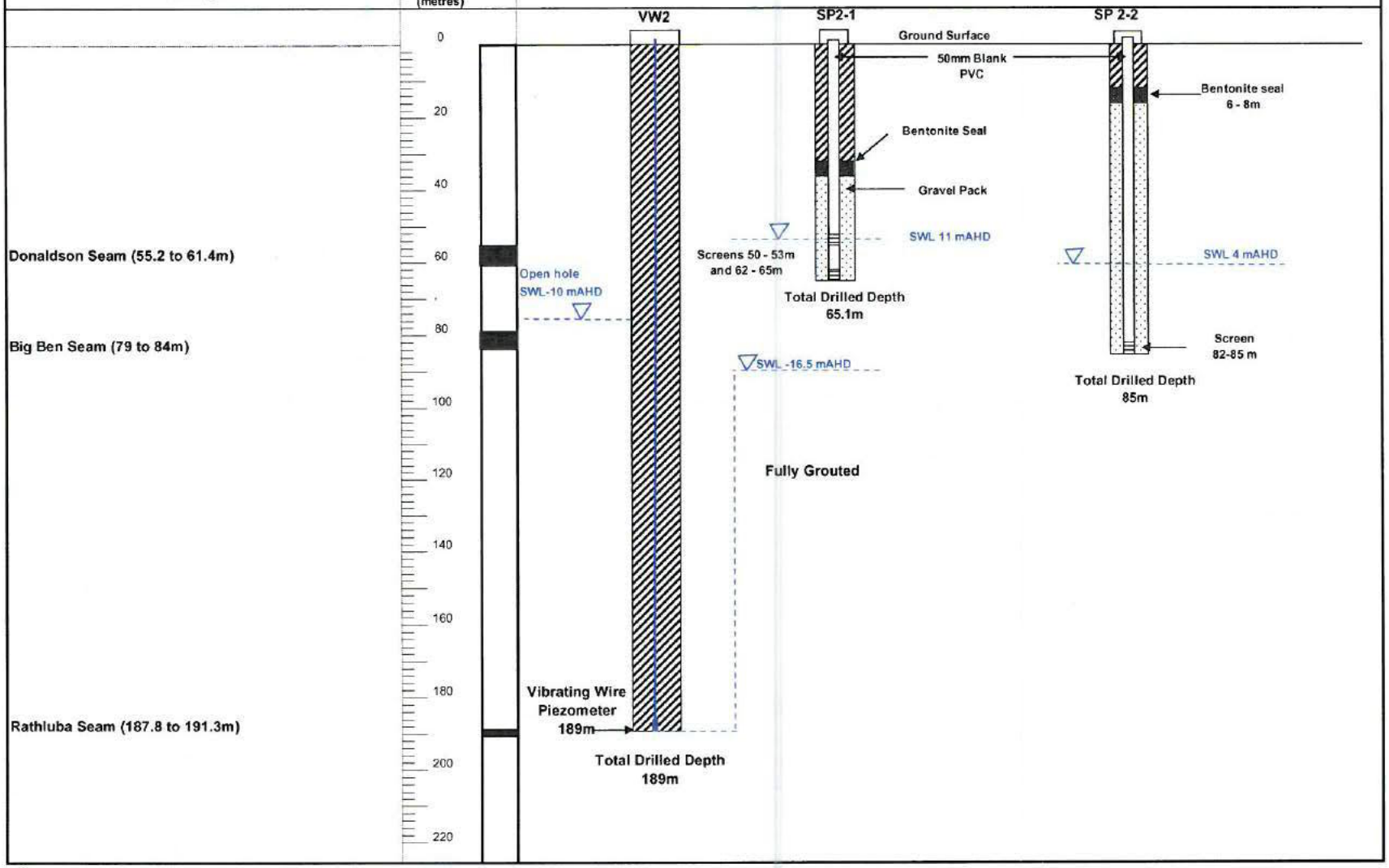
Location:	Hole depths:	Supervised By:
Bloomfield Project	As shown	R McCallum



Aquaterra Consulting Pty Ltd
Logging Sheet

BORES: Site 2

						Project No:	S05
Client:	Bore:	Elevation (GL):	Elevation (TOC):	Stickup:	Drilling Contractor:	Date Started:	Date Finished:
Bloomfield Collieries Pty Ltd	VW2	65.2 mAHD			Hunter Drilling Services	20-Mar-07	27-Mar-07
Location:	SP2-1	65.2 mAHD			Hunter Drilling Services	20-Mar-07	27-Mar-07
Bloomfield Project	SP2-2	65.2 mAHD			Hunter Drilling Services	20-Mar-07	27-Mar-07
			Hole depths: As shown			Supervised By: R McCallum	



Aquaterra Consulting Pty Ltd
Logging Sheet

BORES: Site 3

						Project No:	S05
Client:	Bore:	Elevation (GL):	Elevation (TOC):	Stickup:	Drilling Contractor:	Date Started:	Date Finished:
Bloomfield Collieries Pty Ltd	**VW3**	**38.8 mAHD**			**Hunter Drilling Services**	**11-May-07**	**14-May-07**
Location:	**SP3-1**	**38.8 mAHD**			**Hunter Drilling Services**	**11-May-07**	**14-May-07**
Bloomfield Project							
			Hole depths: **As shown**			Supervised By: **R McCallum**	

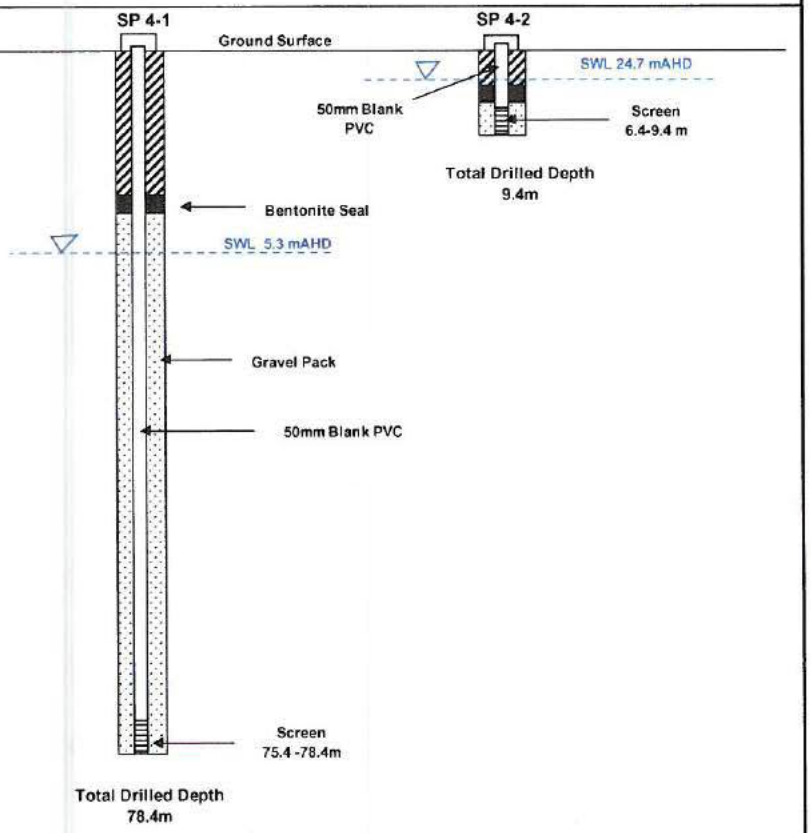
Description	Depth (metres)	Well Construction Details:
	0	VW 3 · Ground Surface · SP3-1 · SWL 29.3 mAHD · Bentonite seal 6 - 8m · 50mm Blank PVC · Screen 11-14 m · Total Drilled Depth 17m · Open hole · SWL 19 mAHD · SWL 16 mAHD · Fully Grouted · Vibrating Wire Piezometer 131m · Total Drilled Depth 131m
Donaldson Seam (12 to 15.2m)	20	
	40	
	60	
	80	
	100	
	120	
Rathluba Seam (129.7 to 131.5m)	140	
	160	
	180	
	200	
	220	

Aquaterra Consulting Pty Ltd
Logging Sheet

BORES: Site 4

Client:	Bore:	Elevation (GL):	Elevation (TOC):	Stickup:	Drilling Contractor:	Project No: S05 Date Started:	Date Finished:
Bloomfield Collieries Pty Ltd	SP4-1	27.8 m AHD			Hunter Drilling Services	16-Mar-07	17-Mar-07
Location:	SP4-2	27.8 m AHD		0.25 m	Hunter Drilling Services	16-Mar-07	17-Mar-07
Bloomfield Project							
			Hole depths: As shown			Supervised By: R McCallum	

Description	Depth (metres)	Well Construction Details:
	0	
Alluvium / weathered Permian	10	
	20	
	30	
	40	
	50	
	60	
	70	
Rathluba Seam (75.4 to 77.4m)	80	
	90	
	100	
	110	



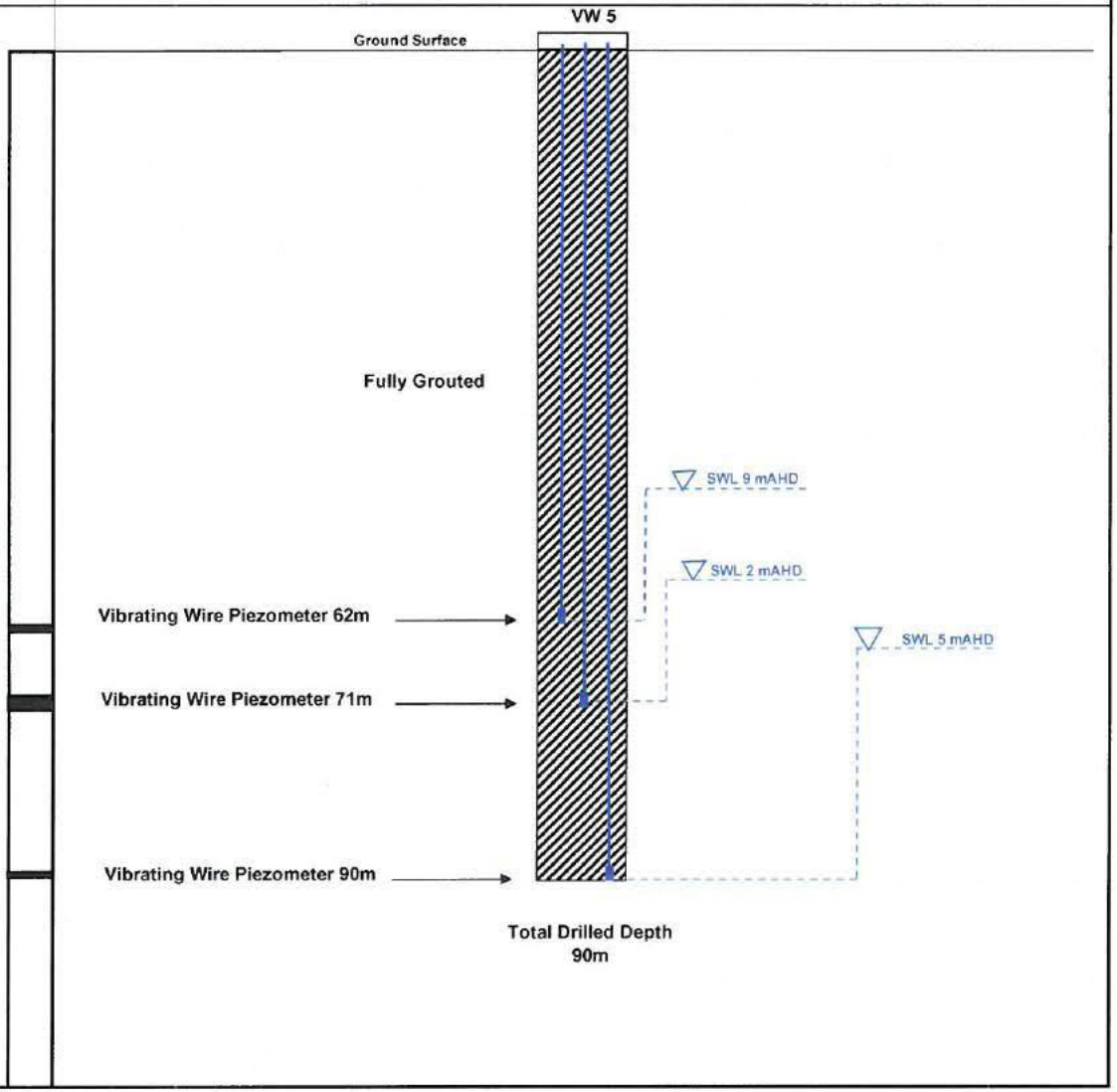
Appendix B-4: Bore Logs - Site 4

Aquaterra Consulting Pty Ltd
Logging Sheet

BORES: Site 5

Client:	Bore:	Elevation (GL):	Elevation (TOC):	Stickup:	Drilling Contractor:	Project No: S05	
Bloomfield Collieries Pty Ltd	VW5	55.7 mAHD			Hunter Drilling Services	Date Started: 05-Apr-07	Date Finished: 27-Apr-07
Location: Bloomfield Project			As shown			Supervised By: R McCallum	

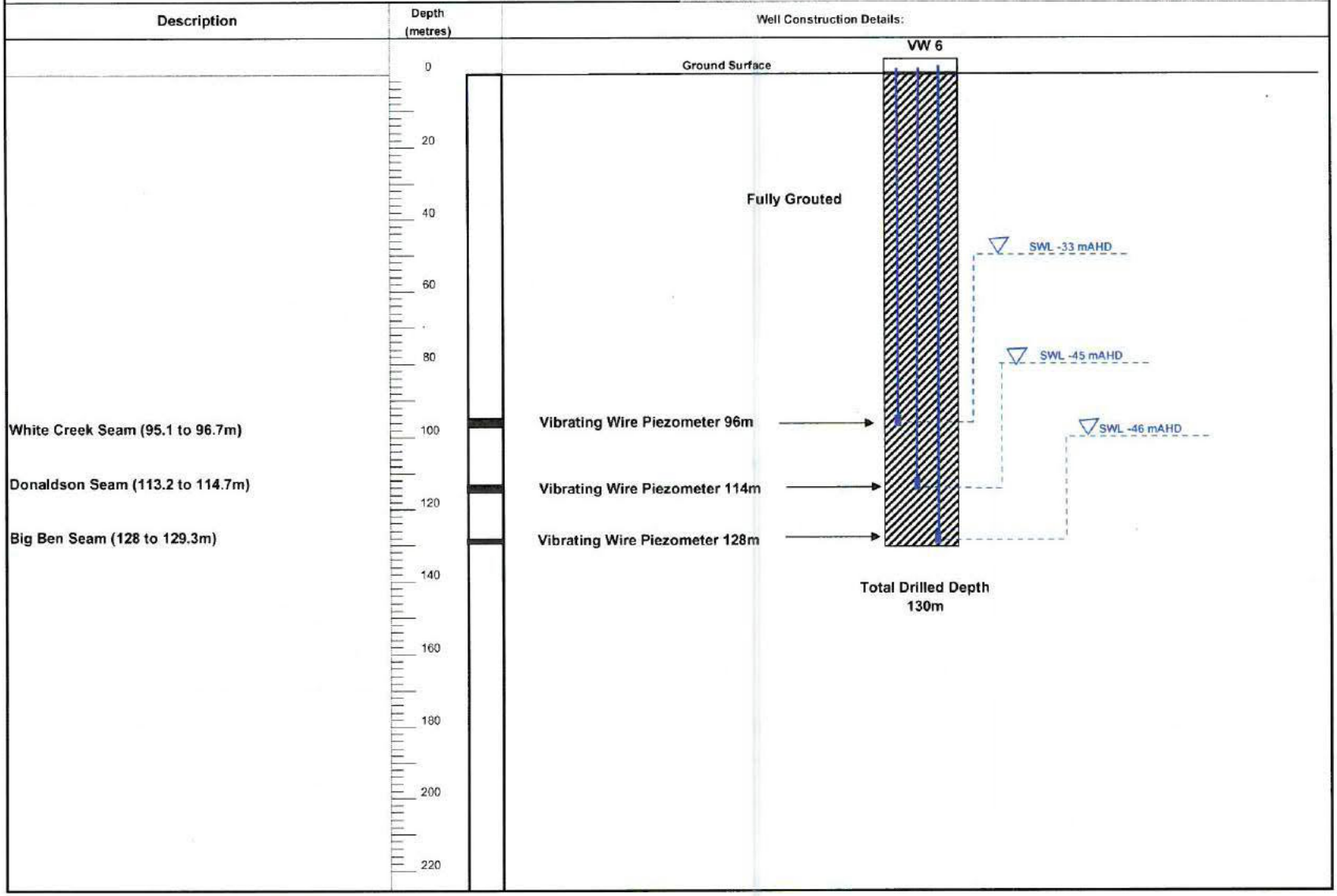
Description	Depth (metres)	Well Construction Details:
	0	Ground Surface
	10	
	20	
	30	
	40	
	50	
	60	
White Creek Seam (62.3 to 63.1m)	70	
Donaldson Seam (70.5 to 71.9m)	80	
	90	
Big Ben Seam (89.3 to 89.7m)	100	
	110	



Aquaterra Consulting Pty Ltd
Logging Sheet

BORES: Site 6

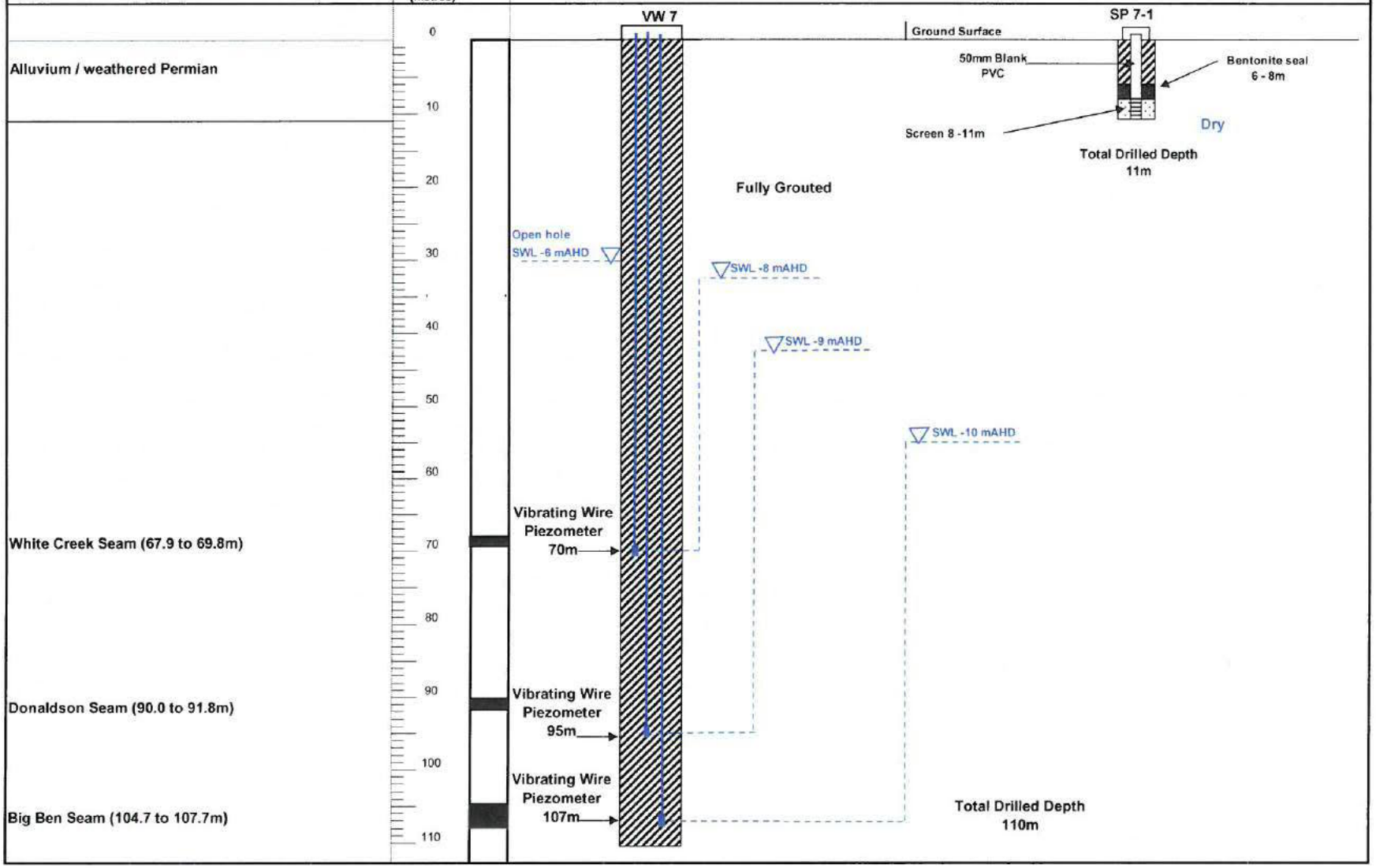
						Project No:	S05
Client:	Bore:	Elevation (GL):	Elevation (TOC):	Stickup:	Drilling Contractor:	Date Started:	Date Finished:
Bloomfield Collieries Pty Ltd	VW6	52.5 mAHD	52.75 mAHD	0.25 m	Hunter Drilling Services	24-Apr-07	27-Apr-07
Location:							
Bloomfield Project			Hole depths: As shown			Supervised By: R McCallum	



Aquaterra Consulting Pty Ltd
Logging Sheet

BORES: Site 7

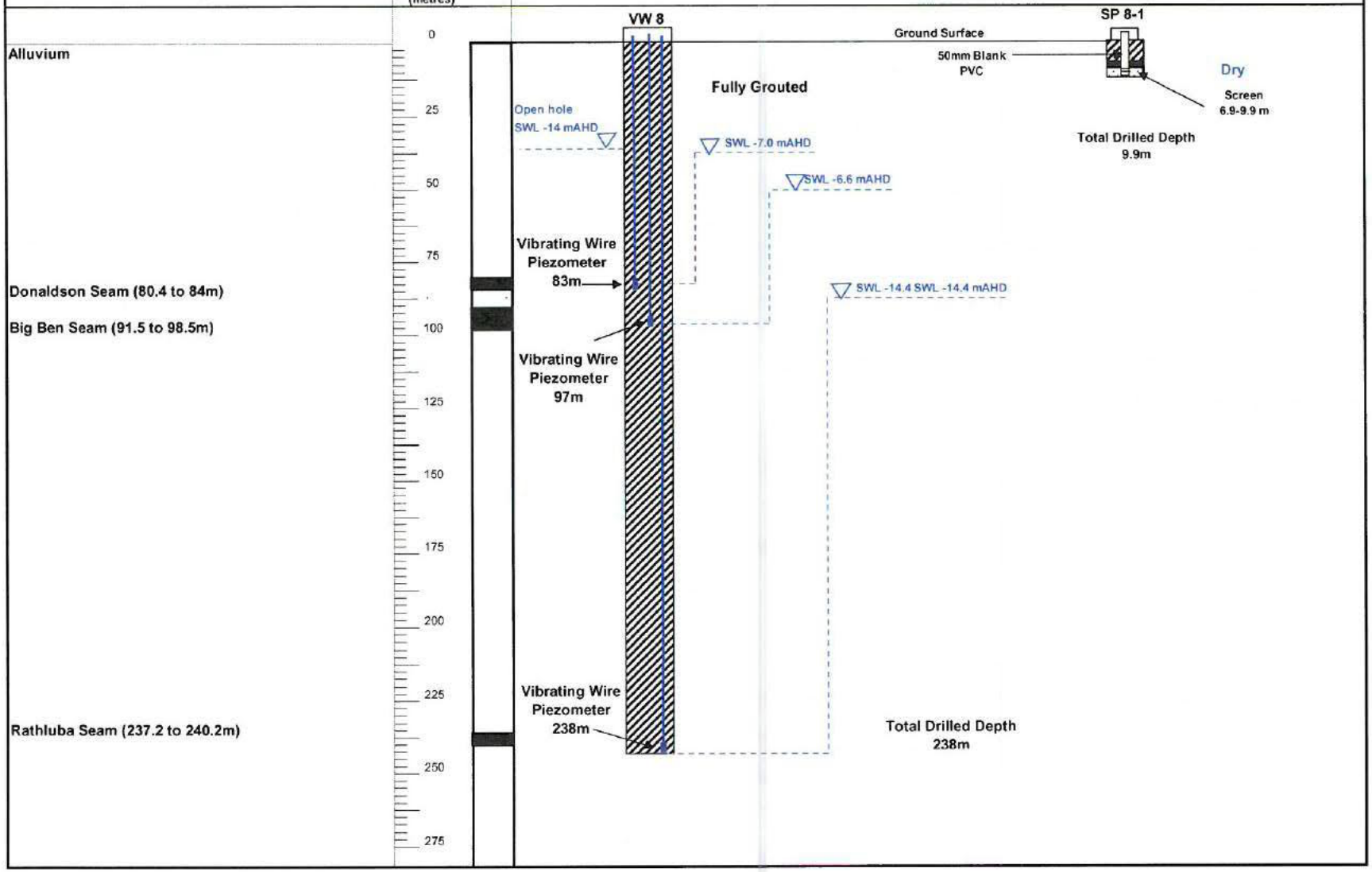
Client:	Bore:	Depth:	Elevation (GL):	Elevation (TOC):	Stickup:	Drilling Contractor:	Project No: / Date Started:	S05 / Date Finished:
Bloomfield Collieries Pty Ltd	VW7		24.9 mAHD			Hunter Drilling Services	18-Apr-07	24-Apr-07
Location:	SP7-1		24.9 mAHD			Hunter Drilling Services		
Bloomfield Project				As shown			Supervised By: R McCallum	



Aquaterra Consulting Pty Ltd
Logging Sheet

BORES: Site 8

Client:	Bore:	Depth:	Elevation (GL):	Elevation (TOC):	Stickup:	Drilling Contractor:	Project No:	S05
Bloomfield Collieries Pty Ltd	VW8		22.5 mAHD			Hunter Drilling Services	Date Started: 29-Mar-07	Date Finished: 18-Apr-07
Location:	SP8-1		22.5 mAHD					
Bloomfield Project				As shown			Supervised By: R McCallum	



Appendix D

DPI-Water Registered Bores

Appendix D DPI-Water Registered Bores

NSW Office of Water
Work Summary

GW051353

Licence: 20BL114994 **Licence Status:** ACTIVE

Authorised Purpose(s): STOCK,DOMESTIC
Intended Purpose(s): STOCK, DOMESTIC

Work Type: Bore open thru rock
Work Status:
Construct.Method: Rotary
Owner Type: Private

Commenced Date:
Completion Date: 01/11/1980
Final Depth: 49.70 m
Drilled Depth: 49.70 m

Contractor Name:
Driller:
Assistant Driller:

Property: ROBIN HILL
GWMA: -
GW Zone: -
Standing Water Level (m):
Salinity Description: 3001-7000 ppm
Yield (L/s):

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:	NORTH	NORTH.057	99
Licensed:	NORTHUMBERLAND	STOCKRINGTON	Whole Lot //

Region: 20 - Hunter
River Basin: 210 - HUNTER RIVER
Area/District:
CMA Map: 9232-3N
Grid Zone:
Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: (Unknown)
Northing: 6365810.0
Easting: 365986.0
Latitude: 32°50'15.3"S
Longitude: 151°34'05.1"E

GS Map: -
MGA Zone: 0
Coordinate Source: GD.,ACC.MAP

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1	1	Casing	P.V.C.	-0.30	1.50	114			Driven into Hole

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
22.60	23.10	0.50	Fractured	15.20		0.12			
24.90	25.20	0.30	Fractured	15.20		0.20			

Geologists Log

Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	0.50	0.50	Soil Clay	Soil	
0.50	3.60	3.10	Sandstone Yellow	Sandstone	
3.60	3.90	0.30	Ironstone Shale	Ironstone	
3.90	10.70	6.80	Sandstone White	Sandstone	
10.70	11.90	1.20	Coal	Coal	
11.90	14.00	2.10	Sandstone Hard	Sandstone	
14.00	15.80	1.80	Shale	Shale	
15.80	22.60	6.80	Sandstone White	Sandstone	
22.60	25.60	3.00	Shale Water Supply	Shale	
25.60	49.70	24.10	Shale Black	Shale	
3.90	10.70	6.80	Shale Seams	Shale	

Remarks

***** End of GW051353 *****

NSW Office of Water
Work Summary

GW051647

Licence: 20BL112319
Licence Status: ACTIVE

Authorised Purpose(s): STOCK
Intended Purpose(s): STOCK

Work Type: Bore
Work Status:
Construct.Method: Rotary
Owner Type: Private

Commenced Date:
Completion Date: 01/09/1980
Final Depth:
Drilled Depth:

Contractor Name:
Driller: Alan Francis Ryan
Assistant Driller:

Property: KARINYA
GWMA: -
GW Zone: -
Standing Water Level (m):
Salinity Description:
Yield (L/s):

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:	NORTH	NORTH.034	L9 (1)
Licensed:	NORTHUMBERLAND	MAITLAND	Whole Lot //

Region: 20 - Hunter
River Basin: 210 - HUNTER RIVER
Area/District:
CMA Map: 9232-3N
Grid Zone:
Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: (Unknown)
Northing: 6373006.0
Easting: 362896.0
Latitude: 32°46'20.3"S
Longitude: 151°32'10.1"E

GS Map: -
MGA Zone: 0
Coordinate Source: GD.,ACC.MAP

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

Geologists Log
Drillers Log

			Drillers Description	Geological Material	Comments

From (m)	To (m)	Thickness (m)			
0.00	0.15	0.15	Topsoil	Topsoil	
0.15	3.00	2.85	Clay	Clay	
3.00	3.81	0.81	Sand Yellow	Sand	
3.81	4.57	0.76	Sand White	Sand	
4.57	6.10	1.53	Clay Sand	Clay	
6.10	12.00	5.90	Sandstone Hard	Sandstone	

Remarks

***** End of GW051647 *****

NSW Office of Water
Work Summary

GW058760

Licence: 20BL130469
Licence Status: ACTIVE

Authorised Purpose(s): FARMING
Intended Purpose(s): FARMING

Work Type: Bore
Work Status:
Construct.Method: Rotary
Owner Type: Private

Commenced Date:
Completion Date: 01/10/1983
Final Depth: 33.00 m
Drilled Depth:

Contractor Name:
Driller:
Assistant Driller:

Property: N/A NSW
GWMA: -
GW Zone: -
Standing Water Level (m):
Salinity Description: 0-500 ppm
Yield (L/s):

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:	NORTH	NORTH.003	L13 DP225727 (46)
Licensed:	NORTHUMBERLAND	ALNWICK	Whole Lot 13//225727

Region: 20 - Hunter
River Basin: 210 - HUNTER RIVER
Area/District:
CMA Map: 9232-3N
Grid Zone:
Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: (Unknown)
Northing: 6371207.0
Easting: 371142.0
Latitude: 32°47'22.3"S
Longitude: 151°37'26.1"E

GS Map: -
MGA Zone: 0
Coordinate Source: GD.,ACC.MAP

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1	1	Casing	P.V.C.	0.00	33.00	900			Seated on Bottom
1	1	Opening	Slots - Horizontal	27.00	33.00	900		1	Mechanically Slotted, A: 5.00mm

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
27.00	33.00	6.00	(Unknown)	27.00		0.10			

Geologists Log
Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments

Remarks

17/01/1985: TDS = 162 MG/L

***** End of GW058760 *****

NSW Office of Water
Work Summary

GW061307

Licence: 20BL133448
Licence Status: ACTIVE

Authorised Purpose(s): DOMESTIC
Intended Purpose(s): DOMESTIC

Work Type: Bore
Work Status:
Construct.Method:
Owner Type: Private

Commenced Date:
Completion Date: 01/10/1984
Final Depth: 30.00 m
Drilled Depth: 30.00 m

Contractor Name:
Driller:
Assistant Driller:

Property: N/A NSW
GWMA: -
GW Zone: -
Standing Water Level (m):
Salinity Description: 501-1000 ppm
Yield (L/s):

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:	NORTH	NORTH.003	L10 DP225727 (46)
Licensed:	NORTHUMBERLAND	ALNWICK	Whole Lot 10//225727

Region: 20 - Hunter
River Basin: 210 - HUNTER RIVER
Area/District:
CMA Map: 9232-3N
Grid Zone:
Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: (Unknown)
Northing: 6371148.0
Easting: 371299.0
Latitude: 32°47'24.3"S
Longitude: 151°37'32.1"E

GS Map: -
MGA Zone: 0
Coordinate Source: GD.,ACC.MAP

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1	1	Casing	Threaded Steel	-0.20	30.00	150			Seated on Bottom
1	1	Opening	Slots - Vertical	25.00	30.00	150		1	Mechanically Slotted, A: 6.00mm

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
25.00	25.50	0.50	(Unknown)						

28.00	28.50	0.50	(Unknown)	25.00		0.40		

Geologists Log

Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	1.80	1.80	Clay	Clay	
1.80	30.00	28.20	Rock White Shale, Sandstone Water Bearing	Rock	

Remarks

***** End of GW061307 *****

NSW Office of Water
Work Summary

GW078044

Licence: 20BL166662
Licence Status: ACTIVE

Authorised Purpose(s): MONITORING BORE
Intended Purpose(s): MONITORING BORE

Work Type: Bore
Work Status:
Construct.Method: Backhoe
Owner Type:

Commenced Date:
Completion Date: 14/11/1997
Final Depth: 30.10 m
Drilled Depth: 30.10 m

Contractor Name: MCDERMOTT DRILLING PTY LTD
Driller:
Assistant Driller:

Property: NOT KNOWN
GWMA: 017 - HUNTER
GW Zone: -
Standing Water Level (m):
Salinity Description:
Yield (L/s):

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:	NORTH	NORTH.003	LOT 102 DP 616161
Licensed:	NORTHUMBERLAND	ALNWICK	Whole Lot 12//1007491

Region: 20 - Hunter
River Basin: - Unknown
Area/District:
CMA Map:
Grid Zone:
Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: Unknown
Northing: 6370151.0
Easting: 370428.0
Latitude: 32°47'56.3"S
Longitude: 151°36'58.1"E

GS Map: -
MGA Zone: 0
Coordinate Source: Unknown

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	30.10	96			Other
1		Annulus	Waterworn/Rounded	8.40	30.10				Ungraded
1	1	Opening	Screen	16.50	26.90			1	
1	1	Opening	Slots - Horizontal	16.50	26.90	55		1	PVC, SL: 10.4mm, A: 5.00mm

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)		Duration (hr)	Salinity (mg/L)

							Hole Depth (m)		
13.70	30.10	16.40	Unknown	13.70			30.10		

Geologists Log
Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	6.00	6.00	SILTSTONE	Siltstone	
6.00	8.70	2.70	SANDSTONE	Sandstone	
8.70	10.60	1.90	COAL	Invalid Code	
10.60	12.00	1.40	MUDSTONE	Unknown	
12.00	14.80	2.80	SILTSTONE/SANDSTONE	Siltstone	
14.80	15.50	0.70	COAL	Invalid Code	
15.50	17.90	2.40	SILTSTONE	Siltstone	
17.90	18.30	0.40	COAL	Invalid Code	
18.30	19.50	1.20	SILTSTONE	Siltstone	
19.50	20.30	0.80	COAL	Invalid Code	
20.30	21.50	1.20	CLAYSTONE	Claystone	
21.50	26.60	5.10	COAL	Invalid Code	
26.60	30.10	3.50	SILTSTONE	Siltstone	

Remarks

***** End of GW078044 *****

NSW Office of Water
Work Summary

GW078045

Licence: 20BL166663 **Licence Status:** ACTIVE

Authorised Purpose(s): MONITORING BORE
Intended Purpose(s): MONITORING BORE

Work Type: Bore
Work Status:
Construct.Method: Backhoe
Owner Type:

Commenced Date:
Completion Date: 14/11/1997
Final Depth: 30.50 m
Drilled Depth: 30.50 m

Contractor Name: MCDERMOTT DRILLING PTY LTD
Driller:
Assistant Driller:

Property: N/A
GWMA: 017 - HUNTER
GW Zone: -
Standing Water Level (m):
Salinity Description:
Yield (L/s):

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:	NORTH	NORTH.003	LOT 23 DP 532814
Licensed:	NORTHUMBERLAND	ALNWICK	Whole Lot 23//532814

Region: 20 - Hunter
River Basin: - Unknown
Area/District:
CMA Map:
Grid Zone:
Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: Unknown
Northing: 6369892.0
Easting: 371836.0
Latitude: 32°48'05.3"S
Longitude: 151°37'52.1"E

GS Map: -
MGA Zone: 0
Coordinate Source: Unknown

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	30.50	96			Open Hole - Water
1		Annulus	Waterworn/Rounded	5.00	30.50				Ungraded
1	1	Opening	Screen	15.80	27.80			1	
1	1	Opening	Slots - Horizontal	15.80	27.80	55		1	PVC, SL: 12.0mm, A: 5.00mm

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)		Duration (hr)	Salinity (mg/L)

							Hole Depth (m)		
17.30	30.50	13.20	Unknown	17.30			30.50		

Geologists Log

Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	2.00	2.00	SANDSTONE	Sandstone	
2.00	16.00	14.00	SILTSTONE/MUDSTONE	Siltstone	
16.00	16.50	0.50	COAL	Invalid Code	
16.50	20.40	3.90	SILTSTONE/MUDSTONE	Siltstone	
20.40	20.90	0.50	COAL	Invalid Code	
20.90	25.00	4.10	MUDSTONE	Mudstone	
25.00	30.50	5.50	SILTSTONE	Siltstone	

Remarks

***** End of GW078045 *****

NSW Office of Water
Work Summary

GW078046

Licence: 20BL166664
Licence Status: ACTIVE

Authorised Purpose (s): MONITORING BORE
Intended Purpose(s): MONITORING BORE

Work Type: Bore
Work Status:
Construct.Method: Backhoe
Owner Type:

Commenced Date:
Completion Date: 14/11/1997
Final Depth: 30.40 m
Drilled Depth: 30.40 m

Contractor Name: MCDERMOTT DRILLING PTY LTD
Driller:
Assistant Driller:

Property: N/A
GWMA: 017 - HUNTER
GW Zone: -
Standing Water Level (m):
Salinity Description:
Yield (L/s):

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:	NORTH	NORTH.057	LOT 92 DP 755260
Licensed:	NORTHUMBERLAND	STOCKRINGTON	Whole Lot 92//755260

Region: 20 - Hunter
River Basin: - Unknown
Area/District:
CMA Map:
Grid Zone:
Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: Unknown
Northing: 6368741.0
Easting: 368651.0
Latitude: 32°48'41.3"S
Longitude: 151°35'49.1"E

GS Map: -
MGA Zone: 0
Coordinate Source: Unknown

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	30.40	96			Open Hole - Water
1		Annulus	Waterworn/Rounded	6.00	30.40				Ungraded
1	1	Opening	Screen	6.80	18.80			1	
1	1	Opening	Slots - Horizontal	6.80	18.80	55		1	PVC, SL: 12.0mm, A: 5.00mm

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

13.60	30.40	16.80	Unknown	13.60			30.40		

Geologists Log
Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	9.20	9.20	SILTSTONE/MUDSTONE	Siltstone	
9.20	9.40	0.20	COAL	Invalid Code	
9.40	11.20	1.80	SILTSTONE	Siltstone	
11.20	11.60	0.40	COAL	Invalid Code	
11.60	30.40	18.80	SILTSTONE/SANDSTONE	Siltstone	

Remarks

***** End of GW078046 *****

NSW Office of Water
Work Summary

GW078047

Licence: 20BL166665
Licence Status: ACTIVE

Authorised Purpose(s): MONITORING BORE
Intended Purpose(s): MONITORING BORE

Work Type: Bore
Work Status:
Construct.Method:
Owner Type:

Commenced Date:
Completion Date: 14/11/1997
Final Depth: 54.30 m
Drilled Depth: 54.30 m

Contractor Name: MCDERMOTT DRILLING PTY LTD
Driller:
Assistant Driller:

Property: N/A
GWMA: 017 - HUNTER
GW Zone: -
Standing Water Level (m):
Salinity Description:
Yield (L/s):

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:	NORTH	NORTH.057	PT LOT 13 DP 755260
Licensed:	NORTHUMBERLAND	STOCKRINGTON	PART LOT 13//755260

Region: 20 - Hunter
River Basin: - Unknown
Area/District:
CMA Map:
Grid Zone:
Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: Unknown
Northing: 6368800.0
Easting: 370784.0
Latitude: 32°48'40.3"S
Longitude: 151°37'11.1"E

GS Map: -
MGA Zone: 0
Coordinate Source: Unknown

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	54.30	96			Unknown
1		Annulus	Waterworn/Rounded	24.90	49.20				Ungraded
1	1	Opening	Screen	25.20	49.20			1	
1	1	Opening	Slots - Horizontal	25.20	49.20	55		1	PVC, SL: 24.0mm, A: 5.00mm

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

22.80	54.30	31.50	Unknown	22.80			54.30		

Geologists Log
Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	6.50	6.50	SILTSTONE	Siltstone	
6.50	12.00	5.50	SANDSTONE	Sandstone	
12.00	14.60	2.60	SILTSTONE/MUDSTONE	Siltstone	
14.60	15.40	0.80	COAL	Invalid Code	
15.40	24.90	9.50	SILTSTONE	Siltstone	
24.90	27.70	2.80	COAL	Invalid Code	
27.70	32.30	4.60	SILTSTONE/SANDSTONE	Siltstone	
32.30	33.40	1.10	COAL	Invalid Code	
33.40	39.30	5.90	SANDSTONE	Sandstone	
39.30	39.90	0.60	COAL	Invalid Code	
39.90	41.10	1.20	SILTSTONE/SANDSTONE	Siltstone	
41.10	43.50	2.40	COAL	Invalid Code	
43.50	45.10	1.60	CLAYSTONE	Claystone	
45.10	49.40	4.30	COAL	Invalid Code	
49.40	54.30	4.90	SILTSTONE	Siltstone	

Remarks

***** End of GW078047 *****

NSW Office of Water
Work Summary

GW078120

Licence: 20BL166666
Licence Status: ACTIVE

Authorised Purpose(s): MONITORING BORE
Intended Purpose(s): MONITORING BORE

Work Type: Bore
Work Status:
Construct.Method:
Owner Type:

Commenced Date:
Completion Date: 14/11/1997
Final Depth: 24.00 m
Drilled Depth: 24.00 m

Contractor Name: MCDERMOTT DRILLING PTY LTD
Driller:
Assistant Driller:

Property: N/A
GWMA: 017 - HUNTER
GW Zone: -
Standing Water Level (m):
Salinity Description:
Yield (L/s):

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:	NORTH	NORTH.029	LOT 115 DP 240782
Licensed:	NORTHUMBERLAND	HEXHAM	Whole Lot 115//240782

Region: 20 - Hunter
River Basin: - Unknown
Area/District:
CMA Map:
Grid Zone:
Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: Unknown
Northing: 6368590.0
Easting: 371176.0
Latitude: 32°48'47.3"S
Longitude: 151°37'26.1"E

GS Map: -
MGA Zone: 0
Coordinate Source: Unknown

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	24.00	96			Open Hole - Water
1		Annulus	Waterworn/Rounded	2.00	24.00				Ungraded
1	1	Opening	Screen	6.00	18.00			1	
1	1	Opening	Slots - Horizontal	6.00	18.00	55		1	PVC, SL: 12.0mm, A: 5.00mm

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)		Duration (hr)	Salinity (mg/L)

							Hole Depth (m)		
6.10	24.00	17.90	Unknown	6.10			24.00		

Geologists Log

Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	14.00	14.00	SILTSTONE/MUDSTONE	Siltstone	
14.00	16.00	2.00	SANDSTONE	Sandstone	
16.00	24.00	8.00	MUDSTONE/SHALE	Mudstone	

Remarks

***** End of GW078120 *****

NSW Office of Water
Work Summary

GW078121

Licence: 20BL166667
Licence Status: ACTIVE

Authorised Purpose (s): MONITORING BORE
Intended Purpose(s): MONITORING BORE

Work Type: Bore
Work Status:
Construct.Method:
Owner Type:

Commenced Date:
Completion Date: 14/11/1997
Final Depth: 43.00 m
Drilled Depth: 43.00 m

Contractor Name: MCDERMOTT DRILLING PTY LTD
Driller:
Assistant Driller:

Property: N/A
GWMA: 017 - HUNTER
GW Zone: -
Standing Water Level (m):
Salinity Description:
Yield (L/s):

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:	NORTH	NORTH.057	LOT 10 DP 11875
Licensed:	NORTHUMBERLAND	STOCKRINGTON	Whole Lot 10//11875

Region: 20 - Hunter
River Basin: - Unknown
Area/District:
CMA Map:
Grid Zone:
Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: Unknown
Northing: 6367262.0
Easting: 368619.0
Latitude: 32°49'29.3"S
Longitude: 151°35'47.1"E

GS Map: -
MGA Zone: 0
Coordinate Source: Unknown

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	43.00	96			Open Hole - Water
1		Annulus	Waterworn/Rounded	2.00	43.00				Ungraded
1	1	Opening	Screen	26.70	42.50			1	
1	1	Opening	Slots	26.70	42.50	55		1	PVC, SL: 15.8mm

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
22.30	43.00	20.70	Unknown	22.30			43.00		

Geologists Log

Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	14.00	14.00	SILTSTONE/SHALE	Siltstone	
14.00	16.00	2.00	SANDSTONE	Sandstone	
16.00	20.00	4.00	SILTSTONE/SHALE	Siltstone	
20.00	22.00	2.00	SANDSTONE	Sandstone	
22.00	25.40	3.40	SILTSTONE/SHALE	Siltstone	
25.40	25.90	0.50	COAL	Invalid Code	
25.90	32.10	6.20	SANDSTONE	Sandstone	
32.10	32.60	0.50	COAL	Invalid Code	
32.60	33.90	1.30	SANDSTONE	Sandstone	
33.90	35.60	1.70	COAL	Invalid Code	
35.60	36.20	0.60	SANDSTONE	Sandstone	
36.20	37.00	0.80	COAL	Invalid Code	
37.00	38.20	1.20	SANDSTONE/SILTSTONE	Sandstone	
38.20	38.60	0.40	COAL	Invalid Code	
38.60	43.00	4.40	SILTSTONE	Siltstone	

Remarks

***** End of GW078121 *****

NSW Office of Water
Work Summary

GW078122

Licence: 20BL166668
Licence Status: ACTIVE

Authorised Purpose (s): MONITORING BORE
Intended Purpose(s): MONITORING BORE

Work Type: Bore
Work Status:
Construct.Method:
Owner Type:

Commenced Date:
Completion Date: 14/11/1997
Final Depth: 35.40 m
Drilled Depth: 35.40 m

Contractor Name: MCDERMOTT DRILLING PTY LTD
Driller:
Assistant Driller:

Property: N/A
GWMA: 017 - HUNTER
GW Zone: -
Standing Water Level (m):
Salinity Description:
Yield (L/s):

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:	NORTH	NORTH.057	LOT 10 DP 11875
Licensed:	NORTHUMBERLAND	STOCKRINGTON	Whole Lot 10//11875

Region: 20 - Hunter
River Basin: - Unknown
Area/District:
CMA Map:
Grid Zone:
Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: Unknown
Northing: 6367663.0
Easting: 368666.0
Latitude: 32°49'16.3"S
Longitude: 151°35'49.1"E

GS Map: -
MGA Zone: 0
Coordinate Source: Unknown

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	35.40	96			Open Hole - Water
1		Annulus	Waterworn/Rounded	19.20	35.40				Ungraded
1	1	Opening	Screen	19.50	35.00			1	
1	1	Opening	Slots - Horizontal	19.50	35.00	55		1	PVC, SL: 15.5mm, A: 5.00mm

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
23.10	51.30	28.20	Unknown	23.10			35.40		

Geologists Log

Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	12.00	12.00	SANDSTONE/SILTSTONE	Sandstone	
12.00	12.40	0.40	COAL	Invalid Code	
12.40	16.00	3.60	SILTSTONE	Siltstone	
16.00	19.50	3.50	SANDSTONE	Sandstone	
19.50	20.90	1.40	COAL	Invalid Code	
20.90	22.00	1.10	SANDSTONE	Sandstone	
22.00	23.60	1.60	COAL	Invalid Code	
23.60	24.40	0.80	SANDSTONE	Sandstone	
24.40	26.60	2.20	COAL	Invalid Code	
26.60	28.00	1.40	SILTSTONE/CLAYSTONE	Siltstone	
28.00	31.70	3.70	COAL	Invalid Code	
31.70	35.40	3.70	SANDSTONE	Sandstone	

Remarks

***** End of GW078122 *****

NSW Office of Water
Work Summary

GW078123

Licence: 20BL166669 **Licence Status:** ACTIVE

Authorised Purpose(s): MONITORING BORE
Intended Purpose(s):

Work Type: Bore
Work Status:
Construct.Method:
Owner Type:

Commenced Date:
Completion Date: 14/11/1997
Final Depth: 33.00 m
Drilled Depth: 33.00 m

Contractor Name: MCDERMOTT DRILLING PTY LTD
Driller:
Assistant Driller:

Property: N/A
GWMA: 017 - HUNTER
GW Zone: -
Standing Water Level (m):
Salinity Description:
Yield (L/s):

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:	NORTH	NORTH.057	LOT 92 DP 755260
Licensed:	NORTHUMBERLAND	STOCKRINGTON	Whole Lot 92//755260

Region: 20 - Hunter
River Basin: - Unknown
Area/District:
CMA Map:
Grid Zone:
Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: Unknown
Northing: 6368165.0
Easting: 369309.0
Latitude: 32°49'00.3"S
Longitude: 151°36'14.1"E

GS Map: -
MGA Zone: 0
Coordinate Source: Unknown

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	33.00	96			Other
1		Annulus	Waterworn/Rounded	12.50	32.20				Ungraded
1	1	Opening	Screen	20.20	32.20			1	
1	1	Opening	Slots - Horizontal	20.20	32.20	55		1	PVC, SL: 12.0mm, A: 5.00mm

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

24.40	33.00	8.60	Unknown	24.40			33.00		

Geologists Log
Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	13.20	13.20	SANDSTONE/SILTSTONE	Sandstone	
13.20	15.30	2.10	COAL	Invalid Code	
15.30	17.00	1.70	SILTSTONE	Siltstone	
17.00	17.90	0.90	COAL/SANDSTONE	Invalid Code	
17.90	19.00	1.10	SILTSTONE	Siltstone	
19.00	19.70	0.70	COAL/SANDSTONE	Invalid Code	
19.70	20.80	1.10	SANDSTONE	Sandstone	
20.80	23.20	2.40	COAL	Invalid Code	
23.20	25.50	2.30	SANDSTONE/CLAYSTONE	Sandstone	
25.50	29.70	4.20	COAL	Invalid Code	
29.70	33.00	3.30	SANDSTONE/SILTSTONE	Sandstone	

Remarks

***** End of GW078123 *****

NSW Office of Water
Work Summary

GW078124

Licence: 20BL166670
Licence Status: ACTIVE

Authorised Purpose(s): MONITORING BORE
Intended Purpose(s): MONITORING BORE

Work Type: Bore
Work Status:
Construct.Method:
Owner Type:

Commenced Date:
Completion Date: 14/11/1997
Final Depth: 40.00 m
Drilled Depth: 40.00 m

Contractor Name: MCDERMOTT DRILLING PTY LTD
Driller:
Assistant Driller:

Property: N/A
GWMA: 017 - HUNTER
GW Zone: -
Standing Water Level (m):
Salinity Description:
Yield (L/s):

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:	NORTH	NORTH.057	PT LOT 13 DP755260
Licensed:	NORTHUMBERLAND	STOCKRINGTON	PART LOT 13//755260

Region: 20 - Hunter
River Basin: - Unknown
Area/District:
CMA Map:
Grid Zone:
Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: Unknown
Northing: 6368018.0
Easting: 369883.0
Latitude: 32°49'05.3"S
Longitude: 151°36'36.1"E

GS Map: -
MGA Zone: 0
Coordinate Source: Unknown

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	40.00	96			Open Hole - Water
1		Annulus	Waterworn/Rounded	11.10	40.00				Ungraded
1	1	Opening	Screen	12.50	36.50			1	
1	1	Opening	Slots - Horizontal	12.50	36.50	55		1	PVC, SL: 30.0mm, A: 2.40mm

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

18.60	40.00	21.40	Unknown	18.60			40.00		

Geologists Log
Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	8.10	8.10	sandstone	Sandstone	
8.10	8.60	0.50	coal	Invalid Code	
8.60	10.00	1.40	siltstone	Siltstone	
10.00	15.50	5.50	sandstone	Sandstone	
15.50	17.20	1.70	coal	Invalid Code	
17.20	18.30	1.10	sandstone	Sandstone	
18.30	19.20	0.90	coal	Invalid Code	
19.20	20.00	0.80	mudstone	Mudstone	
20.00	24.50	4.50	siltstone	Siltstone	
24.50	27.70	3.20	coal	Invalid Code	
27.70	29.90	2.20	sandstone/claystone	Sandstone	
29.90	33.30	3.40	coal	Invalid Code	
33.30	37.00	3.70	mudstone	Mudstone	

Remarks

23/09/2011: Slot Length and Width adjusted due to data entry errors with advice from Madhwan Keshwan. GDS Data Cleanup project 2011.

***** End of GW078124 *****

NSW Office of Water
Work Summary

GW078125

Licence: 20BL166671
Licence Status: ACTIVE

Authorised Purpose (s): MONITORING BORE
Intended Purpose(s): MONITORING BORE

Work Type: Bore
Work Status:
Construct.Method:
Owner Type:

Commenced Date:
Completion Date: 14/11/1997
Final Depth: 30.00 m
Drilled Depth: 30.00 m

Contractor Name: MCDERMOTT DRILLING PTY LTD
Driller:
Assistant Driller:

Property: N/A
GWMA: 017 - HUNTER
GW Zone: -
Standing Water Level (m):
Salinity Description:
Yield (L/s):

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:	NORTH	NORTH.057	PT LOT 13 DP755260
Licensed:	NORTHUMBERLAND	STOCKRINGTON	PART LOT 13//755260

Region: 20 - Hunter
River Basin: - Unknown
Area/District:
CMA Map:
Grid Zone:
Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: Unknown
Northing: 6368464.0
Easting: 370970.0
Latitude: 32°48'51.3"S
Longitude: 151°37'18.1"E

GS Map: -
MGA Zone: 0
Coordinate Source: Unknown

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	30.00	96			Open Hole - Water
1		Annulus	Waterworn/Rounded	5.00	30.00				Ungraded
1	1	Opening	Screen	11.80	29.80			1	
1	1	Opening	Slots - Horizontal	11.80	29.80	55		1	PVC, SL: 18.0mm, A: 5.00mm

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

10.20	30.00	19.80	Unknown	10.20			30.00		

Geologists Log
Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	19.00	19.00	siltstone/sandstone	Siltstone	
19.00	24.00	5.00	sandstone	Sandstone	
24.00	26.50	2.50	siltstone/sandstone	Siltstone	
26.50	26.90	0.40	coal	Invalid Code	
26.90	30.00	3.10	siltstone/sandstone	Siltstone	

Remarks

***** End of GW078125 *****

NSW Office of Water
Work Summary

GW078126

Licence: 20BL166672 **Licence Status:** ACTIVE

Authorised Purpose(s): MONITORING BORE
Intended Purpose(s): MONITORING BORE

Work Type: Bore
Work Status:
Construct.Method:
Owner Type:

Commenced Date:
Completion Date: 14/11/1997
Final Depth: 30.00 m
Drilled Depth: 30.00 m

Contractor Name: MCDERMOTT DRILLING PTY LTD
Driller:
Assistant Driller:

Property: BERESFIELD BORAL-BERESFIELD
GWMA: 017 - HUNTER
GW Zone: -
Standing Water Level (m):
Salinity Description:
Yield (L/s):

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:	NORTH	NORTH.029	LOT 117 DP 568625
Licensed:	NORTHUMBERLAND	HEXHAM	Whole Lot 30//870411

Region: 20 - Hunter
River Basin: - Unknown
Area/District:
CMA Map:
Grid Zone:
Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: Unknown
Northing: 6367736.0
Easting: 371890.0
Latitude: 32°49'15.3"S
Longitude: 151°37'53.1"E

GS Map: -
MGA Zone: 0
Coordinate Source: Unknown

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	30.00	96			Open Hole - Water
1		Annulus	Waterworn/Rounded	2.00	30.00				Ungraded
1	1	Opening	Screen	17.50	29.50			1	
1	1	Opening	Slots - Horizontal	17.50	29.50	55		1	PVC, SL: 12.0mm, A: 5.00mm

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)		Duration (hr)	Salinity (mg/L)

							Hole Depth (m)		
9.00	30.00	21.00	Unknown	9.00			30.00		

Geologists Log
Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	7.00	7.00	sandstone	Sandstone	
7.00	17.10	10.10	siltstone/mudstone	Siltstone	
17.10	17.80	0.70	coal	Invalid Code	
17.80	19.50	1.70	siltstone/claystone	Siltstone	
19.50	19.90	0.40	coal	Invalid Code	
19.90	30.00	10.10	siltstone/mudstone	Siltstone	

Remarks

***** End of GW078126 *****

NSW Office of Water
Work Summary

GW078127

Licence: 20BL166673
Licence Status: ACTIVE

Authorised Purpose(s): MONITORING BORE
Intended Purpose(s): MONITORING BORE

Work Type: Bore
Work Status:
Construct.Method:
Owner Type:

Commenced Date:
Completion Date: 14/11/1997
Final Depth: 30.00 m
Drilled Depth: 30.00 m

Contractor Name: MCDERMOTT DRILLING PTY LTD
Driller:
Assistant Driller:

Property: NOT KNOWN
GWMA: 017 - HUNTER
GW Zone: -
Standing Water Level (m):
Salinity Description:
Yield (L/s):

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:	NORTH	NORTH.057	LOT 82 DP 627798
Licensed:	NORTHUMBERLAND	STOCKRINGTON	Whole Lot 82//627799

Region: 20 - Hunter
River Basin: - Unknown
Area/District:
CMA Map:
Grid Zone:
Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: Unknown
Northing: 6366406.0
Easting: 369073.0
Latitude: 32°49'57.3"S
Longitude: 151°36'04.1"E

GS Map: -
MGA Zone: 0
Coordinate Source: Unknown

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	30.00	96			Open Hole - Water
1		Annulus	Waterworn/Rounded	1.00	30.00				Ungraded
1	1	Opening	Screen	14.30	26.30			1	
1	1	Opening	Slots - Horizontal	14.30	26.30	55		1	PVC, SL: 12.0mm, A: 5.00mm

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

16.60	30.00	13.40	Unknown	16.60			30.00		

Geologists Log
Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	13.00	13.00	siltstone/mudstone	Siltstone	
13.00	17.00	4.00	mudstone	Mudstone	
17.00	30.00	13.00	siltstone/mudstone	Siltstone	

Remarks

***** End of GW078127 *****

NSW Office of Water
Work Summary

GW078128

Licence: 20BL166674 **Licence Status:** ACTIVE

Authorised Purpose(s): MONITORING BORE
Intended Purpose(s): MONITORING BORE

Work Type: Bore
Work Status:
Construct.Method:
Owner Type:

Commenced Date:
Completion Date: 14/11/1997
Final Depth: 30.00 m
Drilled Depth: 30.00 m

Contractor Name: MCDERMOTT DRILLING PTY LTD
Driller:
Assistant Driller:

Property: BERESFIELD BORAL BERESFIELD
GWMA: 017 - HUNTER
GW Zone: -
Standing Water Level (m):
Salinity Description:
Yield (L/s):

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:	NORTH	NORTH.029	LOT 117 DP 568625
Licensed:	NORTHUMBERLAND	HEXHAM	Whole Lot 30//870411

Region: 20 - Hunter
River Basin: - Unknown
Area/District:
CMA Map:
Grid Zone:
Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: Unknown
Northing: 6366923.0
Easting: 370912.0
Latitude: 32°49'41.3"S
Longitude: 151°37'15.1"E

GS Map: -
MGA Zone: 0
Coordinate Source: Unknown

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	30.00	96			Open Hole - Water
1		Annulus	Waterworn/Rounded	1.70	8.00				Ungraded
1	1	Opening	Screen	18.00	30.00			1	
1	1	Opening	Slots - Horizontal	18.00	30.00	55		1	PVC, SL: 12.0mm, A: 5.00mm

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)		Duration (hr)	Salinity (mg/L)

							Hole Depth (m)		
7.80	30.00	22.20	Unknown	7.80			30.00		

Geologists Log
Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	8.00	8.00	siltstone	Siltstone	
8.00	9.00	1.00	shale	Shale	
9.00	12.00	3.00	siltstone	Siltstone	
12.00	12.80	0.80	shale	Shale	
12.80	13.40	0.60	coal	Invalid Code	
13.40	30.00	16.60	siltstone/mudstone	Siltstone	

Remarks

***** End of GW078128 *****

NSW Office of Water
Work Summary

GW079892

Licence: | **Licence Status:**

Authorised Purpose(s):
Intended Purpose(s):

Work Type: Bore
Work Status:
Construct.Method:
Owner Type:

Commenced Date: | **Final Depth:**
Completion Date: | **Drilled Depth:**

Contractor Name:
Driller:
Assistant Driller:

Property: | **Standing Water Level (m):**
GWMA: | **Salinity Description:**
GW Zone: | **Yield (L/s):**

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:	GLOUC	GLOUC.049	
Licensed:			

Region: 20 - Hunter | **CMA Map:**
River Basin: - Unknown | **Grid Zone:** | **Scale:**
Area/District:

Elevation: 6.69 m (A.H.D.) | **Northing:** 6372257.0 | **Latitude:** 32°46'46.3"S
Elevation Source: Unknown | **Easting:** 366598.0 | **Longitude:** 151°34'32.0"E

GS Map: - | **MGA Zone:** 0 | **Coordinate Source:** Unknown

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

Geologists Log
Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments

Remarks

15/02/2000: Form A Remarks:
RZM monitoring bore SK 6560
30/11/2009: Reviewed data - nothing to update.

***** End of GW079892 *****

NSW Office of Water
Work Summary

GW079948

Licence:
Licence Status:
Authorised Purpose(s):
Intended Purpose(s):
Work Type: Bore
Work Status:
Construct.Method:
Owner Type:
Commenced Date:
Completion Date:
Final Depth:
Drilled Depth:
Contractor Name:
Driller:
Assistant Driller:
Property:
GWMA:
GW Zone:
Standing Water Level (m):
Salinity Description:
Yield (L/s):

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:	GLOUC	GLOUC.049	
Licensed:			

Region: 20 - Hunter
River Basin: - Unknown
Area/District:
CMA Map:
Grid Zone:
Scale:
Elevation: 9.87 m (A.H.D.)
Elevation Source: Unknown
Northing: 6372613.0
Easting: 370081.0
Latitude: 32°46'36.2"S
Longitude: 151°36'46.0"E
GS Map: -
MGA Zone: 0
Coordinate Source: Unknown

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

Geologists Log
Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments

Remarks

15/02/2000: Form A Remarks:
RZM MONITORING BORE SK 7653
01/12/2009: Reviewed data - nothing to update.

***** End of GW079948 *****

NSW Office of Water
Work Summary

GW080034

Licence:
Licence Status:
Authorised Purpose(s):
Intended Purpose(s):
Work Type: Bore
Work Status:
Construct.Method:
Owner Type:
Commenced Date:
Completion Date:
Final Depth:
Drilled Depth:
Contractor Name:
Driller:
Assistant Driller:
Property:
Standing Water Level (m):
GWMA:
Salinity Description:
GW Zone:
Yield (L/s):

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:	GLOUC	GLOUC.049	
Licensed:			

Region: 20 - Hunter
CMA Map:
River Basin: - Unknown
Grid Zone:
Scale:
Area/District:
Elevation: 5.94 m (A.H.D.)
Northing: 6370959.0
Latitude: 32°47'27.8"S
Elevation Source: Unknown
Easting: 365222.0
Longitude: 151°33'38.4"E
GS Map: -
MGA Zone: 0
Coordinate Source: Unknown

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

Geologists Log
Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments

Remarks

15/02/2000: Form A Remarks:
RZM MONITORING BORE SK 8368
01/12/2009: Reviewed data - nothing to update.

***** End of GW080034 *****

NSW Office of Water
Work Summary

GW200414

Licence: 20BL169475 **Licence Status:** ACTIVE

Authorised Purpose(s): MONITORING BORE
Intended Purpose(s):

Work Type: Bore
Work Status:
Construct.Method:
Owner Type:

Commenced Date: **Final Depth:** 10.00 m
Completion Date: 09/09/2004 **Drilled Depth:** 10.00 m

Contractor Name:
Driller:
Assistant Driller:

Property: N/A 114 CHELMSFORD DRIVE METFORD 2323 **Standing Water Level:**
GWMA: - **Salinity:**
GW Zone: - **Yield:**

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:	NORTH	NORTH.34	1/1001539
Licensed:	NORTHUMBERLAND	MAITLAND	Whole Lot 1//1001539

Region: 20 - Hunter **CMA Map:**
River Basin: - Unknown **Grid Zone:** **Scale:**
Area/District:

Elevation: 0.00 m (A.H.D.) **Northing:** 6373761.0 **Latitude:** 32°45'58.9"S
Elevation Source: Unknown **Easting:** 369960.0 **Longitude:** 151°36'41.9"E

GS Map: - **MGA Zone:** 0 **Coordinate Source:** Map Interpretation

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	10.00	0			Unknown

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

Geologists Log

Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	0.30	0.30	fill (silty sand, dark brown, medium grained sand, minor medium plasticity clay inclusions without)	Fill	
0.30	0.50	0.20	fill (clayey sand, light brown medium grained sand, medium plasticity clay fines)	Fill	
0.50	1.30	0.80	clay (silty, light grey, orange mottling, low plasticity fines)	Clay	
1.30	2.50	1.20	sandstone (extremely weathered, fine grained, red and grey mottled)	Clay	
2.50	4.00	1.50	sandstone (very weathered, brown orange, fine to very fine grained, trends to siltstone)	Sandstone	
4.00	6.00	2.00	sandstone (moderately weathered, orange brown, fine grained)	Sandstone	
6.00	6.50	0.50	sandstone (fine grained, minor weathering, light grey)	Sandstone	
6.50	8.00	1.50	siltstone (grey, minor unweathered carbonaceous fragments, iron stained bands throughtout)	Siltstone	
8.00	8.20	0.20	coal (black, minor carbonaceous mudstone bands, moderately hard, 90-100% dull, fresh)	Invalid Code	
8.20	10.00	1.80	sandstone (light grey, fine to medium grey, moderately hard)	Sandstone	

Remarks

***** End of GW200414 *****

NSW Office of Water
Work Summary

GW200415

Licence: 20BL169475 **Licence Status:** ACTIVE

Authorised Purpose(s): MONITORING BORE
Intended Purpose(s):

Work Type: Bore
Work Status:
Construct.Method:
Owner Type:

Commenced Date: **Final Depth:** 20.10 m
Completion Date: 10/09/2004 **Drilled Depth:** 20.10 m

Contractor Name:
Driller:
Assistant Driller:

Property: N/A 114 CHELMSFORD DRIVE METFORD 2323 **Standing Water Level:**
GWMA: - **Salinity:**
GW Zone: - **Yield:**

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:	NORTH	NORTH.34	1/1001539
Licensed:	NORTHUMBERLAND	MAITLAND	Whole Lot 1//1001539

Region: 20 - Hunter **CMA Map:**
River Basin: - Unknown **Grid Zone:** **Scale:**
Area/District:

Elevation: 0.00 m (A.H.D.) **Northing:** 6373738.0 **Latitude:** 32°45'59.7"S
Elevation Source: Unknown **Easting:** 369986.0 **Longitude:** 151°36'42.9"E

GS Map: - **MGA Zone:** 0 **Coordinate Source:** Map Interpretation

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	20.10	0			Unknown

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

Geologists Log

Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	1.30	1.30	clay (silty, sandy, light to dark brown, low plasicity, fine to medium grained sand. Some grey orange mottling)	Clay	
1.30	1.50	0.20	clay (sandy silty, orange grey mottled)	Clay	
1.50	4.00	2.50	sandstone (medium grained, light grey, moderately weathered with orange brown mottling near top)	Sandstone	
4.00	6.50	2.50	sandstone (fine to very fine grained, tends to siltstone, orange, moderately weathered)	Sandstone	
6.50	7.00	0.50	coal (black, tends to claystone in part, minor weathering)	Invalid Code	
7.00	9.00	2.00	siltstone (grey, tends to fine sandstone, minor carbonaceous traces)	Siltstone	
9.00	15.00	6.00	sandstone (light grey, white, fine to medium grained, moderately hard, not weathered, minor siltstone bands)	Sandstone	
15.00	17.00	2.00	sandstone (with siltstone, interbedded, light grey, fine to medium grained sandstone, grey siltstone, minor carbonacous)	Sandstone	
17.00	20.10	3.10	sandstone (fine to medium grained, light grey/white, fresh, hard)	Sandstone	

Remarks

***** End of GW200415 *****