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REPORT ON GROUNDWATER STUDY

NEW OAKLEIGH COAL MINE, ROSEWOOD

prepared for
NEW HOPE COAL AUSTRALIA LTD

Project 33358A
August 2004

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REPORT ON
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1.0 INTRODUCTION

The report describes the results of a groundwater study carried out on the New Oakleigh Coal Mine located at Rosewood. Douglas Partners Pty Ltd (DP) was commissioned by New Hope Coal Australia Ltd to carry out the study.

The groundwater study was conducted to address the requirements of groundwater conditions C2-1 to C2-4 of the new Environmental Authority M5637 issued with the granting of a new mining lease, ML50175. The groundwater conditions comprised:

- C2-1 states that a groundwater study must be undertaken of the existing groundwater regimes with the aim of proposing any necessary monitoring programs and contaminant limits;
- C2-2 states that groundwater levels must be monitored and drawdowns in excess of 2 m per year, not resulting from the pumping of licensed bores, must be notified to the administering authority;
- C2-3 states that the sampling of groundwater should comply with the Environmental Protection Authority's (EPA's) water quality sampling manual; and
- C2-4 states that additional testing is to be carried out on Mrs Svennson's property to assess the impact of blasting on groundwater, and continue until the EPA is satisfied that blasting can have no impact to the aquifers on Mrs Svennson's property.

The objective of the groundwater study was to investigate the aquifers and groundwater quality surrounding New Oakleigh Coal Mine to satisfy the above four groundwater conditions. The study comprised the review of existing groundwater data, drilling and installation of monitoring bores,

installation of data loggers to monitor groundwater levels, groundwater sampling and monitoring of groundwater quality.

2.0 SITE INFORMATION

2.1 Location, Climate and Topography

New Oakleigh Coal Mine is located near the town of Rosewood, approximately 65 km west of Brisbane as shown on Drawing 1. The mine currently holds six mining leases which occupy a total area of approximately 994 ha (refer Drawing 1). Mining lease ML50175 has an area of approximately 85 ha and is approximately 2.5 km east of Mrs Svennson's property.

Climatic information obtained from the Bureau of Meteorology shows that the New Oakleigh Mine area has a subtropical climate of warm wet summers and cool dry winters. The average annual rainfall is 865 mm and the wettest months of the year are December, January and February that average approximately 120 mm per month of rainfall.

The topography of the mine site and surrounding area is steep with the land generally sloping towards the south. The surface is dominated by a ridge with a topographic high of approximately 2200 mAHD situated to the north and northeast of the active open cut pit, and slopes down to elevations of approximately 2050 mAHD within the town of Rosewood and along the Bremer River. Ephemeral gullies drain stormwater runoff from the mine site into Western Creek, which joins the Bremer River about 1 km south of Rosewood.

2.2 Regional Geology and Hydrogeology

The Geological Survey of Queensland's 1:100,000 series Ipswich Sheet indicates the New Oakleigh Mine site to be underlain by the Jurassic aged Walloon Coal Measures comprising shale, coal, siltstone and sandstone. These strata are characterised by thin coal seams with multiple splits interlayered with the shale, siltstone, and sandstone. To the southeast of the mine site near Reinke and Urry Roads, Quaternary aged alluvial sediments associated with the Bremer River overlie the coal measures. The alluvial sediments comprise undifferentiated floodplain and river terrace deposits of sand, silt, gravel and clay. The surface geology of the region is shown on Drawing 2.

The Groundwater Resources of Queensland Map, produced by the Queensland Water Resources Commission (1987), indicates that the potential for groundwater within the Walloon coal measures beneath the New Oakleigh Coal Mine and Rosewood district is limited with bore yields typically less than 5 L/s and water quality only marginal for most stock use, ie a total dissolved salt (TDS) content

of between 1,500 – 5,000 mg/L. The New Oakleigh Coal Mine EMOS (2002)[1] states that results of monitoring of groundwater from underground workings within the coal measures show the groundwater has an electrical conductivity of 5,000 to 7,000 μS/cm indicating the groundwater to be brackish.

The groundwater resources map indicates that the potential for groundwater within the unconsolidated alluvial sediments is higher, with bore yields expected to be 5 – 15 L/sec. Water quality is suitable for most uses, although marginal for human consumption, with a TDS of between 500 – 1,500 mg/L.

3.0 REVIEW OF EXISTING INFORMATION

3.1 NRM Groundwater Database

The groundwater database held by the Queensland Department of Natural Resources and Mines (NRM) does not show any privately owned registered bores within the Rosewood district. This is because the area is not within a Proclaimed Groundwater Area under the Water Resources Act1989 and Water Act 2000, and therefore the bores drilled in the district do not require registration with the NRM.

The NRM database did provide details of monitoring bores installed by NRM near Lane Road Lanefield, as well as along Rosewood-Warrill View Road, in Rosewood. Some of these bores are used to monitor groundwater levels on a six monthly basis. Bore logs obtained from NRM are provided in Appendix A. The bores are installed within the Bremer River alluvium and provide background information on water quality and groundwater levels within this aquifer. The details are summarised in Table 1.

[1] New Hope Coal Australia Ltd, April 2002, *EMOS: Environmental Management Overview Strategy New Oakleigh Coal Mine ML4568, 4584, 4683, 4698, 4699, and MLA50175.*

Table 1: NRM Monitoring Bores; Groundwater Levels and Quality

Bore No.	Date Drilled	Depth	Lithology (Aquifer)	Groundwater Quality			Groundwater Level
				TDS (mg/L)	EC (uS/cm)	pH	
14310142	13/1/1965	9.14	BR alluvium	NR	NR	NR	NR
14310143	27/1/1965	21.30	BR alluvium	2100	3900	7.4	8.60
14310144	20/1/1965	18.50	BR alluvium	7396	11700	7.8	8.24
14310145	2/4/1965	20.42	BR alluvium	1638	3000	7.2	6.40
14310146	18/1/1965	20.11	BR alluvium	295	646	6.7	7.74
14310147	25/3/1965	18.30	BR alluvium	3855	7500	7.2	7.60
14310148	22/1/1965	20.11	BR alluvium	1931	3636	8.0	10.57
14310149	24/5/1965	NR	BR alluvium	NR	NR	NR	9.89
14310068	19/3/1958	19.80	BR alluvium	803	NR	6.8	8.16
14310069	2/12/1957	16.40	BR alluvium	855	NR	7.4	7.31
14310070	19/10/1966	NR	BR alluvium	NR	NR	NR	6.17
14310071	31/3/1957	20.10	BR alluvium	2045	4020	7.8	14.00
14310072	26/3/1957	18.28	BR alluvium	1613	3100	7.6	9.88
14310073	26/2/1958	15.70	BR alluvium	1767	3320	7.8	5.17
14310074	NR	NR	BR alluvium	NR	NR	NR	3.11
14310075	24/11958	15.24	BR alluvium	1358	2510	7.9	9.40
14310076	10/2/1958	16.20	BR alluvium	2960	5000	7.9	5.10

Note:
1) BR – Bremer River.
2) NR – No records available.
3) Groundwater levels are the latest recorded water level on the NRM bore log. Measured as depth below reference point.
4) TDS – Total dissolved salt.
5) EC – Electrical conductivity.

The NRM database shows that groundwater quality within the Bremer River alluvium aquifer varies between fresh and brackish with a total dissolved salt (TDS) content of 295 mg/L to 7,396 mg/L. The pH is generally neutral to slightly alkaline.

Since approximately 1965, NRM have monitored groundwater levels in several of the bores listed in Table 1. Hydrographs of the groundwater level monitoring carried out by NRM on three bores (14310071, 14310143, and 14310144) are provided in Appendix B. Since there are no known water supply bores near these bores, the water level fluctuations are considered to be natural and in response to variations in rainfall. The hydrographs show that the natural range in groundwater levels over the monitoring period varied from approximately 4 m in 14310144 to 7.5 m in 14310143, and that levels in 2003 were generally 3 m to 5 m lower when compared to groundwater levels in the 1970's and 1980's.

3.2 New Oakleigh Coal Mine Data

Bore logs for exploration bores that intersected groundwater were obtained from New Oakleigh Coal Mine and reviewed. Copies of the bore logs are attached in Appendix C. The bores were drilled to between 18.0 m and 119 m depth to the south and southwest of ML 50175 at the locations shown on Drawing 1. The bores were drilled through the Walloon Coal Measures, and the general stratigraphy comprised clay and gravel to approximately 11 m depth, underlain by sandstone/siltstone interlayered with carbonaceous mudstone and coal. The coal seams varied in thickness from 0.1 m to 2.3 m.

Groundwater was intersected generally when the first or second coal seam was encountered at depths between 14 m and 24 m depth below ground level. No information was recorded regarding groundwater quality. Airlift flow rates from the bores ranged between 500 gal/hour (0.6 L/s) and 700 gal/hr (0.9 L/s).

The New Oakleigh Coal Mine EMOS (2002) states that yield from exploration bores and active mining pits has been very low or nil, and no significant groundwater resource has been encountered by the mining operations. Also, groundwater level data from the mine site indicates a hydraulic gradient sloping from north to south reflecting the surface topography. Drilling completed across the mining area showed that the only usable groundwater resource was the old underground mine workings.

3.3 New Oakleigh Mine Groundwater Usage

During dry times it is understood that the mine extracts groundwater from three bores within old underground mine workings to supplement the demand of the washplant. These bores are located on Blakes Road (bore 8315P), Rosewood-Marburg Road (bore 8171WB), and near Perrins Lane on Bulow's property (bore 8373P). Ms Shiralee Neverov, Senior Geologist with New Oakleigh Coal Mine, stated that the bores are able to be pumped dry within a day and then take 1-2 days to recharge. Bore locations are shown on Drawing 1.

These bores recharge slowly because once groundwater stored within the void of the old workings is extracted, the system then relies upon the rock mass to supply groundwater seepage to slowly recharge and fill up the void. This indicates the surrounding rock mass has a low permeability and the underground workings are not a continuous aquifer system.

Records from the mine showed that the Blake's Road bore and Marburg Road bore are mainly used to supply water for the washplant. The Marburg Road Bore extracted a total volume of 29,200 m^3 between May 2003 and May 2004, an average of 80 m^3/day. The Blake's Road bore extracted a total volume of 5,100 m^3 between August 2003 and May 2004, an average of approximately 19 m^3/day. Water level monitoring in these two bores showed the static water levels remained

stable over the pumping period with no significant increase or decrease. The extraction rates are considered to be low and minor in comparison to the total recharge entering the aquifer.

Groundwater was also extracted from the Perrins Lane bore, also installed within old mine workings, to supplement the supply for the washplant. No records are available of the volumes extracted from the bore, except that groundwater was pumped irregularly from the bore between 24 November 2003 and 17 February 2004 over the previous year.

Groundwater is also extracted from a fourth bore, known as Kelly's bore (Bore 8345WB), which extracts groundwater from a fractured rock aquifer within the coal measures. This bore is located approximately 5 m from 8345P (refer Drawing 1), and was monitored by DP over the previous six months (refer section 4.3). No records of the volumes extracted from the bore were available, except that groundwater was pumped irregularly from the bore between September 2003 and June 2004 for dust suppression. On 30 June 2004, the mine was extracting groundwater from this bore at a rate of approximately 1.0 L/s to 1.5 L/s.

4.0 FIELD INVESTIGATION

The field investigation for this project was carried out by a Hydrogeologist from DP between September 2003 and June 2004 and comprised:

- Drilling and installation of three monitoring bores (8377P, 8378P, and 8401P);
- Inspection of Mrs Svennson's existing bore;
- Development and groundwater sampling of the monitoring bores;
- Field analysis of groundwater quality; and
- Installation of data loggers to continuously monitor groundwater levels.

4.1 Drilling and Installation of Monitoring Bores

Monitoring Bores 8377P, 8378P, and 8401P were drilled by S and K Drilling, with a Mayne 1000 truck-mounted drilling rig using conventional rotary with air drilling techniques. Bores were installed at the locations shown on Drawing 1. The locations were chosen to allow the groundwater levels within the two potential aquifers within the Walloon Coal Measures and alluvium, to be monitored off the mine site as well as on Mrs Svennson's property (213 Stevens Road, Ashwell).

The bores were drilled to between 12.5 m and 34.0 m depth. Each bore was lithologically logged onsite based on an inspection of the drill cuttings. Logging of the bores indicated that the subsurface profile comprised colluvial or alluvial sediments underlain by the Walloon Coal Measures. Further details of the subsurface conditions encountered are described on the test bore report sheets in Appendix D.

8377P was drilled on Mrs Svennson's property approximately 4 m from an existing bore within a dry gully that drained to the southeast. The depth of the existing bore was 11.0 m below ground level and the groundwater was measured at 9.7 m below ground level on 28 September 2003. The bore was constructed with six inch (152 mm) diameter steel casing that was heavily corroded near the surface. Bore 8377P intersected colluvial sediments comprising silty clay and clayey gravel to 7.5 m depth, underlain by weathered siltstone and clay. Groundwater was encountered at 11.0 m depth whilst drilling within the siltstone of the Walloon Coal Measures. Upon completion of the monitoring bore, groundwater was measured at 1.4 m below ground level.

8378P was drilled to 18.0 m depth and the subsurface comprised alluvial sediments comprising silty clay to 6.0 m depth, underlain by gravelly clay/clayey gravel to 18.0 m depth. Groundwater was intercepted at 10.0 m depth.

8401P was drilled to 34.0 m depth and intersected alluvial sediments comprising clay and clayey gravel to 13.0 m depth, underlain by siltstone and thin coal seams to 34.0 m depth. Groundwater was observed at 20 m depth within the Walloon Coal Measures. No groundwater was observed in the alluvium whilst drilling.

The bores were completed as monitoring bores by installing 50 mm diameter, PVC casing with a slotted screen. A filter pack consisting of 2-3 mm sand or 3–5 mm gravel was installed in the annulus between the bore wall and casing/screen. A bentonite seal was placed in the annulus above the screen to prevent surface water from entering the bores. A protective steel monument cover was concreted over the top of the PVC casing. On completion, New Hope Coal surveyed the bores.

Construction details for the monitoring bores are summarised in Table 2 and are illustrated on the bore report sheets in Appendix D.

Table 2 – Monitoring Well Construction Details

Monitoring Bore	Ground Elevation RL[1]	Total Depth (mBGL)	Screen Interval (mBGL)	Filter Pack (mBGL)	Water Level	
					(mBGL)	RL (m)
8377P	75.05	12.5	10.5 – 12.5	6.5 – 12.5	1.40	73.65
8378P	51.09	17.0	11.0 – 17.0	1.5 – 17.0	2.20	48.89
8401P	60.59	34.0	16.0 – 34.0	14.0 – 34.0	12.95	47.64

Note: 1) RL – relative level of ground surface in mAHD.
2) mBGL – metres below ground level.

4.2 Bore Development and Groundwater Sampling

Monitoring bores were installed and developed in accordance with the Agriculture and Resource Management Council of Australia and New Zealand's 'Minimum Construction Requirements For

Water Bores In Australia', dated July 1997. The bores were drilled without using any polymer drilling fluid additive, thus there was no need for any chemical breakdown products to be used during development.

Bore development involved airlifting and bailing of groundwater to remove the fine sand/silt/clay introduced into the bores during drilling. Bailing continued until the discharged water was visibly clean, and the pH, EC and temperature of the groundwater had stabilised.

To ensure that representative groundwater samples were obtained, bores were sampled in accordance with the EPA's (December 1999) Water Quality Sampling Manual, as well as the 'Murray-Darling Basin Groundwater Quality Sampling Guidelines", published by the Murray-Darling Basin Commission in 1997. Sampling of monitoring bores 8377P, 8378P, 8345WB, and 8401P was carried out using a stainless steel bailer on two occasions; initially when the bores were installed in September and October 2003, and in January 2004 to assess any seasonal variations in quality. Sampling equipment was cleaned and decontaminated between each monitoring bore location. The samples were transferred to the appropriate preserved containers and kept chilled until delivered to the laboratory for analysis.

4.3 Groundwater Monitoring - Field Analyses

Groundwater was monitored once per month from January 2004 to June 2004. Depth to groundwater was measured and samples were analysed on-site for pH, electrical conductivity (EC), and temperature using pre-calibrated hand held equipment. Results of the groundwater monitoring and field analyses are provided in Table 3.

Table 3 – Groundwater Field Monitoring Results

Bore	Sampling Date	SWL (mBTOC)	SWL (mBGL)	Ph	EC	Temp
8377P	28/09/2003	1.4	0.7	7.0	15,500	23.5
	31/01/2004	3.71	2.77	6.9	15,450	23.5
	20/02/2004	2.95	2.01	6.9	15,100	23.0
	26/03/2004	2.18	1.24	-	-	-
	30/04/2004	2.56	1.62	6.8	14,100	22.5
	31/05/2004	3.45	2.51	6.8	14,200	22.2
	30/6/2004	3.99	3.05	6.6	13,200	22.2
8378P	1/10/2003	2.40	2.20	7.6	7730	23.0
	7/01/2004	3.46	2.71	6.3	6540	23.5
	22/01/2004	3.69	2.94	-	-	-
	20/02/2004	3.62	2.87	6.4	6600	23.0
	26/03/2004	3.47	2.72	-	-	-
	30/04/2004	3.31	2.56	6.3	6570	22.7
	31/05/2004	3.38	2.63	6.2	6760	21.6
	30/6/2004	3.34	2.59	6.3	6700	21.3
8401P	13/10/2003	13.66	12.86	7.2	12700	23.0
	7/01/2004	14.04	13.05	6.7	15400	24.0
	22/01/2004	13.72	12.73	-	-	-
	20/02/2004	13.59	12.6	6.8	14,800	23.5
	26/03/2004	13.40	12.41	-	-	-
	30/04/2004	13.07	12.08	6.8	14,650	22.5
	31/05/2004	13.52	12.53	6.7	14,700	22.1
	30/6/2004	13.40	12.41	6.6	13,500	21.6
8348P (8345WB)	13/10/2003	18.4[4]	17.13	7.1	12700	21.5
	7/01/2004	12.28	10.96	7.2	12200	23.2
	30/04/2004	8.48	7.16	7.0	13,300	21.8
	30/05/2004	9.05	7.73	7.0	12,300	21.8
	30/6/2004	13.97[4]	12.65	6.7	13,500	22.1

Notes:
1) EC – Electrical Conductivity.
2) mBTOC – metres below top of steel casing, except 8345P which is below PVC casing.
3) mBGL – metres below ground level.
4) 8348P monitored from a 50 mm monitoring bore approximately 5 m from the water supply bore 8345WB. On 13/10/03 and 30/6/04 New Oakleigh Coal Mine was pumping from the water supply bore.

The results for bores 8377P, 8401P, and 8348P indicate the groundwater within the fractured rock aquifer within the coal measures is brackish to saline, with EC levels ranging between 12,200 and 15,500 μS/cm. These levels are greater than those interpreted from the Groundwater Resources of Queensland Map. The pH of the groundwater was slightly acidic to neutral.

Bore 8378P is screened within the Bremer River alluvium and the monitoring results indicate the groundwater has a lower TDS content than groundwater within the coal measures, as EC levels varied between 6,540 and 7,730 μS/cm. The pH of the groundwater was slightly acidic.

4.4 Installation of Data Loggers

Data loggers were installed in monitoring bores 8378P and 8401P on the 7 January 2004, as well as in 8377P on Mrs Svennson's property on 31 January 2004. The loggers were Odyssey capacitive water level probes capable of monitoring groundwater level variations of up to 3 m. The loggers were installed to allow continuous monitoring of groundwater levels within the bores in relation to rainfall, groundwater extraction and blasting on the mine site. This monitoring was required to comply with groundwater conditions C2-2 and C2-4 of the new Environmental Authority M5637. Data loggers were set to record a water level reading every 30 minutes. Data were downloaded at the end of each month and the results were plotted as depth to groundwater over the six months of monitoring. To allow comparison with rainfall, daily rainfall obtained from New Oakleigh Coal Mine's weather station has been included on the hydrographs attached in Appendix E.

The three hydrographs show a general increase in groundwater levels from January to April in response to the above average rainfall in January (156.5 mm), February (119.5 mm), and March (149.5 mm). The hydrographs show a decreasing trend in groundwater levels during May and June in response to the low rainfall, as April recorded only 20 mm of rain, May 10 mm, and June 1.5 mm for the month. The changes in groundwater level from the beginning to the end of the six month monitoring period were:

- 8377P – decrease of 0.10 m;
- 8378P – increase of 0.20 m; and
- 8401P – increase of 0.69 m.

The variation in groundwater levels in the bores, ie difference between the highest and lowest groundwater levels recorded over the monitoring period were:

- 8377P – 1.90 m;
- 8378P – 0.53 m; and
- 8401P – 1.36 m.

The hydrographs show the response to rainfall and variations in water level are greater in bores 8377P and 8401P compared to those recorded in bore 8378P. This is caused by the difference in aquifer porosity and storage properties between the fractured rock aquifer, monitored by bores 8377P and 8401P, and the clayey gravel/gravelly clay alluvium aquifer monitored by bore 8378P. The groundwater is above the level of the aquifer indicating the water in both aquifers is under pressure and the loggers are recording the potentiometric surface (pressure reading of the water within the pore spaces/voids) and not the water table. As recharge enters the aquifers from rainfall, water is added to the pore spaces or fractures, which compresses the water resulting in a pressure increase and a rise in the water level in the monitoring bore. Since the storage is greater within the alluvium sediments, probably several orders of magnitude, increases in groundwater level in response to rainfall are smaller.

5.0 LABORATORY TESTING

5.1 Laboratory Analyses

Groundwater samples were collected from bores 8377P, 8378P, 8345WB, and 8401P on two occasions and analysed for the following parameters:

- Total dissolved salts (TDS);
- Arsenic, cadmium, chromium, copper, iron, nickel, lead and zinc;
- Major cations – sodium, calcium, magnesium, and potassium
- Major anions – chloride, bicarbonate, carbonate, and sulfate.

5.2 Regulatory Criteria

Groundwater results have been compared to the National Environmental Protection Measures (1999) and ANZECC/NHMRC *Australian Water Quality Guidelines for Fresh and Marine Waters* (2000) Guidelines for the Protection of Freshwater Aquatic Ecosystems, and the guidelines for livestock drinking water.

5.3 Laboratory Results

Laboratory results are summarised in Table 4 for bores 8377P and 8378P, and Table 5 for 8348P and 8401P. The laboratory reports and chain of custody documentation are attached in Appendix F.

Table 4 – Laboratory Results For Bores 8377P and 8378P

Analyte	Unit	ANZECC Guideline		8377P		8378P	
		Fresh Water[1]	Stock Water[2]	28/9/03	31/1/04	1/10/03	7/1/04
TDS	mg/L	1000	5000	9060	9670	6300	4650
pH – field	Units	6.5-8.0	-	7.0	6.9	7.6	6.3
EC – field	µS/cm	5000	-	15,500	15,450	7730	6540
Major Cations:							
Calcium	mg/L	-	1000	167	225	405	238
Magnesium	mg/L	-	2000	438	610	423	224
Sodium	mg/L	-	-	2190	3120	1050	1070
Potassium	mg/L	-	-	20	22	8	8
Major Anions:							
Chloride	mg/L	-	-	4360	5820	1200	1360
Sulfate	mg/L	-	1000	199	146	2640	1210
Carbonate	mg/L	-	-	<1	<1	<1	<1
Bicarbonate	mg/L	-	-	677	1430	669	718
Heavy Metals:							
Arsenic	mg/L	0.094	0.5	<0.001	<0.001	0.031	0.014
Cadmium	mg/L	0.0004	0.01	0.0002	0.0001	0.0002	0.0001
Chromium	mg/L	-	1	0.029	<0.001	0.016	<0.001
Copper	mg/L	0.0018	0.4	0.002	0.002	0.015	0.004
Nickel	mg/L	0.0013	1	0.002	0.004	0.007	0.004
Lead	mg/L	0.0056	0.1	<0.001	<0.001	<0.001	<0.001
Zinc	mg/L	0.0015	20	0.042	0.030	0.018	0.082

Notes:
1) ANZECC 90% protection trigger level for freshwater – lowland rivers.
2) ANZECC Livestock drinking water guidelines. Sheep may tolerate up to 10,000 mg/L.
3) Ph and EC were analysed in the field.
4) <LOR – less than laboratories level of reporting (ie detection limits).
5) Shaded – level exceeds ANZECC livestock guideline.

Table 5 – Laboratory Results For Bores 8348P and 8401P

Analyte	Unit	ANZECC Guideline		8348P		8401P	
		Fresh[1] Water	Livestock Water[2]	13/10/03	7/1/04	13/10/03	7/1/04
TDS	mg/L	1000	5000	8380	8840	7760	11300
pH – field	Units	6.5-8.0	-	7.1	7.2	7.2	6.7
EC – field	µS/cm	5000	-	12700	12200	12700	15400
Major Cations:							
Calcium	mg/L	-	1000	116	117	108	150
Magnesium	mg/L	-	2000	93	99	196	424
Sodium	mg/L	-	-	2870	3030	2520	3480
Potassium	mg/L	-	-	16	19	11	15
Major Anions:							
Chloride	mg/L	-	-	3300	3470	3040	5550
Sulfate	mg/L	-	1000	1340	1450	883	1000
Carbonate	mg/L	-	-	<1	<1	<1	<1
Bicarbonate	mg/L	-	-	993	1010	1270	981
Heavy Metals:							
Arsenic	mg/L	0.094	0.5	<0.001	0.002	<0.001	<0.001
Cadmium	mg/L	0.0004	0.01	<0.0001	0.0002	<0.0001	0.0001
Chromium	mg/L	-	1	0.008	0.008	0.013	0.006
Copper	mg/L	0.0018	0.4	0.003	0.004	0.004	0.003
Nickel	mg/L	0.0013	1	0.003	0.007	0.004	<0.001
Lead	mg/L	0.0056	0.1	<0.001	<0.001	<0.001	<0.001
Zinc	mg/L	0.0015	20	0.035	0.196	0.070	0.076

Notes: 1) ANZECC 90% protection trigger level for freshwater.
2) NHMRC/ARMCANZ National Water Quality Management Strategy Australian Drinking Water Guidelines 1996.
3) Ph and EC were analysed in the field.
3) <LOR – less than laboratories level of reporting (ie detection limits).
4) Shaded – level exceeds ANZECC livestock guideline.

6.0 QUALITY ASSURANCE/QUALITY CONTROL

6.1 Quality Assurance

Quality assurance (QA) was maintained by:

- Compliance with a Project Quality Plan written for the objectives of the study;
- Using a qualified Environmental Engineer and Hydrogeologist to conduct field investigation;
- Compliance with DP QA procedures for soil sampling, field testing and decontamination;
- Dispatching samples using appropriate chain of custody procedures;
- Using a NATA registered laboratory that uses standard laboratory methods of the USEPA and the APHA.

6.2 Quality Control

Quality control of the laboratory analyses was achieved by the following means:

- laboratory control spikes: samples were spiked by the laboratory with a known concentration of contamination and subsequently tested for percent recovery;
- Equipment blanks: the laboratory ran reagent blanks to confirm the equipment and standards used were uncontaminated.

Results of all quality testing conducted by the laboratory are attached with the laboratory reports in Appendix F.

6.3 Quality Control Results

6.3.1 Laboratory Spikes

The laboratories spiked samples with a known concentration of contaminants. The spiked recovery percentages were reported by the laboratory within the acceptable ranges of 75% to 125% for metals.

6.3.2 Equipment Blanks

All equipment/method blanks returned results lower than the laboratory detection limit or level of reporting (LOR), therefore are acceptable.

6.4 Summary - QA/QC

On the basis of the analytical data validation procedure used by DP and ALS, as well as the quality assurance measures maintained, the quality of the soil analytical data produced is considered to be acceptable for interpretive use.

7.0 CONCEPTUAL HYDROGEOLOGICAL MODEL (GROUNDWATER REGIME)

The conceptual hydrogeological model, or description of the groundwater regimes, is based upon a review of the geological and topographic maps for the area, data supplied by New Hope Coal Australia Ltd, field observations, and from the drilling and installation of monitoring bores. The model or groundwater regime is described in the following sections.

7.1 Geological Setting

Three different groundwater regimes were identified by this study, and include:

- Bremer River Alluvium aquifer;
- Walloon Coal Measures fractured rock (coal seam) aquifers; and
- Voids within the old mine workings.

The Bremer River alluvium comprises undifferentiated floodplain and river terrace deposits of sand, silt, gravel and clay, as discussed in section 2.2. The aquifer lithology generally comprises clayey gravel which is confined by the overlying sandy clay and silty clay lithologies.

The Walloon Coal Measures contain fractured rock aquifers mainly present within the various coal seams, but also possibly within carbonaceous mudstone/siltstone lithologies. The coal measures comprise a layered sequence of shale, coal, carbonaceous mudstone, siltstone and sandstone. Groundwater is confined by the low permeability siltstone or sandstone present above and below the coal seams.

Voids within the old mine workings were formed when past underground mining of the coal was carried out. Groundwater is largely present within the voids left by past mining and is confined by the surrounding bedrock, most likely siltstone or sandstone, which have a low permeability.

7.2 Hydrogeology

The Bremer River alluvium aquifer, as intersected by 8378P and the NRM monitoring bores, is considered to be a semi-confined aquifer that receives recharge primarily through rainfall infiltration and leakage through the overlying clay sediments. Groundwater quality is generally brackish with a TDS of approximately 4,500 mg/L and is slightly acidic. The groundwater is suitable for most livestock, but not for human consumption. Water inputs to the aquifer include recharge via rainfall infiltration. Water outputs or losses from the aquifer include discharge to Bremer River and groundwater extraction from bores.

The groundwater in the fractured coal seam or siltstone aquifers, as intersected by 8401P, 8345WB and Mrs Svennson's monitoring bore 8377P, is considered to be under confined conditions. The groundwater flows within the cleats or fractures within the coal seams, and bore yields are generally restricted to <2 L/s depending on the continuous nature of the fractures. Groundwater quality is poor, ie generally saline with a TDS of approximately 9,500 mg/L and neutral pH, and is not suitable for livestock or for human consumption. Multiple aquifers may exist within the different fractured systems or coal seams. However, these aquifers are separated by the confining units and due to the discontinuous nature of the fractures, pumping from one aquifer is unlikely to affect the water levels in another. Water inputs to the aquifer include recharge via rainfall infiltration. Water outputs or losses from the aquifer include groundwater extraction from bores.

Groundwater in the voids of the old mine workings, as intersected by bores 8315P, 8171WB, and 8373P, is considered to be a confined aquifer that receives recharge through rainfall infiltration and leakage from upgradient coal seams (if still present and hydraulically connected to the void). Groundwater quality is generally brackish to slightly saline, as information from New Oakleigh Coal Mine suggests it has a TDS of approximately 4,000 mg/L. This groundwater is suitable for most livestock, but not for human consumption. Water inputs to the aquifer include recharge via rainfall infiltration and leakage from coal seam and surrounding bedrock. Water outputs or losses from the aquifer include discharge to the down-gradient coal seam and groundwater extraction from bores.

7.3 Groundwater Levels and Flow Patterns

Groundwater flow direction within the Bremer River alluvium aquifer is likely to reflect the topography of the region and be directed towards the Bremer River. The data logger installed in 8378P indicated the groundwater elevation at the end of June was approximately 47.8 mAHD. Groundwater will flow in a southerly direction from this bore towards the Bremer River. As discussed in section 4.4 the data logger installed within 8378P recorded variations in the potentiometric surface (pressure reading of the water within the pore spaces/voids) and not the water table. The hydrograph in Appendix E indicates that the groundwater fluctuates according to changes in rainfall.

Groundwater flow direction within the fractured coal seam aquifers is likely to reflect the surface topography and be directed towards the south from the mine site. The data loggers installed in 8377P on Mrs Svennson's property and 8401P indicated the groundwater elevation at the end of June was approximately 72.0 mAHD in 8377P and 48.2 mAHD in 8401P. Groundwater will flow in a southerly direction from these bores. As discussed in section 4.4 these data loggers recorded variations in the potentiometric surface (pressure reading of the water within the pore spaces/voids) and not the water table.

The hydrographs in Appendix E indicate the groundwater levels fluctuated in response to changes in rainfall. The two bores are unlikely to be hydraulically connected due to the distance between them and the discontinuous nature of the fractured rock aquifers within the coal seams. Bore 8401P is located closer to the mine site and water supply bore 8345WB, which the mine has used to extract groundwater for dust suppression purposes on the haul roads. The hydrographs show no drawdown of the levels in response to the groundwater extraction.

Groundwater flow direction within the voids of the old mine workings aquifer is likely to reflect the topography of the basement of the voids or the dip direction of the coal seam that was mined. Groundwater gradient within the old workings is probably relatively flat.

8.0 GROUNDWATER MONITORING - MRS SVENNSON'S PROPERTY

To comply with groundwater condition C2-4 of the new Environmental Authority M5637, monitoring of the groundwater on Mrs Svennson's property was carried out to assess if mining activities, particularly blasting, was impacting upon the groundwater regime. The monitoring comprised the following activities:

- Inspection and airlift test of the existing bore equipped with a windmill pump;
- Drilling and installation of a monitoring bore (8377P) on Mrs Svennson's property next to an existing bore;
- Installation of a data logger to continuously monitor the groundwater level from January to June 2004. The hydrograph from the bore showing the changes in groundwater level elevation and rainfall is attached in Appendix E; and
- Monitoring of groundwater quality from September 2003 to June 2004.

The existing bore on Mrs Svennson's property was equipped with a windmill pump and constructed with six inch (152 mm) diameter steel casing that was heavily corroded near the surface. Minimal quantities of groundwater were discharged on to the ground next to the bore by the pump. No details on the bore construction (ie depth and type of screen) were available from Mrs Svennson. The total depth of the bore was 11.0 m below ground level and the groundwater was measured at 9.7 m below ground level on 28 September 2003.

The bore was airlifted in an attempt to clean the bore and improve its yield, however the bore produced only a few litres (<5 L) of turbid water, which contained fragments of corroded steel, before being pumped dry within minutes. Corrosion of the bore casing has probably closed up the slots in the steel casing/screen restricting the inflow of groundwater into the casing.

Monitoring bore 8377P was drilled approximately 4 m from the existing bore to a similar depth. This bore intersected a fractured rock aquifer at approximately 11 m depth and monitoring has showed the groundwater level (potentiometric surface) varies between 2 m and 4 m below ground level, considerably higher than that measured in the existing bore (9.7 m). This suggests that the corrosion of the existing bore is extensive, and is causing the screen or slotted casing to be practically sealed off from the aquifer.

Blasting records for New Oakleigh Coal Mine were obtained and are attached in Appendix G. The records show that blasting was carried out on the following days during the monitoring period:

- 24, 25, 26, and 27 February 2004;
- 1 and 2 March 2004;
- 25 May 2004; and
- 11, 28, 30 June 2004.

The hydrographs for 8377P and 8401P, located approximately 1.5 km closer to the mine, show no change in the water level or a decreasing trend following the days that blasting was carried out. 8377P shows a greater response to variations in rainfall probably due to the lower aquifer storage and the fractures less extensive compared to the aquifer intersected by 8401P. This also indicates that the bores have intersected separate aquifers that are not hydraulically connected.

The hydrographs also show no impact or drawdown of the groundwater levels as a result of the groundwater extraction as described in section 3.3.

Monitoring of groundwater quality showed no decrease in the quality of groundwater within 8377P. Table 2 shows the pH and EC of the groundwater remained the same throughout the six month monitoring period, with a slight decrease in EC (decrease in salt content or increase in quality) recorded in June 2004. No impact to the quality of the groundwater was observed following blasting.

Monitoring of groundwater quality and levels in 8377P, located on Mrs Svennson's property, and 8401P situated closer to the mine showed no impact from blasting or groundwater extraction at the New Oakleigh Coal Mine. Taking into account the discontinuous nature of the fractured rock aquifers, the poor groundwater quality, and the results of the monitoring over the previous six months, it is considered that future monitoring is not required on Mrs Svennson's property as there is no future risk of the mine impacting upon the groundwater regime on the property.

9.0 SUMMARY AND CONCLUSIONS

The groundwater study carried out for New Oakleigh Coal Mine concluded the following:

- Three separate aquifers or groundwater regimes were identified within the mining lease areas of New Oakleigh Coal Mine:
    - Bremer River Alluvium aquifer;
    - Walloon Coal Measures fractured rock (coal seam) aquifers; and
    - Voids within the old mine workings.

- Groundwater quality within the Bremer River alluvium was brackish with a TDS of approximately 4,500 mg/L (or EC of 7,000 μS/cm). The groundwater is suitable for most livestock, but not for human consumption.

- Fractured rock aquifers within the Walloon Coal Measures contain groundwater of poor quality, ie saline with a TDS of approximately 9,500 mg/L (or EC of 14,500 μS/cm), which is not suitable for livestock or human consumption. Multiple aquifers that are not hydraulically connected may exist within the different coal seams and carbonaceous mudstone layers.

- Groundwater quality within the old mine workings was brackish to slightly saline with a TDS of approximately 4,000 mg/L (or EC of 6,000 μS/cm). This groundwater is suitable for most livestock, but not for human consumption.

- Groundwater is extracted periodically from four bores by the mine to supplement the requirements for the washplant and for dust suppression.

- The existing bore on Mrs Svennson's property was constructed with steel casing that was highly corroded, which appeared to restrict the inflow of groundwater to the bore. As a result, the groundwater level and bores yield were significantly impacted when compared to the results of new monitoring bore 8377P.

- Monitoring of groundwater levels and quality on Mrs Svennson's indicated there was no impact from blasting or groundwater extraction at the New Oakleigh Coal Mine. Given the discontinuous nature of the fractured rock aquifer and the distance between the property and the mine, it is considered that the mining activities would not impact upon the groundwater regime in the future.

10.0 RECOMMENDATIONS

Based upon the results of this groundwater study, the following is recommended:

- Monitoring of groundwater on Mrs Svennson's property be discontinued.

- Monitoring of groundwater quality and levels within bores 8401P, 8378P and 8348P be continued on a quarterly basis (every three months) to assess the seasonal variations in quality for at least two years to obtain reliable background data. Monitoring should also be carried on those bores used as a water source by the mine to supplement the demand of the washplant, ie Blakes and Rosewood-Marburg Road Bores. Once this background information has been obtained and assessed, then groundwater quality objectives (ie contaminant limits) for the mine site should be developed.

11.0 LIMITATIONS OF THIS REPORT

DP has performed investigation and consulting services for this project in accordance with current professional and industry standards for hydrogeological assessments. DP's assessment is necessarily based on the results of limited site investigations and upon the restricted programme of surface/subsurface sample screening and groundwater testing. Neither DP, nor any other reputable

consultant, can provide unqualified warranties, nor does DP assume any liability for site conditions not observed, or accessible during the time of the investigations.

Despite all reasonable care and diligence, the ground conditions, groundwater flow patterns, and groundwater quality measured may not be representative of conditions between the locations sampled and investigated. In addition, site characteristics may change over time in response to variations in natural conditions, chemical reactions and other events, *eg* groundwater movement, recharge and/or spillage of contaminating substances. These changes may occur after DP's investigations and assessment.

This report and associated documentation and the information herein have been prepared solely for the use of New Hope Coal Australia and any reliance assumed by third parties on this report shall be at such parties' own risk. Any ensuing liability resulting from use of the report by third parties cannot be transferred to DP.

DOUGLAS PARTNERS PTY LTD

Reviewed by:

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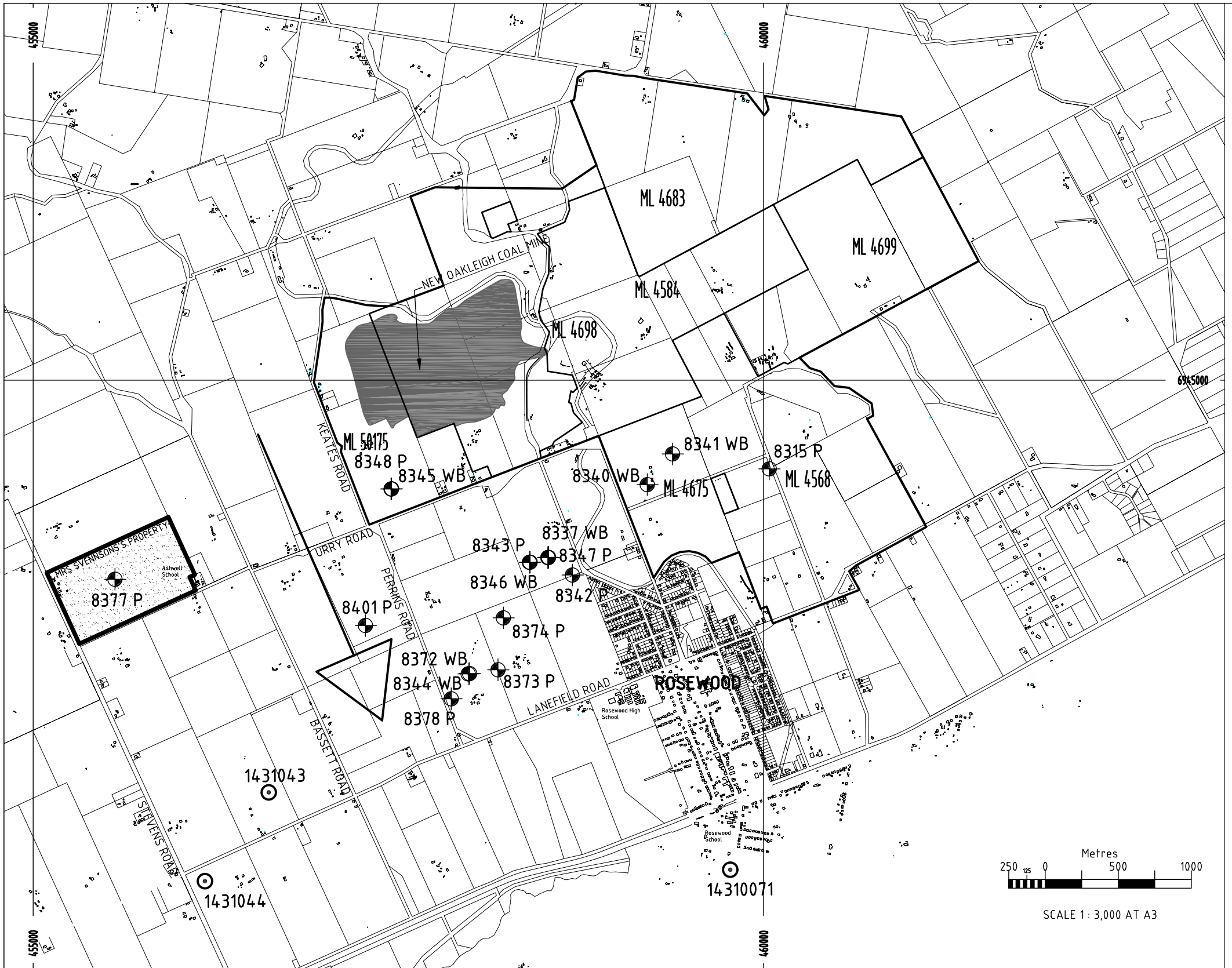
Associate/Hydrogeologist

Alan Lee
Principal - Environment



N

LEGEND

8345 WB	MONITORING BORE LOCATION AND NUMBER
8345 WB	WATER SUPPLY BORE LOCATION AND NUMBER
	MRS SVENNSON'S PROPERTY
	NEW OAKLEIGH COAL MINE PIT
14310071	NRM MONITORING BORE LOCATION
ML 50175	MINING LEASE NUMBER AND LOCATION
	INFERRED GROUNDWATER FLOW DIRECTION

NOTES:-
1. ADAPTED FROM OAK__WBORES SUPPLIED BY NEW HOPE COAL AUSTRALIA Ltd.

2. TEST LOCATIONS ARE APPROXIMATE ONLY AND ARE SHOWN WITH REFERENCE TO EXISTING SITE FEATURES

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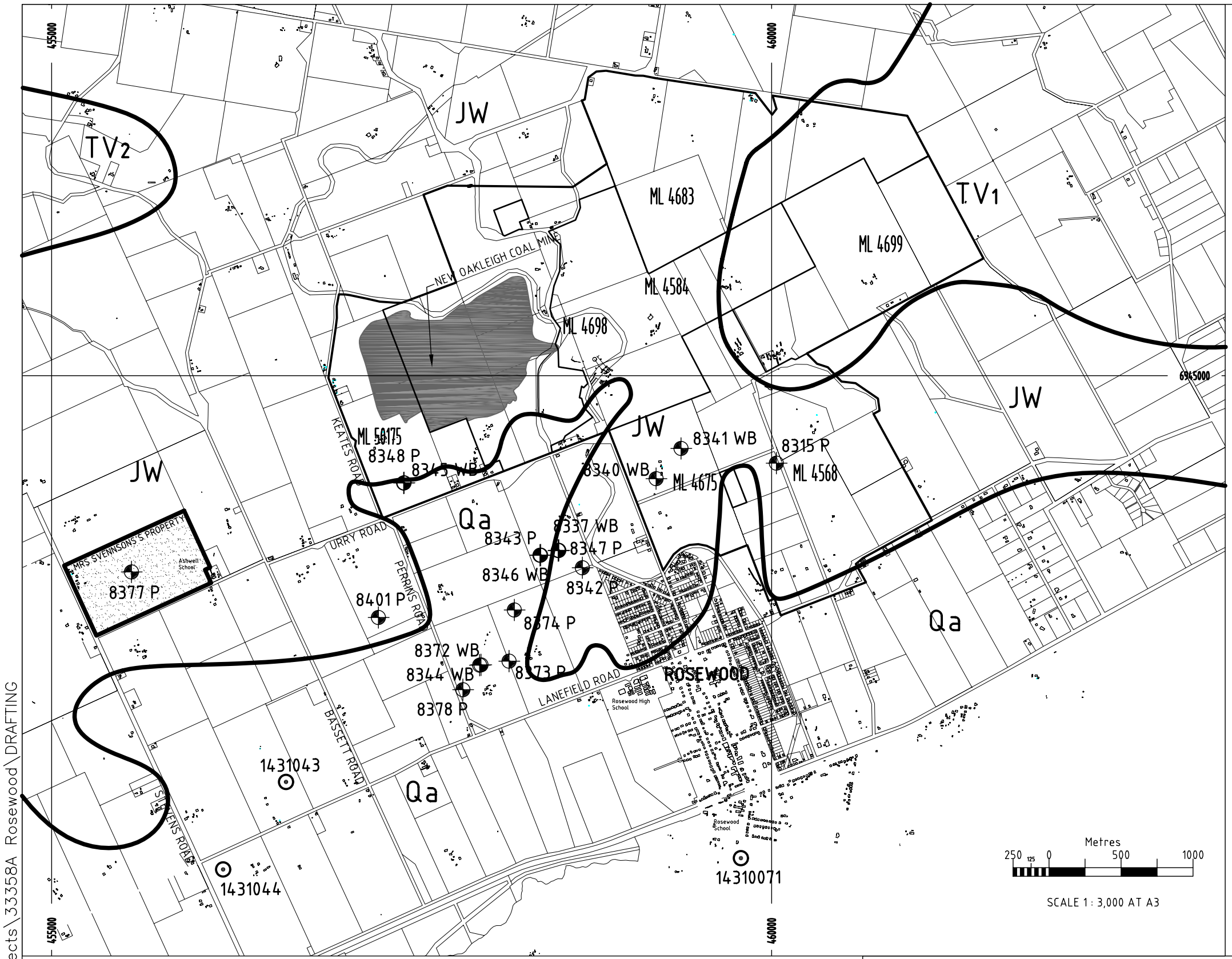
Sydney, Newcastle, Brisbane, Melbourne, Perth, Darwin

Campbelltown, Townsville, Cairns, Wollongong, Wyong

TITLE:
SITEPLAN AND BORE LOCATION PLAN, GROUND WATER STUDY NEW OAKLEIGH COAL MINE, ROSEWOOD

CLIENT: **NEW HOPE COAL AUSTRALIA**			OFFICE: **BRISBANE**
DRAWN BY: VTE	SCALE: AS SHOWN	PROJECT No: 33358A	DRAWING No: **1**
APPROVED BY:		DATE: AUGUST 2004	



N

LEGEND

8345 WB	MONITORING BORE LOCATION AND NUMBER
8345 WB	WATER SUPPLY BORE LOCATION AND NUMBER
	MRS SVENNSON'S PROPERTY
	NEW OAKLEIGH COAL MINE PIT
14310071	NRM MONITORING BORE LOCATION
ML 50175	MINING LEASE NUMBER AND LOCATION

GEOLOGICAL UNITS:

Qa	QUARTERNARY ALLUVIUM
TV_1	CREATACEOUS BASALT
TV_2	TERTIARY BASALT, MINOR VOLCANIC BRECCIA
Jw	JURASSIC WALOON COAL MEASURES

NOTES:-
1. INFERRED FROM GEOLOGICAL SURVEY OF QUEENSLAND 1:100 000 SERIES IPSWICH SHEET.

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TITLE:

SURFACE GEOLOGY PLAN
NEW OAKLEIGH COAL MINE, ROSEWOOD

CLIENT: **NEW HOPE COAL AUSTRALIA**			OFFICE: **BRISBANE**
DRAWN BY: VTE	SCALE: AS SHOWN	PROJECT No: 33358A	DRAWING No: **2**
APPROVED BY:		DATE: AUGUST 2004	

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