



**Rockwater**  
P R O P R I E T A R Y L I M I T E D

**MIDWEST CORPORATION LIMITED** □

□

**RESULTS OF GROUNDWATER** □  
**EXPLORATION DRILLING AT** □  
**KOOLANOOKA AND BLUE HILLS** □

□

□

□

**OCTOBER 2006** □

□

**REPORT FOR** □  
**MIDWEST CORPORATION LIMITED** □

□

309.0/06/01

## CONTENTS

	<b>page</b>
1 INTRODUCTION	1
2 HYDROGEOLOGICAL SETTING	1
2.1 Geology	1
2.2 Hydrogeology	2
3 INVESTIGATION PROGRAMME	2
3.1 Koolanooka Area	3
3.1.1 Groundwater Exploration Sites	3
3.1.2 Results	4
3.1.3 Discussion of Results	4
3.1.4 Bore Census	4
3.1.5 Magnetometer Survey Koolanooka Springs Road Area	4
3.2 Blue Hills Area	5
3.2.1 Groundwater Exploration Sites	5
3.2.2 Results	6
3.2.3 Discussion of Results	6
3.2.4 Bore Census	6
REFERENCES	8

### Tables

Table 1: Summary of Koolanooka Exploratory Bore Data	4
Table 2 : Summary of Koolanooka Bore Census Data	5
Table 3 : Summary of Blue Hills Exploratory Bore Data	6
Table 4 : Summary of Blue Hills Bore Census Data	7

### Figures

1 Locality Plan	
2 Koolanooka Area Bore Locations	
3 Koolanooka Springs Road Magnetometer Survey	
4 Blue Hills Area Bore Locations	

### Appendix

I Bore Completion Data	
------------------------	--



## **1 INTRODUCTION**

Midwest Corporation Limited (Midwest) proposes to develop several iron ore deposits in the Midwest Region of Western Australia for mining and export. Two such deposits are at Koolanooka and Blue Hills where staged development of hematite ore is initially proposed. Stock-piled ore fines are presently being trucked from the Koolanooka Mine to Geraldton for export.

The Koolanooka deposit is located about 20 km east from Morawa and comprises part of the northern section of the Koolanooka Hills. The deposit has been previously mined and an abandoned open pit remains at the site. Blue Hills is 65 km further to the east. Two small open pit mines, the Mungada East and Mungada West pits, have previously provided iron ore from the Blue Hills area. This ore was transported through Morawa via a haul road which now provides road access to the area. The haul road also provides access to the Karara Iron Ore Project of Gindalbie Metals Limited, which lies about 10 km west of the Mungada East Pit. A location plan is provided as Figure 1.

A groundwater exploration drilling programme was undertaken in September 2006 to identify potential sources for water supplies in the two areas. Field supervision for the investigations was provided by Rockwater and the results are presented in this report along with recommendations regarding groundwater supplies at the sites.

## **2 HYDROGEOLOGICAL SETTING**

### **2.1 GEOLOGY**

The area lies on the Yilgarn Craton of mainly crystalline Archaean rocks. The Koolanooka Mine lies about 50 km east of the Darling Fault which separates the Yilgarn Craton from sedimentary rocks of the Perth Basin to the west. The Yilgarn Craton in the exploration areas comprises mainly granitoid rocks containing enclaves of older metamorphosed and folded supracrustal sedimentary, mafic and volcanic rocks. The older rocks include banded iron-formation (BIF) which generally forms prominent linear ridges that protrude from the comparatively flat areas that are underlain by granitoid rocks. The surface of the Archaean rocks has been weathered so that fresh rock may be overlain by 100 m or more of weathered material.

The Archaean rocks are commonly overlain by a Cainozoic veneer comprising sand, silt and clay of eolian, alluvial, colluvial and lacustrine origins, and a discontinuous lateritic hardpan. Minor valley calcrete and silcrete occur in places. In some areas the sediments have been variously reworked by eolian and alluvial processes.

## 2.2 HYDROGEOLOGY

Large groundwater supplies are not uncommon on the Yilgarn Craton. Small water supplies are provided from bores and wells located to access groundwater from the Cainozoic sediments or weathered bedrock at hydrogeologically favourable sites. In most cases, rates of supply are quite low (to provide stock watering) and salinities are in the range 2,000 to 5,000 mg/L TDS. Fresh groundwater is uncommon, generally being associated with hilly areas. Groundwater salinity generally increases markedly towards the lower parts of the landscape and with depth in bores.

The most prospective sites for moderate supplies of comparatively fresh water are likely to be where the more brittle rock units in the BIFs are structurally deformed by faults or folding, or adjacent to geological contacts providing secondary porosity in the rocks.

Hypersaline groundwater occurs in palaeochannel sand within trunk palaeodrainages such as the Lake Monger system, and moderate to high salinity groundwater may occur in tributary palaeochannels.

## 3 INVESTIGATION PROGRAMME

The investigations at Koolanooka were based on information gathered during a short visit to the area in early-2004 when nine exploration drilling sites were selected to investigate specific groundwater targets (Rockwater, 2004). Four exploration drilling sites in the Blue Hills area were selected by Midwest Corporation with the joint aim of investigating the groundwater potential and determining the presence of iron ore.

Drilling was undertaken between 4 and 18 September 2006, by Union Drilling using a Schramm 64 rig with the reverse-circulation aircore method. Lithological samples were collected at one-metre intervals. Bore discharge rates were measured and water samples were collected for on-site salinity and pH measurements. Bore completion data are presented in Appendix I.

Magnetometer surveys were carried out over some of the exploration sites to identify anomalies, which could possibly be associated with geological structures, to refine the locations of the drilling targets. A magnetometer survey was undertaken in the Koolanooka Springs Road area to locate the position of a major fault which has been mapped by the Geological Survey of Western Australia (Baxter and Lipple, 1983).

A census of bores in the Koolanooka and Blues Hills areas was undertaken to provide data on existing groundwater sources.

### 3.1 KOOLANOOKA AREA

#### 3.1.1 Groundwater Exploration Sites

(1) *Koolanooka Springs Road Area*

Three exploration drill sites were selected to intersect fractured BIF, quartzite, and dolerite in the fault along the road (Fig. 2). The line of the fault is covered with overburden, but its location might be identified by magnetometer survey. Access for drilling at these sites was not possible due to land tenure issues at the time of the exploration programme.

(2) *Koolanooka Pit Area*

Three exploration drilling sites were selected to test for groundwater supplies in the vicinity of the pit, targeting weathering features and structural fracturing in the quartzite and magnetitic BIF, on the western side of the deposit. Exploration bores KNWB03-05 were drilled at these sites (Fig. 2).

(3) *Magazine Area*

An exploration drilling site in this area targets potential faulting or structural deformation caused by a cross cutting dolerite dyke. Exploration bore KNWB02 was drilled at this site (Fig. 2).

(4) *Fault Zone*

A cross-cutting, slightly oblique fault has been mapped crossing the whole ridge and meeting the track on the western side of the ridge about 500 m south-southeast of the magazine area. It displaces the strata and might have produced rock-fracturing. Test sites were selected on the eastern and western flanks of the ridge. The site on the eastern side of the ridge was not accessible for the current exploration programme. Exploration bore KNWB01 was drilled at the site on the western side of the ridge (Fig. 2).

(5) *Along Strike North of the Pit*

An additional site was selected to target deformed BIF along strike northwest of the existing pit. A fault, trending broadly parallel to the strata in the pit, has been mapped in the area during detailed geological mapping by Dr Steve Lipple (AAMHATCH, 2004) for Midwest Corporation. The faulting may have caused fracturing of the BIF units. Exploration bore KNWB06 was drilled in this area (Fig 2).

### 3.1.2 Results

The bores mainly intersected weathered metasediments which contain a large proportion of clay with unfractured orthoquartzite or chert at depth. Negligible to small groundwater yields of fresh to marginal quality water were obtained. A summary of bore data and the drilling results are provided in Table 1 and completion reports in Appendix I.

**Table 1: Summary of Koolanooka Exploratory Bore Data**

Bore	MGA Zone 50		Drilled Depth (mbgl)	Water Level (mbgl)	Airlift Yield (m <sup>3</sup> /day)	EC (µS/cm @ 25°C)	TDS (mg/L by EC)	pH	Comments
	Easting (m)	Northing (m)							
KNWB01	423468	6770020	83	44.50	<1	2170	1200	6.90	
KNWB02	423202	6770527	83	48.83	–	–	–	–	No flow
KNWB03	422823	6770840	107	71.45	2.5	2120	1170	7.02	
KNWB04	422540	6771061	125	65.00	0.2	1642	900	7.90	
KNWB05	422152	6771417	107	41.90	1	1265	700	7.66	
KNWB06	422023	6771793	83	42.45	<0.1	939	520	7.99	Granitic basement at 35m

Note: mbgl = metres below ground level

### 3.1.3 Discussion of Results

The drilling results suggested there is minimal fracturing of the metasedimentary rocks on the western side of Koolanooka Hills. A major part of the section that was intersected in most bores comprises weathered fine-grained metasediments which are now represented by very clayey rocks with low permeability. The Koolanooka BIF units are truncated immediately north-northwest of the existing pit by shallow granite porphyry (KNWB06).

### 3.1.4 Bore Census

A summary of results from the bore census in the Koolanooka area is provided in Table 2. Bore locations are shown in Figure 2. The data indicate that groundwater with a salinity of about 1,000 mg/L TDS is available from shallow bores in the area.

### 3.1.5 Magnetometer Survey Koolanooka Springs Road Area

A magnetometer survey was undertaken in the Koolanooka Springs Road area where groundwater exploration drilling sites were proposed by Rockwater (2004). A major fault, which displaces the Koolanooka Hills BIF, is mapped to trend approximately parallel to the road in the area (Baxter and Lipple, 1983). The magnetometer survey was undertaken in an attempt to provide a more precise location for the fault so that future groundwater exploration could target the fault. The station involved 14 lines separated by 50 m and between 200 and 600 m long with 50 m station intervals along the lines. The locations of the survey lines are indicated in Figure 2 and the survey results are presented in Figure 3.

The results indicate the location of the major BIF units showing high total magnetic intensity compared to the surrounding rocks. No major feature is evident trending approximately east-northeast through the centre of the area. An anomaly with that trend appears to occur at the north of the survey area but that trend may be a gridding artefact. To provide confirmation, the survey would need to extend further to the north.

**Table 2 : Summary of Koolanooka Bore Census Data**

Bore	MGA Zone 50		Drilled Depth (mbgl)	Water Level (mbgl)	EC (µS/cm @ 25°C)	TDS (mg/L by EC)	pH	Comments
	Easting (m)	Northing (m)						
BH1	421860	6773756	54	20.43	1729	951	7.43	KB, weakest bore
BH2	421853	6772729	42	21.00	1464	805	7.68	KB
BH3	421822	6772620	48	22.50	1239	681	7.78	KB
BH5	421859	6772791	42	ND	1347	741	7.39	KB, pump installed therefore unable to obtain water level
BH6	421890	6772821	42	ND	1900	1045	7.34	KB, best bore, pump installed therefore unable to obtain water level
BH7	422119	6772917	54	14.97	2540	1397	7.37	KB
BH10	422130	6773087	42	12.33	3710	2041	7.54	KB
KNWD01	420823	6771424	ND	ND	1764	970	6.00	Steel surface casing. Windmill pumping into tank. Koolanooka house supply. Sample taken and analysed.
KNWD02	420829	6771381	ND	ND	ND	ND	ND	Steel casing collapsed at 20.7mbgl.
KNWD03	420838	6771307	36.6	ND	ND	ND	ND	Installed Oct 1989. Windmill pumping
KNWD04	420859	6769531	ND	ND	ND	ND	ND	Windmill pumping no access to bore
KNWD05	420823	6771424	ND	ND	1362	750	6.46	Windmill pumping into tank. Measurements from tank sample.

Notes: KB = Koolanooka borefield. These bores are equipped with 120 mm OD (at bells) uPVC casing with 12 m slotted sections at their bases.  
mbgl = metres below ground level  
ND = Not determined

## 3.2 BLUE HILLS AREA

### 3.2.1 Groundwater Exploration Sites

Four groundwater exploration sites were selected: one along strike to the south from the Mungada West pit and three at the base of the ridge containing the Mungada East Pit at its western end (Figure 4). Several additional sites were selected to test the BIF strata, but they were not drilled for operational reasons.

### 3.2.2 Results

The bore near Mungada West Pit intersected hematitic BIF, plus chert with some carbonaceous shale. The other three bores intersected mainly weathered metasediments containing a large proportion of clay, then unfractured orthoquartzite or chert at depth. Negligible to small groundwater yields of fresh to marginal quality water were obtained. A summary of bore data and the drilling results is provided in Table 3 and completion reports in Appendix I.

**Table 3 : Summary of Blue Hills Exploratory Bore Data**

Bore	MGA Zone 50		Drilled Depth (mbgl)	Water Level (mbgl)	Airlift Yield (m <sup>3</sup> /day)	EC (µS/cm @ 25°C)	TDS (mg/L by EC)	pH
	Easting (m)	Northing (m)						
BHWP01	486371	6776141	114	23.78	<1	570	320	8.35
BHWP02	489190	6776128	83	35.90	<0.1	1233	680	7.15
BHWP03	489433	6776161	195	34.00	2.5	2310	1270	7.86
BHWP04	489528	6776172	95	–	<1	2150	1180	7.86

Note: mbgl = metres below ground level.  
The water level in BHWP04 could not be measured as the drill rods were jammed in the hole.  
ND = Not determined

### 3.2.3 Discussion of Results

The drilling suggested there is minimal fracturing of the metasedimentary rocks on the southern side of Blue Hills ridge. These strata are not suitable for groundwater exploration as they contain large proportions of clay and, therefore, have low permeability. The BIF at BHWP01 yielded only a very small supply.

### 3.2.4 Bore Census

The results of the bore census in the Blue Hills area are presented in Table 4. Bore locations are shown in Figure 4. The bore depths could not be measured, but water levels in two bores were about 20 m and 30 m below ground level. One salinity measurement, 1,370 mg/L TDS at Mungamia Well, indicated good stock quality water, almost at the potable value of 1,000 mg/l TDS.



**Table 4 : Summary of Blue Hills Bore Census Data**

Bore	MGA Zone 50		Water Level (mbgl)	EC ( $\mu\text{S}/\text{cm}$ @ 25°C)	TDS (mg/L by EC)	pH	Comments
	Easting (m)	Northing (m)					
Mulga Bore	488043	6771836	29.78	ND	ND	ND	Partially collapsed at 15 m, unable to get water sample, abandoned
Euro 1 Bore	481293	6771955	ND	ND	ND	ND	Electrical pump cable stuck down bore, no access past 1 m, unable to get water sample, abandoned
Euro 2 Bore	481287	6771951	ND	ND	ND	ND	Collapsed at 4 m, unable to get water sample, abandoned
Mungamia Well	485292	6778324	20.13	2490	1370	8.1	

N = Not determined

## 4 CONCLUSIONS

Large supplies of fresh or process-quality groundwater will not be readily obtainable in the Koolanooka area, based on the results to date. There is potential for useful supplies in structures cutting the BIF ridges to the south of Koolanooka, although a magnetometer survey did not define the structures. The survey needs to be extended further to the north. Additional bedrock sources may be identified from further investigations, particularly in BIF ridges and geological structures.

Palaeochannel sand aquifers of the Lake Monger systems or its tributaries have potential to provide large supplies of hypersaline groundwater.

For large supplies of low salinity water, the Perth Basin lying 50 km to the west of Koolanooka remains the most likely source.

**Dated: 23 November 2006**

**Rockwater Pty Ltd**

**J S Moncrieff  
Principal Hydrogeologist**

**J R Passmore  
Principal Hydrogeologist**



## **REFERENCES**

BAXTER, J.L. and LIPPLE, S.L., 1983, Perenjori Sheet SH 50-6: Western Australia Geological Survey 1:250,000 Geological Series map.

ROCKWATER, 2004, Assessment of groundwater supplies for proposed mining of haematite ore at Koolanooka: report prepared for Midwest Corporation Limited (unpublished).



## FIGURES



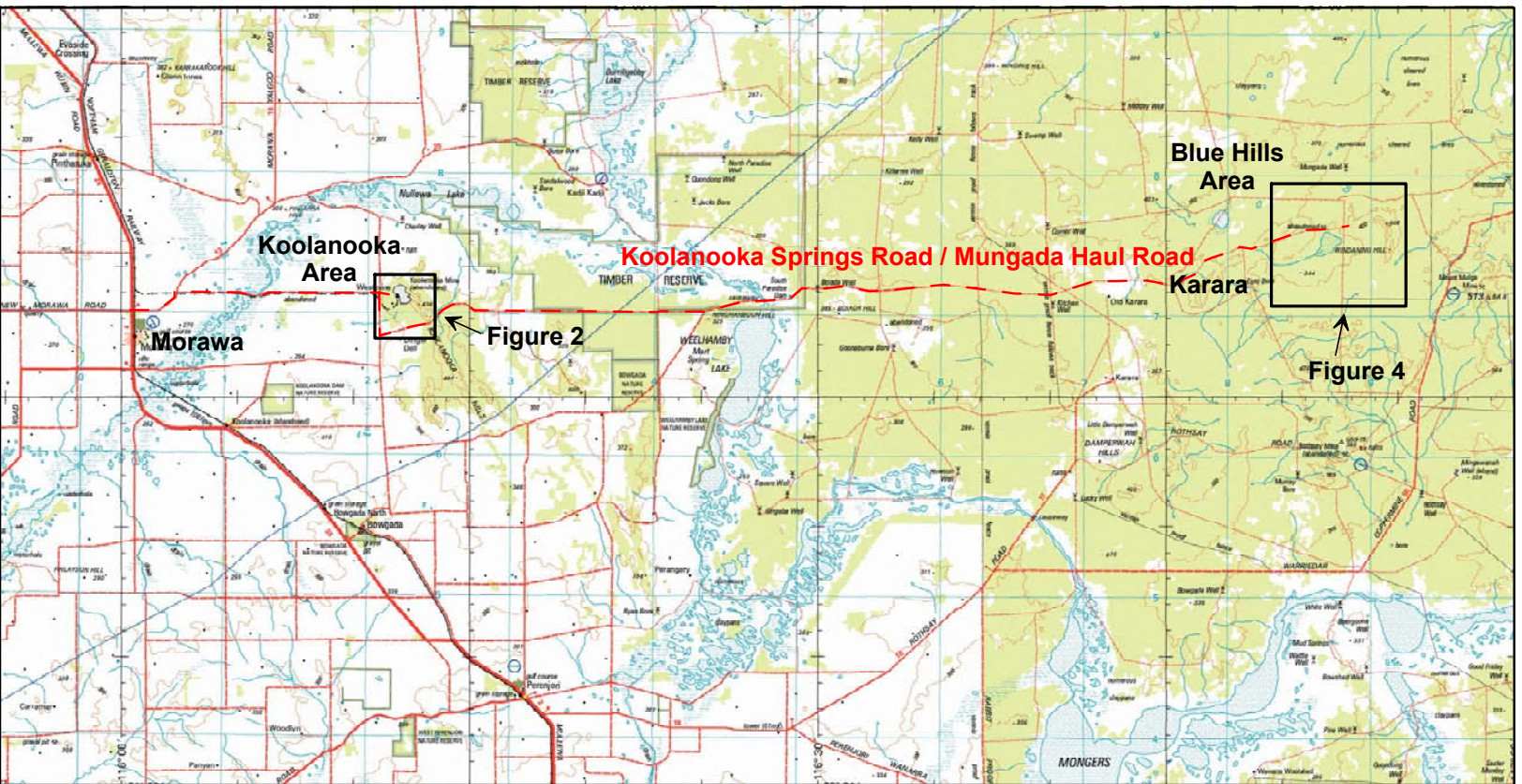


Figure 1

309-0/Surfer/Koolanooka/fig 1 Base regional test.srf

CLIENT: Midwest Corporation Limited

PROJECT: Groundwater Exploration at Koolanooka & Blue Hills

DATE: November 2006

Dwg. No: 309.0/06/1-1

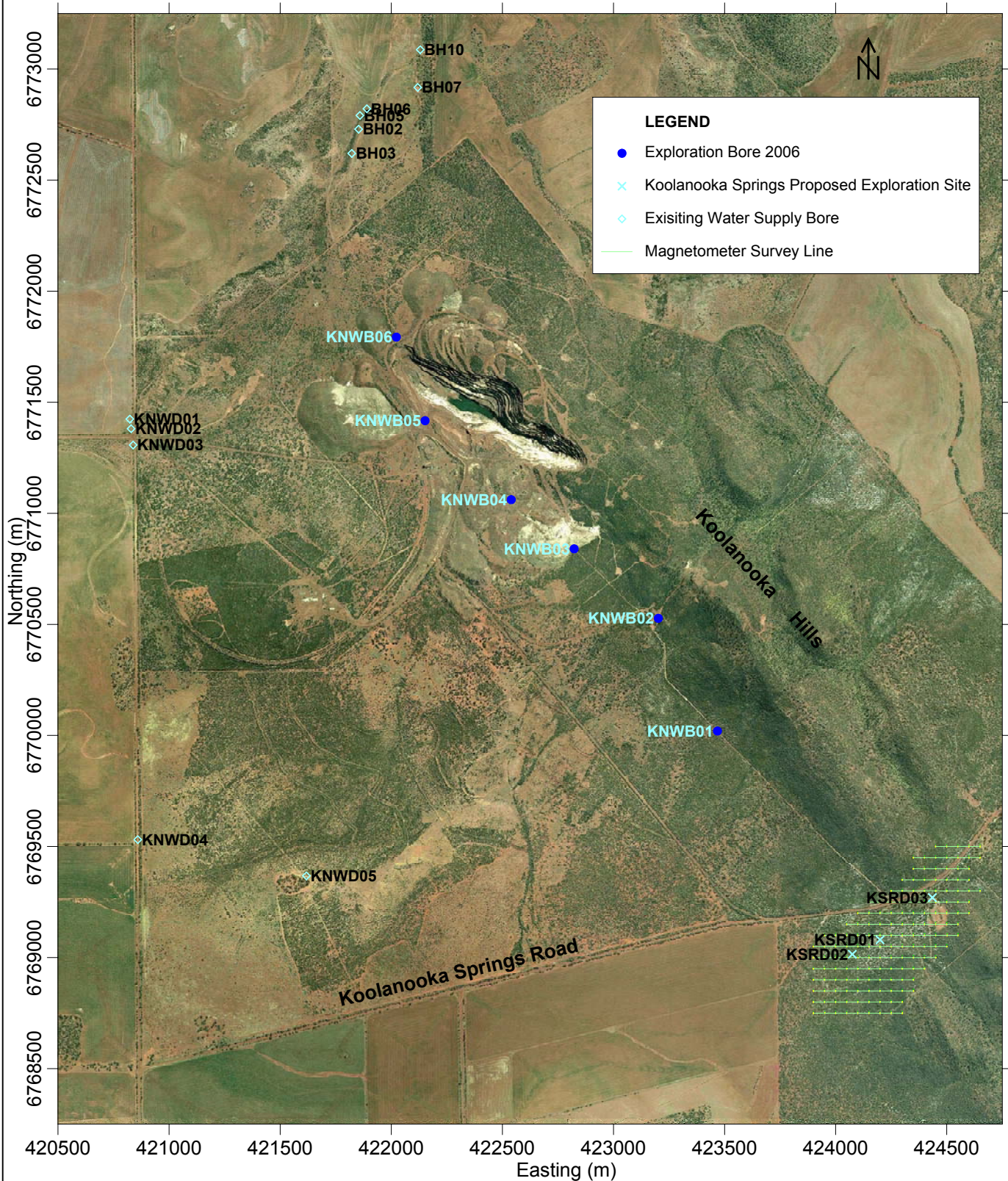
Locality Plan



Rockwater Pty Ltd



Figure 2



309-0/Surfer/Koolanooka/Locality Plan.srf

CLIENT: Midwest Corporation Limited

PROJECT: Groundwater Exploration at Koolanooka & Blue Hills

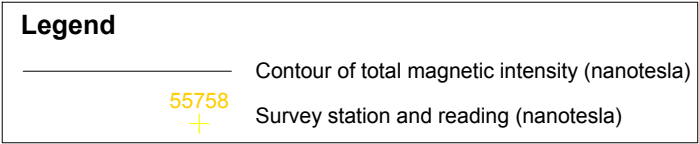
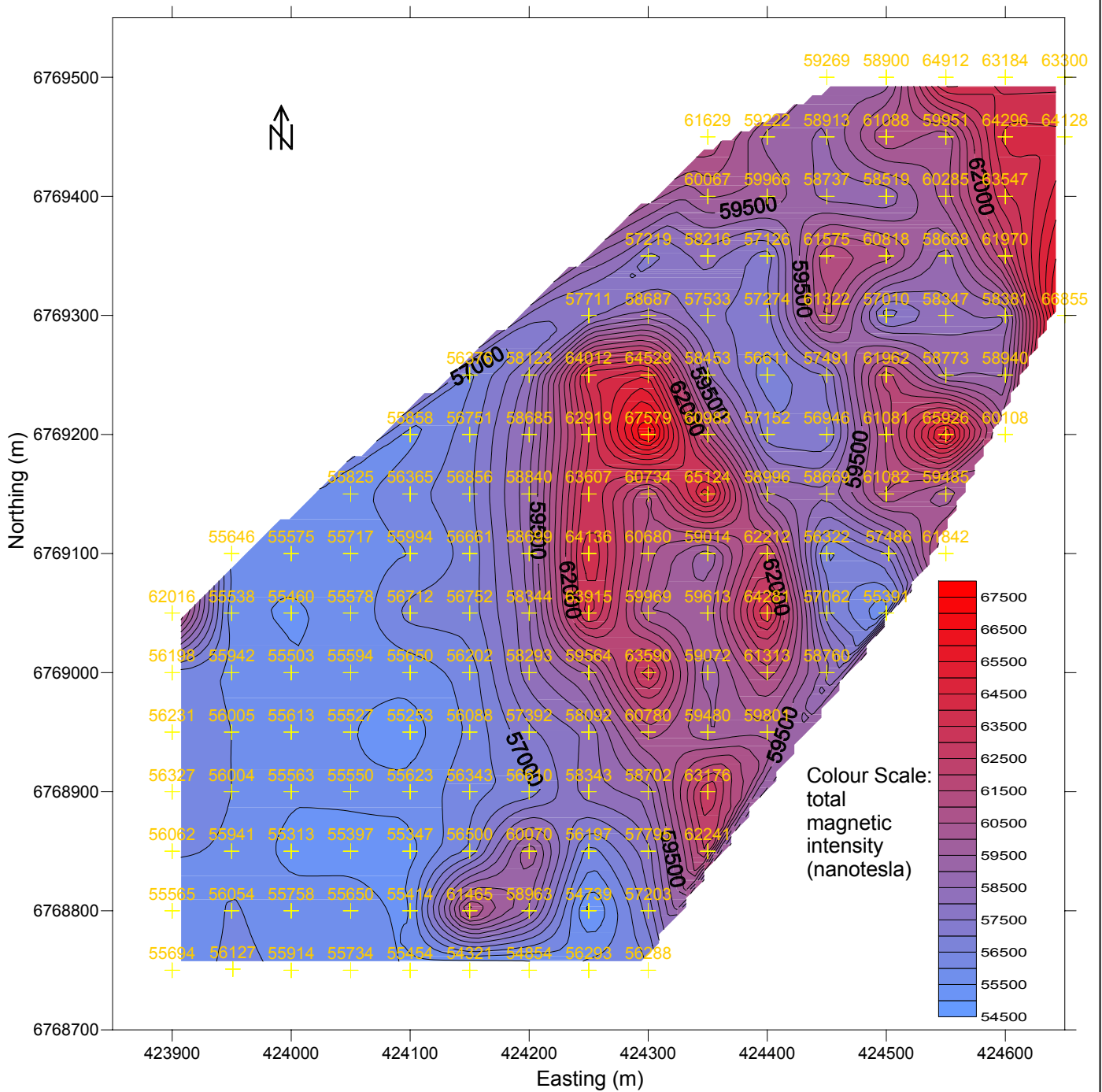
DATE: November 2006

Dwg. No: 309.0/06/1-2

Koolanooka Area  
Bore Locations



Figure 3



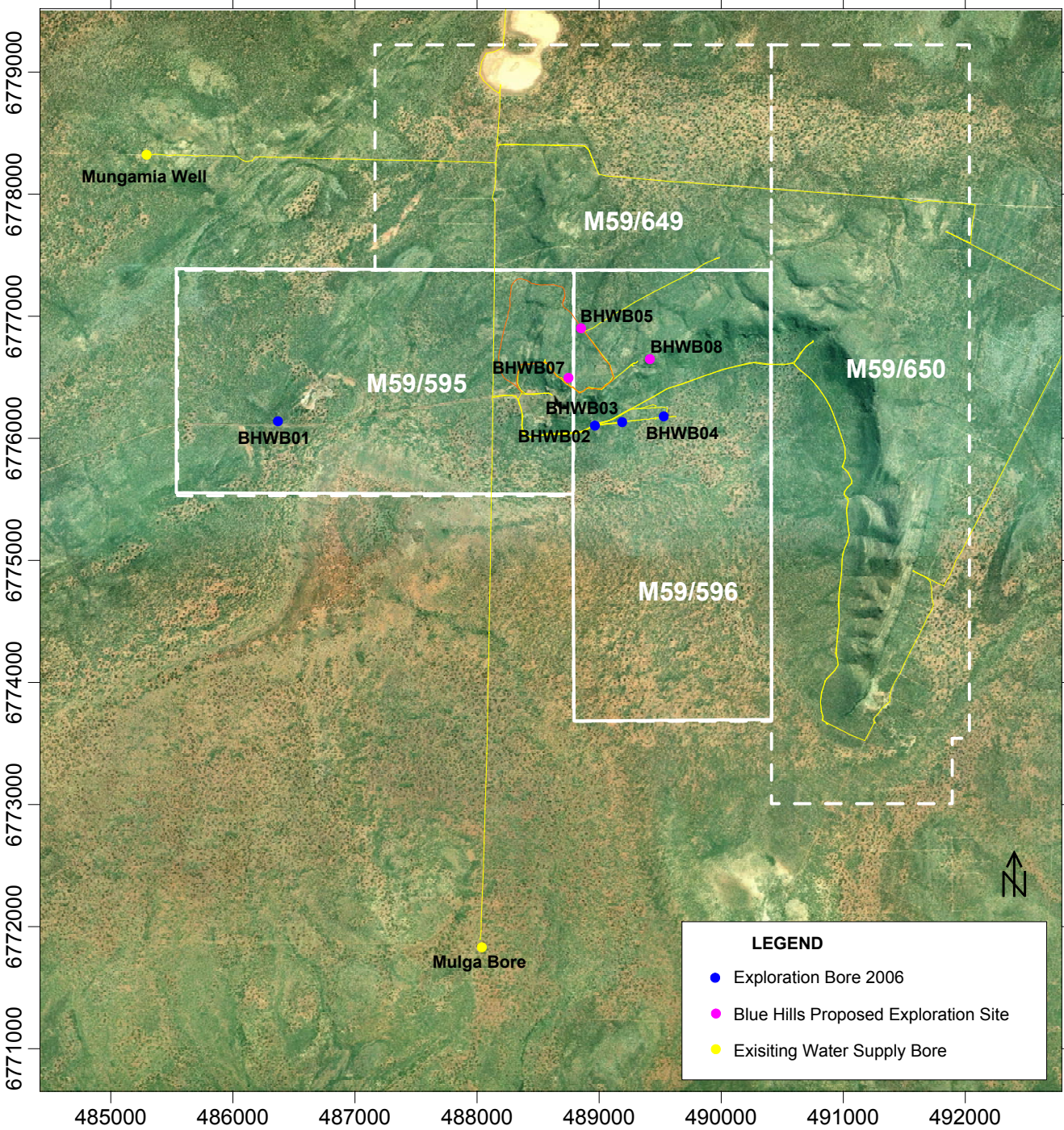
309-0/Surfer/Koolanooka/Fig 3 Koolanooka Springs Road Magnetometer Survey.srf

CLIENT: Midwest Corporation Limited  
 PROJECT: Groundwater Exploration at Koolanooka & Blue Hills  
 DATE: November 2006  
 Dwg. No: 309.0/06/1-3

Koolanooka Springs Road Magnetometer Survey



Figure 4



**LEGEND**

- Exploration Bore 2006
- Blue Hills Proposed Exploration Site
- Existing Water Supply Bore

309-0/Surfer/Blue Hills/Locality Plan jm.srf

CLIENT: Midwest Corporation Limited  
 PROJECT: Groundwater Exploration at Koolanooka & Blue Hills  
 DATE: November 2006  
 Dwg. No: 309.0/06/1-4

**Blue Hills Area  
 Bore Locations**

**APPENDIX I**

**BORE COMPLETION DATA**





**KNWB01  
EXPLORATION HOLE DATA**

**Project:** Koolanooka Magnetite Project

**Hole No:** KNWB01

**GDA Coordinates:** Zone 50, 423 468 mE; 6 770 020 mN

**Status:** Exploration hole, abandoned

**Dates Drilled:** 6 September 2006

**Drilling Contractor:** Union Drilling, Mathew Skeet

**Drilling Rig:** Schram 64

**Depth Drilled:** 83m

**Drilling Details:** 0 – 83m, SDS 125 hammer button bit, 136 mm diameter

**Casing Details:** Hole not cased, backfilled

**Reference Point Elevation:** ground level

**Hydro Data:**

Depth (m)	Flow (m <sup>3</sup> /d)	EC (µS/cm)	Temp (°C)	TDS (mg/L)	pH	Comments
65	<1	1625	20.2	900	6.90	
83	<1	2170	25.9	1200	7.0	

**Water Level:** 44.50 m below ground, 7/9/2006

**Lithology:**

**KNWB01 LITHOLOGICAL LOG**

<b>Depth (m bgl)</b>	<b>Lithology</b>	<b>Description</b>
0 – 1	COLLUVIUM	Red-brown silty sand with rock fragments comprising mainly haematite BIF and ferruginous sandstone.
1 – 6	PISOLITIC HAEMATITE	Red-brown pisoliths 1-5 mm diameter.
6 – 13	IRONSTONE	Brown, goethitic.
13 – 16	CLAY / CLAYSTONE	Brown to pale grey, soft with hard indurated fragments.
16 –19	CLAYSTONE	Brown to bluish grey to pale blue to greyish brown 18-19 m, soft, slightly damp.
19 –21	CLAYSTONE	Grey to brown, soft, slightly soapy feel (?talc).
21 –29	CLAYSTONE	Pale grey with some brown, soft, slightly damp, soapy feel (?talc).
29 –31	CLAY	Pale brown with some pale grey, soft, slightly damp soapy feel (?talc).
31 –54.5	CLAYSTONE	Pale grey with some brown, soft, slightly damp, soapy feel (?talc); slightly hard and contains some weathered rock fragments 49-54.5 m
54.5 – 83 (TD)	?CHERT	Siliceous rock, moderate grey, no discernable texture very hard, massive, very hard, massive, no indication of fracturing.

**KNWB02**  
**EXPLORATION HOLE DATA**

<b>Project:</b>	Koolanooka Magnetite Project
<b>Hole No:</b>	KNWB02
<b>GDA Coordinates:</b>	Zone 50, 423 202 mE; 6 770 527 mN
<b>Status:</b>	Exploration hole, abandoned
<b>Dates Drilled:</b>	5-6 September 2006
<b>Drilling Contractor:</b>	Union Drilling, Mathew Skeet
<b>Drilling Rig:</b>	Schram 64
<b>Depth Drilled:</b>	83m
<b>Drilling Details:</b>	0 – 83m, SDS 125 hammer button bit, 136 mm diameter
<b>Casing Details:</b>	Hole not cased, backfilled
<b>Reference Point Elevation:</b>	ground level
<b>Hydro Data:</b>	no water on airlift from hole from TD at 83 m.
<b>Water Level:</b>	48.83 m below ground, 7/9/2006



**Lithology:**

**KNWB02 LITHOLOGICAL LOG**

<b>Depth (m bgl)</b>	<b>Lithology</b>	<b>Description</b>
0 – 34	ORTHOQUARTZITE	Brown, pale grey and white to cream, moderately hard, medium to coarse grained, welded grains. Includes minor pale grey and pale brown sand and clay 26-27 m.
34 – 35	?META-PELITE	Brown, weathered fine grained with some sericite.
35 – 88 (TD)	?CHERT	Siliceous rock, moderate to dark grey to translucent with small white to translucent patches and capillaries, hard to very hard with depth, no indication of fracturing.

**KNWB03  
EXPLORATION HOLE DATA**

**Project:** Koolanooka Magnetite Project

**Hole No:** KNWB03

**GDA Coordinates:** Zone 50, 422 823 mE; 6 770 840 mN

**Status:** Exploration hole, abandoned

**Dates Drilled:** 9 September 2006

**Drilling Contractor:** Union Drilling, Craig Paul

**Drilling Rig:** Schram 64

**Depth Drilled:** 107m

**Drilling Details:** 0 – 107m, SDS 125 hammer button bit, 136 mm diameter

**Casing Details:** Hole not cased, backfilled

**Reference Point Elevation:** ground level

**Hydro Data:**

Depth (m)	Flow (m <sup>3</sup> /d)	EC (µS/cm)	Temp (°C)	TDS (mg/L)	pH	Comments
77	<1	1976	29.6	1090	6.80	
107	2.5	2120	18.3	1170	7.02	

**Water Level:** 71.45 m below ground, 10/9/2006



**Lithology:**

**KNWB03 LITHOLOGICAL LOG**

<b>Depth (m bgl)</b>	<b>Lithology</b>	<b>Description</b>
0 – 1	MULLOCH HEAP and COLLUVIUM	Red-brown sand, silt and clay with rock fragments comprising mainly haematite BIF, goethite-limonite rock.
1 – 5	COLLUVIUM	Red-brown; sand, silt and clay with rock fragments.
5 – 13	PISOLITIC GEOTHITE AND HAEMATITE	Red-brown, pisoliths from 1-12 mm diameter.
13 – 17	GEOTHITIC /LIMONITIC IRONSTONE	Red-brown moderately hard.
17 –18	SANDSTONE	Pale orange-brown, ferruginised surface of underlying unit.
18 –19	WEATHERED ROCK and QUARTZ	Creamy-white, firm, weathered ?quartz-mica-clay rock, very fine grained, even grained, slightly talcose; containing quartz fragments/chips up to 20 mm diameter.
19 –44	WEATHERED ROCK	Creamy white to very pale greyish white with some orange- and yellow brown; quartz-clay sandstone with about 3% very fine grained mica, fine even grained with noticeable mm-scale layering (?bedding/schistosity); moderately hard.
44 –50	QUARTZ	Translucent with weathered sandstone as above.
50 –51	CLAYEY QUARTZ and FERRUGINOUS SANDSTONE	Translucent quartz, dark grey-brown sandstone, fine\, even grained, white to pale brown clay.
51 –56	CLAYEY SANDSTONE	Fine to very coarse grained, moderately sorted, rounded quartz with some fine sandstone as above.
56 –59	SANDSTONE	Brown, ferruginous, fine grained even grained, moderately hard.
59 –66	CLAYEY SANDSTONE	Quartz is fine to very coarse grained, moderately sorted and rounded in a clayey matrix; moderately hard; at 87 m biotite is discernable in matrix, biotite-?feldspar-quartz meta-pelite.
66 –90	META- SANDSTONE	Pale creamy grey with some pale orange-brown, biotite-feldspar-quartz rock, very fine grained.
90 –91	SILICEOUS ROCK	?meta-pelite/chert, weathered; fragments have pale brown surfaces with grey inside, hard; ? same as deeper rocks in KNWB01 and KNWB02.
91 – 107 (TD)	SILICEOUS ROCK	?meta-pelite/chert; pale to moderate grey, fine grained, no discernable fabric, unweathered, trace mica-?cordierite-quartz rock; very hard.

**KNWB04  
EXPLORATION HOLE DATA**

**Project:** Koolanooka Magnetite Project

**Hole No:** KNWB04

**GDA Coordinates:** Zone 50, 422 539 mE; 6 771 061 mN

**Status:** Exploration hole, abandoned

**Dates Drilled:** 10 September 2006

**Drilling Contractor:** Union Drilling, Craig Paul

**Drilling Rig:** Schram 64

**Depth Drilled:** 125m

**Drilling Details:** 0 – 125m, SDS 125 hammer button bit, 136 mm diameter

**Casing Details:** Hole not cased, backfilled

**Reference Point Elevation:** ground level

**Hydro Data:**

<b>Depth (m)</b>	<b>Flow (m<sup>3</sup>/d)</b>	<b>EC (µS/cm)</b>	<b>Temp (°C)</b>	<b>TDS (mg/L)</b>	<b>pH</b>	<b>Comments</b>
125	0.2	1642	17.7	900	7.90	

**Water Level:** 65.00 m below ground, 11/9/2006

**Lithology:**

**KNWB04 LITHOLOGICAL LOG**

<b>Depth (m bgl)</b>	<b>Lithology</b>	<b>Description</b>
0 – 8	MULLOCH HEAP	Crushed rock and rock fragments, pale brown to red-brown soft.
8 – 12	COLLUVIUM	Pale brown; fragments of BIF, goethite-limonite rock and chert in loamy matrix.
12 – 17	COLLUVIUM	Red-brown, fragments of BIF and goethite-limonite rock in loamy matrix.
17 – 21	GRAVEL	Pale brown goethite-limonite pisoliths in a loamy matrix.
21 –37	HAEMATITE BIF	Red-brown, weathered containing goethite-limonite pebbles(?contamination), and minor magnetite fragments.
37 –100	QUARTZ-SERICITE META-ARKOSE	Creamy-white, firm, weathered ?quartz-mica-clay rock, very fine grained, even grained, slightly talcose; containing quartz fragments/chips up to 20 mm diameter.
100 –118.5	QUARTZ-SERICITE META-ARKOSE	As above but with more quartz, very fine to medium grained, soft weathered.
118.5 –125 (TD)	QUARTZ-SERICITE META-ARKOSE	Pale to moderate grey, much less weathered than above, moderately hard, fine grained, no fracturing.



**KNWB05  
EXPLORATION HOLE DATA**

**Project:** Koolanooka Magnetite Project

**Hole No:** KNWB05

**GDA Coordinates:** Zone 50, 422 152 mE; 6 771 417 mN

**Status:** Exploration hole, abandoned

**Dates Drilled:** 11 September 2006

**Drilling Contractor:** Union Drilling, Craig Paul

**Drilling Rig:** Schram 64

**Depth Drilled:** 107m

**Drilling Details:** 0 – 107m, SDS 125 hammer button bit, 136 mm diameter

**Casing Details:** Hole not cased, backfilled

**Reference Point Elevation:** ground level

**Hydro Data:**

Depth (m)	Flow (m <sup>3</sup> /d)	EC (µS/cm)	Temp (°C)	TDS (mg/L)	pH	Comments
53	<1	na	22.5	na	7.90	
107	1	1265	21.0	700	7.66	

**Water Level:** 41.90 m below ground, 12/9/2006

**Lithology:**

**KNWB05 LITHOLOGICAL LOG**

<b>Depth (m bgl)</b>	<b>Lithology</b>	<b>Description</b>
0 – 7	COLLUVIUM / CONGLOMERATE	Pebbles and cobbles, weakly iron-cemented, ~70% clasts, red-brown in loamy matrix.
7 – 10	PISOLITIC GEOHITE- LIMONITE	Red- to orange-brown; pisoliths to 2 mm diameter.
10 – 16	COLLUVIUM	Quartz, BIF and goethite-limonite fragments in loamy matrix, pale brown, soft.
16 – 50	QUARTZ-SERICITE META-ARKOSE	White to pale brown, highly weathered, clayey. feldspar all weathered to kaolinite, soft, some contamination from above; contains ferruginised fragments 10-15 m; 30-33 m contains very fine to coarse quartz grains including 32-33 m fragments up to 10 mm diameter; 40-50 m some hard indurated pale grey slightly fresher rock.
50 – 61	META-SANDSTONE	Pale brown, very clayey, fine to very coarse grained, moderately sorted, subangular to subrounded quartz, soft; contains dark grey ferruginised fragments 57-61 m.
61 – 63	QUARTZ-SERICITE META-ARKOSE	Pale brown to white, very clayey, weathered.
63 – 84	QUARTZITE	Pale to dark grey orthoquartzite, grains welded, fine to medium grained, very hard, clayey; translucent 82-84 m.
84 – 84	QUARTZITE	Translucent greyish white with clay, weathered, ?fracture.
84 –107 (TD)	QUARTZ META- SANDSTONE	Pale grey to dark grey with depth, much clay (?contamination), very hard, unfractured.

**KNWB06  
EXPLORATION HOLE DATA**

**Project:** Koolanooka Magnetite Project

**Hole No:** KNWB06

**GDA Coordinates:** Zone 50, 422 028 mE; 6 771 783 mN

**Status:** Exploration hole, abandoned

**Dates Drilled:** 12 September 2006

**Drilling Contractor:** Union Drilling, Craig Paul

**Drilling Rig:** Schram 64

**Depth Drilled:** 83m

**Drilling Details:** 0 – 83m, SDS 125 hammer button bit, 136 mm diameter

**Casing Details:** Hole not cased, backfilled

**Reference Point Elevation:** ground level

**Hydro Data:**

Depth (m)	Flow (m <sup>3</sup> /d)	EC (µS/cm)	Temp (°C)	TDS (mg/L)	pH	Comments
71	<0.1	461	22.8	260	7.7	
83	<0.1	939	30.8	520	7.99	

**Water Level:** 42.45 m below ground, 13/9/2006

**Lithology:**

**KNWB06 LITHOLOGICAL LOG**

<b>Depth (m bgl)</b>	<b>Lithology</b>	<b>Description</b>
0 – 3	MULLOCK DUMP	Red-brown to yellow brown, rock fragments in loamy matrix.
3 – 9	PISOLITIC GEOHITE- LIMONITE	Dark grey to pale brown, pisoliths to 20 mm diameter and some rock fragments cemented together contains mm-scale to decimetre-scale vugs.
9 – 11	SANDSTONE	Pale brown quartz with ferruginous cement, slightly hard, ?weathered surface of underlying unit.
11 – 32	SANDY CLAY (WEATHERED QUARTZ-SERICITE META-ARKOSE)	White to pale brown to pale greyish brown; some ferruginised layers 16-19 m; qaurtx is fine to very coarse, subangular, poorly sorted; soft.
32 – 35	BASALT	Dark grey, hard with greenish-grey clay; very fine grained.
35 – 83 (TD)	GRANITE PORPHYRY	Moderate grey, medium to coarse grained with some quartz and feldspar phenocrysts to ~10 mm diameter, biotite-hornblende granite, very hard, unfractured.

**BHWB01  
EXPLORATION HOLE DATA**

**Project:** Blue Hills

**Hole No:** BHWB01

**GDA Coordinates:** Zone 50, 486 371 mE; 6 776 141 mN

**Status:** Exploration hole, abandoned

**Dates Drilled:** 15 September 2006

**Drilling Contractor:** Union Drilling, Craig Paul

**Drilling Rig:** Schram 64

**Depth Drilled:** 114m

**Drilling Details:** 0 – 114m, SDS 125 hammer button bit, 136 mm diameter

**Casing Details:** Hole not cased, backfilled

**Reference Point Elevation:** ground level

**Hydro Data:**

<b>Depth (m)</b>	<b>Flow (m<sup>3</sup>/d)</b>	<b>EC (µS/cm)</b>	<b>Temp (°C)</b>	<b>TDS (mg/L)</b>	<b>pH</b>	<b>Comments</b>
53	<1	345	28.3	200	8.14	
83	1.5	570	30.8	320	8.35	

**Water Level:** 23.78 m below ground, 16/9/2006

**Lithology: BHWB01 LITHOLOGICAL LOG**

<b>Depth (m bgl)</b>	<b>Lithology</b>	<b>Description</b>
0 – 2	COLLUVIUM	Red-orange brown, chert and haematite BIF fragments in loamy matrix.
2 – 6	CHERT & SILTSTONE	Pale brown, ?limonitic for colour.
6 – 10	CHERT & SILTSTONE	Brown to pale brown, with moderately hard and softer layers.
10 – 16	CHERT, SILTSTONE & HAEMATITE BIF	Brown to red-brown, moderately hard.
16 – 23	CHERT, SILTSTONE & HAEMATITE BIF	As above but pale grey to pale brown to red-brown, weathered with clay 16-20 m, more clayey 20-23 m.
23 – 29	SILTSTONE	Cherty, moderate grey-brown and pale brown, ferruginous.
29 – 35	CLAY	White to pale brown to red-brown, soft, kaolinitic, soapy feel.
35 – 40	CHERT, HAEMATITE BIF & CLAY	Red-brown to dark grey fragments, pale coloured clay may be contamination from above.
40 – 51	CHERT & HAEMATITE BIF	Red brown and moderate to dark grey fragments, moderately hard.
51 – 62	HAEMATITE BIF	Red-purple-brown, to moderate to dark grey, hard.
62 – 73	SILTSTONE	Red-brown, cherty, moderately hard.
73 – 76	SILTSTONE & QUARTZ	Pale grey to red-brown, highly weathered, ?fracture zone.
76 – 81	QUARTZITE, SILTSTONE & CLAY	Moderate to dark grey, soft. Some dark grey graphitic clay/shale which leaves a film on water 80-81 m.
81 – 114 (TD)	CHERT	Black, no visible texture but a few fragments show a cleavage (mainly 101-104 m), moderately hard to very hard, trace of sulphide mineral flecks (pale goldish silver colour) in some intervals. Minor fractures to 110 m but unfractured thereafter.

**BHWB02  
EXPLORATION HOLE DATA**

**Project:** Blue Hills

**Hole No:** BHWB02

**GDA Coordinates:** Zone 50, 489 189 mE; 6 776 133 mN

**Status:** Exploration hole, abandoned

**Dates Drilled:** 16 September 2006

**Drilling Contractor:** Union Drilling, Mathew Skeet

**Drilling Rig:** Schram 64

**Depth Drilled:** 83m

**Drilling Details:** 0 – 83m, SDS 125 hammer button bit, 136 mm diameter

**Casing Details:** Hole not cased, backfilled

**Reference Point Elevation:** ground level

**Hydro Data:**

<b>Depth (m)</b>	<b>Flow (m<sup>3</sup>/d)</b>	<b>EC (µS/cm)</b>	<b>Temp (°C)</b>	<b>TDS (mg/L)</b>	<b>pH</b>	<b>Comments</b>
83	<0.1	1233	24.5	680	7.15	

**Water Level:** 35.90 m below ground, 17/9/2006



Lithology:

**BHWB02 LITHOLOGICAL LOG**

<b>Depth (m bgl)</b>	<b>Lithology</b>	<b>Description</b>
0 – 5.5	COLLUVIUM	Red-brown, pebbles to cobbles of rock fragments in a loamy matrix, rock fragments include chert, haematite BIF, minor polymictic breccia, limonite-geothite pisoliths.
5.5 – 7	PISOLITIC LATERITE & CLAY	Orange-brown, 1–8 mm diameter limonite-geothite pisoliths with orange-brown clay. Presumably the top of the a weathering surface of the underlying metasediments.
7 – 27	CLAY (WEATHERED SERICITE KAOLIN ROCK)	Pale yellow-brown to white to pale pinkish brown, pale yellow-brown 14 m+, soft, becoming firm with depth and slightly darker in colour. Include harder ferruginised layers 24-27 m.
27 – 32	SERICITE QUARTZ ROCK	Pale brownish grey, weathered, include fragments of white quartz up to about 5 mm diameter,
32 – 42	CHERT	Moderate grey with mm-scale cleavage, hard, weathered.
42 – 83 (TD)	CHERT	Dark grey, very hard, basically unfractured.



**BHWB03  
EXPLORATION HOLE DATA**

**Project:** Blue Hills

**Hole No:** BHWB03

**GDA Coordinates:** Zone 50, 489 433 mE; 6 776 161 mN

**Status:** Exploration hole, abandoned

**Dates Drilled:** 17 September 2006

**Drilling Contractor:** Union Drilling, Mathew Skeet

**Drilling Rig:** Schram 64

**Depth Drilled:** 95m

**Drilling Details:** 0 – 95m, SDS 125 hammer button bit, 136 mm diameter

**Casing Details:** Hole not cased, backfilled

**Reference Point Elevation:** ground level

**Hydro Data:**

Depth (m)	Flow (m <sup>3</sup> /d)	EC (µS/cm)	Temp (°C)	TDS (mg/L)	pH	Comments
95	2.5	2310	22.4	1270	7.86	

**Water Level:** 34.0 m below ground, 17/9/2006



**Lithology:**

**BHWB03 LITHOLOGICAL LOG**

<b>Depth (m bgl)</b>	<b>Lithology</b>	<b>Description</b>
0 – 5.5	COLLUVIUM	Red-brown, fragments of haematite BIF in a loamy matrix.
5.5 – 7	PISOLITIC LIMONITE- GEOHITE	Pale brown, with some haematite BIF rock fragments.
7 – 34	CLAY WITH FERRUGINOUS LAYERS	Red-brown to brown with some white, soft, but ferruginised layers are hard. Weathered ?quartz-sericite-kaolin rock.
34 – 45	CLAY WITH FERRUGINOUS LAYERS	As above but mainly white with brown and red-brown weathering colours in clay and fewer ferruginised layers.
45 – 55	CLAY	Moderate brownish grey, weathered ?phyllite/schist.
55 – 60	PHYLLITE	Moderate grey, soft to some pale grey, many ships have platy shape and shining grey surfaces. Some hard black chert.
60 – 62	PHYLLITE and CHERT	Phyllite as above with much translucent pale grey to white and brown chert.
62 – 65	CHERT and PHYLLITE	Phyllite weathered to clay, moderate grey chert.
65 – 95 (TD)	CHERT	Dark grey to black, platy indicating possible shearing 69-73 m, very hard.

**BHWB04  
EXPLORATION HOLE DATA**

**Project:** Blue Hills

**Hole No:** BHWB04

**GDA Coordinates:** Zone 50, 489 528 mE; 6 776 172 mN

**Status:** Exploration hole, abandoned

**Dates Drilled:** 18 September 2006

**Drilling Contractor:** Union Drilling, Mathew Skeet

**Drilling Rig:** Schram 64

**Depth Drilled:** 95m

**Drilling Details:** 0 – 95m, SDS 125 hammer button bit, 136 mm diameter

**Casing Details:** Hole not cased, backfilled

**Reference Point Elevation:** ground level

**Hydro Data:**

Depth (m)	Flow (m <sup>3</sup> /d)	EC (µS/cm)	Temp (°C)	TDS (mg/L)	pH	Comments
95	<1	2150	23.6	1180	7.86	Flow out of cyclone, swelling clays blocking hole

**Water Level:** not able to collect due to swelling clays jamming rods in hole and work to clear rods from hole.

**Lithology:**

**BHWB04 LITHOLOGICAL LOG**

<b>Depth (m bgl)</b>	<b>Lithology</b>	<b>Description</b>
0 – 4	COLLUVIUM	Red-brown, fragments of haematite BIF and chert in a loamy matrix.
4 – 5	COLLUVIUM and CLAY	Brown, colluvium as above with weather ?sericite-kaolin rock.
5 – 7	CLAY, HAEMATITE BIF and CHERT	Red-brown to brown.
7 – 36	CLAY with FERRUGINOUS LAYERS	Creamy white, red-brown to brown, soft, weathered ?sericite kaolin rock, thin hard ferruginous bands, lots of ferruginous layers 21-30 m.
36 – 60	CLAY	White to red-brown to pale brown, very soft, includes some pale to moderate grey 45 m+.
60 – 71	CLAY	Moderate brownish grey, weathered ?phyllite.
71 – 76	?PHYLLITE	Pale to moderate grey, soft, very fine grained ?biotite with weathered clayey matrix.
76 – 95 (TD)	CHERT	Dark grey to black, some fragments showing a cleavage and some platy fragments, very hard.