Appendix 10

Groundwater Assessment

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(Note: A colour version of this Appendix is available on the Project CD)

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Australasian
Groundwater & Environmental
Consultants Pty Ltd

REPORT on

DARGUES GOLD MINE

GROUNDWATER MODEL UPDATE

prepared for
UNITY MINING LIMITED

Project No. G1633
May 2013

ABN:64 080 238 642

Australasian Groundwater & Environmental Consultants Pty Ltd

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DARGUES GOLD MINE

GROUNDWATER MODEL UPDATE

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JST:tl (Dargues Gold Mine)
Project No. G1633
May 2013

REPORT ON
DARGUES GOLD MINE
GROUNDWATER MODEL UPDATE

1.0 INTRODUCTION

Unity Mining Limited are currently in the early stages of developing the Dargues Gold Mine (the Mine), which is located about 2.5 km north of the village of Majors Creek in south-eastern New South Wales (Figure 1). Mining will be achieved using a sub-level, open stoping mining method to a depth of about 500 m, with the majority of mined out stopes being backfilled with paste fill. The mine will operate over a five-year period.

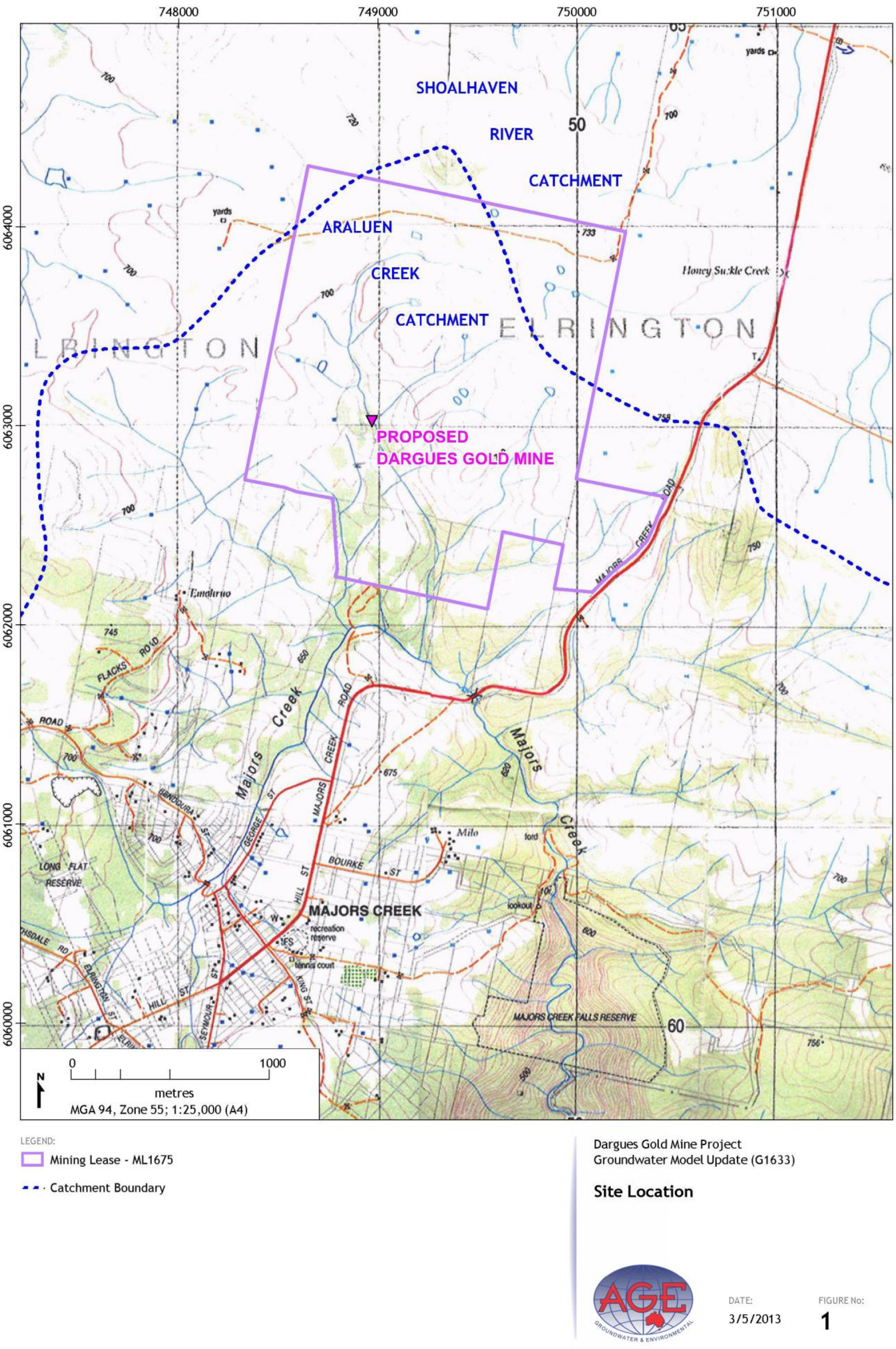
Between 2009 and 2010, Australasian Groundwater and Environmental Consultants Pty Ltd (AGE) undertook a field investigation program to assess the hydrogeology of the region around the proposed mine. The impact of the underground mine on the groundwater regime was also assessed using a numerical groundwater flow model (AGE 2010). Final project approval for the Dargues Gold Mine Project was granted on the 8 February 2012 by the Land and Environment Court. A subsequent challenge to the approval in the Land and Environment Court was upheld and resulted in further conditions being added to the project. This was followed by approval for the use of paste fill in a modification to the original approval on 12 July 2012 (AGE 2012).

The conditions of approval included the requirement for ongoing refinement and verification of the groundwater model first developed by AGE (2010). Unity Mining Limited engaged AGE to update the existing groundwater model in accordance with the conditions of approval. This report presents the results of further refinement, calibration and verification of the groundwater model.

2.0 SCOPE OF WORK

The scope of work for the project included:

- review of rainfall records from surrounding weather stations to determine the most appropriate data source;
- transient calibration of the groundwater model using measured groundwater water levels and stream flows;
- predicting the impact of the project on groundwater levels and stream flows using the recalibrated model;
- investigating groundwater flow recovery and flow directions after closure of the mine; and
- analysing the sensitivity of the adopted model parameters on model predictions.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SHOALHAVEN
RIVER
CATCHMENT
ARALUEN
CREEK
CATCHMENT
PROPOSED
DARGUES GOLD MINE
ELRINGTON
Honey Suckle Creek
MAJORS CREEK
Majors Creek
MAJORS CREEK FALLS RESERVE
0
1000
metres
MGA 94, Zone 55; 1:25,000 (A4)
LEGEND:
Mining Lease - ML1675
Catchment Boundary
Dargues Gold Mine Project
Groundwater Model Update (G1633)
Site Location
DATE:
3/5/2013
FIGURE No:
1

3.0 BACKGROUND

AGE (2010) presents a detailed review of the field exploration programs conducted at the site and the local hydrogeological regime. A brief summary is provided below.

The project is located within the Lachlan Fold Belt and underlain by the Devonian-aged Braidwood Granodiorite, a pluton consisting of multiple intrusions and occupying an area of about 1,000 km^2 (Figure 2). The granodiorite is cut by a primary set of north-west, south-east trending, steeply dipping faults, and a second suite of structures striking to the north-northeast, which appear to control drainage patterns within the area.

Gold mineralisation at the mine is structurally controlled and is hosted within strongly altered granodiorite near the contacts of a sub-vertical dyke. Lenses of mineralisation follow the east-west fracture system in the granodiorite adjacent to the dykes.

The hydrogeological regime of the project site consists of:

- shallow alluvium that forms a low yield aquifer averaging about 100 m wide and 2 m to 3 m deep along Majors Creek;
- regolith (weathered granodiorite) that forms a low yield aquifer when saturated extending to about 15 m depth; and
- fractured granodiorite characterised by “tight” massive granodiorite and localised permeable fracture systems.

Thin, narrow bands of colluvial material washed from the relatively steep side slopes occur along the tributary creeks feeding into Majors Creek. Paired groundwater monitoring bores indicate that the regolith and granodiorite are hydraulically connected. Recharge of the regolith and granodiorite is by diffuse rainfall infiltration, and groundwater flow and discharge is dominantly to Majors Creek and associated alluvium. A small spring is located in the upper catchment of Spring Creek, a tributary of Majors Creek.

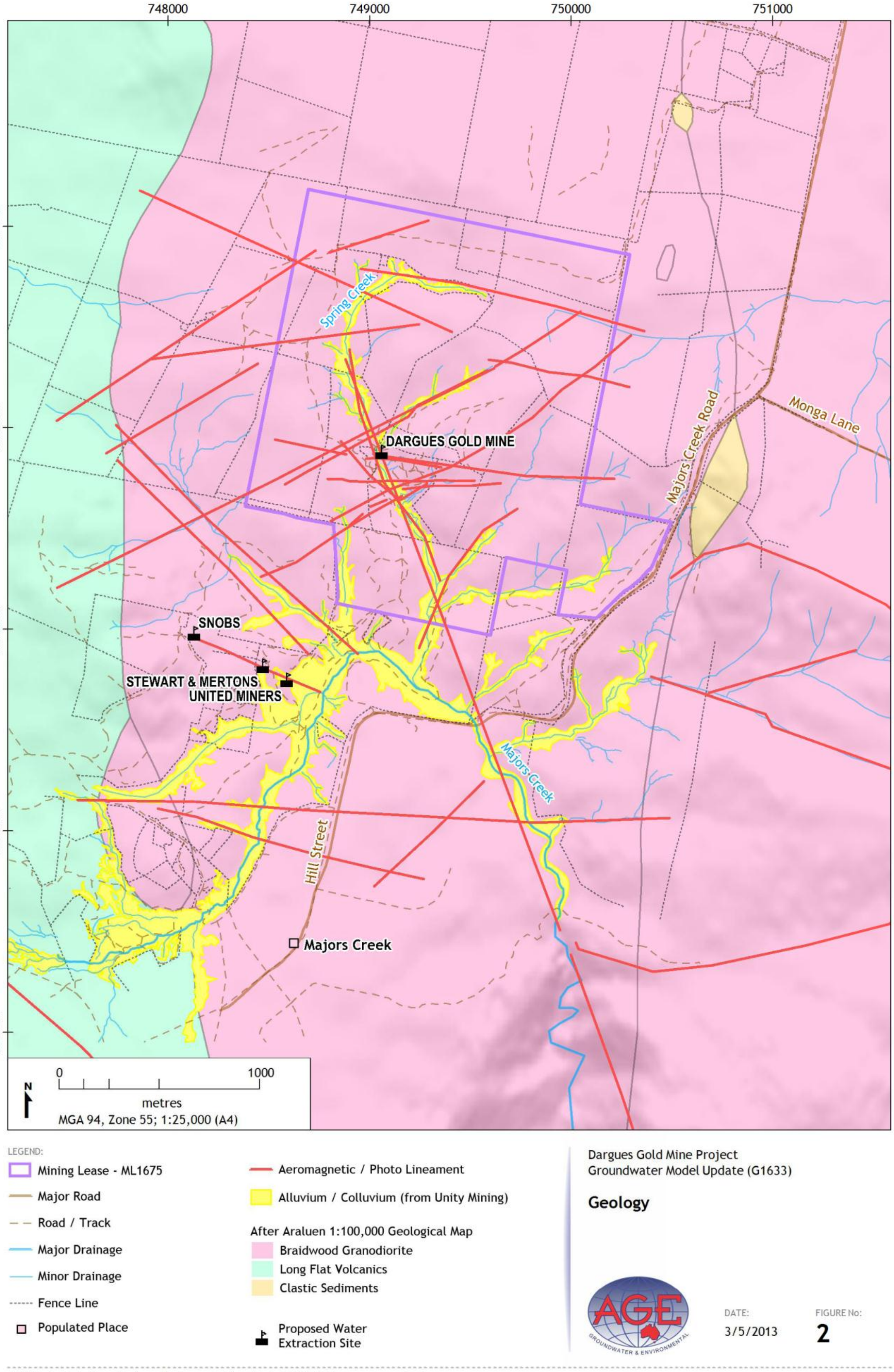
Testing undertaken on the two deep monitoring bores (>60m deep) (DRWB01 and DRWB03) installed during the field investigation indicated a hydraulic conductivity range of 8.7×10^{-5} m/day to 4.7×10^{-4} m/day, indicating outside the fractured zones the granodiorite rock mass has a very low permeability. Tests on the regolith indicated a moderate permeability range of 2.0×10^{-2} m/day to 1.3×10^{-1} m/day.

The water table is a subdued reflection of the topography, with an elevated water table in topographically high areas grading towards the creeks and steeply incised gullies. The groundwater flow direction is from the area of elevated water table towards the gullies and creeks, with Majors Creek being the prime discharge zone. Spring Creek is also a groundwater discharge area.

The nearest registered bore is about 1.5 km from the project with the majority of the private water bores located within the township of Majors Creek. The groundwater samples collected from monitoring bores were generally fresh with a moderate to low salinity and of potable quality.

Groundwater modelling in 2010 of the planned underground mining indicated a seepage rate to the underground workings peaking at between 7 L/sec and 10 L/sec. The numerical modelling indicates the zone of depressurisation will extend up to 2.5 km from the mine. The mining will depressurise groundwater levels under Majors Creek, but groundwater discharge from the granodiorite will continue to the Majors Creek alluvium but at a lesser rate than for pre-mining conditions due to a flatter water table gradient caused by mine dewatering. The model predicted flow in Majors Creek would reduce by up to 1.8 L/s. The modelling indicated that groundwater levels would fall below the bed of Spring Creek and all baseflow would cease.

Post mining groundwater levels and flow were predicted to recover relatively rapidly within 10 years of mine closure.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Spring Creek
DARGUES GOLD MINE
SNOBS
STEWART & MERTONS
UNITED MINERS
Majors Creek Road
Monga Lane
Majors Creek
Hill Street
Majors Creek
0
1000
metres
N
MGA 94, Zone 55; 1:25,000 (A4)
LEGEND:
Mining Lease - ML1675
Major Road
Road / Track
Major Drainage
Minor Drainage
Fence Line
Populated Place
Aeromagnetic / Photo Lineament
Alluvium / Colluvium (from Unity Mining)
After Araluen 1:100,000 Geological Map
Braidwood Granodiorite
Long Flat Volcanics
Clastic Sediments
Proposed Water Extraction Site
Dargues Gold Mine Project
Groundwater Model Update (G1633)
Geology
DATE:
3/5/2013
FIGURE No:
2

4.0 MONITORING PROGRAM

Unity Mining Limited commenced a baseline monitoring program in 2009 as part of the Environmental Assessment (EA) process. This baseline environmental monitoring includes measurement of rainfall, groundwater levels, stream flow rates and water quality. The sections below summarise the results of the baseline monitoring period between 2009 and 2013.

4.1 Climate

The climate of the area is characterised by mild summers with an average maximum temperature in January of 26°C and cold winters with July being the coldest month having an average maximum of 11.4°C and minimum of -0.2°C.

AGE (2010) obtained rainfall data for modelling from the Bureau of Meteorology (BoM) Braidwood (Wallace Street Station – Stn No. 069010) located about 12 km to the north of the Project Site. As part of ongoing refinement and verification of the groundwater model, records for the Majors Creek (The Old School Station – Stn No. 070061) located 2 km to the south of the Project Site were also obtained from BoM. Average annual rainfall for Majors Creek is 944 mm, compared to 719 mm for Braidwood. Figure 3 shows the difference between the monthly rainfall at Majors Creek and Braidwood rainfall as a scatter plot.

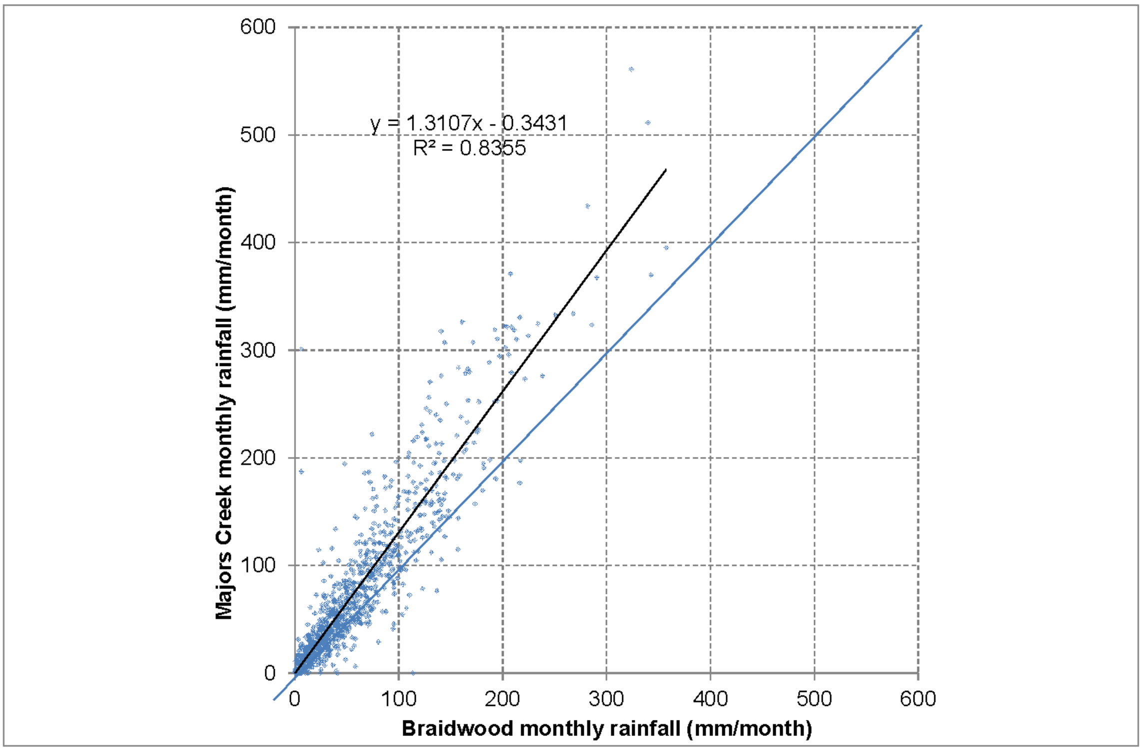


Figure 3: Braidwood vs Majors Creek rainfall

The higher rainfall at Majors Creek is clearly visible in the above chart. The Majors Creek data record has significant gaps, particularly for the period from 1920 to 1950. Large gaps in rainfall data sets can make statistics problematic. SILO data[1] was used to infill the data record for Majors Creek and allow long- term analysis to demonstrate how the period with current monitoring data compares to the long term. In order to place recent rainfall years into an historical context the Cumulative Rainfall Departure (CRD) which is a summation of the monthly departures of rainfall from the long-term average monthly rainfall was calculated as follows:

$$CRD_n = CRD_{n-1} + (R_n - R_{av})$$

Where:	CRD_n	=	CRD for a given month
	CRD_{n-1}	=	CRD for a preceding month
	R_{av}	=	long-term average rainfall for a given month
	R_n	=	actual rainfall for given month

Figure 4 shows the CRD for Braidwood, Major Creek, Majors Creek SILO (in filled) and also the rain gauge at the Project Site. The graphs show similar trends since 1900, similar to many other sites across the eastern seaboard. The prolonged dry period from the late 1990's to 2009/ 2010 is clearly evident with a downward trend at all monitoring sites. The recent above average wet period is also evident with an upward trend in data from 2009/ 2010. Further sections of this report use Majors Creek SILO rainfall record as representative of the Project Site.

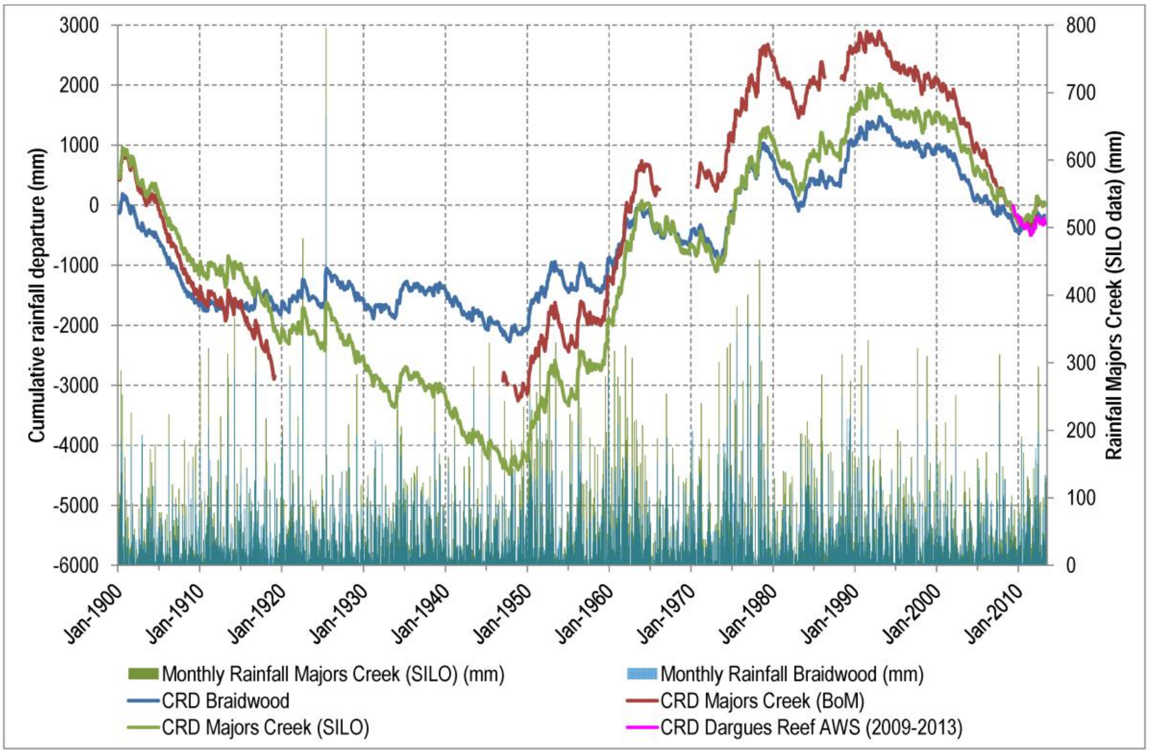


Figure 4: Majors Creek and Braidwood CRD and monthly rainfall

[1] *SILO is interpolated daily rainfall to a 5 km scale over the past 120 years or since records began, the records are mainly based on observed data, with interpolation where there are data gaps. Refer to www.longpaddock.qld.gov.au/silo*

Rainfall is distributed relatively evenly throughout the year as demonstrated by the monthly averages for Majors Creek shown in Figure 5. Evaporation and evapotranspiration data sets available through SILO have also been added to this graph. Evaporation and evapotranspiration exceeds rainfall in most months with the exception of the winter period from May to July. This indicates that groundwater recharge is most likely to occur during the winter months when the soil profile is wet and the low evaporation rates are slow to dry the soil.

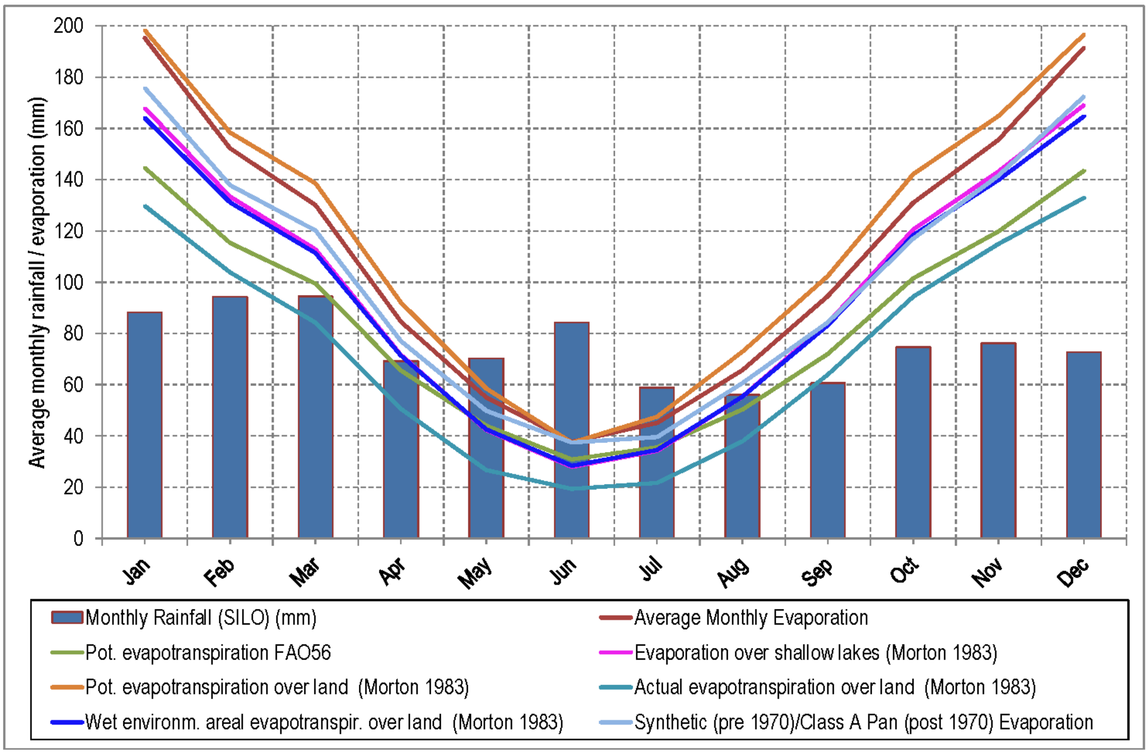


Figure 5: Majors Creek monthly average rainfall and evaporation

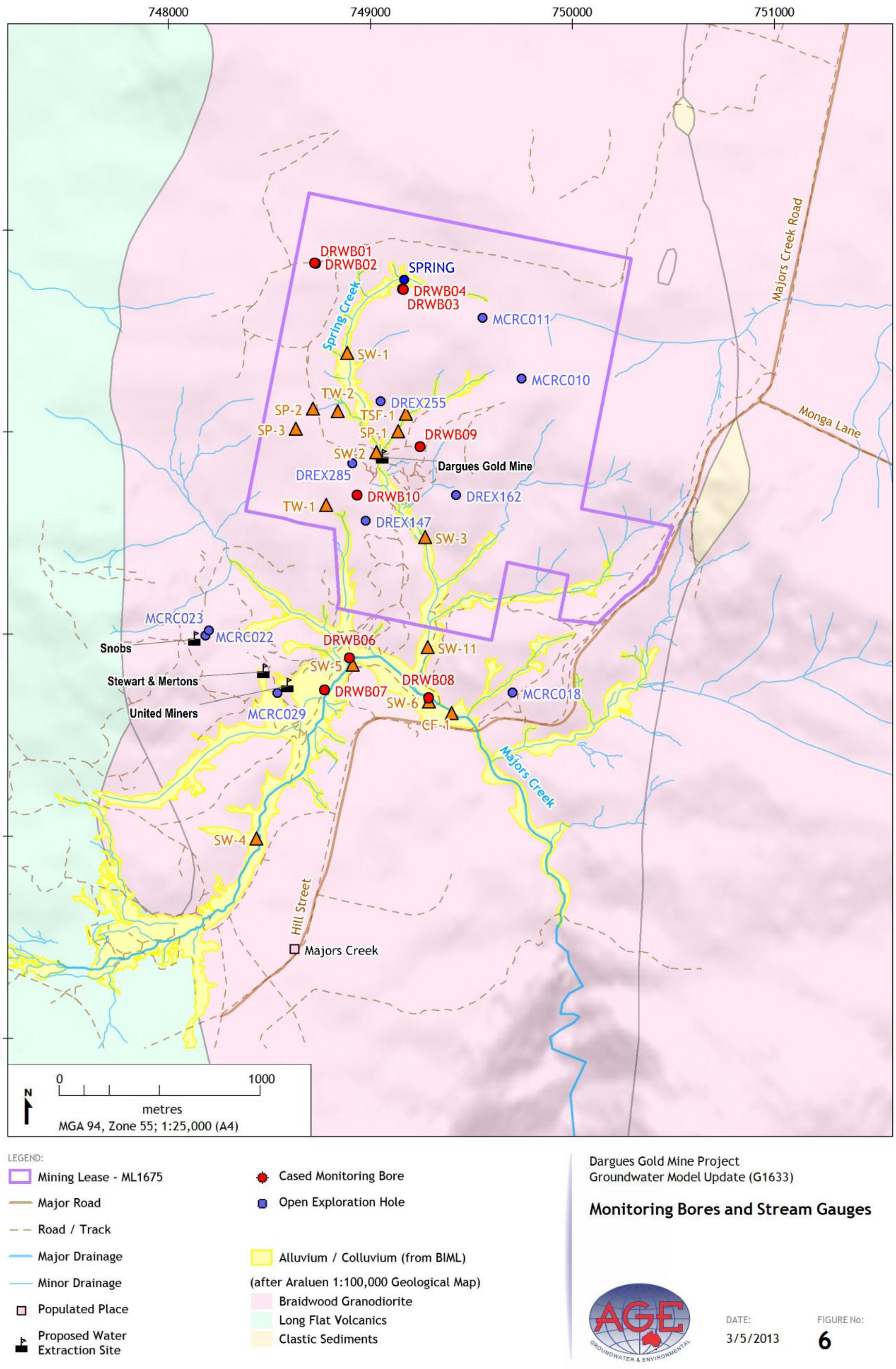
4.2 Groundwater

4.2.1 Groundwater Monitoring Network

Prior to the 2009/2010 study, there were no dedicated monitoring bores that could provide data on the groundwater regime. During the previous study, a number of sites were selected for installation of monitoring bores that would provide baseline data and monitor the impact of the Project during and following mining. AGE (2010) provide full details of the monitoring bores installed.

AGE (2010) constructed ten monitoring bores (DRWB01 to DRWB10) at eight sites. A pair of monitoring bores were installed at two sites (DRWB01/02 and DRWB03/04), one in the weathered zone (regolith) and the second in the deeper fractured rock (granodiorite), in order to assess the hydraulic connectivity between the two systems.

In addition to the monitoring bores, a number of open exploration holes were dipped for groundwater levels. Regular measurements from nine bores (bore DRWB05 was normally dry) and ten exploration holes (MCRC and DREX series holes) started in 2010 comprising bi-monthly measurements in 2011 and monthly measurements since 2012. Figure 6 shows the locations of the monitoring network.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DRWB01
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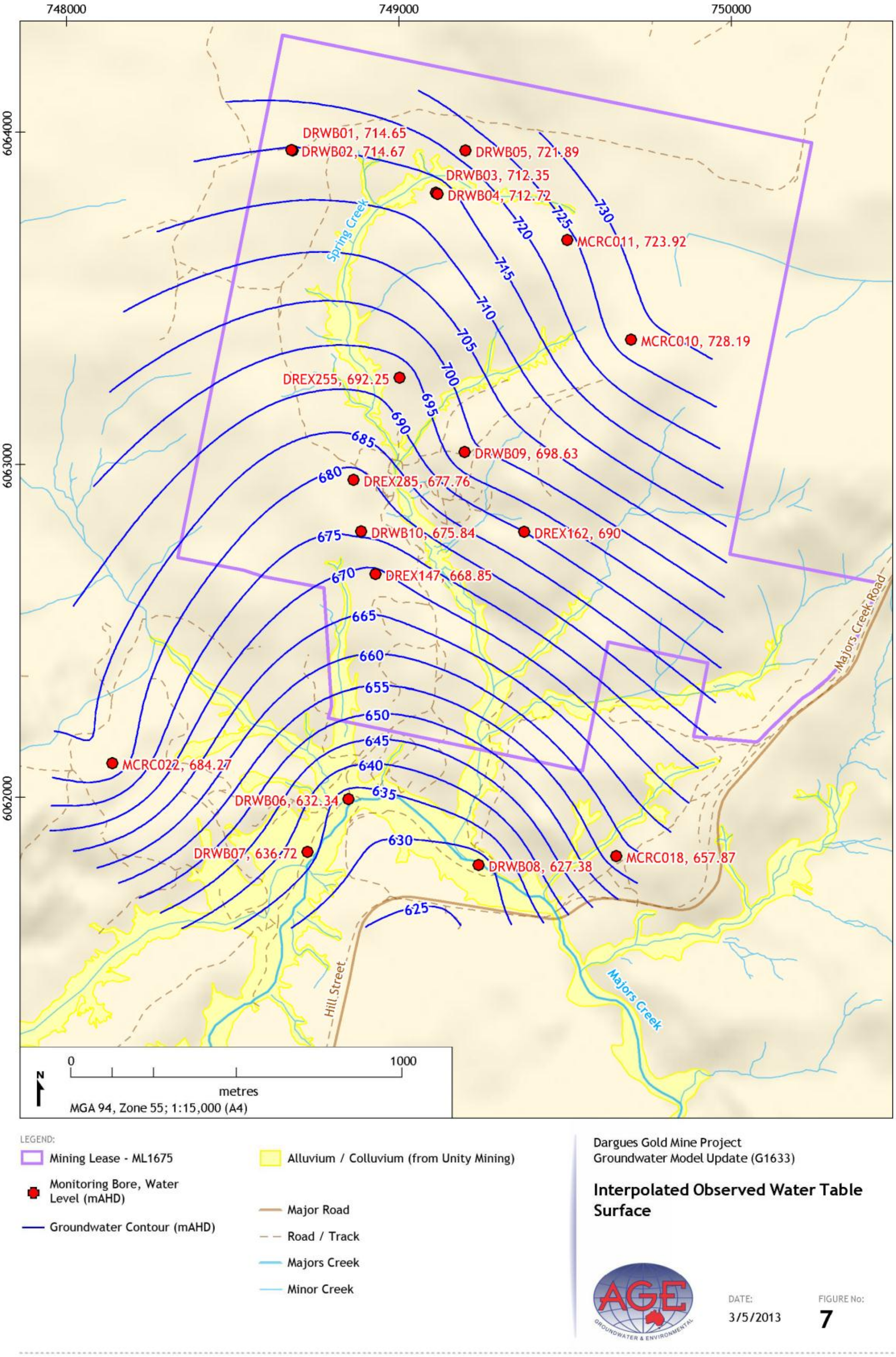
MCRC011
Spring Creek
SW-1
MCRC010
TW-2
DREX255
SP-2
TSF-1
SP-3
SP-1
DRWB09
SW-2
Dargues Gold Mine
DREX285
DRWB10
DREX162
TW-1
DREX147
SW-3
MCRC023
MCRC022
Snobs
DRWB06
SW-11
Stewart & Mertons
SW-5
DRWB08
DRWB07
MCRC018
United Miners
MCRC029
SW-6
CF-1
Majors Creek
SW-4
Hill Street
Majors Creek
Majors Creek Road
Monga Lane
0
1000
N
metres
MGA 94, Zone 55; 1:25,000 (A4)
LEGEND:
Mining Lease - ML1675
Major Road
Road / Track
Major Drainage
Minor Drainage
Populated Place
Proposed Water Extraction Site
Cased Monitoring Bore
Open Exploration Hole
Alluvium / Colluvium (from BIML)
(after Araluen 1:100,000 Geological Map)
Braidwood Granodiorite
Long Flat Volcanics
Clastic Sediments
Dargues Gold Mine Project
Groundwater Model Update (G1633)
Monitoring Bores and Stream Gauges
DATE:
3/5/2013
FIGURE No:
6

4.2.2 Groundwater Levels

Figure 7 presents the interpolated groundwater surface measured in January 2013. Figure 7 shows the water table surface is generally a subdued reflection of the topography, with flow from the elevated areas in the north towards Majors Creek. The hydraulic gradient is moderate to steep at about 1 m in 20 m.

Figure 8 shows groundwater levels measured in each monitoring bore. Groundwater levels generally show a slight rising trend in response to above average rainfall over the three-year monitoring period. Most of the bores record a gradual rise in groundwater levels of between 0.5 m and 2 m indicting diffuse recharge occurs slowly through the unsaturated zone to the regolith.

The exploration holes are likely open across numerous water bearing zones and therefore represent a composite of water levels across these zones.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DRWB02, 714.67
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DRWB03, 712.35
DRWB04, 712.72
MCRC011, 723.92
MCRC010, 728.19
DREX255, 692.25
DRWB09, 698.63
DREX285, 677.76
DRWB10, 675.84
DREX162, 690
DREX147, 668.85
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DRWB06, 632.34
DRWB07, 636.72
DRWB08, 627.38
MCRC018, 657.87
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630
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Spring Creek
Majors Creek Road
Majors Creek
Hill Street
0
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metres
N
MGA 94, Zone 55; 1:15,000 (A4)
LEGEND:
Mining Lease - ML1675
Monitoring Bore, Water Level (mAHD)
Groundwater Contour (mAHD)
Alluvium / Colluvium (from Unity Mining)
Major Road
Road / Track
Majors Creek
Minor Creek
Dargues Gold Mine Project
Groundwater Model Update (G1633)
Interpolated Observed Water Table Surface
DATE:
3/5/2013
FIGURE No:
7

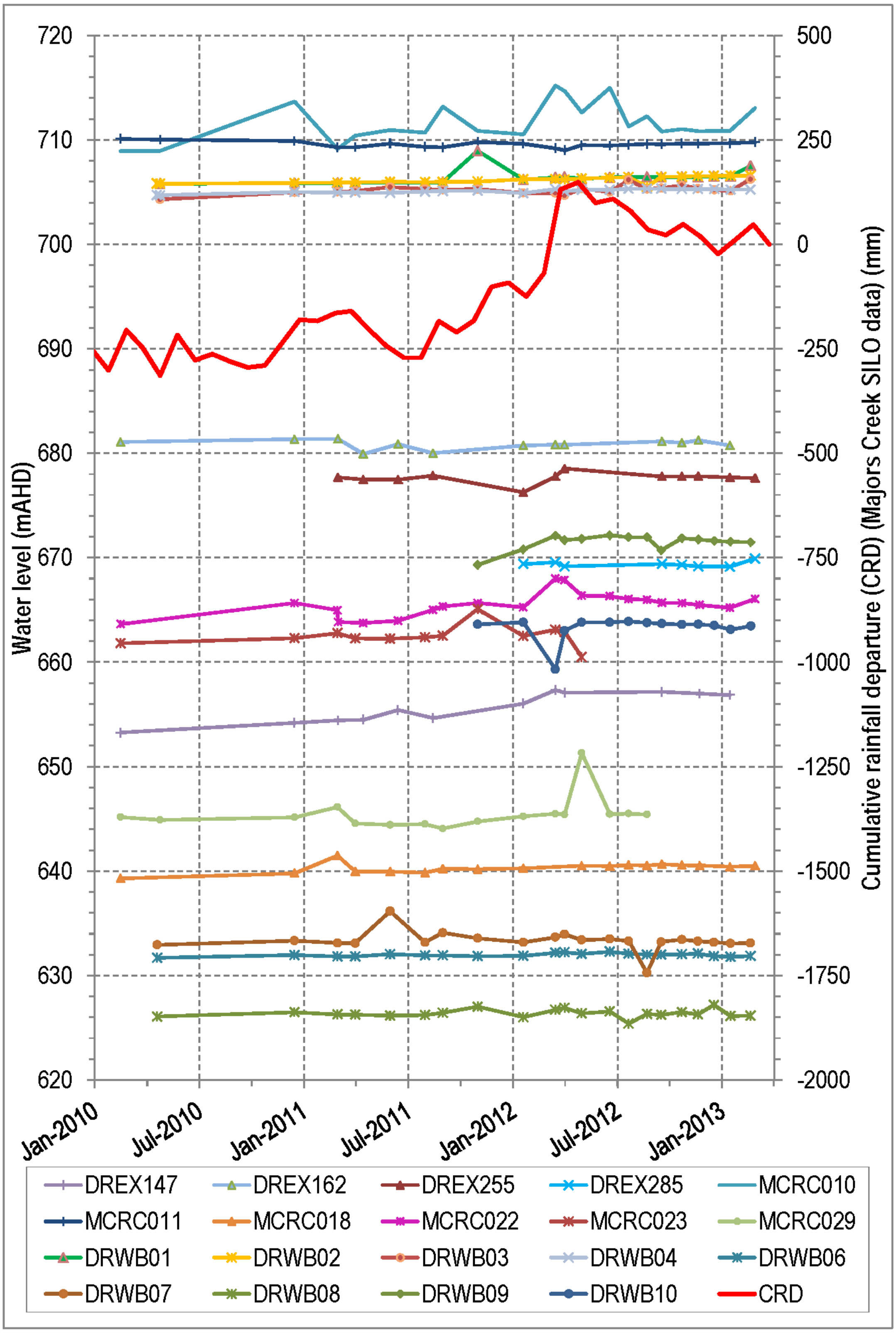


Figure 8: Monitoring bore hydrographs

4.2.3 Groundwater and Surface Water Quality

There have been 224 surface water samples taken at 24 sites between July 2006 and December 2011. The analysis comprised:

- 200 pH / electrical conductivity (EC);
- 110 major ions and nutrients; and
- between 70 and 200 results for minor metals.

Table 4.1 and Table 4.2 summarises the available water chemistry data.

Table 4.1: SUMMARY OF WATER QUALITY ANALYSES – SURFACE WATER AND ALLUVIUM

Type / Aquifer	Unit	Surface Water				Groundwater - Alluvium			
Statistics		Min	Max	Average	Amount	Min	Max	Average	Amount
Temperature, field	degC					11.8	17.6	14.4	16
Dissolved oxygen	mg/L					1.09	5.1	2.86	13
pH	pH unit	6	8.35	7.31	204	6.3	7.7	6.9	18
Electrical Conductivity	uS/cm	152	1720	740.8	192	174.1	678	369.6	18
Redox (Eh)	mV					-116.3	151	17.09	16
Total Dissolved Solids	mg/L	179	1650	780.88	17				0
Suspended Solids	mg/L	2.5	1890	75.44	108	230	8200	3943.3	3
Major Ions									
Sodium	mg/L	9.6	68	30.54	110	11	21	16.67	6
Potassium	mg/L	0.5	56	2.21	110	1.7	5.9	3.58	6
Calcium	mg/L	5.3	190	60.02	141	28	96	63.83	6
Magnesium	mg/L	3	54	21.88	110	4	17	10.68	6
Chloride	mg/L	7	460	133.98	108	12	51	32.00	6
Sulphate as SO_4	mg/L	0.5	34	16.31	108	4.1	110	33.38	6
Hydroxide Alkalinity as $CaCO_3$	mg/L	0.05	5	0.98	117	0.05	0.1	0.09	8
Carbonate Alkalinity as $CaCO_3$	mg/L	0.05	0.5	0.49	104	0.05	0.1	0.09	8
Bicarbonate Alkalinity as $CaCO_3$	mg/L	21	215	93.74	113	82.3	163	100.9	6
Total Alkalinity as $CaCO_3$	mg/L	21	215	93.74	113				0
Metals									
Aluminium	mg/L	0.005	9.64	0.31	110	0.02	0.06	0.03	6
Antimony	ug/L	1.5	1.5	1.50	3				0
Arsenic	mg/L	0.0005	0.015	0.0008	196	0.0005	0.003	0.001	8
Bismuth	mg/L	0.0005	0.0005	0.0005	4				0
Cadmium	ug/L	0.005	0.05	0.05	89	0.025	0.09	0.05	8
Chromium	mg/L	0.0005	0.0005	0.0005	88	0.0005	0.001	0.0009	8
Copper	mg/L	0.0005	0.02	0.0013	195	0.0005	0.7	0.34	5
Iron, total	mg/L	0.025	177	5.14	121				0
Iron, dissolved	mg/L	0.005	2.14	0.27	110	0.02	6.8	2.1	6
Lead	ug/L	0.0005	3	0.50	89	0.025	0.29	0.09	8
Manganese	mg/L	0.13	0.29	0.21	2	0.29	0.55	0.41	6
Mercury	ug/L	0.05	0.3	0.06	71	0.05	0.1	0.09	8
Nickel	ug/L	0.05	3	0.79	76	1	3	1.83	6
Zinc	mg/L	0.002	0.224	0.01	197	0.0025	0.14	0.05	7

Table 4.1: SUMMARY OF WATER QUALITY ANALYSES – SURFACE WATER AND ALLUVIUM

Type / Aquifer	Unit	Surface Water				Groundwater - Alluvium			
Statistics		Min	Max	Average	Amount	Min	Max	Average	Amount
Nutrients									
Ammonia as N	mg/L	0.005	1.46	0.06	108	0.1	0.3	0.15	6
Nitrite as N	mg/L	0.005	0.005	0.01	111	0.005	0.01	0.01	5
Nitrate as N	mg/L	0.005	0.99	0.25	110	0.005	0.05	0.03	5
Nitrite + Nitrate as N	mg/L	0.005	0.99	0.26	108				0
TKN as N	mg/L	0.05	6.2	0.64	108	0.2	7.8	1.95	6
T.Oxid Nit as N	mg/L	0.025	2.4	0.79	77	0.005	0.05	0.04	8
Total N	mg/L	0.05	6.2	1.06	33	0.23	7.8	1.97	6
Total P	mg/L	0.005	2.43	0.10	108	0.46	8.4	2.51	6

Table 4.2: SUMMARY OF WATER QUALITY ANALYSES – REGOLITH AND BEDROCK

Type / Aquifer	Unit	Groundwater - Regolith				Groundwater - Granodiorite			
Statistics		Min	Max	Average	Amount	Min	Max	Average	Amount
Temperature, field	degC	14.1	16.1	14.86	11	13.6	18.2	15.095	20
Dissolved oxygen	mg/L	1.4	4.57	3.23	8	0.9	6.83	2.58	16
pH	pH unit	6.48	8.6	7.03	13	6.72	12.47	8.6	22
Electrical Conductivity	uS/cm	280.6	1300	694.6	13	344	4300	1144.0	22
Redox (Eh)	mV	35.9	201	97.77	11	-183	220.7	30.00	20
Total Dissolved Solids	mg/L				0				0
Suspended Solids	mg/L	69	410	239.50	2	8	13	10.0	3
Major Ions									
Sodium	mg/L	23	64	41.00	4	31	240	71.29	7
Potassium	mg/L	0.9	4.3	2.30	4	0.9	9.7	2.56	7
Calcium	mg/L	29	140	78.00	4	15	150	84.57	7
Magnesium	mg/L	9.4	43	26.33	4	0.025	43	14.51	8
Chloride	mg/L	43	300	109.50	4	38	320	124.43	7
Sulphate as SO_4	mg/L	13	41	21.50	4	14	41	25.14	7
Hydroxide Alkalinity as $CaCO_3$	mg/L	0.05	0.1	0.08	6	0.05	306	38.33	8
Carbonate Alkalinity as $CaCO_3$	mg/L	0.05	0.1	0.08	6	0.05	129	16.21	8
Bicarbonate Alkalinity as $CaCO_3$	mg/L	72.6	154	109.50	4	0.05	274	151.0	8
Total Alkalinity as $CaCO_3$	mg/L				0				0
Metals									
Aluminium	mg/L	0.02	0.03	0.03	4	0.02	1.5	0.24	7
Antimony	ug/L				0				0
Arsenic	mg/L	0.0005	0.001	0.0008	6	0.001	1	0.117	9
Bismuth	mg/L				0				0
Cadmium	ug/L	0.025	0.31	0.09	6	0.025	0.05	0.04	9
Chromium	mg/L	0.0005	0.001	0.0008	6	0.0005	0.004	0.0013	8
Copper	mg/L	0.0007	0.5	0.3336	3	0.0006	1	0.40	5
Iron, total	mg/L				0				0
Iron, dissolved	mg/L	0.01	0.01	0.01	4	0.01	1.2	0.226	7
Lead	ug/L	0.025	0.06	0.05	6	0.05	3.1	0.80	7

Table 4.2: SUMMARY OF WATER QUALITY ANALYSES – REGOLITH AND BEDROCK									
Type / Aquifer	Unit	Groundwater - Regolith				Groundwater - Granodiorite			
Statistics		Min	Max	Average	Amount	Min	Max	Average	Amount
Manganese	mg/L	0.002	0.27	0.13	4	0.001	0.38	0.12	7
Mercury	ug/L	0.05	0.1	0.08	6	0.05	1.1	0.29	9
Nickel	ug/L	0.5	4	2.10	5	2	4	2.86	7
Zinc	mg/L	0.005	0.093	0.04	4	0.005	0.18	0.05	7
Nutrients									
Ammonia as N	mg/L	0.1	0.1	0.10	4	0.1	2	0.41	7
Nitrite as N	mg/L	0.005	0.01	0.01	4	0.01	0.01	0.01	3
Nitrate as N	mg/L	1.4	3.2	2.1	4	0.05	1.5	0.53	3
Nitrite + Nitrate as N	mg/L				0				0
TKN as N	mg/L	0.1	0.4	0.23	4	0.1	2.4	0.59	7
T.Oxid Nit as N	mg/L	1.4	1.7	1.60	4	0.05	4.8	1.02	7
Total N	mg/L	1.6	2.1	1.83	4	0.13	5	1.60	7
Total P	mg/L	0.09	2.1	0.70	4	0.02	0.11	0.05	7

Surface water is neutral with an average pH of 7.3 (minimum 6.0 and maximum 8.4). The EC on average is 745 µS/cm (minimum 152 µS/cm, maximum 1720 µS/cm) and as such is fresh to slightly brackish. EC is higher in Spring Creek (470 µS/cm to 1100 µS/cm) than in Majors Creek (150 µS/cm to 480 µS/cm), which is likely related to the higher flow rate in the wider Majors Creek. Salinity is increasing downstream within each creek. Salinity in Spring Creek is increasing from 580 µS/cm (SW1) to 840 µS/cm (SW2) and further to 870 µS/cm (SW3), while the downstream trend in Majors Creek is from about 200 µS/cm (SW4) to 250 µS/cm (SW5) to 350 µS/cm (SW6).

There have been 92 groundwater samples taken at 24 sites between April 2010 and February 2013. A total of 68 samples were taken from alluvium, regolith and granodiorite respectively, while the source is unknown for 24 samples. The groundwater samples, where possible, have been grouped into the three general hydrostratigraphic units (alluvium, regolith and granodiorite), and a summary of these is as follows:

Alluvium

- pH in the alluvium groundwater is generally neutral with an average of 6.9 and all data between 6.3 and 7.7; and
- Alluvial groundwater is fresh with EC between 180 µS/cm and 680 µS/cm with a mean of 370 µS/cm.

Regolith

- the average pH in the regolith is neutral (7) with all data being between 6.5 and 8.6; and
- regolith groundwater is fresh to slightly brackish with an average EC of 670 µS/cm (minimum 280 µS/cm, maximum 1200 µS/cm)

Granodiorite

- the average pH is alkaline at 8.6 with all data being between 6.7 and 12.5; and
- granodiorite groundwater is fresh to brackish with an average EC of 1000 µS/cm (minimum 350 µS/cm, maximum 4300 µS/cm).

The water quality analysis of 134 samples, 111 surface water and 23 groundwater samples, comprised all relevant major ions, which permitted the water type assessment using a Piper diagram (Figure 9).

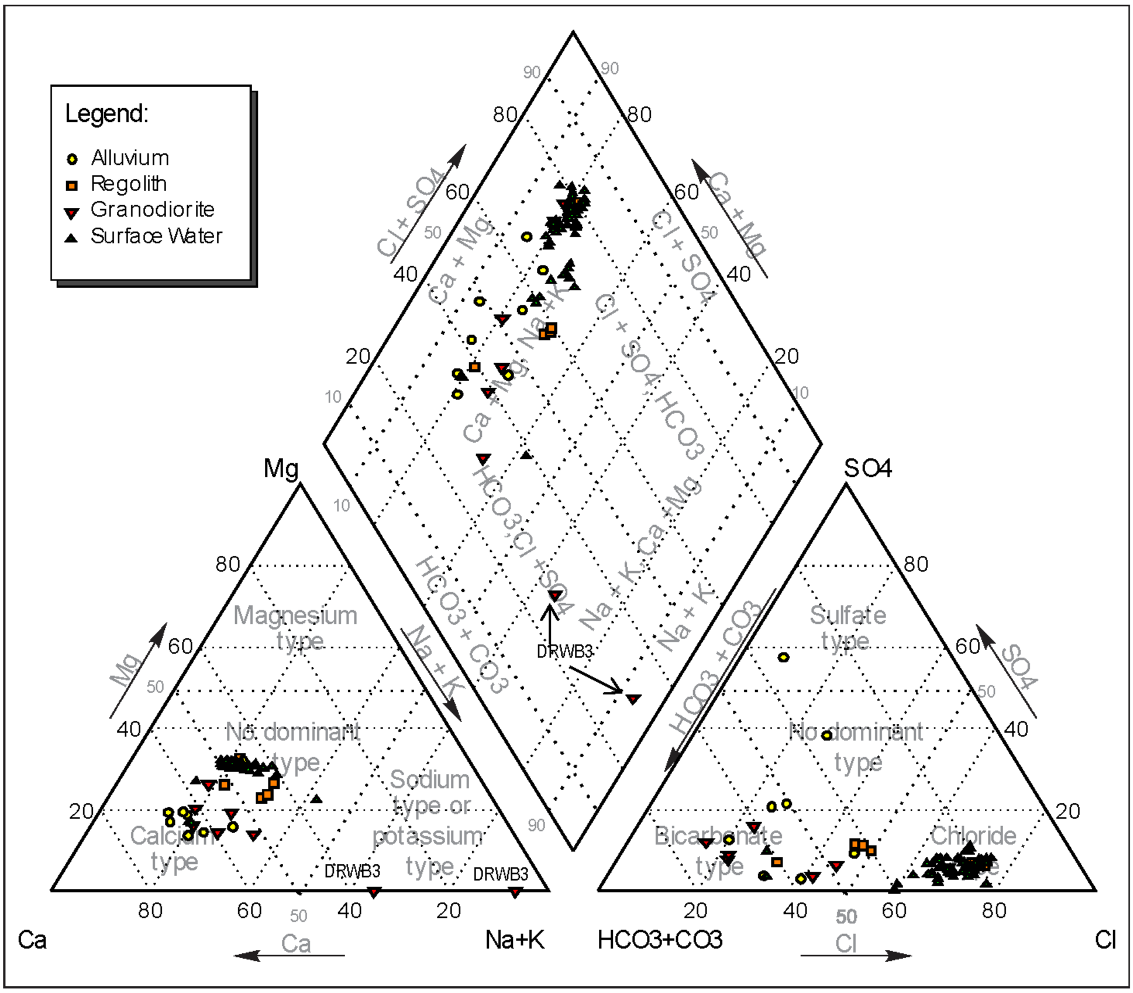


Figure 9: Major ion composition of surface water and groundwater – Trilinear (Piper) diagram

The granodiorite samples marked ‘DRWB3’ in the Piper diagram are considered to be outliers and not representative for the granodiorite water quality. The major ion composition of the remaining data sets can be summarised as follows:

- surface water is high in calcium/magnesium and chloride and as such of calcium/ magnesium-chloride water type;
- compared to surface water, groundwater is generally lower in chloride and magnesium;
- groundwater in the alluvium is of a calcium-bicarbonate type;
- regolith groundwater is generally of a calcium/magnesium-bicarbonate/chloride type; and
- groundwater in the granodiorite is of a calcium-bicarbonate type.

Surface waters have a similar chemical composition to groundwater confirming baseflow from alluvium, regolith and / or granodiorite as a source of surface water flows, particularly at low flows. The main difference between water types being that surface waters are enriched in chloride, likely due to evaporation along the creek lines.

4.3 Surface Water Flow

Early baseline monitoring for the project included gauging flows at the small spring located in the headwaters of Spring Creek. AGE (2010) report the spring occurs as a minor seepage in a steeply incised area of the creek and flows at about 0.3 L/sec. Unity Mining have recorded flow in Spring Creek periodically at a v-notch weir located about 1km downstream of the spring. Figure 10 shows the flows recorded on Spring Creek, and also downstream on Majors Creek.

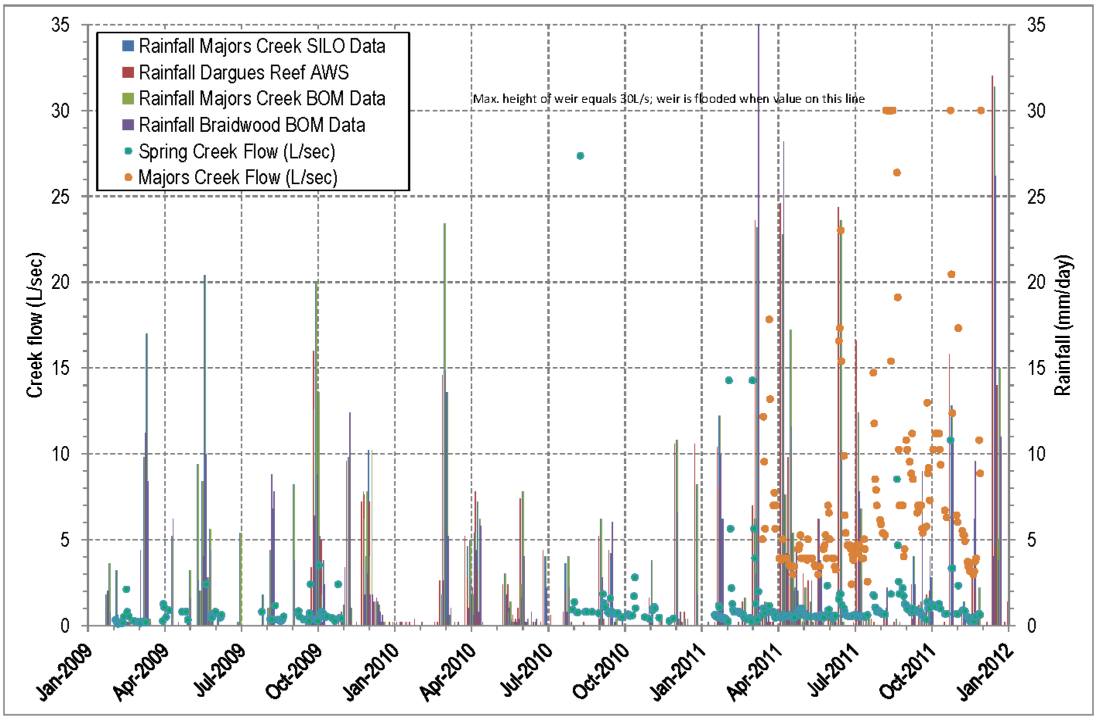


Figure 10: Spring flow hydrographs

Figure 10 indicates the baseflow in Spring Creek is generally between 0.3 L/sec and 1 L/sec.

In 2013, Unity Mining installed additional stream flow gauges in Spring Creek and Majors Creek to monitor the impacts of mining on surface water flows. Figure 6 shows the location of the gauges with Figure 11 presenting the recorded stream flow. The period of record is still relatively limited and it will not be possible to assess baseflow until a longer record has been collected across a full seasonal cycle.

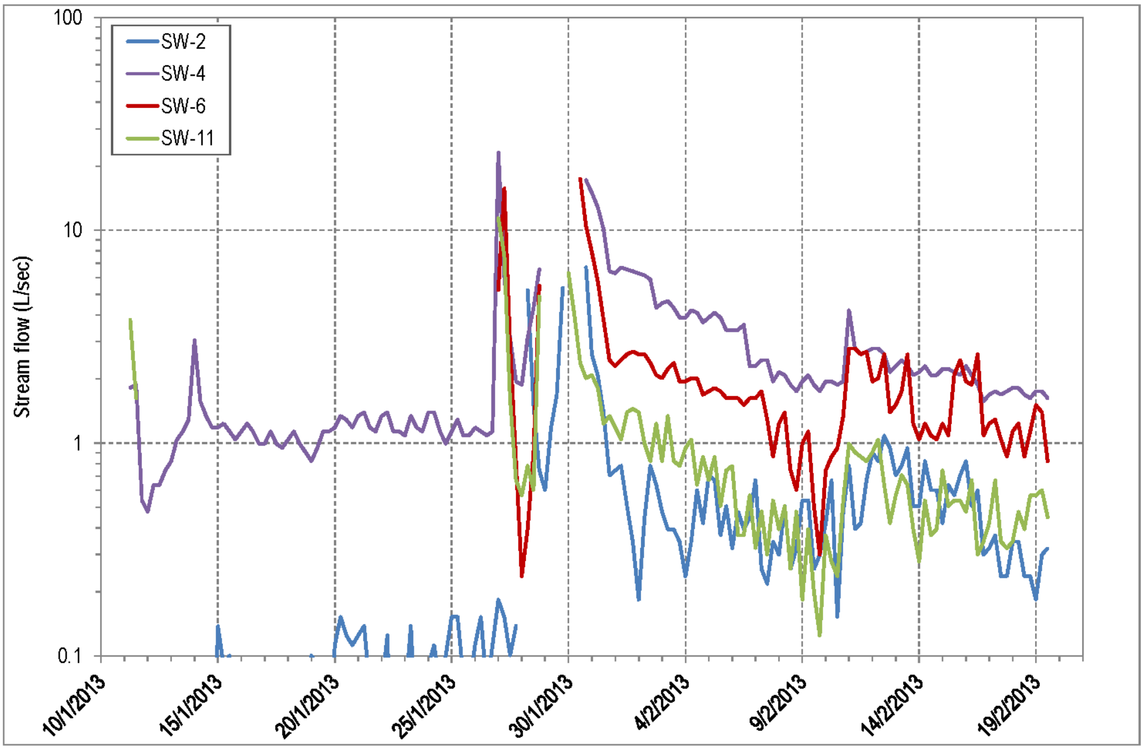


Figure 11: Stream flow hydrographs

5.0 NUMERICAL GROUNDWATER MODEL

5.1 Previous Groundwater Model

AGE (2010) constructed a groundwater model using the MODFLOW SURFACT code to simulate the impact of the Project. The model cells were 12.5 m by 12.5 m within the mining area, extending to 100 m by 120 m at the extremities of the model. The model extent was 7 km from west to east and 6 km from north to south. Figure 12 shows the model grid, which was rotated to align the axes with the principal direction of groundwater flow.

The model consisted of seven model layers representing the three main hydrostratigraphic units as follows:

- Layer 1 - alluvial deposits and weathered bedrock with thickness varying from 1 m to 3 m;
- Layer 2 - weathered bedrock (regolith) with the base 15 m below ground level;
- Layers 3 to 7 - granodiorite with the layers being 50 m, 100 m, 200 m, 300 m and 600 m below the ground surface.

Faults and lineaments appear to control drainage patterns within the area, and are zones of weakness. The faults and lineaments were represented in the model with a higher hydraulic conductivity than the surrounding strata. Groundwater level measurements from 35 open exploration holes within the Project area and from the seven monitoring bores were used as observation data for a steady state calibration of the model.

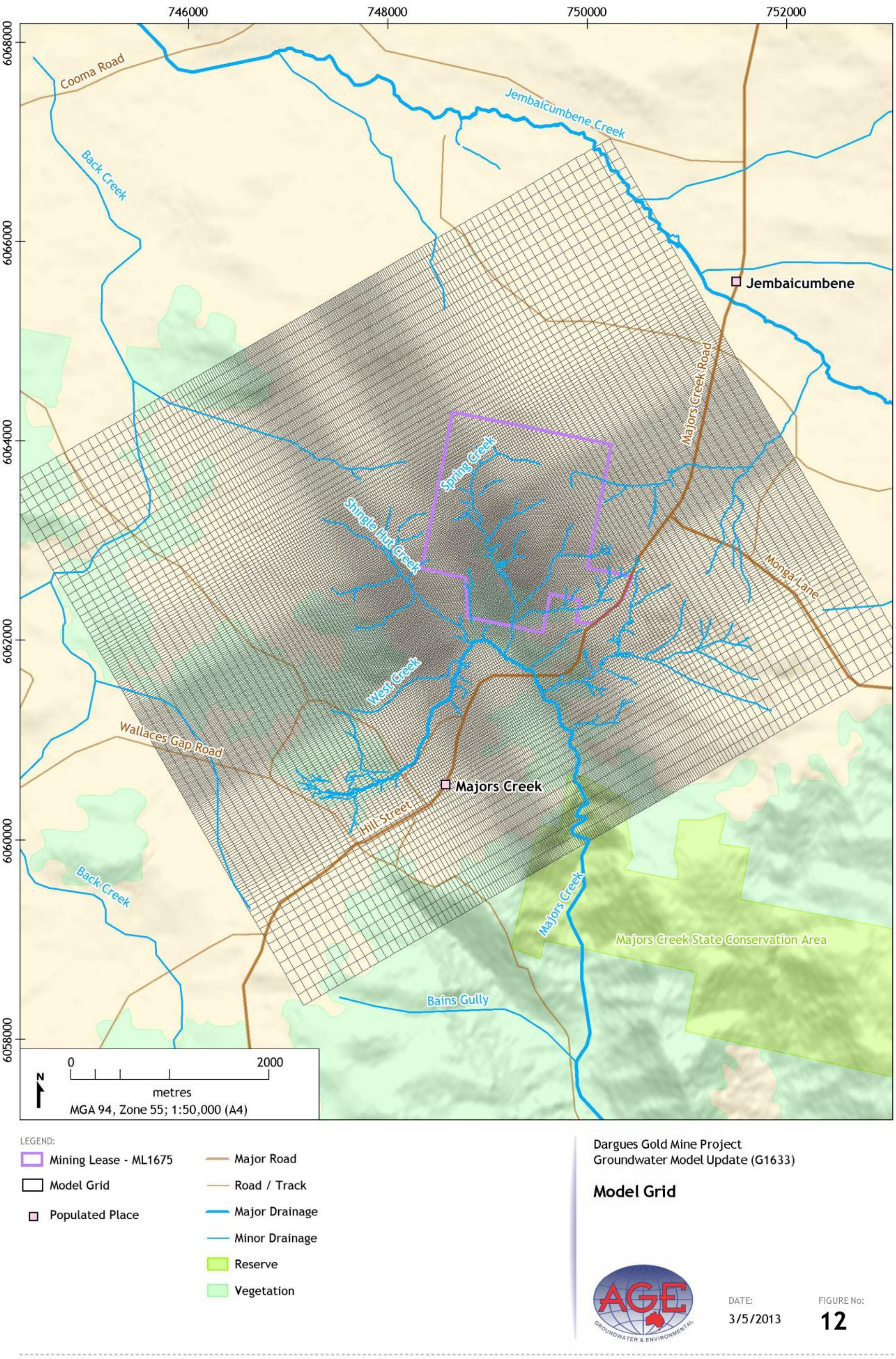
Calibrated hydraulic conductivity values were within the range of field data, and were:

- alluvium - 2.7 m/day;
- regolith - 1.6 x 10^{-1}m/day; and
- granodiorite - 3.8 x 10^{-5}m/day.

The model calibrated the hydraulic conductivity of the fault zones in the regolith at 2.9 x 10^{-3} m/day and 1.9 x 10^{-3} m/day for faults in fresh rock.

The model was then used to simulate the impact of the proposed mining on the groundwater regime. Section 5.0 discusses the predictive modelling and compares results to the recalibrated model described in this report.

AGE (2012) updated the groundwater model to simulate the impact using paste fill in the mine workings. The model predicted a marginally faster rate of water level recovery post mining when paste fill is used. Regulatory authorities subsequently approved the use of paste fill.


746000
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6068000
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6060000
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Cooma Road
Jembaicumbene Creek
Back Creek
Jembaicumbene
Majors Creek Road
Spring Creek
Shingle Hut Creek
Monga Lane
West Creek
Wallaces Gap Road
Majors Creek
Hill Street
Back Creek
Majors Creek
Majors Creek State Conservation Area
Bains Gully
0
2000
metres
N
MGA 94, Zone 55; 1:50,000 (A4)
LEGEND:
Mining Lease - ML1675
Model Grid
Populated Place
Major Road
Road / Track
Major Drainage
Minor Drainage
Reserve
Vegetation
Dargues Gold Mine Project
Groundwater Model Update (G1633)
Model Grid
AGE
GROUNDWATER & ENVIRONMENTAL
DATE:
3/5/2013
FIGURE No:
12

5.2 Model Verification and Updates

The model developed by AGE (2010) was initially run with the new water level measurements to determine if it could replicate the observed water level fluctuations from the baseline monitoring period. The predicted water levels were considered a poor match to the observed water levels and it was therefore decided to recalibrate the model.

Prior to recalibration the faults and lineaments, which had been simulated by AGE (2010) were removed from the regolith layers. This was appropriate as the weathering of the fault zones and country rock would likely result in similar hydrogeological properties. The topographic surface of the model and the stream-bed was also updated with more recent digital elevation data from Geoscience Australia (2011).

5.3 Recalibration

5.3.1 Calibration Objective and Targets

The objective of the steady state and transient model calibration was to simulate pre-mining groundwater levels from early 2010 to early 2013. The groundwater model was calibrated by adjusting aquifer parameters and stresses to produce the best match between the observed and simulated water levels and fluxes. The calibration of the model followed the objectives set out by Barnett et al, (2012). Initial calibration was undertaken manually and followed by automated calibration using parameter estimation software (PEST).

The targets for the steady state and transient calibration of the model were the baseline water level data from the monitoring bore network and the open exploration holes groundwater levels. The model was not calibrated to the gauging data from Spring Creek and Majors Creek as the period of record was limited to summer 2013, when there had been significant rainfall events and the baseflow component of flows was uncertain. When a longer record of flows has been collected across a full seasonal cycle, the baseflow will be more evident and could be used in subsequent model calibrations.

5.3.2 Recharge

Initially zones were created in the model to represent diffuse rainfall recharge to the hill tops, sloping areas and the alluvial flats, similar to those used by AGE (2010). With refinement, it was found the model calibrated in steady state best with a uniform recharge rate of 87 mm/yr across all zones, which is equivalent to about 3 % of annual rainfall. This is within the range that was estimated using the chloride mass balance method. Three percent of rainfall was applied to the measured monthly rainfall in the transient model, hence increasing the recharge rate in the wetter months.

5.3.3 Hydraulic Parameters

Table 5.1 presents the calibrated hydraulic parameters for each hydrostratigraphic unit.

Table 5.1: HYDRAULIC PARAMETERS

Layer	Sequence	Hydraulic Conductivity (m/day)		Specific Yield (Sy) %	Specific Storage (Ss)
		Horizontal	Vertical		
1	alluvium	7.5	0.27	0.49	8×10^{-4}
1 - 2	regolith	0.1	0.1	0.58	$7. \times 10^{-4}$
3 - 7	granodiorite	0.0001	0.0001	0.50	9×10^{-6}
3 - 7	faults and lineaments	0.005	0.05	0.50	3.6×10^{-5}

The most significant change was the hydraulic conductivity of the granodiorite layers that increased from 3.8 x 10^{-5} m/day adopted in the AGE (2010) model to 1 x 10^{-4} m/day. The hydraulic conductivity of the alluvium, regolith and faults remained in a similar range to that determined by AGE (2010).

AGE (2010) could not calibrate the storage parameters (specific yield and specific storage) as there was very limited transient data available at this time. The transient calibration using the baseline water level data reduced the specific yield values from around 5% adopted by AGE (2010) to between 0.5% and 0.6%. The specific storage increased in the alluvium and regolith, and was similar in the granodiorite and faults compared to the previous model.

5.3.4 Hydraulic Heads

During calibration the recharge rate and hydraulic properties varied between realistic ranges until the best match between predicted and field measured water levels occurred. Figure 13 compares the model simulated and observed groundwater levels for both the steady state and transient calibrations. Appendix 1 includes the observed and predicted water level for each monitoring bore.

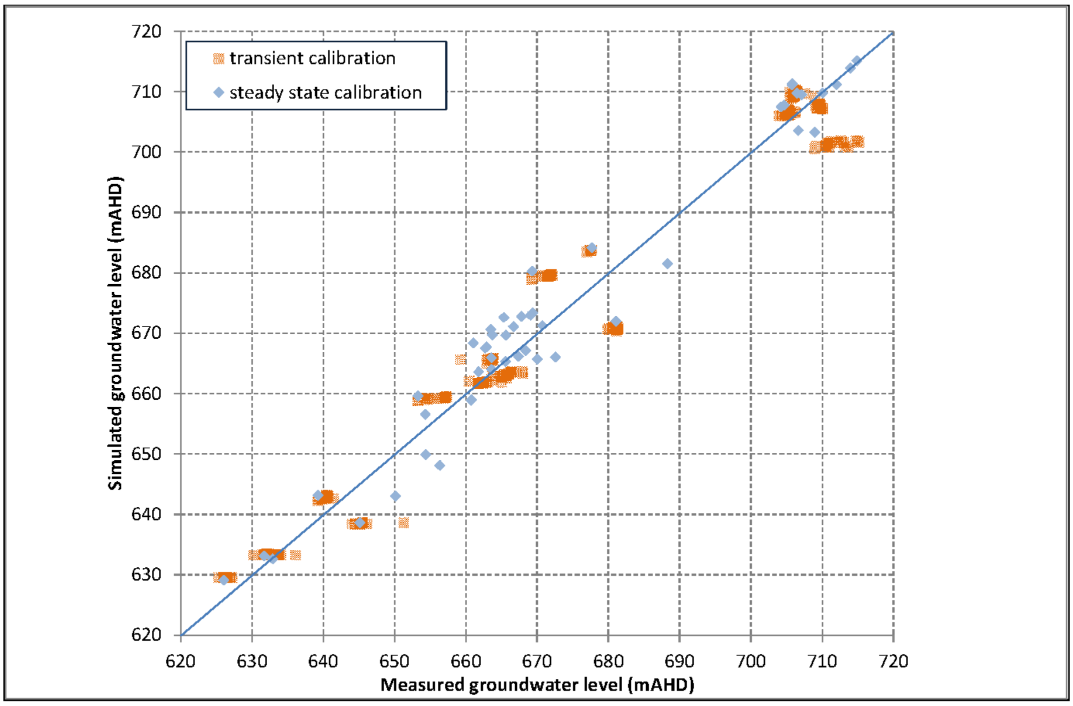
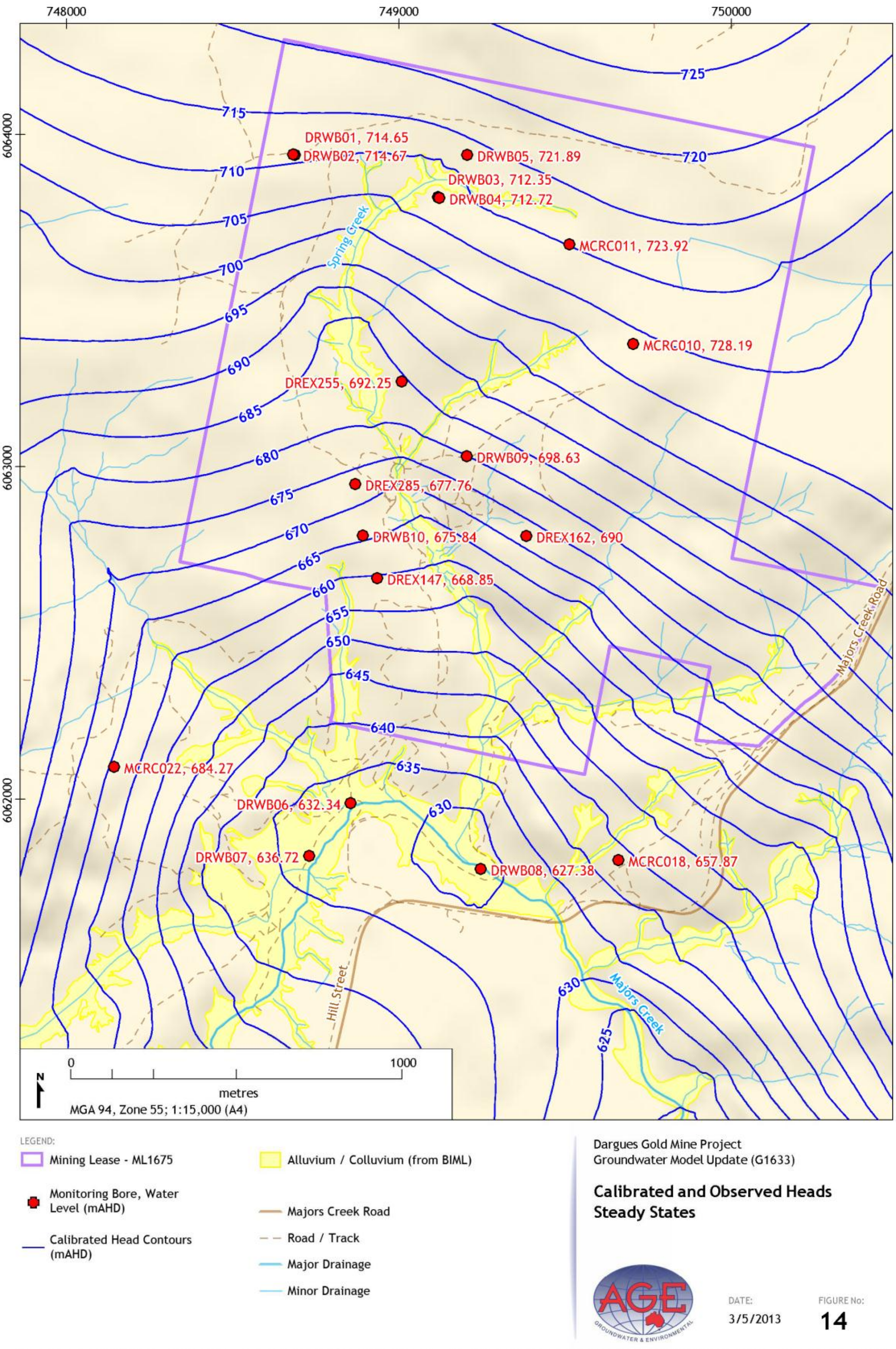


Figure 13: Calibrated and observed heads – scattergram

Figure 13 indicates that visually the model achieved a good correlation between observed and simulated heads. The scaled RMS for the modelled and observed water levels was 5.3%, which is relatively low for a fractured rock system and is considered an acceptable level of calibration (Barnet et al 2012).

Figure 14 compares the simulated water levels in the regolith layer and the measured groundwater levels in the observation network. Figure 14 indicates that the model simulates groundwater levels most accurately in proximity to Spring Creek and Majors Creek. In areas more remote from the creek system, the match between observed and simulated groundwater levels is more variable.

The observed and simulated hydraulic gradients and flow directions are very similar indicating the model replicates well the processes in the groundwater regime (refer Figure 7 and Figure 14).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665
660
655
650
645
640
635
630
625
DRWB01, 714.65
DRWB02, 714.67
DRWB05, 721.89
DRWB03, 712.35
DRWB04, 712.72
MCRC011, 723.92
MCRC010, 728.19
DREX255, 692.25
DRWB09, 698.63
DREX285, 677.76
DRWB10, 675.84
DREX162, 690
DREX147, 668.85
MCRC022, 684.27
DRWB06, 632.34
DRWB07, 636.72
DRWB08, 627.38
MCRC018, 657.87
Spring Creek
Majors Creek Road
Hill Street
Majors Creek
0
1000
metres
N
MGA 94, Zone 55; 1:15,000 (A4)
LEGEND:
Mining Lease - ML1675
Monitoring Bore, Water Level (mAHD)
Calibrated Head Contours (mAHD)
Alluvium / Colluvium (from BIML)
Majors Creek Road
Road / Track
Major Drainage
Minor Drainage
Dargues Gold Mine Project
Groundwater Model Update (G1633)
Calibrated and Observed Heads
Steady States
AGE
GROUNDWATER & ENVIRONMENTAL
DATE:
3/5/2013
FIGURE No:
14

5.3.1 Water Budget

Figure 15 presents the model water budget for the transient calibration period.

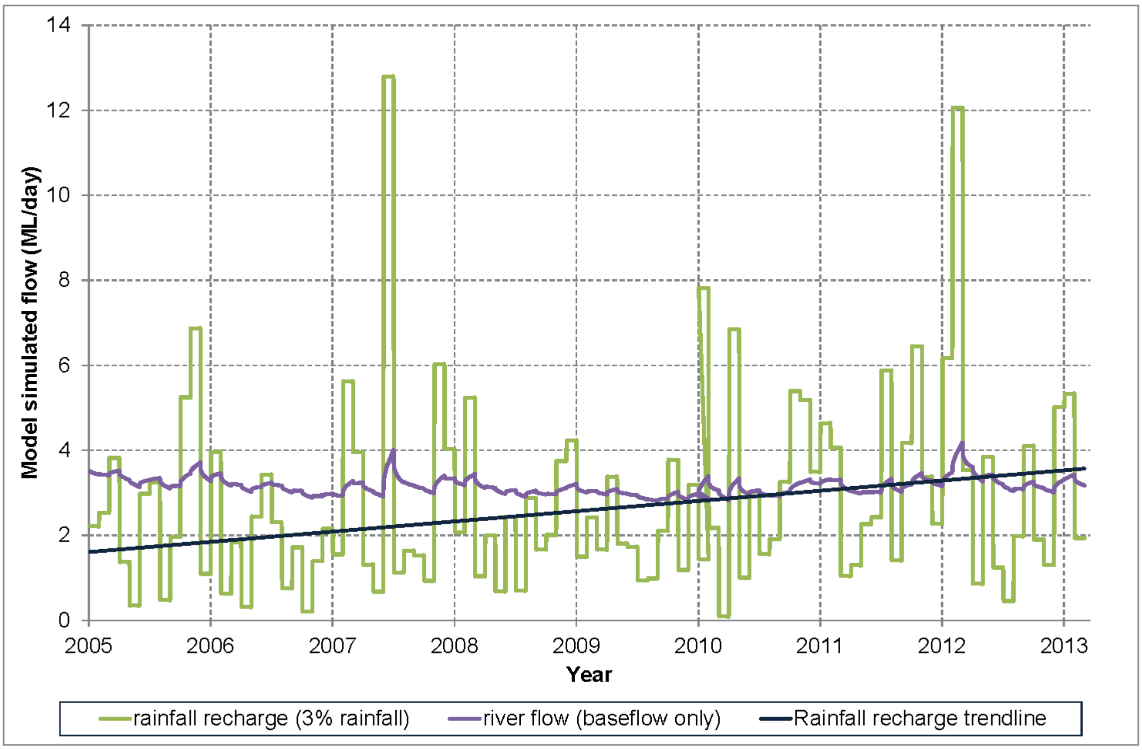


Figure 15: Water budget – transient calibration

Figure 15 indicates rainfall recharge typically varies between about 0.5 ML/day and 6 ML/day across the model domain, with peaks of about 12 ML/day during wet periods. The recharge rate increases over the calibration period due to above average rainfall recorded since 2010. Baseflow is the only discharge mechanism from the model that ranges between 2.9 ML/day and 3.3 ML/day. Figure 15 shows peaks in river baseflow up to 4 ML/day occur following significant rainfall and recharge events.

The discrepancy in the model transient water budget was less than 0.5% indicating an accurate numerical solution, and within limits recommended by Barnet et al (2012).

6.0 PREDICTIVE SIMULATIONS

6.1 Assumptions

An updated mine plan provided by Unity Mining was used to represent the progress of mining in the groundwater model. Seepage of groundwater to the mine was represented using the SURFACT Drain package. Drain cells were set across the mining and decline footprint, and gradually advanced deeper with time according to the mining schedule. AGE (2010) included drains in the regolith layers, however as no mining, (only the sealed portal excavation) will be present in this zone the drains in the updated model were limited to layers 4 to 7. Figure 16 shows the mine plan in three dimensions.

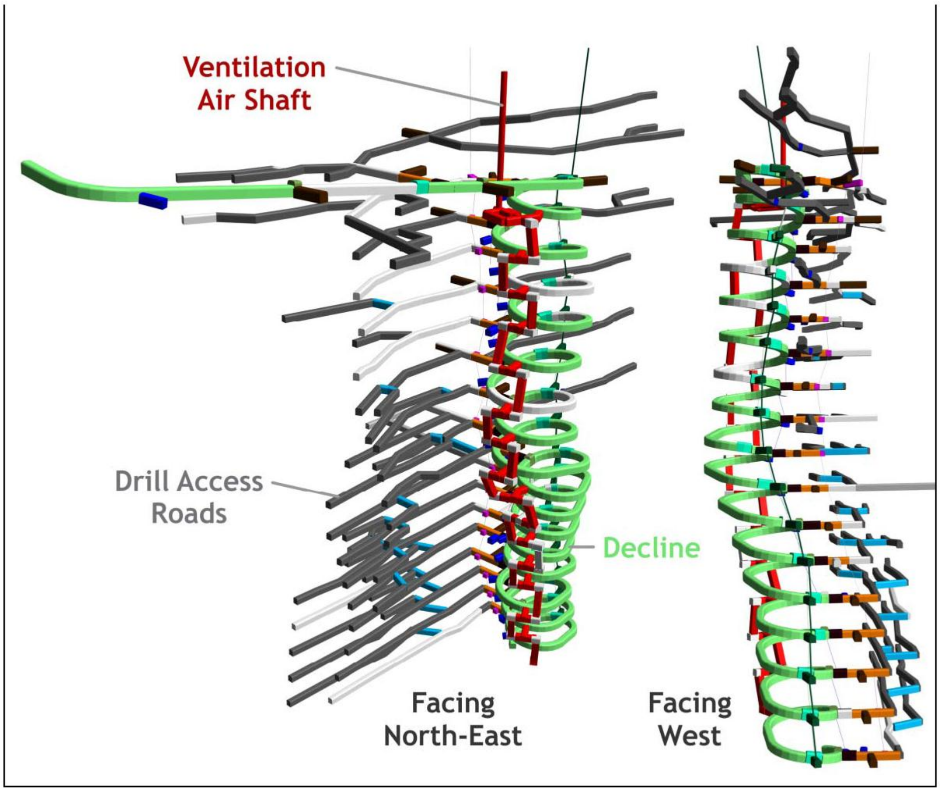


Figure 16: 3D view of mining

Rainfall recharge during the mining period was assumed to be 3% of the average monthly rainfall observed during the calibration period. This rainfall recharge rate therefore has a seasonal cycle, which is reflected in the fluctuating water levels presented in the predictions below. In addition, it assumes that mining will be undertaken during a period when rainfall is less than has been observed during the 2010 to 2013 baseline monitoring period. This has important implications as it is likely if rainfall returns to average then groundwater levels will fall in response to this as well as mining. Therefore, identifying and separating the impact of climate from mining induced impacts on groundwater levels will be important.

6.2 Inflow to Dargues Gold Mine

Figure 17 shows the model predicted fluxes of water into the mine workings and decline.

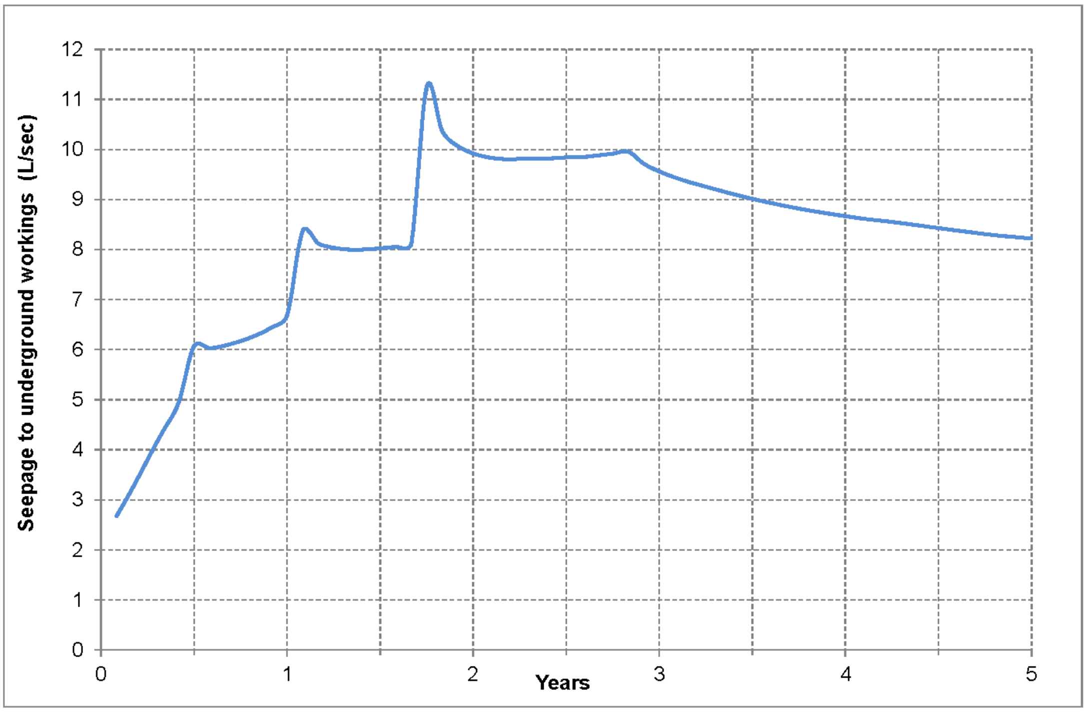


Figure 17: Predicted inflow to mine

AGE (2010) predicted groundwater inflows would be highest during the first two years of mining at between 9 L/sec and 10 L/sec, then gradually reduce after the decline had reached full depth, and hydraulic gradients gradually reduce. The updated model predicts a similar pattern of inflows with a slightly higher peak at 11 L/sec, which then slowly reduces after the decline reaches the target depth to 8 L/sec at the end of mining.

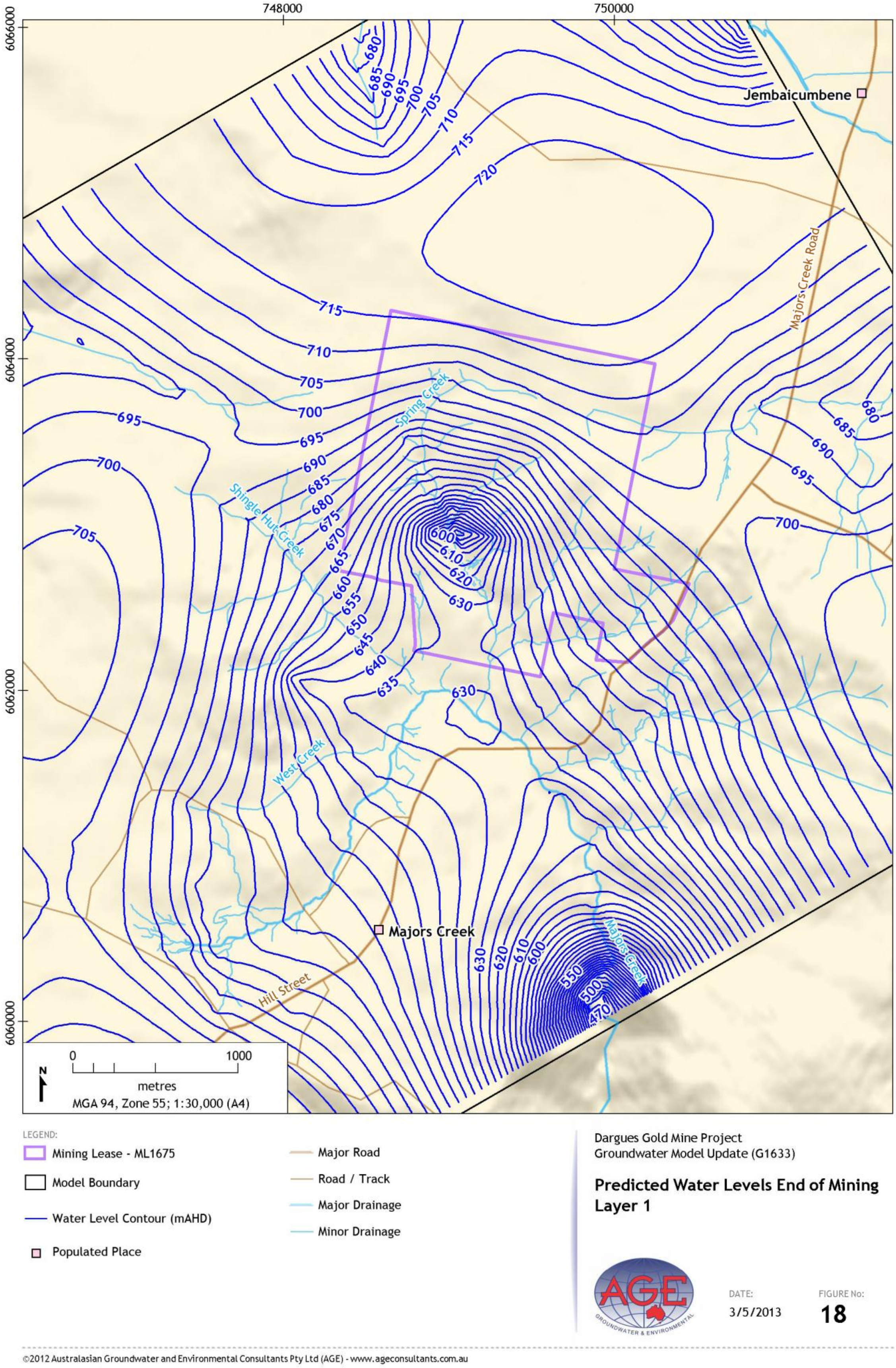
6.3 Groundwater Level and User Impacts

Figure 18 shows the groundwater levels at the end of the five years of mining in the regolith layer. The depressurised zone is evident centred on the mine workings and the abandoned workings that are pumped to simulate a water supply for the mine.

Figure 19 shows the simulated drawdown in groundwater levels in the regolith layer at the end of mining. The 1 m drawdown contour simulated by AGE (2010) is also presented to allow the original and recalibrated model to be compared. Figure 19 indicates the zone of drawdown is slightly less extensive than predicted by AGE (2010). This is due to the changes to the aquifer parameters and the representation of the mining in the recalibrated model.

Figure 20 shows the simulated drawdown in the granodiorite (layer 5) also at the end of mining. The zone of depressurisation is less extensive in the low permeability granodiorite compared with the overlying regolith. Again, the drawdown is centred on the mine workings and the abandoned workings that may be used as a water supply if required. The zone of depressurisation extends out along fault zones and lineaments and creates the irregular shape evident in Figure 20.

The less extensive zone of depressurisation compared to the 2010 predictions means there are no known private bores impacted by the predicted drawdown.


748000
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Jembaicumbene
Majors Creek Road
Spring Creek
Shingle Hut Creek
West Creek
Majors Creek
Hill Street
680
685
690
695
700
705
710
715
720
670
665
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655
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640
635
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620
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600
550
500
470
0
1000
metres
N
MGA 94, Zone 55; 1:30,000 (A4)
LEGEND:
Mining Lease - ML1675
Model Boundary
Water Level Contour (mAHD)
Populated Place
Major Road
Road / Track
Major Drainage
Minor Drainage
Dargues Gold Mine Project
Groundwater Model Update (G1633)
Predicted Water Levels End of Mining
Layer 1
AGE
DATE:
3/5/2013
FIGURE No:
18
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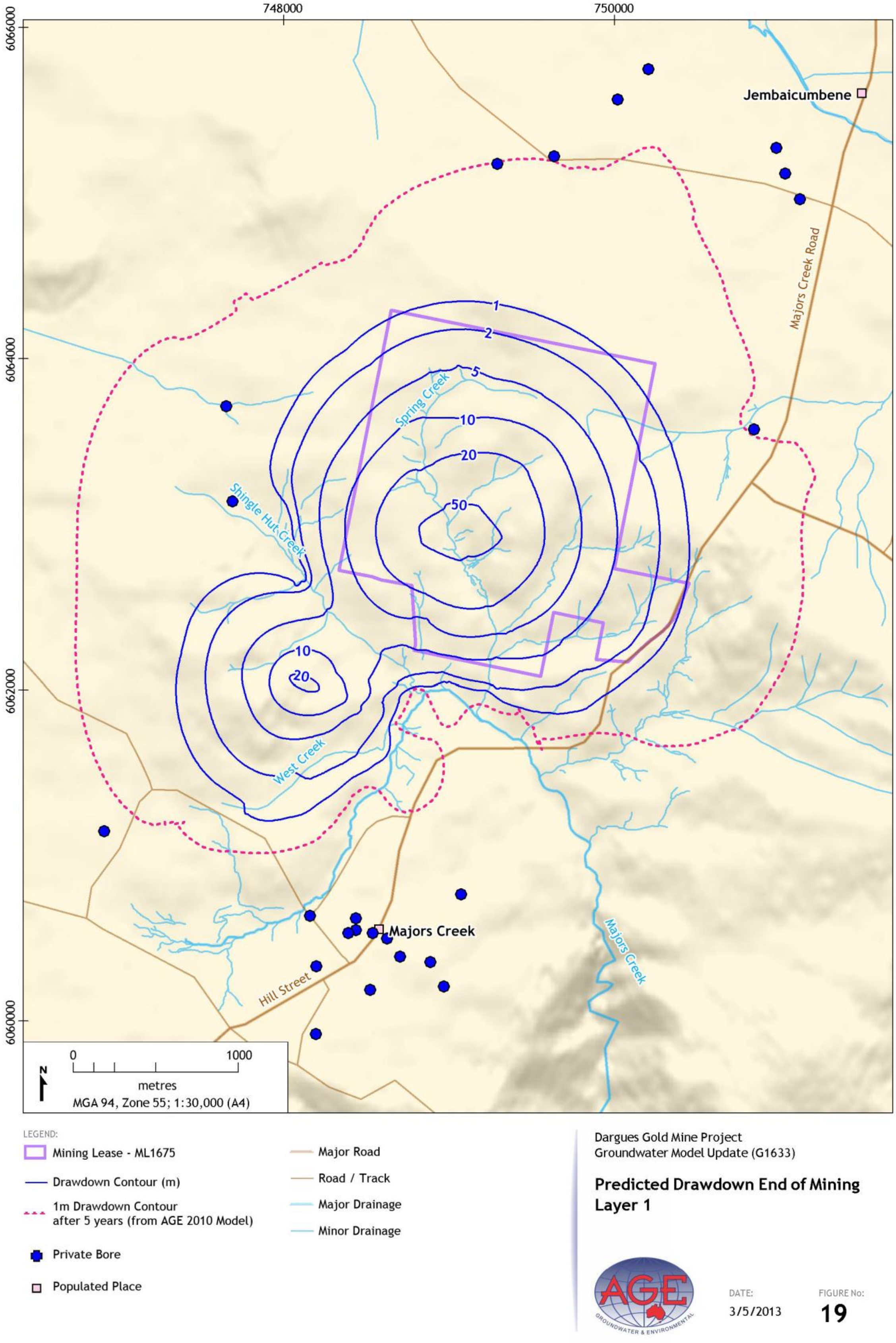
748000
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Jembaicumbene
Majors Creek Road
Spring Creek
Shingle Hut Creek
West Creek
Majors Creek
Hill Street
Majors Creek
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metres
MGA 94, Zone 55; 1:30,000 (A4)
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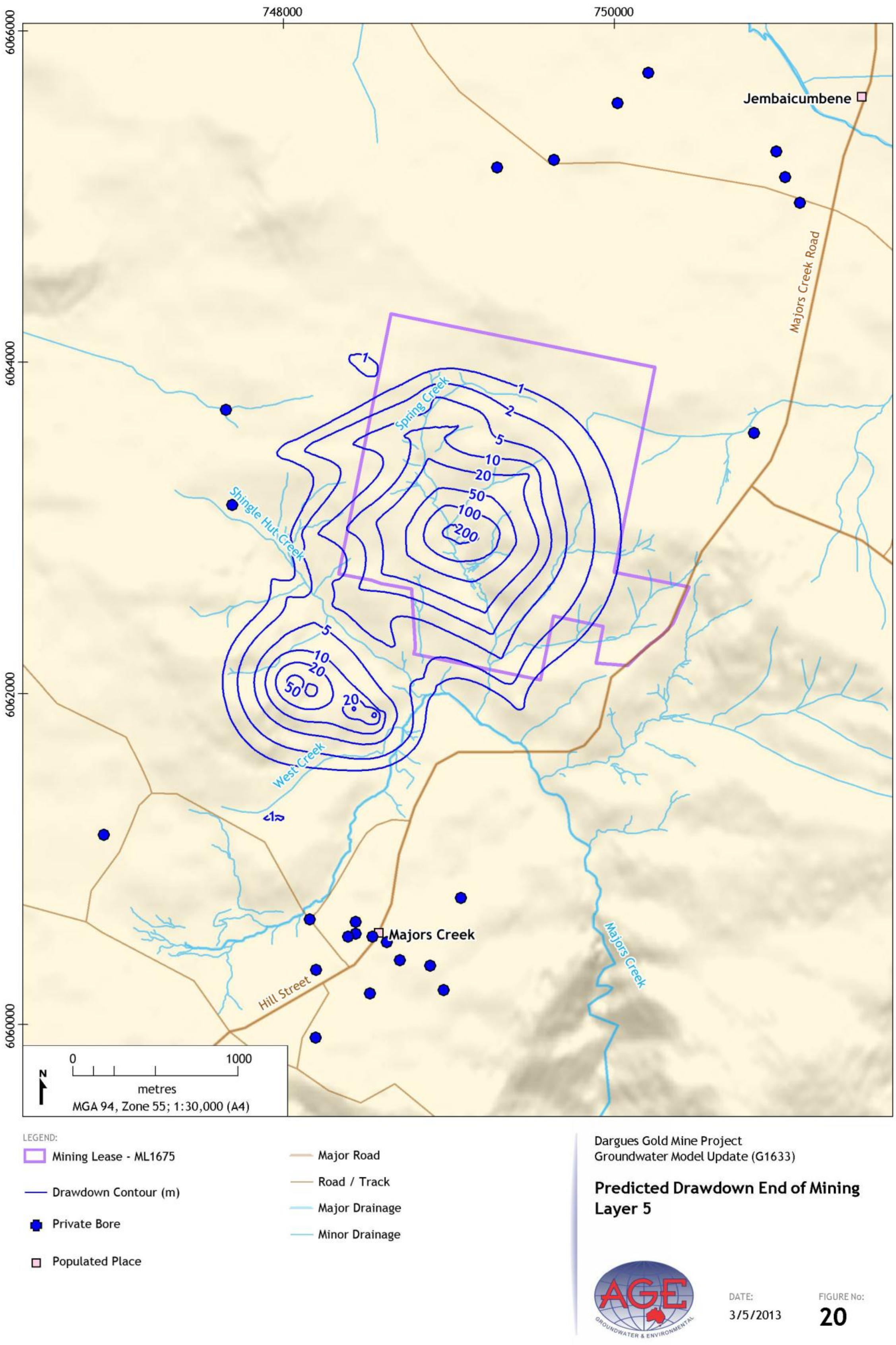
LEGEND:
Mining Lease - ML1675
Drawdown Contour (m)
1m Drawdown Contour after 5 years (from AGE 2010 Model)
Private Bore
Populated Place
Major Road
Road / Track
Major Drainage
Minor Drainage
Dargues Gold Mine Project
Groundwater Model Update (G1633)
Predicted Drawdown End of Mining
Layer 1
DATE:
3/5/2013
FIGURE No:
19


748000
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Jembaicumbene
Majors Creek Road
Spring Creek
Shingle Hut Creek
West Creek
Majors Creek
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MGA 94, Zone 55; 1:30,000 (A4)
LEGEND:
Mining Lease - ML1675
Drawdown Contour (m)
Private Bore
Populated Place
Major Road
Road / Track
Major Drainage
Minor Drainage
Dargues Gold Mine Project
Groundwater Model Update (G1633)
Predicted Drawdown End of Mining
Layer 5
AGE
GROUNDWATER & ENVIRONMENTAL
DATE:
3/5/2013
FIGURE No:
20

6.4 Surface Water Impacts

The model assessed the impact of mining on baseflow in creeks by running two scenarios, the first with no mining, and the second with the mining active. The impact of mining was then determined by comparing the difference between the two scenarios.

The model calculated baseflow in the following zones:

- upper catchment of Spring Creek upstream of the mine including the spring;
- lower catchment of Spring Creek downstream of the mine to the confluence of Majors Creek; and
- Majors Creek upstream of the confluence with Spring Creek.

Figure 21 to Figure 23 present the predicted baseflow for each zone with and without mining. The change in baseflow due to mining is also on the figures.

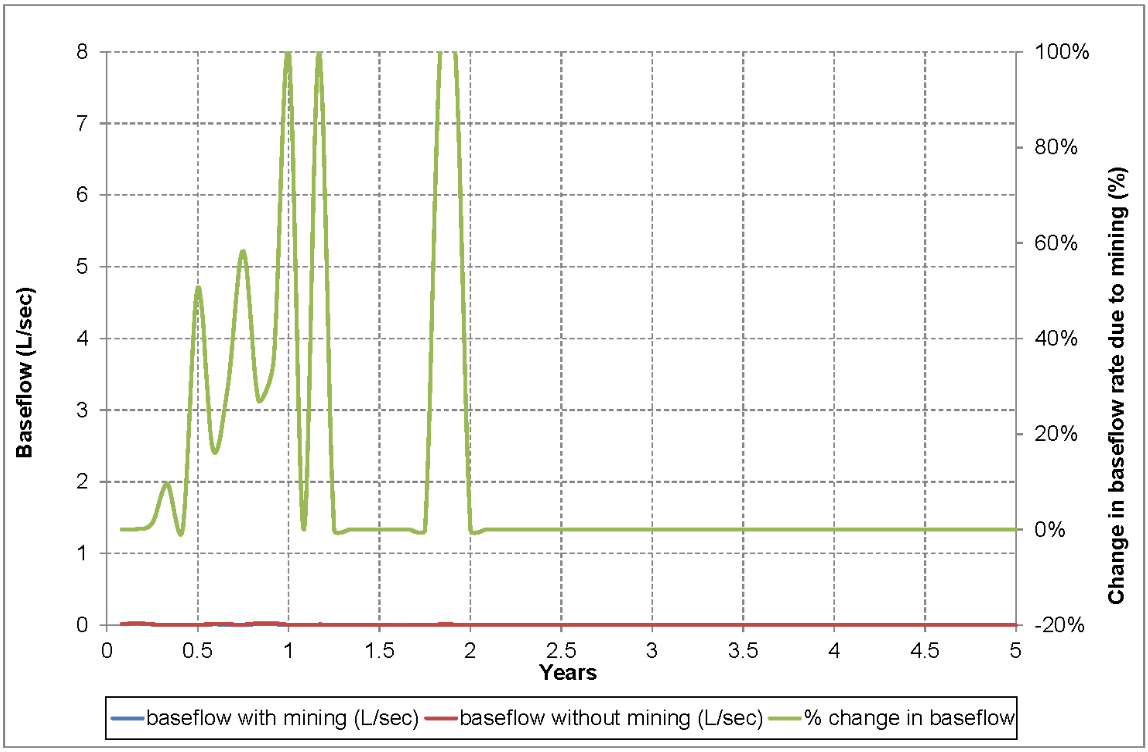


Figure 21: Predicted baseflow - upper Spring Creek

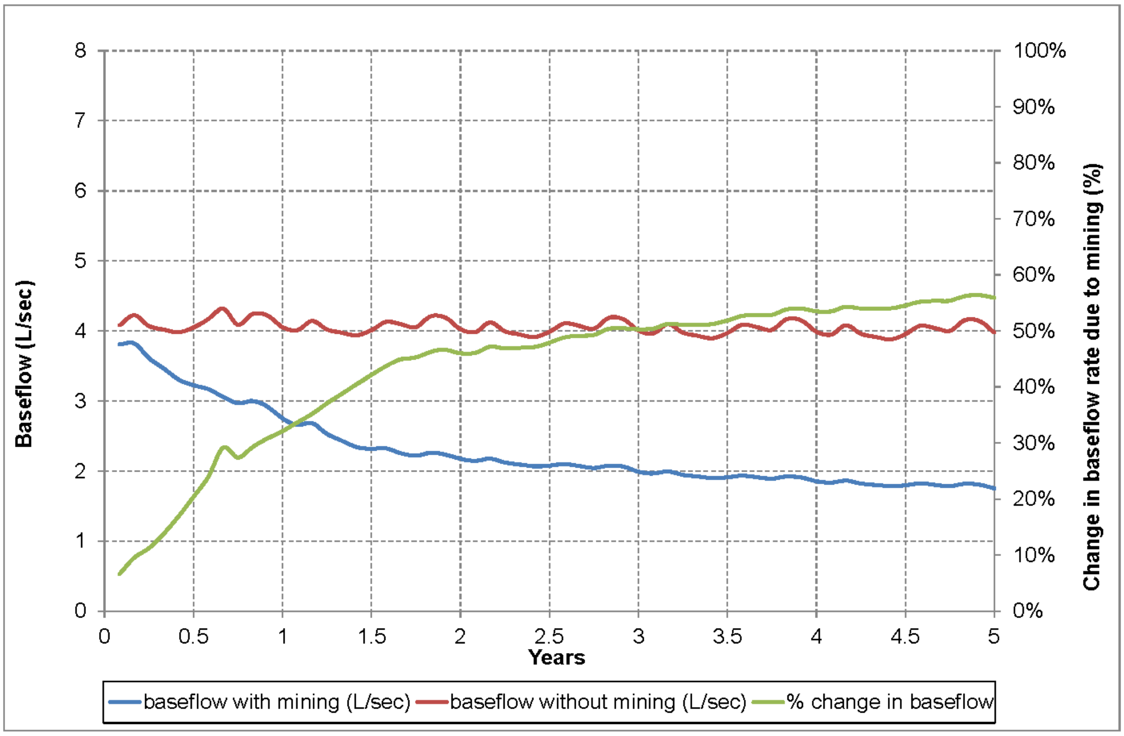


Figure 22: Predicted baseflow – lower Spring Creek

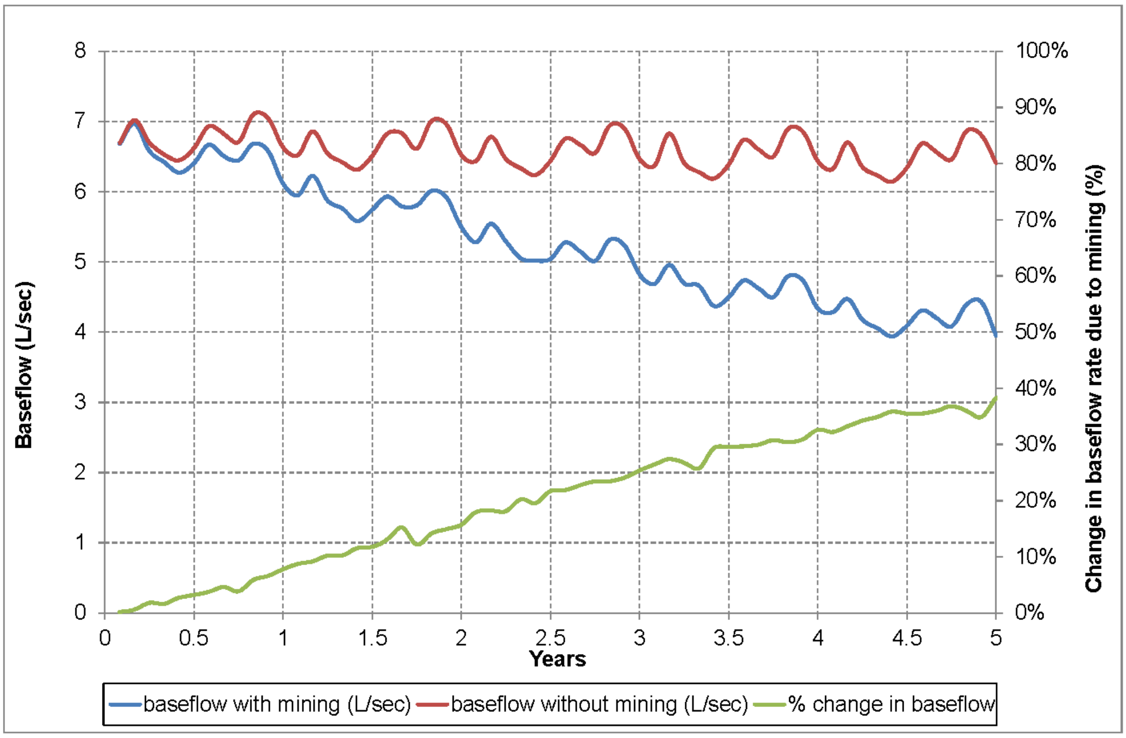


Figure 23: Predicted baseflow – Majors Creek

Figure 21 indicates the impact of the mining is most evident in the upper reaches of Spring Creek where the baseflow ceases due to mining. This is consistent with the previous findings of AGE (2010) that also concluded the spring may cease to flow. However, the recalibrated model also indicates that the baseflow in the upper catchment also ceases naturally in response to dry climatic conditions.

Figure 22 indicates that mining will reduce the baseflow in the lower catchment of Spring Creek by about 55% by the end of the five-year mining period, which is equivalent to a reduction of about 2 L/sec at the end of mining.

Figure 23 shows baseflow in Majors Creek reduced by up to 40% or 2.5 L/sec at the end of mining, predominantly due to the water extracted from the abandoned workings (Snobs, Stewert & Mertons, United Miners).

It is important to note that data on the baseflow rates in Spring Creek and Majors Creek is still very limited, and the model still has not been calibrated to baseflow data. Therefore, the predicted changes should be used as a guide, and further monitoring undertaken during the early years of mining. At this time, the magnitude of the impacts is likely to be very limited and the baseflow rates can be further defined.

6.5 Groundwater Recovery and Water Quality

6.5.1 Water Level Recovery

The model simulated the recovery of groundwater levels post mining by removing the drain cells representing mining after Year 5. The model assumed the paste fill has the same hydraulic properties as the granodiorite pre-mining. Figure 24 shows the predicted groundwater level recovery rate within the workings from the recalibrated model and from AGE (2010).

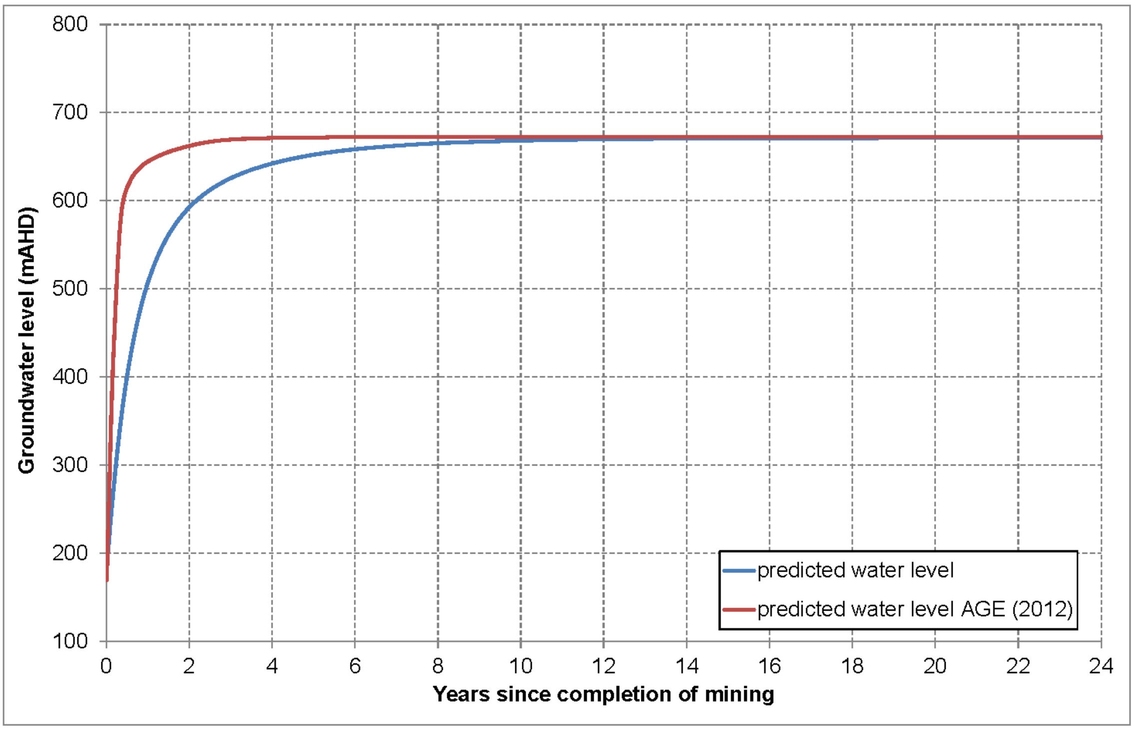


Figure 24: Groundwater level recovery post mining

The recalibrated model predicts the water level will fully recover within 10 years of the end of mining, similar to AGE (2010). The rate of recovery is initially slower in the recalibrated model as the mine is not directly connected to the regolith layer, which results in a lower rate of drainage to the abandoned workings. The recovery rate also varies because the model parameters were changed during the transient calibration and are therefore different to AGE (2010). Groundwater recovers to 670 mAHD, which is well below the ground level at the portal and therefore water will not spill from the workings.

6.5.1 Post Mining Flow and Water Quality

Post mining groundwater will continue to move through the paste fill in the abandoned mine workings and ultimately discharge to the creek systems as baseflow. The model was used to better understand the volume of groundwater water that will interact with the paste fill and then discharge to the creeks systems. The modelled water budget post mining was used to extract groundwater flows in and out of the abandoned workings.

Immediately after mining ceases there is a net inflow of groundwater into the abandoned workings of 3 L/sec. The net inflow to the abandoned mine drops rapidly as water levels rebound, and reduces to 0.25 L/s one year after closure. After 50 years, the inflow and outflow stabilise at a predicted flux of 0.03 L/s through the paste fill. This means that 0.03 L/sec of groundwater that flows through the abandoned workings will eventually discharge to the creek systems.

As discussed previously the model also predicted baseflow to the creeks post mining. The total baseflow out of the model gradually increases post mining as the groundwater levels rise and the water table under the creeks rises higher than the creek water level. At the end of mining, the total predicted baseflow is around 30 L/s across the model domain. Given time (~ 50 years), the baseflow is predicted to recover back to the pre-mining levels at about 41 L/s.

The water budget indicates that water that interacts with the paste fill and abandoned workings will only be a very small portion (<0.1%) of the groundwater that reports to the creek systems as baseflow on the model scale. The abandoned mine is not expected to have any significant impact on water quality in the creek systems as:

- groundwater that interacts with the paste fill is likely to become slightly alkaline due to the cement binding, and therefore solubilisation of trace elements will not occur as acidic conditions are required for metals to remain in solution at high concentrations;
- as groundwater flows out of the abandoned workings it will gradually mix and be diluted by the surrounding groundwater; and
- within the creek systems there will be further dilution by fresh groundwater discharge and again by surface water runoff.

6.6 Sensitivity Analysis

Sensitivity analysis evaluates the effects of model parameters on model results and the uncertainty in the parameter estimates. The sensitivity of simulated water levels to model parameters was assessed using relative composite sensitivity (RCS) method developed by Watermark Numerical Computing, 2008[2]:

The composite sensitivity values were calculated during the calibration process for the steady-state model and were converted to RCS as shown in Figure 25.

[2] Watermark Numerical Computing, (2008), *"PEST – Model-Independent Parameter Estimation; User Manual"*.

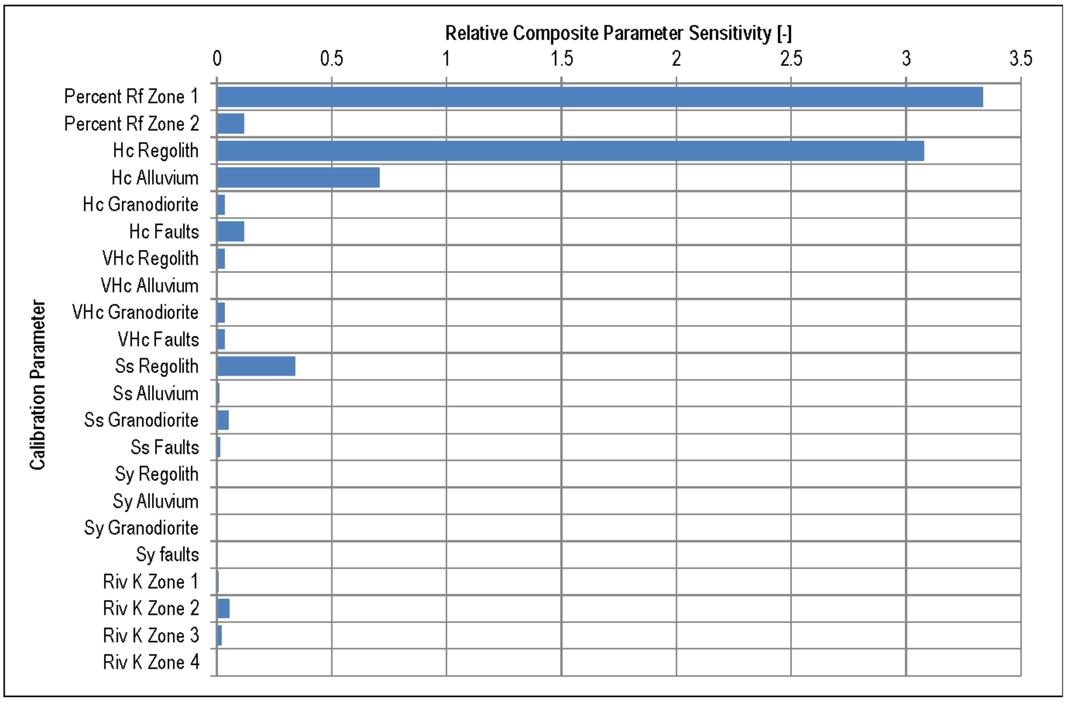


Figure 25: Relative composite sensitivity for parameters from the calibration

RCS is a dimensionless statistic and is a measure of the composite changes in model outputs resulting from a change in the value of the parameter. RCS determines whether the model calibration is sensitive to an input parameter, for example such as hydraulic conductivity or recharge. RCS assesses the relative sensitivity of model parameters given the set of observations used in the model.

Where parameters have a low RCS, the model calibration is less sensitive to these parameters. The key sensitive parameters above are easily identifiable as rainfall recharge and hydraulic conductivity of the regolith zone.

Parameters in the model that were insensitive to the model calibration, but may have impacts on the model predictions were selected for the broader sensitivity analysis, and are listed below in Table 5.2. An upper and lower bound was simulated for each parameter. The parameter type was factored up or down and re-run through the steady state, historical transient, predictive mining, and recovery models.

Table 5.2: PARAMETERS AND VALUES FOR SENSITIVITY ANALYSIS

Parameter	Parameter Value		
	Baseline	Increase (x5)	Decrease (÷5)
Fault Hc	5.0000E-03	2.5000E-02	1.0000E-03
Fault Ss	3.6368E-05	1.8184E-04	7.2736E-06
Fault Sy	5.0000E-03	2.5000E-02	1.0000E-03
Granodiorite Hc	1.0000E-04	5.0000E-04	2.0000E-05
Granodiorite Ss	9.0877E-06	4.5438E-05	1.8175E-06
Granodiorite Sy	5.0000E-03	2.5000E-02	1.0000E-03

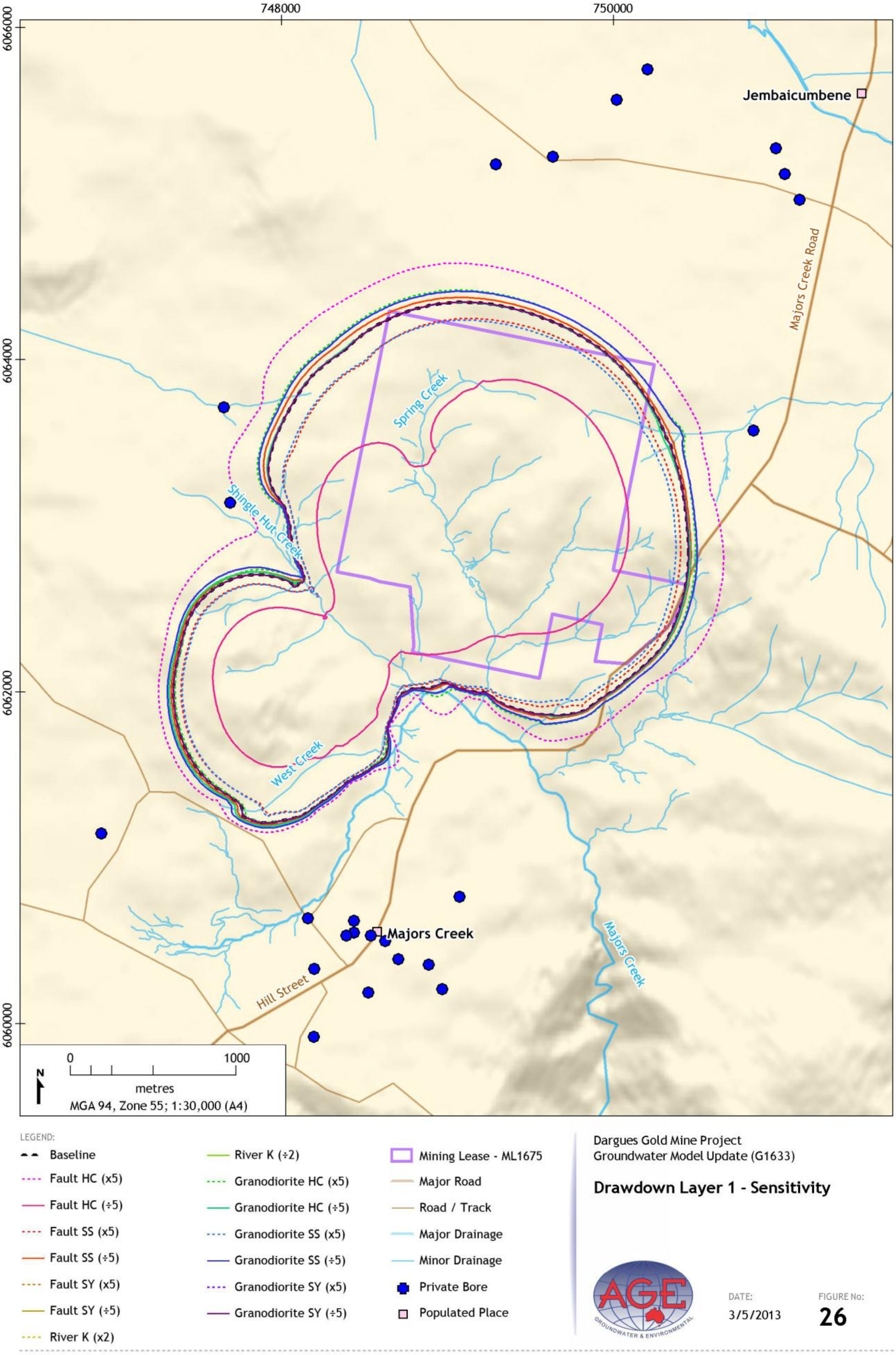
Table 5.2: PARAMETERS AND VALUES FOR SENSITIVITY ANALYSIS			
Parameter	**Parameter Value**		
	Baseline	**Increase (x5)**	**Decrease (÷5)**
		Increase (x2)	**Decrease (÷2)**
River K Zone1	6.146	12.292	3.073
River K Zone2	30.000	60.000	15.000
River K Zone3	3.254	6.507	1.627
River K Zone4	3.875	7.749	1.937

Table 5.3 presents the model calibration statistics for each of the above changes.

Table 5.3: SENSITIVITY ANALYSIS CALIBRATION STATISTICS						
Sensitivity Run	**Steady State**			**Transient**		
	ssq	**rms**	**srms**	**ssq**	**rms**	**srms**
	[m2]	**[m]**	**[%]**	**[m2]**	**[m]**	**[%]**
Baseline	1095.667	4.7777	5.3809	7340.632	4.70926	5.24358
Fault HC (x5)	1232.312	5.06687	5.70658	8171.05	4.9685	5.53223
Fault HC (÷5)	1086.626	4.75795	5.35865	7275.141	4.68821	5.22014
Fault SS (x5)	1095.667	4.7777	5.3809	7400.723	4.7285	5.265
Fault SS (÷5)	1095.667	4.7777	5.3809	7322.414	4.70341	5.23707
Fault SY (x5)	1095.667	4.7777	5.3809	7340.632	4.70926	5.24358
Fault SY (÷5)	1095.667	4.7777	5.3809	7340.634	4.70926	5.24358
River K (x2)	1095.351	4.77701	5.38012	7340.325	4.70916	5.24347
River K (÷2)	1096.35	4.77919	5.38257	7341.06	4.7094	5.24373
Granodiorite HC (x5)	1110.478	4.80988	5.41714	7893	4.88323	5.43729
Granodiorite HC (÷5)	1100.453	4.78812	5.39264	7301.264	4.69662	5.2295
Granodiorite SS (x5)	1095.667	4.7777	5.3809	7272.229	4.68727	5.21909
Granodiorite SS (÷5)	1095.667	4.7777	5.3809	7375.671	4.72049	5.25608
Granodiorite SY (x5)	1095.667	4.7777	5.3809	7340.283	4.70915	5.24346
Granodiorite SY (÷5)	1095.667	4.7777	5.3809	7340.741	4.7093	5.24362

Table 5.3 indicates there is generally very little change in the calibration statistics for each of the parameter changes. This is expected as these parameters were chosen due to their insensitivity during the calibration process. For each of the scenarios, the key model predictions were analysed and compared to the baseline predictions.

Figure 26 shows the extent of the predicted drawdown (1m contour) for all the sensitivity simulations. Varying the fault hydraulic conductivity (both increase and decrease) results in the most significant changes to the extent of the drawdown.


748000
750000
6066000
6064000
6062000
6060000
Jembaicumbene
Majors Creek Road
Spring Creek
Shingle Hut Creek
West Creek
Majors Creek
Hill Street
Majors Creek
0
1000
metres
N
MGA 94, Zone 55; 1:30,000 (A4)
LEGEND:
Baseline
Fault HC (x5)
Fault HC (÷5)
Fault SS (x5)
Fault SS (÷5)
Fault SY (x5)
Fault SY (÷5)
River K (x2)
River K (÷2)
Granodiorite HC (x5)
Granodiorite HC (÷5)
Granodiorite SS (x5)
Granodiorite SS (÷5)
Granodiorite SY (x5)
Granodiorite SY (÷5)
Mining Lease - ML1675
Major Road
Road / Track
Major Drainage
Minor Drainage
Private Bore
Populated Place
Dargues Gold Mine Project
Groundwater Model Update (G1633)
Drawdown Layer 1 - Sensitivity
DATE:
3/5/2013
FIGURE No:
26

Another key prediction of the groundwater model is the mine inflow. Figure 27 shows how the predicted mine inflow varies for all sensitivity scenarios.

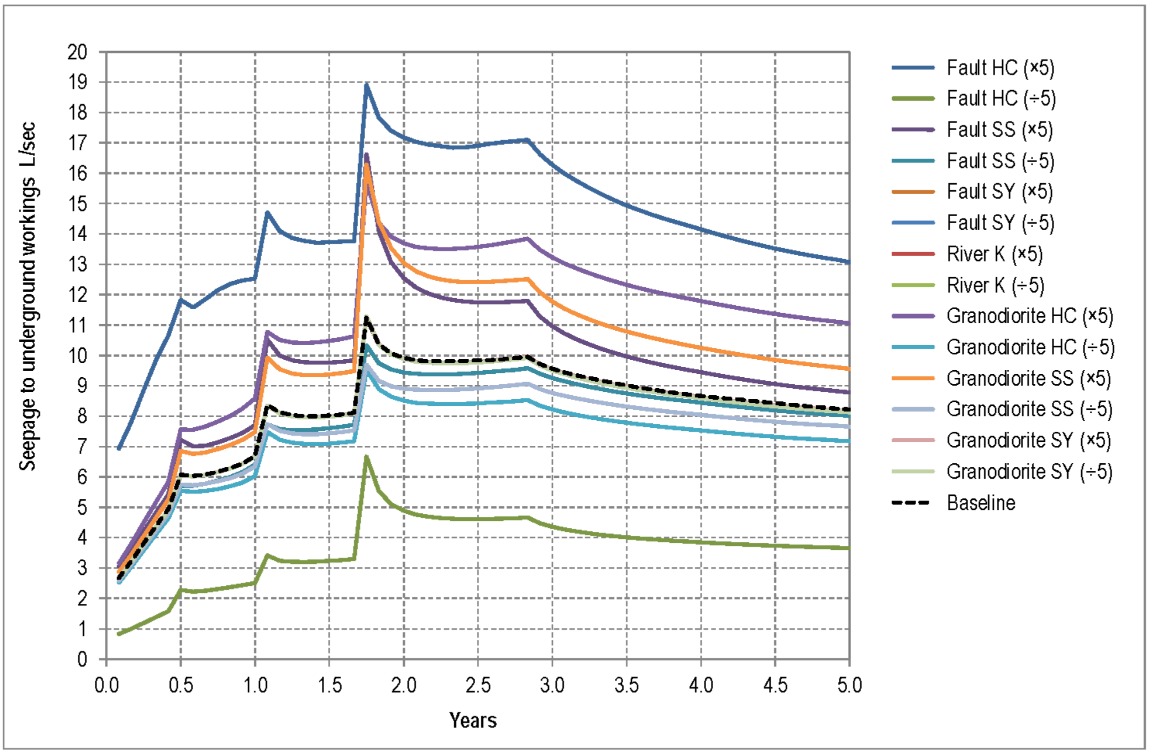


Figure 27: Sensitivity analysis – predicted mine inflow

Increases in all parameters (except for the river bed hydraulic conductivity) increase the predicted mine inflow rate, with the hydraulic conductivity and the specific storage of the faults/granodiorite the most sensitive. The hydraulic conductivity of the faults is the most sensitive generally doubling the baseline predicted mine inflow.

Figure 28 and Figure 29 show the sensitivity of the baseflow in Spring Creek and Majors Creek to varying the model parameters.