GeoTerra

CENTENNIAL TAHMOOR

LONGWALL PANELS 22, 23A and 23B SURFACE WATER, DAMS & GROUNDWATER END OF PANEL MONITORING REPORT

Tahmoor, NSW

TA5-R1

15 JANUARY, 2007

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TA5-R1 (15 JANUARY, 2007)

GeoTerra

Centennial Tahmoor
Remembrance Driveway
TAHMOOR NSW 2573

Attention: David Clarkson

David,

RE: Panels 23A and 23B End of Panel Monitoring Report

Please find enclosed a copy of the above mentioned report.

Yours faithfully

GeoTerra Pty Ltd

Andrew Dawkins (AuSIMM CP-Env)

Managing Geoscientist

Distribution:	Original	GeoTerra Pty Ltd
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Date:	15.01.2007

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1. INTRODUCTION

This document provides a summary of monitoring conducted in the Bargo River, Myrtle Creek, Redbank Creek, private dams, piezometers and domestic bores during the extraction of Longwalls 22, 23A and 23B.

Relevant features within the monitoring area, which encompasses surface water and groundwater features overlying the Panel 22 to 26, 20mm subsidence zone, as shown in **Drawing 1,** include;

- the main channel and tributaries of Myrtle Creek and Redbank Creek, which flow to the Nepean River,
- the main channel, gorge and tributaries of the Bargo River between Teatree Hollow and the outflow edge in the gorge defined by the Panel 26, 20mm subsidence zone,
- domestic and rural water storage dams overlying panels 22, 23A and 23B, and
- One well (Well 1), one piezometer (P1), two open coal exploration bores (P2 and P3) and three domestic bores (P4, P5 and P6) in the Tahmoor / Thirlmere area.

Panels 22, 23A and 23B are located underneath Tahmoor and Thirlmere villages as well as surrounding urban and semi-rural areas.

2. GENERAL DESCRIPTION

2.1 Mine Layout and Progression

Tahmoor Colliery has extracted coal by longwall mining Panels 1 to 23B in the Bulli Seam within the Tahmoor and Tahmoor North Lease Area.

Panels 22, 23A and 23B extraction dates are shown in **Table 1**.

TABLE 1 PREVIOUS AND PROPOSED MINING SCHEDULE

Longwall	START	FINISH
Longwall 22	7 June 2004	28 June 2005
Longwall 23A	12 September 2005	26 February 2006
Longwall 23B	20 March 2006	27 August 2006
Longwall 24B	11 September 2006	*April 2007*
Longwall 24A	*June 2007*	*October 2007*
Longwall 25	*November 2007*	*December 2008*
Longwall 26	*January 2009*	*January 2010*

Panels 22, 23A and 23B were mined from south to north, with a 300m long block of coal left between 23A and 23B due to poor ground conditions around an intrusive doleritic dyke.

Extraction of Panels 22, 23A and 23B occurred between 395m and 440m below surface, with the depth generally increasing to the northeast.

Seam thickness varied from 2.0m to 2.2m. The panels were 283m wide rib to rib, and were between 620m and 1860m long with 34.5m to 40m wide chain pillars.

2.2 Subsidence

The maximum monitored subsidence, tilt and strain following extraction of Panels 22, 23A and 23B have been observed over the middle of Panel 22, with the predicted and observed movements shown in **Table 2**.

TABLE 2 Maximum Post Panel 23B Subsidence (MSEC, 2006B)

Parameter	**PREDICTED**	**OBSERVED**
Vertical subsidence (mm)	815	750
Tilt (mm/m)	5.5	+5.2 to -9.8
Tensile Strain (mm/m)	0.8	2.2
Compressive Strain (mm/m)	-1.7	-4.4

Subsidence within Myrtle Creek has generated bedrock cracking in one location and soil cracks in the banks and flanks of a second location, even though the channel floor was not cracked, with the crack locations shown in **Drawing 2.**

It has been assessed that the additional tilts and strains above predicted levels after extraction of Panel 23B were due to the anomalous ground movement resulting from the effect of the remnant coal left between Panels 23A and 23B (MSEC, 2006).

Redbank Creek has not yet been undermined and has no observed subsidence tilt or strain to date.

2.2.1 Bargo River Gorge

Panels 22, 23A ad 23B are at least 1.2km from the Bargo River, with the closest point located between the southwestern corner of Panel 22 and the Main Southern Railway bridge over the Bargo River.

To date, no observed subsidence effects have been noted in the Bargo River up to the final extraction of Panel 23B.

The Bargo River gorge over Panels 12 and 13 has previously sustained up to 550mm of subsidence, 2mm/m of tensile and 3mm/m of compressive strain in the vicinity of the "potholes" area and Rockford Road Bridge (Rickard & Partners Pty Ltd 1994) where the gorge was directly undermined.

2.3 Land Use

The southern end of Panel 22 and over 23A is primarily used for residential development, whilst the northern end of Panel 22 and over 23B is primarily rural residential, with properties used for housing, vegetable production, poultry, wholesale nurseries, pet farms, horses, minor cattle grazing, shops and light industrial operations.

Remembrance Driveway and the Main Southern Railway lie off the southern end of the panels.

Water is obtained from both town water supply and farm dams.

2.4 Topography and Drainage

The study area is overlain by the main channel and tributaries of Myrtle Creek, which flows to the Nepean River, north of and outside the Panel 22 to 26 20mm subsidence zone. Myrtle Creek drains the residential area of Tahmoor, as well as semi rural fallow, orchard or grazing areas to the south of Thirlmere village.

The plateau is flat to undulating and incised by the Bargo River approximately 1.2km south of Longwall 22, with steep to vertical sandstone cliff faces and vegetated scree slopes, whilst the gorge and river bed comprise a series of exposed sandstone shelves interspersed with sandstone boulder fields, rock bars and pools.

2.4.1 Myrtle Creek

Myrtle Creek flows directly into the Nepean River approximately 3.4km north-east of Panel 23A. Its headwaters are located upstream of Panel 22 and the channel generally consists of small grass covered channels that become larger and more incised downstream of Panel 23.

The western headwaters of Myrtle Creek overlie subsided areas over Longwalls 3, 4, 20 and 22, whilst one of two channels overlies the unmined barrier between Panels 23A and 23B, with the second channel on the eastern edge of Panel 23B.

The riparian flanks have been significantly altered by residential development in Tahmoor, whilst the channel has not been significantly affected except where general rubbish or solid waste has been dumped in the creek or it is overgrown by invasive weeds.

2.4.2 Dams

Surface runoff into the Tahmoor / Thirlmere streams and subsequently into the Bargo or Nepean Rivers is regulated by 9 dams over Panels 22, 23A and 23B as shown in **Drawing 2**. The dams are constructed of earthen walls that collect and store surface runoff that would otherwise drain directly into Myrtle Creek.

2.5 Geology

The plateau and Bargo River bed is underlain by the fine to medium to coarse grained Hawkesbury Sandstone, with remnants of Wianamatta Shale in elevated areas north of Myrtle Creek where a thin soil profile has developed that is highly localised and variable across the area.

Finer grained siltstone and shale facies are likely to be present that would form vertical flow barriers under the plateau, whilst cavernous zones in the cliffs are associated with leaching of the sandstone's granular cement by groundwater seeps sourced from "perched" ephemeral aquifers.

The Hawkesbury Sandstone extends to approximately 175m below the plateau and 55m to 75m below the river bed, which in turn is underlain by the Narrabeen Group Newport and Garie Formation sandstones, which are underlain by the Bald Hill Claystone. The Claystone is a major barrier to vertical groundwater flow through the sequence and divides the groundwater systems above and below the Claystone.

The Bulgo Sandstone underlies the Bald Hill Claystone and is subsequently underlain by the interlayered claystone and sandstone horizons and the 3m thick Bulli Seam of the Illawarra Coal Measures.

Mapped and inferred geological structures in the study area include NW and NNW trending faults and a NW trending intrusive dyke with a subset of EW to ENE trending faults. The dyke which caused mining problems in Panel 22 and was avoided in a dilational zone between Panels 23A and 23B, has also been extrapolated into Panel 24 along the same southeastern strike. The dyke may also continue along strike into Panels 25 and 26.

Three additional dykes are exposed in the west scarp and bed of the Bargo River between Rock Bar V and Pool U as shown in **Photograph 1**. No seepage from the cliff walls has been observed directly associated with the dykes.

PHOTOGRAPH 1 Pool U Dyke Rock Bar V Dykes

The NNW trending Victoria Park Fault Zone lies within the surface projection of Panel 23B. The Nepean Fault and Bargo Fault Zones are approximately 2 kilometres east of the longwalls and are unlikely to influence subsidence profiles or groundwater flows over the monitored longwalls.

The more significant water flow zones in to the workings are likely to be from low angled fractures associated with bedding planes, however, no additional water inflows were encountered whilst mining the subject panels.

2.6 Hydrogeology

1 DNR registered well, 1 piezometer, 2 open coal bores and 3 private bores are located within the monitoring area as shown in **Drawing 1** and **Table 3**.

Groundwater has been obtained from sandstone aquifers with yields ranging from 0.2L/sec to 5.0L/sec between 18m and 138m below surface. DNR bore data indicates it is likely that significant aquifers are intersected below depths of approximately 18m to 60m, depending on whether the bore is drilled on top of a hill or in a valley.

Most of the bores have low to moderate salinity, acidic to circum-neutral pH and moderate to high iron levels.

None of the bores or wells over Panels 22 to 23B are currently used for groundwater supply.

TABLE 3 BORES, WELLS AND PIEZOMETERS

GW	Drilled	Depth (m)	SWL (m)	Aquifer	YIELD (L/s)	EC (mg/L)	pH	Purpose
SMP AREA								
P1 (GW pending)	2004	48	Fig 9	18 - 20	0.75	2650	5.30	monitoring
P2	-	150	Fig 9	-	-	2295	5.61	coal explor.
P3	-	100	Fig 9	-	-	850	6.13	coal explor.
P4 (GW67570)	1988	85	App A	-	0.22	8210	6.63	domestic
P5 (GW63525)	1954 / 1990	76 / 91	App A	60-66 & 70-91	1.0	3550	5.65	stck dom irrig
P6 (GW42788)	1976	148	App A	105 - 135	1.52	-	-	agriculture
Well 1	-	4	App A	-	-	365	7.05	domestic

Note: All bore water supply is from Hawkesbury Sandstone - no data available

3. FIELD INSPECTIONS, MONITORING AND LABORATORY ANALYSES

3.1 Bargo River

Numerous inspections, monitoring and sampling regimes have been conducted prior to and during extraction of Panels 22, 23A and 23B as detailed below.

It should be noted that the Bargo River gorge has not been undermined or affected by any subsidence due to extraction of Panels 22, 23A or 23B.

3.1.1 Geomorphology

Field surveys to date have identified rockbars and boulder fields that influence pool levels and river flow, with some pools notably drying up as inflow from the Teatree Hollow licensed discharge as well as natural catchment runoff reduces.

The river has dissected the Hawkesbury Sandstone plateau, forming scarps and discrete cliffs which are more developed and prevalent downstream of Rockford Road Bridge, near the southern ends of the proposed Panels 24A, 25 and 26.

Where the channel trends along the systematic joint direction, the cliff line is usually close to the channel, with the cliff usually formed in competent sandstone containing stratigraphically controlled cavernous zones and intermittent, ephemeral seeps.

Exposed bedrock and interspersed boulder fields are present in the base of the gorge and on the alluvial flanks, with minor development of sand banks and bars in the river bed.

The Bargo River gorge between Picton Weir to near the confluence with the Nepean River has been inspected, mapped and photographed by Centennial Tahmoor staff and various consultants (Geoterra, HCS, MSEC, PSM) over the last few years.

Following submission of the Panel 24 to 26 SMP Application, a comprehensive photographic survey of the Bargo River bed, slopes, cliffs and cliff tops, as well as all pools, rockbars and boulder fields was conducted within the Panel 24 to 26 20mm subsidence application area (MSEC, in prep). The results of the study are recorded on an interactive CD.

In addition, specific logging and photographing of;

- structural features, such as joints, bed forms such as boulder fields, washed out bedding planes or joints that currently affect the volume and nature of water flow, and
- iron rich groundwater seeps in the river bed

was conducted by Geoterra Pty Ltd in August / September 2006. The results of this survey are also stored on CD due to the large file size, with the records being incorporated into the overall, larger, survey records (MSEC, in prep).

3.1.2 Bargo River Subsidence Effects

No bedrock cracking or changes in river flow, pool depths or water quality have been observed in the Bargo River during extraction of Panels 22, 23A and 23B

3.1.3 Bargo River Flow

Flow in the Bargo River is derived from ephemeral unnamed first and second order gullies and larger streams as well as overflows from Picton Weir.

Teatree Hollow enters the Bargo River approximately 1km downstream of the railway bridge and maintains a continuous, albeit variable, flow in the river from Tahmoor Colliery's licensed discharge. Flows from Myrtle Creek do not enter the Bargo River, but discharge into the Nepean River approximately 4km along the stream channel to the east.

The majority of flow in the river is regulated by Picton Weir, which is upstream of Panel 19, outside the current study area. Flow from the weir varies depending on the frequency and intensity of rainfall, with flows between rain events typically less than 5 ML/day, and gradually reducing in response to reducing head pressure behind the weir. Overtopping has occurred on at least three occasions since early 2002, whilst the weir pond has been almost empty on a number of occasions during the last four years.

Due to Colliery discharges, river flow downstream of Teatree Hollow is currently continuous, except where natural sub-surface diversions occur through jointed / cross bedded or stratigraphically discontinuous rockbars. If the Colliery discharge did not occur, the river would potentially consist of disconnected pools after periods of extended dry weather.

Flow monitoring has been conducted in the river since June 2004 through a combination of regular and opportunistic manual flow gauging, v notch weir flows, pool depth monitoring and reference to static bolts between Picton Weir and downstream of the Panel 24 to 26 SMP application area (Geoterra, 2006).

Since monitoring was initiated, site names have either changed at the same location, or monitoring has switched from the use of pressure transducers to monthly measurement of water levels with reference to static bolts, whilst some sites are no longer monitored with others added in as the program developed.

The current suite of flow meter / water level transducer monitoring locations being conducted by HCS Pty Ltd are shown in **Table 4**, whilst pool depth measurements with reference to static bolts are described under separate cover (HCS, in prep).

The current bolt and logger / flow meter monitoring locations shown in **Drawing 4**.

Continuous daily flow monitoring was initiated at the downstream sites (Pools K, J, and H) on 31 January 2006, with the remaining, upstream sites starting on 2 May, 2006. Flow monitoring in Pool F has been hampered by the pool running dry at the initial logger site and other operational issues (HCS, 2006).

To date, flows upstream of Teatree Hollow range from 0.654ML/day to 5.939ML/day, whilst downstream of the mine's licensed discharge in Teatree Hollow, flows range from 2.02ML/day to 17.04ML/day as shown in **Figure 1**.

TABLE 4 Bargo River Flow Monitoring Locations

Site	Description	Parameter	Method
Upstm Teatree	Bargo River Upstream of Teatree Hollow inflow	Pool depth, flow	Flow meter / Logger
Downstream Teatree	Bargo River Downstream of Teatree Hollow	Pool depth, flow	Flow meter / Logger
Teatree Hollow	Tea Tree Hollow Discharge to Bargo River	Pool depth, flow	Flow meter / Logger
Rckfd Rd	Rockford Road Bridge	Pool depth, flow	Flow meter / Logger
Upstream Mermaid Pool	Upstream of Mermaid Pool	Pool depth, flow	Flow meter / Logger
Pool N	Was called “Pencil Falls”	Pool depth, flow	Flow meter / Logger
Pool K	Was called “Pool 12”	Pool depth, flow	Flow meter / Logger
Pool J	Was called “Pool 10”	Pool depth, flow	Flow meter / Logger
Pool H	Was called “Pool 8”	Pool depth, flow	Flow meter / Logger
Pool F	Was called “Pool 9”	Pool depth, flow	Flow meter / Logger

River flows upstream of Teatree Hollow are modulated by the lack of instantaneous release through Picton Weir, as the pool has been below the spill height during the monitoring period, with a relatively constant slow release through a broken gate valve in the dam wall.

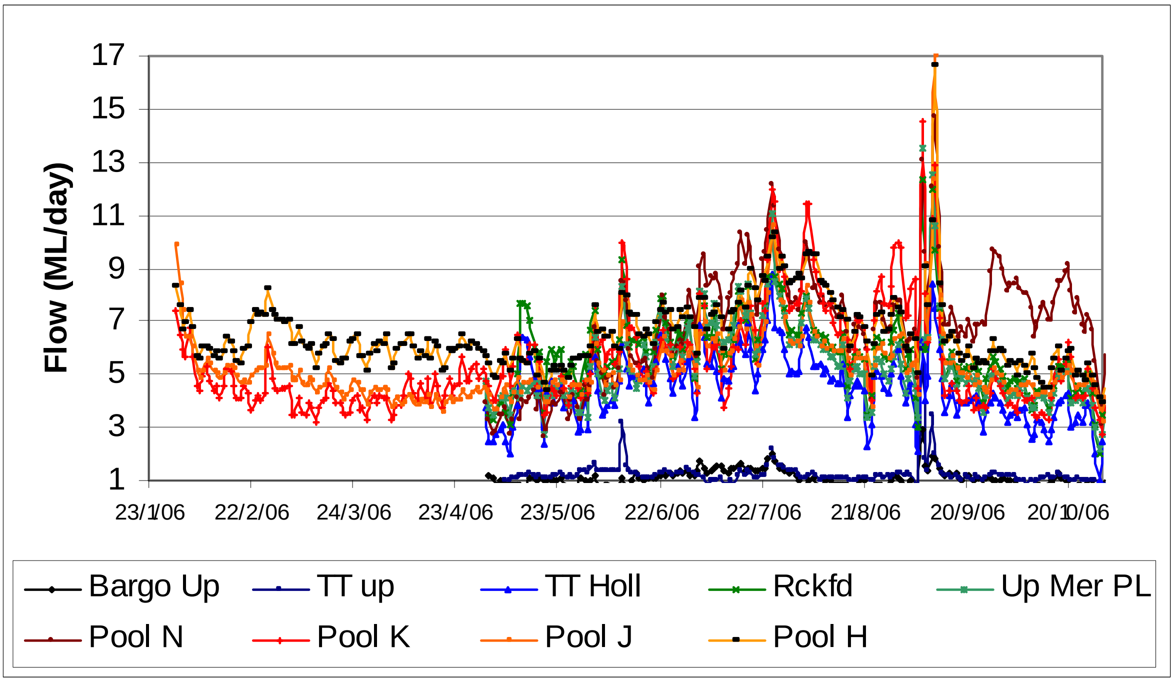
Flows downstream of Teatree Hollow are primarily affected by the quantum of daily release from the mine’s licensed discharge, as well as catchment runoff and groundwater seeps.

Maximum daily rainfall during the monitoring period has been below 33mm/day, and as a result, the majority of rain has soaked into the dry soil and / or evaporated with minimal runoff to the river due to the longstanding drought.

Variability in river flow downstream of Teatree Hollow, within the study area, is due to;

- Tea Tree Hollow discharge variability;
- Sub-surface diversion through washed out joints or bedding plane discontinuities;
- Flow through boulder fields
- Variable rate of groundwater seepage, and;
- Runoff after rain events.

Why does pencil falls exceed downstream sites in latter period?



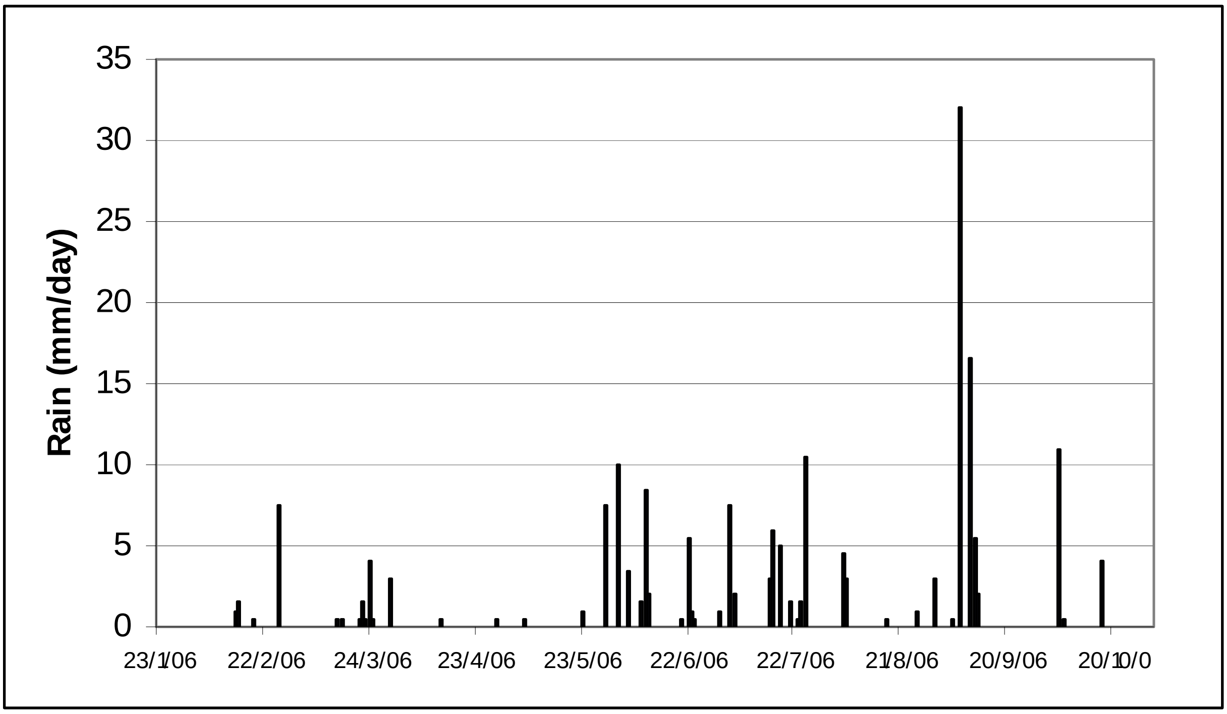


FIGURE 1 Bargo River Flow and Rainfall

3.1.4 Bargo River Flow Diversions

Field assessment has identified five locations with varying levels of flow diversion (MSEC, in prep) as shown in **Drawing 4**.

Diversions can comprise flow through boulder races or through joints and bedding discontinuities in rock bars at the downstream end of a pool.

The most notable diversion in the study area is between Pools H and F, through Rock Bar G, where all flow monitored to date passes through cross bedded laminae with a bedding discontinuity at the top and base of the cross set as shown in **Photograph 2.**

No overland flow has been observed over Rock Bar G during the monitoring period, where maximum daily flow reached up to 16.56ML/day in Pool H, indicating that more than at least 16.6ML/day of flow is required for Pool H to be full, with ongoing monitoring required to assess the pools "cease to flow" rate. (HCS TO CONFIRM)

PHOTOGRAPH 2 Rock Bar G Throughflow

3.1.5 Bargo River Ferruginous Seeps

Five pools within the study area were observed to contain ferruginous seeps as shown in **Drawing 4, Photographs 3 to 8** and **Table 5.** Seepage rates are all very low (<0.5L/sec), with the flows occurring as a "slow bleed" from joints and bedding discontinuities, and occur as thin sheet films of outflow water.

Mixing zones within the river pools are also very limited to less than 1m from the source discharge point, with discolouration of the river bank at the outflow point, although no discolouration or "plumes" within the main river or its substrate have been observed under current flow conditions.

TABLE 5 FERRUGINOUS SEEPS

Pool	No. of Seeps	Flow Rate
F	1	<0.5L/sec
I	1	<0.5L/sec
K	1	<0.5L/sec
V (East)	2	<0.5L/sec
V (West)	6	<0.5L/sec
W (South)	2	<0.5L/sec
W (West)	1	<0.5L/sec

Leaching of diffuse iron sulfide (marcasite), carbonate (siderite) and oxyhydroxides from the matrix cement and secondary deposits within the sandstone gorge walls precipitates where low flow seeps discharge into the river as orange-brown iron “seeps”. At the point of discharge, sulfuric acid is generated and dissolved, reduced species of iron, manganese, nickel and zinc, which usually exceed the ANZECC 95% protection of aquatic species trigger values, precipitate as a layer at the seepage point in the gorge wall and as stream bed substrate as a naturally occurring process.

The effect of the seepage is lowered through dilution with the river’s alkaline buffering capacity ($HCO3^-$ & OH^- species), with the increased acidity, dissolved metals and low dissolved oxygen in the river observed within 1m of the discharge point, with the extent depending on the proportional mixing between the river and seepage flow rates.

Downstream dilution of the discharge as well as precipitation of metallic hydroxides, adsorption of dissolved Ni and Zn onto iron hydroxide and binding / adsorption onto dissolved / total organic carbon significantly improves water quality downstream of the seepage point.

The river can also be affected by elevated salinity close to the discharge point, however this diminishes over a short distance downstream of the mixing zone.

To date, monitoring and laboratory analysis has not indicated any significant adverse effect on river water salinity, pH, discolouration or dissolved metals within any pool containing a ferruginous groundwater seep.

No changes to seep flow rate, seepage outflow points or water quality effects in the Bargo River have been observed during extraction of Panels 22, 23A and 23B.

PHOTOGRAPH 3 POOL F Seep

PHOTOGRAPH 4 POOL I Seep

PHOTOGRAPH 5 POOL K Seep

PHOTOGRAPH 6 POOL V Seep East

PHOTOGRAPH 7 POOL V Seep West

PHOTOGRAPH 8 POOL W Seep West

3.1.6 Bargo River Water Extraction

There are no registered surface water licences in the Bargo River between Rockford Road bridge and the confluence with the Nepean River according to Department of Natural Resources (DNR) records, with one licence located upstream of the Main Southern Railway Culvert near Olive Lane, however no details of the licence owner or quantity and frequency of use is available.

One pump not listed in current DNR records is located on the north bank of the Bargo near Teatree Hollow, however its pump rate and usage is not known.

3.1.7 Bargo River Water Quality

Water quality in the Bargo River is highly variable, and often exceeds the ANZECC 2000 (95% protection of aquatic species) trigger levels for pH, salinity, Ni, Zn, Se and Total P / N as shown in **Appendix A**, due to the very large variability of runoff in the catchment and the wide range of urban, agricultural and industrial pollutant sources in the river.

At present, the river water quality in the study area is primarily determined by the volume and quality of flow from the mine's licensed discharge into Teatree Hollow.

River flow within the study area in the gorge has been primarily due to the Teatree Hollow outflow during the drought affected study period, and it is likely that, without the discharge, the river downstream of Teatree Hollow could have intermittent flow periods after rain, with the river forming a series of disconnected pools behind rock bars during extended dry periods.

Water quality in the Bargo as shown in **Figures 2** to **4** changes significantly downstream of the confluence with Teatree Hollow by becoming more alkaline (pH 4 - 5 to pH 8 - 9) and more saline (EC 250µS/cm to 1250 - 2250µS/cm), although there is no notable change in river water oxidation / reduction potential or dissolved oxygen levels. Temperature readings indicate a slight rise of up to 4^{o}C downstream of Teatree Hollow with the current 6 months of monthly data.

Under the current dry flow conditions, with Teatree Hollow dominating the river flow, the river progresses from HCO3-Cl dominant immediately downstream of Bargo Weir, through Na-Cl dominant to the confluence with Teatree Hollow, after which it becomes Na-HCO3 dominant through the main Panel 22 to 26 study area, then slightly altering to Na-HCO3-CL dominant toward the confluence with the Nepean River.

Significant rises of up to 4mg/L for Total Nitrogen downstream of Teatree Hollow are also noted, whilst Total Phosphorous does not indicate a definitive rise due to inflow from Teatree Hollow.

Total Iron does not generally show a distinctive rise with Teatree Hollow inflow.

Filterable manganese essentially drops from around 1.2mg/L to just below the lower detection limit on mixing with Teatree Hollow discharge, primarily due to the change in pH from 4.4 – 6 (upstream) to 8.03-9.23 (downstream).

Filterable copper does not show a distinctive rise with inflow from Teatree Hollow and zinc has a small rise which tapers off with distance downstream in the river.

Filterable nickel shows a distinctive rise downstream of the Teatree Hollow inflow by up to 0.08mg/L, which does not notably taper off with flow downstream, whilst arsenic, with rises by up to 0.05mg/L tapers off with flow downstream of the mine discharge.

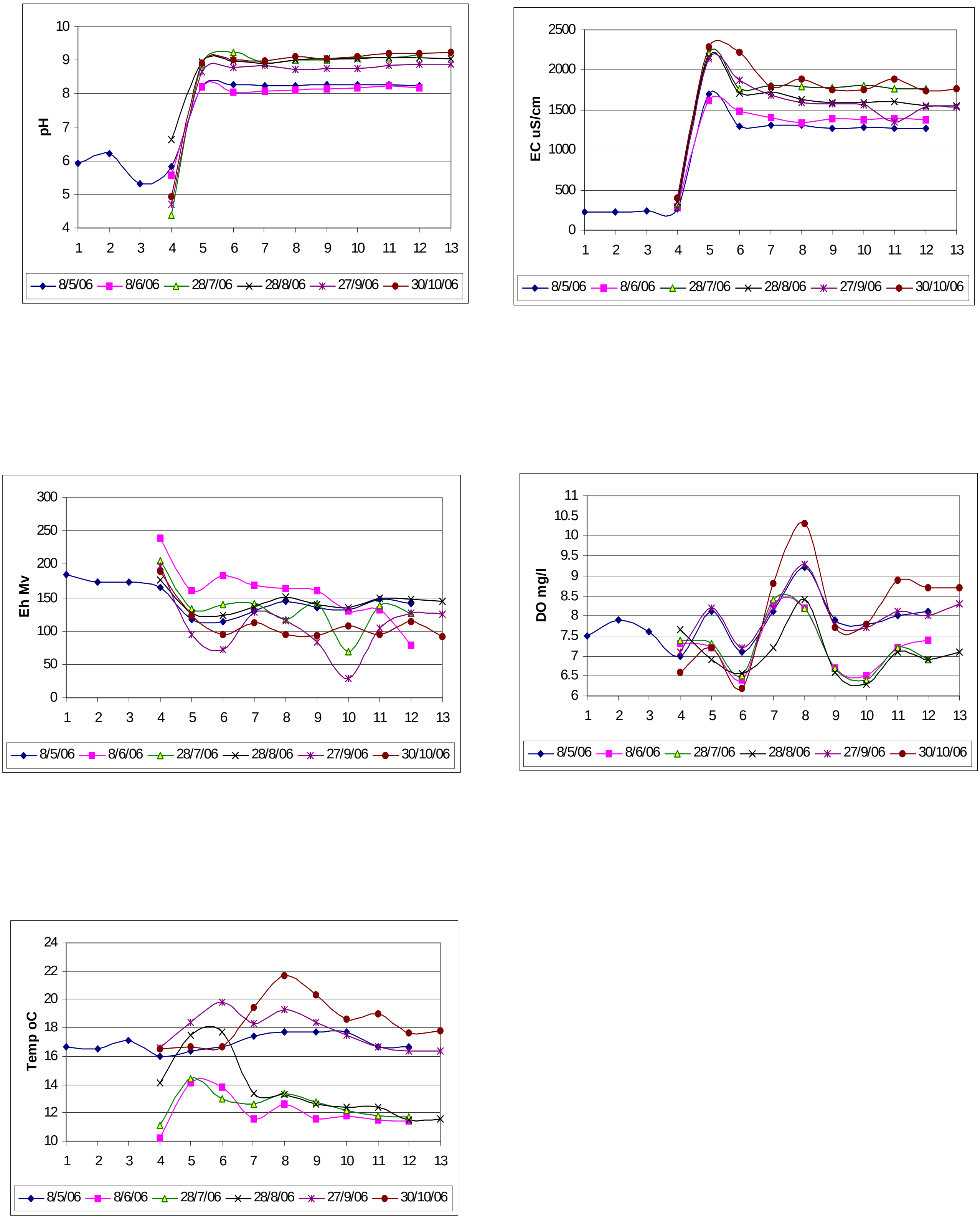


FIGURE 2 BARGO RIVER FIELD WATER QUALITY

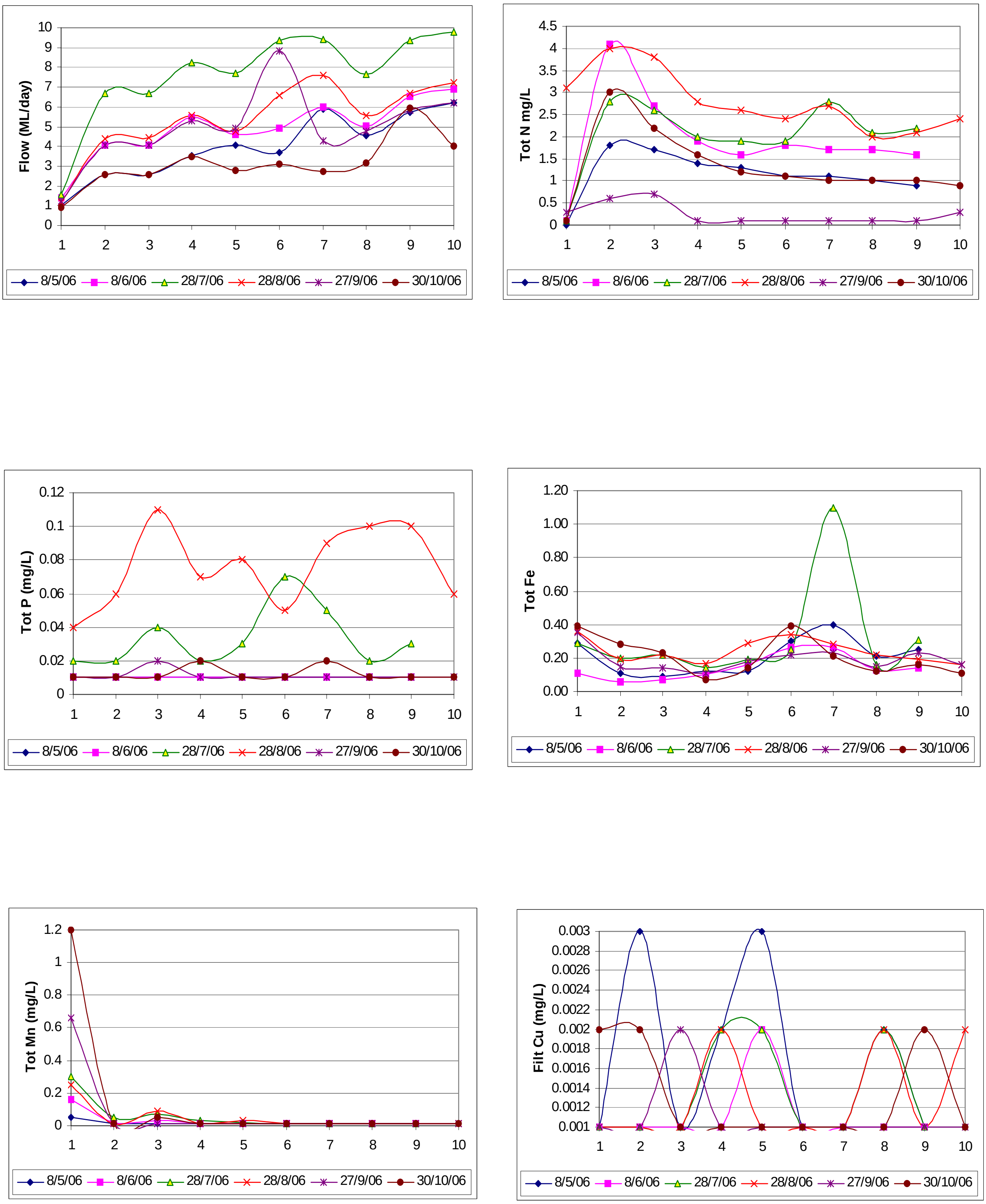


FIGURE 3 BARGO RIVER WATER QUALITY ANALYSES

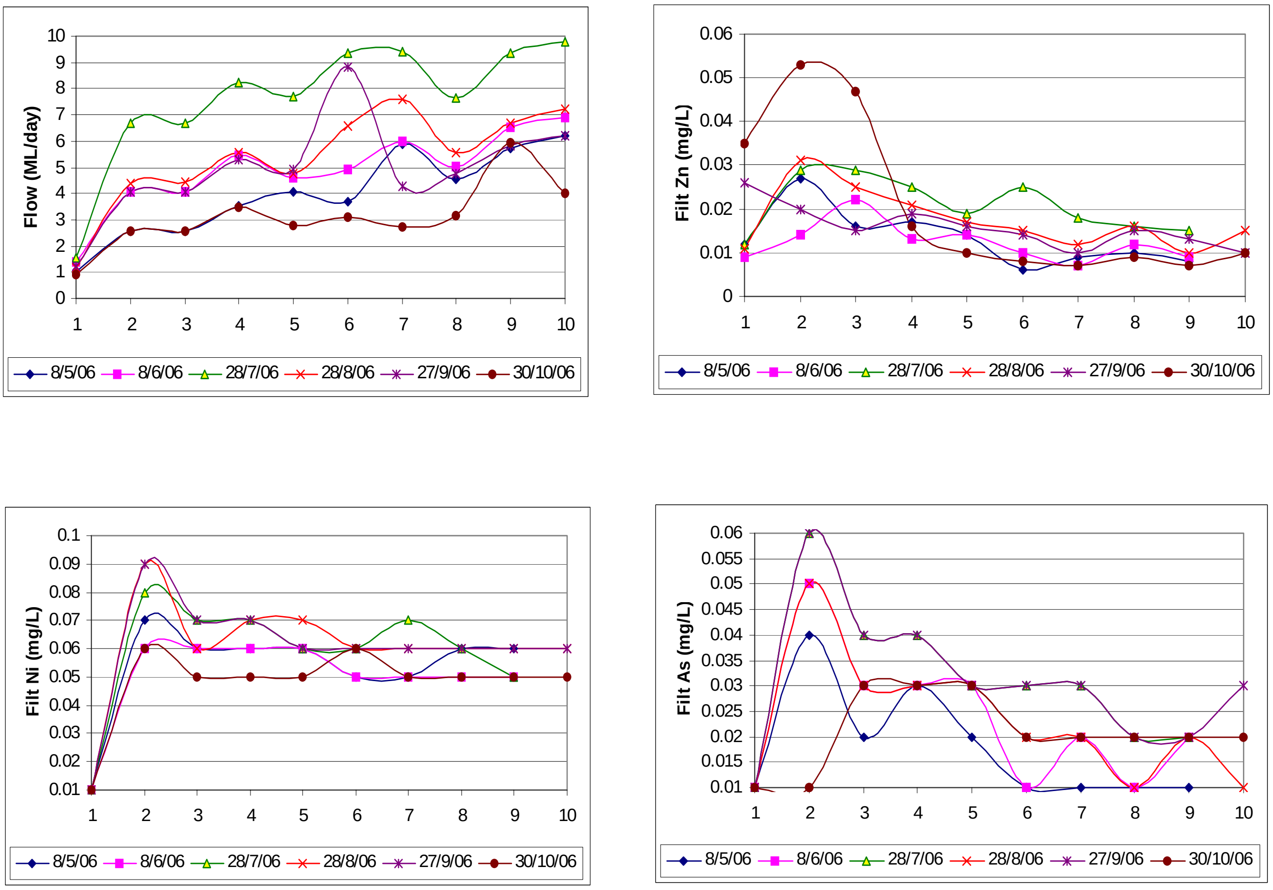


FIGURE 4 BARGO RIVER WATER QUALITY ANALYSES

Total flux of selected parameters in the river shown in **Figure 5** was derived by multiplying the monitored or interpreted river flow at selected points in the gorge (HCS, in prep) with the relevant laboratory analysis.

Based on the calculated data, the main input from the mine discharge is Total Nitrogen, with a rise downstream of Teatree Hollow of up to almost 3 orders of magnitude, followed by nickel with a 1 to 2 order of magnitude rise and arsenic with a rise of over 1 order of magnitude.

It should be noted that where analyses were below the lower detection limit (LDL), the LDL was used in the calculations, thereby enhancing the actual flux of that reading.

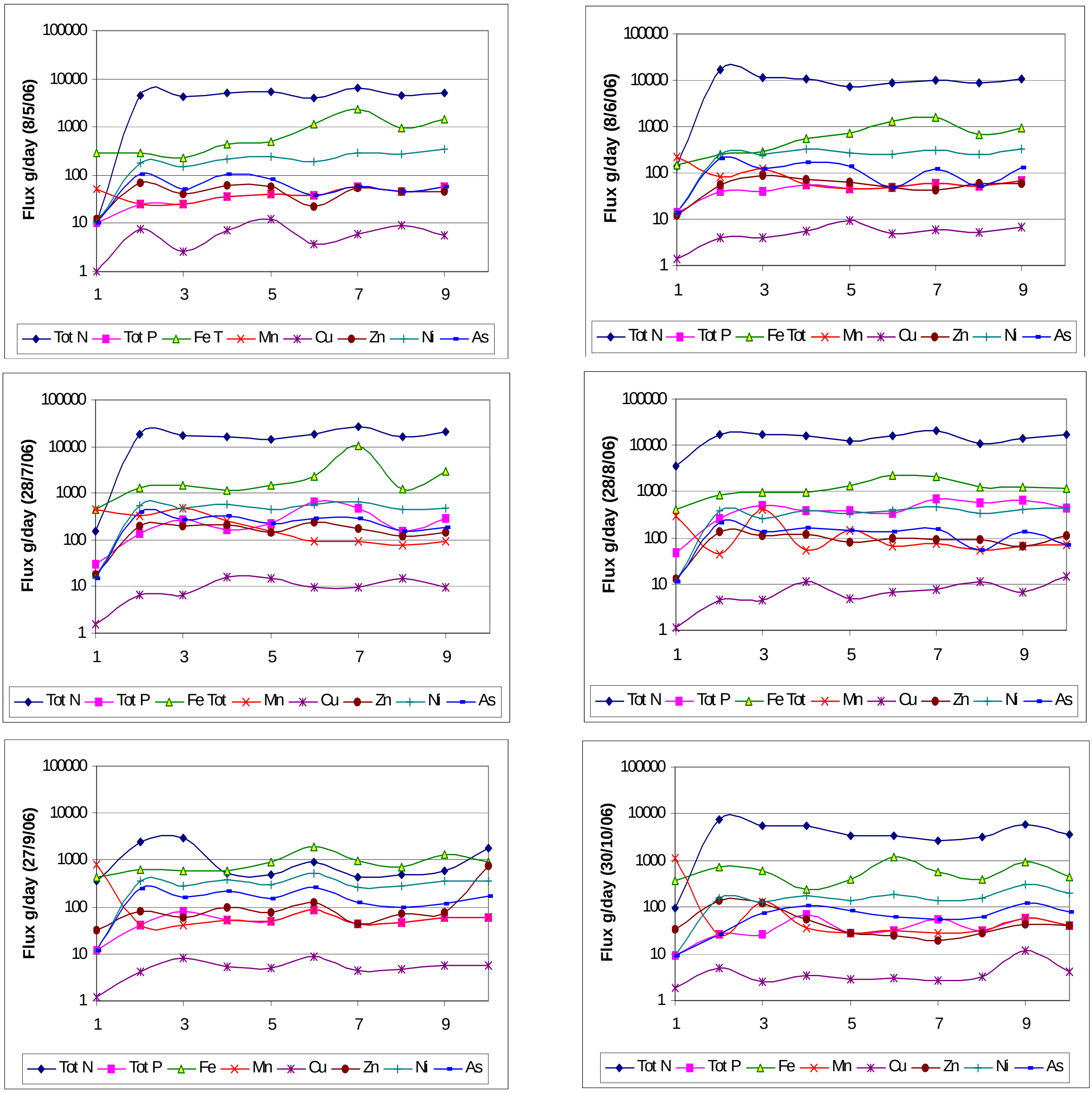


FIGURE 5 BARGO RIVER WATER PARAMETER FLUX

3.2 Bargo River Tributaries

Tributary flow to the Bargo in the study area originates from two unnamed gullies over the Panels 24 to 26, as well as Teatree Hollow, Dogtrap Creek and Sugarloaf Gully.

Teatree Hollow and Dogtrap Creek were undermined by Panels 1 and 2, as well as Panels 11, 12 and 13, however no creek flow or water quality monitoring was conducted in the catchments at the time.

The headwaters of Teatree Hollow are contained within the disturbed infrastructure area of Tahmoor Colliery, with the creek bed being within undisturbed bushland downstream of the Colliery discharge point.

Dogtrap Creek and Sugarloaf Creek are located within natural bushland, whilst the unnamed gullies over Panels 24 to 26 are within property primarily used for turkey production and processing.

No stream flow or water quality monitoring has been conducted in the unnamed gullies over the eastern edge of the SMP area, near the Bargo gorge, as well as in Dogtrap Creek or Sugarloaf Gully as they have been mostly dry, with their flow being ephemeral and highly dependent on short term interflow storage following rainfall / runoff and groundwater seepage in their respective catchments.

3.2.1 Teatree Hollow Subsidence Effects

No subsidence effects have occurred from extraction of Panels 22, 23A or 23B in Teatree Hollow.

3.2.2 Teatree Hollow Stream Flow

The licensed discharge into Teatree Hollow constitutes the main baseflow in the Bargo River upstream of the study area during dry periods, apart from runoff into the Bargo River after storm events.

Teatree Hollow discharges averaged approximately 4.5ML/day over the monitoring period and ranged from 1.02ML/day to 8.81ML/day as shown in **Figure 1**.

3.2.3 Teatree Hollow Water Quality

See Section 3.1.7.

3.3 Myrtle and Redbank Creeks

Both creeks are in the vicinity of built up areas and are generally in a poor state, with weed growth and rubbish that has been dumped or washed into them, whilst the creeks outside the built up areas are generally in better condition.

Myrtle and Redbank Creeks discharge into the Nepean River, outside and to the north of the Panel 22 to 26 20mm subsidence zone.

Some creek sections have been rehabilitated by local community or Landcare groups, such as the Thirlmere Wetlands on Redbank Creek (upstream of Site RC1), which is upstream of Panel 25 and on the western of the end of Panel 24, within the 20mm subsidence zone. The wetlands form an aquatic and riparian habitat for plants, animals and birds whilst improving runoff water quality. Other sites exist outside of the study area, such as in Redbank Creek (site RC3) off Remembrance Driveway.

The stream bed and banks of the plateau streams are generally well vegetated, and do not show significant erosion or bank instability.

Subsidence has occurred in Myrtle Creek over Panel 22 and 23B with no adverse effect observed on stream flow or water quality.

No DNR registered water extraction is listed within both creeks, however an unlicensed pump is present in Myrtle Creek over the middle of Longwall 25, off Castlereagh Street.

3.3.1 Myrtle and Redbank Creek Subsidence Effects

Cracking of the soil and bedrock over Panels 22 and 23B have been observed in Myrtle Creek as shown in **Photograph 9** from locations shown in **Drawing 2**.

PHOTOGRAPH 9 Myrtle Creek Cracks

The bedrock cracking is up to 10mm wide and is limited to the base of the creek within a small rock bar over Panel 22, whilst the soil cracking occurred at the southern end of Panel 23B, close to the barrier pillar between Panels 23A and 23B.

The soil cracking was up to 65mm wide and extended into the soil an unknown depth (>1.5m) over an approximate length of 40m, however, the crack did not develop within the channel bed of Myrtle Creek, even though it was observed on both the upper banks and flank of the creek channel.

No observable adverse effects on plateau stream bed or bank stability have been observed in Myrtle Creek, Redbank Creek, or the small unnamed gullies within the Panel 22, 23A and 23B subsidence area during the monitoring period.

Even though soil cracking has been noted in Myrtle Creek over Panel 23B, it is not anticipated that the bed or bank stability will be adversely affected as the crack can be easily rehabilitated and revegetated prior to the next main flow event.

The bedrock crack located over Panel 22 is within a small, restricted sandstone rock bar outcrop and is not anticipated to have an adverse effect on stream flow when the creek runs after sufficient rain, and therefore, no rehabilitation of the cracking is proposed.

A remnant subsidence "high" in Myrtle Creek of up to 0.75m is located over the chain pillar between Panels 22 and 23B, however due to the low quantum of subsidence and high vegetative cover in the creek, it is not anticipated that subsidence over Panels 22, 23A and 23B will initiate erosion of the creek bed or banks or sediment accumulation in subsidence troughs.

Reversal of flow in the creek will not occur due to the monitored subsidence as the creek gradient exceeds the post subsidence tilt in the creek bed.

3.3.2 Myrtle and Redbank Creek Flow

Stream depth monitoring was instigated in Myrtle Creek prior to extraction of Panels 22 to 23B and subsequently extended into lower Myrtle Creek and Redbank Creek in April 2005.

Both creeks have had extended periods of no flow during the monitoring period due to lack of rain rainfall runoff, with interspersed short periods of flow followed by static pondage as the creeks gradually dried up.

Permanent pondage has been observed at MYC3, RC2 and RC3.

No change in stream flow has been observed within Myrtle Creek or Redbank Creek during or after extraction of Panels 22, 23A and 23B, with creek flow at selected locations shown in **Figure 6**.

Cracking has been observed in Myrtle Creek over Panels 22 and 23B, however the effect on stream flow, water quality, ponding or flow reversal have not been directly measured within the Panel 22, 23A and 23B 20mm subsidence zone as the creek has been essentially dry during the monitoring period.

Redbank Creek has also been essentially dry throughout the monitoring period, within the potential subsidence zone, however it has not been undermined as yet by longwall extraction.

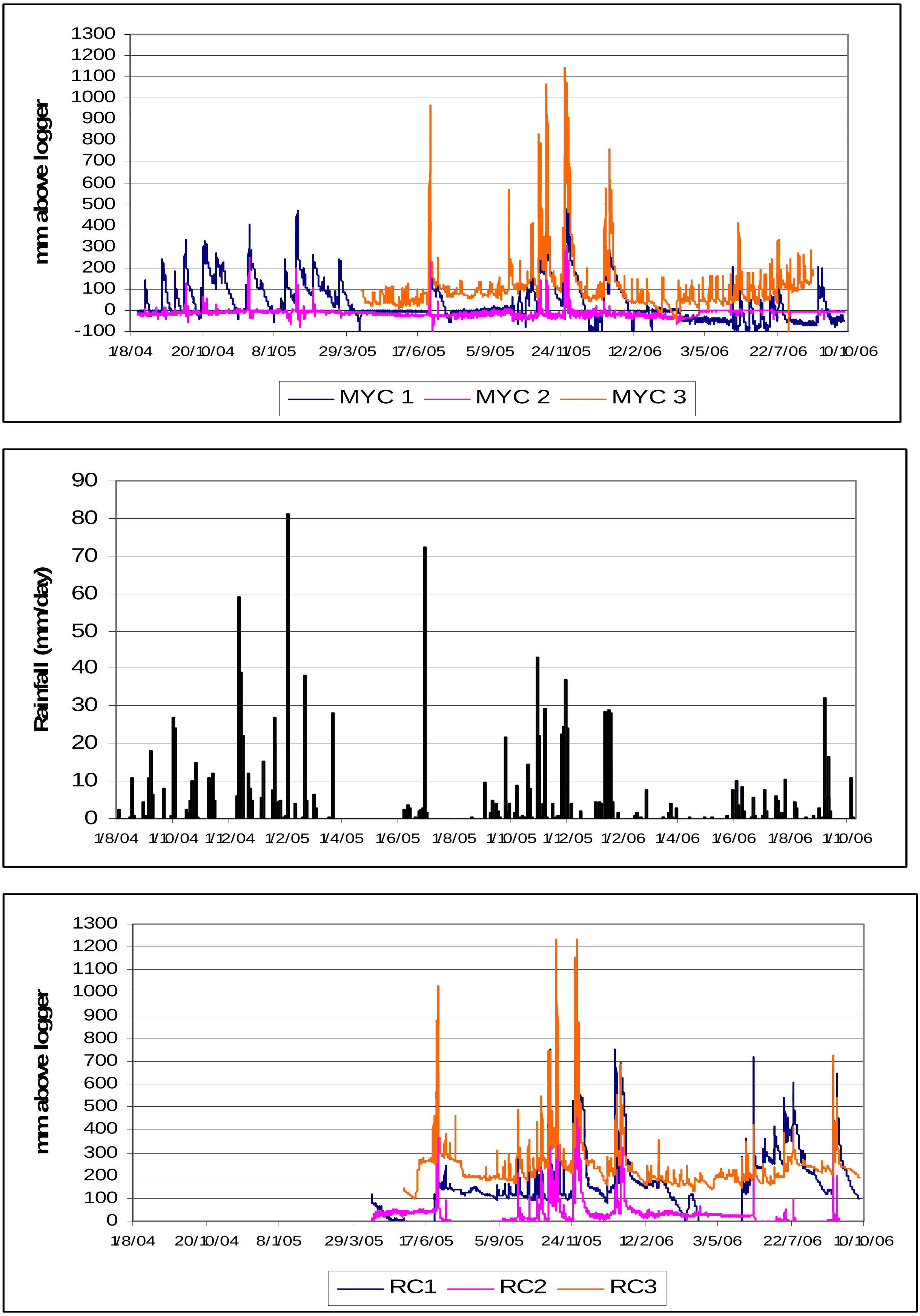


FIGURE 6 Stream Water Depth in Myrtle and Redbank Creeks

3.3.3 Myrtle and Redbank Creek Water Quality

Field and laboratory water quality monitoring and analysis from samples collected in Myrtle Creek and Redbank Creek between December 2004 and the present is shown in **Appendix A**.

Within the monitoring period, Myrtle Creek has been generally dry at RC1, generally ponded at RC2 and RC3, with short periods of flow in the creek following sufficient rainfall.

Myrtle Creek has a pH range between 5.3 and 7.72, with EC between 128uS/cm and 2440uS/cm, with the creek becoming more alkaline and more saline downstream. Full sampling in the creek has been restricted by the lack of water, however the available results indicate Myrtle Creek can have very high Total N (up to 180mg/L) and Total P (up to 30mg/L) at MYC3, which is significantly higher than at MYC2 or MYC1. Myrtle Creek can also exceed the ANZECC 2000 trigger levels for filterable copper (<0.008mg/L) and zinc (<0.012mg/L).

Redbank Creek has a pH range between 4.15 and 6.95, with EC between 211uS/cm and 1950uS/cm, with the creek becoming distinctly acid and saline at RC2, where a ferruginous seep maintains ponded water as shown in **Photograph 10**.

PHOTOGRAPH 10 Iron Hydroxide in Redbank Creek (RC2)

Redbank Creek has more frequent water availability compared to Myrtle Creek, with Total N up to 7.6mg/l, Total P to 0.14mg/L as well as potentially having filterable manganese, copper, zinc and nickel above ANZECC 2000 trigger levels.

No observable adverse effects on water quality in Myrtle or Redbank Creeks due to subsidence have been observed following extraction of Panels 22, 23A and 23B.

3.4 Groundwater

3.4.1 Groundwater Levels

Regular standing water level monitoring in the study area began in June 2004 with the drilling of P1, which is located on the southwest periphery of the Panel 22, 20mm subsidence zone, with water levels monitored every 12 hours.

Piezometers P2 and P3 also have water levels monitored at 12 hourly intervals in remnant coal exploration bores over Panel 23B and the chain pillar between Panels 25 and 26. Piezometer P4 is an unused private bore in an undeveloped, unsecured block of land, 300m northeast of Panel 26. P5 is a disused private bore 950m north west of Panel 26 that was used for general domestic / irrigation water and P6 was drilled as a water supply bore for the Jay-R-horse stud, 1.1km east of Panel 26 which was never used as the water was too deep.

A plot of water levels is shown in **Figure 7**, whilst the manual readings are listed in **Appendix A**.

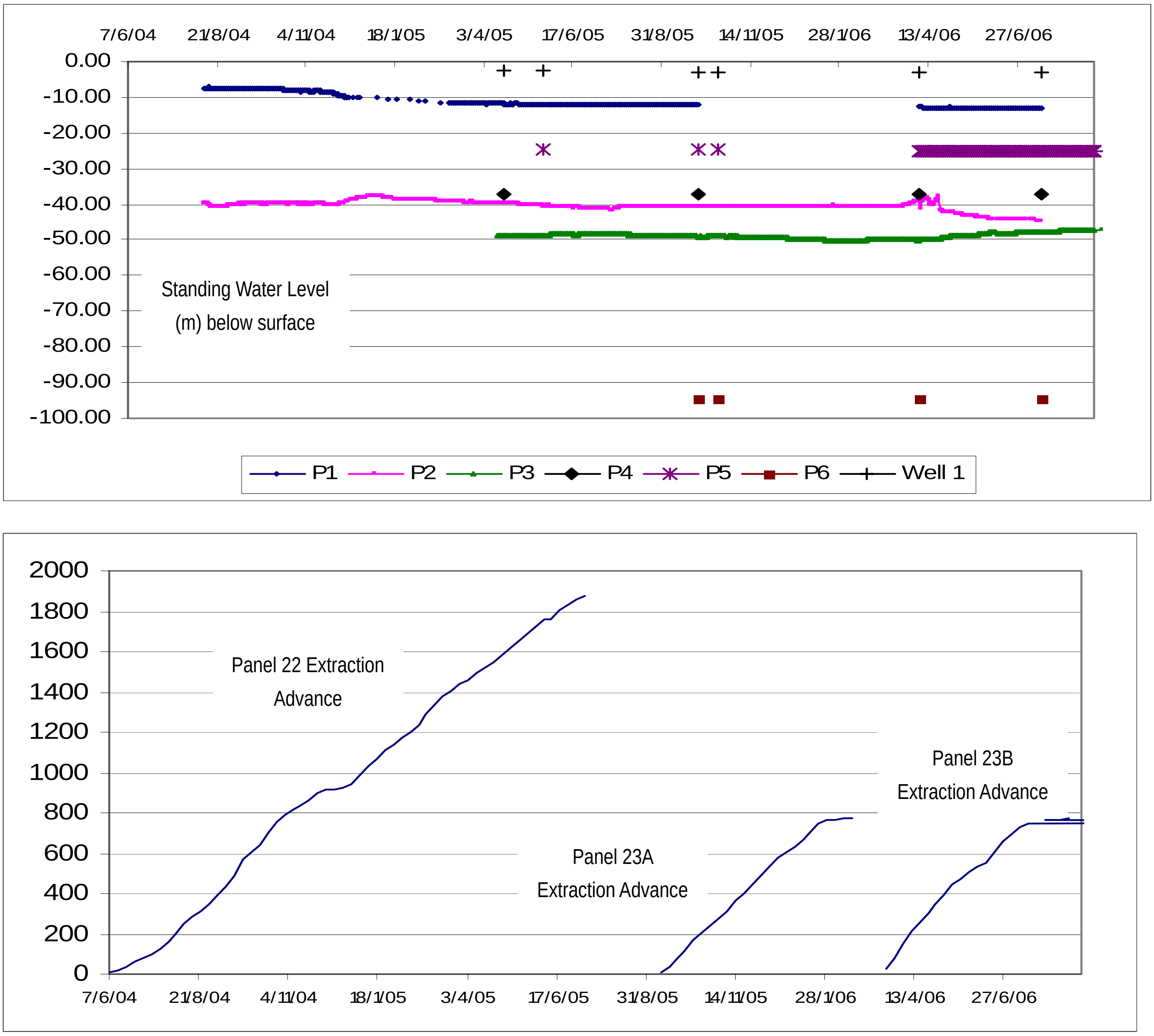


FIGURE 7 Standing Water Levels and Panel Extraction

The post subsidence reduction in groundwater levels is anticipated to be temporary, until such time that sufficient rainfall and infiltration occurs to replenish the groundwater system. Permanent post mining water level reduction is not anticipated as none of the bores are located close to the Bargo River gorge for new enhanced flow paths to be generate and allow additional groundwater to drain to the river.

Water levels in P1 fell by approximately 4.5m due to extraction of Panel 22 between mid/late November 2004 to early / mid December 2004, which was superimposed on a gradual, drought related decline of around 0.1mm / month, which existed both before and after extraction of Panels 22, 23A and 23B.

At the same time that P1 dropped, P2 in Glenanne Place over Panel 23 initially rose by around 2.2m, then fell by less than 1m below the pre Panel 22 extraction period water level. The cause of the initial rise in P2, and its subsequent 3.3m fall over 7 months is interpreted to be subsidence related as there has been no significant rainfall that could have caused the rise.

Water level monitoring in P3, P4, P5, P6 and Well 1 started in the latter stage of Panel 22 extraction.

Water levels in P2 continued to fall in the latter stage of Panel 23A extraction, then did not fall and remained relatively static in the changeover between Panels 22 and 23A, as well as during extraction of Panel 23A. In the changeover between Panel 23A and 23B, water levels in P2 rose by around 3m then sharply fell by at least 6.75m, with its stabilised post subsidence level to be assessed with ongoing monitoring.

During the initial extraction of Panel 23A, water levels in P3 fell by 1.95m then rose by around 3.75m in the latter stage of 23A and all of the Panel 23B extraction period.

No significant rise or fall in Piezometers P4, P5, P6 and Well 1 have been observed during extraction of Panels 22, 23A and 23B.

Complaints were received prior to extraction of Panels 22, 23A ad 23B in regard to private bores at least 175m north of Panel 21. Two bores were redrilled, one property received temporary trucked in water and another complaint was dismissed as it was assessed that mining did not affect the bore's performance as it was outside the probable area of subsidence effects. It should be noted, however that the effects were not able to be quantified as the bores had not been monitored prior to mining.

Subsequent complaints were received during December 2006 about three private, unregistered and unmonitored bores over Panel 3 near the intersection of Stokes Road and Byron Road. Investigations are ongoing as to the potential cause of the lack of water in the recent complaints, as they likely to be outside the subsidence effect zone for Panels 22, 23A and 23B.

3.4.2 Groundwater Quality

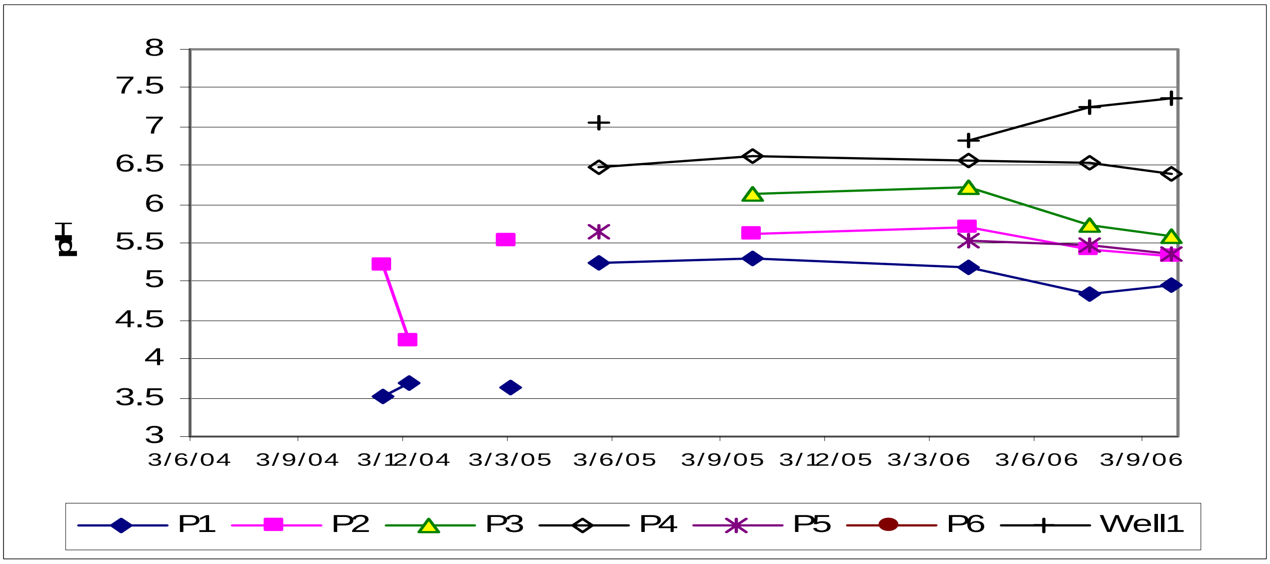
Groundwater in the study area has generally brackish salinity (564µS/cm to 14,940µS/cm) with acid to circum-neutral pH (3.53 to 7.36) as shown in **Figure 8**.

Laboratory analyses indicate that the bore water generally is outside ANZECC 2000 criteria (default trigger values for physical & chemical stressors in SE Aust upland rivers / 95% protection of freshwater species / livestock / irrigation) for pH, electrolytical conductivity, sodium, hardness, total nitrogen, total phosphorous, as well as filterable manganese, copper, zinc, nickel, and to a small degree, lead, with the exceedance varying depending on the applicable guideline applied for the end use of the water as shown in **Appendix A.**

Groundwater in the SMP area is suitable for selected livestock and limited irrigation use, but not for potable water.

No complaints regarding groundwater quality changes have been reported in the study area during the monitoring period.

Adverse changes to groundwater quality of the subsided bores has not been observed, with no distinctive increase in dissolved total iron or salinity and no distinctive lowering of pH.



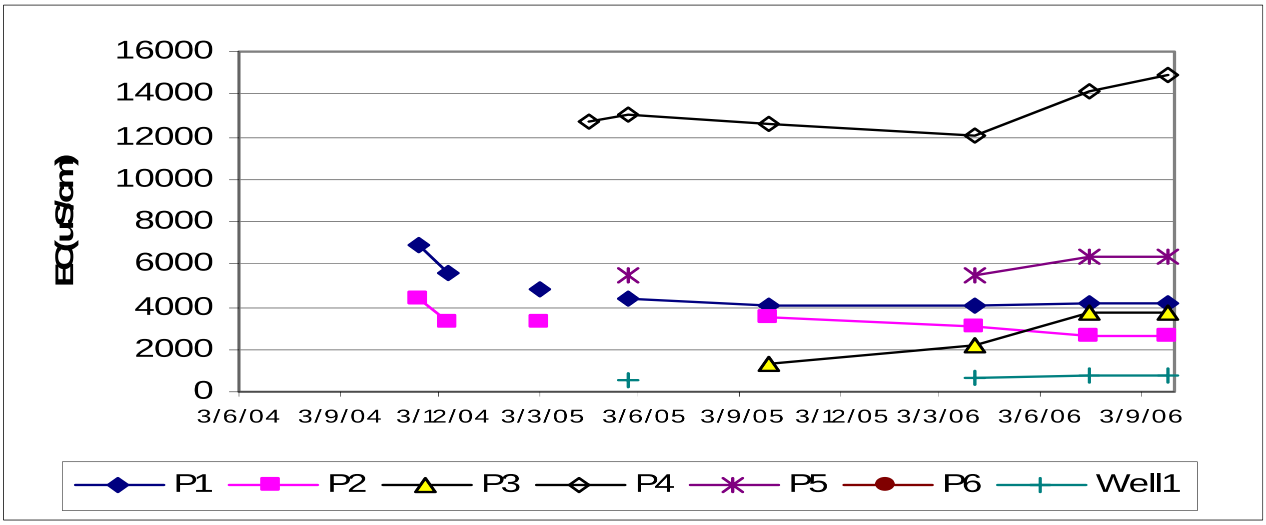


FIGURE 8 Field Groundwater Quality

3.5 Dams

A total of 9 dams are located within the Panels 22, 23A and 23B 20mm subsidence zone as shown in **Drawing 2** and **Table 6**.

The dams are all located within rural residential properties.

Field inspection of the dams was conducted prior to mining, between November 2004 and May 2005 and after Panel 23B was completed.

The majority of dams are constructed through a combination of excavation and emplacement of an earthen bund wall, with one dam constructed within Myrtle Creek, whilst the small dams are excavations on the slopes of Myrtle Creek with a small earthen bund wall at the downslope end.

All dams were low due to the lack of recharge, and no landowners reported any adverse effects due to subsidence.

TABLE 6 Dams Over Panels 22, 23A and 23B

Dam	Size	Construction	Subsidence Effects
MO8i	Small	Small earth bank on slopes	None observed or reported
MO8j	Small	Small earth bank on slopes	None observed or reported
MO8k / MO9j	medium	2 dams sharing common wall	None observed or reported
MO9i	Medium	Earth Wall in Myrtle Creek	None observed or reported
O13d	Small	Small earth bank on slopes	None observed or reported
O14e	Medium	Medium earth bank on slopes	None observed or reported
O15d	Medium	Medium earth bank on slopes	None observed or reported
O16d	Medium	Medium earth bank on slopes	None observed or reported
O17e	Small	Small earth bank on slopes	None observed or reported

Direct measurement of subsidence, tilt and strain in the nine subsided dams has not been directly conducted, however, no dam floor or wall cracking has been observed within the subsidence range measured along the Denmead St, Brundah Road and Macquarie Place survey lines.

No observed movement or cracking of dam walls was observed, and no loss of stored water was reported during the monitoring period.

Of the nine dams, MO8j, MO8i as well as the joined MO9j / MO8k dams are located along the zone of maximum strain and tilt on the maingate side of Panel 22, where the main zone of cracking was expected, but did not occur. Cracking was, however, observed within Myrtle Creek in a small bedrock bar near MO9i, in the centre of the panel, but was not observed within the soil profile near the dam.

Soil cracking also occurred in the Panel 23B edge, in the centre of the panel, perpendicular to the panel axis where maximum strain developed due to strata flexing along the north / south oriented edge of the remnant coal block.

3.6 Inflow to Mine Workings

No notable change to underground working water inflows have been reported during extraction of Panels 22, 23A and 23B.

4. MONITORING AND MANAGEMENT

4.1 Bargo River Flow and Pool Depths

Daily automated monitoring of river flow and selected pool water depth measurement to bolts from upstream of Teatree Hollow to Pool A should continue until at least after Panel 26 has been completed, with the flows and pool depths compared to rainfall in the local catchment and licensed discharges into Teatree Hollow.

The monitoring should continue to measure the inputs from catchment runoff, Teatree Hollow and tributaries within the study area to assess the pre and post Panel 26 flow variations in the Bargo River at the following locations;

- Upstream Teatree Hollow
- Teatree Hollow
- Downstream Teatree Hollow
- Rockford Road
- Upstream Mermaid Pool, and;
- Pools N, K, J and F

The need for subsidence / uplift impact management should be reassessed at the end of each panel by reviewing any observable changes that develop, and, subsequently developing a plan to manage the issue if appropriate.

4.2 Bargo River Water Quality

Monthly water quality monitoring should be conducted in the Bargo River from upstream of Teatree Hollow to Pool F.

Monitoring should assess the inputs from catchment runoff and Teatree Hollow discharge and any water quality variations that occur before, during or after Panel 26 is extracted. Monitoring should be conducted for the following parameters;

- Field pH, electrical conductivity, temperature, dissolved oxygen and oxidation reduction potential
- total dissolved solids,
- Na / Ca / Na / K / SO_4 /Mg / Cl / F,
- total alkalinity,
- total organic carbon
- total / filterable Fe
- filterable Mn, Ni, Zn, As, Cu, Al
- total nitrogen, and
- total phosphorous

Water quality monitoring should be coupled with flow monitoring at the same location.

All samples should be appropriately collected, stored, transported and analysed according to ANZECC 2000 standards, with 0.45µm filtering and nitric acid preservation to <pH2 for metals samples.

Trigger values for selected pollutants of concern should be set after one year of full data is collected, and where the values are exceeded, the cause and effect of the exceedance should be investigated and a management plan developed if the cause is directly related to subsidence / uplift.

4.3 Bargo River Bed and Banks

The river bed and banks are not anticipated to be observably affected by subsidence, however water depths in Pools N, K, J, H and F should be monitored and photographed regularly, unless access to the sites is temporarily unsuitable due to OH&S reasons.

If the river is potentially affected, an inspection of the river structure should be conducted, and if cracking is noted, a specific management / mitigation program should be developed if the effect is due to subsidence / uplift.

4.4 Bargo River Cliff Seeps

Sampling and analysis of selected seeps should be conducted within the Panel 22 to 26 20mm subsidence zone to assess the flow rate and water quality from seeps prior to extraction of Longwall 24B. Monitoring should be conducted for the following parameters;

- Field pH, electrical conductivity, temperature, dissolved oxygen and oxidation reduction potential
- total dissolved solids,
- Na / Ca / Na / K / SO4 /Mg / Cl / F,
- total alkalinity,
- total organic carbon
- total / filterable Fe
- filterable Mn, Ni, As, Cu, Pb, Zn, Al, Se and Sr
- total nitrogen, and
- total phosphorous

All samples should be collected with no atmospheric contact, tested for field variable parameters, filtered, acidified, transported and analysed according to ANZECC 2000 standards.

The presence and duration of observable cliff seeps within the application area should be photographically and semi quantitavely recorded during field monitoring sessions.

4.5 Plateau Stream Flow

Daily water level data logging in Myrtle and Redbank Creeks should continue to be conducted at locations MYC1 to MYC3 and RC1 to RC3.

4.5.1 Plateau Stream Bed and Banks

Subsidence may induce minor bed or bank cracking and/or erosion over the proposed panels, particularly in the headward and downstream sections of the subsidence troughs, as well as over the chain pillars.

As the creeks are well vegetated, no significant change in stability is anticipated and it is not envisaged that stream bed or bank remediation will be required.

Any changes to the current state will be visually monitored after significant stream flow events, and if adverse subsidence / uplift effects occur, a specific management and rehabilitation plan should be developed for the affected areas.

4.5.2 Bedload Movement

If erosion occurs in the stream, it may cause a minor increase in potential bedload movement in and downstream of the subsidence area, which will be visually monitored during and after significant flow events.

Significant bedload movement is not anticipated and therefore stream bed or bank management and rehabilitation is not anticipated to be required.

4.5.3 Plateau Stream Gradient

It is not anticipated that significant observable change will occur due to subsidence and that stream gradient rehabilitation measures will not be required.

4.5.4 Plateau Riparian Vegetation

Vegetation in the stream and banks will be visually monitored over the panels before and after the streams are undermined, particularly after significant flow events.

As no adverse effect on the riparian vegetation is anticipated, no vegetation rehabilitation measures are anticipated.

4.5.5 Plateau Stream Water Quality

Stream water pH and EC will be measured every second month, or when flowing water is present in the stream with hand held meters at locations MYC1 to MYC3 and RC1 to RC3.

Monitoring will continue after the SMP area has been subsided at locations and time intervals to be determined after the conclusion of mining Panel 26.

Pre and post subsidence water sampling and analysis in Myrtle Creek and Redbank Creek should be conducted before and after a panel undermines a subject creek for the following parameters;

- Field pH, electrical conductivity, temperature,
- total dissolved solids,
- Na / Ca / Na / K / SO4 / Mg / Cl / F,
- total alkalinity,
- total / filterable Fe
- filterable Ni, Zn, As, Cu, Mn, Al
- total nitrogen, and
- total phosphorous

4.6 Dams

Each dam overlying Panels 24, 25 and 26 will be inspected one week before and one week after undermining to assess its pre and post subsidence condition. If a dam loses water storage due to cracking and the wall is not adversely affected, the dam will be sufficiently drained, resealed and reinstated to its original storage level that prevailed before the dam was undermined.

If subsidence adversely affects the wall, floor or water storage capacity of a dam, the dam will be rehabilitated. Remediation requirements for adversely affected dams will be assessed within 1 week of full subsidence, which may take up to four weeks after undermining a subject location.

Water levels as well as pH and EC will be monitored in higher risk dams prior to undermining to provide a baseline water level and water quality assessment on which to base any rehabilitation targets, if required. Specific dams that may require particular attention are the Inghams dams Z75l and Z75m near the edge of Panel 24A.

Prior mining of Panel 24B and subsidence of dams will provide an opportunity to monitor ground movements and observe the development and magnitude of surface cracking around dams in similar locations to Z75l and Z75m. This will enable the current subsidence predictions to be updated and to assess the potential for remaining dams to sustain wall deterioration or water loss.

Undermining of Dam Z75l and Z75m will be closely monitored daily for 2 weeks when maximum subsidence is expected to allow for contingency measures to be brought into operation if adverse tilting or cracking is observed.

Subject to detailed discussion with Inghams, in the event that tilting or crack development monitoring indicates a significant potential for dam wall failure in Dams Z75l, Z75m, Z75n and Z75o:

- the dam water will either be pumped out and either transferred to another suitable dam or, alternatively, disposed at a suitably licensed facility, and;
- contingency measures will be brought in to allow continued operation of the meat processing plant according to the SSSSMP (MSEC, 2006).

Detailed dam monitoring and contingency plans will be developed in collaboration with Inghams if monitoring of dam subsidence reactions over Panel 24B indicates a potential problem for the Inghams dams over Panel 24A.

Factors to be monitored include dam water depth and quality. Monitoring and contingency plans acceptable to Inghams will be developed to maintain the effective treatment of the site's process water to manage any adverse impact on the environment or their operations.

Farm and domestic dams over the SMP area will be monitored for adverse effects from subsidence as mining proceeds to ensure that they remain safe and operational. In the event that a dam loses water due to subsidence, an alternate water supply will be provided during the mining period, and the dam will be repaired on completion of subsidence.

4.7 Groundwater

4.7.1 Standing Water Levels

Standing water levels will be logged twice daily in piezometers P1, P2, P3 and P5, along with manual readings in P4 and P6 at least bi-monthly by manual dip meter.

Should the accessibility, available drawdown or yield of a bore be unacceptably affected due to subsidence, the Colliery can provide an alternative water supply until the water level recovers.

If the level does not sufficiently recover and the effect is due to subsidence rather than regional climatic or anthropogenic factors, repairs or maintenance to a bore can be undertaken after maximum subsidence has developed, after which time the pump intake can be lowered, the bore extended to a greater depth or a new bore can be established.

4.7.2 Groundwater Quality

At least one appropriately purged and prepared groundwater sample should be collected from each piezometer pre and post undermining to enable ongoing assessment of any subsidence related changes in groundwater quality. Samples should be analysed for;

- Field pH, electrical conductivity, temperature,
- total dissolved solids,
- Na / Ca / Na / K / SO4 / Mg / Cl / F,
- total alkalinity,
- total / filterable Fe
- filterable Ni, Zn, Cu, Se, Mn
- total nitrogen and total phosphorous

The use of each bore should be ascertained and observations made on the quantum of iron hydroxide precipitating from the pumped water before and after undermining.

4.8 Mine Inflows

Mine inflows will be monitored through measurement of all water pumped into and out of the workings.

4.9 Rainfall

Rainfall will be monitored daily at the mine's and the Picton Bureau of Meteorology weather station for the duration of the mining operation.

The quantity and variability of streamflow in Myrtle and Redbank Creeks will be monitored by data loggers to assess the rainfall / runoff relationship, with photography used to monitor flow conditions in both creeks as well as the unnamed tributaries.

4.10 Reporting

An end of extraction report will be prepared for each panel, which summarises all monitoring over the period. The report will outline any changes in the surface water or groundwater system over the mined out areas.

If required, a meeting will be convened with the Department of Primary Industries - Mineral Resources at the mine office to discuss requirements for remediation and ongoing monitoring.

All monitoring and management activities will be reported in the Annual Environmental Management Report (AEMR) in subsequent years.

4.11 Ongoing Monitoring

All results will be reviewed one year after each panel has been completed and an updated ongoing monitoring and remediation program will be developed in association with the Department of Primary Industries - Mineral Resources and Department of Natural Resources.

4.12 Quality Assurance and Control

QA/QC will be attained by calibrating all measuring equipment, ensuring that sampling equipment is suitable for the intended purpose, NATA registered laboratories are used for chemical analyses and that site inspections and reporting follow procedures outlined in the ANZECC 2000 Guidelines for Water Quality Monitoring and Reporting.

Field sample collection, storage, despatch, laboratory analysis, interpretation and reporting will be conducted according to ANZECC 2000 requirements.

4.13 Subsidence Impact Management and Contingency Measures

At this time, there are no specific recommendations for stream, groundwater dams, ponds or alluvial land management and rehabilitation over the proposed mining area as the predicted impacts are not anticipated to be significantly adverse.

Ongoing monitoring is required to assess whether any subsidence related physical and / or chemical changes to stream flows, stream water quality and stream integrity occur, as well as to validate predicted impacts on groundwater levels, mine seepage, groundwater water quality and dam integrity.

All relevant rehabilitation actions will be derived in association with the DPI-DMR and DNR and will be acted upon as appropriate.

Every six months, assessment of the field and laboratory data will be completed to determine whether any unanticipated trends are occurring, and a review of measures will be required to address the issue if a subsidence / uplift related trend is apparent.

5. REFERENCES

ANZECC 2000 Australian and New Zealand Guidelines For Fresh and Marine Water Quality

Geoterra, 2004 Longwall Panels 22 and 23 Surface Water, Stream, Alluvial Land and Groundwater Subsidence Management and Monitoring

Geoterra Pty Ltd, 2006 Longwall Panels 24 to 26 Surface Water & Groundwater Subsidence Management Plan

Mine Subsidence Engineering Consultants Pty Ltd 2003 The Prediction of Subsidence Parameters and the Assessment of Mine Subsidence Impacts on Natural Features and Surface Infrastructure (In support of a section 138 application)

Mine Subsidence Engineering Consultants Pty Ltd 2006A The Prediction of Subsidence Parameters and the Assessment of Mine Subsidence Impacts on Surface and Sub Surface Features Due to Mining Longwalls 24 to 26 at Tahmoor Colliery in Support of and SMP Application

Mine Subsidence Engineering Consultants Pty Ltd 2006B End of panel Monitoring report for Longwall 23B at Tahmoor Colliery

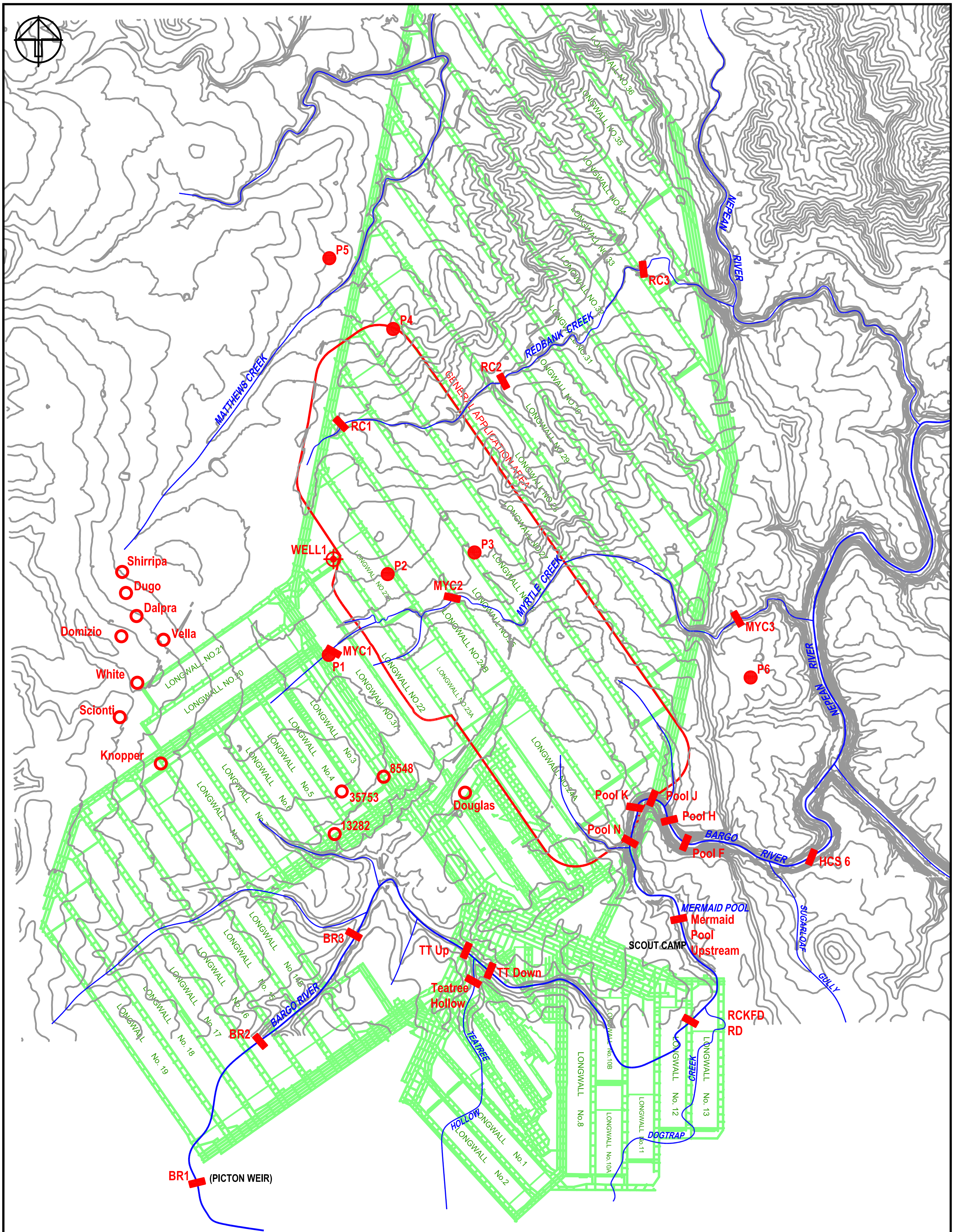
LIMITATIONS

This report was prepared in accordance with the scope of services set out in the contract between Geoterra Pty Ltd (Geoterra) and the client, or where no contract has been finalised, the proposal agreed to by the client. To the best of our knowledge the report presented herein accurately reflects the clients requirements when it was printed. However, the application of conditions of approval or impacts of unanticipated future events could modify the outcomes described in this document.

In preparing this report, Geoterra has relied upon information and documentation provided by the client and / or third parties. Geoterra did not attempt to independently verify the accuracy or completeness of that information. To the extent that the conclusions and recommendations in this report are based in whole or in part on such information, they are contingent on its validity. Geoterra assume the client will make their own enquiries in regard to conclusions and recommendations made in this document. Geoterra accept no responsibility for any consequences arising from any information or condition that was concealed, withheld, misrepresented, or otherwise not fully disclosed or available to Geoterra.

The findings contained in this report are the result of discrete / specific methodologies used in accordance with normal practices and standards. To the best of our knowledge, they represent a reasonable interpretation of the general condition of the site in question. Under no circumstances, however, can it be considered that these findings represent the actual state of the site at all points.

Interpretations and recommendations provided in this report are opinions provided for our Client's sole use in accordance with the specified brief. As such they do not necessarily address all aspects of water, soil or rock conditions on the subject site. The responsibility of Geoterra is solely to its client and it is not intended that this report be relied upon by any third party. This report shall not be reproduced either wholly or in part without the prior written consent of Geoterra.



LEGEND

- PIEZOMETER LOCATIONS
- STREAM MONITORING LOCATIONS
- WELL LOCATION
- DNR REGISTERED BORE

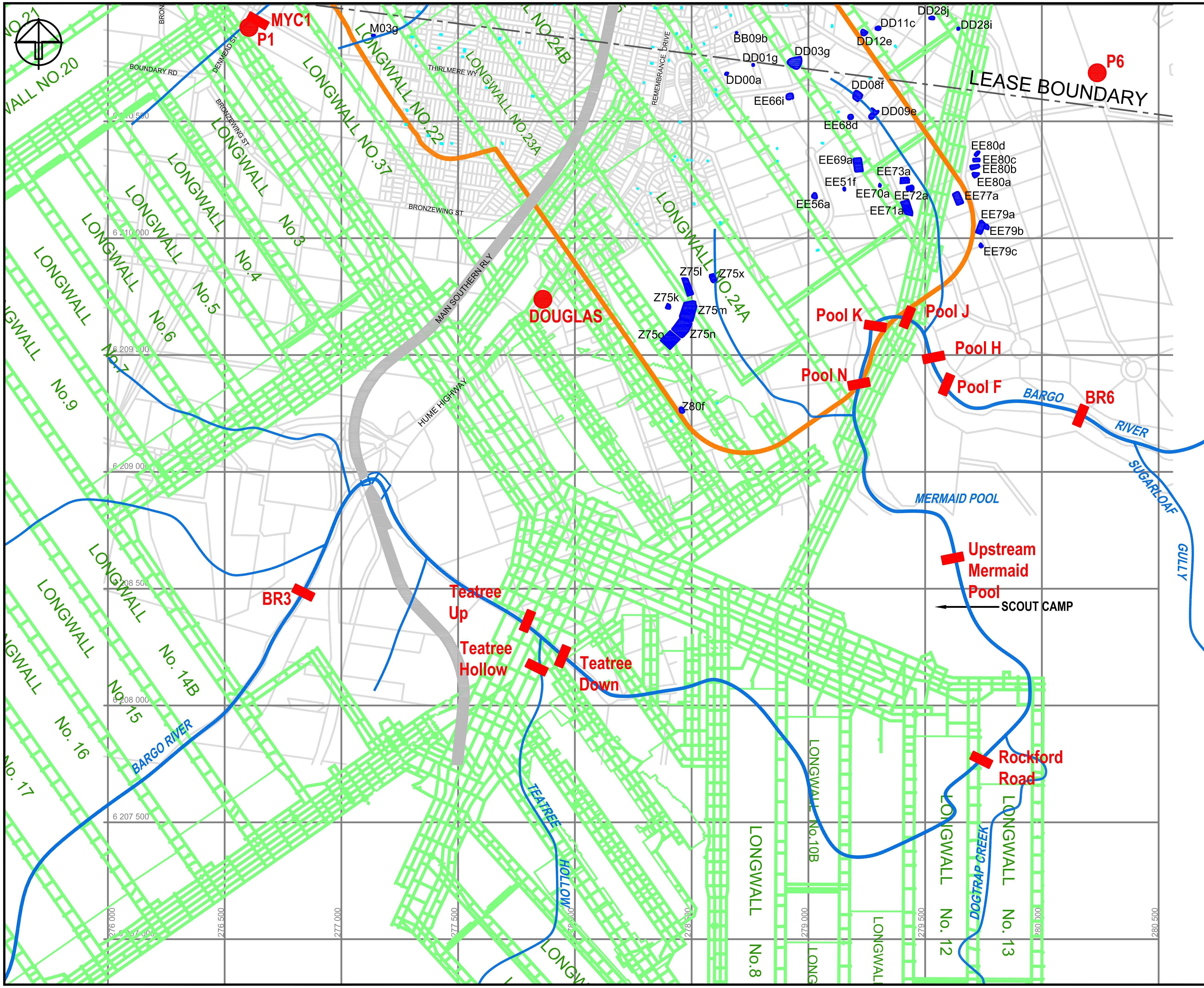
PROJECT:	TA5-R1
DRAWN:	A. DAWKINS
DATE:	18 DEC 2006
SCALE:	1:30 000

CENTENNIAL TAHMOOR PANELS 22 TO 26

MONITORING SITES

GeoTerra

DRAWING1



PROJECT: TA5-R1
DRAWN: A. DAWKINS
DATE: 18 DEC 2006
SCALE: 1:15 000

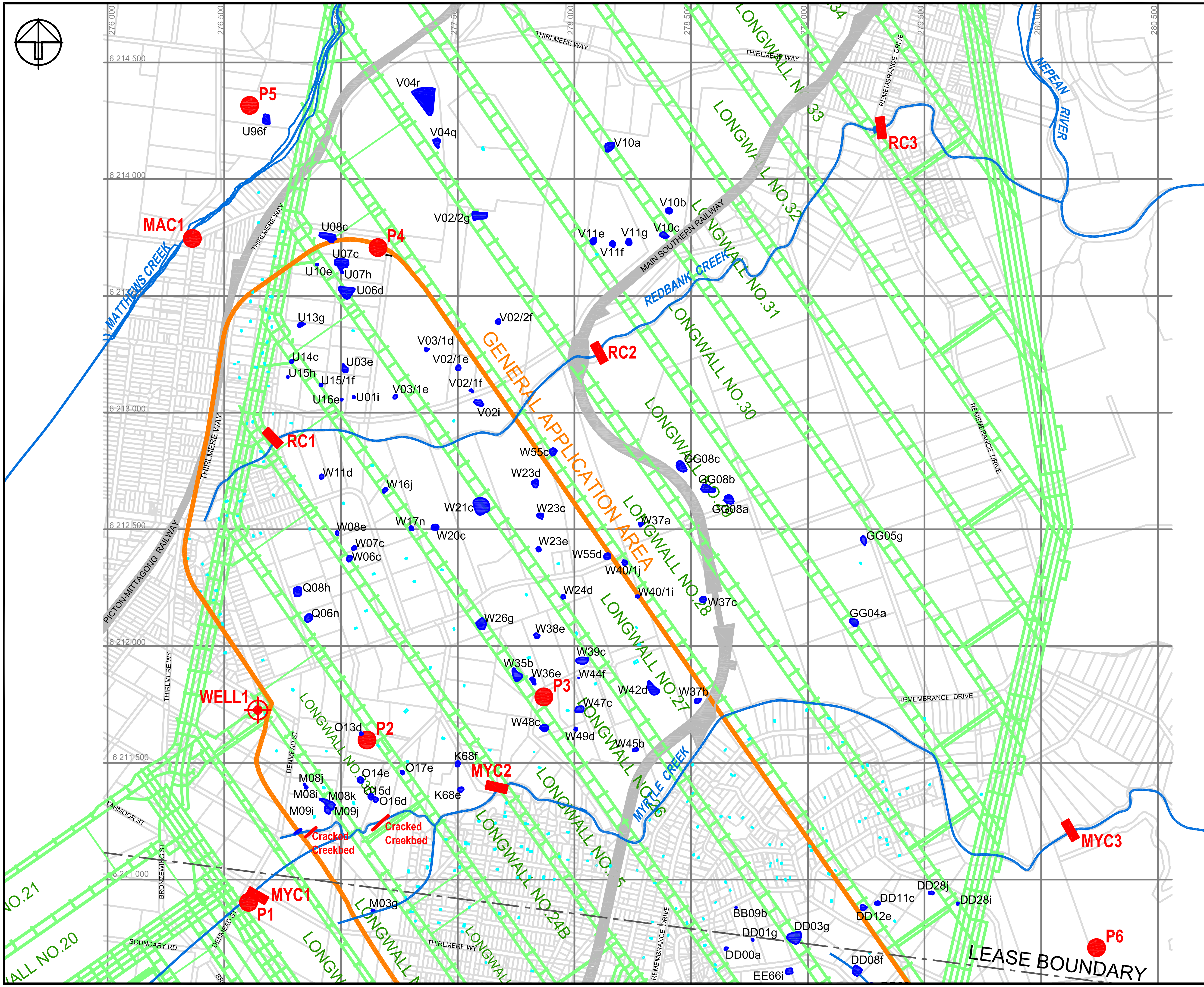
CENTENNIAL TAHMOOR

LONGWALLS 24 TO 26

Monitoring Sites (South)

DRAWING 2

GeoTerra



LEGEND

- DAMS
- PIEZOMETER / BORE
- STREAM SITE
- WELL

PROJECT:	TA5-R1
DRAWN:	A. DAWKINS
DATE:	18 DEC 2006
SCALE:	1:15 000

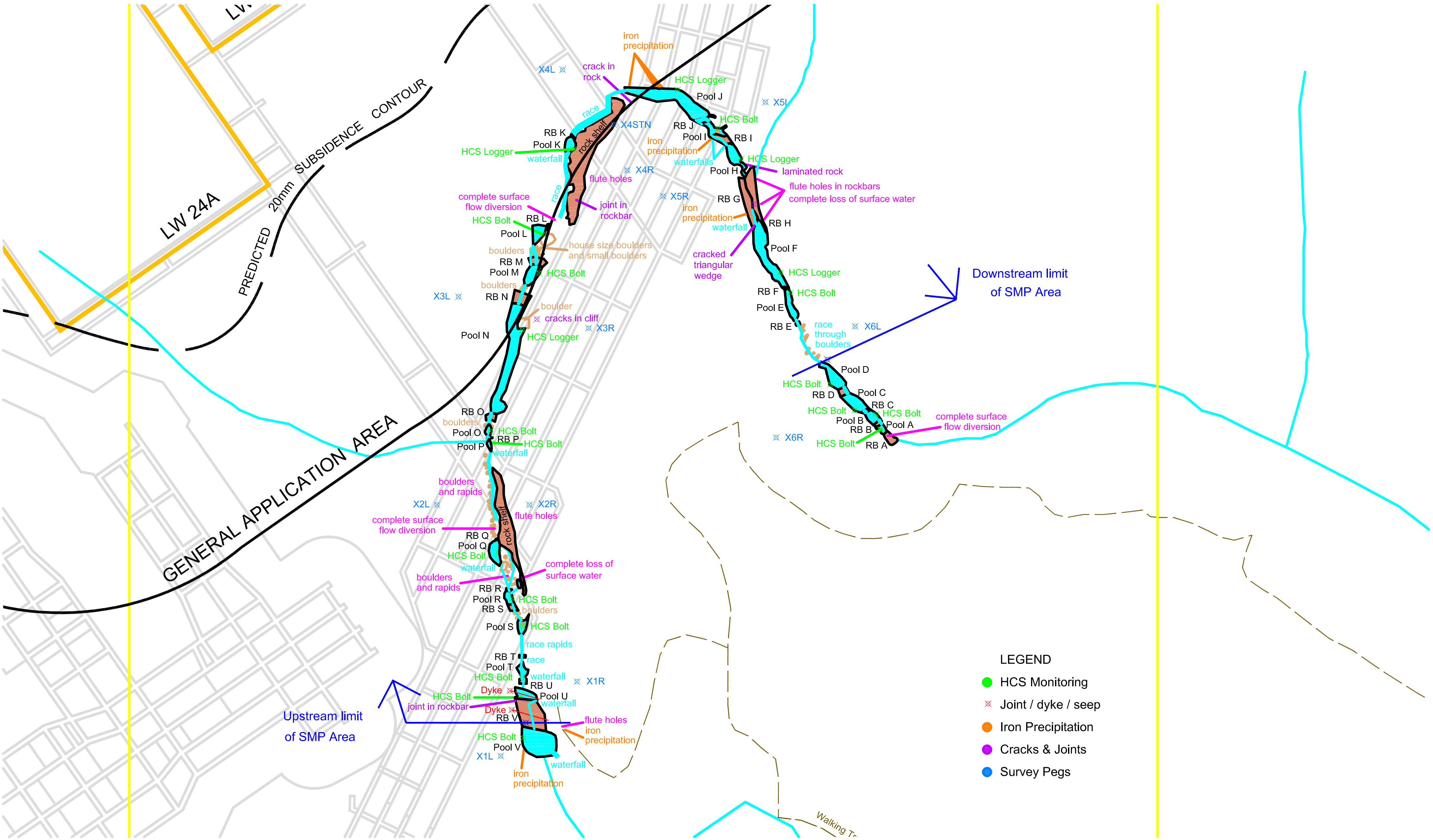
CENTENNIAL TAHMOOR

LONGWALLS 24 TO 26

Monitoring Sites (North)

DRAWING 3

GeoTerra



LEGEND
HCS Monitoring
Joint / dyke / seep
Iron Precipitation
Cracks & Joints
Survey Pegs
Downstream limit of SMP Area
Upstream limit of SMP Area
GENERAL APPLICATION AREA
PREDICTED 20mm SUBSIDENCE CONTOUR
LW 24A
Pool A
Pool B
Pool C
Pool D
Pool E
Pool F
Pool H
Pool I
Pool J
Pool K
Pool L
Pool M
Pool N
Pool O
Pool P
Pool Q
Pool R
Pool S
Pool T
Pool U
Pool V
RB A
RB B
RB C
RB D
RB E
RB F
RB G
RB H
RB I
RB J
RB K
RB L
RB M
RB N
RB O
RB P
RB Q
RB R
RB S
RB T
RB U
RB V
HCS Bolt
HCS Logger
X1L
X1R
X2L
X2R
X3L
X3R
X4L
X4R
X4STN
X5L
X5R
X6L
X6R
complete surface flow diversion
race through boulders
laminated rock
flute holes in rockbars
complete loss of surface water
iron precipitation
waterfall
waterfalls
cracked triangular wedge
crack in rock
race
rock shelf
flute holes
joint in rockbar
house size boulders and small boulders
boulders
boulder
cracks in cliff
boulders and rapids
complete loss of surface water
race rapids
Dyke
Walking Tr

APPENDIX A

WATER QUALITY DATA

Table C1 Field Water Quality Parameters

ANZECC	6.5-7.5					
pH	**8/5/06**	**8/6/06**	**28/7/06**	**28/8/06**	**27/9/06**	**30/10/06**
BR1	5.94					
BR2	6.2					
BR3	5.3					
TT Up	5.82	5.58	4.4	6.64	4.7	4.94
TT	8.2	8.19	8.88	8.94	8.65	8.9
TT Down	8.26	8.03	9.23	8.96	8.78	9.02
Rckfd Rd	8.22	8.07	8.92	8.9	8.85	8.96
Mer PL	8.25	8.12	8.99	8.99	8.71	9.11
Pool N	8.26	8.13	9	9.04	8.76	9.04
Pool K	8.28	8.18	9.08	9.04	8.76	9.09
Pool J	8.26	8.22	9.06	9.07	8.84	9.2
Pool H	8.25	8.18	9.16	9.07	8.87	9.21
Pool F				9.05	8.87	9.23

ANZECC	6.5-7.5					
EC	**8/5/06**	**8/6/06**	**28/7/06**	**28/8/06**	**27/9/06**	**30/10/06**
BR1	222					
BR2	222					
BR3	247					
TT Up	265	292	316	348	279	398
TT	1695	1616	2210	2160	2140	2290
TT Down	1296	1484	1761	1709	1877	2220
Rckfd Rd	1308	1398	1804	1722	1690	1785
Mer PL	1306	1342	1793	1632	1586	1890
Pool N	1269	1384	1777	1593	1571	1748
Pool K	1278	1375	1800	1591	1568	1751
Pool J	1267	1391	1770	1598	1350	1880
Pool H	1264	1374	1771	1548	1541	1743
Pool F				1552	1541	1763

DO	**8/5/06**	**8/6/06**	**28/7/06**	**28/8/06**	**27/9/06**	**30/10/06**
BR1	7.5					
BR2	7.9					
BR3	7.6					
TT Up	7	7.3	7.4	7.65	7.1	6.6
TT	8.1	7.2	7.3	6.9	8.2	7.2
TT Down	7.1	6.4	6.5	6.55	7.2	6.2
Rckfd Rd	8.1	8.3	8.4	7.2	8.2	8.8
Mer PL	9.2	8.2	8.2	8.4	9.3	10.3
Pool N	7.9	6.7	6.7	6.6	7.8	7.7
Pool K	7.8	6.5	6.4	6.3	7.7	7.8
Pool J	8	7.2	7.2	7.1	8.1	8.9
Pool H	8.1	7.4	6.9	6.9	8	8.7
Pool F				7.1	8.3	8.7

Temp	**8/5/06**	**8/6/06**	**28/7/06**	**28/8/06**	**27/9/06**	**30/10/06**
BR1	16.7					
BR2	16.5					
BR3	17.1					
TT Up	16	10.2	11.1	14.1	16.6	16.5
TT	16.4	14.1	14.4	17.5	18.4	16.7
TT Down	16.7	13.8	13	17.7	19.8	16.7
Rckfd Rd	17.4	11.6	12.6	13.4	18.3	19.4
Mer PL	17.7	12.6	13.4	13.3	19.3	21.7
Pool N	17.7	11.6	12.8	12.6	18.4	20.3
Pool K	17.7	11.8	12.2	12.4	17.5	18.6
Pool J	16.7	11.5	11.8	12.4	16.7	19
Pool H	16.7	11.4	11.7	11.5	16.4	17.6
Pool F				11.6	16.4	17.8

Eh	**8/5/06**	**8/6/06**	**28/7/06**	**28/8/06**	**27/9/06**	**30/10/06**
BR1	185					
BR2	174					
BR3	173					
TT Up	166	239	205	176	197	190
TT	117	161	132.7	127.3	95	123
TT Down	114	183	140	124.1	72	95
Rckfd Rd	130	168	141	136.6	128	112
Mer PL	145	164	117	150.6	115	95
Pool N	135	161	141	139	83	93
Pool K	131	130	69	134.1	29	107
Pool J	148	132	138	148.5	104	95
Pool H	141	78	126	148.3	126	114
Pool F				145	125	91.6

Table C2 Initial Water Quality Parameter Monitoring

ANZECC	6.5-7.5				
pH	**22/12/04**	**17/3/05**	**22/5/05**	**27/7/05**	**30/9/05**
BR1	5.77		6.11		5.92
BR2	6.46		7.08		5.97
BR3	5.5		6.14		5.04
Mer PL	6.84	8.01	7.91	7.76	8.55
Pool N	6.9	7.25	7.94	7.72	8.54
HCS6	6.85	7.35	7.83	8.15	8.67

ANZECC	30-350				
EC	**22/12/04**	**17/3/05**	**22/5/05**	**27/7/05**	**30/9/05**
BR1	226		218		138
BR2	225		248		225
BR3	269		254		236
Mer PL	515	971	1470	1187	1330
Pool N	503	758	1470	1047	1390
HCS6	413	901	1264	1011	1640

Table C3 Bargo River Flux (g/day)

8/05/2006	Tot N	Tot P	Fe Tot	Filt Mn	Filt Cu	Filt Zn	Filt Ni	Filt As	Flow (ML/day)
TT Up	10	10	290	50	1	12	10	10	0.999
TT	4601	26	281	26	8	69	179	102	2.556
TT Down	4362	26	231	26	3	41	154	51	2.566
Rckfd Rd	4977	36	427	36	7	60	213	107	3.555
Mer PL	5294	41	489	41	12	57	244	81	4.072
Pool N	4084	37	1114	37	4	22	186	37	3.713
Pool K	6488	59	2359	59	6	53	295	59	5.898
Pool J	4531	45	952	45	9	45	272	45	4.531
Pool H	5141	57	1428	57	6	46	343	57	5.712
Pool F									6.2

8/06/2006	Tot N	Tot P	Fe Tot	Filt Mn	Filt Cu	Filt Zn	Filt Ni	Filt As	Flow (ML/day)
TT Up	139	14	153	222	1	13	14	14	1.39
TT	16724	41	245	82	4	57	245	204	4.079
TT Down	11040	41	286	123	4	90	245	123	4.089
Rckfd Rd	10391	55	547	55	5	71	328	164	5.469
Mer PL	7365	46	736	46	9	64	276	138	4.603
Pool N	8834	49	1276	49	5	49	245	49	4.908
Pool K	10159	60	1554	60	6	42	299	120	5.976
Pool J	8527	50	652	50	5	60	251	50	5.016
Pool H	10480	66	917	66	7	59	328	131	6.55
Pool F									6.9

28/07/2006	Tot N	Tot P	Fe Tot	Filt Mn	Filt Cu	Filt Zn	Filt Ni	Filt As	Flow (ML/day)
TT Up	154	31	445	461	2	18	15	15	1.536
TT	18684	133	1335	334	7	194	534	400	6.673
TT Down	17376	267	1470	468	7	194	468	267	6.683
Rckfd Rd	16418	164	1149	246	16	205	575	328	8.209
Mer PL	14598	230	1460	154	15	146	461	230	7.683
Pool N	17799	656	2342	94	9	234	562	281	9.368
Pool K	26281	469	10325	94	9	169	657	282	9.386
Pool J	16094	153	1226	77	15	123	460	153	7.664
Pool H	20636	281	2908	94	9	141	469	188	9.38
Pool F									9.8

28/08/2006	Tot N	Tot P	Fe Tot	Filt Mn	Filt Cu	Filt Zn	Filt Ni	Filt As	Flow (ML/day)
TT Up	3581	46	416	289	1	13	12	12	1.155
TT	17644	265	838	44	4	137	397	221	4.411
TT Down	16800	486	973	398	4	111	265	133	4.421
Rckfd Rd	15585	390	946	56	11	117	390	167	5.566
Mer PL	12345	380	1377	142	5	81	332	142	4.748
Pool N	15732	328	2229	66	7	98	393	131	6.555
Pool K	20471	682	2123	76	8	91	455	152	7.582
Pool J	11070	554	1218	55	11	89	332	55	5.535
Pool H	14087	671	1275	67	7	67	402	134	6.708
Pool F	17280	432	1152	72	14	108	432	72	7.2

	BARGO	RIVER	FLUX	(g/day)					
27/09/2006	**Tot N**	**Tot P**	**Fe Tot**	**Filt Mn**	**Filt Cu**	**Filt Zn**	**Filt Ni**	**Filt As**	**Flow (ML/day)**
TT Up	367	12	428	807	1	32	12	12	1.222
TT	2444	41	611	41	4	81	367	244	4.073
TT Down	2858	82	572	41	8	61	286	163	4.083
Rckfd Rd	530	53	582	53	5	101	371	212	5.295
Mer PL	490	49	883	49	5	78	294	147	4.904
Pool N	884	88	1945	88	9	124	530	265	8.84
Pool K	429	43	986	43	4	43	257	129	4.289
Pool J	478	48	717	48	5	72	287	96	4.78
Pool H	583	58	1342	58	6	76	350	117	5.833
Pool F	1750	58	933	58	6	758	350	175	6.2

30/10/2006	**Tot N**	**Tot P**	**Fe Tot**	**Filt Mn**	**Filt Cu**	**Filt Zn**	**Filt Ni**	**Filt As**	**Flow (ML/day)**
TT Up	94	9	365	1122	2	33	9	9	0.935
TT	7641	25	713	25	5	135	153	25	2.547
TT Down	5625	26	588	128	3	120	128	77	2.557
Rckfd Rd	5571	70	244	35	3	56	174	104	3.482
Mer PL	3318	28	387	28	3	28	138	83	2.765
Pool N	3405	31	1207	31	3	25	186	62	3.095
Pool K	2718	54	571	27	3	19	136	54	2.718
Pool J	3172	32	381	32	3	29	159	63	3.172
Pool H	5959	60	953	60	12	42	298	119	5.959
Pool F	3600	40	440	40	4	40	200	80	4

Table C4 Myrtle Creek / Redbank Creek Field Monitoring

pH	Myrtle	Creek		Redbank	Creek	
	MYC1	MYC2	MYC3	RC1	RC2	RC3
8/12/2004	6.29	6.3				
22/12/2004						
4/03/2005		5.31				
5/03/2005	6.17					
17/03/2005						
19/04/2005				5.74	4.36	6.93
22/05/2005			7	6.73	4.15	7.03
27/07/2005						
30/09/2005	6.4	6.2	7.47	6.92	6.51	6.45
5/04/2006			7.72	6.82	3.1	6.95
18/07/2006	6.42	6.43		6.91	5.76	6.79
28/08/2006			7.83			
5/10/2006		6	7.69	6.47	4.49	6.83
30/10/2006						6.45

EC	Myrtle	Creek		Redbank	Creek	(µS/cm)
	MYC1	MYC2	MYC3	RC1	RC2	RC3
8/12/2004	186	732				
22/12/2004						
4/03/2005		906				
5/03/2005	209					
17/03/2005						
19/04/2005				650	1960	415
22/05/2005			1121	573	1931	566
27/07/2005						
30/09/2005	165	391	583	211	340	280
5/04/2006			2440	694	590	482
18/07/2006	128	315		301	688	438
28/08/2006			1913			
5/10/2006		421	1581	507	1949	527
30/10/2006						753

BARGO RIVER LABORATORY ANALYSES

ANZECC 2000											0.25	0.02			1.9			0.055	0.0014	0.0034	0.008	0.011	0.024 (III) / 0.013(V)	0.011	
Location	**22/12/04**	**TDS**	**Na**	**Ca**	**K**	**Mg**	**Cl**	**F**	**SO4**	**HCO3**	**Tot N**	**Tot P**	**Fe Tot**	**Fe Filt**	**Mn**	**Filt Mn**	**Al**	**Filt Al**	**Filt Cu**	**Filt Pb**	**Filt Zn**	**Filt Ni**	**Filt As**	**Filt Se**	**TOC**
BR1			15	8.2	10	8.5	65	0.24	8	380	0.8	0.01	0.22						0.004	0.001	0.035		0.01	0.01	
Pool N			160	9.5	10	9.2	68	0.21	7	390	0.8	0.01	0.28						0.001	0.001	0.008		0.01	0.01	
HCS6			150	10	10	9.6	75	0.21	8	360	0.7	0.01	0.25						0.001	0.001	0.008		0.01	0.01	
Location	**8/5/06**	**TDS**	**Na**	**Ca**	**K**	**Mg**	**Cl**	**F**	**SO4**	**HCO3**	**Tot N**	**Tot P**	**Fe Tot**	**Fe Filt**	**Mn**	**Filt Mn**	**Al**	**Filt Al**	**Filt Cu**	**Filt Pb**	**Filt Zn**	**Filt Ni**	**Filt As**	**Filt Se**	**TOC**
BR3		125	32	4.3	1.2	3.7	62	0.01	7	8															
TT Up		115	31	1.9	1.4	4.1	60	0.001	6	4	0.01	0.01	0.29	0.04	0.08	0.05	0.1	0.1	0.001	0.001	0.012	0.01	0.01	0.01	3
TT		930	325	18	23	13	93	0.43	7	880	1.8	0.01	0.11	0.01	0.01	0.01	0.2	0.1	0.003	0.001	0.027	0.07	0.04	0.01	2
TT Down		740	255	16	17	11	86	0.01	6	680	1.7	0.01	0.09	0.01	0.01	0.01	0.1	0.1	0.001	0.001	0.016	0.06	0.02	0.01	3
Rckfd Rd		720	250	16	18	12	75	0.31	7	660	1.4	0.01	0.12	0.01	0.01	0.01	0.1	0.1	0.002	0.001	0.017	0.06	0.03	0.01	2
Mer PL		710	240	15	17	12	79	0.28	7	610	1.3	0.01	0.12	0.01	0.01	0.01	0.1	0.1	0.003	0.001	0.014	0.06	0.02	0.01	2
Pool N		680	235	15	16	12	79	0.3	6	580	1.1	0.01	0.30	0.01	0.01	0.01	0.1	0.1	0.001	0.001	0.006	0.05	0.01	0.01	2
Pool K		680	240	14	17	12	79	0.3	6	600	1.1	0.01	0.40	0.01	0.04	0.01	0.1	0.1	0.001	0.001	0.009	0.05	0.01	0.01	2
Pool J		710	245	14	17	12	76	0.3	6	610	1	0.01	0.21	0.01	0.01	0.01	0.2	0.1	0.002	0.001	0.01	0.06	0.01	0.01	7
Pool H		700	240	14	16	12	79	0.3	7	640	0.9	0.01	0.25	0.01	0.01	0.01	0.1	0.1	0.001	0.001	0.008	0.06	0.01	0.01	2
Location	**8/6/06**	**TDS**	**Na**	**Ca**	**K**	**Mg**	**Cl**	**F**	**SO4**	**HCO3**	**Tot N**	**Tot P**	**Fe Tot**	**Fe Filt**	**Mn**	**Filt Mn**	**Al**	**Filt Al**	**Filt Cu**	**Filt Pb**	**Filt Zn**	**Filt Ni**	**Filt As**	**Filt Se**	**TOC**
TT Up		120	34	1.9	2.1	5.4	69	0.01	7	5	0.1	0.01	0.11	0.02	0.26	0.16	0.1	0.1	0.001	0.001	0.009	0.01	0.01	0.01	2
TT		1040	395	18	30	15	85	0.36	8	1000	4.1	0.01	0.06	0.01	0.02	0.02	0.1	0.1	0.001	0.001	0.014	0.06	0.05	0.01	2
TT Down		860	310	24	23	14	79	0.3	7	760	2.7	0.01	0.07	0.01	0.06	0.03	0.1	0.1	0.001	0.001	0.022	0.06	0.03	0.01	1
Rckfd Rd		890	290	21	21	13	80	0.33	8	710	1.9	0.01	0.10	0.01	0.01	0.01	0.1	0.1	0.001	0.001	0.013	0.06	0.03	0.01	1
Mer PL		810	290	19	20	13	91	0.34	7	690	1.6	0.01	0.16	0.01	0.01	0.01	0.1	0.1	0.002	0.001	0.014	0.06	0.03	0.01	1
Pool N		810	295	17	19	13	86	0.33	8	690	1.8	0.01	0.26	0.01	0.01	0.01	0.1	0.1	0.001	0.001	0.01	0.05	0.01	0.01	0.1
Pool K		770	275	17	19	13	79	0.32	7	650	1.7	0.01	0.26	0.01	0.01	0.01	0.1	0.1	0.001	0.001	0.007	0.05	0.02	0.01	2
Pool J		780	285	17	19	13	84	0.31	8	620	1.7	0.01	0.13	0.01	0.01	0.01	0.1	0.1	0.001	0.001	0.012	0.05	0.01	0.01	2
Pool H		770	280	16	19	13	80	0.32	8	630	1.6	0.01	0.14	0.01	0.01	0.01	0.1	0.1	0.001	0.001	0.009	0.05	0.02	0.01	2
Location	**28/7/06**	**TDS**	**Na**	**Ca**	**K**	**Mg**	**Cl**	**F**	**SO4**	**HCO3**	**Tot N**	**Tot P**	**Fe Tot**	**Fe Filt**	**Mn**	**Filt Mn**	**Al**	**Filt Al**	**Filt Cu**	**Filt Pb**	**Filt Zn**	**Filt Ni**	**Filt As**	**Filt Se**	**TOC**
TT Up		110	28	2.7	2.1	5.3	60	0.1	5	7	0.1	0.02	0.29	0.06	0.4	0.3	0.1	0.1	0.001	0.001	0.012	0.01	0.01	0.01	1
TT		1140	420	25	28	15	74	0.46	9	1200	2.8	0.02	0.20	0.01	0.05	0.05	0.1	0.1	0.001	0.001	0.029	0.08	0.06	0.01	2
TT Down		960	335	26	23	14	69	0.92	10	970	2.6	0.04	0.22	0.01	0.09	0.07	0.1	0.1	0.001	0.001	0.029	0.07	0.04	0.01	2
Rckfd Rd		900	320	23	23	14	74	0.38	7	830	2	0.02	0.14	0.03	0.04	0.03	0.1	0.1	0.002	0.001	0.025	0.07	0.04	0.01	1
Mer PL		875	320	220	22	14	75	0.4	6	850	1.9	0.03	0.19	0.01	0.02	0.02	0.1	0.1	0.002	0.001	0.019	0.06	0.03	0.01	1
Pool N		805	285	20	22	13	74	0.39	4	730	1.9	0.07	0.25	0.01	0.02	0.01	0.1	0.1	0.001	0.001	0.025	0.06	0.03	0.01	0.1
Pool K		850	305	19	22	14	73	0.42	5	780	2.8	0.05	1.10	0.01	0.02	0.01	0.1	0.1	0.001	0.001	0.018	0.07	0.03	0.01	2
Pool J		835	300	19	21	14	74	0.4	4	760	2.1	0.02	0.16	0.01	0.01	0.01	0.1	0.1	0.002	0.001	0.016	0.06	0.02	0.01	0.1
Pool H		830	305	19	21	14	73	0.39	4	770	2.2	0.03	0.31	0.01	0.01	0.01	0.1	0.1	0.001	0.001	0.015	0.05	0.02	0.01	1

BARGO RIVER LABORATORY ANALYSES

ANZECC 2000										0.25	0.02			1.9			0.055	0.0014	0.0034	0.008	0.011	0.024 (III) / 0.013(V)	0.011	
TT Up		135	40	2.2	1.3	6	68	0.1	7	10	3.1	0.04	0.36	0.01	0.32	0.25	0.1	0.1	0.001	0.001	0.011	0.01	0.01	0.01	0.1
TT		1230	440	13	31	17	73	0.27	13	1230	4	0.06	0.19	0.01	0.01	0.01	0.1	0.1	0.001	0.001	0.031	0.09	0.05	0.01	2
TT Down		960	330	21	23	15	73	0.23	12	930	3.8	0.11	0.22	0.01	0.15	0.09	0.1	0.1	0.001	0.001	0.025	0.06	0.03	0.01	2
Rckfd Rd		1010	355	22	24	16	73	0.27	9	950	2.8	0.07	0.17	0.01	0.02	0.01	0.1	0.1	0.002	0.001	0.021	0.07	0.03	0.01	2
Mer PL		950	340	20	24	15	72	0.26	9	870	2.6	0.08	0.29	0.01	0.03	0.03	0.1	0.1	0.001	0.001	0.017	0.07	0.03	0.01	1
Pool N		960	345	19	23	15	76	0.27	9	890	2.4	0.05	0.34	0.01	0.02	0.01	0.1	0.1	0.001	0.001	0.015	0.06	0.02	0.01	2
Pool K		945	345	19	23	15	73	0.26	11	900	2.7	0.09	0.28	0.01	0.02	0.01	0.1	0.1	0.001	0.001	0.012	0.06	0.02	0.01	2
Pool J		940	340	18	22	17	74	0.27	9	850	2	0.1	0.22	0.01	0.01	0.01	0.1	0.1	0.002	0.001	0.016	0.06	0.01	0.01	1
Pool H		950	350	18	24	15	74	0.27	11	850	2.1	0.1	0.19	0.01	0.01	0.01	0.1	0.1	0.001	0.001	0.01	0.06	0.02	0.01	2
Pool F		940	345	18	24	15	73	0.26	9	850	2.4	0.06	0.16	0.01	0.01	0.01	0.1	0.1	0.002	0.001	0.015	0.06	0.01	0.01	2

Location	**27/9/06**	**TDS**	**Na**	**Ca**	**K**	**Mg**	**Cl**	**F**	**SO4**	**HCO3**	**Tot N**	**Tot P**	**Fe Tot**	**Fe Filt**	**Mn**	**Filt Mn**	**Al**	**Filt Al**	**Filt Cu**	**Filt Pb**	**Filt Zn**	**Filt Ni**	**Filt As**	**Filt Se**	**TOC**
TT Up		75	15	2.9	1	5.9	38	0.1	6	4	0.3	0.01	0.35	0.01	0.72	0.66	0.1	0.1	0.001	0.001	0.026	0.01	0.01	0.01	1
TT		1210	440	12	28	17	81	0.35	11	1210	0.6	0.01	0.15	0.01	0.01	0.01	0.1	0.1	0.001	0.001	0.02	0.09	0.06	0.01	1
TT Down		1020	350	21	24	16	82	0.33	11	990	0.7	0.02	0.14	0.01	0.03	0.01	0.1	0.1	0.002	0.001	0.015	0.07	0.04	0.01	2
Rckfd Rd		900	310	19	22	14	76	0.39	21	840	0.1	0.01	0.11	0.01	0.01	0.01	0.1	0.1	0.001	0.001	0.019	0.07	0.04	0.01	1
Mer PL		910	325	18	20	14	73	0.38	20	890	0.1	0.01	0.18	0.01	0.01	0.01	0.1	0.1	0.001	0.001	0.016	0.06	0.03	0.01	1
Pool N		830	285	17	19	14	73	0.34	15	790	0.1	0.01	0.22	0.01	0.01	0.01	0.1	0.1	0.001	0.001	0.014	0.06	0.03	0.01	1
Pool K		830	290	18	19	14	73	0.34	15	770	0.1	0.01	0.23	0.01	0.01	0.01	0.1	0.1	0.001	0.001	0.01	0.06	0.03	0.01	1
Pool J		810	275	18	19	14	73	0.34	15	760	0.1	0.01	0.15	0.01	0.01	0.01	0.1	0.1	0.001	0.001	0.015	0.06	0.02	0.01	1
Pool H		810	275	18	20	14	73	0.33	14	760	0.1	0.01	0.23	0.01	0.01	0.01	0.1	0.1	0.001	0.001	0.013	0.06	0.02	0.01	1
Pool F		770	255	17	18	14	72	0.32	14	720	0.3	0.01	0.16	0.01	0.01	0.01	0.1	0.1	0.001	0.001	0.01	0.06	0.02	0.01	1

Location	**30/10/06**	**TDS**	**Na**	**Ca**	**K**	**Mg**	**Cl**	**F**	**SO4**	**HCO3**	**Tot N**	**Tot P**	**Fe Tot**	**Fe Filt**	**Mn**	**Filt Mn**	**Al**	**Filt Al**	**Filt Cu**	**Filt Pb**	**Filt Zn**	**Filt Ni**	**Filt As**	**Filt Se**	**TOC**
TT Up		125	33	3	1.2	6.5	76	0.1	4	1	0.1	0.01	0.39	0.03	1.2	1.2	0.1	0.1	0.002	0.001	0.035	0.01	0.01	0.01	4
TT		1250	450	14	30	20	86	0.31	12	1250	3	0.01	0.28	0.02	0.01	0.01	0.1	0.1	0.002	0.001	0.053	0.06	0.01	0.01	3
TT Down		1070	390	18	24	18	86	0.29	11	1090	2.2	0.01	0.23	0.02	0.06	0.05	0.1	0.1	0.001	0.001	0.047	0.05	0.03	0.01	3
Rckfd Rd		960	335	17	23	15	79	0.42	10	920	1.6	0.02	0.07	0.01	0.01	0.01	0.1	0.1	0.001	0.001	0.016	0.05	0.03	0.01	2
Mer PL		910	330	14	23	14	79	0.42	8	890	1.2	0.01	0.14	0.01	0.01	0.01	0.1	0.1	0.001	0.001	0.01	0.05	0.03	0.01	2
Pool N		920	340	13	21	14	81	0.41	9	830	1.1	0.01	0.39	0.01	0.01	0.01	0.1	0.1	0.001	0.001	0.008	0.06	0.02	0.01	2
Pool K		900	330	13	22	15	82	0.4	7	790	1	0.02	0.21	0.01	0.01	0.01	0.1	0.1	0.001	0.001	0.007	0.05	0.02	0.01	1
Pool J		910	330	13	22	15	80	0.41	8	800	1	0.01	0.12	0.01	0.01	0.01	0.1	0.1	0.001	0.001	0.009	0.05	0.02	0.01	1
Pool H		910	335	13	23	15	81	0.4	8	820	1	0.01	0.16	0.01	0.01	0.01	0.1	0.1	0.002	0.001	0.007	0.05	0.02	0.01	2
Pool F		920	340	13	22	15	82	0.4	9	840	0.9	0.01	0.11	0.01	0.01	0.01	0.1	0.1	0.001	0.001	0.01	0.05	0.02	0.01	2

MYRTLE AND REDBANK CREEK WATER QUALITY

ANZECC 2000 6.5-8.5 <350

5/12/03	pH	EC	TDS	Na	Ca	K	Mg	Cl	F	SO4	HCO3
MYC1	6.64	198	87	10	11	4.8	5.6	11	<0.1	6	71
MYC2	6.6	419	170	27	20	2.8	13	68	0.1	5	81

8/12/04	pH	EC	TDS	Na	Ca	K	Mg	Cl	F	SO4	HCO3	Tot N	Tot P
MYC1	6.29	186	120	10	15	4.3	4.5	10	0.1	6	80	0.9	0.05
MYC2	6.3	732	475	55	32	4.3	25	160	0.1	15	92	0.8	0.05

28/2/05	pH	EC	TDS	Na	Ca	K	Mg	Cl	F	SO4	HCO3
MYC1	dry										
MYC2	dry										
MYC3		925	600	120	25	50	13	120	0.24	10	320
RC1		460	300	40	54	6.8	11	42	0.13	2	270
RC2		1325	860	220	14	3.4	59	540	0.1	5	1
RC3		445	290	51	32	6.4	16	55	0.2	6	230

4/3/05	pH	EC
MYC1	6.17	209
MYC2	5.31	906
MYC3	_	_

26/5/05	pH	EC
MYC1	dry	
MYC2	dry	
MYC3	7	1121
RC1	6.73	650
RC2	4.15	1931
RC3	6.93	566

30/9/05	pH	EC
MYC1	6.4	165
MYC2	6.2	391
MYC3	7.47	583
RC1	6.92	211
RC2	6.51	340
RC3	6.45	280

MYRTLE AND REDBANK CREEK WATER QUALITY

7/4/06	pH	EC	TDS	Na	Ca	K	Mg	Cl	F	SO4	HCO3	Tot N	Tot P	Fe Tot	Fe Filt	Filt Mn	Filt Al	Filt Cu	Filt Pb	Filt Zn	Filt Zn	Filt As	Filt Se	TOC
ANZECC 2000	6.5-8.5	<350										0.25	0.02			1.9	0.055	0.0014	0.0034	0.008	0.011	0.024 (III) / 0.013(V)	0.011	
MYC1	dry																							dry
MYC2	dry																							dry
MYC3	7.72	2440	1390	250	34	120	16	240	0.34	40	820	180	30	2.00	0.85	0.26	0.1	0.008	0.001	0.012	0.01	0.01	0.01	47
RC1	6.82	694	300	57	38	7.2	10	60	0.19	14	210	7.6	0.1	1.90	0.07	0.1	0.1	0.001	0.001	0.015	0.01	0.01	0.01	11
RC2	5.09	1950	1030	220	15	3.6	56	610	0.1	7	1	0.4	0.1	3.50	0.35	3.4	0.1	0.005	0.003	0.035	0.04	0.01	0.01	1
RC3	6.95	482	220	44	26	5.6	11	57	0.31	13	150	2.6	0.14	1.20	0.08	0.04	0.1	0.001	0.001	0.004	0.01	0.01	0.01	10

18/7/06	pH	EC
MYC1	6.42	128
MYC2	6.43	315
MYC3		
RC1	6.91	301
RC2	5.76	688
RC3	6.79	438

5/10/06	pH	EC	TDS	Na	Ca	K	Mg	Cl	F	SO4	HCO3	Tot N	Tot P	Fe Tot	Fe Filt	Filt Mn	Filt Al	Cu	Pb	Zn	Ni	As	Se	TOC
MYC1	dry																							dry
MYC2	6	421	210	28	17	3.5	13	55	0.14	22	120	5.7	0.66	22.00	13	0.08	0.1	0.001	0.001	0.008	0.01	0.01	0.01	17
MYC3	7.69	1581	740	180	22	63	13	110	0.32	22	580	69	20	1.20	1	0.18	0.1	0.001	0.001	0.004	0.01	0.01	0.01	32
RC1	6.47	507	265	53	33	5	7.3	44	0.2	19	190	2.1	0.05	3.20	0.29	0.01	0.1	0.001	0.001	0.01	0.01	0.01	0.01	9
RC2	4.49	1949	950	210	75	3.2	53	490	0.25	13	200	0.1	0.01	4.20	0.02	2	0.1	0.001	0.001	0.026	0.02	0.01	0.01	1
RC3	6.83	527	250	50	24	4.2	11	64	0.24	11	150	2.7	0.06	3.00	0.95	0.04	0.1	0.001	0.001	0.003	0.01	0.01	0.01	9

TAHMOOR THIRLEMERE GROUNDWATER ANALYSES

Location	Date	Fld pH	EC	TDS	Na	Ca	K	Mg	Cl	F	SO4	HCO3	Tot N	Tot P	Fe Tot	Fe Filt	Filt Mn	Filt Al	Cu	Pb	Zn	Ni	As	Se
P1	8/12/04	5.3	2650		850	11	1.6	150	1800	<0.1	5	1	0.8	<0.1										
P1	7/04/06	5.17	3140	2010	600	7.6	2.1	110	1250	0.1	10	1	0.3	0.1	65.00	37	4.5	0.1	0.002	0.001	0.38	0.11	0.01	0.01
P1	5/10/06	4.96	2660	1720	480	13	1.3	99	1110	0.1	5	1	0.9	0.01	37.00	21	2.8	0.1	0.003	0.002	0.31	0.12	0.01	0.01
P2	8/12/04	5.61	2295		370	27	7.2	110	940	0.19	31	1	0.9	<0.1										
P2	7/04/06	5.71	3020	1910	495	35	9.6	135	1200	0.27	47	9	0.3	0.13	28.00	12	5.4	0.1	0.001	0.001	0.45	0.13	0.01	0.01
P2	5/10/06	5.32	1620	1050	250	14	2.7	76	650	0.1	12	1	0.3	0.13	7.20	1.7	3.5	0.1	0.002	0.004	0.53	0.08	0.01	0.01
P3	7/04/06	6.22	1580	1020	275	20	3.9	61	600	0.2	5	88	1	0.11	75.00	36	3.6	0.1	0.001	0.001	0.011	0.07	0.01	0.01
P3	5/10/06	5.59	2500	1600	390	22	3	105	960	0.21	27	4	0.1	0.04	64.00	50	3.6	0.1	0.001	0.001	0.1	0.09	0.01	0.01
P4	28/02/05	6.63	10925	7100	1600	180	55	585	3830	0.31	150	1210												
P4	7/04/06	6.55	10700	6890	1580	185	59	565	3740	0.37	145	1160	0.2	0.1	1.30	0.03	0.66	0.1	0.002	0.001	0.005	0.01	0.01	0.01
P4	5/10/06	6.39	10500	6750	1490	185	58	625	3690	0.27	150	1240	0.1	0.01	0.52	0.5	0.59	0.1	0.001	0.001	0.006	0.01	0.01	0.01
P5	28/02/05	5.65	3940	2560	730	8.3	21	145	1510	0.77	67	86												
P5	7/04/06	5.53	4450	2880	850	8.8	23	145	1700	79	72	82	0.6	0.1	3.40	0.08	5	0.1	0.001	0.001	0.3	0.14	0.01	0.01
P5	5/10/06	5.36	4150	2900	795	8.4	22	155	1620	0.7	72	96	0.1	0.01	4.80	0.09	4.2	0.1	0.001	0.001	0.28	0.11	0.01	0.01
Well1	28/02/05	7.05	460	300	51	41	8.1	8.5	74	0.1	22	170												
Well 1	7/04/06	6.82	420	270	46	38	6.7	7.9	80	0.14	36	100	1	0.1	0.86	0.18	0.16	0.1	0.003	0.001	0.055	0.01	0.01	0.01
Well 1	5/10/06	7.36	500	320	56	40	7.1	9.9	90	0.2	43	130	0.9	0.04	1.20	0.05	0.08	0.1	0.001	0.001	0.063	0.06	0.01	0.01