

Surface Water – Mining Area and Surrounds

Metropolitan Coal's Longwalls 20-22 underground mining area includes Waratah Rivulet and its tributaries (such as Tributaries A and B) and the Eastern Tributary and its tributaries (Figure 1). These streams flow directly to the Woronora Reservoir (Figure 1).

Metropolitan Coal's surface water monitoring program includes monitoring of:

- stream features;
- surface water flow;
- pool water levels;
- stream water quality; and
- reservoir water quality.

The monitoring results are described below.

Stream Features

Visual and photographic surveys of streams are conducted to monitor changes to stream features (such as surface cracking and iron staining) as mining progresses.

Stream bed cracking was observed in two sections of the Waratah Rivulet, namely between Flat Rock Crossing and the rock bar of Pool H, and at the rock bar of Pool N (located between Longwalls 21 and 22).

Evidence of flood damage was apparent following heavy rainfall (e.g. bent saplings on the stream banks) consistent with observations made during the Waratah Rivulet vegetation surveys. Some scouring of the stream banks due to flooding was also noted.

During the reporting period, gas releases in the Waratah Rivulet have been observed in Pools K, L and O (Figure 2). In accordance with the Metropolitan Coal Longwalls 20-22 Water Management Plan, the following actions were undertaken following identification of the gas release:

- monitoring conducted weekly to determine the extent of the gas releases;
- gas concentration monitoring; and
- identification of any observable environmental effects (e.g. impacts to riparian vegetation or fish).

No environmental effects resulting from the gas releases have been observed.

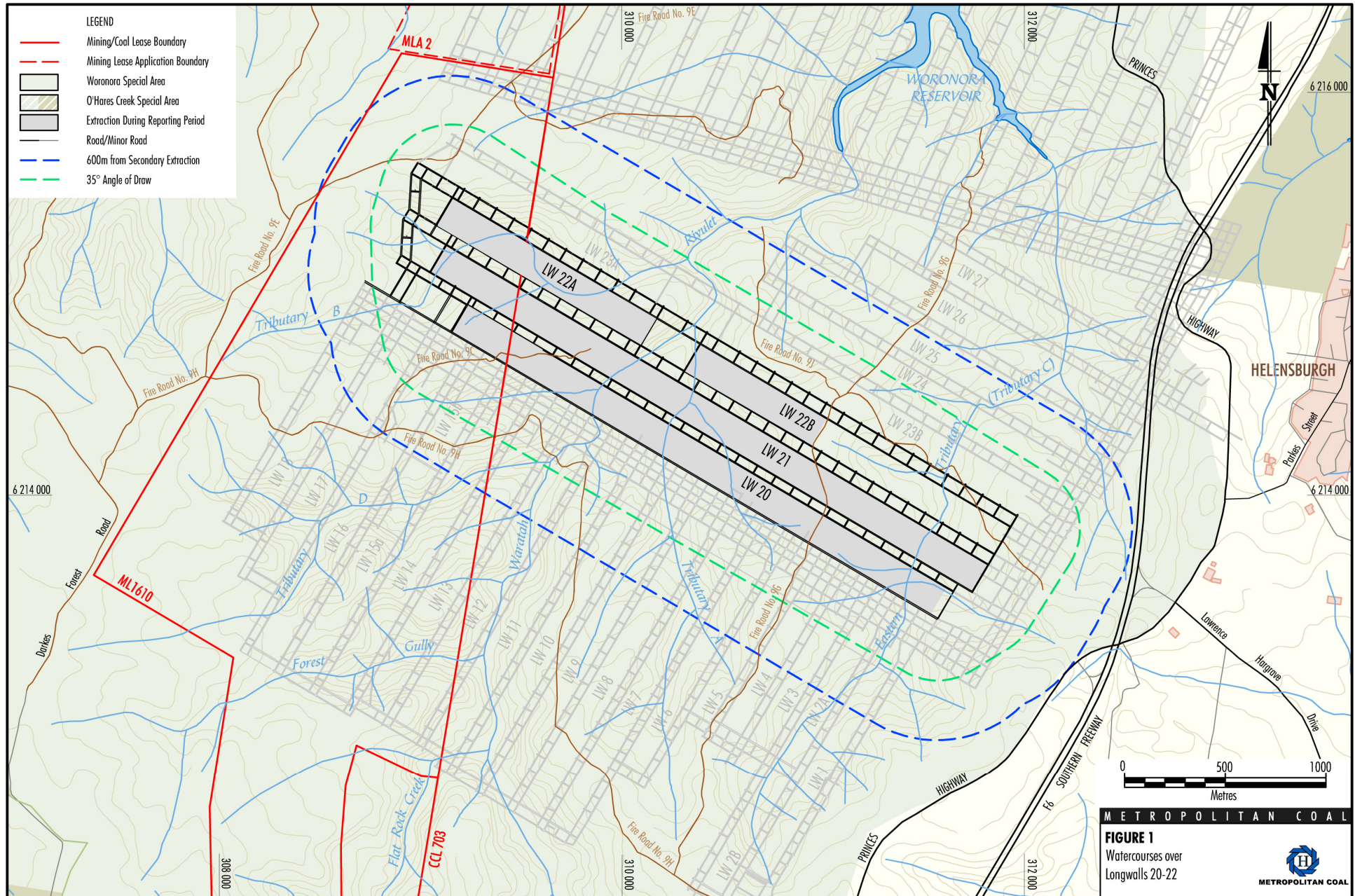
Surface Water Flow

Surface water flow monitoring has included continuous flow monitoring at the Sydney Catchment Authority (SCA) owned gauging stations on the Waratah Rivulet (GS2132102) and Woronora River (GS2132101) (Figure 2) and at the New South Wales Office of Environment and Heritage (OEH) gauging station on O'Hares Creek at Wedderburn (GS213200).

Chart 1 shows concurrent streamflow data from the SCA-owned gauging stations on Waratah Rivulet and Woronora River and the OEH-owned gauging station on O'Hares Creek at Wedderburn. Streamflow is expressed on a per unit catchment area basis (in millimetres) to allow direct comparison of flow magnitudes without having to adjust for contributing catchment area.

Chart 2 shows the same data expressed as the distribution of monitored flows (flow duration curves) expressed as megalitres/square kilometre/day (ML/km²/day) to remove the effect of catchment area on flows. Of the three streams, Waratah Rivulet yielded the highest flow per unit catchment area in medium and low flows, with strong low flow persistence. O'Hares Creek (at Wedderburn) yielded similar flows, with slightly greater high flows. Woronora River recorded the lowest low flows per unit catchment.

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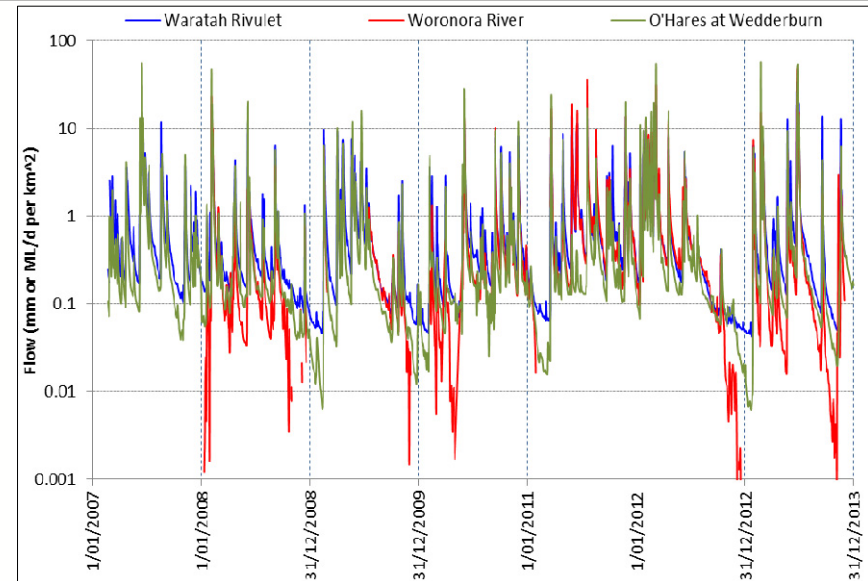
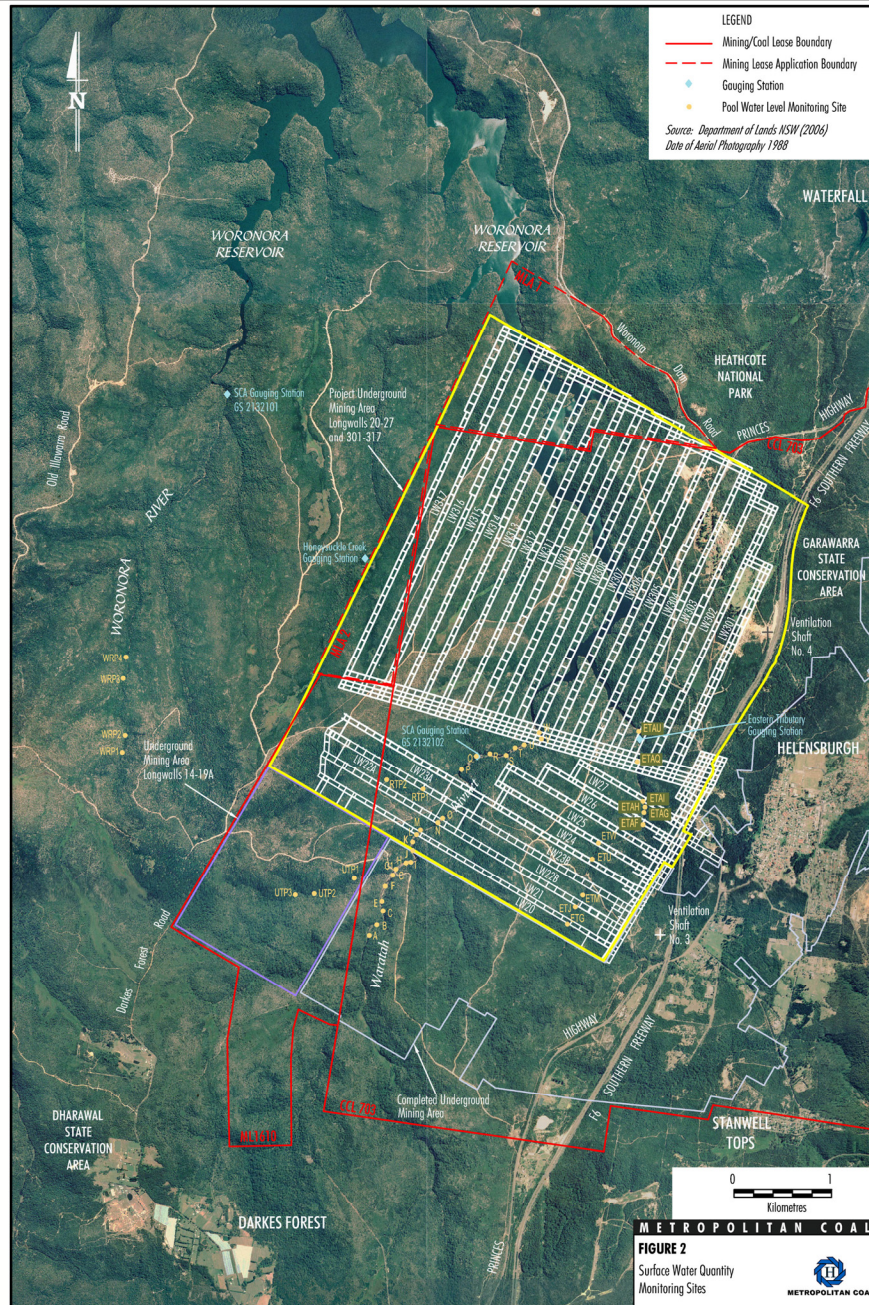


Chart 1 Recorded Streamflow Hydrographs – Waratah Rivulet, Woronora River and O'Hares Creek at Wedderburn

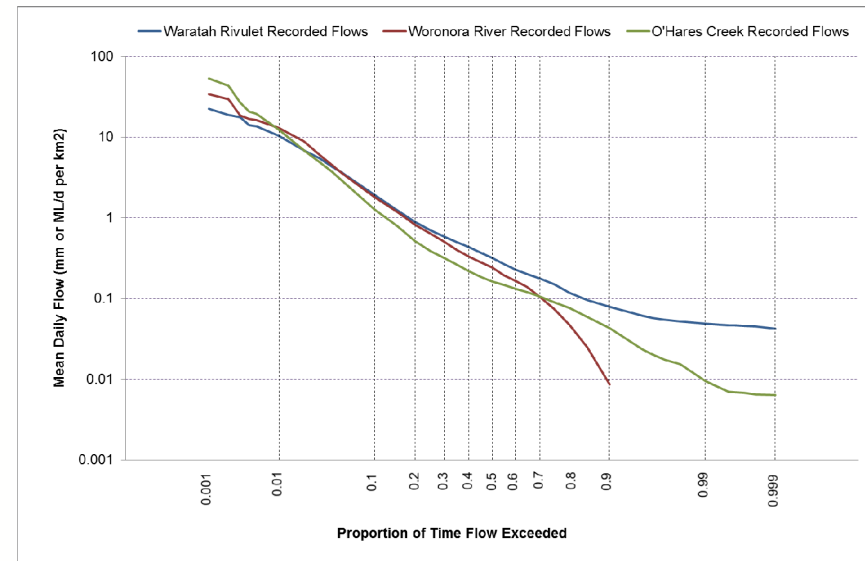


Chart 2 Recorded Flow Duration Curves - GS2132102 Waratah Rivulet, Woronora River GS213101, O'Hares Creek GS213200

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Pool Water Levels

Water levels in a number of pools on the Waratah Rivulet, Eastern Tributary, Tributary B and Woronora River are manually monitored on a daily basis or monitored using a continuous water level sensor and logger.

Pools A, B, C, E, F, G, G1, H and I on the Waratah Rivulet are situated in the completed mining area (i.e. overlying Longwalls 1 to 13) between Flat Rock Swamp and the tailgate of Longwall 20 (Figure 2). As a result of previous mining, the water levels in pools upstream of Flat Rock Crossing (i.e. Pools A to F) and immediately downstream of Flat Rock Crossing (Pools G and G1) have previously been impacted by mine subsidence.

During the reporting period, Pools A, B, E, F, G1, K and O temporarily ceased to flow during December 2012 and/or January 2013. Reference pools on Woronora River also ceased overflowing during the same December 2012 to January 2013 period. The Woronora River has not been impacted by longwall mining activity and these pools are considered to be reference or control pools reflecting natural conditions. The cease to flow behaviour of the Waratah Rivulet pools previously impacted by mine subsidence would have been influenced by the same period of low flow. Based on the similarity with the pools on Woronora River, the pool levels in Pool K and Pool O are considered to reflect natural pool behaviour. Water levels in the Waratah Rivulet pools remained above their respective cease to flow levels over the remainder of the reporting period.

Water levels in Pools C and G fell below their cease to flow levels during December 2012 and/or January 2013, and at other times during the reporting period (Pool C - between the 22 November 2012 and 25 January 2013 and between the 7 and 8 November 2013; Pool G - from the 24 September 2012 to the 25 January 2013 and then periodically over the remainder of the reporting period). As indicated above, Pools C and G have previously been impacted by mine subsidence.

Pool N ceased overflowing in early September 2012, and accordingly the stream remediation process has been initiated at this site. Notwithstanding, pool water levels subsequently recovered and continued to overflow the downstream rock bar over the remainder of the reporting period (Chart 3).

The water level monitoring results indicate that the remainder of the pools did not stop overflowing or reflected continuous through-flow and natural pool level behaviour over the reporting period. Stream remediation activities on the Waratah Rivulet are described in the Rehabilitation section of this Environmental Monitoring Summary.

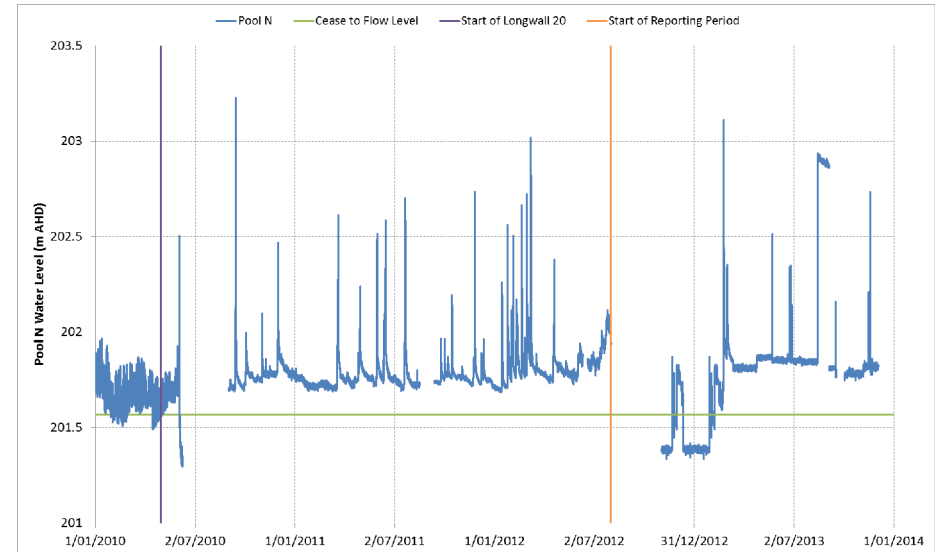


Chart 3 Pool N - Recorded Pool Water Level

Stream Water Quality

Surface water quality sampling has been conducted monthly at a number of sites on Waratah Rivulet, Tributary B, Tributary D, Eastern Tributary, Far Eastern Tributary, Honeysuckle Creek, Bee Creek and the Woronora River (Figure 3).

Water quality parameters sampled include electrical conductivity, pH, redox potential, dissolved oxygen, turbidity, calcium, magnesium, sodium, potassium, chloride, sulphate, bicarbonate, total nitrogen, total phosphorus, nitrate, barium, strontium, manganese, iron, zinc, cobalt and aluminium.

The results of key water quality parameters, namely pH, electrical conductivity, dissolved aluminium, dissolved iron and dissolved manganese, are shown on Charts 4 to 8, respectively, for a selection of sites (Woronora River control sites WOWQ 1, WOWQ 2 and WOWQ 4, Waratah Rivulet sites WRWQ 1, WRWQ 8 and WRWQ 9 and Eastern Tributary sites ETWQ F and ETWQ AU, Figure 3). Summary statistics from all sampling locations on the Eastern Tributary, Waratah Rivulet and Woronora River are presented in Table 1.

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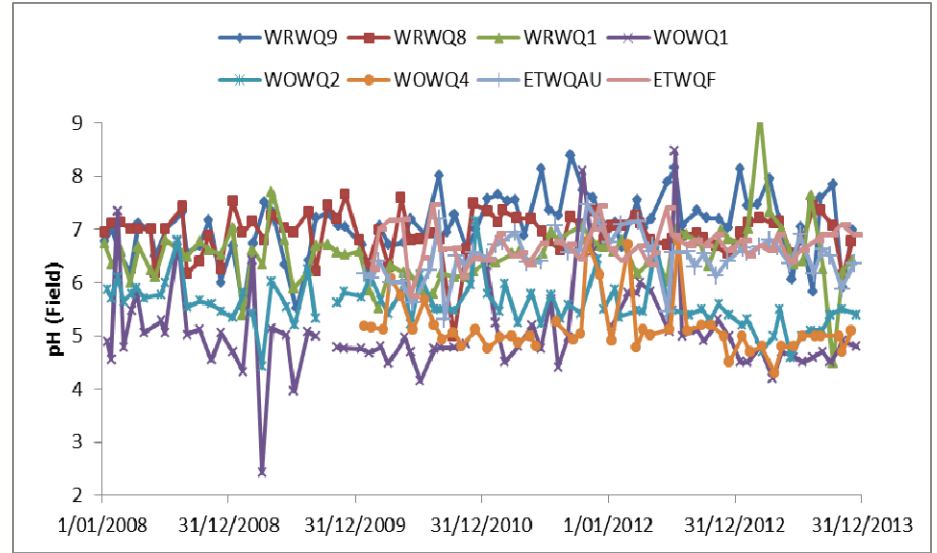
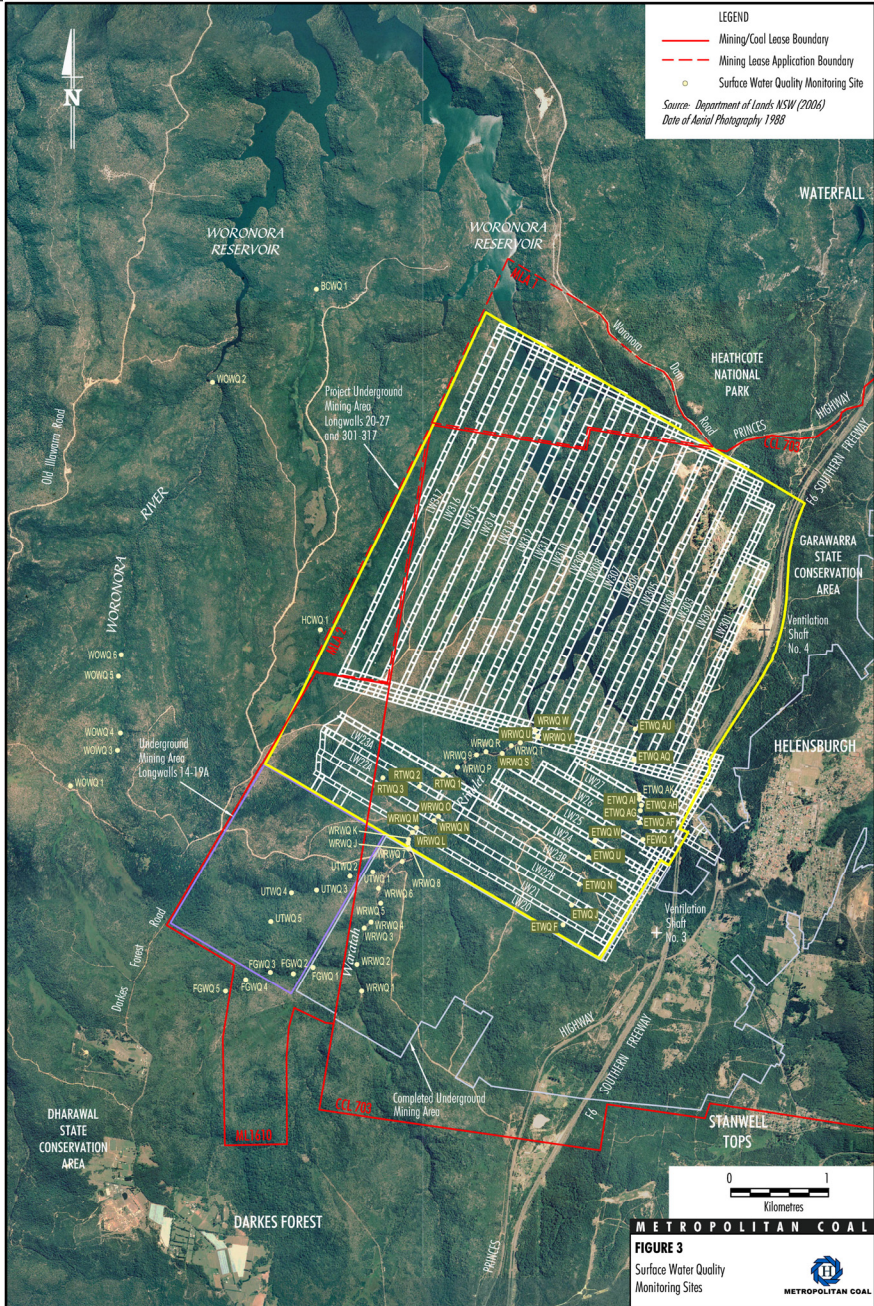


Chart 4 **pH**

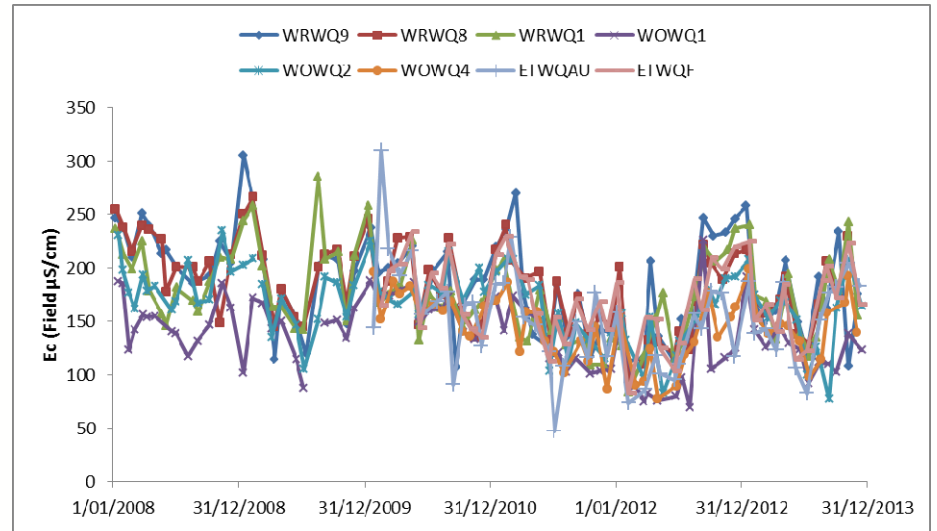


Chart 5 Electrical Conductivity (EC)

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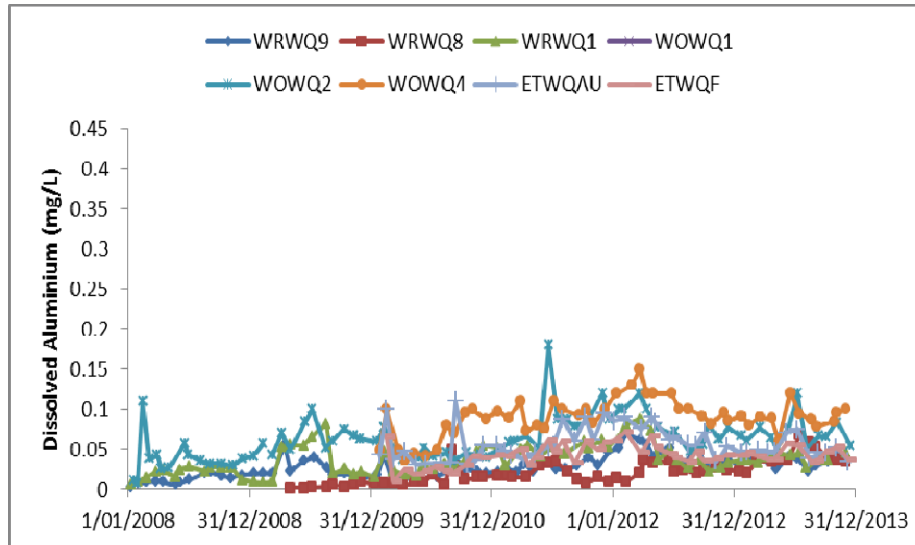


Chart 6 Dissolved Aluminium (Al)

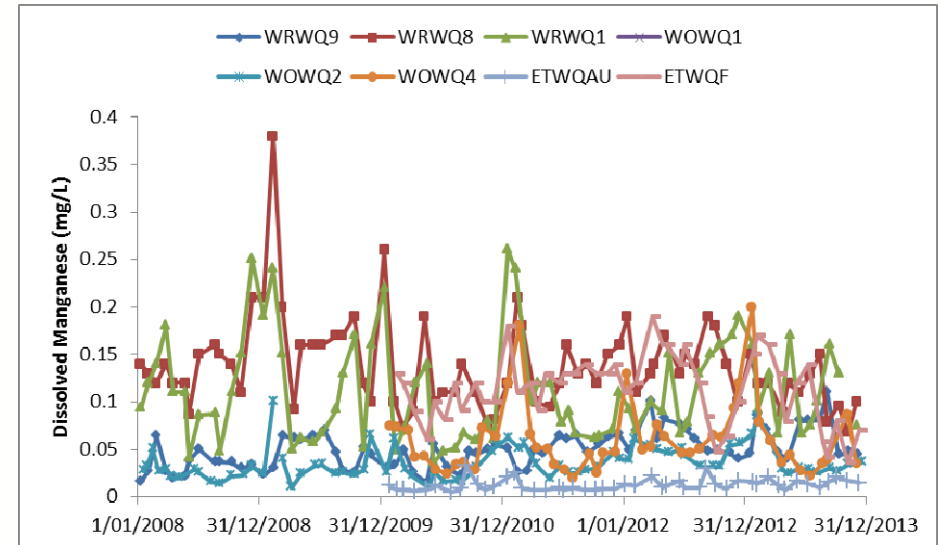


Chart 8 Dissolved Manganese (Mn)

Table 1
Surface Water Quality Summary

Location	Eastern Tributary		Waratah Rivulet		Woronora River	
Parameter	Range	Average	Range	Average	Range	Average
pH (field)	4.69 – 9.50	6.74	5 – 8.39	6.66	2.42 – 8.48	5.46
EC (field) (µS/cm)	47.2 – 310.0	157.8	84 – 306	177.78	75 – 245	149.31
Mn (mg/L)*	0.005 – 0.290	0.052	0.015 – 1.0	0.11	0.001 – 0.18	0.05
Fe (mg/L)*	0.027 – 1.0	0.303	0.034 – 2.9	0.47	0.012 – 15	0.37
Al (mg/L)*	0.011 – 0.2	0.052	0.002 – 0.095	0.03	0.008 – 0.42	0.10

* Field filtered.

Note: EC = electrical conductivity; µS/cm = microSiemens per centimetre; Mn = manganese; Fe = iron; Al = aluminium.

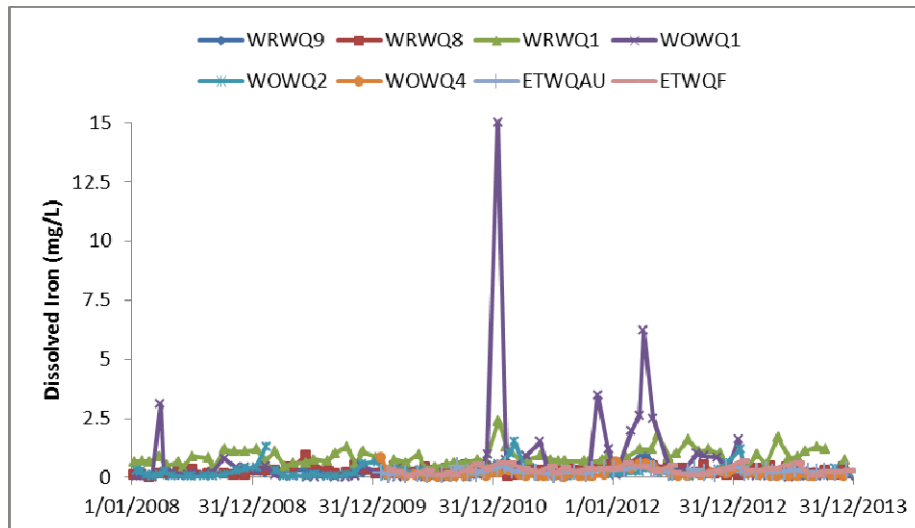


Chart 7 Dissolved Iron (Fe)

Concentrations were relatively consistent between the sites with all watercourses experiencing spikes or pulses throughout the time series. The Waratah Rivulet appeared to have higher dissolved manganese concentrations and the Woronora River higher dissolved aluminium concentrations.

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Woronora, Nepean and Cataract Reservoir Water Quality

Metropolitan Coal sources surface water quality data for the Woronora Reservoir, Nepean Reservoir and Cataract Reservoir from the SCA in accordance with a data exchange agreement. The monitoring data is used to assess potential mining impacts on the water quality of the Woronora Reservoir.

Assessment of Environmental Performance

The monitoring results were used to assess the Project against the water resource and watercourse performance indicators relevant to surface water. The assessment indicated the following performance indicators were not exceeded during the reporting period:

- *Changes in the quantity of water entering Woronora Reservoir is not significantly different post-mining compared to pre-mining, that is not also occurring in the control catchment(s).*
- *Changes in the quality of water in the Woronora Reservoir are not significantly different post-mining compared to pre-mining concentrations, that are not also occurring in the Nepean Reservoir (control site).*
- *No change to the natural drainage behaviour of Pool P. Specific indicators include: no new cracking in the stream bed of Pool P or rock bar; continual flow through/below the rock bar of Pool P such that water is ponded upstream; and continual surface water flow along the length of Pool P.*
- *Analysis of water depth data for Pool P (when mining is within 400 m of Pool P) indicates the water depth is at or above the pool's previous minimum (i.e. when mining is beyond 400 m of Pool P).*
- *Analysis of water depth data for Pools Q, R and S on Waratah Rivulet indicates the water depths are above that required to maintain water over the downstream rock bar.*
- *No gas releases observed at Pool P on the Waratah Rivulet.*

One performance indicator was exceeded during the reporting period, namely:

Changes in the quality of water entering Woronora Reservoir are not significantly different post-mining compared to pre-mining concentrations that are not also occurring at control site WOWQ2.

The performance indicator is considered to have been exceeded if data analysis indicates a statistically significant change in the quality of water post-mining of Longwall 20. Specifically, if:

- any water quality parameters (dissolved aluminium, dissolved iron and dissolved manganese) exceed the baseline mean plus two standard deviations for two consecutive months; or
- the sliding 12 month mean for any water quality parameter (dissolved aluminium, dissolved iron and dissolved manganese) exceeds the baseline mean plus one standard deviation; and
- there was not a similar increase in the same measure(s) at the control site.

The results indicated that the sliding 12 month means for dissolved aluminium and dissolved iron at site WRWQ9 on Waratah Rivulet exceeded the baseline mean plus one standard deviation during the reporting period, and there were not similar exceedances at the control site.

In accordance with the Metropolitan Coal Longwalls 20-22 Water Management Plan, an assessment was made against the subsidence impact performance measure:

Negligible reduction to the quality of water resources reaching the Woronora Reservoir.

The assessment included the following considerations:

- Whether the dissolved aluminium and dissolved iron concentrations which resulted in the exceedance were high relative to historical concentrations observed in other sites on Waratah Rivulet.
- Whether the dissolved aluminium and dissolved iron concentrations were high relative to historical concentrations measured in other watercourses contributing to inflows to Woronora Reservoir.
- Whether the dissolved aluminium and dissolved iron concentrations exceed the SCA's bulk water supply agreement values for aluminium (0.4 mg/L) and iron (1 mg/L).

The assessment concluded that the performance measure had not been exceeded.

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In accordance with the Metropolitan Coal Longwalls 20-22 Water Management Plan, a peer review of the assessment was conducted by Evans & Peck. The peer review concluded that there is no evidence to suggest that the subsidence impact performance measure, *Negligible reduction to the quality of water resources reaching the Woronora Reservoir*, had been exceeded during the reporting period.

Accordingly, none of the performance measures relevant to surface water were exceeded during the reporting period:

- *Negligible reduction to the quantity of water resources reaching the Woronora Reservoir.*
- *Negligible reduction to the quality of water resources reaching the Woronora Reservoir.*
- *Negligible reduction in the water quality of Woronora Reservoir.*
- *Negligible environmental consequences (that is, no diversion of flows, no change in the natural drainage behaviour of pools, minimal iron staining, and minimal gas releases) on the Waratah Rivulet between the full supply level of the Woronora Reservoir and the maingate of Longwall 23 (upstream of Pool P).*

In the next reporting period, Metropolitan Coal will consider the recommendations of the Evans & Peck peer review, which will include conducting a review of the performance indicator and data analysis for the quality of water resources reaching the Woronora Reservoir.