Groundwater

The conceptual model developed of the hydrogeological regime at Metropolitan Coal supports three distinct groundwater systems, including:

- Perched groundwater system – generally above and independent of the regional groundwater table.
- Shallow groundwater system – the shallow groundwater system is separate from the perched groundwater system and defines a regional water table.
- Deep groundwater system – although the shallow and deep groundwater systems are connected, low permeability of the Bald Hill Claystone provides a degree of isolation between the Hawkesbury Sandstone that hosts shallow groundwater and the underlying Bulgo Sandstone and deeper formations that host deep groundwater.

Metropolitan Coal's groundwater monitoring program includes monitoring of:

- swamp groundwater levels;
- shallow groundwater levels;
- deep groundwater levels/pressures;
- groundwater quality; and
- mine water make.

The monitoring results are described below.

Swamp Groundwater Levels

Piezometers were installed in the following upland swamps in July 2010 to monitor groundwater levels (Figure 1):

- Valley side Swamps 16/17 overlying Longwalls 20-22 (sandstone piezometer to a depth of 10 m).
- Valley side Swamp 25 overlying Longwalls 20-22 (swamp substrate piezometer to a depth of 0.9 m and sandstone piezometer to a depth of 10 m).
- Valley side Swamp 101 (control - swamp substrate piezometer to a depth of 0.9 m and sandstone piezometer to a depth of 10 m).
- In-valley Swamp 20 overlying Longwalls 20-22 (swamp substrate piezometer to a depth of 0.9 m and sandstone piezometers to depths of 3 and 10 m).
- Headwater Swamp Woronora River 1 (WRSWAMP1) (control - swamp substrate piezometer to a depth of 0.9 m and sandstone piezometers to depths of 3 and 10 m).

The upland swamp groundwater monitoring results for the above sites will be described in the 2011 Annual Review and subsequent Environmental Monitoring Summary update.

Shallow Groundwater Levels

Continuous water level monitoring of shallow groundwater levels has been conducted at sites WRGW1 and WRGW2 along Waratah Rivulet and site RTGW1A on Tributary B (Figure 1).

Sites WRGW1 and WRGW2 are located on opposite banks of the Waratah Rivulet, to the immediate south of Longwall 20 (Figure 1). The groundwater monitoring results for these bores are shown on Chart 1 and compared with rainfall data from the Waratah Rivulet catchment (PV1 pluviometer).

Sites WRGW1 and WRGW2 show the same dynamic responses to stream flow interaction and rainfall, with rapid response to rainfall events. From early May 2010, water levels at sites WRGW1 and WRGW2 gradually declined, apart from recharge during a wet episode in late May 2010. The slight decline is attributed to natural recession, and is consistent with the downwards trend in rainfall residual mass at pluviometer PV1 (Chart 1).

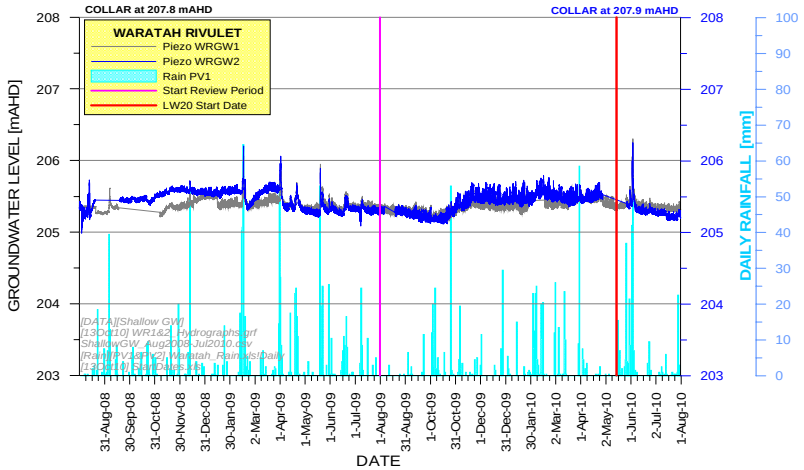
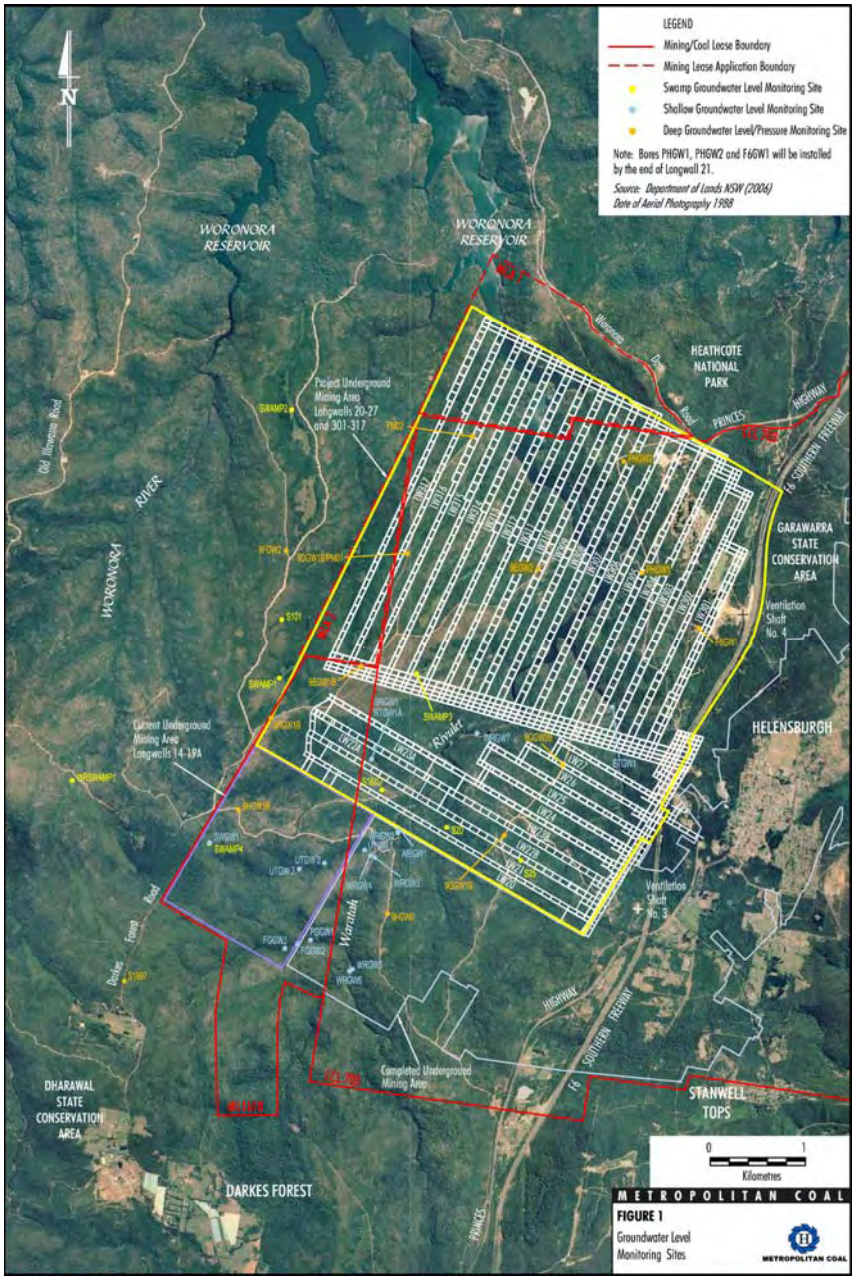


Chart 1 Shallow Groundwater Hydrographs on Waratah Rivulet at WRGW1 and WRGW2

Monitoring sites WRGW7 and ETGW1 on the Waratah Rivulet and the Eastern Tributary respectively have since been installed and data analysis will be reported in the 2011 Annual Review.



Deep Groundwater Levels/Pressures

Continuous groundwater level/pressure monitoring has been conducted at site 9HGW0 (Longwall 10 Goaf Hole), site 9EGW1B, site 9FGW1B, site 9GGW1B, site 9HGW1B and site PM02 (Figure 1).

Monitoring sites closest to recent mining include site 9HGW1B (adjacent to Longwall 18) and site 9GGW1B (above Longwall 22) (Figure 1).

The time-series record for site 9HGW1B is shown on Chart 2. Site 9HGW1B terminated in the Stanwell Park Claystone, with the lower Bulgo Sandstone as the deepest monitored lithology. During the mining of Longwall 18 (November 2009 to April 2010), the groundwater heads increased gradually within all formations from the lower Hawkesbury Sandstone down to the mid Bulgo Sandstone, with evidence of declines at the end of panel mining. As site 9HGW1B is located within the abutment zone of Longwall 18, this response is attributed to vertical stress redistribution and strata compression to the west of the Longwall 18 extraction.

The time-series record for site 9GGW1B is shown on Chart 3. Site 9GGW1B shows strong depressurisation below the Bulgo Sandstone, with heads about -20 m Australian Height Datum (AHD) in the Scarborough Sandstone and the Coal Cliff Sandstone. The heads in this hole are stable and are yet to show any effect from Longwall 20 mining.

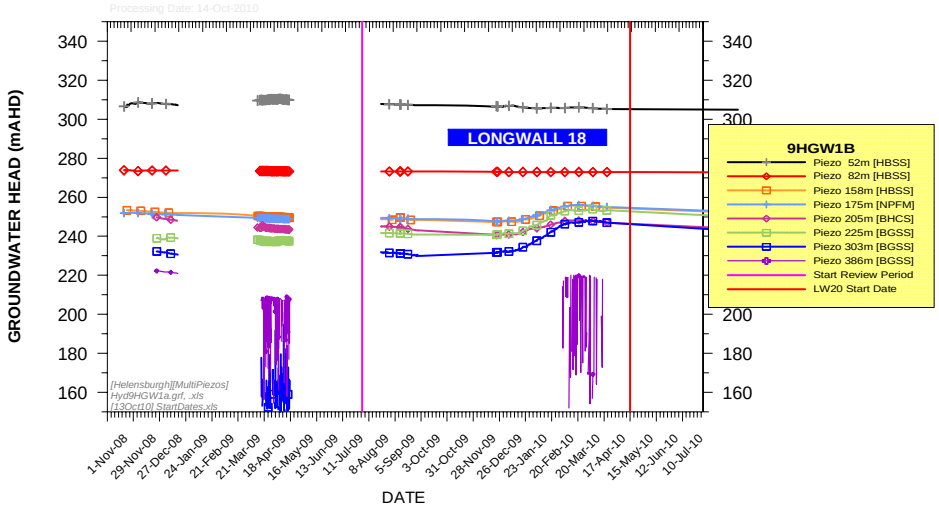


Chart 2 Time Variations in Potentiometric Heads at Site 9HGW1B

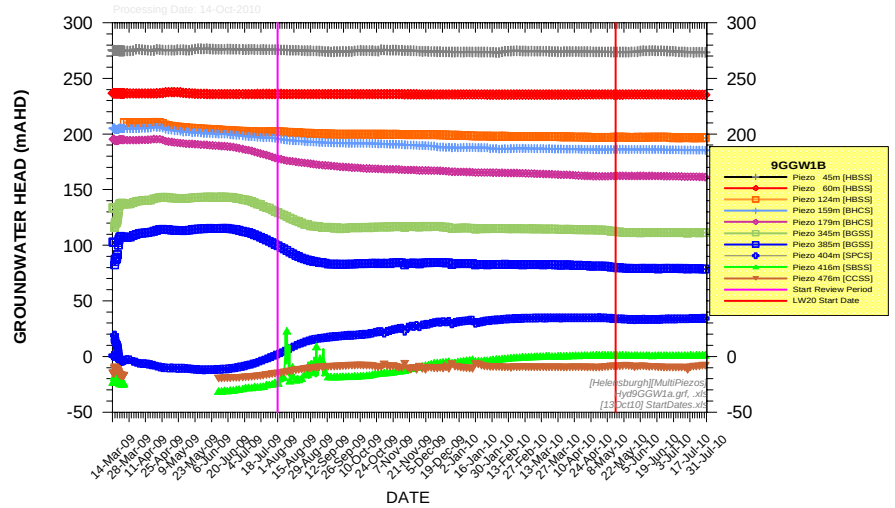


Chart 3 Time Variations in Potentiometric Heads at Site 9GGW1B

Groundwater Quality

Shallow groundwater quality has been sampled monthly at sites WRGW1 and WRGW2 along the Waratah Rivulet and site RTGW1A adjacent to Tributary B (Figure 2). Water quality parameters sampled include electrical conductivity, pH, redox potential, calcium, magnesium, sodium, potassium, chloride, sulphate, bicarbonate, barium, strontium, manganese, iron, zinc, cobalt and aluminium. The samples collected for the analysis of cations, anions and metals have been field filtered.

Monitoring results for iron, manganese and pH levels at sites WRGW1 and WRGW2 are shown on Charts 4 to 6. Monitoring results for sites WRGW3 to WRGW6 are also shown on Charts 4 to 6 to show trends over the length of the Waratah Rivulet.

The key observations at the Waratah Rivulet groundwater quality monitoring sites (WRGW1 to WRGW6) are:

- Iron concentrations are usually in the 1 - 10 milligrams (mg)/Litre (L) range, with a peak value of 14 mg/L.
- Manganese concentrations are typically less than 1 mg/L.
- Groundwater is generally acidic with pH usually between pH 5.5 and 7.
- Iron and manganese concentrations increase with distance downstream.

There is no evidence of irregular behaviour during the mining of Longwall 18 (November 2009 to April 2010) or Longwall 20 (from its commencement in May to the end of the reporting period i.e. July 2010).

Site RTGW1A on Tributary B (north of Longwall 20) is sampled monthly for groundwater quality. To provide context for the monitoring results at site RTGW1A, comparison has been made with the upgradient groundwater quality monitoring site SWGW1 (west of Longwall 18) (Figure 2). Groundwater quality at both sites is shown on Charts 7 to 9 for iron, manganese and pH.

Iron concentrations are generally equal to or below 1 mg/L, with one isolated value of 6 mg/L at site RTGW1A. Manganese concentrations are low at both sites, being always below 0.4 mg/L. Aluminium was below the detection limit in all samples. The groundwater at site SWGW1 is acidic, generally around pH 5, while the groundwater at site RTGW1A is neutral (pH generally around 7).

There is no systematic temporal pattern for any analyte, and neither site shows any irregularities due to the mining of Longwall 18 (November 2009 to April 2010) or Longwall 20 (from May to July 2010).

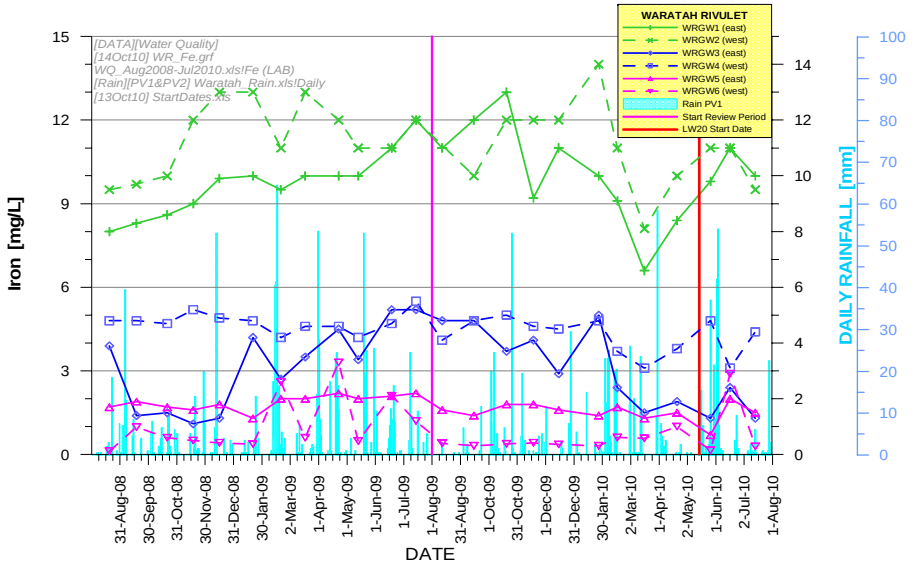


Chart 4 Iron Concentration at Sites WRGW1 to WRGW6

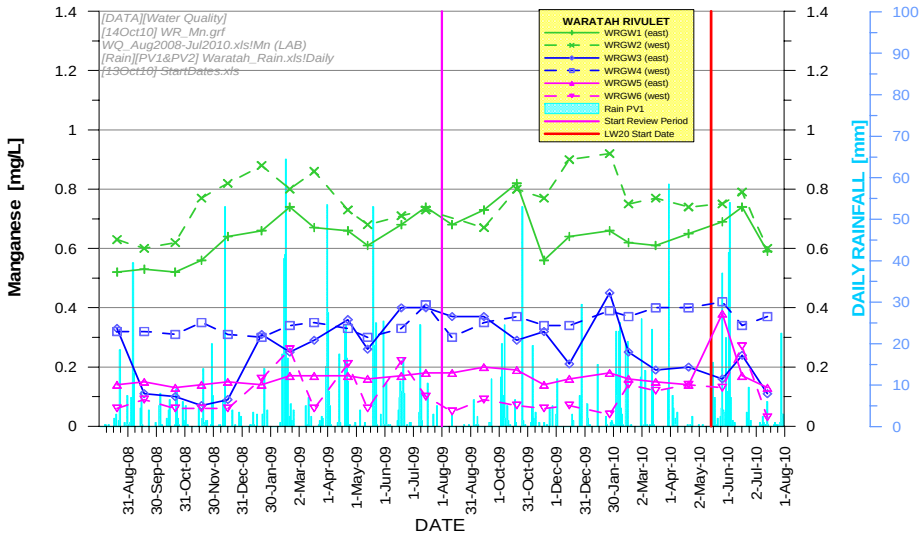


Chart 5 Manganese Concentration at Sites WRGW1 to WRGW6

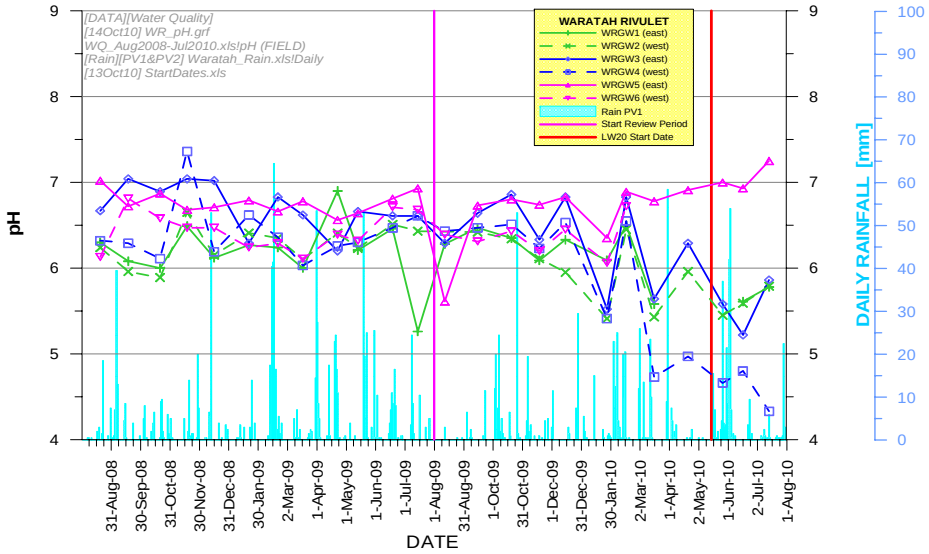


Chart 6 pH Levels at Sites WRGW1 to WRGW6

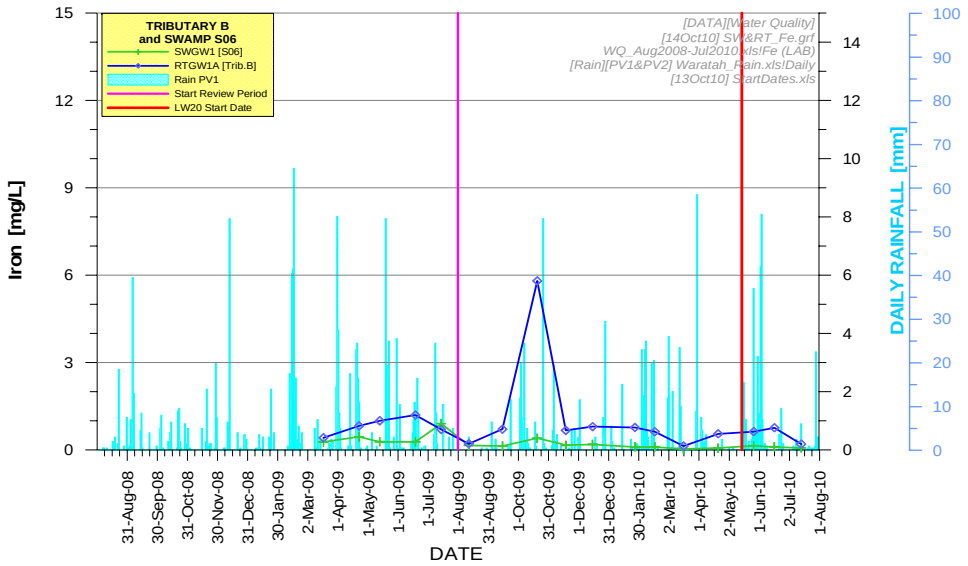


Chart 7 Iron Concentrations at Sites RTGW1A and SWGW1

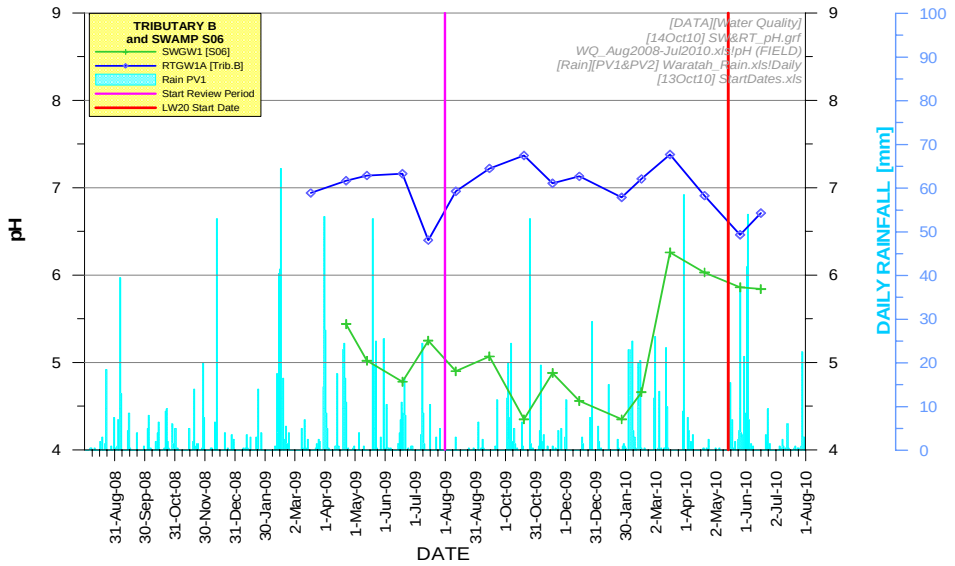


Chart 9 pH Levels at Sites RTGW1A and SWGW1

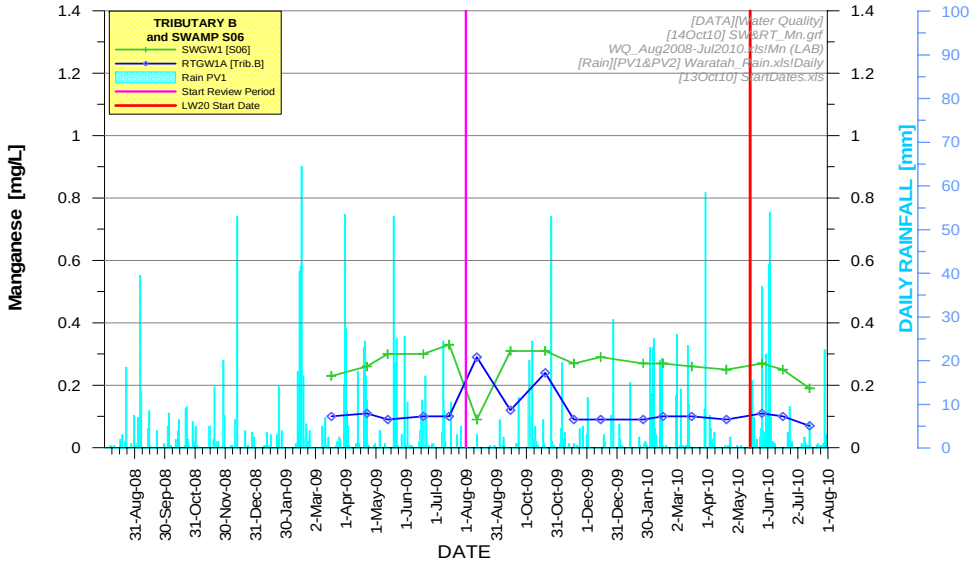


Chart 8 Manganese Concentrations at Sites RTGW1A and SWGW1

Mine Water Make

Metropolitan Coal conducts inspections of mine workings and monitors mine water make as indicators of potential connective cracking from the surface to the mine.

The inspections of mine workings have not identified any abnormal water flows from the goaf, geological structure, or strata generally.

Monitoring of the mine water balance includes calculation of the inferred water make. The inferred water make (i.e. groundwater that has seeped into the mine through the strata) is calculated from the difference between total mine inflows (reticulated water into the mine, moisture in the downcast ventilation, and the *in-situ* coal moisture content) and total mine outflows (reticulated water out of the mine, moisture in the exhaust ventilation, and moisture in the ROM coal).

Given the large fluctuations in daily water usage and the cycle period for water entering the mine, being used by machinery, and draining to sumps for return pumping to the surface, a 20 day average is used to provide a more reliable estimate of water make. The average daily water make was 0.1 megalitres (ML)/day (Chart 10).

The inspections of mine workings, monitoring of mine water make and analysis of deep groundwater level/pressure results indicates that the following subsidence impact performance measures relevant to groundwater have not been exceeded:

No connective cracking between the surface and the mine.

Negligible leakage from the Woronora Reservoir.

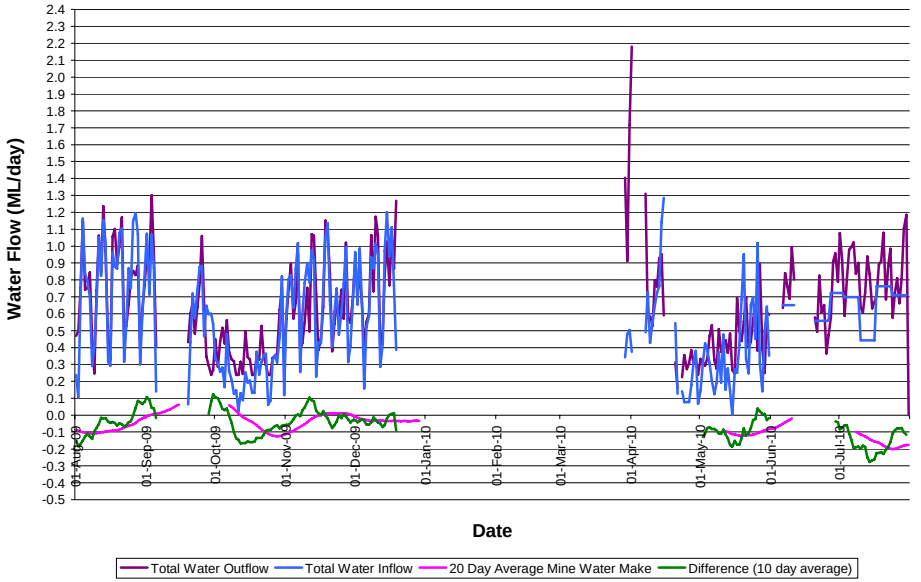


Chart 10 Estimated Daily Mine Water Make