Memorandum

To:	Jon Degotardi	At:	Metropolitan Collieries
From:	E Watts/ I Epari	At:	SLR Consulting Australia Pty Ltd
Date:	29 March 2023	Ref:	665.10000-M18-v2.0-20230329.docx
Subject:	Metropolitan Coal Groundwater Investigation 2022 Transect bores T2, T3 and T5		

1 Introduction

The six-monthly groundwater reviews for 2022 (SLR, 2022a[1] and SLR, 2023[2]) identified TARP exceedances for the transect bores T2, T3-R and T5. Metropolitan Collieries Pty Ltd (Metropolitan Coal) has commissioned SLR to undertake an investigation to assess likely causes of these exceedances.

Previously, SLR Consulting Australia Pty Ltd (SLR) undertook an investigation into an exceedance of the Level 3 groundwater trigger level measured at bores T2, T3-R and T5 (SLR, 2021[3]). A recommendation from this investigation report was to assess the groundwater level of T3-R and its relation to the water level in Woronora Reservoir after a significant rain event (i.e., a significant increase to the water level in the Woronora Reservoir [WRL]). This significant increase in the Woronora Reservoir has occurred in March 2022 and was subsequently reported (SLR, 2022b[4]). This latest investigation concluded that the reduction in water level at T3-R is localised and there is no leakage from the Woronora reservoir.

2 Background

Groundwater monitoring results at the Metropolitan Mine are assessed against performance indicators using the Trigger Action Response Plan (Table 25) detailed in the Longwalls 305-307 Water Management Plan[5].

The performance indicator for bore T2 is:

> *"The hydraulic gradient to the Woronora Reservoir from bore T2 is reduced by no more than 10% from that measured on 30 June 2017."*

[1] SLR, 2022a, Metropolitan Coal, Groundwater Six-Monthly Review, January – June 2022
[2] SLR, 2023, Metropolitan Coal, Groundwater Six-Monthly Review, July - December 2022
[3] SLR, 2021, Groundwater Investigation for Transect bores T2, T3 and T5, 15 November 2021
[4] SLR, 2022b, Groundwater Investigation for Transect bores T2, T3 and T5, 1 June 2022
[5] Peabody, 2020, Longwalls 305-307 Water Management Plan[5] (Revision WMP-R01-B approved 16 March 2020)

The performance indicator for bore T3 (now T3-R) is:

> *"The hydraulic gradient to the Woronora Reservoir from bore T3 is reduced by no more than 10% from that measured on 30 June 2017."*

The performance indicator associated with bore T5 is:

> *"The hydraulic gradient from bore T5 to bore T3 is reduced by no more than 10% from that measured on 30 June 2017."*

2.1 Bore Details

They key survey details for bores T2, T3 (and re-drilled T3-R) and T5 are listed in Table 1. A figure with the bore locations is shown in Figure 1, and a detailed plan in relation to the reservoir is shown in Figure 1.

Table 1 Key survey details for transect bores

Survey detail	T2	T3	T3-R	T5
Hole depth (m)	35	61	81.2	94
Collar level (mAHD)	195.12	225.45	226.83	258.04
Diver sensor level (mAHD)	Not known	166.44	146.83	166.10
Bottom of hole (mAHD)	159.62	164.45	145.62	164.04

Located between bores T3 and T5 is bore T4, which Metropolitan Coal has advised was sheared during the extraction of Longwall 306 (directly beneath bore T4). The last observation at this bore was recorded on 23 August 2021.

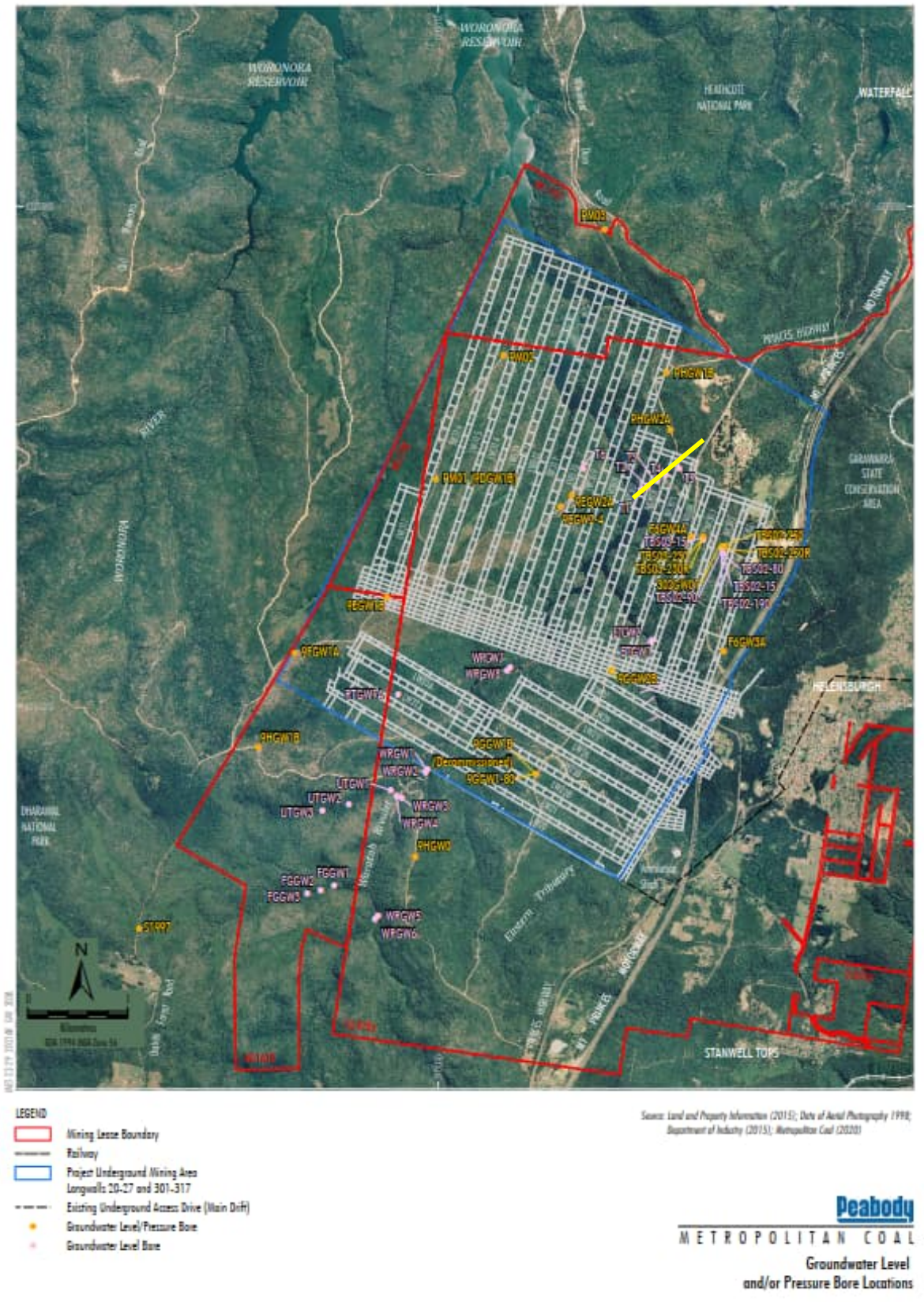


Figure 1 Bore network and cross section location

Figure 2 shows a cross section from the reservoir towards the transect bores to the east (the location of the cross-section is shown as a yellow line in Figure 1), with the transect bores located on the cross-section line and other bores projected onto the line. Figure 2 also shows the Woronora Reservoir Full Supply Level and the water level observations at the bores. The water levels in the transect bores have been decreasing since the baseline, whereas the bores further east have increased. Overall, the groundwater flow gradient and hence flow is towards the reservoir and has remained towards the reservoir throughout 2022.

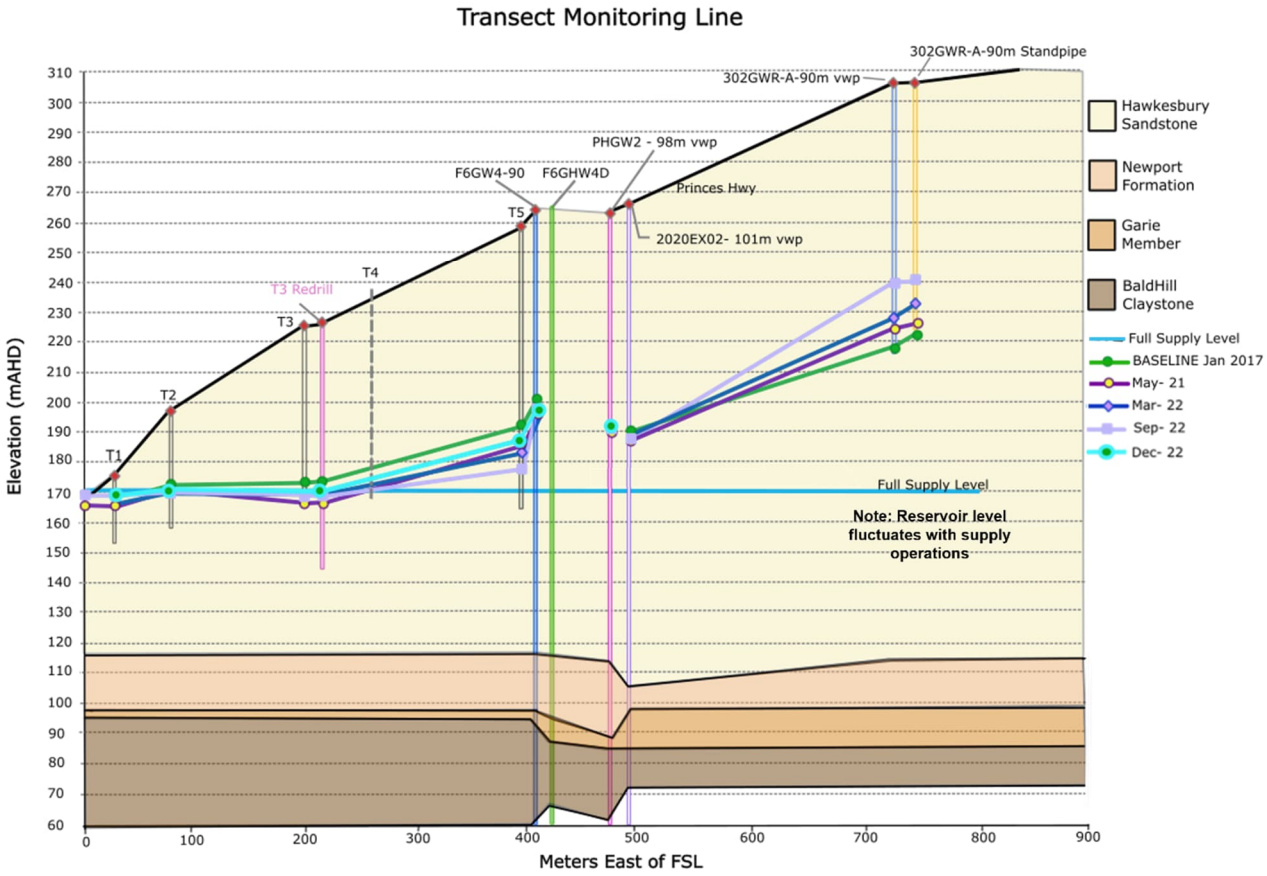


Figure 2 Cross section with observed groundwater levels

2.2 Transect bores observations

The hydrographs for all transect bores are shown in Figure 3, together with the reservoir level and rainfall. A more detailed hydrograph for bores T1, T2, T3-R is presented in Figure 4.

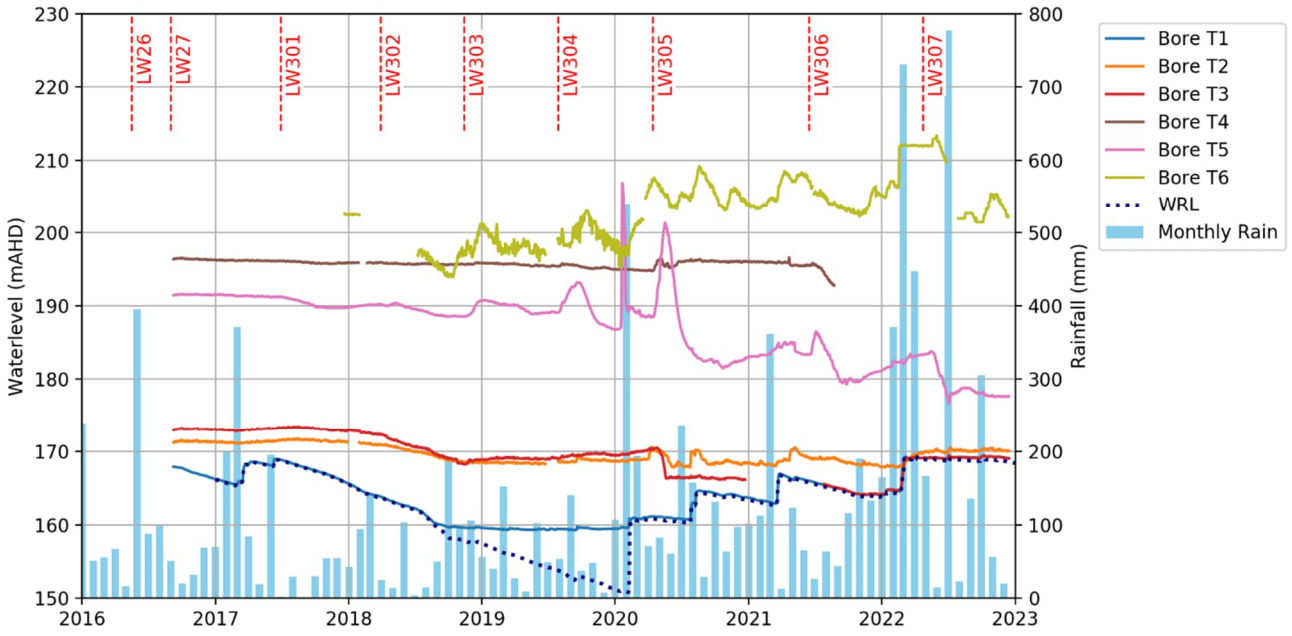


Figure 3 Groundwater hydrographs for bores T1 to T6 compared with reservoir water level and rainfall

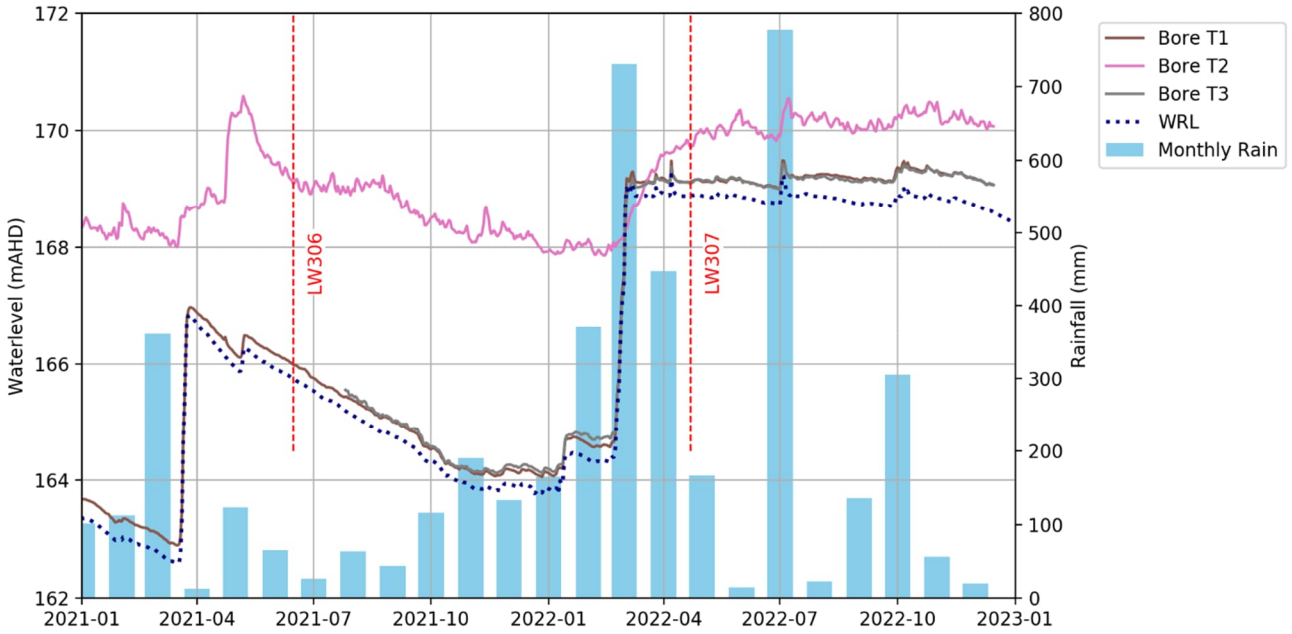


Figure 4 Groundwater hydrographs for bores T1 to T3 compared with reservoir water level and rainfall

2.3 Bore T2 to WRL Performance Indicator and exceedance

At 30 June 2017, the WRL was 168.90 mAHD and the T2 water level was 171.55 m AHD, giving a baseline difference of:

T2 – WRL = 2.65 m

An exceedance of the Level 3 trigger performance indicator would occur for the following condition:

T2 – WRL =< 2.39 m

where *WRL* is the dynamic Woronora Reservoir Level.

An exceedance of the T2 Performance indicator (up to Level 3) was observed between 23 March 2021 and 22 April 2021 (Figure 5), and more recently since 25 February 2022.

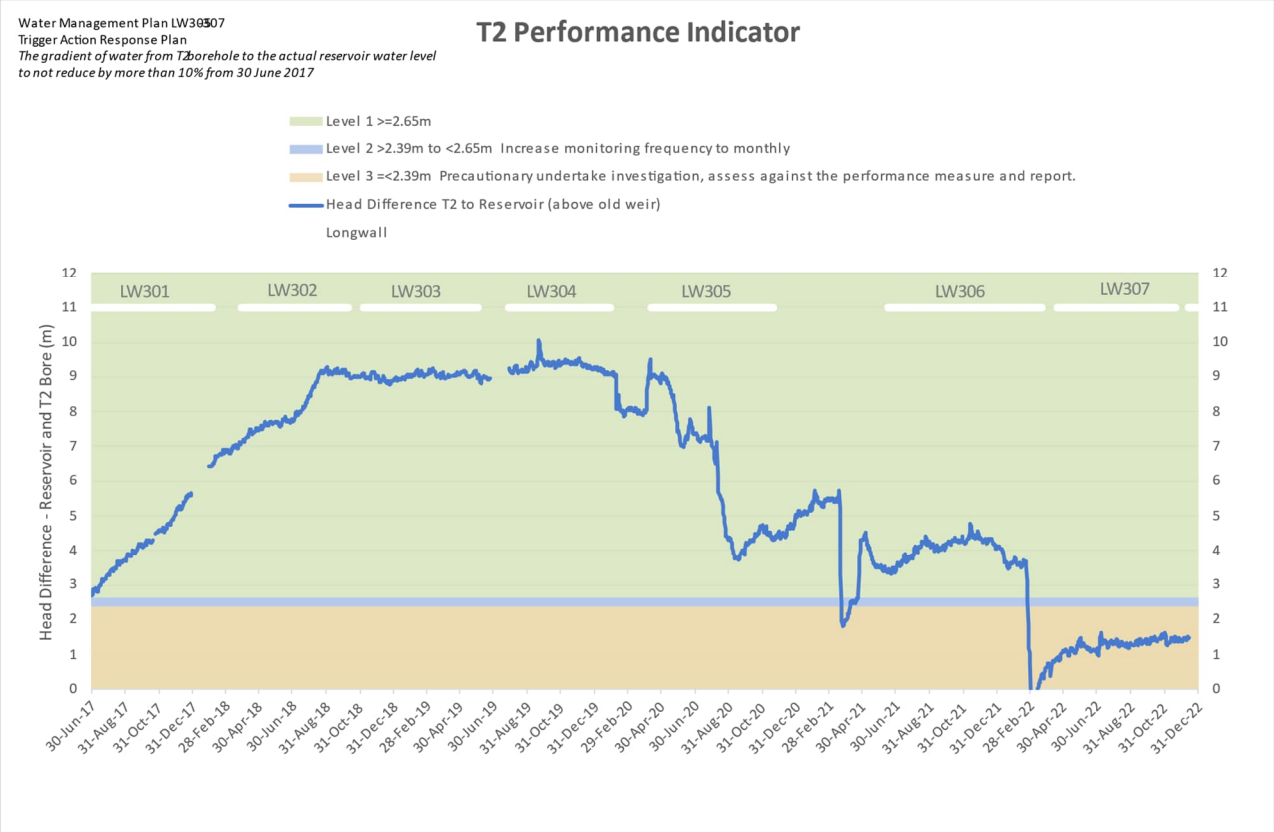


Figure 5 Performance indicator for Bores T2-WRL

The exceedance occurring since February 2022 is driven by an increase in the reservoir level, caused by widespread large rain events in the Woronora Reservoir catchment (over 3,212 mm of rain during 2022, 2,500 of which between February and July 2022). The significant increase in the WRL reduces the gradient from bore T2 to the reservoir level. Figure 4 shows that there is no decrease in the groundwater levels at T2 that would explain the decrease in the gradient. Since March 2022, the groundwater level at bore T2 has increased steadily at a lower rate than the reservoir as expected. Despite the recovery of the groundwater level at bore T2, the Performance Indicator has remained at Level 3 until the end of December 2022. The groundwater levels at bore T2 continue to be reviewed monthly and will be reported in the upcoming six-monthly review.

2.4 Bore T3 to WRL Performance Indicator and Exceedance

At 30 June 2017, the WRL was 168.90 mAHD and the bore T3 water level was 173.32 m AHD, giving a baseline difference of:

T3 – WRL = 4.42 m

An exceedance of the Level 3 trigger performance indicator would occur for the following condition:

T3 – WRL =< 3.98 m
where *WRL* is the dynamic Woronora Reservoir Level.

As previously reported in SLR (2020)[6], an exceedance of the T3-WRL performance indicator was first identified on 29 July 2020, as shown in Figure 6. The exceedance has continued through to 21 December 2020, when the bore was abandoned. As recommended in SLR (2020), a deeper replacement bore was drilled. The new bore, T3-R, was drilled 10 m from the original bore and has a depth of 81.2 m, approximately 20 m deeper than the original bore T3 (Table 1). Since the new bore T3-R started recording in May 2021, the performance indicator has remained at Level 3. The current observations show a reflection of the reservoir (and bore T1) water levels. The increase in the WRL in early 2022 has confirmed that the groundwater level at bore T3-R now also is a reflection of the WRL and water level at bore T1 (SLR, 2022b).

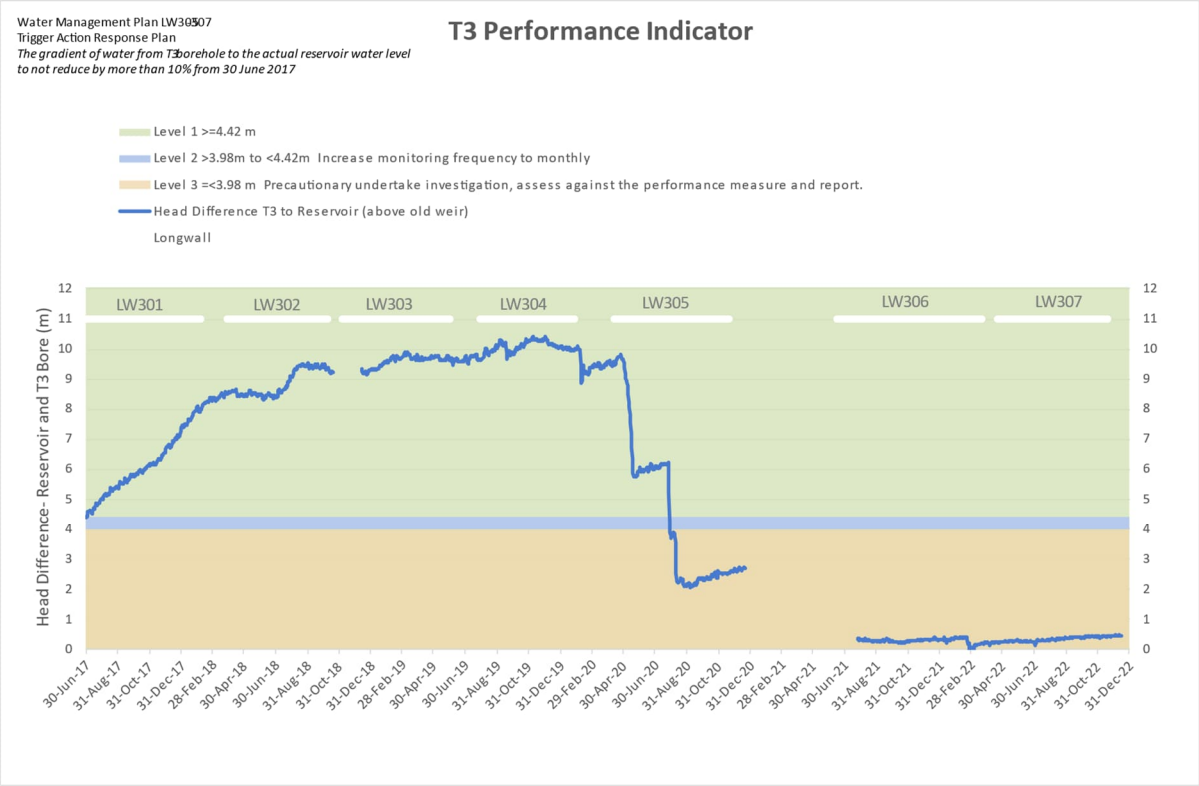


Figure 6 Performance indicator for Bores T3-WRL

[6] SLR, 2020. Metropolitan Coal Groundwater Investigation into water level changes at bore T3 and T5. 21 September 2000.

Although an exceedance has occurred for the gradient between bore T3 and the reservoir, there has not been a reversal of gradient from bore T3 to the Woronora Reservoir that would induce leakage from the reservoir (the performance measure) because the intervening bore T2 still shows a hydraulic gradient towards the reservoir. This suggests the depressurisation at bore T3-R is localised, perhaps due to its being directly over the centre line of Longwall 306 which passed beneath this bore in spring 2021.

2.5 Bore T5 to Bore T3 Performance Indicator and exceedance

At 30 June 2017, the water levels in bores T5 and T3 were 191.24 mAHD and 173.32 m AHD, respectively, giving a baseline head difference of:

T5 – T3 = 17.92 m

An exceedance of the Level 3 trigger performance indicator would occur for the following condition:

T5 – T3 =< 16.13 m

An exceedance was first identified for the (T5-T3) trigger on 19 August 2020, as shown in Figure 7. The exceedance of Level 3 occurred for the remainder of the data record at bore T3 (December 2020), with some observations at Level 2. Since the installation of T3-R in May 2021, the performance indicator is at Level 3. This is due to the permanent decrease in T3-R, which is now reflecting the reservoir level (SLR, 2022b).

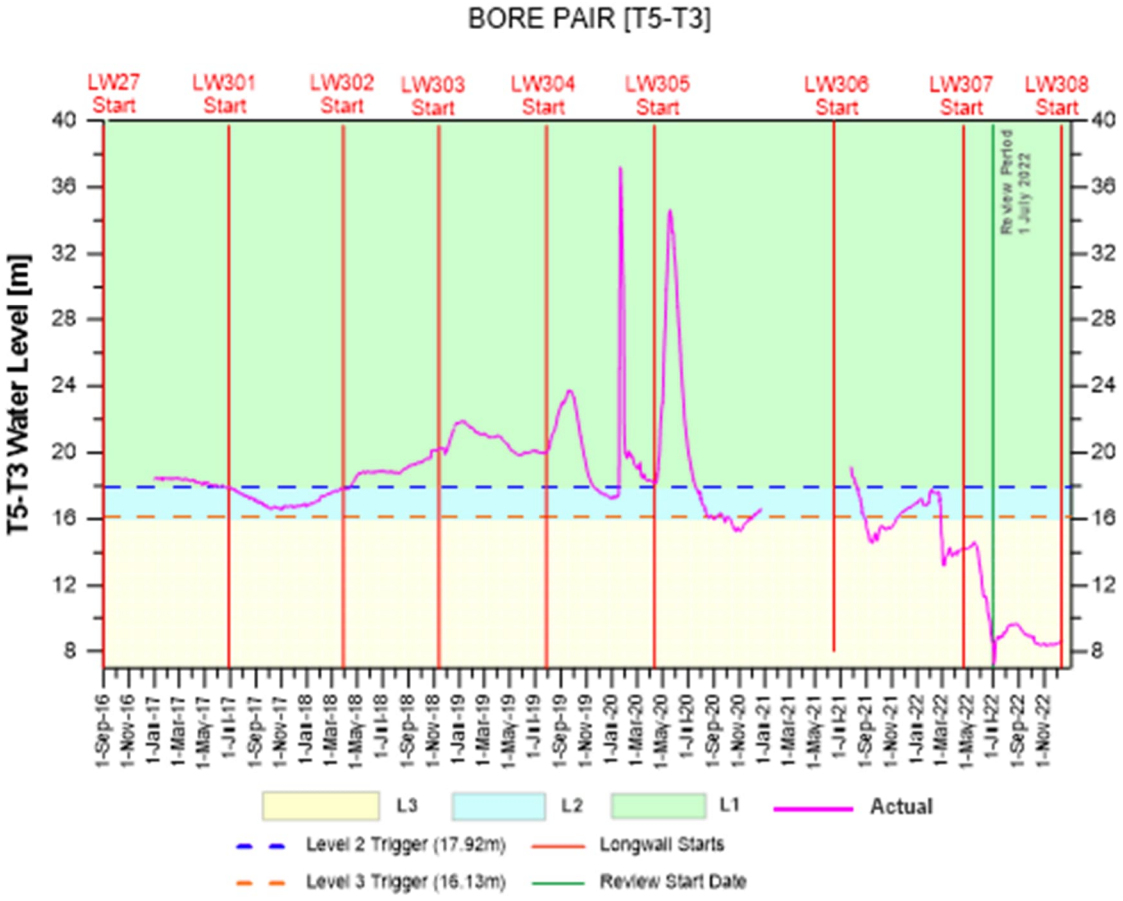


Figure 7 Performance indicator for Bores T3 and T5

The large changes in water level at bore T5, occasioned by proximity to Longwalls 304, 305, 306 and 307 as mining passed nearby (Figure 3), appear to be mining related. The water level at T5 has lost around 10m of water since before the LW304 mining passed by and it has not yet regained its pre-mining water level.

However, even though at Level 3, the positive gradient towards the reservoir is intact, with a gradient between T5 and T3 of over 8m.

3 Performance Measure Assessment

In accordance with the Trigger Action Response Plan, an investigation has been conducted and an assessment has been made against the following performance measure:

> *Negligible leakage from the Woronora Reservoir.*

Several performance indicators involving bores T2, T3 and T5 are designed to provide an early warning for assessment of potential exceedances of this performance measure.

Leakage from the Woronora Reservoir to the surrounding groundwater environment would occur if there was a reversal of hydraulic gradient (i.e. if the water table in surrounding piezometers falls below the water level in the Woronora Reservoir).

Bores T2 and T5 maintain a hydraulic gradient to the reservoir, whereas bore T3-R has a water level almost coincident with reservoir level. However, this does not imply an overall absence of hydraulic gradient, as the intervening bore T2 defines the effective hydraulic gradient close to the reservoir. Both bores T3-R and T5 show localised depressurisation of the groundwater, in the case of T5 definitely due to mining beneath the bore, and in the case of bore T3-R probably due to mining directly beneath the bore.

The performance measure relating to bores T2, T3 and T5, *Negligible leakage from the Woronora Reservoir*, has not been exceeded.

4 Conclusion and Recommendations

In accordance with the Trigger Action Response Plan, investigations have been conducted into observed exceedances of the Level 3 groundwater trigger levels associated with bores T2, T3 and T5 in the form of the gradient from T2 to the reservoir, the gradient from T3 to the reservoir, and the gradient from bore T5 to bore T3. While the T3-WRL TARP no longer provides useful information, the T2-WRL and T5-T3 TARPs continue to be fit for purpose and are suitable for assessment of whether the performance measure has been exceeded.

Although an exceedance has occurred for the gradient between bore T3 and the reservoir, there has not been a reversal of gradient from T3 to the Woronora Reservoir that would induce leakage from the reservoir (the performance measure) because the intervening bore T2 still shows an hydraulic gradient towards the reservoir (Figure 5).

The depressurisation at bore T3-R is localised. The review of the data after the significant increase in the reservoir level in early 2022 does conclude that T3-R is connected to the reservoir.

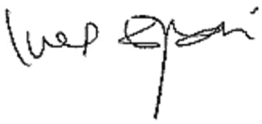
The opposing trends in the bore T5 and T3 water levels, since spring 2021, has caused the (T5-T3) head difference to increase slowly across the Level 3 threshold into the Level 2 zone, as shown in Figure 7. When heavy rain occurred in early 2022, the water level rose more rapidly in bore T3 than in bore T5, resulting in the gradient from T5 to T3 changing to the Level 3, where it remained. Although the Performance Level is at Level 3, the lateral hydraulic gradient is still strongly from T5 towards T3-R (currently around 8m water level difference).

The Longwalls 305-307 Water Management Plan requires Metropolitan Coal to consider the need for management measures following the exceedance of a performance indicator.

- Performance indicator (T2-WRL): The investigation has shown that the groundwater levels at T2 are stable and the decrease in the gradient (which triggered the Level 3 TARP) is related to the high water levels in the reservoir. The gradient continues to be towards the reservoir.
- Performance indicator (T3-WRL): It was confirmed that the water level at T3-R is permanently low and did not recover after the passage of Longwall 306 directly beneath the bore. The water level in the bore does reflect the water level in the reservoir, indicating that there is a direct connection between them. The connection is not pervasive, as the water level at the intervening bore T2 is generally about 4m higher, except after heavy rainfall.
- Performance indicator (T5-T3): No specific management measure is considered to be required, other than ongoing monitoring and a check on performance each month. There is still a substantial hydraulic gradient to the reservoir, with a current head difference of about 8m.

It is recommended also that the water level at bore T1 be endorsed as a surrogate reservoir level, as the data at T1 are collected at the same frequency as measurements at the other transect bores.

Yours sincerely



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Authorised by: Dr N Merrick