

Our Reference: 24160.91986
Your Reference: Legacy Way Ground Water Levels - June 2017



04 July 2017

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Dear Luke,

Re: Legacy Way Groundwater Levels June 2017

As requested by Egis, EnviroAg Australia undertook the June 2017 quarterly groundwater survey of the existing monitoring bores along the Legacy Way Tunnel alignment. Monitoring of groundwater levels is required as part of the Coordinator Generals conditions for the Operation and Maintenance phase of the Legacy Way Tunnel.

Field work was undertaken on 13 June 2017. All monitoring locations were sampled, with this being the first monitoring round since the replacement of level loggers during the April 2017 monitoring round.

NL5-4 in Sleath Street Toowong was collapsing due to installation on a 50-degree angle with vehicle and soil weight onto the PVC casing causing joints to slip. On 6th June 2017 this well was decommissioned in accordance with the Minimum Requirement for Water Bores in Australia V3 (2012). Monitoring of groundwater in the surrounding area to NL5-4 is adequately covered with the groundwater bores located in Birdwood Terrace, Thorpe Street and within Toowong Cemetery.

On 6th June, an attempt to re-develop BH205 at the ICB was undertaken, as during previous monitoring rounds the well had consistently reported less than 10cm of water and was unable to be used for data logging. Re-development of the well was unsuccessful, and it was noted that joints on the PVC casing appeared to have slipped. Consequently the well was decommissioned in accordance with the Minimum Requirement for Water Bores in Australia V3 (2012).

1. Groundwater June 2017

Groundwater monitoring has been conducted in compliance with the Hydrogeology and Groundwater Environmental Management Plan (LWTP-ENV-PLA-005). Monitoring locations were previously selected due to their location, geology and accessibility along the Legacy Way Tunnel corridor. The quarterly groundwater works included measuring standing water levels along the tunnel alignment and downloading data from *in situ* water level loggers. For the purpose of this study the monitoring wells are targeting bedrock (confined) and alluvial (unconfined) aquifers.

2. Groundwater Monitoring Locations

The monitoring locations assessed during this month's works are outlined in Table 1.

Table 1 – Groundwater Locations

Locality	ID	Reference	Geology	Monitoring
West	NL2-02	Toowong	Bedrock	Groundwater level
	NL3-05S	Toowong	Alluvium	Groundwater level
	NL3-16	Toowong	Alluvium	Groundwater level
Alignment	BH108	Toowong	Bedrock	Groundwater level
	BH320	Toowong	Bedrock	Groundwater level
	NL2-12	Toowong	Bedrock	Groundwater level
	NL2-14	Auchenflower	Open Bore – Bedrock and Alluvium	Groundwater level
	BH309	Rosalie	Bedrock	Groundwater level
	BH311	Rosalie	Bedrock	Groundwater level
	BH312	Rosalie	Bedrock	Groundwater level
	BH313	Rosalie	Bedrock	Groundwater level
	BH313A	Rosalie	Alluvium	Groundwater level
	NL4-HG10	Rosalie	Alluvium	Groundwater level
	NL4-HG6A	Paddington	Alluvium	Groundwater level
	NL4-5	Paddington	Bedrock	Groundwater level
	NL4-A2	Rosalie	Bedrock	Groundwater level
	NL2-06	Red Hill	Bedrock	Groundwater level
	NL2-09	Red Hill	Bedrock	Groundwater level
East	BH221	Kelvin Grove	Bedrock	Groundwater level
	BH222	Inner City Bypass	Bedrock	Groundwater level

The groundwater locations in Table 2 have previously been decommissioned. It is understood that most have been destroyed since the commencement of the project. The quantity of the remaining monitoring locations is deemed sufficient for the purposes of the groundwater monitoring and no additional replacement wells are planned. Monitoring had previously ceased in the Botanic Gardens following handback of the tunnel conveyor to Brisbane City Council.

Table 2 - Decommissioned Groundwater locations

Locality	ID	Reference	Geology	Monitoring
West	BH503	Botanic Gardens	Bedrock	Conveyor Tunnel no longer in use - no further monitoring to be conducted
	BH502	Botanic Gardens	Bedrock	Conveyor Tunnel no longer in use – no further monitoring to be conducted
	BH104D	Botanic Gardens	Bedrock	Destroyed
	BHSC1A	Botanic Gardens	Alluvium	Destroyed
	BHSC1B	Botanic Gardens	Bedrock	Destroyed
Alignment	NL5-4	Sleath Street	Bedrock	Decommissioned due to damaged casing
	BH314	Toowong	Bedrock	Not located – Note NL2-14 located nearby this location
	BH310	Rosalie	Alluvium	Replaced by BH313A
	BH307	Red Hill	Bedrock	Decommissioned, due to proximity to the alignment
East	NL4-HG4	Brisbane Grammar	Bedrock	Destroyed
	NL4-HG5	Brisbane Grammar	Bedrock	Destroyed
	BH205	Inner City Bypass	Bedrock	Decommissioned due to damaged casing
	BH203	Brisbane Grammar	Bedrock	Destroyed
	BH220	Kelvin Grove	Bedrock	Decommissioned due to damaged casing

3. Groundwater Monitoring Results

3.1 Groundwater Level Monitoring

Groundwater levels below ground surface were collected along the tunnel corridor at 20 locations. All locations monitored were equipped with Solinst LevelTrolls (automated water data) loggers, which were calibrated via the static water groundwater level measurements and corrected for barometric pressure. Static groundwater level measurements are detailed in Table 3.

Table 3 – Groundwater elevation

Locality	West	Alignment												East	West	Alignment				
Geology	Bed rock	Bedrock												Bedrock	Alluvium	Alluvium				
Location	NL2-02	BH108	BH320	NL2-12	NL2-14	BH309	BH311	BH312	BH313	NL4-5	NL4-A2	NL2-06	NL2-09	BH221	BH222	NL3-16	NL3-05S	BH313A	NL4-HG10	NL4-HG6A
Units	mAHD	mAHD	mAHD	mAHD	mAHD	mAHD	mAHD	mAHD	mAHD	mAHD	mAHD	mAHD	mAHD	mAHD	mAHD	mAHD	mAHD	mAHD	mAHD	mAHD
Ground Elevation mAHD	25.78	23.65	47	26.07	47.7	4.1	4	4.1	3.8	5.6	2.2	63.9	41.4	29.3	23.9	18.9	25.01	3.8	2.2	5.58
Water Elevation mAHD June 2017	15.82	18.80	18.65	18.53	5.59	-0.05	-0.04	0.80	0.29	4.38	0.77	36.67	31.45	18.58	18.46	16.18	15.60	0.57	0.57	2.20

3.2 Groundwater Level Results

Figure 1 and Figure 2 demonstrate water level variations in the bedrock and alluvium respectively.

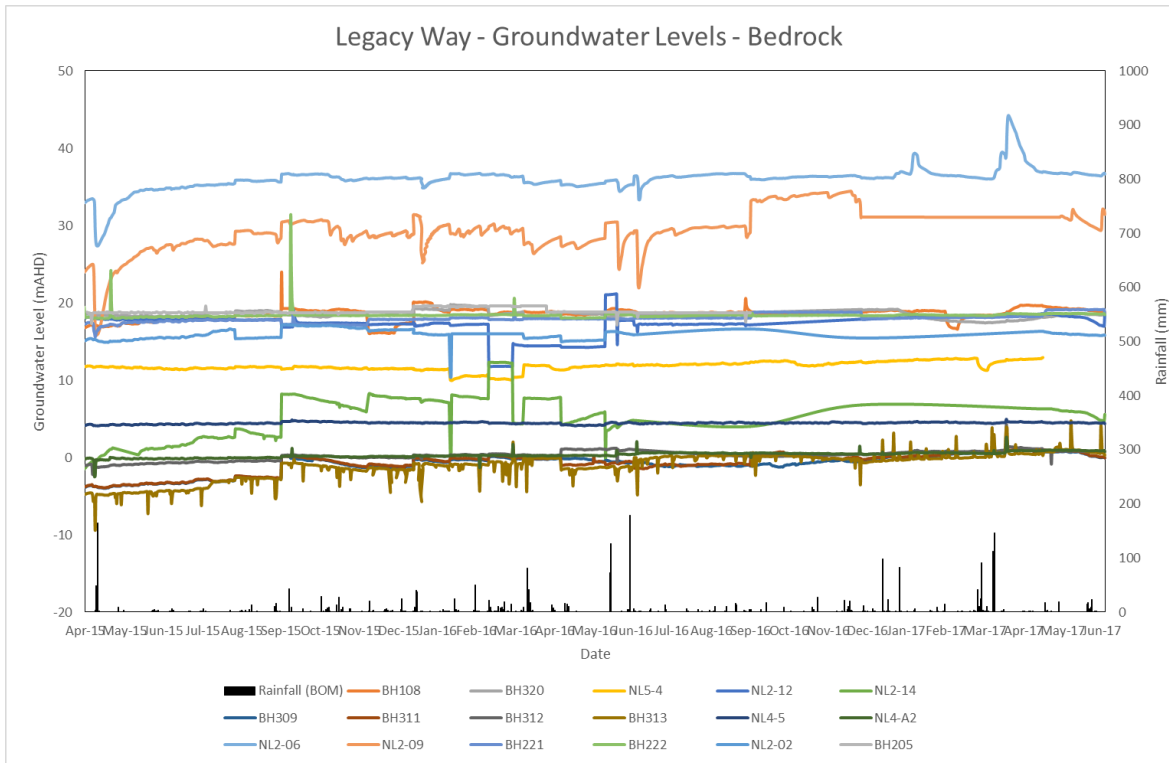


Figure 1 - Groundwater levels – bedrock

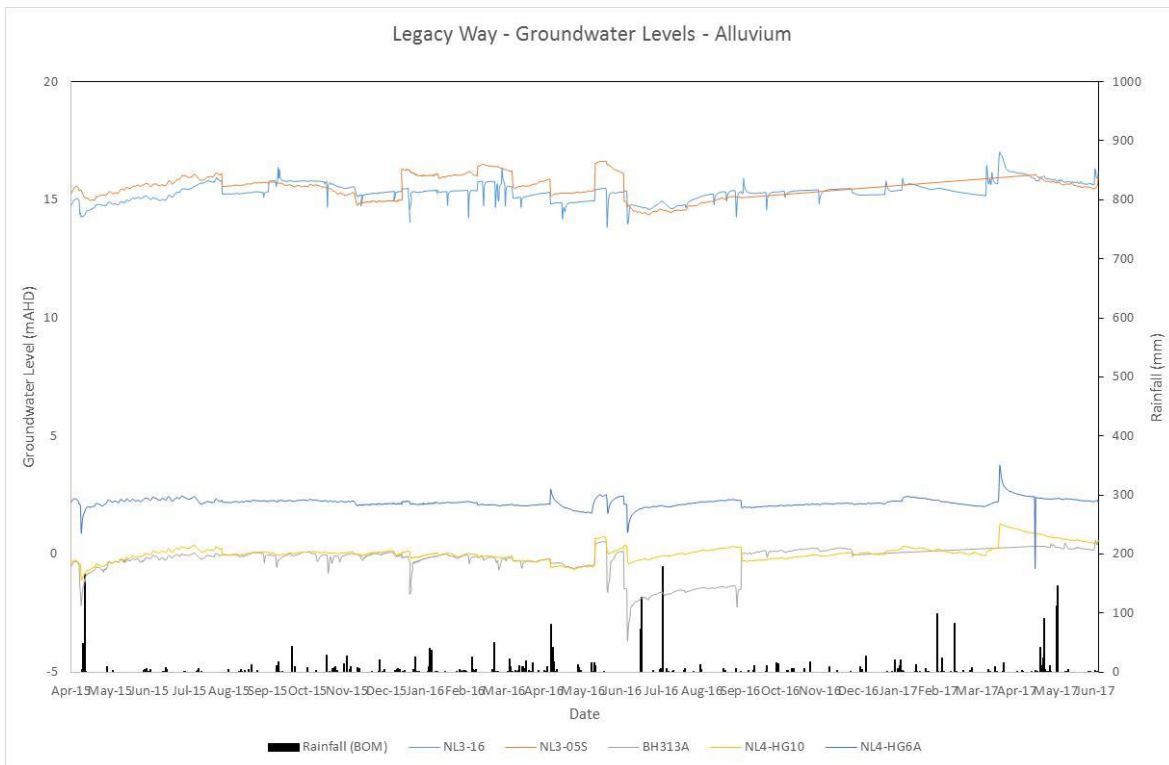


Figure 2 - Groundwater levels - alluvium

4. Discussion

The standing water levels continue to follow previous trends displayed during the construction phase i.e. relationship of groundwater fluctuations to rainfall levels, with the following of note:

Groundwater in the Toowong Cemetery and surrounds, the groundwater level in boreholes BH108, BH320, NL2-14 had historically been reported as exceeding the 200% of the natural variation and was associated with the tunnelling activities in close proximity to the boreholes. BH108 showed a steady decrease in groundwater level over the quarter, corresponding with decreased rainfall. BH320 showed a gradual increase in water levels through May, reaching a maximum level on the 28th May, before showing a gradual decline, which is consistent with the historically indicated slow recharge following rainfall events. Groundwater levels in NL 2-14 showed a steady decrease in groundwater level similar to that seen in BH108. NL 2-14 has historically displayed a high variation of up to 3.5m since the March 2016 monitoring period. It is expected that this location will continue to fluctuate based on sessional trends.

Along the tunnel alignment in Rosalie and surrounding areas, the groundwater level in boreholes BH309, BH311, BH312, BH313 had previously been reported as historically exceeding the 200% of the natural variation and was associated with tunnelling activities in close proximity to the boreholes. These boreholes are assessing water levels in the bedrock, and drawdown from tunnelling operations was predicted in this area. BH313 shows sudden increases in groundwater levels corresponding to rainfall events confirming observations from the previous monitoring round that that the well has been compromised due to roadway water ingress. BH309 and BH311 have decreased since the April 2017 monitoring event, corresponding with decreased rainfall.

Of the alignment borehole locations monitoring the alluvium adjacent to the tunnel alignment, wells NL4-HG10, NL4-HG6A and NL3-05s have shown gradual decreases in water levels since the April 2017 monitoring event. Wells NL3-16 and BH313A also showed a gradual decrease over the monitoring period, but both had an elevation increase in response to the rainfall event of 11/12 June.

Groundwater monitoring of the Eastern Portal area continued, with slow recovery noted in the bores. BH221 and BH222 remained static since the April 2017 monitoring period with no fluctuation noted due to rainfall events. NL2-06, and NL2-09 in upper Clifton Terrace and lower Clifton Terrace, respectively, showed an overall decreasing trend in groundwater levels since the April 2017 monitoring event. However it is noted that both NL2-06 and NL2-09 showed obvious influence by surface water ingress with spikes correlating with significant rainfall events during the monitoring period.

At the Western portal, NL2-02 decreased by 0.5m since the April monitoring round, corresponding with a decrease in rainfall intensity over the previous quarter. It has been previously noted that levels at this site may be impacted by localised rainfall events and potentially influenced from external activities (i.e. Mt Coot-Tha Quarry and the botanic garden ponds). The monitoring well showed a steady decrease in groundwater levels over the monitoring period.

It should be noted that at this stage Egis does not propose any mitigation strategies in regards to fluctuations in groundwater levels. Ongoing monitoring will be undertaken to assess any impacts and stabilisation of water levels.

Yours sincerely,



Matthew Conroy
Principal Environmental Scientist
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